Indian Journal of Forensic Medicine and Pathology

Indexing Information: NLM catalogue & locator plus, USA, Google Scholar, Index Copernicus, Poland. EBSCO Publishing`s Electronic Databases, USA , Academic Search Complete, USA, Academic Search Research & Development, USA, ProQuest, USA, Genamics JournalSeek.

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Indian Journal of Forensic Medicine and Pathology

July - September 2013
Volume 6 Number 3

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Adrenal Haemorrhages and Burns: An Autopsy Study

A.G. Vijay Kumar*, Kumar U.*, Shivaramu M.G.**

Abstract

Adrenal haemorrhage occurs secondary to both traumatic conditions and atraumatic conditions. Burns accounts for maximum number of cases of traumatic haemorrhages. The purpose of this study was to investigate the prevalence of adrenal haemorrhage in non-surviving patients with burns by evaluating the compiled autopsy study data. During the period between 1st july 2009 to 31st june 2011, totally 51 burns cases were autopsied, among them, adrenal haemorrhage was seen in 14 cases, of which 10 cases showed bilateral haemorrhages and 04 cases showed unilateral haemorrhages. Extensive, bilateral adrenal haemorrhages were more commonly seen in males. Acute adrenal insufficiency is an uncommon but devastating complication of severe burn injury. The diagnosis is rarely made ante mortem. The clinical importance of bilateral adrenal haemorrhage is that it may lead to acute adrenal insufficiency and possible death. Therefore, when a sudden deterioration in the patient with thermal injuries is encountered, adrenal insufficiency must be considered.

Key words: Burns; Adrenal hemorrhage; Septicemic shock.

Introduction

Adrenal haemorrhage occurs secondary to both traumatic conditions and atraumatic conditions. Burns accounts for maximum traumatic hemorrhages. Atraumatic causes of adrenal hemorrhage include Stress, Haemorrhagic diathesis, Neonatal stress, Underlying adrenal tumors and Idiopathic disease.[1]

Bilateral adrenal haemorrhages are a common condition that may lead to acute adrenal insufficiency and death. The clinical features of adrenal insufficiency are nonspecific and are easily confused with sepsis or common postoperative complications leading to haemodynamic abnormalities and multiorgan involvement**.** The pathogenesis of adrenal haemorrhage in burn cases is typically multifactorial. Necrosis and haemorrhage may occur during burns as a result of ischemia or during adrenal stimulation from vascular engorgement and stasis.[2,3,4]

The diagnosis of adrenal insufficiency resulting from adrenal haemorrhage is often overlooked because of the nonspecific nature of the clinical presentation. Until recently, most diagnoses of adrenal haemorrhage were made at post-mortem examination. The reported prevalence of adrenal haemorrhage in general hospital autopsy studies is 0.14% to 1.8% although extensive bilateral adrenal hemorrhage may be present in 15% of individuals who die of burns.[5]

Aims & Objective

The purpose of this study was to investigate the prevalence of adrenal haemorrhage in non-surviving patients with burns by evaluating the compiled autopsy study data.

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(Received on 27.12.2012, accepted on 22.05.2013)

Material and Methods

In this study, all the burn cases that were brought for post-mortem examination at mortuary of Adichunchanagiri Institute of Medical Sciences, Mandya District, Karnataka, India between 1st july 2009 to 31st june 2011 have been studied. The ethical clearence and permission from institutional ethics committee and review board has been obtained.

Results

During the period between 1ST july 2009 to 31st june 2011, 51 burns cases were autopsied.

Table 1: In the present study, 35.3% of victims were between 21-30 years of age. Women were more involved than men with a ratio of 2.6: 1.

Table 1 Distribution of cases according to age and sex

Age group	Male	%	Female	%	Total	%
<10	00	00	00	00	00	00
11–20	04	18.2	00	00	04	7.8
21–30	07	31.8	11	37.9	18	35.3
31–40	05	22.7	09	31	14	27.5
41–50	03	13.6	06	20.7	09	17.6
>50	03	13.6	03	10.3	06	11.8
Total	22	100	29	100	51	100

Table 2: Survival period of up to 2 days were seen in 41% of cases.

Table 2 Distribution of cases according to survival period

Period of survival	No. of cases	%
Brought dead	00	00
<1 day	03	5.8
1–2 days	21	41.2
3–4 days	12	23.5
>5 days	15	29.4
Total	51	100

Table 3: Around 39% of victims sustained burns over 76-100% of their total surface area.

Table 3 Distribution of cases according to total body surface area involved

TBSA	No. of cases	%
<25%	07	13.7
26-50%	09	17.6
51-75%	15	29.4
76-100%	20	39.2
Total	51	100

Table 4: The most common cause of death was septicemic shock (41.2%), followed by multiorgan failure (29.4%).

Table 4 Distribution of cases according to mode of death

Mode of death	No. of cases	%
Neurogenic shock	03	5.8
Septicaemic shock	21	41.2
Acute renal failure	12	23.5
Multi organ failure	15	29.4
Total	51	100

Table 5: Adrenal haemorrhage was seen in 14 cases, of which 10 cases showed bilateral hemorrhages and 4 cases showed unilateral hemorrhages. Extensive, bilateral adrenal hemorrhages were more commonly seen in males (male to female ratio of 2:1).

Table 5 Autopsy Findings

Total no. of burn cases	Adrenal hemorrhage seen	Unilateral Adrenal hemorrhage	Bilateral Adrenal hemorrhage
51 cases	14 cases (27.5%)	04 cases (28.6%)	10 cases (71.4%)

Discussion

Acute adrenal insufficiency is an uncommon but devastating complication of severe burn injury. The diagnosis is rarely made ante mortem.[6]

In a study done by Kallinen O and Koljonen V, maximum numbers of victims were males and all of them were beyond 30 years age group. Out of four victims, three members died due to multiple organ failure and survival period was more than seven days in most of the cases.[6]

According to Rao RH, most patients with nontraumatic, extensive, bilateral adrenal haemorrhage were aged 40-80 years at the time of the acute event. In contrast, patients with traumatic adrenal haemorrhage typically are in the second to third decade of life.[7]

Reiff *et al* found higher % TBSA and older age to be risk factors for acute adrenal insufficiency in severely burned patients by case–control study.[8]

According to a study done by Outi K and Virve K, bilateral adrenal haemorrhages were found in 3 cases and unilateral adrenal haemorrhage was seen in one case.[6]

According to a study done by Botteri A. and Orell SR. (1964), adrenal haemorrhages were observed in 19 cases and a minor bleeding in adrenal gland was found in 4 cases.[9]

A study done in University of Texas Southwestern Medical Center shows Acute, fatal, adrenal insufficiency in 3 patients among 807 critically ill patients with burns treated at their institution.[10]

A study done by Sammy AD, Robert BR, Richard JW, John AG Texas Tech University Health Sciences Center found adrenal hemorrhage in a 3 year old burns patient.[11]

In a study of 2000 consecutive general hospital autopsies, only 22 (1.1%) revealed bilateral AH[12]; however, as many as 15% of patients dying in shock have been demonstrated to have bilateral AH.[13]

Conclusion

Acute adrenal insufficiency may occur in association with extensive, bilateral adrenal haemorrhage, and it is uniformly fatal if unrecognized and untreated. Patients with adrenal haemorrhage may die because of underlying disease or diseases associated with adrenal haemorrhage, despite treatment with stress-dose glucocorticoids.

Overall, adrenal haemorrhage is associated with a 15% mortality rate, which varies according to the severity of the underlying illness predisposing to adrenal haemorrhage. Bilateral adrenal haemorrhage is rarely diagnosed clinically as its presentation is generally non-specific. The clinical importance of bilateral adrenal haemorrhage is that it may lead to acute adrenal insufficiency and possible death. Therefore, when a sudden deterioration in a patient with thermal injuries is encountered, adrenal insufficiency must be considered.

Conflicting Interests

The authors declare that they have no conflicting interests. The authors have read and approved the final manuscript.

Consent

Written informed consent was obtained from the relatives of the deceased.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Cross Sectional Study to Determine Gestational Age by Metrical Measurements of Hand Length

B. Manjunatha*, M.D. Nithin, Sasidharan Sameer*****

Abstract

This was cross sectional study conducted to assess the gestational age by hand length of foeti. This method was used as it is simple and noninvasive. Hand lengths of 126 foeti – (77 live & 49 dead) were included in this study.

The results were encouraging and comparable with other similar studies. The hand length (independent variable) is strongly related with the period of gestation. As this method is simple, economical and accurate it can be used by a basic medical doctor and also paramedical even in a rural setup

Keywords: Gestational age; Hand lenght; Fetus; Infants**.**

Introduction

In the recent past, the major factor responsible for infanticide was pregnancy arising out of wedlock, which is now considered to be one of the most common motivating factors. Most of these teenagers seek abortion when pregnancy is advanced.[1] Some strata of the society resort to selective female foeticide either in utero or after being born, so as to avoid the burden of dowry. This is being practiced even after the 'Prenatal Diagnostic Technique' (Regulation and prevention of misuse) Act, 1994. In India neither is infanticide recognized as a separate crime nor is there any separate provision for it in the I.P.C. Infanticide is punishable u/s 302 I.P.C. i.e., infanticide is not differentiated from murder in India.[2]

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(Received on 10.12.2012, accepted on 27.12.2012)

So, to prove an infanticide, it is essential to prove that the baby has been born "alive" & was capable of separate existence i.e, "Viability". These two form the important parts of the overall medical evidentiary. The former will be determined by the establishment of respiration and the child's reflexes and voluntary acts. The latter is determined by estimating gestational age and foetal maturity. In medico legal practice viability is confirmed purely by the gestational age and courts are reluctant to accept the gestational ages of less than 28 weeks as sufficient to ensure survival.[3]

Abortion has been liberalized since introduction of 'Medical Termination of Pregnancy Act 1971' but it has put forth certain restrictions with regards to the period of gestation. If there are any Criminal or Civil proceedings against the doctor for violating the rules and regulations of M.T.P. Act, again we may have to examine the foetus for estimating the gestational age.

In short, there are three distinct Medico legal situations where in determination of gestational age assumes importance.

1. Where it is alleged that criminal abortion has been procured.
2. Where it is alleged that infanticide has been committed

3. In cases of abortion procured under M.T.P. Act, the determination of gestational age may become legally important because of the restrictions imposed by the Act.

