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Original Article

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Prevalence of Uterine Anomalies in Relation with Radiological Anatomy among Patients Attending Tertiary Care Centre

Azhagiri R.[1], M. Anitha[2], Hemapriya J.[3]

Abstract

Introduction: Uterine anomalies arise due to malformation in the Mullerian duct development. These anomalies were often asymptomatic and unrecognized, also increases the risk of adverse pregnancy outcome like infertility, recurrent pregnancy loss, preterm delivery, amenorrhea, pain and fetal malpresentation. Many of these malformations were detected by radiologic or sonographic studies. *Materials and Methods:* Observational study includes 150 women between 18-35 yrs with gynecological problem in a tertiary care hospital in Kancheepuram district over a period of 1 year from January 2017 to January 2018. Pelvic imaging of study subjects with transabdominal and transvaginal ultrasound was performed as per the standard procedure. *Results:* Among 150 patients 75 had the complaint of primary infertility, 71 had primary amenorrhea and 4 came with frequent miscarriage. Out of 150 study subjects who underwent 2D ultrasonography, 69 showed uterine anomalies. Overall prevalence of anomalies was 46%, of which frequency of septate form of anomalies was maximum (45%), followed by Bicornuate uterus (17%), arcuate uterus (16%), didelphic uterus (13%), unicornuate uterus (4.3%), and subseptate uterus (4.3%). *Conclusion:* Actual prevalence with correct assessment of anomalies using radiological anatomy will help to differentiate uterine anomalies and thereby suggest a right therapeutic option.

Keywords: Reproductive Problems; Prevalence; Uterine Anomalies; Radiological Anatomy.

Introduction

Anatomical abnormalities of female genital tract can be classified as congenital (disorders of mullerian tract) and acquired (adhesions, cervical incompetence, polyps, and uterine myomas). Although some anomalies may have little to no effect on pregnancy outcome, others may cause recurrent pregnancy loss**.** Hence, prevalence of anatomical abnormalities in patients with repeated miscarriages is high, ranging from 6.3% to 67%, depending on the type of the study and the study population [1].

Of all mullerian anomalies, those involving the uterus are most commonly implicated in causing poor obstetric outcomes. Uterine anomalies are a defect from normal anatomy of the uterus with estimated prevalence of 4–7% among general population and even higher in selected populations such as recurrent aborters. Presentation of uterine anomaly is reported as one of the main reason for recurrent abortion [2,3].

Uterine anomalies are associated with diminished cavity size, insufficient musculature, impaired ability to distend, abnormal myometrial and cervical function, inadequate vascularity, and abnormal endometrial development. These abnormalities of uterine space, vascular supply, and associated local defects contribute to increased rates of recurrent pregnancy loss, preterm delivery, and malpresentation associated with uterine anomalies [4].

A classification of the Müllerian anomalies was introduced in 1980 and, with few modifications, was adopted by the American Fertility Society (currently, ASRM). The Society identified seven basic groups according to Müllerian development and their relationship to fertility: agenesis and hypoplasia, unicornuate uteri (unilateral hypoplasia), didelphys uteri (complete nonfusion), bicornuate uteri (incomplete fusion), septate uteri (nonreabsorption of septum), arcuate uteri (almost complete reabsorption of septum), and anomalies related to DES syndrome [5].

Author's Affiliation: [1]Assistant Professor [3]Tutor, Department of Anatomy, ESIC Medical College & PGIMSR, KK Nagar, Chennai, Tamil Nadu 600078 Dr. MGR Medical University, Chennai, India. [2]Lecturer, Department of Microbiology, Shri Sathya Sai Medical College & Research Institute, Ammapettai, Tamil Nadu 603108, India.

Corresponding Author: Azhagiri R., Assistant Professor, Department of Anatomy, ESIC Medical college & PGIMSR, KK Nagar, Chennai, Tamil Nadu 600078, India.
E-mail: drazhagirir@gmail.com
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These anomalies were often asymptomatic and unrecognized, but reported in 2–4% among normal reproductive age women [2,3,4,6] and up to 5–25% in women with adverse reproductive outcomes [6,7]. Presence of anomalies increases the risk of adverse pregnancy outcome like infertility [2] recurrent pregnancy loss [8] preterm delivery [9] amenorrhea, pain and fetal malpresentation [10].

Usually diagnosis of Mullerian duct abnormality is diagnosed when the female fails to attain menarche and fails to conceive after marriage. Due to their high prevalence, diagnosis of MDAs and their sub type identification is important for management and therapeutic decision-making of these structural anomalies [11].

Imaging plays an essential role in diagnosis of these conditions. Many of these malformations were detected by radiologic or sonographic studies. 2D ultrasonography remains a baseline procedure in detecting malformations. MRI was considered the preferred modality due to its multiplanar capabilities as well as its ability to evaluate the uterine contour, junctional zone, and other pelvic anatomy [12,13]. Compared to *MRI* 2D US method has the additional advantage of offering a better imaging of the uterine cavity, thus enhancing the accuracy in identifying the anatomy of the female genital tract and especially that of the uterus [14].

Hence, careful understanding of uterine anatomy using sonographic imaging will improve the detection of these anomalies, which could play an important role in recognizing and managing the obstetric and gynecological impediments. Hence our study was undertaken to assess the morphology of uterus using 2D Ultrasonography and evaluate the anomalies.

Materials and Methods

Inclusion Criteria

- Age Group: 18- 35 years Females
- Females with gynecological problem (primary infertility, primary amenorrhea and frequent miscarriage)
- No previous history of Hysterectomy

Exclusion Criteria

- Patients known to have sexually transmitted diseases,
- Pelvic inflammatory diseases
- Genetic anomalies

This observational study involved the prospective recruitment of women referred to a tertiary care center for the assessment and treatment of gynaecological problems. The study was carried out in a Tertiary care hospital in Kancheepuram district over a period of 1 year from January 2017 to January 2018. A total of 150 women were included in the study. The study was conducted after getting approval from Institutional ethics committee and the patients were informed about complete details of imaging procedure and their safety measures. A written informed consent was obtained from each subject before performing the technique.

All the study subjects underwent a radiologic and operative diagnostic workup using 2D trans abdominal and transvaginal ultrasonography. Pelvic imaging with transabdominal and transvaginal ultrasound was performed as per the standard procedure [3].

As our study population include both married and unmarried women, 2D trans abdominal as well as transvaginal ultrasonography procedure was carried out only for married women whereas unmarried women underwent only transabdominal ultrasonography.

Sampling technique adapted for the study was Complete Enumeration Method, Ultrasonography images were collected from Radiology Department, these images evaluated anatomically and as per American Fertility Society (AFS) established in 1988 [5]. Data were analysed and compiled statistically.

Results

A total of 150 patients with the complaint of primary infertility (75), primary amenorrhea (69) and frequent miscarriage (6) were included in this study. Out of 150 study subjects who underwent 2D ultrasonography, 69 showed uterine anomalies including septate uterus, Bicornuate, arcuate, didelphic, unicornuate, and subseptate uterus.

Out of 69 cases of Mullerian duct anomalies examined by ultrasonography, 50 (72.4%) patients presented with primary infertility, 15 (21.7%) with primary amenorrhea and 4 (5.7%) had the history of recurrent miscarriage.

Overall prevalence of anomalies was 46%, of which frequency of septate (Figure 2) anomalies was maximum (45%), followed by Bicornuate (17%) (Figure 3), arcuate (16%), didelphic (13%), unicornuate (4.3%), and subseptate (4.3%) (Table 1).

Number of patients with different gynecological problems and the corresponding uterine anomaly types were as follows. Among 50 primary infertility cases with uterine anomalies 26 was examined with septate uterus, 10 with bicornuate uterus, 5 with arcuate uterus, 6 with didelphic uterus and 3 with unicornuate uterus. Of 15 primary amenorrhea patients, 5 showed septate uterus on examination followed by 6 arcuate uterus, 1 didelphic uterus and 3 subseptate uterus. (Table 2, 3 & 4).

Bicornuate uterus and septate uterus type of anomalies were seen among 4 frequent miscarriage cases. Two cases with bicornuate uterus and two cases with septate uterus was found to have recurrent miscarriage during first trimester of pregnancy. Uterine anomalies with respect to period of miscarriage was depicted in (Fig 3 & Table 5).

Table 1: Distribution of uterine anomalies by 2D ultrasonography

Uterine anomalies	Number of cases	Percentage%
Septate uterus	31	45
Bicornuate uterus	12	17
Arcuate uterus	11	16
Didelphic uterus	9	13
Unicornuate uterus	3	4.3
Subseptate uterus	3	4.3
Total	69	100

Table 2: Number of patients with primary infertility and type of uterine anomalies present

Uterine anomalies	Primary Infertility
Septate uterus	26
Bicornuate uterus	10
Arcuate uterus	5
Didelphic uterus	6
Unicornuate uterus	3
Subseptate uterus	-
Total - 69 (100%)	50(72.4%)

Table 3: Number of patients with primary amenorrhea and type of uterine anomalies present

Uterine anomalies	Primary amenorrhea
Septate uterus	5
Bicornuate uterus	6
Arcuate uterus	-
Didelphic uterus	1
Unicornuate uterus	-
Subseptate uterus	3
Total - 69 (100%)	15(21.7%)

Table 4: Number of patients with recurrent miscarriage and type of uterine anomalies present

Uterine anomalies	Recurrent miscarriage
Septate uterus	2
Bicornuate uterus	2
Arcuate uterus	-
Didelphic uterus	-
Unicornuate uterus	-
Subseptate uterus	-
Total - 69 (100%)	4 (5.7%)

Table 5: Uterine anomalies in relation to recurrent miscarriage

Type of Uterine anomalies	No of recurrent miscarriages	10-13 weeks	15 -20 weeks
Septate uterus	2	1	1
Bicornuate uterus	2	0	2

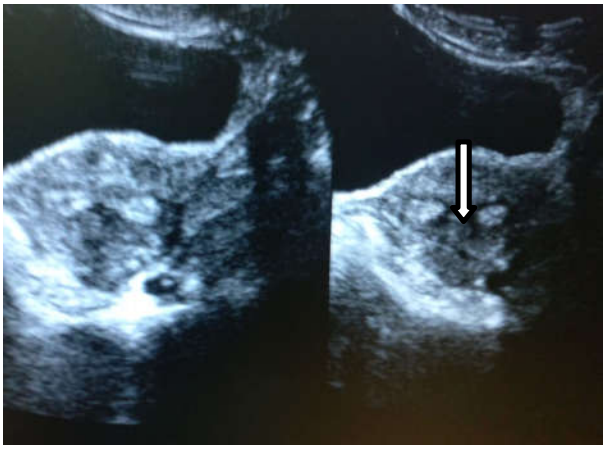

Fig. 1: Arrow depicts the Septate uterus

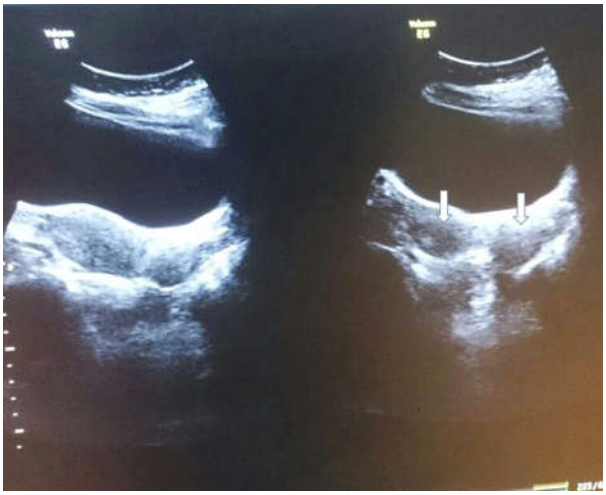

Fig. 2: Picture shows Bicornuate uterus

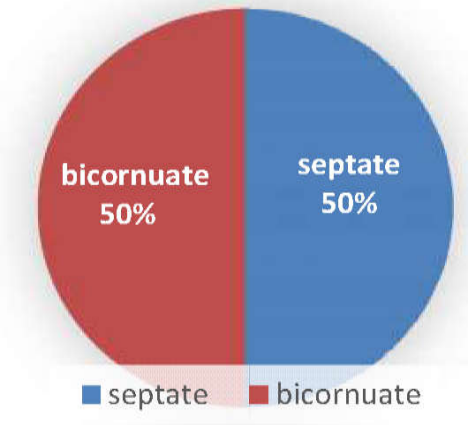

Fig. 3: Prevalence of Uterine Anamolies vs Miscarriage

Discussion

Normal Anatomy of Uterus

The uterus is a hollow, pear shaped, thick-walled and muscular organ, normally situated in the lesser pelvis between the urinary bladder and the rectum. The uterus is divided into two main regions – the body – corpus uteri – forms the upper two thirds, and the cervix – cervix uteri - forms the lower third. The uterine tubes are attached to the upper part of the body of uterus with their ostia opening into the lumen [15].

Embryology: Uterine Development

Embryologically, the uterus, fallopian tubes and upper one third of vagina develops from the paramesonephric (Mullerian) ducts. The cranial part of the paramesonephric ducts forms the uterine tubes, and the coelomic invagination remains as the pelvic opening of the fallopian tube. The caudal part of two mullerian ducts fuses to form the uterovaginal primordium, from which uterus and upper one third of vagina develops [16].

