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Ultrastructure of Cerebral Cortex Investigation during Early Postmortem Changes in a Rat Model

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Abstract

Estimation of the postmortem interval (PMI) is a very essential task for forensic experts, especially in criminal cases. The PMI is the time passed since the death of an individual and refers to the stages of autolysis. The current study was designed to estimate PMI by determination of the oxidative markers, RNA integrity, GAPDH mRNA level in the brain of adult male albino rats and the autolytic ultrastructure changes of the cerebrum at time of death (0 hour), and then on 1st, 2nd, 4th, and 6th hours postmortem (hpm). Thirty-five male albino Wistar rats were included in the present study (Seven rats for each time). The results revealed a significant time-dependent malondialdehyde elevation with a decrease the antioxidant CAT, SOD, and GSH started from the 1st till the 6th hpm. On the other hand, the brain tissue GAPDH-mRNA gene expression level showed a significant decrease at the 1st and the 6th hpm. The ultrastructure changes showed significant autolytic changes in the nerve cell, the nerve axon, and the blood vessels starting from the 1st till the 6th hpm. In conclusion, oxidative markers and ultrastructure examination of the brain tissue especially cerebrum could be helpful for determination the early postmortem interval time.

Keywords: Postmortem; Oxidant/Antioxidant status; Molecular; Ultrastructure; Brain.

Introduction

The postmortem interval (PMI) is a significant focal point of examination in forensic medicine.[1] There are some factors that affect the postmortem process and make the determination of PMI difficult such as age, sex, physical, and physiological state of the deceased. In addition, there are external factors including environmental temperature and humidity as well as animal and insect activity.[2]

Different techniques have been proposed to estimate the time since death by chemical techniques, prompting the appearance of a scope called "Thanatochemistry" where all chemical changes can be evaluated after death.[3]

Decomposition starts ~4 min after death by autolysis. The cells will be gradually destroyed. As a result, liberation and damage in cellular components and metabolites occur.[4] There is a continuous release of free radicals in living tissue, which are scavenged by antioxidant systems. Post-mortem, oxidant/antioxidant balance cannot be controlled by the body, prompting biochemical aggravations.[5]

Molecular alterations in protein, DNA and RNA degradation are disentangled to give a more exact assurance of PMI.[6] The RNA is believed to be more

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susceptible to disintegration than protein and DNA. If RNA disintegration after death, tissues could be determined quantitatively. This could help in the exact determination of the PMI.[7]

So that, the goal of this research was to study the early biochemical, molecular and ultrastructure postmortem changes in the rat's brain at 0-hour, the 1st, 2nd, 4th, and the 6th-hour postmortem (hpm). The oxidant/antioxidant markers, RNA integrity, and changes in the cell organelles using an electron microscope were also investigated.

Material and Methods

Animals

Male albino Wistar rats (5 weeks old, 120–140 g weight), were obtained from the Animal House, National Cancer Institute, Egypt. Prior to the experiment, the animals were kept in cages and given a standard diet and water ad libitum. All rats were exposed to a normal light/dark cycle and room temperature (23±2 °C).

Experimental design

A total of 35 male Wistar rats were arbitrarily dispensed into five groups (7 rats each): the control group (G1) that was sacrificed and the brain tissue was taken immediately after death (0- hour). The G2, G3, G4, and G5 were sacrificed and the brain tissue was taken at the 1st, 2nd, 4th, and 6th hpm, respectively. Brain specimens were collected from all rats at the particular time of the experiment (at room temperature 25°C) for estimation of the oxidant/antioxidant markers, gene expression and the changes in the cell organelles using the electron microscope.

Determination of oxidant/antioxidant markers in brain homogenates

Preparation of brain homogenate and Assay techniques

Brain tissue homogenates were prepared according to the method of Hegazy et. al.[8] Determination of the activities of catalase (CAT),[9] superoxide dismutase (SOD),[10] and the levels of reduced glutathione (GSH),[11] lipid peroxidation by-products (as malondialdehyde; MDA)[12] and the total protein content[13] were performed in the brain homogenates.

All the oxidant/antioxidant markers were measured using a spectrophotometer (Model, JASCO 7800, UV/VIS, Japan).

Determination of RNA integrity in brain tissue

RNA Extraction and cDNA Synthesis

The brain specimenswere taken at 0, 1, 2, 4 and 6 hpm then stored at -80°C. Frozen brain samples were crushed and homogenized in 1 ml Trizol solvent (Invitrogen, USA) and the total RNA was extracted according to the manufacturer's commands. The yield and quality of RNA was analyzed using NanoDrop™ 1000 spectrophotometer (Thermo Fisher Scientific, USA). The RNA integrity and degree of deterioration are assessed by agarose gel electrophoresis. The RNA (2 µg) was treated with an RNase-free DNase kit (Promega) to remove any genomic DNA contamination and cDNA turned into synthesized using PreMix cDNA Kit supplied from iNtRON Biotechnology, Korea in keeping with the producer's instructions.

Real-Time PCR Analysis

Three genes Glyceraldehyde-3-phosphate dehydrogenase (GAPDH), endogenous control, were used in the present study. The primer sequences of GAPDH (target gene) with accession number NM_001289726.1 and β-actin (reference gene) with accession number J00691 as follows:

GAPDH	F:5'- AACTTTGGCATTGTGGAAGG -3',
	R: 5'- ACACATTGGGGGTAGGAACA -3'
β-actin	F: 5'-TGTTGTCCCTGTATGCCTCT-3'
	R: 5'-TAATGTCACGCACGATTTCC-3

A negative control sample was included. The thermal Real-time polymerase chain reaction (PCR) was performed in Strata gene Mx3005P Real-Time PCR System (Agilent Technologies) in a 20 µl reaction. Each 20 µL PCR cocktail contained one µl cDNA, 10 µl TOP real TMqPCR 2X Pre MIX (SYBR Green with low ROX) (Enzynomics), 0.75 µl of forward primer (10 pmol), 0.75 µl of reverse primer (10 pmol) and 7.5 µl ddH2O. Amplification conditions included 15 min at 95°C, followed by 40 cycles at 95°C for 15 sec, at 60–63°C for 15 sec and 72°C for 30 sec. Melting curve analysis was conducted following each real-time PCR and analyzed using the $2^{-\Delta\Delta Ct}$ method.[14] β-Actin was used as a reference gene because it is one of the most common housekeeping genes for normalizing gene expression levels, and its transcription level remains relatively constant in reaction to experimental

manipulation within the maximum tissues.[15] Changes in gene expression have been calculated from the acquired cycle threshold (Ct) values furnished through real-time PCR instrumentation using the comparative CT technique to a reference (housekeeping) gene (β-Actin).[16]

Ultrastructure of the cerebral cortex

Transmission electron microscopy (T.E.M) processing

Four blocks 1 x^2mm was taken from each sample immediately after animal dissecting and fixed in cold glutaraldehyde (5%) for 24–48 h. The specimens were then washed 3–4 times in cacodylate buffer (pH 7.2) for 20 min every time and post-fixed in osmium tetroxide (OSO_4) solution 1% for 2 h after that washed in the same buffer four times. Dehydration was done by ascending grades of alcohol (30 – 50 – 70 – 90 and 100%) for 2 h then embedded in epon–araldite mixture according to Winey et. al.[17] From the embedded blocks, semi-thin sections using LKB ultramicrotome in a thickness of 0.5–1μ were prepared for orientation of the tissue and photographed by SC30 Olympus Camera and then ultrathin section in a thickness of 500–700 A was made using Leica AG ultramicrotome and contrasted in uranyl acetate and lead citrate, as usual. The sections were examined using JEM-100 CXII transmission electron microscope at 80kv and photographed by CCD digital camera Model XR-41.

Statistical analysis

Data were expressed as mean± standard deviation (SD). Statistical analysis was performed between the control at 0-time and different time's postmortem groups using ANOVA followed by Duncan's multiple range test.[18] Differences were considered significant at $P<0.05$ level using SPSS for Windows (Version 20.0; SPSS Inc., Chicago, Ill).

Results

Changes in the brain oxidant/antioxidant parameters

In the brain tissue of the postmortem groups, the CAT and SOD activities and GSH level decreased significantly from the 2nd to 6th hpm (G3 to G6) when compared with the first group (at the time of death). Moreover, the MDA levels a marker of lipid peroxidation- were significantly increased at the 4th and 6th hpm (G4 and G5) when compared with 0, 1st and 2nd hpm (G1, G2, and G3) (Table 1).

RNA integrity in brain tissue

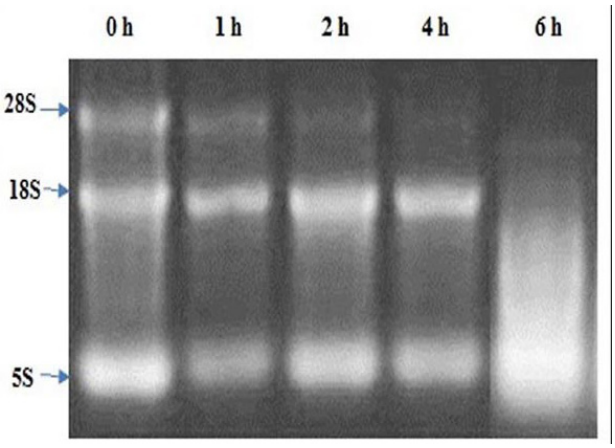

Fig. 1: Total brain RNA extracts during postmortem intervals. Total RNA extracts from dead rat brain electrophoresis in agarose gel (stained with ethidium bromide). The28S-rRNA bands lowered with the increase postmortem interval.

Total RNA became efficiently extracted from all rat samples. The mean RNA yield of brain tissue was 576 ng/mg (ranged 249–1187 ng/mg). The degradation profile of the total RNAs was evaluated during the postmortem interval and become assessed by electrophoresis in agarose gel. The amount of 28S-rRNA of rat brain at various postmortem durations declined gradually inside the PMI (Fig. 1). It was apparent that the control group (0 h) had three clear bands: 28S, 18S, and 5S,

Table 1: Oxidant/antioxidant markers in the rat's brain homogenates along the time of the experiment. (mean±SD, n=7).

Parameters	Time of death (hours)				
	0	1	2	4	6
Catalase (U/mg protein)	66.66±2.56^a	25.55±2.58^b	16.14±6.13^c	8.62±0.80^d	5.28±0.37^d
SOD (U/mg protein)	1.28±0.12^a	0.70±0.12^b	0.36±0.03^c	0.25±0.03^c	0.03±0.01^d
GSH (U/mg protein)	1.12±0.12^a	0.95±0.07^b	0.51±0.06^c	0.28±0.04^d	0.18±0.02^d
MDA μmol/mg protein)	0.86±0.16^c	1.16±0.08^c	1.73±0.05^c	3.41±0.52^b	5.51±1.29^a

Means with different superscripts in the same row are significantly different at $P< 0.05$.

SOD= Superoxide dismutase. GSH= Reduced glutathione. MDA= Malondialdehyde.

then the bands of 28S-rRNA reduced with growing postmortem interval time in G5 (6 hpm).

The control group (0 h) showed three clear bands, and the band depth of 5S changed into twice the other two bands. After 1st hpm, G2 showed that the three bands' intensities had been weaker than that of the control group, especially the 28S band. It changed into equal exchange from the 4th hpm until the 6th hpm in G4 and G5. The band intensity of 28S reduced to be nearly invisible, and the bands after 6th hpm (G5) degraded to be like a comet. The bands of 28S-rRNA reduced with the longer PMI.

RT-qPCR

The mean relative brain GAPDH-mRNA degrees after the different time intervals within the studied groups were proven in Fig. 2. The mean GAPDH-mRNA levels after the special studied postmortem interval time confirmed significantly reduced in G1 and G5, while the GAPDH ranges confirmed non-significant variations in the other three groups.

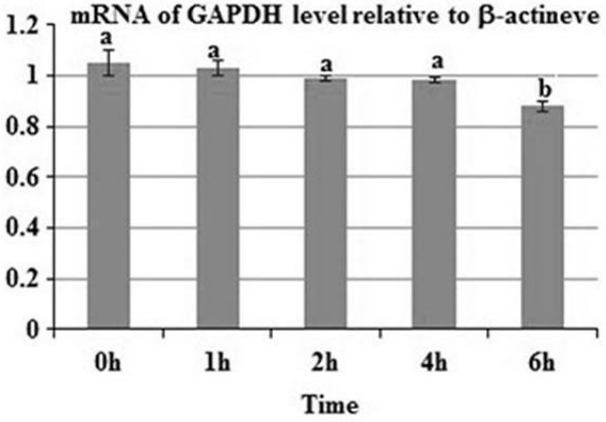

Fig. 2: Effect of postmortem interval on mRNA expression levels of the GAPDH gene in the brain tissue of rats.Mean values with different letters were significantly different at P≤0.05.

Transmission electron (T.E.) micrograph of the cerebral cortex

Postmortem Ultrastructure changes on nerve cells (Fig. 3).

At the time of death (0 h), (G1) showing the presence of large vesicular nucleus (N) containing prominent electron dens nucleolus (ne), nuclear sap informs of fine electron dense granules (X) and the nuclear chromatin small clumped attached to the nuclear membrane (arrow). The cytoplasm of the cell is rich with cell organelles such as free ribosomes (r), mitochondria (m), lysosomes (arrow), and rough endoplasmic reticulum (RER) (er). Also, surrounding the body of the nerve cell, processes of the glial cells and nerve axons containing cell organelles (XX) were noticed (Fig. 3a). On the 1st hpm (G2) showing evidence of lyses of the nuclear sap (x), shrinkage of the nucleolus (ne) and partial lyses of the nuclear membrane of the nerve cell (arrow). The cell cytoplasm contained contracted electron dens mitochondria (m), numerous electron dens lysosomes (arrow head) and numerous variable size vacuoles (v). The surrounding cell processes, as well as nerve axons containing electron dens mitochondria (m) with dispersion of the neurofilaments (x), were detected (Fig. 3b). On the 2nd hpm (G3), showing the nucleus (N) of the nerve cells having an irregular outline, shrinkage contained small electron dense granules. The cytoplasm contained numerous vacuoles (v), electron dense granules (arrow) and the mitochondria (m) became light electron dense. Also, the cell organelles of the cell processes appeared homogenous and electron dense (XX) were seen (Fig. 3c). At 4th hpm (G4), showing lyses of the nuclear chromatin (N), presence of homogenous electron dens nucleolus (ne) with partial loss of the nuclear membrane and the cytoplasm contained variable size and shape vacuoles (v) and electron-dense granules (arrow) (Fig. 3d). On the 6th hpm (G5), showing cytolyses of the nucleus and cytoplasm and appeared lost their detailed structures and became light electron dense with the presence of electron dense granules (arrow) and vacuoles (V). Also, lyses of the surrounding glial cell processes (X) and myelinated nerve axons and their myelin sheath (XX) were noticed (Fig. 3e).

Postmortem Ultrastructure changes on the nerve axon (Fig. 4).

At 0-hpm, (G1) showing the nerve axons of unmyelinated fiber (1) and myelinated nerve fiber with electron dens myelin sheath (2) contained neurofilament (x) and mitochondria (m). The cell process of the glial cells surrounding the nerve axons having normal cell organelles (XX) was observed (Fig. 4a). On the 1st hpm (G2), partial lyses of the myelin sheath of the myelinated nerve fiber (arrow) and the unmyelinated axons (x) were seen. Also, the mitochondria (m) of the axons and cell processes lost its membranous structure and became homogenous (Fig. 4b). The changes on 2nd hpm (G3), showing a variable degree of disorganization of the myelinated nerve fibers (X). Most of the cell organelles of the glial cell processes and nerve axons especially mitochondria (m) showing lyses, and light electron dense or

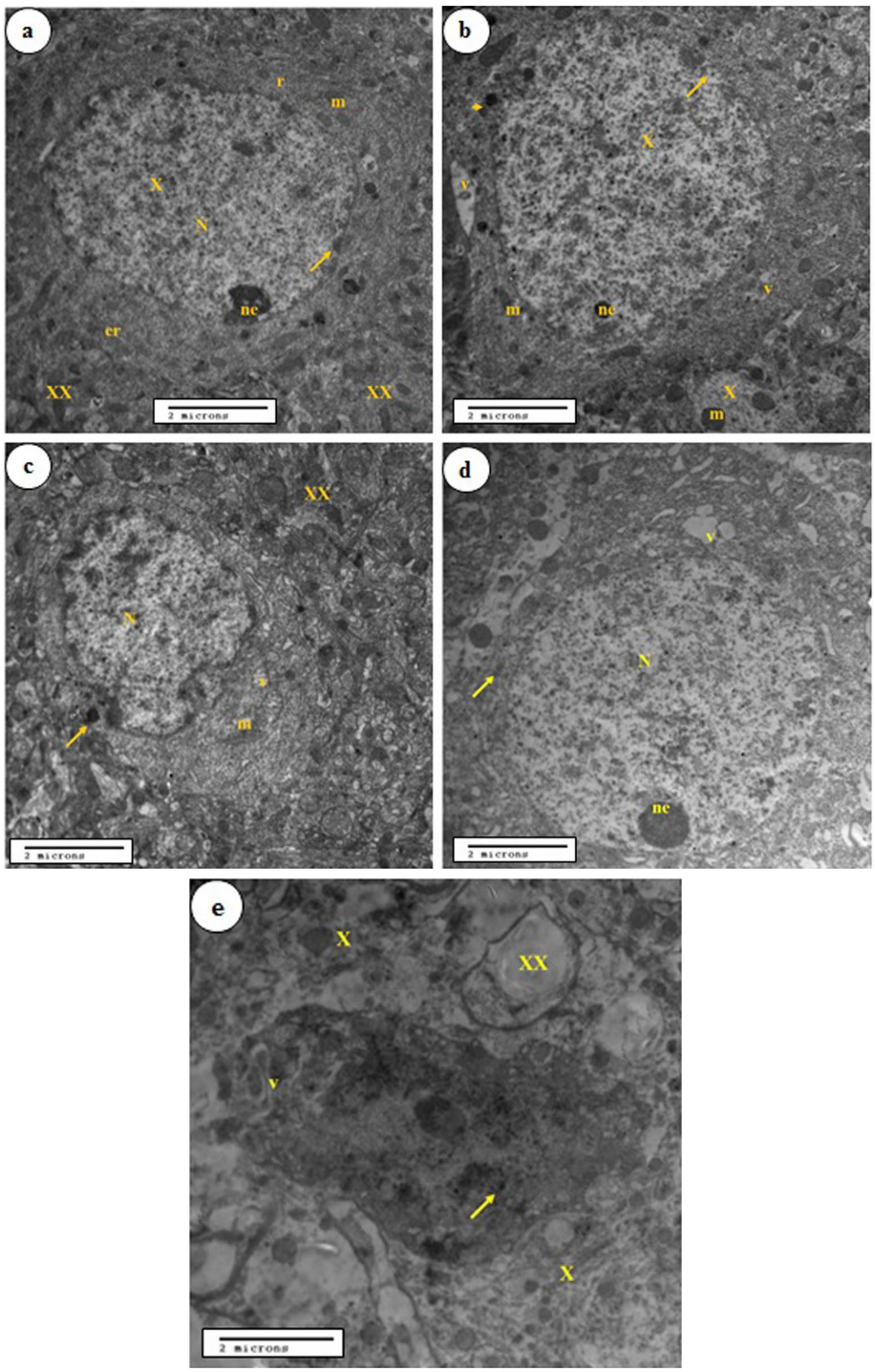

Fig. 3: Ultrastructure of early postmortem changes in nerve cells of rat's brain.

fragmented were detected (Fig. 4c). On the 4th hpm (G4), showing marked lyses of the myelin sheath (X) and vacuolation (V) of the myelinated nerve fiber. The unmyelinated nerve axons (XX) and glial cell processes showing lyses of the cell organelles with the presence of numerous electron dense lysosomes (arrow) (Fig. 4d). Finally, On the 6th hpm (G5), showing marked lyses of the umyelinated nerve axon (X) and marked disorganization and lyses of the glial cell processes (XX) with the presence of small electron dense granules (arrow) (Fig. 4e).

Postmortem Ultrastructure on the blood vessels (Fig. 5).

At 0-hpm (G1) showing the blood vessel lined with endothelial cells filled with blood plasma

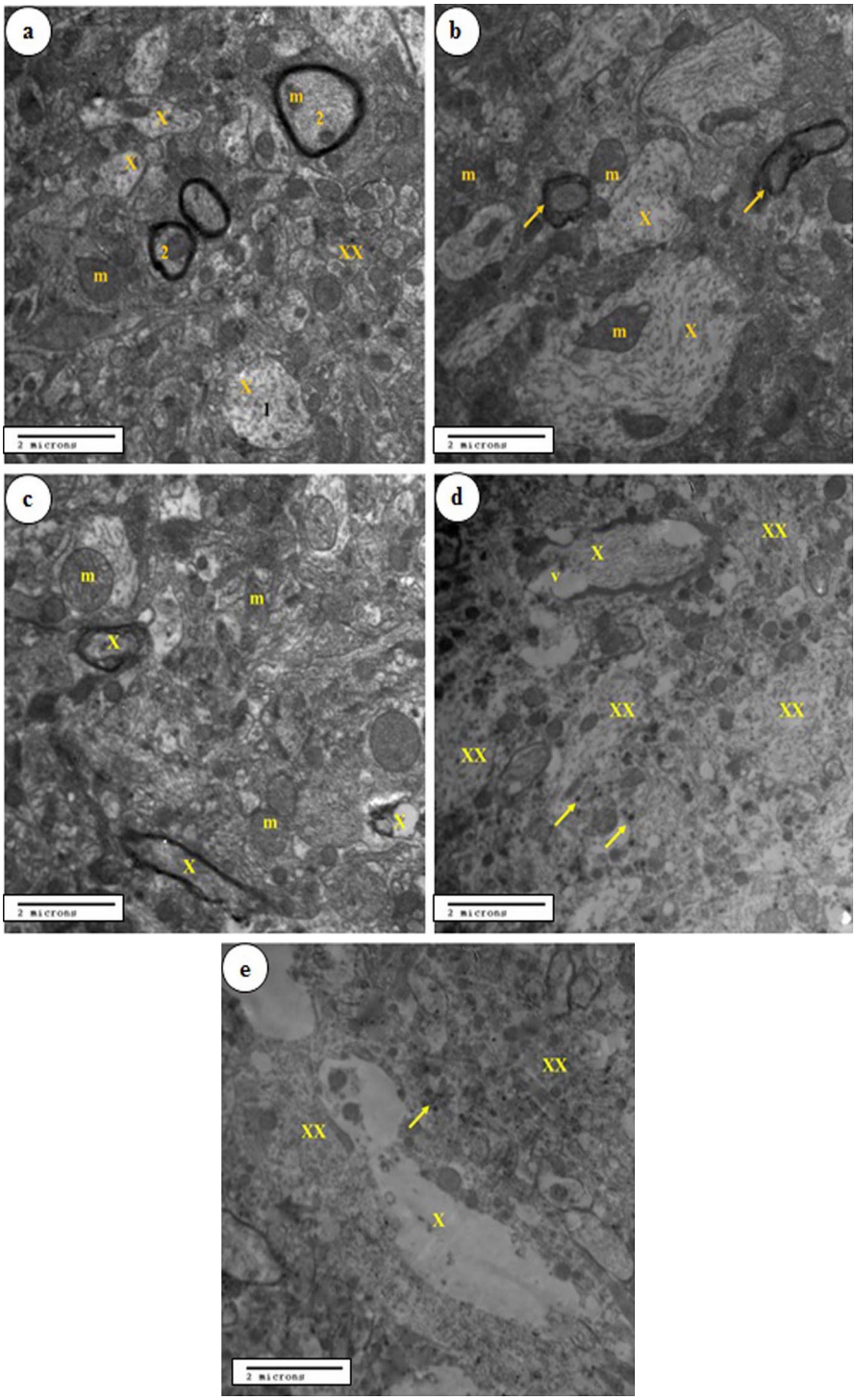

Fig. 4: Ultrastructure of early postmortem changes in nerve axon of rat's brain.

(x) and RBCs (rc). The nerve axons (1) and cell processes of glial cells (XX) were noticed closely attached to the blood vessel (Fig. 5a). While on the 1st hpm (G2), showing the wall of the blood vessel degenerated (X) and surrounded by empty spaces or vacuoles (v). Partial lyses of the nerve axon with the presence of small electron dense granules in the unmyelinated nerve fiber (arrow) were observed. The presence of numerous small electron dense bodies (arrow) and the mitochondria (m) of the cell processes lost its membranous structures with the presence of numerous vacuoles in the processes (XX) (Fig. 5b). The changes at the 2nd and 4th hpm (G3 and G4), showing degeneration of the blood vessel wall (X) and surrounded by empty spaces or large vacuoles (v). The organelles of the cell

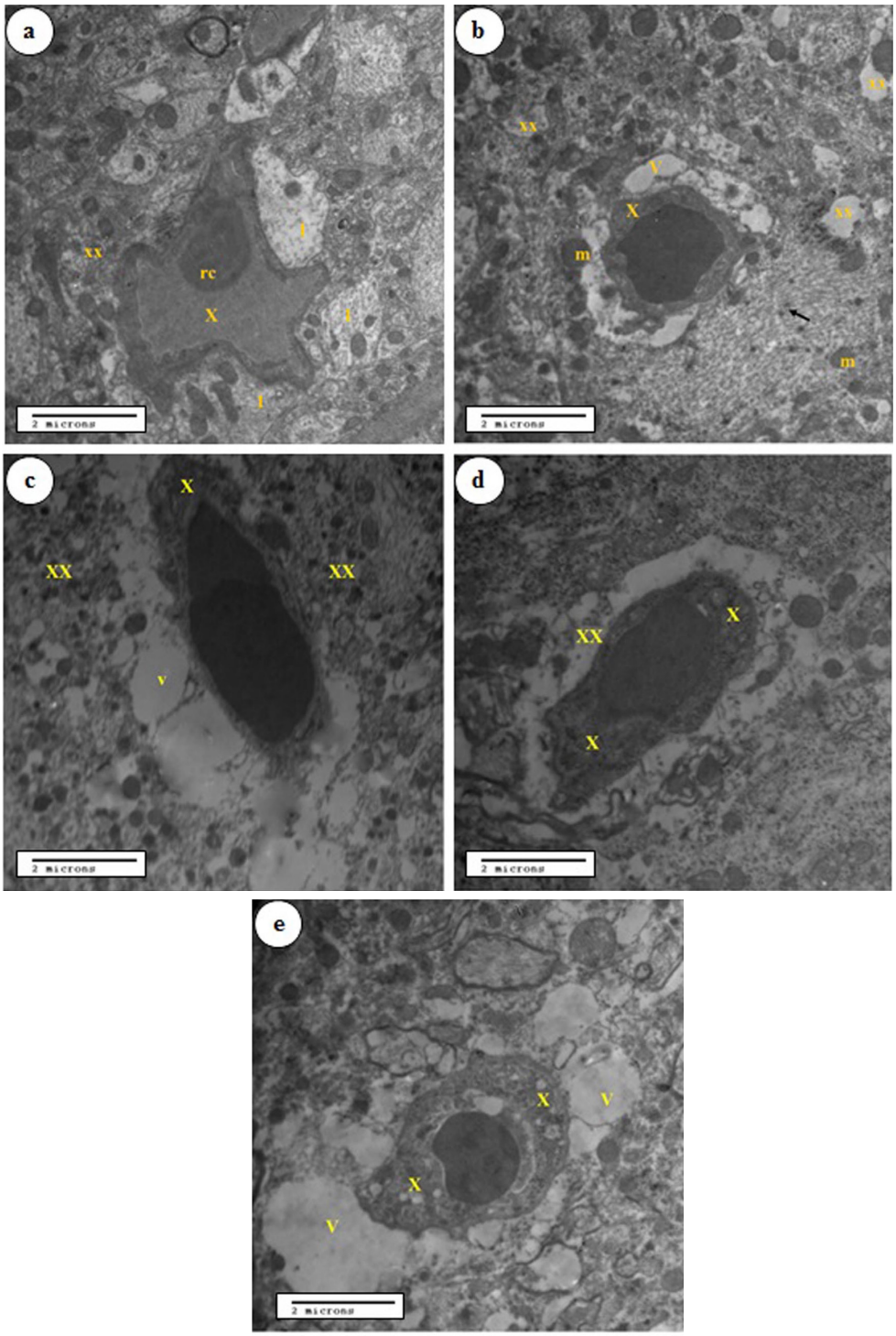

Fig. 5: Ultrastructure of early postmortem changes in blood vessels of rat's brain.

processes and nerve axons became disorganized and lyse with the presence of variable size electron dense granules or fragments (xx) (Fig. 5c and d). Finally, at the 6th hpm (G5), showing shrinkage and prominent degenerative changes of the wall of the blood vessel (X) and surrounded by empty space or vacuoles (V) (Fig. 5e).

Discussion

The present work was designated to record the biochemical, molecular and histopathological changes in rat's brain during the early 6 hours after death (at 0-h, 1st, 2nd, 4th, and the 6th hpm). The oxidant/antioxidant markers, RNA integrity, and

changes in the cell organelles using an electron microscope were assessed.

Thanatochemistry is the chemistry of death used for the description of the progressions that occur in the chemical composition of the human corpse immediately after death. The PMI is defined as the time passed since the death of an individual and refers to the stages of autolysis.[1] A precise estimation of the PMI requires the assessment of the parameters that change constantly with time after death. This definition fits well in postmortem changes of biochemical parameters since each change has its own time factor.[3]

After death, a drop in the concentration of oxygen (anoxia) is the most immediate biochemical change. It is due to the absence of circulation that resulting in a switch to anaerobic metabolism with the absence of the citric acid cycle. In the early postmortem period, there is a continuation of biochemical changes. In addition, the distribution of easily diffusible substances between erythrocytes and plasma as well as between interstitial fluid, tissue cells, and the blood were recorded.[19] The oxidant/antioxidant defense system in the human body is characterized by the formation of free radicals and their removal by means of the antioxidant systems. Increase the oxidant levels and decrease the antioxidant levels were observed in the damaged tissues.[20]

In the brain tissue, MDA started to increase significantly from the 4th till the 6th hpm. The increased MDA levels with increasing PMI are attributed to increased lipid peroxidation which in turn leads to increased binding and detoxification by GSH that is eventually reduced. These results were in accordance with Shaaban et. al.[20] These findings also agree with Ozturk et. al.[21] in a similar study on rat femoral muscle, who recorded that the MDA displayed a significant increase in contrast to antioxidants markers (CAT, SOD, and GSH), which showed a significant decrease during the 2nd to the 5th hpm. The amount of MDA is increased in parallel to the increase in the extent of damage in the experimental animal studies.[22] Moreover; the average increase of MDA in an experimentally damaged tissue has not been greatly different from that observed during further hours after death. Cell death increased the free radicals (oxidative stress) that could lead to the autolysis process.[5]

In the current study, the values of CAT were found to be significantly decreased at the 1st, 2nd and 4th hpm in the brain tissue. These results agree with those of Shaaban et. al.[20] who recorded that the CAT values be significantly decreased at the 3rd to 4th hpm in the brain tissue. Shaaban et. al.[20] found that the decrease in CAT level in rat liver became a significant decrease at the 1st to 2nd hpm. Catalase breaks hydrogen peroxide down into O and H2O using either an iron or manganese cofactor; in the brain, the CAT level is very low in comparison with other tissues.[23] It was hypothesized that the low activity of CAT in the brain is partially responsible for the high sensitivity of this organ to oxidative injury.[24] The results of the present study disagree with those of Harish et. al.[25] who stated that in human brain tissue there is no obvious alteration in the activity of CAT with increasing PMI.

In the present study, SOD and GSH values started to decrease significantly at the 1st and 2nd hpm in the brain. These findings agree with Shaaban et. al.[20] and disagree with those of Harish et. al.[25] who measured SOD activity in human brain tissue and showed no significant alteration with increasing PMI. In fact, the SOD is high at the time of death (0-hpm). It may be due to an aerobic medium in the brain is adequate for SOD to apply its antioxidant activity in this hour, later when enzymatic degradation by lytic enzymes starts in the brain, SOD starts to decrease. The GST catalyzed the reactions of toxic substances through conjugation with GSH protecting the cells from oxidative damage. Glutathione it is the crucial enzyme to maintain the cells from oxidative damage.[4] The difference in the enzyme responses may be in part due to the differences in the nature, amount, and activities of these enzymes in the tissues. The low activity of some antioxidant enzymes in the tissues was leading to tissue damage, damage of enzymatic structure, function, and gene expression.[26]

In this study, four different postmortem time intervals were examined (1, 2, 4. and 6 hpm) in addition to the fresh tissue at zero interval (0 h). In all studied groups, the brain GAPDH mRNA mean expression values decreased with growing PMI. These findings coincide with those of Inoue et. al.[27] who noticed that the Ct values for GAPDH mRNA in the rat brain increased linearly with PMI. Also, the adjustments of Ct values of brain β-actin mRNA of rats confirmed a good linear relationship with PMI at temperature 20°C.[28] In addition, the Ct values of GAPDH mRNA and β- actin mRNA of rat's brain measured by using real-time RT-PCR correlated well with the PMI recorded by way of Hunter et. al.[29] Elghamry et. al.[30] observed that the decrease of GAPDH mRNA levels with increasing PMI in the brain tissue of albino rats. Our results revealed significant negative correlations between GAPDH expression and postmortem time intervals, inside the G1, G2, G3, and G4. This may be due to

RNA from postmortem brain is more stable than RNA from postmortem of other tissues. A similar result was recorded some organs like pancreas and liver exhibit rapid RNA fragmentation due to the fact those organs contain considerable ribonuclease, the enzymatic activity activated at once after body death, and RNA degraded rapidly, whereas other tissues like brain and heart show much more balance up to ninety-six hpm.[31] Therefore, it's feasible that the stability of mRNA is adequate for postmortem evaluation, even if a dead body is left for numerous days at room temperature. Many mRNA markers had been studied for postmortem interval determination, including β-actin, and GAPDH.[32] These genes had been used as housekeeping genes in preferred molecular biology experiments and used as endogenous reference genes in qRT-PCR information evaluation but, they showed a close relationship with postmortem interval in PMI determination; it's unsuitable to be used as endogenous reference markers in our study. The decrease brain GAPDH mRNA mean expression values with increasing PMI may be attributed to the fact that RNA is degraded after death by means of ribonucleases already present inside the cells and/or originating from bacteria or other environmental contamination additionally, the consequences of the environmental elements including pH, UV light and humidity.[33] Hunter et. al.[29] reported significant loss of individual mRNA transcripts by increasing PMI.

