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Correlation between Weight of the Thyroid Gland and Height of Cadavers

Charulata Satpute[1], Megha Saknure[2]

Abstract

Introduction: The thyroid gland is a very important endocrine gland, which is concerned with rate of metabolism, blood calcium level, and affects on growth and development in mammals.The size of thyroid gland varies considerably with age, sex, physiologic state, race and geographical location. So this study is to carry out the macroscopic architecture of thyroid glands of males and females. *Objectives:* To study the correlation between the weight of thyroid gland to the height of the cadavers. *Material & Methods:* Present study includes total 100 thyroid glands from cadavers, embalmed with 10% formalin of known sex from Medical collages. *Study Periods & Designs:* Between years DEC 2012 to JAN 2014. *Statical Analysis:* Analysed by simple statistical techniques and tests of significance including chi-squre tests were applied. *Results:* The Correlation of thyroid weight and height of cadaver was studied for males. There was negative correlation between height of cadaver and weight of thyroid gland. For females when correlation of thyroid weight and height of cadaver was studied. The result showed that there was positive correlation between height of cadaver and weight of thyroid gland. *Coclusion*: In case of male subject as height of cadaver increases, weight of thyroid gland decreases. In case of female subject as height increases, weight of thyroid gland also increases.

Keywords: Thyroid Gland; Weight; Height of Cadaver.

Introduction

The thyroid is a brownish red, highly vascular earliest endocrine glandular structure appears in mammal. Weight of thyroid gland is about 25 gm [1]. The thyroid gland is a notably labile gland that varies greatly in size and structure [2]. Several authors from various countries reported the data on thyroid gland's weight but still to set a normal range considering the variations in race,age, sex and other environmental factors like iodine intake, seasonal variation as well as different measuring procedures [3]. In the routine examinations of workers who are exposed to radiation, to give full protection against the accompanying hazards, the standard weight, size, and shape of the thyroid should be known.

Furthermore, knowledge of variations of the thyroid is substantial for surgeons dealing with head and neck surgery. Therefore, training and understanding of the thyroid anatomy and its associated anatomical variations are obligatory in order not to overlook these anomalies in differential diagnosis [4].

Material and Methods

The present study was carried out in the Department of Anatomy between years Dec 2012 to Jun 2014. Permission was obtained from the Head of Department of colleges to conduct this study. The project was submitted to Independent Ethical committee of our college. After getting the approval letter from Independent Ethical Committee, the study was started. Present study includes total 100 thyroid glands from cadavers, embalmed with 10% formalin of known sex (62 Males and 38 Females) from Medical

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colleges.

Gross and fine dissection was carried out and the thyroid gland was separated from its bed, dried with a sponge and blotting paper, and then weighed on a digital balance weight of each thyroid gland was taken in grams [3,4]. Height of cadavers was measured with the help of measuring tape in centimeter.

Observation and Results

Table 1 shows that the height of cadavers in cms, and weight of thyroid gland in gms. In 21 male cadaver's height ranged between 150-160 cms. and weight of thyroid gland was 16.21± 3.09 gms. It ranged between 11.3 - 21.07 gms. In 23 male cadavers height ranged between 161-170 cms. and weight of thyroid gland was 15.65±2.97 gms. It ranged between 11.01 - 21.77gms. In 18 male cadavers height ranged between 171-180 cms. and weight of thyroid gland was 15.21± 2.89 gms. It ranged between 11.2- 20.47gms.

It indicates that in case of male subject as height increases, weight of thyroid gland decreases.

In 7 female cadavers height ranged between 140-150 cms. and shows weight of thyroid gland was 12.28 ± 4.21 gms. It ranged between 7.54 -18.34 gms.

In 17 female cadaver's height ranged between 151-160 cms. and weight of thyroid gland was 13.79± 2.03 gms. It ranged between10.13 -16.31 gms.

In 12 female cadavers height ranged between 161-170 cms. and weight of thyroid gland was 14.40± 3.61gms.It ranged between 6 -18.32 gms.

In 2 female cadaver's height ranged between 171-180 cms. and weight of thyroid gland was 13.05± 0.07 gms. It ranged between 13 –13.1 gms.

It indicates that In case of female subject as height increases, weight of thyroid gland also increases.

Table 2 shows the Correlation of thyroid weight and height of cadaver in both sexes. The Correlation of thyroid weight and height was studied for males. The correlation coefficient was determined using the Carl pearson formula. The result showed the r- value of -0.2331 which means that there was negative correlation between height of cadaver and weight of thyroid gland with p value 0.0683, which was not statistically significant. For females when correlation

Table 1: Thyroid weight (gm) in various height (cm.) of cadavers in both sexes

Sex	Height (cm)	Number (n)	Thyroid weight (gm)	
			Mean ± SD	Range
Male (62)	150-160	21	16.21± 3.09	11.3 - 21.07
	161-170	23	15.65 ±2.97	11.01 - 21.77
	171-180	18	15.21± 2.89	11.2 - 20.47
Female (38)	140-150	7	12.28 ±4.21	7.54-18.34
	151-160	17	13.79± 2.03	10.13 – 16.31
	161-170	12	14.40 ±3.61	6 – 18.32
	171-180	2	13.05± 0.07	13 - 13.1

Table 2: Correlation of thyroid gland weight and height of cadaver in both sexes

	Thyroid Weight			
	Male		Female	
	r-value	p-value	r-value	p-value
Height (cm)	-0.2331	0.0683, Not Significant	0.1696	0.3088 Not Significant

Table 3: Correlation between thyroid weight and height of cadavers in male and female

Authour	Parameter	Thyroid weight Males		Females		Result
O.Tanriover[3]	Height	R	P	R	P	Not Significant
Present study(2014)		0.172	0.139	-0.161	0.566	
		-0.2331	0.0683	0.1696	0.3088	Not Significant

Table 4: Correlation between thyroid weight and height of cadaver

Name of author (year)	Results in Male	Results in Female
O. Tanriover[3](2011)	Not significant	Not significant
Enayetullah[7] (1996)	Significant	Significant
Sultana[8](2005)	Significant	Significant
Present study (2014)	Not significant	Not significant

of thyroid weight and height was studied. The result showed the r- value of 0.1696 which means that there was positive correlation between height of cadaver and weight of thyroid gland with p value 0.3088 which was not statistically significant.

Discussion

Thyroid disorder is a common health problem among large number of endocrinopathies. About 5% of the world population is affected from various thyroid disorders. This requires medical and surgical intervention.

In 1938, Noland stated that the weight of the thyroid gland is 18-31 gms [5].

Mortensen,Woolner, Bannett (1955)studied 821 cadavers with clinically normal thyroid gland and showed that the average weight of the normal thyroid gland depends almost entirely on the age of the person and is not consistently affected by sex or geographical residence [6].

Correlation between thyroid weight and height of cadavers in present study was non-significant in both sexes, p value 0.0683 in males and 0.3088 in females. It was correlating with study of O.Tanriover [3]. In his study p value was 0.139 in males and 0.566 in females.

Correlation between thyroid weight and height of cadavers in present study was non-significant in both sexes, p value 0.0683 in males and 0.3088 in females.

It is correlating with study of O. Tanriover [3] .In his study p value was 0.139 in males and 0.566 in females.

Mortensen et al. observed that the average weight of the normal thyroid glands depends almost entirely on the age of the patient and is not consistently affected by the sex or their usual geographic residence [6].

Conclusion

In case of male subject as height of cadaver increases, weight of thyroid gland decreases. In case of female subject as height increases, weight of thyroid gland also increases. The present study is an approach to objective to increase the information pool and help the clinicians and surgeons in their practice.

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Study of Chiari Malformations in North Karnataka Region

Vijaykumar Shinde[1], Pratik Khona[2]

Abstract

The most common anomalies of cranio-vertebral junction are Chiari malformations. Chiari malformations constitute a variety of four main syndromes (I, II, III, and IV), which describe the protrusion of brain tissue into the spinal canal through the foramen magnum. These malformations frequently occur in combination with other pathological entities such as myelomeningocele, hydrocephalus, and/or hydrosyringomyelia.They involve both skeletal and neural structures. The incidence of Chiari Malformation was 1 in 1000 births but with the increased use of imaging techniques such as CT scans and MR imaging it is suggested that this condition is much more common than thought earlier to be. However it is very difficult to estimate the exact rate of occurrence as some of cases are asymptomatic or do not develop symptoms till adulthood. In the present study 100 MRI films of patients with symptoms pertaining to chiari malformations from North Karnataka region were studied and interpreted.

Keywords: Chiari Malformations; Hydrocephalus; Myelomeningocele; hydrosyringomyelia.

Introduction

Chiari malformations constitute a group of different clinicopathological entities with varying etiology, pathophysiology, and clinical features. They represent varying degrees of hindbrain herniation through the foramen magnum. In 1883, John Cleland described a case of hindbrain malformation found during autopsy. Hans Chiari, an Austrian pathologist, performed post-mortem examination of forty cases in 1891 and 1896 and gave a detailed description of hindbrain malformations [1]. Chiari described these malformations as congenital anomalies of the hindbrain characterized by downward elongation of the brain stem and cerebellum into the cervical portion of spinal cord [2]. In his initial description, Chiari classified the hindbrain malformations into type I, II and III and then latter added type IV malformation [3].

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Classification of Chiari Malformation

Chiari malformations were described to be of four types:

Type I

It is the most commonly observed Chiari malformation. In this type, there is tonsillar herniation through foramen magnum. It is often associated with syringomyelia but not hydrocephalus. This type of Chiari malformation is congenital as well as acquired. Radiologically, Type I is described as tonsillar decent of 5 mm below foramen magnum. Patients with Type I Chiari malformation may be asymptomatic or present with mixture of cerebellar and pyramidal tract signs associated with dysfunctioning of lower cranial nerves [4].

Type II

It is also called as classic Chiari malformation or Arnold- Chiari malformation. It is less common. In type II Chiari malformation there is caudal descent of cerebellar tonsils and the vermis into the spinal canal

along with brain stem and fourth ventricle. Type II Chiari malformation is usually accompanied by myelomeningocele. Hydrocelaphus is seen in 90% of cases. Symptoms arise from dysfunctioning of brain cells and lower cranial nerves. Myelomeningocele results in the partial or complete paralysis of area below the spinal opening. Due to the severity, Type II patients become symptomatic in infancy or early childhood [4].

Type III

It is the most serious form of Chiari malformations. There is occipital or cervical encephalocele alongwith intra cranial abnormalities seen in type II Chiari malformation and a wide foramen magnum. This defect is readily visible and palpable. Plain radiographs help to identify the scull or cranial defects while MR imagining identifies the herniated brain tissue [4].

Type IV

It is a very rare type. It is characterised by cerebellar hypoplasia or aplasia and tentorial hypoplasia. There is no hind brain herniation in this type.

Other types of Chiari malformations include Chiari 0 and Chiari 1.5 types. Chiari 0 includes minimal or no hind brain herniation but the headache and other symptoms of Chiari malformation are present. Chiari 1.5 includes patients with tonsillar herniation without brain stem elongation or fourth ventricle deformation [5].

The incidence of Chiari malformations has been increased with the evolution of CT and MRI scans and hence this study was taken up to give further more insight on Chiari malformations in North Karnataka region.

Materials and Methods

In the present study 100 MRI films from different scan centers in North Karnataka region were studied. The MRI films of patients presenting with Headache and problems in balance and cordinationwere selected for the study. The signs of chiari malformations like herniation of hind brain, syringomyelia and myelomeningocoeleswerelooked for in the MRI films and tabulated according to different parameters.The reliable morphological features leading to diagnosis of Chiari II malformation on MR imaging are downward herniation of the cerebellum, downward displacement of the medulla, pons and fourth ventricle, medullary kinking, abnormally shaped fourth ventricle, hypoplastic tentorium and breaking mesencephalic tectum [6]. Along with above signs, Myelomeningoceole and Hydrocephalus are very often associated with Chiari malformations [7,8]. Hence these signs on MRI were considered for diagnosis of Chiari malformations in present study.

Results

Out of the 100 cases studied with headache, imbalance and incoordination, 58 cases were of females and 42 cases were of males (Table 1). There were 78 cases with age less than 7 years. Out of all the MRI films studied Cerebellar herniation was seen in two cases and both the patients were female child. Hydrocephalus was seen in 6 cases. Myelomeningocoele was seen in 2 cases. The cases in which cerebellar herniations were seen also had syringomyelia.

Table 1: Shows the gender distribution of cases with headache, imbalance or incoordination

Gender	Male	Female
No. of Cases(n=100)	48	52

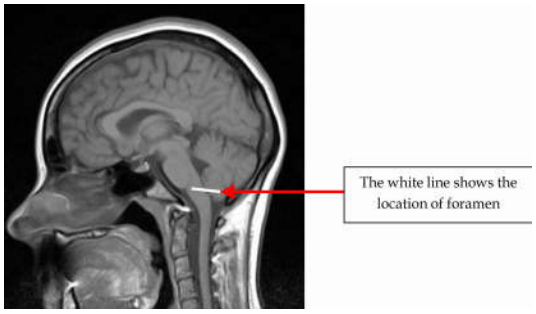

Fig. 1: Shows T1 weighted MRI image of normal sagittal section of brain

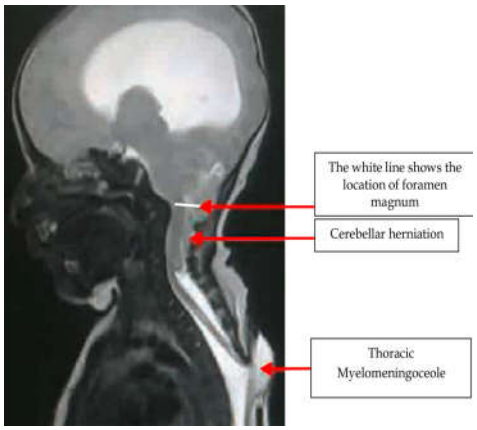

Fig. 2: Shows T2 weighted MRI image of sagittal section of brain with cerebellar herniation with Thoracic myelomeningoceole

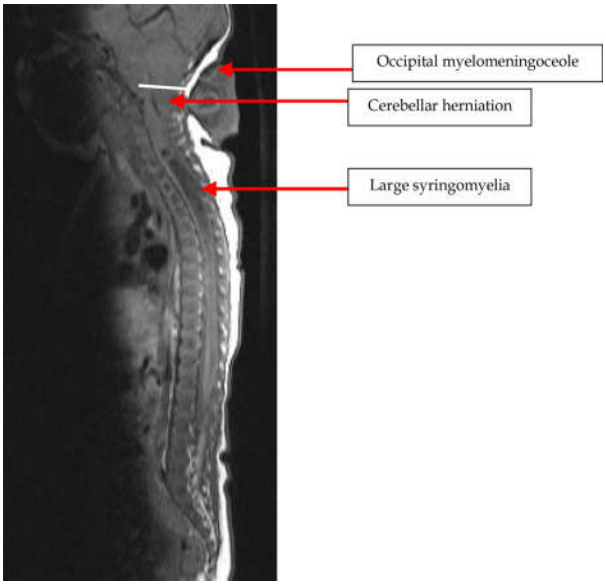

Fig. 3: Shows T1 weighted MRI image of sagittal section of brain with cerebellar herniation with Occipital myelomeningoceole and large syringomyelia

Case 1 (Fig. 2) had cerebellar herniation with thoracic myelomeningoceole with hydrocephalus and syringomyelia. Case 2 (Fig.3) had cerebellar herniation with occipital myelomeningoceole with large syringomyelia.

Discussion

Numbers of studies have been done on Chiari malformations. It has been found that the prevalence of Chiari I malformation is one per thousand in general population. With invent of the CT scans, MRI scans and newer imaging techniques, the diagnostic abilities have also improved.

Niel sGeerdinll et al carried out MR imaging study on 79 children and concluded that the reliable morphological features leading to diagnosis of Chiari II malformation on MR imaging are downward herniation of the cerebellum, downward displacement of the medulla, pons and fourth ventricle, medullary kinking, abnormally shaped fourth ventricle, hypoplastic tentorium and breaking mesoncephalic tectum [6]. Gammal T et al stated that myelomeningocoele is present with Chiari II malformation almost in all cases. However, the reverse is not true all the time [7]. According to Rauzzino M et al, Hydrocephalus is seen in 90% of the cases and ventricles are seen asymmetrically [8]. According to Stevenson KL, approximately 1/3rd of the patients with Chiari II malformation develop signs and symptoms of brain stem compression [9]. Curnese JT carried out a study on 33 patients with Chiari II malformation and found out that 36% of patients were symptomatic while 64% were asymptomatic [10]. Wolpert SM et al carried out a study to see the relation between the amount of brain stem herniation and neurological status of the children with Chiari II malformation and found out that the neurological status was not affected by either the amount of herniation of the characteristics of cervico-medullary and hence concluded that the breathing and swallowing difficulties experienced by children with Chiari II malformation is due to other factors like disorganization of brain stem nuclei [11]. Tsai T et al did a biometric analysis of 25 patients with myelomeningocele and Chiari II malformation and concluded that degree of vermion herniation and cervicomedullary junction herniation are independent variables in Chiari II malformation while the size of posterior cranial fossa is an important factor in explaining the variability of vermian herniation [12].

The initial description of CM type III was based on the description of a single case with a large dermal sac in the occipital region, containing herniated cerebellum.Type III is characterized by caudal displacement of the medulla and herniation of part of the cerebellum intoan occipitocervicalmeningocele. Sometimes, part of thehindbrain is also herniated. Hydrocephalus is present in 50% of these cases and is always of obstructive etiology, due to either aqueductal stenosis or an associated Dandy-Walker malformation. Chiari type III is a neuroectodermal malformation [13].

In the present study Arnold-chiari malformation was seen in one case and Chiari III malformation was seen in other. Invariably both the cases were having myelomeningoceoles and syringomyelia. It is would be appropriate to say that all chiari malformations cases are associated with myelomeningoceoles.

The embryological basis of above anatomical variation can be understood by different theories suggested by researchers. The theory of overgrowth suggested that the overgrowth of neural plate before neurulation prevents fusion of neural folds. According to hydrodynamic theory, imbalance between pulsating choroid plexus of forth and lateral ventricles result in Chiari malformation [14]. According to Jenning et al, Chiari malformation occurs because the normal zone of fusion at third and fourth somites is displaced caudally below the third to fifth somite pairs thus causing the displacement of the area of formation of cervicomedullary junction [15]. A theory was given by Daniel and Strich, which stated the developmental arrest, especially in the progression of pontine flexure

during 28th and 29th day of gestation as a cause of Chiari malformation [16].

Conclusion

Chiari malformations are not as rare as would be expected from the small number of reported cases but with the increased use of CT and MRI scans they can be much more common. The defect is almost always, but not invariably, associated with meningomyelocele or spina bifida occulta in lumbosacral region. Hydrocephalus is present in most cases. Other associated defects of development include craniolacunia, hydromyelia, syringomyelia, double cord, basilar impression [5]. Limitations of present study are the selection of target population, as mentioned in literature not all cases present with symptoms, No proper diagnostic facilities in rural areas and poor people cannot afford the cost of CT and MRI scans.

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Study of Anatomical Variations of Temporal Bone Using High Resolution Computed Tomography of Temporal Bone

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Abstract

Background and objective: High Resolution Computed Tomography **(**HRCT), a modification of routine Computed Tomography, provides a direct visual window into the temporal bone providing minute structural details. Purpose of the present study is to evaluate the normal anatomical variations involving the temporal bone. *Materials and Methods*: A cross-sectional study of 80 randomly selected HRCT temporal bone films were studied in the department of ENT at Navodaya Medical College, Raichur during the month of February 2017. The HRCT films were studied in both the coronal and axial planes with thin 2mm sections using ultra high algorithm obtaining both contrast and non-enhanced images. Results were tabulated using percentages. *Results*: In our entire series of 80 films, we found that the facial canal was dehiscent in 2 cases. In both the cases, the dehiscence was at the region of the oval window niche. *Conclusion:* HRCT is a revolutionary imaging modality that helps in evaluating the anatomical variations affecting the temporal bone. HRCT of temporal bone predicts certain normal anatomical variants of surgical significance preoperatively.

Keywords: Human; Anatomy; Variations; Computed Tomography; Temporal Bone.

Introduction

Many imaging modalities are available for the evaluation of the temporal bone pathologies including plain radiographs, angiography, air and non-ionic contrast cisternography, computed tomography (CT), and magnetic resonance imaging (MRI). CT and MRI are currently the most widely used techniques and have largely replaced the other modalities [1]. CT scanning excels in the evaluation of bone and air space anatomy and disorders [2].

Because CT scans are more accurate in identifying many soft tissue abnormalities and are much less prone to artifacts, they have largely replaced polytomography; there is also less radiation to the lens of the globe with CT scans than with polytomography. CT has the advantage of producing images with higher contrast and a better spatial resolution [3].

High Resolution Computed Tomography **(**HRCT), a modification of routine CT provides a direct visual window into the temporal bone providing hitherto unavailable minute structural details [3]. The purpose of the study is primarily to study the different anatomical variations of the temporal bone using a randomly selected pool of HRCT films of temporal bones.

Materials and Methods

Our study is a cross-sectional study where in 80 randomly selected HRCT temporal bone films were studied in the department of ENT at Navodaya Medical College, Raichur of Karnataka state during the month of February 2017. The HRCT films were studied in both the coronal and axial planes with thin 2mm sections using ultra high algorithm obtaining both contrast and non-enhanced images. Pathological or fractured temporal bone HRCT films were excluded from the study.

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The CT scans were taken previously in the ENT department for evaluation of patients coming with ear symptoms. Patients were scanned in the axial and coronal (supine or prone) axes. Scout films were taken routinely in all patients before starting the scan. Scanning commenced from the lower margin of the external auditory meatus and extended upward to the arcuate eminence of the superior semicircular canal as seen on lateral topogram. HRCT comprises the use of a thin collimation, a high spatial frequency algorithm, smallest practical FOV (15 to 20cm) and a large reconstruction matrix (512 x 512). With a 1cm collimation the volume averaging within the plane of scan reduces the ability of CT to resolve small structures significantly. CT images are usually acquired or displayed in axial and coronal planes. For axial imaging, sections are made in a plane rotated 300 superior to the anthropologic base line. Scan produced in this plane display the temporal bone structures to good advantage. This plane allows separation of individual component of the temporal bone so that they are better visualized in their entirely, with less of overlap and fewer partial volume imaging artifacts. Direct coronal images are usually obtained at an angle of approximately 1200 from arthropologic baseline, while reconstruction coronal images are usually oriented 900 from arthropologic baseline.

All the 80 scans were studied for presence of anatomical variations of the temporal bones. We searched for anatomical variants like dehiscent facial nerve, aberrant internal carotid artery, Jugular bulb variants, persistent stapedial artery, anterior and wider sigmoid sinus, size of mastoid antrum, presence of Korner's septum, deep posterior wall recesses and low lying middle cranial fossa. Anatomical variations, if present, were noted down.

Results and Observations

In our study we noted that of the total 80 films, 52 (65%) were of male subjects and 28 (35%) were of female subjects. In our entire series of 80 films, we found that the facial canal was dehiscent in 2 cases. In both the cases, the dehiscence was at the region of the oval window niche (Figure 1). In both the cases, the bony canal defect was present over the oval window. In one case, the length of dehiscence was 1.4 mm and in another case, the length of dehiscence was 2.1 mm. We did not find any other anatomical variation mentioned above in the temporal bones' scan study.

Fig. 1: High-resolution ct scan of left ear, demonstrating dehiscence of facial nerve canal

Discussion

The two temporal bones are situated laterally at the base of the skull. Each one consists of five parts, namely squamous, mastoid, petrous, tympanic and styloid process. The squamous portion is easily seen on routine skull films. The styloid process can be studied in a prone Townes projection [2].

Squamous

The squamous portion forms the anterolateral, thin shell like part of the bone from which arises the zygomatic process. The external surface gives attachment to the temporalis muscle; it forms part of the wall of temporal fossa. The inner surface is concave and irregular. Meningeal vessels groove the inner surface. The superior border articulates with parietal bone, and the anteroinferior border with the greater wing of sphenoid [2].

Styloid Process

The styloid process is 2.5cm long and projects downward and forward, anterior to the stylomastoid foramen [2].

Mastoid

The mastoid portion is hollowed to form a number of mastoid air cells [1]. The largest air cell which is situated in the upper and anterior part is the antrum. It communicates with the remaining air cells and attic by a narrow channel called aditus ad antrum. In the upper and anterior part of the bone these cells are large and irregular, towards the middle they diminish in size and in the apexes are small [2].

Petrous Portion

The petrous portion is a three sided pyramid resting

on its side, wedged between the sphenoid and occipital bones with its long axis 450 to sagittal plane. its base is lateral and apex is directed medially. The apex has a shallow depression medially where the semilunar ganglion lies (Meckel s cave). The petrous portion has an anterior surface which, separates it from the middle cranial fossa. In the midportion is the arcuate eminence formed by the underlying superior semicircular canal. The cranial cavity is separated from the tympanic cavity by the tegmen tympani. The posterior surface is the bony demarcation between the posterior fossa and the tympanic cavity. It is more vertical. Near its centre is the internal auditory meatus which transmits the VIIth and the VIIIth nerves. The opening is Porous Acousticus. The lateral end of the internal auditory canal is closed by a bony plate known as lamina spirales, which separates the fundus of the canal from the vestibule. The fundus is divided by a bony crest crista falciformis into the smaller upper and the larger lower compartment. Postero-inferior to the internal aqueduct., superiorly and inferiorly are the respective petrosal sinuses [4].

The Tympanic Portion

It is a "C" shaped curved plate which forms the anterior wall, floor and posterior-inferior aspect of the external auditory canal [2]. At the medial end is the tympanic sulcus which lodges the tympanic membrane. The lateral border forms a large part of the margins of the opening of external auditory canal [4].

The External Auditory Canal

It comprises of a lateral fibro-cartilagenous part and a medial bony part. The osseous part is a bony canal 16mm long and is directed downwards, forwards and inward. On sagittal scan the canal is oval or elliptical with its long axis directed downward and slightly backward. The tympanic membrane is oriented obliquely so that the inferior and anterior walls of the external auditory canal are longer. It forms the medial boundary of the external auditory canal, separating the canal from the middle ear [2].

The Middle Ear

It is a irregular, laterally compressed space within temporal bone. It is filled with air conveyed from the nasopharynx via the Eustachian tube. It is transversed by an ossicular chain, connecting the lateral and medial walls. It consists of three parts. a) Mesotympanum b) Attic c) Hypotympanum [4].

Roof or Tegmen Wall

The tegmen tympani is a plate of bone that arises from the petrous portion of temporal bone. It separates the middle cranial fossa from the tympanic cavity. In children the lateral margin of tegmen tympani may be unossified and may allow direct passage of infection from the middle ear to epidural space [2].

Floor or Jugular Wall

It is a thin plate of bone that separates the hypotympanum from the internal jugular vein. The jugular foramen is a complex canal coursing anteriorly, laterally and inferiorly to exit from the skull base. It has a smaller anterior compartment (pars nervosa) and larger posterior compartment (parsvascularis). The terminal portion of the sigmoid sinus flows anteriorly to enter the jugular foramen (pars vascularis), turns laterally to expand and form the jugular bulb and then drains inferiorly into the internal jugular vein [5]. The Carotico-Jugular spine is a vertically oriented plate which separates the jugular foramen from the carotid canal [5].

Posterior or the Mastoid Wall

It has the aditus ad antrum superiorly which connects the epitympanic recess to the mastoid antrum. The pyramidal eminence is a "W" shaped elevation situated behind the oval window and gives origin to the stapedius muscle. It divides the posterior wall into two recesses [1]. The facial recess between pyramidal eminence medially and bony tympanic annulus laterally. The sinus tympani between the labyrinthine wall medially and pyramidal eminence laterally. The incudal fossa is a shallow depression in the epitympanum for the attachment of the posterior ligament of the short process of incus [2].

Anterior or Carotid Wall

It is wider above than below and corresponds to carotid canal, from which it is separated by a thin plate of cortical bone that is perforated by tympanic branch of internal carotid artery and by tympanic nerve. The internal carotid artery is intimately related to the horizontal vertical segments of the anterior wall. Superiorly are the orifices for origin of semicanals of tensor tympani and Eustachian tube [2].

Eustachian Tube

The tympanic cavity communicates with the nasopharynx through this tube. It is 3.5cm and is directed downward, forward and medially. It has both osseous and cartilaginous parts. The pharyngeal opening of the cartilaginous portion is "C" shaped and can open its lumen maximally during swallowing. This helps ensure that the middle ear and pharyngeal air pressures are equilibrated during swallowing [6].

Lateral or Membranous Wall

It is formed by the tympanic membrane. It is lodged in the tympanic ring. It is directed downwards and medially with an angle of 500 to the floor of external auditory canal. It is divided into two parts by the manubrium of the malleus. The superior pars flaccida and the inferior pars tensa [2].

The Medial or Labyrinthine Wall

This wall separates the inner ear from the middle ear. Posterior-superiorly is prominence produced by the anterior limb of the lateral semicircular canal. Below this and more anteriorly is the prominence of the intratympanic portion of the facial nerve canal. Anterior to this prominence is the curving terminus of septum canalismusculotuborii, which serves as a landmark for the position of geniculum of facial nerve. Immediately inferior to the facial nerve canal is the laterally directed oval window niche, which contains the oval window at its medial terminus. The promontory is a convex bulge formed by the otic capsule over the basal turn of the cochlea. Below and behind the promontory is the round window niche leading to round window. Posterior to promontory is subiculum-promontorii which forms inferior border of tympanic sinus [6].

The Tympanic Cavity

It consists of three parts: Mesotympanum-Medial to the tympanic membrane, Epitympanum or attic-Above the level of the membrane and Hypotympanum- Inferior and medial extension of the mesotympanum. The contents of the tympanic cavity are: 1) Auditory ossicles 2) Ligaments and muscles and 3) Facial nerve [2].

Auditory Ossicles

The ossicular chain extends from the medial to the lateral wall of the middle ear cleft and is a sound conducting medium. Malleus consists of head, neck, anterior process and lateral process. The head lies in the epitympanum. The neck (manubrium) is attached to the tympanic membrane. The lateral process abuts the tympanic membrane below the pars flaccida. The anterior process is a very small spicule of bone. The incus is shaped like a premolar. It has a body and two processes. The body has an anterior concavo-convex facet, which articulates with the head of malleus. The short process is placed horizontally and directed backwards. It is attached to the incudal fossa. The long process descends parallel to the manubrium and bends medially to end in a rounded projection called lenticular process. The stapes has a head, two crura and a foot plate. The head articulates with the lenticular process of incus. The neck is constricted. Stapedius muscle is inserted on its posterior aspect.

The anterior and posterior crura diverge from the neck and meet the foot plate. The foot plate covers the oval window. The ossicles are connected to the walls by ligaments and muscles [4].

Ligaments and Muscles

The anterior malleolar ligament commences from the neck of malleus and is inserted over the carotid wall. The superior malleolar ligament is attached from the roof of epitympanum to the head of malleus. The lateral ligament goes from the posterior part of notch of Rivinus to the head of malleus. The posterior incudal ligament connects the short crus of incus to the posterior wall of incudal fossa. The annular ligament of the base of stapes encircles the base of the stapes along the margin of oval window. Tensor tympani muscle is in an osseous compartment above the Eustachian tube. It takes a sharp bend around the processuscochleaformis and is inserted over the neck of malleus. Stapedius muscle arises from the hollow cavity of the interior of pyramidal eminence and is inserted on the posterior surface of the neck of stapes [4].

The Facial Nerve

It emerges from the brainstem by a sensory and a motor root; leaving the brainstem at the inferior border of pons medial to the VIIIth nerve. The intracranial segment is 23-25mm long. The internal auditory canal segment is 7-8mm and lies above the cochlear nerve. The labyrinthine segment is 3-4mm and passes forward and laterally in its bony canal (fallopian canal). At a point laterals to the cochlea. It angles forward perpendicular to the petrous to reach the geniculate ganglion. At the ganglion the direction of the nerve reverses. This is the first knee or genu. The

tympanic segment is 12mm long and passes posteriorly and laterally on the medial wall of the middle ear. It lies below the bulge of the lateral semicircular canal and above the oval window. At the level of sinus tympani the nerve assumes a vertical position. This is the second genu of the facial nerve. It runs along the posterior wall of the tympanic cavity to exit at the base of the skull from the stylomastoid foramen. This mastoid segment is 15-20mm in length. The three important branches of the facial nerve arising in the temporal bone are – 1) Greater superficial petrosal nerve arises at the geniculate ganglion and carries the secretomotorfibres to the lacrymal gland. 2) The nerve to the stapedius is given off in the mastoid course of the facial nerve behind the pyramid eminence. 3) The chorda tympani which is the special gustatory nerve to the anterior 2/3rd of tongue originates 5mm above the stylomastoid foramen [7,8].

The Inner Ear

The bony labyrinth consists of the vestibule, semicircular canals and the cochlea. Vestibule is an ovoid perilymphatic space, 4mm in diameter, opening anteriorly into the cochlea and posteriorly into the semicircular canals. The vestibule has two openings. Oval window – for communication with the foot plate of stapes.Vestibular aqueduct – this is a bony canal which extends from the posterior-medial wall of the vestibule to the posterior surface of the petrous pyramid. It is inverted "J" shaped. The proximal "isthmus" arches medial to the crus and measures 03mm in diameter. The duct widens inferiorly and forms a triangular slit parallel to the posterior surface of the pyramid. Outer aperture is 2-6mm in diameter. The aqueduct contains the endolymphatic duct which enlarges to end blindly in the endolymphatic sac on the posterior surface of the petrous pyramid [9].

Semicircular Canals

There are three canals communicating with the vestibule. Each canal makes 2/3rd of a circle and is 1mm in diameter. Each is enlarged anteriorly to form the ampulla. The non-ampullary ends of the superior and posterior canals join to form the common crus. A portion of the superior semicircular canal forms a ridge on the anterior surface of the petrous bone called arcuate eminence. The lateral semicircular canal projects as a ridge on the medial wall of the attic [9]. The superior and posterior semicircular canal are aligned in a vertical orientation perpendicular to each other. The superior semicircular canal is placed at an angle of 450 to the mid-sagittal plane antero laterally and is directed postero-laterally at a corresponding angle. The posterior semicircular canal is similarly placed with the angle directed postero-laterally. The lateral semicircular canal does not occupy a horizontal plane and for this reason the older terminology has been discarded. The anterior limb of the lateral semicircular canal lies in the plane higher than that of posterior limb, making at angle of 300 with the horizontal. In the erect position therefore the neck would have to be fixed about 300 for the lateral semicircular canal to be "horizontal" [9].

Cochlea

It consists of a central conical axis – modiolus and a bony canal wound spirally around it for 2 ½ turns [10]. The 1st turn bulges along the medial wall to form the promontory. The cochlear aqueduct is a well corticated notch medial to the pars nervous and inferior to porusacousticus. It serves as a potential communication between the sub arachnoid space and inner ear perilymph [9].

Anatomical Variants

The common anatomical variants of the temporal bone are dehiscent facial nerve canal, aberrant internal carotid artery, jugular bulb variants, persistent stapedial artery, anterior and wider sigmoid sinus, size of mastoid antrum, presence of Korner's septum, deep posterior wall recesses and low lying middle cranial fossa.

HRCT Appearance

1. *Dehiscent Facial Nerve:* The mid tympanic segment is the most common site of involvement. The nerve is seen in cross section below the lateral semi circular canal on coronal images. This nerve is prone to infection and surgical trauma [7].
2. *Aberrant Internal Carotid Artery:* It occurs when an enlarged inferior tympanic artery anastomoses with enlarged carotico-tympanic artery as a result of regression of cervical internal carotid artery. Aberrant internal carotid artery is seen entering the tympanic cavity through the enlarged tympanic canaliculus posterior to the normal internal carotid artery. It courses anteriorly across the promontory to join the horizontal internal carotid artery. It is seen as a soft tissue density and may mimic a vascular middle ear mass [11].
3. *Jugular Bulb Variants:*

   1. Asymmetric jugular bulbs- A high riding jugular bulb which extends above the tympanic spine 2) A dehiscent jugular bulb presents as a vascular

mass in the retrotympanum. It is best seen on coronal CT as being directly continuous with the middle ear. 3) Jugular diverticulum 47 is a finger like projection from the jugular bulb which projects cephalad [5,12,15].

4. *Persistent Stapedial Artery:* The foramen spinosum is absent and the proximaltympanic segment of the facial nerve canal is enlarged. This important anomaly is to be identified to prevent excess intraoperative bleeding [2].
5. *A wide Sigmoid Sinus and Mastoid Antral Size:* It is present more anteriorlyand the mastoid antral size is consequently compromised. The post auricular approach has to be guarded in these cases to prevent entry into the sigmoid sinus [2].
7. *Koerner's septum:* It is a bony demarcation between mastoid and temporalsquamae. It presents as a thick bony plate during mastoid surgery and may mimic sigmoid wall [2].
8. *Deep Posterior Wall Recesses:* These are the facial canal recess and sinus tympani.On occasion these may be abnormally deep and house occult infection [2].
9. *Low Lying Middle Cranial Fossa:* It occurs due to absence of tegmentalpneumatization. The tegmen plate is thin and prone to infection and surgical trauma [2].

In our entire series of 80 films, we found that the facial canal was dehiscent in 2 cases (2.5%). In both the cases, the dehiscence was at the region of the oval window niche. In both the cases, the bony canal defect was present over the oval window. In one case, the length of dehiscence was 1.4 mm and in another case, the length of dehiscence was 2.1 mm. Moreano et. al have mentioned in their study about prevalence of facial canal dehiscence to be 56%. Like in our study, their study also had the oval window area as the most site for facial canal dehiscence, followed by the facial nerve genu area and the area of tensor tympani [14]. Baxter has reported the prevalence of facial canal dehiscence as 0.75% in his study [15].

We did not find any other anatomical variation mentioned above in the temporal bones' scan study.

Conclusion

HRCT is a revolutionary imaging modality that helps in evaluating the anatomical variations affecting the temporal bone. HRCT of temporal bone predicts certain normal anatomical variants of surgical significance preoperatively.

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Original Article

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Sexing Adult Human Atlas Vertebrae in South India

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Abstract

Background: Bone is often the only material remaining after decaying process of the human body. Therefore identification of age, sex is aim of anatomist, forensic expert as well as anthropologist. Present study will be helpful in medico legal cases in identification of sex with atlas vertebra 150 atlas vertebrae with known sex 98 male and 52 female were obtained. Measurements of atlas vertebrae were taken by using Vernier callipers. Mean, range, standard deviation calculated. Z test was used to find out statistical significance. *Results:* Demarking point regarding Distance between both tips of transverse process of atlas vertebrae in male was>86.34 and in female it was <62.98. Demarking point regarding transverse diameter of vertebral canal of atlas vertebrae in male was>32.6 and in female it was <22.07 Demarking point regarding anterioposterior diameter of vertebral canal of atlas vertebrae in male was>33.12 and in female it was <25.23 Demarking point regarding area of vertebral canal of atlas vertebrae in male was > 632.5 and in female it was < 455.8 Demarking point regarding circumference of vertebral canal of atlas vertebrae in male was > 100.45 and in female it was < 80.4. *Conclusions:* Parameters of atlas vertebrae more than Demarking point will be definitely of male atlas vertebrae and less than Demarking point will be of female atlas vertebrae. Present study will help in identification of sex of unknown atlas vertebra.

Keywords: Atlas Vertebra; Demarking Point; Sex Determination.

Introduction

If total skeleton is available, then it is easy to identify the sex of given skeleton but many time few or single bone is available, then it becomes difficult to identify sex of given unknown skeleton. A study on sex determination of skull was done by Stewart. He gave correct sex determination of skull in above 77% of crania [1].

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Jit and sigh evolved demarking point (DP) based on statically calculated ranges of various measurable characters of clavicle which are useful to identify sex with 100% accuracy [2].

Stini have argued that body size is different in male and female because of requirement of reproduction and lactation [3].

According to Stinson sexual dimorphism is influenced by genetic, environmental and nutritional as well as functional characters [4].

Holland has studied sex determination of fragmentary crania by analysis of cranial base [5].

Krogman had carried out study on individual bones; according to them all the bones of the skeleton do not have the same importance in sexing skeleton. In more than 90% of cases skull, femur sacrum and pelvis help in sexing accurately [6].

Shamersingh and K C Gangrade have done study on sexing of adult clavicles and demarking points. Demarking points were found out from calculated range which was equal to mean +/- 3 S.D (standard

deviation) . Sex can be identified with 100% accuracy by using demarking points [7].

In study by Venkatesh G et al the anteroposterior diameter , transverse diameter and area of the foramen magnum can be employed as better tools for sexing the skulls, when only fragments of skull such as foramen magnum is available for identification of sex [8].

According to Ramamoorthy B et al the most dimorphic variable to determine sex of the skull, was biauricular breadth followed by weight of the skull [9].

In a review study by Krishnan K Geometric morphometry, Diagnose Sexuelle Probabiliste method, the newer 3D methods and molecular techniques are available but morphometric study of dry skeleton is still very important in identification of sex [10]. In present study morphometric and stastical analysis of atlas vertebra is considered for sex determination. It will be helpful to anatomists, anthropologists and forensic experts.

Material and Method

Hundred and fifty human first cervical vertebrae with known sex 98 male and 52 female were obtained from medical college in Maharashtra.

Following measurements were recorded with Vernier calliper accurate to 0.1 mm for linear measurements

1. Distance between both tips of transverse process
2. Transverse diameter of vertebral canal
3. Anterioposterior diameter of vertebral canal,
4. Area of vertebral canal superior articular facet length, right
5. Circumference of vertebral canal

Mean, range and Standard deviation were calculated from all measurements of 152 atlas vertebrae . Demarking points were calculated from formula mean +/-3 S.D (standard deviation)

'Z' test was used to find out statistical significance.

Result

Table 1: Anatomical Parameters of the Atlas vertebrae (in mm)

Sr. No.	Parameter	sex	Mean	S.D	D.P	Statistical Significance
1	Distance between both tips of transverse process	M	78.49	+/-5.17	> 86.34	P<0.001
		F	70.17	+/-5.39	< 62.98	P<0.001
2	Transverse diameter of vertebral canal	M	27.2	+/-1.71	>32.6	P<0.001
		F	25.58	+/-2.34	<22.07	P<0.001
3	Anterioposterior diameter of vertebral canal,	M	29.61	+/-1.46	>33.12	P<0.001
		F	27.0	+/-2.04	<25.23	P<0.001
4	Area of vertebral canal,	M	632.5	+/-58.9	>775	P<0.001
		F	538.87	+/-78.9	<455.8	P<0.001
5	Circumference of vertebral canal,	M	98.5	+/-3.7	>100.45	P<0.001
		F	82.06	+/-6.13	<80.40	P<0.001

SD= standard deviation, DP=demarking point, M=Male, F=Female, > = greater than and < = less than

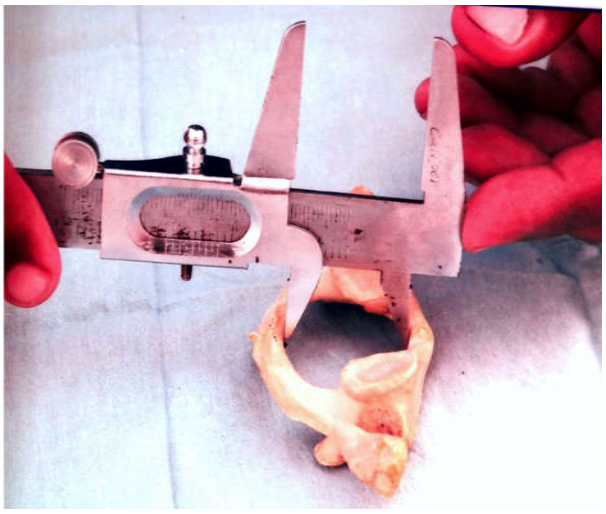

Fig. 1: Measurement of atlas vertebra by Vernier caliper

Discussion

Similar study was done by G.P. Pal et al [11] and E.A. Marino [12].

In a study by G.P. Pal et al mean distance between both tips of transverse process in male was 74.2mm and standard deviation was +/-14.4. Demarking points for distance between both tips of transverse process in male was >75.4mm, so atlas vertebrae having distance between both tips of transverse process >75.4mm will be male atlas vertebrae. Mean distance between both tips of transverse process in female was 66.7mm and standard deviation was +/-3.0 and demarking points for Distance between both tips of transverse process in female was <81mm, so atlas vertebrae having distance between both tips

of transverse process <81mm will be female atlas vertebrae . In present study mean distance between both tips of transverse process in male was 78.49mm and standard deviation was +/- 5.17 and demarking points in male was >86mm Mean distance between both tips of transverse process in female was <70.17mm and standard deviation was +/- 5.39 demarking points in female was 62.98mm

Mean Transverse diameter of vertebral canal in male in study by G.P. Pal et al was 28.71mm and in female it was 24.8mm and standard deviation was +/- 3.4 in male and +/- 1.8 in female and mean in present study was 27.2mm in male and 25.58mm in female and standard deviation was +/- 1.71 in male and +/- 2.34 in female

Demarking points for transverse diameter of vertebral canal in male in study by G.P.Pal et al was >30.2mm in male and in female it was <18.51mm and in present study it was >32.6 mm in male and <22.07mm in female

Mean anteroposterior diameter of vertebral canal in male in study by G.P. Pal et al was 33.30mm and in female it was 28.8mm and standard deviation was +/- 3.8 in male and +/- 2.2 in female and mean in present study was 29.61mm in male and 27.0mm in female and standard deviation was +/- 1.46 in male and +/- 2.04 in female

Demarking points for anteroposterior diameter of vertebral canal in male in study by G.P. Pal et al was >35.4mm in male and in female it was <21.9mm and in present study it was >33.12 mm in male and <25.23mm in female

Mean area of vertebral canal in male in study by G.P.Pal et al was 710.0mm^2 and in female it was 563.0mm^2 and standard deviation was +/- 175 in male and +/- 93.0 in female and mean in present study was 632.5mm^2 in male and 538.87mm^2 in female and standard deviation was +/- 58.90 in male and +/- 78.95 in female

Demarking points for area of vertebral canal in male in study by G.P.Pal et al was >842mm^2 in male and in female it was <185mm^2 and in present study it was >775 mm^2 in male and< 455mm^2 in female

Mean circumference of vertebral canal in male in study by G.P.Pal et al was 103.02mm and in female it was 91.4mm and standard deviation was +/- 8.6 in male and +/- 4.7 in female and mean in present study was 98.5mm in male and 82.6mm in female and standard deviation was +/- 3.7 in male and +/- 6.13 in female

Demarking points for circumference of vertebral canal in male in study by G.P.Pal et al was >105.5mm in male and in female it was <74.4mm and in present study it was >100.45 mm in male and <80.4mm in female

Difference is seen in present study and study by GP Pal as variation is present due to, as racial variation is present between north Indian and south Indian population [18].

E A Marino studied sex estimation using the first cervical vertebrae regarding eight parameters from the articular region of superior articular facet of both sides and inferior articular facets of both sides seven regression and seven discriminate function equations were created that predict sex with 77% to 85 % and 75% to 85% accuracy respectively In present study we have used demarking points with the help of these, sex of unknown atlas vertebra can be identified with 100% accuracy [12].

Conclusion

In present study we have calculated demarking points of distance between both tips of transverse process, anteroposterior diameter of vertebral canal, transverse diameter of vertebral canal, area of vertebral canal and circumference of vertebral canal for both male and female atlas vertebrae. If Parameters of atlas vertebra with unknown sex are more than Demarking points then that atlas vertebra will be definitely of male and if less than Demarking point then it will be of female. Present study will help in identification of sex of atlas vertebra with unknown sex which is frequently required in medico legal cases.

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Original Article

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Dominance of Coronary Arteries: A Combined Gross Anatomical & Angiographic Study

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Abstract

Introduction: The dominant coronary artery is that which gives the posterior interventricular branch, traversing the posterior interventricular sulcus and supplying the posterior part of the ventricular septum and often part of the posterolateral wall of the left ventricle as well. In various studies the right coronary artery dominance was observed in 63-90% cases, left coronary artery dominance was observed in 6-20% cases and Co-dominance was observed in 1-28% cases by various methods of study. *Material and Methods:* 55 heart specimens were dissected and 82 cases of angiography were studied. The dominance pattern along with sexual dimorphism were noted and analysed. *Result:* Amongst the total 137 cases right dominance was found in 72.3%, left dominance in 15.3% and co-dominance in 12.4%. Right dominance was found in 67.6% males & 85.7% females, Left dominance in 15.7% males & 14.3% females, Co-dominance in 16.7% males & in females no case of co-dominance was found. *Conclusions:* In females Right dominance was more than in males, while Left dominance and Co-dominance was more in males. The difference in dominance pattern male and females is statistically significant.

Keywords: Dominance; Co-Dominance; Right Coronary Artery; Left Coronary Artery.

Introduction

The arteries which are the first branches from the ascending aorta occupy atrioventricular and interventricular groove in a shape of crown, hence named coronary arteries [1].

Coronary arteries are classified as "end circulation" since they represent only source of blood supply to the myocardium; there is very little redundant blood supply, which is why blockage of these vessel can be so critical [2].

The term 'dominant' coronary artery was introduced by Schlesinger (1940) who used it to indicate the areas of heart supplied by each artery. Although the left coronary artery always supplies a greater mass of myocardium than does the right, it is not usually 'dominant'. The dominant coronary artery is that which gives the posterior interventricular branch, traversing the posterior interventricular sulcus and supplying the posterior part of the ventricular septum and often part of the posterolateral wall of the left ventricle as well (Allwork, 1980) [1].

In various studies the right coronary artery dominance was observed in 63-90% cases, left coronary artery dominance was observed in 6-20% cases and Co-dominance was observed in 1-28% cases by various methods of study [3-16].