The uterus is formed at around 8–16 weeks of fetal life from the development of the two paired paramesonephric ducts, called Mullerian ducts. The process involves three main stages [3,17].

- Organogenesis of mullerian ducts, fusion and septal resorption are the three phases which aid in the normal development of the female reproductive tract from the paramesonephric ducts.
- *Fusion*: the lower Mullerian ducts fuse to form the upper vagina, cervix and uterus; this is termed lateral fusion. The upper cranial part of the Mullerian ducts will remain unfused and form the Fallopian tubes.
- *Septal absorption*: after the lower Mullerian ducts fuse, a central septum is left which starts to resorb at 9 weeks eventually leaving a single uterine cavity and cervix.

The various Mullerian anomalies are the consequence of 4 major disturbances in the development of the female genital system during the fetal life [11].

- Failure of one or more mullerian duct to develop (agenesis, unicornuate uterus without rudimentary horn).
- Failure of the ducts to canalize (Unicornuate uterus with rudimentary horn without proper cavities).
- Failure to fuse or abnormal fusion of the ducts (Uterus didelphys, bicornuate uterus)
- Failure of resorption of the midline uterine septum (Septate uterus, arcuate uterus).

In our study population, prevalence of *primary infertility* with MDAs was 72.4%, this is high when compared to other studies where 25% of infertility among MDAs was reported by Krishna Pratap Singh Sengeret al., [18] and human reproduction update 2011 by Chan et al., [3] reported only 8% of infertility cases. This could be due to small sample size where human reproduction updates 2011[3] analysed about 89,861 cases.

Our study revealed 21.7% of MDAs patients with *primary amenorrhea* which is less when compared to study done by Rao and Pillai [19] who performed a study with a sample size of 40 to evaluate causes of primary amenorrhea and found a prevalence of MDAs of 50%. Another study done by Kumar and Mittal [20] on a study sample of 48 patients to evaluate etiological factors for primary amenorrhea has revealed prevalence of MDAs as 54.2% in their study population.

Recurrent miscarriage with MDAs in our study was 5.7%. In contrast to our study 37.5% of recurrent abortions/miscarriages were reported by Krishna Pratap Singh Senger et al., [18] and prevalence of 13.3% was mentioned in Human Reproduction Update 2011 [3].

The data in this study suggested a high prevalence of uterine anomalies (46%), which is found to be quite higher than the other reports [3,18].

Among our study subjects 46% had *Septate uterus*, whereas Francisco Raga et al., in 1997 [21] showed an incidence of 33.6% of septate uterus, and 35% was observed by Grigoris F. Grimbizis et al., in 2001 [22] and Braun P. et al., in 2005 [17] reported 24.3%, while Saravelos S.H. [23] in his review in 2008 found the dominance of septate uterus in infertile women.

Second most common anomaly was *Bicornuate uterus* 17% in the current study. Grigoris F. Grimbizis et al. [22] reported a mean incidence of 25% of bicornuate uterus and Braun P. et al., [17] in retrospective study stated incidence of 13.6% of bicornuate uterus.

In the current study arcuate uteruswas third most common anomaly accounting for 16%. Similarly to our study a mean incidence of 20% was reported by Grigoris F. Grimbizis et al., in 2001 [22] , whereas Francisco Raga et al., in 1997 [21] reported higher incidence of 32.8%.

Present study revealed equal prevalence of unicornuate and substrate uterus (4.3%). Similar incidence of 4.5% of unicornuate uterus was reportedby Braun P et al., [17], whereas 6.7% of prevalence was reported by Krishna Pratap Singh Senger et al.,[19].

Our study also reported 13% of didelphic uterus, didelphis (double uterus) Both Müllerian ducts develop but fail to fuse, and thus the patient has a "double uterus". Apart from high miscarriage rates and preterm deliveries, cases of didelphic uterus run the risk of Cesarean section for dystocia, and malpresentation [24].

Our study revealed 5.7% of recurrent miscarriage cases during first trimester of pregnancy with 2 septate uterus and 2 bicornuate uterus form of anomaly.

Dabirashrafi et al., Kupesic et al., [25,26] have found significantly more blood vessels in biopsy samples of the uterine septum, and Kupesic et al., [26] found that patients with vascularized septum had significantly higher prevalence of early pregnancy failure and late pregnancy complications than those with avascularized septa. Our finding had similar report to that of Human Reproduction Update 2011 where their study showed common cause of recurrent abortions was septate uterus. Also, surgical correction of uterine septum was less morbid and easy. High prevalence of early pregnancy loss and late complications were more seen in vascularised septum. [3] Thus, embryos that do implant on the septum are more likely to miscarry as a result of this, possibly because the septum has a disorderly and decreased blood supply, which is insufficient to support subsequent placentation and embryo growth [27,28,29].

Similar to our study, Fedele and Bianchi et al., [30] and Rock JA et al., [31] confirms bicornuate uterus as a reproductive anomaly in pregnant women reported with frequent miscarriage. Excessive preterm delivery, retained placenta, malpresentation and miscarriage rates were characteristic in bicornuate uterus cases. This anomaly therefore requires extensive surgical repair. Women with bicornuate uterus have an increased risk of first trimester miscarriage, preterm birth and fetal malpresentation. Our finding was consistent with these previous studies [28,29,32].

Ultrasonography was considered as first imaging technique in evaluation of Mullerian duct anomalies among women. Ultrasonography is a simple and widely available option with no radiation risk and can be performed repeatedly.

Conclusion

Uterine anomalies being the most common anatomical variations causing numerous major gynecological and obstetrical problems such as consecutive abortions, infertility and primary amenorrhea among reproductive age group women, it becomes a great struggle for low socio economic status women to face it. 2D Ultrasonography being a noninvasive, easily feasible, cost effective procedure, most importantly has no radiation hazards and is thus suitable as first line of investigation. Hence 2D Ultrasonography has brought a revolution in diagnosing uterine anomalies for such low socioeconomic patients. The knowledge of the relationship by appropriate anatomical understanding of these anomalies using 2D imaging helps the gynecologist in early diagnosis and surgical treatment of uterine anomaly. Thereby preventing recurrent abortion in pregnancy and brings a boon in the life of many cases of infertility patients.

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Original Article

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Study of Supraorbital Foramen and Notch in the Skulls of the Eastern Indian Population

Sudeepa Das[1], Bikash Chandra Satapathy[2], Minati Patra[3]

Abstract

Introduction: The supraorbital notch/foramen (SON/F) is present in the frontal bone through which the supraorbital nerve passes. The knowledge regarding the different positions of the SON/F becomes essential while performing surgeries around the orbit and in the face. This study aims to provide a baseline metrical data regarding the supraorbital foramen (SOF) in eastern Indian population. *Material and Methods:* In this study 52 dry human skulls (36 male, 16 female) were taken and a detailed viewing of all 104 sides was done for its form, position and occurrence along with measuring the dimensions of SON/F and its distance from different bony landmarks. *Result:* Our study shows the supraorbital notch was present more commonly as in 76.92%cases than supraorbital foramen which was found only in 23.08% cases. The mean distances of SON/F from the mid facial line is 19.9±3.8 mm on left and 20.9±3.4 mm on right, from the frontozygomatic suture it is 28.1±2.5 mm in left and 27.7±1.9 mm in right. And from the temporal crest is found to be 25.5±2.5 mm in left and 25.4±2.3 mm in right. *Conclusion:* Accuracy in knowing the position of SON/F will aid preventing iatrogenic damage to the supraorbital nerve in various surgeries.

Keyword: Supraorbital Foramen; Supraorbital Notch; Accessory Foramina; Mid Facial Line; Frontal Bone; Frontozygomatic Suture.

Introduction

The supraorbital notch/foramen(SON/F) lies at the superomedial margin of the orbit in frontal bone through which the supraorbital nerve and vessels emerges to supply the skin of scalp, upper eyelid, forehead and nose [1,2]. Supraorbital nerve is the sole sensory supply in this region, making it a nerve of choice for rendering optimum regional block required for the biopsies and surgeries done for cosmetic purposes by the surgeons and anesthetists. Knowledge of the location of different facial foramina with accuracy is needed for various invasive approach into the maxillofacial areas [3–5] and the reconstructive surgeries involving flaps. There may be bleeding, paraesthesia or hypoesthesia or even anaesthesia, neuralgia and entrapment neuropathies as the supraorbital neurovascular bundle lies in close proximity while passing through SON/F [4,6]. Various literature suggests the existence of the variability in the position and occurrence of SON/F. There are evidences which clearly shows that the exit of the supraorbital neurovascular bundle varies in different population [7–10]. Thus anatomical knowledge of this foramen is of great use. As per the data there is very less known facts about the morphology of SON/F in the eastern population hence this study is an attempt to establish some of the parameters important for the localization of SON/F using its morphology and distances from certain bony landmarks.

Author's Affiliation: [1]Assistant Professor [3]Professor, Department of Anatomy, Kalinga Institute of Medical Sciences KIIT Deemed to be University, Bhubaneswar, Odisha 751024, India. [2]Assistant Professor, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Vijayawada, Andhra Pradesh 520008, India.

Corresponding Author: Dr. Bikash Chandra Satapathy, Department of Anatomy, All India Institute of Medical Sciences, Mangalagiri, Temporary Campus, Siddhartha Medical College, Vijayawada, Andhra Pradesh 520008, India.
E-mail: bikash.satapathy@gmail.com,

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Material and Methods

Fifty two skulls of known gender were collected from the osteology unit of the department of anatomy of KIMS; Bhubaneswar. 104 sides of these 52 skulls were inspected for any damage in the orbit and frontal

bone region. The intact skulls only were considered for this study while the damaged ones were rejected. The supraorbital foramen was studied in relation to different bony anatomical landmarks. The morphometric measurements of the supraorbital foramen and its distances from the various anatomical bony landmarks were measured with the aid of digital caliper which is calibrated with accuracy nearest to 0.1mm. All measurements were taken twice by the authors from which average value was calculated. The following parameters were studied.

- Transverse diameter of SOF
- Vertical diameter of SOF
- The distance of the medial margin of SON/F from the mid facial line (FM).
- Distance between SON/F from the temporal crest of the frontal bone.
- Distance between SON/F from the frontozygomatic suture.
- Distance between the superior orbital margin from the inferior margin of SOF.
- Position of SON/F with respect to infraorbital foramen.

The data collected were compiled and statistically analyzed in Quickcalcs online calculator by www.Graphpad.com.

Result

Supraorbital nerve comes out of the cranium either through the corresponding notch or foramen. Our study shows that the supraorbital notches are more frequently seen as in 76.92% cases as compared to supraorbital foramen which is found only in 23.08%cases. Out of the 52 skulls, bilateral supraorbital notches seen in 55.8% cases while bilateral supraorbital foramina seen in 9.6%cases as shown in table1. In one of the skull double accessory foramina was found to be present unilaterally. One of the female skull showed presence double accessory foramina on one side. Presence of bilateral accessory foramina observed only in 8 skulls (Table 1).

Discussion

There are noted variations in position and occurrence of SON/F as per various studies done in different populations [7–12]. Supraorbital notches are more common than supraorbital foramen which is similar with the findings of other researches. The supraorbital neurovascular bundle if passes through the foramen then its position is fixed and its clinical implication will be more as there will be chance of stretching of the nerves and vessels during retraction procedure of the cranium [11]. In the population where the incidence of SOF is higher, the superior border of the orbital rim needs careful handling by the operating surgeons. Not all the nerve fibers pass through the corresponding foramen but few exits by different routes where the role of accessory foramen comes into play. There is documented evidences suggestive of presence of more than one supraorbital nerve [9,10,13]. The prevalence of accessory foramen in the present study is 38.5% while in other studies the incidence seen is less but Ashwini et al in 2012 reported the presence of accessory foramen in their study to be 66.25% which is very high. In 64.5% cases these accessory foramina lies lateral to SON/F [9]. This finding is at par with the studies done earlier by Gupta [13] and Ashwini et al. [9]. In this study we found 63.33% of the accessory foramina lying laterally and 36.67% lying medially to SON/F which coincides with the study done by Ashwini et al. [9]. Due to these accessory exits there may be incomplete anaesthesia during the regional Supraorbital Nerve block. The incidence of bilateral presence of supraorbital notches is much higher than the presence of bilateral foramina [4,9,10]. Our study concludes that in 55.8% cases (56.3%females, 55.6%males) there is supraorbital notches present bilaterally whereas only in 9.6%cases (6.3%females, 11.1%males) the supraorbital foramina are present bilaterally and in 25% cases there is unilateral notch or a foramen. There are various other studies done by different authors in different races suggesting the

Table 1: Position of SON/F in relation to IOF

	Male (36)	Female (16)	Total (52)
Bilateral supraorbital notches	20(55.6)	9(56.3)	29(55.8)
Bilateral supraorbital foramina	4(11.1)	1(6.3)	5(9.6)
Unilateral notch and foramen	9(25)	5(31.3)	13(25)
Bilateral accessory foramina	5(13.9)	3(18.8)	8(15.4)
Unilateral Accessory foramina	10(27.8)	2(12.5)	12(23.1)

Table 2: Comparison of parameters between male and females

Distance	Male		Female		p value
	Number	Mean ± SD in mm	Number	Mean ± SD in mm	
SOF-TD	18	2.8±0.8	6	2.3±0.7	0.156
SOF-VD	18	1.4±0.3	6	1.3±0.2	0.59
SOF-SOM	18	1.7±0.9	6	1.4±1.4	0.53
SON/F-FM	72	20.5±3.2	32	20.2±4.5	0.766
SON/F-TCFB	72	25.6±1.8	32	25.1±3.4	0.294
SON/F-FZS	72	28.1±1.8	32	27.4±2.9	0.127

wide range of discrepancy regarding the SON/F (table 2).

