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Facts of Medical Record Keeping - The Integral Part of Medical and Medico Legal Practice.

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Abstract

Proper handling and maintenance of patient's /deceased person's medical records is an integral part of medical and medico legal practice. This is the least bothered and most neglected section in medical practice, especially in developing countries like India. Medical records have proven of great help in medico legal matters and in cases of negligence suits filed against the medical practitioner. Properly kept medical records can save the doctor from many unpleasant situations. Indian law is not very clear about the facts of medical records. There are some guidelines issued by recognised professional bodies regarding them. So it is must for a medical and medico legal practitioners to know about the facts of medical and legal aspects of maintaining the patient's records for their own benefits, as ignorance is not always bliss.

Key words: Medical records, medical practitioner, medico legal expert, record keeping, patient

Introduction

All written material is documentary evidence in the eyes of courts of law. Preparation and maintenance of these records is the integral part of every profession. Same principle applies to the medical profession too. The technical, medical and legal knowledge of preparing, keeping and maintaining medical records is an essential art to be known to every medical practitioner. Medical records are documentary evidences, which are of immense help not only in medico legal cases but also in defending the doctor in cases of negligence suits or allegations against him/her. There are many cases / instances which are decided in favor of doctors only on the grounds of well kept and well reproduced records in consumer courts. Medical records have assumed more importance and significance because of application of Consumer Protection Act to medical profession. However, doctors because of their busy schedule, either don't maintain records or records are kept very brief, incomplete, cryptic records which are of no use in court matters.¹

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Reasons for knowing about them

India is slowly becoming a litigant society. The doctors are being sued by the patients or by the patient's relatives on regular basis for trivial matters. In the present days of medical practice, it is very important & essential to know about this most neglected but important aspect of medical profession. In many of the occasions the allegations are either proved or disproved only on the basis of the well kept or ill kept medical records. It is high time that the medical professional should take a serious look at the facts of the physical and legal details of medical records. Just imagine the situation, you approaching a patient or a research project without any prior history or records, it is like few blind men describing an elephant. Medical records are not only of great help in medico-legal matters, but also they form an essential data of patient's history, illness, treatment, prognosis etc. which are essential in research and advancement of medicine. They also act as statistical data used for formulating public health guidelines and health policies of a nation.

Essential ingredients of a good medical record

Medical records should be maintained serially in a chronological order with dates and they should preferably contain the following entries in them. $^{\rm 2}$

- 1. General particulars of the patient eg; Name, age, sex, address, emergency contact no, who brought him / her [with details]. etc.
- 2. Consent form duly filled and signed.
- Dates and timings of examination / admission and discharge – in patients.
- 4. Dates and timings of all visits and consultation.
- 5. Details of the complaints in a chronological order
- 6. Personal and past history.
- 7. Physical and laboratory / investigation findings (reports enclosed).
- 8. Treatment given / surgical procedures in detail.[immediate entry not later]
- 9. Day to day prognosis.
- 10. In case of death; precise cause of death, date and time of death.
- 11. Details of consultation by other doctors and their opinion.
- 12. In medico legal cases police need to be informed both at the time of admission as well at the time of discharge.
- In patients; details of discharge, cause of discharge – cured / referred to other centre /discharge on request or against medical advice [DAMA]etc.
- 14. Any other special findings which you feel noteworthy.

How the records are to be prepared and maintained

All medical practitioners must maintain different registers for specific purposes in their office or place of practice. Doctor must maintain a separate register for the medical certificates issued, where in all details must be entered. Every certificate must include two identification marks ,if not at least one identification mark of patient, his signature /left thumb impression should taken in the space meant for that. Certificates are to be prepared in duplicate and one copy must be kept in the records as office copy which should contain the receipt signature of the patient or the legal representative. The certificates must be prepared in a prescribed performa.³ All these documents should be written in a legible way or type written Eg; writing diagnosis or prescription in capital letters is a better way. Scribbling must be avoided. The medical records must be accurate, up to date, placed in order and complete in all respects. Incomplete or altered records create room for suspicion.

Any alterations made must be initialed without obliterating the original entry. Eg : drawing a single line over the sentence / word.⁴ It just not sufficient to diagnose and treat a patient properly. The doctor must take some time / spend some time to prepare the patient's details in documentary form or get them prepared by a trained competent assistant [in western countries trained medical clerks are used by the doctors]. India is a global hub for computer and information technology. Medical fraternity must make use of the talents available in these fields. Where ever possible sincere efforts are to be made to computerize the data, so that we can minimize the errors and the paper work can be brought down. Important and wonderful part of these computerized data is that they can be easily retrieved with a click of a button by the authorised user with basic computer knowledge, as they are well protected by passwords.

Ideally if you are keeping the records with you then keep them under lock and key or in the record room specifically meant for that, if such facilities are available with the hospital or institution. Make very sure that they are accessible only to the authorized persons of the institution.

Discussion

Ownership of medical records

Who owns these records?, Treating doctor or hospital or the patient or the legal representative of the patient. This question is raised frequently in various situations / forums by both doctors and patients. Due to many reasons the custody of records varies from country to country. In some they are the property of the concerned doctor who is treating the patient. In that case the patient can have the copy of records whenever the necessity arises. In India it is very common practice that the patient keeps all the records with him or her especially in private practice. In Government offered health services, the records are with the respective hospitals, only the treatment summary is given to the patient during discharge or need arises. India is becoming the most preferred destination for health tourism .The benefits of this influx are being reaped by the mushrooming private or corporate hospitals. In most of these corporate hospitals the patient's records are with the hospital and only the copies [may be in the form of treatment summary or photocopies of the entire case file] are given to the patient. In many parts of rural India or for that matter any developing countries the word of preparing or maintaining medical records is almost unheard. Every one have developed and adopted their own methods suitable for their setups. Likewise there are several methods which are adapted presently due to lack of proper legal guidelines in India with this respect.

Legal status in India and abroad

As such there are no legal guidelines for keeping or maintaining the medical records in India. Law do not specify any period beyond which the records can be destroyed. With so many negligence cases which are being filed against the doctors under consumer protection act, it has become essential to have some legal stipulations for preparation, maintenance and discarding the medical records. The consumer protection act advises to preserve the in patient records for five years and out patient records for three years. Even though the records need not be kept beyond 2 years, as the limitation period for filing a case in consumer court is 2 years. Cases can be filed beyond 2 years period, provided the delay can be explained to the satisfaction of the consumer court.⁵

The Medical Council of India has given few guidelines/ recommendations with reference to the maintenance of the medical records. Doctor must keep the medical records of an indoor patient for at least period of 3 years from the date of commencement of treatment in the standard performa which has been laid down by the Medical Council of India in 2002.⁶ Medico-legal records to be kept for at least period of 30 years or up till the cases are decided in the court of law

whichever is earlier ,even though it is so difficult to keep them for such along period. The need to maintain the records properly and produce them when asked by the courts of law itself is may detour many doctors from entertaining medico legal cases in their day to day practice. There is an urgent need to do something about this matter by the authorities.

If any request is made for medical records either by patient/authorized attendant or legal authorities involved, the same may be duly acknowledged and documents shall be issued with in 72 hrs. If the doctor refuses to give the details / copies when requested by an authorized person, he shall be charged for professional misconduct. Doctor will be held liable if he/she discloses the records or the contents to any unauthorized person or without the consent of the patient. At present the medical records are not covered under Right to Information act. No one can force a doctor to disclose the details of the patient other than the clauses given under the doctrine of Privileged communications. According to the Access to medical records act 1988, the patient's records cannot be shown to the insurance agency or to the employer until the patient has consented for its disclosure.⁷ Patient's records cannot be used for any purpose except for statistical data or for quality care determination even without his/her consent. If used with consent for presentations at conferences, CME's etc identity of the person should not be revealed either in text or in photographs. A discharged patient should be given discharge summary even when he is Discharged Against Medical Advice (DAMA) and death summary should be issued to the next of kin. Under Sec 104 of Cr.P.C. [power to impound document etc. produced] Courts have power to summon any medical record.8

U S congress passed (1996) the health insurance portability and accountability act (HIPAA) and more stringent privacy rules went in to effect in 2003. It included –

- National standards for medical records.

- Patient's right to see his own medical records.

- Right to know how his records are used and disclosed.⁹

There is an urgent need to bring an act to have uniformity in preparing and maintaining the medical records in our country. Enacting and implementation of such act will have positive effects on the health care sector as well on the national health policies and programmes.