In India, medicolegal autopsy is performed predominantly by Medical Officers in the Primary Health Centers which are located in the rural areas. The Medical Officers working in Rural Primary Health Centers only have basic Medical qualification. With only a M.B.B.S., degree we cannot expect them to dissect the foetus and look for the ossification centers in the sternum Riach I.C.F[4] or length of the femur Yagel S., *et al*[5] which are quite reliable tools to assess the gestational age. Gestational age can also be reliably assessed by radiological study of ossification centres of sternum Krechowiechi.[6] But as rural P.H.C.'s lack even the basic infrastructure, radiology unit is a big ask. Moreover the Medical Officers are not given any special training to perform such autopsy techniques. Several parameters have been used to estimate the gestational age by different workers. They are:

1. Birth weight, Haddock F.P.[7]
2. Development of convolutional pattern of cerebral cortex, Katerina Dorovini Zis *et al*.[8]
3. Development of tooth germ, Berkouitz B.K.B.[9]
4. Crown Heel length and appearance of ossification centres, Polson *et al*.[10]
5. Assessment of serum placental lactogen, Whittaker P.G., Lind T. and Lawosn J.Y.[11]
6. Microscopic examination of body tissues, Kellet R.J.[12]

In this study, metrical measurements of hand length are used for estimating the gestational age, as it is a simple and non invasive technique. It can be carried out by a doctor even with a basic medical qualification. This study is carried out as there is no such study done in this area.

Aims and Objectives

1. To assess the gestational age by a simple and non invasive method.
2. To assess the gestational by an accurate method this is also economical.

Material and Methods

This study was conducted in the District Hospital, Belgaum with the assistance of Department of Obstetrics and Gynaecology, Jawaharlal Nehru Medical College, Belgaum. Permission for this study was obtained from the Principal, Jawaharlal Nehru Medical College and District Surgeon, District Hospital, Belgaum. This study was conducted between 11th October 1997 and 30th September 1998.

Material

A total of 126 cases were included in this study, of which 77 were live and 49 were dead

Out of 77 live preterm infants, 63 foeti were obtained from preterm vaginal deliveries and the remaining 14 from lower segment caesarian section.

Out of 49 dead foeti that were obtained from abortion, most were due to medical causes like ante partum haemorrhage, hypertension etc and 2 from abortion due to trauma. 11 foeti were obtained from preterm deliveries.

As followed by Kulkarni and Rajendran,[13] in this study also all live infants and dead foeti were examined within 48 hours after being expelled or extracted.

Inclusion criterion

1) All cases (live preterm infants and dead foeti) between 24 and 36 weeks of gestation with reliable dates of last menstrual period dates.
2) All cases irrespective of their socioeconomic status, religion or region

(urban/rural) were included.

Exclusion criterion

1) Cases diagnosed as intrauterine growth retardation.
2) Babies of mothers suffering from diabetes mellitus (as incidence of big babies is more in diabetic mothers).
3) Cases in which reported period of gestation and estimated gestional age by clinical examination differed by more than +2 weeks.[14]

Method

Written consent was obtained from the parents. In most of the cases in this study, only mothers' consent was obtained due to unavailability of the other parent during the examination. Staff in charge was requested to give consent for examination in cases where parents left behind the dead foeti.

Apart from the name and address, brief antenatal history which included the date of last menstrual period was obtained. Date, time and mode of delivery were noted.

Gestational age estimated by clinical examination was noted. General physical examination of foetus was done looking particularly for presence of vernix caseosa in the folds, presence and distribution of lanugo hair and development of external genitalia.

Hand length

As there was no statistical difference between right or left hand length, all measurement was done on the right side.

Hand length measurement was done using a vernier caliper within 48 hours after the foetus/infant being born, expelled or extracted. Vernier calipers used is of sliding type, graduated in cm upto 12 cm.

Hand length was measured between wrist crease and tip of the middle finger Kulkarni and Rajendran[13] and Kumar and Kumar[15] and recorded on a graph paper using a pencil with the help of compass.

Results

Statistical abbreviations

RPG = Reported period of gestation in weeks (Dependent variable)

HL = Hand length in cm (Independent/ explanatory variable)

R = Correlation coefficient

R^2 = Extent of variation in dependent variable explained by the changes in explanatory variable

DF = Degree of freedom

F = Variance ratio

b = Regression Coefficient

K = Constant

SEb = Standard error of regression coefficient

T = Derived from students 'T' test

Statistical analysis

Statistical analysis was done using the Statistical Package for Social Service (SPSS Plus) software on the computer.

The analysis of regression coefficient method was adopted for this data and is evaluated in terms of 'variance ratio test' or 'F' test, value of R^2 and statistical significance of 'b' *i.e.*, regression coefficient. The change of gestational age (dependent variable) with respect to changes in the hand length (explanatory variable) is known as regression. The 'F' test as well as statistical significance of 'b' are judged by the value of 'P' obtained from the respective tests. If 'P' value is less than or equal to 0.05, it was considered to be statistically significant.

The second criterion for evaluation of regression is by 'R^2, which indicates the extent of variation in gestational age (dependent variable), explained by the 'changes in hand length (explanatory variable). In our study R^2

= 0.97. It indicates that 97% of the variation in dependent variable is due to its relationship with explanatory variable.

The square root of R^2 indicates the magnitude of the correlation coefficient ®. The value of 'R' may vary between – 1 and +1. A positive correlation coefficient means that increase in one variable is usually associated with increase in another variable. Similarly a decrease in one variable is associated with decrease in another variable. A negative correlation shows that while one variable increases the other decreases and vice versa. If R=O, it indicates that there is no relation. In our study 'R' value for hand length is 0.988 indicating a positive correlation.

Hand length was used as an explanatory variable. Taking the reported period of gestation as the dependent variable (predicting value), the regression between the explanatory variable (independent variable) ie. Hand length and dependent variable, reported period of gestation was calculated using simple linear regression analysis. The independent variable was strongly related with reported period of gestation. This has been brought out by high 'R' and R^2. The regression coefficient was tested for statistical significance by analysis of variance. It was found to be highly significant P<0.001.

'b' is the regression coefficient which is equivalent to change in the gestational age for increase in hand length. That is, if there is an increase in 1 cm in the hand length, there will be an increase in 5.399 gestational weeks according to the present study. 'K' (constant) is the interceptor or correlation factor.

Multiple R	0. 98361
R Square	0. 96748
Adjusted R Square	0. 96722
Standard Error	0. 91656

Multiple Regression

The above analysis shows the relationship between the reported period of gestation and hand length. The correlation coefficient ® = 0.983 indicating a positive correlation.

P is <0.001 and standard error of regression coefficient is 0.88, which is statistically significant.

Gestational age (GA) can be calculated using the formula, GA = b x HL + K. In the present study:

GA = 5. 399 x HL + 5.577

Discussion

In the present study, hand length in cm (HL) of foetus of 126 cases both live preterm infants and dead foeti were recorded. The reported period of gestation ranged between 24 and 36 weeks. Using linear regression analysis, regression coefficient (b) and constant (k) were estimated with gestational age as the dependent variable and HL as independent / explanatory variables. Gestational age (GA) can be estimated using the formula:

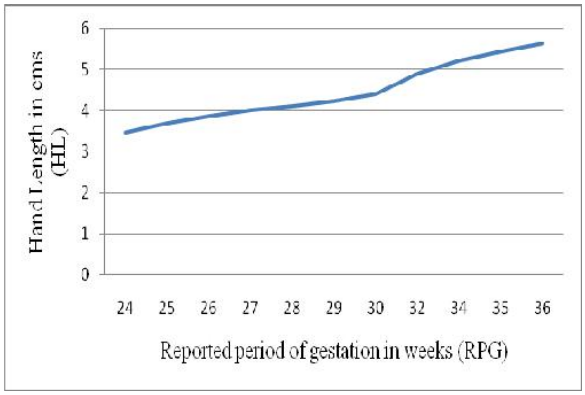
GA = b x HL + K

When a graph were plotted with gestational age as X axis and mean values of hand length, as Y axis, a linear association was obtained.

The independent variable HL is strongly related with reported period of gestation, which has been supported by high R and R^2 values.

Yakovsivan, Paul Merlob and Salmon H.Reisner[16] studied 198 term and preterm

Fig 1: Linear relationship between Reported period of gestation (RPG) and Hand Length (HL) in the present study



Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	3099.54420	3099.5442
Residual	124	104.17009	0.84008

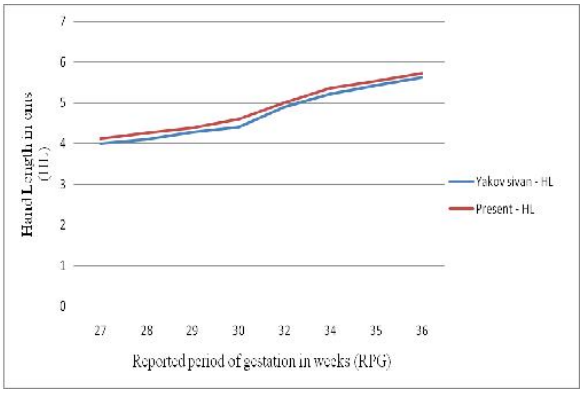
F = 3689.57631 Sgnif F = 0.0000

foeti with reported period of gestation ranging from 27 to 41 weeks. They used hand lengths of foeti to estimate the gestational age. Mean values of hand length obtained from Yokovsivan's study was compared with those from the present study. Comparison was only possible between gestational age range of 27 to 36 weeks (as this is the common age range). The mean values of hand length in the present study are slightly less in comparison to the corresponding weeks in Yokovsivan's study.

However in Yakovsivan's study, a curvilinear association is also obtained when mean values of hand length and gestational age are plotted on a graph, which is similar to the present study .

Kulkarni and Rajendran[13] studied 817 full term and preterm foeti with reported period of gestation of 26 to 42 weeks. Foeti with gestational range of 26 to 36 weeks were 107 in number. The gestational age was estimated using hand length. All the measurements were done within 48 hours as in the present study. The mean values of hand length in the range of 26 to 36 weeks of gestation of the two studies (i.e., Kulkarni and Rajendran's study and the present study) were compared. Mean values of hand length were found to be slightly lower in the corresponding weeks than in the present study.

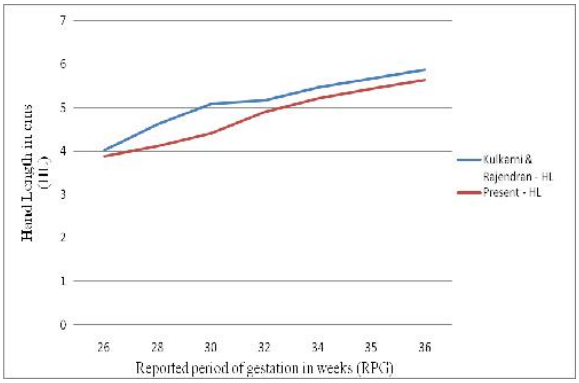
Fig 2: Comparison of mean values of Hand Length in cms against Reported period of gestation in weeks between Yakov Sivan's study and Present study



Variables in the Equation

Variable	B	SE b	Beta	T	Sig T
HL	5.399992	0.088901	0.983608	60.742	0.0000
(Constant)	5.577654	0.420268		13.272	0.0000

Fig 3: Comparison of mean values of Hand Length in cms against Reported period of gestation in weeks between Kulkarni & Rajendran's study and Present study



When gestational age and mean values of hand length were plotted on a graph on X and Y axis respectively a linear line of association was obtained in both the studies.