In the present study, there were postmortem ultrastructure changes on nerve cells, nerve axons, and blood vessels. The changes on the nerve cells were involved in the nucleus, nucleolus, nuclear sap, and cytoplasm; there were cytolyses of the nucleus and cytoplasm with the presence of electron dense granules and vacuoles on the 6th hpm. The changes on nerve axons were involved in the myelin sheath of the myelinated and unmyelinated nerve fiber, and mitochondria of the axon; that appear normally at the time of death, but on the 6th hpm there were marked lyses of the unmyelinated nerve axon and the glial cell processes. The changes on the blood vessels have involved in the wall of the blood vessels and its surround tissues; there were shrinkage and prominent degenerative changes in the wall of the blood vessel that was surrounded by empty space or vacuoles at 6th hpm. These findings were agreed with Sheleg et. al.[34] who was studded the postmortem changes in rat's cortical neurons.

Ultrastructure changes in the present study were attributed to the anoxic post mortem effects, which occur after death and make changes in enzyme activity and cellular structure.[35] The process of autolysis (alterations in size, shape, electron density, and localization of cell structures) caused a gradual loss of highly arranged structural organization of cells.[36] The autolytic enzymes proved in lysosomes of living cells cause the destruction of their own cell components after death. Those enzymes disintegrate intracellular material, including cell organelles, so the cytoplasm became homogenous with a loss of cell details.[35]

In the present study, the brain tissues of rats (cerebrum) were examined to disclose whether or not a significant association was present among levels of oxidant/antioxidant parameters and PMI (0, 1st, 2nd, 4th, and 6th hpm). The current study revealed gradual deterioration in the ultrastructure of the cerebrum, which matched in time with the expansion in oxidant levels and reduction in antioxidant levels. These findings were in agreement with Ozturk et. al.[21] who reported that the histopathological changes in rat femoral muscle were matched with the oxidant/antioxidant postmortem changes.

Conclusions

In this work, we provide different methods for determining the early postmortem interval time in forensic cases using the brain tissues. Oxidative/antioxidative markers, GAPDH-mRNA gene expression, and ultrastructure postmortem changes in the brain tissues could be helpful in determining the changes in the first 6th hpm at room temperature (25^{0}C) before the autolysis occur. Future investigations will be studies the factors affected in postmortem autolytic processes such as the cause and manner of death, temperature, air humidity, environmental conditions, more durationof up to 24 hours.

Recommendations

We recommended that the oxidative markers and the ultrastructure changes in brain tissues more realistic in determining the early postmortem interval time than RNA integrity and GAPDH m-RNA gene expression.

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This experiment was carried out according to the guidelines of the Institutional Review Board for Animal Experiments at Benha University, Egypt, the Approval Protocol No.: (284/2019).

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Original Article

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Student's Perspective on Existing Teaching Process of Forensic Medicine and Toxicology in a Government Medical College, West Bengal

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Abstract

Background: Medical education in Indian Colleges is still mostly dependant on traditional lecture classes along with practical classes for the Undergraduate students. Teaching methods that enhance student engagement and encourage self directed learning can be effective in delivering core knowledge and explaining difficult concepts, leading to increased learning. The present study was conducted to understand the Indian Medical Graduates' perspective on different teaching methods practised and different attributes of a good medical teacher, involved in teaching Forensic Medicine and Toxicology.

Method: This observational, cross-sectional, prospective, questionnaire based study was done among 240 MBBS students of 5th semester in FMT Department, NRSMCH, Kolkata. The study tool was a pre-designed, pre-tested and validated questionnaire with twelve questions about different teaching methods practised in department and also involving attributes of a medical educator.

Results: 71.3% teachers had good communication skills whereas 89.6% faculties were approachable and helpful. Students preferred one-to-one interactions, group discussions and tutorials over normal traditional lectures. Most of the students liked a combination of blackboard teaching and audio-visual aided teaching over their individual use during lecture classes. Good communication skill, good sense of humour, thorough knowledge of subject and politeness emerged as the most important traits of a teacher.

Conclusion: An adaptable, approachable teacher who interacts with the students always wins their hearts. All future doctors are society's assets and thus a Forensic Medicine and Toxicology teacher should be efficient and careful enough to ensure that the students imbibe basic medicolegal knowledge.

Keywords: Lecture class; One-to-one interaction; Demonstration class; Medical Educator; Communication skill; Medicolegal knowledge.

Introduction

The continuous increase in number of Medical institutions countrywide lately with gradually increasing number of medical graduates annually has made it a challenge for the medical educators to teach larger classes while maintaining and improving the quality of medical education.[1] Out of the different accepted methods of teaching and learning worldwide, lecture classes and practical classes are the most commonly employed teaching methods globally. Lecture classes are the oldest method of teaching in all the streams since time immemorial and are used extensively in medical education, even though academic physicians are not well trained in giving effective lectures.[2] It has been suggested that teaching methods that

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enhance student engagement and encourage self directed learning can be effective in delivering core knowledge and explaining difficult concepts leading to increased learning.[3] Traditional, didactic lectures were perceived by the students as the least effective method used, yet involving students actively within the lecture time was regarded as a more effective learning tool.[4] A Demonstration class or a Practical class provides information visually instead of verbal delivery. Practical classes are intended for retention of the knowledge gathered from the lecture classes, for scientific reasoning skills by which students can apply their knowledge in real world situations and for conceptual understanding of the particular subject. Unlike lecture class, which is unidirectional, practical class is two directional as it is comprised of smaller groups and are more interactive and specific, where the students can learn things directly from their teacher while having individual attention from him/her and clarifications of problems can be sorted out. In the present study the authors have tried to understand the problems and preferences of Indian Medical Graduates with respect to Forensic Medicine and Toxicology teaching and also assess the different attributes of a good medical educator. The study aims to help improve the science and art of medical education by identifying key areas for efficient teaching, the critical elements of an effective lecture class and also the traits of a good and interesting teacher.

Materials and Methods

This observational, cross-sectional, prospective, questionnaire based study was carried out on fifth semester students of Nil Ratan Sircar Medical College and Hospital, Kolkata, West Bengal. The study was conducted after obtaining approval from the Institutional Ethics Committee. The study tool used for the study was a pre-designed, pre-tested and validated questionnaire as shown in Fig. 1, having twelve questions about the different

SEX- Male / Female AGE- years

Q1. FMT department faculties covered interesting topics during lectures:
1. Agree 2. Disagree 3. Can't say

Q2. FMT department faculties are approachable & help to clarify any doubts:
1. Agree 2. Disagree 3. Can't say

Q3. FMT department faculties have good communication skills:
1. Agree 2. Disagree 3. Can't say

Q4. FMT department faculties make the lectures interesting:
1. Agree 2. Disagree 3. Can't say

Q5. FMT department faculties are well versed with the use of Audio Visual aids:
1. Agree 2. Disagree 3. Can't say

Q6. While taking lecture classes, usually teacher:
1. Discuss all important topics 2. All important topics are not covered
3. Discuss above average things that are difficult to understand

Q7. Which of the following methods of teaching do you find most effective?
1. Normal lectures 2. Tutorial 3. Seminar 4. Group Discussion
5. Student teacher one-to-one interaction

Q8. Which of these is a most effective method of teaching in a lecture class?
1. Blackboard (Chalk & Talk) teaching 2. Audio- visual aid assisted teaching
3. Combination of both 4. None

Q9. The method of evaluation you find best:
1. Long essay Question 2. Short essay questions 3. Short notes 4. Multiple choice questions
5. Combination of all these

Q10. Time duration of a lecture class should be:
1. 30 min 2. 45 min 3. 60 min 4. More than 60 min

Q11. According to you, which of these traits should a good teacher have:
1. Punctuality 2. Politeness 3. Proper dressing sense 4. Sense of humour
5. Thorough knowledge of subject 6. Good communication skills

Q12. Which of following qualities makes a teacher interesting? (Choose any one from each option)
1. Interacts/ does not interact with students while taking a class
2. Keeps standing at one place/ roams around in the class while teaching
3. Teaches only in English/ only in regional language / uses both languages
4. Gives interesting examples/ teaches entirely from book
5. Describes a topic fully/ discusses Q—A wise during the class

Fig. 1: Questionnaire

teaching methods practised in the Department and also involving the attributes of a medical educator. All MBBS students of the College attending Forensic Medicine and Toxicology lecture and practical classes were included in the present study. Before supplying the questionnaire, written informed consent was obtained from all the participants. The data collection was done over one month during November, 2015. The students who submitted incompletely answered questionnaire and those who did not consent for voluntary participation were excluded from the study. The students were informed in details about the purpose and relevant details of the study and the questionnaire was distributed among students in a single page printed format during practical classes. Out of the available 250 MBBS students who were given the questionnaire, applying the Exclusion criteria, 240 subjects were selected for the study, who submitted completely filled response forms. They were strictly advised not to disclose their names or roll numbers, thereby ensuring that the data become anonymous and because of this anonymity, frank and honest responses were provided by the students about the teaching methods and the teachers involved in departmental teaching activities. The data collected during the study was tabulated and analysed by the help of standard statistical tool and represented in the form of graph and charts.

Results

Among the study population of 240 students of 5th Semester batch, the age ranged from 19—22 years with mean age being 20.4±0.75 years. There were 135 males and 105 females, with a Male: Female ratio of 1.28:1. Regarding the faculties of Forensic Medicine and Toxicology department of the institute, as seen in Table 1, 77.9% (187) thought their faculties cover interesting topics in lecture, 80.4% (193) students agreed that all the important topics are covered, 69.2% (166) students believed that the faculties manage to make their lecture classes interesting. To 89.6% (215) students their teachers were helpful and approachable at the same time while 71.3% (171) students answered their teachers had good communication skills and 75% (180) students agreed that the faculties are well versed with different audio-visual aids during lecture class. Among the students, maximum number i.e. 32.1% (77) answered that one-to-one interaction with the teacher was the best teaching method, while nearly same 30.8% (74) found Group Discussion to be best effective method. The least preferred method was Seminar 2.5% (6), followed by Didactic lectures 6.3% (15), as is observed in Fig. 2. Maximum number of students i.e. 70.4% (169) suggested that a combination of both blackboard teaching assisted by audio-visual aids makes a lecture class most effective, as seen in Fig. 3. As far as the evaluation method in examination is concerned, maximum number of students, a 40.4% (97) agreed that a combination of long essay type questions, short essay type questions, short notes and Multiple Choice Question (MCQ) is the best evaluation method; this was followed by MCQs as the best choice for an evaluation, i.e. 36.2% (87), as depicted in Fig. 4. Only 2.9% (7) students suggested that Long answer type question is the best evaluation method in examination. Maximum number of students i.e. 42.1% (101) opted that 45 minutes duration is ideal for a lecture class, while 39.6% (95) students suggested that a lecture class should be of 1 hour duration, as seen in Fig. 5. Only 16.3% (39) students opted that 30 minutes duration is sufficient. The qualities of a good teacher, in their opinion, are good communication skills (90.4%, 217), good sense of humour (62.9%, 151), thorough knowledge about the subject (61.7%, 148), politeness (56.7%, 136), punctuality (34.2%, 82) and proper dressing sense (26.3%, 63), as shown in Fig. 6. Some of the qualities or gestures which made a teacher interesting to this study population, as described in Table 2, were the following: a teacher who interacts with the students (97.9%, 235), who roams continuously while in the class instead of standing still and delivering lectures (92.9%, 223), who uses both English as well as the regional language while teaching (71.3%, 171), who gives some real life scenarios instead of teaching only from the textbook (98.3%, 236) and who does not teach according to the familiar questions on the topic rather teaches the whole topic (63.8%, 153).

Table 1: Statements about Department Faculties.

Statements	Agree (%)	Disagree (%)	Cannot say (%)
Faculties cover Interesting Topics in lectures	187 (77.9)	33 (13.7)	20 (8.4)
Faculties cover important topics in Lectures	193 (80.4)	21 (8.8)	26 (10.8)
Faculties make lectures interesting	166 (69.2)	46 (19.2)	28 (11.7)
Faculties are approachable and helpful	215 (89.6)	8 (3.3)	17 (7.1)
Faculties have good communication skills	171 (71.3)	40 (16.7)	29 (12.1)
Faculties well versed with Audio Visual Aids	180 (75.0)	36 (15.0)	24 (10.0)

Table 2: Qualities of an Interesting Teacher.

Qualities	Response	Number	Percentage (%)
Interaction with Students	Interacts	235	97.9
	Does not Interact	5	2.1
Position during Class	Stands at one place	17	7.1
	Roams around class	223	92.9
Language of Teaching in Class	English Only	60	25.0
	Regional Only	9	3.8
	Uses Both languages	171	71.3
Style of Teaching	Gives examples during Class	236	98.3
	Teaches from Book only	4	1.7
During Class	Teaches full topic	153	63.8
	Teaches Question-Answer	87	36.2

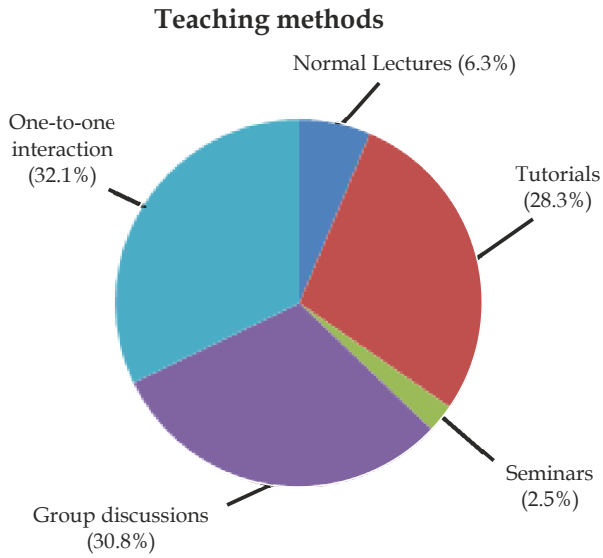

Fig. 2: Most Effective Teaching Method.

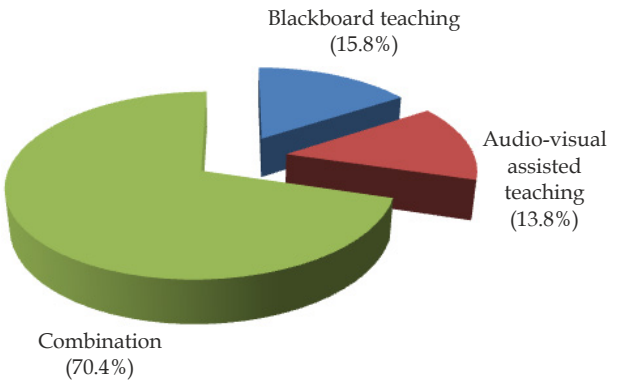

Fig. 3: Best method for a Lecture Class.

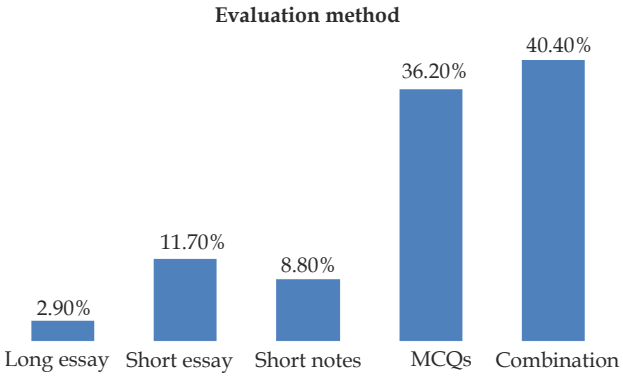

Fig. 4: Best Evaluation Method.

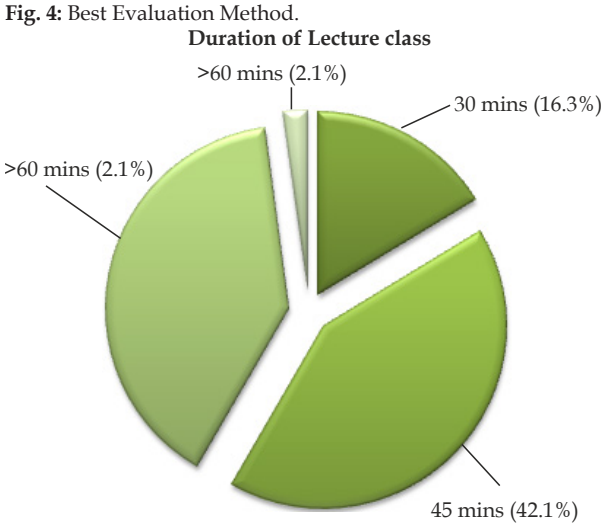

Fig. 5: Duration of Lecture Class.

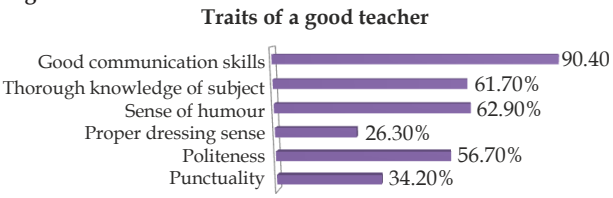

Fig. 6: Traits of Good Teacher.

Discussion

Medical education of the Indian Medical Graduate has undergone several changes over the past few decades. However, learning by means of traditional didactic lecture still remains the most commonly used method for transferring information in medical education.[5] Reviewing of the existing teaching methodology by students feedback and corresponding modification of methodologies is very important for the undergraduate medical teaching.[6-9] Although the didactic lecture method is used extensively in medical education, academic physicians often are not trained in delivering effective lectures.[2] Lecturing is frequently a one-way process with no interaction, unaccompanied by discussion, questioning or immediate practice,

which makes it a poor teaching tool.[10] In the current study, almost equal number of students preferred one-to-one teacher-student interaction (32.1%) and group discussion (30.8%) as compared to traditional didactic lectures (6.3%). Lecture format for large classes is outdated and ineffective.[11] Furthermore, when students have copies of lecture notes or a text, a significant percentage would prefer reading them rather than attending classes that offer little or no interaction. In the present study, maximum number of students i.e. 70.4% endorsed for a combination of blackboard teaching and audio-visual aids over their solo use in a lecture class. This finding is similar to the observations of Bhowmick K et. al. in their study.[12] Most of the students i.e. 40.4% expressed that a combination of long essay type questions, short essay type questions, short notes and MCQs form a best evaluation paper unlike in the study done by Dash SK et. al., who found MCQs to be the preferred evaluation method, in their study.[13] In our present study most of the students (42.1%) suggested that 45 minutes duration is sufficient for a lecture class in place of a regular 60 minutes duration (39.6%). This finding matches with the study conducted by Abraham G et. al., where it was observed that the main reason mentioned by students for not preferring interactive lecture was their inability to concentrate after 30 minutes of lecture.[5]

Knowledge of subject is a cognitive quality which can be developed and has been found to be an important characteristic in various studies across non-medical disciplines also.[14-16] Apart from the knowledge, which a teacher should have while teaching, there are other prominent traits that can directly affect the teaching-learning process. The medical educator who establishes open communication in the learning system is usually able to complete most of the learning goals.[17] In the present study, only 75% students thought that teachers are well versed with audio visual aids, which may be due to the old age faculty population who are eminent teachers otherwise but finds it difficult to use the said aids. In a study by Young and Shaw, effective communication skills emerged as one of the top seven qualities accounting for teaching effectiveness.[18] Teachers who use regional languages are more accepted by the students for obvious reasons, may be the students can imbibe it better in their own languages and they can relate more to the facilitator. As the lecture class is unidirectional, a teacher standing still on a dais and not interacting with the students always makes the class very boring and is less accepted by the students. A teacher who interacts and moves in the class very often can attract students' visual attention easily. Also this way a facilitator can activate one student emotionally and academically. Vast knowledge of a teacher can be shared in the class as examples as to different real-life medicolegal situations instead of merely teaching from the book; students get insight and practical understanding of the subject this way.

N Hueppchen et. al.[19] stated that most of the medical faculty learns to teach by observing their mentors or their teachers. Thus a medical teacher should be aware of the different qualities required to be able to produce the ever evolving vastness of the medical education. An ideal medical teacher is a role model who rules the minds and hearts of his students not out of fear and intimidation; but out of respect and admiration. The nature of such a teacher is polite, empathizing and gentle rather than authoritative, impatient or ill-tempered. A punctual, well dressed and polite teacher incorporates certain personality traits among their students like attitudes, values, professionalism, etc. Tang et. al. found that "personality related" features separated an effective teacher from an ineffective one and both effective and ineffective teachers were similar with respect to knowledge of subject.[20] Relationships and emotions that a teacher forms with his/her students play an important role in students' retention of knowledge, conceptualization of phenomena, and future behaviors.[21] In this study students emphasized on good communication skills of the teacher as compared to his/her knowledge, which eventually proves the myth that a knowledgeable person is not necessarily always a good teacher. In this study, only 5th semester MBBS students were considered, hence there is a limited scope of generalization. Inclusion of other confounding factors could not be done in this study. Students from a single institute were considered, and this may not represent the entire student community, which can be explored in a further extensive multi-centric study.

Conclusion

It is very difficult for a teacher to imbibe all the required qualities of a good teacher and deliver an effective and informative lecture every time to the students. All teachers have their own shortcomings, although with experience, they should develop themselves to better medical educators. Teachers' training is aimed to develop the teaching skills, and ensures that a teacher makes his/her class more effective compared to his/her own previous oration. A knowledgeable medical teacher with good communication skills and a sense of humour, who is adaptable, flexible and captures the audience's

attention, is always remembered timelessly. In this country, where majority of medicolegal work is carried out by MBBS doctors only, it is of utmost importance that they should have some preliminary knowledge about the different practical problems in their MBBS course. As these doctors receive exposure to these medicolegal issues only once in their MBBS curriculum, during their Forensic Medicine and Toxicology classes, the role of a teacher becomes crucial in educating them with recent relevant scientific information that can be applied by the students in the future to solve real life scenarios. They should be tactful and updated enough to impart the essential knowledge to their students in this limited time period. To conclude, a medical teacher should remain a lifelong learner and develop his teaching skills regularly to ensure that the students receive effective training to become better doctors in future and conduct their roles efficiently.

Ethical Clearance: Prior approval was obtained from the Institutional Ethics Committee

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Original Article

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Study on Nineteen Years (1996-2014) Trend of Illegal Abortion in the Transkeisub-Region of South Africa

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Abstract

Illegal abortion is a serious and preventable public health problem affecting women of reproductive age. Despite theimplementation of a law legalising abortion in 1996 in South Africa, a high number of illegal abortions are still being carried out. The objective of thisstudy the trend of illegal abortion in the Transkei sub-region of South Africa (1996–2014). This is a retrospective record review, descriptive study on criminal abortion. All aborted foetuses brought formedico-legal examination at the Mthatha Forensic Pathology Laboratory between 1996 and 2014 were recorded in the post-mortem register. In total 4 986 unnatural deaths among females were recorded, which accounted for 21.51% of all unnatural deaths in this region from 1996 to 2014. Abortus material or products of conception ranked ninthin the list of autopsied cases of unnatural deaths; these numbered 208(4.17%) of all autopsied non-natural deaths. The average number of foetal deaths were 10.94 (5.2%) each year. This was highest (17.31%) in 2010, and lowest (0.48%) in 1997 in this study.There is an increasing trend ofillegal abortion in the Transkei sub-region of South Africa. Government must pay attention to the issue of illegal abortion in this region.

Keywords: Illegal Abortion; Foetuses; Death.

Introduction

According to a World Health Organization (WHO) estimation, each year about 44 million induced abortions occur globally.[1] About fifty percent of these abortions are unsafe, contributing substantially to maternal morbidity and leading to approximately 13% of maternal mortality.[1] Every year, about 19–20 million abortions are done by individuals without the requisite skills, or in environments below minimum medical standards, or both.[2] Nearly all unsafe abortions (97%) occurin developing countries.[2] Unsafe abortion is prevalent in many developing countries, mostly in sub-Saharan Africa, Latin America, and South and South East Asia, where abortion laws are more restrictive, the unmet need for contraception is high and the status of women in society is low.[3]

The number of induced abortions in Africa rose from 5.6 million to 6.4 millionbetween 2003 and 2008.[4] In 2008, most abortions occurred in Eastern Africa (2.5 million), followed by Western Africa (1.8 million), Northern and CentralAfrica (0.9 million), and Southern Africa (0.2 million).[4] About 13% of all pregnancies in Africa ended in abortion in 2008.[4] Out of 6.4 million abortions performed in Africa in 2008, only 3% were performed insafe conditions.[4] From 2010–2014, an estimated 8.3 million induced abortions occurred each year in Africa.[5] This number represents an increase from 4.6 million annually during 1990–1994, mainly because of an increase in the number of women of childbearing age.[5]

The Choice on Termination of Pregnancy Act, promulgated in 1996 in South Africa, provided for abortion upon request up to and including 12 weeks of gestational age, under certain

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circumstances between 13 and 20 weeks of gestation, and under limited circumstances after 20 weeks.[6] The Medical Research Council (MRC) found that 425 women died as a result of unsafe abortion prior to the promulgation of the Choice on Termination of Pregnancy Act.[7] The purpose of this Act was to improve women's health and to prevent unnecessary deaths. A2000 repeat study conducted by the MRC showed that there had been a dramatic decrease in maternal mortality (91%) and maternal morbidity (50%).[8]

Available data seem to indicate that a relatively high level of abortion correlates with low access to modern contraception, low status of women, strong sanctions against out-of-wedlock pregnancy, traditional tolerance to abortion and the availability of modern abortion practices.[9] The circumstances under which women obtain unsafe abortion vary and depend on traditional methods known and types of providers present. Health professionals are prone to use instrumental procedures to induce the abortion, whereas traditional providers often make a brew of herbs to be drunk in one or more doses.[10] There is widespread poverty and lack of education in the Transkei region of South Africa.[11] The purpose of this study is to determine the trend of illegal abortion in the Transkei sub-region of South Africa, and to explore the underlying factors that make women choose an illegal abortion, despite the legality of abortion in South Africa.

Method

The retrospective descriptive study was carried out from the records of the post-mortem register of Mthatha Forensic Pathology Laboratory from 1996 to 2014. The Mthatha Forensic Pathology Laboratory is the only laboratory in this region catering for a population of about half a million in the region of Mthatha. It is attached to the Nelson Mandela Academic Hospital, which is the only teaching hospital in this province. It is associated with the Walter Sisulu University Medical School, and all medico-legal cases in this area of South Africa are dealt with at this facility. In total 23 170 autopsies were conducted between 1996 and 2014 and recorded in the post-mortem register at this laboratory. Between 1996 and 2014 the laboratory dealt with 208 items of abortus material or products of conception. Foetuses of which theage could not be ascertainedwereignored in this study. Such foetuses were only found once they were in a state of advanced putrefaction, so the gender and cause of death could not be recorded. The majority of them were not viable yet, meaning the mother had been less than 28 weeks pregnant.

Fourteen forensic officers are engaged in collecting corpses round the clock from 17 different police stations in four municipalities in the area. These municipalities are OR Tambo, Mhlontlo, Chris Hani and the Mbashe municipal area of about 200 square kilometres. The OR Tambo municipality is the largest and is covered fully by 10 police stations. Mhlontlo municipality has four police stations, there are two in Chris Hani and Mbashe municipality has one. The combined population was 439 091 in 1996, but this number has been increasing at an average rate of 3% annually. In 2005 there were five police stations to be taken into account. Therefore, the population in the area of this study has increased. Population statistics were calculated with the help of the South African Statistics Department in Mthatha. However, it is difficult to estimate the total population involved. The data were collected in hard copies designed to reflect post-mortem number and year. These data were transferred to the Excel computer program and analysed with the help of the SPSS computer program.

Result

In total 4 986 unnatural deaths among females were recorded, representing 21.52% of all the unnatural deaths in this region from 1996 to 2014 (Fig. 1). Abortus material or foetuses ranked ninthin the list of causes of unnatural death (Table 1 and Fig. 2). The total number of foetuses autopsied was 208 in this study, which was 4.17% of all autopsied cases in Mthatha Forensic Pathology laboratory over

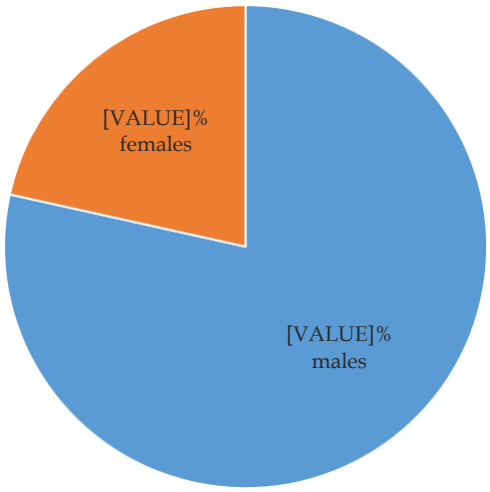

Fig. 1: Percentage of unnatural deaths among males and females in the Transkei sub-region of South Africa from 1996 to 2014 (n=23 170).

Table 1: Ranks of percentage of cause of death among females in the Transkei sub-region of South Africa from 1996 to 2014 (n=4 986).

Rank	Cause of death	Number of deaths	Percentage (%)
1	MVA	1563	31.34
2	Gunshot	632	12.67
3	Poisoning	481	9.64
4	Stabbing	430	8.62
5	Assault	365	7.32
6	Drowning	303	6.07
7	Collapse	259	5.19
8	Burns	242	4.85
9	Abortion	208	4.17
10	Lightning	170	3.4
11	Hanging	167	3.34
12	Fall from height	113	2.26
13	Decomposition	28	0.56
15	Gas suffocation	25	0.50
All ranks	All causes	4986	100

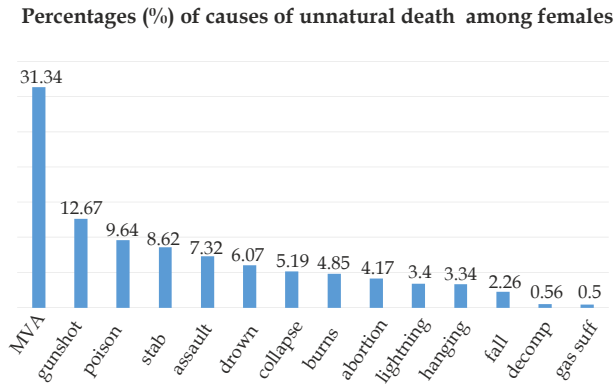

Fig. 2: Ranks of percentage of cause of death among females in the Transkei sub-region of South Africa from 1996 to 2014 (n=4 986).

Table 2. Yearly distribution of foetuses in the Transkei Sub-region of South Africa from 1996 to 2014 (n=208).

Year	Number of foetuses received	Percentage
1996	5	2.40
1997	1	0.48
1998	5	2.40
1999	4	1.92
2000	2	0.96
2001	2	0.96
2002	3	1.44
2003	3	1.44
2004	1	0.48
2005	8	3.85
2006	1	0.48
2007	31	14.90
2008	30	14.42
2009	14	6.73
2010	36	17.31
2011	21	10.10
2012	17	8.17
2013	12	5.77
2014	12	5.77
Average	10.94	5.26

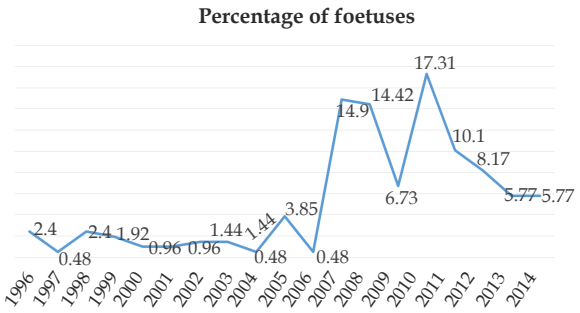

Fig. 2. Yearly distribution of criminal abortion in the Transkei sub-region of South Africa from 1996 to 2014 (n=208).

a period of 19 years (1996–2014) (Table 1 and Fig. 2). The average number of foetal deaths was 10.94 (5.2%) each year (Table 2). This was highest (17.31%) in 2010 and lowest (0.48%) in 1997 in this study (Table 2 and Fig. 3). The percentage of foetuses recorded in the register was 16.82% between 1996 and 2006 (Table 2 and Fig. 3). Eighty-three percent (83.17%) of the cases of foetal tissue in this study were reported to the laboratory from 2007 to 2014 (Table 2 and Fig. 3).

Discussion

This study is based on the assumption that all foetuses received at the Forensic Pathology Laboratory werethe product of illegal abortion. This could be a small tip of a very large iceberg, as most of the evacuated products of conception were probably disposed of by illegal abortionists in ways that would make them difficult to discover. It is like

wise difficult to estimate the total number of illegal abortion clinics in the Transkei sub-region of South Africa. Theremay be between 50 and 70 illegal abortion clinics in Mthatha and the surrounding area. At least 30 to 40 can be counted easily from their advertisement onlamp posts, street walls and pamphlets with their contact numbers. The illegal abortionists try to earn their bread by any means. They provide a guarantee of safe, painless, cheap and confidential abortion, as is evident from their advertisements. Most of the Transkei region is rural or semi-rural. Although the area merged with South Africa soon after the democratic elections in 1994, it is still not developed.[11] People are poor, ignorant and the illiteracy rate is high;[11] therefore, they do not understand the risks of abortion by unqualified abortionists and a poorwoman whois desperate for abortion is easy prey for them.