Conclusion

Medical records are the integral part of medical practice/ medical profession. These records are important documents for the doctor, to the patient and to the society in general, more so in situations like medical emergencies, negligence suits, medical researches etc. In the present days of consumer awareness and litigation suites, they help the treating physician to prove that he / she has used proper care and skill while treating the patient. Maintaining and preserving them in a proper and methodical way is the responsibility of the concerned doctor. They also form medical database of the region in particular and country in general useful while tabling health policies. Data can be made available instantly to the treating doctor, which can be life saving in critical medical conditions like drug hypersensitivity, comatose patients etc.

Lastly in the present digital era every effort shall be made to computerize the medical records, which are fairly well protected for the purpose of safety and easy retrieval. It will save space and labour by eliminating paper based records. Remember that honest and best maintained records will save you from crisis and claims not just once but all the times.

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Age Estimation by Morphological Analysis of Third Molar Maturity on Orthopantomograph

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Abstract

The present study was aimed to estimate the age of an individual by morphological analysis of third molar maturity on orthopantomograph. The study was undertaken at the Dept of Orthodontics, Rural Dental College, Loni, from 1st March 09 to 31st August 09, among students of Rural Dental College, Loni in the age group of 16 to 23 years. Assessment and fixing of age of a person in these age groups is necessary in issues pertaining to establishing criminal responsibility, dispensing judicial punishment, classification of an offence as rape and kidnapping, validity of marriage contract and attainment of majority. Orthopantomograph of 196 subjects were taken, of which half i.e. 98 were male and 98 were females. Developmental stages of 3rd molars in all four quadrants were evaluated using Demirjian 8 stage scoring scale. The predominant developmental stage in age 16 years in all quadrants was 'D'. In females it appeared in the range of 60-70%, while it was in the range of 71.4-86 % in males. In age 18 years predominant development stage in females in upper jaw was 'F' in 60 % cases, while in lower jaw it was in the range of 20-40 %. Stage 'G' was seen in 20 % cases in all quadrants. Stage 'H' appeared in upper jaw in 20 % cases. In males predominant stages seen in upper jaw were 'F' and 'G' in 50 % cases each. In the lower jaw 'F' was the predominant stage followed by 'G' in 33.3 % cases. Our study results confirm the utility of morphological analysis of third molar maturity by Demirjian 8 stage classification on orthopantomograph as a means of estimating biological age of the subjects and can be practically implemented.

Key words: Dental age, Third molar, Demirjian's score scale, orthopantomograph

Introduction

Age assessment of living has become increasingly important over the last few years, with the questions of criminal responsibility, rape, kidnapping etc, frequently confronting the medico-legal experts¹⁻⁴. Age detection is a complicated procedure. Determining chronologic age in persons within the range of 15.5 to 23.5 years remains a problem. There are many ways of determining age in human. Morphological and radiological examination of skeletal features and examination of the development of third molars are useful for estimation of age in this juvenile age group. But, it is known that chronology of dental development is less variable than bone

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Reader, Dept of Orthodontics and Dentofacial Orthopaedics, Rural Dental College, Loni, Tal: Rahata, Dist: Ahmednagar. 413736 (MS), Email: shubhangimani@yahoo.co.in development and teeth, being the hardest calcified tissue in the body, tend to be intact even when other components of the skeleton have disintegrated. Hence the dental examination method applied for this particular period of life is a reliable indicator of age. The continuation of third molar development during adolescence makes the third molar most useful when there is a need to determine the juvenile or adult status of an individual.

The dental development has shown a good correlation with chronological age. A number of studies have proved the worth of dental age assessment. In fact the multidisciplinary study group on forensic age diagnostics has also recommended the use of evaluation of orthopantomograms for age assessment ⁵. A very meticulous orientation of the various measures of age should be synchronized with reference to chronological age. The dental age has to be

assessed with reference to the calcification of the crown and roots, the eruption period of teeth, attrition and exfoliation. Considering these associated characters, dental age can be predicted to near accurate calculation.

The development of third molar teeth shows remarkable diversity among different ethnic groups, and thereby the elaboration of maturity standards based on various populations has been suggested for forensic purposes. Up to now several studies have been undertaken in different populations to explore the usefulness of the third molar as a reliable age indicator. These studies show that dental development varies slightly between different populations, making population-specific studies necessary. Hence, it was considered worthwhile to determine thirdmolar developmental Demirjian 8 stage scoring scale in a sample of Maharashtrian population, to assess chronologic age.

Material and Methods

The study was carried out in the Dept of Orthodontics, Rural Dental College, Loni. The subjects of the present study consisted of 98 males and 98 females in the age group of 16-23 years.

The study subjects are bonafide residents of Maharashtra with known birth date and were apparently healthy at the time of study. The subjects were selected by random sampling. The Orthopantomograph were taken at Dept of Oral Radiology & Medicine, Rural Dental College, Loni.

The identification number, sex, date of birth and X-ray examination date of each subject were documented and the developmental stages of the 3rd molar were determined. The age of the subjects was calculated as the date of X-ray minus the date of birth.

The following scoring system was used for classification of 3rd molar eruption stages.

| S. No. | Classification | Characteristics |
|--------|----------------|--|
| 1 | А | Cusp tips are mineralized but have not yet coalesced |
| 2 | В | Mineralized cusps are united so the mature coronal morphology is wellefined |
| 3 | С | The crown is about half formed; the pulp chamber is evident and interval and its occurring |
| 4 | D | Crown formation is complete to the dentinœnamel junction. The pulp chamber has a trapezoidal form. |
| 5 | Е | Formation of the interradicular bifurcation has begun. Root length is less than the crow length. |
| 6 | F | Rootlength is at least as great as crown length. Root have funn o haped endings |
| 7 | G | Root walls are parallel, but apices remain open. |
| 8 | Н | Apical ends of the roots are completely closed, and the periodontal membrane has a uniform width around the root. |

Scoring scale (Demirjian 8 stage classification)⁶

Impacted wisdom teeth were excluded from analysis. Wisdom teeth with an unclear direction of emergence also were not included in the analysis. All staging was carried out by the same observer.

Statistical analysis: It was performed using SPSS software.

Results

The results of the present study are given in table 1-2. A total of 196 subjects were evaluated

of which 98 were males and 98 were females. The details of the same are highlighted in table no 1.

Table 2.shows the various stages of development of 3rd molar teeth in females and males as per the Demirjian classification.

The predominant developmental stage in age 16 years in all quadrants was 'D'. In females it appeared in the range of 60-70%, while it was in the range of 71.4-86 % in males. The other stages

seen in age 16 were 'E' 10-30% and 'F' 10% in females and stage 'E' in 14.2% cases in males.

Predominant stage in females in age 17 years in upper jaw was 'E' in 57% cases followed by 'F' in 28.7 % cases, while in lower jaw it was 'D' in 57% cases followed by 'E' in 28.7 % cases and 'F' in 14.3 % cases. In males the predominant stage seen in all quadrants was 'E' in 50 % cases, followed by 'F' in 25 % cases. Stages 'G' appeared in this age group in 25 % cases in lower jaw only.

In age 18 years predominant development stage in females in upper jaw was 'F' in 60 % cases, while in lower jaw it was in the range of 20-40 %. Stage 'G' was seen in 20 % cases in all quadrants. Stage 'H' appeared in upper jaw in 20 % cases. In males predominant stages seen in upper jaw were 'F' and 'G' in 50 % cases each. In the lower jaw 'F' was the predominant stage followed by 'G' in 33.3 % cases.

Age 19 years in females showed predominance of stage 'G' in 50% cases along with appearance of stage 'H' in 25-37.5 % cases. Stage 'F' was seen in this subject group in 12.5 % cases, where as in males the stage 'G' was in the range of 42.9-57.1 % and 'H' in the range of 28.6-57.1 %.

The prevalence of stage 'H' in females increased to the range of 50-75 % in age 20 years with stage 'G' being in the range of 25-50 %. In males the stage 'H' predominated all quadrants in range of 57-100 %, when 14.3-28.7 % samples were excluded being absent or not assessable.

In age 21 yrs in females stage 'H' was seen in 100 % cases, and in males it was the only stage seen i.e. 71.4% to 85.7%. 14.3 % samples were excluded being third molar absent or in assessable. Similar findings were also seen in age 22 yrs.