The present study observes the dominance in males and females by doing the dissection on cadaveric hearts and observing the angiograms of various patients.

Material and Methods

The study was carried out with the permission of institutional ethics committee in the department of Anatomy, in collaboration with the Private cardiology institute in the city.

For gross study 55 heart specimens were dissected,

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For angiography study, angiographic data of 82 cases was studied which were already recorded with the help of CT Angiographic machine from the well equipped cardiology unit from a private institute in the city. In both type coronary arteries were traceable up to its termination.

By stripping the visceral pericardium from the anterior and posterior interventricular sulcus, as well as from right & left atrioventricular sulcus, the right coronary artery (RCA), left main coronary artery (LMCA), left circumflex artery (LCX) was identified.

Dominance was decided by the origin of posterior interventricular artery, if it was given by RCA then it was termed as Right Dominance, if it was given by LCX then it was termed as Left dominance. If both RCA & LCX were giving branches in the posterior interventricular sulcus then it was termed as co-dominance.

Group of 82 samples of angiography were selected randomly from the vast data which was already recorded in a private cardiology institute in the city, With the help of DICOM software on computer interface attached with the CT Machine under guidance of the senior interventional cardiologist the dominance pattern was observed. Collectively 137 cases observations were analyzed on SPSS V.13 software by Pearson Chi-square test.

Result

As shown in table 1, there were total 137 cases studied, amongst that 102 were males and 35 were females. Amongst 137 of total, 55 cases were of Gross samples and 82 cases were of Angiography.

As shown in table 2, Amongst the total 102 males right dominance was found in 67.6% (Figure 1 & 2), left dominance in 15.7% (figure 3 & 4) and co-dominance in 16.7% (Figure 5, 6 & 7).

Amongst the total 35 females right dominance was found in 85.7%, left dominance in 14.3% and no case of co-dominance found.

Amongst the total 137 cases right dominance was found in 72.3%, left dominance in 15.3% and co-dominance in 12.4%.

Table 1: Sample Distribution

	Gross	Angiography	Total
Male	42	60	102
Female	13	22	35
Total	55	82	137

Table 2: Coronary Dominance

	Right dominance	Left dominance	Co-dominance	p-Value & Significance
Male	67.6%	15.7%	16.7%	
(n=102)	(n = 69)	(n = 16)	(n = 17)	0.030
Female	85.7%	14.3%	0.00%	**Significant**
(n=35)	(n = 30)	(n = 5)	(n = 0)	
Total	72.3%	15.3%	12.4%	
(n=137)	(n = 99)	(n = 21)	(n = 17)	

Table 3: Comparison of Coronary Artery Dominance In Different Studies

Authors	Right dominance	Left dominance	Co-dominance
Abdelmoneim AAA et al [3]	77%	8%	15%
Ballesteros LE et al [4]	76%	6.8%	17.2%
Bezerra FS [5]	80%	20%	----
Bhimalli Shilpa [6]	65%	17.5%	10%
Cheemalapati S et al [7]	75%	15%	10%
Hussain MA et al [8]	90%	10%	----
Jeffrey J. Popma [9]	85%	7.5%	7.5%
Kahn [10]	70%	10%	20%
Kalpana, R [11]	89%	11%	----
Kini s et al [12]	80-85%	15-20%	5%
Koşar P. et al [13]	76%	9.1%	14.8%
Laurens FT et al [14]	87%	12%	1%
Paolo Angelini [15]	89.1%	8.4%	2.5%
Rahman [8]	70%	13%	17%
Sarami et al [16]	87.25%	10.78%	1.97%
Sarker [8]	63%	9%	28%
Present study	72.3%	15.3%	12.4%

Fig. 1: Right dominance (Gross)

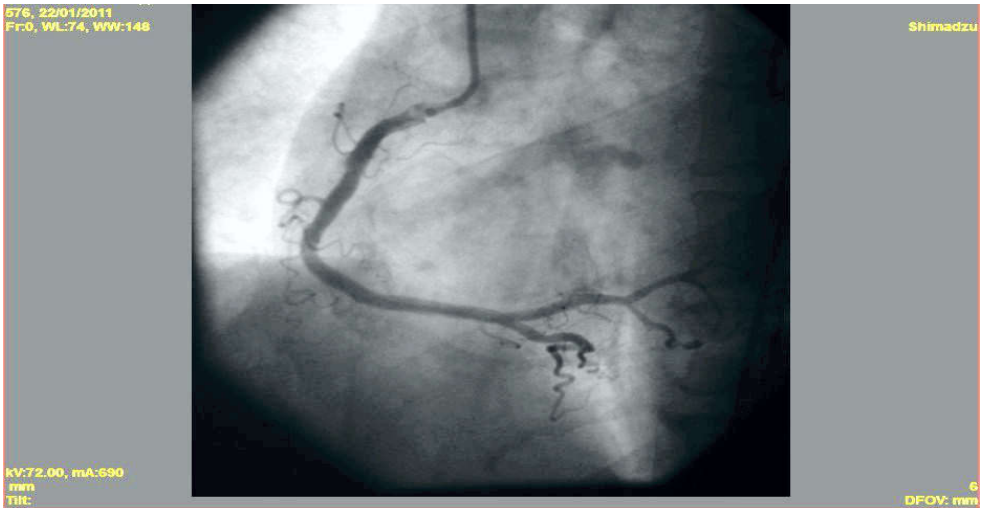

Fig. 2: Right Dominance (Angiographic) (Left Anterior Oblique View)

Fig. 3: Left dominance (Gross)

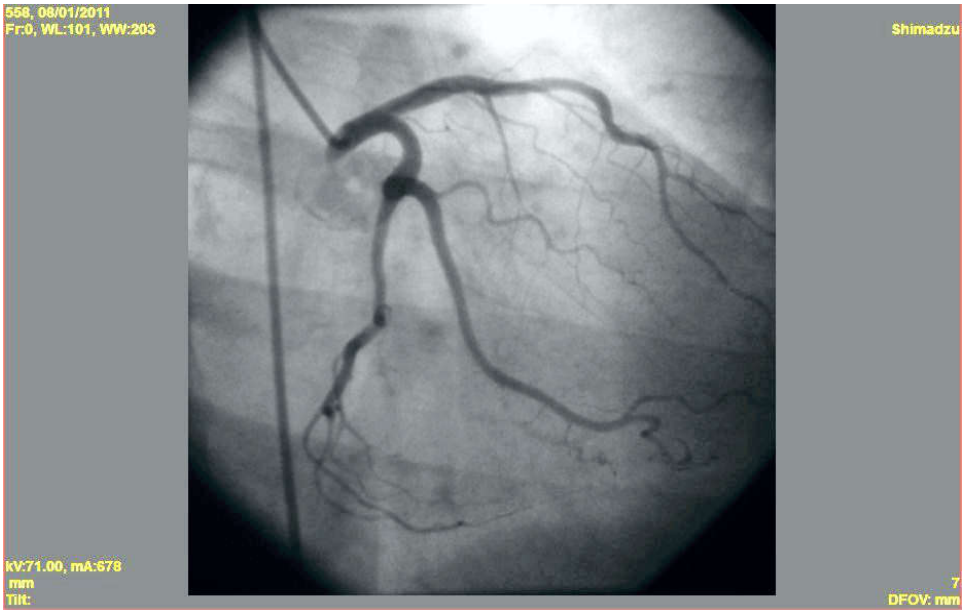

Fig. 4: Left Dominance (Angiographic) (Right Anterior Oblique View)

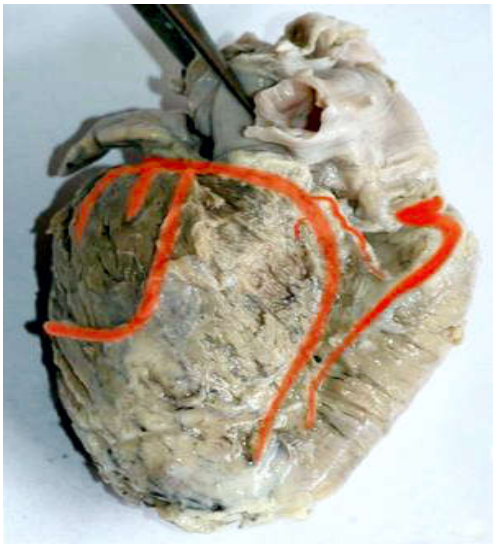

Fig. 5: Co-Dominance (Gross)

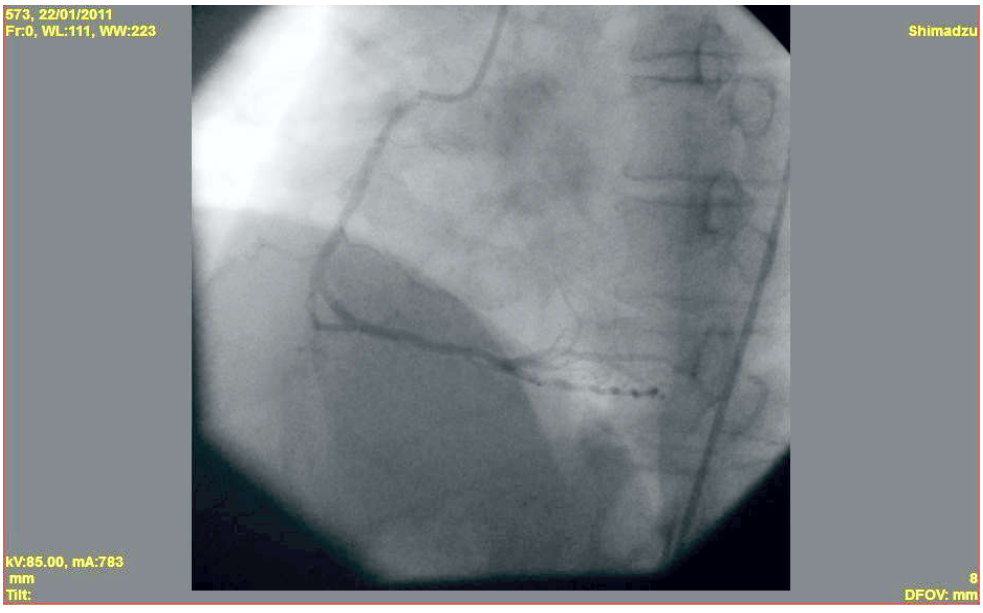

Fig. 6: Co-Dominance (Angiographic) (Left Anterior Oblique View)

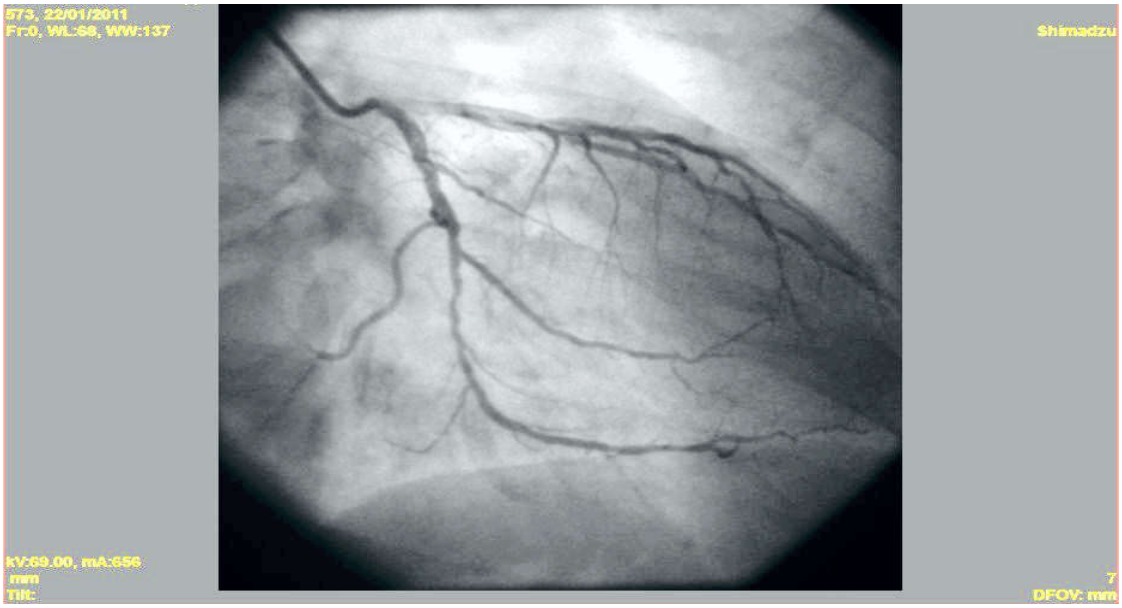

Fig. 7: Co-Dominance (Angiographic) (Right Anterior Oblique View)

Discussion

In present study right dominance was present in 72.3% cases. This result correlates with the results of Ballesteros LE et al [4], Cheemalapati S et al [7], Kahn [10], Kosar P. et al [13] and Rahman [8].

The left dominance in the present study was in 15.3% cases and this result correlates with the results of Bhimalli Shilpa [6], Cheemalapati S et al [7], Kini s et al [12], Laurens FT et al [14] and Rahman [8].

The co-dominance in the present study was found in 12.4% cases which correlate with the results of Abdelmoneim AAA et al [3], Bhimalli Shilpa [6], Cheemalapati S et al [7] and Kosar P. et al [13].

The dominance pattern when compared between male and females of present study, it was found statistically significant.

Conclusions

Right dominance was found in 72.3% (n = 99) cases, Left dominance in 15.3% (n = 21) cases and Co-dominance in 12.4% (n = 17) cases.

In females Right dominance was more than in males, while Left dominance and Co-dominance was more in males. The difference in dominance pattern male and females is statistically significant.

List of Abbreviations

- RCA – Right Coronary Artery.
- LMCA – Left Main Coronary Artery.
- LCX – Left Circumflex Artery.
- N – Sample size

Conflict of Interests: None

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Morphometric Study of Human Adult Orbit Using Computed Tomography Images

Deepa G.[1], Shrikrishna B.H.[2]

Abstract

Background and objective: Computed Tomography, provides a direct visual window into the morphological anatomy of the orbit. The morphometric information of the human orbit is of great importance to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons. Purpose of the present study is to do morphological study of human adult orbit using randomly selected computed tomography images. *Materials and Methods*: Ours is a cross-sectional study where in 100 randomly selected computed tomography films of skull were studied in the department of ENT at Navodaya Medical College, Raichur during the month of January 2017. The morphological parameters of the orbit which were studied include shape, height, breadth, perimeter and orbital index. *Results:* Of the total 200 orbital readings in the total of 100 CT films, 94 (47%) orbits were round in shape and 106 (53%) orbits were in square shape. The mean height of the orbit was 3.58 cm (SD ±0.41). The mean breadth of the orbit was 4.18 cm (SD±0.47). The mean perimeter of the orbit was 12.58 cm (SD±0.94). The mean orbital index was 75.28 (SD±9.05). *Conclusion*: Computed Tomography, provides a direct visual window into the morphological anatomy of the orbit. The morphometric information of the human orbit is of great importance to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons.

Keywords: Human; Anatomy; Morphology; Computed Tomography; Orbit.

Introduction

The human orbit is a complex anatomic region. Each of its four bony walls has its own unique features and is perforated by a number of fissures and foramina that carry important nerves and blood vessels [1]. Each orbital cavity contains associated muscles, vessels, nerves, lacrimal apparatus, fascial strata and soft pad. This anatomical region is of clinical & surgical interest to many disciplines like ophthalmology, oto-rhinolaryngology, forensic science, oral and maxillofacial surgery and neurosurgery [2]. The orbit may be involved in conditions like trauma, inflammation, infections, and tumors, thereby compromising the visual apparatus. Also, a precise anatomy of the orbit is essential to avoid complications during orbital surgeries. Accurate measurements of orbital dimensions are also very important in designing various eye protective equipments. Hence is the requirement of a morphological study of the human orbit. The advent of the computed tomography has immensely helped in gaining insight into this morphological anatomy of the orbit. Purpose of the present study was to do morphological study of human adult orbit using randomly selected computed tomography images.

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Materials and Methods

Ours is a cross-sectional study where in 100 randomly selected computed tomography films of skull were studied in the department of ENT at Navodaya Medical College, Raichur during the month of January 2017. The CT scans were taken previously in the ENT department for evaluation of patients coming with head injuries. However,

pathological or fractured orbital bone CT films were excluded from the study. The morphological parameters of the orbit which were studied include shape of the orbital rim, height of the orbit, breadth of the orbit, perimeter of the orbital rim and orbital index (calculated as height divided by breadth multiplied by 100). The orbital height (Ht) was measured as the distance between the midpoint of the upper and lower margins of the orbital cavity and orbital breadth (Br) was measured as the distance between the midpoint of the medial and lateral margin of the orbit (Fig 1). All the data collected was statistically analysed using Microsoft office Excel 2007 software.

Results and Observations

Of the total 200 orbital readings in the total of 100 CT films, 94 (47%) orbits were round in shape and 106 (53%) orbits were in square shape. The mean height of the orbit was 3.58 cm (SD ±0.41). The mean breadth of the orbit was 4.18 cm (SD±0.47). The mean perimeter of the orbit was 12.58 cm (SD±0.94). The mean orbital index was 75.28 (SD±9.05).

Fig. 1: CT scan with graphical depiction of measurement of height (a -b) and breadth (c-d) of the orbit

Discussion

As discussed above, the morphological anatomy of the orbit is of immense importance in the fields like ophthalmology, oto-rhinolaryngology, forensic science, oral and maxillofacial surgery and neurosurgery [2]. Computed tomography has made significant contribution in understanding the morphometry as well as pathology of the orbit. CT scan helps us in getting accurate measurements for soft tissue structures such as the eye, as well as the underlying bony structures that surround and protect the eye [3].

A similar radiological study was done on 64 Chinese adults in whom the researchers observed that there were no differences in the anatomic parameters between the two sides in the same individual. No laterality of the orbital features was detected in normal Chinese adult population [4]. A similar CT assisted morphological study has been done on 70 European adults (140 orbits) with unaffected orbits and the authors have presented an easily measurable 2D reference data set of the bony orbit for study of individual orbital morphology prior to decompression surgery in Graves' orbitopathy [5]. In a study conducted in Malaysia, the authors have concluded that the orbital breadth, bi-orbital breadth and inter-orbital breadth are not useful for identifying anthropological race [6].

In our study, both the orbital shapes, round and square were found, even though, the number of square shaped orbits was marginally higher. E.Pretorius et al conducted a study in which the female orbits were considered as round shaped and male orbits as square. However, we did not do gender based study [7]. The mean perimeter of the orbit in our study was 12.58 cm (SD±0.94). This is comparable to the findings of the studies by Yongrong ji et al [4] (12.20 to 12.65) and Ashley A. Weaver et al [8] (11.21 to 11.47) even though their study populations were racially different.

In our study, the mean height of the orbit was 3.58 cm (SD ±0.41). This finding is in line with similar findings by Sanjai Sangvicichien et al [9](3.289 to 3.314). Even in this study, the sample population was racially different from our sample population. The Jaswinder Kaur et al study done on Indian population has mentioned the height of the orbit as 3.19 to 3.22 cm [10]. The minimal difference noticed between our study and this study could be due to environmental and genetic factors. In a similar CT guided study Yongrong ji et al [4] has mentioned the height of adult orbit to be 3.332 to 3.335, again comparable with our finding.

In our study, the mean breadth of the orbit was 4.18 cm (SD±0.47). A similar observation was done by Sanjai Sangvicichien et al in their study. In their study, the breadth of the orbit was between 3.80 and 4.01 cm [9]. In their study, Yongrong ji et al has mentioned the breadth of the orbit as between 3.80 and 4.00 cm [4]. The slight differences in values could be due to environmental factors and differences in the methodology of recording.

In our study, the mean orbital index was 75.28 (SD±9.05). The mean orbital index of Nigerian study population as per the study by Ukoha U et al8 was

89.21 [11]. The mean orbital index of Indian study population as per the study by Jaswinder Kaur et al was 81.65 [10]. Variation of orbital index between and within the population could be due to genetic and environmental factors and also different patterns of craniofacial growth mainly resulting from racial and ethnic differences. The importance of orbital index lies in its use for the interpretation of fossil records, skull classification in forensic medicine and the explanation of trends in evolutionary and ethnic differences [12].

Conclusion

The computed tomography gives valuable information about the various anatomic parameters of the orbit which is helpful to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons. Accurate measurements of orbital dimensions are also very important in designing various eye protective equipments.

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Original Article

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Pencil Grip Pattern and Its Effect on Handwriting in Medical Students of Maharashtra

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Abstract

The impact of pencil grasp on handwriting has been a topic of investigation since the 1940's. Assessment of the handwriting skills in the form of speed fluency, mechanical fluency and its correlation with pencil grip pattern was done in the present study. 102 medical students were evaluated for mechanical and speed fluency in writing. Four types of pencil grips were recognised which include dynamic tripod, lateral tripod, dynamic quadrupeod, lateral quadrupod in the study. Dynamic tripod grip pattern was most common grip type used by students to write but contrary to the previous belief that dynamic tripod is an ideal grip when correlated to handwriting skills like mechanical and speed fluency present study shows that both this skills has shown highest score with dynamic quadrupod grip. So further evaluation on grip type and effect on writing can be studied in kinematic fashion using advance methodology.

Keywords: Pencil Grip; Speed Fluency; Mechanical Fluency; Handwriting Skill.

Introduction

Pencil grip/grasp means the position of the fingers involved in grasping a pencil [1]. Handwriting is an important skill needed to express oneself in written form. Speed and legibility are two major components of handwriting that are believed to be affected by pencil grasp [2]. Handwriting is an essential skill for both children and adults. Even in the age of technology, handwriting remains the primary tool of communication and knowledge assessment for students in the classroom [3]. Human hand use can be separated into two types of grasping behaviours: 1) power grasping, in which the palm and digits hold an object; and 2) precision grasping, in which the digit pads are the only surfaces that hold the objects. Precision and power grasping have many variations, determined by object features. Grasping, especially precision grasping is considered to be "critical in many daily living activities". As quoted by Wong Y [4](2004); Napier (1956) provided the first classification of grasping in adults by describing two types of grasping: 1) power grasps, in which an object is clamped between the palm and the digits of a hand, and 2) precision grasps, in which an object is grasped between the digits and the opposing thumb of one hand. There are many implications looking at the normal variance of grasping preferences in normal children, adults and elderly people. For example, knowing normal hand grasping patterns can help in the building of new prosthetic hands and arms as well as robotic arms. Normal commercial prosthetics consist of one type of grasp pattern, the pincer grasp, which is not very helpful for behaviours needing stronger or more stable grips. To have a more useful prosthetic, Light and Chappell [5] (2000) have proposed to build a multiple-axis prosthetic, and hence knowing the normal variance of grasping patterns would be very informative and helpful. Pencil grasp is a term used to describe the position of the fingers involved in grasping a pencil. The impact of pencil grasp on handwriting has been a topic of investigation since the 1940's [1].

So present study is conducted to see whether there is any correlation between pencil grasp pattern and its effect on handwriting skills. To study the pencil grasp pattern in medical students assessment of the handwriting skills in the form of speed fluency,

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mechanical fluency and its correlation with pencil grip pattern was done.

Material and Methods

102 medical students of 1st MBBS from Government Medical Colleges of Maharashtra were included in the study (51 males and 51 females). All right handed students with no obvious anomaly of hand were included. Natraj gel ball pen was provided to students for writing. White paper with linings was provided for writing. Students were explained about the study. 6 students were evaluated at a time. Pencil grip pattern were photographed after 5 minutes of continuous writing. Mechanical and speed fluency was evaluated according to study done by Ann-Sofie Selin [6] (2003).

Copywriting (group assignment): A group six students at a time were asked to copy textbook text for 10 minutes. Each pupil had a book on the desk B.D.Chaurasia Volume 3 HNF 6th edition Page 60 from line 'The skin is thick….'. Students were told that the aim of present assignment was to learn more about the way pupils hold their pencils; and that the pupils would be observed while copywriting from their textbook. A photograph would be taken of the writing hand after approximately 10 minutes of writing. The writing assignment was carried out at a desk of standard height and size used by the college. Up to six pupils were simultaneously observed. For each task, sheets of A4-sized lined paper was given to the students and were ask to write a unique identification number given to them in top of the paper. Same number was used to label the photograph and other assignment to the same student. Different students were provided with different identification number. A gel pen of NATRAJ GELIX company was provided to the students for assignment. After instruction and possible questions and answers, the students were asked to copy a textbook text for period of 10 minutes. Photographs were taken after 5 minutes of continues writing. Assignment papers were collected for further observations.

Speedwriting (individual task): Students were asked to write a 20 letter six word sentence in a decipherable cursive script as many times as possible during 2 minutes. The sentence "yes I am your best friend" was easy to memorise and included 14 different letters of various shapes. After learning the sentence by heart and repeating it, the students was instructed to keep writing until told to stop. We timed the assignment by setting the stopwatch for 2 minutes.

All this criteria's were used to minimise the bias in the study.

Mechanical Fluency was estimated from the copywriting task by counting the words written in ten minutes. The score was equal to the number of words written in stipulated time.

Speedwriting Fluency was measured from the speedwriting task by counting the number of letters produced in two minutes. The score was equal to the number of letters.

Observations and Results

Four types of pencil grips were recognised which include dynamic tripod, lateral tripod, dynamic quadrupeod, lateral quadrupod in the study. The tripod grasp involves the thumb, index and middle finger in opposition, functioning as a "tripod" and allowing small, very co-ordinated movements [1]. In quadrupod grasp additional involvement of ring finger is there along with thumb, index and middle finger. In dynamic tripod grip (Figure 1) thumb and index finger helps in holding the shaft of the pen by its pulp and middle finger rest below for support. In dynamic quadrupod grip (Figure 2) thumb and middle finger helps in holding the shaft of the pen by its pulp, index finger overrides the shaft and ring finger rest below for support. In lateral tripod grip (Figure 3) thumb overrides the shaft of pen and pulp of middle finger touches the shaft and middle finger rest below for support. In lateral quadrupod grip (Figure 4) thumb from one side and index finger from other side overrides the shaft of pen and pulp of middle finger touches the shaft of the pen and ring finger rest below for support.

Frequency of grip pattern and its effect on mechanical and speed fluency score is shown in table

Table 1: Showing grip pattern, its frequency and mean score of each grip in mechanical and speed fluency

Type of grip	Mechanical fluency score (Mean ± SD)	Speed fluency score (Mean ± SD)	Grip type frequency (Total = 102 subjects)	Percentage
Dynamic tripod	310.28 ± 40.84	269.76 ± 42.63	73	71.56%
Dynamic quadrupod	321.15 ± 36.39	271.21 ± 38.49	19	18.62%
Lateral tripod	293.25 ± 47.67	265 ± 42.42	8	7.84%
Lateral quadrupod	243.5 ± 33.23	250 ± 98.99	2	1.96%

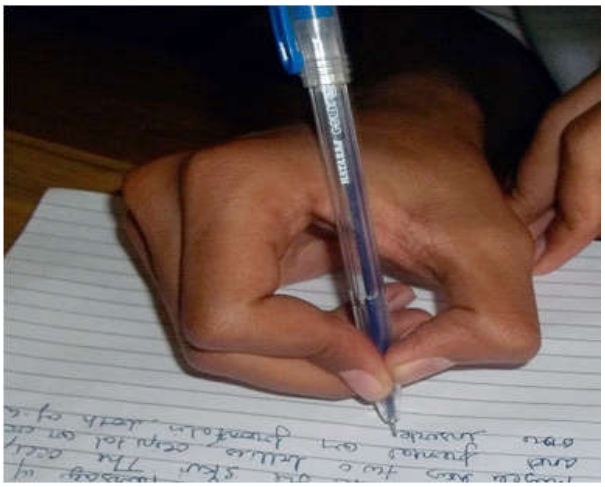

Fig. 1: Dynamic tripod grip

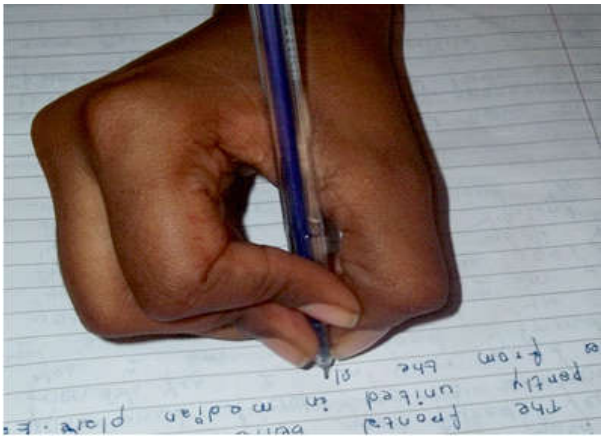

Fig. 2: Dynamic quadrupod grip

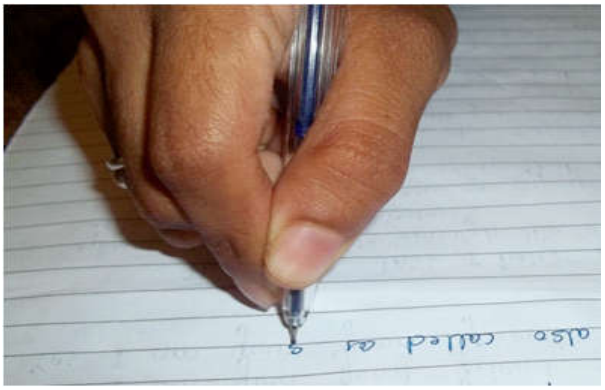

Fig. 3: Lateral tripod grip

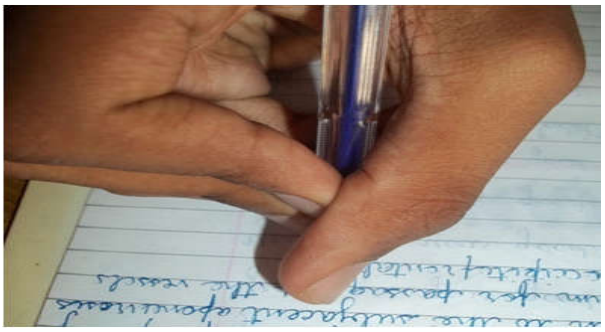

Fig. 4: Lateral quadrupod grip

below (Table 1). Dynamic tripod grip pattern was most common grip type used by students to write. And mechanical as well as speed fluency score was higher for dynamic quadrupod grip.

Discussion

Schwellnus H et al [1] (2012) stated that four grasp patterns that have been identified as mature and appropriate for functional writing are dynamic tripod, lateral tripod, dynamic quadrupeod, lateral quadrupod. But when they conducted study on 120 typically developing fourth grade students they found six categories of pencil grasp: four mature grasp patterns, one immature grasp pattern, and one alternating grasp pattern. Multiple linear regression results revealed no significant effect for mature grasp on either legibility or speed. And they concluded that pencil grasp patterns did not influence handwriting speed or legibility in this sample of typically developing children. This finding adds to the mounting body of evidence that alternative grasps may be acceptable for fast and legible handwriting.

Selin AS [6] (2003) stated that the dynamic tripod grip is considered by many teachers and therapists to be ideal. However, the basis for recommending the dynamic tripod pencil grip and for excluding other grips is subjective and lacks scientific underpinning. For example, little is known about the possible detrimental effects on writing caused by deviation from this recommended grip. Pencil grasp can have effect on writing.

Gladson B & Shah LJ [2] (2015) study shows 85% grips are dynamic tripod & no significant difference seen between grip type and speed, mechanical fluency. Schwellnus H et al [1] (2012) also stated that grasp patter has no influence on speed & mechanical fluency in children's between age group of 6-13yrs. Bergmann KP [7] (1990) found dynamic tripod grip in 86% subjects and lateral tripod in 10% as second common type. But correlation with writing skill was not studied. In present study dynamic quadrupod appears to be best grip when correlated with writing speed and mechanical fluency. Dynamic tripod is recommended as correct grip for writing despite of lack of evidence in form of writing output [2]. Wong Y [4] (2004) suggested that grip pattern analysis should be assisted by videos and behavioral analysis in order to obtain better understanding of grip patterns. Grip pattern was studied and variations were found but they stated that these variations are not obviously related to external factors such as object size, hand size, sex and handedness.

Contrary to the previous belief that dynamic tripod is an ideal grip when correlated to handwriting skills like mechanical and speed fluency present study shows that both this skills has shown highest score with dynamic quadrupod grip. So from this finding we can say that dynamic quadrupod grip can be better grip when concerned with speed and mechanical fluency. But further evaluation on grip type and effect on writing is required to be studied in kinematic fashion using digitizing tablet and pressure sensitive instrumented styli to measure force and pressure while writing with particular grip pattern.

Conclusion

In present study dynamic quadrupod appears to be best grip when correlated with writing speed and mechanical fluency. Dynamic tripod is recommended as correct grip for writing despite of lack of evidence in form of writing output. So further evaluation on grip type and effect on writing can be studied in kinematic fashion using advance methodology.

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Morphometric Analysis of Orbit: A Study on Dry Indian Human Skulls

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Abstract

Background and Aims: The morphometric study of the orbit is a common practice among anatomists, anthropologists, surgeons and forensic experts as it derives its importance with surgical procedures indicated for trauma, decompression, tumours and metastases. Surgically orbital morphometric study provides parameters for preoperative planning and prediction of postoperative outcome. Racial and ethnic differences noted on the basis of Orbital Index (OI) amongst different population formulates database for respective studies. *Materials and Methods*: 54 dry Indian human skulls of known sexes studied for orbital length , breadth and biorbital & inerorbital length. Orbital index calculated and compared for ethnic , racial differences. *Results*: no significant difference in orbital height and breadth noted on right and left side. Orbital index was found more in females. *Conclusion*: Present studies assess the clinical and surgical significance of the orbit to establish a morphometric analysis with interrelated structures, thus enhancing anatomic and anthropological knowledge regarding Indian orbits. Parameters of the study formulates guidelines for operative procedures.

Keywords: Orbital Index; Race and Ethnicity; Morphometric Classification.

Introduction

The orbit is a pyramid shaped cavity with its apex directed posteriorly and the base anteriorly located at the viscerocranium [1]. The roof of the orbit is composed largely of the orbital plate of the frontal bone anteriorly and of the lesser wing of the sphenoid with a minor part in the posterior part. The triangular shape of the roof narrows toward the orbital apex. The floor of the orbit is shorter in its anteroposterior extent than the three other orbital walls and terminates in the Inferior Orbital Fissure in front of the orbital apex that consequently turns into a triangular frontal cross section [2]. For its most part, the floor consists of the orbital plate of the maxilla supplemented by the tiny orbital plate of the palatine bone posteriorly and by the inferior orbital process of the zygoma anterolaterally. The medial orbital wall is formed, again in the anterior posterior direction, by the frontonasal maxillary process, the lacrimal bone, the lamina papyracea of the ethmoid bone, which is quadrangular in shape, and the anterolateral surface of the sphenoid body.[3] The lateral orbital wall consists of the lateral orbital process of the zygoma constituting the anterior part and the greater wing of the sphenoid posteriorly.

The orbit contain the eye and associated muscles, the lacrimal glands, the ophthalmic artery and veins, the ophthalmic nerve, the optic (II), oculomotor (III), trochlear (IV), and the abducens (VI) nerves. The orbital characters vary amongst different races and ethnic groups, also, it is known to possess sexual dimorphism, and it is anthropologically relevant in race definition [4].

Thus seven osseous components of the orbit can be conceptualized into a simple geometrical layout of a four-sided pyramid with the anterior aditus as a base and the posterior cone as apex. All neurovascular structures pass through bony openings in the sphenoid bone before diversification in the mid and anterior orbit. A set of landmarks such as the optic

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and maxillary strut comes into new focus. Within the topographical surfaces of the internal orbit the lazy S-shaped floor and the posteromedial bulge are principal determinants for the ocular globe position. The inferomedial orbital strut represents a discernible sagittal buttress. The periorbita and orbital soft tissue contents—extraocular muscles, septae, neurovasculature—are detailed and put into context with periorbital dissection [2].

Surgically Orbital morphometric study will also provide parameters for preoperative planning and prediction of postoperative outcome. Among modern human groups there is considerable variability in the characteristics of the orbit [4]. The orbital index (OI), the proportion of the orbit height to its breadth multiplied by 100 is determined by the shape of the face and varies with race, regions within the same race and periods in evolution [5,6].

Taking the orbital index(OI) as the standard, three classes of orbit are recognised

1. Megaseme (Large) with OI 89 or over found in Yellow races
2. Mesoseme (Intermediate) with OI 83-89 found in European (87), English
3. Microseme (Small) with OI 83 or less found in Black

Understanding the structural disposition of the human body is aided by the advances in medical imaging techniques such as radiography, MRI, CT scan etc. But direct measurement on dry skulls is a more natural perspective in assessing the orbital cavities [7].

Thus a prior knowledge of the orbital morphometry is very essential for better surgical approach and outcome. Not many studies have been done pertaining to morphometry of orbit in Indian population. Hence, this study of morphometry of orbit in skulls becomes essential to develop a database to determine normal range of orbital values and orbital index Indian population [8].

Aim and Objective

1. To measure and compare orbital length and breadth bilaterally.
2. To calculate orbital index(OI) and compare it with available studies.

Materials and Methods

54 skulls of known sexes (35 male and 19 female) were studied at the Department of Anatomy, Govt Medical College, Aurangabad, Maharashtra, India . The orbital height was measured as the distance between the midpoint of the upper and lower margins of the orbital cavity and orbital breadth was measured as the distance between the midpoint of the medial and lateral margin of the orbit by using manual Vernier calliper.

Orbital index (OI) was calculated by using the following formula,

OI = orbital height / orbital breadth x 100

Similarly interorbital bredth is measured as distance between medial walls of two orbits and biorbital breadth is measured as distance between lateral walls of both orbits.

Illustration 2: Showing Measurement of Orbital Breadth

The data obtained were tabulated and analysed statistically by computing descriptive statistics like mean, standard deviation and range.

Results

In all the studied skulls orbital height was found more on left than right but difference was insignificant. No significant gender difference was noted in orbital height. Orbital breadth was comparable on either side with no gender difference. Interorbital breadth was found more in females whereas biorbital breadth was lesser ($p<0.001$). Orbital index was comparable in both sides but in females it was significantly more than males ($p<0.001$).

Table 1:

	Orbital Height		Orbital Breadth		Interorbital Breadth	Biorbital Breadth	Orbital Index	
	Right	Left	Right	Left			Right	Left
A	31.90±2.04	32.30±2.20	39.10±2.15	39.17±2.03	22.27±2.72	95.27±3.87	81.77±6.49	82.60±6.11
M	31.72±1.97	32.15±2.20	39.53±2.02	39.45±1.85	21.96±2.93	95.69±3.33	80.38±5.81	81.56±5.69
F	32.24±2.19	32.58±2.20	38.29±2.20	38.69±2.28	22.85±2.20	94.46±4.72	84.40±7.03	84.58±6.54

A-ALL
M- MALE
F- FEMALE

Illustration 1: Showing Measurement of Orbital Height

Illustration 2: Showing Measurement of Orbital Breadth

Illustration 3: Showing Measurement of Biorbital length

Illustration 4: Showing Measurement of Interorbital length

Discussion

The morphometric study of the human skull is a common practice among anatomists, anthropologists, surgeons and forensic experts, as it is a structure of great interest since it possesses sexual dimorphic characters and ethnic differences. Furthermore, the cranium seems to be less affected by factors such as nutrition and they are more genetically driven [19]. The skull alone can provide 90% of accuracy regarding the gender aspect. Similarly orbital morphology derives its importance with surgical procedures indicated for trauma, decompression, tumors and metastases. It involves complicated inter-relations of neurovascular structures which often presents with profound clinical symptoms even in early involvement in above mentioned entities [10]. The formation of the orbit is set within 2 months of embryogenesis. Cells from the neural crest migrate over the face over 2 different routes: the frontonasal anlage migrates to the prosencephalon, approaching the orbit from above, and the maxillary waves curves around and forms the orbit from below. The frontonasal process originates the lacrimal and ethmoid bones, while the maxillary process forms the floor and lateral walls of the orbit. All bones of the orbit ossify and fuse between the sixth and seventh months of gestation. It is worth mentioning that the development of the eyes is vital to the formation of the bony orbit and its surrounding soft tissue contents. The lesser wing of the sphenoid ossificates through endochondral ossification, and all of the other orbital bones and the greater wing of the sphenoid arises from intramembranous ossification [11.

Regarding the morphometric aspects of the orbit, we found relatively few studies that used the same anatomical points that ours did to measure the bony orbit. Ji et al observed the orbit measures through a CT-scan in Chinese subjects, and their results revealed that the mean Right Orbital Height (ROH) was 33.28±1.58 mm, and the mean Right Orbital Breadth(ROB) was 38±94 mm, also, their research revealed that there wasn't a statistically significant difference of the Orbital height between male and female patients [12].

Ukoha et al. (2011) found that the Right Orbital Breadth was 36.03±0.37 mm and the ROH was 31.90±0.70 mm, stating that there were no statistically significance difference between the right and left sides [13].

Fetouh and Mandour (2014) stated that in a male Egyptian population, the mean ROH was 35.83±1.23 mm, the mean ROB was 43.62±1.13 mm, and the mean

OI was 82.20±2.97 mm, and in females, the mean ROH was 35.53±0.95 mm, the mean ROB was 42.75±1.35 mm, and the OI was 84.13±3.76 mm [14].

Elzaki et al. (2015) found that the ROB was 34.10±1.76 mm and the ROH was 37.90±2.57 mm, they also found that the OB was slightly higher in man than in woman, but the OH was similar. Many results showed that the males orbit area was significantly larger than in females although there is some divergence whether the symmetry of the orbit: some authors agree that there is a significant difference between right orbit and left orbit while other authors found no statistically significant difference between [15]

Lal N et al in their study of Sri-lankan orbits could note that, the left and right orbital heights and breadths in males and females were not significantly different, suggesting left and right symmetry. However, when these parameters were used to derive OI, differences between the left and right sides in males and females became apparent. This indicates that individually, the differences found between the left and right side orbital height and width were not large enough to be detected by their statistical tests. But insignificant height difference detected in present study may answer their query in orbital index differences. Left-right asymmetry in orbital height or breadth was previously reported in Egyptian and Nigerian populations; morphological asymmetry is not unique to this region and was identified in other studies as well [16].

Additionally present study records Interorbital breadth , which was found more in females whereas biorbital breadth was found lesser as compared to males. These notifications could not be sited in literature and unique for this study. They definitely have aesthetic implications in plastic surgery.

The importance of orbital index lies in its use for the interpretation of fossil records, skull classification in forensic medicine and the explanation of trends in evolutionary and ethnic differences. Normal values of orbital indices are vital measurements in the evaluation, and diagnosis of craniofacial syndromes and post traumatic deformities, and knowledge of the normal values for a particular region or population can be used to treat abnormalities to produce the best aesthetics and functional result. Variation of OI between and within the population could be due to genetic and environmental factors and also different patterns of craniofacial growth mainly resulting from racial and ethnic differences [2,5].

OI has been studied by several authors. It has been reported that the racial and ethnic differences occur in OI amongst different population. The present study involves comparison of the OI of the Indian population with available data from

other populations of the world. In the present study there was statistically significant difference observed in the OI, between the genders. As female OI was more than male. This finding is similar to that of study by Lal et al. hence in present study, as per standard classification the mean OI male orbits can be classified as microseme (OI<83) and female as mesoseme (OI=83–89), which is an unusual finding given many Asian populations are said to have megaseme (OI>89) [2,5,16].

On comparison with other Indian authors present study differs. Jaswinder Kaur et al studied on Indian population, the OI values are lower compared to our results [17]. Deepak S Howale et al studied Indian population and have reported a slightly higher mean OI (86.4) compared to our results. They followed different classification to categorize the skulls according to OI [18].

Conclusion

Even though morphometric studies of the orbit are relatively frequent, factors such as different ethnic classification, different methods of taking the measurements, different methods of statistical analysis can make the comparison difficult or impossible. We assessed the clinical and surgical significance of the orbit, furthermore, we were able to establish a morphometric parameter with interrelated structures, thus enhancing anatomic and anthropological knowledge regarding Indian skulls, as different Indian authors' had varied findings on this issue. Furthermore, our data presented a base in which the investigation of the quantitative morphology of the orbit development can be reoffered.

Since the orbit is an anatomic area used to determine the sex and the ethnicity, its importance in various ocular surgeries leave this study utmost important landmark for surgeons.

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Original Article

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A Study of Variations in the Posterior Inferior Cerebellar Artery

Mahendrakar Madhuri A.

Abstract

Background: Posterior inferior cerebellar artery and its branches supply extensive and vital areas of the nervous system. This vessel is reported as the most variable cerebellar artery in the literature. The knowledge of normal anatomy as well as variations in this artery is of utmost importance to help diagnosis and treatment of vascular lesions as well as space occupying lesions in the region of its distribution. *Aims and Objectives*: To study the normal gross anatomy and development of posterior inferior cerebellar artery, with incidence of variations and their embryological correlation. *Materials & Methods*: The posterior inferior cerebellar artery was studied by digital subtraction angiography. The procedure of digital subtraction angiography was performed in Department of Radiology of a tertiary care hospital of Mumbai in 102 consecutive subjects on both sides. *Results*: A significant number of variations were observed in origin, course and distribution of the posterior inferior cerebellar artery in this study. *Conclusion*: This study confirms as well as adds to the knowledge of the existing literature on posterior inferior cerebellar artery and assists interventional radiologist, neurosurgeons and neurologist in diagnosis and treatment of cerebrovascular diseases.

Keywords: Posterior Inferior Cerebellar Artery (PICA); Anterior Inferior Cerebellar Artery (AICA), Variations.

Introduction

The posterior inferior cerebellar artery (PICA) arises from the vertebral artery at the anterolateral aspect of the brainstem, near the inferior olive. Numerous authors have described variations in origin, course and vascular distribution of PICA [1-13]. Despite many variations of this artery, Hauge 1954 [11] described the standard course comprising of a caudal loop at the lower part of the tonsil and the cranial loop coinciding with its upper border. Huang and Wolf in 1969 [11] divided the main trunk of PICA into four segments. Anterior medullary, lateral medullary, posterior medullary and supratonsillar segment of the vessel have been designated the names according to their relation to medulla oblongata and cerebellar tonsil respectively. The PICA gives of perforating, choroidal and cortical branches and terminates by dividing into inferior medullary and cerebellar hemispheric arteries.

The long tortuous course of PICA is related to medulla, fourth ventricle, cerebellar tonsil, vermis, and cerebellar hemisphere, so that displacement or distortion may be deduced from careful study of this vessel. It is possible to localize these structures because of the characteristic configuration of this vessel in relation to them. Unfortunately this artery more than any other artery in the posterior fossa is subjected to many variations, which may cause difficulties in diagnosis. Thus this study was done to evaluate the vessel for variations using the advanced technique of digital subtraction angiography which will help the investigators to diagnose and treat cerebrovascular diseases.

Materials and Methods

The posterior inferior cerebellar artery was studied

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by digital subtraction angiography. The radiological procedure was performed in the Department of Radiology of a tertiary care hospital of Mumbai. The study was done in 102 consecutive subjects who underwent the procedure on both sides. Age of the subjects ranged from 3years to 75years and most of the subjects were having cerebrovascular diseases. Of the 102 patients, 57 were males and 45 were females.

The origin, course, termination and branches of the artery were studied for variations. The data collected has been analysed and discussed.

Results

The posterior inferior cerebellar artery (PICA) was studied by digital subtraction angiography in 102 subjects who underwent the procedure on both sides. The origin, course, termination and branches of 204 PICAs were evaluated for variations.

In this study of 102 subjects, 27 subjects (26.47%) showed variations in right or left or both sides of PICA, while 75 subjects (73.53 %) had normal vessel on both sides (Table 1 and Chart 1).

In the 27 subjects with variations, 13 subjects (12.75%) were with variation in the right PICA, 11 subjects (10.78%) were with variation in left PICA, and 3 subjects (2.94%) showed variations in both PICAs (Table 2 and Chart 1).

The angiograms of PICA examined in this study showed variations in origin of the vessel. PICA originated as a continuation of vertebral artery in 3 subjects (2.94%), 2 subjects (1.96%) on right side and 1subject (0.98%) on left side. Vertebral artery terminated into PICA and a small branch to fill basilar artery. This variation was seen in 4 subjects (3.92%), 2 subjects (1.96%) on right side and 2 subjects (1.96%) on left side. Vertebral artery terminating into PICA and a posterior meningeal branch was seen in 1 subject (0.98%) on right side (Table 3 and Chart 2).