More than one fifth of the victims of unnatural death in this region of Transkei between 1996 and 2014 in this study were female (Fig. 1). Of the cases affecting women, 208 (4.17%) were aborted foetuses, taken from municipal dustbins and streets over a period of 19 years (Table 1 and Fig. 2). Evidence shows that induced abortions are more likely in countries in which abortion is illegal or restricted compared to those that are liberated.[12] South Africa is not among those countries and legalised abortion already in 1996. The Choice on Termination of Pregnancy Act, promulgated in 1996 in South Africa, provided for abortion upon request.[6] South African women have the choice to undergo abortion but there is still serious stigma attached to it. Legalisation of abortion on request is a necessary but insufficient step to improve women's health.In some countries, such as India, where abortion has been legal for decades, access to competent care remains restricted because of other barriers.[2]

This Act has provided enough room to aget abortion without any problem in South Africa at various legal abortion clinics. However, it seems that a liberal abortion law does not attract Transkeian women to utilise the facility of free legalised abortion clinics, as the number of foetuses foundincreased after the abortion law was passed. In 1996, only 2.4% of cases involved foetuses brought to the laboratory, but this increased to 5.7% in 2014 (Table 2 and Fig. 3). This more than double increase in illegal abortions in this region indicates that there is some problem in this region, involving either the health care service or the ignorance of women or both. Many women in South Africa risk their lives to end an unwanted pregnancy. Despite the liberalisation of laws and formalisation of services dedicated to abortions, women continue to resort to illegal and unsafe solutions that render them vulnerable to health and social risks, serious morbidity and even death.[13] The highest (17.31%) percentage of foetuses were brought to the mortuary in 2010. It is difficult to explain this high number in 2010, but it is well understood that aborted products of conception werepicked up by chance either by road cleaners or by strangers who were walking alongthe road. There is no human tissue disposal system that could help in counting the total number of abortions carried out in the town. Illegal abortionist have their own way of disposing of the product of conception.The municipality and police areignoring these abortionists, despite the fact that they advertise their services in public places. It is easy to meet them;one just has to make a call totheir cell phones.It is absolutely shocking that people can advertise their willingness to commit a crime with impunity!

In South Africa access to safe reproductive health services remains a challenge, particularly in under-privileged areas such as the Transkei. Women want to obtain services quickly. Illegal abortionists respond to their problem quickly in town and therefore they avoid going to the legal abortion facilities.[13] In addition to this, at the legal abortion facilities patients report ill-treatment by the staff and lack of confidentiality, and a long waiting lists.[13] It has become more problematic in rural areas such as Transkei, where the availability of these services is limited. After theabortion law was promulgated in 1997 in South Africa, a study reported that the annual number of abortion-related deaths had fallen by 91% between 1994 and 1998–2001.[5] However, this study was carried out in metropolitan cities such as Cape Town and Pretoria, where all facilities are on the doorstep of the service seekers. The same may not be true in rural parts of South Africa. A high number of maternal deaths is reported in the Transkei region. A study conducted by the author (2004) showed that maternal deaths necessitated improved obstetric care in the Transkei region of South Africa.[14] Maternal mortality as a result of illegal abortion in the Transkei region could not be calculated with any accuracy, but 35% of all maternal deaths were considered to be preventable.[15]

Rural women who come from a distance want to return home on the same day after getting an abortion. This would help them maintain confidentiality. Therefore they need to get an abortion in a limited time. Illegal centres provide

them full proof of confidentiality.[13] Although they are poor and obtaining money is difficult for these women, they are still willingto pay illegal abortionist to solve their problem instantly. Many service providers in legal clinics are known to the client, and therefore these women do not want to risk their confidentiality. There are long waiting times, as the number of beds islimited. The behaviour of the nursing staff isanother challenge. One of the reasons for the high number of deaths, which still occur due to incomplete or septic backstreet abortions, is that many women requesting abortions are turned away because there are insufficient beds. Staff at clinics around Umtata and at Umtata General Hospital see between six and eight women daily, mostly between 16 and 22 years of age. Those women request abortions for a variety of reasons. Some abort claiming that they are not ready to raise a child, some say they became pregnant unexpectedly, and some use abortion as a means of contraception. There are private places around Umtata that also perform abortions,in addition to government centres. These places are mostly available in the streets of Umtata town and they post directions and contact details on the streets to attractwomen who prefer to go for an illegal abortion (Photograph 2). These places are said to be major causes of death resulting from abortions, since there is usually no follow-up when there are complications. Illegal abortionists do not understand the consequences of unsafe abortions, such as haemorrhage, infection and poisoning.[2]

To understand the dynamics of illegal abortion on the African continent, one has to understand the level of illiteracy, lack of empowerment of women, sexual promiscuity, and poverty. Traditional healers are the first line of health care providers, and belief in them is deeply ingrained in the psyche of many Africans. Poverty is severe in the Transkei region. Seventy-three percent of the rural people in the Eastern Cape were living on less than R300 per month in 2005/2006, and more than half of them on less than R220 per month.[11] Education is probably the only way to deal with this problem, but it is going to take more than one generation.

Limitations

Despite the assistance of Statistics South Africa, it is difficult to make an accurate estimation of the population in South Africa as a whole, and the region in particular, because of the awkward geographical position of police stations and migration numbers. The annual growth in population is accepted as 3%, which may not be strictly accurate in view of the lack of precise death and birth ratios. However, the author has tried to estimate the number as accurately as possible.

Conclusion

There wasan increasing trend ofillegal abortion in the Transkei sub-region of South Africa from 1996 to 2014. The basic purpose of the Abortion Act of 1996, to improve the health of women, has not been achieved in this region. Legal abortion clinics must be accountable fortheir quality of service. Government must make people aware of the consequences of illegal abortion,and illegal abortionclinics must be shut down without delay.

Ethical Issue

The author has ethical permission for collecting data and publication (approved project No. 4114/1999) from the Ethical Committee of the University of Transkei, South Africa. The photograph 2, the number blurred purposely to hide the contact number.

Acknowledgment

The author would like to thank all staff of the Forensic Pathology Laboratory for helping to collect data, and providing information on police stations in this region. The author would also like to thank the South African statistics department at Mthatha for providing a population estimate of all the police stations.

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Original Article

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Can Vascular Channels in the Bone Determine the Age of A Human Being?

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Abstract

The accurate assessment of age-at-death from skeletal remains is a key factor in both forensic anthropology and bioarchaeology. Several methods of determining age at death are currently employed that utilize the age specific changes of several anatomical regions of the skeleton. However, as skeletal remains are often incomplete, it is useful to develop new methods based on previously unevaluated anatomy. This makes it more likely that sets of incomplete skeletal remains may include some feature that can be used to determine age-at death.

The purpose of this study was to develop standards for estimating age at death, using bone microstructure, that are applicable to a South Indian population. The sample consisted of 67 individuals (59 males and 8 females) of known age and sex. The sample was removed 5 cm lateral from the costo-chondral junction of the fourth riband slides were prepared according to standard histological methodology.

It was found that the number of Non-Haversian canals tend to reduce with age in a linear fashion which is also seen in the previous studies with coefficient of determination being 0.6703. Then the regression equation was calculated for estimating age using the number non-haversian canal Y = –10.3637X + 70.37784 with standard error of estimate being ± 9.14 years.

Keywords: Non-Haversian canal; Rib; Age estimation; Vascular channels.

Introduction

Age estimation is a quintessential step for the identification and profiling of an unknown corpse in Forensic medicine. It is also critical for profiling of the population as it can provide a new horizon of data on demographics from the bio-statistical context. Whether we are trying to bridge a clear basis of understanding to age related changes in bone macroscopically and micro-anatomically or our specific goal is to create methods for practitioners to apply for estimating age, Forensic experts need an in depth understanding of the distribution, degenerative and quanta of biological processes related to skeletal age changes.

Macroscopic methods like examination of the bones grossly by looking at the degenerative changes are one of the commonly used methods as it can be easily visualized and requires no equipment.[1,2] But this approach is highly subjective according to the person and has a very high standard error of estimate and also gets higher when the person's age climbs above 50.[3,4] Moreover, age markers can start varying if the bones were buried and can cause a series of taphonomic and fossilization processes which may render the observation invalid and thus, can't be used in regular practice.[5]

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On the other hand, Microscopic approach using histological methods was first applied to estimate chronological age on bones in the mid-20th century certifying that it could be used for measuring and arriving at the age of unknown individuals with decent amount of reliability. From then on, multiple techniques of staining and histological analysis were created and improvised for better age estimation. The foundation and basis of bone remodelling comprises of the substitution of older bone and the genesis of new bone taking place by synchronized and harmonious activity of bone cells (osteoclasts and osteoblasts). These two are often called together as bone multicellular unit (BMU) and also sometimes as bone remodelling units. The microscopic features which are created by change in osteonal structures is known as the remodelling events, number of secondary osteonal structures significantly correlated to age, rising with age and erasing complete evidence of the primary bone microscopic structures present in young adults.[6]

Non–Haversian canals are all primary and the main vascular channels, including those that have filled in partially with concentric lamellae to form primary osteones or false, pseudo-Haversian systems are vascular channels that were formed, by the addition or inclusion of minute, circumferential, tangential blood vessels into the bone by accelerated increase in size of the cortex in radius. Since these canals were created at the time the surrounding lamellar bone was formed, they are primary and indicate the places of unremodeled bone. The secondary osteon is created in the area left by osteoclastic resorption and represents internal remodelling of the bone microstructure. The primary osteon can be distinguished from the secondary osteon by the unremodeled bone or lamellar bone surrounding it. The primary osteon has no immaculate reversal or cement line surrounding it, and the surrounding lamellae curve smoothly around the external limits. In the secondary osteon, the lamellae surrounding it run towardsthe reversal line and curb the osteoclasts during the resorptive phase.[7]

Methodology

The present study was conducted in Forensic Medicine and Toxicology Department of Sri Ramachandra Medical College & Research Instituteabout 67 samplesof 4th rib taken from dead body brought for post-mortemexamination in mortuary during the period of May 2019 to September 2019. Its particularswere recorded and age was cross checked from relatives. The proposal for research was submitted to ethics committee, Sri Ramachandra Medical College & Research Institute, Chennai, Tamil Nadu. The research work was approved by the ethical committee. Before taking the sample from deceasedthe consent form was filled & signed by kin of deceased.

The specimens were separated from the body by cutting the fourth rib at a point i.e. five centimetre outer to costo-chondral junction using a ribcutter. The muscles attached to the ribs were cut using scissors. Then after labelling the sample fixation was done before decalcification. For decalcification, formic acid was used. After decalcification regular tissueprocessing & staining was done & sample was stained with H&E. The bone slides were examined under light microscope (Olympus), with a 10X objective & 10X ocular lens piece and Non-Haversian Canals were observed and recorded (Figure 1).

In present study simple linear regression analysis has been done.The standard error of the estimate (SEE) was also determined with help of SPSS software (Version 21).

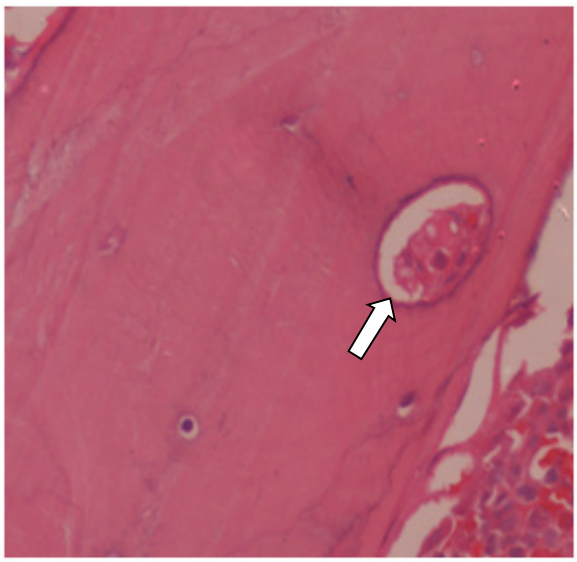

Fig. 1: H&E Staining – Cross section of 4th Rib -Non- Haversian Canals.

Results

In the below graph, the number of Non-haversian canals was taken as the variable in the X-axis and the age of the individual is taken as the variable in the Y-axis (Figure 2) to arrive at a regression equation given below.

The value of R was–0.8187.

The value of R2, the coefficient of determination, was 0.6703. The P-Value was< .00001.

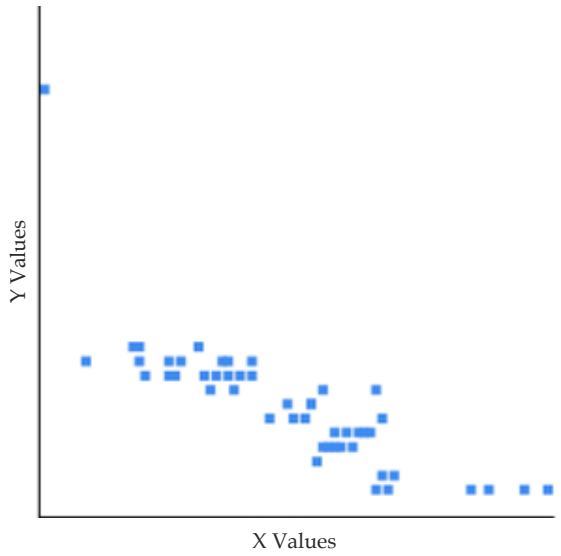

Fig. 2: Scatter plot which reports the negative correlation between age and non-Haversian canal.

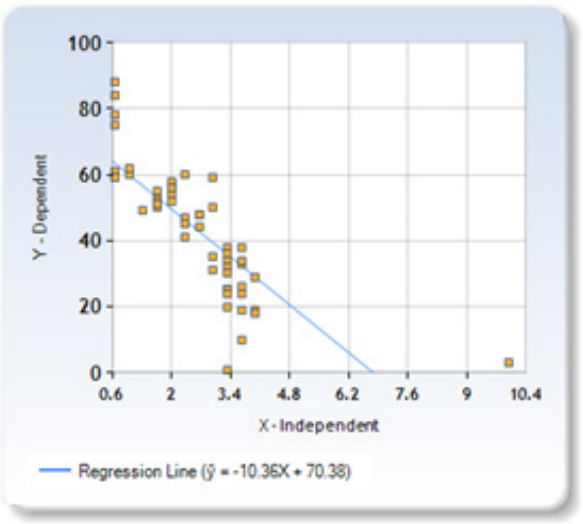

Fig. 3: Scatter plot which reports the negative correlation between age and non-haversian canal.

Then the regression equation was calculated for estimating age using the number of non-Haversian canal (Figure 3).

$\hat{y} = -10.3637X + 70.37784$ (SE of estimate = ± 9.14 years).

Discussion

The results and correlation of this study (average Haversian canal size) agree with the results obtained by Yoshino et. al. (1994), Watanabe et. al. (1994) in suggesting that the size of the Haversian canal does not display any significant age-related changes but seems to be constant overall throughout the life time.

When the total number of non-Haversian canals were calculated and analyzed, it was seen that the numbers generally tend to decrease with age.[8] This result coincides and confirms with the analysis by Kerley et. al. (1965) and Ericksen et. al. (1991) whose results indicated that there was a strong negative co-relationship which led to decrease in the number of non-Haversian canals with rise in age. Kerley et. al. (1965) mentioned that non-Haversian canals were not seen in individuals above the age of 55 years and theorized that non-Haversian canals had been completely remodeled by osteons which would occupy the majority of the lamellar bone butin this study, it was found that non-Haversian canals were present even at the age of 88 years, with some of the other older individuals having similar numbers of non-Haversian canal.

Although there were still non-Haversian canals present in these individuals, the total number drastically declined after 70 years of age.[9] In the male sample, non-Haversian canals were not observed in one or two fields in the individuals who were 70 years of age and above. This indicated that even though resorption process is present throughout life, not all of the lamellar bone is replaced by true osteons until approximately 80 years of age. It was clear that there was no real difference between the correlation values for the male and female groups. Similar findings were seen in the study when Ericksen's (1991) results are examined.[9]

Conclusion

The number of Non-Haversian canals tend to reduce with age in a linear fashion which is seen in the previous studies like Kerley et. al. (1965) and Ericksen et. al. (1991) and further research should be conducted to identify the changes occurring in sexual dimorphism, diseases altering bone metabolism and also diet.

The reason the rib was specifically chosen for this study is that it is more likely to survive and remain fairly undamaged after death.[10] At first, it is easily accessible and removable bone from the body in the post mortem examination, unlike the other long bones like femur, tibia etc. Removal of just one rib causes almost no mutilation or disfigurement of the body. Unlike other long bones, which are usually weight bearing bones, ribs are less vulnerable to

mechanical stress and in turn stress induced aging changes.

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A Cross Sectional Study of Diabetic Foot in Diabetes Mellitus Patients– Prevalence, Practice of Preventive Measures and Medico-Legal Aspects

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Abstract

Introduction and Background: Diabetes mellitus is a chronic endocrine disorder. Diabetic foot is most common complication observed in patients with diabetes mellitus which may leads to debilitating disability like gangrene, non healing sepsis and amputation. Clinically diabetic foot occurs due to diabetic neuropathy or ishchemic or combined neuro-ischemic.

Aim and Objectives: This study was conducted with aim to evaluate the problem of diabetic foot among type 1 and type 2 diabetic mellitus patients and to increase the awareness regarding practice of proper preventive measures among them. Objectives were to find out prevalence of diabetic foot among type 1 and type 2 diabetes mellitus patients and to evaluate practice of proper preventive measures to prevent diabetic foot among them.

Materials And Methods: A cross sectional study conducted among diagnosed patients of type 1 and type 2 diabetes mellitus visiting at Dhiraj Hospital, SBKSMIRC, SVDU, Vadodara between January 2017 to April 2017. Total 98 patients were studied as per inclusion and exclusion criteria. Participants were examined clinically for neuropathy and ischemic features in both feet for diagnosis of diabetic foot, while questionnaire based interview done for evaluation of practice of preventive measures among them. Data was compiled and statistically analyzed.

Observations and Results: Prevalence of diabetic foot was found 32.8% in male and 30% in female diabetic patients. Prevalence of diabetic foot was 86.4% in type 1 diabetes mellitus patients and 15.8% in type 2 diabetis mellitus patients. 58.6% of patients with diabetic foot were practicing good care and preventive measures while practice of preventive care was found irregular in 41.4% of patients with diabetic foot. Medico-legal examination for disability related to diabetic foot and neuropathy is to be done as per Government of India guidelines under the Rights of Persons with Disabilities Act and Rules.

Conslusion: Diabetic mellitus is a chronic incurable disorder till date. Common complications of diabetes mellitus like diabetic foot and diabetic foot ulcer needs proper preventive care and management. So that morbidity and disability can be prevented in patients with diabetes mellitus.

Keywords: Diabetic foot; Diabetes mellitus; Disability; Preventive care.

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Introduction and Background

Diabetes Mellitus (DM) is an endocrine disorder with defective functioning in insulin production and/or secretion or its end organ resistance. Type1 DM is an auto immune disorder of defective insulin production and secretion due to destruction of the beta cells in the pancreas which produce insulin.

Type2 DM is a multi-factorial pathology disorder having combination of defective insulin secretion and increased insulin resistance.

Diabetic foot is a very important long-term or chronic complication of diabetes mellitus. A diabetic foot is a foot condition in diabetes mellitus patient that exhibits one or more characteristics such as diabetic foot ulcer, peripheral vasculopathy, neuropathy, osteoarthropathy and infection that directly resulted from diabetes mellitus.[1] Diabetic foot ulcer (DFU) is the most common complication of DM. Along with diabetic foot, it leads to lower limb amputation in many cases. DFU has shown an increasing trend over previous decades. Around 15–34% of patients with diabetes will suffer from DFU during their lifetime. The rate of lower limb amputation in patients with diabetes is 15 times higher than non-diabetic people.[2–5,6] After successful healing the recurrence rate of DFU is 40% within a year and 65% within 3 years.[6] CDC, USA notes that about 60% of all non-traumatic lower-limb amputations in people aged 20 years or older are done in diabetic patients in 2010.[7]

Clinically diabetic foot is due to diabetic neuropathy or ischemic (diabetic vasculopathy) or combined neuro-ischemic. Pure ischemic foot is rare while neuropathic foot is most commonly seen, neuro-ischemic in rest. Clinical features of neuropathic foot are decreased sensations (superficial and deep), oedema, intact peripheral pulses, callus and ulcer formation over tips of toes and plantar surface of metatarsal heads, sepsis, necrosis and charcot's joints. charcot's joint is a foot condition showing features of loss of pain sensations with rarefaction of bones and edema leading to deformity and disability in chronic diabetic neuropathy. Clinical features of ischemic foot are absent or diminished peripheral pulses, cold temperature, pain, ulceration over margins of foot, toes and heel, sepsis, critical ischemia- pink, painful, pulseless, cold foot and gangrene.[8]

In view of such common complication of diabetes mellitus, we conducted a cross sectional research study among diabetes patients with following aim and objectives.

Aim

Aim of this study was to evaluate the problem of diabetic foot among type1 and type2 DM patients and to increase the awareness regarding practice of proper preventive measures among them.

Objectives

- To find out prevalence of diabetic foot among type1 and type2 DM patients visiting Dhiraj General Hospital, a tertiary hospital in Vadodara, Gujarat.
- To evaluate practice of proper preventive measures to prevent diabetic foot among them.

Materials and Methods

We conducted a Cross sectional study among patients of type1 and type2 DM visiting at Dhiraj Hospital between January 2017 to April 2017. Dhiraj Hospital is a tertiary superspeciality hospital affiliated to SBKSMIRC, Sumandeep Vidyapeeth Deemed University which serves medical services to rural as well as urban population of Vadodara and surrounding districts of central Gujarat state and adjacent regions of Madhya Pradesh state in India.

Inclusion Criteria:

- Patients with confirmed diagnosis of type1 and type2 DM.
- Participants who gave written informed consent for the study.

Exclusion Criteria:

- Patients who denied to consent for the study.

According to above mentioned inclusion and exclusion criteria total 98 patients of type1 and type2 DM patients were enrolled. The diagnosis of diabetic foot was done by taking clinical history and clinic based physical examination for neuropathy and ischemic features, while questionnaire based interview done for evaluation of practice of preventive measures among them. To increase awareness, after completion of clinical examination and data collection, each participant was counseled regarding how to practice preventive measures properly at home.

Collected data compiled in MS office Excel sheet. Data processed using Epi info statistical software. Descriptive and analytical statistical methods used for the preparation of results.

Ethical Considerations:

Approval from the Sumandeep Vidyapeeth Institutional Ethical Committee obtained prior to the study.

Observations and Results

Table 1: depicts sample distribution in regard to sex and type of DM.

	Type1 DM n	Type2 DM n	Total n
Male	14	44	58
Female	8	32	40
Total	22	76	98

(Table 1). shows distribution of samples in relation to sex and type of DM.

Table 2: Prevalence of signs and symptoms of Diabetic foot in patients of DM.

Clinical findings	Present in either or both foot n(%)	Not present in any foot n(%)
Past history of ulcer/ nail infections/ amputation or confirm diagnosis of diabetic foot	26 (26.5)	72 (73.5)
Tingling/ numbness/ burning sensations over foot or slippage of footwear without knowledge	88 (89.8)	10 (10.2)
Nail infection or infective cracks in any toe or sole	22 (22.4)	76 (77.6)
Ulcer or hard callus	14 (14.3)	84 (85.7)
Recurrent pedal Edema	80 (81.6)	18 (18.4)
Absent/feeble pulse of dorsalis pedis artery	24 (24.5)	74 (75.5)
Absent/feeble pulse of posterior tibial artery	23 (23.5)	75 (76.5)
Absent/decreased superficial touch sensations over sole, dorsum and all toes (monofilament examination)	68 (69.4)	30 (30.6)
Absent/decreased superficial pain sensations over sole, dorsum and all toes (pin prick examination)	67 (68.4)	31 (31.6)

Depicts sample distribution in regard to sex and type of DM (Table 1). From observations of Table 2, we could segregate three groups of patients for further analysis as

No Diabetic foot: patients having no past history of any signs-symptoms of neuropathy, vasculopathy, nail infections and ulcer.

Pre diabetic foot: patients having one or more signs-symptoms of neuropathy and vasculopathy but no ulcer, nail infections or such past history. These patients have high probability to develop diabetic foot.

Diabetic foot: patients with definitive diagnosis of diabetic foot, ulcers, nail infections or past history of it.

So, they are tabulated in Table 3 and 4 with reference to sex and type of DM.

Table 3: Sexwise prevalence of diabetic foot.

	No Diabetic Foot n(%)	Pre diabetic foot n(%)	Diabetic Foot n(%)	Total n(%)
Male	0	39 (67.2)	19 (32.8)	58 (59.2)
Female	2	28 (70)	10 (30)	40 (40.8)
Total	2 (2)	67 (68.4)	29 (29.6)	98 (100)

Table 4: Type of DM wise prevalence of diabetic foot.

	No Diabetic Foot n(%)	Pre diabetic foot n(%)	Diabetic Foot n(%)	Total n(%)
Type1 DM	0	3 (13.6)	19 (86.4)	22 (22.4)
Type2 DM	2	64 (84.2)	10 (15.8)	76 (77.6)
Total	2 (2)	67 (68.4)	29 (29.6)	98 (100)

Table 5: Practice of preventive measures for Diabetic foot in patients.

Sr. No.	Questions	Yes n(%)	No/don't care n(%)
1	Do you wear proper size footwear and socks?	83 (84.7)	15 (15.3)
2	Do you apply heat/ oil massage your feet regularly?	69 (70.4)	29 (29.6)
3	Do you take proper care for nail hygienes (regular cutting and trimming)?	81 (82.7)	17 (17.3)
4	Do you check your feet for any cracks, ulcers, minor trauma or infections regularly?	82 (83.7)	16 (16.3)
5	Do you regularly check your blood sugar level at home or with any doctor/laboratory?	91 (92.8)	7 (7.2)
6	Do you take your antidiabetic medicines regularly (as per prescribed by physician)?	98 (100)	0 (0)
7	Do you take proper antidiabetic diet (less sugar and fat, more proteins and fibres)?	95 (96.9)	3 (3.1)

From observations of Table 5, we could segregate two groups of patients for further analysis as

Good care: patients with answers 'yes' to all questions.

Less/no care: patients with 'no/don't care' answers to one or more questions.

The relation to the above two groups with diabetic foot status was observed as Table 6.

Table 6: Relation of practice of foot care in patients and Diabetic foot status.

Practice of Foot care / Diabetic foot status	Good care n(%)	Less/ no care n(%)	Total n(%)
No Diabetic Foot	2 (100)	0	2(2)
Pre diabetic foot	38 (56.7)	29 (43.3)	67 (68.4)
Diabetic Foot	17 (58.6)	12 (41.4)	29 (29.6)
Total	57 (58.2)	41 (41.8)	98 (100)

Disscusion

The global prevalence of Diabetes Mellitus is 8.5% in adult population. The majority among them are affected by Type2 DM. There is significant rise of diabetes cases in children and young adults now which was earlier used to occur in middle age adults and elderly in common.[9] A study by Whiting DR et. al. shows that in 2011 there are 366 million people with diabetes worldwide and it is expected to rise to more than 550 million by 2030.[10] In India, the prevalence of DM is 7.9% and 7.5% in male and female adult population respectively.[11]

Though the pathogenesis of type1 and 2 DM are different, many long time complications of them are overlapping. A very important one among it is Diabetic Foot. The risk factors for diabetic foot are as follows: male gender, duration of diabetes longer than 10 years, advanced age, high body-mass index and other co-morbidities such as diabetic peripheral neuropathy, peripheral vascular disease, glycated hemoglobin level (HbA1c), foot deformity, high plantar pressure, infections and inappropriate footcare habits.[5]

In present study, we found that prevalence of diabetic foot among diabetes patients is 29.6%, which is almost double to the findings of Yazdanpanah L et. al.[5] It means that 1/3rd of DM patients are likely to develop diabetic Foot. And as per Table 3, this rate is same for male and female. But prevalence of diabetic foot is very high in type1 DM (86.4%). These findings are similar to the findings in studies of Kumar S et. al. and Daneman D.[12,13] Study by Kumar S et. al. found prevalence of neuropathy in 41.6%, vasculopathy (Peripheral Vascular Disease) in 11% and foot ulcers in 5.3% patients of type 2 DM.[12]

Regarding the infectious agent, a north India study on 80 patients of diabetic foot infections showed that gram negative aerobic microbes were most common (51.4%) followed by gram positive (33.3%), but strikingly 72% patients among all were having multi drug resistant organisms (MDRO) which is a very serious issue in management of these patients.[14] A study by Visvanathan V et. al. in south Indian type2 DM patients showed that the healing time of wound infected with anaerobic pathogens was higher than aerobic while most of cases were having polymicrobial in nature and presence of neuropathy increased the risk of foot infection.[15]

Preventive measures are very important to stop development of diabetic foot. But surprisingly when we evaluated the prevalence of practice of preventive measures, we found that more than 1/3rd of patients (41.8%) of DM were not practicing one or more preventive measures regularly. These finding needs further evaluation of reasons for that and resolve them. A study by Sekhar MS et. al. in 400 diabetic patients (including 200 DFU patients) showed that patients with DFU have very poor HRQoL (Health related quality of life) scores in both physical and mental health aspects.[16]

Medico-legal Aspects

Diabetes is a non communicable disorder and a chronic debilitating illness. As per current laws in India, DM comes under physical 'impairment' which may cause functional limitations and disability. Legally 'disability' is a permanent injury(damage) to body for which a person should or should not be compensated.[17]

Chronic DM may cause many serious disabilities in long term which includes diabetic foot, amputations due to diabetic neuropathy and vasculopathy, vascular complications like angina pectoris, myocardial ischemia and cerebrovascular stroke, visual disabilities due to diabetic retinopathy, renal failure due to diabetic nephropathy. These are to be evaluated for permanent physical impairment(PPI) according to guidelines mentioned under the Rights of Persons with Disabilities Act and Rules for various civil rights of disabled or differently abled persons, i.e.travel concessions, tax-deduction benefits, admission to various academic courses and institutes, employment, retirement etc.[18,19] It might be extremely rare that diabetes mellitus would be an effect of any occupational, work related hazard or any vehicle accidents. So, disability due to DM would rarely come in purview of Workmen's Compensation Act, ESI act or any other accident compensation legal cases under Motor Vehicle Accident Act, Railways Act etc.

Conslusion

Diabetes mellitus is a non-communicable chronic disorders which have no definitive cure available till date and complications like diabetic foot is responsible for emotional and physical distress with productivity and financial loss that lower the quality of life. To check this, it demands great adherence from the patients towards regular treatment and lifestyle modifications. These not only needs proper awareness, instructions, demonstration of care

practices and constant motivation from physician and healthcare staff, but also requires efforts and strong adherence to preventive measures from patients.

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Original Article

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Age Estimation from Pulpal Width of Maxillary Central Incisors: A Digital Radiographic Study

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Abstract

Background: Age is one of the prime factors employed to establish the identity of an individual and the use of teeth for this purpose has been considered reliable. The measurement of reduction in pulpal width with advancing age due to secondary dentin deposition can been used as indicators of age.

Aim: To estimate the age of patients using pulpal width of permanent maxillary central incisors and to assess reliability of estimated age based on pulpal width of permanent maxillary central incisors with that of chronological age.

Materials and methods: 240 subjects aged between 20–50 years,with equal gender distribution were included in the study. Digital intraoral periapical radiography (Charge- coupled device sensor) of maxillary central incisors with paralleling angle technique were made for all study subjects and pulpal cavity width was measured at Cemento-enamel junction (CEJ) , midpoint between CEJ and midroot level, midroot level using Planmeca Romexis software. Regression analysis was carried out to obtain the estimated age using pulpal width.

Results: The mean estimated age showed no statistical difference from the chronological age in both males and females ($p>0.05$).

Conclusion: Pulp width serves as a good indicator for age estimation in forensic odontology.

Keywords: Age estimation; chronological age; Maxillary Central Incisors; pulpal width; digital radiography; forensic odontology.

Introduction

Age, which denotes to a period of life in an individual is an important factor in establishing the identity of an individual in forensic odontology. Forensic odontology involves the examination, evaluation, management and presentation of dental evidence in criminal or civil proceedings, all in the interest of justice.[1]

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Saunders, a dentist, was the first to publish the information regarding dental implications in age assessment by presenting a pamphlet entitled "Teeth-A Test of Age" to the English parliament in 1837.[2]

Age-related changes occur in teeth between approximately 10 weeks in utero to old age.[3] Clinically, age establishment can be done by regressive changes but as age advances changes often take place inside tooth which are obscured to naked clinical examination. This further necessitates radiological examination. The dental pulp cavity reduction as result of secondary dentin deposition is an age indicator according to Kvaal et. al.[4]

Studies in the past have established a correlation between chronological age and pulp tooth ratio of maxillary central incisors based on the regression equation derived.[4,5,6] In this backdrop, the present study had been designed to determine age based on mesiodistal pulpal widths of permanent Maxillary

Central Incisors and check on its reliability in clinical settings.

Materials and Methods

The present study was conducted from June 2016 to September 2016 in the Department of Oral Medicine and Radiology, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysuru. Ethical approval was attained from Institutional Ethical Review Board following which 240 random patients were enrolled in this study.

Subjects falling in the age group of 20–50 years divided into three groups with gender distributed equally and with both intact permanent maxillary central incisors, having integrated dentition and good occlusion were included in the study. Optimal quality Digital intraoral periapical images of permanent Maxillary Central Incisors of these subjects only were considered.

Subjects with history/evidence of local/systemic disease/anomalies/trauma that could affect the maxillary permanent central incisors were excluded from the study. Radiographically absence of permanent maxillary central incisors teeth, presence of malformed teeth/ pulpal calcifications/ developmental variations in root canal except single canal and any distortion of images and artifacts were excluded.

The selected individuals were subjected to Digital Intraoral periapical radiography (Charge Coupled device Sensor- Size one) of Maxillary Central Incisors using paralleling technique taken at standard parameters adapting requisite radiation protection measures. All the 240 digital intraoral periapical images recorded were evaluated and 3 fixed reference lines were marked on the image using Planmeca Romexis Software measurement and enhancement tools (Fig 1). Root length (R) from Cemento-enamel junction (CEJ) till apex was measured and midpoint of root (M) was marked following which pulpal measurements were made at 3 different levels: (Fig 2).

Fig. 1: Measurement of Maxillary Central incisors pulp cavity width at 3 different levels using Planmeca Romexis Software.

- At the CEJ (A)
- At the midpoint between CEJ and mid root level (B)
- At the mid root level (C)

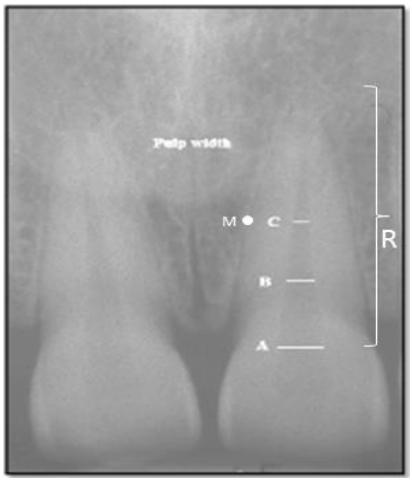


Fig. 2: Pulpal width measurements at three different levels.