In age 23 yrs 'H' was the predominant stage in females in the range of 62.5-75 %, with presence of stage 'G' in 12.5-25 % samples. In males the presence of stage 'H' was seen predominantly in the range of 71.4-100 %, with exception of Right upper quadrant where stage 'G' was present in 57.1 % samples with the rest 42.9 % either absent or not assessable

Discussion

Age assessment has always played a pivotal role in general and medico-legal practice. Be it

issues of employment, retirement, marriage, child labor, or identification of the living or dead persons, evaluation of age has a paramount importance.

Various methods are available for assessment of age, namely assessment of cranial suture closure, radiological evaluation of developmental stages of permanent teeth, changes in symphysis pubis, changes in sternal end of ribs, secondary changes in the vertebrae etc. Of these radiological evaluation of developmental stages of permanent teeth gives a fairly accurate assessment of age of an individual.

The various stages of development of the 3rd molar shows a linear correlation with age in both sexes, as evident in other studies too ⁷⁻¹⁰.

Early maturity stages were predominant in age group 16-18 years as also seen in study by Introna F and colleagues ⁷.

There was a similarity of maturity stages in both sexes in age 16, 17 and 20 yrs. The predominant stages in these age groups were same i.e. stage 'D' in 16 yrs, 'E' in 17 yrs, 'H' in 20 yrs. Females showed presence of a delay in dental maturity, consistent with findings of other studies ^{6, 8-10} as were evident from presence/ predominance of early maturity stages as compared to males in the age group 16-20 yrs and 23 yrs. This corroborated the fact that unlike the other teeth which mature and erupt early in females, the third molars mature and erupt later in females.

Age 18 yrs showed distinct difference in the two sexes, as the predominant stage in females was 'F' while those in males were 'F' and 'G'. This corroborated the fact that unlike the other teeth which mature and erupt early, the third molars mature and erupt later in females.

Except for age 18 yrs, significant similarity in predominant stages was seen in all age groups. This finding was in slight variance with the other studies which found similarity in maturity stages in age above 18 yrs, whereas in our study similarity was seen in age less than 18 also.^{7,9,11}

Stage 'D'-'F' were predominant in age 16-18 yrs, unlike stage D-G in Introna and colleagues study ⁷. Predominant stages in age 18-19 were lagging in maturity by one stage, when compared to by Introna and colleagues ⁷, which shows delayed dental maturation in Indians as compared to Europeans (Italians).

Contrary to the findings of Bolanos and colleagues ¹² who used the 10 stages of Nolla classification, we found a significant correlation between age and development of third molar, and also presence of sexual dimorphism.

Consistent with the findings of Introna and colleagues ⁷ the maxillary third molars showed early maturity compared to that of mandibular third molars.

The probability of cases with stages 'F' and 'G' being above 18 yrs was significantly high, which is similar to the findings of Salvia AD and colleagues ⁸.

In the Indian legal system age 16 yrs and 18 yrs have great medico-legal importance. Assessment and fixing of a person in these age groups is necessary in issues pertaining to establishing criminal responsibility, dispensing judicial punishment, classification of an offence as rape and kidnapping, validity of marriage contract and attainment of majority. Our study results confirm the utility of morphological analysis of third molar maturity by Demirjian's 8 stage classification on orthopantomograph as a means of estimating biological age of the subjects from 16 to 23 years and can be practically implemented in assessment of age of an individual with significant accuracy. Bisexual variations are seen hence one should keep the sex of the subject in mind while viewing the orthopantomograph.

| S. No | Age (years) | S | Total | |
|-------|-------------|------|--------|------|
| 5.110 | nge (jeuro) | Male | Female | Tour |
| 1 | 16 | 14 | 20 | 34 |
| 2 | 17 | 8 | 14 | 22 |
| 3 | 18 | 12 | 10 | 22 |
| 4 | 19 | 14 | 16 | 30 |
| 5 | 20 | 14 | 8 | 22 |
| 6 | 21 | 14 | 6 | 20 |
| 7 | 22 | 8 | 8 | 16 |
| 8 | 23 | 14 | 16 | 30 |
| To | otal | 98 | 98 | 196 |

Conclusion

Table No 1. Age and sex wise distribution of the sample

| | Age | | | 16 | 1 | 7 | | 18 | 1 | 9 | | 20 | | 11 | 22 | 2 | 2 | 3 |
|-------|------------------|-----------------|--------------|--------------|-------------|-----------|-----------|-------------|-------------|-------------|-----------|--------------|------------|--------------|------------|-----------|--------------|--------------|
| | Sex | | F | M | F | M | F | м | F | M | F | M | F | M | F | M | F | M |
| | N_{-} | | 20 | 14 | 14 | 8 | 10 | 12 | 16 | 14 | 8 | 14 | 6 | 14 | 8 | 8 | 16 | 14 |
| S.no. | Tooth | Stage | л (%) | л (%) | # (%) | л (%) | (%) | # (%) | (%) | л (%) | л (%) | (%) | n (%) | (%) | л (%) | л (%) | (%) | (%) |
| | | AB* | 1.741 | 2 (14.2) | 1.747 | 1.747 | 1/0/ | 1/9/ | 1.761 | 1.761 | 2 (25) | 1.797 | 1747 | 1.007 | 2 (25) | 1.747 | 2 (12.5) | 4 (286) |
| | | NA** | | (14.2) | | 2 | | | 2 | | (0.) | 2 | | 2 (14.3) | (10) | 2 | (saley | 2 (143) |
| | | Α | | | | Lead | | | (1457 | | | (14.2) | | (14.2) | | Lead | | 11421 |
| | | В | | | | | | | | | | | | | | | | |
| | | с | (10) (10) | | | | | | | | | | | | | | | |
| 1. | URM" | D | 14 (70) | 10 (71.4) | 2 (14.3) | | | | | | | | | | | | | |
| | | E | 2 (10) | 2 (14.2) | 8 (57) | 4 (50) | | | | | | | | | | | | |
| | | F | 2 (10) | | 4 (28.7) | 2 (25) | 6 (60) | 6 (50) | 2 (12.5) | | | | | | | | | |
| | | G | | | | | 2 (20) | 6 (50) | 8 (50) | 6 (42.9) | 2 (25) | | | | | | 4 (25) | |
| | | н | | | | | 2 (20) | | 4 (25) | 8 (57.1) | 4 (50) | 12 (85.7) | 6 (100) | 12 (85.7) | 6 (75) | 6 (75) | 10 (62.5) | 8 (57.1) |
| | | AB ^a | | | | | 2 (20) | | (12.5) | 2 (14.3) | | | | 2 (14.3) | | 2 (25) | | |
| | | NA** | | | | (25) | | | (12.5) | | | | | (14.3) | | | (12.5) | (143) |
| | | A | | | | | | | | | | | | | | | | |
| | | В | | | | | | | | | | | | | | | | |
| | | с | (10) | | | | | | | | | | | | | | | |
| 2. | ULM ² | D | 14 (70) | 12 (86) | 2 (14.3) | | | | | | | | | | | | | |
| | | Е | 2 (10) | 2 (14) | 8 (57) | 4 (50) | | | | | | | | | | | | |
| | | F | 2 (10) | | 4 (28.7) | (25) | 6 (60) | 6 (50) | 2 (12.5) | | | | | | | | | |
| | | G | | | | | 2 (20) | (50) | 4 (25) | 4 (28.6) | 2 (25) | | | | | | 2 (12.5) | (143) |
| | | н | | | | | | | (375) | 8 (57.1) | 6 (75) | 14 (100) | 6 (100) | 10 (71.4) | 8 (100) | 6 (75) | 12 (75) | 10 (71.4) |
| | | AB* | | 2 (14) | | | | | 2 (12.5) | | | | | | 2 (25) | | 2 (12.5) | |
| | | NA** | | | | | | | | | | 4 (28,7) | | (14,3) | | (25) | | |
| | | A | | | <u> </u> | | | | | | | | | | | | | |
| | | в | 2 | | | | | | | | | | | | | | | |
| | | с | (10) | | | | | | | | | | | | | | | |
| 3, | LIM | D | (60) | (86) | (57) | | | | | | | | | | | | | |
| | | E | 6 (3 0) | | (28.7) | (50) | (40) | 2(16.7) | | | | | | | | | | |
| | | F | | | 2 (14.3) | 2 (25) | 4 (40) | 6 (50) | 2 (12.5) | | | | | | | | | |
| | | G | | | | 2 (25) | 2 (20) | 4 (33.3) | 8 (50) | 8 (57.1) | 4 (50) | | | | | | | |
| | | н | | | | | | | 4 (25) | 6 (42.9) | 4 (50) | 10 (71.3) | 6 (100) | 12 (85.7) | 6 (75) | 6 (75) | 14 (87.5) | 14 (1.00) |
| | | AB* | | 2 (14) | | | | | | | | 2 (14.3) | | | | | 4 (25) | 2 (143) |
| | NA** | | | | | | | | | | (28,7) | | (14.3) | (25) | 4 (50) | | | |
| | A | | | | | | | | | | | | | | | | | |
| | В | | | | | | | | | | | | | | | | | |
| | | с | (10) | | | | | | | | | | | | | | | |
| 4. | LLM | D | 12 (60) | 12 (86) | 8 (57) | | | | | | | | | | | | | |
| | | E | 6 (30) | | 4 (28.7) | 4 (50) | 6 (60) | 2 (16.7) | | | | | | | | | | |
| | | F | | | 2 (14.3) | (25) | (20) | 6 (50) | (12.5) | | | | | | | | | |
| | | G | | | | (25) | (20) | (33.3) | 8 (50) | 8 (57.1) | 4 (50) | | | | | | (12.5) | |
| | | н | | | | | | | (375) | 6 (42.9) | 4 (50) | 8 (57) | (100) | 12 (85.7) | 6 (75) | 4 (50) | 10 (62.5) | 12 (85.7) |