The mid facial line is very often considered as an important landmark for the localization of SON/F [3,6,9–11,14]. In the Chinese population Cheng et al. [11] found that the distance between the facial midline and the supraorbital notch/foramen was 24.56 mm. Their study also revealed that 80% of the exits of supraorbital nerve were lying at a distance 20.77 mm and 30.52 mm from the facial midline. In our study apart from the mid facial line, the distances of the frontozygomatic Suture and the temporal crest of the frontal bone were used for the localization the SON/F. Gender predisposition is quite evident in our studies as per the linear measurements of SON/F from FZS and TCFB is considered. Side related disparity have been reported in earlier studies for the SON/F position with relation to TCFB, FZS and FM [11,15]. No significant differences was observed between the right and left side measurements in our study (Table 3). Cheng et al. [11] reported asymmetry in right side location of SON/F in relation to the superior border of the orbital rim. Chrcanovic et al. [15] in their study showed differences in distance of SON/F from FZS and TCFB in both sides which was significant statistically. However there are many studies including in Indian population not showing any side related disparity [9,10,14,16]. Table 5 shows the average distances of SON/F from the mid facial line, TCFB and FZS with its statistical values. As stated by Cutright et al. [7] the localization of mid facial line could be difficult intra operatively, so the temporal crest which can be palpated easily by getting the temporalis muscle can be considered as more reliable bony landmark to locate the supraorbital neurovascular bundle while performing surgeries.

Standard textbooks in anatomy writes that both infraorbital and supraorbital foramina lie in the same sagittal plane [1]. As per the findings of this study(as shown in table) in 57.7% cases SON/F lies medial to infraorbital foramen and only in 1.9% SON/F is present lateral to infraorbital foramen while in rest in 40.4% cases it lies in the same sagittal plane. But many other studies have shown different location of SON/F with regard to infraorbital foramen [3,7,10]. These differences may be due to racial and ethnic factors.

Table 3: Parameters of left and right sides of crania

Distance	Left		Right		p value
	Number	Mean ± SD in mm	Number	Mean ± SD in mm	
SOF-TD	10	2.5±0.53	14	2.8±0.9	0.441
SOF-VD	10	1.5±0.28	14	1.3±0.3	0.325
SOF-SOM	10	1.1±0.47	14	2.1±1.2	0.0258
SON/F-FM	52	19.9±3.84	52	20.9±3.4	0.185
SON/F-TCFB	52	25.5±2.47	52	25.4±2.3	0.783
SON/F-FZS	52	28.01±2.51	52	27.8±1.9	0.542

Table 4: Position of SON/F in relation to IOF

Position	No	%
Medial to IOF	60	57.7
Lateral to IOF	2	1.9
In the same vertical plane as IOF	42	40.4

Table 5: Comparison of different parameters with other authors

Study	SON/F-FM (mm)	SON/F-FZS (mm)	SON/F-TCFB (mm)
Gupta [13] (Indian)	23.9	-	29.9
Cheng et al. [11] (Chinese)	24.6	-	-
Apinhasmit et al. [10] (Thai)	25.14	-	26.57
Agthong et al. [14] (Thai)	24.4 (right side) 25.1 (left side)	-	-
Chrcanovic et al. [15] (Brazilian)	26.98	-	23.57
Chung et al. [3] (Korean)	22.7	-	-
Barker et al. [6] (Caucasian)	23.97±4.07	-	-
Ashwini et al. [9] (Indian)	22.2 (right side) 22.2 (left side)	29.3 (right side) 28.7 (left side)	-
Nanayakkara et al [2] (Sri Lankan)	23.6 (male) 22.7 (female)	27.9 (male) 26.3 (female)	28.7 (male) 27.3 (female)
Present Study (Indian)	20.45±3.24 male 20.22±4.45 female	28.10±1.83 male 27.38±2.91 female	25.60±1.8 male 25.06±3.35 female

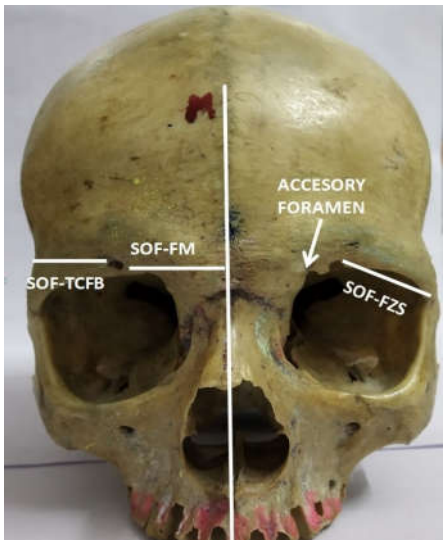

Fig. 1:

Conclusion

The supraorbital nerve exits either through a foramen or a notch. This nerve is important for the anaesthesiologist giving nerve block for treating chronic paroxysmal hemicrania and migraine [17]. These metrical linear data are of practical use clinically that will aid the surgeons for locating SON/F with more accuracy thereby reducing the risk of damage to the adjacent neurovascular bundle.

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Original Article

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Infraorbital Foramen: A Morphometric Analysis in Dry Skulls of Adult Indian Population with its Clinical Implications

Mehandi V. Mahajan[1], Kalpana R.[2], Anupriya Alagesan[3]

Abstract

Aims: 1. To study the morphometric dimensions of infraorbital foramen. 2. To compare the differences with other populations. 3. To study its clinical implications. *Settings and Design*: The data was collected from various medical colleges in Chennai.it was an observational study. *Methods and Material*: Total of 257 (514 sides) dry human adult skulls of unknown age and gender were assessed. The data was collected with help of Vernier caliper, scale, needle & compass. The measurements were performed onthe right and left side of the skull. The study was conducted and the distances were analyzed of infraorbital foramen (IOF) with respect to the infraorbital margin (IOM), supraorbital foramen (SOF), nasion, the nasal rim, the superior alveolar margin (SAM) and the distance from the opposite infraorbital foramen. The height and width of the IOF was also measured. The direction of the infraorbital canal was also noted.The mean and the range was observed and compared with other populations. The data were analyzed statistically. *Statistical Analysis used:* SSPS. *Results*: Mean distances of IOF to Superior orbital foramen [SOF] are 40.2mm and 40.6mm, IOF to Nasion [N] are 42.9mm and 42.8mm, IOF to Nasal Rim [NR] are 16.3mm and 16.4mm, IOF to Infraorbital Margin [IOM] are 7.0mm and 6.9 mm, IOF to Superior Alveolar Margins [SAM] are 25.5mm and 25.4mm on the right and left side respectively. The mean distance of the IOF of one side to the opposite IOF was 50.58mm. Average height & breadth of IOF was3.85mm and 3.65mm on the right and left side respectively. These values were statistically analyzed and also compared with other populations. *Conclusions:* This analytical study gives detailed information of IOF which will facilitate professionals to ascertain the neurovascular bundle and in turn assist in noninvasive & invasive surgical repairs.

Keywords: Infraorbital Nerves; Infraorbital Vessels; Morphometric Data.

Introduction

Infraorbital foramen [IOF] is situated bilaterally on the frontal aspect of the maxillary bone, below the infraorbital margin, varying from 5-10mm and is usually directed infero-medially through which the nerves and vessels of the same name pass [1]. The infraorbital nerve is a continuation of the maxillary nerve which passes through the infraorbital groove and canal to emerge out through the infraorbital formaen. This nerve plays an important role in regional anesthetic blocks for nasal endoscopic surgeries in cases like recurrent sinusitis, nasal polyposis, antrochoanal polyps, sinus mucoceles and excision of selected tumors [2]. These blocks are also useful in oral surgeries for cases such as dentoalveolar abscess, trauma or maxillary and mandibular fractures, pulpitis, or root impaction, orofacial laceration repair (eg- tongue, lip, mucosal), and in postoperative analgesia as well as chronic pain settings [3,4]. The infra orbital nerve and vessels located within the foramen supply important structures such as the inferior eyelid, nasal wing, superior lip and the vestibular gums of the anterior and premolar molar teeth [5]. Any improper techniques can lead to hemorrhages, hematomas and trauma with damages to nerves and vessels. So a proper well defined landmark could help in

Author's Affiliation: [1]Associate Professor, Department of Anatomy, Sri Muthukumaran Medical College, Hospital & Research Institute, Chennai. The Tamil Nadu Dr. M.G.R Medical University, Gunidy, Chennai, Tamil Nadu, India. [2]Professor and Head, Department of Anatomy, Sri Muthukumaran Medical College, Hospital & Research Institute, Chennai. The Tamil Nadu Dr. MGR Medical University, Gunidy, Chennai, Tamil Nadu, India. [3]Assistant Professor, Department of Anatomy, Sri Ramchandra Medical College & RI, Chennai. Sri Ramchandra Medical University, Porur, Chennai, Tamil Nadu, India.

Corresponding Author: Kalpana R., Professor and Head, Department of Anatomy, Sri Muthukumaran Medical College, Hospital and Research Institute, Chennai 600069, Tamil Nadu, India.
E-mail: mm1710@gmail.com

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preventing wrong procedures. Any variations with regards to its position, size , shape and distances from important anatomical landmarks will help in reducing hazards during the operative procedures. A detailed knowledge of these parameters would thus facilitate therapeutic, diagnostic and surgical manipulations during any maxillofacial surgical treatment [6]. There are numerous studies showing marked variation in the morphometry of the infraorbital foramen amongst various different populations and race [7-13]. Thus the aim of present study was to carry out a detailed analysis of the morphometric dimensions of infraorbital foramen in Adult Indian population, compare it with other studies and study its clinical relevance.

Subjects and Methods

A total of 514 infraorbital foraminas [257 on right & 257 on left sides] were studied in dry adult human skulls of unknown age and gender. They were obtained from department of Anatomy of various Medical Colleges in Chennai where they were used for teaching purposes. The inclusion criteria was the use of only adult human skulls and any skulls with deformed, damaged or with multiple foramina were excluded from the study. For measurements, the instruments used were Digital Vernier caliper [0.01mm], Scale, Needle and Divider [Figure 1].

Fig. 1: Instruments

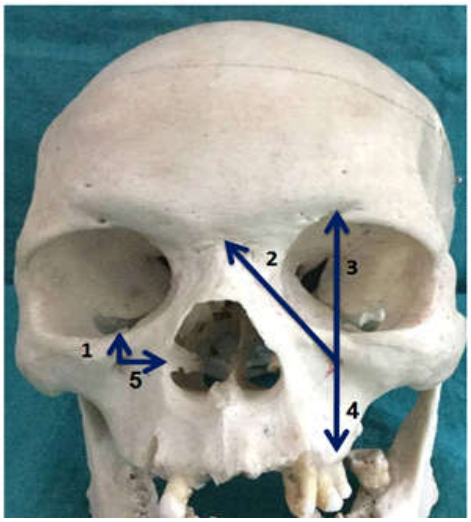

Fig. 2: Points No. 1,2,3,4,5

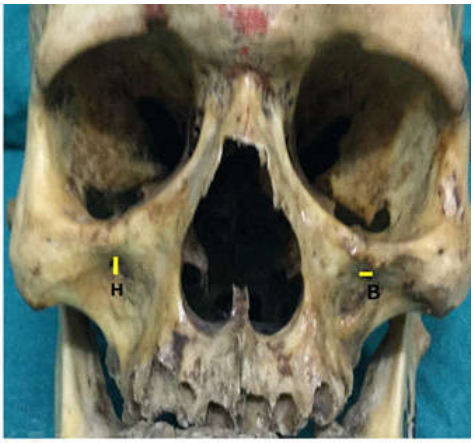

Fig. 3: Points No. 6

Fig. 4: Points No. 7,8

The following parameters were studied [Figure 2,3,4].

1. Distance between IOF & Infraorbital margin [IOM]
2. Distance between IOF & Nasion [N]
3. Distance between IOF & Supraorbital Foramen [SOF] of the Same side
4. Distance between IOF & Superior Alveloar Margin [SAM] of the Same side
5. Distance between IOF & Nasal Rim[NR]of the Same side.
6. The height [H] and breadth [B] of the IOF alongwith with its shape - oval [O] , round [R] , vertical oval [VO] or horizontally oval [HO] .
7. The direction of the infraorbital canal - Forward, Downward and Medially [FDM] and Forward and Downwards [FD].
8. The tooth at which the IOF vertically corresponds too.

The Mean, Standard Deviation [SD], Students t-test and significance [$p<0.05$] was noted. The SPSS software, 20th version was used for statistical data analysis.

Results

The results obtained in the Present Study are summarised below in the form of tables and figures.