Table 1: Incidence of findings observed in PICA in total examined subjects

Sr. No.	Subjects	NOS	%
1	PICA with variations	27	26.47
2	PICA without variations	75	73.53

Table 2: Incidences of findings in PICA with variations in 27 subjects examined out of 102 subjects

Sr. No.	Subjects with	NOS	%
1	Variations only in Rt PICA	13	12.75
2	Variations only in Lt PICA	11	10.78
3	Variations in both PICAs	3	2.94

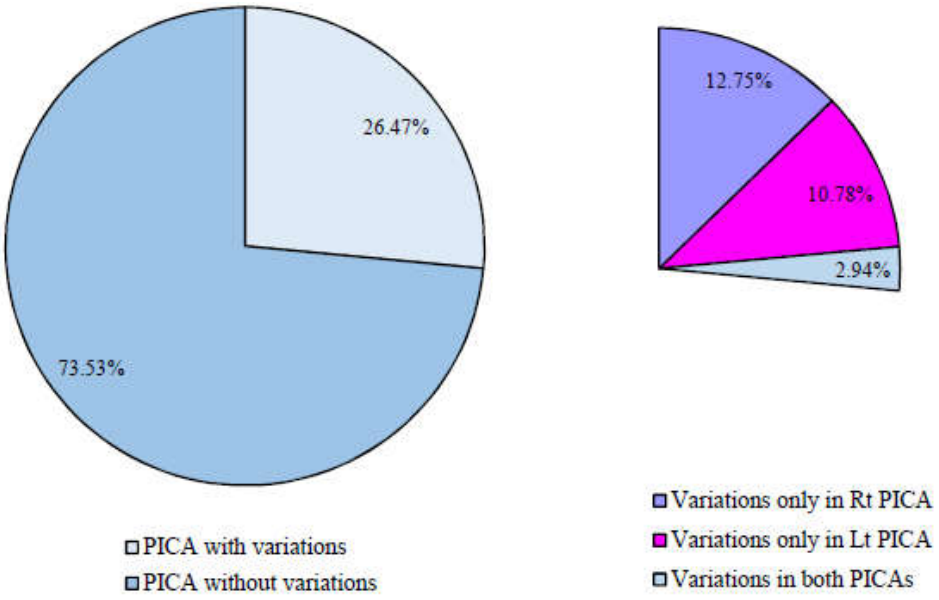

Chart 1: Incidence of variations in PICA in examined subject

There were cases in which AICA and PICA originated as a common trunk from basilar artery. This variation was seen in 14 subjects (13.72%) of the 102 subjects. The variation was seen on right side in 8 subjects (7.84%), on left side in 4 subjects (3.92%) and on both sides in 2 subjects (1.96%). In 1 subject (0.98%) on left side AICA and PICA originated as a common trunk from vertebral artery. Proximal origin of PICA at C1C2 level of cervical vertebra was observed in1 subject (0.98%) (Table 3 and Chart 2).

PICA was absent on left side in 2 subjects (1.96%) and in them right PICA supplied both PICAs territory. In 1 subject (0.98%) both AICAs were absent and PICAs supplied their territory.

Chart 2 shows the incidence of variations in PICA.

Table 3: Incidence of variations in origin of PICA

Sr. No.	Variation in origin of PICA	Rt.		Lt.		Both	
		NOS	%	NOS	%	NOS	%
1	PICA as continuation of vertebral artery	2	1.96	1	0.98	-	-
2	VA terminating as PICA and a small branch to BA	2	1.96	2	1.96	-	-
3	VA terminating as PICA and a small posterior meningeal artery	1	0.98	-	-	-	-
4	AICA-PICA common trunk from BA	8	7.84	4	3.92	2	1.96
5	AICA-PICA common trunk from VA	-	-	1	0.98	-	-
6	Proximal origin of PICA at C1C2 level	-	-	1	0.98	-	-

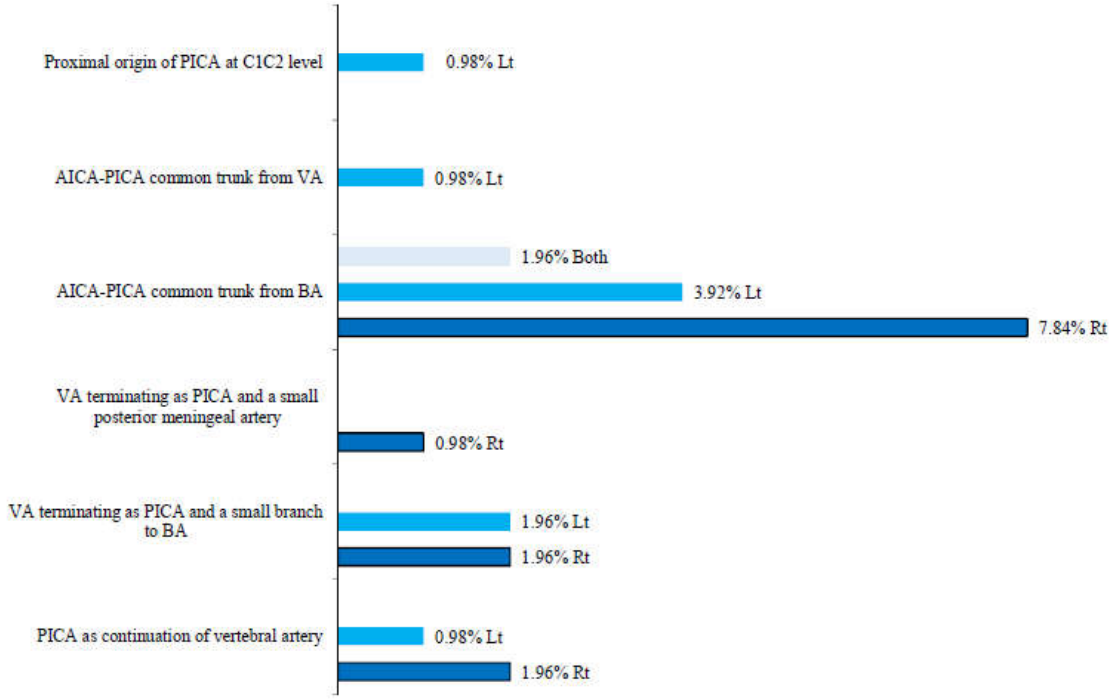

Chart 2: Incidence of variations in PICA

Discussion

The posterior inferior cerebellar artery (PICA) is normally a branch of distal part of intradural vertebral artery. Variations in the origin of PICA are reported frequently in the literature. Significant number of cases of PICA originating as a continuation of vertebral artery are reported [10, 12]. Berry and Anderson 1910 [10] described the autopsy findings in a case of non-union of the vertebral arteries. One vertebral artery was extremely large and supplied the whole of the vertebro-basilar system apart from the PICA on opposite side. The contralateral vertebral artery was small and terminated in the PICA. They found only one similar case reported in literature, which for many years, subsequently showed scant reference to this variation. With the advent of the vertebral arteriography, this variation has been more frequently recognized. Morris 1962 [10] also reported 2 such cases of non-union of vertebral arteries. Krayenbuhl and Yasargil 1965 [10] and Osborn 1999 [12] stated that in 0.2% the vertebral artery fails to join the basilar artery on one side and thus terminates in the PICA

and the opposite vertebral artery provides most of the posterior fossa blood supply.

In present study the incidence of PICA originating as a continuation of vertebral artery is similar to earlier reports. But in literature there are no reports of cases as vertebral artery terminating into PICA and a small branch to fill basilar artery Figure 1 and vertebral artery terminating into PICA and a small posterior meningeal artery, however in this study such cases were observed.

Fig. 1: Showing Lt vertebral artery terminating into PICA and a small branch to basilar artery

Level of origin of PICA from vertebral artery varies from vertebrobasilar junction to below the foramen magnum as low as C1, C2 or C3 [4, 5, 6, 9, 11, 12]. Newton, Potts 1974 [11] described PICA on a study based on an analysis of forty cerebellar hemispheres and compared the data with a hundred normal vertebral arteriograms. In their study they reported that in the necropsy material PICA originated from the vertebral artery at an average distance of 16mm, below origin of basilar artery and in 2 cases origin was at vertebrobasilar junction. In their study of arteriograms, PICA originated at an average of 13mm below the origin of basilar artery. In relation to the foramen magnum, in 18% of arteriograms PICA originated below the foramen magnum, in 4% at the level of the foramen magnum, in 57% it arose above the foramen magnum. Hollinshead 1982 [4] stated that PICA usually arises from the vertebral artery but varies in the level of its origin, and may even arise from the basilar artery. Lasjaunias et al 1987 [5], 1990 [6] reviewed the earlier gross anatomy descriptions of PICA and stated that PICA is the most variable cerebellar artery. They also reported the possible variations C1, C2, C3 origins of PICA. Osborn 1999 [12] stated that an extradural origin of the PICA occurs in 5% to 18% of cases in which PICA originates from the extracranial vertebral artery and then courses superiorly through the foramen magnum. He added that a third of all cases PICA originate from intradural vertebral artery and in unusual cases the PICA may originate as low as C1, C2 level.

In this study a proximal origin of PICA at C1C2 level of cervical vertebra was observed in a subject.

Atkinson 1949 [1] described the AICA variations, along with the corresponding PICA variations. He studied the variations and findings in a series of consecutive necropsies and stated that, not only each case is different but there is usually a difference between either side in an individual case. He also found that the variation in the size of AICA was in inverse proportion to the size of PICA and sometimes to that of vertebral artery. He quoted about common AICA-PICA trunk arising from either basilar artery or vertebral artery. Osborn 1999 [12] stated that a shared AICA-PICA trunk is a common normal variant and occasionally a single trunk supplies both PICAs.

A significant number of cases were observed in this study having AICA-PICA originating as a common trunk from basilar artery Figure 2 and AICA-PICA originating as a common trunk from vertebral artery.

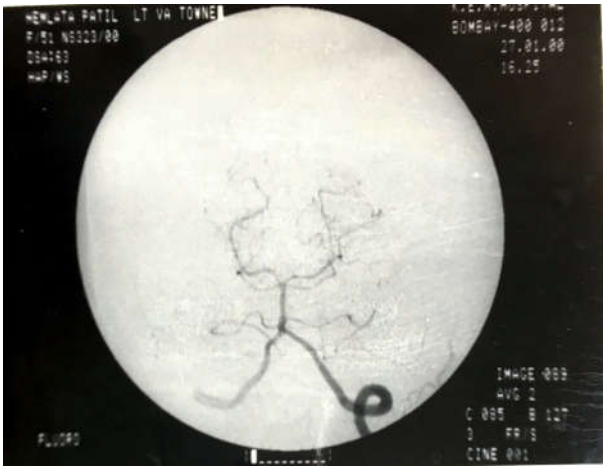

Fig. 2: Showing AICA - PICA common trunk from basilar artery

Stopford 1916 [4] observed absence of PICA bilaterally in 3%, absence on right in 15%, absence on left in 6% and also emphasized the variation in distribution of PICA. Krayenbuhl and Yasargil in 1957 [11] and Takahashi et al 1968 [11] stated the occasional absence of PICA. Crosby et al 1962 [13] stated that in these instances of absence of the PICA, the AICA supplies the territory. The entire inferior cerebellar hemisphere may be supplied by the contralateral PICA. Sometimes a single stem takes the place of both AICA and PICA. In Newton, Potts 1974 [11] anatomic studies PICA was absent in 6 hemispheres (15%), hypoplastic in 2 hemispheres

(5%). In their study of arteriograms, PICA was absent in (20%), of the cases. AICA supplied PICA territory in majority of cases, 1 hemisphere was supplied by both AICA and superior cerebellar artery, 2 hemispheres were supplied by the superior cerebellar artery alone. In 5% hypoplasia of the PICA, accessory blood supply from the AICA was noted. Lasjaunias et al 1987 [5], 1990 [6] reviewed the earlier gross anatomy descriptions of PICA. They stated that PICA is the most variable cerebellar artery and the vessel is reported to be absent in high percentage of cases and PICA hemispheric supply is from AICA.

In present study absence of PICA was observed on one side in two subjects and in them contralateral PICA supplied both PICAs territory (Figure 3a, 3b). Also angiogram showing both AICAs absence and PICAs suppliying their territory was seen. Hypoplastic PICA was not observed in this study.

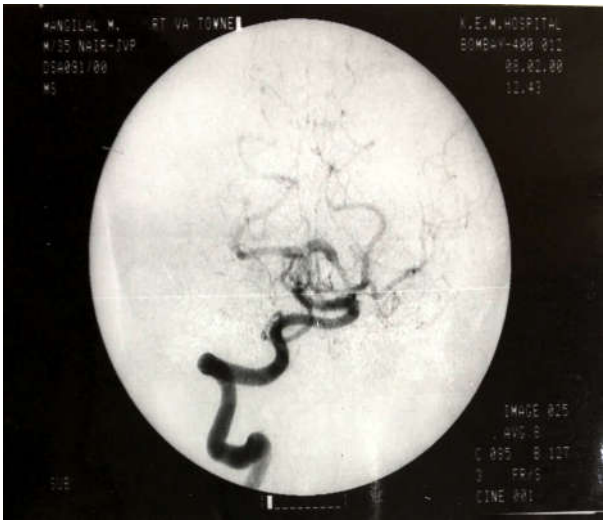

Fig. 3a: Showing normal origin of Rt PICA from Rt vertebral artery, supplying both hemispheres

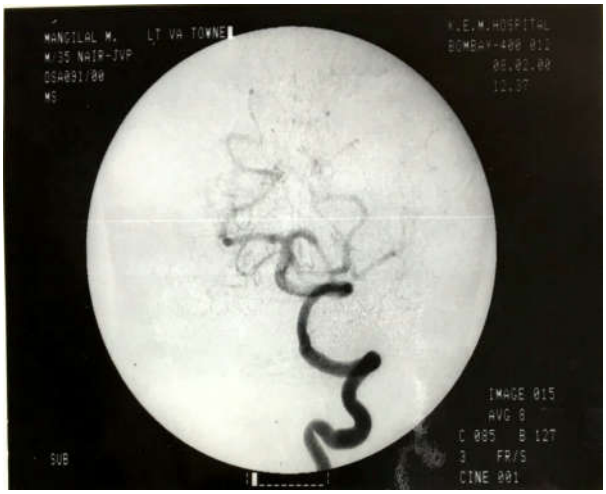

Fig. 3b: Showing Absence of Lt PICA

Anatomic or angiographic reports of cerebellar arteries arising from the internal carotid artery are present but rare. Newton, Potts 1974 [11] and Haughton 1978 [3] reported origin of PICA from the internal carotid artery. Lasjaunias et al 1981 [7] reported a case of PICA originating from the ascending pharyngeal artery and gave its embryological mechanism. Osborn 1999 [12] stated that PICA origin from posterior meningeal artery or the internal carotid artery as uncommon. He also quoted about duplicated PICA that arises as two or more vessels instead of a single dominant trunk, has been identified in 2% of anatomic dissections.

In this study these rare origins of PICA or a duplicated origin of PICA were not observed.

Lasjaunias et al 1987 [5], 1990 [6] has given the embryological explanation for the occurrence of variations in the posterior inferior cerebellar artery. In embryos between 20 and 44mm, both anterior and posterior inferior cerebellar arteries are represented by vessels that terminate in the large choroid plexus of the fourth ventricle. Before 40mm stage the arteries are usually identified tentatively only as larger and longer than numerous other branches of the basilar and vertebral arteries that supply the hindbrain region. These transverse branches are often connected by longitudinal remnants of prominent lateral channel (the primitive lateral vertebrobasilar anastomosis). This channel parallels the intracranial part of the primitive vertebral artery and the basilar artery. The arteries of the embryonic medulla therefore present somewhat plexiform appearance. This development process explains the varied origin of the anterior and posterior inferior cerebellar arteries in the adult.

The course of PICA has been described by numerous authors Stopford 1916, Sjogren 1953, Hauge 1954, Krayenbuhl and Yasargil 1957, Crosby et al 1962, Gray 1962, Wolf et al 1962, Greitz and Sjogren 1963, Huang and Wolf 1969, Stephens and Stilwell 1969 [11].

Mones 1961 [9] performed a study to evaluate vertebral angiography as a diagnostic tool. Mones reported these PICA findings by studying lateral views of 79 vertebral angiograms. PICA was above the foramen magnum throughout in 56 subjects, started below the foramen magnum in 8 subjects, gradually looped below the foramen magnum from above in 10 subjects and had a sharp loop below the foramen magnum from above in 5 subjects. Wolf et al 1962 [13] described the course of PICA angiographically. He stated that despite numerous variations it is possible to select a configuration of the PICA in both lateral and anteroposterior projections, which can be considered as typical or

standard and helps in localization of expanding lesions. Greitz and Sjogren 1963 [2] studied anatomy of PICA at autopsy by dissection and postmortem angiography and at vertebral angiography in living subjects in normal and pathological conditions. They stated that PICA and its branches although subject to numerous variations have a constant relationship to certain brain structures, which enables diagnosis of posterior fossa lesions. Margolis and Newton 1972 [8] studied PICA by correlating the gross and angiographic anatomy, and stated that the origin, course and distribution of the PICA vary considerably.

This study confirms the findings of earlier studies which state that PICA and its branches are a subject to numerous variations and despite the variations the vessel shows a standard course.

Conclusion

The literature states that the occurrence of variations in the posterior inferior cerebellar artery are very common and this study further confirms and adds to the documentation in the literature. To evaluate this vessel a interventional radiologist should have knowledge of normal anatomy and variations in the vessel with their embryological correlation. This knowledge will also help the neurosurgeons and neurologists to investigate and treat the cases of cerebrovascular diseases and space occupying lesions.

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Original Article

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Morphological Lung Variations: A Cadaveric Study in South Indians

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Abstract

Introduction: In the light of increase in incidence of pulmonary diseases, there is a concomitant increase in study of lungs and bronchial tree morphologically and clinically. The knowledge of this study is of immense value in endoscopic procedures for diagnostic and therapeutic purposes. The lungs are the essential organs of respiration which are divided into lobes by fissures. The fissures facilitate the movement of the lobes and help in a more uniform expansion of the whole lung. These fissures may be complete, incomplete or absent. In addition to these fissures, lung might also have accessory fissures, usually indicating the junction between bronchopulmonary segments. Knowledge of fissures is necessary for the appreciation of lobar anatomy and thus for locating the bronchopulmonary segments which are significant both anatomically and clinically. *Aims and objectives*: To study morphological variations in relation to fissures and lobes of lung and calculating percentage and comparing it with the previous studies to conclude incidence of occurance of variations bilaterally among coastal south Indians. *Materials & Methods*: we have studied 77 lungs obtained from embalmed cadavers by dissection method according to standard method described in Cunningham's Practical manual. *Results*: Out of total 37 right lungs, 9 showed absences of horizontal fissure, 9 showed incomplete horizontal fissure and 19 lungs showed complete both horizontal and oblique fissures. Out of total 40 left lungs, 30 lungs showed complete oblique fissure and 10 showed incomplete oblique fissures. No Accessory fissure was seen bilaterally. *Conclusions:* Awareness of the variations in the lobes and fissures of the lungs is important for radiologists for proper radiological interpretation and to clinicians for performing segmental lung resections, lobectomies and endoscopic procedures.

Keywords: Lobes; Fissures; Oblique; Lung; Variant; Accessory; Craig and Walker; Morphology.

Introduction

Anatomical knowledge of variation in fissure and lobes are important not only for students of anatomy but also to clinicians of cardiothoracic as well as for the faculties of radiology and imaging. The knowledge of anatomical variations alerts the surgeons to potential problems that might be encountered during surgical intervention. The fissures may be complete whereas lobes remain intact at the hilum by bronchii and pulmonary vessels. Sometimes they may be incomplete when there is a parenchymal fusion between the lobes or the fissure may be completely absent. The fissures are also helpful in the movement of lobes in relation to one another in order to accommodate greater distension of lower lobe during respiration. The fissures also help in the uniform expansion of lung. Appreciation of lobar anatomy thus becomes more significant with the finding of fissure that forms the boundaries of lobes and this will facilitate location of bronchopulmonary segment for performing lobectomies and segmental dissection of lobes [1].

The lungs are a pair of essential organs of respiration located within the thoracic cavity. Each lung is divided into lobes by fissures. Anatomically, left lung is divided into upper and lower lobes by oblique fissure whereas right lung is divided into upper, middle and lower lobes by oblique and

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horizontal fissures. In each lung, the oblique fissure begins from the mediastinal surface above and behind the hilum and cuts the posterior border of the lung about 2.5cms lateral to the junction of the T4 and T5 spine. Then it runs along the costal surface, cuts the inferior border of the lung and reappears on the mediastinal surface and ends at the lower end of hilum. The horizontal fissure begins at the oblique fissure near midaxillary line, passes horizontally forward to anterior border of the lung, level with the sternal end of fourth costal cartilage and then passes backwards to the hilum on the mediastinal surface [14].

Knowledge of the fissures and lobes of the lungs are important to plan various surgical procedures to avoid post-operative complications like air leakage. It can also help to explain various radiological appearances of lobar anatomy of the lungs and the position of the interlobar fluid. Prior anatomical knowledge and suspicion for probable variations may be crucial for clinicians, surgeons and radiologists. [2]

Materials and Methodology

The lungs of 77 adult cadavers were studied after proper embalming with 10% formalin. Thoracic wall of embalmed cadavers were dissected; the lungs were removed to study morphological features like the number of lobes and extent of fissures. Three damaged lungs were discarded. The anatomical classification proposed by Craig and Walker was followed to determine the presence and completeness of fissures and percentage of incidence of occurance was calculated and compared with the previous studies.

Results

Out of 77, 37 were right sided lungs, 40 were left sided lungs.

Right lungs (oblique fissure): out of 37, 31(83.78%) shown normal pattern of oblique fissure. 5(13.5%) had incomplete oblique fissure and 1(2.7%) had absence of oblique fissure.

Right lungs (horizontal fissure): out of 37, 19(51.35%) shown normal pattern of fissure, 9(24.32%) had incomplete horizontal fissure and 9(24.32%) had complete absence of horizontal fissure.

Left lungs (oblique fissure): out of 40, 30(75%) shown normal pattern of oblique fissure, 10(25%) had incomplete oblique fissure.

Table 1: Showing percentage of occurance of variation in horizontal and oblique fissure

Right side lungs(37)					Left side lungs (40) Oblique fissure		
Horizontal fissure			Oblique fissure				
Complete	Incomplete	Absence	Complete	Incomplete	Complete	Incomplete	Absence
19(51.35%)	9(24.32%)	9(24.32%)	31(83.7%)	5(13.5%)	30(75%)	10(25%)	0(%)

Table 2: Showing the incidence of percentage of occurance of variations classified according to Craig and Walker

Grades	Right Lungs(37)				Left Lungs(40)	
	Horizontal Fissure		Oblique Fissure		Oblique Fissure	
	No. of lungs	%	No of lungs	%	No. of lungs	%
Grade I	19	51.35	24	64.86	23	57.5
Grade II	4	10.8	07	18.91	07	17.5
Grade III	7	18.9	05	13.50	10	20.0
Grade IV	7	18.9	01	02.70	NIL	00

Table 3: Comparative incidence of variations of oblique and horizontal fissures

Authors	Year	Right Lung – Oblique Fissure (%)		Right Lung Horizontal Fissure (%)		Left Lung – Oblique Fissure (%)	
		Incomplete	Absent	Incomplete	Absent	Incomplete	Absent
Medlar EM[8]	1947	25.6	4.8	62.3	-	10.6	7.3
Lukose et.al[7]	1999	-	-	21	10.5	21	-
Meenakshi S et al[9]	2004	36.6	-	63.3	16.6	46.6	0
Prakash et.al[12]	2010	39.3	7.1	50	7.1	35.7	10.7
Nene AR et.al[11]	2011	6	2	8	14	12	0
Present study	2015-16	13.5	2.7	24.32	24.32	25	0

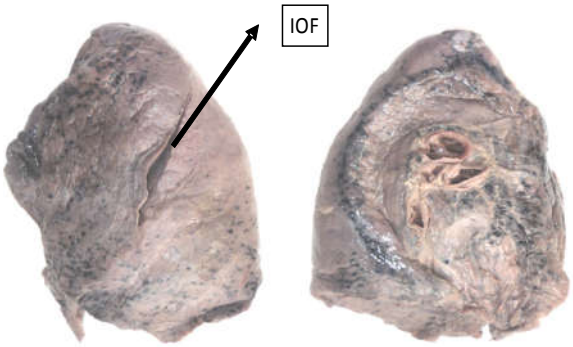


Fig. 1: Incomplete oblique fissure (IOF) –left lung

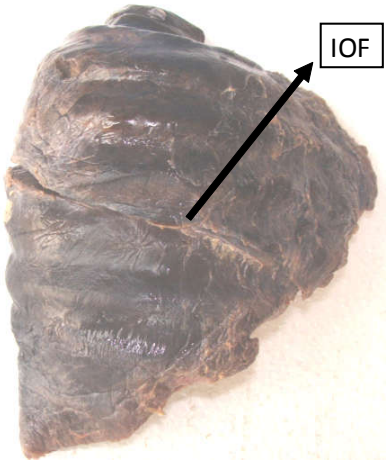


Fig. 2: Incomplete Oblique fissure (IOF) –right lung

Fig. 3: Absence of fissure-right side

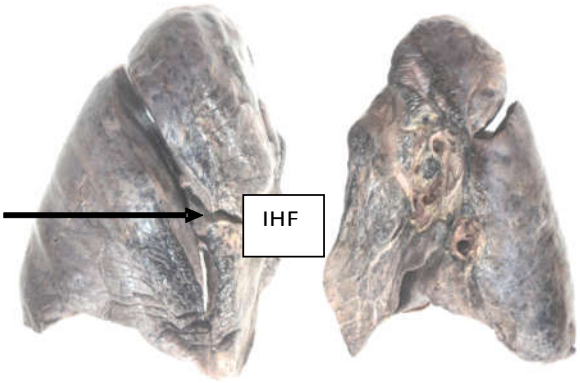


Fig. 4: Incomplete horizontal fissure(IHF)-right side

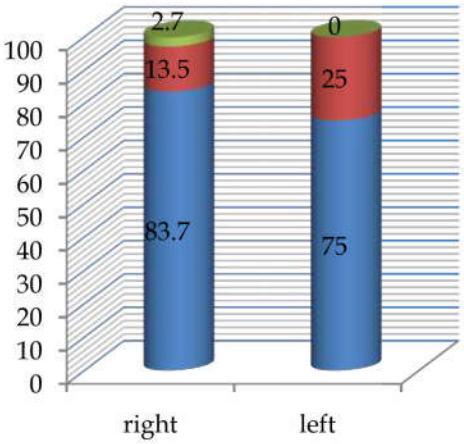
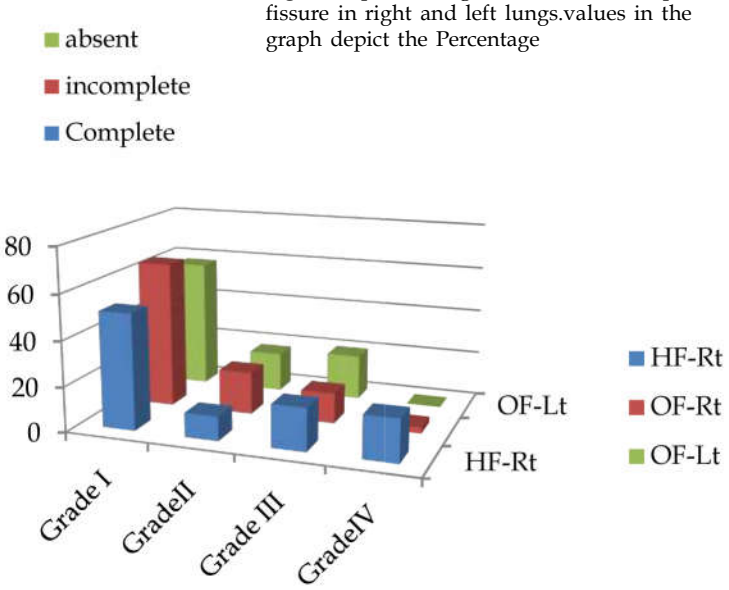


Fig. 6: Graph depicting the comparison of percentage of variation of oblique fissure(OF) on right(Rt) and left(lt) side lungs and horizontal fissure(HF) on right lung

Fig. 5: Graph showing the variation of oblique fissure in right and left lungs.values in the graph depict the Percentage



Further according to Craig and Walker grade I type of horizontal fissure in right lung were observed among 19(51.35%) and oblique fissure among 24(64.86%) on left side among 23(57.5%), grade II type of horizontal fissure in right lung among 4(10.8%) and oblique fissure in 7(18.91%) and on left side among 7(17.5%), grade III type of horizontal fissure in right lung in 7(18.9%) and oblique fissure among 5(13.5%) and on left side among 10(20%) and grade IV type horizontal fissure in right lung among 7(18.9%) and oblique fissure among 1(2.7%).

Discussion

Ontogenetically the lung is a composite of endodermal and mesodermal tissues. The endoderm of the lung bud gives rise to the mucosal lining of the bronchi and to the epithelial cells of the alveoli. The vasculature of the lung & the muscles & cartilage supporting the bronchi are derived from the foregut splanchnopleuric mesoderm, which covers the bronchi as they grow out from the mediastinum into the pleural space.

When the embryo is approximately 4 weeks old, the respi-ratory diverticulum (lung bud) appears as an outgrowth from the ventral wall of the foregut. On day 22 it bifurcates into two primary bronchial buds between day 26 and day 28. Early in the 5th week the right bronchial bud branches into three secondary bronchial buds while the left one branches into two. By 6th week secondary bronchial buds branch into tertiary bronchial buds (ten on the right and eight on the left) to form the bronchopulmonary segments. All the spaces between individual bronchopulmonary seg-ments get obliterated except along the line of division of prin-cipal bronchi where deep complete fissures remain dividing the right lung into 3 lobes and left lung into 2 lobes. These fis-sures are oblique and horizontal in position in right lung where as only in oblique position in left lung [6].

Morphological variations in the lobes and fissures of lung are mainly due to the defective pulmonary development. During the development, as the lung grows, the spaces or fissures that separate individual bronchopulmonary buds/segments become obliterated except along two planes, evident in the fully developed lungs as oblique or horizontal fissures. Obliteration of these fissures either completely or partially may lead to absence or incomplete fissures. Accessory fissure could be due to non-obliteration of spaces which normally are obliterated [16].

Craig and Walker have proposed a manner of classification of fissure for describing operative technique and also for comparing different surgical series. The criteria used to classify the lung fissures were degree of completeness of fissure and the location of the pulmonary artery at the base of the oblique fissure. Four grades have been described: Grade I- complete fissure with entirely separate lobes; Grade II- complete visceral cleft but parenchymal fusion at the base of the fissure; Grade III- visceral cleft evident for a part of the fissure; and Grade IV- complete fusion of lobes with no evident fissure line [3].

The present study showed that, in majority of cases the fissures were incomplete more on right side (Table 1). These findings were compared with those of other studies as shown in table 3. Increased incidence of incomplete oblique fissures on the right side might indicate early commencement of fusion of the prenatal fissures which may proceed further before birth, leading to fusion along floor of the oblique fissure. Table 3 shows wide variability which may be due to the regional variations. In the present study oblique fissure was incomplete in 13.5% and 25% on right and left side respectively but in our study variation observed was more on left sided lung as compared to others.

Finding accessory fissures in lung specimens is not uncommon, but appreciating them on radiographs and CT scans is difficult and hence they are either not appreciated as distinct entities or are completely misinterpretated. They usually occur at the boundaries between bronchopulmonary segments. The commonly found accessory fissures are superior accessory fissure, inferior accessory fissure and left minor fissure. The superior accessory fissure (SAF) separates superior segment from the rest of the segments of lower lobe of lung, the inferior accessory fissure (IAF) separates a small 'infracardiac lobe' from other segments of lower lobe of lung on the diaphragmatic surface and the left minor fissure (LMF) separates the lingula from the other segments of upper lobe of left lung [13].

Surgically the gradation of fissure is important. The surgeon approaches to ligate the vessels and bronchi through the depth of the fissure. Grade 1 oblique fissure facilitates the approach while doing lobectomy and video assisted thoracoscopic surgery. But otherwise the lung parenchyma has to be dissected to reach those structures leading to intra-operative hemorrhage and more postoperative complications [4].

In patients with endobronchial lesion, an accessory

fissure might alter the usual pattern of lung collapse and pose difficulty in diagnosing a lesion and its extent. Pneumonia in a particular lobe is contained within the confines of the lobe by complete fissures. In patients with incomplete fissures, pneumonia may spread to adjacent lobes through the parenchymal continuation [10].

LUKOSE et al, (1999) worked on the morphology of the lungs and variations in lobes and fissures along with a comparative study with the earlier authors stated that incomplete and absence of horizontal fissures was reported as 21% and 10.5%. MEDLAR, (1947) reported that incomplete oblique fissure in right and left lungs as (25.6% & 10.6%), incomplete horizontal fissure in right lung (17%) and absent oblique fissure (4.8% & 7.3%) absent horizontal fissure (45.2%) which is supported by the present study. The presence of fissures in the normal lungs enhances uniform expansion, and their position could be used as reliable landmark in specifying lesions within the lungs in particular [5].

Even though variations in the fissures are mainly due to defective development,they are of great clinical importance. An incomplete fissure frequently leads to postoperative air leakage. They alter the spread of infection within the lung from one lobe to other. It may causes odd appearances of fluid tacking within the lung. The lymphatics of lung drain from pleura towards the hilum. Altered course of oblique fissure would lead to altered course of visceral pleura,thereby changing the arrangement of lymphatic drainage [15].

And incomplete fissures are also responsible for altering the spread of diseases. Gradation of fissures is important surgically. The surgeon approaches to ligate the vessels and bronchi through the depth of the fissure. Grade I oblique fissure makes the approach easy while doing lobectomy and video assisted thoracoscopic surgery [4].

Knowing the frequency of occurrence of a variant fissure in a particular population might help the radiologist and clinician to make correct diagnosis. Similarly, it might help the surgeon to plan, execute and modify a surgical procedure depending on the merit of the case. This will help to reduce the morbidity and mortality associated with lung surgeries. Documentation and familiarization of these anomalies remains important for making correct radiological diagnosis and for proper surgical management of lung pathology. Recognition of lung anomalies improves understanding of pneumonia, pleural effusion, and collateral air drift along with disease spreading through lung.

Conclusion

Considering the clinical and surgical importance of such variations, from anatomical point of view, one can opine that prior anatomical knowledge and high index of suspicion for probable variations in the fissures, lobes and bronchopulmonary segments in the lung may be important for clinicians, surgeons and radiologists. Variations in the number and pattern of hilar structures in both human lungs have been studied in detail by earlier researchers, thus this study add a database for the same. Knowing the frequency of occurrence of a variant fissure in a particular population can help the radiologist and clinician to make correct diagnosis, plan, execute and modify a surgical procedure depending on the merit of the case. This will help to reduce the morbidity and mortality associated with lung surgeries.

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Original Article

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Sutural Morphology of the Types of Asterion: A Study on Dry Human Skulls

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Abstract

Introduction: Asterion is the junction of parietal, mastoid part of temporal & occipital bones. It is related to junction of transverse and sigmoid sinuses. Developmentally asterion is the location of posterolateral fontanelle. *Aim:* To study the morphological features of asterion with or without sutural bones in 110 (220 sides) human adult dry skulls. *Material & Methods*: 220 sides of 110 dry adult skull bones of both male & female were studied, for the morphological features of asterion. Depending on the observations, classification is done as type I and type II. *Results:* Incidence noted is 20.9% are type-I and 79% are type-II. *Conclusion:* Presence of sutural bones at the asterion will be of greater significance, during neurosurgical procedures and also during radiological investigations.

Keywords: Asterion; Parietal; Sinus.

Introduction

Asterion is the junction between the lambdoid, parieto-occipital & parieto-mastoid sutures. During linear growth of the skull vault, the bones surrounding the asterion start ossifying, these bones will fuse in the middle of the second year. Sometimes new ossification centres appear as suture bones [1]. Asterion is a surface landmark for the transverse - sigmoid sinus complex [2] and also a surgical landmark for approach to the posterior cranial fossa for the neurosurgeions [3], ENT and Oro-fascio-maxillary surgeons [4].

The surgical importance of the posterior cranial fossa lies in its dense collection of neurovascular structures housed in a small, rigid space. This makes the invasive approach very delicate and prone to accidents or errors in surgery [5,6,7]. The sigmoid sinus is easy to get lacerated during posterior fossa craniotomy, because it is located in a groove in the bone, may be adherent to the bone and is further attached by an emissary vein [4].

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Presence of sutural bones at these points may complicate the surgical orientation leading to pitfalls as exact pinpoint of location cannot be made and burr hole may be smaller to larger which extend from asterion to foramen magnum [8]. Newer spiral CT and MRI 3D image with fading technique are taken to see exact location of asterion in relation to transverse-sigmoid complex & approach to the exact location of the tumour or lesion [9].

Material & Methods

The present study was done in 220 sides of 110 dry adult human adult skulls, procured from the department of Anatomy and Forensic Medicine in KIMS, Koppal, Karnataka. Each skull was observed for the type of asterion, on both the sides, and classified as, Type I Asterion (asterion with sutural bone) and Type II Asterion (asterion without sutural bone).Classification of asterion is done according to previous studies [6,9,10]. Skulls with breakage or advanced synostosis were excluded from the study [11]. Data is collected, in the tabulated form, compared with the previous studies and the significance of the types of asterion has been dicussed.

Observations

Out of 220 sides of asterion the Type –I asterion on

right side is 18% & on left side is 23.6%, compared to type-II which is 81.8% on the right side and 76.3% on the left side respectively. Total incidence of type –I asterion is 20.9% and type-II asterion is 79%. Further, bilateral incidence of type-I asterion is 7.2% and type-II asterion is 67.2%.

Table 1: Incidence of types of asterion

Asterion	Right side	Right side %	Left side	Left side %	Total	Total %	Bilateral	Bilateral %
Type-I	20	18%	26	23.6%	46	20.9%	8	7.2%
Type-II	90	81.8%	84	76.3%	174	79%	74	67.2%
Total	110	-	110	-	220	-	82	-

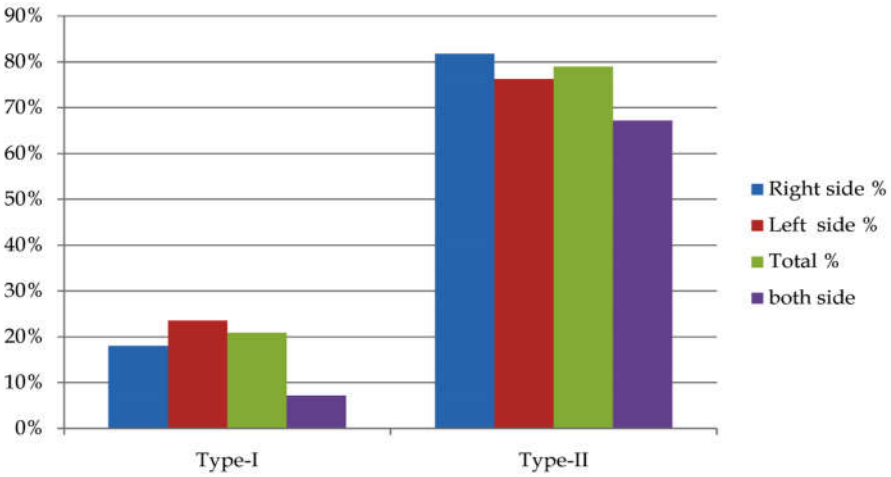

Chart 1: Coloured column chart of Incidence of types of asterion. Incidence of type –I asterion is less than that of type-II

Table 2: Comparison of various studies on asterion in different populations

Population Group	Author & year	No. of Bones	Type-I	Type-II
North americans	Berry[12] 1967	50	12 %	88 %
South americans	Berry [12] 1967	53	7.5 %	88 %
Egyptians	Berry[12] 1967	250	14.4 %	85.6 %
Indians –burma	Berry[12] 1967	51	14.7 %	85.3 %
Indians-punjab	Berry[12] 1967	53	16.9 %	83.1 %
Turks	Gumusburun[13] 1997	302	9.92 %	90.08 %
Kenyans	Mwachaka[6] 2009	79	20 %	80 %
Indians	Hussain[14] 2011	125	23.15 %	76.85 %
South indian	R Sudha[11] 2013	150	7.6 %	92.3 %
South indian	Pavan[7] 2015	250	19.2 %	80.8 %
Indian	Rajani singh[15] 2012	55	16.36 %	83.64 %
Present study	India (Karnataka)	220	20.9 %	79 %.

Fig. 1: Type 1 sterion (with sutural bone)

Fig. 2: Type 2 asterion (without sutural bone)

Discussion

The mechanism of formation of sutural bone is not fully understood. Some of the authors believe that these bones develop from pathological influences such as hydrocephalus [16]. Some others believe that development of sutural bone is a natural process and is genetically determined [17]. Approach to the asterion itself is difficult due to thick muscles present on it and emissary vein below it [9]. Incidence of type I asterion was 16.36% [15]. The incidence of type-I asterion is nearer to that done by Berry in Indian Punjabi population [12]. Studies done by different researchers revealed that there is racial variation in the incidence of the types of sterion [11-14].

Type –I asterion is less predominant on right side (18%), than left side (23.6%). Whereas, on the right side type-II asterion is 81.8%. On the left side incidence of type-I asterion is 23.6% which is less than type-II (76.3%). When an observation was done on bilateral occurrence, type-I asterion was found on both the sides in 7.2% of the cases and type-II was bilateral is 67.2%. Type-I is predominant on left side & type-II is on right side. The present study is close to the study done in Kenyans [6], Indian Hussain [14]. Our results are almost similar the study done by Pavan et al [7] (Type –I 19.2% and Type -II 80.8%). The differences in the incidence of types of asterion may be attributed to the region, race and population, as it is clearly depicted in Table 2.

Conclusion

Regional wise study of asterion is very important. Predominance of type of asterion, its correlation is significant, which helps neurosurgeons, ENT surgeons, radiologists & oro-facio maxillary surgeon for pre-operative assessment and plan for procedure. Asterion type I was found in 20.9%. Sutural bones, whenever present are of particular significance. Knowledge of sutural bones at the asterion is clinically and surgically significant, during neurosurgical procedures and also during radiological investigations. Our study results are of immense help in the surgical and radiological field for an insight into the types of asterion. This study is also an addition to the previously available data of types of asterion for comparison with population groups.

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Original Article

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Sexual Dimorphism and Racial Differences in the Various Parameters of Head and Neck of Talus in Gujarati Population

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Abstract

Introduction: Talus is the key tarsal bone of the foot. It is unique in the sense that it has no muscular attachments. Sexual dimorphism and racial differences in the talus is utmost important for the forensic experts, anatomists as well as physical anthropologists. The purpose of the present study was to determine whether sex or race related morphometric differences in the various parameters of head and neck of talus could be demonstrated, and if so whether they are useful for the identification of individuals of unknown sex and race or not. *Material and Method:* Current study was done on the 221 dry adult human talus. The parameters of head and neck of talus included in the study are length, breadth and height of head of talus as well as head-neck length of talus. *Results:* Findings of all four parameters of head and neck of talus in male were more as compared to those of female in the Gujarati population of present study. *Discussion*: Findings of present study were compared with the findings of other researchers who measured the same parameters in the different populations. *Conclusion*: All four parameters of head and neck of talus included in the study are useful for the sexual dimorphism of talus in the Gujarati population of present study as well as they are useful for the identification of individuals of unknown race.

Keywords: Head and Neck of Talus; Gujarati Population; Sexual Dimorphism; Racial Differences.

Introduction

Seven tarsal bones occupy the proximal half of the human foot. The tarsal bones of the foot and the carpal bones of the hand are homologous, but the tarsal elements are larger, reflecting their role in supporting and distributing the body weight [1]. Talus is the key tarsal bone of the human foot. It is unique in the sense that it has no muscular or tendinous attachments [2]. Talus (the tarsal bone of the foot) is homologous with the scaphoid (the carpal bone of the hand) [3].

Determination of sex and race of the unknown individual by using the available bone of the human skeleton has remained the area of interest for physical anthropologists, forensic experts as well as anatomists. Different bones or part of bones have been used to identify the sex and race of unknown individual, like pelvis [4], sacrum [5], skull [6], mandible [7], femur [8,9], sternum [10], clavicle [11], scapula [12] etc. Patella, talus and calcaneus, the robust bones which are often recovered intact, can be used for the same [13]. All human populations show at least some sexual dimorphic features regarding talus. These features are population specific and show racial variations also. The purpose of the present study was to determine whether sex or race related morphometric differences in the various parameters of head and neck of talus could be demonstrated, and if so whether they are useful for the identification of individuals of unknown sex and race or not.

Aims and Objectives

- To determine the normal range of the values of various parameters of head and neck of talus
- To determine; whether these parameters are useful for the sexual dimorphism of talus or not

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- To determine; whether these parameters are useful for the identification of individuals of unknown race or not.

Material and Method

Present study was conducted on 221 dry adult human talus during the period of five years from 2011 to 2015. The bones were obtained from the dead bodies donated to the Department of Anatomy, Shree M P Shah Government Medical College, Jamnagar. Out of total 221 talus, 127 were of male and 94 were of female. Pathological, fractured or talus of unknown sex were excluded from the study. Only fully ossified talus of known sex were included in the study.

Following parameters of head and neck of talus were taken in the present study:

Length of Head of Talus

Length of head of talus was measured as the distance between both the end points of longitudinal axis of navicular articular surface of head of talus. The surface of navicular fibrocartilage is also included in this measurement.

Fig. 1: Showing the measurement of length of head of talus

Instrument used: Sliding Caliper [14]

Breadth of Head of Talus

Breadth of head of talus was measured as the greatest breadth at right angle to the longitudinal axis. In some simian groups, it is difficult to determine the lower margin of the articular surface, where it merges into the anterior articular surface of the calcaneus.

Fig. 2: Showing the measurement of breadth of head of talus

Instrument used: Sliding Caliper [14]

Height of Head of Talus

Height of head of talus was measured as the height of perpendicular on the chord joining the end points of the middle longitudinal curve of the navicular articular surface of the head of talus.

Fig. 3: Showing the measurement of height of head of talus

Instrument used: Co-ordinate Caliper [14]

Head-neck Length of Talus

Head-neck length of talus was measured as the projective distance from the furthermost point of navicular articular surface to the anterior end of the midsagittal curve of trochlea in the longitudinal axis of the neck and projected to lower surface of the bone.

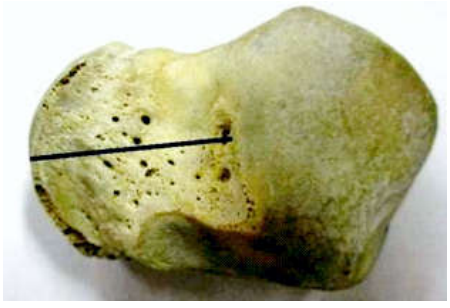

Fig. 4: Showing the measurement of head-neck length of talus

Instrument used: Sliding Caliper with movable arms [14]

To avoid intra-observer variation, each measurement was taken at three different times and the mean of all three readings was taken as the final reading.

Student t test was applied and p value was calculated at 95% confidence interval by using statistical aids (SPSS-Statistical Package for the Social Sciences) for the comparison of various parameters of head and neck of talus between male and female.

If 'p value' of a particular parameter for male and female is >0.05, there is no statistically significant difference for that particular parameter between male and female.

If 'p value' is between 0.05-0.01, there is statistically significant difference for that particular parameter between male and female.

If 'p value' is between 0.01-0.005, it will suggest statistically highly significant difference.

If 'p value' is <0.005, it will suggest statistically very highly significant difference [15].

Results

As we can see in the Table 1, in the Gujarati population of present study, mean length of head of talus in male is 28.92 mm, SD is 3.78 mm, range from 21 mm to 38 mm, mean±SD from 25.14 mm to 32.70 mm and mean±3SD from 17.58 mm to 40.26 mm. Mean length of head of talus in female is 27.63 mm, SD is 4.34 mm, range from 18 mm to 36 mm, mean±SD from 23.29 mm to 31.97 mm and mean±3SD from 14.34 mm to 40.65 mm.

Mean breadth of head of talus in male is 23.05 mm, SD is 2.45 mm, range from 18 mm to 33 mm, mean±SD from 20.60 mm to 25.51 mm and mean±3SD from 15.68 mm to 30.43 mm. Mean breadth of head of talus in female is 21.82 mm, SD is 1.96 mm, range from 18 mm to 28 mm, mean±SD from 19.86 mm to 23.80 mm and mean±3SD from 15.93 mm to 27.73 mm.

Mean height of head of talus in male is 20.07 mm, SD is 1.83 mm, range from 16 mm to 25 mm, mean±SD from 18.24 mm to 21.90 mm and mean±3SD from 14.58 mm to 25.56 mm. Mean height of head of talus in female is 19.17 mm, SD is 1.58 mm, range from 16 mm to 24 mm, mean±SD from 17.59 mm to 20.75 mm and mean±3SD from 14.43 mm to 23.91 mm.

Mean head-neck length of talus in male is 23.54 mm, SD is 1.86 mm, range from 19 mm to 30 mm, mean±SD from 21.68 mm to 25.40 mm and mean±3SD from 17.96 mm to 29.12 mm. Mean head-neck length of talus in female is 21.81 mm, SD is 1.74 mm, range from 17 mm to 26 mm, mean±SD from 20.07 mm to 23.55 mm and mean±3SD from 16.59 mm to 27.03 mm.

Mean length, breadth and height of head of talus as well as mean head-neck length of talus in male are more as compared to female in Gujarati population of present study.

As we can see in Table 2, (for both- with equal variances assumed as well as equal variances not assumed) p value for the length, breadth and height of head of talus as well as head-neck length of talus are 0.000, which suggest statistically very high significant difference between the male and female talus for these parameters.

Discussion

As we can see in Table 3, various parameters of head and neck of talus of different races (White and Black South Africans, Americans, and Korean) have been studied by the various researchers.