URM: Upper right molar, ULM: Upper left molar, LRM: Lower right molar, LLM: Lower left molar.* AB: absent. ** NA : not assessable. M: Male, F: Female

Table No 2. Stages of development of 3rd molars on orthopantomograph in females and males

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Ear lobe crease: a cutaneous skin marker of coronary artery disease

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Abstract

In spite of advances in the diagnosis and treatment, the mortality in coronary heart disease remains high. Number of risk factors blamed for coronary heart disease are diabetes mellitus, hypertension, type A personality, raised cholesterol, family history of ischaemic heart disease, chronic alcoholism, obesity, tobacco addiction, long term use of oral contraceptive pills etc. Hence, primordial prevention is the key for controlling this deadly disease.

The present study has been attempted to evaluate skin crease over the ear lobe - as a physical marker of coronary artery disease. It is carried out at S.R.T.R. Medical college Hospital Ambajogai comprising 100 cases of coronary artery disease. The age sex and other risk factors matched to 100 control cases attending the medicine O.P.D. without having coronary artery disease. All cases were examined for ear lobe crease, characterized by deep diagonal wrinkle in lobar portion of one or both auricles extending for a distance greater than or equal to one third of ear lobe length. In study group, 72% cases had ear lobe crease while in control group 14% cases had ear lobe crease. By applying test of significance the probability was less than 0.001 i.e. highly significant. Then odd ratio was calculated and it was 15.79, suggesting that, if other risk factors are matched, person with ear lobe crease is 15.79 times at more risk to have coronary artery disease, than without.

Key words: Ear lobe crease, coronary heart disease, physical marker' or 'a cutaneous skin marker'

Introduction

Skin is the icing on the anatomical cake, and without it not only would we all look rather unappealing, but a variety of unpleasant physiological phenomena would bring about our demise. Skin is thought to be the mirror of internal organs because it gives clue for internal disease and helps in early diagnosis e.g. greenish yellow discolouration of skin and itching may reflect obstructive jaundice.

In spite of advances in the diagnosis and treatment, the mortality in coronary heart disease remains high. Number of risk factors blamed for coronary heart disease are diabetes mellitus, hypertension, type A personality, raised cholesterol, family history of ischaemic heart disease, chronic alcoholism, obesity, tobacco

Reprints Requests: Dr. (Mrs). S. K. Chavan Associate Professor

Department of Anatomy, Rural Medical College Loni, Ahmednagar- 436736 (MS) addiction, long term use of oral contraceptive pills etc. Hence, primordial prevention is the key for controlling this deadly disease.

All the risk factors so far identified have involved a patient's history or laboratory studies. It was only in 1973 that the first extra cardiac physical sign was reported "the diagonal ear lobe crease" as risk factor by Frank.1 He published his observations which clarified that ear lobe crease was seen in 95% of cases of coronary artery disease. After that so many authors2-3 have reported the ear lobe crease as the significant risk factor for coronary heart disease. In the present study skin crease over the ear lobe is evaluated for as a physical marker or a cutaneous skin marker of coronary artery disease.

Material and methods

The study was carried out at S. R. T. R. Medical College Hospital; Ambajogai during the period March 2000 to August 2001, comprised of 100 cases of coronary artery disease with age, sex and other risk factors matched 100 controls attending the medicine O.P.D. without having coronary artery disease.

All patients were examined in good light for ear lobe crease. Cases having ear lobe crease characterized by diagonal deep wrinkle in the lobar portion of one or both auricles extending for a distance greater than or equal to one third of the ear lobe length in sitting position were considered to be ear lobe crease positive.

Observations and discussion

There were 100 individuals in study group and 100 individuals in control groups. Most of the individuals were in the age group of 31 - 70 years in both the groups. There were 67 males and 33 females in study group while 68 males and 32 females in control group (Table No. 1).

| 1 | А | Cusp tips are mineralized but have not yet coalesced |
|---|---|---|
| 2 | В | Mineralized cusps are united so the mature coronal morphology is wellefined |
| 3 | С | The crown is about half formed; the pulp chamber is evident and entitient deposition is occurring |
| 4 | D | Crown formation is complete to the dentinœnamel junction. The pulp chamber has a trapezoidal form. |
| 5 | Е | Formation of the interradicular bifurcation has begun. Root length is less than the crow length. |
| 6 | F | Rootlength is at least as great as crown length. Root have funnehaped endings |
| 7 | G | Root walls are parallel, but apices remain open. |
| 8 | Н | Apical ends of the roots are completely closed, and the periodontal membrane has a uniform width around the root. |

Table 1. Age and sex wise distribution in study group and control group

| S. No | Age (years) | Sex | | |
|-------|-------------|------|--------|--|
| 5.110 | Age (Jeurs) | Male | Female | |
| 1 | 16 | 14 | 20 | |
| 2 | 17 | 8 | 14 | |
| 3 | 18 | 12 | 10 | |
| 4 | 19 | 14 | 16 | |
| 5 | 20 | 14 | 8 | |
| 6 | 21 | 14 | 6 | |
| 7 | 22 | 8 | 8 | |

Table 2. Distribution of cardiac risk factors among patients in each group

| | Study group (n=100) | Control group (n= 200) |
|-----------------------------|---------------------|------------------------|
| No. Of patients with ELC | 72 (72%) | 14 (14%) |
| No. of patients without ELC | 28 (28%) | 86 (86%) |
| Total | 100 (100%) | 100 (100%) |

X2= 66.28, d.f.= 1, p<0.001, significant. Odds ratio = 15.79.

Table 3. Incidence of ear lobe crease in study and control groups and its significance

As shown in Table No.2 many of the known risk factors were equally distributed in both the groups only because of group matching of these risk factors.

In the study group, 72 patients (72%) had ear lobe crease (Fig.1 & 2) while in control group 14 patients (14%) had ear lobe crease. In the study group 28 patients (28%) did not have ear lobe crease while in the control group 86 patients (86%) did not have ear lobe crease. By applying test of significance (Chi-square test with Yate's correction) the probability was less than 0.001 i.e. highly significant (Table No. 3).

Odd ratio was calculated and it was 15.79.

In other words, if other risk factors are matched, person with ear lobe cease is 15.79 times at more risk to have coronary artery disease, than a person without ear lobe crease. The correlation between ear lobe crease and coronary artery disease may be because end arteries supply the ear lobe and heart. Another view is regarding the generalized loss of elastin and elastic fibers seen in biopsy specimen from ear lobe reflecting micro vascular disease that is also present in coronary vasculature.4-5

In the present study, incidence of ear lobe crease (72%) correlates with the studies of Kaukola et al 3 in which the incidence was 76.9%, Kaukola et al2 in which the incidence was 72% and Shoenfeld et al4 in which incidence was 77.1%.



Figure 1. Showing ear lobe crease



Figure 2. Showing ear lobe crease

Conclusion

Incidence of ear lobe crease was 72% in study group and 14% in control group, statistically significantly associated with presence of coronary artery disease (p < 0.001).