Kumar and Kumar[15] studied a total of 108 healthy human foeti of various age groups ranging from 14 to 36 weeks of gestation. They used hand lengths for assessing the gestational age. The mean values of hand length derived from the study conducted by Kumar and Kumar was compared with mean values of hand length obtained from the present study. Hand lengths of both the studies compared favorably with each other.

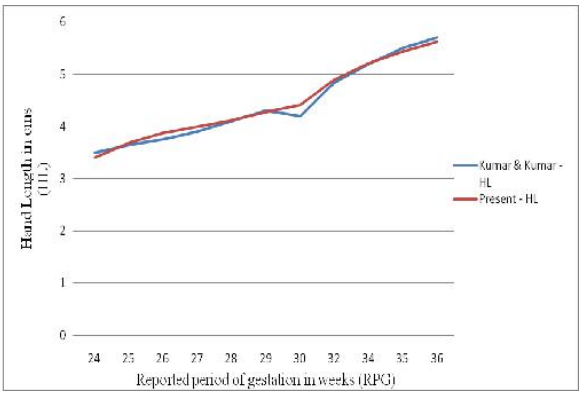
A linear association was obtained when hand length was plotted against gestational age, which is similar to the linear curve obtained in the present study .

When the statistical data of present study was compared with those of Kumar and Kumar the following inferences were drawn.

The R and R^2 values (0.97 and 0.95 respectively in Kumar and Kumar's study and 0.98 and 0.96 respectively in the present study) are both very high. They indicate that there is a strong correlation between gestational age and hand length. P value in both the studies is <0.001, which is statistically significant.

Gestational age can be calculated using the formula: **Gestational age = b (Regression coefficient) x Hand length + K (constant)**
In Kumar and Kumar's study **Gestational age = 4.62 x Hand length + 8.05**
In the present study **Gestational age = 5.39 x Hand length + 5.57**

Fig 4: Comparison of mean values of Hand Length in cms against Reported period of gestation in weeks between Kumar & Kumar's study and Present study



Standard error was 1.04 for the estimation of hand length in Kumar and Kumar's study, whereas in the present study, it is 0.088.

Summary

This study was conducted in District Hospital, Belgaum in the year 1997-98. It was a cross sectional study (not involving follow-up of the cases), where gestational age was estimated using hand length. Measurements of 126 cases (both live and dead) were included in this study. Reported period of gestation considered in this study was in the range of 24 to 36 weeks. Measurements of both live and dead cases and of either sex were combined as no statistical difference was found. Hand length measurement was obtained using a vernier caliper.

Applying regression analysis, statistical data was derived. Statistical values like R (correlation coefficient) and R2 (Extent of variation with gestational age which is explained by changes in hand length) were high, indicating a strong relation between gestational age and hand length.

Tests of significance like,

1) 'F' test
2) Students 'T' Test
3) 'P' value
4) Standard error of regression coefficient

were all found to be statistically significant.

A linear association was obtained when mean values of hand length were plotted against gestational age on a graph.

Applying the statistical data derived from hand/length, gestational age can be calculated using the formula:

Gestational age = b (Regression coefficient) x Hand length + K (Constant)

Gestational age = 5.39 x Hand length + 5.57

The findings and results of this study are well supported by similar studies by other workers. Only a slight discrepancy was found when mean values of hand length of the present study was compared with those of western workers. That is, mean values of hand length of the present study were marginally lesser. This difference can be explained by variations in socioeconomic status, environmental and nutritional factors.

Conclusion

Establishing precise duration of pregnancy is of paramount importance for a forensic pathologist. Hand length of both live preterm infants and dead foeti has shown a high correlation with gestational age, which reflects the accuracy of this study.

It is a non invasive technique. There is no need for any special training to calculate gestational age by this method as the methodology is simple. As the expenditure involved in this study is minimal, it can be considered as an economical one. As it is a simple and economical method, it can be used even in rural areas by doctors with a basic

medical qualification. Another advantage of this study is that it is not lengthy and time consuming. This study can also be of help in cases where only fragmented remains of the foetus is available; where other parameters like crown heel length, weight etc cannot be applied. In most of the cases it is unlikely to have both hands destroyed either due to extraction of foetus during delivery/abortion or due to attack by carnivorous animals. Out of the various parameters available to assess the gestational age, this appears to be equally accurate, less tedious and highly practical for the reasons already explained.

Enough work has been made by many workers and the accuracy and its benefits have been already highlighted. Many workers are of the opinion that it is very practical and reliable. It is felt that this technique must be popularized by using it more frequently in day to day practice.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Cranial Capacity: A Useful Parameter in Sexing of Crania

Ruta N. Ramteerthakar*, B.N. Umarji**

Abstract

The cranial capacity of 310 dried crania (155 males and 155 females) was measured using the Breitinger's mustard seeds technique. The mean cranial capacity for male crania was 1285cc and for female crania it was 1176cc. The sex difference in the mean values of cranial capacity of male and female crania was statistically significant. The knowledge of the cranial capacity is important because it indicates indirectly the brain volume.

Keywords: Cranial capacity; Breitinger's; Sex difference.

Introduction

The correct sex determination of skeleton is a critical requirement in physical anthropology and forensic medicine. Anatomists are often called to give an expert opinion in medico-legal cases pertaining to sex from the available skeleton of the deceased. For this purpose the cranial capacity was studied.

Knowledge of the cranial capacity is important to study and to compare crania of populations with various fundamental differences like racial, geographic, ethnic, and dietary etc.[1] Medically an analysis of cranial capacity exposes another aspect of growth and development which permits critical evolution of unusually large, small or misshapen crania.[2] It is necessary as it indicates indirectly the brain volume and it is important investigation used for reconstruction of brain or skull in forensic or anthropological studies.[3,4]

Material and Methods

For the present study Breitinger's (1936) mustard seeds technique was used to measure cranial capacity.

In this technique to begin with all the foramina of the skull were plugged with cotton. Then, the cavity was filled through the foramen magnum with mustard seeds of uniform size by the help of a funnel. The skull was shaken intermittently to fill the cavity entirely. When the skull cavity was filled upto the brim, the seeds were pressed gently with the right thumb at the foramen magnum. Then the seeds were poured into a volumetric jar through a funnel. Reading on the jar was taken. Breitinger (1936) had devised a cylinder with a graduated piston. The reading was taken after gently placing the piston on the seeds in the cylinder. There is increased probability of personal error in taking the measurement by this technique but with proper precautions and controls the error can be reduced to 10cc.[5]

An overview of the methodologies available in the literature has been studied by

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(Received on 10.12.2012, accepted on 22.05.2013)

Manjunath KY.[6]

Observations

Range, mean and standard deviation of the cranial capacity of adult, fully ossified crania was calculated. The identification point was calculated from the range of each measurement. From this percentage of identified bones was calculated. But when nearly 100% accuracy of sexing is required e.g. in medico-legal cases, it is advisable to calculate the maximum and minimum limits by adding ±3S.D to the mean value. This gives the calculated range. It covers 99.75% of the sample from this zone and will be useful also for any other sample from this zone. Demarking points were worked out from calculated range.[7] The percentage of bones identified by each demarking point in both sexes was estimated. The demarking points identify sex with 100% accuracy.[8] The difference observed between means of male and female to know whether it is statistically significant, that is value of 'P' is calculated by applying 'Z' test.

Discussion

The present study is compared with the studies by Thomas IM. Ricklan DE, Hwang Y. The cranial capacity of the present study in male and female crania is comparable with the study of Thomas IM. While all the other studies by Ricklan DE, Hwang Y showing that the mean values of the cranial capacity are higher in male and female crania than the present study.

Table 2: Discussion table for cranial capacity

Investigators Side	No. Of Bones		Mean	
	M	F	M	F
Thomas IM [9]	172	173	1257.6	1167.87
Ricklan DE [10]	50	50	1373.3	1251.2
Hwang Y [11]	64	23	1470	1317
Present study	155	155	1285	1176

Graph 2

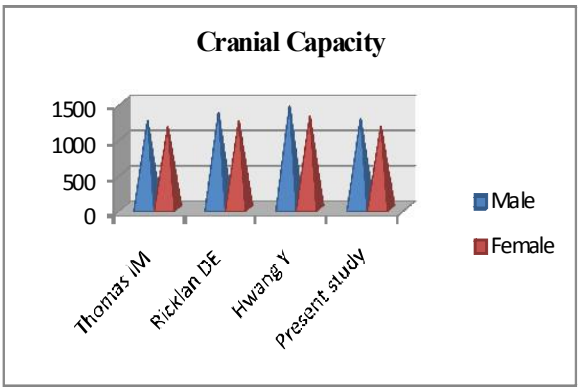
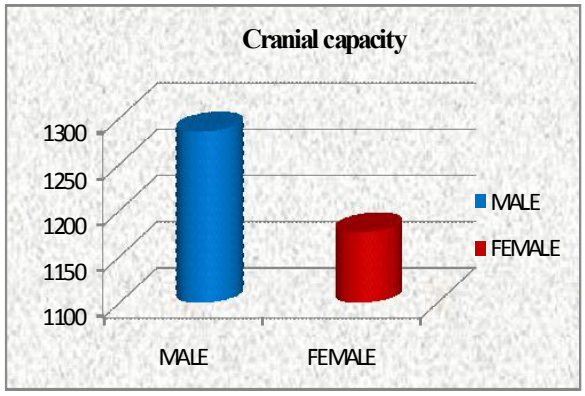


Table 1: Observation table of cranial capacity

Sr. No.	Details of measurements	Male	Female
1.	No. of bones	155	155
2	Range	1040 - 1600	1000-1440
3	Mean	1285	1176
4	Standard deviation	84.96	71.78
5	Statistical significance	P<0.01	
6	Identification point	>1440	<1040
7	Percentage of identified bones	5.16	1.94
8	Calculated range	1030-1541	961-1392
9	Demarking point	>1392	<1030
10	Percentage beyond demarking point	9.68	0.65

Graph 1



Conclusion

The statistical significant sex difference was found in the mean of cranial capacity in male and female crania. This data will be helpful for opinions in the medico-legal cases regarding the determination of sex.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Head Circumference in Maharashtrian School Children and Socio-economic Status

Santosh V. Shinde*, A.D. Kundalkar, B.R. Zambare***, Sudhir E.Pawar******

Abstract

Aim: Head circumference - one of the most significant findings in physical examination and diagnosis of neurological disorders. This parameter is an useful anthropometric tool. Keeping in purview the point that no literature is available regarding Maharashtrian population, this study was undertaken where Head circumference was compared with socio-economic status of 9–12 aged school children.