Table 1: Showing the Sex-Male/Female, N-number of bones taken, Mean, SD-Standard deviation, Standard error of mean, Range (minimum-maximum), Mean±SD, Mean±3SD of various parameters of head and neck of talus of Gujarati population of present study

Para-Meters	SEX	N	Mean (mm)	SD (mm)	Std. Error Mean (mm)	Range (min-max) (mm)	Mean±SD (mm)	Mean±3SD (mm)
Length of Head of Talus (MM)	male	127	28.92	3.78	0.33606	21-38	25.14-32.70	17.58-40.26
	female	94	27.63	4.34	0.44866	18-36	23.29-31.97	14.34-40.65
Breadth of Head of Talus (MM)	male	127	23.05	2.45	0.21802	18-33	20.60-25.51	15.68-30.43
	female	94	21.82	1.96	0.20273	18-28	19.86-23.80	15.93-27.73
Height of Head of Talus (MM)	male	127	20.07	1.83	0.16301	16-25	18.24-21.90	14.58-25.56
	female	94	19.17	1.58	0.16335	16-24	17.59-20.75	14.43-23.91
Head-Neck Length of Talus (MM)	male	127	23.54	1.86	0.16535	19-30	21.68-25.40	17.96-29.12
	female	94	21.81	1.74	0.17958	17-26	20.07-23.55	16.59-27.03

Table 2: Showing the statistical analysis and the results of independent samples test applied to various parameters of head and neck of talus of Gujarati population of present study

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	sig	t	DF	Sig. (2-tailed)	Mean Difference	Standard Error Difference	95% Confidence Interval of the Difference	
									Lower	Lower
Length of head of talus (mm)	Equal variances assumed	5.305	.022	2.336	219	.000	1.28296	.54910	.20076	2.36517
	Equal variances not assumed			2.289	183.903	.000	1.28296	.56056	.17700	2.38892
Breadth of head of talus (mm)	Equal variances assumed	3.234	.074	3.983	219	.000	1.22533	.30768	.61894	1.83172
	Equal variances not assumed			4.116	217.642	.000	1.22533	.29771	.63857	1.81209
Height of head of talus (mm)	Equal variances assumed	.705	.402	3.851	219	.000	.90853	.23593	.44354	1.37351
	Equal variances not assumed			3.937	213.891	.000	.90853	.23077	.45364	1.36341
Head-neck length of talus (mm)	Equal variances assumed	.259	.612	6.992	219	.000	1.72416	.24661	1.23813	2.21018
	Equal variances not assumed			7.063	207.470	.000	1.72416	.24411	1.24290	2.20542

Table 3: Showing the comparison of various parameters of head and neck of talus of Gujarati population of present study with the findings of the other researchers

No	Researchers	Populations	Sample size	Sex	PARAMETERS			
					Length of head of talus (mm) (Mean ±SD)	Breadth of head of talus (mm) (Mean ±SD)	Height of head of talus (mm) (Mean ±SD)	Head-neck length of talus (mm) (Mean ±SD)
1	Bidmos and Dayal (2003)[13]	White south Africans	60	Male	-	-	28.45 ±2.50	23.89 ±2.50
			60	Female	-	-	27.37 ±2.30	21.43 ±1.80
2	Bidmos and Dayal (2004)[16]	Black south Africans	60	Male	-	-	25.33 ±1.77	20.85 ±2.38
			60	Female	-	-	21.84 ±2.00	19.56 ±2.21
3	Ferrari J et Al (2004)[17]	Americans	114	Male	29.52 ±2.53	19.23 ±2.25	-	-
			113	Female	26.13 ±2.05	17.26 ±1.54	-	-
4	Lee UY et al (2012)[18]	Korean	70	Male	-	-	26.74 ±2.35	20.99 ±2.13
			70	Female	-	-	25.30 ±1.94	19.28 ±1.64
5	Present study (2017)	Gujarati	127	Male	28.92 ±3.78	23.05 ±2.45	20.07 ±1.83	23.54 ±1.86
			94	Female	27.63 ±4.34	21.82 ±1.96	19.17 ±1.58	21.81 ±1.74

In 2003 Bidmos and Dayal measured the height of head of talus and head-neck length of talus in 60 male and 60 female White South Africans. In their study, mean height of head of talus in male White South Africans was 28.45 mm with SD 2.50 mm and in female White South Africans was 27.37 mm with SD 2.30 mm. In their study, mean head-neck length of talus in male White South Africans was 23.89 mm with SD 2.50 mm and in female White South Africans was 21.43 mm with SD 1.80 mm. In the present study

of Gujarati population we found mean height of head of talus 20.07 mm with SD 1.83 mm in male and 19.17 mm with SD 1.58 mm in female. By comparing the above findings, we can say that mean height of head of talus in male as well as in female Gujarati population of present study are less as compared to the findings of male and female White South Africans studied by Bidmos and Dayal, while the mean head-neck length of talus in male as well as female Gujarati population of present study are coinciding with the findings of male and female White South Africans studied by Bidmos and Dayal respectively.

In 2004 Bidmos and Dayal measured the height of head of talus and head-neck length of talus in 60 male and 60 female Black South Africans. In their study, mean height of head of talus in male Black South Africans was 25.33 mm with SD 1.77 mm and in female Black South Africans was 21.84 mm with SD 2.00 mm. In their study, mean head-neck length of talus in male Black South Africans was 20.85 mm with SD 2.38 mm and in female Black South Africans was 19.56 mm with SD 2.21 mm. By looking at these findings, we can say that mean height of head of talus in male as well as in female Gujarati population of present study are less as compared to the findings of male and female Black South Africans studied by Bidmos and Dayal, while the mean head-neck length of talus in male as well as female Gujarati population of present study are more as compared to the findings of male and female Black South African talus studied by Bidmos and Dayal respectively.

In 2012 Lee UY et al measured the height of head of talus and head-neck length of talus in 70 male and 70 female Koreans. In their study, mean height of head of talus in male Korean was 26.74 mm with SD 2.35 mm and in female Koreans was 25.30 mm with SD 1.94 mm. In their study, mean head-neck length of talus in male Koreans was 20.99 mm with SD 2.13 mm and in female Koreans was 19.28 mm with SD 1.64 mm. By looking at these findings, we can say that mean height of head of talus in male as well as in female Gujarati population of present study are less as compared to the findings of male and female Koreans studied by Lee UY et al, while the mean head-neck length of talus in male as well as female Gujarati population of present study are more as compared to the findings of male and female Koreans studied by Lee UY et al respectively.

In 2004 Ferrari J et al measured the length and breadth of head of talus in 114 male and 113 female Americans. In their study, mean length of head of talus in male Americans was 29.52 mm with SD 2.53 mm and in female Americans was 26.13 mm with SD 2.05 mm. In their study, mean breadth of head of talus in male Americans was 19.23 mm with SD 2.25 mm and in female Americans was 17.26 mm with SD 1.54 mm. By looking at these findings, we can say that mean length of head of talus in male Gujarati population of present study is less as compared to the findings of male Americans, while the mean length of head of talus in female Gujarati population of present study is more as compared to the findings of female Americans studied by Ferrari J et al. We can also say that mean breadth of head of talus in male as well as female Gujarati population of present study are more as compared to the findings of male and female Americans studied by Ferrari J et al respectively.

Differences in the findings of various parameters of head and neck of talus of different populations may be due to racial variations or may be due to differences in measuring techniques or may be due to coincidence. Similarities in the findings of various parameters of head and neck of talus of different populations may be due to migrating populations or may be due to coincidence.

Conclusion

In the present study, we determined the normal range of the values of various parameters of head and neck of talus in the Gujarati population. Values of these parameters (length of head of talus, breadth of head of talus, height of head of talus, head-neck length of talus) can be used for the sexual dimorphism of talus with statistically very highly significant differences between the male and female talus. These findings can be used in the identification of individuals of unknown race.

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Original Article

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A Morphometric Study of Foramen Magnum and Posterior Condylar Foramen

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Abstract

Foramen magnum is a large opening through which vital structures pass. The foramen magnum is an important landmark of the skull base. Posterior condylar canal, Posterior condylar vein and Occipital emissary vein are of utmost importance for postero-lateral surgical approaches to foramen magnum. *Aim*: To provide a database of dimensions of foramen magnum and posterior condylar foramen to help in various surgical procedures. *Methods and Materials*: Seventy five dry human skull of unspecified gender and age obtained from Department of Anatomy of Medical colleges. Various parameters of foramen magnum and presence or absence of posterior condylar foramina were noted. *Results and Conclusions*: The mean antero-posterior distance through the centre of foramen magnum was 33.56mm, mean transverse distance was 28.38mm, Foramen magnum index was 84.89 and Foramen magnum surface area was 751.46 mm^2. The posterior condylar foramina were present bilaterally in 66.66% of skulls, absent bilaterally in 14.66% and were unilateral in 18.66%. This study will be helpful to clinicians and surgeons dealing with the region of posterior cranial fossa before planning a surgery in the occipital condylar region.

Keyword: Foramen Magnum; Posterior Condylar Foramen; Foramen Magnum Index; Foramen Magnum Surface Area.

Introduction

The skull base at bottom of the cranium supports and protects the brain. Major vascular and neural structures enter and exit through various foramina's. Foramen magnum is a large opening in occipital bone of cranium. It lies in posterior cranial fossa. It contains the lower end of the medulla oblongata, meninges, vertebral arteries and spinal accessory nerve. These vital structures can undergo compression in cases of foramen magnum herniation and foramen magnum meningiomas.

The knowledge of foramen magnum diameters is needed to determine some malformations such as Arnold Chiari syndrome, which shows expansion of transverse diameter [1]. Configuration and size of the foramen magnum play an important role in the pathophysiology of various disorders of the craniovertebral junction [2]. The foramen magnum is an important landmark of the skull base and is of particular interest for anthropology, anatomy, and forensic medicine. Emissary veins connect the extracranial venous system with intracranial venous sinuses. The posterior condylar emissary vein connects the lower end of the sigmoid, marginal or occipital sinuses with the internal vertebral venous plexus [3].

Emissary valveless veins are an important component in selective brain cooling by allowing blood to flow bidirectionally thereby allowing cooler blood from the evaporating surfaces of the head to cool the brain. In upright position they also provide as primary outflow route [3]. Posterior condylar canal, Posterior Condylar vein and Occipital emissary vein are of utmost importance for posterolateral surgical approaches to foramen magnum [4].

Any variations in these veins can lead to change in surgical approach in posterior fossa. Our study will provide a database of dimensions of foramen

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magnum and posterior condylar foramen.

Methods

The present study was carried out on Seventy five dry human skulls obtained from Department of Anatomy of Medical colleges. The skulls were of unspecified gender and age. Fractured, deformed skulls were excluded from study. Serial numbers were assigned to the skull. Measurements were taken using a vernier caliper (0-300mm with a precision of 0.01 mm). Two authors made all measurements at separate sittings, one measurement serving as a check to the other. Mean of the two readings was taken for final statistics. The mean value and standard deviation was then calculated for that foramen magnum. Presence or absence of posterior condylar foramen was also noted. Observations were made by passing a probe into the posterior condylar foramina to confirm whether they were opening into the posterior cranial fossae in their entire course. Photographs were taken of skull base with a digital camera.

The following parameters were recorded:

Mean Antero-posterior diameter (APD) of foramen magnum was recorded from anterior border (basion) through centre of foramen magnum until the end of posterior border (opistion).

Mean transverse diameter (TD) was measured from end of right border with maximum concavity through the foramen magnum to end of left border with maximum concavity.

Surface area of Foramen magnum [FMA] was calculated using Radinsky's formula [5].

Radinsky's formula (Foramen magnum area)

$$= ¼ * \pi(pi) * \text{APD} * \text{TD}$$

Foramen magnum index [FMI] was calculated using formula

FMI= TD*100/ APD

The mean values, Standard deviation for above parameters were computed.

Results

- The antero-posterior distance through the centre of foramen magnum ranged from 25.8-41.9mm with a mean of 33.56mm± 2.86.
- The transverse diameter through the centre of foramen magnum ranged from 21.3 – 35.07mm with a mean of 28.38mm ±2.64
- The foramen magnum surface area ranged from 500.39- 1049.36 mm^2 with a mean of 751.46 ±115.61 mm^2
- The foramen magnum index ranged from 71.23 – 117.82 with a mean of 84.89±8.28.
- Posterior condylar foramina were present bilaterally in 66.66% of skulls i.e., 50 skulls.
- Posterior condylar foramina were absent bilaterally in 14.66% of skulls i.e., 11 skulls.
- Posterior condylar foramina were present unilaterally in 18.66% of skulls. i.e., 14 skulls.
- Posterior condylar foramen only on right side was present in 12% while only on left side was present in 6.66% of skulls.

Table 1: Mean Antero-posterior and Transverse diameter of Foramen magnum.

	Mean AP Diameter (mm)	Mean Transverse Diameter (mm)
Tubbs et al [2]	31	27
Gruber et al.,[6]	36.6	31.1
Muthukumar et al. [8]	33.3	27.9
Natis et al.[9]	35.53	30.31
Nagwani [10]	34.68	27.24
Deepa G.[11]	34.1	28.68
Present study	33.56	28.38

Table 2: Surface area of Foramen magnum

	Foramen magnum surface area (mm^2)
Tubbs et al.[2]	558
Nagwani [10]	757.09
Deepa G.[11]	774.17
Acer et al [12]	760
Present study	751.46

Table 3: Foramen magnum index

	Foramen magnum index
Nagwani [10]	78.71
Deepa G.[11]	84.18
Chaturvedi and Harneja [13]	83.81
Howale et al [14]	84.85
Present study	84.89

The results of present study are in compliance with other studies.

Table 4: Posterior condylar foramen

	Bilateral (%)	Right unilateral (%)	Left unilateral (%)	Bilateral absence (%)
Sadamate [16]	48.68	19.29	15.35	16.66
Manoj K. [17]	48.33	15	18.33	16.66
Manoj B. [18]	58	15	10	17
Present study	66.66	12	6.66	14.66

Ginsberg observed the posterior condylar canal to be bilateral in 55.9% and unilateral in 17.6% [15].

Fig. 1: Measuring anteroposterior diameter

Fig. 3: Bilateral absence of posterior condylar canal

Fig. 2: Measuring transverse diameter

Fig. 4: Left unilateral posterior condylar canal

Discussion

The Foramen Magnum has raised interest in many fields of medicine as an important landmark of the base of the skull [6].

In addition to its significance for the surgery, the morphometry of FM medicolegally plays an important role in identification of unknown individuals in Forensic medicine [7].

Conclusion

Passage of vital structures and increasing use of skull base microsurgical approaches like far lateral and transcondylar approaches has made knowledge of foramen magnum very important. Morphometric analysis of foramen magnum plays an important role in transcondylar approach. This anatomic study describes geometric characteristics of foramen magnum and may serve as a standard reference for future. This study provide a baseline useful data that enable surgeons to perform effective and reliable surgery in FM region with maximum safety. The emissary veins are important agents to equalize intracranial pressure, acting as safety valves. The posterior condylar foramen serves as a communication between the intracranial and extracranial venous drainage. Posterior condylar foramen and posterior condylar emissary vein are important structure for posterolateral surgical approach to foramen magnum region. This study will be helpful to clinicians and surgeons dealing with the region of posterior cranial fossa before planning a surgery in the occipital condylar region.

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Accessory Sulcus of Liver: An Anatomical Study and Its Clinico-Surgical Implications

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Abstract

Background: Accessory Sulci can be incidentally detected during any radiological procedures, routine autopsies, surgery or anatomical dissections. These have been investigated as congenital development or acquired due to pressure exerted by surrounding viscera. *Aim*: The aim of the present study was to find out the presence of Accessory Sulcus (AS) in the embalmed cadaveric livers, compare it with the normal liver and correlated its clinical implications. *Materials and Methods*: All intact cadaveric formalin-fixed 20 livers were utilised for the study. All the livers belonged to adults of unknown age and known sex (male-18, female-2) in the Department of Anatomy, in order to observe the presence and pattern of AS. *Result:* The diaphragmatic sulci (DS) were present in 2 cases. They were starting from the right side of the inferior vena cava on right lobe of liver extending from superior surface to the anterior and right surfaces. A Rouviere's sulcus containing the right portal pedicle extending from the right of the porta hepatis, anterior to the caudate process was seen in 10% of cases. In one case sulcus extending from the right of fossa for gall bladder having a curved course bisecting the inferior border, was seen. Besides this, some minor sulci on the quadrate and caudate and left lobes were also seen.*Conclusion*: The anatomical knowledge of these hepatic AS may be utilised by radiologists to avoid possible errors in interpretation and subsequent misdiagnosis and may assist hepatobiliary surgeons to plan a safe surgical approaches.

Keywords: Hepatic Segments; Laproscopic Cholecystectomy; Portal Fissure; Rouviere's Sulcus.

Introduction

The liver is the largest abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It has four lobes or eight segments, depending on whether it is defined by its gross anatomical appearance or by its internal architecture. Grossly liver has been divided into the right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments [1]. Depending on the internal architecture, the most widely-accepted nomenclature is described by Couinaud (1957) and Healy and Schroy (1953) which was also accepted by Federative Committee on Anatomical Terminology. According to this classifications, an imaginary "principal parasagittal plane" passing through the gall bladder fossa, divides the liver into functional right and left lobes. Segments I, II, III and IV make up the functional left lobe, and segments V, VI, VII and VIII make up the functional right lobe [1,2].

Accesory groove or fissure can be incidentally detected at any surface of liver during radiological procedure, routine biopsy, anatomical dissection or during hepatobiliary surgery [3]. The grooves have various lengths, are linear or curve-shaped and are single or multiple in numbers [4]. Diaphragmatic sulcus have been investigated as congenital development or acquired due to diaphragmatic or costal pressure [5,6]. They are commonly present on anterior and superior surface of right lobe of the liver. Apart from diapharagmatic sulcus numerous sulcus, fissure or notches have been observered on inferior

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and posterior surface of both lobe of the liver by many authors.

Rouvier's sulcus is a cleft in the liver running to the right of the hilum, anterior to caudate process which contains the right portal pedicle and accurately identifies the plane of the common bile duct. This sulcus is consider as one of the important landmark which can be use as referance point to guide safe dissection of Calot's triangle during laproscopic cholecystectomy [7].

Though all these sulci and fissure were observed by different author from different countries including India but so far none of the article showed this study in Uttarakhand region. So our aim was to study the presence and frequency of Accessory Sulcus (AS) in the embalbed cadaveric livers, compare it with the normal liver and to correlate its clinical implications in Uttarakhand population.

Materials and Methods

All intact cadaveric formalin-fixed 20 livers were utilised for the study. All the livers belonged to adults of unknown age and known gender(male-18, female-02) in the Department of Anatomy, VCSGGMS & RI, Srikot, Uttarakhand in order to observe the presence, frequency and pattern of AS. Liver with features of cirrhosis, congenital anomalies apart from accessory sulcus or any damage was excluded from the study. Grossly the major and minor sulci on the hepatic surface were observed.The photographs were captured by 14.1 megapixel digital camera.

Results

The diaphragmatic sulci (DS) were present in two cases (Figure 1 and Figure 2). The single DS (5%) was seen extending between the anterior and right surface of Liver. The multiple DS (5%) was seen of total cases with variable shape, depth and length. They were starting from the right side of the inferior vena cava on right lobe of liver extending from superior surface to the anterior and right surfaces.

A Rouviere's sulcus containing the right portal pedicle extending from the right of the porta hepatis, anterior to the caudate process was seen in 10% of cases (Figure 3 and Figure 4). In one case (Figure 4) sulcus extending from the right of fossa for gall bladder having a curved course bisecting the inferior border, was seen. Besides this, some minor sulci on the quadrate and caudate and left lobes

Fig. 1: The multiple minor sulcus (*) of variable length starting from the right side of inferior vena cava on superior surface of the liver extending downwards on anterior and right surfaces of liver.

Fig. 2: The solitary minor sulcus (*) extending from the superior surface of the liver downwards on anterior surface of liver.

Fig. 3: The single minor sulcus (*) extending from the right side of porta hepatis on inferior surface of the right lobe of liver

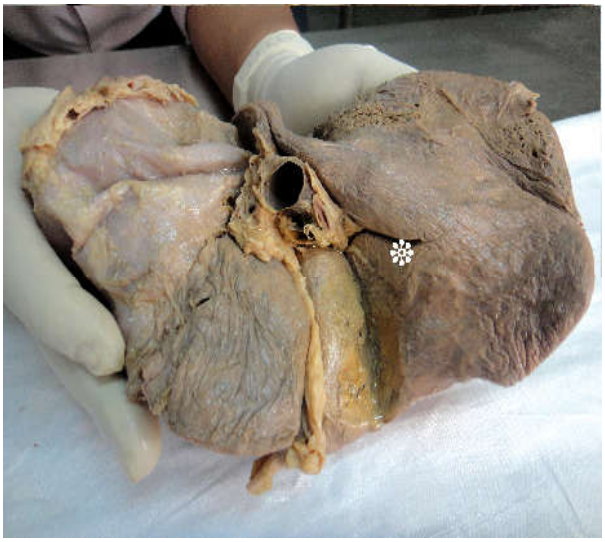

Fig. 4: The multiple minor sulcus (*) present on postero-inferior surface of the right and left lobes of liver.

were also seen. The diaphragm did not show any signs of hernia.

Discussion

The AS of the liver is a rare anomaly. It may be due to a developmental defect or may be acquired as a result of pressure by superficial structures. Macchi et al. reported that diaphragmatic sulcus represents weak zones of the hepatic parenchyma particularly susceptible to the mechanical effectsof different bundles of the diaphragm muscle.

He also showed the relationship between diaphragmatic sulcus and portal fissures as fissure are localized at boundary between the territories of distribution of the segmental branch of portal veins thus indicate the boundaries between adjacent hepatic segments. He also found correspondence between the topography of the sulci and course of right and middle hepatic vein and their tributaries. It was 73% (RHV more than LHV) with corrosion cast and 67% in radiological findings. In radiological practice the course of hepatic veins is used to identify the boundaries between hepatic sector and the hepatic veins constitute indirect landmark for delineation of portal fissure [8].

So, DS may be used as a surface mark for the portal fissures and the superficial projection of the deep course of the hepatic veins and their tributaries, representing evidence of the functional vascular anatomy of the liver. This relationship can be utilized by the surgeon during segmental resection of the liver.

We found DS in 10% of cases with compare to Joshi (6%),Yong Ho Auh (25%) and Macchi (40%) [1, 6, 8]. These grooves were present on the right lobes of the liver because the rightcrus and fibers on the right side are more substantial than those of the left, thus able to produce sulcus.

Joe Hoon Lee found single DS in CT which was coincided with Cantile line and was extended towards vena cava. The large groove was present between VIIIa & VIIIc were utilized for subsegmentation and minor groove was present between VI & VII segment helped to do mono segmentectomy as groove played an important role. The minor grooves were also seen in left lobe but it was relatively small & less close to intersegmental line.

In our study posterior and inferior surface of the right lobe was the most common site of AS as seen by Joshi et al. and he also observed veins in the depth of fissure in all the cases. In one case we saw that sulcus extending from the right of fossa for gall bladder having a curved course bisecting the inferior border which was not mentioned in any literature before. Though Joshi et al. (2009) reported that in 80% of liver, fissure for ligamentum teres was continued for a variable distance after cutting the inferior border onto the anterior surface, where the fissure was vertical, oblique or T-shaped. The accessory sulcus on the inferior surface of the right lobe may be caused by the pressure exerted by the colon. Besides this, some minor sulci on the quadrate, caudate and left lobe were also seen which was similar to the Joshi findings.

The frequency of presence of Rouvier's sulcus in our study was 10% as compare to Zubair et al. (68.13%) in Karachi population and 78% in developed world population. Rouviere's sulcus is present in 12% of persons in the Afro-Caribbean population, but when it is present there is 100% correlation with the right branch of portal vein [9].Thus surgeons can utilize the Rouvier's sulcus as important landmark in laproscopic cholecystectomy.

Cho et al., (2004) reportedthat the anterior groove of the liver may be regarded as the third door of the liver exposing all the Glissonian pedicles [10]. It is applicable and useful to approach liver hilum using the Glissonean Pedicle Transection Method (GPTM). The major limitation of this study is that it is a small observational study. In this study 20 cadaveric dissections were utilized. It may have been possible to detect other differences if larger numbers of cadaveric dissections were performed. According to Auh et al., (1984) during imaging, any collection of fluid in these fissures may be mistaken for a liver cyst, haematoma or liver abscess [6].

Conclusion

The anatomical knowledge of hepatic AS may be utilized by radiologists to avoid possible errors in interpretation and subsequent misdiagnosis and may assist hepatobiliary surgeons to plan a safe surgical approaches.

Conflicts of Interest

None

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Morphometric Sexual Dimorphism of Tibial Tuberosity in Maharashtra

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Abstract

Introduction: The revolutionary changes in the surgical treatment of unicompartmental and total knee arthroplasty make it important for surgeons and radiologists to acquaint themselves with relevant knowledge pertaining to the morphometry of tibial tuberosity and it's clinical significance. *Material and Methods:* This study was undertaken on 122 normal dry adult human tibia of known sex and side (62 males & 60 females) in terms of Distance of tibial tuberosity from anterior border of inter condylar area, length and breadth in upper smooth part and lower rough partof tibial tuberosity. *Result:* Different parameters in male and female bones were taken on right and left side, the differences among them are significant. *Conclusions*: Sound knowledge of tibial tuberosity morphometry and variability helps orthopaedic surgeon in carrying out surgical procedures

Keywords: Sexual Dimorphism; Tibial Tuberosity; Knee Arthroplasty.

Introduction

According to Hughes ES et al (1946) [1] tibial tuberosity varies from a faint elevation to a prominent part of bone which instigates 2cm below the anterior margin of tibial plateau. Shape size and position of Tibial tuberosity are particularly essential in extension of knee joint. Weight bearing is mainly related to extended knee joint.

Tibial tuberosity develops from secondary ossification centre at the upper end of tibia. Tibial tuberosity is apophysis ossifies in traction [2]. Fusion of proximal tibial epiphysis with apophysis may leave behind a mechanically vulnerable area which predisposes the tuberosity to avulsion injury. Also an accurate and repeatable morphometric system of tibial tuberosity aids in definition of tibial deformity, improvement of prosthesis design which requires adequate sizing specific to population in knee arthroplasty [3].

Non-union between epiphyseal part of tibial tuberosity and diaphysis is common in tibial tuberosity fracture. Hence, it is important for surgeons and radiologists to acquaint themselves with relevant knowledge pertaining to the morphometry of tibial tuberosity and it's clinical significance [4].

Material & Methods

With prior approval of the ethical committee, study was carried out over 122 normal dry adult human tibia of known sex and side. They were grouped side and sex wise. All measurements recorded with Digital Vernier Calliper (Min. count 0.01mm).

Length and breadth of both upper smooth and lower rough part were measured. Also the distance of tibial tuberosity from anterior border of inter condylar area was taken at it's maximum measurement as shown in Figure 1.

1. *Distance of tibial tuberosity from anterior border of inter condylar area (CD)*distance taken from anterior border of inter condylar area to upper smooth part of tibial tuberosity Figure 2.

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2) Upper Smooth Part

i. Length (EF)verticaldistance taken from highest point on upper smooth part of tibial tuberosity to horizontal ridge separating upper smooth and lower rough part of tibial tuberosity Figure 3(i).

ii. Breadth (GH)taken at maximum width of upper smooth part of tibial tuberosity Figure 3(ii).

3. Lower Rough Part

i. Length (FG)verticaldistance taken fromhorizontal ridge separating upper smooth and lower rough part of tibial tuberosity to the point where lower end of rough part of tibial tuberosity where it continue as anterior border of tibia Figure 4(i).

ii. Breadth (JK)taken at maximum width of lower rough part of tibial tuberosity Figure 4(ii).

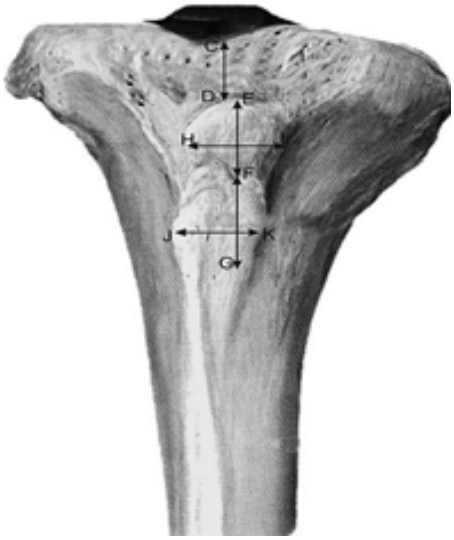

Fig. 1: Measurement of all parameters of tibial tuberosity

Fig. 2: Distance of tibial tuberosity fromanterior border of inter condylar area

Fig. 3(i): Length of upper smooth part

Fig. 3(ii): Breadth of upper smooth part

Fig. 4(i): Length of lower rough part

Fig. 4(ii): Breadth of lower rough part

Statistical Analysis

Statistical analysis of different parameters were done. Data expressed as (Mean ± Standard Deviation). A paired t-test was applied and p-value yielded. The statistical analysis was done by using SPSS (20).

Results

The measurement of different dimensions of tibial tuberosity viz. Distance of tibial tuberosity from anterior border of inter condylar area, length and breadth in upper smooth part and lower rough part are taken and shown age-wise, gender-wise and side-wise in tabulated form. The study sample includes 122 normal dry adult human tibia in which 62 were males (50.8%) and 60 (49.2%) females. Collected data was compared with previous studies

Study Group

Table 1: Sex and Side Distribution

Sex	Right	Left	Total
Male	31	31	62
Female	30	30	60

Distance of Tibial Tuberosity from Anterior Border of Inter Condylar Area (CD)

Mean values of Distance of tibial tuberosity from anterior border of inter condylar area (CD) were compared sex and side wise. In sex wise comparison the difference between male and female found significant on left side whereas, male had higher values on right side but difference was insignificant Table 2 (a). While, sidewise comparison among right and left side shown significant difference in female whereas, male had higher values on left side but difference was insignificant Table 2(b).

Table 2 (a): Sex wise comparison

Side	Sex	(Mean ± SD) in mm	P value
Right	M	**17.48 ± 2.26**	>0.05
	F	16.78 ± 2.25	Non significant
Left	M	18.26 ± 3.25	<0.01
	F	13.35 ± 2.98	**Significant**

Table 2 (b): Side wise comparison

Sex	Side	P value
M	Right	>0.05
	Left	Non significant
F	Right	<0.01
	Left	**Significant**

Length of Upper Smooth and Lower Rough Part

Mean values of Length were compared sex and side wise in upper smooth and lower rough part of tibial tuberosity. In sex and side wise comparison the difference was significant in upper and lower part of tibial tuberosity except, in female where right side had little higher values in lower part of tibial tuberosity Table 3 (a and b).

Table 3 (a): Sex wise comparison

Length	Side	Sex	(Mean ± SD) in mm	P value
Upper part	Right	M	**17.07± 3.24**	<0.01
		F	14.79 ± 3.04	**Significant**
	Left	M	19.11 ± 3.24	<0.01
		F	12.024 ± 3.45	**Significant**
Lower part	Right	M	**31.90± 5.09**	<0.01
		F	25.80± 4.87	**Significant**
	Left	M	38.33± 6.20	<0.01
		F	25.67± 6.00	**Significant**

Table 3 (b): Side wise comparison

Length	Sex	Side	P value
Upper part	M	Right	<0.01
		Left	**Significant**
	F	Right	<0.01
		Left	**Significant**
Lower part	M	Right	<0.01
		Left	**Significant**
	F	Right	>0.05
		Left	Non significant

Breadth of Upper Smooth and Lower Rough Part

Mean values of Breadth were compared sex and side wise in upper smooth and lower rough part of tibial tuberosity. In sex and side wise comparison the difference was significant in upper and lower part of tibial tuberosity except; in male, where left side had higher values in upper part of tibial tuberosity and on right side, where male had higher values in upper part of tibial tuberosity Table 4 (a and b).

Table. 4 (a): Sex wise comparison

Length	Side	Sex	(Mean ± SD) in mm	P value
Upper part	Right	M	**16.97 ±2.39**	>0.05
		F	16.26 ±1.84	Non significant
	Left	M	17.51 ± 1.66	<0.01
		F	12.86 ± 3.22	Significant
Lower part	Right	M	**17.44 ± 3.70**	<0.05
		F	15.39 ± 2.20	Significant
	Left	M	19.21 ± 2.63	<0.01
		F	13.95 ± 3.89	Significant

Table. 4 (b): Side wise comparison

Length	Sex	Side	P value
Upper part	M	Right	>0.05
		Left	Non significant
	F	Right	<0.01
		Left	Significant
Lower part	M	Right	<0.05
		Left	Significant
	F	Right	<0.05
		Left	Significant

Discussion

The present study demonstrates various dimensions of tibial tuberosity. Series of observations revealed previously unreported anatomic study of tibial tuberosity. Morphometric study of tibial tuberosity is an important tibial component to observe proper postoperative alignment of prosthesis. Ultimately it determines success of arthroplasty and present a challenge to the operating orthopaedic surgeon [5].

Earlier *Hughes ES and SunderlandS (1946)* [1] had measured the distance of tibial tuberosity from anterior border of inter condylar area to be 20 mm in Australian population but irrespective of side and sex but, in present study values are towards lower side. This distance could be of great significance in case of intramedullary nailing in tibial fracture.

In present study, the mean difference in different parameters of tibial tuberosity is towards lower side as compared to study carried by Swati G, et al. (2015) [4]. This variation could be due to different ethinic origins of samples.

In India one of the commonest mode of sitting is squatting. Extensive flexion of knee joint in squatting position brings about some adaptations in upper end of tibia due to friction of quadriceps tendon [6,7].

Conclusion

The literature search revealed limited documentation of morphometric study of tibial tuberosity in Maharashtrian population. So, this study will be helpful to anatomists, arthropologists and radiologists.

Sound knowledge of tibial tuberosity morphometry and variability helps orthopaedic surgeon in carrying out surgical procedures like unicompartmental and total knee arthroplasty. Also this study will give basis for designing the optimal tibial compenent during arthroplasty.

Finally, we had made an attempt to study mean differences of different sex and side compared gender and side wise.

List of Abbreviations

- F – Female
- M – Male
- mm – Millimeter
- SD – Standard Deviation

Conflict of Interests: None

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Incidence of Congenital Anomalies of Urinary Tract in Patients with Dysuria in South Maharashtra Population

Renuka S. Ahankari[1], Mahesh S. Ugale[2]

Abstract

One hundred and five patients (81 males and 24 females) with symptoms of dysuria associated with urinary tract infections, reflux of urine, urinary stasis were studied at MIMSR Medical College and YCR Hospital , Latur, from Feb 2012 to Feb 2015. These patients were from different areas of South Maharashtra. These cases were evaluated by micturating cystourethrogram (M C U) & Retrograde cystourethrography (RCG). The patients with congenital malformation of the urinary tract system were studied separately to find out the incidence of these malformations in South Maharashtra. The Congenital anomalies which we came across were - Posterior Urethral Valves, Urinary bladder diverticulum, Urethral Diveticulum, Prune belly Syndrome & Meatal Stenosis. Most of them were seen in 0-5 years of age & all were male patients. The overall incidence of Congenital anomalies of urinary system in our study is 7.4%. We also calculated incidence of individual Congenital anomaly. The results were analysed and compared with similar other studies.

Keywords: Congenital Anomalies; Urinary Tract; Dysuria; Posterior Urethral Valves, Urinary bladder diverticulum, Urethral Diveticulum, Prune belly Syndrome; Meatal Stenosis.

Introduction

Dysuria is the sensation of pain, burning, or discomfort on urination [18].

It is a representative symptom of many diseases affecting urinary system like trauma, infections, calculi, bladder neck obstruction, urethral or bladder fistula, neoplasms etc.

Congenital anomalies of the urinary system also present with dysuria as a major symptom [10].

Congenital malformations of the urinary tract system comprise diversity of abnormalities. This wide range of anomalies results from multiplicity of factors that interact to influence urinary tract development in sequential and an orderly manner. Abnormal maturation or inappropriate timing of these factors at the critical points in development can produce any number of deviations in the development of kidneys, ureters, bladder and urethra [17].

To understand the anomalies of the urinary system, let's take a quick review of normal development of urinary system.

Development of Urinary System

The urinary and genital systems develop from the intermediate mesoderm and subdivisions of cloaca.

Its development starts at 5th week of intra uterine life & it is completed by 37th week [9, 20]. The following diagram illustrates development of Urinary system.

The Kidneys

The collecting part of kidneys is derived from ureteric bud and excretory part from the metaneprhic blastema.

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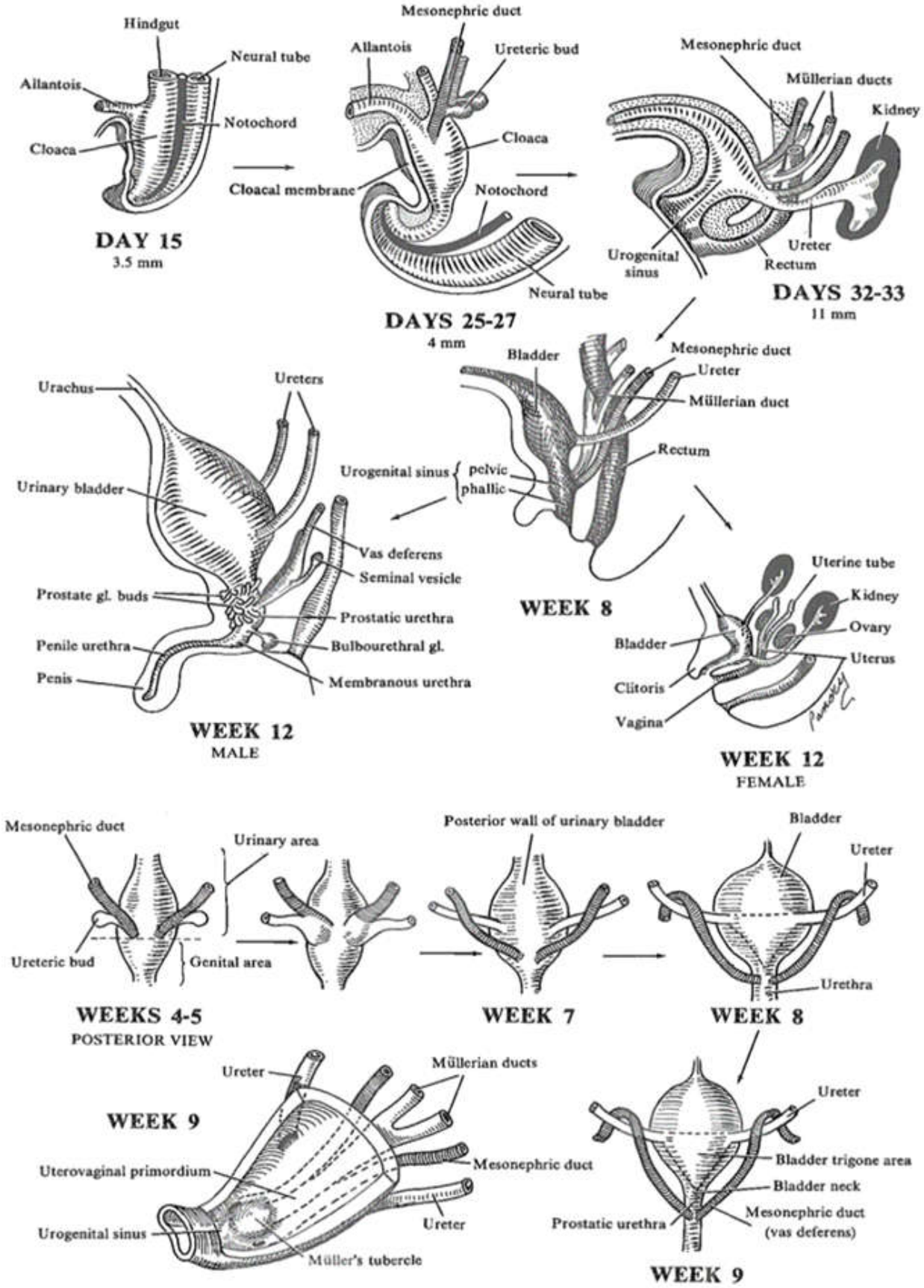
Hindgut
Neural tube
Allantois
Notochord
Cloaca
DAY 15
3.5 mm
Mesonephric duct
Allantois
Ureteric bud
Cloaca
Cloacal membrane
Notochord
Neural tube
DAYS 25-27
4 mm
Mesonephric duct
Müllerian ducts
Kidney
Urogenital sinus
Ureter
Rectum
DAYS 32-33
11 mm
Urachus
Ureters
Urinary bladder
Urogenital sinus
pelvic
phallic
Vas deferens
Seminal vesicle
Prostate gl. buds
Prostatic urethra
Penile urethra
Bulbourethral gl.
Penis
Membranous urethra
WEEK 12
MALE
Bladder
Mesonephric duct
Ureter
Müllerian duct
Rectum
WEEK 8
Uterine tube
Kidney
Ovary
Bladder
Uterus
Clitoris
Vagina
WEEK 12
FEMALE
Mesonephric duct
Urinary area
Ureteric bud
Genital area
WEEKS 4-5
POSTERIOR VIEW
Posterior wall of urinary bladder
WEEK 7
Bladder
Ureter
Urethra
WEEK 8
Ureter
Müllerian ducts
WEEK 9
Uterovaginal primordium
Mesonephric duct
Urogenital sinus
Ureter
Müller's tubercle
Ureter
Bladder trigone area
Bladder neck
Prostatic urethra
Mesonephric duct
(vas deferens)
WEEK 9

The Ureters

The ureters are derived from the part of the ureteric bud which lies between the pelvis of the kidney & the vesico-urethral canal.

The Urinary Bladder

The epithelium of the urinary bladder develops from the cranial part of the vesicourethral canal (endoderm). The epithelium of the trigone develops from the absorbed mesonephric ducts (mesoderm). The muscular and serous walls of the organ are derived from splanchnopleuric mesoderm.

The Female Urethra

Most of the female urethra develops from caudal narrow part of the vesico- urethral canal.

A small terminal part of the urethra develops from pelvic part of definitive urogenital sinus. Phallic part of definitive urogenital sinus forms vestibule of vagina in to which the urethra opens.

The Male Urethra

1. *Prostatic Part*: Above the openings of ejaculatory ducts- develops from the narrow caudal part of vesico urethral canal. Below the openings of ejaculatory ducts- develops from the upper pat of definitive urogenital sinus.
2. *Membranous Part*: It lies in the deep perineal pouch & develops from the upper part of the definitive urogenital sinus.
3. *Spongy Part:* It lies partly in the bulb of penis & partly in the shaft of penis. Both these parts are derived from phallic part of definitive urogenital sinus except a small part at the tip of penis which is derived from ectoderm.

Congenital Anomalies of Urinary System Associated with Dysuria

The knowledge of congenital urinary tract anomalies is extremely essential to anatomists as well as clinicians as it may contribute to end-stage renal disease. The complications in these patients are due to urinary stasis which happens by 2 processes: either obstruction or reflux and these may lead to pyelonephritis or stone formation & progressive end stage renal disease. A significant proportion of these patients will have persistent abnormal anatomical and physiological characteristics of the urinary tract, requiring more attention, more evaluation and may lead to reconstructive surgery to preserve renal function [17].

The congenital anomalies of the urinary tract associated with symptom of dysuria are- Congenital meatal stenosis, Urethral diverticulum, Posterior urethral valves, Congenital bladder neck obstruction, Weakness of uretero-trigonal muscle, Ureteral anomalies like duplication, ectopia , congenital non-meatal stenosis, and Prune Belly Syndrome. [2,3,10,11,17].

Here, we are describing those congenital anomalies which we have came across in our study.

• *Posterior Urethral Valves (PUV)*

It is a congenital defect in males that results in obstruction of the bladder due to extra tissue that projects into the urethra. This excess tissue blocks urine from flowing freely from the bladder to the outside of the body leading to back pressure on the bladder which may enlarge considerably & / or develop a very thick muscle wall. This in turn can lead to further back pressure up to the ureters resulting in collection of excess fluid in the kidneys- a condition known as hydronephrosis. This blockage, if not corrected, can cause problems in all the organs in the urinary system including the kidneys, ureters, urethra and bladder.

Depending on the extent of blockage, the organs can swell, causing damage to the tissues and cells within those organ [4, 6, 8].

• *Urinarybladder Diverticulum*

A congenital bladder diverticulum is the out pouching of bladder mucosa which herniates through the wall of bladder. They may be solitary or multiple and usually diagnosed in early life [11,12,16].

Urethral Diverticulum

The urethra develops a weak spot that forms a small outpouching or herniation on the side — called urethral diverticulum [13,14,15].

• ***Meatal Stenosis (Urethral Stricture)***

It is a congenital anomaly in which the opening of the urethra becomes abnormally narrow [13,19,20].

• *Prune Belly Syndrome {Abdominal Muscle Deficiency Syndrome}*

Prune belly syndrome is a congenital disorder of the urinary system, characterized by a triad of

symptoms –a partial or complete lack of abdominal wall muscles with wrinkles of skin covering the abdomen, Cryptorchidism (undescended testicles) in males and Urinary tract abnormality such as unusually large ureters, distended bladder, accumulation and backflow of urine from the bladder to the ureters and the kidneys

It is a rare, genetic defect affecting about 1 in 40,000 births. About 97% of those affected are male. The syndrome is named for the mass of wrinkled skin that is often (but not always) present on the abdomen of those with the disorder (3, 5, 11).

Methodology

The patients referred for dysuria from the departments of surgery and paediatrics were investigated in Department of Radiology, MIMSR Medical college & YCR Hospital in last three years. Their routine blood & urine examination were also carried out before investigating them by procedures like micturating cystourethrogram (MCU) & Retrograde cystourethrography (RGU).

In some patients, however combination of both M C U & R G U was utilised.

The contrast medium used was Conray 280 (meglumine iothalamate 60% containing equivalent of 280 mg iodine in each ml). It was diluted with equal quantity of distilled water. Patients were asked to empty the bladder before the procedure and local parts were cleaned. For male urethra 1% Xylocaine jelly was used for local anaesthesia before introducing catheter or canula.

Observations

Our observations are tabulated below. Owing to more complicated development, incidence of congenital anomalies is more common in males than the females [20].

In our study we have found all the congenital anomalies in male patients only.

We have also calculated incidence of individual congenital anomaly as tabulated in tables.

Congenital urinary tract anomalies are known to cause obstruction to the normal passage of urine as well as reflux of urine in a reverse direction. Hence we have also analysed the percentage of patients with vesico- urethral reflux (VUR) associated with congenital malformation of the urinary system.

Discussion

Dysuria, which accounts for 5 to 15% of the patients with urinary tract symptoms [17,18] can result due to congenital anomaly or can be due to acquired conditions like trauma, infection etc.

We aimed to study the incidence of congenital anomalies of urinary tract in patients complaining of dysuria in MIMSR Medical College and YCR Hospital, Latur over a period of 3 years i.e. from Feb 2012 to Feb 2015. The patients were from different areas of South Maharashtra. They were diagnosed based on clinical symptoms & procedures like micturating cystourethrogram (MCU) and retrograde cysto urethrography (RCG). The incidence of the individual congenital anomalies in patients with dysuria in different age groups as found in our study is tabulated below. We found a markedly higher incidence of congenital urinary tract anomalies in younger age group that indicates a higher morbidity and mortality.

Sa'ad H and et al studied incidence of congenital anomalies in patients with recurrent urinary tract infection. They have calculated the incidence according to age; which is tabulated below. They have classified the congenital anomalies in upper and lower urinary tract anomalies in contrast to our study where we have given incidence of individual anomaly. In our study the upper urinary tract was involved less commonly as compared to lower urinary tract.

Urinary tract infection in patients with congenital urinary tract anomalies may develop either from obstruction or reflux. Vesico-Urethral Reflux (VUR) is the retrograde flow of urine from the bladder to the upper urinary tract. It can be primary or secondary. In primary VUR the ureterovesical junction is in adequately closed due to some intrinsic factor.

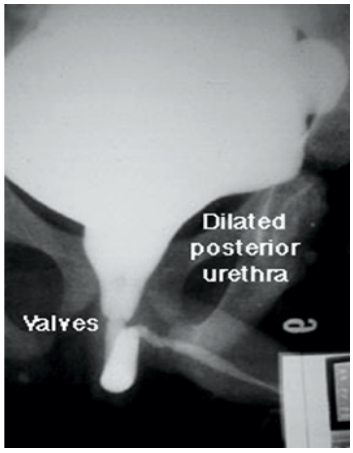

Fig. 1: MCU Image showing Posterior urethral valves

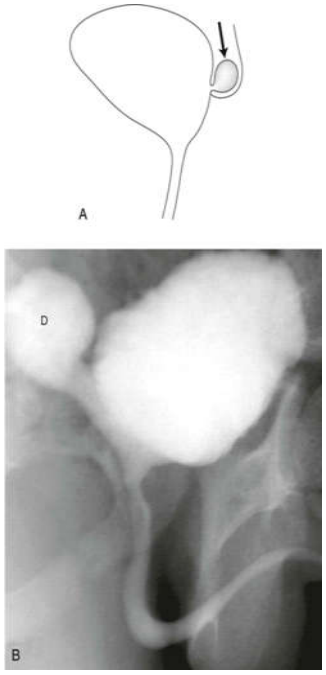

Fig. 2: MCU Image showing Urinary bladder diverticulum

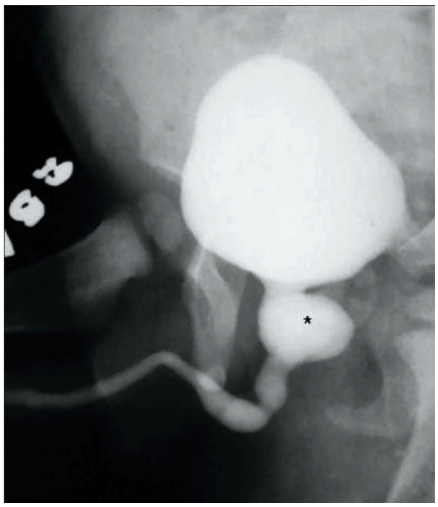

Fig. 3: MCU Image showing Urethral Diverticulum

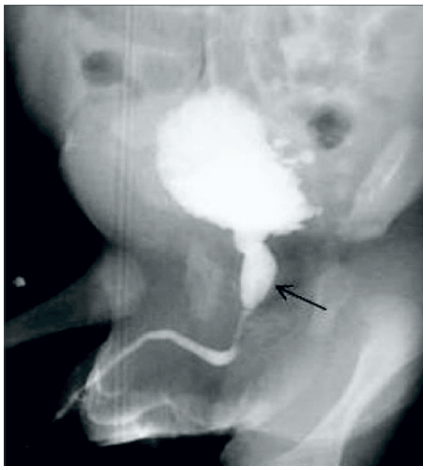

Fig. 4: MCU Image showing Meatal Stenosis

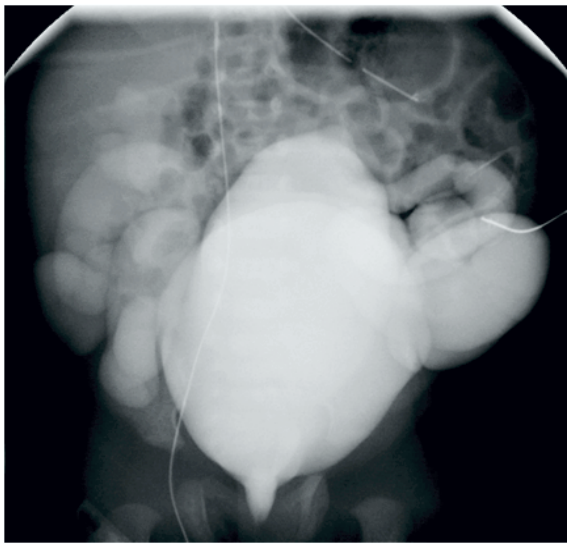

Fig. 5: MCU Image showing Prune Belly Syndrome

Secondary VUR is commonly due to anatomical bladder outflow obstruction resulting due to anomalies like PUV & Urethral Stricture [11].