Inspection of the ear lobe for skin crease can give clue to the underlying coronary artery disease. So ear lobe crease can be regarded as 'a physical marker' or 'a cutaneous skin marker' during general examination, which can forecast the disease before it, is manifested. It is for the clinician to remember that while reviewing through the risk factor, if ear lobe crease is present the risk of coronary artery disease in increases even more.

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| Egypt | Lake Como, (Italia) |
| February 5-5, 2010 | July 07-14, 2010 |
| 13th Annual Europe Pacific Medical & Legal Conference Pocoi, (Italia) January 07-14, 2010 | East West Medical and Legal Conference St. Petersburg, (Rusia) July 19-26, 2010 |
| Arab Health 2010 Dubai, (Emiratos Arabes Unidos) January 25-28, 2010 | 3er International Bodily Injury Association Congress Madrid,(España) September 20-24,2010 |
| International Conference on Medical Negligence & | The 20th International Symposium on the Forensic |
| Litigation in Medical Practice | Sciences |
| Tamilnadu, (India) | Sydney, (Australia) |
| January 25-26, 2010 | October 05-10, 2010 |
| 2010 Annual Meeting of The American Medical Group Association (Amga). New Orleans, (Estados Unidos) February 23-28, 2010 | ••••••••••••••••••••••••••••••••••••••• |

Study of patterns of cranio-cerebral injuries in deaths due to fatal vehicular accidents

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Abstract:

The present work entitled study of Patterns of Cranio-cerebral Injuries in Deaths due to Fatal Vehicular Accidents was undertaken at Forensic Medicine Department at M. R. Medical College, Gulbarga. The objective of the study is to find out the magnitude of the problem with reference to different host factors and to analyze the significance of nature of injury and the part of the brain injured with the time of survival and also to study the patterns of cranio-cerebral injuries in deaths due to fatal vehicular accidents. In this study 128 cases of head injury victims in fatal vehicular accidents autopsied from June 2003 to June 2008 were included. Maximum cases of road traffic accidents were among males (88%), male to female ratio was 5:1 and maximum incidence was in the age group of 21-40 years comprising 55%. Most common victims were pedestrians (36%) followed by occupants (34%) and drivers (25%). Incidence was more common among the four wheeler vehicles. Temporal (20%) and frontal (20%) bones were the commonest sites of fracture. Subdural hemorrhage was the commonest among the intracranial hemorrhages seen in 40% cases.

Keywords: Cranio-cerebral injuries, Vehicular accidents.

Introduction:

Cranium is the crown of the human body, not only from the point of view of situation but because it contains and protects the most vital organ, the super unbeatable computer, 'The Brain'. One of the characteristic features of brain is that once it is damaged, regeneration or complete healing does not occur. The brain is well protected within the bony cranial cage. But once the impact of a force crosses the protective threshold, then life is invariably in danger.

Head is that part of the body which is frequently injured as a result of accident and criminal violence. Because of its size and anatomical position, it is a major site of trauma in road accidents. Even with the improvement

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Professor, Dept of Forensic Medicine& Toxicology, Rural Medical College, Pravara Institute of Medical Sciences Deemed University, Loni Ahmednagar (MS) in safety measures in vehicles and greater availability of state of the art resuscitative measures, the mortality rate in injuries has not declined. Head injury is one of the serious fatal injuries. So it is true to say that "no form of cranio cerebral injury is too trivial to be ignored or too serious to be despaired of".¹

In this study an attempt is made to analyze cases as regards victim's age, sex, vehicle involved, type of victims, distribution and patterns of cranio-cerebral injuries sustained in road traffic accidents and survival period. The medico legal importance of examination of road traffic injury case is to find out the cause of death and to reconstruct traffic accident. Such examination will also help to detect "hit and run" cases. Proper examination and evaluation of such traffic injuries will help us while facing the cross examination and also helps towards reconstruction of the whole accident.

Materials and Methods

The study was undertaken at M. R. Medical College, Gulbarga, during the period from June

2003 to May 2006 (records of the cases were analyzed) and during June 2006 to June 2008 prospective study was conducted. Total 138 cases of cranio-cerebral injury in fatal vehicular accidents were included in this study. For noting the findings separate proforma was prepared and used.

Preliminary data related to name, age, sex, address, time of admission, treatment given and time of death were noted. The inquest report was carefully read, before starting the post-mortem examination. Detailed history regarding mode of cranio-cerebral injury was obtained from inquest report, indoor papers, from the investigating officer concerned and also from relatives. The clinical records of the admitted cases were also carefully studied to know the nature, extent and gravity of injury. The available record of radiological investigation including CT scan was also carefully reviewed. After careful examination of each case, findings were recorded as per porforma and results are tabulated.

Results

The age of the victims in present study varied from 1-70 years. The peak incidence was observed in the age group of 31-40 years comprising 29.68% of cases. It was also observed that 25% belonged to the age group 21-30 years. Thus, 54.68% of the cases comprised of age group of 21-40 years in the study. Individuals in the age group of 0-10 years were the least affected 2.34% followed by older people i.e., 60 years and above in 5.46% of total cases. Males comprised a majority and constituted 112 (87.5%) compared to females who were only 16 (12.5%). The male to female ratio in the study was 7:1 (male=112; females=16). (Table-1).

| Age range (years) | Male | Female | Total | Percentage |
|-------------------|-------------|------------|-------|------------|
| 0 - 10 | 2 | 1 | 3 | 2.35 |
| 11 – 20 | 14 | 2 | 16 | 12.50 |
| 21 - 30 | 30 | 2 | 32 | 25.00 |
| 31 - 40 | 35 | 3 | 38 | 29.68 |
| 41 - 50 | 18 | 1 | 19 | 14.87 |
| 51 - 60 | 8 | 5 | 13 | 10.15 |
| 61 – 70 | 5 | 2 | 7 | 5.46 |
| Total | 112 (87.5%) | 16 (12.5%) | 128 | 100.00 |

Table 1. Age and sex wise distribution of cases

It is obvious from the table no. 2 that maximum number of victims i.e., 48.43% died within 24 hours, after sustaining injuries. While 28.12% died on the spot, 10.15% cases died between 2nd - 3rd day and 7.81% cases died between 4th - 7th day, 5.46% patients survived for more than 7 days.

Among 128 cases, there was no fracture in 29

| Time of death | No. of cases | Percentage |
|---|--------------|------------|
| Death on spot | 36 | 28.12 |
| Within 24 hours | 62 | 48.43 |
| Between 2 nd – 3 rd day | 13 | 10.15 |
| Between 4 th – 7 th day | 10 | 7.81 |
| Beyond 7 th day | 7 | 5.46 |
| Total | 128 | 100.00 |

Table 2. Time lapse between injury and death

cases. Table- 3 shows that, 51.5% cases showed fractures of vault and base, whereas 47% cases showed fractures of the vault only. In 1% cases basal solitary fracture of skull was observed.

From table - 4, it is obvious that in fatal cases of head injury linear fracture of skull is the commonest i.e. 52.53%. In 18.18 cases there was comminuted fracture while in 17.17% cases depressed fracture and in 9.09% cases depressed comminuted fracture. Sutural fracture separation associated with linear fracture in 2.02% cases and sutural fracture separation with depressed fracture in 1.01% cases. While there were no cases of pond fracture.

From the table no. 5, it is obvious that if type of hemorrhage is considered in isolation, then cases having subdural hemorrhage were the highest in number (40%) followed by cases of subarachnoid hemorrhage (9.93%), extradural hemorrhage (6.67%) and intracerebral hemorrhage (2.67%). If combinations of hemorrhages are taken into account, then also combination of subdural hemorrhage with subarachnoid hemorrhage was on the first place (30.67%), followed by various other combinations. It is depicted in the table 6, that the contusion of brain matter is often seen in fatal head injury cases (61.54%) followed by laceration (26.37%) and combination of contusion and laceration (12.09%).

It is obvious from table 7 that, pedestrians are most commonly affected in vehicular accident i.e., 36%. It also reveals that the occupant is more commonly affected (34%), than the driver (20%) of the vehicle. The pedal cyclists were involved in 5% cases and in 5% cases the type of victim was unknown.

From table no. 8, it is obvious that the vehicles most commonly involved in fatal head injury cases are heavy four wheelers (60%), while next commonly involved vehicles are two wheelers (30%). 2.22% vehicles were bicycles, 2.2% were three wheelers and 5.56% vehicles were not known.