Table 1: Distance between Right and Left IOF with other anatomical landmarks

Distance[mm]	Right [257] Mean[mm]±[SD]	Left [257] Mean[mm]±[SD]	Total [514] Mean [mm]±[SD]
IOF-IOM	7±2.3	6.9±1.7	6.95±2
IOF & SOF	40.2±2.2	40.6±1.9	40.4±2.05
IOF-SAM	25.5±3.9	25.4±3.5	25.45±3.7
IOF-NR	16.3±2.5	16.4±2.7	16.35±2.6
IOF-N	42.9±2.5	42.8±2.3	42.85±2.4

Table 2: Dimension of IOF with regards to Height and Breadth Dimensions of the Infraorbital Foramen

[mm]	Dimensions of the Infraorbital Foramen Right [257] Mean [mm]±[SD]	Left[257] Mean [mm]±[SD]	Total[514] Mean [mm]±[SD]
IOF-Height	3.8±0.8	3.9±1.1	3.85±0.95
IOF-Breadth	3.6±1.1	3.7±1.1	3.65±1.1

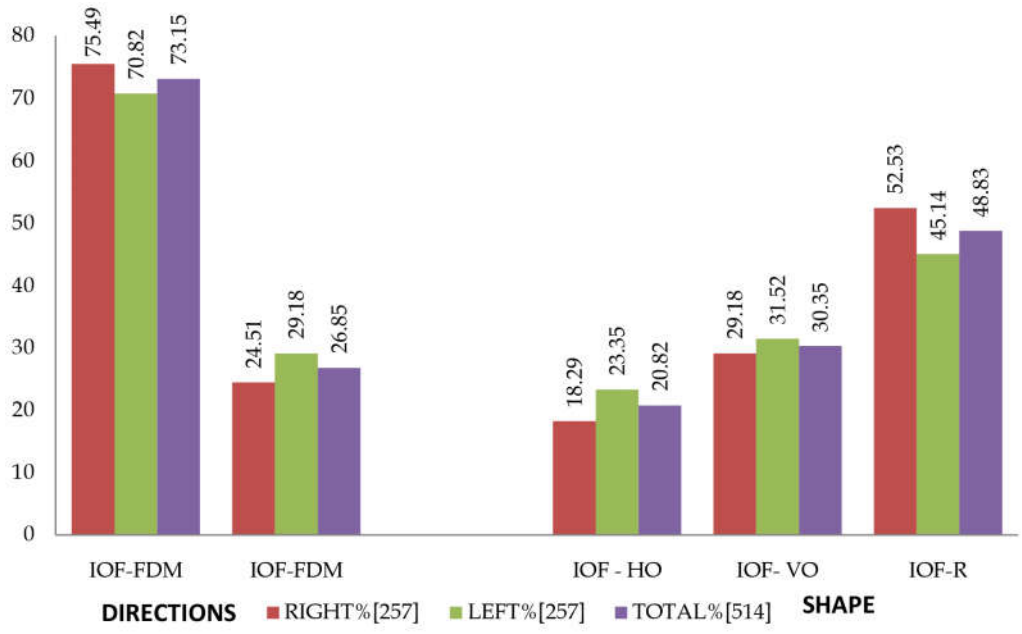

Fig. 5: Frequency of Right and Left IOF with respect to Directions and Shape

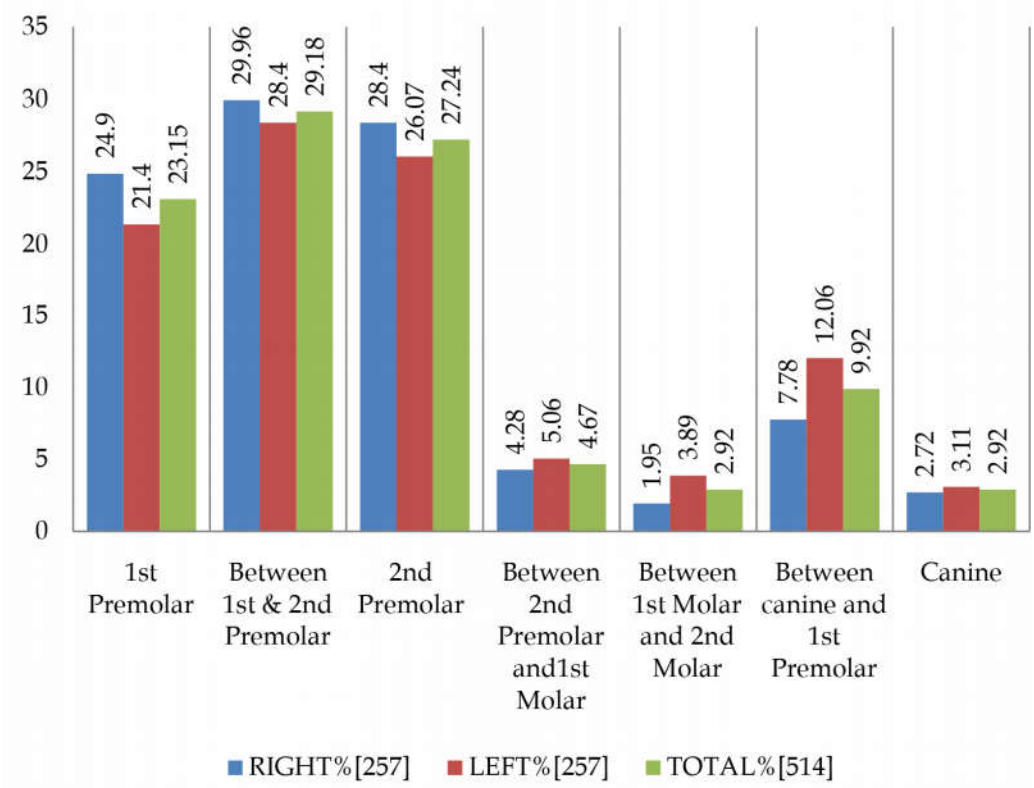

Fig. 6: Percentages of Right and Left IOF with vertically corresponding tooth

Table 3: Comparison between the Present Study and other studies with regards to various parameters

Study	Distance between IOF-IOM Population	Sample Size	Mean±S.D
Present	Tamil Nadu	257	6.95 ± 2
Hwange S H et al[7]	Korea	100	9.6 ±1.7
Ilayperuma I et al[8]	Srilanka	108	9.79±1.66
Ongeti K et al[10]	Kenya	104	6.26±1.75
Aphinhasmit W et al[11]	Thailand	106	9.12±1.87
Aziz et al[12]	Columbia	47	8.15±1.9
Ukoha et al[14]	Nigeria	130	7.38 ± 2.28
Bakirici S et al[15]	Turkey	32	7.32±1.84
Study	**Distance between IOF- SOF Population**	**Sample Size**	**Mean±S.D**
Present	Tamil Nadu	257	40.4±2.05
Ilayperuma I et al[8]	Srilanka	108	44.06±3.49
Aphinhasmit W et al[11]	Thailand	106	44.95±2.96
Aziz et al[12]	Columbia	47	42.75 ±2.75
Tezer et al[16]	Turkey	112	42.75 ±2.75
Study	**Distance between IOF- N Population**	**Sample Size**	**Mean±S.D**
Present	Tamil Nadu	257	42.85±2.4
Nanayakkara D[17]	srilanka	54	42.44±3.4
Przygocka et al[18]	poland	32	44.79±2.98
Singh et al[19]	Uttar Pradesh	64	44.95±4.63
Study	**Distance between IOF- NR Population**	**Sample Size**	**Mean±S.D**
Present	Tamil Nadu	257	16.35±2.6
Saini, Kopal [5]	Maharashtra	100	17.4±2.48
Macedo et al [9]	Brazil	295	17.68±2.07
Hindy AM et al [13]	Egypt	45	14.7 ±2.7

Distance between IOF- SAM

Study	Population	Sample Size	Mean±S.D
Present	Tamil Nadu	257	25.45±3.7
Ongeti K et al[10]	Kenya	104	32.29 ±2.88
Tezer et al[16]	Turkey	112	31.62±3.09
Brando FH et al[20]	Brazil	210	33.4 ±1.7

Average Height of IOF

Study	Population	Sample Size	Mean±S.D
Present	Tamil Nadu	257	3.85 ±0.95
Saini, Kopal [5]	Maharashtra	100	4.25±0.95
Ilayperuma I et al[8]	Srilanka	108	3.4±0.84
Tezer et al[16]	Turkey	112	4.21±0.91
Singh, R[21]	Uttar Pradesh	55	3.57±1.0
Ezzeddin, E et al[22]	Egypt	59	3.39±0.75

Average Breadth of IOF

Study	Population	Sample Size	Mean±S.D
Present	Tamil Nadu	257	3.65 ±1.1
Aphinhasmit W et al[11]	Thailand	106	3.35±0.62
Tezer et al[16]	Turkey	112	3.11±0.62
Nanayakkara D[17]	Srilanka	54	4.16±0.74
Singh, R[21]	Uttar Pradesh	55	3.35±1.3
Ezzeddin, E et al[22]	Egypt	59	3.28±0.98
Chung et al[23]	Korea	124	4.8±1.2

Direction of IOF as FDM

Study	Population	Sample Size	%
Present	Tamil Nadu	257	73.15
Saini, Kopal[5]	Maharashtra	100	53.33
Ilayperuma I et al[8]	Srilanka	108	85.19

Shape of IOF

Shape	Study	Population	Sample Size	%
Round	Present	Tamil Nadu	257	48.83
	Aphinhasmit W et al[11]	Thailand	106	21

Shape of IOF

Shape	Study	Population	Sample Size	%
Round	Present	Tamil Nadu	257	48.83
	Aphinhasmit W et al[11]	Thailand	106	21
	Bakirici S et al[15]	Turkey	32	58.5
	Nanayakkara D[17]	Srilanka	54	15.3
	Singh, R[21]	Uttar Pradesh	55	29
Vertically Oval	Present	Tamil Nadu	257	30.35
	Aphinhasmit W et al[11]	Thailand	106	50
	Nanayakkara D[17]	Srilanka	54	37.47
	Singh, R[21]	Uttar Pradesh	55	42.7
Horizontally Oval	Present	Tamil Nadu	257	20.82
	Aphinhasmit W et al[11]	Thailand	106	29
	Singh, R[21]	Uttar Pradesh	55	28.1

IOF with highest % of corresponding level of superior alveolar tooth

Study	Population	Sample Size	%	Tooth
Present	Tamil Nadu	257	29.18	Between 1st &2nd Premolar
Ilayperuma I et al[8]	Srilanka	108	55	2nd Premolar
Aziz et al[12]	Columbia-c	47	68	1st Premolar
Hindy AM et al [13]	Egypt-c,s	45	50	2nd Premolar
Fabino et al[24]	Brazil-c	32	68	1st Premolar
Rebaz.S.I [25]	Kurdistan	40	40	Between 1st &2nd Premolar

The infraorbital foramina was studied in 257 skulls on both sides of the skull and hence 514 intact foraminas were examined. The linear distances between the IOF and the selected anatomical parameters are shown in the Table 1.The average distances between IOF-N was 42.85mm,IOF-SAM was 25.45mm, IOF-IOM was 6.95mm, IOF-NR was 16.35mm and IOF-SOF was 40.4mm. In the present study, it is found that the distance between IOF and SOF for the right and left side foraminas were highly significant [$p<0.05$]. All other parameters were not significant. The average height was 3.85mm and the breadth was 3.65mm, with no significance between the right and left foramen [Table 2].

The maximum % foramina were directed forwards, downwards and medially [73.6%] followed by 26.8% which were forwards and medially. The direction was noted with the help of the needle. Predominant of the foramens in the present study were round in shape [48.8%] followed by the vertically oval [30.35%] and then horizontally oval [20.82%] [Fig 5]. The percentage of IOF in relation to the maxillary teeth is shown in Fig 6. It was observed that maximum of the IOF corresponded vertically down between the 1st and the 2nd premolar [29.2%], followed by 2nd premolar [27.25%] and then Ist Premolar [23.15%].

Discussion

The importance of anatomical characteristics of facial foramens have increased due to various surgical procedures like endoscopics and reconstructives surgeries. Regional blocking techniques are described in various books, but as the foraminas are inconsistent, hence there are chances of imperfect analgesia [26]. Hence the knowledge of the IOF 's size and location are essential for surgeons and anaethestics which prevents them from guessing their way through the IOF with the needle and damaging the neurovascular bundle. Also there some studies to indicate that there is diversity in the location of the infraorbital foramen with age, side, race and sex [27].

Thus the present study gains utmost importance as it helps in standardising the various morphometric measurements of IOF as well as determining the distances from various anatomical landmarks and with this elaborate information also enabling surgeons and anasthestics to achieve an an effective nerve block.

Interestingly, the distance of IOF location in relation to the Infraorbital Margin, Superior Alveloar Margin, Nasal Rim and Nasion on the right and the left side did not show much difference and were statistically not significant [Table 1] . This helps to conclude that there is a symmetry that is maintained on both sides with respect to these parameters, but on comparing with various other population studies of different geographic location, the study provides information on the racial differences with regards to IOF and various parameters. To support these findings , there are numerous evidences of racial variation amongst different populations with regards to the morphometry, relative position of the IOF and also its relation with the maxillary teeth [10-13,23,28,29].