In our study the VUR was mostly of secondary type and was seen in 2 patients with urinary bladder diverticulum, 1 patient each of posterior urethral valve and Prune Belly Syndrome.

Comparisons of our study with other similar type studies are as follows:

1. *Posterior Urethral Valve:* Various studies done by different researchers [1,4,6,8] suggests that PUV occur in 1 in every 7,000–8,000 live births and like our study, they found majority of cases occuring in the neonatal period. In our study the incidence of PUV is 1.2% .
2. *Bladder Diverticulum*: Urinary bladder diverticula are more common in males than females. They later manifest as stone formation and infection

Table 1: Overall Incidence of congenital urinary tract (UT) anomalies in patients with Dysuria In our study

Total No. of cases with dysuria	Dysuria associated with Congenital UT anomalies	Overall Incidence of congenital U T anomalies
81	6	7.4

Table 2: Incidence of Specific congenital Anomaly

Sr. No.	Clinical Diagnosis	No. of Cases	Incidence
1	Posterior urethral valves (PUV)	1	1.2
2	Urinary bladder diverticulum (U B D)	1	1.2
3	Urethral diverticulum (UD)	2	2.4
4	Meatal stenosis (MST)	1	1.2
5	Prune belly syndrome (PBS)	1	1.2

Table 3: Incidence of VUR Associated with congenital Anomalies

Diagnosis	No. of Cases	Percentage
U B D	2	33
P U V	1	16.6
	1	16.6
P B S	1	16.6
	1	16.6
Total	4	

Table 4: Congenital Urinary Tract anomalies according to age distribution

Age Groups	No. of Cases with associated UT anomaly
0-5	PUV 1, B D 1 , PBS 1
5-10	B D 1, U D 1, MST 1

Posterior Urethral Valve - PUV Bladder Diverticulum - BD Urethral Diverticulm - UD
Prune Belly Syndrome PB Meatal stenosis - MST

Table 5: Congenital Urinary Tract anomalies according to age distribution accdg to Sa'ad H and et al

Age Groups	No. of Cases	Upper UT anomalies	Lower UT anomalies	Total
0-10	3	7	0	10
11-20	9	1	0	10
21-30	18	5	1	24
31-40	8	7	0	15
Total	55	23	3	81

predisposing to malignancy. The incidence of it is found to be 1.7 % [3,11,12 16] .We found 2 cases of bladder diverticulum one in a 2 year boy and another in a 5 year boy; both associated with vesicourethral reflux,

3. *Urethral Diverticulum:* It is more common in females due to less supported urethra. In males the various studies indicate its incidence in the range of 1-3%, which coincides with our findings also. [13,14,15,16]. However, age of presentation of Urethral Diverticulum in our study was late i.e. at 6 years ; which is comparatively is rare.
4. *Meatal Stenosis*: Various studies done indicate overall incidence of 8-10 % and common age of presentation is 3-12 years. In our study we found a single case of meatal stenosis in a boy of age 9 [2,13,18,19].
5. *Prune Belly Syndrome*: It's a rare congenital anomaly seen mostly in male infants with an incidence of 1in 30,000-40,000 births. 4% of cases are found associated with Twin pregnancies [5,7,10].

We found a male neonate with this syndrome showing vesicourethral reflux.

Conclusion

Early identification of congenital urinary tract anomalies among patients complaining of dysuria is of extreme importance in order to preserve the renal function as much as possible and to prevent further progressive renal damage [17].

The overall incidence of Congenital anomalies of urinary system in our study is 7.4% where as maximum incidence seen was that of Urethral Diverticulum 2.4%.The patients were diagnosed based on clinical symptoms & Micturating Cystourethrogram and Retrograde cystourethrography (RGU). Also we found a strong association of vesicourethral reflex along with four out of six patients.

The studies on congenital anomalies of urinary tract to find out their incidence can help to diagnose the population at risk for UTI which includes: newborn particularly premature, pre-puberty girls, young boys, and elderly males and elderly females [11].

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Original Article

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Histogenesis of Muscularis Mucosae of Human Urinary Bladder

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Abstract

Background: Urinary bladder serves an important function of temporary storage of urine without changing its constituents. Many studies are available for the gastrointestinal tract [1,2,3] ellustrating the muscularis mucosae presence and its role in local contractility. But only few studies are available to describe the development and role of muscularis mucosae layer of urinary bladder. Current study is on the urinary bladder involving the microscopic examination of wall of 50 aborted human fetuses urinary bladders of different gestational age from 9th week onwards. *Aims:* 1. To note presence, structural differentiation and maturity of muscularis mucosae layer which it attains at different stages of development to show the adult picture. 2. To compare and contrast differences between different age groups and with previous studies and available literature. *Study Design:* Observational (Qualitative) study. *Material and Method*: 50 aborted human fetuses (29 females and 21 males) of different gestational age from 9th week onwards were collected, urinary bladder were taken out and fixed in a fixative. Blocks of tissues were made from bladder wall proper, trigone & bladder neck and processed to get sections which were stained with 1) Haematoxylin and Eosin [4], 2) Masson's trichrome stain [4]. *Statistical Analysis*: No measurements have been taken as it is an Observational study, so statistical analysis is not applicable. *Results:* The stained sections were examined under light microscope at 10 X and 40 X magnifications. Muscularis mucosae was not differentiable between 12-16 weeks. At 17th week, it was first seen as a thin, discontinuous layer of spindle shaped cells. 24th week onwards muscularis mucosae was thicker, wavy and stained dark eosinophilic. Further it showed adult picture and stained bright red with special muscle stain Masson's Trichrome. *Conclusions:* Muscularis mucosae was discernible from 17th week and increased in thickness and differentiated in subsequent weeks. It was found in 75% of studied aborted fetuses.

Keywords: Histogenesis; Muscularis Mucosae; Fetus; Urinary Bladder**.**

Intoduction

All vertebrates do not have urinary bladder, as birds and most reptiles (snakes and crocodiles)[1]. Urinary bladder is present in all mammals and in ostrich. The present paper describes some light and electron microscopic observations on the smooth muscle cells comprising the muscularis mucosae.

The Urinary tract is composed of four layers. Each layer has different tissues and functions. From the inside out they are called: lining epithelium (Urothelium), lamina propria, muscularis propria and serosa.

The muscularis mucosae is a thin layer of muscle in the gastrointestinal tract and also in urinary tract from the renal pelvis to the bladder; but as it is discontinuous, it is not be regarded as a true muscularis mucosae [5]. In the gastrointestinal, the muscularis mucosae has been shown to exhibit spontaneous phasic contractility and also to respond to nerve-induced stimulation. In the colon, spontaneous phasic activity of the muscularis

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mucosae has been suggested to play a role in modulating mucosal secretion, reducing mucosal surface area in response to noxious stimuli, and facilitating the release of acids into the stomach [1].

Motor activity of the muscularis mucosae shows a great regional and species difference. In urinary bladder,the muscularis mucosae has been identified between the basement layer of the urothelium and the detrusor muscle [6,7]. Although the existence of the muscularis mucosae is well established in the medical literature, particularly with respect to its role in the development of urinary bladder cancer, its functional role in normal urinary bladder contractility and physiology is still not clear [8,9].

There is little information on the innervation of the muscularis mucosae [10]. Some studies say, the muscularis mucosae is nonneurogenic and contracts in rhythmic bursts, suggesting local regulation.This suggest that the muscularis mucosae is functionally distinct from the detrusor [11]. The physiological role of Spontaneous phasic contractions in urinary bladder had been the focus of numerous studies; however, the precise role of spontaneous phasic contractions remains unclear and said to be contributing minimally to micturition [11].

Material and Method

Collection of Materials

After approval from the institutional ethical committee, during period of 2 years, 50 aborted human fetuses (29 females and 21 males) of different gestational age from 9th week onwards were collected from the department of Obstetrics and Gynaecology, Aurangabad (Figure 1). Written consent from parents of aborted fetuses was taken.

Inclusion Criteria

Spontaneously aborted fetuses from 9th week onwards, stillborn fetuses, and terminated fetuses under the Medical termination of Pregnancy Act of India 1971.

Exclusion Criteria

Fetuses less than 9 weeks, twins, presence of any congenital anomalies, post mortem decomposition were excluded from the study.

Fetuses were obtained within 1-2 hrs of abortion to avoid post-mortem decomposition changes and preserved immediately in 10% formalin. Gestational age was calculated from Body weight and Crown-rump length (CRL). They were dissected within 2 hrs of collection by taking a midline vertical incision extending from umbilicus to pubic symphysis (Figure 2). Bladder was then carefully removed along with its neck. Subsequently bladders were passed through following procedures [4]:

1. *Fixation of Bladder*: in Bouin's fluid for 4-5 days. Longitudinal and transverse sections of specimen were taken from bladder wall proper, trigone region and bladder neck region, each section being 3-4 mm thick.
2. *Dehydration*: The tissue was processed in ascending grades of 50%, 70% and 90% alcohol.
3. *Clearing*: done to remove alcohol from tissue. Tissue was placed in xylene for about 30 minutes. It also increases the refractive index of tissues.
4. *Paraffin bath*: It involves soaking of tissue in molten soft paraffin wax (melting point 45-50^{0}C). Tissue was subjected to two changes of paraffin wax each for three hours.
5. *Casting (block making)*: The blocks were prepared by pouring molten paraffin wax (melting point 55-60^{0}C) into a mould. Using two 'L' moulds, suitable size bocks were prepared and wax impregnated tissue was placed eccentrically and oriented so that it could be sectioned in the right angle plane.
6. *Microtomy (Section Cutting)*: The block was cut with the section thickness of 5-7 microns in the form of ribbon with the help of rotary microtome.
7. *Fixing Sections on the Slide*: The ribbon of sections was placed on the surface of warm water in the flotation bath. This removes all wrinkles from the tissue and wax (flattening). The glass slide was smeared with egg albumin and sections were mounted on it and slides were placed on the hot plate at 45^{0}C - 50^{0}C for 2 hours or more as per the requirement for drying.

The sections were stained with the following stains:

• *Haematoxylin and Eosin Staining* [4]

Technique

1. Removal of paraffin wax from the sections was done by dipping the slide into two changes of xylene for one to two minutes each.
2. Removal of xylene done by dipping the slide into two changes of absolute alcohol for one to two minutes each and then treated with descending grades of alcohol- 90%, 80%, 70% for one minute each.

3. The slide was kept under running tap water for 2-3 minutes.
4. The slide was stained with Haematoxylin for about five to seven minutes followed by washing under running tap water for 2-3 minutes. This leads to bluing of the section.
5. Excess stain is removed (Differentiation) by dipping the slide in acid alcohol for few seconds. This changes blue color to red because of the acid.
6. The blue color was regained by washing in running tap water for 5 minutes and it was checked under the microscope, for nuclear staining.
7. The section was counterstained with 5% aqueous solution of eosin for about 5 minutes and dehydrated by dipping in ascending grades of alcohol as 70%, 90%, and absolute alcohol (100%) for one minute each.
8. Clearing was done in two changes of xylene for one minute each.
9. The slide was mounted in DPX (Distrene Plastsizer and Xylene) and coverslip was applied and the slide was kept at room temperature for some hours for firm adhesion of the coverslip to the section.

Result

Nuclei-blue, cytoplasm- pink, muscle cells- pink, collagen fibres- light pink.

• *Masson's Trichome Staining* [4]

Technique

1. Wax was removed and section was brought to water.
2. Nuclei were stained with Weigert's Iron Haematoxylin and then slide was washed well in water.
3. It was stained with diluted Ponceau Acid Fuschin for five minutes.
4. The slide was rinsed in distilled water.
5. Section was differentiated in 1% Phosphomolybdic acid until collagen was decolorized and again rinsed in distilled water.
6. Section was counterstained with light green or aniline blue for two minutes.
7. Light green was differentiated in water.
8. Slide was dehydrated and cleared.
9. Lastly the slide was mounted.

Result

Nuclei- blue to black.

Muscle, red blood cells, fibrin and some cytoplasmic granules– red.

Collagen, some reticulin, basement membrane, amyloid and mucin– green or blue according to counterstain used.

Observations and Results

The slides were stained with Haematoxylin and Eosin and Masson's Trichome stain and observed under light microscope at low (10X) and high (40X) magnifications for thin layer of smooth muscle fibers in lamina propria – Muscularis mucosae.

Starting with fetus of 12th week, muscularis mucosae was not demarcable between 12-16 weeks. At 17th week, Muscularis mucosae was first seen as mesenchymal condensation under low power. Under high power it was seen as a thin interrupted layer of spindle shaped cells with elongated nuclei (Figure 3). Lamina propria was distinct with abundant connective tissue fibres, stellate cells and consisted of blood vessels as endothelium lined spaces. Muscularis mucosae failed to take specific muscle stain Masson's Trichrome. Muscularis mucosae was well demarcated, more condensed, eosinophilic and appeared as a wavy layer and it was found in 10 out of total 16 cases of 19-23 weeks duration (Figure 4,6,7). At this stage, Muscularis mucosae stained bright red with Masson's Trichrome (Figure 5). 24th week onwards Muscularis mucosae was thicker, wavy and stained dark eosinophilic (Figure 8,9). Between 31-38th week it was more distinct and wavy (Figure 10). Among all 50 fetuses studied, muscularis mucosae was found in 75% of bladder wall proper. It was missing at bladder trigone and bladder neck regions as lamina propria layer is negligible (Figure 11,12).

Fig. 1: Fetuses of differentage group

Fig. 2: Urinary bladders of fetuses of different age groups

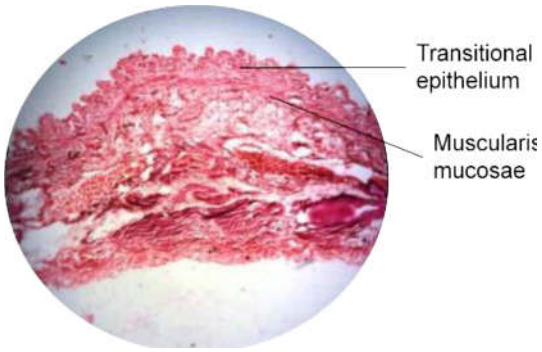

Fig. 3: 17 Weeks: 10X H&E

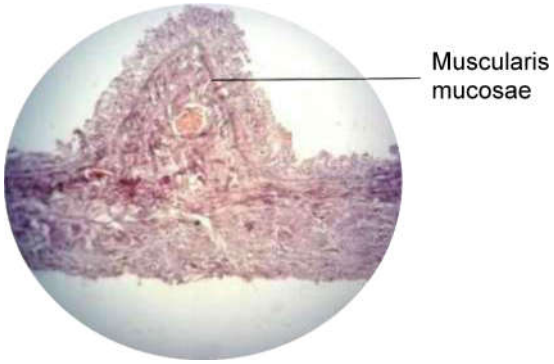

Fig. 4: 19 Weeks: 10XH&E

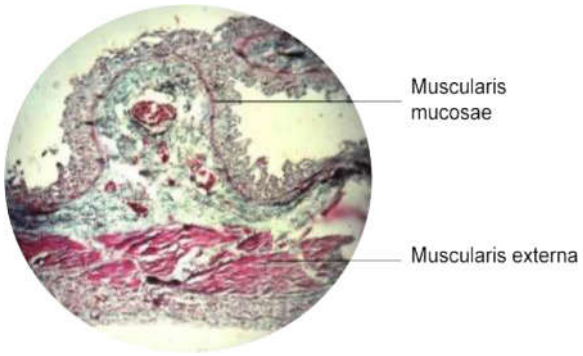

Fig. 5: 19 Weeks: 10X Masson's trichrome

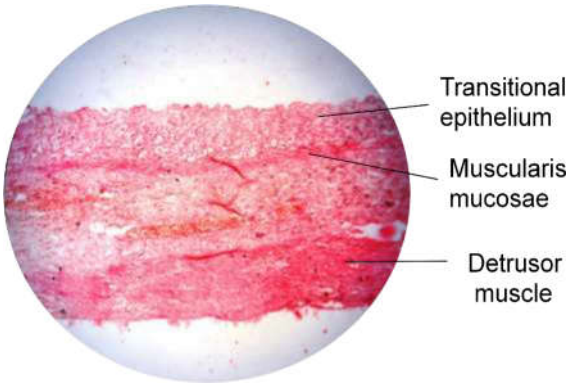

Fig. 6: 20 Weeks: 10 X H&E

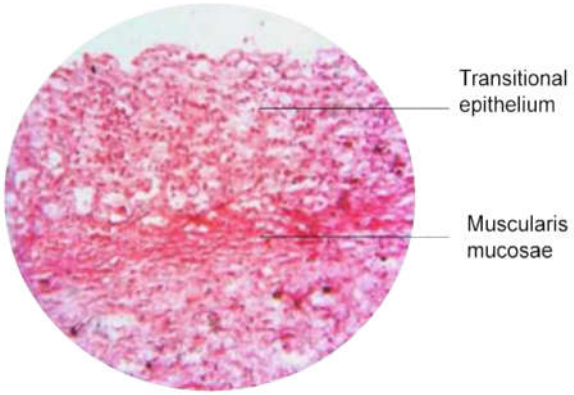

Fig. 7: 20 Weeks: 40X H&E

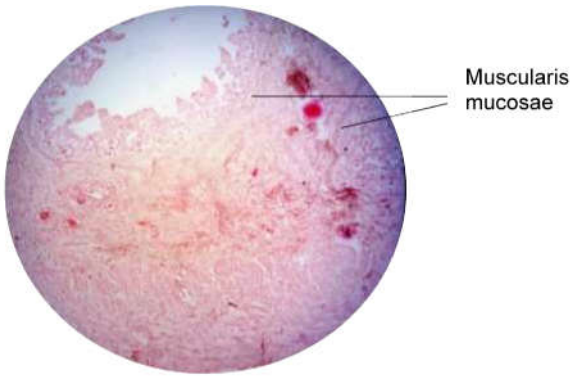

Fig. 8: 24 Weeks: 10 X H&E

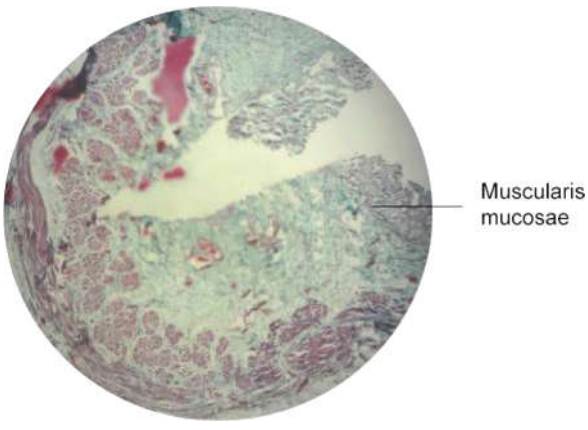

Fig. 9: 24 Weeks: 10 X Masson's trichrome

Fig. 10: 34 Weeks: 10 X H&E

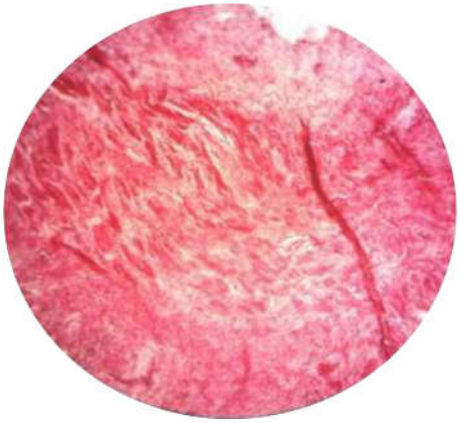

Fig. 11: 20 Weeks: 10X H&E Trigone

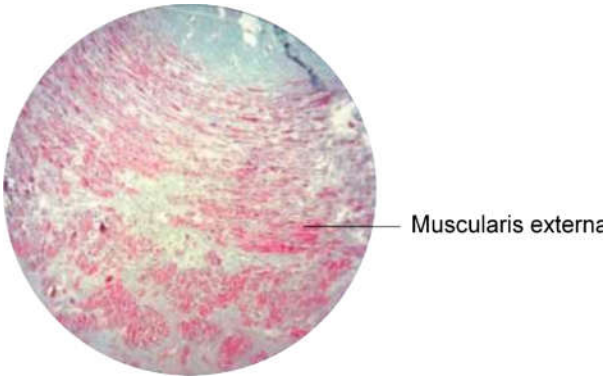

Fig. 12: 32 Weeks: 10X Masson's trichrome–Bladder neck

Disscussion

According to Dixon JS and Gosling JA (1983), mucosa of 78% human bladder possessed distinct muscularis mucosae in all regions of bladder wall midway between urothelium and detrusor. It was present as irregularly arranged bundles of muscle fibres in discontinuous manner [13].

The present study findings coincides with above findings where muscularis mucosae was not demarcable between 12-16 weeks. Muscularis mucosae made its appearance by 17th week as an interrupted layer of spindle shaped cells with elongated nuclei and was present in about 75% fetal bladders.

According to Thomas J. Heppner et al (2011) study done on guinea pig urinary bladder, a type of smooth muscle the muscularis mucosae had been identified between the basement layer of the urothelium and the detrusor layer. They found that mucosal strips of muscularis mucosae exhibited spontaneous phasic contractions (SPC). These SPCs likely result from bursts of Ca^{2+} (flashes) that elevate Ca^{2+} in the mucosal layer. The force of SPCs generated by the mucosal layer was equivalent to that of detrusor SPCs; however, the peak force of detrusor contractions evoked by 60 mM K^+ was < 40-fold greater than that of the muscularis mucosae. However, the precise role of SPCs remains unclear [11].

Like urinary bladder, in gastrointestinal tract the muscularis mucosa appeared first at about 18 weeks of gestational age [13]. While in other study Muscularis mucosae is discernible from 13th week [14].

Conclusion

Muscularis mucosae was demarcable from 17th week, become more thick and wavy in subsequent weeks. It was found in about 75% fetal bladder walls.

These findings suggest that the muscularis mucosae is functionally distinct from the detrusor and may contribute to bladder physiology.

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Conflict of interest: Nil

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Original Article

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Anatomical Variants of Foramen Transversarium in Dried Cervical Vertebrae and Its Applied Importance

Roopali D. Nikumbh[1], Anjali N. Wanjari[2], Dhiraj B. Nikumbh[3]

Abstract

Background: The unique identity of cervical vertebrae is the presence of foramen transversarium in their transverse processes. Foramen transversarium (FT) differentiate cervical vertebrae from other vertebrae. It transmits vertebral artery, vertebral vein and sympathetic nerves from inferior cervical ganglion. Variations in number and size of FT of the cervical vertebrae may lead to headache, migraine and fainting attacks due to compression of vertebral artery. *Objective*: To study anatomical variants of foramen transversarium in dried cervical vertebrae and its applied importance. *Material &Methods*: The present study was conducted on 65dry human cervical vertebra of unknown age and sex in the Department of Anatomy, ACPM Medical College, Dhule. This was an observational study over a period of six months from August 2016 to Jan 2017.All the cervical vertebrae were observed macroscopically for the presence of double foramen transversarium on both sides and the results were analyzed and compared with other studies. *Results*: Double foramen transversarium was seen in 12 (18.5%) cervical vertebra out of total 65 vertebra studied. Out of 12 double FT, unilateral double FT was noted in 07 (58.3%) and bilateral double FT was seen in 05(41.7%) of cervical vertebra. Regular foramen was larger than accessory foramen. *Conclusion*: Anatomical variants of FT leads to various clinical symptoms and pathological conditions. Thorough knowledge of FT variants is helpful for neurosurgeons while operating and preventing injury to vertebral vessels in the spinal region and the radiologists for proper diagnosis.

Keywords: Variants; Foramen Transversarium; Cervical Vertebra; Vertebral Vessels.

Introduction

Foramen transversarium or transverse foramen is the unique identity of cervical vertebrae and differentiate it from other vertebra. In the developmental process, the costal element grows backwards to join the transverse element thereby enclosing a special foramen formation called foramen transversorium (FT) [1]. The FT transmit the vertebral artery, vertebral vein and sympathetic nerves from inferior cervical ganglion [2]. Accessory transverse foramen is small in size and generally found in 6th cervical vertebra and less frequently in the adjacent vertebra [3]. Anatomical variants of FT in shape, size and number as double FT are known to exhibit. Among these variants, double FT is a rare anatomical variant with applied importance as it may affect the course of vertebral artery or may give distorted appearance leading to vertebro basilar insufficiency.[4]

The objective of the present study is to find out incidence of anatomical variants -double FT in dry cervical vertebrae which has clinical importance to radiologists and surgeons for diagnosing and operating on cervical spine respectively.

Material & Methods

The present study was conducted in the department of Anatomy, ACPM Medical College, Dhule over a period of six months from August 2016 to January 2017. A total of 65 dry cervical vertebrae of unknown sex and age were collected from the boxes

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of osteology room and observed morphologically for the anatomical variants in vertebrae. All the well preserved cervical vertebrae with FT were included and defective, damaged or irregularly broken vertebrae were excluded. Among 65, 52 were typical cervical vertebrae (C3,C4,C5and C6) and 13were atypical (C7). Grossly the cervical vertebrae were observed for double FT on both sides, whether they were complete or incomplete or unilateral/bilateral or multiple/accessory etc. The results were analyzed and compared the findings with other researchers.

Results

We studied 65 cervical vertebrae morphologically for the presence of double FT either unilaterally or bilaterally. Out of 65 cervical vertebrae, the double FT was found in 12 vertebrae. The incidence of double FT in present study calculated as 18.5%.Among them, unilateral duplication found in 07(58.3%)% vertebrae and bilateral double FT was seen in 05(41.7%) vertebrae as shown in Table 1. Unilateral duplication was slightly more than bilateral one in our study. The accessory foramina were smaller than regular foramina.

Among bilateral double foramina transversorium (05), 04 were noted in typical and 01 was observed in atypical C7 vertebrae as shown in Figure 1(1a to1d) and Figure 3a respectively. In the unilateral FT(07),05 were found in typical and 02 were noted in atypical C7 vertebrae as shown in Figure 2 (2a to 2e) and figure 3b respectively. The incidence of double FT in the present study was 18.5% and this was compared with various previous studies.

Table 1: Incidence of double FT in present study

Types of vertebra	Number of vertebra (%)	Unilateral double FT (%)	Bilateral double FT (%)
Typical	52	05	04
Atypical	13	02	01
Total	65(100)	07(10.8)	05(7.7)

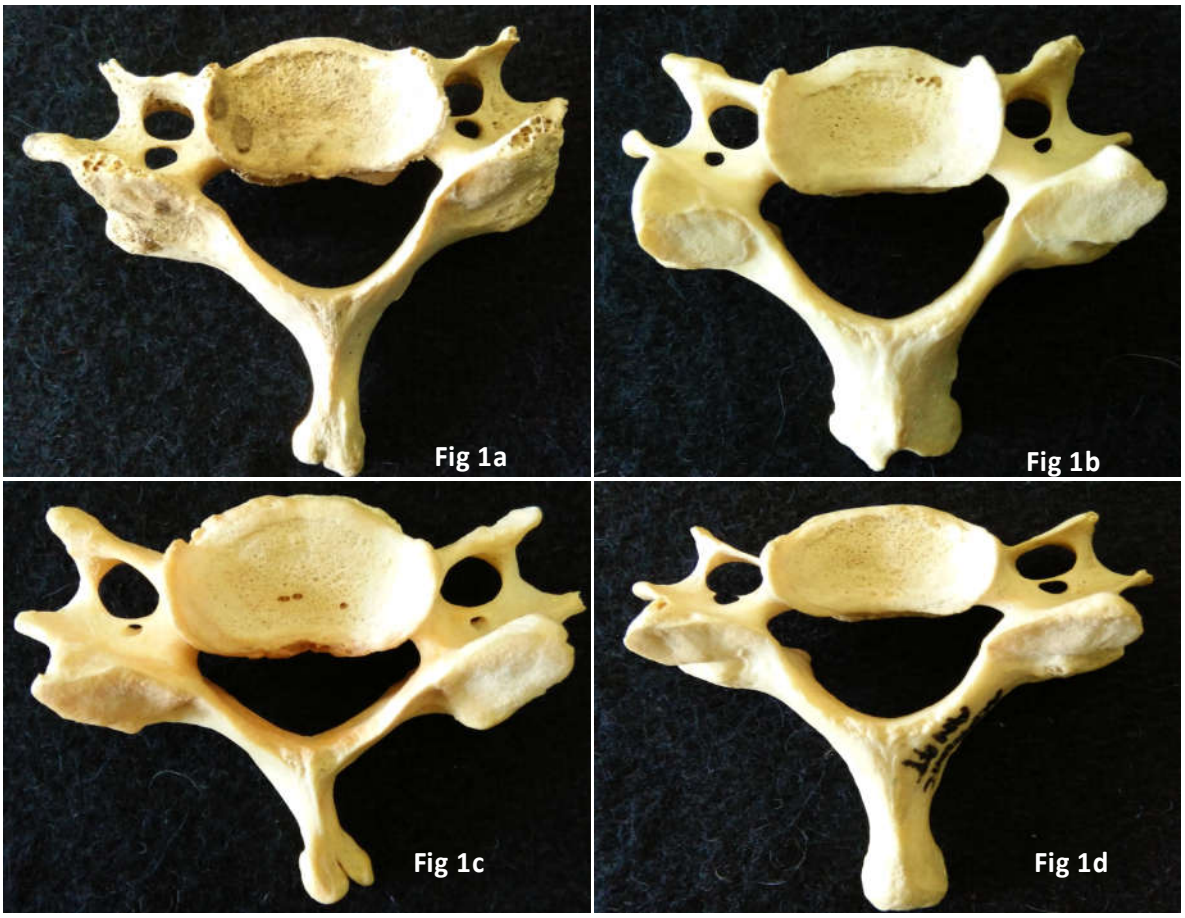

Fig. 1(a,b,c,d): Photograph showing bilateral double foramina transversorium in typical cervical vertebrae

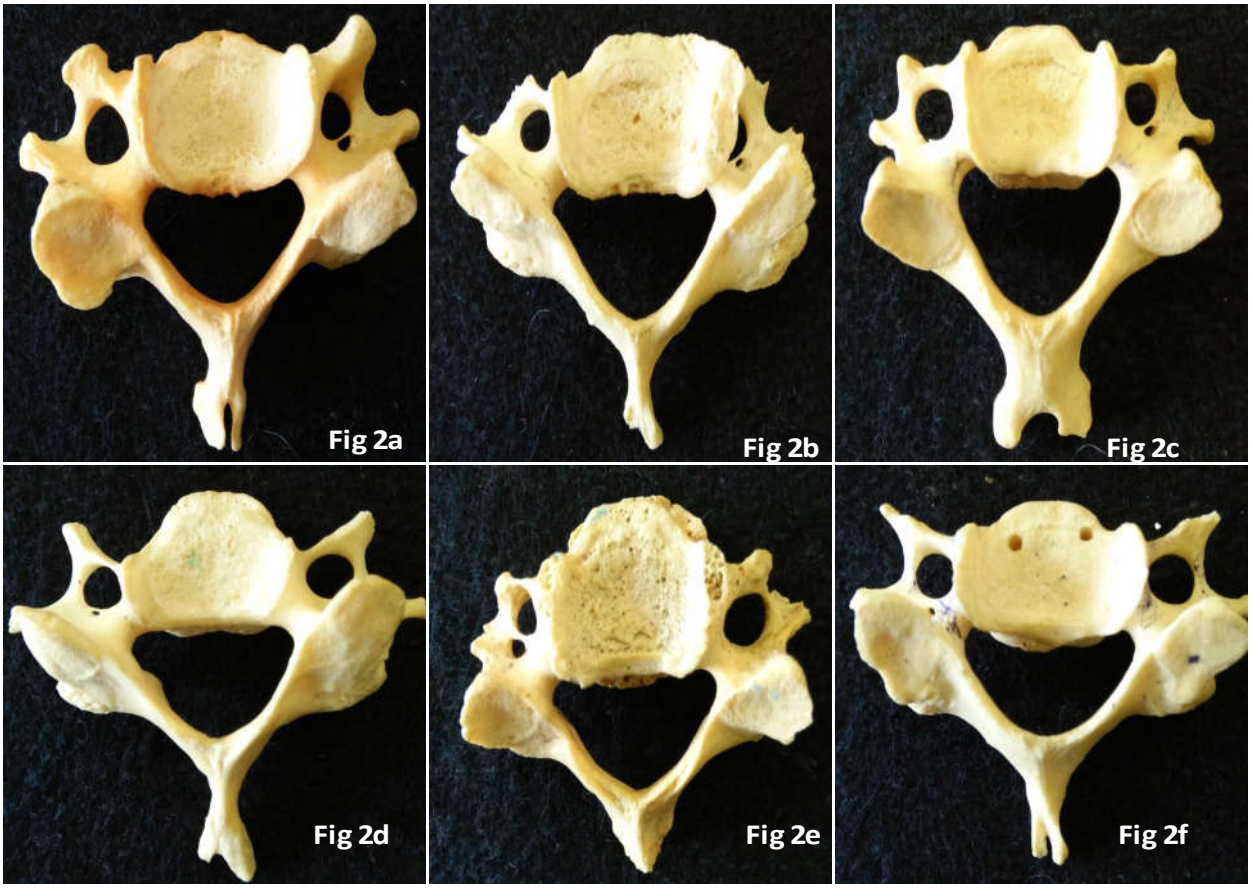

Fig. 2: Photograph showing right unilateral double foramen transversorium (a,b,c) and left unilateral duble foramen transversorium (d,e,f) in typical cervical vertebrae

Fig. 3: Photograph showing bilateral double foramen transversorium (3a) and unilateral (left) double foramen transversorium (3b) in atypical C-7 cervical vertebra

Table 2: Comparative study of incidence of double FT in different population

Authors	Year of study	Incidence of double FT	No of vertebrae	Population observed
Taitz C et al[7]	1978	7.0 %	480	India
Nagar Y et al[9]	1999	8.6 %	1388	Roman
Das S et al[10]	2005	1.5 %	132	India
Kaya S et al[11]	2011	22.5%	262	Jewish
Chaudhari ML et al[12]	2013	23.15%	133	India
Verma P et al[13]	2016	8.0%	200	North India
Patra A et al[14]	2017	10.67%	150	North India
Present study	2017	18.5%	65	Maharashtra, India

Discussion

Anatomical variants regarding size, shape and number of foramina transversorium of cervical vertebrae has been documented by many authors. The foramina transversorium is described by fibrous or bony bridge separating the vertebral artery and vein. It is formed by vestigial costal element fused to the body and the true transverse processes of the vertebrae. The vertebral vessels and nervous plexus are caught between these two bony parts. The FT closed laterally by the costochondral bar, a thin plate of bone connecting the rib elements to the original transverse process [5]. The vertebral nerve ascends from the stellate ganglion upto level of C3, two branch from this nerve are formed and one of these branch passed through accessory vertebral foramina (Smaller posterior part that encloses branch of vertebral vein and vertebral nerve) [6].

The vertebral artery passes through FT, therefore variations in vertebral artery might lead to variation in foramen. Hence it can be assessed that the variation in the process of course of the vertebral arteries will manifest as variation of the FT. In contrast variation of the FT can be useful in estimating variation of the vertebral artery [7]. Accessary FT may be bilateral/ unilateral depending upon the course of vertebral artery. Etiology of presence of accessory FT can be developmental or vascular [8].

The comparison of the incidence of double FT in different population is shown in Table 2. Previous studies by Taitz C et al (1978) [7] and Nagar Y et al (1999) [9] showed 7% and 8.6% of double FT in 480 and 1388 vertebrae respectively. Das S et al (2005) [10] studied 132 vertebra and found only 1.2% of double FT. In Jewish population (262), Kaya S el al (2011) [11] found 22.7% of double FT whereas in Indian population (2013), study by Chaudhari ML et al [12] showed 23.15% incidence of double FT on 133 cervical vertebrae. Recent reference like Verma P et al [13] from North India showed 8% of double FT in 200 cervical vertebra, whereas 10.67% by Patra A et al [14] in 2017 on North Indian population. In the present study, we studied 65 cervical vertebra and noted 12 (18.5%) vertebrae with double FT. In which, 12 double FT we observed unilateral double FT in 07 (58.3%) vertebrae and bilateral double FT in 05 (41.7%) vertebrae. We noted slightly higher incidence of unilateral double FT than bilateral FT as concordance with other studies by Kaya S et al [11] and Chaudhari ML et al [12].

In the literature, details are not available regarding the content of accessory FT. It is not clear whether one of the foramina is occupied by the artery and other by vein or each foramina is occupied by branch of vertebral vessels [15]. The knowledge of anatomical variants of FT is important for neurosurgeon and the radiologists due to vertebral artery. Their anatomy and morphology is useful to the operating spinal surgeons and radiologists in the interpretation of radiological films and CT /MRI scan. Maintaining of vertebral artery intact constitutes an important concern during cerebral procedures since minor lesions may result in severe hemorrhages or even death [16]. The vertebral and basilar arteries constitute to the blood supply of not only brain but also inner ear. Compression or spasm of vertebral artery are manifested not only by neurological (headache, migraine, fainting attacks) but also hearing disturbances [17].

Conclusion

In the present study, we observed 18.5% of double foramina transversarium in cervical vertebrae. Unilateral presence was more common than bilateral and double foramina were observed in lower cervical vertebra. Knowledge of anatomical variants is clinically important since course of vertebral artery may be distorted in such situations. Hence surgical anatomy of these variants foramina is important for the operating neurosurgeons on spine and radiologists while interpreting CT/MRI scans. Future prospective on the study of this subject includes correlation with dissected specimens and angiograms.

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Cross Sectional Study: Students Perspectives on the Orientation Programme for First Year MBBS Students from Northern Kerala

Rosemol Xaviour[1], Sruthi M.V.[1]

Abstract

MBBS or bachelor of medicine and bachelor of surgery is one of the longest and toughest course in any university. The practice of medicine is an art, not a trade, a calling, not a business- a calling in which your heart will be exercised equally with your head [1]. Students entering Medical College come from different backgrounds and have different expectations. They are faced by multiple problems like home sickness, peer pressure, ragging, language and other adjustment problems. Along with these problems different study environment and new medical subjects would make them more stressed. Rising above all these teething problems, there is a need to appreciate the nature of their chosen profession Hence MCI has set clear regulations regarding the crucial foundation course or orientation programme to shape them into model doctors. According to the Medical Council of India Vision 2015, Foundation course or orientation programme will be of 2 months duration after admission to prepare a student to study Medicine effectively. Orientation programme is mainly intended to familiarize a person to a new programme or environment. It should be the first task of any organization and can be conducted in the form of a conventional orientation program (OP) or merely a walk around the establishment. It has got a role in lowering the anxiety of new workplace, and would be beneficial for both faculty and for new students. The Foundation course or orientation program should enable the student to acquire enhanced skills in: i) Language, ii)Interpersonal relationships, iii) Communication, iv) Learning including self or directed learning, v) Time management, vi) Stress management, vii) Use of information technology and train the students to provide: i)First aid ii) Basic life support [2]. Many medical colleges in India are running Orientation programme for new MBBS entrants of varying duration of 1-3 days. [3,4]. In this scenario the medical education unit of P K Das Institute of Medical sciences developed and conducted an orientation programme of four days duration for first year MBBS students. The program was structured around 8 core areas - 1)orientation in the clinical departments of hospital, 2) the qualities of an ideal doctor, 3) doctor patient relationship and ethics, 4) biomedical waste disposal, 5) medical teacher student relationship, 6) how to give a first aid in emergency, 7) how to be a leader in a group and 8) how to give a summary on the discussions. The sessions included use of innovative methods such as skits, role play and student team building exercises after an initial ice-breaking session. Sessions were all interactive requiring active participation from both the students and the faculties. The program ended on a positive note on the 4th day, with a short feedback from the student representative and staff representative. The orientation program was first one of this kind held and to know the strengths and weaknesses of this programme for further improvement an evaluation was conducted from students perspective. *Aim & Objectives* 1. To evaluate the orientation programme conducted among first year MBBS students, from students perspective. 2. To evaluate the overall teaching skills of the faculties who had conducted the Orientation program.

Keywords: Orientation Programme; Foundation Course; Interpersonal Relationship; Time Management.

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Introduction

MBBS or bachelor of medicine and bachelor of surgery is one of the longest and toughest course in any university. The practice of medicine is an art, not a trade, a calling, not a business- a calling in which

your heart will be exercised equally with your head [1].

Students entering Medical College come from different backgrounds and have different expectations. They are faced by multiple problems like home sickness, peer pressure, ragging, language and other adjustment problems. Along with these problems different study environment and new medical subjects would make them more stressed. Rising above all these teething problems, there is a need to appreciate the nature of their chosen profession Hence MCI has set clear regulations regarding the crucial foundation course or orientation programme to shape them into model doctors. According to the Medical Council of India Vision 2015, "Foundation course or orientation programme will be of 2 months duration after admission to prepare a student to study Medicine effectively. Orientation programme is mainly intended to familiarize a person to a new programme or environment. It should be the first task of any organization and can be conducted in the form of a conventional orientation program (OP) or merely a walk around the establishment. It has got a role in lowering the anxiety of new workplace, and would be beneficial for both faculty and for new students.

The Foundation course or orientation program should enable the student to acquire enhanced skills in: i) Language, ii)Interpersonal relationships, iii) Communication, iv) Learning including self or directed learning, v) Time management, vi) Stress management, vii) Use of information technology and train the students to provide: i) First aid ii) Basic life support [2].

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Aim & Objectives

1. To evaluate the orientation programme conducted among first year MBBS students, from students perspective.
2. To evaluate the overall teaching skills of the faculties who had conducted the Orientation program.

Methodology

A cross-sectional study was conducted on the evaluation of orientation program held on October 2015 for first year MBBS students of PK Das institute of Medical Sciences,Vaniamkulam, Ottappalam. MBBS students of 2015 -16 batch were included in the study. After obtaining an IEC clearance and verbal oral consent from students, participants were included for the study. The universal sampling is used and all students attended the orientation program were included. Data collection was done by means of anonymous, standardized, validated questionnaire. The questionnaire was developed with a view to elicit student response in respect to their prior knowledge, gain in knowledge and need for further knowledge on each topic. Questionnaire had questions on a Likert scale 1) strongly disagree 2) disagree 3) neutral 4) agree 5) strongly agree on Programme structure and feed back and contribution to learning . For analysing the overall quality of Orientation program, each category were given a scoring starting from 1 to 5 and total scores were calculated and classified based on Adhoc classification. The scores varied from 11-55 and classified into following classification 11-25 – negative, 26-40 – Neutral and 41-55 as positive.

Faculties who had conducted the orientation program was evaluated at the end of session on teaching and availability skills by the students. The rating was done by 1) moderate 2) satisfactory 3) very good & 4) excellent scale. There were 11 questions on faculty evaluation. The students were also asked to indicate the extent to which, various topics delivered in the orientation program helped them to understand the skills and attributes required by a medical professional along with a need to understand a

different learning environment in the midst of cultural diversity. As anonymous questionnaires were used, students were given a space to express their views without fear of judgement.

Data Analysis

The data was collected, coded and entered into Microsoft Excel 2007. The whole data was rechecked and analyzed using statistical software SPSS Version 16. After collection of filled-questionnaire, data was analyzed using descriptive statistical methods. The Chi-square test ($\chi 2$) was used for finding out association between various categorical variables. P value < 0.05 was considered statistically significant. Recommendations for the change in the OP were submitted to the higher authorities.

Results & Discussion

Out of 150 students of 2015-16 batch only 138 could attend the orientation program, since 12 of them joined the institution after 2nd/3rd counselling. Out of 138 students majority 78(56.5%) were girls. Mean age was 18.86 + 0.79 ranging from 17 to 21. Majority of students, 71 (51.4%) belonged to age 19 followed by age 18 ie 40 students (29%).

Out of 138 students attended the orientation program, 67 (48.6%) students agreed and 38 (27.5%) students strongly agreed that the overall quality of the course was excellent. Whereas 3 (2.2%) students strongly disagree and 8 (5.8%) students disagree the overall course quality and 22 (15.9%) of them had a neutral opinion .This indicates that the overall quality of orientation program was good, even though slight modification is needed (Figure 1).

Further analysis was done on adding the scores of 11 question on program structure & contribution to learning and classified based on Adhoc classification mentioned in the methodology. The mean response score was 39.57 ± 5.24 .Out of total students, 74 (53.6%) of students had a positive response and 61(44.2%) of students had neutral response. Only 3 (2.2%) of students had negative response. Figure 2. There is a statistically significant difference between the level of response to orientation program and sex of the students (p value - <0.001) Table1. Out of 78 female students, 58 (74.4%) of students had positive response and none of them had negative response. Out of 60 boys, only 16(26.7%) had positive response and 41(68.3%) and 3 (5%) of students had neutral and negative response respectively.

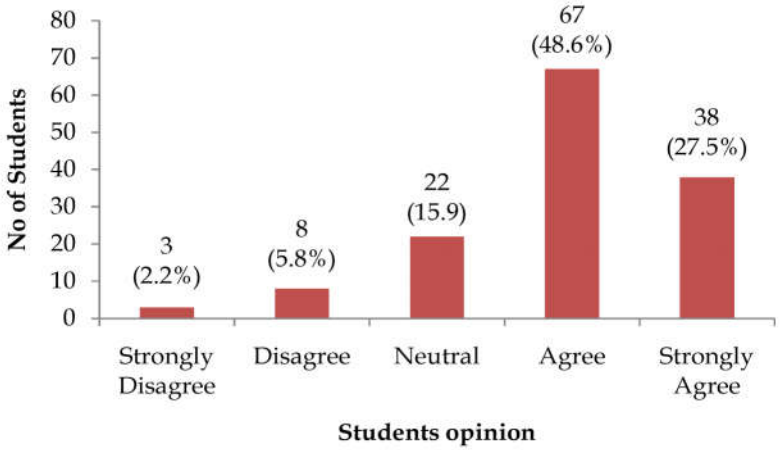

Fig. 1: Distribution of students opinion on overall quality of orientation program

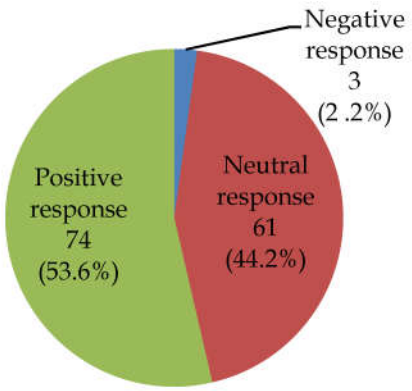

Fig. 2: Distribution of students according to level of response towards orientation program

The program structure was evaluated using a questionnaire having two sections. One part contains questions on content of program covering general structure, assessment, content and workload of program. Second part contain questions on contribution to learning. Results were experseed in Likert's scale.

In this study majority of students 64 (46.4%) and 27 (19.6%) agreed and strongly agreed that the program was comprehensive, clear and accurate. About half of the students 72 (52.2%) agreed that the learning goals were clearly stated and 30 (21.7%) of students strongly agreed for the same. There was a question on timing of orientation program and 50 (36.2%) of students agreed that the classes started and ended on time, whereas 31 (22.5%) of students disagree for the same question and 31 (22.5%) of students had a neutral opinion. This indicates that time management of orientation program was improper. About half of the students 69 (50%) had agreed that the assessment program allowed them to demonstrate what they had learned from the orientation program, but 33 (22.9%) of students had neutral opinion for the same. Out of total students attended the orientation program 60 (43.5%) of students had agreed that the content covered was challenging, but 49 (35.5%) of students had neutral opinion and 50 (36.2%) of students had agreed that the program required lot of preparation (Table 2).