Reliability of measurements were assessed by remeasuring the above parameters in a sample of 40 radiographs by the same observer after 15 days. It was determined by paired t test and found to display statistically no difference with that of previous measurements.

Statistical Analysis

The data tabulated was subjected to statistical analysis using the SPSS software for windows (version 20.0). Descriptive statistical procedures including mean, Standard deviation, standard error mean were used to summarize all variables. Pearson's correlation test was performed to determine the correlation between pulp cavity width and age. Regression analysis was computed for estimating age using width of pulp cavity, later students t test was performed to compare the mean estimated age with that of chronological age.

Results

Significant difference was found between the morphological variables among males and females, indicating that gender did influence the regression model used to estimate chronological age for both male and female groups (Table 1). Hence, the correlation and linear regressions for males and females were determined separately.

Table 1: Comparison of mean age, CEJ, midpoint of CEJ and midroot, midroot pulp cavity widths in males and females.

Variables	Male		Female		P Value
	Mean	Sd	Mean	Sd	
AGE (Years)	35.55	8.19	35.16	8.78	0.85 NS
CEJ pulp cavity width (mm)	4.4	0.75	3.9	0.95	0.000 S
Midpoint of CEJ and midroot level pulp cavity width (mm)	2.9	0.59	2.7	0.63	0.045 S
Midroot pulp cavity width (mm)	1.9	0.36	1.8	0.42	0.017 S

Table 2: Student's t-test between mean chronological age and mean estimated age in males.

	Mean	N	Std. Deviation	Std. Error Mean	p-value
Chronological age	35.56	120	8.192	.748	0.999
Estimated age	35.55	120	1.55788	.14221	

Table 3: Student's t-test between mean chronological age and mean estimated age in females.

	Mean	N	Std. Deviation	Std. Error Mean	P-value
Chronological age	35.17	120	8.782	.802	0.999
Estimated age	35.16	120	1.77934	.16243	

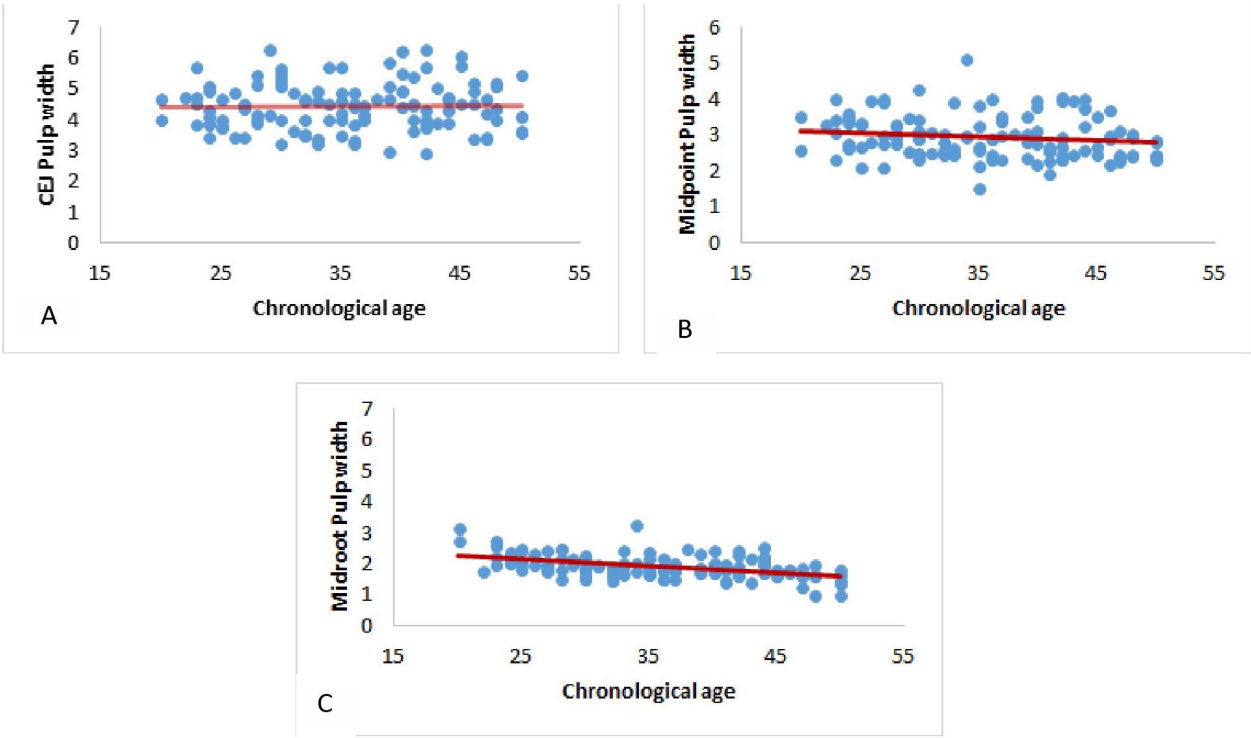
Pearsons correlation test performed between pulpal widths and chronological age revealed values in males as, CEJ: r = 0.028, midpoint= -0.161 and midroot, r = –0.481 and in females as, CEJ: r = –0.193, midpoint= –0.257 and midroot, r = –0.225 respectively. A negative linear relationship was attained,indicative of the fact that as age increases, the pulp cavity width decreases (Graphs 1–2). Strong correlation was observed with midroot level in males whereas strong correlation was observed with midpoint of CEJ and midroot of pulp cavity in females.

Multiple linear regression analysis was performed with age as a dependent factor and pulp cavity width as an independent factor. To obtain an estimated age of 3 means (ABC), the linear functions were calculated using the formula: $y = a + b_1x_1 + b_2x_2 + b_3x_3$; where, y is estimated age, a= constant, b= rate of change and x is corresponding pulp widths at 3 different levels.

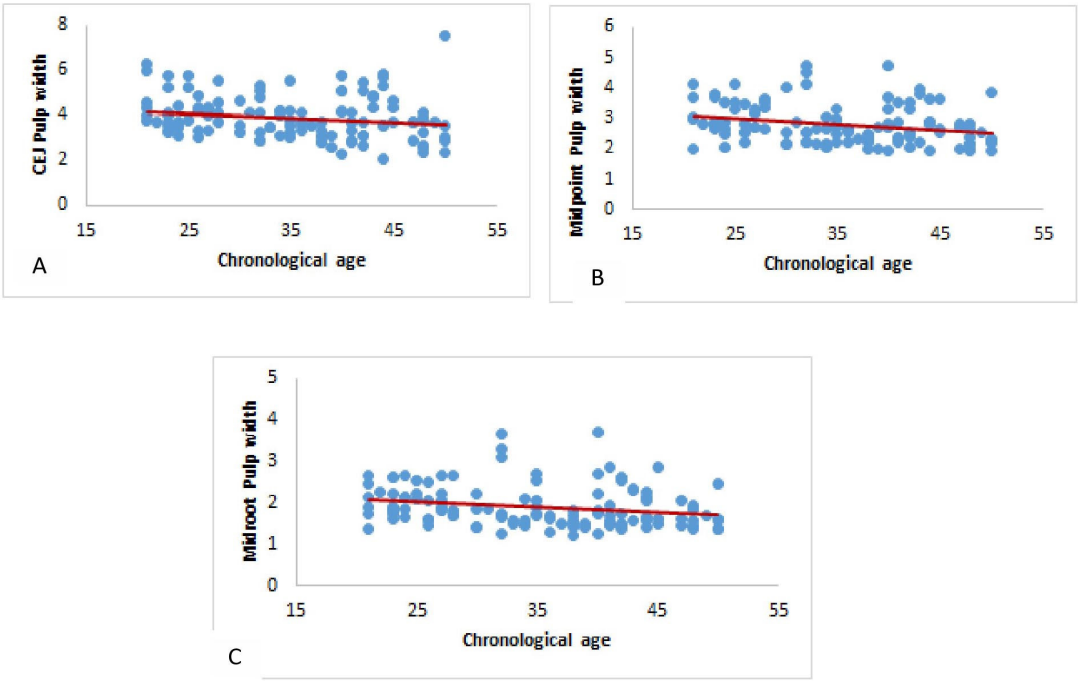
Males: AGE= 51.688 + (0.903* X_1) + (0.743* X_2) + (-11.57* X_3)

Females: AGE= 45.199 + (–0.131* X_1) + (–2.95* X_2) + (–0.683* X_3)

The effect of gender on age estimation was determined and found to have no significant influence on age (Tables 2 and 3) i.e., no significant difference was noted between the chronological age and estimated age in both males and females.



Graph 1: Scatterplot showing a) Correlation of chronological age Vs CEJ pulp cavity width in males. b) Correlation of chronological age Vs midpoint of CEJ and midroot pulp cavity width in males. c) Correlation of chronological age Vs midroot pulp cavity width in males.



Graph 2: Scatterplot showing a) Correlation of chronological age Vs CEJ pulp cavity width in females. b) Correlation of chronological age Vs midpoint of CEJ and midroot pulp cavity width in females. c) Correlation of chronological age Vs midroot pulp cavity width in females.

Discussion

Age estimation constitutes a key factor in the identification of an individual in forensic odontology. Teeth are the most useful biological markers for human age estimation because they may be preserved for long time after death. They show great resistance to post-mortem alterations caused by humidity, high temperature, microbial activities and mechanical forces.[7] Hence, for these reasons teeth can be better predictors of age.

The study of morphological parameters of the teeth on radiographs are considered to be more reliable than most other methods of age estimation available like Gustafson's parameters, Nolla's method, Johanson's grading, dental translucency etc which require extraction and a destructive approach which is unethical for scientific reasons.[8] Hence radiographs were considered in our study.

With an increase in age, marked changes occur in pulpal cavity width i.e pulpal cavity width recedes with secondary dentin deposition which is more prominent in maxillary central incisors as compared to other single rooted teeth. The amount of secondary dentin varies according to various factors like race, ethnicity, diet and lifestyle.[9]

In the Maxillary arch, central incisors in particular were employed in our study because they are single-rooted teeth with the largest pulp area. Additionally, angulation errors in radiography are avoided while recording central incisors compared to canines. Also, Maxillary anterior teeth show considerably less crowding and attrition as compared to their mandibular counterpart, and encompass more secondary dentin tissue than canines[10] which make them the preferred teeth for such investigations as ours.

Digital intraoral periapical radiography was used in current study considering plethora of advantages like Superior gray scale resolution, reduced exposure to radiation, increased speed of image viewing, increased efficiency, enhancement of diagnostic image, effective patient education tool and teleradiology.[11] Paralleling technique was followed in this study because it minimizes image distortion and best incorporates all the intraoral imaging principles.[11,12]

Kvaal et. al.[4] conducted a study to find a method to estimate the chronological age of an individual from measurements of size of the pulp(pulp/root length, tooth/root length, and pulp/root width) on full mouth dental radiographs of six different teeth at 3 levels and found pulp width to have a strong correlation with age. Hence the width of pulp at 3 different levels was considered as our predictors of age.

Bodrumlu and co-authors in 2013 from their study on 200 OPGs concluded that the pulp chamber can be more readily exposed in female patients compared to males, as the pulp chamber is shallower in the former.[13] Chandler

et. al. reported that the pulp chambers in male mandibular molars were larger and they also suggested that the human first molar pulps exhibit sexual dimorphism.[14] In current study we found statistically significant difference in mean pulpal widths between males and females with females having lesser pulpal width when compared to males. This indicates strong sexual dimorphism in pulpal widths of maxillary central incisors.

A negative linear relationship between the width of pulp cavity and age was obtained in present study which was suggestive of the fact that pulpal width reduces in size as age progresses. These results are in similarity with Du C and co-investigators, Ginjupally et. al., Zaher and co-authors.[15,16,17]

The midroot pulp cavity had strong correlation in current study when compared to midpoint and CEJ pulp cavity in males and this is in accordance with Ginjupally et. al.,[16] whereas in females a strong correlation was noted in midpoint of CEJ and midroot level.

The mean chronological age of males was 35.56 years and estimated age was found to be 35.55 years with a mean difference of 0.01 yrs. The mean chronological age of females was 35.17 years and estimated age was found to be 35.16 years with a mean difference of 0.01 yrs. Similarly results obtained in studies by Zaher et. al.,[17] Ginjupally et. al.,[16] showed a mean difference of 0.1 years between the estimated age and real age. In this study mean difference was opinioned to be very much minimal when compared to the above studies.

Student's t-test revealed no statistical significant difference between mean chronological and estimated age in males and females indicating the reliability of the derived formula.

Conclusion

The present study suggested that it is reasonable to derive a regression formula based on data of pulp cavity width and substantiate the estimated age. The estimated age showed an average difference of 0.01 years in both males and females, supporting the accuracy of pulp width in age estimation and hence further could serve as an introducing scope for new avenues in forensic odontology.

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Original Article

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Estimation of Stature from Length of Middle Finger Among People of Nellore District State Andhra Pradesh

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Abstract

Background: It is necessary to establish a biological profile of an individual by estimation of age, race, sex and stature to determine the individuality of an individual. It is considered as Big Four parameters in Anthropology.

Aim and Objective: To obtain a specific regression equation for stature estimation from middle finger length among male and female population of Nellore district of state Andhra Pradesh

Type of Study: Descriptive cross sectional study with analytical and comparative components.

Place of Study: At Narayana Medical College, Chinthareddy Palem, Nellore State Andhra Pradesh by the Department of forensic medicine and Toxicology.

Material and Method: The measurement was taken in standing position with stabilization of hand on table. The caliper was horizontally placed along the ventral surface of the hand. The fixed part of the outer jaw of the caliper was applied to the proximal crease of middle finger and the mobile part of the caliper was approximated to the tip of the middle finger and measurement was taken and the measurement was obtained up to one decimal place.

Result and Discussion: The mean middle finger length of 8.031 (SD±0.542)cm on right side as compared to 8.036 (SD±0.536)cm on left side indicate that the descriptive parameters are more on left side as compared to right side in males. Similarly in females also the mean middle finger length of 7.578 (SD±0.427) cm on right side and 7.586 (SD±0.428) cm on left side indicates the same thing that the parameters are more on left side. Our observation are in accordance to findings of a study conducted by Rahule et. al. in Indian population where good correlation existed between right middle finger length and stature in males and females and higher correlation coefficient in females than males similar to our study.

Conclusion: Middle finger length provides good reliability in Stature estimation, by deriving the population specific linear regression equations; as well the study reveals that the middle finger length can be used successfully to predict stature in the population of Nellore region of Andhra Pradesh state.

Keywords: Middle Finger Length; Stature; Regression.

Introduction

It is necessary to establish a biological profile of an individual by estimation of age, race, sex and stature to determine the individuality of an individual. It is considered as Big Four parameters in Anthropology.[1] It also forms the features of tentative Identification.[2] In the era of modern advancement and digital technology has

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facilitated identification of an individual on various aspects which includes National Identity, gender, age, profession or any criminal record or any involvement in conspiracy.[3,4] IO often experience problematic situations in determination of identity of an individual where death of an individual may be caused due to natural disasters such as floods, hurricanes, earth quakes, and tsunami or in cases of explosion and plane crash. Excessive complication is usually faced in burnt dead bodies where only remnants are recovered.[5,6]

In various study significant correlations were found in between stature and different body measurements of a person. This principle helps to establish stature and thus overall it helps in partial identity of a person in natural and manmade disaster where fragmented and mutilated body parts are available. In previous studies estimation of stature are available but applicable to only one specific population group and it cannot be generalized to other population, the reason behind is variations in genetic and environmental factors, hence it becomes necessary to determine stature estimation methods in various different ethnic groups.[7,14-23] Many researchers had done studies to calculate stature from foot length and long bones, but there is paucity of research on finger lengths in south India population. The middle finger length do show a significant correlation with stature so we made an efforts to evolve a regression equation to determine stature from middle finger length using statistical methods in South India population of Nellore District of state Andhra Pradesh.

Aim and Objective

The present study was undertaken with an aim and objective to obtain a specific regression equation for stature estimation from middle finger length among male and female population of Nellore district of state Andhra Pradesh, To find out correlation between middle finger length with stature of the individual and to devise a linear regression equation to determine stature from middle finger length.

Material and Method

Present study was conducted at Narayana Medical College, Chinthareddy Palem, Nellore State Andhra Pradesh by the Department of forensic medicine and Toxicology on the Consenting volunteers of Nellore District of State Andhra Pradesh. The research was with the aim of estimation of stature from per cutaneous Tibial Length measurements collected in 300 adult volunteers with age of 18 to 25 years.

The subjects were confirmed to be descent from Nellore district and were specifically selected with residence of Nellore district only, irrespective of their caste, religion, dietary habits and socio-economic status. The study was a predominantly descriptive cross sectional study with analytical and comparative components. Sufficient permissions and consents are procured before the measurements of the volunteers are taken and clearance from the Institutional Ethical committee is obtained in advance. Measurements taken by single investigator and with the same instrument to avoid any technical or inter observer error and to maintain reproducibility and measurements were taken thrice and their men value were considered for stature estimation.

Stature: Using the stadio-meter, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Middle Finger Length: Anthropometric measurement Middle finger length of both hands: It is the distance between middle of metacarpo - phalangeal crease (proximal flexion crease) of the middle finger and the extreme projecting point on the tip of middle finger.

Instruments: Digital Vernier caliper. Technique: The measurement was taken in standing position with stabilization of hand on table. The caliper was horizontally placed along the ventral surface of the hand. The fixed part of the outer jaw of the caliper was applied to the proximal crease of middle finger and the mobile part of the caliper was approximated to the tip of the middle finger and measurement was taken and the measurement was obtained up to one decimal place. In entire course of the study for each volunteers measurement was taken twice, that is once with the spreading caliper and second with a self retracting measuring tape. To avoid diurnal variations and to eliminate any discrepancies both measurements were taken in a time slot between 1:00 to 15:30 hours of the day. Any kind of error from Instrumental, all the instruments were verified at significant level and variation of + 0.01 cm was observed.

Exclusion Criterion: Those with any apparent disease, orthopedic deformity, morphologically showing the congenital malformations, Dwarfism /

Achondroplasia, features of nutritional deficiencies and injuries to extremities, using medication thought to alter growth, neuromuscular weakness or abnormal tone or with any other major medical illnesses or growth disturbance were excluded from the study.

Statistical Part: Descriptive statistics like min., max., mean, standard deviation, stand. Error etc. of height and length of right and left middle finger of male, female and combined group were done. We compared the length between right and left middle finger of male and female and combined group. Association between Stature and middle finger length were positively correlated and it is shown by scatter diagram also checking the significance of correlation between height and middle finger length of right and left hand by using correlation t-test. So, on the basis of that we calculate the simple regression equations of Stature on right and left middle finger length, by using regression equation we can predict the Stature value by using independent variable middle finger length. We evaluated the significance at 5% level of significance and complete statistics was done in MS-Excel.

Results

Data collected was statistically analyzed and regression equation, pearsons correlation coefficient and various other statistical parameters were evaluated and calculated using MS Excel sheet.

Table 1: Descriptive statistics of stature [CMs].

Parameter	Male	Female	Combined
Minimum	150	148	148
Maximum	190	184	190
Mean	170.808	163.013	166.911
Std. Deviation	9.924	9.143	10.295
Standard error of mean	0.810	0.747	0.594

As per Table No 1 in our study reflects that the distribution of stature among study population, ranging from 150 – 190 cm in males and 148 – 184 cm in females, mean stature among males is 170.80 cm with the standard deviation of ± 9.924 cm and the mean stature among females was 163.013 cm with the standard deviation of ± 9.143 cm. The overall mean stature of the population is 166.911 cm with the standard deviation of ± 10.295 cm.

As per Table No 2 and 3. It reflects the descriptive statistics of middle finger length of both right and left side in males and females. The mean middle finger length of 8.031 (SD±0.542)cm on right side as compared to 8.036 (SD±0.536)cm on left side indicate that the descriptive parameters are more on left side as compared to right side in males. Similarly in females also the mean middle finger length of 7.578 (SD±0.427) cm on right side and 7.586 (SD±0.428) cm on left side indicates the same thing that the parameters are more on left side.

Table 2: Descriptive statistics of RMFL & LMFL in male and females.

Parameter	Male		Female		Combined	
	RMFL	LMFL	RMFL	LMFL	RMFL	LMFL
Minimum	7.07	7.1	6.9	6.9	6.9	6.9
Maximum	9.1	9.1	8.5	8.5	9.1	9.1
Mean	8.031	8.036	7.578	7.586	7.805	7.811
Standard deviation	0.542	0.536	0.427	0.428	0.537	0.534
Standard error	0.044	0.044	0.035	0.035	0.031	0.031

Table No 3: Comparing length significance between RMFL & LMFL.

Parameter	RMFL	LMFL	t - test	P - Value	Significance
	Mean ± SD	Mean ± SD			
Male	8.03 ± 0.542	8.04 ± 0.536	–0.765	0.47	All are not significant
Female	7.58 ± 0.428	7.57 ± 0.428	–0.148	0.441	
Combined	7.81 ± 0.537	7.81 ± 0.534	–0.138	0.4452	

Table 4: Correlation analysis of Stature on RMFL & LMFL of male and female.

	Parameter	Correlation (r) with Stature	t–test	P-value	Significance
Male	Right middle finger length	0.695	11.75928	0.000001	All are highly significance
	Length middle finger length	0.689	11.56525	0.000001	
Female	Right middle finger length	0.688	11.53336	0.000001	
	Length middle finger length	0.681	11.31355	0.000001	
Combined	Right middle finger length	0.7393	16.97313	0.000001	
	Length middle finger length	0.734	16.7082	0.000001	

To assess the statistical differences between the observations of Right and Left side in males and females separately, paired sample "t" test was performed and analyzed.

As per Table 4 In our study it shows the correlation of stature with middle finger length among males and females. It was observed that in males the right middle finger length (r=0.695) shows greater correlation with stature than left middle finger length (r=0.689). Whereas in case of females it was right middle finger length (r=0.688) that shows greater correlation with stature than left middle finger length (r=0.681). All the parameters exhibit statistically highly significant positive correlation with stature in both males and females.

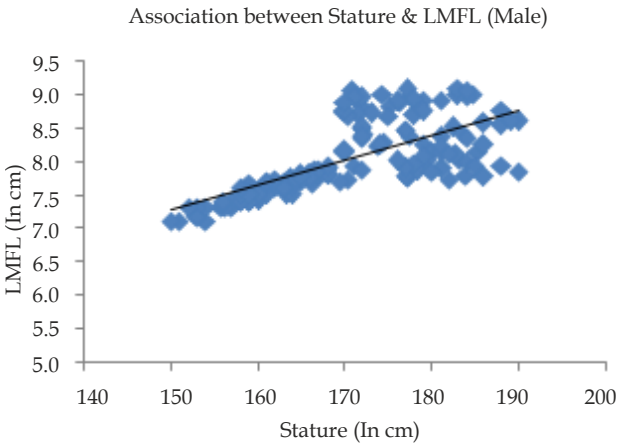
As per Table 5 and 6, in our study it reflects linear regression equations predicting stature using middle finger length of both sides in both males and females. The equations also exhibit Standard Error of Estimate (SEE). The SEE predicts the deviation of estimated stature from the actual stature. It ranges between ± 7.156 to ± 7.215 in males and ± 6.652 to ± 6.72 in females. Lower values indicate greater reliability in the estimated stature. Left Middle Finger Length exhibits a lower value in males and Left Middle Finger Length in females and thus gives better reliability in prediction of stature. The table also shows the power of prediction or coefficient of determination (r2), which is a measure of how well the variation in one variable explains the variation of the other. In case of males it is the Right Middle Finger Length which has the higher prediction power (r2 = 0.484) and in case of females also it is the Right Middle Finger Length which has the higher prediction power (r2 = 0.474).

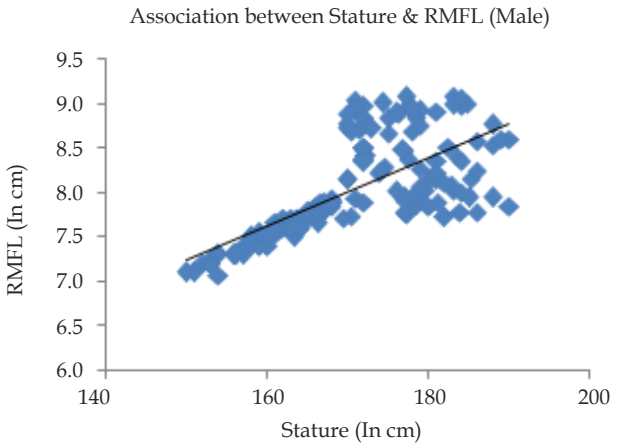
Table 5: Linear regression equation for Right middle finger length in Males and Females

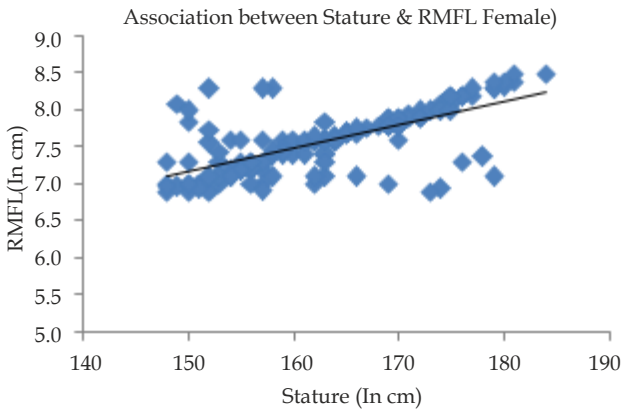
Regression analysis of RIGHT MIDDLE FINGER	Male (Average Stature = 170.81)	Female (Average Stature = 163.01)	Combined (Average Stature = 166.11)
Independent Variable (x)	12.74	14.75	14.17
Intercept	68.51	51.27	56.33
Coefficient determination (R^2)	0.484	0.4743	0.547
Std. error of estimate (SEE)	7.156	6.652	6.94
Significance (p)	0.000001	0.00001	0.000001
Regression Formula of Stature	68.51 + 12.74 * RMFL	51.27 + 14.75 * RMFL	56.33 + 14.17 * RMFL
Predicted height (y) on RMFL	170.81	163.05	166.93

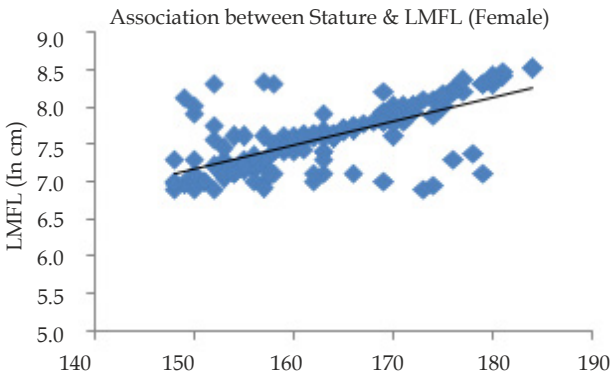
Table 6: Linear regression equation for Left middle finger length in Males and Females.

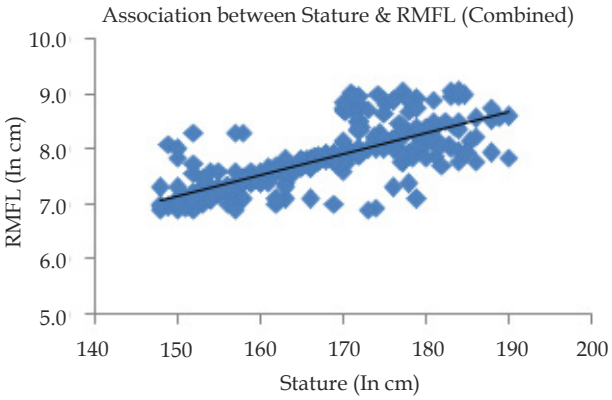
Regression analysis of LEFT MIDDLE FINGER	Male (Average Stature = 170.81)	Female (Average Stature = 163.01)	Combined (Average Stature = 166.11)
Independent Variable (x)	12.753	14.53	14.124
Intercept	68.33	52.81	56.52
Coefficient determination (R^2)	0.475	0.464	0.538
Std. error of estimate (SEE)	7.215	6.72	7.01
Significance (p)	0.000001	0.00001	0.000001
Regression Formula of Stature	68.33 + 12.753*LMFL	52.81 + 14.53 * LMFL	56.52 + 14.124 * LMFL
Predicted height (y) on LMFL	170.81	163.035	166.843

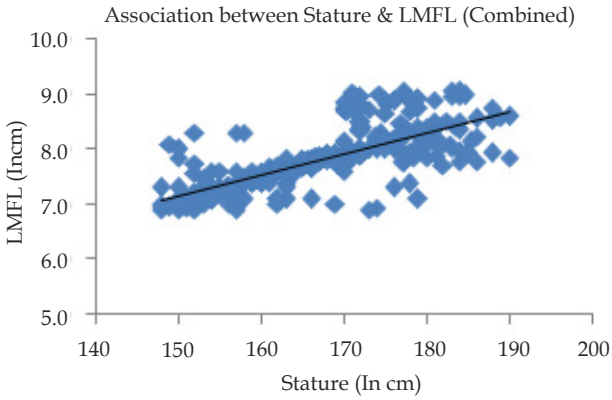












Discussion

The identification of dismembered and mutilated human remain after a disaster is a challenge to forensic experts and hence demands studies on estimation of stature from various body parts in different population groups. Studies like this can help in narrowing down the pool of possible victim matches in cases of identification from dismembered remains.

The mean stature among males is 170.80 cm with the standard deviation of ± 9.924 cm and the mean stature among females was 163.013 cm with the standard deviation of ± 9.143 cm. The males having greater stature than females and this difference was found to be statistically highly significant (P<0.001).

In present study strong correlation was observed between right middle finger length and stature in males and females. Our observation are in accordance to findings of a study conducted by Rahule et. al.[8] in Indian population where good correlation existed between right middle finger length and stature in males and females and higher correlation coefficient in females than males similar to our study. In our study the correlation coefficient was slightly higher (0.484) in males than females (0.474) suggestive of better correlation in males than females.

It was Shivakumar AH et. al.[9] who also found a statistical significance correlation between right middle finger length and stature among males of south Indian population in Karnataka state of India. It was again Shiv Kumar AH et. al.[10] in his another study among females with same south India population, again found a significant correlation between right middle finger length and stature. On the contrary the correlation coefficient and regression equations he obtained from his study is different from our study as per Table No 1, 2, 5 and 6. In an another study made by Verghese AJ et. al.[11] in Mysore and surrounding regions of Karnataka, south India found significant correlation between middle finger length of both the hands and stature in males and females and recommended that those equations should be used for estimation of stature in their region of south India.

Our results were comparable with the previous studies made by Abdul-Malek et. al. (1990),[12] and Jasuja (2004),[13] They have observed that the mean stature was greater in males than females. Such statistical significant differences may be due to the early pubertal growth spurt in girls which stops early and is under the influence of oestrogen, leading to early fusion of epiphysis. In males although the growth spurt occurs comparatively later, they continue to grow for a longer period under the influence of testosterone. This strongly insists different equations for males and females.

In our study parameters were statistically significant and positive correlation with stature in the present study and hence can be successfully utilized for the stature estimation. However, in case of males the right middle finger length showed comparatively higher correlation coefficient (r=0.484) than left middle finger length(r=0.475) and similarly in case of females it was also the Right middle finger length that showed higher values(r=0.474) as compared to Left (r=0.464). Thus, in case of male, middle finger length of right side as well in case of female's middle finger length of right side is the best parameters for the estimation of stature.

Conclusion

In present study it was concluded that middle finger length provides good reliability in Stature estimation, by deriving the population specific linear regression equations, as well the study reveals that the middle finger length can be used successfully to predict stature in the population of Nellore region of Andhra Pradesh state, even if only an amputated hand is found and other body parts are unavailable. However results of present study are applicable only when an intact middle finger is examined. Such type of studies can help in narrowing down the pool of possible victim matches in cases of identification from dismembered remains.

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Original Article

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Histomorphological Analysis of Renal Lesions in Autopsy Specimens

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Abstract

Background: Autopsy is crucial to identify asymptomatic and often undiagnosed lesions. Renal diseases have high morbidity and mortality and the information provided by morphological evaluation of renal autopsy specimens is crucial to prevent renal disease that tends to be asymptomatic. Hence this study was undertaken to analyze the morphological features of kidney lesions in autopsy specimens.

Materials and methods: The study was conducted on renal specimens from routine autopsies, over duration of five years, at a south Indian tertiary health care center. The specimens were evaluated morphologically and histological sections were interpreted and classified into glomerular lesions, nonglomerular lesions and normal findings.

Results: A total of 570 specimens from 285 autopsies, with mean age of 38.8 years and male: female ratio of 3.4:1, were included in the study. The major cause of death was cardiorespiratory failure (36.4%). Normal histology was identified in 63.5% of the kidneys. Tubulointerstitial, glomerular, cystic, vascular and neoplastic lesions were identified in 22.8%, 5.6%, 3.9%, 3.5% and 0.4% of the kidneys, respectively.

Conclusion: The frequency of renal lesions encountered in autopsies was 36.5%. Nonglomerular lesions outnumbered gomerular lesions with male predominance. The commonest tubulointerstitial lesion was acute tubular necrosis. Chronic glomerulonephritis, benign nephrosclerosis and simple renal cysts were the major glomerular, vascular and cystic lesions identified, respectively. Thus, through autopsy, varied preventable renal lesions that tend to be asymptomatic can be discovered and this data is indispensible for further assessment of the disease trends.

Keywords: Autopsy; Glomerular lesions; Nonglomerular lesions; Renal lesions; Renal specimens.