Material and Method: A cross-sectional study including 623 subjects (312 male, 311 female) of 9–12 yrs was undertaken. The study group is further divided into high income group (HIG) and low income group (LIG) for which sardar dasture high school, municipal school no. 7, were taken respectively. Anthropometric measurements of Head circumference subjects who are all normal and healthy children, judged by criteria established by Gill *et al*, were taken.

Results: 1) Values of head circumference is higher in high group as compared to those of low socio-economic group.

2) It is observed that growth spurt in head circumferences is at a latter date between 11-12 yrs in female in both socio-economic groups, while in males, growth spurt is earlier between 10-11 yrs of age.

3) It is observed that all populations in the world are undergoing temporal changes with reference to body measurement.

4) Mean values have shown a drop towards higher income group in some age cohorts.

5) Growth spurt is revealed through data which clearly shows that HIG children attained such spurts much earlier than those of LIG.

Conclusion: With latest trend of globalization, world is coming closer and people are travelling far and wide. Although there exists few studies on adolescent growth, no serious attempts have been made in respect to population.

Keywords: Head circumference; Cross sectional analysis; Anthropometry; High income group (HIG); Low income group (LIG).

Introduction

Head Circumference is one of the most significant findings in physical examination of children, especially in the evaluation of the development and early diagnosis of neurological disorders.[1,2] There is a rapid increase in Head Circumference and marked histological changes in the brain in early infancy.[3,4] Therefore early recognition of deviation from normal growth is important.

Reference data for a large age range allow the follow-up of children and recognition of the catch-up growth in Head Circumference that can occur up to about 5 years, when cranial sutures interlock.[5,6,7] Head Circumference of school aged children may prove a useful anthropometric tool in deciding early nutritional history.[8,9] Any significant reduction in Head circumference found in malnourished children may have serious

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(Received on 10.12.2012, accepted on 28.04.2013)

implication for their future performance and achievement.[10]

In Maharashtra, there is no standard values for Head Circumference of children, that can be used as one of the standard charts for developmental evolution. Our objective was to construct standard Head Circumference and relative Head Circumference for each sex of Maharashtrian children from 9 to 12 years of age, and compare our data with socio-economic status.

Material and Methods

This was a cross-sectional study, including 623 subject (312 male and 311 female) of age 9 -12 years. The study group is further divided in to Higher income group (HLG) and Lower income group (LIG). Two schools were selected according to socio-economic status, Sardar Dastur High school for high income group and Municipal school no.7 for low income group. Those children studying in Municipal school are from low income group (LIG), are in contrast with their counterparts who are with the predominantly English medium school, where high income (HIG) are found. The Anthropometric measurement of Head circumference of each child was obtained and studied by cross sectional analysis along with socio-economic status.

The subjects were all normal and healthy school going children belonging to Higher income Group and Lower income Group. The subject were judged to be normal and healthy based on the criteria recommended by Gill *et al*.[4] The selection of subjects was on the basis of random sampling.

The age of the subjects was determined from their dates of birth recorded in the school register. The age was rounded off to the nearest whole number. The subject were divided in to the three age groups *i.e.* 9-10, 10-11 and 11-12. All the subjects came from the same environment.

For head circumference the male and female subjects were asked to sit in correct and comfortable position. For female subjects, objects likes hair pins were removed and plaits were lifted up. Then the measurements from glabella around to the opisthocranium, maximum projection of the occiput was taken in centimeters. Then the mean is calculated, then compared with socio-economic status in all age groups among both sexes.

Socio-Economic groups

Ideally it is necessary to assess objectively the economic status of each subject. However, it is extremely difficult to carry out such a survey as subjects for this study were not in a position to give their family income correctly. Thus it was decided to select those schools (corporation / Municipal school), where the student are belonging to the lower economic status (LIG), generally opt to enroll. The English medium schools, especially run by the Christian Missionaries, on the contrary have a majority of the students (more than 95 %) belonging to the upper and higher class families (HIG), where the income is quite high. Thus the present study purposely selected such school which provided students who belonged to these two opposite economic grades or status also indicating their levels of nutritional intake among these contrasting groups.

Observation and Result

The study was carried out on a total 623 subject of both the sexes from the age group of 9 – 12 years and were considered separately for both the higher (HIG) and lower (LIG) as well as for sex differences.

It is observed that values of the head circumference is higher in higher socio-economic group as compared to those of low socio-economic group. The analysis is as follows:

Head circumference (cm)

It is observed that growth spurt in head circumference is at a latter date between 11–

Table 1: Mean and standard deviation of Head circumference

Age Group (yrs)	High Socio-economic status (HIG)				Low Socio-economic status (LIG)			
	Male		Female		Male		Female	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
9-10	52.28	1.77	53.49	1.72	54.44	1.12	50.84	1.76
10-11	53.54	1.47	53.38	1.31	51.80	1.75	50.80	2.36
11-12	52.80	2.01	54.26	1.94	51.70	1.43	51.60	2.31

12 years in females of both socio-economic groups, while in males, growth spurt is earlier between 10–11 years of age.

The dropping of values in parameters at age 11-12 years in male of higher socio-economic group can be explained on the basis that the studies were cross sectional, where such differences could be possible. It is observed that the head circumference does not grow appreciably much after the early childhood. Thus it may be stated that this measurement is not a good parameter to be considered in such studies on growth.

Discussion

It is believed that good fertile and properly maintained soil produces good crop. Likewise, healthy children of today would be the better citizens and parents of tomorrow. Hence, this pre-pubertal age group should be well attended for and looked after.

For the same, WHO is also stressing upon the health program of pre-pubertal and adolescent girls. This data will assist in preparing various health programs.

Bhandari B. *et al*[11], in 1972 had also done the same work as follows:

Head circumferences

The above table shows the increase in head circumference in 9-12 years is negligible and same is observed in Bhandari *et al*[11] study though the value is lower in general.

The study, as mentioned earlier has been undertaken with the view to comprehend the dynamics of measurements of head circumference among the LIG and HIG and also to understand the sexual dimorphism presented by the measurements.

The study also provides a comparative picture with those similar studies under taken from Bhandari B. *et al*[11] in 1972 and Zaki M. E. *et al* in 2008.[12] It is now well established that all populations in the world are undergoing temporal changes with reference to body measurements mainly caused by the lifestyle changes and better nutritional food intake.

There also appears to be conscious changes brought about by exercise and food regulation for specific and desired body dimensions, specifically along the higher income group children in the urban area.

Comparing the values for the measurements, in all the three age groups considered here and across the genders and income groups of various previous studies clearly shows that these temporal changes and their impact on the measurements.

Although this general principle could be applicable when we compare all these studies, we have to be careful in providing interpretation of the obvious differences amongst these studies. This is mainly due to the fact that there is wide heterogeneity observed amongst the Indian population across the length and breadth of the country, as well as between the rural urban population divide.

Table 2: Comparison of Head Circumference with other similar studies

Age Group (yrs.)	Present Study				Bhandari B. *et al.* (1972)			
	HIG		LIG		HIG		LIG	
	M	F	M	F	M	F	M	F
9-10	52.28	53.49	54.44	50.84	48.4	---	---	---
10-11	53.54	53.38	51.80	50.80	48.9	---	---	---
11-12	52.80	54.26	51.70	51.60	49.0	---	---	---

The mean values have shown a drop towards the higher age group in some age cohorts. We have to keep in mind that the selection of these cohorts is based on only one criteria that is income. However, within the same age group cohorts, there can be children belonging to different caste or religious groups, who would represent different body dimensions. The fluctuation which we observe here between age cohorts thus could be introduced by this sampling error.

Summary and Conclusion

With the latest trend of globalization, the world is coming closer and people are traveling far and wide. So, India with its present mode of acceleration on developmental process, also hope to level the economic disparities amongst people. It is said that national development is intimately integrated with the population of adolescents and youngsters of the nation as their strong burning desires and agile minds can make or break the nation. Hence, reproductive child health is its prime concern. Although there exists a few studies on adolescent growth and its dynamics, no serious attempt has been made to analyze the growth pattern amongst the pre-pubertals, especially in Pune. The present study attempts to fill this gap, with a view to understand the growth variations between sexes, belonging to two distinguishable economic categories.

The result clearly divide these two groups LIG and HIG as reflected through their anthropometric parameter.

Head circumference increases at a later date between 11-12 years in females and both socio-economic groups, while in males, growth spurt is earlier between 10 – 11 years of age.

The growth spurt is revealed through the data which clearly shows that HIG children attained such spurts much earlier than those who belong to LIG, who exhibited delayed spurt in head circumference.

The data would be quite useful not only to understand the underlying cause (genetic as well as environmental) for such variation, but also the factors which affect the growth of pre-pubertal individuals.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Imaging Techniques: A New Approach in Forensic Medicine

Wadhawan M.*, Kumar S., Mandal S.P.***, Murali G.*****

Abstract

Forensic radiology is a specialized area of medical imaging using radiological techniques so as to help forensic specialists in matters pertaining to law. Radiological techniques have become more sophisticated with the introduction of CT, MRI and ultrasonography (USG). These are widely being applied by forensic experts and require active intervention of Radiologists. Radiographic images are widely used in identification of foreign bodies, child abuse cases, body identification, age estimation, determination of cause of death and injuries.

Keywords: Forensic radiology; Virtopsy; Identification; Biological age; Necroscopic examination.

Introduction

Radiology has got a significant role in Forensic Medicine and is often used in medicolegal matters in various ways. Radiological studies play a pivotal role in forensic cases for locating foreign bodies within the body like bullets, gas embolism etc., documentation of fractures and other mechanical injuries. Virtual autopsy (Virtopsy), which involves a full body computed tomography and magnetic resonance imaging examination to get two-dimensional and three-dimensional view is developing as an alternative to conventional autopsy. Antemortem and postmortem radiographic comparison is often used in the identification of unknown human remains. The use of radiographs in routine and mass disaster identification is well known and it's usage in necroidentification is an efficient easy method. Age estimation of the living as well as of cadavers relies on dental and skeletal radiographs. The aim of this review is to discuss the various uses of radiology in the clinical forensic medicine.