Discussion

In the present study the total numbers of cases studied are 128, out of which 87.5% were males and 12.5% were females with a sex ratio 7:1. In a study of acute injuries of head, the sex ratio was 5:1.2 As shown in table no. 1, high preponderance

| Location | No. of cases | Percentage |
|--------------------------------------|--------------|------------|
| Fracture of vault of skull | 47 | 47.50 |
| Basal fracture | 1 | 1.00 |
| Fracture of vault of skull and basal | 51 | 51.50 |
| Total | 99 | 100.00 |

Table 3. Location of fracture skull, vault and base

of male in fatal head injury may be because males are bread earners, for which they go out of homes and major bulk of activities and assignment are carried by them as compared to females.

Head injury can occur at any age. In the present study, the maximum number of cases are (29.68%) in the age group of 31-40 years and if a broader age group of 21-40 years is considered then the percentage of head injury cases in this

age group comes to 54.68%. Janine Jagger et al³ in a study found that maximum occurrence of head injury for 20-29 years age group and then decline progressively. Katz Douglas⁴ in a study of 243 cases found that incidence to be the highest in 20-30 years age group as 47%.

Maximum number of victims died within 24 hours (48.43%) and on the spot (28.12%) after sustaining injury, 10.15% cases died between 2nd

| Type of fracture | Total | Percentage |
|-------------------------------|-------|------------|
| Linear | 52 | 52.53 |
| Linear + Suture separation | 02 | 2.02 |
| Comminuted | 18 | 18.18 |
| Depressed comminuted | 09 | 9.09 |
| Depressed | 17 | 17.17 |
| Depressed + Suture separation | 01 | 1.01 |
| Pond | 00 | 0.00 |
| Total | 99 | 100.00 |

Table 4. Percentage of type of fracture of skull

to 3rd day and 7.8% cases died between 4th to 7th day, 5.46% patients survived for more than 7days (Table- 2). The maximum number of deaths during first 24 hours can be explained by the fact that the contusions, lacerations, edema of brain or intracranial hemorrhages which are not-compatible with life can occur immediately or within 24 hours of the injury. In 28.12% cases death occurred on the spot, it indicates the severity of the injury and its graveness.

In the present study, 77.5% cases had fracture skull, of which 51.50% had fracture of vault and base, whereas 47.5% cases showed fracture of vault only. 1% cases solitary basal fracture of skull was observed (Table-3). In a study of 20 cases of fatal injury by Devadiga & Jain2, 12 of these had fracture of vault as well as of the base of skull. Of the remaining cases, 8 had fracture of vault and 6 had basal fracture of skull. In fatal cases of head injury, linear fracture of skull was commonest i.e., 52.52%. In 18.18% cases there were comminuted fracture, 17.17% cases depressed fracture. Sutural fracture separation associated with linear fracture in 2.02% cases and

sutural fracture separation with depressed fracture in 1.01% while there was no case of pond fracture in our study (Table-4). The findings of the present study are also in accordance with the findings of a study at the Institute of Neurology, Madras. ⁵

Intracranial haemorrhage was observed in 75 out of 128 cases of fatal head injury. If the isolated type of haemorrhage is considered then cases having subdural haemorrhages were maximum in number (40%) followed by subarachnoid haemorrhage 9.33%, extradural haemorrhage 6.67% and intracerebral haemorrhage 2.67% (Table-5). Walpole Levin⁶ in a study showed that in fatal head injury cases, subdural haemorrhage occurred in 60% cases and extradural haemorrhage in 50% cases. Reddy⁷ found that 25% of the haemorrhages were extradural, 53.5% subdural & 28% Subarachnoid. Devadiga & Jain² found that 13.9% were extradural haemorrhages, 72.3% subdural & 30.5% subarachnoid.

In the present study, occurrence of contusion of brain was 62.14% followed by laceration 26.55% and combination of contusion and laceration 10.77% (Table-6). Blackwood et al⁸ found that contusions of the brain are extremely common

| Type of hemorrhage | Total | Percentage |
|--|-------|------------|
| Extradural hemorrhage | 5 | 6.67 |
| Subdural hemorrhage | 30 | 40.00 |
| Subarachnoid hemorrhage | 7 | 9.33 |
| Intracerebral hemorrhage | 2 | 2.67 |
| Subdural hemorrhage + subarachnoid hemorrhage | 23 | 30.67 |
| Extradural + subdural + subarachnoid hemorrhage | 1 | 1.33 |
| Subdural hemorrhage + interacerebral hemorrhage | 2 | 2.67 |
| Intraventricular hemorrhage + subdural hemorrhage | 1 | 1.33 |
| Intraventricular + Intracerebral hemorrhage | 1 | 1.33 |
| Extradural + Intercerebral | 1 | 1.33 |
| Subarachnoid hemorrhage + intracerebral hemorrhage | 1 | 1.33 |
| Extradural + subarachnoid hemorrhage | 1 | 1.33 |
| Total | 75 | 100.00 |

Table 5. Type and percentage of intracranial hemorrhage

| Injury to brain matter | No. of cases | Percentage |
|------------------------|--------------|------------|
| Contusion | 56 | 61.54 |
| Laceration | 24 | 26.37 |
| Contusion + laceration | 11 | 12.09 |
| Total | 91 | 100.00 |

Table 6. Types of injuries to brain matter in fatal cases of head injuries

in fatal head injury. Sharma et al⁹ concluded that cerebral contusion was the commonest finding in head injury. Our observations are similar in correlation with the above documented series.

Percentage of type of victims in vehicular accident shows that pedestrians are most commonly affected i.e. 36% than occupant other than driver (34%) and driver (20%). The pedal cyclists were involved in 5% cases (Table-7). Karrae Solheim¹⁰ found that pedestrians are most commonly affected in vehicular accidents

as seen in the present study. It also suggested that the pedestrians should be made "More traffic minded". The factors contributing to the higher percentage of pedestrians are the congestion of pavement by street traders, forcing pedestrians on the roads, the poor street lighting and the general lack of road sense. In the present study, occupants are seen more involved than drivers, can be explained on the basis of crowding in the vehicles, lack of restricting devices i.e. chest belt, seat belt and difference in degree of alertness between driver and occupants in the developing

| Type of victim | No. of cases | Percentage |
|----------------|--------------|------------|
| Driver | 26 | 20.00 |
| Pedestrian | 46 | 36.00 |
| Occupant | 44 | 34.00 |
| Pedal cyclist | 6 | 5.00 |
| Unknown | 6 | 5.00 |
| Total | 128 | 100.00 |

Table 7. Percentage of type of victims in vehicular accident

| Type of vehicle | No. of vehicles | Percentage |
|-----------------|-----------------|------------|
| Bicycle | 2 | 2.22 |
| Two wheeler | 27 | 30.00 |
| Three wheeler | 2 | 2.22 |
| Four wheeler | 54 | 60.00 |
| Vehicle unknown | 5 | 5.56 |
| Total | 90 | 100.00 |

Table 8. Involvement of type of vehicle in accident

countries like India. The higher involvement of driver in this study could be explained due to environment of drivers in developing countries like India, young age, continuous strenuous driving, poor road conditions, and intake of alcohol and other drugs.

The vehicles most commonly involved in vehicular accident in fatal head injury cases are four wheelers i.e. 60%, while next commonly involved vehicles are two wheelers 30%. 2.22% bicycle are involved 2.22% were three wheelers are in 5.56% the involvement of vehicles are not known (Table-8). As regards the type of vehicles there is common involvement of four wheelers. It can be on account of the problems of carrying heavy load to and fro and usually the drivers of such vehicles do not pay attention and due regards to the traffic rules and regulations. Similarly they do not offer appropriate signals or indicators. Karrae Solheim¹⁰ found that out of 168 vehicles in road traffic accidents, lorry, truck and bus were involved in 61 accidents, private car and taxi in 57 accidents, motor cycle in 6 accidents, and train in 25 accidents. In 17 accidents, involved vehicle was unknown. Another study found that heavy goods vehicles are main motor vehicles involved in road traffic accidents¹¹.

Conclusion

In this study 128 cases of head injury victims in fatal vehicular accidents autopsied from June 2003 to June 2008 were included. Maximum cases of road traffic accidents were among males (88%), male to female ratio was 7:1 and maximum incidence was in the age group of 21-40 years comprising 55%. Temporal (20%) and frontal (20%) bones were the commonest sites of fracture. Subdural hemorrhage was the commonest among the intracranial hemorrhages seen in 40% cases. Most common victims were pedestrians (36%) followed by occupants (34%) and drivers (25%). Incidence was more common among the four wheeler vehicles. Proper examination and evaluation of such traffic injuries will help us while facing the cross examination and also helps towards reconstruction of the whole accident.