Introduction

Autopsy provides an opportunity to correlate the morphological features of organs with clinical and laboratory findings as well as helps to determine the possible cause of death and emphasize on the incidental findings and rare lesions.[1,2]

Kidney specimen from autopsy are routinely sent to look for morphological changes in unnatural death and sudden death of unknown reason.[3] Histologic evaluation of autopsy kidney may be the first opportunity to identify renal lesions wherein we can encounter a wide spectrum of renal pathology.[4]

Chronic kidney disease has been recognized as a major public health problem and is an independent risk factor for cardiovascular system.[5]

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Renal diseases are responsible for high morbidity and its histological evaluation might provide crucial information on pathological changes in general population for preventing chronic renal disease that tend to be asymptomatic and often go undiagnosed.[1,3,6]

There have been numerous autopsy series elaborating renal pathology findings including patients with hematological malignancies, HIV / AIDS and hematopoietic stem cell transplants.[7] But there are very few studies done on renal system for the lesions.

Hence this study was undertaken to determine the frequency of different pathological lesions encountered in routine renal autopsy specimens and to evaluate the varied histomorphological features of these lesions.

Materials and Methods

This was a single center study, conducted on all renal specimens from routine autopsies received at the autopsy section of the department of Pathology, M.S Ramaiah Medical College and Hospitals, Bengaluru, over a duration of five years (between January 2015 and December 2019).

Neonatal and pediatric autopsy specimens and autolysed kidney specimens were excluded from the study.

Method of data collection

All the renal autopsy specimens received in the autopsy section were weighed and measurements noted. In every case the standard protocol for surgical grossing of specimens was followed. The specimens were fixed in 10% formalin and after a detailed gross examination, multiple representative bits were taken and processed as per standard protocol and paraffin embedded tissue blocks were made. Paraffin sections of 3–5µm were cut and stained with hematoxylin and eosin (H&E). All the histological sections were interpreted independently and blindly by two pathologists and classified into i) glomerular lesions; ii) tubulointerstitial lesions; iii) vascular lesions; iv) cystic lesions; v) neoplastic lesions; vi) nephrolithiasis and vii) No significant lesion / close to normal histology. The relevant details including age, sex, clinical findings and cause of death were retrieved from the deceased postmortem files.

Statistical analysis: Data was entered in Microsoft excel and SPSS Version 18.0 software was used for analysis. All the continuous variables were expressed as mean and standard deviation and all the qualitative variables as proportion. The frequency and percentage of each type of renal lesion was computed.

Results

598 renal specimens from 299 sequential autopsies were received over duration of five years, of which 28 specimens, exhibiting extensive autolysis, were excluded. The remaining 570 specimens from 285 autopsies were included in the study. The age range of autopsies was 18 to 75 years with mean age of 38.8±13.4 and comprised of 77.2% males and 22.8% females with male: female ratio (M:F) of 3.4:1. The mean age of male deceased cases was 39.8±13.1 years (range: 19 to 75 years) and female cases was 34.6±13.9 years (range: 18 and 73 years). Fig. 1 shows the year wise gender distribution. Majority of the cases (53.33%; 152/285) were between 21 to 40 years age group with mean age of 35±10 years (Fig. 2).

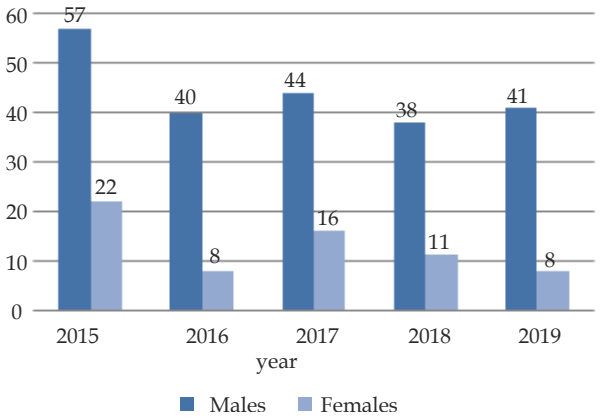

Fig. 1: Gender distribution of autopsy study.

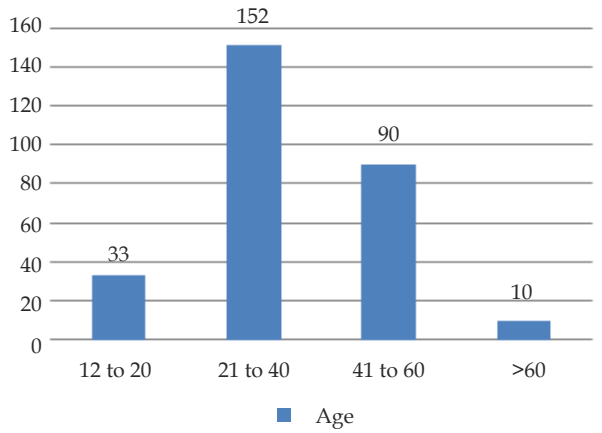

Fig. 2: Age distribution of autopsy cases.

Cause of death: The most common cause of death was cardiorespiratory failure (36.4%) followed by

unnatural death (26%) (Table 1). The latter included road traffic accidents, consumption of poisons, snake bite, burns, fall from height, hanging and drowning.

Table 1: Distribution of immediate causes of death.

Cause of death	No. of specimens	%
Cardiorespiratory cause	103	36.4
Unnatural death	74	26
Unknown	34	11.9
Neurologic injury/Stroke	25	8.8
Infection/ Sepsis	23	8.1
Decompensated cirrhosis	22	7.7
Renal failure	04	1.4
Total	285	100

Renal lesions: In 362 (63.5%) kidneys there was no significant lesion, with the gross and microscopic morphology being normal or close to normal histology with mild interstitial edema and congestion. Remaining 208 (36.5%) kidneys had pathological findings. Table 2 summarizes the various renal lesions in renal autopsies. The percentage of tubulointerstitial lesions (22.8%) was higher as compared to that of glomerular lesions (5.6%), followed by cystic lesions (3.9%) and vascular lesions (3.50%). We noted a male preponderance in the distribution of renal lesions (Table 2).

Tubulointerstitial lesions: The commonest lesion identified was acute tubular necrosis (ATN), accounting for 48.1% of all lesions (100/208). These lesions showed patchy involvement of the tubules with varying severity of epithelial necrosis, tubulorrhexis, epithelial simplification, attenuation of brush border, cytoplasmic vacuolation and patchy epithelial sloughing into lumina (Fig. 3). Chronic pyelonephritis was the second commonest diagnosis, comprising of 12% of renal lesions (25/208). Grossly the kidneys showed irregular coarse corticomedullary scarring overlying deformed calyces (Fig. 4) and on microscopy tubular atrophy, thyroidization and simplification were noted along with variable interstitial chronic inflammation and fibrosis and vascular intimal sclerosis (Fig. 5). Ten of these lesions exhibited superimposed hydronephrosis which, in addition, showed dilation of pelvicalyceal system. Tuberculous pyelonephritis was present in 5 specimens, characterized by caseating granulomatous inflammation (Fig. 6).

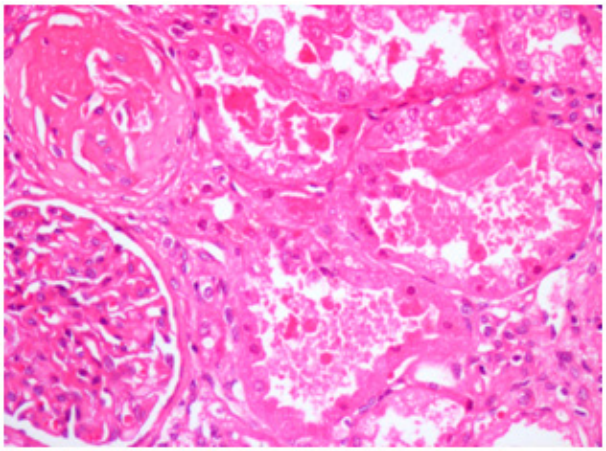

Fig. 3: Acute tubular necrosis with tubules showing degenerative changes and luminal necrotic epithelial cells and debris. (H&E, 20x).

Table 2: Distribution of various renal lesions in autopsy study.

	Renal lesions	No. of cases	% of cases	% of Male	% of Female	Mean age distribution
I	Glomerular lesions	32	5.6			
	1. Chronic glomerulonephritis	16	2.8	77.7	22.2	50.2±8.5
	2. Focal segmental glomerulosclerosis	02	0.4	100	0	33
	3. Diabetic nephropathy	14	2.5	71.4	28.5	39.2±15.6
II	Tubulointerstitial lesions	130	22.8			
	1. Acute tubular necrosis	100	17.5	71.5	28.5	38.1±12.9
	2. Chronic pyelonephritis	25	4.4	64	36	46.1±12.8
	3. Tuberculosis pyelonephritis	05	0.9	60	40	28.3±18.9
III	Vascular lesions	20	3.5			
	1. Benign Nephrosclerosis	14	2.5	78.6	21.4	52.8±4.6
	2. Focal infarction	06	1.1	83.3	16.7	55.1±3.2
IV	Cystic lesions	22	3.9			
	1. Simple cysts	20	3.5	75	25	59.1±10.5
	2. Polycystic kidney disease	02	0.4	0	100	54
V	Neoplasms	02	0.4			
	1. Tubular adenoma	01	0.2	100	0	33
	2. Renal cell carcinoma	01	0.2	0	100	50
VI	Nephrolithiasis	02	0.4	100	0	55±1
VIII	Normal /close to normal histology	362	63.5	76.4	23.6	37.5±12.7

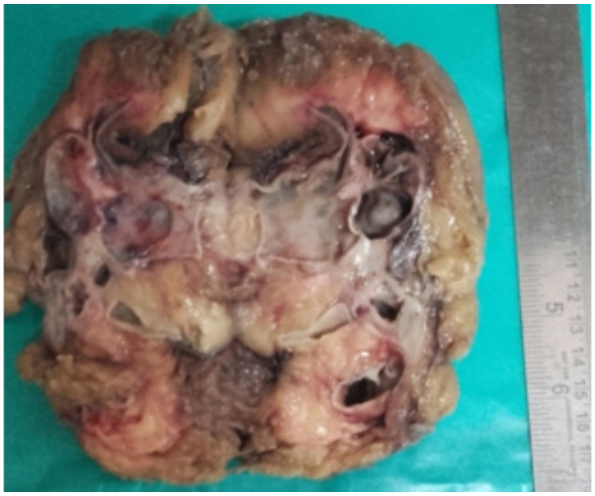

Fig. 4: Gross specimen of chronic pyelonephritis with cut surface exhibiting discrete corticomedullary scars overlying deformed calyces.

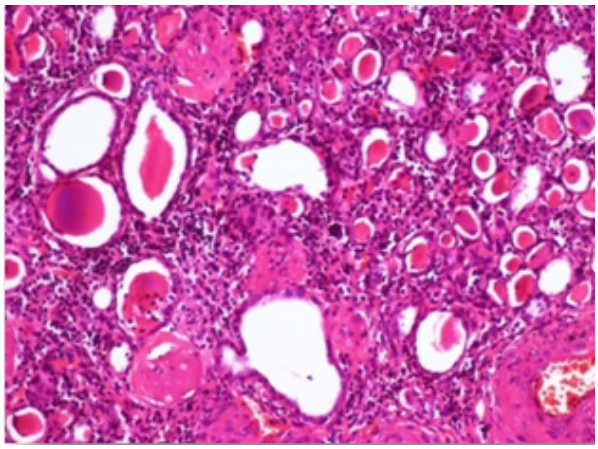

Fig. 5: Chronic pyelonephritis exhibiting interstitial fibrosis and chronic inflammation and tubular thyroidization. (H&E, 10x).

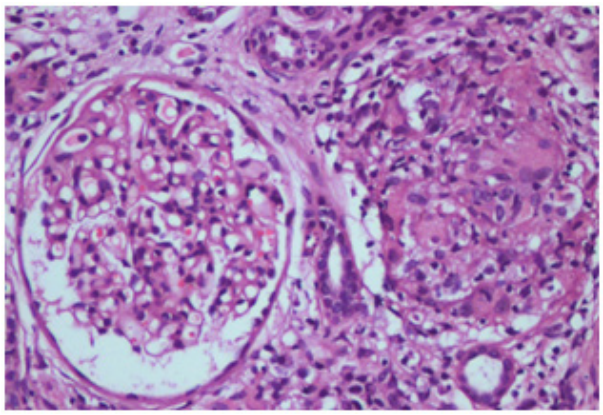

Fig. 6: Tuberculous pyelonephritis exhibiting chronic interstitial inflammation with epithelioid granulomas. (H&E, 20x).

Glomerular lesions: Chronic glomerulonephritis was identified in 16 specimens, all of which were grossly contracted with diffuse granular cortical scarring, cortical atrophy and loss of corticomedullary demarcation. On microscopy there was diffuse global glomerulosclerosis with variable tubular atrophy, interstitial fibrosis and chronic inflammation and arteriosclerosis. In some of these cases the viable glomeruli showed increase in mesangial matrix and cellularity and basement membrane thickening. The histological diagnosis, in two kidneys, was focal segmental glomerulosclerosis, characterized by focal and segmental obliteration of tuft architecture with synechiae formation. Diabetic nephropathy was present in 14 renal specimen's from seven diabetic deceased patients. On microscopy these cases showed diffuse mesangial sclerosis or nodular glomerulosclerosis with glomerular capillary basement membrane thickening and hyaline arteriolosclerosis. In addition four of these specimens showed superimposed acute interstitial nephritis, probably of infective etiology.

Vascular lesions: There were 14 specimens of benign nephrosclerosis which, on microscopy, showed hyaline arteriolosclerosis of arterioles and small arteries and fibrointimal expansion and medial hypertrophy of the interlobular arteries. Infarcts were present in six specimens. Grossly these lesions were wedge shaped and yellowish white with ischemic coagulative necrosis on microscopy. The infarcts were solitary in two specimens and multiple in the rest.

Cystic lesions: Solitary renal cysts were the commonest cystic lesion identified (91%; 20/22). These ranged in size from 0.5 cm to 4 cm and on microscopy were lined by focally denuded bland flattened epithelium. One autopsy case showed adult polycystic kidney disease, in which both the kidneys were enlarged and completely effaced by variably sized cysts.

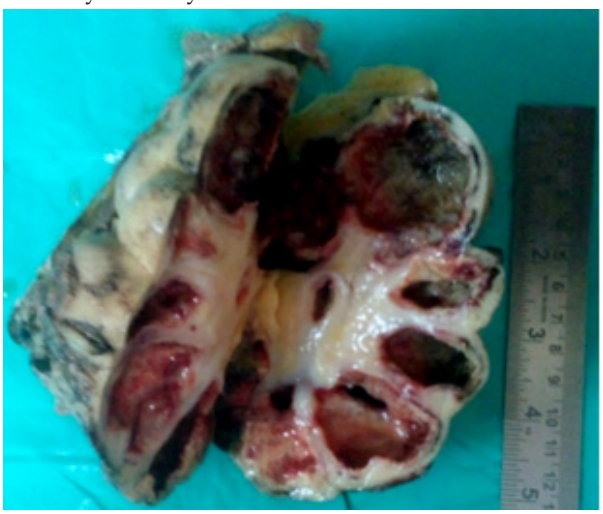

Fig. 7: Renal cell carcinoma, specimen exhibiting a relatively circumscribed mass at the upper pole with variegated cut surface.

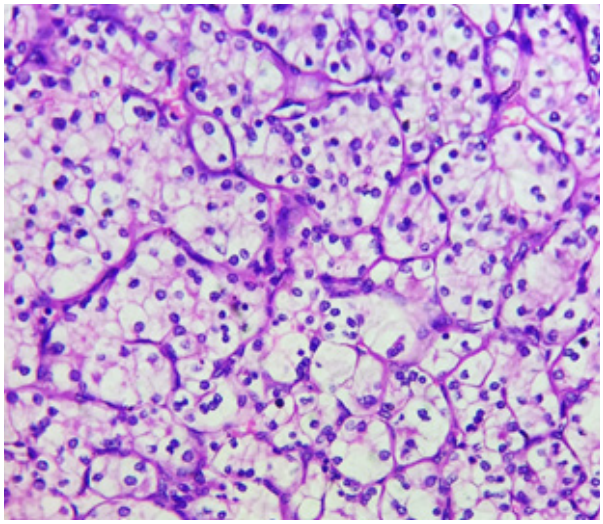

Fig. 8: Renal cell carcinoma, clear cell type with nests and islands of polygonal tumour cell exhibiting abundant clear cytoplasm. (H&E, 20x).

Neoplasms: Incidental renal masses accounted for 1% of all renal lesions (2/208) and composed of one tubular adenoma (1.5 cm in greatest dimension) in a 33 year male and one renal carcinoma, clear cell type (3 cm in greatest dimension) in a 50 year female (Fig. 7 and 8).

Nephrolithiasis: There was one specimen with staghorn calculus and another specimen with multiple irregular and spiky brownish stones reminiscent of calcium oxalate stones.

Discussion

The distribution pattern of renal lesions, at autopsy, varies according to age, gender, race, socio-economic conditions, environmental and nutritional factors and cause of death.[1] Similar studies conducted by Sandhu et. al. (M:F= 1.7:1), Patel et. al. (M:F= 1.5:1) and Yadav et. al. (M:F= 1.8:1) revealed male predominance of renal lesions.[1,2,8,9] Similarly the current analysis revealed male predominance, however the proportion of renal lesions in males was more than the former studies (3.4:1), but less than that observed by Pandian et. al. (6.5:1).[9]

Studies conducted by Patel et. al. and Kaur et. al. revealed that maximum deaths occurred in the age group of 21–40 years which is in concordance with our study.[2,10]

We identified that 36.4% cases show cardiorespiratory failure as the most common cause of death which is in agreement with the study done by Perrone ME et. al.[7] The latter study stated that cardiorespiratory failure, which comprised 26% (36/140) of their cases, was the most common immediate cause of death.

In the current analysis 63.5% (362/570) of all renal specimens exhibited normal histology/ close to normal histology, which is in concordance with study conducted by Yadav who did not find any renal pathology in 85.9% (422/ 491) of the autopsies studied.[8] However studies conducted by Sandhu et. al., Kaur et. al. and Usta et. al. revealed greater proportion of renal pathology with normal histology only in 22.5%, 25% and 41% of the renal autopsies, respectively.[1,10,11]

In the present study non-glomerular lesions (31%; 176/570) significantly outnumbered glomerular lesions (5.6%; 32/570). Similarly, majority of the studies on renal autopsy specimens revealed predominance of non-glomerular lesions.[1,10,12] In the studies conducted by Kaur et. al. and Sandhu et. al. non-glomerular lesions accounted for 58% and 60.7% of the autopsy cases studies.[1,10]

Similar to our study, literature review revealed that tubulointerstitial pathology comprise the majority of all renal lesions as well as non-glomerular lesions.[1,3,8,10] The major tubulointerstitial lesion identified in our study was ATN (17.5%;100/570), which is in synchrony with studies conducted by Sandhu et. al. (22.5%) and Chethan et. al. (35.7%).[12] In autopsy specimens, differentiating autolysis from ATN is a major challenge. ATN exhibits patchy involvement of the tubules with features of injury like cellular swelling and blebbing of cell membrane, attenuation of brush border, desquamation of necrotic cells, tubulorrhexis, presence of luminal casts with necrotic epithelial cells and interstitial inflammation and edema and features of regeneration like epithelial simplification, nuclear hyperchromasia and presence of mitotic activity. Whereas autolysis involves all tubular segments with diffuse detachment of the epithelium from the underlying tubular basement membranes and absence of features of injury and regeneration.[4,13] Kocovski et. al. investigated the morphological characteristics that may differentiate between acute tubular necrosis (ATN) and autolysis in postmortem samples and concluded that tubular whorls, tubulorrhexis, proliferating tubular epithelial cells and presence of interstitial expansion are characteristic features of ATN when compared with autolysis.[13]

Similar to our study (4.4; 25/570), chronic pyelonephritis was the second commonest tubulointerstitial lesion in the study by Sandhu et. al. (6.6%; 8/120).[1] However, according to Yadav et. al., chronic pyelonephritis was the commonest lesion identified (6.1; 30/491).[8]

Renal tuberculosis is clinically silent and often

incidentally found in autopsy studies and develops in approximately 5% of patients with active tuberculosis.[1,14] In the present study, the frequency of renal tuberculosis was low (0.9%). Sandhu et. al. found tuberculosis in 6 cases (5%) where as Yadav et. al. did not report any case of renal tuberculosis.[1,8]

Different studies have stated different percentages of glomerular and vascular lesions. The frequency of glomerular lesions ranged from 0.61 to 16.6% and that of vascular lesions ranged from 1.4% to 26%.[1,8,10,12] In our study the frequency of glomerular and vascular lesions were 5.6% and 3.5% respectively with chronic glomerulonephritis being the major glomerular lesion and benign nephrosclerosis being the commonest vascular lesion. Such discrepant findings is probably due to varying sample size among studies, differing socio-economic and environmental conditions, different causes of death and varying frequencies of normal histology. According to Yadav et. al. the commonest glomerular and vascular lesions were nephrosclerosis and glomerulonephritis respectively.[8] Whereas Sandhu et. al. reported focal global sclerosis and arteriosclerosis as the major glomerular and vascular lesion, respectively.[1]

Most of the cystic lesions identified in the current study were simple cysts, which is in concordance with literature review that revealed that commonest renal cystic lesions are benign simple cysts.[15]

Renal neoplasms, detected incidentally at autopsy are rare. Our study revealed 2 incidental neoplasms (1 tubular adenoma and 1 clear cell renal carcinoma) accounting for 0.4% of all specimens. Sandhu et. al. encountered 1.6% (2/120) of neoplasm's, all of which were clear cell renal carcinomas.[1] Patel et. al., evaluated 269 autopsies and encountered 2 cases of renal cell carcinomas (0.7%).[2]

One of the limitation of the current analysis is that, it does not reflect the real incidence of the renal lesions in the population.

Conclusion

This study highlights the morphological spectrum of renal lesions detected in autopsies. Nonglomerular lesions outnumbered gomerular lesions with male predominance of renal lesions, which is in concordance with other Indian studies. The frequency of pathological renal lesions encountered in routine autopsies was 36.5% with preponderance of tubulointerstitial lesions. The commonest tubulointerstitial lesion was ATN followed by chronic pyelonephritis. Chronic glomerulonephritis, benign nephrosclerosis and simple renal cysts were the major glomerular, vascular and cystic lesions identified, respectively. The frequency of incidentally detected renal neoplasm was 0.4%. Thus, through autopsy, varied preventable renal lesions that tend to be asymptomatic and often go undiagnosed can be discovered and this data is indispensible for further assessment of the disease trends.

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Original Article

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Pathological Study of Percutaneous Image Guided Biopsy of Vertebral and Paravertebral Lesions; Our Experience

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Abstract

Background: The presence of a spinal lesion whether symptomatic or not, presents a diagnostic challenge and is always a cause for concern. In Indian population common spinal pathologies include tuberculosis and malignancy. We aim to study the spectrum of vertebral and paravertebral lesions, analyse with regard to age, sex, site, pathological diagnosis and evaluate diagnostic utility of percutaneous image guided biopsy.

Methods: This was an Institutional Ethics Board approved retrospective study conducted in the Department of Pathology on vertebral and paravertebral biopsy specimens received from January 2014 to September 2019.

Results: A total of 152 cases of vertebral and paravertebral lesions were reviewed with age range of 2–80 years and majority of 42 cases among 61–70 years age group. Male predominance with male to female ratio of 1.62:1 was noted. Out of 152 cases, a majority of 62 cases were in lumbar region followed by 59 cases in thoracic region. Paravertebral involvement was noted in 24 cases. Among the 152 cases, 55 cases (36.2%) were non-neoplastic lesions, 84 cases (55.3%) were neoplastic. Among neoplastic lesions secondary deposits (60%) were common followed by primary malignancy (27%) and benign tumours (13%). Most common among, metastasis was Adenocarcinoma; primary malignancy was multiple myeloma; and benign tumour was schwannoma. Tuberculosis was seen in 17 cases and majority involving the thoracic segments.

Conclusion: CT guided biopsy is a valuable tool for evaluation of vertebral and paravertebral lesions. Metastatic lesions were common followed by multiple myeloma and schwanoma. Tuberculosis was second common among non neoplastic lesions.

Keywords: Image guided biopsy; Vertebral lesions.

Introduction

Vertebral region has a diversity of anatomic structures which challenges both the clinicians and pathologists with a heterogeneous array of pathologic lesions. Vertebral lesions pertain to tissues of the spine and epidural space which includes vertebrae, meninges, spinal nerve roots and spinal cord.[1] The presence of a spinal lesion whether symptomatic or not, presents a diagnostic challenge and is always a cause for concern.[2]

In Indian population common spinal pathologies include tuberculosis and malignancy. While clinico-radiological diagnosis was considered to be sufficient to start anti-tubercular treatment in earlier days, with modern era of evidence based medicine, it is essential to establish the diagnosis by biopsy.[3]

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In the process of diagnosing a neoplastic lesion, or excluding a probable malignancy, the most important step is performing a biopsy which can provide an accurate diagnosis. Open biopsy, the traditional and gold standard method that gathers sufficient material for histological and immunohistochemical studies in musculoskeletal system lesions, is considered difficult procedure due to the risk of high complications.[4] Recently percutaneous image guided needle biopsy is more popular as an alternative to open biopsy, as this is a less invasive procedure and proved to have higher accuracy rate.[4]

In the present study, we aim to study the spectrum of vertebral and paravertebral lesions, analyse with regard to age, sex, site, pathological diagnosis and evaluate diagnostic utility of percutaneous image guided biopsy of these lesions.

Materials and Methods

This was an Institutional Ethics Board approved retrospective study conducted in the Department of Pathology on vertebral and paravertebral biopsy specimens received from January 2014 to September 2019, in Department of Pathology, NRI Medical College, Chinakakani, Guntur, Andhra Pradesh, India.

All vertebral and paravertebral lesions diagnosed on percutaneous image guided needle biopsies were included in the study. Biopsies with inconclusive diagnosis on histopathological evaluation were noted to calculate diagnostic accuracy of the procedure. Excision biopsies were excluded from the study.

Age, sex, site and histopathological diagnosis were retrieved from the records. These parameters were compared with the available data in the literature.

Frequency of various conditions leading to vertebral and paravertebral pathology were expressed in percentage and tabulated in relation to age, sex, and site.

Results

A total of 152 cases of vertebral and paravertebral lesions were reviewed. The age ranged from 2–80 years with a maximum number of 42 cases among 61–70 years age group. Male predominance was noted with male to female ratio of 1.62:1.

Table 1: Distribution of site involved in relation to histopathological diagnosis:

Pathology (n)	Cervical	Thoracic	Lumbar	Sacral
Non neoplastic				
1. Non Specific inflammation (27)	2	9	16	–
2. Tuberculosis (17)	2	11	4	–
3. Degenerative lesions (11)	0	4	7	–
Neoplastic				
1. Primary (34)	5	15	4	10
2. Secondary (50)	6	17	22	5
Myelofibrosis (4)	0	0	4	0
Inconclusive (9)	0	3	5	1
Total (152)	15	59	62	16

Table 2: Frequency and Sex distribution of Vertebral and Paravertebral Lesions:

Histopathological Diagnosis	Number (%)	Male	Female
A. Non Neoplastic	**55 (36.2)**	**31**	**24**
1. Acute/Chronic Non Specific inflammation	27 (17.8)	19	8
2. Tuberculosis	17 (11.2)	4	13
3. Degenerative lesions	11 (7.2)	8	3
B. Neoplastic	**84 (55.3)**	**56**	**28**
I. Primary Benign Lesions:	11 (7.2)	6	5
1. Schwannoma	4 (2.6)	3	1
2. Meningioma	3 (1.9)	1	2
3. Hemangioma	2 (1.3)	1	1
4. Neurofibroma	1 (0.7)	1	–
5. Osteoblastoma	1 (0.7)	–	1
II. Primary Malignant lesions:	23 (15.1)	18	5

Histopathological Diagnosis	Number (%)	Male	Female
1. Myeloma	14 (9.2)	12	2
2. PNET/ Ewings	4 (2.6)	2	2
3. Chordoma	3 (1.9)	2	1
4. Osteosarcoma	1 (0.7)	1	–
5. Chondrosarcoma	1 (0.7)	1	–
III. Secondary Deposits	50 (32.9)	32	18
1. Non Mucin secreting Adenocarcinoma	22 (14.5)	15	7
2. Poorly Differentiated carcinoma	8 (5.3)	6	2
3. Non Hodgkin Lymphoma	6 (3.9)	5	1
4. Mucin secreting Adenocarcinoma	4 (2.6)	1	3
5. Follicular thyroid carcinoma	3 (1.9)	1	2
6. Clear Cell Renal Cell Carcinoma	2 (1.3)	2	–
7. Squamous cell carcinoma	2 (1.3)	1	1
8. Ductal carcinoma (Breast)	1 (0.7)	–	1
9. Anaplastic carcinoma	1 (0.7)	–	1
10. Adenosquamous carcinoma	1 (0.7)	1	–
C. Myelofibrosis	4 (2.6)	4	0
D. Inconclusive	9 (5.9)	3	6
Total	152	94	58

Table 3: Age distribution in relation to histopathological diagnosis.

Age (years)	Non specific inflammation	Tuberculosis	Degenerative	Primary neoplasms	Secondary deposits
0–10	–	–	–	1	–
11–20	1	2	–	2	1
21–30	2	5	2	1	1
31–40	2	–	–	6	3
41–50	7	3	4	6	4
51–60	7	2	2	10	17
61–70	8	4	2	6	20
71–80	–	1	1	2	4
Total	27	17	11	34	50

Out of 152 cases, a majority of 62 cases were in the lumbar region followed by 59 cases in thoracic region among the vertebral lesions. Paravertebral involvement was noted in 24 cases. Among the 152 cases, 55 cases (36.2%) were non-neoplastic lesions, 84 cases (55.3%) were neoplastic, 4 cases showed myelofibrosis and 9 cases were inconclusive. Site wise distribution of all the lesions is shown in Table 1. The frequency and sex distribution of all vertebral and paravertebral lesions are depicted in Table 2. Age distribution among all the lesions is summarized in Table 3.

Discussion

A systematic approach is preferred to minimize the diagnostic errors in diagnosing diverse group of vertebral lesions and this can be done by initial clinical and radiological analysis followed by histopathological examination that helps us to arrive at a diagnosis which can help the clinician in making further decision in management of patients.[1]

In the present study among 152 cases of vertebral and paravertebral lesions with different histopathological patterns, maximum number of cases were seen in the age group of 61–70 years which was similar to study done by Aithala JP et. al.,[3] whereas in studies done by Dikondwar AR et. al.[5] and Nithin et. al.[6], 41–60 years and 21–30 years age group were involved respectively. There was male preponderance in the present study with male to female ratio of 1.6:1 which was correlating with the study done by Dikondwar AR et. al.[5], in contrast, female predominance was reported by Aithala PJ et. al.[3]

A majority of 62 cases (40.8%) involved the lumbar region, followed by 59 cases (38.8%) in thoracic segments which was in contrast to study done by Dikondwar AR et. al.[5] where thoracic (33.3%) was common followed by lumbar (22%).

In the present study neoplastic lesions (55.3%) were more common than non-neoplastic lesions (36.2%), similar to study done by Dikondwar AR et. al.[5] Neoplastic lesions were seen predominantly in 51–60 and 61–70 years age groups similar to study done by Hirano K et. al.[7] The neoplastic lesions showed male preponderance which was similar to studies done by Hirano et. al.,[7] Feroz I et. al.[11] and Jobanputra GP et. al.[12]

Vertebral tumours were divided into primary tumours which originate from the spine or its adjacent structures and secondary (metastatic) tumours from distant organs spread through haematogenous or lymphatic routes and are located in the spine and its surrounding tissues. As the spine is well vascularized and has close relationship with regional lymphatic and venous drainage systems (especially Batson's venous plexus), it is generally susceptible to metastasis. Metastatic tumours are most common tumours of the spine.[13]

Among the 84 neoplastic lesions in the present study, a majority of 50 cases showed secondary deposits (50/84, 59.5%), followed by primary malignancy (23/84, 27.4%) and least being benign tumours (11/84, 13.1%), whereas in studies done by Dikondwar AR et. al.,[5] Nithin et. al.,[6] Hirano K et. al.[7], Schellinger KA et. al.[8] benign tumours were more common.

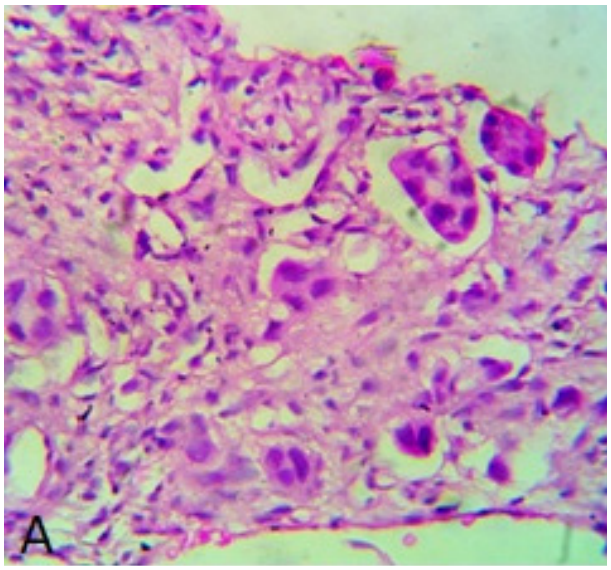

Fig. 1A: Adenocarcinoma deposits in vertebrae in which tumor cells arranged in gland patterns (H&E 400x).

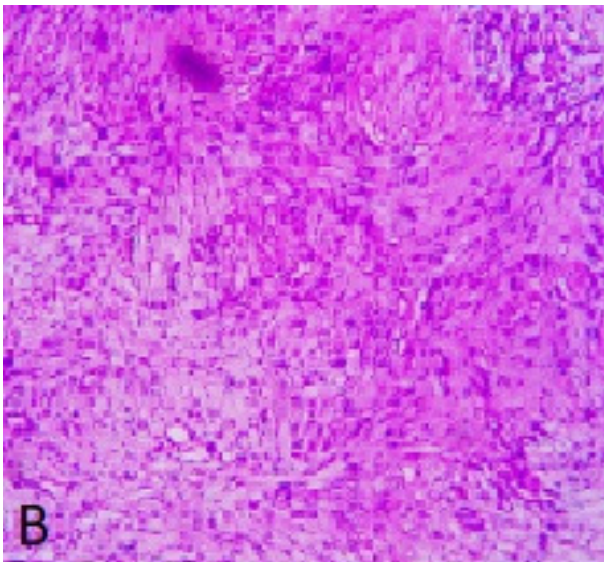

Fig. 1B: Schwanoma showing hypercellular and hypocellular areas with focal verucay body (H&E 400x).