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(Received on 10.12.2012, accepted on 27.12.2012)

Necroscopic examinations

Postmortem radiological examination is common in forensic medicine. The permanent nature of x-ray plates makes them available for reevaluation and reinterpretation. Generally, radiographs are taken after the external examination and before the dissection, except in bombings and charred bodies. In natural death cases and assumed medical malpractice, the implementation of various imaging techniques help in spotting pathological features like pneumothorax, pneumo peritoneum, barotrauma injuries and air embolisms. In cases of suspected traumatic subarachnoid hemorrhage, vertebral angiography can be performed after death.[1] When the body to be examined is badly decomposed or exhumed, full body radiographic study help in envisioning hidden injuries and pathological findings.

Radiographs are used in forensic evaluation of gunshot wounds to localize the bullets, to determine the number and caliber of bullets, angle and direction of fire. Bullets often travel to distant sites from entry wound. Hence, radiographic examination should be of the

whole body. Trajectory of bullet can be traced by characteristic finding of multiple tiny lead fragments referred as lead snowstorm[2] or by sophisticated imaging techniques like computed tomography.[3]

"Virtopsy" (virtual autopsy) has developed as an alternative to conventional autopsy with the merits of removing the hindrances by relatives of the deceased and providing objective, everlasting documentation of postmortem evidence. The technique combines whole-body examination by CT and MRI to obtain two-dimensional and three-dimensional documentation. It has the ability to provide the findings at the moment of the investigation without causing damage and permitting the forensic expert to recapitulate the results afterwards. Further benefits include safe and easy examination of infected dead body minimizing the risks to the forensic specialist.[4,5,6]

Identification of human remains

The identification of human remains is a vital requirement in forensic cases of skeletonized, decomposed, and burnt victims. Radiography is a common diagnostic tool in various dental and medical ailments. Hence, antemortem radiographs can be easily procured for positive identification.[7] Personal identification of human remains is accomplished when specific features noticed on the cadaver match the information documented during the life of individual. The radiographic identification of the deceased is influenced by the similarity in position and intensity conditions of antemortem and postmortem radiographs.[8] Radiographs of skull, dental, chest and abdomen are most commonly employed for positive identification.[9] Positive radiographic identification is accomplished by careful comparison of the details present on the film. The features depicted on radiographs must be unique to each individual, and should remain stable over time despite ongoing life processes and aging. Usually, one to four unique analogous features and no discrepancies are considered enough for a positive identification.[10] Radiographic positive identification of unknown human remains is done by comparison of features present on the antemortem and postmortem plates like old surgical or orthopedic procedures, prosthetic devices, evidences of healed trauma, variation and configuration of the frontal and para nasal sinuses[11], osseous and vascular degenerative changes, congenital malformations.[12] Radiographic techniques for identification are also used in daily forensic cases and mass disaster situations.[13] Panoramic radiographs, which enable the visualization of most structures of the jaws and related areas on a single film, have been advocated for mass screening.[14)]

Digital image processing is of paramount importance in forensic radiology. Contrast enhancement, brightness correction, and segmentation of images are acceptable measures, but any manipulations that alter radiologically visible structures by varying their angular relationship are unacceptable; the use of drawing tools which retouch, accentuate, or fade out contours should be shunned.[15,16]

The potential value of comparison between antemortem and postmortem radiographs in forensic pathology is nowadays fully appreciated. Similar comparisons between antemortem and postmortem CT images can yield successful personal identification.[17] This type of comparison is becoming more feasible as CT equipment is growing to be more available to forensic facilities worldwide.

Age estimation of the living

The estimation of the biological age is obtained from combining clinical and radiological data on dental and osseous development. Dental age is assessed from the degree of mineralization of dental buds, teeth eruption, and the root formation. Skeletal age can be appraised by the sequence of development and fusion of epiphyses of long bone, ossification centers in small bones, hands and knees.[18,19] A CT scan of the clavicle has been suggested as a reliable age indicator

for individuals younger than 21 to 25 years of age.[20] Through radiography, age can be established with considerable accuracy from time of skeletal development at about 20th week of gestation until early adulthood.[19] Most common radiographs used for establishing age up to 16 years are dental and hand radiographs. Postcranial radiographs of specific ossification centers are used for estimating older ages.[21]

Non accidental injury

Radiological technology plays a significant part in establishing physical abuse in children. In cases of suspected nonaccidental injuries, a complete radiographic skeletal examination is required, which should include the entire axial and appendicular skeleton.[22] Skeletal scintigraphy is very sensitive in revealing the rib, spinal, and diaphyseal fractures. This technique is an auxiliary consideration in suspected cases of nonaccidental injuries.[23] Subdural hemorrhages are a common sequel to violent shaking of an infant. Forensic radiologists recommend CT for detection of subarachnoid hemorrhages and MRI for revealing subdural hematomas, concussive and shear injuries. CT and MRI are equally efficient for demonstrating epidural hematoma and CT is favored for fractures.[24] Cranial CT is sensitive and specific in defining acute (recent up to several days old) extracerebral blood collections. MRI is superior to CT in depicting subacute (a few weeks old) and chronic (more than 3 months old) extracerebral bleedings and deep cerebral injuries.[25,26] Posttraumatic brain swelling can be detected on head CT as early as 1 hour and 17 minutes after the injury.[27]

Conclusion

Radiological examination play a significant role in determination of identity, evaluation of injury and death in both accidental and non-accidental cases, in diagnosing medical negligence and physical abuse of children and establishing the biological age. The implementation of imaging techniques, such as MRI and CT has further strengthened the radiographic evaluation. Radiological digital imaging methods are leading to the advent of bloodless and minimally invasive - Virtopsy as an alternative to conventional autopsy.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Life's Just Short to be Miserable

P.N. Murkey*, K. Suken Singh, V.G. Pawar****

Abstract

A 45 years old female was brought by the relatives in the casualty with the history that the wall which was under construction suddenly collapsed on her while she was working at her home and then she became unconscious instantly. She was declared brought dead by the casualty medical officer. Panchanama was made by the Investigating police officer and body was sent for the postmortem examination. Details have been discussed in the case reports.

Keywords: Casualty; Hospital; Panchanama; Post-mortem.

Introduction

Trauma is one of the leading preventable causes of death in developing countries, and is a major leading problem. Trauma affects generally the young people and accounts for loss of more lives than lost due to cancer, heart diseases and other causes.[1] Accidents are epidemic in civilized world; and our country is not an exception to this universal trend, and has witnessed a steady increase in accidental trauma, at present ranking fourth among chief cause of death.[2]

Often the victims are unconscious due to alcoholism, drug abuse or head injury. The problems in diagnosis are compounded by the fact that relatively trivial injury may rupture abdominal viscera.[3] Deaths are occurring every day, in many different settings, from injuries to the upper abdomen and lower cage that produce damage to the liver, spleen and pancreas.[4]

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(Received on 11.12.2012, accepted on 22.05.2013)

The solid organs are much more likely to be damaged by compression from blunt straining than the hollow viscera. The solid organs are more vulnerable while the hollow organs are less likely to be involved.[5]

The outstanding feature of injury to solid organs are haemorrhage and shock, while in hollow visceral injury shock follows with development of peritonitis.[5]

There is more or less copious hemorrhage in all the wounds inflicted during life except occasionally the victim dies immediately from a fatal injury and shock.[6]

Postmortem findings

External examination

Dry reddish coloured blood staining present on both of the nostrils, eyes were closed and pupils were fixed and dilated. Petechial hemorrhages were present in both of the eyes. Mouth was partially opened, teeth were intact and tongue inside the mouth cavity. No oozing was present from other natural orifices like ear and mouth. Cyanosis of the lips was present and nail beds showing bluish discoloration. Rigor mortis was absent and postmortem lividity was difficult to appreciable. No injuries were present on the chest from the front and backside. While examining the external genitalia, vulvas shows edema and evidence of purging of the stool was present.

Lacerated wound was present over the anterior aspect of the right knee joint which was oblique in direction, reddish color blood was oozing out with the size of 7x4 cm in length. Abrasion was present on the medial aspect of the left thigh which was 2x1 cm in length, horizontal in direction and reddish color blood adherent at that site.

Swelling was present over middle of the right gluteal region, on giving incision it shows fracture of the neck of the femur with linear tearing of the gluteus maximus, medius and minimus muscles and vessels were present.

No evidence of the fracture of the base and vault of the skull can be seen.

Larynx, trachea and bronchi were congested, edematous and no evidence of blood froth seen.

Internal examination

Rupture of the pleura was present on the right side of lung on middle and lower lobe and fracture of the right side of the ribs 3rd to 8th was present at mid-axillary line and reddish coloured blood adherent at the fracture site.

On gross examination, right lung shows contusion of 3x2 cm on the lateral aspect of lung with collection of about 600cc blood present in the right pleural cavity. On giving incisions over right lung hemorrhages were present. Left pleura was intact and left lung was normal in size and shape.

Pericardium was intact, both the chambers of heart were empty and coronaries were patent and normal in caliber.

In the peritoneal cavity, collection of about 900cc of blood was present.

Stomach contains about 60 cc of greenish coloured fluid with some partially digested food particles were present. Mucosa was congested; petechial hemorrhages were present at some places.

Liver shows lacerations over the anterior and antero-lateral aspect of the right lobe measuring 7x3 cm and 3x1 cmx parenchymal deep, directed obliquely and reddish coloured blood adherent at the site.

Conclusion

Finally, we could conclude that death was due to Haemorrhagic shock as a result of injury to the vital organ lung and liver.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Original Article

Pattern of Skull Fracture in Fatal Road Traffic Accident Victims: An Autopsy Study

Singh B.K.*

Abstract

Head injuries are the most serious injuries in the term of morbidity and mortality. This study was conducted in Maulana Azad Medical college, New Delhi Mortuary among the 102 post mortem cases of road traffic accident victims over the period of three years from 2008-2011. Objective of this study was to find out pattern of skull fracture in fatal road traffic accident victims. Most common type of fracture was linear fracture of vertex. Parieto-temporal fracture was most common followed by base of the skull. Fracture involving more than one bone was common.

Keywords: Skull fractures; Linear fractures; Basal fractures; Depressed fractures; Manner of death.

Introduction

In medico-legal practice blunt head injuries are most frequently caused by traffic accident, fall from height, assault, train accident etc. Head injury has been defined[1] as " a morbid state resulting from gross or subtle structural changes in the scalp, skull and/or the content of skull, produced by mechanical force. Severe head injury with or without peripheral trauma is commonest cause of death and/or disability up to the age of 45 years in developed countries.[2] According to study conducted in Chandigarh[3] head injuries accounted for 73% of all fatal road traffic accident cases. Head injury, a common term that is actually craniocerebral damage, has been recognized since ages. The manner of death in cases of craniocerebral trauma may be accidental, homicidal or suicidal. Accidental deaths are by far the most common and road traffic accidents are the main component, followed by falls from height and railway accidents.. As being developing countries India have road and traffic problem, so fatal road traffic accidents are quiet common.