Infraorbital Margin [IOM] is widely used as an anatomical landmark to ascertain the location of the IOF and wide variations have been documented in different studies. Aziz et al. Columbia [12] have measured the distance of IOF-IOM on 47 cadaveric heads and found the distance to be 8.15± .9mm. A study by Apinhasmit et al. [11] on Thai adult skulls found that the IOF was located 9.23 ± 2.03mm below the infraorbital margin. Thus on comparing the distance between IOF-IOM of the Present study with other studies like Hwange S H et al. [7] Korea, Ilayperuma I et al. [8] Srilanka, and Ongeti K et al. Kenya [10], Apinhasmit et al. [11] Thai , Aziz et al. [12] Columbia, Ukoha et al. [14] Nigeria and Bakirici S. et al. [15] Turkey - a very high significance was noted [$p<0.0001$] [Table 3]. This difference among various populations can be attributed to racial difference [8]. Fear of injury to the patient's eye, prevents dentists for giving an infraorbital nerve block [30]. Thus, the knowledge of the distance between the IOF and IOM would help to locate the danger zone during dissection of the fracture of the anterior maxillary wall or in locating infraorbital plexuses which is a risk zone for plastic surgeons [7,8]. It would also help in determining the position of the acupuncture needle as in trigeminal neuralgias [9] and knowing the morphometric variations helps to decrease the risk in orbital surgeries [31].

The average distance between IOF- SOF in the Present study was 40.4±2.05.On comparison with other population studies like Ilayperuma I et al. [8] Srilanka, Apinhasmit et al. [11] Thailand, Aziz et al. [12] Columbia and Tezer et al. [16]Turkey, very high significance was noted [$p<0.0001$] [Table 3]. As it is evident that the comparative studies between various populations do show a difference due to their racial differences, hence emphasizes for a meticulous evaluation of IOF is needed for any operative procedures [10,29].

When comparing the average distance between IOF And Nasal Rim [NR] of the Present study with Saini, Kopal - Maharastra [5], Macedo et al. [7]

Brazil and Hindy AM et al. [13] Egypt: 45; 14.7±2.7 , very high significance was noted [p<0.0001][Table 3]. Also when comparing the average distance between IOF And Superior Alveolar Margin [SAM] of the Present Study- 257; 25.45±3.7 with Ongeti K et al. [10] Kenya 104; 32.29±2.88, Tezer et al. [12] Turkey: 112; 31.62±3.09 and Brando FH et al. [20] Brazil: 210; 33.4 ±1.7, very high significance was noted [p<0.0001] [Table 3]. Kazkayasi M et al. [32] had also conducted an anatomical study on 35 adult bony heads and noted the distance to be 17.23±2.64. Thus it was noted the the data presented different population were not similar and this differences can be attributed to racial difference, their dietary habits and their dentition [10,27,33].

The average vertical height of IOF of the Present study noted was 3.85±0.95; and on comparing with Saini Kopal- Maharastra [5], Ilayperumal et al. [8] Srilanka and Tezer et al. [16] Turkey, very high significance was noted [p<0.0001][Table 3]. The average Breadth of IOF of the Present study was 3.65 ±1.1 and when compared with Aphinhasmit W et al. [11] Thailand,Tezer et al. [16] Turkey and Chung et al. [23] Korea, very high significance was noted [p<0.0001][Table 3]. Dimensions of the foramens are dependent on the thickness of the neurovascular bundle, which may also determine the dosage of the drug needed in the anaesthetic procedure [5].

In the Present study the direction of the IOF was noted to be forward, downward and medially in 73.2% as compared to the Downwards & Forward which was 26.8%. In other studies like the Saini Kopal-Maharastra [5]: 100; 53.33% and Ilayperumal et al. [8] Srilanka: 108;85.19%, maximum direction of IOF was FDM[Table 3]. Hence from the results obtained in the Present study, it can be hypothesised that the direction of the needle for infraorbital nerve block should be superolaterally and Saini Kopal et al. [5] study also concurred with the same. With regards to the shape of IOF, 48.83% were round, 30.35% were vertically oval and 20.82% very horizontally oval out of the 257 skull study. Aphinhasmit W et al. [11] study showed that out of 106 skulls, 21% were round, 50% were vertically oval and 29% were horizontally oval [Table 3]. On comparing both these works, a Very High Significance [p<0.0001] was noted between both the studies.

In the Present study, IOF was in direct vertical line between 1st and 2nd Premolar in 29.2% cases followed by the 2nd Premolar tooth which was 27.2%. Other population studies like Ilayperumal et al. [6] Srilanka, 55% had IOF corresponding to 2nd Premolar, in Hindy AM et al- Eygpt [13] had 50% of IOF corresponding to 2nd Premolar, Fabino et al-Brazil [24] had 68% IOF corresponding to 1st Premolar which was similarly noted in Aziz et al-Columbia study [12] whereas Rebaz. S. I et al- Kurdistan [25] had 40% between 1st &2nd Premolar. Thus this data highlights the racial differences between the Asians, Whites, and Hispanics with regards to the position of the IOF in relation to the maxillary teeth. All this data becomes important whenever planning maxillary sinus surgeries. In Cladwell -Luc surgery, maxillotomy is done above the dental alveolus especially 1st premolar, thus the passage created has external access to maxillary sinus [24]. During such surgeries the most frequent complications are lesions of Infraorbital nerve leading to paresthesia of the facial region [24]. To prevent such hazards the present data can be utilised during surgical procedures.

Externally, the infraorbital foramen is just medial to the intersection of a vertical line from the pupil (when midline) to the inferior border of the infraorbital ridge [4]. Internally, the infraorbital foramen is approached at the intersection of the mucobuccal fold and the junction of 1st and 2nd. So whenever an infraorbital nerve block is given, the lower eyelid, upper cheek, part of the nose, and upper lip is anesthetizesed [4] . So as per the results obtained from the present study, it can also be hypothesised that the best site for the nerve block would be 6.95 mm inferior to IOM, 16.35mm lateral to the nasal rim and the direction of the needle being superolateral.

All these findings need to be further correlated with the cadaveric studies and studies in living subjects by way of CT scan. Studies with regard to accessory foramens and duplicated foramens need to be conducted. Having noted such diverse ethnic variations with regards to other population studies, where in some studies the sample size was low which could lead to one of the reasons of showing variation, hence to bring out more precision and accuracy, huge sample size studies needs to be undertaken in various population studies for better standardisation. Studies with regards to sex and various age groups also to need to be taken into consideration.

Conclusion

As the infraorbital nerve is used to accomplish regional anesthesia in the maxillo-facial region for diagnostic, surgical and other invasive procedures as well as for therapeutic nerve blocks in intractable unresponsive trigeminal neuralgia, the results of the present study may assist surgeons to localize foramina thus facilitating the surgical outcome. These results may also play an important role as newer techniques for minimally invasive surgery are

developed. The diversity in the various parameters with regards to infraorbital foramen may be attributed to race, age, dentition and dietary factors. Our findings also reinforce that there is ethnic variation in the occurrence of infraorbital foramen among different populations.

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Original Article

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Cytogenetic Evaluation of Infertile Couples in Manipur

Suzanne L. Colney[1], N. Damayanti Devi[2], Thounaojam Naranbabu Singh[3], Sarah Ralte[4]

Abstract

Purpose: This study was conducted to determine the frequency and contribution of chromosomal abnormalities in couples presenting with infertility in the state of Manipur. *Materials and Methods:* Study was done on 23 infertile couples (23 male and 23 female) making a total of 46 cases. Chromosomal analysis from peripheral blood lymphocytes was performed according to standard cytogenetic methods using G-banding technique. *Results:* Among the males, chromosomal abnormalities were found in 3 (13%) cases i.e, 2(8.6%) cases with 47,XXY (Klinefelter syndrome) and 1 (4.3%) case with 47,XYY syndrome. All the remaining males showed normal karyotype 46,XY . Among the females, all the karyotype shows a normal female karyotype i.e, 46,XX. *Conclusions:* This study may be indicative that chromosomal abnormalities are common among the males with infertility which included Klinefelter Syndrome and XYY syndrome. Cytogenetic analysis could be valuable for these couples when clinical data fail to clarify the cause.

Keywords: Cytogenetic analysis; Infertile.

Introduction

Infertility is a global problem. It is defined as absence of pregnancy after one year of unprotected intercourse and with this definition, the prevalence has been estimated to be 10-15% [1]. In 2007, the prevalence of infertility is approximately 9% [2]. Infertility affects about 15 percent of allcouples attempting pregnancy [3]. According to WHO, 50-80 million people in the world are facing the problem of getting an integrated family and in India, it is estimated to be 15-20 million [4]. It can be speculated that in about 15% of male and 10% of female infertile subjects, genetic abnormalities could be present [5].

Author's Affiliation: [1]Assistant Professor, Department of Anatomy, TMC and Dr BRAM Teaching Hospital, Agartala, Tripura 799014, India. [2]Professor [3]Professor and Head, Department of Anatomy, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur 795004, India. [4]Assistant Professor, Department of Anatomy, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences (NEIGRIHMS), Shillong, Meghalaya 793012, India.

Corresponding Author: Suzanne L. Colney, Assistant Professor, Department of Anatomy, TMC and Dr BRAM Teaching Hospital, Agartala, Tripura 799014, India.
E-mail: drsuzannertc@gmail.com

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Research on genetic causes of male and female infertility has rapidly expanded in the last years, following the development of Assisted Reproductive techniques.

Causes of infertility are numerous. Male factors contribute about 40%, female factors about 40% and both male and female factors are found in 20% of the cases [6]. While chromosomal or genetic abnormalities associated with azoospermia, severe oligospermia or primary ovarian failure were of no importance prior to the era of in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI), advances in assisted reproduction techniques (ART) now enables many infertile couples to have children. To prevent the genetic risk for the future child, cytogenetic screening of both partners is mandatory prior to any type of ART [7].

The general causes of infertility in female may be tubal blockage, pelvic and cervical factors , ovarian and uterine factors [8]. The genetic causes of female infertility may be whole X chromosome deletionseg, Turner Syndrome, X-chromosome microdeletions, X chromosome-autosome translocationsor single gene disorders like the diaphanous gene, FMR1 gene, FSHR gene, LH/HCGR gene, the CYP17 gene etc. WHO recommends that all infertile males should undergo semen analysis in addition to

measurements of hormones [9]. In less than 5 million sperms per milliliter, the incidence of chromosomal abnormality is 4% [10]. Based on the frequencies of chromosomal aberrations in patient with different sperm concentration, karyotype analysis is indicated in azoospermic men and in oligospermic men with less than 5million sperms per milliliter [11].

The general causes of male infertility includes varicocele, cryptorchidism, ejaculatory dysfunction, sexual dysfunction, testicular failure, cancer, heat and radiation [12]. Genetic causes may be chromosomal aberrations, microdeletions and single gene disorders [13].

They include Klinefelter Syndrome, XYY Syndrome, XX male, mixed gonadal dysgenesis, Y-chromosome structural abnormalities, sex chromosomal reciprocal translocation, Robertsonian translocation, Reciprocal translocation, supernumerary marker chromosomes and ring chromosomes [12]. Microdeletions of the long arm of the Y chromosome are found in approximately 13% of azoospermic men [12]. The aim of the present study is to find out the chromosomal abnormalities in infertile males and females in Manipur.

Materials and Methods

The study was a cross-sectional study done in the Department of Anatomy, Regional Institute of Medical Sciences, Imphal for a duration of 2 years. A total of 46 cases were studied who attended RIMS-OPD which included infertile patients with suspected genetic abnormalities and excluded couples with known causes of infertility. The mean age among the males was 38.5 years and among the females was 29.5 years. A formal permission was sought from the Institutional Ethics Committee of the college. Informed consent was taken from the patients and their data collected. New suspected cases prevailing for the last one and a half years were taken and karyotyping was carried out. Sample size were calculated by using the formula $n=4pq/L^2$ (p=prevalence, q= 100-p) taking p=3% and allowable error of 5% of p. Peripheral blood from these cases were collected and lymphocyte tissue culture were done for about 48-72 hours. 15-20 metaphases were examined under trinocular research microscope, the best metaphases were selected, photographed, printed and karyotypes were prepared. The chromosomes of these patients were examined for any structural or numerical anomalies.