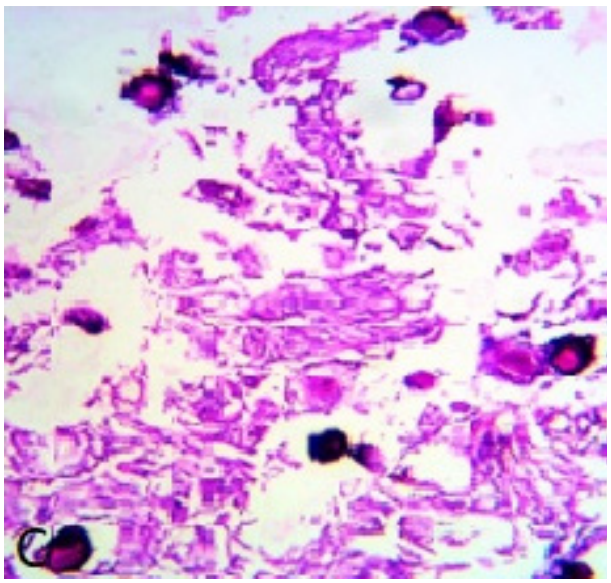

Fig. 1C: Meningioma with predominantly psammomatous calcifications (H&E 100x).

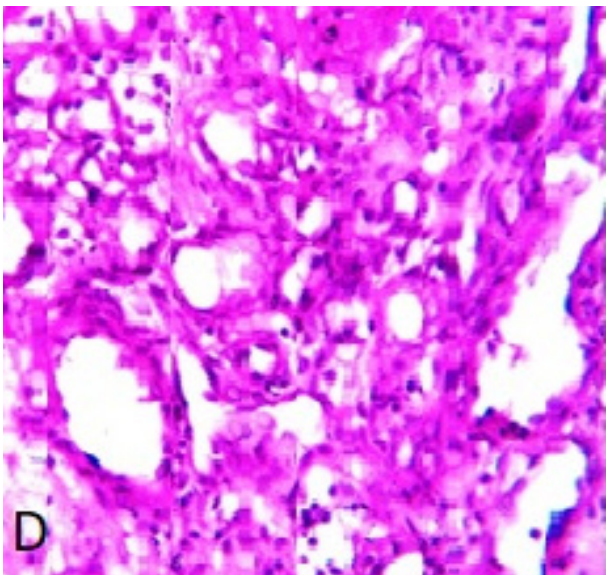

Fig. 1D: Hemangioma showing closely packed vascular spaces with endothelial lining and some showing RBC (H&E 400x).

Among the 50 cases of secondary deposits in the present study, the age ranged from 11–80 years and maximum number of cases was noted in the 61–70 and 51–60 age group which was similar to study done by Hirano K et. al.[7] and Feroz I et. al.[11] Skeletal metastasis is second only to pulmonary and hepatic metastasis. The most frequently affected segment of skeleton is vertebral column.[15]

The secondary deposits were commonly seen in males and the most common metastasis was Adenocarcinoma (22/50) (Fig. 1A), similar to studies done by Dikondwar AR et. al.[5] and Feroz I et. al.,[11] in contrast to study done by Bhat AR et. al.[16] (24% 16/65) where non Hodgkin lymphoma was most common. In all these cases, the frequently involved site was lumbar level which was similar to study done by Feroz I et. al.[11] whereas in studies done by Dikondwar AR et. al.[5] and Nithin et. al.[6] thoracic level was common.

Primary spinal cord tumours are one of the rarest categories of tumours, representing about 4–16% of all tumours arising from the central nervous system.[17]

Spinal schwanomas account for about 25% of intradural spinal cord tumours in adults.[18] In this study among the 11 benign tumours a majority of 5 were peripheral nerve sheath tumours (5/11, 45.5%). These nerve sheath tumours were predominant in males and out of 5 cases, 4 were diagnosed as schwannoma (Fig. 1B) and 1 case was neurofibroma which is consistent with studies done by Dikondwar AR et. al.,[5] Nithin et. al.,[6] Hirano K et. al.[7] and

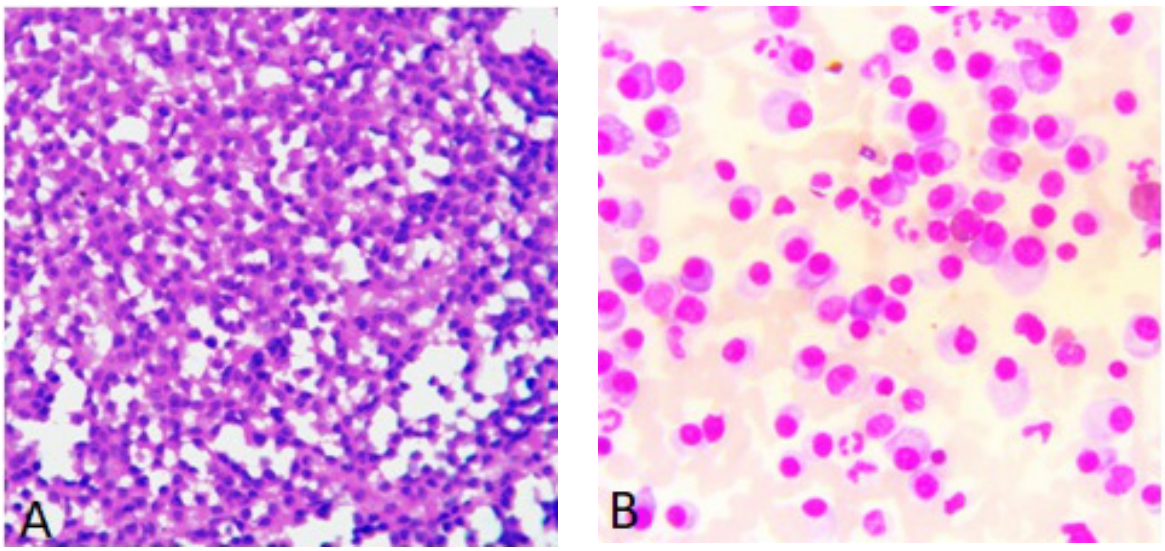

Fig. 2A&B: Multiple myeloma showing sheets of plasma cells having eccentrically placed nucleus with perinuclear hoff (H&E 100x & 400x)

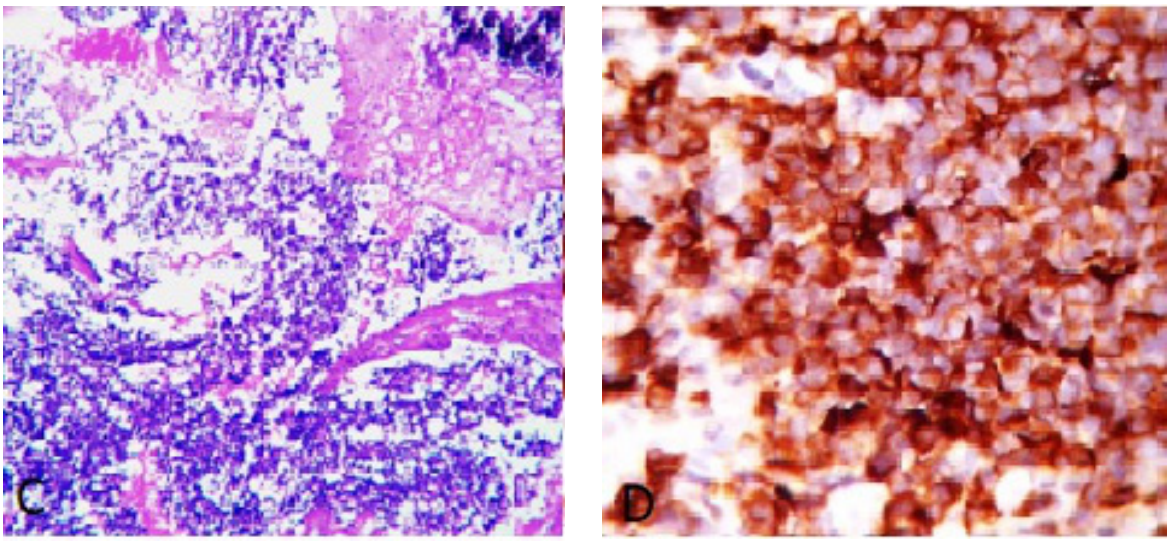

Fig. 2C&D: Peripheral neuroectodermal tumor (PNET) showing sheets of small blue round cells and IHC marker CD 99 showing positivity in cytoplasm of tumor cells (H&E 100x 400x).

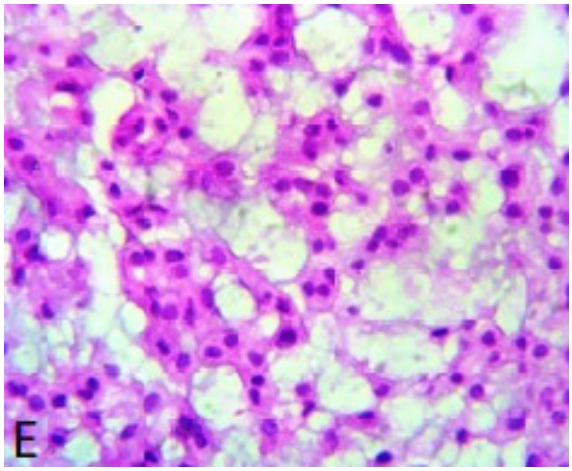

Fig. 2E: Chordoma with tumor cells arranged in cords, cells having abundant clear vacuolated cytoplasm (physaliferus cells) (H&E 400x)

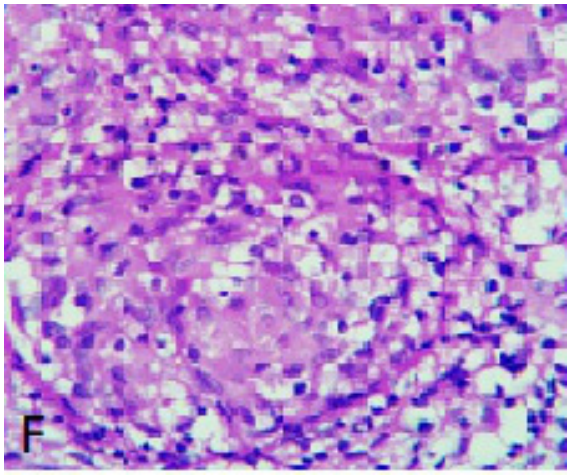

Fig. 2F: Granuloma with langhan giant cell in tuberculosis (H&E 400x)

Govada N et. al.[19] The frequently involved vertebral level was cervical which is contrast to studies done by Moien P et. al.,[9] Dikondwar AR et. al.,[5] Hirano K et. al.[7] and Govada N et. al.[19] where lumbar, thoracolumbar and lumbosacral were common.

Three cases among 11 benign tumours were Meningioma (27.3%) (Fig. 1C) which was the second common tumour with female preponderance and thoracic segment was frequently involved, similar to studies done by Dikondwar AR et. al. 5, Moien P et. al.,[9] Nithin et. al. 6 and Hirano K et. al.[7] Two cases of hemangioma (Fig. 1D) were diagnosed which were located in thoracic segment similar to study done by Hirano K et. al.[7]

Among the primary malignancies multiple myeloma (14/23 cases, 60.9%) (Fig. 2A&B) was the most common type similar to study done by Feroz I et. al.[11] (12/15 cases) and Bhat AR et. al.[16] (12/22 cases) and in contrast Moein P et. al.[9] reported malignant astrocytomas (5/20 cases) to be more common followed by multiple myeloma (3/20 cases). The second common primary malignancy in this study was PNET/Ewings (4/23 cases) (Figure 2C&D) similar to study done by Bhat AR et. al.[16] (5/22 cases, 22.7%) and in contrast to studies done by Dikondwar AR et. al.[5] and Arora RK et. al.[8] who reported only one case.

There were 3 cases of chordoma (Fig. 2E) in the present study, (2 males and 1 female) similar to study done by Dikondwar AR et. al.[5] All the 3 cases were involving the sacral segments in contrast to lumbar predominance reported by Dikondwar AR et. al.[5] study.

Among the 55 non-neoplastic lesions, 27 cases were of non specific inflammation followed by 17 cases of tuberculosis. Tuberculosis still remains major public health problem in India. Tubercular meningitis and cerebral tuberculoma are the commonest manifestation of neuro-tuberculosis and involvement of spinal cord compared to that of the brain occurs in the ratio of 1:42.20 This study included 17 cases of tuberculosis (Fig. 2F) which was second common non neoplastic lesion frequently involving the thoracic segments with mean age of 30 years similar to studies done by Dikondwar AR et. al.[5] and Jain AK et. al.[21] Female preponderance was seen which is in contrast to above studies where male predominance was reported.[5,21]

Conclusion

CT guided biopsy is a valuable tool for evaluation of vertebral and paravertebral lesions. In our study metastatic lesions were more in number in which adenocarcinoma was common. In primary tumours maximum cases were of multiple myeloma followed by PNET and schwanoma was common in benign tumours. Tuberculosis was second common cause for non neoplastic lesions.

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Original Article

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Estimation of Stature from Head Length and Head Breadth by Regression Analysis in South India Population

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Abstract

Background: In Legal investigations like in crimes resulting in fatalities or when unknown skeletal human remains are being recovered by investigating agencies, it is the forensic pathologist who is often asked to give his opinion regarding personal identification for the deceased. Stature is considered to be one of the most valuable parameter to determine the physical identity of an individual.

Aim and objective: To find out correlation between Head length and Head breadth with stature of the individual and to devise a linear regression equation to determine stature from Head length and Head Breadth.

Type of Study: Descriptive cross sectional study with analytical and comparative components.

Place of Study: Department of forensic medicine and Toxicology Narayana Medical College, Nellore District of Andhra Pradesh State.

Material and Method: Present study comprised of total 300 young and healthy subjects in the age range 18–25 years, of Nellore region of south India. The subjects were studied for the following parameters: Stature, maximum head length and head breadth.. The measurements were tabulated and statistically analyzed.

Observation and Discussion: The Mean height of males was 166.3±5.92 and that of females is 154.9±5.53. Mean Head Length and Head Breath in males are 18.62±0.55, 13.62±0.52 and that in females are 17.77±0.44, 13.22±0.27. The Pearson correlation of stature with head length and head breadth in male is r = 0.315, r = 0.227 which is significant with p-value is 0.00043, 0.0026 and that in females are r = 0.276, 0.148 is significant with p-value is 0.00032, 0.03536 and in combined (Male and Female) r = 0.619, r = 0.431 is significant with p-value is 0.000001, 0.000001.

Conclusion: We conclude that the regression equations presented here can be used to estimate ante-mortem stature, with reasonable accuracy of unknown mutilated or dismembered human remains from Head Length and Head Breadth in medico-legal cases, particularly from Nellore district of State Andhra Pradesh.

Keywords: Head length; Head Breadth; Regression equation; Stature.

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Introduction

In Legal investigations like in crimes resulting in fatalities or when unknown skeletal human remains are being recovered by investigating agencies, it is the forensic pathologist who is often asked to give his opinion regarding personal identification for the deceased.[1-3] Stature is considered to be one

of the most valuable parameter to determine the physical identity of an individual. As such there is a definite biological relationship of stature with various body parts for example extremities, head, trunk, vertebral column and so on. Various studies had been conducted in past t determine stature from percutaneous measurements of various body parts which includes arms, legs, feet, hands etc.[4-13]

As such there are two methods to determine stature, Anatomical and Mathematical method, Anatomical method is also called as Folly method and it was traduced by Dwight and developed by Fully as reported by,[14] it determines stature in living subjects using length of bones in body, together with correction factors and adjusting depreciation pattern of stature on ages to attain estimation of living stature.[15] It reconstruct stature by adding measurements of skeletal elements that contribute to stature and adding a correlation factor for soft tissue and this method is being considered as highly accurate, but similarly it is time consuming. In mathematical method to estimate stature from few pieces of bone, it considers the linear correlation between long bones and stature. Commonly used bones that present high accuracy are long bones of upper and lower extremities. Approximate stature can be estimated by using this technique but it always remains a daunting task for any anthropological examiner.[16]

From south India population, very few studies are there for stature estimation from skull alone; as well it is proved beyond doubt that each race requires its own formula for determination of stature. Dietary habits and climate of different regions of India are variable, racial and ethnic variations also exist in different geographical regions. Hence conclusions based on the results of studies done in one population cannot be entirely be applicable to other population.[17] Several studies have been conducted on stature estimation by percutaneous measurements of various body parts which includes arm, leg, feet etc. so considering the current scenario of scarcity in studies on this topic a need of systematic study to determine stature from skull dimensions, the present study was undertaken to determine stature amongst south India population of Nellore region using head length and head breath.

Aim and Objective

The present study was undertaken with an aim and objective to obtain a specific regression equation for stature estimation from Head length and head breadth among male and female population of Nellore district of state Andhra Pradesh, To find out correlation between Head length and Head breadth with stature of the individual and to devise a linear regression equation to determine stature from Head Length and Head Breadth.

Material and Method

In the present study was conducted at Narayana Medical College, Chinthareddy Palem, Nellore State Andhra Pradesh by the Department of forensic medicine and Toxicology on the Consenting volunteers of Nellore District of State Andhra Pradesh. The research was with the aim of estimation of stature from Head Length and Head breadth measurements collected in 300 adult volunteers with age of 18 to 40 years.

The subjects were confirmed to be descent from Nellore district and were specifically selected with residence of Nellore district only, irrespective of their caste, religion, dietary habits and socio-economic status. The study was a predominantly descriptive cross sectional study with analytical and comparative components. Sufficient permissions and consents are procured before the measurements of the volunteers are taken and clearance from the Institutional Ethical committee is obtained in advance. Measurements taken by single investigator and with the same instrument to avoid any technical or inter observer error and to maintain reproducibility and measurements were taken thrice and their men value were considered for stature estimation.

Stature: Using the stadio-meter, the subject was made to stand barefoot in the standard standing position on its baseboard. Both feet are in close contact with each other and head oriented in Frankfurt's plane. The height was then recorded in centimeter from the standing surface to the vertex in the weight bearing position of foot.

Head Length (HL): It is the distance between Glabella to Inion. Glabella; most prominent point on the frontal bone above the root of the nose, between the eyebrows to Inion; most prominent posterior point on the occipital protuberance of head in the mid-sagittal plane.

Head Breath (HB): The maximum transverse diameter on the head is from euryon to euryon. Euryon is bilaterally paired point that forms the terminus of the line of greatest breadth of the skull. Both measurements were taken with spreading calliper.

All the above measurements were taken by principal Investigator at a fix time between 2 to 5 pm only to eliminate the discrepancies due to diurnal variation. The measurements were taken three times and their mean value was taken as a final measurement. The data were analyzed using regression analysis and correlation coefficient.

Exclusion Criterion: Those with any apparent disease, orthopedic deformity, morphologically showing the congenital malformations, Dwarfism / Achondroplasia, features of nutritional deficiencies and injuries to extremities, using medication thought to alter growth, neuromuscular weakness or abnormal tone or with any other major medical illnesses or growth disturbance were excluded from the study.

Statistical Part: Descriptive statistics like min., max., mean, and standard deviation etc. of stature and head length and breadth of male, female and combined group was done. Association between stature on head length and breadth were positively correlated and it is shown by scatter diagram and checking the significance of correlation between stature and head length and breadth by using correlation t-test. So, on the basis of that we calculated the simple regression equations of stature on head length and breadth and by using regression equation we can predict the stature on the basis of independent variable head length and breadth, as well evaluated the significance at 5% level of significance. The complete statistics was done in MS-Excel.

Results

In our study Mean age of subjects (n=300) was 22.14 with Standard Deviation (SD) of 2.66. The Minimum age of subjects was 18 and maximum age was 27. The Pearson correlation coefficient was used to find the relation between head measurements and height and regression analysis was done. The Statistical analysis was presented in tabular form. As per Table 1 it presents mean, SD, and range in male and female subjects. The Mean height of males was 166.3±5.92 and that of females is 154.9±5.53. Mean Head Length and Head Breath in males are 18.62±0.55, 13.62±0.52 and that in females are 17.77±0.44, 13.22±0.27.

As per Table 2 it shows the correlation between stature with head length and stature with head breadth. The Pearson correlation of stature with head length and head breadth in male is r = 0.315, r = 0.227 which is significant with p-value is 0.00043, 0.0026 and that in females are r = 0.276, 0.148 is significant with p-value is 0.00032, 0.03536 and in combined (Male and Female) r = 0.619, r = 0.431 is significant with p-value is 0.000001, 0.000001. All correlations are positively associated. From this one can conclude that Pearson's correlation coefficient is significant for Head Length and Head Breath in both male and female subjects. The equations show the effect of head length on stature and head breadth on stature in male, female and combined group. As per Table 3 it shows the multiple correlations between stature with head length and head breadth

Table 1: Descriptive statistics of stature and head measurement.

Gender	Parameter	Minimum	Maximum	Mean ± SD
Male	Age	18	26	21.9 ± 2.59
	Stature	156	176	166.3 ± 5.92
	Head Length (HL)	17.63	19.49	18.62 ± 0.55
	Head Breadth (HB)	12.3	14.5	13.62 ± 0.52
Female	Age	18	27	22.4 ± 2.73
	Stature	145	163	154.9 ± 5.53
	Head Length (HL)	16.9	18.6	17.77 ± 0.44
	Head Breadth (HB)	12.4	13.8	13.22 ± 0.27
Combined	Age	18	27	22.14 ± 2.66
	Stature	146	176	160.57 ± 8.07
	Head Length (HL)	16.9	19.49	18.2 ± 0.66
	Head Breadth (HB)	12.3	14.5	13.42 ± 0.46

Table 2: Pearson correlation between stature and head length and head breadth.

Gender	Variable	Correlation (r)	t - test	P - Value	Significance
Male	Head Length (HL)	0.315	4.04	0.000043	Highly Significance
	Head Breadth (HB)	0.227	2.84	0.0026	Significance
Female	Head Length (HL)	0.276	3.49	0.00032	Highly Significance
	Head Breadth (HB)	0.148	1.82	0.03536	Significance
Combined	Head Length (HL)	0.619	11.095	0.000001	Highly Significance
	Head Breadth (HB)	0.431	6.724	0.000001	

in male, female and combined is 0.368, 0.279 and 0.647. All are positively correlated and highly significant with p-value is 0.000002, 0.000287 and 0.000001. The equations show the effect of head length and head breadth on stature in male, female and combined group.

Regression analysis

Male Stature (cm) = 103.65 + 3.36 * Head Length

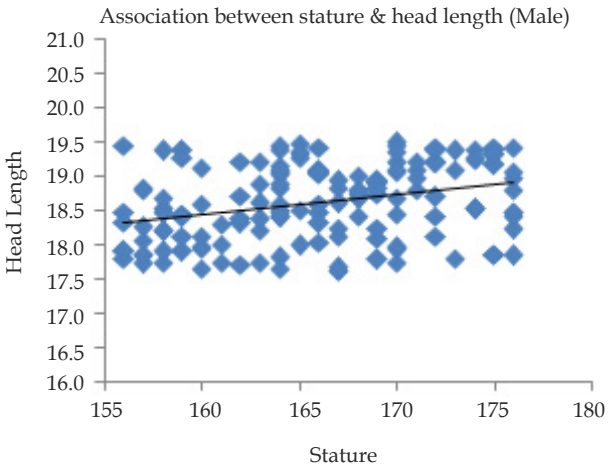
Male Stature (cm) = 131.21 + 2.57 * Head Breadth

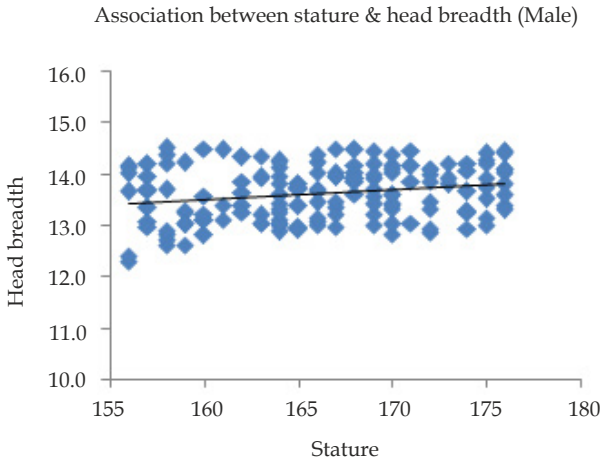
Female Stature (cm) = 93.66 + 3.45 * Head Length

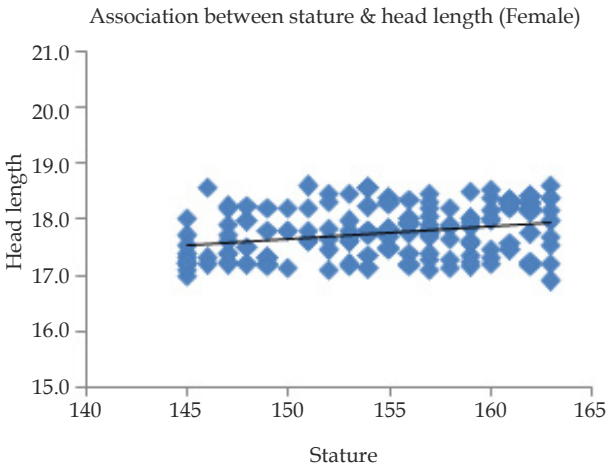
Female Stature (cm) = 114.34 + 3.07 * Head Breadth

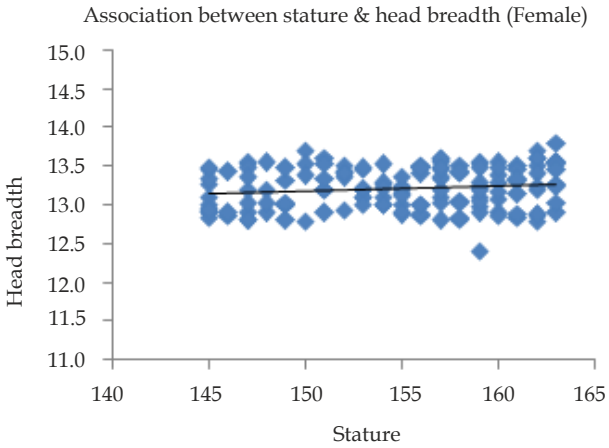
Stature (cm) = 22.59 + 7.58 * Head Length

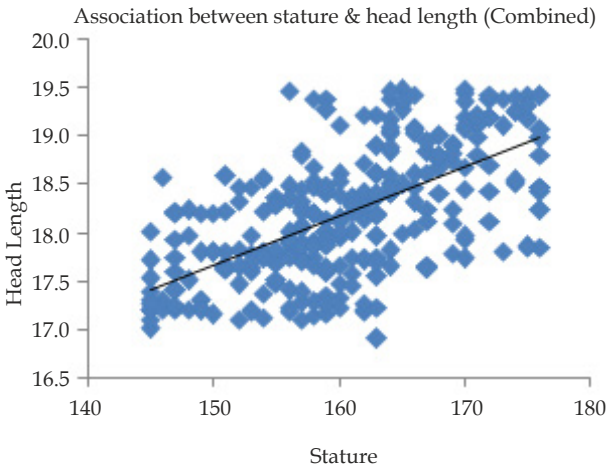
Stature (cm) = 59.01 + 7.57 * Head Breadth











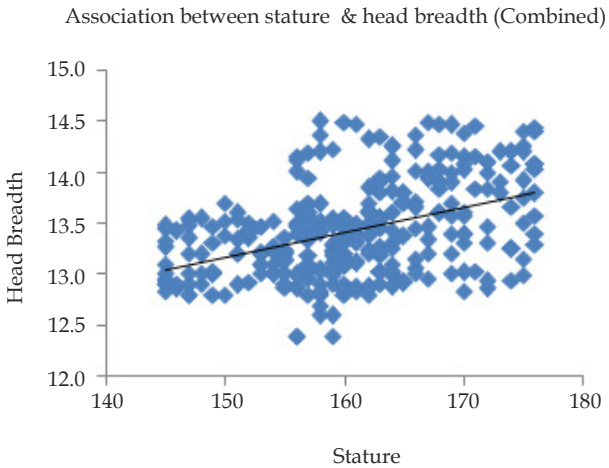


Table 3: Combined effect of head length and breadth on stature.

Gender	Correlation (r)	t - test	P - Value	Significance
Male	0.368	4.794	0.000002	All are highly significance
Female	0.279	3.519	0.000287	
Combined	0.647	14.629	0.000001	

Multiple regression equations:

Male Stature (cm) = 3.1 * Head Length + 2.17 * Head Breadth + 79.02

Female Stature (cm) = 3.22 * Head Length + 0.953 * Head Breadth + 85.12

Combined Stature (cm) = 6.515 * Head Length + 3.643 * Head Breadth – 6.849

Discussion

Present study is a cross sectional study which comprised of 300 young healthy subjects and parameters studied were Stature, Head Length and Head breath. In our observation when we compared both sexes it was found that values were more for males and it was found that differences were statistically significant. In our observation it clearly reflects that stature can be estimated from Head dimensions by applying regression equation. Positive correlation was found between stature and head length and head breadth in both sexes and was statistically significant.

In present study, mean HL in males and females were 18.62 ± 0.55 and 17.77 ± 0.44 and HB were 13.62 ± 0.52 and 13.22 ± 0.27 respectively. The difference between mean head length and breadth of male and female subjects i.e. gender difference was statistically significant ($p< 0.001$) which coincides with that of previous studies.[18–21] It was reported in study made by Glaister et. al.[22] head length was 1/8th of total height of a person. Similarly Chiba and Terazawa[23] derived a regression equation for height from head length amongst the population of Japanese. He reported the regression equation has standard error of estimate of 7.09 and correlation coefficient of head length with height was 0.39 and for female standard error of estimate of 6.97 and correlation coefficient of head length with height was 0.003. While in our study correlation coefficient of head length with height was 0.315 for males and for female correlation coefficient of head length with height was 0.276.

In Study by Bardale and Dixitl[24] they reported that in males correlation coefficient for head length with height as 0.39 with standard error of estimate as 6.08 and In females, for the same they found correlation coefficient of 0.32 with standard error of estimate of 5.67. Similarly it was found in male correlation coefficient of head breadth with height as 0.26 and standard error of estimate for regression formula on head breadth was 6.40, and in females the correlation coefficient of head breadth with height was 0.23 and standard error of estimate was 5.81.

It was Sarangi et. al.[25] who reported that no significant correlation exist between stature and skull parameters, correlation coefficient of stature for skull parameters like heal length, head breath and head circumference was found in his study to be insignificant. Over a period of years close relationship between stature and various body segments are reported and the results are frequently used in medico legal investigation. Various studies in which an attempt has been made to establish the correlation between stature and skull dimensions.

Conclusion

In our study there exists a significant and positive correlation between stature and Head length and Head Breadth between both the sexes indicating strong and reliable relationship between the parameters. We conclude that the regression equations presented here can be used to estimate ante-mortem stature, with reasonable accuracy of unknown mutilated or dismembered human remains from Head Length and Head Breadth in medico-legal cases, particularly from Nellore district of State Andhra Pradesh. However the formulae derived cannot be generalized to all population groups, hence it is necessary to derive regression equations which are region wise and population specific. Thus the data of this study are recommended in anthropological studies for stature estimation amongst the ethnic group under study.

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Original Article

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Analysis of Asphyxial Deaths at Rural Hospital, Ambajogai, Dist. Beed of Maharashtra: An Autopsy Based Retrospective Study

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Abstract

A retrospective study of post mortem examinations conducted between years 2014–2018 at Rural Tertiary Care Hospital, Ambajogai, Dist. Beed was carried out to know the incidence of asphyxial deaths with respect to age, sex, month, diurnal variations and type of Asphyxial death. Out of total 2168 autopsies conducted during that period, 350 deaths were asphyxial deaths, which constitute 16.14% deaths. Most commonly involved age group was 21–30 years (92 cases i.e. 26.28%), followed by 31–40 years (69 cases i.e. 19.71%). The incidence of asphyxial death was more in males than females with the ratio of 2.09:1. Maximum cases were noted in the month of January (44 cases i.e. 12.57%), followed by May (35 cases i.e. 10.00%). Maximum deaths were in the morning hours (131 cases i.e. 37.42%), followed by afternoon (113 cases i.e. 32.28%) cases. In this study, we found that among all asphyxial deaths, Hanging was most common (228 cases i.e. 65.14%) followed by drowning (89 cases i.e. 25.42%) and strangulation (11 cases i.e. 03.14%) respectively.

Keywords: Mode of death; Asphyxia; Hanging; Drowning.

Introduction

Mode of Death refers to the abnormal physiological state that existed at the time of death. According to Bichat, there are three modes of death depending upon the system most obviously involved, irrespective of what the remote cause of death may be. These are Asphyxia, coma and syncope.[1]

Asphyxia commonly means 'lack of oxygen'. Adelson defined asphyxia as, "the physiological and chemical state in a living organism in which acute lack of oxygen available for cell metabolism is associated with inability to eliminate excess of carbon dioxide". Hypoxia is inadequate supply of oxygen to the tissues or an impairment of the cellular utilization of oxygen for any reason.[2]

Hanging produces painless death for the victims and there is no costs involvement other than that of the ligature material. A thin rope around the neck will cause unconsciousness within 15 seconds.[1] Hanging and drowning are commonly seen in suicidal cases, while strangulation including throttling is usually homicidal in nature. In addition, accidental compression or trauma to chest that prevents respiratory movement, which is known as traumatic asphyxia or crush injury, is also one of the causes for violent asphyxial death.[3]

This study was conducted in a rural region where majority of population make their both ends meet by cultivating the farm. Remaining population is composed of farm labours who depend on farm work. Adverse conditions such as drought, scanty water supply, non-breeding of crops are prevalent. Financial condition of society is poor and

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above mentioned adverse conditions makes the population vulnerable to commit suicide. Hanging is adopted as most common method for suicide as it causes painless and sure death as compared to other methods. Being a male dominated society males are more exposed to financial stress. That's why we decided to study the prevalence of asphyxial deaths with respect to socioeconomic factors.