Material and Methods

The study was conducted on 102 cases of fatal road traffic accident victims in Maulana Azad Medical College, New Delhi from 2008 to 2011. In fifty-four out of 102 cases, cause of death was craniocerebral damage. Brief history was taken from the relatives of the victims, the accompanying police personnel, hospital records and inquest papers. Fracture type and location of fracture were noted at the time of autopsy.

Observation

Table 1: Showing fatal road traffic accident victims with or without skull fracture

Road traffic accidents	No of cases	Percentage
RTA without skull fracture	48	47.06
RTA with skull fracture	54	52.94

Table 2: Pattern of skull fracture in fatal road traffic accident victims

Type	No of cases	Percentage
Linear	46	85.19
Depressed	O2	3.70
Linear + Depressed	O1	1.85
Comminuted	05	9.26

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(Received on 10.12.2012, accepted on 22.05.2013)

Table 3: Distribution of skull fracture in fatal road traffic accident victims

Site	Total	Percentage
Frontal	O1	1.85
Temporal	05	9.26
Parietal	06	11.11
Occipital	02	3.70
Fronto-parietal	07	12.96
Parieto-temporal	13	24.07
Parieto-occipital	06	11.11
Base of the skull	08	14.81
Multiple site	06	11.11

Discussion

In present study skull fracture was present in 52.94 % of cases of fatal road traffic accident victims.

In present study out of 102 cases, head injuries were present in 82 cases. Out of 82 cases skull fracture was present in 54 cases accounting for 65.85% cases. Study conducted by Kumar A *et al* showed[4] that skull fractures were present in 69.63 % cases of head injury.

Linear fractures comprised majority of cases. Depressed and comminuted fractures were present in relatively fewer cases. Young and Schmidek[5] also reported that linear fractures were the most common and depressed the least common in 134 patients with occipital fractures. Jamieson and Yelland[6] reported that out of 109 fracture cases, 23 were depressed and the rest were linear (78.9%). All the above mentioned studies are consistent with our study for linear fracture being most common. In present commiuted fracture was also repoted in contrast to Jamieson and Yelland study. In study conducted by Chaudhary BL *et al*[7] temporal fracture was the commonest one, comprising 29.78% cases. In present study parieto-temporal fracture

Chart 1: Showing fatal road traffic accident victims with and without skull fracture

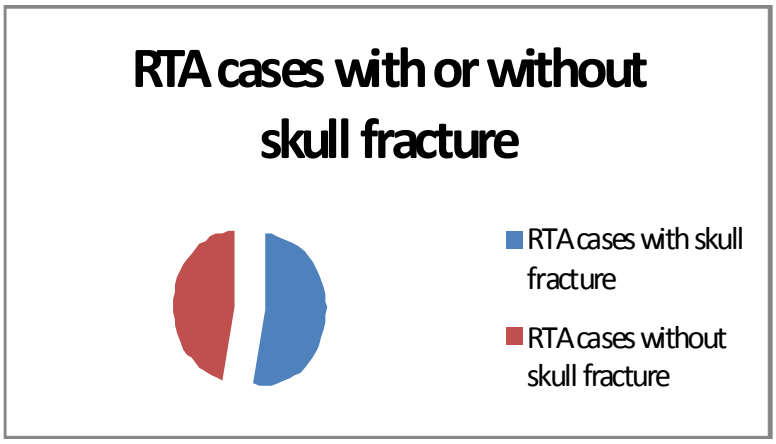
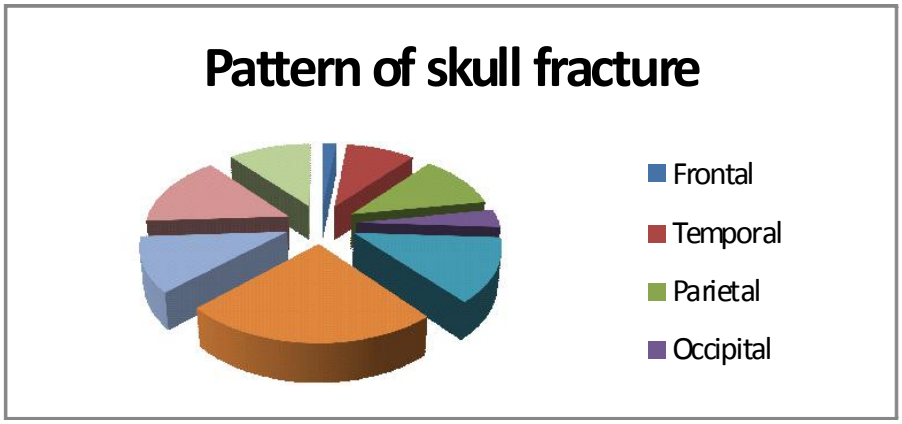


Chart 2: Showing pattern of skull fracture in fatal road traffic accident victims



was most common in 24.07 % cases followed by fracture of the base of skull in 14.81% of cases.Fractures confined to the base of the skull only were present in 14.81% cases. Such a large proportion of the fractures of base are due to the occurrence of contrecoup fractures as reported by Hirsch and Kaufman.[8] The most likely mechanism of causing contrecoup fractures in closed head injuries is transmission of forces from the point of impact through the brain to the floor of the skull. Cases of head injuries having skull fracture tend to have more complications and are more often fatal than those without skull fracture.[9] Chandra *et al* reported[10] that temporal bone fracture was most common in 59 % cases followed by occipital bone fracture in 58% cases in contrast to present study where pareto-temporal bone fracture was most common.

Conclusion

In present study skull fracture was present in 52.94 % of cases of fatal road traffic accident victims. Most common type of fracture was linear, which is consistent with existing literatures. Fracture involving more than one skull bones was most common followed by fracture involving basal area of skull in the present study. Fracture involving skull bone should be looked carefully all over the skull as multiple sites fracture is common.

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Publication -in-Charge

Indian Journal of Forensic Meidicne and Pathology

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Review Article

Is Re-Creation Of Human Identity Possible Using Tooth Prints? An Experimental Study to Aid in Identification

Nidhi Gupta*, Kiran Jadhav*, Ahmed Mujib B.R, Vikram S. Amberkar*****

Abstract

Enamel in teeth, as documented is the hardest substance in the entire human body. Tooth prints are the enamel rod end patterns on the tooth surface. Could this fact be a boon in utilizing it for an individual's identification in the hands of forensic experts? A study has been attempted towards the same. These tooth prints were recorded for sixty extracted tooth specimens after acid etching using a cellophane tape. Subsequently a digital image of the print was obtained which was subjected to biometric conversion using Verifinger standard SDK version 6.0 software followed by the use of Automated Fingerprint Identification System (AFIS) software for comparison of the tooth prints. In results we observed that tooth prints were composed of varied patterns and sub patterns. A comparison was made between the tooth prints of different and the same individual and also between different classes of teeth (incisors, canines, premolars and molars). None of the patterns exhibited intra- and inter- individual similarity. Nor did any particular class of the tooth could be preferentially used over the other for an individual identification. This field demands a need for further exploration towards the use of tooth prints for establishing an individual's identity.

Keywords: Ename,Tooth prints,Forensic experts.

Introduction

Forensic investigations are based on finding differences – polymorphisms, between different individuals. These differences can take many forms such as differences in facial appearances, differences in hair color etc. Some variations are unique and some are not. Indeed individual identification is the tenet of biology.[1] Positive identification traditionally involves a comparison of data unique to an individual like finger prints, palm prints, foot prints, DNA identification and radiographic superimposition. [1]These identification methods have limitations and may not be efficient when bodies are decomposed, burned or in cases when only small fragments of calcified tissues are left.[2]

To identify individuals is an ongoing request made to the dentists throughout the world.[3] Dental evidence may produce compelling associations to aid in the victim's identity and establish facts that can affect direction and ultimate outcome of investigative caseword. This is more so, because teeth are relatively resistant to environmental factors and post-mortem proteolysis. Human dentition is considered as a hard tissue analog to fingerprints (reliable tools only in a body obtained prior to decomposition or mutilation).[3] In fact enamel is the least reactive of the three hard tissues of the teeth and resists decomposition. Superior organization and mineralization give dental enamel its outstanding physical properties, making it the hardest tissue in the vertebrate body.[4] In 1991, Skinner & Anderson had attempted at individualization using Striae of Retzius in enamel by correlating it with the known stressors of life to recognize a missing child, though there was a limitation of age dependency.[3] An attempt has been made in this study to see if enamel in teeth, the most durable part of the body could be used in an individual identification.

Enamel is a product of ectoderm derived

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(Received on 16.02.2013, accepted on 18.04.2013)

cells called ameloblasts.[5] The basic structural unit of enamel is the enamel rods (enamel prisms). Formation of enamel is a highly organized process wherein ameloblasts(cells forming enamel) lay down the enamel rods (enamel prisms) in an undulating and inter-twining path. This is reflected on outer surface of enamel as patterns of ends of a series of adjacent enamel rods. Tooth Prints is the word used to describe these enamel rod end patterns. Ameloglyphics is the word used for the study of patterns of enamel rods *(amelo* – enamel, *glyphics* – carvings).[2] Enamel does not remodel nor does it remain in close contact with the cells which synthesize it, rather the ameloblasts retract away from the enamel surface once it has matured and the tooth has erupted. Enamel prisms morphology reflects the morphology of ameloblasts in a species specific manner. Alterations to the matrix are reflected as defects in the structural organization of enamel.[1] The enamel rod end patterns could be duplicated by various methods like using cellulose acetate paper, rubber base impression materials etc.[2] In the present study a cellophane tape has been used to obtain the replica of enamel surface. The same cellophane tape is much frequently used method by the finger prints experts to obtain an imprint of the finger.

Biometrics refers to identification of individuals using biological traits, such as those based on retinal or iris scanning, fingerprints, or faces recognition.[2] Verifinger standard SDK version 6.0 is biometric software designed to compare and analyze finger prints.

Aim

To investigate if tooth prints patterns could be used for an individual's identification to aid in forensic investigations.