Table 1: Association between level of response to orientation program and sex of the students

Sex	Level of Response				
	Negative	Neutral	Positive	Total	Significance
Male	3 (5%)	41 (68.3%)	16 (26.7%)	60	Fischer's Exact
Female	0	20 (25.6%)	58 (74.4%)	78	value – 34.5
Total	3	61	74	138	P value - **<0.001**

Table 2: Distribution of students opinion on general structure and content of orientation program

Sl. No	Particulars	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly Agree N (%)
	General Structure					
1.	The program was comprehensive, clear & accurate.	5(3.6%)	8(5.8%)	34(24.6%)	64(46.4%)	27(19.6%)
2.	The learning goals clearly stated.	5(3.6%)	6(4.3%)	25(18.1%)	72(52.2%)	30(21.7%)
3.	Classes started and ended in time.	5(3.6%)	31(22.5%)	31(22.5%)	50(36.2%)	21(15.2%)
	Feedback & Assessment					
4.	Assessment allowed the student to demonstrate what he/she had learnt during the program	4(2.9%)	14(10.1%)	33(23.9%)	69(50%)	18(13%)
	Content & Workload					
5.	Content was challenging	3(2.2%)	11(8%)	49(35.5%)	60(43.5%)	15(10.9%)
6.	Program required lot of preparation	7(5.1%)	14(10.1%)	47(34.1%)	50(36.2%)	20(14.5%)

Table 3: Distribution of students opinion on contribution on learning of orientation program

Sl. No	Particulars	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly Agree N (%)
	Contribution on Learning					
1.	Stated goals for the program were met	4 (2.9%)	8 (5.8%)	34 (24.6%)	74 (53.6%)	18 (13%)
2.	Program improved oral communication skills	6 (4.3%)	18 (13%)	44 (31.9%)	55 (39.9%)	15 (10.9%)
3.	Program helped to develop creative ability	2 (1.4%)	15 (10.9%)	36 (26.1%)	58 (42%)	27 (19.6%
4.	Program helped to reason better and think more critically.	5 (3.6%)	10 (7.2%)	26 (18.8%)	63 (45.7%)	34 (24.6%)
5	Program helped to consider the alternative perspectives on complex issues.	3 (2.2%)	8 (5.8%)	32 (23.2%)	66 (47.8%)	29 (21)

The second part of questionnaire is on contribution to learning, containing questions on what qualities the students achieved at the end of orientation program. Majority of students 74(53.6%) agreed that the stated goal of the program were met, 34 (24.6%) of students had neutral opinion for the same question.

Out of 138 students 55 (39.9%), 58 (42%) & 63 (45.7%) had agreed that the orientation program helped them to improve or develop communication skills, creative ability and critical thinking respectively (Table 3).

Overall faculty assessment was also done in this study and reveals that majority of students 55 (39.9%) had very good opinion on faculty time devotion to rounds and patient care. About 53 (38.4%), 52 (37.7%) & 57 (41.3%) of students had satisfactory opinion on questions on usually prompt, adhered to rounds & program schedule, & minimum interruptions respectively. Questions on teaching skills showed 68

Table 4: Distribution of students response on teaching skills of overall faculties of orientation program

Sl. No	Particulars	Moderate N (%)	Satisfactory N (%)	Very good N (%)	Excellent N (%)
	Availability				
1.	Usually prompt	24(17.4%)	53(38.4%)	50(36.2%)	11(8%)
2.	Adhered to program schedules	15(10.9%)	52(37.7%)	48(34.8%)	23(16.7%)
3.	Interruptions minimum	21(15.2%)	57(41.3%)	37(26.8%)	23(16.7%)
4.	Enough time devoted to rounds & patient care	20(14.5%)	39(28.3%)	55(39.9%)	24(17.4%)
	Teaching				
5.	Organised content logically	12(8.7%)	35(25.4%)	63(45.7%)	28(20.3%)
6.	Presented useful information at appropriate level	8(5.8%)	35(25.4%)	50(36.2%)	45(32.6%)
7.	Kept discussions focused on case/topic	8(5.8%)	40(39%)	54(39.1%)	36(26.1%)
8.	Asked questions appropriately	15(10.9%)	33(23.9%)	67(48.6%)	23(16.7%)
9.	Integrated social/ethical aspects	10(7.2%)	26(18.8%)	45(32.6%)	57(41.3%)
10.	Encouraged student to clear doubts	15(10.9%)	23(16.7%)	50(36.2%)	50(36.2%)
11.	Encouraged critical think	2(1.4%)	22(15.9%)	46(33.3%)	68(49.3%)

(49.3%), 50 (36.2%) & 57(41.3%) of students had an excellent opinion on encouragement of critical thinking, clearing doubts & integration of social & ethical issues respectively by the faculties (Table 4).

Conclusion

Even though overall quality or rating of orientation program was excellent slight modification were needed on time management and on feedback assessment. Assessment of faculties by students showed that modification is needed on devotion of time to rounds and patient care and adherence to program schedule. These factors were considered for further improvement of orientation program for subsequent batches.

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Original Article

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Light Microscopic Study of Developing Cortex of Fetal Adrenal Gland

Rucha R. Kulkarni

Abstract

In this study, we observe the developing cortex of the fetal adrenal gland in one hundred normal Human fetuses (71 males and 29 females) over a period of two and half years in various stages of development. Subsequently, we correlate the light microscopic studies of the fetal adrenal gland with respect to its development and functional activity. Moreover, the width of definitive and fetal cortices is noted and its ratio for the respective gestational age is calculated. The ratio of the measurements of width of definitive cortex and fetal cortex remains constant i.e. 1:4 at all stages of development; consequently, it can be suggested that the definitive cortex is continuously proliferating and adding cells to fetal cortex where the cells become differentiated and functional. After functioning for some time, the fetal cortical cells must be degenerating. Further, the fetal cortex comprises 80% of adrenal cortex till birth. The cells of the fetal cortex show vacuolated cytoplasm indicating a steroidogenic activity as early as 15-16 weeks of gestation and acts as an endocrine gland throughout the gestational period. Finally, we affirm and compile the development of the cortex in various gestational stages.

Keywords: Definitive Cortex; Fetal Cortex; Zona Glomerulosa; Zona Fasciculata.

Introduction

The adrenal glands were first recognized as organs distinct from the kidneys by Bartholomeo Eustachius in 1563. Subsequently, Emil Huschke first differentiated the cortex from medulla anatomically [1]. Next, the three concentric zones of the cortex were described by J. Arnold [2]. Although, the growth and differentiation of human adrenal cortex has been a subject of much investigation in recent years, the formation of fetal adrenal cortex and its subsequent invasion by neural precursors of medulla was described by Rudolph Albert Von Kolliker in 1861 [3].

Investigations carried out previously on the morphogenesis of the fetal adrenal cortex have led to conflicting views with respect to the development and functional activity of the two zones composing this endocrine organ. According to the first theory, the two zones of the fetal adrenal cortex develop separately from each other [4]. However, the findings of a second study suggested that there is a gradual development of the two zones from one original zone of early embryonic gland [5].

Ross et al, in 1962, described the electron microscopic structure of adrenal gland and suggested that permanent cortex or outer zone might represent a germinative zone where as the ultra-structure of fetal or inner zone might reflect a functional activity.

Materials and Methods

The present study was carried out on 71 male and 29 female fetuses in various stages of development having crown-rump length ranging from 7 cm to 36 cm. The fetuses were obtained from medical termination of pregnancy and spontaneous abortions from a tertiary care hospital in Mumbai.

Preservation

In order to minimize post-mortem changes, the

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fetuses were immediately preserved by injecting formalin into the abdominal cavity. Subsequently, they were immersed in formalin solution. For identification, numbered tags starting from 1 were tied to their wrists.

Normal growth of the fetus was ensured by taking different external measurements and ascertaining various parameters.

Dissection and Fixation

The fetuses were dissected by taking vertical abdominal incision. Subsequently, the adrenals were removed along with the kidneys by blunt dissection. Immense care was taken during the separation of the right adrenal from the liver. The left adrenals were kept in small locked plastic pouches to differentiate from the right. Finally, the adrenals were stored in small bottles and were numbered.

Next, the large adrenals were cut into pieces with sharp razor blade. The capsule was not damaged in the process.

Finally, the tissues were fixed by immersing in Sublimate-Salt solution for 24–36 hours.

Dehydration

First, the tissues were immersed in 50% alcohol solution for 6–8 hours. Next, they were transferred to 70% alcohol and allowed to stay in it overnight. Subsequently, the tissues were bathed in 90% alcohol for one hour and finally they were subjected to absolute alcohol for duration of one hour each. Lastly, the tissues were dried using filter paper.

Clearing and Embedding

Post dehydration, the tissues were subjected to two–three xylene changes until they turned transparent.

Once the tissues were impregnated with xylene, they were embedded in melted paraffin at 58°–60° for duration of 5–6 hours. The paraffin blocks containing tissues were made using L-shaped molds. These blocks of paraffin were then numbered accordingly. Care was taken during the preparation of the tissues to ensure that the respective numbering was maintained.

Sectioning

The numbered blocks of paraffin containing tissues were sanctioned by microtome steel blade to a thickness of 4–8 μm. The sections were floated on warm water and transferred to glass slides which were rubbed with a drop of albumin. A drop of 70% alcohol was put on a glass slide to ensure spreading of the section.

Subsequently, the slides were numbered accordingly with diamond marker and kept in over for a few seconds to fix the section on slide.

Slide Staining

Next, the slides were stained with Hematoxylin and Eosin stain. After the slides were stored in Koplin jar, the following procedure was undertaken:

1. First, two changes of xylene were given for a short period of time. Next, the slides were successively bathed in descending grades of alcohol starting from absolute alcohol (three momentary changes as absolute alcohol I, II, III) to 90% and 70% alcohol.
2. The Koplin jars were kept under running water for 5–10 minutes. Then, the slides were stained with Hematoxylin for 10–15 minutes. After checking the intensity of staining under the microscope, the Koplin jars were kept under running water for 15 minutes,
3. Subsequently, Eosin was used as an acid dye for staining the slides for 3–5 minutes.
4. After the Eosin staining, the slides were transferred from absolute alcohol I to II and III and then kept in xylene.
5. Using DPX mount, the coverslips were added. The slides were then cleaned and readied for the microscopic study.

The slides were then examined under the microscope to study the developing cortex of fetal adrenal gland under various stages. Histological slides of adrenal glands from each group were photomicrographed using trinocular Nikon microscope.

Measurements of width of definitive and fetal cortex were taken using an eyepiece grid. The adrenals were then studied under a light microscope and the width of the fetal cortex was measured. The materials used for the measurement are as follows:

1. Dispensing weight balance
2. Transparent scale
3. Thread
4. Divider
5. Grid in eyepiece.

Finally, we calculate and record the ratio of width of definitive and fetal cortex.

Results and Discussion

The ratio of definitive to fetal cortex is calculated and listed in Table 1.

Weeks 12–14

The adrenal cortex is distinctly developed into two zones: outer definitive cortex and inner fetal cortex.

Fetal cortex is differentiating into fascicular pattern. In terms of nucleus–cytoplasm ratio and staining characteristics of nucleus and cytoplasm, the cells of the definitive cortex appear to be immature whereas those of fetal cortex seem matured.

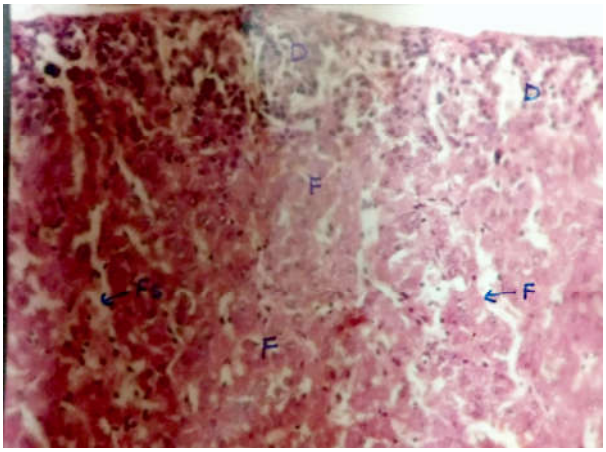

Fig. 1.1: Depicting definitive cortex (D) and fetal cortex (F) and the sinusoids in fetal cortex (Fs)

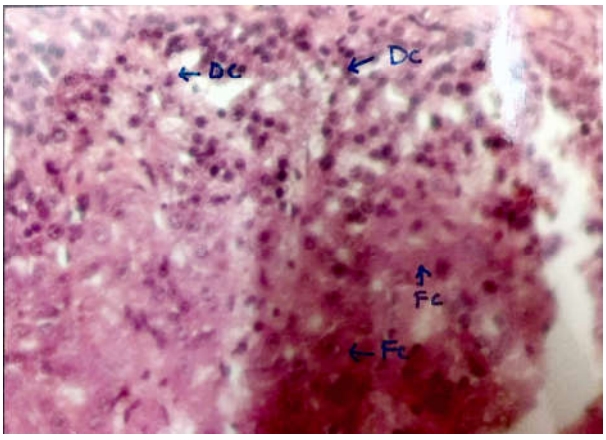

Fig. 1.2: Cells of definitive cortex (DC) and fetal cortex (FC) showing nuclei

Weeks 15–16

Cells of the definitive cortex have started differentiating into mature cells. Density of cells decreases with the appearance of blood vessels. This suggests rudimentary glomerulosa.

Next, the fascicular pattern of the fetal cortex is distinct and clear. Dilated sinusoids are arranged between the cell cords. The cells of the fetal cortex exhibit a spongy appearance.

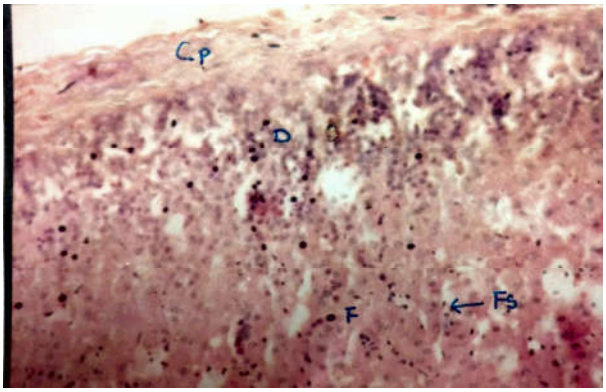

Fig. 2.1: Depicting capsule (Cp), fetal cortex (F), definitive cortex (D), and dilated sinusoids in fetal cortex (Fs)

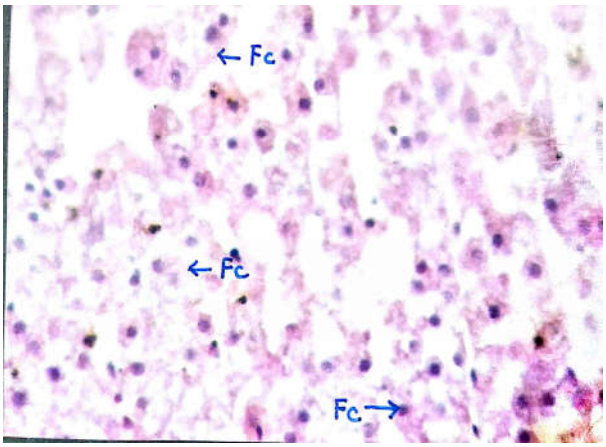

Fig. 2.1: Cells of fetal cortex (Fc) showing spongy appearance.

Weeks 17–18

No changes are observed in the definitive cortex. Towards medulla fascicular arrangement of fetal cortical cells is broken into reticular network. It may be the indication of degeneration of fetal cortical cells.

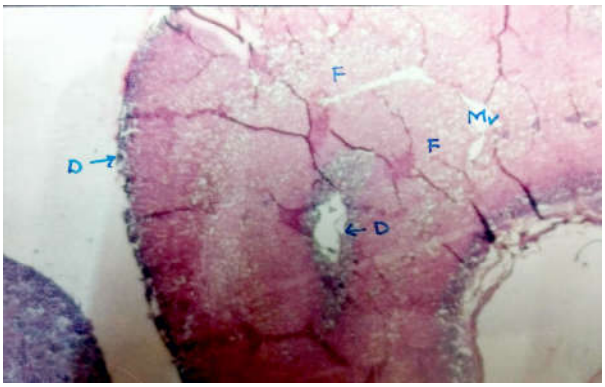

Fig. 3.1: Fetal cortical cells (F) broken in reticular network and appearance of medullary vein

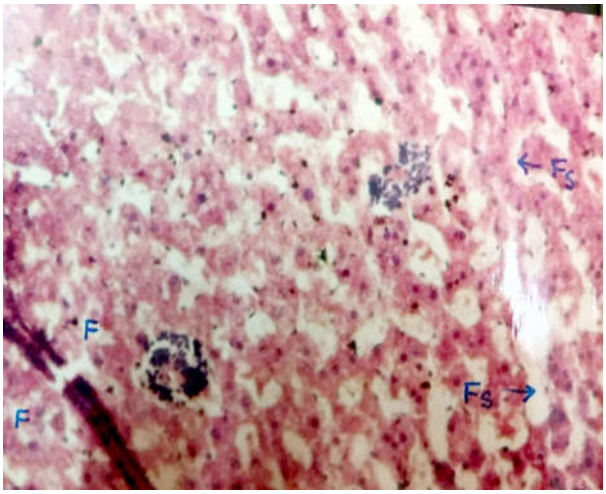

Fig. 3.2: Sinusoids in fetal cortex (Fs) and fetal cortex (F)

Weeks 19–20

This stage exhibits the appearance of a transitional zone between fetal and definitive cortex. The cells of this zone are of intermediary stage, i.e. they are neither functional as cells of fetal cortex nor undifferentiated as the cells of definitive cortex. This suggests a migration of stem cells from the definitive cortex into fetal cortex where they proliferate and differentiate to begin function.

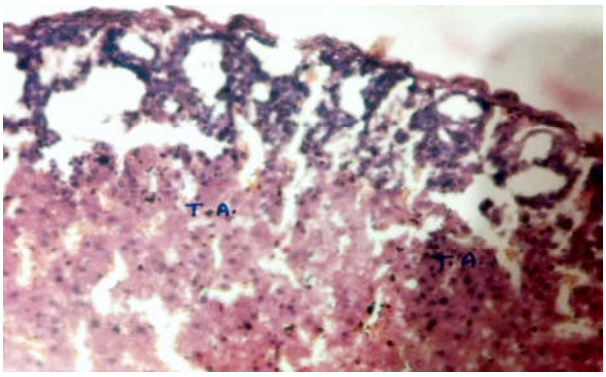

Fig. 4.1: Appearance of a transitional area (TA) between fetal and definitive cortex

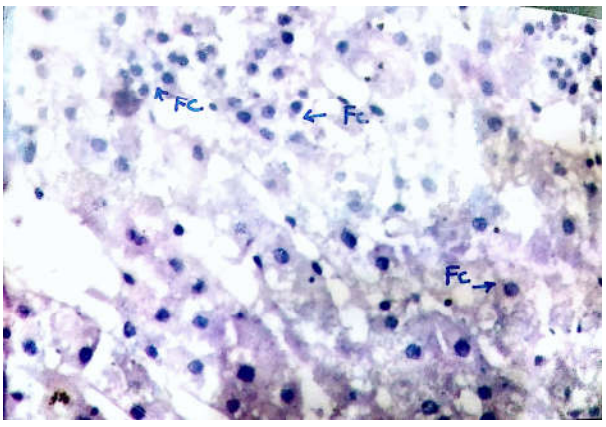

Fig. 4.2: Marked spongy appearance of fetal cortical cells.

The fetal cortical cells show marked spongy appearance indicating that these are highly functional.[6] Therefore, this indicates that the cortex not only degenerates but also functions as a steroidogenic organ.[7]

Weeks 21–22

The definitive cortex does not reveal any changes. However, the cells of the transitional area of the fetal cortex are enlarged indicating that the cells are maturing. Spongy appearance is well marked in fetal cortex.

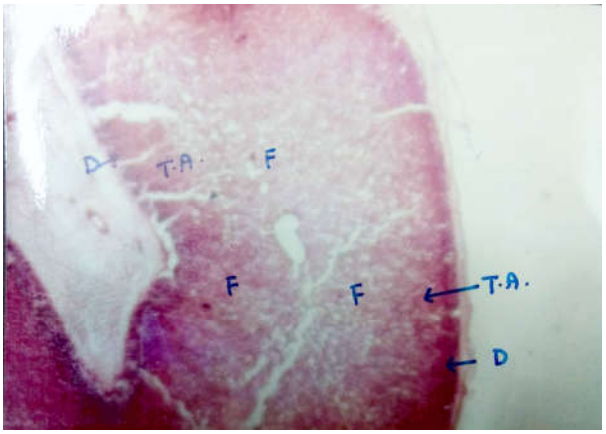

Fig. 5: Enlarged fetal cortical cells (F) in the transitional area (TA)

Weeks 23–28

Cortex does not reveal any changes.

Weeks 29–30

Marked basophilic staining of definitive cortex is decreased. The cells appear differentiated. Also, there appears to be a decrease in the density of cells. The cells of the transitional area of fetal cortex have started functioning, as depicted by their vacuolated cytoplasm.

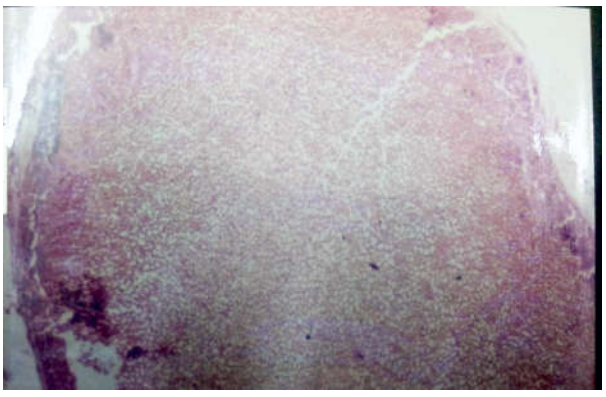

Fig. 6.1: Marked basophilic staining of definitive cortex decreased

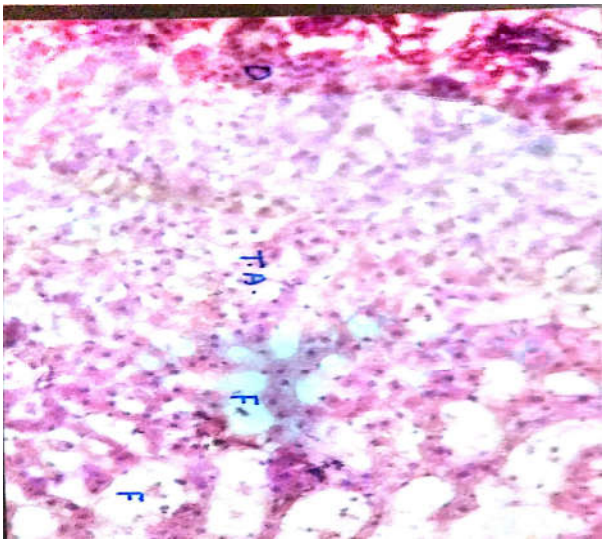

Fig. 6.2: Cells of transitional area (TA) show vacuolated cytoplasm

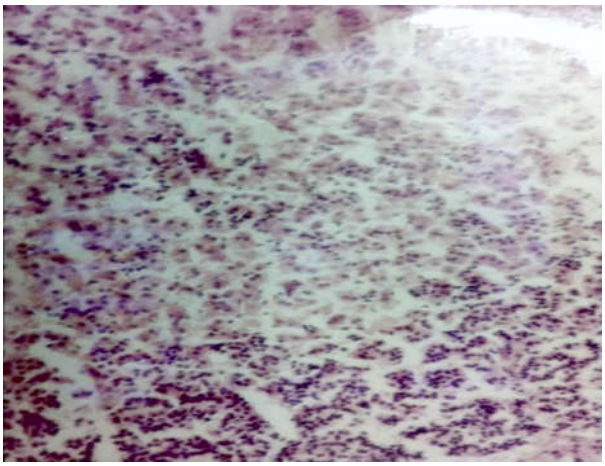

Fig. 6.3: Decrease in density of cells

Weeks 31–35

No significant changes are observed.

Weeks 36–38

In this stage, we observe a striking feature, i.e. the differentiation of definitive cortex into zona glomerulosa and zona fasciculata. The staining of this zone is totally different from what was observed in previous stages. The small dark basophilic cells of definitive cortex have transformed into large lightly staining cells arranged into zona glomerulosa and zona fasciculata.

The cells of zona glomerulosa are arranged in ovoid groups as observed in an adult mature cortex. Next, the cells in zona fasciculata are arranged in fascicular pattern with sinusoids between them. The cells are large and eosinophilic with vesicular nucleus and vacuolated cytoplasm suggestive of liquid droplet accumulation.

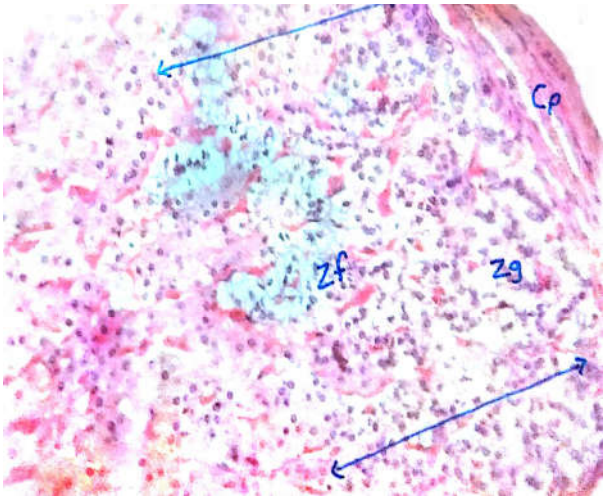

Fig. 7.1: Depicting capsule (Cp), zona glomerulosa (Zg) and zona fasciculate (Zf)

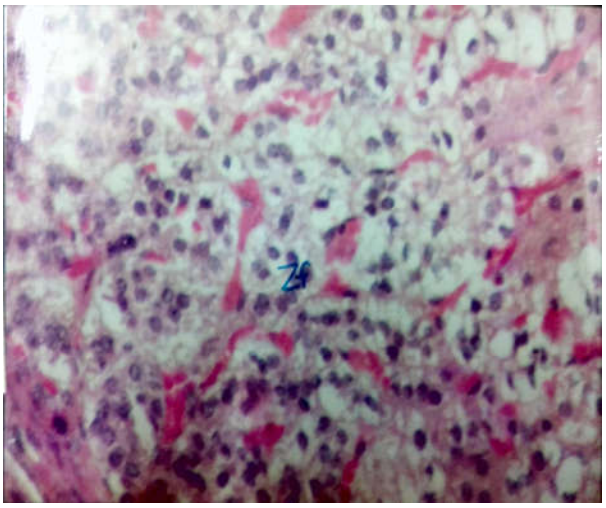

Fig. 7.2: Zona fasciculate (Zf) cells are large with vacuolated appearance

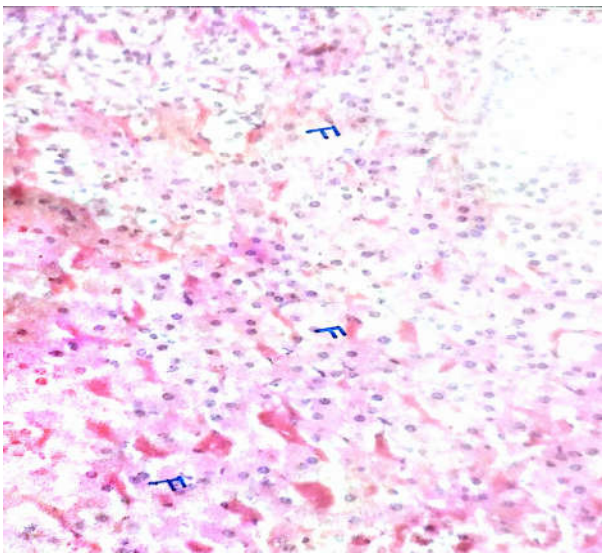

Fig. 7.3: No further differentiation in Fetal Cortex

Table 1: Ratio of definitive to fetal cortex

Gestational Age (Weeks)	Definitive Cortex	Fetal Cortex	Ratio of Definitive to Fetal Cortex
12–14	20	80	1:4
15–16	12.5	50	1:4
17–18	16	60	1:3.7
23–24	15	65	1:4.3
27–28	20	80	1:4
29–30	22.5	90	1:4
36–38	25	102	1:4

Fetal cortex occupies around 80% of adrenal cortex without any further differentiation.

Finally, as depicted in Table 1, the ratio of measurements of width of the definitive cortex and fetal cortex is constant i.e. 1:4 at all stages of development.

This suggests that the definitive cortex is continuously proliferating and adding cells to the fetal cortex where the cells are differentiated and become functional. After functioning for some time, the fetal cortical cells begin degenerating.

Conclusion

In this paper, we observe the development of cortex in fetal adrenal gland. We observe that in early as 12–14 weeks, the adrenal cortex comprises of two distinct zones i.e. definitive cortex and fetal cortex.

The definitive cortex, which is going to develop into permanent adult cortex, has not shown much differentiation till 29-30 weeks of gestation. The definitive cortex is also named as rudimentary zona glomerulosa. As the ratio of the measurements of width of definitive cortex and fetal cortex remains constant i.e. 1:4 at all stages of development, it can be suggested that the definitive cortex is continuously proliferating and adding cells to fetal cortex where the cells become differentiated and functional. After functioning for some time, the fetal cortical cells must be degenerating. Further, the fetal cortex comprises 80% of adrenal cortex till birth. The cells of the fetal cortex show vacuolated cytoplasm indicating a steroidogenic activity as early as 15-16 weeks of gestation and acts as an endocrine gland throughout the gestational period.

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The Study of the Variant Origin and Course of the Vertebral Artery

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Abstract

The aim of study was to present and describe the variant anatomical origins of the vertebral artery and its entrance into the cervical vertebra. The study material consists of 50 embalmed cadavers 9 females and 41 males at the Dr. D. Y. Patil Medical College, Nerul, Navi Mumbai. Out of which in 3 (6%) cadavers were found where the left vertebral artery arises directly from the arch of aorta between the origins of the left common carotid and the left subclavian artery. In all cadavers right vertebral artery arises from the first part of right subclavian artery. These vertebral arteries coursed upward to the transverse foramen of cervical vertebra at different levels. Out of the 50 cadavers, the right vertebral arteries entered through transverse foramen of 6th and 5th cervical vertebrae 46 (92%) and 4 (8%) respectively. left vertebral artery entered through transverse foramen of 6th cervical vertebra in 44 (88%), while those of 5th and 4th in 4(8%) and 2(4%). The vertebral artery is important to posterior cerebral circulation so it is of clinical important to know the origin and course of the vertebral artery. The relation is important while performing transpedicular fixation or other spinal surgeries.

Keywords: Vertebral Artery; Arch of Aorta; Cervical Vertebrae.

Introduction

An understanding of variability of vertebral artery remains most important in angiography and surgical procedures where incomplete knowledge of anatomy can lead to serious complication. This has become important era of carotid artery stents, vertebral artery stents and therapeutic options of intracranial interventions.

The vertebral arteries arise from the superoposterior aspect of the first part of subclavian artery, medial to scalenus anterior muscle. The vessel takes a vertical posterior course to enter into the foramen transversarium of sixth cervical vertebra. The vertebral artery on both sides passes through the foramina transversarium of the first six cervical vertebrae, after passing through the transverse foramen of atlas passes posteromedially on its posterior arch, penetrate the posterior atlanto-occipital membrane and dura matter respectively and then enter the cranial cavity through the foramen magnum. They unite at the caudal border of the pons to form an unpaired basilar artery, which supplies the brain [1]. The vertebral artery (VA) is important to posterior cerebral circulation. The segment of the artery from its origin at subclavian artery to its respective transverse foramen of cervical vertebra is called the pretransverse or prevertebral segment [2].

A variation in the origin and distribution of the vertebral artery can cause alterations in cerebral hemodynamic that may predispose to aneurismal formation with a greater risk of accidents [3, 4].

The present study showed anomalous origin of left vertebral artery and variation of vertebral artery

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entering the transverse foramen of cervical vertebra, have variable prevertebral course which is clinically important.

Material and Method

The present study consisted of dissection of head and neck region, was carried out on 50 adult cadavers 9 females and 41 males in dissection hall of Anatomy Department of Dr. D. Y. Patil Medical College Nerul, Navi Mumbai over the period of three years (2011-2014).

During the dissection, we observed the origin and course of vertebral artery from its origin to the entry in the foramen transversarium of cervical vertebra. Each vertebral artery was identified in the root of the neck arising from first part of subclavian artery lying behind common carotid artery and vertebral vein and passing through a scaleno-vertebral triangle between longus colli and scalenus anterior muscle. Each vertebral artery was dissected free of its loose connective tissue attachments from its origin up to the transverse foramen of the cervical vertebrae.

Result

In present study, 50 human cadavers 9 females and 41 males were dissected to study variations in the origin of vertebral artery and its entrance into the transverse foramen of the cervical vertebra. In all cadavers right vertebral artery arises from the first part of subclavian artery. Variant origin of left vertebral artery was found in 3 (6%) cadaver. In which the left vertebral artery took origin directly from the arch of aorta between the left common carotid artery (LCCA) and the left subclavian artery (LSA) (Figure 1). Then artery, ascended behind the left common carotid artery while stellate ganglion and ventral rami of cervical spinal nerves were related posterior and thoracic duct arched anterior to it before it entered the foramen transversarium of cervical vertebra.

As per Table 1, Out of the 50 cadavers, the right vertebral arteries entered through transverse foramen of 6th and 5th cervical vertebrae 46 (92%) and 4 (8%) respectively (Figure 2). left vertebral artery entered through transverse foramen of 6th cervical vertebra in 44 (88%) cases, while in 4(8%) cases it entered through the 5th cervical vertebra (Figure 1). and in only 2(4%) cases, we observed that it entered into the C4 (Figure 2).

Table 1: Present study showing variation of vertebral artery entering foramen transversarium of cervical vertebrae

	RT VA (50)	Lt VA (50)	Total VA (100)
C_4	-	2(4%)	2%
C_5	4(8%)	4(8%)	8%
C_6	46(92%)	44(88%)	90%
C_7	-	-	-

Table 2: Aortic Origins of vertebral artery described by other studies

Author (Year)	Incidence
Bean (1905)[8]	5.2%
Adachi (1928) [9]	5.4%
Stein et al. (1962)[10]	6%
Argenson et al. (1980)[11]	5.8%
Nizanowski et al. (1982)[12]	3.1%
Lippert Pab(1985) [7]	3%
Cavdar and Arisan (1989)[13]	8.3%
Takafuji and Safo (1991)[14]	6.9%
Vorster et al. (1998)[15]	5%
Panicker et al. (2002)[16]	5%
Komiyama et al. (2001)[17]	2.4%
Yamaki K et al.(2006)[6]	5.8%.
Patil ST et al. (2012)[18]	8%
C Bhattarai et al. (2010)[19]	7%

Table 3: Comparisons of Variation of vertebral artery entering foramen transversarium of cervical vertebrae

Entrance into the cervical vertebra	Adachi (1928)	Yamaki (2006)	Present study
C3	0	6.7%	0
C4	7.4%	16.7%	2%
C5	66.66%	43.3%	8%
C6	14.8%	33.3%	90%
C7	11.11%	0	0
Number of cases	**27**	**30**	**100**

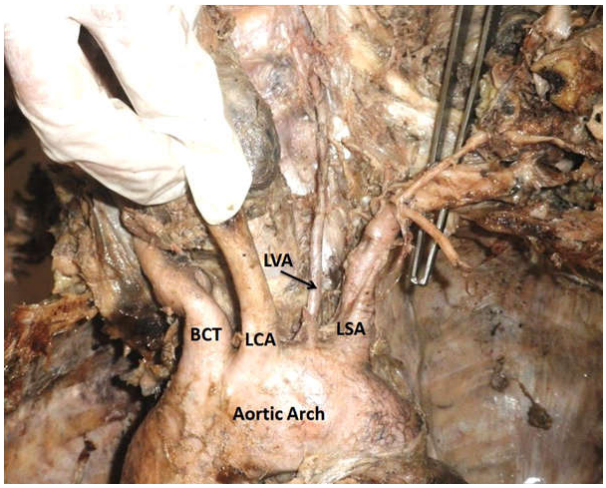

Fig. 1: Origin of left vertebral artery from the arch of aorta and enters into foramen transversarium of C5, LVA: Left Vertebral Artery, LCA: Left Common Carotid Artery, BCT: Brachio Cephalic Trunk, LSA: Left Subclavian Artery

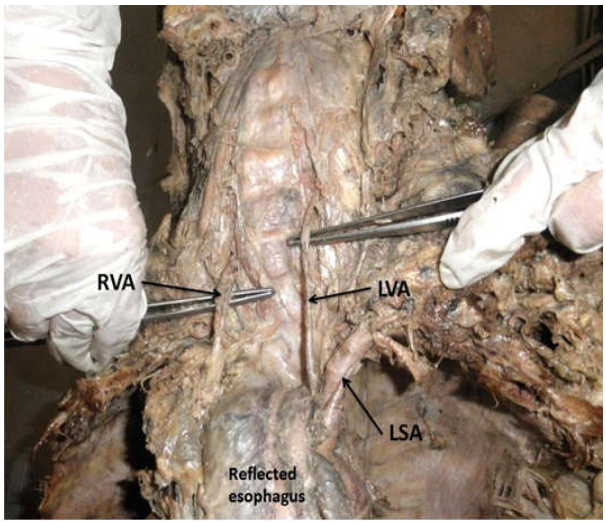

Fig. 2: LVA: Left vertebral artery enters foramen transversarium of C4, RVA: Right vertebral artery enters foramen transversarium of C5, LSA: Left Subclavian Artery

Discussion

Anatomic and morphological variations of the vertebral artery are of immense importance in Surgery, angiography and all non-invasive procedures**.** The right vertebral artery may arise from the following: **A**. First part of subclavian artey, closer to the brachiocephalic artery (1%) or to the anterior scalene muscle; **B**. directly from the aortic arch (3%); **C**. The right common carotid artery when the right subclavian artery is branching from the aorta beyond the left subclavian artery; **D**. The brachiocephalic trunk, the right vertebral artery may pass behind the oesophagus [5]. The left vertebral artery may arise directly from the left common carotid artery, or the root of subclavian artery, close to the arch of aorta. It may arise from the arch of aorta [6]. In our study all 50 right vertebral arteries arises from the first part of subclavian artery.

Lippert Pab's classified the LVA according the origin from the aortic arch as: between the LCCA and LSA (Type A, 3%), between a common trunk formed by BT and LCCA and LSA (Type B, <1%), after the LCCA (Type C, <1%), after the LSA as the third branch (Type D, <0.1%), after a common trunk as the second branch (Type E, <0.1%), different from Type A, RSA appears from descending aorta (Type F, <0.1 %), one of two roots as a penultimate branch (Type G, <1%), both VA branch from the aortic arch (Type H, <0.1%) [7]. In present study 6% LVA originates from aortic arch between the LCCA and LSA.

The vertebral artery of aortic arch origin has been earlier described by different authors in the range of 1.6 - 8.3% (Table 2).

Nizanowski, in their study on 160 cadavers and 100 fetuses, found the Left Vertebral Artery originating from the aortic arch in seven adults and one fetus [12]. Panicker reported the Left Vertebral Artery originated directly from arch of aorta between the left common carotid artery and left subclavian artery [16].

Yamaki k et al. [6] described the correlation exist between vertebral artery entering the foramen at abnormal level and variation of its origin from subclavian artery.

Entrance point of the Left Vertebral Artery originating from the aortic arch was also reported variable. Most common entrance points were reported as C5 and C6, respectively [6, 9].

Different levels of entry of the VA to the transverse foramen may also contribute to differences in

hemodynamics [17]. According to Gray's Anatomy, the artery enters the transverse foramina of the 6th cervical vertebra in 90% cases, while those of 7th, 5th, 4th and 3rd in 2%, 5%, 2% and 1% cases respectively [1]. We also found the same findings, on right side 46(92%) and on left side 44(88%), total 90% vertebral arteries entered into the transverse foramen of sixth cervical vertebra while in C5 and C4, it is 8% and 2% respectively.

In a study by Bruneau M et al., out of 500 vertebral arteries studied, by means of MRI and CT angiographic images found variations in 7% (35) cases. In his study it was also found vertebral artery entering at C3, C4, C5 or C7 level respectively in 0.2%, 1.0%, 5.0% and 0.8% of all specimens. Bruneau et al also described bilateral anomaly 0.8% (2) and unilateral anomaly 12.4% (31out of 250) which was more common on left side [20]. Kajimoto BHJ et al. in his study described variations of vertebral artery entering the transverse foramen of 7th cervical vertebra to be 7.5% [21].

Embryological Basis

Usually the first part of vertebral artery develops from proximal part of dorsal branch of seventh cervical intersegmental artery proximal to postcostal anastomosis. The second part is derived from longitudinal communications of the postcostal anastomoses [22]. In the present study left sixth dorsal intersegmental artery might have persisted as first part of vertebral artery hence left vertebral artery is arising from arch of aorta. According to Vorster et al. (1998) the proximal parts of the segmental arteries are exposed to longitudinal tension and bending due to caudal shifting of the aorta resulting in retarded blood flow and abnormal connections between longitudinal channels (vertebral artery) and subclavian artery or aorta [15].

Conclusion

If we see the variant origin of the vertebral artery, it is found mostly on left side. We found 6% of left vertebral artery arising from arch of aorta. While all right vertebral artery arising from their normal site i.e. 1st part of the right subclavian artery. The knowledge of potential left vertebral artery origin variants is necessary and beneficial for planning aortic arch surgery or endovascular interventions [2]. It is of clinical importance to know the origin and course of prevertebral segment of the vertebral artery in detail and being aware of the possible variations, like in this study we found that it is more variable on left side than right side, this relation is important while performing transpedicular fixation or other spinal surgeries. The vertebral artery is subject to mechanical stress, dynamic obstructions, thrombosis that propagates to brain infarction and traumatic dissecting aneurysms in addition to constriction, embolism, and occlusive disease. In order to prevent complications, it is critical to assess vascularization in this region prior to conducting medical procedures. The extracranial portion of Vertebral Artery is frequently affected from atherosclerosis. The most common site of the consequent stenosis is its origin.

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Original Article

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Improvisation in Lectures as a Teaching Method to Develop Interest in Medical Students

Rucha R. Kulkarni

Abstract

This paper introduces different teaching aids to enhance the interest in students pursuing medical education. Two hundred subjects are presented with different forms of teaching and their feedback is recorded. The subjects are surveyed on multiple parameters such as duration of the lecture, interaction between students and teachers, using audio-visual aids, emphasis on practical knowledge, concentration and interest generated by the teacher towards the topic. Finally, it is concluded that to maximize the learning potential among the students, the duration of the lecture should be between 45 to 60 minutes with ample audio-visual aids and regular interaction between the teacher and student.

Keywords: Lectures; Teaching Aids; Lecture Duration.

Introduction

Despite the latest advances in technology, classroom lectures as teaching methods to a group of students is mainstream and globally accepted form of imparting knowledge [1]. In recent times, with the help of technology, education can be imparted online and need not be restricted to classrooms only [2]. Many education portals provide complete training for various subjects and topics. Some portals are also providing personalized methods of education.

However, irrespective of the modes of education available, the globally accepted norm across universities and classrooms is the same, i.e. transmitting knowledge to a group of students pursuing the same subject [3]. However, learning through lectures depends on student factors such as listening, observation, and concentration skills. The attitude of students while attending lectures also influences on the teaching- learning outcomes. Consequently, it is important to understand the feedback of the students on various parameters such as the duration of the lecture, use of teaching aids, and interaction between lectures and so on.

This study aims to improvise the efficiency of lectures by surveying the students on various such parameters.

Materials and Method

Two hundred students pursuing M.B.B.S admitted in two consecutive years were presented with a survey questionnaire consisting of objective as well as subjective questions. The results were analyzed and the outcomes were documented.

The following questions were presented to the students as a part of the survey:

1. What should be the duration of the lecture
   - A. One hour
   - B. One to Two Hours
   - C. 45 Minutes or less
2. Overall, are you able to concentrate on the lecture? If no, please describe the reasons for distraction.
3. Do you prefer interactive lectures?
4. For how long can you concentrate during the lecture?
5. Do teaching aids (presentations, slides, images,

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multimedia, etc) enhance your focus and help you concentrate?

6. Which of the following teaching aids do you prefer:
   A. Black Board
   B. OHP
   C. Multimedia Slides
   D. A combination of above
7. Do you take down notes during the lecture? Does this affect your concentration?
8. Would you prefer being handed over the notes at the end of the lecture?
9. While studying, which of the following do you refer to:
   A. Textbook
   B. Notes
   C. Combination of above
   D. Other
10. While attending the lecture, you give maximum emphasis on:
   A. Understanding the topic
   B. Taking down lecture notes
   C. Fulfilling the attendance criteria
11. Please state some other factors that stimulate you to attend the lectures
12. Do you think it is necessary to know the topic before attending the lectures?

The survey results were then analyzed and studied.

Results

Based on the survey results, we derive the following results:

• *Lecture Duration*

Only 2.8% students are in the favor of keeping lecture duration of two hours.

56.4% of the students recommend lectures of one hour and

40.73% of the students prefer lectures to be of only forty-five minutes.

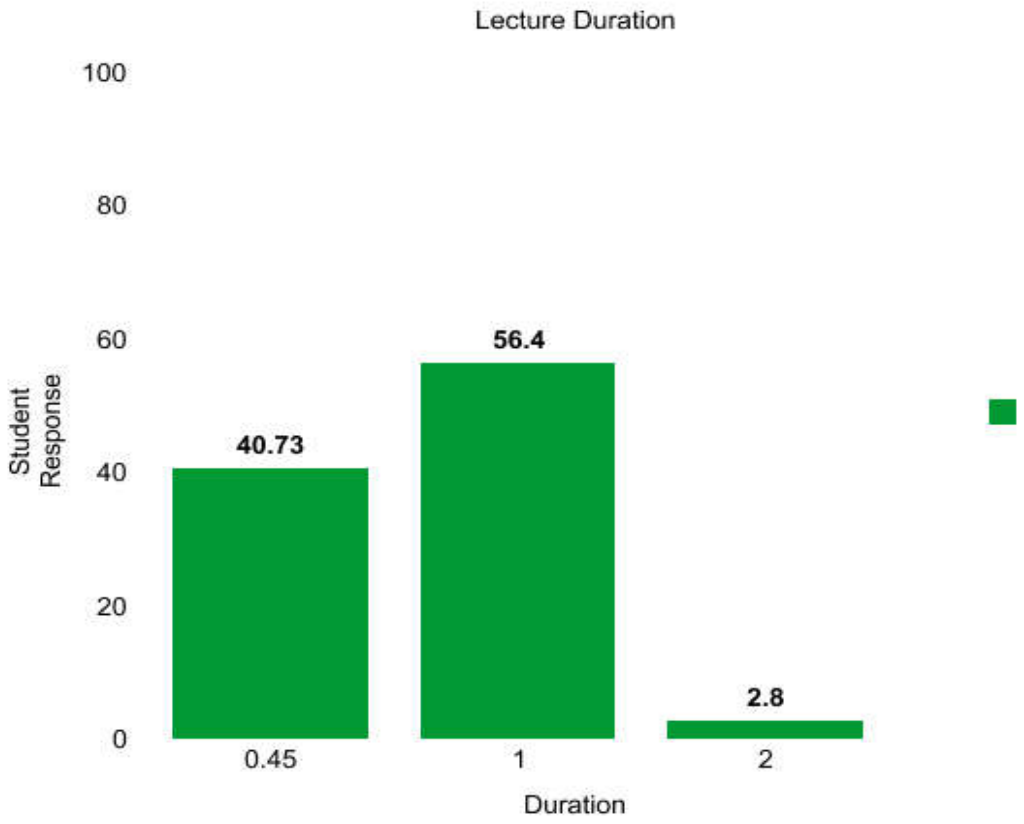

Fig. 1: Graph depicting student response against lecture duration

• *Concentration during Lecture*

55.9% students are unable to concentrate throughout the lecture.

As their concentration level decreases, thoughts about studies, exam, home, hostel, friends come into their mind. However, slide projection, change in tone of lecturer's voice, class interaction draws their attention back to the lecture.

• *Use of Teaching Aids*

100% of the students feel that using teaching aids during a lecture is beneficial.

Black board and overhead projector is preferred by 13.3% and 11.3% of the students respectively. Slide projector is preferred by 26.3% of the students while 49.3% students believe a combination of all teaching aids will provide maximum benefit.

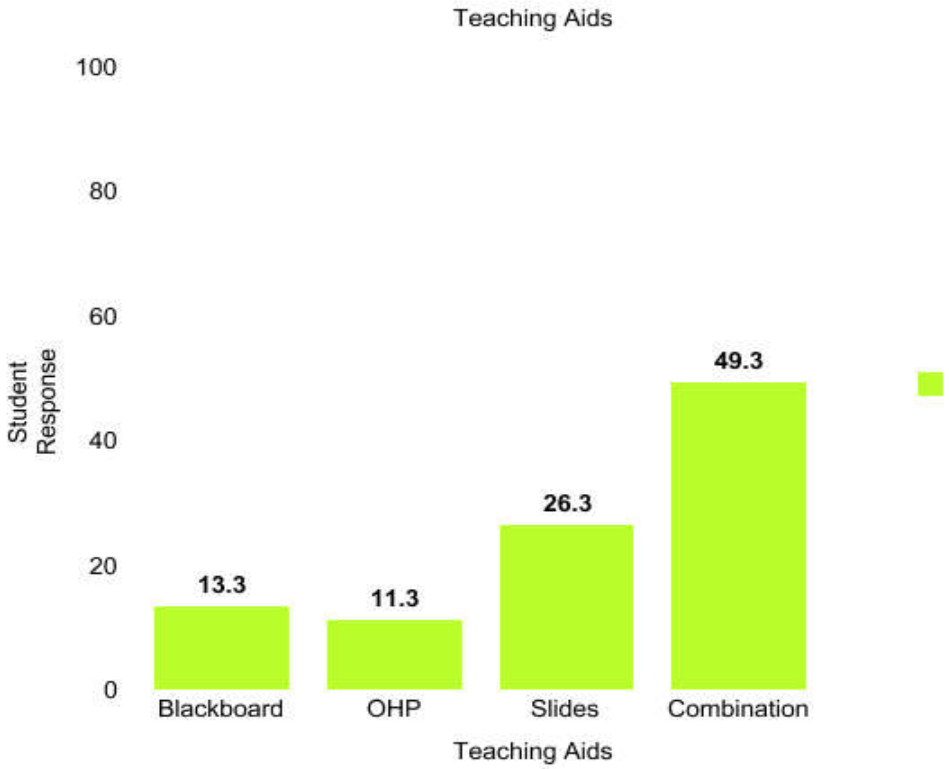

Fig. 2: Graph depicting student Response against various teaching aids

• *Lecture Notes*

80.89% of students take down notes and 91.6% students refer to the notes while studying.