Material and Method

In this study, autopsies conducted at rural tertiary care hospital, Ambajogai, Dist. Beed between the years 2014 to 2018, were considered for retrospective study. The data was collected from police requisition form, postmortem report. The cases were studied to know the incidence of asphyxial deaths with respect to age group, sex, month, diurnal variation and type of deaths.

Results and Discussion

Total 2168 autopsies were conducted at this autopsy center during the study period, of which 350 cases were of asphyxial deaths (Table 1). The asphyxial deaths were more common in third decade of life followed by forth decade followed by second decade. (Table 2). Our findings were similar to the study conducted by Srinivasa Reddy P et. al.[4]

Table 1: Proportion of Asphyxial deaths.

Year	Total no of PM	Total Asphyxial deaths	%
2014	409	69	16.87
2015	398	74	18.59
2016	448	82	18.30
2017	451	50	11.08
2018	462	75	16.23
Total	2168	350	16.14%

Table 2: Age group wise distribution of cases due to Asphyxial deaths.

Age Group (in years)	No of Asphyxial deaths(year wise)						%
	2014	2015	2016	2017	2018	Total	
0-10	06	06	11	02	03	28	08.00
11-20	07	14	13	08	15	57	16.28
21-30	15	19	22	13	23	92	26.28
31-40	16	12	17	14	10	69	19.71
41-50	12	08	08	04	08	40	11.42
51-60	07	10	02	06	10	35	10.00
61-70	03	04	05	02	05	19	05.42
>70	03	01	04	01	01	10	02.85
Total	69	74	82	50	75	350	100

Most of the asphyxial death were common in males followed by females. (Table 3). Similar findings were mentioned by Srinivasa Reddy P et. al.[5] and the study of Sharma B R et. al.[7]

Table 3: Sex wise distribution of cases due to Asphyxial deaths.

Sex	No of Asphyxial deaths (year wise)						%
	2014	2015	2016	2017	2018	Total	
Male	47	51	53	37	49	237	67.71
Female	22	23	29	13	26	113	32.28
Total	69	74	82	50	75	350	100

It has been suggested that seasonal vulnerability is biologically determined and associated with the circannual rhythm of central serotonin neurotransmission.[6]

Maximum cases were reported in the month of January (12.57%) followed by May (10.00%) (Table 4). Tanuj Kanchan[8] found that peak incidence of suicidal hanging was more common among males in June and females in September. Co-relation between season and suicides is variable due to various geographical, cultural and educational parameters. It vary from region to region.[9,10] Maximum deaths due to asphyxia were reported in the morning hours (37.42%), followed by afternoon (32.28%) (Table 5).

Table 4: Month wise occurrence of Asphyxial deaths.

Month	No of Asphyxial deaths (year wise)						%
	2014	2015	2016	2017	2018	Total	
Jan	11	13	06	04	10	44	12.57
Feb	03	04	07	02	06	22	06.28
March	05	06	05	07	03	26	07.42
April	04	03	10	03	07	27	07.71
May	07	09	07	02	10	35	10.00
June	08	06	04	05	11	34	09.71
Jully	06	05	07	05	02	25	07.14
Aug	03	02	09	05	02	21	06.00
Sept	06	08	03	05	09	31	08.85
Oct	05	05	11	05	06	32	09.14
Nov	08	08	06	01	04	27	07.71
Dec	03	05	07	06	05	26	07.42
Total	69	74	82	50	75	350	100

Table 5: Diurnal Variation.

Time of death	No of Asphyxial deaths (year wise)						%
	2014	2015	2016	2017	2018	Total	
Morning	33	25	29	18	26	131	37.42
Afternoon	17	21	31	18	26	113	32.28
Evening	11	17	11	04	10	53	15.14
Night	08	11	11	10	13	53	15.14
Total	69	74	82	50	75	350	100

Hanging (65.14%) and drowning (24.42%) were most common form of asphyxial deaths (Table 6).

These findings are similar to the study of Srinivasa Reddy P et. al.[5]

Table 6: Asphyxial deaths as par Type of death.

Type of death	No of Asphyxial deaths (year wise)						%
	2014	2015	2016	2017	2018	Total	
Hanging	41	46	46	36	59	228	65.14
Drowning	22	18	26	13	10	89	25.42
Strangulation	03	02	03	01	02	11	03.14
Compression of Neck	02	03	04	00	04	13	03.71
Chocking	01	01	01	00	00	03	00.85
Smothering	00	03	00	00	00	03	00.85
Throttling	00	01	02	00	00	03	00.85
Total	69	74	82	50	75	350	100

We observed that, among total asphyxial deaths, suicide was commonest (65.14%), accidental was less common (26.29%) and homicide was still less common (08.57%) (Table 7).

Table 7: Distribution of Asphyxial deaths as par manner.

Manner of death	No of Asphyxial deaths (year wise)						%
	2014	2015	2016	2017	2018	Total	
Suicidal	41	46	46	36	59	228	65.14
Accidental	23	19	27	13	10	92	26.29
Homicidal	05	09	09	01	06	30	08.57
Total	69	74	82	50	75	350	100

Conclusion

As study was conducted in a rural area and adverse conditions such as drought and scanty water supply makes financial condition of society poor leading to financial, mental stress making hanging the most common method for suicide. Being a male dominated society males are more exposed to financial stress.

A well designed and comprehensive programme, like PRAKALPA PRERANA is needed to identify the causative factors and prevention of suicidal behaviors, which should be strengthened and should be implemented overall.

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Original Article

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Incidence of Traumatic and/or Violent Deaths in the Transkei Sub-region of South Africa Over Twenty-Three Years (1993-2015)

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Abstract

Background: Traumatic and violent deaths are the most prominent public health problem in South Africa. The number of such deaths is under-estimated and under-reported in rural and poor parts of South Africa, where the majority of the population resides.

Objective: To study the incidence of traumatic and/or violent death in the Mthatha region of South Africa.

Method: A record review was undertaken from 1993 to 2015 of 24 419 medico-legal autopsies performed at Mthatha Forensic Pathology Laboratory.

Results: Between 1996 and 2015 autopsies were performed on 26972 victims of unnatural death of these, 18703 (69.3%) followed traumatic deaths. The average traumatic and violent death rate is 135 per 100000 of the population annually. There has been a steady decline in the death rate from 156/100000 of the population in 1996 to 123.6/100000 in 2015. Most (32.7%) victims were between 21 and 30 years old. Males outnumbered females at a ratio of 4:1in respect of traumatic and violent deaths in this region of Transkei in the study period.

Conclusion: The incidence of traumatic and/or violent deaths in the Transkei sub-region of South Africa is high. The situation needs urgent intervention to save lives.

Keywords: Trauma; Injury; Wound; Unnatural; Death.

Introduction

Every 5 seconds someone in the world dies as a result of trauma, amounting to about 5.8 million people who die each year as a result of trauma. Every day the lives of over 15 000 people are cut short by injury. This accounts for 10% of the world's deaths, 32% more than the number of fatalities that result from malaria, tuberculosis, and HIV/AIDS combined.[1] Three times more people die each year from homicide than from war-related injury (WHO, 2010). South Africa, a country not at war, faces an unprecedented burden of morbidity and mortality arising from violence and injury. In 2000, violence and unintentional injuries combined were the second leading cause of all death.[2] South Africa registered 59 935 deaths due to injury in 2000, which is an overall death rate of 157.8 per 100 000 of the population.[3] South Africa experiences high levels of violence, as more people are killed by gunfire each year than in motor vehicle accidents (MVA).[4] In 2000, there were 654 homicides of children younger than 5 years, representing an estimated 0.6% of all child deaths in that year.[5] Injuries and violence are unevenly distributed between males and females. The deaths of men from homicide outnumber those of women by more than 7:1. Many female victims of intimate partners have high blood alcohol concentrations at the time of their death, and most of the men who kill them are similarly intoxicated.[7]

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An earlier similar study carried out in the Transkei sub-region between 1993 and 1999 by the author revealed that the average annual incidence of violent and/or traumatic deaths in the Transkei region of South Africa was 162 per 100 000 of the population. This violent and/or traumatic death rate was 2.4 times higher than in Cape Town.[8] Seventy-three percent of the rural people in Eastern Cape were living on less than R300 per month in 2005/2006.[9]

The economic cost of RTA globally has been estimated at USA$ 518 billion annually. In most countries RTA cost between 1–2% of the gross national product (GDP), but it can reach up to 5% in some countries.[1] An analysis of the costs and benefits of a number of selected injury and violence prevention measures show that they yield significant value for money.[1] The purpose of this study is to highlight the problem of traumatic violent deaths in the Transkei–sub region of South Africa. It will also discuss the causative and preventive factors related to these deaths.

Subjects and Method

The retrospective descriptive study was carried out from the records of the post-mortem register from 1993 to 2015 at Mthatha Forensic Pathology Laboratory. The Mthatha Forensic Pathology Laboratory is the only laboratory in this region catering for a population of about half a million in the region of Mthatha. It is attached to the Nelson Mandela Academic Hospital, which is the only teaching hospital in this province. It is associated with the Walter Sisulu University Medical School, and all medico-legal cases in this area of South Africa are dealt with at this facility. In total 26 972 autopsies were conducted between 1993 and 2015 and recorded in the post-mortem register at this laboratory. Between 1993 and 2015 the laboratory dealt with 18703 victims of traumatic violent death. The age groups could not be verified clearly between 1993 and 1995, therefore this period was not taken into account in considering age groups in this study. All traumatic and/or violent deaths have been considered together in this study, for example death caused by mechanical trauma such as MVAs, as well as death related to violence, such as firearm injuries, stab wounds and blunt trauma (assault). Deaths caused by hanging, burns, and even poisoning etc. are labelled non-violent deaths, although it does not mean such deaths are not traumatic and non-violent. The words trauma and injury have been used interchangeably in this study. Decimal points were omitted in calculations to adjust the final figures.

The details of names, addresses, age, gender and date of autopsy, with cause of death, were recorded. Fourteen forensic officers are engaged in collecting corpses round the clock from 17 different police stations in four municipalities in the area. The combined population was 400 000 in 1993, but this number has been increasing at an average of 3% annually. In 2005 there were five police stations to be taken into account. Therefore, the population in the area of this study has increased. Population statistics were calculated with the help of the South African Statistics Department in Mthatha. However, it is difficult to estimate the total population involved. The data were collected in hard copies designed to reflect post-mortem number, year, gender and cause of death. These data were transferred to an Excel computer program and analysed with the help of the SPSS computer program.

Results

Between 1993 and 2015 medico-legal autopsies were performed on the victims of 26 972 unnatural deaths (Table 1). Of these, 18 703 (69.3%) died traumatic and/or violent deaths (Fig. 1). The average annual rate of traumatic, violent death was 135 per 100 000 of the population (Table 2). It was highest (161.9/100 000) in 1997, and lowest (107.2/100 000) in 2014 (Table 2 and Fig. 2). Overall, homicide (stab, firearm and blunt trauma) was the most important cause of these traumatic and violent deaths, accounting for 80 deaths per 100 000 of the population annually in this study (Table 2). Death as a result of MVA is the single most frequently recorded cause of death, at a rate of 50/100 000 of the population annually (Table 2). On average the majority of homicide deaths were caused by stabbing, at a rate of 34 per 100 000 of the population, followed by gunshot wounds at a rate 30 per 100 000, and blunt trauma at a rate of 21 per 100 000 of the population annually (Table 2 and Fig. 3). Most (80%) of the victims were male in this study (Table 3, 4 and Fig. 4).Most of the victims (32.7%) were between the ages of 21 and 30 years (Table 3, 4 and Fig. 4).

Discussion

This is the first descriptive study considering such a large sample of deaths due to trauma and/or violence in the Transkei sub-region of South Africa,

Table 1: Ranking of percentage of cause of death by gender in the Transkei sub-region of South Africa from 1993 to 2015 (N=26972).

Rank	Males (n = 21 047)		Females (n = 5 925)		Total (n = 26 972)	
	Cause of death	(n) %	Cause of death	(n) %	Cause of death	(n) %
1	MVA	4 789 (25)	MVA	1 840 (31)	MVA	6 629 (24.6)
2	Stabbing	4 706 (22)	Gunshot	706 (12)	Stabbing	5 216 (19.3)
3	Gunshot	3 236 (15)	Collapse	590 (10)	Gunshot	3 942 (14.6)
4	Assault	2 433 (11.5)	Poisoning	537 (9.0)	Assault	2 916 (10.8)
5	Collapse	1 574 (7)	Stabbing	510 (8.6)	Collapse	2 164 (8)
6	Hanging	1 422 (6.6)	Assault	483 (8.2)	Hanging	1 606 (6)
7	Drowning	983 (4.5)	Drowning	338 (5.7)	Drowning	1 321 (4.9)
8	Poisoning	615 (2.8)	Burns	286 (4.8)	Poisoning	1 152 (4.3)
9	Burns	466 (2.1)	Lightning	207 (3.5)	Burns	752 (2.8)
10	Fall from height	467 (2.1)	Fall from height	205 (3.5)	Fall from height	672 (2.5)
11	Lightning	284 (1.1)	Hanging	184 (3.1)	Lightning	491 (1.8)
12	Gas suffocation	72 (0.3)	Gas suffocation	39 (0.6)	Gas suffocation	111 (0.4)
	All causes of death	100%	All causes of death	100%	All causes of death	100%

Table 2: Traumatic and violent deaths in Transkei sub-region of South Africa from 1993 to 2015 (n=18703).

Year	Estimated population | MVA/100 000		Stab/100 000	Gun/100 000	Assau/100 000	Total deaths/100 000
1993	40 0000	62	42	27	25	156
1994	41 2000	64.6	27	34	21	146.6
1995	42 4360	52.8	27	30	27	136.8
1996	43 9091	61.3	28	37	25	151.3
1997	45 2264	61	26	51	24	161.9
1998	46 5832	59.9	32	47	23	160
1999	47 9807	39.8	29	53	19	140.8
2000	49 4201	41.5	29	49	19	138.5
2001	50 9027	32.2	24	54	19	127.2
2002	52 4298	32.6	27	45	16	120.6
2003	54 0027	43.5	29	39	21	132.5
2004	55 6227	41.2	28	31	17	117.2
2005	72 0304	46.2	29	23	21	119.2
2006	74 1913	38.3	36	26	16	116.3
2007	76 4171	47.9	40	25	16	128.9
2008	78 7096	41.2	38	19	17	115.2
2009	81 0708	43.4	35	14	17	109.4
2010	83 5030	45.5	41	14	23	123.5
2011	86 0081	42	42	13	24	121
2012	88 5883	44.2	42	15	23	124.2
2013	91 2460	40.5	42	20	22	124.5
2014	93 9833	33.2	39	15	20	107.2
2015	96 8028	41.6	44	13	25	123.6
Average	64 8810	50	34	30	21	135

Table 3: Age-wise distribution of traumatic and violent deaths among males in the Transkei Sub-region of South Africa from 1996 to 2015 (both genders, n=15 460).

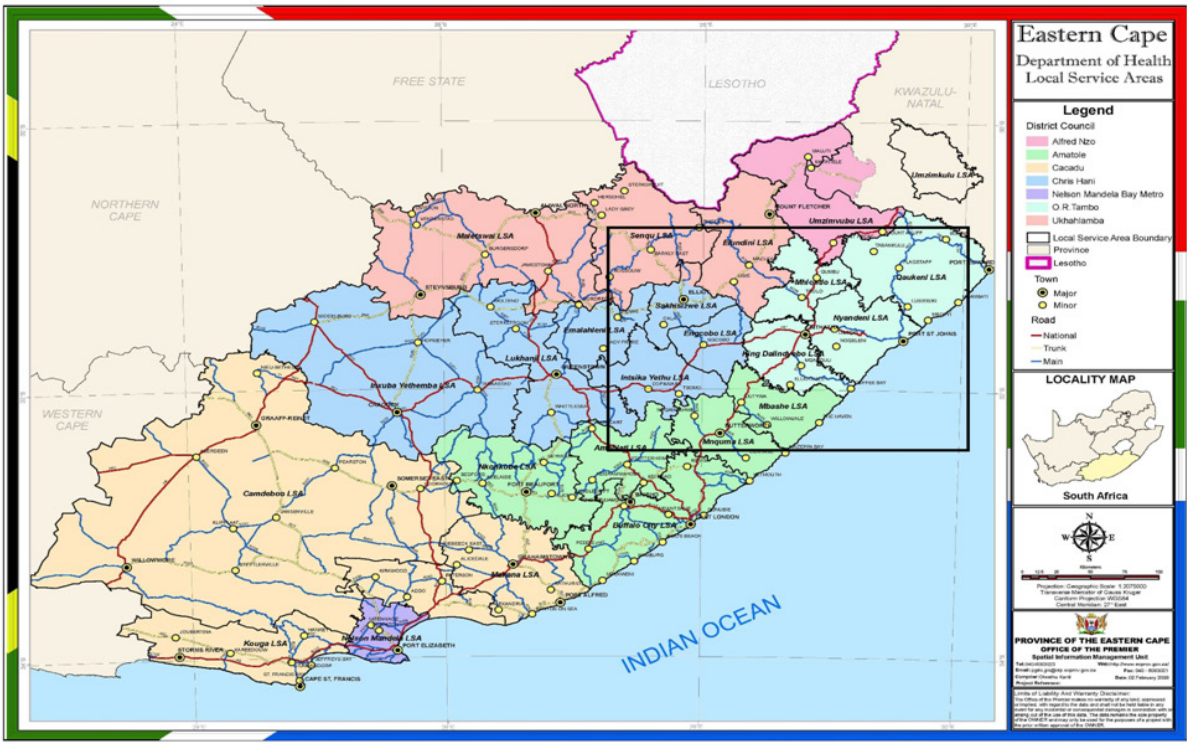
Age groups	MVA	Stab	Firearm	Assault	Sub-total
1-10	382	35	36	48	501 (3.24%)
11-20	556	977	392	527	2 452 (15.86%)
21-30	1 120	1 723	945	663	4 451 (28.8%)
31-40	747	668	621	314	2 350 (15.2%)
41-50	523	291	415	195	1 424 (9.2%)
51-60	319	143	199	137	798 (5.16%)
61-70	170	69	113	83	435 (2.81%)

71-80	86	40	52	50	228 (1.47%)
81-90	31	2	7	11	51 (0.32%)
>90	0	0	1	3	4 (0.02%)
Total	3 934 (25.4%)	3 948 (25.5%)	2 781 (18%)	2 031 (13.1%)	12 394 (80.2%)

Table 4: Age-wise distribution of traumatic and violent deaths among females in the Transkei Sub-region of South Africa from 1996 to 2015 (both gendes , n=15 460).

Age groups	MVA	Stab	Firearm	Assault	Sub-total
1–10	263	12	21	18	314 (2%)
11–20	282	89	83	42	496 (3.2%)
21–30	298	110	130	64	602 (3.9%)
31–40	223	65	108	61	457 (2.9%)
41–50	183	59	104	57	403 (2.6%)
51–60	151	42	80	43	316 (2%)
61–70	104	25	64	42	235 (1.5%)
71–80	85	20	34	46	185 (1.2%)
81-90	21	10	5	17	53 (0.3%)
>90	2	0	1	2	5 (0.03%)
Total	1 612 (10.4%)	432 (2.8%)	630 (4%)	392 (2.5%)	3 066 (19.8%)

Photograph 1: Map of Transkei sub-region of South Africa – population catered for by Forensic Pathology Laboratory indicated by a square.



covering 23 years. An earlier study was published by the author on a similar topic but it covered only a limited number of years and involved a smaller sample. Seventy-three percent of the rural people in the Eastern Cape were living on less than R300 per month in 2005/2006, and more than half of them on less than R220 per month.[9] The South African Institute of Race Relations believes that more than half of the crimes in South Africa are not reported.[10]

The 26 972 unnatural deaths considered were recorded in the post-mortem register of Mthatha Forensic Pathology Laboratory (Table 1). Just less than three quarters (69.3%) of all deaths were related with trauma, which could be the highest rate in the world, but is definitely the highest in South Africa (Table 1). A recent (1997) study published by the author has shown that the number of unnatural deaths was very high in this region, and needed

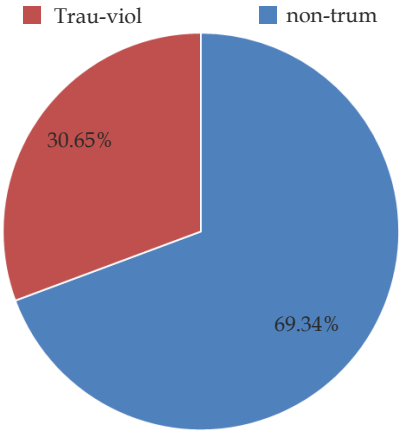


Fig. 1: Traumatic and violent deaths vs. non-traumatic deaths in the Transkei sub-region of South Africa (n=2 6972).

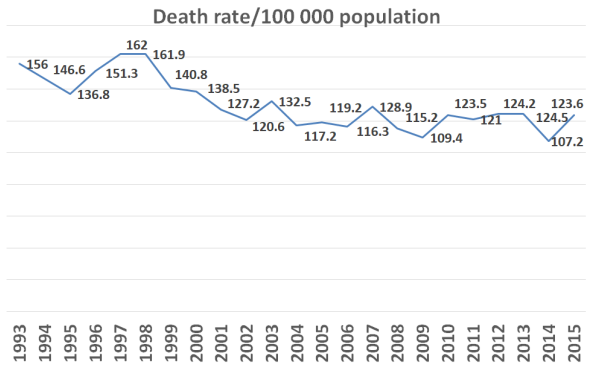


Fig. 2: Incidence of traumatic and violent deaths in Transkei sub-region of South Africa from 1993 to 2015 ((n=18703).

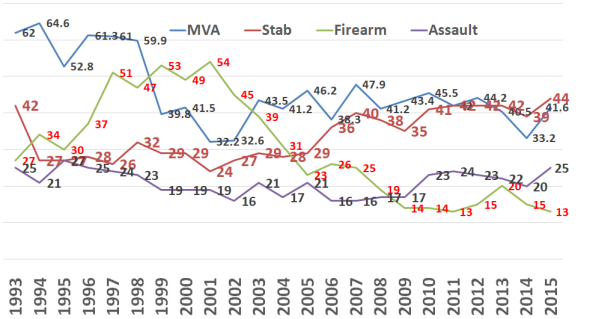


Fig. 3: Incidence of traumatic and violent deaths (MVA, stab, firearm and assault) in the Transkei sub-region of South Africa from 1993 to 2015 (n=18 703).

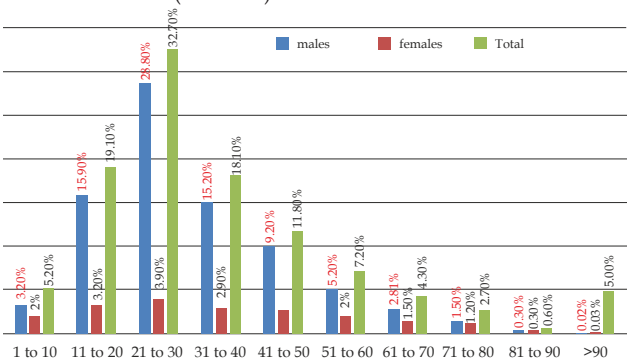


Fig. 4: Age-wise distribution of traumatic and violent deaths in the Transkei sub-region of South Africa from 1996 to 2015 (n=15 460).

urgent attention from the government.[11] Such a high (26 972) number of unnatural deaths would normally only be expected in large-scale disasters such as an earthquake or tsunami. More people died unnatural deaths in the Transkei sub-region in the period under study than in Iraq, although South Africa is a country that is not at war. A report published in 2011 estimated that approximately 500 000 Iraqis had died as a result of the conflict since the invasion.[12]

Death has no meaning for the people in the region, as they are so used to it. The Transkei region is also unique in respect of its political history and its social and economic inequalities, which have been identified as some of the factors possibly contributing to the high rate of interpersonal violence.[7] The average annual rate of traumatic and/or violent deaths was 135 per 100 000 of the population in this study (Table 2 and Fig. 2), which is lower than indicated in an earlier report by author in 2004.[11] There is hardly any literature available to compare the combined number of traumatic and/or violent deaths. There has been a change in the trend in traumatic and violent death over a period of 23 years (1993–2015). It has come down from 156 per 100 000 (1993) to 123.6 per 100 000 of the population (2015) (Table 2 and Fig. 3). RTAs are the leading cause of traumatic death in this region. The average RTA death rate was 50 per 100 000 of the population in the study period (Table 2 and Fig. 3). It has come down from 62 per 100 000 (1993) to 41.6 per 100 000 (2015), but is still almost twice as high as the national average. South Africa has the 42nd highest road mortality rate in the world, with 25.1 RTA deaths annually per 100 000 of the population.[13]

About two-thirds (58 per 100 000) of the violent and traumatic deaths were caused by homicide in this region (Table 2 and Fig. 3). In the Transkei, people could be killed when they are sleeping in their homes, going to market or church or school. Poverty is both a cause and effect of these violent traumatic deaths. Because of being poor, one is at a disadvantage at all levels. Poverty and inequality are inseparable and often lead to a mindset in which human life becomes cheap. This is a key driver of death as a result of violence.[7]

A reduction in deaths as result of firearm injuries has made a significant difference in the total number of traumatic violent deaths in this region. The rate of firearm-related death has almost halved, from 27 per 100 000 to 13 per 100 000 of the population in this study (Table 2 and Fig. 3). A recent report on firearm deaths by Matzopoulos et. al. in 2016 asked

where all the gun deaths have gone. Stricter gun control after the implementation of the 'Firearm Control Act of 2000 accounts for this decrease.[14] The number of guns per capita per country is a strong and independent predictor of firearm-related deaths in a given country.[15] The number of traumatic and/or violent deaths could be lowered even further if government could pass an 'Act on Sharp Weapon Control' similar to the Firearm Control Act. Sharp-edged pointed weapons are the single most frequent cause of homicide deaths in this region. The average rate is 34 per 100 000 of the population annually (Table 2 and Fig. 3). The rate of death inflicted by sharp and pointed objects has been showing an increasing trend from 27 per 100 000 (1994) to reach a level of 44 per 100 000 of the population in 2015 (Table 2 and Fig. 3). There has not been much change in the rate of death as a result of blunt trauma (assault), as it was the same in 1993 and 2015, namely 25 per 100 000 of the population annually (Table 2 and Fig. 3).

Traumatic violent deaths are unevenly distributed among males and females as well as among age groups in this study (Table 3, 4 and Fig. 4). The rate is four times (80.2%) higher among males than among females, and it is at least three times (59.8%) higher in the age group 11–40 years than in the rest of the age groups (Table 3, 4 and Fig. 4). According to the WHO, the worldwide rate is much less than Transkeian figures, since only twice as many men as women die each year as a result of injury.[1] In the Transkei deaths of men from homicide outnumber those of women by more than 7:1.7 This has been a constant feature in all earlier studies published by the author in this region: traumatic violent deaths among males outnumbered those among females.[16,17] Xhosa women do not kill others, but they are killed. Most of the time, their male partners or husbands kill them in their homes. Males are involved in most of the deaths related with violence and trauma. Beyond the measurable costs, violence causes pain and suffering, can lead to chronic trauma, affects child development, and can increase the risk of chronic health outcomes later in life.[18] Spending money on prevention strategies would be much more beneficial than turning a blind eye to an ongoing serious problem.

Poverty, illiteracy, alcoholism, and psychiatric illnesses are the main factors that are propagating traumatic and violent death. There has always been extreme poverty in the Transkei region of South Africa.[9] It has been part of the culture for generations, since ancient times. This is going to demand a huge educational effort that might only bear fruit in a generation or two, if economic conditions and the entire lifestyle could be improved. Poor men also consume excessive alcohol in an effort to forget their problems of poverty. Alcohol consumption rates in South Africa are the highest in the world, and are continuing to rise.[19] South Africa is a hard-drinking country. It is reckoned that we consume in excess of 5 billion litres of alcohol annually.[20] In the study period about half (49.5%) of traumatic deaths were related to alcohol in the Transkei region.[21] Alcohol and psychiatric illnesses also have a cause and effect relationship. A third of South Africans suffer from mental health disorders. More than 17 million people in South Africa are dealing with depression, substance abuse, anxiety, bipolar disorder and schizophrenia.[22] Despite the fact that the number of traumatic and violent deaths is so high, there is hardly any trauma care centre to deal with these cases and prevent deaths. Apart from inadequate facilities, few, if any, qualified professionals are prepared to work in rural areas, especially in view of the conditions under which they have to work. A study carried out by the author showed that at least 12% of pre-hospital deaths are preventable.[23] Trauma-related deaths have also been compounded by the high HIV infection rate in this region, which poses an even bigger threat to the country than does violence.[24]

Conclusion

Although the incidence of traumatic and/or violent deaths has declined somewhat, it has remained a serious problem in the Transkei sub-region of South Africa over the 23 years of the study (1993–2015). Annually, a little less than half (64 per 100 000 of the population) of the violent and traumatic deaths were caused by penetrating weapons. About one third (28.8%) of the victims of these deaths are young men between 21 and 30 years of age. Males are predominantly both the perpetrators and victims of these traumatic and violent deaths. There is a need to improve the health care delivery system in the region. Stricter law enforcement, along with political will and determination, is important to curb the high incidence of traumatic and violent deaths in the Transkei sub-region of South Africa.

Ethical Issue

The author has ethical permission for collecting data and publication (approved project No. 4114/1999) from the Ethical Committee of the University of Transkei, South Africa.

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Original Article

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Epidemiology of Domestic Violence on women at Addagutta, Secunderabad, TS

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Abstract

Back Ground: Domestic violence is one of the common evils of society and it is a worldwide phenomenon. It is more common in underdeveloped countries. Wide variations in domestic violence are observed in rural and urban slums. Present study to know in depth the reasons for DV. It is more common in the age group of 12 to 50 years.

Objectives: 1. To study various types of domestic violence. 2. To know the nature and periodicity of violence. 3. To understand the triggering points and underlying factors. 4. To compare the results of the study with regional and national statistics.

Methodology: The present study is a longitudinal study conducted in a slum area of Hyderabad, TS from April to September 2018. A pre-designed questionnaire was prepared and tested in a slum area and after necessary correction it was administered to women in the study area. 100 women included in the study after taking oral/written consent based on educational status. Demographic and socio-economic factors were included in addition to factors pertaining to domestic violence in designing format.

Results: Statistics on 100 women showed 90% of them were from nuclear family and only 10% from joint family lack of elders support was the preliminary cause, 35% did not have any educational qualifications, 60% of the women were depended on their spouses, 55% were unemployed, 60%of the women were harassed by their husband 20% by their father and remaining 10% by their sons, the type of assault was verbal abuse, paranoid behavior, suspicious nature. Frequency was daily in 75% of women, 5% weekly and the triggering factor being Dowry in 22%, Birth of a girl child in the family 14% and 64 % were suffering harassment from paranoid husbands.90% of them had suffered from the social stigma of revealing to their close people and were silent sufferers.

Keywords: Domestic violence; Trigger points.

Introduction

This study of Domestic violence on women of age groups from 12 to 50 years who were subjected to cultural deprivation and low socioeconomic status. Lack of awareness of criminal laws, birth of a girl child, female infanticide, sexual harassment and paranoid alcoholic husbands abusing their wives was the main subject of study. Women who were subjected to violence of various types like not giving dowry, economic, political, social, family, partner, self-abuse, Interpersonal, suicidal behavior etc. were the preliminary factors taken into consideration while surveying was done.

Women in India is a personification of Goddess Lakshmi, having all the qualities of a good home

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maker, she is like the minister who manages the house hold responsibilities, a good mother nurturing her child, Satisfying her husband needs and is equivalent to mother earth in patience and tolerance.

"Karyeshu Dasi, Karaneshu mantra, Bhojyeshumatha, shayane shurambha, roopeshu lakshmi, kshamayadharitri.

Domestic Violence is an act of gender based violence that results in or is likely to result in the suffering to women with deprivation of liberty to public and private life. As per the NCRB data, the city of Hyderabad with DV (1,311 cases), stands only second to Delhi with 3,645 cases of DV.[1] Telangana has the highest number of DV cases (7,202) in south India and seventh in the whole country.[2] (Indian express dt. Nov. 14 2019) As per the National Family Health Survey (NFHS),[3] the prevalence of DV in India is 39.7%. As per WHO[4] Violence against women dt. 29/11/17, the DV all over the world is 35%. Domestic violence is in the mindset of the society that the women are physically and emotionally weaker than males and they economically depend on them.[5] (Ankur.k) Women suffering from violence have more chances of suffering physical, emotional and mental problems like anxiety, depression, PTS and suicide.[6(2,3)] Violence against women is a cycle of abuses that manifests itself in many forms throughout the different stages of their lives,[7] like physical harm, sexual harm and psychological harm.[7] In India women are considered as a weaker sex even now, not only from physical point of view but also from sociological aspects. Women always depend on Men right from their birth-During childhood on her father, After marriage on her husband and during her old age on her children. The national statistics utilizing conflict tactical scale (CTS) to measure the prevalence of lifetime physical, sexual DV is 40%[8] (Yoshikawa et. al. 2012). Study for high frequency of DV in India is deep rooted patriarchal roles[9] (Visaria 2000) Long standing cultural norms that propagate the view of women as subordinates throughout their lifespan[10] (Fernandez, 1997; Gundappa & Rathod, 2012) Even before the child is born, many families have a clear preference for the male child, care of the same while preferring sex selective abortions, female infanticide and abandonment of the girl child (Gundappa & Rathod, 2012). In reproductive years, mothers pregnant with or/ and who give birth to only female children may be more susceptible to DV[11] (Mahapatro, Gupta & Kundu, 2011). In addition DV is also linked tobacco use[12] (Ackerson, Kawachi, Barbeau & Subramanian, 2007). It is also linked to males with higher frequency of depression, post-traumatic stress disorder and attempted suicides.[13] (Chandra, Satyanarayana & Carey, 2009; Shidhaye & Patel, 2010). There are studies to highlight the role of non-partner DV perpetrators living in nuclear and joint families[14] (Fernandez, 1997; Kaur & Garg, 2010, Raj et. al. 2011.

Social Causes of Crime Against Women

Illiteracy, Low economic status, broken homes, physical dependency, Poor psychological environment, lack of proper moral education, unemployment, addiction to alcohol, drugs, tobacco and gutka.