Results and Observations

A total of 46 cases were examined and evaluated. Among the males, 3 (13%) shows abnormal karyotype i.e, 2 (8.6%) cases with 47, XXY (Klinefelter syndrome) (Figure 1) and 1 (4.3%) case with 47, XYY syndrome (Figure 2). All the remaning females

Table 1: Karyotype of the patients

Sex	Normal Karyotype (46,XY)	Abnormal Karyotype	Total
Male	20	3 (2 with 47,XXY; 1with 47,XYY)	23
Female	23	0	23

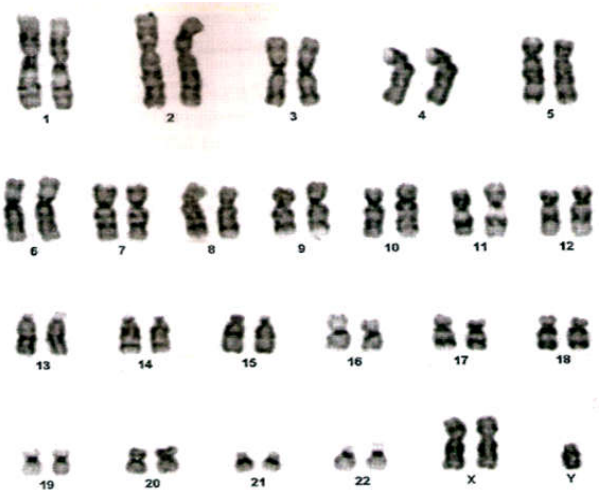

Fig. 1: Karyogram showing 47, XXY karyotype

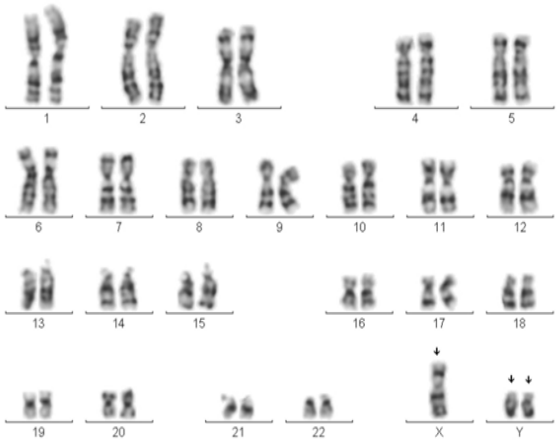

Fig. 2: Fig Chromosome analysis (GTG- banding) revealed karyotype with an extrachromosome Y ie 47, XYY pattern in all the cells analysed

Fig. 2.1: Metaphase spread of female chromosomes

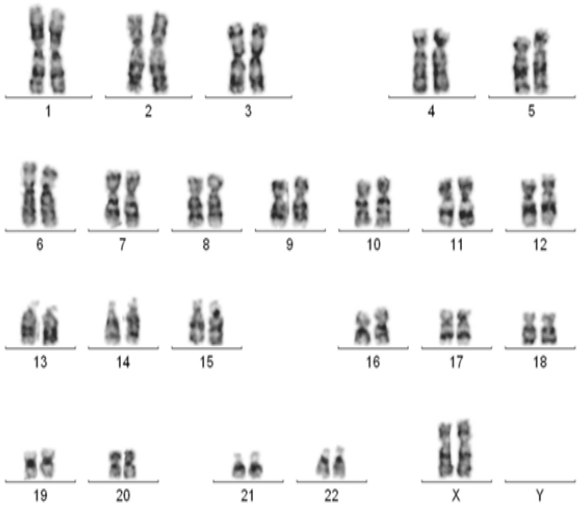

Fig. 3: Metaphase spread of Male chromosomes

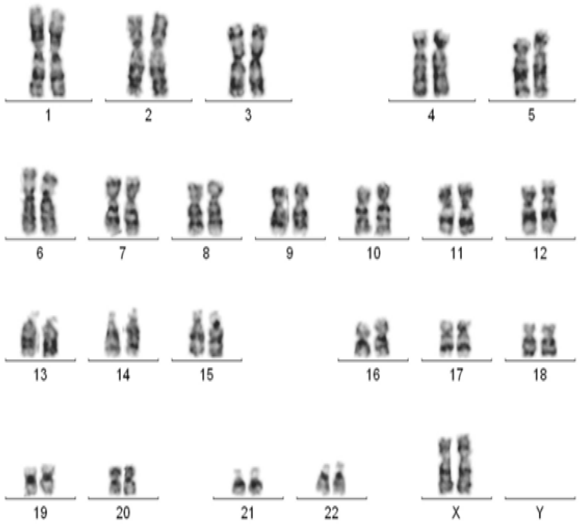

Fig. 4: Karyogram showing normal male karyotype 46,XY

showed normal karyotype, 46, XX (Figure 3). Among the males, all the karyotype shows a normal male karyotype i.e, 46, XY (Figure 4).

Discussion

In the present study, a total of 23 couples (46 cases) were diagnosed with primary infertility i.e. absence of pregnancy after one year of unprotected intercourse, with unknown cause of infertility, with no previous issue, no family history of infertility and consented to participate in the study procedures were done peripheral blood karyotyping. Infertility is associated with an increased frequency of chromosome anomalies with Klinefelter syndrome being the commonest [14]. Mau UA et al. [15] reported chromosomal abnormalities in 18% of their study population of which males constitute 12% and females 6%. Meschede D et al. [16] also reported sex chromosomal abnormalities in 7.3% of their study cases of which males were 2.1% and females 5.5%. Gekas J et al. [17] also reported a higher rate of aberrant karyotype in males than in females. They reported 3.32% in males and 2.77% in females for sex chromosomal abnormalities and 2.77% in males and 2.07% in females for autosomal abnormalities. Peschka B et al. [18] reported 64.4% normal karyotype in his study of infertile couples and 13.1% with abnormal karyotype. In the present study (Table 1) abnormal karyotype i.e. sex chromosomal abnormalities was found in 3 (6.5%) of the cases all of which were male. Two (8.6%) of them had 47, XXY karyotype and one (4.3%) of them had 47, XYY karyotype. The rest of the men 86.9% had normal karyotype i.e. 46, XY. Among the females, all the karyotypes showed a normal female karyotype i.e. 46, XX. The present study did not show any couple with both partners having chromosomal abnormalities.

Conflict of Interest: None

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Organogenesis & Histogenesis of Spleen in Human Foetuses at Different Weeks of Gestation

Arpan Haldar[1], Amit P. Tirpude[2], Manisha R. Gaikwad[3], Soumya Chakraborty[4], Provas Banerjee[5]

Abstract

Spleen is the organ of anatomic & functional component of reticulo- endothelial system & functions as a complex filter interposed in blood stream. Haematopoietic function of spleen continues & regresses after birth but production of lymphocytes continues in post-natal life. This study was done to correlate the chronological pattern of spleen development in this geographical eastern region of India, Odisha & compare the results from other researchers nationwide & worldwide. Aborted human foetuses without obvious congenital anomaly of gestational age between 12 weeks and 36 weeks were collected and processed for histology by H/E stain to note the differences of fetal spleen with the adult spleen.

Keywords: Spleen; Organogenesis; Reticulo-Endothelial System; Lymphocytes; Haematopoietic.

Introduction

The spleen is formed in the 6th week of fetal life due to interaction of coelomic epithelium and angiogenic mesenchyme of dorsal mesogastrium in several adjoining areas. Histologically spleen consist of a peripheral capsule from which the trabeculae are sent into a reticulo-lympho-endothelial complex filter interposed in blood stream. The reticular meshwork perfused with arterial blood is called as red pulp whereas, the lymphocytic aggregation around arterioles is called as white pulp [1]. Red Pulp is concerned with clearing the blood of particulate matter, efferent cells & White Pulp is a lymphoid organ which is concerned with immune defence against blood-borne antigens. Haematopoietic function of spleen continues throughout foetal period & regresses after birth but production of lymphocytes continues in post-natal life [2]. Spleen is termed the graveyard of RBCs as splenic macrophages engulf any blood borne antigens [3].

Fetuses exposed to antigen-related diseases underwent morphological changes in lymphoid organs presumably as a consequence of the primary fetal immune reaction. These changes were characterized by an increase in the number of lymphoblasts and partly of macrophages in the spleen and lymph nodes. Exposure of fetuses to antigen-related diseases thus appears to cause marked changes in the normal ontogenesis of lymphoid organs [4].

In children with Sickle-Cell Anaemia, RBCs become sickle shaped & there is heavy destruction of RBCs in spleen, so splenectomy is done [5]. Spleen is also a lymphoid organ so lymphocyte level may decrease in splenectomy patients making them prone to infections [6]. Splenectomy is the only option left in Thalassemia children resistant to blood transfusion [7]. In Splenic rupture also, Splenectomy is the only life saving treatment option [8].

Several attempts have been made to study the histogenesis of spleen in human foetuses, we attempt to study in eastern region of India and compare with previous studies.

Author's Affiliation: [1]Senior Resident [2]Assistant Professor [3]Additional Professor and Head, Department of Anatomy, All India Institute of Medical Sciences, Bhubaneswar, Odisha 751019, India. [4] Professor and Head, Department of Anatomy, ESI-PGIMSR, Joka, Kolkata, West Bengal 700104, India. [5]Professor and Head, Department of Anatomy, Hi-Tech Medical College & Hospital, Rourkela, Odisha 769004, India.

Corresponding Author: Amit P. Tirpude, Assistant Professor, Department of Anatomy, All India Institute of Medical Sciences, Bhubaneswar, Odisha 751019, India.
E-mail: amit_tirpude2005@rediffmail.com
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Aims & Objectives

Study was done to correlate the Chronological Pattern of Spleen development in this geographical eastern region of India & compare the results from other researchers nationwide & worldwide.

Materials & Methods

This is a hospital based, observational, cross sectional study conducted at Hi- Tech Medical Colleges & Hospital, Bhubaneswar, India by the Department of Anatomy in collaboration with Department of Obstetrics & Gynaecology from November 2011 to June 2013 on thirty-two aborted human foetuses without obvious congenital anomaly of gestational age between 12 weeks and 36 weeks collected within 6 hours of delivery by spontaneous miscarriages & therapeutic legal abortions. Study samples were arbitrarily divided into groups of biweekly gestational age by duration of amenorrhoea from medical records & ultrasound fetometry after receipt of informed consent from mother and legal guardians. Fetuses were immediately fixed in 10% Formalin for 1-2 hrs. Spleen was dissected by Dissecting Microscope, fixed in 10% Formalin for 48-72 hrs. After fixation by formalin, the tissues were transferred to 30%, 50%, 70%, 90% and Absolute alcohol each for 30 minutes. This ascending grades of the dehydrating fluid was done because when alcohol mixes with water, it produces diffusing current which can damage the tissues. Then the tissues were put in xylol for 24 hours to clear the residual alcohol. These tissues were processed for paraffin sections by tissue blocking (Paraffin Embedding). 3 pots of hard paraffin were taken; paraffin was melted in the incubator at 56 degrees, as hard paraffin is ideal for materials which are to be cut in thin sections about 12 mu. The tissue was put in the first pot containing equal parts of paraffin and xylol and then changed to second and third pots containing only fresh melted paraffin at 90 minutes interval. Then the tissues were mounted in fresh melted paraffin with L-Block. The L-Block was then trimmed to a rectangular shape. Then the L-Block was fixed with the block holder (choke) and the block holder was clamped in the rotary microtome. 5 mu sections were cut in rotary microtome. The microtome was revolved at 40 rpm and ribbon was formed. Then the ribbon was put in tissue flotation bath. Albuminised slide was then made by putting a drop of Mayor's albumin (equal parts of glycerine and egg white) and spreading it uniformly by rubbing with finger. The piece of ribbon was then taken on the slide and dried at room temperature. The slide was then put in the slide warming table. When the paraffin melted the slide was put into xylol for 2-3 minutes because xylol removes paraffin. Then the tissue slide was put in decreasing grades of alcohol (Absolute alcohol, 90%, 70%, 50% and 30%) then was put in the prepared Harris Alum Haematoxylin (nuclear) stain for 7 minutes and lastly washed with distilled water.2-3 drops of 1% acid alcohol (1cc HCl in 75% alcohol) was added to remove the excess stain beyond the nucleus. The slide was then put in running tap water for 30 minutes to develop haematoxylin colour (bluish). Then the slides were again dipped in ascending grades of alcohol (30%, 50%, and 70%) and then put in eosin Y (cytoplasmic) stain for 30 seconds. Then the slide was washed with absolute alcohol for a few seconds so that excess of eosin was removed and lastly the slide was placed in xylol. The slide was then taken out from xylol and after putting1-2 drops of DPX (Adhesive agent) and a cover slip was put on it and pressed slightly so that air bubbles were removed. Sections were then seen in light microscope under low power 10X followed by high power 40X magnification. Thereafter photomicrographs were taken by camera using microscope adapter.

In 14 Weeks

Capsule is ill defined. Scattered lymphocytic infiltration can be seen. No central artery seen but blood vessels were obvious. Formative stage of white pulp not visible.