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Correlation between age and degree of fusion, Between sternal joints

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Abstract

The relationship between age and degree of fusion between manubrium and mesosternurm and xiphoid process and mesosternurm was studied. The data was statistically analyzed. The mean age for onset and completion of these joints were calculated, followed by their regression equation for males and females respectively. Combined regression equation was also calculated for use where sex of the person is not known. The findings are presented in this article.

Key words: Sternum, Sternal joints, Degree of fusion, Age estimation

Introduction

Age estimation of unidentified human skeletal remains is a considerable problem in Forensic Medicine. Determination of age is required in many medicolegal cases. Sternum has been studied by very few regarding its utility for estimation of age. Authors have described fusion of xiphoid process with mesosternum at about 40 years of age and that of manubrium with mesosternum at "Very old age" i.e. 55-60 years¹⁻ ³. Forensic experts usually base their opinion on these observations. In view of its utility and limited studies, we have studied the fusion of these two joints for estimating age.

Aims and Objectives

- 1 To study the relationship between age and degree of fusion between-
- a) manubrium and mesosternurm
- b) xiphoid process and mesosternurm
- 2. To obtain regression formulae from the above, in males and females.

Methods And Materials

The work was carried out in the mortuary of Forensic Medicine department at Lady Hardinge Medical College, New Delhi on cadavers brought for post mortem examination. A total of 100 sterna (50 males and 50 females) were collected from subjects of known age. Subjects above 18

Reprints Requests: Dr. Wadhawan M.

Senior Resident Department of Forensic Medicine & Toxicology, PGIMER, Chandigarh year of age without any congenital or acquired bony defects only were included in the study. Each dissected sternum was properly labeled. The soft tissues were macerated, cleaned and dried. The degree of fusion between the manubrium and mesosternum & between mesosternum and xiphoid process was studied and graded according to the following scale-

- 1. 0 degree- no fusion present in the joint.
- 2. I degree-fusion present but less than half of joining surface
- 3. II degree- fusion present half or more than half of joining surface.
- 4. III degree-complete fusion present.

The data was statistically analyzed for the relationship between fusion of joints and the ages and regression equations were obtained, separately for males and females. A combined regression equation for both the sexes together, was obtained for use in situations where the sex of sternum is not known.

Results and Observation

Fusion between manubruim and mesosternum in males (Table 1)

| | Grade 1 | Grade M | | | | |
|----------------|---------|---------|------|------|-------|--|
| Age (in years) | 0.00 | 1.00 | 2.00 | 3.00 | Total | |
| 18 - 25 | 5 | - | - | - | 5 | |
| 26 - 30 | 3 | - | - | - | 3 | |
| 31 - 35 | 8 | 1 | - | - | 9 | |
| 36 - 40 | 5 | - | - | - | 5 | |
| 41 - 45 | 1 | 4 | - | - | 5 | |
| 46 - 50 | - | - | 4 | 2 | 6 | |
| 51 - 55 | - | - | 3 | - | 3 | |
| 56 - 60 | - | - | - | 5 | 5 | |
| > 61 | - | - | - | 9 | 9 | |
| Total | 22 | 5 | 7 | 16 | 50 | |

Table 1. showing the age and grades of fusion between manubrium and mesosternum in males (Grade M) It was observed that no fusion of manubriomesosternal joint (Grade 0) was seen to occur in almost all the cases who were below 41 years of age except one case who was in age group of 31-35 years. This group consisted of 22 cases (44%) out of total 50 cases studied in males. Grade I fusion was seen to start between age group of 41-45 years and consisted of 5 cases (10%) out of total 50 cases studied. Grade II fusion was seen to occur between age group of 46-55 years and consisted of 7 cases (14%) out of total 50 cases. Complete fusion (Grade III) was observed in subjects, most of whom were more than 56 years of age and above, except two cases in which complete fusion was observed in age group of 46-50 years. This group consisted of 16 cases (32%) out of total 50 cases. Mean age for onset of fusion (grade I) between manubrium and mesosternuim in males was found to be 42.6 \pm 4.3359 years and for complete fusion (grade III) was 65.8125 \pm 10.6847 years.

| | Grade M | | | | |
|----------------|---------|------|------|------|-------|
| Age (in years) | 0.00 | 1.00 | 2.00 | 3.00 | Total |
| 18 - 25 | 10 | - | - | - | 10 |
| 26 - 30 | 6 | - | - | - | 6 |
| 31 - 35 | 5 | - | - | - | 5 |
| 36 - 40 | 3 | 3 | 1 | - | 7 |
| 41 - 45 | 1 | 5 | - | - | 6 |
| 46 - 50 | - | - | 4 | - | 4 |
| 51 - 55 | - | - | 1 | 4 | 5 |
| 56 - 60 | - | - | - | 4 | 4 |
| > 61 | - | - | - | 3 | 3 |
| Total | 25 | 8 | 6 | 11 | 50 |

Fusion between manubruim and mesosternum in females (Table 2)

Table 2. showing the age and grades of fusionbetween manubrium and mesosternum infemales (Grade M)

It was observed that no fusion of manubriomesosternal joint (Grade 0) was seen to occur in women below 35 years of age. This group consisted of 21 cases (42%) of total 50 cases studied in females. However, there were 4 cases in age group of 36-46 years which did not show fusion of the joint. Thus, half the total number of cases studied, who were less than 45 years of age did not show any fusion of manubriomesosternal joint. The onset of fusion (Grade I) was seen in the age group 36-45 years and this group consisted of 8 cases (16%) out of total 50 cases. Grade II fusion was found in 5 cases which were between age group of 46-55 years. In one case, Grade II fusion was found in age group of 36-40 years. Thus grade II fusion was seen in 12% of total cases. Complete fusion (Grade III) was found in women who were 51 years and more, in age. This consisted of 11 cases (22%) out of total 50 cases. Mean age for onset of fusion (grade I) between manubrium and mesosternuim in females was found to be 42.1250 ± 3.2705 years and for complete fusion (grade III) was 58.3636 ± 5.0055 years.

Mean age for onset of fusion (grade I) between manubrium and mesosternuim in both sexes was found to be 42.3077 ± 3.5446 years and for complete fusion (grade III) was 62.7778 ± 9.4557 years.

| | Grade X | | | | |
|----------------|---------|------|------|------|-------|
| Age (in years) | 0.00 | 1.00 | 2.00 | 3.00 | Total |
| 18 – 25 | 5 | - | - | - | 5 |
| 26 - 30 | 3 | - | - | - | 3 |
| 31 – 35 | 2 | 6 | 1 | - | 9 |
| 36 - 40 | - | 2 | 2 | 1 | 5 |
| 41 - 45 | - | - | 1 | 4 | 5 |
| 46 - 50 | - | - | - | 6 | 6 |
| 51 – 55 | - | - | - | 3 | 3 |
| 56 – 60 | - | - | - | 5 | 5 |
| > 61 | - | - | - | 9 | 9 |
| Total | 10 | 8 | 4 | 28 | 50 |

Fusion between mesosternum and xiphoid process in males (Table 3)

Table 3. showing the age and grades of fusion between mesosternum and xiphoid process in males (Grade X)

Males who were below 30 years of age did not show any fusion (Grade 0). Subjects in age group 31-35 years showed the mixed pattern of fusion wherein 2 cases showed non fusion, 6 cases showed grade I fusion, 1 case had grade II fusion. 5 cases between the age group of 36-40 years also showed a variable picture, where 2 cases had grade I degree of fusion, another 2 cases also had grade II fusion and 1 cases had grade III fusion. Complete fusion (Grade III) was seen in rest of subjects who were in age group of 41-45 years and above. All the cases who were more than 60years showed grade III fusion. Mean age for onset of fusion (grade I) between xiphisternum and

mesosternuim in males was found to be 35.1250 ± 0.6409 years and for complete fusion (grade III) was 58.0000 ± 12.4811 years.

| | Grade X | | | | |
|----------------|---------|------|------|------|-------|
| Age (in years) | 0.00 | 1.00 | 2.00 | 3.00 | Total |
| 18 - 25 | 10 | - | - | - | 10 |
| 26 - 30 | 6 | - | - | - | 6 |
| 31 - 35 | 2 | 3 | - | - | 5 |
| 36 - 40 | - | 3 | 4 | - | 7 |
| 41 - 45 | - | - | 2 | 4 | 6 |
| 46 - 50 | - | - | - | 4 | 4 |
| 51 - 55 | - | - | - | 5 | 5 |
| 56 - 60 | - | - | - | 4 | 4 |
| > 61 | - | - | - | 3 | 3 |
| Total | 18 | 6 | 6 | 20 | 50 |

Fusion between mesosternum and xiphoid process in females (Table 4)

Table 4 showing the age and grades of fusion between mesosternum and xiphoid process infemales (Grade X)

Cases who were below 30 years of age did not show any fusion. However, 2 cases in age group 31-35 years also did not show any fusion. At the same time, 3 cases in this age group showed grade I fusion. Grade I fusion was also seen in age group 36-40 yeas. 6 cases who were between age group 36-45 years showed grade II fusion. Complete fusion (Grade III) was seen in subjects who were of age group 41-45 years and above. This group had 20 cases out of the total of 50 cases which were studied.Mean age for onset of fusion (grade I) between xiphisternum and mesosternuim in females was found to be 35.8333 ± 1.4720 years and for complete fusion (grade III) was 53.1000± 7.2758 years.