Factors Precipitating Domestic Violence

In general there is an acceptance of men superiority over the women.

Pregnancy and lack of sex leads to violence.

Sex selective abortions and female infanticide,

Low level of legal literacy in women.

There are 60 million female births missing according to the WHO records and 70% of the female murder victims are killed by the male partners as per the records. Women yield to various types of pressures due to social biasness, not only by Husband, their Father-in-law, Brother-in-law, they also ill-treated by mother-in-law and sister in law in context of the dowry and domestic works.

Rates of Offence: One crime committed against women in every 3 minutes, One molestation in every 15 minutes, one sexual harassment in every 53 minutes, one kidnapping/abduction in every 23 minutes, one rape case in every 29 minutes, four out of 10 women experience domestic violence at home, 45% of women have suffered at least one incidence of DV in their life .According to NCRB1 (National crime rate bureau) 6000 dowry deaths are recorded in India.

Trigerring Factors: The husband may be illiterate, paranoid, of low economic status addicted to alcohol sexual and emotional violence.

Materials and Methods

Type of study: Our study is based on cross sectional observational study.

Place of study: Urban slum of addagutta ,East Marredpally in Telangana state.

Duration of Study: April 2018 to September 2018.

Study population: All the women in the catchment area of the slum in general and 100 women victims of age group 12–50 years who were subjected to domestic voilence.

Inclusion criteria: All the 100 women victims who gave consent for the study.

Study tool: A predesigned pretested and structured questionnaire.

Result

Statistics on 100 women showed 90% of them were from nuclear family and only 10% from joint family (Fig.4) lack of elders support was the preliminary cause, 35% did not have any educational qualifications, 60% of the women were depended on their spouses (Fig. 3), 55% were unemployed, 60%of the women were harassed by their husband 20% by their father and remaining 10% by their sons (Fig. 7), the type of assault was verbal abuse, paranoid 60% verbal abuse 39%,Assault 1% (Fig. 6). Frequency was weekly monthly 20% and daily 5% (Fig. 8) and the triggering factor being Dowry in 22%, Birth of a girl child in the family 14% and 64 % were suffering harassment from paranoid husbands (Fig. 11). 99% of them had suffered from the social stigma of revealing to their close people and were silent sufferers and 1%had psychiatric history (Fig. 11).

Table 1: Age Wise.

Below 15	7%
15–30	50%
31–45	25%
46–55	18%

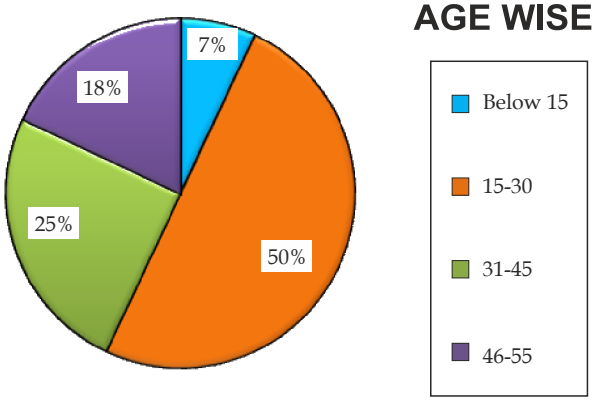

Table 2: Marital Status.

Married	70%
Divorce	10%
Unmarried	20%

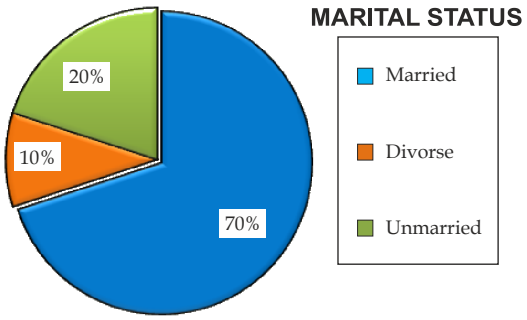

Table 3: Economic Status.

Employees	40%
Housewife	60%

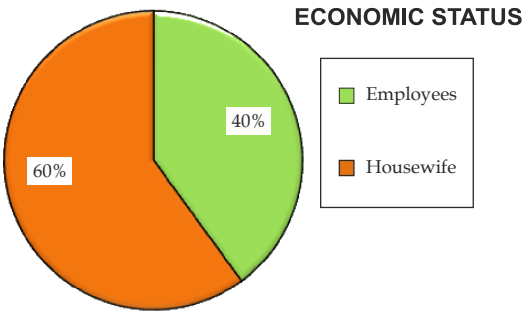

Table 4: Type of Family.

Joint	10%
Nuclear	90%

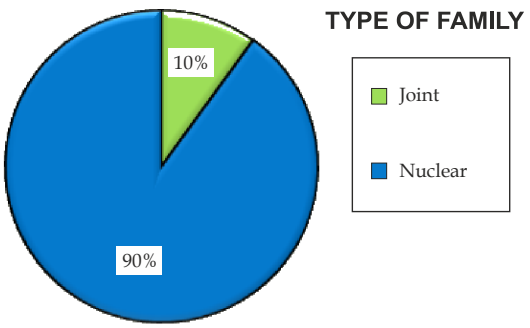

Table 5: Type of Addiction By Family.

Alcohol	70%
Toddy	20%
Other	10%

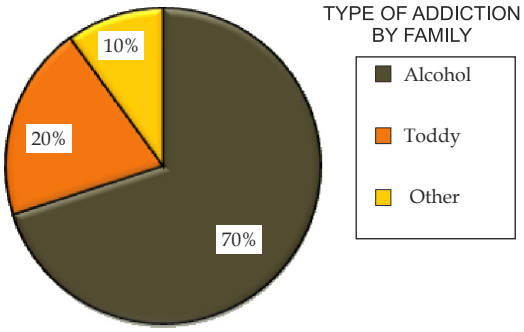

Table 6: Type of Psycho Social Element.

Paranoid	60%
Assaulting	1%
Verbal Abuse	39%

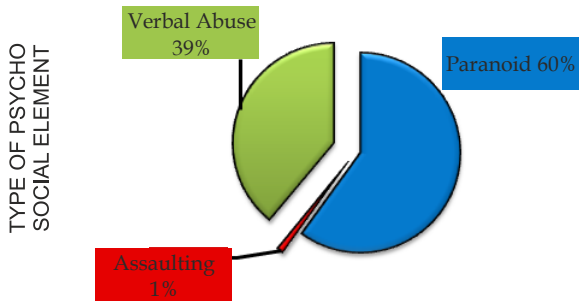

Table 7: Violence by Whom.

By Husband	60%
By Father	20%
By Sons	10%
Other	10%

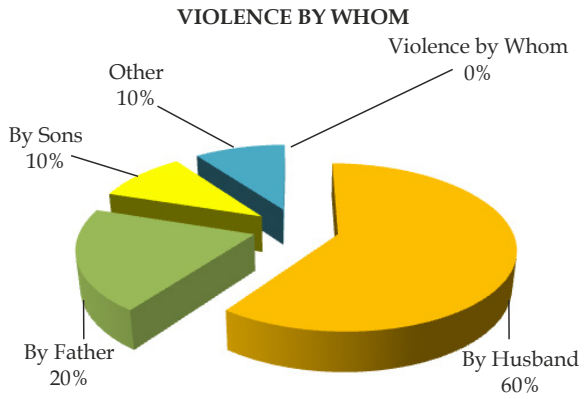

Table 8: Frequency of Abuse.

Weekly	75%
Monthly	20%
Daily	5%

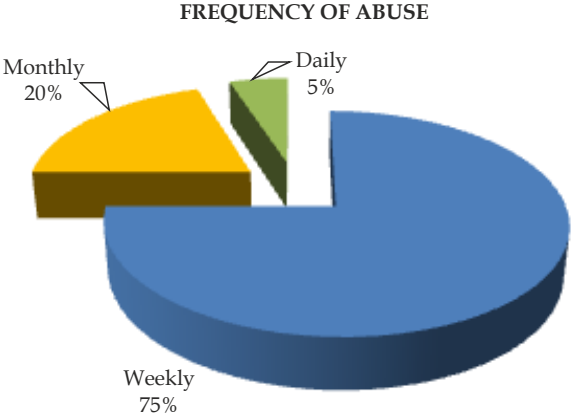

Table 9: Reaction to Abuse

Irritable	60%
Depress	30%
Tolerate & Calm	10%

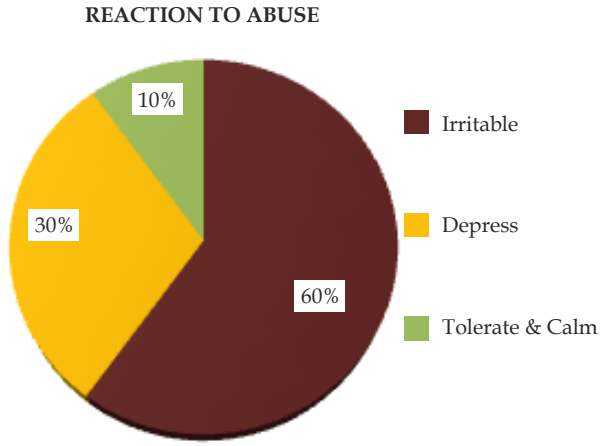

Table 10: History of Abuse.

(1–2)	60%
Less Than 1Y	27%
(2–5)	10%
(5–10)	3%

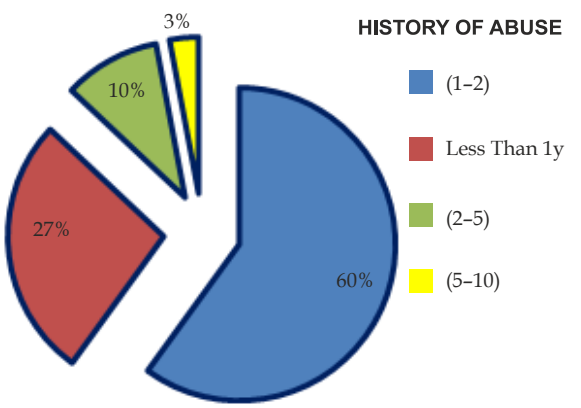

Table 11: Triggering Factors.

Parnoid Husband	64%
Dowry	22%
Female Birth	14%

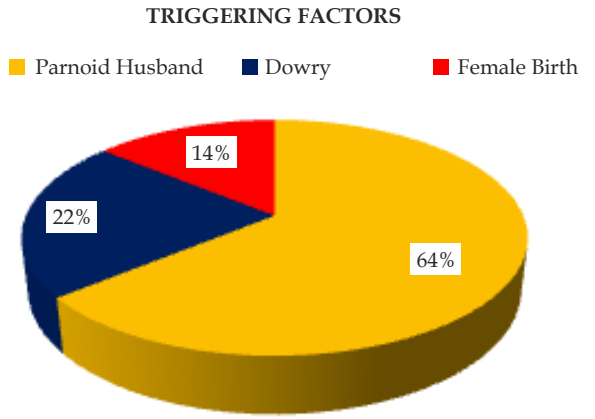

Table 12: Psychiatric History.

Mental Ill In Family History	1%
Normal	99%

Table 13: Any Couselling Taken.

Counselling	6%
Not Willing	94%

Discussion

Our study was compared, with the study of the planning commission Government of India research study of Nature, Incidence, extent and impact of domestic violence in states of Andhra Pradesh, Chhattisgarh, Gujarat, Madhya Pradesh and Maharastra by Yugantar Educational society[7] 2003 and also other studies mentioned accordingly.

Prevalence of different forms of domastic violence in the form of: Psychological abuse physical violence, Sexual abuse and Multiple forms of DV in various studies by (solmon etal 2009) 15 (sharma and vatsa 2011).[16] A Nadda[20] in 2018 Jismay George[19] et. al. in Puducherry, S.K. Dash[21] and Gayathri. M 23 was compared with our study (Tabal 3). In another study, the physical abuse was by husbands who were alcoholics (Stanley 2012).[17]

Types of Families in Domestic Voilence

Family	Our study	AP[7]	Chattis[7]	Gujarat[7]	MP[7]	MAHA[7]
Nuclear Family	90%	72%	8.8%	56.8%	63.2%	52%
Joint Family	10%	28%	43.2%	43.2%	36.8%	48%

Study indicates Nuclear families are susceptible for domestic violence.

Educational Status of Victims of DV

Education	Our study	AP[7]	Chattis[7]	Gujarat[7]	MAHA[7]	MP[7]	Harihar Study[18]	Sarkar Study[22]
Illiterate	35 %	40%	13.2 %	10.8%	15.6%	58.4%	25%	46.15%
Primary school	35 %	14.8%	16.4%	13.2%	19.2%	14%	25.3 %	10 %
Middle school	30 %	11.02%	14.4%	6.4%	20 %	18.4%	14.3 %	10 %

Illiterate and uneducated women are susceptible for DV

Types of Abuses in Domestic Voilence

Abuse	Our study	Solmon study[15]	Sharma Study[16]	Sk Dash Study[21]	Gayatri M Study[23]	Nadda A Study[20]
Psychological	60%	22%	22%	34%	46%	27.2%
Physical	01%	29%	22%	50%	26%	26.9%
Sexual	–	12%	07%	–	08%	14.7%
Multiple forms/Verbal	39%	41%	30%	42%	20%	10%

Marital Status in Domestic Voilence

Abuse	Our study	AP[7]	Chattis[7]	Gujarat[7]	MP[7]	MAHA[7]
Married	70%	92.4%	68.0%	84.8%	82.4%	82%
Divorced	10%	26%	26%	07.2%	07.2%	13%
Widow	–	06%	06%	08%	10.4%	6.4%
Unmarried	20%	–	–	–	–	–

The study of educational status of victims of domestic violence was conducted by Hari-saho Study[18] and sarkar study[22] which was compared with our study (Tabal 2).

As per Planning commission, government of India research study group. a study of nature, incidence extent and inputs of DV in women in states in AP, Chatissgur, Gujrat, MP and MAHA was done by Yugantar educational society Nagpur.[7] In the five states, 1250 women from rural and urban areas were selected, with 125 rural samples and 125 urban samples from five states, depicting their social and demographic back ground ,like marriage divorce, widowhood and unmarried which were studied(Table 4) and also the type of family like nuclear and joint families (Table 1). The following charts are the parameters depict the nature of domestic violence and this is compared with our study.

Conclusion

The present study shows the magnitude of domestic violence in the urban slum Addagutta Secunderabad, there should be a change in the mindset of people in general and that of the spouse in particular. The women who were victims must be respected and empowered. Women of low socioeconomic status were silent suffers with paranoid behavior of their family members is an unveiled truth of the slum.

Prevention of Domestic Voilence

Judiciary: Measures dealing severely with alcoholics who perpetuate DV.

Special courts for DV with videography of victims.

Mobile courts to be set up for slums and rural areas for DV.

Government: Effective enforcement of existing laws towards females

Government should take help of NGO's with knowledge of law for legal aid of victims of DV.

Police: To treated DV as serious has any other crime.

Special train staff dealings with women's issues attached to all police stations, avoiding all other duty.

NGO's: Made to work actively and council victims of DV.

Women in distress due to DV should be given facilities give like short stay home for re habitations Children's with DV– should be educated given social and psychological upliftment.

Health care support: It is given recognizing DV as a public health issue.

Special care is given on priority for females of DV episodes, As DV as a great Impact on women's health, DV should be included in the teaching curriculum during study.

Counselling: Centers with qualified Counsellors should be started at rural and urban slums urgently Council to public is done by adopting DV as part of school and college curriculum thus changing mind set of males towards ladies. The list of NGO's and government organizations and councilors should be kept open to the public for utilizing Educating ladies about their rights, community screening and pamphlets distribution should be done.

There should be a team work by all the above in crisis intervention.

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Fatal Acute Upper Airway Obstruction Due to Cervical Goiter: A Rare Case Report

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Abstract

Acute upper airway obstruction may occur due to swelling of the thyroid gland. In such cases the onset of symptom is gradual as compared to fatal compression of neck and rarely causes sudden death. The authors report a case of death due to acute airway obstruction by complications of thyroid gland enlargement. The patients with a large goiter/ thyroid neck swelling, even asymptomatic, should be counseled about the impending complications by the treating doctor. The authors aim to add to Medical literature that acute airway obstruction due to natural causes may also be a cause of sudden death. Forensic Pathologists should consider this diagnosis in cases of sudden death with signs of asphyxia so as to prevent any misdiagnosis of violent asphyxial deaths.

Keywords: Acute Airway obstruction; Asphyxial deaths; Fatal thyroid enlargement; Adenomatous goiter.

Introduction

Human Upper respiratory system includes nasal cavity, pharynx and larynx. Acute upper airway obstruction causes narrowing or occlusion of the respiratory passage leading to respiratory distress and even death. Neck is a complex anatomical structure containing parts of the upper respiratory system. Any abnormality, deformity or trauma in neck structures could lead to compression of the respiratory passage, subsequent asphyxia and fatality. In Forensic Pathology practice generally the cases of airway obstruction are commonly encountered in cases of fatal compression of neck due to ligature, manual or by means of any object.[1]

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Upper airway obstruction may also occur due to swelling of the thyroid gland. In such cases the onset of symptom is gradual as compared to fatal compression of neck and rarely causes sudden death. The authors report a case of death due to acute airway obstruction by complications of thyroid gland enlargement. The authors aim to add to Medical literature that acute airway obstruction due to natural causes may also be a cause of sudden death.

Case History

The deceased was a 47 years old female taking treatment for goiter from past few years. One day she suddenly faced difficulty in breathing and was brought to hospital where she was declared brought dead.

Autopsy Findings

The deceased was an average built middle aged female. The clothes were intact. No external injury

was present over the body. A swelling of size 9 x 7 cm was present over the anterior aspect of neck. Bluish discoloration of lips and nail beds was present. Neck was dissected in bloodless field. Thyroid gland enlargement across midline was present with size of 10 x 8 x 3cm and is adhered with trachea compressing its lumen (Image 1). Weight of thyroid was 65 gm. The larynx was edematous and congested. Trachea, bronchii, lungs and brain were congested. Other organs did not have any gross pathology. Stomach contained about 800 ml of partially digested food material. There was no offensive smell or features of poisoning present in the stomach contents.

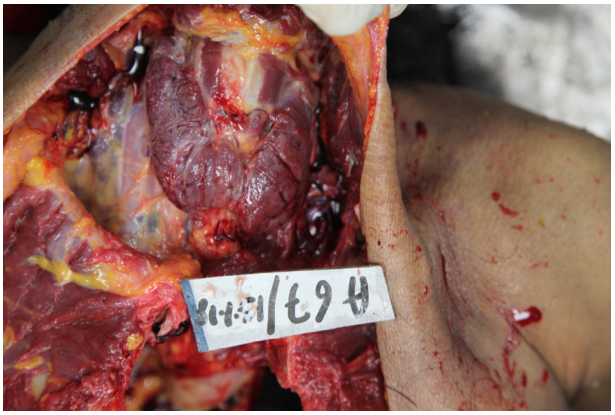

Image 1: Thyroid gland enlargement across midline with trachea compressing its lumen.

On gross examination, thyroid gland was enlarged grossly with lobulated surface and intact capsule. On sectioning, cut surface showed variably dilated and cystic spaces filled with colloid. On microscopy the thyroid gland showed benign thyroid follicles of variable size along with cystically dilated follicles filled with colloid substance. Focal areas showing hyperplasic changes were also noted. There was no evidence of malignancy even after extensive sampling. Hence, the final histopathological diagnosis of adenomatous goiter was rendered (Image 2).

The cause of death was concluded as Asphyxia due to laryngeal edema consequent upon thyroid gland enlargement.

Discussion

Benign Nodular Goitre (BNG) affects 5% of the general population in non-endemic areas2and up to 15% in endemic areas.[3] Indian population is prone to Iodine Deficiency Disorders (IDD) due to deficiency of iodine in the soil of the Indian subcontinent.[4] Surveys conducted by the Central and State Health Authorities have recognized the IDD as a public health problem in all States and union territories in India.[4] Goitre is included in the spectrum of diseases caused by IDD's which also include cretinism, hypothyroidism, brain damage, abortion, still birth, mental retardation, psychomotor defects and hearing and speech impairment.[4] Adenomatous goiter as confirmed after histopathological examination in our case is a form of Benign Nodular Goiter (BNG). Thyroid Adenomas are typically discrete solitary masses derived from follicular epithelium5. Clinically Palpable thyroid nodules are present in approximately 4% of the adult population, with the prevalence increasing in the later decades of life.[6] Women are affected more commonly than men in

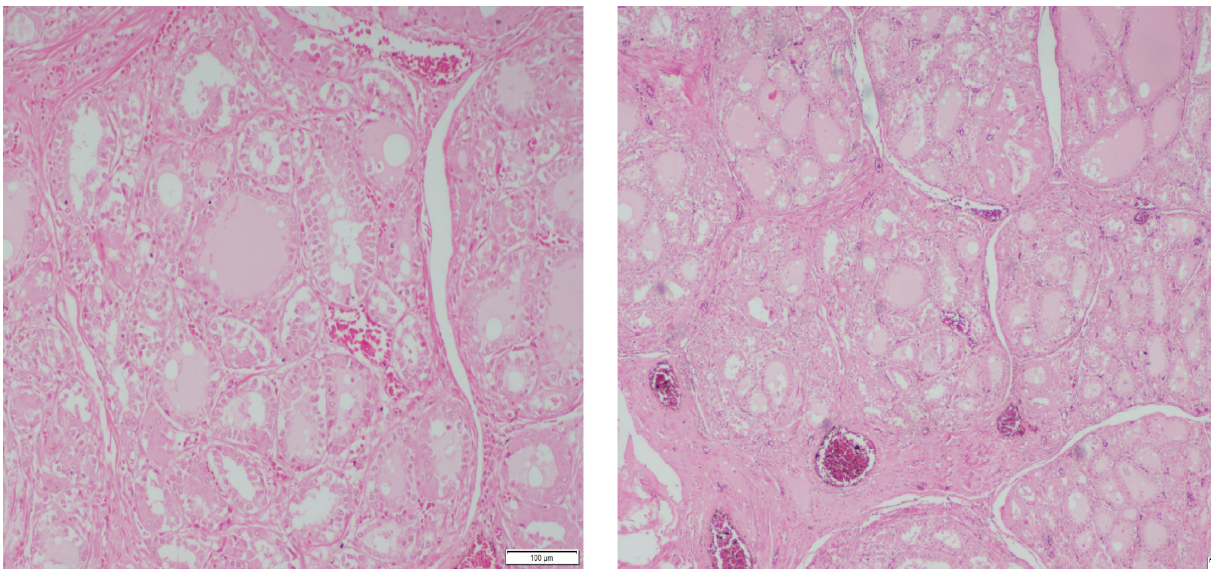

Image 2: Thyroid gland showing benign thyroid follicles of variable size along with cystically dilated follicles filled with colloid substance; Adenomatous goiter was rendered.

relation to the presence of enlarged thyroid gland due to nodules.[7] The deceased in our case was a middle aged female belonging to an endemic region, thus falling in this high risk group.

Acute airway obstruction by enlarged thyroid gland are commonly reported in presence of malignancies of thyroid gland[8,9] and benign retrosternal goiters.[10,11] Benign goitre causing acute airway obstruction is very rare[12,13] and amongst them Cervical Benign goiters have a very low mortality rate and death due to airway obstruction.[14] Airway problems due to enlarged thyroid glands appear usually in a gradual manner and are frequently associated with the insidious onset of symptoms. Previous studies have shown that tracheal occlusion in many patients ranging upto 50 to 70 percent is well tolerated and only minimal respiratory changes are observed in them.[15] Benign goiters generally have a slow growth rate which allows adaptation to extrinsic hypoventilation without causing any acute symptoms.[14] There may be cases in which patients present with acute premonitory symptoms which if ignored by the patient may precipitate a life threatening situation needing immediate management.[15] In benign cervical thyroid enlargements few risk factors like acute hemorrhage into a cyst, an upper respiratory tract infection causing edema, tracheal collapse or worsening of comorbidities can cause acute airway obstruction.[16] Agarwal et.al in their study described that the incidence of tracheomalacia due to huge goiters was another risk factor for acute upper airway obstruction.[17] Thyroid with diffusely grown lobes pushing into the space between the posterior wall of the trachea and esophagus, can lead to the tracheal stenosis by compressing the posterior wall of the trachea.[18] In our case acute upper airway obstruction occurred due to laryngeal edema in a case with already compromised respiratory passage. Laryngeal edema occurs due to mucopolysaccharide deposition in the supraglottic region, including the aryepiglottic folds, false vocal folds, vocal cords and surrounding regions. The edema can subsequently causes upper airway obstruction and acute respiratory distress.[19,20] Though rare, laryngeal edema has been reported previously in hypothyroid cases, both with or without enlargement of thyroid gland due to goiter.[21,22] But in these cases patients were saved due to timely Medical intervention. The same mechanism is seen in the present case, where no diagnosis of any infection of throat or respiratory tract was made. Histopathological examination of the gland also ruled out presence of any malignancy or haemorrhage into any cyst. The deceased was not fortunate to reach the Hospital on time so that timely intervention could have saved her life.

Conclusion

The patients with a large goiter/ thyroid neck swelling, even asymptomatic, should be counseled about the impending complications by the treating doctor. The possibility of acute airway obstruction should always be discussed. An elective thyroidectomy should be performed with large goiters even with lesser grades of compressive symptomatology. Forensic Pathologists should consider this diagnosis in cases of sudden death with signs of asphyxia so as to prevent any misdiagnosis of violent asphyxial deaths.

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Male Genital Self Mutilation

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Abstract

To inflict injury upon one's own genitals is not easy and most of the times it is associated with psychotic disorders. In the absence of any psychiatric disorder the reason could be religious, cultural or suffering from gender identity disorder. Here I present case of married male, aged 35 years suffering from gender identity disorder who has strong belief that it would have been much better for him if he was female. He has dislike for his own genitalia. Sexual conflict with his wife led to genital mutilation by him to remove testes. Great majority of cases does not seek any medical help being from rural background, illiterate and unavailability of medical access at the local places. Psychological counselling and medical assistance at appropriate time would have helped him.

Keywords: Genitals; Gender identity disorder; Mutilation.

Introduction

Gender identity disorder is classified under ICD-10. Psychotic individuals may use edged weapons to mutilate either themselves or others. Mutilation usually involves the genitalia, ears, or nose. Non psychotic individuals may mutilate as a warning, in revenge, or to collect souvenirs (usually ears). Husbands occasionally mutilate the genitalia of cheating wives.[1] Some of the risk factors for this act are the presence of religious delusions, command hallucinations, low self-esteem, and feelings of guilt associated with sexual offences.[2] Three general patient groups are identified: psychotic individuals, nonpsychotic individuals with significant character pathology, and individuals influenced by socio cultural factors and religious beliefs.[3] In the early 1960s Blacker and Wong uncovered 40 cases worldwide since the turn of the century, and the number had increased to only 53 cases by 1979.[4,5]

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Case Details

A 35-year-old farmer, graduated high school was admitted to casualty, with history of severing of his scrotal sac (Photograph 1) and removal of both testes (Photograph 2) with a knife 11 hours back. He was hemodynamically stable, conscious, oriented. He was accompanied by his wife who did not reveal any history. History was given by subject himself. The physical examination revealed an average built patient weighing 65 kg, height measuring 168 cm. Scrotum was sliced with sharp knife with both testes brought in a small polythene bag. He was intoxicated with alcohol and cannabis at the time of incident. He was married and has 3 children. Past history revealed no mental illness. He gave history of fight with his wife previous night as his wife blames him for unsatisfied sexual act daily. He felt himself helpless and felt of testis have now became useless as he cannot satisfy his wife. He has always felt disgusted about sexual organs.

The patient expressed a long held desire to have his male genitalia removed secondary to belief that he was more female than male. He always wanted to be female and interested in female dress to put on. He himself felt being trapped in male body wrongly. He is uncomfortable in male dress but feels happy and elated when dressed as woman. He desired for sex change a decision which was structured in his mind at the age of 15. He had history of suicide attempt once in the recent past. He has not sought any medical help for the same. Psychological assessment by psychiatrist revealed the absence of psychosis.

Photograph 1: Severed scrotal sac.

Photograph 2: Removed testes.

Discussion

Genital self mutilation is an extremely rare entity observed by treating doctors. The present case signifies many hurdles associated with assessment and management of persons seeking sex change. These patients have immense difficulty in being properly assessed and this particular patient was no exception as he could not seek anybody's help for sex change being from rural background and lack of knowledge about it. Earlier investigators had assumed that these individuals were psychotic, given the nature of their acts. Later research showed that many of these individuals were not psychotic at the time of GSM. The condition occurs in both sexes but is under-reported.[6,7] Yearning for sympathy may occasionally be the motive in grief-stricken patients.[8] One patient was reported to have carried out bilateral orchidectomy to prevent alopecia.[9] GSM has also been associated with unresolved sexual conflicts.[10] A group of transsexuals amputated their genitals in anticipation of a change of policy on sexual reassignment surgery (SRS) in Canada.[11] Another impatient transsexual sequentially amputated his left testis, right testis and finally his penis over a period of 9 months in a vain effort to secure SRS.[12] Motives for GSM are usually mixed; in the presence of substance abuse, the definition of the main motive for GSM is difficult.[13,14] In one bizarre case, a 51-year-old German repeatedly practiced GSM and ate the mutilated parts of his body. On the last occasion, after bleeding to death, his penis was recovered from his colon at autopsy.[15,16] Some abnormality of mind leads the victim to mutilate his or her body. Those caused by mental aberration are bizarre in either multiplicity or their site. Paranoid schizophrenics often with strong religious flavors to their delusions are known to attack themselves in this manner.[17]

Conclusion

Unable to get medical help in obtaining sex assignment treatment seems to be the major stress factor for the auto castration. Untreated gender identity disorder with alcohol and cannabis addiction in the present case led to drastic behavior with significant consequences. Psychological counselling and medical assistance at appropriate time would have helped him.

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Fatal Hyperextension Cervical Spine Injury due to Unusual Fall

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Abstract

Cervical spine fracture is commonly reported trauma due to fall in elderly. This article presents a case of hyperextension injury of neck in an elder subsequent to slip and fall in an unusual prone position, and stress the importance of complete autopsy examination, death scene photographs and toxicological analysis in such cases.

Keywords: Neck injuries; Spinal injuries; Neck dissection; Accidental fall; Autopsy.

Introduction

Cervical spine injury is relatively rare and its fatality is less often reported. Cervical spine fracture caused by trauma includes accidental or suicidal falls, traffic accidents, sport accidents, hanging, diving, fall of a heavy object onto the head or neck, bull attack, blunt or penetrating assault etc.[1–8] Cervical spine fractures are reported to be common in males than females.[1–5] It is mostly noticed among age group 15–45 years, followed by 65 – 80 years.[2,3,6] Fall either from height or at same level have been reported to be frequent cause of cervical spine injury following motor vehicular accidents.[1,2] Prevalence of fatal cervical spine fracture in association with fall increases monotonically with increasing age. [1,3,6,9] We report here a case of unusual fall of an elderly man which resulted in hyper extension injury of the neck with cervical spine fracture with no other associated major injuries.

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Case report

The dead body of a 65-years-old man was brought to mortuary, department of forensic medicine and toxicology for postmortem examination by investigation police officer under suspicious circumstances of death. According to the inquest by the investigation officer, the deceased, watchman by occupation was residing alone in his room in first floor. The incidence happened when his owner's family were on vacation in weekend. When they returned, they noticed his dead body lying in room opposite to his room. The scene of death photographs provided by the investigation officer depicted the deceased in unusual prone position with body leaning on the floor and head on the wall with hyperextension of neck (Fig. 1).

Fig. 1: Position of the deceased at the scene of death.

At autopsy, external examination showed features of decomposition. Face was swollen, abdomen was distended with putrefactive gases. Marbling was noticed over front and lateral aspect of abdomen and thigh (Fig. 2). Blisters and peeling of skin was present over front and back of chest and abdomen. Pressure abrasion of size 4 cm x 2 cm present on right side of face over malar eminence (Fig. 3). Abrasion of size 8 cm x 5 cm was present on lateral aspect of right arm, 6 cm below the tip of right shoulder. Abrasion of size 3 cm x 1 cm present on lateral aspect of right elbow. On internal examination, fracture-dislocation of body of C5 cervical vertebrae was noted (Fig. 4). No other internal injuries was noted. The viscera was preserved and sent to forensic science laboratory for toxicological analysis which reported the presence of alcohol. The cause of death was opinioned as 'death due to cervical spine injury'.

Fig. 2: Marbling on lateral aspect of abdomen and thigh on right side.

Fig. 3: Pressure abrasion on right side of the face.

Fig. 4: Fracture-dislocation of body of C5 cervical vertebrae.

Discussion

Cervical spine injury due to fall is common above 65 years of age.[1,3,6,9] Fracture of C5 and C6 cervical vertebrae are commonly involved.[1,7,10] The cervical spine injury revealed in our postmortem examination of deceased following the impact of the face or the forehead subsequent to fall or slip from a low height occurs on occasion. Such a common association of cervical spine fracture with facial or frontal trauma has been reported earlier.[2,10–12] Hyperextension injuries to cervical spine due to fall as observed in our case have been mentioned by other authors.[13–15] Although rare, cervical spine injury, which is potentially overlooked during external postmortem examination, should be investigated by meticulous neck dissection in such cases. The cervical spine must be suspected and examined carefully, whenever facial injuries are present. As seen in our case, incidence of such accidental acute deaths in elderly due to fall under influence of alcohol was also reported.[13]

Cervical spine injuries occur when the load extends beyond the physiologic range of backward motion or when extension causes posterior compression and anterior distraction. Hyperextension may occur in combination with lateral tilting or rotational forces, resulting in additional patterns of injury.[16] When the neck goes into hyperextension, force is first directed backward and then downward, and, further, finally in a forward direction. The relatively inelastic anterior longitudinal ligament may rupture, and the articular processes or pedicles are compressed and fractured.[15] In our cases, hyperextension in combination with rotational or lateral forces have resulted in the cervical spine fracture.

Conclusion

This case emphasizes the importance of photographs of the undisturbed death scene, in addition to a full autopsy and toxicological analysis in order to confirm suspected manner of death in cervical spine fracture.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540–7.

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Article in supplement or special issue

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Corporate (collective) author

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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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