96% students believe notes should be handed out at the end of the lecture. This will allow them to focus completely on the lecture and no distractions will happen while taking down the notes.

• *Student Attitude during Lecture*

66% students give emphasis on understanding the topic, whereas 18% of the students simply focus on taking down the notes. Remaining 16% of the students attend the lectures only to fulfill the attendance criteria.

Moreover, 93.28% students believe it is necessary to know the topic beforehand.

• *Factors attracting students to attend the lecture*

A. Teaching skills
B. Questions that are asked during the lecture
C. To understand the important topics emphasized during the lecture
D. Learning with friends
E. Develop interest in a topic

Discussion

After analyzing the above results, it is understandable that without attending the lecture, it becomes difficult for students to get a basic idea of the topic. Consequently, students should study the topic with reference of the topic notes after the lecture

concludes.

Moreover, in order to generate interest, the teacher must take effort and innovate ideas to keep the topic interesting throughout the lecture. Regular feedback from the students can help teachers inculcate interest from the students during lecture.

Teachers should keep various factors that affect the students level of interest, conceptration and attitude during the lecture. Therefore, it is important to keep these factors in mind while planning and preparing for the lecture.

Conclusion

Based on the above study, we can conclude that the topic of the lecture should be announced before hand.

Duration of the lecture should be sixty minutes or less to keep the focus and concentration levels of the students high. Moreover, the lecture should be interactive and ample teaching aids should be used by the teacher.

Finally, teaching skills and preparation of the teacher toward the lecture is the prime factor that attracts students to the lecture.

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Placental Weight Fetal Weight and Fetoplacental Weight Ratio in Normotensive and Hypertensive Pregnancies

Vaishali S. Mandhana[1], Anagha S. Nawal[2], Gautam A. Shroff[3]

Abstract

Placenta develops and grows till 37th week of pregnancy.Any insult durings its development such as PIH, a disease unique to pregnancy not only affects maternal health but also affects the placental development which in turn jeopardize the fetal normalcy. Present study was carried out to know the effect of PIH on placental weight , fetal weight and fetoplacental weight ratio. A total of 100 placentae of which 50 placentae of normotensive (control group) and 50 placentae of hypertensive pregnancy (PIH group) were collected fresh from either the delivery room or operation theatre. Placentae were washed, dried and weighted. Fetus were also weighted on the same weighing machine. Fetoplacental weight ratio was calculated. It was found that the weight of placenta and weight of fetus were significantly decreased in PIH group as compared to control group. The mean Placental weight was found to be 439.8 grams in control group and 378.6 gram in PIH group. Fetal weight was also decreased significantly. The mean fetal weight in control group was 2677.6 grams and 2112.2 grams in PIH group. The study showed linear co relation between fetal weight and placental weight in control group and there was significant decrease in fetoplacental weight ratio in PIH group.

Keywords: Placental Weight; Fetal Weight; Fetoplacental Weight Ratio; Pregnancy Induced Hypertension (PIH).

Introduction

Fetus is totally dependent on the Placenta for its nutrition and respiratory support hence a balance between fetus placenta and mother is required for the proper growth and development of fetus.Placenta not only determines fetal growth and well being but also an important factor in determining the health of the fetus in adulthood.Hence appropriate growth and development of the placenta is essential[1]. Placenta grows till 37th week of pregnancy and its morphology varies considerably during this short period.

A term placenta is discoid,its diameter 15 to 20 cms (6-8 inches) Thickness 2.5 to 3 cms at centre, and weight is 500 to 600 grams.

The inability of placenta to transport nutrients to the fetus or small placenta may affect the wellbeing of fetus or can limit the intra uterine fetal growth [2]. As low weight of placenta is unable to meet fetal growth requirnments.

Instead of considering it a waste and throwing it away placenta should be considered very important organ as it can give us an idea about the fetal journey. Placental weight is also very important parameter as several studies have shown the corelation between placental weight and future chronic diseases notably diabetes and hypertension [3].

Not only placenta but condition of mother during pregnancy also affects fetal growth and development.Pregnancy complications such as hypertension or gestational diabetes invariably causes structural changes in the placenta.It has been recorded that the maternal utero placental blood flow is decreased in pre-eclampsia because there is maternal vasospasm [4] the origin of Pre eclampsia, a disease unique to pregnancy is still matter of debate and numerous theories have been proposed.

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Preeclampsia develops after a partial disorder in the process of placental formation perhaps due to deficiency of trophoblastic invasion by its spiral arteries and acute atherosis in its myometrial segments [5].

Present study is carried out to study how the PIh, a disease unique to pregnancy affects placenta, particularly to its weight which in turn affects fetal well being and Feto placental weight ratio which has become an important indicator to predict the future sufferings of fetus.

Material and Methods

This was a prospective study carried out in our institute. Placentae were obtained from the department of Obstretics and Gynacology where the mothers were delivered normally or by ceserian section in the labour room or in the operation theatre. A total of 100 placentae were collected in two groups.

Group I

This group included 50 placentae. These were collected from the mothers who had normal full term pregnancy,not suffering from PIH (Blood pressure was <140/90 ml of Hg without edema or proteinuria), blood coagulopathies,respiratory or cardiac diseases or any other disease which can affect the blood pressure of mother or fetal outcome in any way. This group was labelled as control group/normotensive group.

Group II

This group consisted of the cases with blood pressure of 140/90 or above with edema or proteinuria or both.Some cases also had eclamptic fits with symptoms like blurring of vision, headache, upper abdominal pain or oliguria.None of the cases had hypertension prior to pregnancy. A total of 50 placentae were collected in this group, and lebelled as PIH group Hypertensive group.

Collection of Placentae

Placentae were collected immediately after the delivary. Blood was allowed to drain out by keeping it flat on a tray. Then it was washed under running tap water and dried with blotting paper. Umbilical cord was cut 5 cm away from its insertion.

1. Weight of placenta along with the membranes and 5 cm of cord was recorded onthe scientific weighing machine.
2. Fetal surface and the membranes were examined for their glossiness,translucency and colour.

Fetal Weight

The weight of baby was measured in grams on the same weighting machine on which the placental weight was recorded. A note was made about congenital anomalies if any.Feto placental weight ratio was calculated in both the normotensive and hypertensive group.

Results/Observations

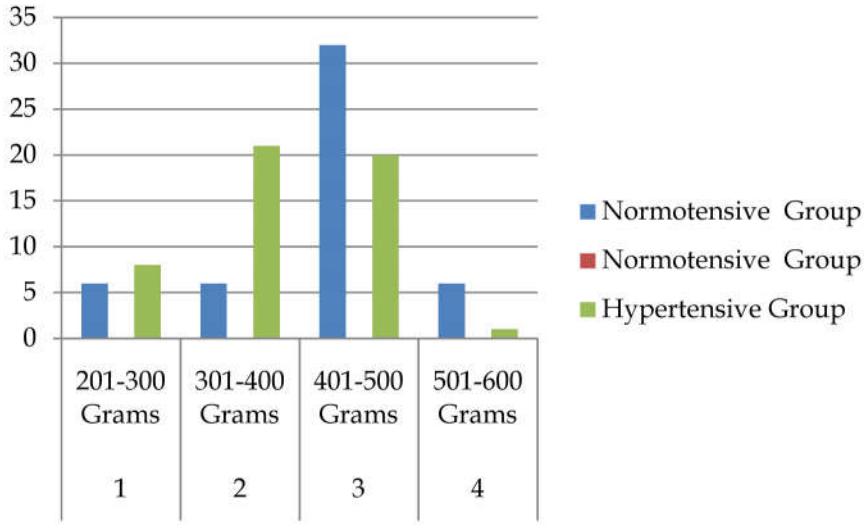
The mean Placental weight in Hypertensive group was 387.6 gms. ± 79.73 gms as compared to 439.8 gms ±78.75 gms in Normotensive group. In PIH the weight of Placenta was found to be less as compared to normotesnsive group. Values less than 250 grams were found in Hypertensive group only. The difference in the weight of Placenta in both the groups was found to be statistically singnificant (P value < 0.05).

Table 1: Weight of placenta

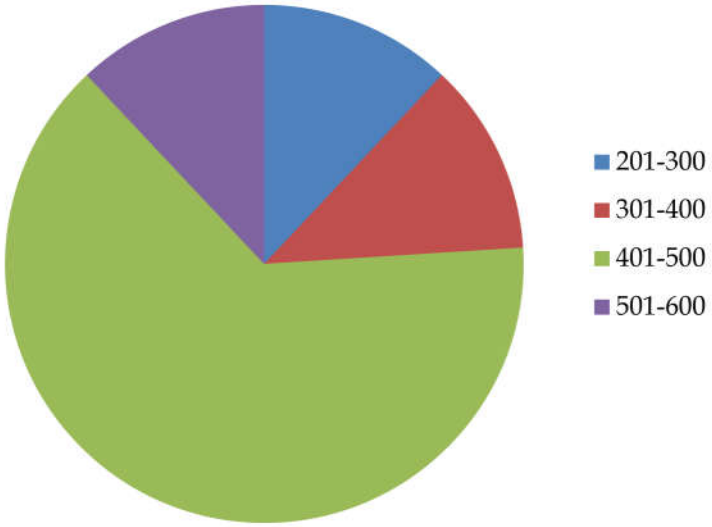
Sr. No.	Weight in GMS.	No. of Cases			
		Normotensive group	%	Hypertensive group	%
1	201-300	6	12%	8	16%
2	301-400	6	12%	21	42%
3	401-500	32	64%	20	40%
4	501-600	6	12%	1	2%

Table 2:

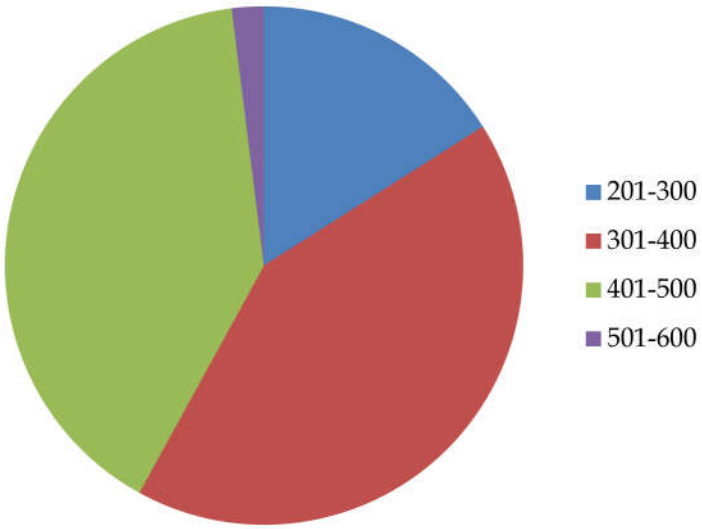
	Normotensive Group	Hypertensive Group
Mean Placental weight	439.8 gms	387.6 gms.
Max. Placental weight	570 gms.	510 gms.
Min. Placental weight	250 gms.	210 gms.
S.D.	78.75	79.73
Coe. of variation	18.23	20.57



Bar Diagram 1: Weight of Placenta



Pie Chart 1: Weight of Placenta (in grams) in Normotensive Group



Pie Chart 2: Weight of Placenta (in grams) in Hypertensive Group.

Fetal Weight

Present study showed that there was a significant decrease in the Fetal weight in Hypertensive group as compared to Normotensive group. The mean foetal weight in Hypertensive group was 2112.2 gms. ± 511.23 gms. as compared to 2677.6 gms. ± 520.6 in Normotensive group.

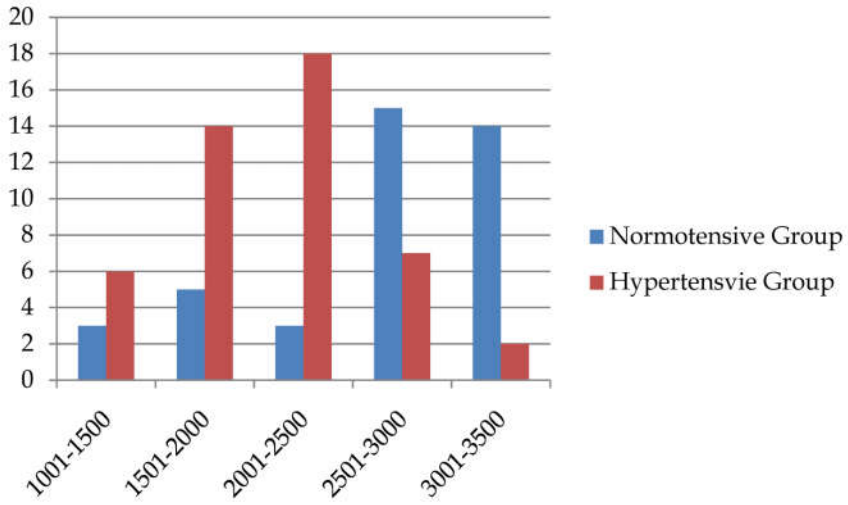
Moreover the foetal weight showed more variability in Hypertensive group.(Coe.of Variation = 24.20) as compared to Normotensive group (Coe. of variation = 19.44).

Table 3: Showing Fetal Weight

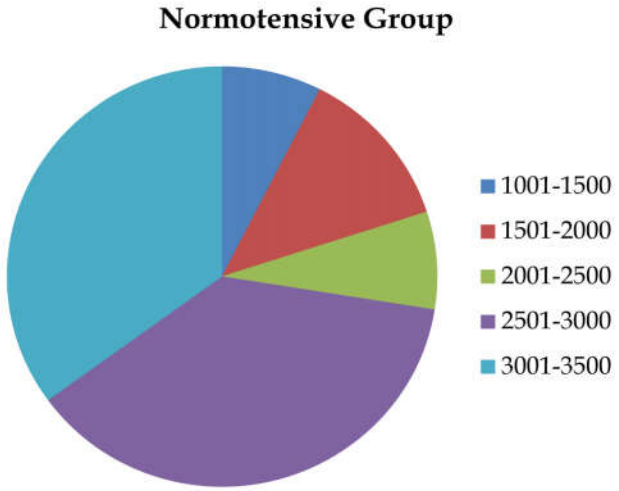
Sr. No.	Weight in GMS.	No. of cases			
		Normotensive group	%	Hypertensive group	%
1	1001-1500 gms.	3	6%	6	12%
2	1501-2000 gms.	5	10%	17	34%
3	2001-2500 gms.	3	6%	18	36%
4	2501-3000 gms.	15	30%	7	14%
5	3001-3500 gms.	14	28%	2	4%

Table 4:

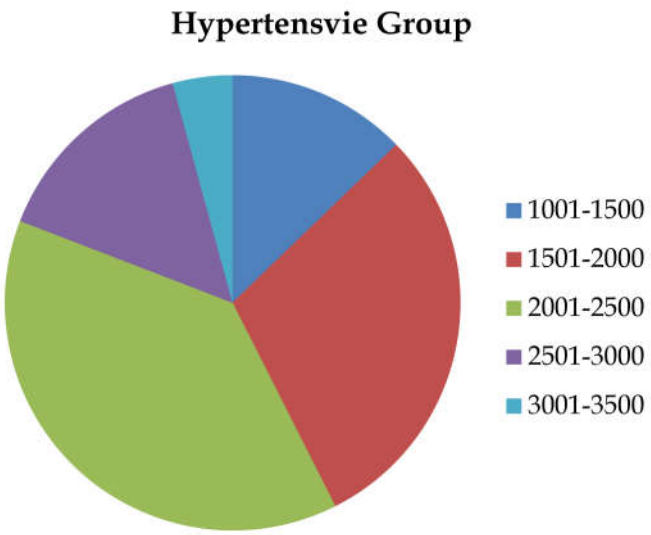
	Normotensive Group	Hypertensive Group
Mean Fetal weight	2677.6 gms	2112.2 gms.
	3400 gms.	3200 gms.
Min. Fetal weight	1420 gms.	1150 gsm.
S.D.	520.6	511.23
Coe. .of variation	19.44	24.2



Bar Diagram 2: Fetal Weight (in Grams)



Pie Chart 3: Fetal Weight in Normotensive Group (In Grams)



Pie Chart 4: Fetal Weight in Hypertensive Group (In Grams)

Feto placental weight ratio was calculated in both the normotensive and hypertensive group.

The mean fetoplacental weight ratio was found to be 6.07 in Normotensive group and 5.42 in Hypertensive group.

Discussion

Placenta is the most important organ for maintaining and continuing healthy pregnancy. It transfers and exchanges oxygen and nutrition needed for fetus.The examination of placenta would demonstrate important information about whatever has happened to fetus.

It plays a vital role in normal fetal development and failure of placenta to gain weight and insufficiency of its function can result in fetal disorders [6]. As placeta is the only gateway to the fetus any lesion, insufficiency or abnormality can affect the outcome of the fetus. Placenta is developing till 37th week of gestation. Weight of placenta is regarded by many as an appropriate marker of the balance between fetal and placental growth.A term placenta of a single full term pregnancy is 500 to 600 grams [2]. As noted by Burkhardt [3] mode of delivery also affectes placnetal weight which he found to be higher in caesarean section than in Vaginal delivaries.Kevin V Blake[7] has stated that mother's own birth weight is statistically singnificant predictor of placental weight. Sitti Patimah [8] stated that maternal age has significant effect on placental weight.

Table 5: Comparison of Placental Weight(Weight in Grams)

	Normotensive Group	Hypertensive Group
Nobis & Das (1991)	368	359
Udania & Jain (2001)	495	403.53
Majumdar, S. (2005)	485.85±47.31	399.10±90.31
Prabjyot Kour (2013)	458.28±42.13	375.95±67.195
Present Study	439.8 ±78.75	387.6±9.73

Our study shows that there was significent decrease in Placental weight in the Hypertensive group. Values less than 250 gms.were found in Hypertensive group only.These values are comparable with study of Prabjyot Kour [9] who found the Placental weight of 458.28±42.13 in Normotensive group and 375.95±67.195 grams in Hypertensive group.

Raghvendra and Colleagues (2014) [4] in their study also found decreased Placental weight in all grades of PIH. Majumdar (2005)[10], Udania and Jain (2001)[11] and Nobis Das (1991)[12] also found decreased placental weight in Hypertensive group as compared to Normotensive group as shown in Table 5. Das B etal(1996)[13] co relates decrease in placental weight in PIH with the duration of hypertension. M. Asgharria (2006)[6] in his study has mentioned that there were more low weight placenta in pre eclamptic mothers. Kalpana Chhetri (2015)[14] has found that decreasing Placental weight with

increasing gestational age was observed only in pre eclamptic mothers with the maximum at 31(0.2) weeks and minimum(0.16) at 38 weeks.This shows that the placental growth peak was delayed in pre eclamptic mothers.

Table 6: Comparrision of Fetal weight (Weight in Grams)

	Normotensiv Group	Hypertensive Group
Nobis & Das (1991)	2840	2660
Udania & Jain (2001)	2640	2265
Majumdar,S. (2005)	2800±0.32	2040±0.48
Prabjyot Kour (2013)	28.78±305.53	2422±613.27
Present Study	2677.6	2112.2

The Mean fetal weight in our study was 2677.6 grams in control group 2112.2 grams in Hypertensive group. Prabjyot kour (2013)[9] found decreased fetal weight in Hypertensive group as compared to Normotensive group as shown in Table 6. Raghvendra A.Y(2014)[4] found that the mean birth weight in Hypertensive group is low and directly related with increasing grades of Hypertension. M. Asgharnia (2007)[6] has mentioned that low weight Placentae were associated with low birth weight fetuses. Our values are comparable with Udania and Jain (2001)[11] and Majumdar S (2005)[10] as shown in the Table 6. Rath, G. Garg K, and Sood M (2000)[15] also have mentioned the significant decrease in the fetal weight in Hypertensive group.Nobis and Das (1991)[12] also confirms the same but slighly higher value in both the groups in their study may be due to regional or socio economic difference in the two population groups. Kevin V. Blake [7] has established a significant inverse relationship between blood pressure and birth weight.He stated that this association may be the result of fetal adaptations to an adverse intrauterine enviornment.

The ratio between fetal weight and placental weight varies considerably throughout gestation and is affected by many factors as well.

The feto placental weight ratio in normal pregnancy is as under [16].

Month	Fetus:Placenta
1st Month	1:6
4th Month	1:1
At birth	6:1

The present study shows a linear co relation between fetal weight and placental weight with the fetoplacental weight ratio of 6.07 in control group. This observation is in conformity with A. Sedlis (1967)[17] and N.Vasudeva(1991)[18]who stated that there is linear co relation between fetal weight and placental weight in normal pregnancy. Moore (1999)[16] stated that fetal weight is 6 times the placental weight in normal pregnancy. B. Mukherjee (1983)[19] also found that there is significent relation between fetal weight, placental weight and diameter of Placenta in normal pregnancy, in last trimester.

In Hypertensive group The feto placental weight ratio in present study is 5.42 .The significent decrease in feto placental wight ration in Hypertensive group is in conformity with Nobis and Das (1991)[12],who found that feto placental weight ratio is 7.72 in Normotensive group and 7.41 in Hypertensive group.Slighlty higher values of feto placental weight ration in both the groups in his study are obivious due to lower values of placental weight. Our findings are also compareable with findings of Majundar (2005)[10] who found that Fetoplacental weight ration was 6.23 in Normotensive group and 5.89 in Hypertensive group (Table 7). Rath G. , Garg. K and Sood. M (2000)[15] also found that the mean fetoplacental weight ratio of hypertensive group was low than Normotensive group.

Conclusion

As placenta is essential not only for fetal growth

Table 7: Comparission of fetoplacental weight ratio

	Normotensive Group	Hypertensive Group
Nobis & Das (1991)	7.72	7.41
Majumdar,S. (2005)	6.23	5.89
Present Study	6.07	5.42

and well being but also affects the health of the infant in future.

PIH, one of the commonest problems affecting pregnancy, affects the placental development which in turn affects the fetus hence early diagnosis and proper management of PIH cases is required.At the same time evaluation and follow up of placental growth in early pregnancy, placental examination and recording its all parameters is important in improving the health of infant in future.

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Morphological Study of Suprascapular Notch of Adult Scapula

Vinay G.

Abstract

Background: One of the common etiology for shoulder pain is suprascapular nerve entrapment. The suprascapular notch is a depression present on the lateral part of superior border of scapula, which is bridged by superior transverse scapular ligament. It transmits the suprascapular nerve to supraspinatus fossa. Variations in the morphology of suprascapular notch is one of the cause for suprascapular nerve entrapment syndrome. It also forms an important landmark for suprascapular nerve in arthroscopic shoulder surgeries. The aim of the present study is to note the various shapes of suprascapular notch and its clinical implications. *Materials and Methods:* One hundred and ten dry adult scapulae of both sides were examined for variations in shapes of suprascapular notch. We classified suprascapular notch in to six types based on study done be Rengacahry et al. *Results:* In the present study, out of 110 scapulae, we observed Type I (without discrete notch) in 12 scapulae. Type III was the commonest with fifty-seven scapulae. The incidence of Type VI (complete ossified notch) was seen in 10 scapulae. *Conclusion:* The knowledge of anatomical variations in the shapes of suprascapular notch will be helpful in understanding the etiology of suprascapular nerve entrapment. The determination of type of notch helps the clinicians in screening the high risk population in patients with shoulder pain. Anatomical knowledge of such variations should be kept in mind by a radiologist, Orthopaedicians and neurosurgeons as these variations may alter the technique of surgery.

Keywords: Suprascapular Notch; Morphology; Suprascapular Nerve; Entrapment.

Introduction

The scapula is a triangular, flat bone of pectoral girdle which lies on posterolateral aspect of the thorax, between second to seventh ribs. The posterior convex surface of scapula is unevenly divided by the spinous process into larger infraspinous fossa and a smaller supraspinaous fossa. The suprascapular notch (SSN) is a depression present on the lateral part of superior border of the scapula just medial to the root of coracoid process. This notch is converted into a foramen by the superior transverse scapular ligament and serves as a passage for suprascapular nerve, whereas suprascapular vessels pass backwards above the ligament. Suprascapular nerve supplies motor branches to the supraspinatus and infraspinatus muscles and sensory branches to rotator cuff muscles, shoulder joint, coracoacromial and coracohumeral ligament [1]. The morphology of suprascapular notch is considered to be a risk factor for suprascapular nerve entrapment either in combination with an anomalous superior transverse scapular ligament (STSL) or as a narrowed notch [2].

The etiology in 1-2% of patients with shoulder pain is considered to be suprascapular nerve entrapment [3]. Koepell and Thompson were the first to describe the suprascapular nerve entrapment syndrome. They reported that abduction or horizontal adduction of the shoulder exerted traction on the suprascapular nerve, which led to its compression against the superior transverse scapular ligament [4]. Suprascapular notch forms an important landmark during arthroscopic shoulder operation [5]. The morphological variation of the SSN can be correlated to the individual's predisposition to the

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suprascapular nerve entrapment [6]. The partial or complete ossification of the STSL is considered to be a most common predisposing factor for suprascapular nerve entrapment, as the ossified ligament further decreases the size of the notch thus increasing the chances for suprascapular nerve entrapment [7]. The suprascapular nerve entrapment leads to the weakness of arm, difficulty in external rotation and abduction, atrophy of the infraspinatus and supraspinatus muscles. This entrapment syndrome is most frequently found in volleyball players and athletes who repeatedly experience stress on their shoulder [8,9,10].

Suprascapular notch has been varyingly classified by many researchers based on morphometric measurements. Rengachary et al has classified the suprascapular notch into six types based on its morphology [11]. The purpose of the present study was to document the incidence of the various morphological types of the suprascapular notch in South Indian population and to compare the observations with its prevalence in other ethnic populations.

Materials and Methods

The present study was carried out on 110 dried, human scapulae (60 right and 50 left) obtained from osteology collection in department of Anatomy of MES Medical college, Perinthalmanna, Kerala. The obtained bones were grossly examined irrespective of age, gender and race for the different shapes of suprascapular notch based on Rengachary et al, absence of suprascapular notch and for the degree of ossification of STSL. Damaged and broken scapulae were excluded from this study.

Rengachary et al [11]assified suprascapular notch into six types:

Type-I –wide depression in the superior border of the scapula

Type-II - wide blunted V-shaped notch

Type-III - symmetrical and U-shaped notch

Type-IV - very small narrow V-shaped notch

Type-V - partially ossified medial portion of STSL, notch minimal & U-shaped,

Type-VI - completely ossified STSL.

The type of suprascapular notch was noted and the findings were compared with other morphological studies in various populations based on Rengachary et al classification.

Results

One hundred and ten scapulae (sixty – right side and fifty - left side) were analyzed, out of which suprascapular notch was absent in twelve scapulae. The incidence of various types of suprascapular notch was classified into six types based on Rengachary et al is represented in Table 1. Type III was the commonest one with fifty-seven scapulae and type V with partial ossification was the least one with five scapulae.

Table 1: Different types of suprascapular notch

Type	Right	Left	Total (%)
Type 1	8	4	12 (10.9%)
Type 2	10	8	18 (16.4%)
Type 3	31	26	57 (51.9%)
Type 4	5	3	8 (7.2%)
Type 5	2	3	5 (4.5%)
Type 6	4	6	10 (9.1%)

Table 2: Comparison of types of notch with other studies

Authors	Types of notch					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Rengachary et al[11]	8%	31%	48%	3%	6%	4%
Paolo Albino et al[16]	12.4%	19.8%	22.8%	31.2%	10.2%	3.6%
Sinkeet et.al[7]	22%	21%	29%	5%	18%	4%
Ushakannan et al[17]	20%	10%	52%	4%	4%	10%
Sumathi et al[15]	11.7%	23.2%	43%	3.5%	5.8%	12.8%
Present study	10.9%	16.4%	51.9%	7.2%	4.5%	9.1%

Fig. 1: Type 1: Absent Notch

Fig. 2: Type 2: Shallow V notch

Fig. 3: Type 3: Symmetrical U notch

Fig. 4: Type 4: Deep V notch

Fig. 5: Type 5: Partial Ossification

Fig. 6: Type 6: Complete Ossification

Discussion

The suprascapular nerve entrapment is an acquired neuropathy, most commonly at the level of suprascapular notch due to the narrow dimensions of notch or ossification of suprascapular ligament. Several morphological variations and classifications of suprascapular notch have been reported in various populations. Rengachary et al [11] done a study on 211 American scapulae and classified suprascapular notch into six types (Type I – Type VI) based on the width at superior border of the notch, the widest point within the notch, and the depth of the notch. Joe De Beer [12] stated that the shape of the notch and calcified STSL has been associated with increased risk of suprascapular nerve entrapment, resulting in weakness and wasting of supraspinatus and infraspinatus muscles. Sinkeet et al [7] in their study classified 6 types of SSN with description, which also includes degree of STSL ossification. According to their study Type I represent wide 'U', Type II represents 'J' shape, Type III, which has explained has most common, represents symmetrical, Type IV represents 'V' shape, Type V&VI are related to the

degree of ossification of STSL. Iqbal et al in their two different studies in Pakistani population showed four types of notches, with 10% without notch (type 1), 14% symmetrical (type 2), 68% 'V' shape (type 3) and 8% inverted 'V' (type 4) which is having a greater inferior maximum length as compared to superior length [13,14].

The comparison of different shapes of suprascapular notch depending upon size and shapes by various authorswith the present study are illustrated in Table 2. These various shapes are thought to play a part in predisposition for suprascapular nerve entrapment, assuming that a small notch gives a larger chance of nerve impingement than a large notch. The incidence of complete absence of suprascapular notch in present study was found in 10.9% and in the study by Rengachary et al [11] it was 8%. The prevalence of type I notch as per study by Sumathi et al [15] and Paolo Albino et al [16] was 11.7% & 12.4% respectively. In the current study the predominant type was type III which correlates with study conducted by Rengachary et al in American population and by Sinkeet et al in Kenyan population. The partial or complete ossification of the STSL has been identified as a predisposing factor for suprascapular nerve entrapment.

The incidence of type 6 which is complete ossification of STSL in present study is 9.1% which is similar to the values got by Usha et al [17] and Sumathi et al [15], which is 10% and 12.8% respectively. The tendency of STSL to ossify suggests that the ligament responds to changes in the mechanical load [18]. The variations in the thickness and length of STSL are also considered to have an effect on the suprascapular nerve as it traversesthrough the suprascapular notch. Such cases are more prone for suprascapular nerve entrapment as the ossified ligament further decreases the size of the notch and decreases the space available for the suprascapular nerve. Overhead athletes continually put their arms in the extremes of motion which creates large torques on the shoulder. This causes traction on the suprascapular nerve at the SSN through which it traverses.

This is called the sling effect which proposes that in certain functional positions the suprascapular nerve is exposed to damaging sheer stress in the notch [9,19]. The investigations like nerve conduction velocity and electromyography studies, X-ray, CT Scan and MRI may be helpful in correct diagnosis. The electrophysiological studies and MRI should always be used when clinical findings are suggestive of suprascapular nerve entrapment.

Conclusion

The present study showed various types of suprascapular notches. Out of these type III was most predominant. The suprascapular nerve is very intimately related to the suprascapular notch while passing through it. Variations in shape and size can be considered as a possible causative factor in nerve impingement. The knowledge about the classification and the anatomical variations ofthe suprascapular notch will help the clinicianto easily define the type of notch and correlate the suprascapular nerve entrapment with aspecific type of notch. This should also be taken into consideration during surgical or arthroscopic shoulder procedures. This can further be helpful in avoiding iatrogenic suprascapular nerve injuries during shoulder arthroscopies.

Abbreviations

SSN - Suprascapular notch

STSL - Superior transverse scapular ligament

Conflicts of Interest: None

Source(s) of Support: Nil

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Original Article

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Anatomical Variants of Obturator Artery in Human Cadavers among North Karnataka Subjects

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Abstract

Context: Normally Obturator Artery arising from anterior division of internal iliac artery. It supplies perineum and pelvic organs. The enlightenment and proper knowledge of the obturator artery of its origin, course will provide the surgeon proper guidelines of the artery during various surgical procedure. Hence the present study was been undertaken with reference to their surgical significance. *Aims:* To study the origin and course of obturator artery in human cadaveric specimen. *Materials and Methods*: The study was conducted in the Department of Anatomy, Raichur Institute of Medical Sciences for duration of 2 year from April 2015 to April 2017. In the present study, 30 dissected hemi pelvic specimens of both male and female formalin fixed cadavers were taken. The origin and course of obturator were traced along with noting down the variations in them. *Results*: In the present study, Obturator artery arising from anterior division of internal iliac artery was noted in 14 cases, 5 cases from inferior epigastric artery, 4 cases from external iliac artery and it also arising from the common trunk of anterior division of internal iliac artery in 7 cases. *Conclusion*: Anatomical data obtained about variations in origin of obturator artery is of importance for surgeons and radiologists for procedures in reconstructive surgeries involving in the groin.

Keywords: Anatomical Variations; External Iliac Artery; Internal Iliac Artery; Obturator Artery.

Introduction

Anterior division of the internal iliac artery branches into Obturator artery (OA) which courses downwards and forwards on the lateral pelvic wall to reach the upper part of the obturator foramen, and leaves the pelvic cavity by the obturator canal. Iliac, vesical and pubic branches are given off by obturator artery. Later obturator artery divides into anterior and posterior branches to supply the medial compartment of the thigh. Posterior branch gives off the acetabular branch, which enters the hip joint [1].

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The study of vascular pattern and their variations are of much importance in pelvic region as large number of organs and anatomical structures are cramped in this anatomical region. Clear awareness of the vascular anatomy of pelvis is critical in surgeries performed here, which require ligation of the arteries concerned and also because such anomalous origins may cause profuse bleeding during surgical procedures. This is particularly true with regard to the variations in the origin of the obturator artery, while performing pelvic and groin surgeries [2]. Surgeons dealing with direct or indirect inguinal, femoral or obturator hernia need to know the variations of the Obturator Artery and their close proximity to the femoral ring [3].

So, aim of this study was to know the variations in origin and course of obturator artery in North Karnataka population.

Materials and Methods

This study was conducted on 30 adult pelvic halves

in the Department of Anatomy from Raichur Institute of Medical Sciences, Raichur for duration of 2 years from April 2015 to April 2017. Dissection method was employed for this study in each of the formalin fixed pelvis. The Internal Iliac Artery and its branches were dissected and cleaned. The variations in origin and course of obturator artery were observed and photographs were taken. It is then dehydrated with acetone. The bisected halves of the pelvis with the vessels in situ have been preserved in 10% formaldehyde solution. The percentages of anatomical variations in origin were calculated.

Observation and Result

In the present study, Obturator artery arising from anterior division of internal iliac artery was noted in 14 pelvic specimens, 5 pelvic specimens from Inferior epigastric artery, 4 pelvic specimens from External iliac artery and it was also arising from the Common trunk of anterior division of Internal iliac artery in 7 specimens (as shown in Figure-1,2,3 and 4).

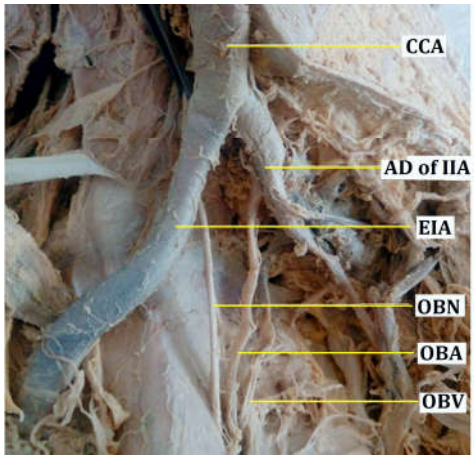

Fig. 1: Showing the origin of Obturator Artery from Anterior division of Internal Iliac Artery (AD of IIA)

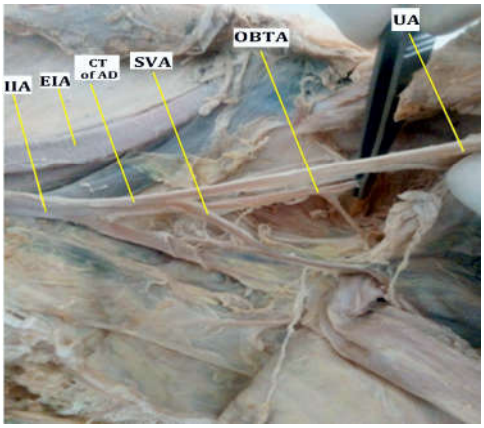

Fig. 2: Showing the origin of Obturator Artery from Common Trunk of Anterior Division of Internal Iliac Artery (CT of AD)

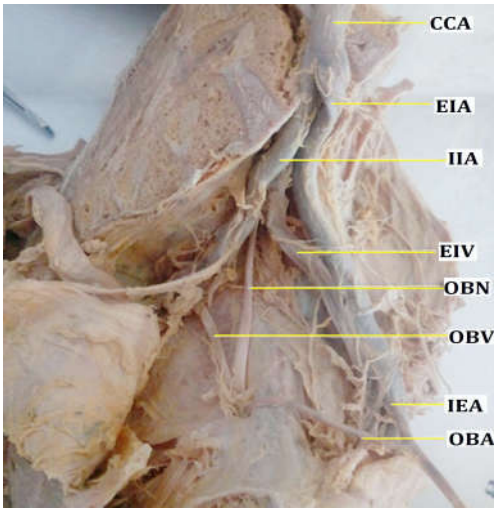

Fig. 3: Showing the origin of Obturator Artery from Inferior Epigastric Artery (IEA)

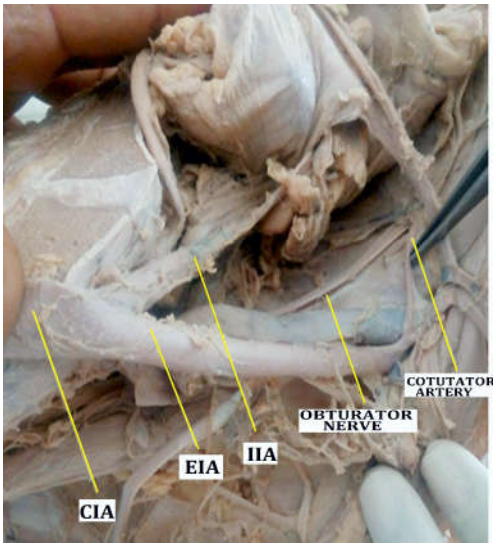

Fig. 4: Showing the origin of Obturator Artery from External Iliac Artery

Discussion

The nutrition to pelvic wall, pelvic viscera, external genitalia, the perineum, buttocks and the medial part of the thigh is provided by internal iliac artery branches [4]. Obturator artery is normally a branch from anterior division of internal iliac artery. The obturator artery has been documented to be arising from all the possible neighbouring arteries, namely common iliac artery, external iliac artery from any branch of internal iliac artery in either sex [5]. Interesting variations in the origin of obturator artery have long since attracted the attention of anatomists and surgeons.

Table 1: Showing the percentage of incidence in variation of Obturator Artery

Sl. No.	Site of origin of Obturator Artery	Percentage of incidence in variation in origin of Obturator artery.
1.	Anterior division proper(normal)	47.2%.
2.	Common trunk of anterior division from Internal iliac Artery	23.33%
3.	Inferior epigastric artery	17%
4.	External iliac artery	13.33%

Table 2: Showing frequency of variations in origin of obturator artery reported by various Authors

Origin of Obturator artery	Frequency of origin in obturator artery reported by various Authors						
	Persons and kaith[2] (1897)	Pick Ashely and Anson[7] (1942)	Braithwaite[8] (1952)	Sanudo.et. al[9] (2011)	Tirupathirao et al., [10] (2013)	Akshara.et.al[2] (2015)	In the present study (2016)
Direct from anterior division of internal iliac artery	39.3%	42.6%	41.4%	52.68%	35.55%	54%	47.2%.
Common trunk of anterior division from Internal iliac Artery	-	-	-	-	-	-	23.33%
Inferior epigasteric artery	25%	21.3%	19.5%	29.02%	26.66%	22%	17%
Direct from external iliac artery	1.6%	0.9%	1.1%	1.79%	8.88%	4%	13.33%

In the present study, it was observed Obturator artery arising from anterior division proper in 47.2%, in 17% from inferior epigastric artery, in 23.33% from common trunk of anterior division from Internal iliac Artery with superior vesical and inferior vesical artery, in 13.33% from external iliac artery.

According to Bergman.et.al in a compendium of human anatomic variations document that the most common source source of origin of the Obturator Artery that is 41.4% of cases from common iliac or anterior division of internal iliac, in 25% from the inferior epigastric, in 10% from the superior gluteal, in 10% the interior gluteal/ internal pudendal trunk, in 4.7% the inferior gluteal, in 3.8% the internal pudendal and in 1.1% the external iliac artery respectively [6].

In 2015 Akshara Venmalassery Rajive and Minnie Pillay conducted study on 50 pelvic specimens found obturator artery was arising normal from anterior division of internal iliac artery in 54% cases, from common trunk of the internal iliac artery in 4 % cases, from inferior epigasteric artery in 22% cases and external iliac artery in 4% cases respectively [2]. In the present study frequency of variation in origin of obturator artery was different when compared to other study due to racial differences. (as shown in Table 2)

If the anterior division of internal iliac artery is obstructed due to any cause, the obturator artery and its branches to the head of Femur, when the obturator artery arises from the external iliac artery [11].

The 'corona mortis' located behind the superior pubic ramus is an anatomical variant where there is an anastomosis between the obturator and the external iliac or inferior epigastric arteries or veins. 'Corona mortis' meaning crown of death, is so named due to its immense importance for its potential in causing considerable hemorrhage when cut and the difficulty in achieving subsequent haemostasis. Darmanis. et. al could find a vascular anastomosis in 83% of the cases in their cadaveric dissection study [12]. Namking.et.al in study on 204 north eastern Thai cadavers reported the presence of arteria corona mortis in 22.5%, venous corona mortis in 70.6% and both structures in 17.2% [13]. According to Akshara.et.al in 2015 corna mortis is present in 26% of the cases there was a vascular connection between obturator artery and inferior epigastric (22%) and between Obturator artery and external iliac (4%) arteries [2]. In the present study is seen in 30% cases among which 17% was between obturator artery and inferior epigasteric artery and 13% in between obturator artery and external iliac artery.

The corona mortis or (CMOR) has widespread clinical implications being closely related to the superior pubic ramus, the acetabulum and the femoral ring and thus the femoral hernial sac that might enter the ring [14]. CMOR is at risk in groin or pelvic surgeries [15], could be avulsed in the fractures of superior pubic ramus leading to significant

haemorrhage [16], could be injured in laproscopic hernia repair while dissecting the preperitoneal space of Bogros and the hernial sac [17] could prove to be a hazard for orthopaedic surgeons planning an anterior approach to the acetabulum such as ilioinguinal or intrapelvic [12].

Other variations that were noted in this series included one in which the OA was seen arising from the Common trunk of anterior division of Internal iliac artery in 7 specimens.

The embryological explanations for the anomalies in the arterial patterns of the limbs are based on an unusual selection of channels from a primary capillary plexus, wherein the most appropriate channels enlarge, while others retract and disappear, thereby establishing the final arterial pattern [18,19]. The Obturator artery arises comparatively late in development as a supply to plexus, which in turn is joined by the axial artery of the lower limb that accompanies the sciatic nerve [20]. Before the Obturator artery appears as an independent blood vessel from the rete pelvicum, the blood flow destined for this territory makes an unusual choice of source channels. Instead of arising from the internal iliac artery as usual, it arises from the inferior epigastric artery, or directly from the external iliac artery [20].

The study implies the frequent occurrence of obturator artery from external iliac artery and inferior epigastric artery in North Karnataka population. Such common variations indicate the necessity of the surgeons and orthopaedicians to look for such vascularity to avoid undue haemorrhage and complications.

Key Message

In this study obturator artery was arising from inferior epigastric artery in 17% cases and external iliac artery in 13% cases due to unusual selection of channels from primary capillaries during embryological development. This knowledge is useful for surgeons in order to avoid untoward complications during the time of pelvic surgeries.

Conclusion

The branching pattern of obturator artery does vary very often from one side to other side in the same person and individual-to-individual. So surgeons should know the branching pattern of obturator artery while doing endoscopic repair of inguinal or femoral hernias because accessory obturator artery arising from the inferior epigastric artery. It runs close or across the femoral ring to reach the obturator foramen. It is closely related to free margin of the lacunar ligament and to the neck of the femoral hernia. Hence the present study has been undertaken with reference to their surgical significance.

Abbreviations

AD of IIA- Anterior division of Internal Iliac Artery.

CCA or CIA- Common iliac Artery.

CMOR- Corona mortis.

CT of AD- Common Trunk of Anterior division.

EIA- External Iliac artery.

IEA- Inferior Epigasteric artery.

IIA-Internal iliac artery.

OA,OBA,OBTA- Obturator artery.

OBN- Obturator Nerve.

OBV-Obturator Vein.

SVA- Superior vesical Artery.

UA-Umbilical Artery.

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Original Article

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A Study of Morphometric Variability of Temporal and Occipital Horns of Lateral Ventricle of Human Brains: A Dissection Study

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Abstract

Background and aims: The lateral ventricles lies in each cerebral hemisphere with its three horns and body. The study of normal and variant anatomy of ventricles of brain is very useful for clinicians and neurosurgeons in their routine practice. This study is directed to look for the changes in size of occipital and temporal horn of lateral ventricle as per age and sex of cadaveric brain. *Materials and Methods*: 32 brains(20 males and 12 females) of cadavers with age ranging from 31 to 90 years were dissected and the lengths of occipital and temporal horns were measured. Data was analyzed with respect to age and sex of cadavers. *Results*: It was observed that mean lengths of both the horns increases with advancing age. No significant gender difference in dimensions of both the horns of lateral ventricle was observed. *Conclusion*: The present study showed that the age factor is responsible for change in the size of occipital and temporal horns of lateral ventricle. The present study will be helpful to radiologist and neurosurgeons to differentiate the enlarged size of occipital and temporal horns by aging from that of other pathological conditions.

Keywords: Lateral Ventricle; Occipital Horn; Temporal Horn.

Introduction

The lateral ventricles are the largest of all ventricles of ventricular system in the brain. It has three horns, frontal horn in frontal lobe, occipital horn in occipital lobe, temporal horn in temporal lobe and body in the parietal lobe.

The normal and variant anatomy of ventricles of brain is very useful for clinicians and neurosurgeons in day to day practice [1]. The development of ventricles is a predictor of neurodevelopment and it is unique marker of brain development [2]. Neurosurgeons and radiologist usually face queries like whether ventricles are within normal limits or enlarged with aging of individuals.

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The cortical atrophy is neurodegenerative condition which ultimately affects the ventricular size. The other pathological conditions such as Balint's syndrome, Gestermann's syndrome, Alzheimer's disease also shows cortical atrophy [1,3].

Asymmetry in size of lateral ventricles found in 5-12% of population. The handedness of individual also determines the size. Left handed person, have longer right occipital horn [4].

The purpose of this study is to look for the changes in size of occipital and temporal horn of lateral ventricle as per age and sex of cadaveric brain. This study will be helpful as temporal and occipital horns are surrounded by important functional areas.

Present study was conducted on 32 cadaveric brains (20 males and 12 females of known age) obtained from donated bodies to the Department of anatomy, Govt. Medical College Aurangabad.

Aims and Objectives

1. To measure and analyse various morphometric parameters of temporal and occipital horns of lateral ventricles by dissection.
2. To compare and contrast the obtained findings of

present study with that of previous studies.

Anatomy and Development of Lateral Ventricles

Each lateral ventricle is C-shaped structure begins with temporal horn in temporal lobe travels through body in parietal lobe and terminates at interventricular foramen into third ventricle. It has extension in occipital lobe as posterior horn and in frontal lobe as frontal horn. The collateral trigone of lateral ventricle is a triangular area formed by temporal horn inferiorly, occipital horn posteriorly and body of lateral ventricle anteriorly [4,5].

The lateral ventricles develop from the central canal of neural tube. The portion of tube in developing prosencephalon during three months of prenatal life gives origin to lateral ventricle by expansion of central canal. Later the choroid plexus appears which produce cerebrospinal fluid [6].

Material and Methods

Present study was conducted on brains of 32 cadavers (20 males and 12 females of known age) received through body donation procedure to the Department of Anatomy, Govt. Medical College Aurangabad in academic year 2015-16 and 2016-17 for period of two consecutive years.

As bodies we received through donations, the age and sex was known ranging from 30-90 years.

During brain dissection the cavity of lateral ventricle on each side was opened after taking median sagittal section of cerebrum. With digital Vernier Calliper length of occipital horn was measured from splenium of corpus callosum to its tip in occipital lobe. Similarly the length of temporal horn was measured from collateral trigone to its tip in temporal lobe. Measurements obtained as per age and sex of cadavers were tabulated.