Objectives

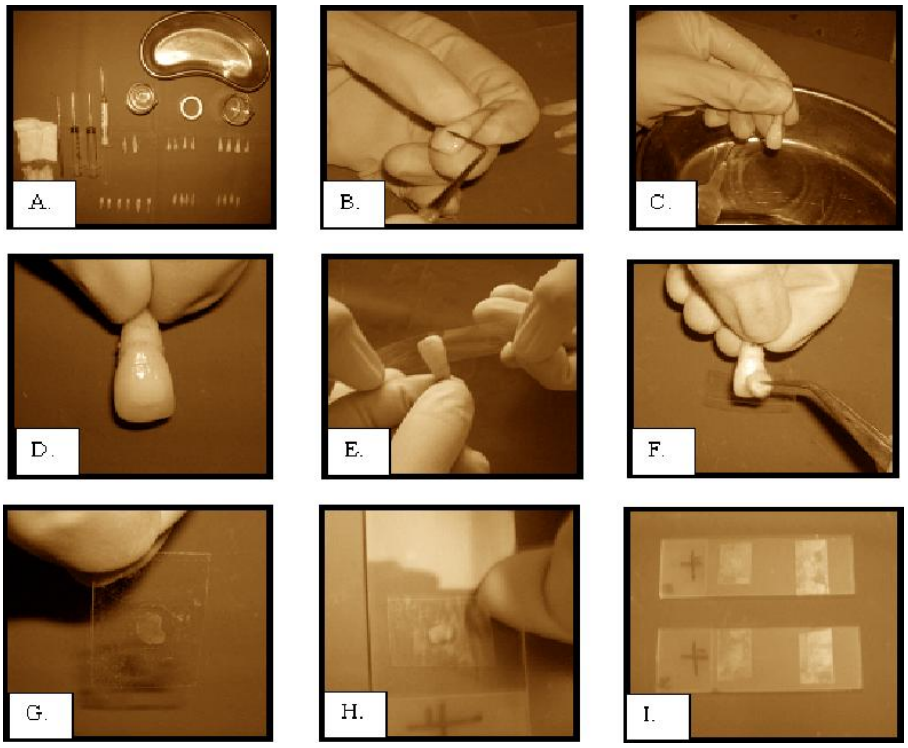
- To analyze the similarity of tooth prints of teeth from different individuals (incisors with incisors; canines with canines; premolars with premolars and molars with molars),
- To analyze similarity of tooth prints of teeth from same individual (incisors with incisors; canines with canines; premolars with premolars and molars with molars).
- To analyze which of the four classes of teeth (incisors, canines, premolars or molars) could be a best indicator of an individual identification.

Materials and Methods

In the present study, 60 different extracted teeth were collected. Of these 60 teeth, 30 were from different individuals (for inter individual comparison) and the remaining were in different numbers from the same individual (intra individual comparison). Teeth with any decay, restorations or any other regressive alterations like attrition, abrasion or erosion, hypoplasia were not a part of the selection.

All the extracted teeth were scaled. The mid of the middle third of the facial/buccal surface of the tooth was etched with 37% orthophosphoric acid for 2 minutes. The reason behind this site selection being that, the rods here run nearly horizontally from the dentino-enamel junction to the enamel surface. The etched surface was then washed with water. This was followed by a spray of ethyl alcohol on the same area. This made the drying of the etched surface easier without any leftover residual moisture prior to taking of an imprint. Next a portion of extended cellophane tape was applied over the etched area without any finger pressure. A small piece of cotton roll was applied over the same for a better adaptation of the cellophane tape. The cellophane tape was then pulled gently immediately. The portion of the cellophane tape was cut and transferred on a glass slide and observed under light microscope (Figure 1). A digital image was obtained using a digital camera (Nikon) at 40x magnification

Figure 1: A: Instruments used. B: Middle thirds of facial surface etched with 37% orthophosphoric acid. C: Water spray to be followed with spray of alcohol. D: Etched area evident as frosted surface. E: An extended cellophane tape applied over the etched area. F: Light cotton pressure applied. G: An imprint after removal of cellophane tape. H: Tooth print while transferring on the slide. I: Tooth prints transferred on the slides.



(Figure2).

The image was subjected to biometric conversion using Verifinger standard SDK version 6.0 software. The software recognizes the patterns of enamel rod endings as series of lines running in various directions. The software uses certain points called minutae for identification of each pattern. These minutae will be used by the software to compare the similarity and differences of two patterns. Minutae are discontinuities of the lines, it may be line endings the point at which the ridge stops, dot very small lines, ponds empty spaces between the two line etc.[2]

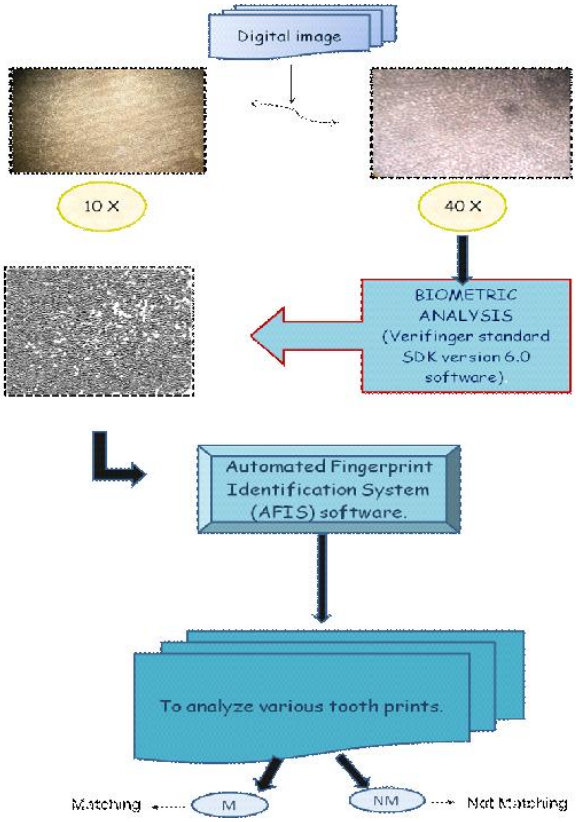
Tooth prints obtained from different teeth were analyzed for similarity among the same individuals, between different individuals and between different classes of teeth using Automated Fingerprint Identification System (AFIS) software to see if they were matching or not matching (Figure 3).

Results

In the present study a total of 60 teeth were analyzed. Each tooth print consisted of series of lines representing series of adjacent enamel rod ends. These lines created a variety of patterns and sub patterns. Some of them were like straight, linear branched, linear unbranched, turning loops, radiating whorls, open whorls, closed whorls and wavy patterns (Figure 3). A single tooth print could sometimes consist of more than one such pattern. Analysis of these patterns for the same and between different individual has yielded us totally distinct patterns.

All the 60 tooth prints so obtained were distinct from each other. A comparison of tooth prints from different individuals (incisors with incisors; canines with canines; premolars with premolars, molars with molars) and from

Figure 2: Images at 10x and 40x magnification followed by the use of the softwares for comparison



same individuals (incisors with incisors; canines with canines; premolars with premolars, molars with molars) were also dissimilar (Figure 4). Nor did any the imprint of any particular class of the tooth (incisors, canines, premolars or molars) was matching with the same type to be preferentially used over the other for an individual identification.

Discussion

Enamel is a hard protective substance that covers the crown of the teeth.[6] The enamel surface presents a variable appearance, exhibiting features such as aprismatic enamel, perikymata, prism end markings, pits and elevations. The basic structural unit of enamel is the enamel prism consisting of several million hydroxyapatite crystals packed into a long thin rod 5-6 micrometers in diameter and up to 2.5 mm in length. These prisms run from the dentino-enamel junction to the surface.[7]

Acid etching removes the smear layer producing an uneven dissolution of the enamel

Figure 3: Distinct sub-patterns observed in tooth prints. A: wavy branched. B: straight. C: linear. D: turning loops. E: wavy unbranched. F: open whorls. G: branching. H: loop. I: radiating.

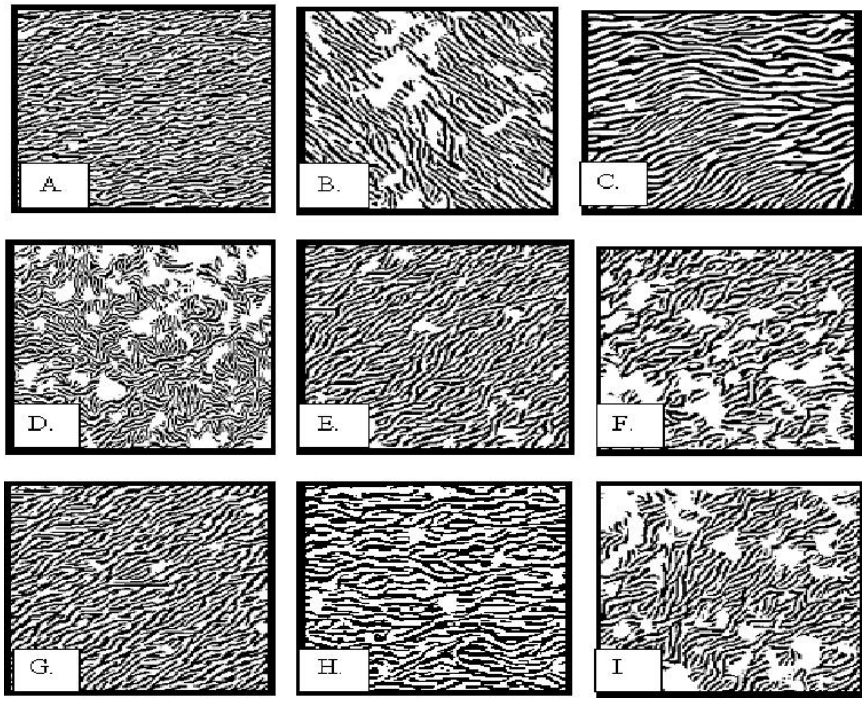
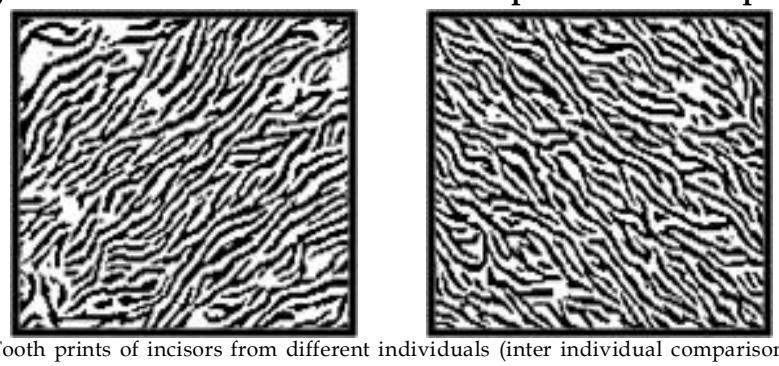
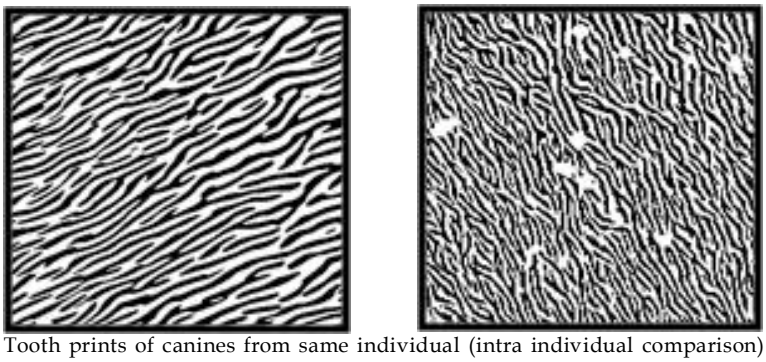