Mean age for onset of fusion (grade I) between xiphisternum and mesosternuim in both sexes was found to be 35.4286 ± 1.0894 years and for complete fusion (grade III) was $55.9583 \pm$ 10.8097 years.

Statistical Analysis

The data was statistically analysed and from the relationship between fusion of sternal joints and age, following regression equation were obtained.

1. Males

Regression equation for age from grade of fusion between manubrium and mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X).

Age = 28.151 + 8.599 Grade M + 3.403 Grade X R² = 82.5% (significant)

2. Females

Regression equation for age from grade of fusion between manubrium and mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X).

Age = 25.816 + 5.021 Grade M + 5.296 Grade X R² = 88.9% (significant)

3. For both sexes

Regression equation for age from grade of fusion between manubrium and mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X).

Age = 26.710 + 7.170 Grade M + 4.284 Grade X R² = 83.9% (significant)

Discussion

According to Susan Standring et al⁴, in occasional individuals older than 30 years, the manubrium is joined to sternal body by bone but the intervening cartilage may be only superficially ossified; it is in the aged that this is completed. According to Basmajian and Solenecker⁵, the manubriosternal joint becomes ossified in 10% individuals after the age of 30 years. Krogman & Iscan⁶ are of the view that the manubrium fuses with the body of sternum "in old age"⁶. Modi has stated that manubrium rarely unites with body of sternum except in old age⁷. In our study of

manubriomesosternal joint in males, it was observed that fusion was seen to start between age of 41-45 years. Complete fusion was observed in subjects, most of whom were more years of age. Fusion than 56 of manubriomesosternal joint in females was seen to start between age of 36-45 years and complete fusion was seen in subjects who were 51 years or more in age.Mean age for onset of fusion in male was 42.6±4.3359 years and for complete fusion was 65.8125±10.6847 years. In females, mean age for onset of fusion was 42.125±3.2705 years and for complete fusion was 58.3636±5.0055 years. Onset and completion of fusion was seen to occur earlier in females as compared to males.

According to Susan Standring et al⁴, xiphisternal joint is a symphysis. It is usually transformed to synostosis by the fortieth year. It sometimes remains unchanged even in old age. According to Rentoul & Smith¹, fusion of mesosternum with xiphisternum occurs at 40 years. According to Krogman & Iscan⁶, at the base of sternal body, there is a cartilage (ensiform or xiphoid) which may or may not calcify. According to Modi⁷, xiphoid process unites with body at about 40 years of age. In our study of fusion between mesosternum and xiphoid process in males, it was observed that fusion was seen to start between age of 31-35 years and complete fusion was observed in subjects greater than 41 years of age. In females, it was observed that fusion was seen to start between age group of 31-35 years and complete fusion was observed in subjects greater than 41 years of age. Mean age for onset of fusion in males was 35.1250±0.6409 years of age and for complete fusion was 58±12.4811 years. In females, mean age for onset of fusion was 35.8333±1.4720 years and for complete fusion was 53.10±7.2758 years. There was negligible difference in age of onset of fusion in males and females but complete fusion occurred earlier in females.

Summary and Conclusion

In our study, we found that the study of fusion of manubriomesosternal joint and xiphiod process with mesosternum can help in estimating the approximate age of the individual. Mean age for onset of fusion of manubriomesosternal joint in males was 42.6 ± 4.33 years and in females was 42.12 ± 3.27 years and for complete fusion in males was 65.81 ± 10.68 years and in females was 58.36 ± 5.00 years. Mean age for onset of fusion of xiphoid process with mesosternum in males was 35.12 ± 0.64 years and in females was 35.83 ± 1.47 years and for complete fusion in males was 58 ± 12.48 years and in females was 53.10 ± 7.27 years.

Regression equations in males

Regression equation for age from grade of fusion between manubrium and mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X) was

Age = 28.151 + 8.599 Grade M + 3.403 Grade X

Regression equations in females

Regression equation for age from grade of fusion between manubrium and mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X) was

Age = 25.816 + 5.021 Grade M + 5.296 Grade X

Mean age for onset of fusion of manubriomesosternal joint in both sexes is 42.30±3.54 years and for complete fusion was 62.77±9.45 years. Mean age for onset of fusion of xiphoid process with mesosternum joint in both sexes is 35.42±1.08 years and for complete fusion is 55.98±10.8 years.

For both sexes, regression equation for age from grade of fusion between manubrium and

mesosternum (Grade M) & between xiphisternum and mesosternum (Grade X) was Age = 26.710 + 7.170 Grade M + 4.284 Grade X.

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Accidental strangulation with moving belt of electric motor- A Case Report

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Abstract

A 40 years old male was accidentally strangulated, when his clothes got caught in the belt of electric motor while working at the farm. He was brought dead in mortuary wing of hospital. Cause of death was given as fracture of cervical vertebrae as a result of ligature strangulation.

Key words: Accidental strangulation, Ligature mark, fracture

Introduction

Strangulation is a type of mechanical asphyxia due to constriction of neck by a ligature or hand, when a constricting force other than weight of body is applied. It is mostly homicidal in nature. Accidental Strangulation is rare, but it may occur when an article of clothing, neckband or cord is tightly drawn around the neck. This may occur in an epileptic or an intoxicated person who may be helpless in extricating himself from such tight encirclement of neck.¹⁻⁵

In present case, victim was operating electric motor in a farm, when his clothes suddenly got entangled in moving belt and death occurred on the spot.

Case Report

A 40 years old male was brought dead in mortuary wing of Department of Forensic



Photograph I

Reprints Requests: Dr. Rajiv Joshi Associate Professor Dept. of Forensic Medicine, MAMC, Agroha Medicine for autopsy with the alleged history of accidental ligature strangulation. White shirt, the deceased wearing, was torn at several places. Ligature mark was present around the neck. Rigor mortis was present in upper extremities. Postmortem staining was present at back, but was not fixed. Tongue was bitten between teeth.

On Examination Following injuries were detected

Ligature mark measuring 2cm x 2cm in dimension was present encircling the neck. Involvement of ligature mark was more on right side and about 13 cm square area of neck was spared on left side.(photograph 1)

On Dissection

*Ante mortem infiltration was present underneath muscle of neck. Thyroid muscles



Photograph II

were showing infiltration. Rapture of muscular sheet was present. Fracture of cervical vertebrae C2 and C3 was present. (Photograph 2)

*Reddish abrasion of size 8.5cmx3cm was present on right side of neck 3.5cm below injury No.1.

*Reddish abrasion of size 7cm x 4cm was present on left clavicle region.

*Reddish abrasion of size 4cm x 2cm was present on medial aspect of left arm.

Organ of deceased was found congested and sent for detection of intoxicant to chemical examiner. Cause of death was given as fracture of cervical vertebrae as a result of ligature strangulation.

Discussion

Case is typical of accidental strangulation by ligature. Generally strangulation is presumed to be homicidal unless proved otherwise. In medico legal literature, only few case of accidental ligature strangulation is reported⁶. Looseness of clothes, intoxication and epileptic condition act as key factor in entrapping the person in such event, more ever force and pressure of operating machinery prevent the escape of person from clutches of death^{1, 5}. Precaution while handling these instruments can save precious life of person.

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