Observation and Results

The mean length of occipital and temporal horn on both right and left side was calculated and analysed as per age groups 31-40, 41-50, 51-60, 61-70.71-80 and 81-90. Also the finding were grouped under male and female category

Fi. 1: Showing measurement of left Temporal horn

Fig. 2: Showing measurement of left Occipital horn

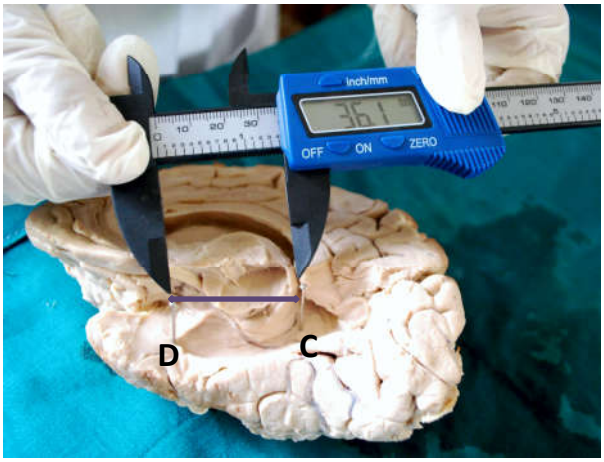

Fig. 3: Showing measurement of Right Temporal horn

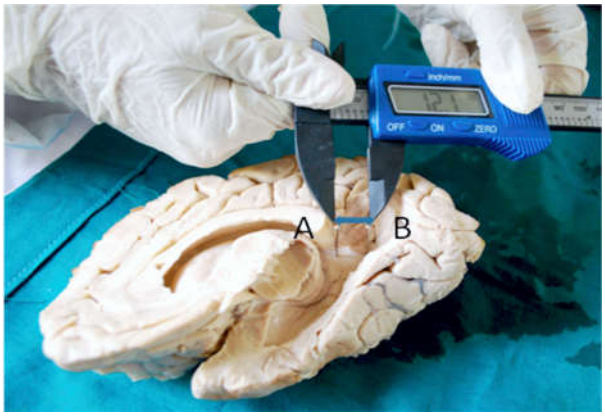

Fig. 4: Showing measurement of Right Occipital horn

Abbreviations

A: Splenium of Corpus Callosum

B:Tip of Occipital horn

C:Collateral Trigone

D:Tip of Temporal horn

The mean length of occipital horns and temporal horns of both sides was found to increase from age group 41-50 to age group 71-80.

Also mean size of occipital and temporal horns showed no gross difference in male and female brains. Thus the difference in size of both horns in male and female was insignificant.

Table 1: Illustrates Mean length (cm) of bilateral temporal and occipital horn as per age group

Age group	No. of Brains Studied	Temporal horn		Occipital horn	
		Right	Left	Right	Left
31-40	1	3.6	3.7	1.2	1.7
41-50	3	3.3	3.4	2.4	2.4
52-60	10	3.4	3.3	2.5	2.5
61-70	12	3.4	3.5	2.6	2.5
71-80	6	3.8	3.7	2.9	2.9
81-90	1	4	4.4	3	3.2
Total brains	32	3.5	3.5	2.6	2.5

Table 2: Illustrates Mean length (cm) as per age group in males

Age Group	No. of Brains Studied	Temporal Horn		Occipital Horn	
		Right	Left	Right	Left
31-40	1	3.6	3.7	1.2	1.7
41-50	2	3.5	3.5	2.6	2.6
51-60	5	3.5	3.4	2.5	2.6
61-70	7	3.6	3.7	2.6	2.5
71-80	4	3.8	3.7	2.8	2.8
81-90	1	4	4.4	3	3.2

Table 3: Illustrates Mean length (cm) as per age group in females

Age group	No. of Brains Studied	Temporal Horn		Occipital Horn	
		Right	Left	Right	Left
41-50	1	3.1	3.2	2.3	2
51-60	5	3.2	3.2	2.5	2.5
61-70	4	3.2	3.2	2.6	2.4
71-80	2	3.8	3.8	3	3

Discussion and Conclusion

The pathological conditions like Alzheimers disease cause posterior cortical atrophy which is neurodegenerative condition. This produce dilatation of posterior horn of lateral ventricle. Similarly enlargement of posterior and temporal horns of lateral ventricle results into development of structural and functional changes in the respective areas of involvement [7,8].

The picture of fairly symmetrical ventricular system of two sides is not cleared in many articles , so frequent asymmetry between both side of normal ventricle are less appreciated . The variant anatomical dimension of lateral ventricles is of great academic interest regarding CSF circulation and also for clinical, radiological and surgical interventions. The volume of cerebral ventricles is determined by nuclei and white matter tracts that abut them and rate of ventricular expansion is accelerated with age. Aging is responsible for loss of white matter integrity. The changes occur in white and grey matter volume in occipito-parietal and temporal region due to aging or pathology causes ventricular expansion [9,10].

The temporal horn enlargement seen in hydrocephalus is due to increased intraventricular pressure. Similarly congenital anomalies showed agenesis of corpus callosum with enlarged temporal horn. Incomplete inversion of hippocampal formation during the development showed the configuration of enlarged temporal horn. These findings were also found in premature infants who have incomplete sulcation. In dogs the ventricular enlargement was found to be related with aging process [11,12].

Baker L analysed 75% of patient with brain anomalies had enlarged temporal horn mostly involving inferolateral aspects of ventricle. The patient with hydrocephalus has also showed

temporal horn enlargement in superolateral region. The ventricular enlargement was as result of increased intraventricular pressure.

The rate of ventricular volume change is highly correlated with an increase in senile plaques due to old age [7,13].

Kunjan M studied 12 patients retrospectively. He noted changes in grey and white matter in parieto-occipital region and ventricular expansion due to recurrent falls. He also mentioned age, hypertension and diabetes could be the factor which aggravates above condition [1,14].

Torkildsen shows greatest variations of occipital and temporal horn size between right and left ventricle. The size of posterior horn of lateral ventricle measured average 1.39 cm in 11 brains and that of temporal horn 4.08cm in left side. On right side occipital horn measured 1.45cm and temporal horn measured 3.97 cm. He measured these horns by ventriculography [5].

So the normal intact size of occipital horn and temporal horn is not mentioned in any previous studies.

By taking into consideration of fact that visual area surrounding the occipital horn and hippocampal area around temporal horn, the enlargement of both occipital and temporal horn ultimately shows disturbance and compression symptoms in nearby and surrounding structures of both horns.

To summarise we have compared the pattern of temporal horn and occipital horn enlargement in different age groups cadavers. The distinct morphology and size of temporal and occipital horn was noticed with remarkable differences as per age of individuals.

As the study was done on brains of cadavers, the detailed clinical history was missing. Our next goal is to measure and analyse occipital and temporal horn size on MRI and compare it with present study.

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Original Article

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Morphometric Study of Glenoid Cavity in South Indian Population

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Abstract

Background: The glenoid cavity is a shallow pyriform articular surface on the lateral angle of scapula. The shape and dimensions of glenoid cavity are important in the design and fitting of glenoid component for total shoulder arthroplasty. The shoulder arthroplasty is a common orthopedic intervention in the clinical management of shoulder arthritis. Appropriate fixation of glenoid component is essential to evade loosening which is the common indication for revision surgery. *Aims and Objectives:* To determine the morphometry of glenoid cavityof scapula bones belonging to South Indian population. To assess the incidence of different shapes of glenoid cavity. *Methodology:* The present study was carried out on 182 dry adult scapulae of unknown sex belonging to South Indian population. Three glenoid diameters were measured using Vernier caliper. The shape of glenoid cavity was classified as inverted comma, pear and oval shape based on a notch present on anterior glenoid rim. *Results:* The mean superior-inferior diameter was 34.70 ± 3.64 mm. The mean anterior-posterior diameter of lower half of glenoid cavity was 23.59 ± 2.33 mm. The average anterior-posterior of upper half was 15.50 ± 1.55 mm. *Conclusion:* The left glenoid cavity was slightly longer in length. This fact may be taken into consideration while designing glenoid prosthesis for south Indian population. The morphometric data regarding the glenoid cavity will be helpful in evaluating the defects or lesions of glenoid cavity and is important in the diagnosis and management of diseases of shoulder joint.

Keywords: Glenoid Cavity; Morphometry; Scapula; Glenoid Notch.

Introduction

The scapula is a pair of triangular large flat bones that are situated dorsally in the rib cage in relation to second to seventh ribs.The glenoid fossa is oriented at lateral angle of scapula. The vertical diameter of glenoid cavity is the longest and is broader below than above. The shoulder joint is a synovial joint of ball and socket variety. It has gained mobility at the cost of stability [1]. The two articular surfaces of shoulder joint are hemispherical head of humerus and glenoid cavity of scapula.

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The shoulder joint is the most frequently dislocated joint of body. Dislocation with fracture of glenoid are quite common in trauma [2]. Along with repair of labrum and rearrange of anterior muscles, total shoulder replacement is also being used as treatment [3]. The glenoid cavity regarded as head of scapula. The morphology of glenoid cavity is highly variable. The shape of glenoid cavity varies from pear shape, inverted comma and oval depend on the presence or absence of a notch on anterior glenoid rim [4]. The studies have reported that the glenoid inclination is associated with full thickness rotator cuff tears [5]. The glenoid morphology has a prognostic implication on primary gleno-humeral osteo arthritis [6]. The morphometry of glenoid cavity has clinical application in orthopedic joint replacement, gleno humeral instability and rotator cuff tear management [7]. The purpose of present study is to obtain the morphometric data of glenoid cavity, to study the various shapes of glenoid cavity relevant to south Indian population and to compare the data obtained from present study with earlier studies.

Materials and Methods

The present study was carried out on 182 dry adult scapula of unknown sex obtained from department of anatomy of various medical colleges in and around Bangalore and Kerala. Of the 182 scapulae 96 were right side and 86 were from left side. All the measurements were manually performed with the help of Vernier caliper and were performed directly by placing the calipers on the glenoid surface.

Scapulae having clear and intact glenoid cavity were selected for the study. Damaged and broken scapulae were excluded. All the measurement was taken in millimeters (mm) using Vernier caliper. Data was analyzed using SPPS software and presented in tables.

The following parameters were studied in glenoid cavity.

1. Superior-Inferior glenoid diameter (SI):maximum distance from the inferior point on the glenoid margin to the most prominent point of the supraglenoid tubercle.
2. Anterior-Posterior glenoid diameter (AP-1): maximum breadth of the articular margin of the glenoid cavity perpendicular to the glenoid cavity height.
3. Anterior-Posterior glenoid diameter (AP-2): the anterior-posterior diameter (breadth) of the upper half of glenoid cavity at the mid-point between the superior rim and the mid equator.
4. Shape of glenoid cavity: a piece of white sheet was placed on the glenoid cavity and held firmly in position to trace the shape of glenoid cavity. The side of the point of a lead pencil was rubbed along the rim of glenoid cavity to get a tracing of the shape of glenoid cavity on the paper. 3 types were classified – oval, pear and inverted comma shape.

Results

In the present study the superior-inferior (SI) diameter of glenoid cavity on the right side varied from 27 mm to 48 mm. with an average of 34.39 ± 3.55 mm and on the left side superior-inferiordiameter varies from 28 mm to 48 mm, with a mean of 35.05 ± 3.73 mm.

The Anterior-Posterior (AP-1) glenoid diameter of right and left side varies from 16 mm to 30 mm and 16 mm to 29 mm respectively. The mean AP-1 diameter of right glenoid was 23.54 ± 2.39 mm and of left glenoid was 23.56 ± 2.27 mm.

The range of AP-2 diameter of right glenoid cavity was 11 to 19 mm and the mean was for the same was 15.40 ± 1.45 mm. the AP-2 diameter for left glenoid varied from 11 to 20 mm, while the mean for left glenoid was 15.61 ± 1.66 mm.

A total of 96 glenoid on the right side were looked, out of them 11 were inverted comma shaped, 53 were pear shaped and 32 were oval shaped. 86 glenoid belongs to the left side out of them inverted comma shaped glenoid were 12, pear shaped were 39 and oval shaped were 35 in number.

Table 1: Comparison of measurements of right and left glenoid

Parameters	Range		Mean		Standard deviation		P value
	Right	Left	Right	Left	Right	Left	
SI diameter	27 - 48 mm	28 - 48 mm	34.39 mm	35.05 mm	3.55	3.73	0.22
AP–1 diameter	16 – 30 mm	16 – 29 mm	23.54 mm	23.56 mm	2.39	2.27	0.74
AP-2 diameter	11 – 19 mm	11 – 20 mm	15.40 mm	15.61 mm	1.45	1.66	0.36

Table 2: Comparison between shape of right and left glenoid

Shape of Glenoid	Incidence of shape		Total
	Right glenoid (96)	Left glenoid (86)	
Oval	32 (33.3%)	35 (40.69%)	67
Pear	53 (55.20%)	39 (45.34%)	92
Inverted comma	11 (11.45%)	12 (13.95%)	23

Table 3: Comparison of superior-inferior (SI) diameter and anterior-posterior (AP-1) diameter by various authors

Observers	No of specimens	Mean SI diameter	Mean AP-1 diameter
Iannotti et al [11]	140	39 ± 3.5 mm	29 ± 3.2 mm
Luis Rios Frutos [12]	Male – 65	36.08 ± 2.0 mm	26.31 ± 1.5 mm
	Female – 38	31.17 ± 1.7 mm	22.31 ± 1.4 mm
Ozer et al [8]	Male – 94	38.71 ± 2.71 mm	27.33 ± 2.4 mm
	Female – 92	33.79 ± 3.08 mm	22.72 ± 1.72 mm
Mamatha et al [2]	Right – 98	33.67 ± 2.82 mm	23.35 ± 2.04 mm
	Left - 104	33.92 ± 2.87 mm	23.02 ± 2.30 mm
Present study	Right – 96	34.39 ± 3.55 mm	23.54 ± 2.39 mm
	Left – 86	35.05 ± 3.73 mm	23.56 ± 2.27 mm

Discussion

Anterior dislocation of the shoulder joint is the commonest dislocation and is more common in adults than in children. It results due to a direct force pushing the head of humerus out of the glenoid cavity and thereby injuring the later consequently.In the present study the various diameters of glenoid cavity and various shapes of glenoid cavity were measured and compared with similar studies. Several studies have been conducted on different population by various authors. The SI diameter of right glenoid was 34.39 ± 3.55 mm and of left was 35.05 ± 3.73 mm, the right glenoid value was slight lower than the left. Mamatha et al [1] worked on 202 dry scapulae out of which 98 were right and 104 belongs to left, SI diameter of glenoid on right side is 33.67 ± 2.82 mm and on left side was 33.92 ± 2.87 mm which were slightly lower than the values got in present study. Ozer et al [8] studied 186 scapulae, SI diameter of male glenoid was 38.71 ± 2.71mm. and of female was 33.79 ± 3.08 mm. Hina BR et al [9] studied 100 scapulae of which 43 belongs to right and 57 belongs to left side. The mean SI diameter on right side was 34.76 ± 3.0 mm and on left side was 34.43 ± 3.21 mm, which is similar to the values of present study.

The average anterior-posterior of lower half of glenoid (AP-1) of right side was 23.54 ± 2.39 mm and that of left was 23.56 ± 2.27 mm in the present study. In the study of Mamatha et al, the average anterior-posterior diameter (AP-1) of lower half of the glenoid of the right side was 23.35 ± 2.04 mm and that of left side was 23.02 ± 2.30 mm. the values were similar to the values of present study. The AP-1 diameter recorded by Karelse et al [10], was 27.2 ± 3.0 mm which is higher than the current study. The average AP-1 diameter of right side is 23.31 ± 3.0 mm and on left side is 22.92 ± 2.8 mm as per study done by Hina BR et al, which is similar to the present study.

The mean anterior-posterior of upper half (AP-2) of right glenoid was 15.40 ±1.45 mm and that of left glenoid was 15.61 ± 1.66 mm in current study. In the study of Mamatha et al, the average anterior-posterior diameter (AP-2) of upper half of the glenoid of the right side was 16.27 ± 2.01 mm and that of left side was 15.77 ± 1.96 mm. the values were slightly larger than the values of present study. Hina BR et al studied 100 scapulae, the AP-2 of right was 15.10 ± 2.54 mm and that of left was 13.83 ± 2.45 mm.

In the current study, incidence in percentage of various shapes of glenoid cavity were recorded. 11.45% of right and 13.95 % of left glenoid were inverted comma shape with a distinct notch. The pear shaped glenoid were 55.2 % on right side and 45.34 % on left side. The right side 33.3 % were oval and on left side 40.69 % were oval. Hira BR et al found out that 35% of right and 39% of left glenoid were inverted comma shape. The oval glenoid were found on 16 % on right and 15% on left side and in Mamatha et al 20% on right side and 24% on left side. In present study the percentage of pear shape and oval shape are more prevalent than previous studies.

Conclusion

The knowledge of size and shape of glenoid will be helpful for the surgeons in the design and fitting of glenoid components for total shoulder arthroplasty. An understanding in variation in normal anatomy of glenoid is essential while evaluating pathological conditions like osseous lesions and osterochondral

defects related to shoulder joint. Dimensions of glenoid fossa exhibit racial variations hence the important parameters for selecting appropriate shoulder implants. Since the present study was performed on a limited number of scapulae, further cadaveric, radiological and clinical studies are indicated.

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Study of External Ear Indices by Digital Photometry among Adult Population

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Abstract

Background: External ear is a defining feature of the face as it contributes to facial aesthetics by its appearance and symmetry. Its shape and size is influenced by age, sex and ethnic origin. Features of auricle had long been recognized as an important anthropological variable for studying racial variability and for identifying few genetic abnormalities at an early stage of life. Out of all available methods to study external ear indices, digital photometry is most convenient and useful method. *Objectives:* To study external ear indices using digital photometry among adult population. *Methods:* The present cross sectional study consisted of 500 adult subjects between 20 to 30 years of age. Patients with malignancies, previous surgery or trauma to the earlobe, or congenital earlobe anomalies were excluded. Ear features were then captured using a digital camera mounted on stand. Various soft tissue landmarks were tagged on the photo and the various tagged points were connected on the photo. Different parameters on right and left ear were measured. The indices like auricular, lobular and conchal were computed. The measurements were statistically analyzed by calculating their mean and standard deviations. *Results:* There were 250 women and 250 men. Oval shape of auricle was more common both in males as well as in females. Auricular and conchal index in males as well as females on right and left side were statistically insignificant. These indices were significantly different in both genders. Lobular index in males on right and left side was statistically not significant, but was significant in females. Gender wise lobular index on right side was statistically significant. *Conclusion:* The result of the present study also can be used in the field of Forensic Science for excluding criminals. Ear Biometrics is a promising new passive approach to Human Identification system used for screening people. This knowledge will be useful in designing a new identification tool-'Ear Biometrics'

Keywords: External Ear; Indices; Digital Photometry.

Introduction

External ear is a defining feature of the face as it contributes to facial aesthetics by its appearance and symmetry. The ear is the organ that detects sound. The outer ear is the only visible portion of the ear in humans and almost all vertebrates and consequently the word "ear" may be used to refer to the pinna alone. The ear is an important component of the facial complex which gives an impression of its bearer's age and sex. Its size, shape and spatial location on the face are important from an aesthetic point of view. The external ear is composed of three primary components: the helixantihelical complex, the conceal complex and the lobule [1]. Though shape, size and orientation of each external ear is unique as fingerprint it is plausible to make some conclusion; male have larger ears than the female counterpart [2,3]. Various studies have been conducted on morphometry of the external ear from different parts of the world [4,5,6]. These studies prove that much variability exists depending on the age, sex, ethnic group and even in the same person between the right and left ears. Photometry, cephalometric and anthropometric methods are used to take

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measurements of ear. Among them photometry is most convenient and useful method. Features of auricle had long been recognized as an important anthropological variable for studying racial variability and for identifying few genetic abnormalities at an early stage of life [5]. Hence the present study is an attempt to examine various parameters of the external ear in adult population by photometry.

Material and Methods

The present cross – sectional and descriptive study was conducted in the Department of Anatomy, Bharati Vidhyapeeth Medical College and Hospital, Sangli. The individuals were selected randomly from Sangli district for external ear morphometry. The study was approved by Institutional Ethical Committee. The inclusion criteria consisted of individuals between 18 to 30 years of age with normal external ear. Individuals whose normal external ear morphology has been altered by congenital anomaly, trauma, accidents, surgery and due to any disease were excluded from the study. External ear was thoroughly visualised and observations regarding shape of auricle, pre-auricular region, external auditory meatus, anterior surface of each ear, tragus, ear lobe attachment, hypertrichosis were tabulated. After written informed consent from the study participants, the somatoscopic features of the external auricle were recorded. The subjects were photographed to obtain the lateral surface and the posterior view of the auricle with the help of a digital camera (Sony Cyber Shot, 16.0 Megapixel) mounted on a tripod stand against a green curtain and maintaining a distance of 90cm between the subject and the lens.. All necessary precautions and standard guidelines were followed as per the protocol. Mid vertical grid line of camera aligned to pass through the mid-sagittal plane of face, while the mid horizontal passed through the Frankfurt horizontal plane. Digital images were transferred to a computer and the images were edited in Adobe Photoshop CS3 Lite. Computerized color print copies of all photographs were taken of 5.83" length and 4.13" width which is ISO standard for postcard size. Photographs were analyzed by first marking the various soft tissue landmarks on the photo and drawing relevant lines on the images. All the various soft tissue landmarks were tagged on the photo as per the protocol. The various tagged points were connected on the photo to bring about relevant lines on the image. All measurements were recorded and the indices were calculated. The various indices were calculated by using following formulae:

1. Auricular index = The width of the auricle(mm) / length of auricle (mm)X 100
2. Lobular index = The lobular width (mm)/ lobular length (mm) X 100
3. Conchal index = The conchal width (mm)/ conchal length (mm) X 100

The photographs taken were used for research purpose only. The measurements were statistically analyzed by calculating their mean and standard deviations. Appropriate test of significance were applied to find out the difference in mean and proportions.

Results

The present cross sectional study consisted of 500 adult subjects between 20 to 30 years of age. There were 250 women and 250 men. Different parameters on right and left ear were measured as shown in Figure 1, 2 and 3. It was observed that oval shape of auricle was more common in males (78.0%) as well as in females (62.4%) followed by round shape in males (13.6%) and in females (21.2%). Triangular shape was rarely found in (8.8%) males and (15.5%) in females. The anterior surface of each ear showed normally rolled helix in 46.8% males and 51.0% females. Next most common type was wide helix covering scapha, found in 40.8% males and 38.8% females. Flat helix was found more common in males than females. It was observed that females showed a higher proportion of small tragus than males. The developmental defects of auricle were higher in females (6.4%) than males with the observation of slight hypoplastic auricle or shape deformity. 6.8% of males showed helical pattern of hypertrichosis followed by meatal and lobular in only 0.8%. The other somatoscopic observations as per gender are shown in Table 1. The auricular index did not differ significantly between right and left side in both males and females. Similarly the conchal index also did not differ significantly on both right and left side in both males and females. The lobular index between right and left side was significant in female population in this study, while it was insignificant in males. The findings are shown in Table 2.

The gender wise comparison between male and female auricle on right side showed significant difference in the mean values of all the 3 indices. With regards to left ear auricle, the mean values of lobular index between male and female population did not show any statistically significant difference. The other 2 indices like auricular index and conchal index

showed a statistically significant difference between the mean values among the male and female population ($p < 0.01$). The findings are shown in Table 3. The test of significance applied was 'Z' test. The present study proves that much variability exists depending on the gender and even in the same individual between right and left ears.

Table 1: Gender wise Somatoscopic observations of auricle

S. No.	Characteristic	Observations	Percentage (%)	
			Male	Female
1	Shape of auricle	Round	13.6	21.2
		Oval	78.0	62.4
		Triangular	8.8	15.5
2	Pre-auricular region	Normal	100.0	100.0
3	External auditory meatus	Normal	100.0	99.2
		Narrow	0.0	0.8
4	Anterior Surface of each ear	Flat helix	12.8	9.2
		Normally rolled helix	46.8	51.0
		Wide helix covering scapha	40.8	38.8
5	Tragus	Normal	90.8	79.6
		Small	6.8	18.8
		Large	2.4	1.6
6	Developmental defects	None	99.2	93.6
		Slight hypoplastic and shape deformity	0.8	6.4
7	Earlobe attachment	Free	95.6	95.6
		Attached	4.4	3.6
		Hypoplastic attached earlobe	0.0	0.8
8	Hypertrichosis	Absent	92.4	NA
		Helical	6.8	NA
		Meatal	0.8	NA
		Lobular	0.8	NA

NA-Not applicable

Table 2: Comparison of various indices among each gender between right and left side

Index		Male				Female			
		Right (mm)	Left (mm)	Z value	p value	Right (mm)	Left (mm)	Z value	p value
Auricular index	Mean	48.6	48.4	- 0.58	> 0.05	50.0	49.6	- 0.97	> 0.05
	SD	4.6	4.3			3.9	3.8		
Lobular index	Mean	155.4	151.6	- 1.27	> 0.05	166.2	157.1	- 2.62	**< 0.01†**
	SD	36.1	34.4			40.8	36.8		
Conchal index	Mean	67.8	66.5	- 1.19	> 0.05	72.1	70.4	- 1.83	> 0.05
	SD	12.3	12.5			9.6	10.9		

SD- Standard deviation, † Highly significant

Table 3: Comparison of various indices between gender on each side

Index		Right Ear				Left Ear			
		Male (mm)	Female (mm)	Z value	p value	Male (mm)	Female (mm)	Z value	p value
Auricular index	Mean	48.6	50.0	- 3.58	< 0.01†	48.4	49.6	- 3.46	**< 0.01†**
	SD	4.6	3.9			4.3	3.8		
Lobular index	Mean	155.4	166.2	- 3.12	< 0.01†	151.6	157.1	- 1.81	> 0.05
	SD	36.1	40.8			34.4	36.8		
Conchal index	Mean	67.8	72.1	- 4.26	< 0.01†	66.5	70.4	- 3.67	**< 0.01†**
	SD	12.3	9.6			12.5	10.9		

SD- Standard deviation, † Highly significant

Fig. 1: Is markings on ear

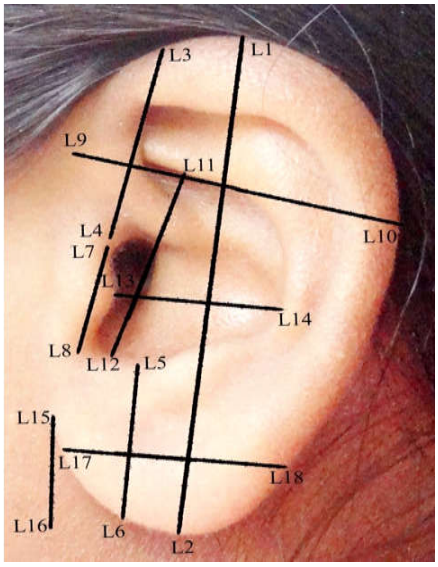

Fig. 2: Is lines on these markings

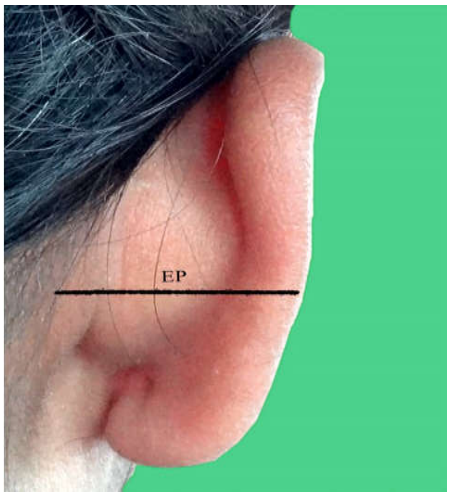

Fig. 3: Is posterior view

Discussion

Appearance and bilateral symmetry of external ear contribute to the facial aesthesis. Any external ear deformity like disproportionate size, abnormal elongation of the ear lobe or a missing part, all this can be corrected by surgery. Facial rejuvenation and cosmetic surgery have been quite popular in western countries and now in India [7]. The current study initiates a step in this direction to furnish data for males and females from Maharashtra because they form a major part of Indian population. Existence of sexual dimorphism in external ear dimensions was documented [8,9]. It was shown that sexual dimorphism exists in auricular linear dimensions between males and females with higher values in males [10]. The auricular indices of ear in present study did not significantly differ between right auricle and left auricle in both male and female populations. The results were in accordance with Kumar P et. al [11]. Bozkir et al [9] and Ferrario et. al [12] found that the ear indices of both sides in males were significantly higher than females similar to the findings in the present study. The findings were in contrast to those reported by Barut and Aktunc observed insignificantly higher right ear indices and significantly higher left ear indices in males [13]. External ear linear dimensions can serve as additional tool for age estimation of individuals [14]. The mean values for all parameters of ear morphometry reported in the literature by different scientists vary in different populations. This could be due to several factors such as differences in age, number of subjects, gender of the subjects and geographical conditions, moreover the method adopted. Deopa et al. [15] found that the ear indices of the both sides showed no statistical difference although left ear indices were found to be higher than the right ear indices for all Indian subjects.

Conclusion

This study provides the mean values of the different morphometric measurements of the left and right ears in both male and female adult population. The results support the findings that sexual dimorphism does exist and showed the statistically significant difference between the sexes. The morphometry of auricle is important in the diagnosis of congenital malformations, acquired deformities, syndromes and in the treatment planning. This study would prove helpful to plastic surgeons to reproduce an anatomically correct ear during its reconstruction. This study gives new auricular indices of adult

population in this part of Maharashtra. The ear lobule morphometry gives information on age and sex which plays a valuable role in forensic investigation. Ear Biometrics is a promising new passive approach to Human Identification system used for screening people. This knowledge will be useful in designing a new identification tool-'Ear Biometrics'

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Original Article

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Morphometrical Study of Scapula for Determination of Sex in Marathwada Region

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Abstract

Objective: The aim of this study was to calculate the morphometric values of scapula and to determine the scapular index in Marathwada population. *Material and Methods:* The study was carried out on 142 adult dry human scapulae of known sex in department of Anatomy, Government Medical College, Aurangabad. Out of these, 102 belong to males and 40 belong to females. *Result:* Mean scapular length and breadth were statistically significant as having p value <0.05. The mean scapular length was 141.8 $\pm$ 8. 23 mm and 123.887.57 mm in males and femalesrepectively. The mean scapular breadth was102.836.24 mm in males and 90.456.19 mm in females. The correlation between scapular length and breadth was expressed as scapular index. The mean scapular index was 72.34.2mm in males and 73.12 4.75mm in females. *Conclusion:* Knowledge of scapular measurements like scapular length, breadth and index can be useful to determine the sex of an individual in medicolegal cases.

Keywords: Scapular Length; Scapular Breadth; Scapular Index.

Introduction

Scapula is a triangular flat bone situated on the posterolateral aspect of thoracic wall between second to seventh rib. It gives attachment to number of muscles. Morphologically, scapula is a composite bone and formed by fusion of dorsal and ventral elements. Dorsal segment is represented by body of scapula and ventral segment is represented by the coracoid process and pre coracoid bone at the tip of coracoid process [1]. Scapula plays an important role in movements of shoulder girdle. Scapula also provides additional protection to the thoracic cage from behind [2].

The development of scapula has been studied and concluded that the triangular shape of scapula is not due to the forces applied on it during development but is a mammalian characteristic. The most obvious modifications have occurred in scapular shape which is studied as scapular length and scapular breadth.[3]

In forensic and medico legal cases, the determination of sex of an individual is important for identification. The present study was carried out on the scapulae of known sex. We had studied the mean scapular length, breadth and index in male and female scapulae.This may be useful in comparative anatomy and also to find out the sex of an individual.

Material and Methods

The present study was conducted on 142 adult dry human scapulae of known sex available in Bone Bank, in department of Anatomy, Government Medical College, Aurangabad. Out of these, 102 were of males and 40 were of females. All the scapulae studied were dry, intact and showed normal anatomical features. All the measurements were carried out manually with the help of ofosteometric board and digital vernier caliper. The measurements were recorded in millimeters. The following morphometric measurements of scapulae were studied.

1. Maximum scapular length: It was measured from

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the highest point of superior angle to the lowest point of the inferior angle. (In Fig No.1: Point A to B).

2. Maximum scapular breadth : It was measured from the point at the middle of the outer border of glenoid cavity to the prominent point where the spine intersects the vertebral border. . (In Fig No.1: Point C to D).
3. Scapular index: was calculated from scapular length and breadth by formula

Scapular index=Breadth/Length x 100

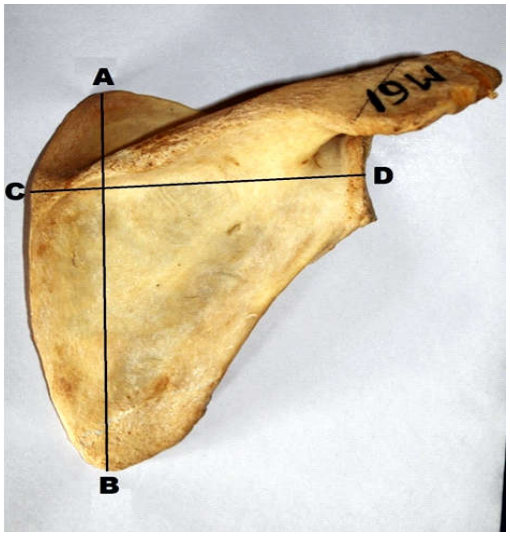

Fig. 1: Showing measurements of Scapula

A-B : maximum scapular length
C-D : maximum scapular breadth

Fig. 2: Showing measurement of scapular length with osteometric board

Fig. 3: Showing measurement of scapular breadth with digital vernier caliper

Observations and Results

142 dry human scapulae of known sex were studied . Out of these 102 were male scapulae and 40 were female scapulae. The mean scapular length and breadth was measured separately in male and female scapulae and tabulated. The mean and standard deviation of scapular measurements were studied and these values were analyzed using an unpaired T test. The observed scapular diameters were -

1. Scapular length: In present study, scapular length in male and female scapulae was statistically significant as having p value with < 0.05.

The length of scapulae in males varied from 125.1 mm to 160. 8 mm with a mean value 141.8 $\pm$ 8. 23 mm. The statistical value of mean3 SD is 166.49-117. 11 mm. The demarcating point in males was > 146.59 mm.

The length of scapulae in females varied from 108. 7 mm to 140.2 mm with a mean of 123.887.57 mm. The statistical value of mean 3 SD was 146.59-101.17 mm with a demarcating point <117.11 mm in females.

2. Scapular breadth: In present study, the scapular breadth in males ranged from 81.7 mm to 120.1 mm with a mean of 102.83 $\pm$ 6.24 mm. 121.55-84.11 mm is the statistical value of mean 3SD. The demarcating point was >109.02 mm for scapular breadth in males.

The value of scapular breadth in females was 77.5 mm to 99.8 mm. The mean scapular breath was 90.456.19 mm. The statistical value of mean 3SD was 109.02-71.88 mm with demarcating point as <84.11 mm.

The values of scapula breadth in males and females for statistical significant as having the P <0.05.

Scapular index : In present study, scapular index ranged from 63.36mm to 82.08mm with a mean of 72.3 ± 4.2mm in males. In females, scapular index ranged from 60.61mm to 81.62mm and had a mean of 73.124.75mm.

Table 1: Scapular length in males and females

Measurements	**Male**(mm)	**Female**(mm)
Range	125.1 to 160.8	108.7 to 140.2
Mean ± SD	141.8 ± 8.23	123.88 ± 7.57
Mean ± 3 SD	166.49_117.11	146.59_101.17
D.P.	> 146.59	< 117.11
P value	< 0.05	< 0.05

Table 2: Scapular breadth in males and females

Measurements	**Male**(mm)	**Female**(mm)
Range	81.7 to 120.1	77.5 to 99.8
Mean ± SD	102.83 ± 6.24	90.45 ± 6.19
Mean ± 3 SD	121.55_84.11	109.02_71.88
D.P.	> 109.02	< 84.11
P value	< 0.05	< 0.05

Table 3: Scapular index in males and females

Measurements	**Male**(mm)	**Female**(mm)
Range	63.36 to 82.08	60.61 to 81.62
Mean ± SD	72.3 ± 4.2	73.12 ± 4.75

Table 4: Comparison of scapular length andscapular breadth by various authors

Authors	**No. of Specimens**			**Mean Scapular length(mm)**	**Mean Scapularbreadth(mm)**
Flower W.H. (1879)[5]		200		155.54	105.6
GeetaSingal et al (2013)[6]		162		141.7 ± 8.9	96.4 ± 7
Dr. M.Krishnaiah et al (2014)[7]		50		143.28 ± 11.44	105.6 ± 5.08
Chhabra N.et al (2015)[8]	126	Right	55	141.93 ± 12.88	103.64 ± 6.41
		Left	71	141.94 ± 12.76	103.76 ± 7.16
Md. Jawed Akhtar et al (2016)[9]	228	Right	126	135.70 ± 14.32	97.97 ± 9.07
		Left	102	134.29 ± 14.14	97.02 ± 0.30
Present study (2017)	142	Male	102	141.8 ± 8.23	102.83 ± 6.24
		Female	40	123.88 ± 7.57	90.45 ± 6.19

Table 5: Comparison of scapular index by various authors

Authors	**No. of specimens**			**Scapular index Range (mm)**	**Mean Scapular index (mm)**
GeetaSingal et al (2013)[6]		162		57 to 76.9	68.5 ± 4
Dr. M.Krishnaiah et al (2014)[7]		50		67.16 to 80.63	73.99 ± 4.6
Chhabra N.et al (2015)[8]		126		62.5 to 89.6	73.32 ± 4.8
Present study (2017)	142	Male	102	63.36 to 82.08	72.3 ± 4.2
		Female	40	60.61 to 81.62	73.12 ± 4.75

Discussion

In present study, the average scapular length, breadth and index of the scapulaewere studied and compared the findings of present study with that of previous workers. This had been done by various ways including direct measurements on dry scapulae, direct measurements of fresh or embalmed cadavers, radiographic measurements in living patients and radiographic measurements of scapulae derived from the cadavers [4].

These studies have been performed on different groups of population. While evaluating the data obtained in present study , we observed several differences as well as similarities with previous studies.

Scapular Length

In present study, the length of scapula varied between 125.1 mm to 160.8 mm with a mean of 141.8±8.23 mm in males.The length of scapula was in the range of 108. 7 mm to 140.2 mm in females with a mean of 123.887.57 mm.

Md. Javed Akhtar et al [9] observed scapular length ranged from 112.10 to 157.79mm on right side and 111.79 to 157.20 mm on left side. Total mean SD was 135.0714.23 mm.

Chhabra N. et al [8] observed the length of scapula ranged from 118mm to 176mm with a total mean SD was 141.9412.76 mm. The mean value observed by Chhabra N. et al [8] is simillar to mean scapular length in males in present study. The mean scapular length observed in Md. Jawed Akhtar et al [9] study is less as compared to present study.

Dr. M. Krishnaiah et al [7] observed mean scapular length was 143.2711.44mm in population of Nalagonda region.

Geeta Singal et al [6] recoarded a mean scapular length of 141.78.9mm in ranged from 115 to 160mm in Saurashtra region, Gujrat. The values observed in Nalagonda and sausrashtra region populatoion are similar to values observed in males in present study.

Flower W.H [5] study was in European population and observed the mean scapular length was 155.54mm. The value observed by Flower WH [5] is very much higher than that of present study.

The previous studies were done on right and left sides separately and had observed values on right sides were more than that of left sides. We had studied scapular length in males and females separately and observed mean scapular length was more in males than that of females.

Scapular Breadth

Mean scapular breadth observed in present study was 102.836.24mm in males and 90.456.19mm in females.

Md. Jawed Akhtar et al [9] observed range of scapular breadth was 79.56mm to 118.20mm on right side and 78.86 to 116.98mm on left side. The value of total mean SD was 97.559.63mm. The values observed are lower than that of present study. Chhabra N. et al [8] observed the breadth of scapula ranged betweeen 86.5mm and 121mm with total a mean of 103.656.82mm. The values observed by Chhabra N. et al [8] was similar to that of observed in males in present study.

Dr. M. Krishnaiah et al [7] studied the scapular breadth in Nalgonda region and observed that maximum number of scapulae were in the range of 105 mm to 110 mm and minimum scapulae were in the range of 90mm to 100mm. They observed the scapular breadth ranged from 90.3mm to 113.3mm. The total mean SD was 105.65.08mm. The observed value is much more greater than that of the present study.

The values observed by Flower W.H. [5] in European population was almost similar to that of observed in males of present study. Geeta Singal et al [6] observed the scapular breadth in the range of 80 to 110 mm with a mean SD was 96.47mm. The value observed is less than that was observed in males and it was much more greater than that of females observed in present study.

Scapular Index

In present study, range of scapular index was 63.36mm to 82.08mm with a mean of 72.34.2mm in males. In females, scapular index was in the range of 60.61mm to 81.62mm and had a mean of 73.12 4.75mm.

In Chhabra N. et al [8] study, mean scapular index observed was 73.32 4.8 mm in North Indian population. They distributed the scapulae according to the scapular index and observed that maximum number of scapulae were found in the scapular index range of 70mm to 74mm (32.5%). Dr. M. Krishnaiah et al [7] observed mean scapular index73.994.6mm in Nalgonda region and maximum number of scapulae were found in the range of scapular index 71mm to 74mm (52%). The mean scapular index observed in both the studies is similar to that of the present study.

Geeta Singal et al [6] recorded the mean scapular index 68.54mm which is less than the present study. They found maximum number of scapulae were found to be in the range of 69mm to 73mm (32.7%).

In most of the previous studies, values were observed on right and left sides separately and did not show very much differences between the values on both sides. In present study, we observed that the values of scapular length and breadth were higher in male scapulae than that of female scapulae, but scapular index was more in female than in male scapulae.This indicate that the male scapulae were longer and broader than female scapulae. This may be due to larger size of scapulae in males.

Conclusion

The knowledge of scapular measurements like scapular length and breadth is used for comparative anatomy and also for determining race of an individual. Our study is an attempt to use the parameters to determine the sex of an individual. These findings will also useful in surgical procedures such as hardware fixation, prosthetic positioning and also for manufacturing prosthetic products. In the present study , the various parameters studied can also be useful to determine the sex of an individual in medicolegal cases.

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Case Report

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Meningomyelocele with Hydrocephalus: A Case Report

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Abstract

Neural tube defect (NTD) is a complex congenital anomaly affecting meninges, vertebral arches, muscle and skin. Spina bifida denotes non-fusion of two vertebral arches causing herniation of meninges and spinal cord through it which is termed as meningomyelocoele (MMC). Meningomeylocoele develops around 4th week of gestation and accounts for an incidence of 1 per 1000 live births. Nearly every case of MMC is associated with hydrocephalus. These neural tube defects form a greater part of fetal morbidity and mortality. Early surgery should be performed because of risk of infection and to prevent further damage to nervous tissue. Proper medical and nutritional advice can reduce the incidence of neural tube defects.

Keywords: Neural Tube Defect; Meningomyelocoele; Hydrocephalus.

Introduction

Spina bifida is a developmental anomaly that occurs when vertebral arches fail to fuse and thus creates a defect. Herniation of spinal cord and meninges occurs through this defect known as meningomyelocoele. Spina bifida develops in 4th week of gestation [1].

Meningomyelocoele is the most common form of neural tube defects [2] with incidence of approximately 1 in 1000 live births[3]. Other congenital conditions associated with spina bifida with meningomyelocoele are hydrocephalus, club foot, dislocation of hip, exstrophy of bladder and rarely cardiac defects. Amongst them hydrocephalus is most common presentation [4]. We present a case of a day old neonate who presented with spina bifida with meningomyelo-coele with hydrocephalus because of its rarity.

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Case Report

A one day old full term female baby was born to a 20 year old gravida-1 para-1 mother by caesarean section. The mother had no H/O drug intake, radiation exposure, or any illness during pregnancy. Mother never attended ANC visits and never received folic acid tablets or supplements.

Birth wt of baby was 3.04 kg with APGAR score 7. On physical examination the baby had enlarged head, having circumference of 41.5cm (Figure 1) and a cystic swelling at lumbosacral region of size 6x4cm with ruptured membranes over it (Figure 2). There was no pallor, icterus, cyanosis, clubbing, oedema or lymphadenopathy. Ophthalmic examination showed positive sunset sign (Figure 3).

On central nervous system (CNS) examination patient was conscious and active but both lower limbs showed hypotonia and absence of reflexes. Other examinations like cardiovascular system, respiratory system and per abdominal examination were normal.

Ultrasonography (USG) skull showed enlargement of both lateral ventricles and dilatation of 3rd& 4th ventricles. USG local part showed evidence of 1.2 cm defect in lumbosacral region with herniation of contents of spinal cord suggestive of meningomyelocoele. Considering this clinical profile

ventriculoperitoneal shunt was done for hydrocephalus & surgical closure was planned for meningomyelocoele afterwards.

Fig. 1: Hydrocephalus-enlarged head, having circumference of 41.5cm

Fig. 2: A cystic swelling at lumbosacral region of size 6x4cm with ruptured membranes over it

Fig. 3: Positive sunset sign

Discussion

Development of CNS involves series of events. By 20th day of gestation neurulation i.e. formation of neural plate, neural fold and its closure to form neural tube starts. First the surface ectoderm of trilaminar embryonic disc gets thickened to form the neural plate. This neural plate invaginates on its central axis to form median neural groove having neural folds on either side. These neural folds fuse to form neural tube and it gets detached from surface ectoderm. Notochordal process is the precursor of spine. Mesoderm gathers around notochord to form the primitive spinal column. Further it gets segmented and form vertebral bodies. Mesoderm condenses over dorsum of spinal cord to form neural arch [5].

Severe neural tube defects involving neural and non-neural structures can occur at any developmental stage. The incidence varies approximately 1/1000 births to 1/100 births depending on the population [3]. Meningomyelocoele is hernial protrusion of meninges plus neural tissue resulting from congenital failure of neural tube to close [6]. Spina bifida is a general term for NTDs with multifactorial etiology, affecting the spinal region consists of a splitting of the vertebral arches & may or may not involve underlying neural tissue. There are two different types of spina bifida [7] .

A. *Spina Bifida Occulta*: It accounts for 10% of cases.

- This defect is due to a lack of fusion of the vertebral arches.
- It occurs in the lumbosacral region.
- It is covered by skin, does not involve underlying neural tissue & marked by a patch of hair overlying the affected region.

B. *Spina bifida cystica*: It is a severe type NTD.

- Neural tissue and/or meninges along with skin protrude through a defect in the vertebral arches to form a cyst like sac.
- It lies in the lumbosacral region.
- It result in neurological deficits, but they are usually not associated with mental retardation.
- It may be of following 3 types:

a. Spina bifida with *meningocoele*- When only fluid ûlled meninges protrude through the defect.

b. Spina bifida with *meningomyelocoele*- When neural tissue is included in the sac.

c. Spina bifida with *myeloschisis* or *rachischisis*- When occasionally the neural folds do not elevate but remain as a flattened mass of neural tissue.

Spina bifida with meningomyelocoele is a more common and a more severe defect than spina bifida with meningocoele. This neural tube defect can occur anywhere in vertebral column, but lumbosacral region gets commonly involved [1]. Child with meningomyelocoele presents with a cystic swelling at lumbosacral region covered with or without weeping skin, sometimes with ruptured membranes. Spinal cord will be on open platform covered with meninges which is liable to infections [8]. When the membrane ruptures the ultimate outcome will be meningitis secondary to infections. They also complain decreased motility of lower legs and dribbling of urine due to dysfunction of cauda equina roots or conus medullaris contained in the sac [9]. Our patient had lower limb hypotonia. About 90% of patients of meningomyelocoele will present with hydrocephalus. Hydrocephalus is a Greek word meaning hydor "water" and kephale "head" due to excess cerebrospinal fluid (CSF) accumulation in the head. As spinal cord gets tethered to the vertebral column, it gets elongated. This tethering pulls the cerebellum downward & thus occluding the foramen magnum. Hence there is cutting off the ûow of cerebrospinal ûuid resulting in the development of hydrocephalus. Hydrocephalus ultimately causes bulging fontanelle, enlarged scalp veins, macrocrania, suture diastasis, and positive Macewen (ie, cracked pot) sign and sunset sign. Our patients had hydrocephalus with wide open and bulging fontanelle and positive sunset sign. Meningomyelocoele patients with hydrocephalus often presents with Arnold Chiari II Malformation, an abnormal downward herniation of the cerebellum and brain stem through foramen magnum. If untreated they develop headaches, blurred vision, decline in intellectual performance, and gradual drowsiness, which, lead to coma and death due to respiratory arrest. There are some prenatal screening tests that are used to detect congenital anomalies. For example quadraple test done in second trimester detects meningomyelocoele, Down's syndrome and other congenital malformations. Patients carrying baby with with spina bifida will have increased AFP levels in blood higher than the normal. Currently, in-utero USG scanning can detect hydrocephalus at an early intrauterine life. This permits good identification of any ventricular dilatation that indicates active hydrocephalus. In a suspected case of hydrocephalus CT scan confirms the diagnosis. In selected cases amniocentesis can be performed [10]. Regular ANC visits in each trimester and folic acid & vitamins supplements taken in periconceptional period have shown to reduce the incidence of neural tube defect by 70% [1]. After the baby is born with meningomyelocoele, a surgical closure is indicated under full antibiotic control because of risk of meningitis. Hydrocephalus is managed by ventriculoperitoneal shunt in which excess CSF is continuously drained in peritoneal cavity to normalize the pressure. Though with successful treatment a close follow up of these patients is mandatory [10].

Conclusion

Spina bifida with meningomyelocoele with hydrocephalus is rare congenital anomaly with incidence of 1 in 1000 live births that is associated with fetal mortality and morbidity. Prenatal screening for congenital anomalies and nutritional supplement of folic acid can lower the incidence of neural tube defects.

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Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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Indian Journal of Hospital Infection	2	12000	9000	857	800
Indian Journal of Law and Human Behavior	2	5500	5000	393	350
Indian Journal of Library and Information Science	3	9000	8500	643	600
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9000	8500	643	600
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