Figure 4: Inter and Intra individual comparison of tooth prints



Tooth prints of incisors from different individuals (inter individual comparison)



Tooth prints of canines from same individual (intra individual comparison)

rods and their sheath or enamel heads and their tails so that a relatively smooth surface becomes pitted and irregular.[3] Acid etching removes the surface 10 micrometers producing different enamel etching patterns. These include type I, in which there is predominant dissolution of prism cores; type II, in which there is predominant etching of prism peripheries; and type III, in which no prism structures are evident.[8]

In the study of tooth prints, we found that they are entirely different from one and another, when compared between teeth of the same and even for different individuals. Even with a slight change of field of tooth print of same individual and even the same tooth, the pattern had changed. This could probably be due to differential movement of adjacent ameloblasts in relation to the same tooth during the formation of enamel. The variations in environmental factors surrounding a developing tooth like with time might be also causing an obvious effect. These factors could include placement of the developing tooth bud, temperature, pressure, nutrition to the ameloblasts cells etc. Genetics might also have a role in predetermining the type of pattern.

Some pitfalls in the study need a mention. From the dentino-enamel junction the rods run a somewhat tortuous course to the surface of the tooth and rarely run straight throughout. This would lead to a different rod end pattern at varying depths even in the same tooth. Rods have an arcade outline near the DEJ and keyhole shaped at the enamel surface creating an obvious difference at varying depths. Rod ends are more pronounced in newly erupted teeth.[9] The various surface structures of enamel are lost subsequent to the attrition and abrasion. This could further change the enamel rod end patterns with time. But as such teeth were with regressive alterations were not included in the study group diagnosis is questionable if investigations are required for such teeth. There was a difficulty in maintaining a consistency in localization of field at 40x magnification for different teeth.

Conclusion

One of the new areas of research in the field of enamel is tooth prints. The tooth prints are unique to an individual, with dissimilarities

between those of different individuals and also the same individual. So on the whole seems to be not of much importance in a diagnostic case word. Still a lot needs to be explored about enamel rod end patterns in relation to deciduous teeth, teeth with developmental disorders and differences as per the type of etching patterns. The significance of tooth prints in forensic investigations so totally demands further studies, and more importantly with a consistency of results to recognize the truth behind these wonderful rods end patterns.

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Indian Journal of Forensic Medicine and Pathology
Volume 6 Number 3, July - September 2013

Case Report

Mass Effect: A Case Report on Sudden Death due to Thymoma

V.T. Venkatesha*, Viswakanth B., Shruthi P.**, Dominic I.R.**, Roopak S.N.****

Abstract

Thymomas are rare in children. Most of them are asymptomatic and found incidentally on chest radiographs. In literature there are very few number of deaths reported due to the compressional effect of a Thymoma on the lungs. We present a case of a 14 year old girl, who died suddenly following an acute onset chest pain and dyspnoea. The autopsy revealed a mediastinal mass which encroached upon and compressed the Lungs causing respiratory failure and death. Further, Histopathological examination revealed the mass to be a Thymoma B1 (WHO classification).

Keywords: Thymoma; Sudden death; Mediastinal mass; Respiratory failure.

Introduction

The thymus is a lymphoid organ located in the anterior mediastinum. In early life, the thymus is responsible for the development and maturation of cell mediated immunological functions. The thymus is composed predominantly of epithelial cells and lymphocytes. It reaches its maximum weight at puberty and undergoes involution thereafter.[1]

Thymoma is a rare tumor stemming from the epithelial cells of the thymus.[2,3] It mostly presents in the fourth and fifth decades of life and less than 10% of Thymomas are diagnosed in patients younger than 20 years of age.[4] Thymic neoplasms constitute about 15% of anterior mediastinal masses in children with thymomas being the most common one.[5]

Sudden deaths due to an enlarged thymus or thymic tumors encroaching upon and compressing the trachea and/or one or both atria have been reported.[6,7,8] The present report describes the sudden death of a young girl due to the compressional effect of Thymoma on both the Lungs.

Case report

A 14 year old girl suffered from an acute attack of chest pain and breathlessness in the middle of the night. There was considerable delay arranging transport owing to the odd hour of occurrence during which the symptoms worsened, rendering her unconscious. On arrival at the nearest hospital, she was declared 'Brought Dead'.

A Medico-legal autopsy was ordered by the Inve stigating officers to confirm the cause of death and the body was brought to our Institution.

Further enquiry into the girl's past medical history (Informant – mother) revealed that she had been having occasional chest pain, dyspnoea, cough and fever in the last 6 months. She had been shown to a physician a couple of times but physical examination, chest radiogram and blood investigations revealed no significant abnormalities. We also learnt that she was apparently healthy in the last few days.

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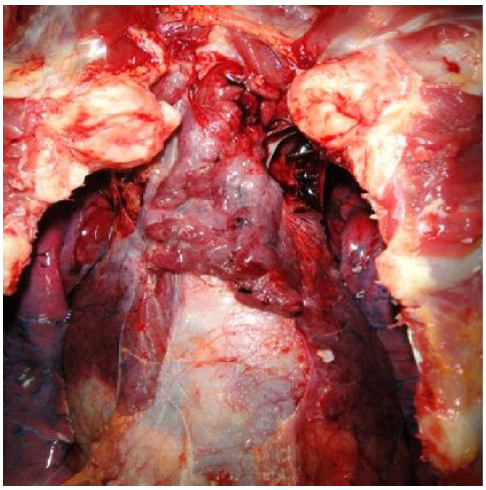
(Received on 04.05.2013, accepted on 22.05.2013)

Fig 1: Gross appearance of the mediastinal mass encroaching upon the lungs



Post mortem examination

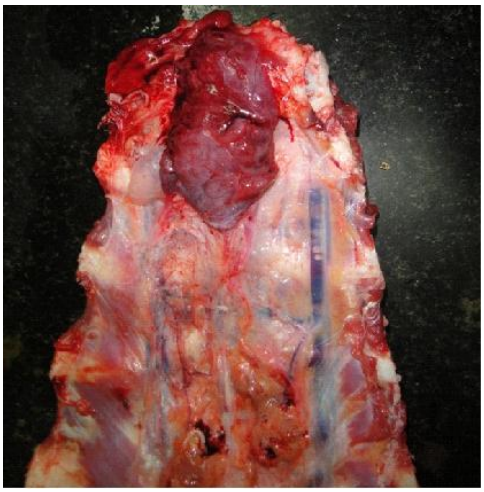
External findings

- She Measured 155 cms in length, moderately built and nourished.
- Rigor Mortis was present throughout the body.
- Purplish blue lividity was present over the back of the body.
- Lips and nail beds were cyanosed.
- No injuries were present on the body.

Internal findings

- A Mediastinal mass [extending from the lower part of the neck to the upper part of middle mediastinum] measuring 15x15x7cms was present partly covering the lungs and the heart. The mass was firm to touch, a portion of which was adherent to the sternum. Cut surface exuded dark colored fluid blood. [Fig 1 & 2]
- Both Lungs were Oedematous and exuded frothy blood.
- Heart was congested. Coronaries were patent and Valves were Normal.
- Other Visceral organs were congested and unremarkable on gross examination.

Fig 2: A Portion of the mediastinal mass adherent to the sternum



Histopathological findings

- Examination of the mass revealed the typical picture of a Thymoma B1[Lymphocytic Rich, WHO classification]
- Sections of the lungs showed marked pulmonary oedema with haemorrhages at places and peribronchiolitis.
- Sections of Liver showed Tubercular granulomatous hepatitis.
- Analysis of the other organs ruled out pathological alterations.

Chemical and Toxicological examination ruled out the intake of exogenous toxic substances.

In view of the autopsy and Histopathological findings, cause of death was opined as Respiratory Failure as a result of Compression of Both lungs by Mediastinal mass [Thymoma].

Discussion

Thymoma is rare in childhood. Very few cases of sudden deaths due to the compressional effects of Thymoma have been reported in literature. It is the most common

neoplasm of the anterior mediastinum and accounts for 20-35% of all mediastinal tumors and 50% of all anterior mediastinal masses. Patients with a Thymoma one-third to one half are asymptomatic and one-third of patients present with local symptoms related to tumor encroaching on surrounding structures. These patients may present with cough, chest pain, superior vena cava syndrome, dysphagia and hoarseness of voice if the recurrent laryngeal nerve is involved. One-third of cases are found incidentally on radiographic examinations during a workup for Myasthenia gravis.

Children are more likely than adults to have symptoms. The proposed explanations for the prevalence of symptoms in children are as follows:

1. Children are more likely to have malignancy
2. Lesions are more likely to cause symptoms by compression or invasion in the smaller thoracic cavity of a child.
3. The most common location is near the trachea resulting in respiratory symptoms.[8]

An enlarged thymus or Thymoma when not specifically searched for is generally found on routine radiograms of chest presenting as a mediastinal mass. Thymomas are often not detectable, however, on Antero-posterior radiograms, though easily seen in side views.[9] An enlarged thymus or Thymoma may exert pressure on the trachea thus causing respiratory disturbances of all grades of severity.[10] This complication however on rare occasions causes death and some cases reported occurred in the younger age groups.[6,7]

In the case presented above it is clear that the terminal symptoms; chest pain and breathlessness were directly related to the pressure effect of the Thymoma.

Conclusion

It is a common practice by most physicians to investigate only the Antero-posterior radiogram of the chest when presented, especially with mild to moderate respiratory symptoms. In rare scenarios, like in the discussed case, the physician when presented repeatedly with the same symptoms, should be aware and suspect the likelihood of a mediastinal mass. In addition to the Antero-posterior radiogram, a lateral radiogram of the chest may provide a higher chance of detecting the mediastinal mass. In conclusion the history and autopsy finding in our case suggests a sudden apparent expansion of the tumor causing death.

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Article in supplement or special issue

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