Table 1: Crown Rump Length & Crown Heel Length

Weeks	Length (in cm)
10	3.1
12	5.4
14	8.7
16	11.6
18	14.2
20	16.4
22	27.8
24	30.0
26	35.6
28	37.6
30	39.9
32	42.4
34	45.0
36	47.4
38	49.8

Table 2: Observations

Weeks	Length (in cm)	Breadth (in cm)	Width (in cm)	Weight (in gm)
10	0.9	0.6	0.3	0.04
12	0.6	0.4	0.4	0.08
14	1.1	0.8	0.6	0.2
16	1.3	1.0	0.7	0.27
18	1.3	1.0	0.6	0.25
20	1.4	0.9	0.6	0.29
22	1.0	0.8	0.6	0.35
24	1.8	1.2	0.6	2.45
26	2.1	1.0	0.8	1.0
28	1.3	1.0	0.6	0.47
30	2.6	1.9	1.1	0.14
32	3.2	2.7	1.8	3.25
34	4.8	3.9	2.3	4.8
36	5.6	4.8	3.2	5.7
38	7.8	6.5	3.7	6.5

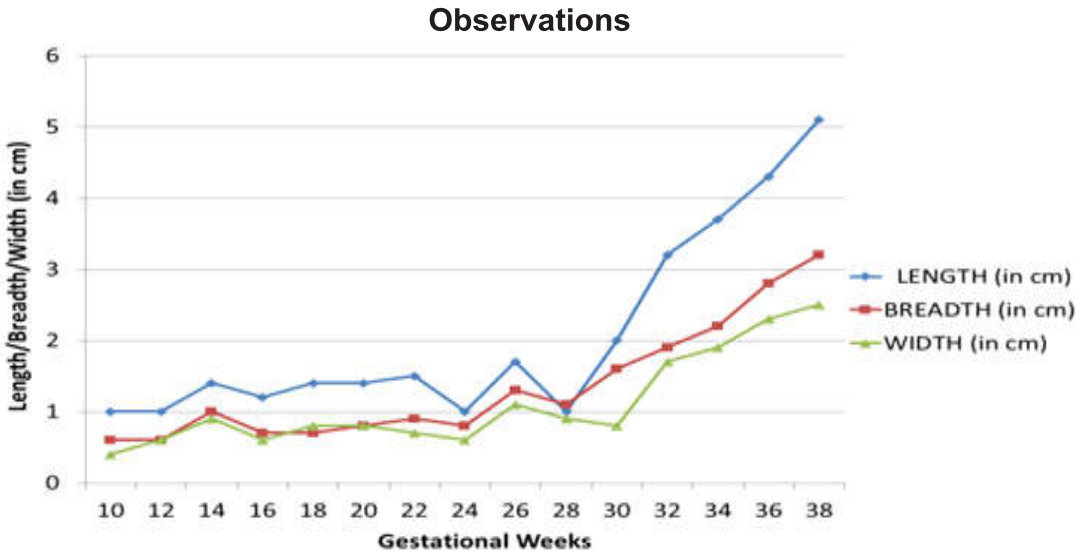


Fig. 1:

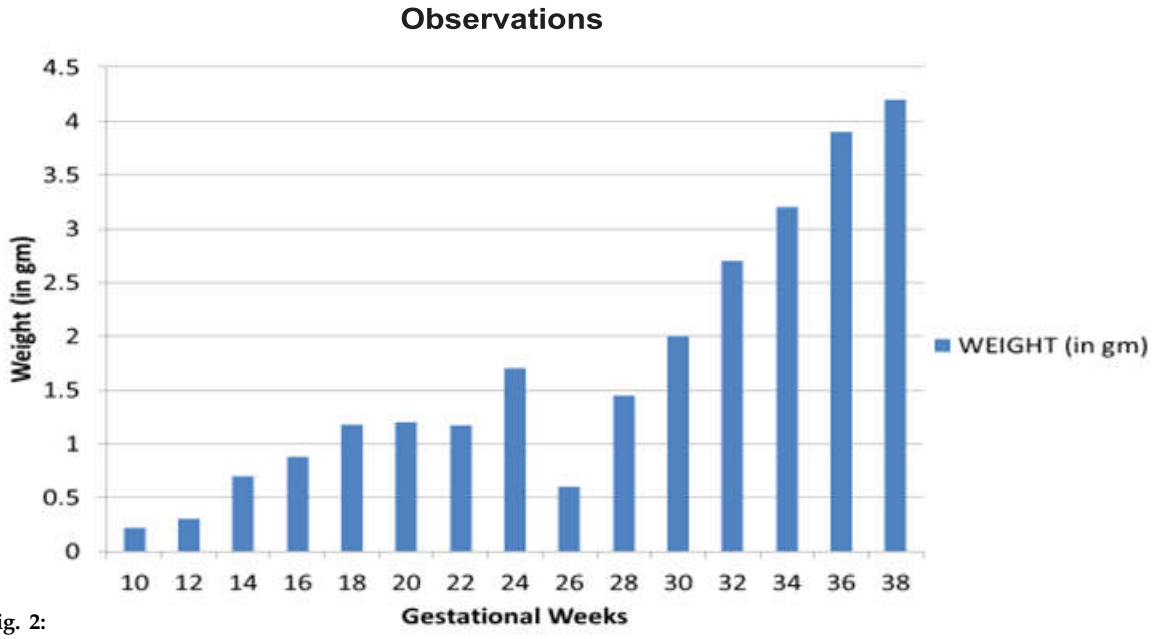
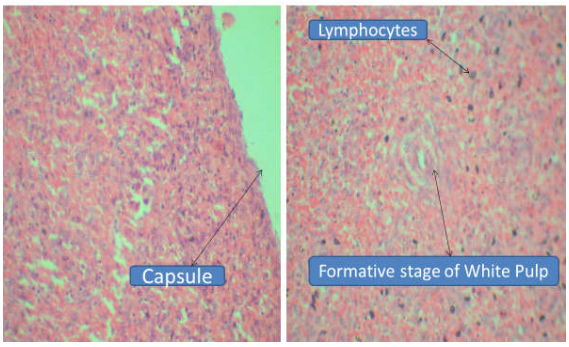
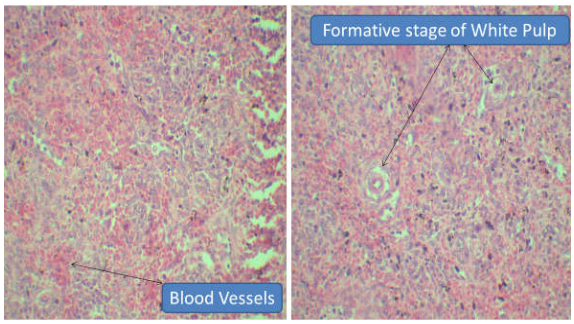


Fig. 2:

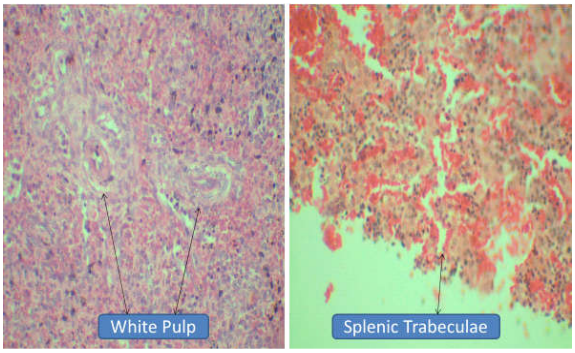
14 Weeks Spleen



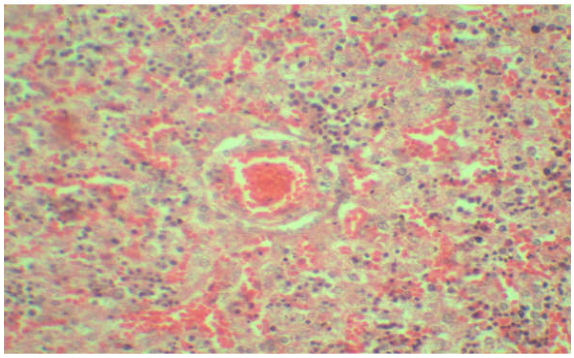
16 Weeks Fetal Spleen



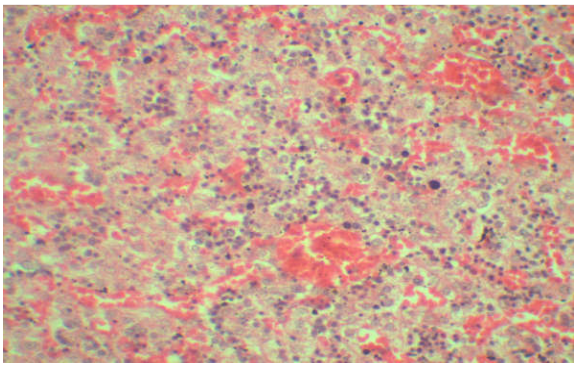
18 Weeks Fetal Spleen



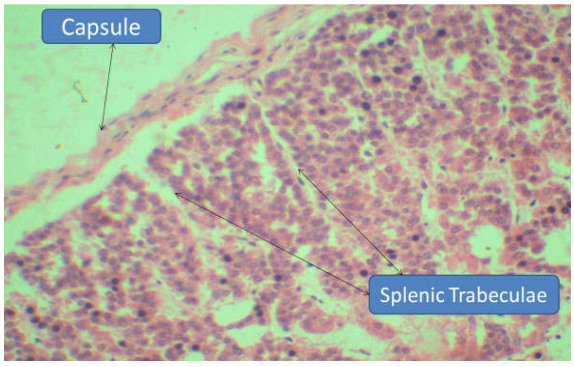
20 Weeks Fetal Spleen



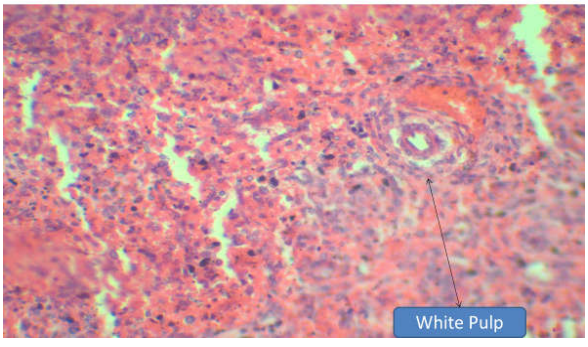
22 Weeks Fetal Spleen



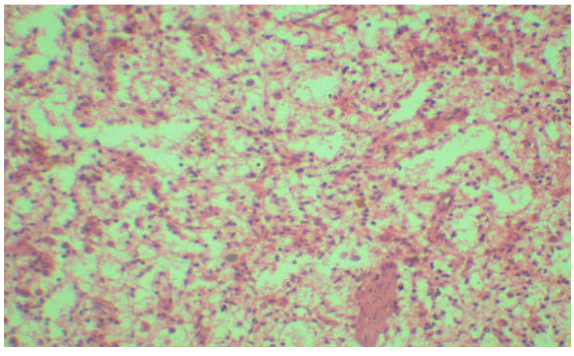
24 Weeks Fetal Spleen



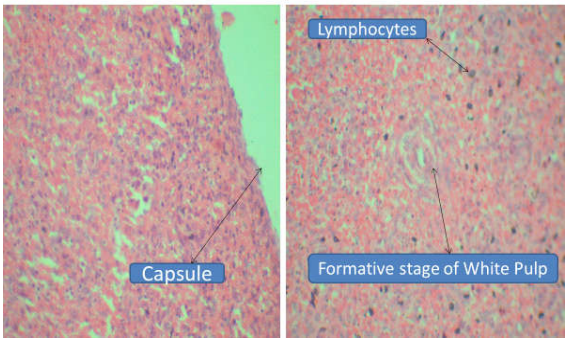
26 Weeks Fetal Spleen



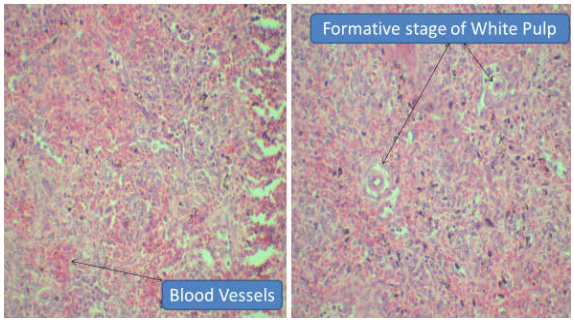
28 Weeks Fetal Spleen



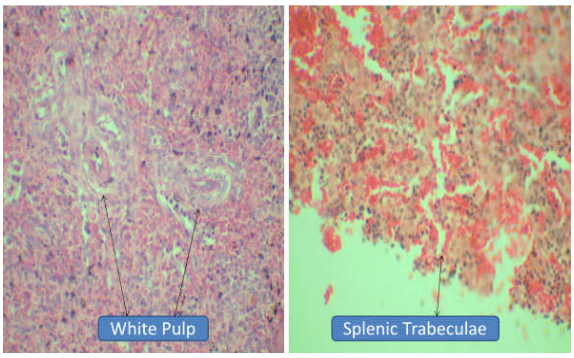
14 Weeks Spleen



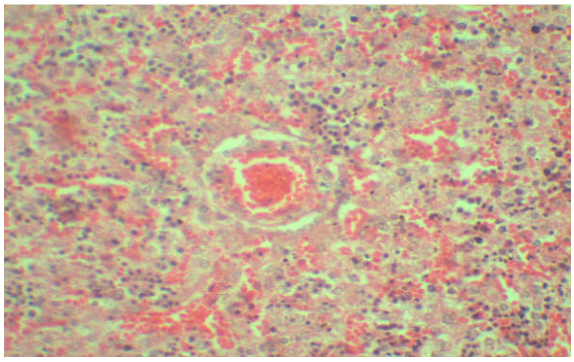
16 Weeks Fetal Spleen



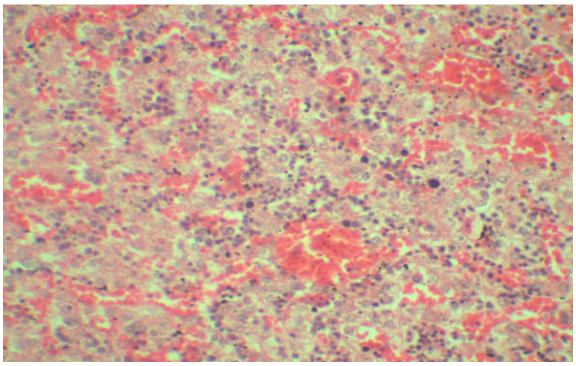
18 Weeks Fetal Spleen



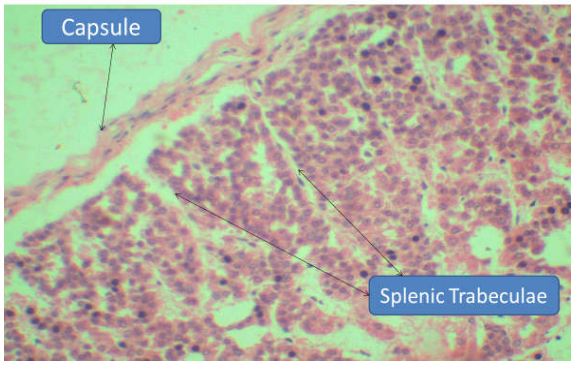
20 Weeks Fetal Spleen



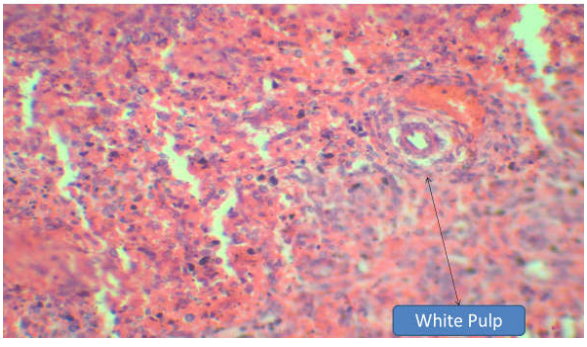
22 Weeks Fetal Spleen



24 Weeks Fetal Spleen



26 Weeks Fetal Spleen



28 Weeks Fetal Spleen

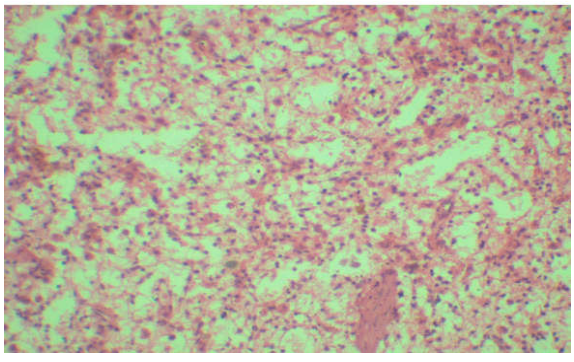


Fig. 3:

In 16 Weeks

Capsule is well demarcated. Definite central artery is not visible. Scattered lymphocytes are visible and formative stage of a few white pulp is visible off & on.

In 18 Weeks

Capsule is well defined, and fibroblast seen with collagen fibres. Scattered lymphocytes were only present. Well defined trabeculae not visible. No definitive white pulp present. Plenty of blood vessels can be seen with sinusoids seen. Mixed cells were seen.

In 20 Weeks

Trabeculae of spleen visible. Definitive formative stage of white pulp visible. Scattered lymphocytes present in the field, but they are not aggregated to form white pulp. In between White pulp definite red pulp is visible with Billroth cords & venous sinuses.

In 22 Weeks

The structures were similar as above with no marked changes compared to previous weeks.

In 24 Weeks

Definite capsule present. Just deep to capsule white pulp present. Splenic Trabeculae present. In between White pulp definite red pulp is visible with Billroth cords & venous sinuses.

In 26 Weeks

Definite capsule visible. White Pulp becoming more prominent. In between White pulp definite red pulp is visible with Billroth cords & venous sinuses.

In 28 Weeks

White Pulp is Prominent. Many blood vessels are seen in medulla. In between White pulp definite red pulp is visible with Billroth cords & venous sinuses. Reticular network and lymphatic nodule were established.

In 30 Weeks

Definitive white pulp is present. In between White pulp definite red pulp is visible. Billroth Cords visible. In white pulp lymphocytes were compactly arranged in nodules and arteriole were eccentric in position. Reticular cells have increased in number forming network.

In 32 to 36 Weeks

Thick Capsule is present and splenic Trabeculae present. Prominent White Pulp visible in the field. Definitive lymphatic nodule with eccentric arteriole was seen. In between White pulp definite red pulp is visible with Billroth cords & venous sinuses. Adult spleen structure was attained.

Discussion

We compared the histological changes in the different weeks of foetal spleen with the findings of different scientists.

Ajit Kolkunde et al. in their study found that in 14-16thweek the thin capsule was visible, lymphocytes and other cells were scattered and vascularity and connective tissue network increased. Around 18thweek they observed prominent capsule, trabeculae formation, and increase vascularity. They started seeing the differentiation between red and white pulp. Aggregation of lymphatic nodule and sinusoids were noticed in red pulp.

From 22nd-38th week they noticed thick capsule and prominent trabeculae. The differentiation of red and white pulp was well established. The lymphatic nodules with periarteriolar lymphatic sheath and eccentric arteriole was seen [9].

Rajiv Mukhia et al in their study in 10th-15th week noticed thin capsule with fibroblasts, thin trabeculae, interstitial fibroblasts, RBCs and collagen fibres,increasing vascularity, scattered lymphocytes but no distinct white and red pulp.

During 16th-20th week they noticed increased connective tissue, sinusoidal spaces, mixed cells, starting of lymphocytic aggregation at periphery of arteriole and clear capsule and trabeculae.

During 21st-25th week they found centrally placed arteriole around lymphocytic aggregation and differential red and white pulp with increased vascularity. From 26th week onward they found distinct capsule and trabeculae, periarteriolar lymphatic sheath around eccentric arteriole, and well established red and white pulp [10].

Anne Dsouza et al divided their findings according to trimesters. In first trimester they found changing thickness of capsule, aggregation of lymphocyte but no red pulp.

During second trimester after 20th week they noticed increase vascularity and accumulation of hematopoietic cells and sinusoids in red pulp whereas white pulp was evident as lymphocytic aggregation around central arteriole.

During third trimester from 30-36th week well established lymphoid follicle with eccentric arteriole

in white pulp, medullary cords with sinusoids in red pulp and thick capsule and trabeculae were appreciated [11].

Lizamma Alex et al. in their study showed white pulp with periarterial lymphatic sheath in 24 weeks. In 24 weeks, capsule was thick and prominent and splenic trabeculae were scattered through the substance of spleen. Spaces with discontinuous epithelium, probably sinusoids were identifiable. Plenty of sinusoids and splenic cords were clearly seen in 32 weeks in their study. Loosely arranged lymphocytes both T and B cells were clearly seen around central arteriole and the number of arterioles in each of developing follicles varied from 3-5 in 24 weeks of fetus [12].

In comparison with these studies except for some differences of few weeks, findings agree with our study, these differences can be due to variation in maternal, ethnic, nutritional and geographical status. Formative stage of white pulp with scattered lymphocytes were present in 20 weeks but they were aggregated to form white pulp at 24 weeks of gestation. Fetal capsule was well demarcated in 16 weeks but definite capsule was present by 24 weeks. Trabeculae were visible in 20 weeks, but they were prominent by 24 weeks. Red pulp was visible with Billroth cords and venous sinuses in 24 weeks. Definite central artery was visible and plenty of blood vessels were seen in white pulpby 18 weeks.

Conclusion

The present study was carried out to find out the histological changes of the spleen during its development in the human foetuses. During early development, spleen was composed of collagen fibres with fibroblast cells, fibrocytes and bigger reticular cells. The spleen at 16th week showed prominent capsule and lymphocytic aggregation. The lymphocyte aggregations started differentiating around the central arteriole forming the periarteriolar lymphatic sheath (PALS), cords of Billroth and sinusoids after 22nd weeks. Reticular cells framework, differentiated red and white pulp was well differentiated by 32nd weeks.

Hence, we concluded that allsplenic histological attributes showed variations in the weeks as per with other researchers nationwide and worldwide, so ultrastructural studies have to be carried out to know the detailed developmental histology of spleen. In future cadaveric splenic grafts can be used due to the presence of high vascularity of fetal spleen the changes of graft rejection will be minimal thus minimizing the chances of immunosuppression after splenectomy.

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Conflicts of Interests: None

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Original Article

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Chronologic Developmental Histology of Human Adrenal Medulla

Avinash Thakur[1], Ratesh Kumar[2], Gayatri Rath[3]

Abstract

Development of human adrenal medulla has always been a topic of quandary because of insufficient literature. Most of the studies on adrenal medulla pertain to various species of animals but human fetuses. This research work emphasizes on the developmental chronology of events by studying 36 human fetal adrenal medullas. This study confirms that neural crest derived sympathoblasts migrate through the cortex into the medulla at 12 weeks as opposed to the prevalent view of 8 weeks in animal studies. Cortical and medullary differentiation begins at 12 weeks of gestation and is complete by 16 weeks. Medullary sinusoids appear at 16 weeks. Adrenaline and noradrenaline secreting cells are separate entities and they differentiate from the chromaffin cells at 22 weeks. Moreover ganglionic cells are seen in the medulla for the first occasion at 22 weeks. It is imperative to understand the human medullary differentiation in order to shed light on emerging diseases due to developmental anomalies of adrenal medulla.

Keywords: Adrenal Medulla; Sympathoblasts; Chromaffin Cells; Sinusoids; Ganglionic Cells.

Introduction

The adrenal medulla is a chief neuroendocrine gland which mediates the stress response in humans by secreting catecholamines especially epinephrine. In addition it also secretes a cocktail of bioactive substances like neuropeptides, encephalins, cytokines and neurotrophic factors [1,2]. Fetal adrenal glands are comparatively large consistent with its endocrine capabilities. Adrenal medulla is composed of glial cells, ganglion cells and chromaffin cells, all of which are derivatives from neural crest cells [3,4]. Sympathoadrenal (SA) progenitor cells and other medullary precursor cells derived from the lumbar neural crest migrate through the fetal adrenal cortex as early as 6-8 weeks of gestation [5] although certain authors have reported that the glial cells do not appear in the adrenal gland till 20th week of intra-uterine life [6]. SA cells later differentiate into ganglion and chromaffin cells. Non chromaffin cells of the adrenal medulla include connective tissue cells and endothelial cells which invest clusters and rosettes of chromaffin cells in a fenestrated capillary network and are diverse anatomically from the adrenal sinusoids [7,8]. There has been a paucity of observations regarding the appearance and migration of these medullary cells through the fetal adrenal cortex into the central medulla. Likewise there is very little information in the literature whether these cells are responsible for the destruction of the fetal cortex while their invasion. The aim of this study was to investigate the chronological pattern of migration of the chromaffin cells through the fetal adrenal gland and their aggregation in the medullary region.

Materials and Methods

Thirty six human fetuses (20 males, 16 females) with gestational age ranging from 8 weeks to 22 weeks (CRL 36mm to 240mm) were examined. These still born fetuses were donated to the department of Anatomy for research purposes with the agreement of the families concerned. The age of the fetuses was calculated taking into consideration different factors like maturity, mother's menstrual history and crown rump length (CRL). All fetuses were normal on examination with no apparent signs of any

Author's Affiliation: [1]Assistant Professor [2]Associate Professor, Dept. of Anatomy, ESIC Medical College Faridabad, Haryana 121012, India. [3]Professor, Dept. of Anatomy, North DMC Medical College & Hindu Rao Hospital, New Delhi, Delhi 110007, India.

Corresponding Author: Ratesh Kumar, Associate Professor, Dept. of Anatomy, ESIC Medical College Faridabad, Haryana 121012, India.
E-mail: rateshmunjal@gmail.com
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developmental anomalies. Adrenal glands were dissected out bilaterally from all the fetuses and fixed in 10% formalin solution. After proper tissue processing adrenal specimens were embedded in paraffin wax and 6µm sections were taken for preparation of histological slides with haematoxylin and eosin stains.

Results

General Appearance

The adrenals become an apparently visible neuroendocrine organ by 8th week of gestation and hence were clearly visible in all the fetuses covered by an inconstant capsule. The weight of the gland gradually increased from 8th to the 22nd week of gestation ranging from 0.4 gms at 8weeks to a maximum of 2.0 gms at 22 weeks. There was no significant difference in the weight of the right and left adrenals belonging to fetus of either sex. The adrenals were approximately the size of the corresponding kidneys at 22nd week. Transverse sections of the adrenals revealed a highly vascular central core and a comparatively less vascular, pale peripheral cortical rim.

Vasculature

Variable numbers of adrenal arteries were seen during gross dissection of the fetuses. Most of them took origin from the embryonic dorsal aorta. Fetuses in the later stages of gestation also showed adrenal arteries originating from variable sources especially renal arteries. An ill formed sub-capsular plexus was seen in most of the fetal adrenal glands in histological sections. These sub capsular plexuses were seen to give rise to multiple numbers of medullary arterioles to supply the human fetal adrenal medulla. Density of the cortical and medullary sinusoids increased with increasing fetal age.

Microscopic Appearance of Fetal Adrenal Medulla

8 weeks (Fig. 1A): An undifferentiated mass of adrenal cells is present. The cells stain pale with haematoxylin and eosin. Fetal adrenal cortical cells and sympathoblasts/chromaffinoblasts are not histologically distinct. Differentiation between cortex and medulla is not possible.

12 weeks (Fig.1B & 1C): Cortex begins to differentiate and numerous eosinophillic cortical cell masses can be easily identified. Interspersed and migrating through these cortical cells are highly darkly stained sympathoblasts which are derived from the migrating neural crest cells. These sympathoblasts will differentiate into chromaffin and non-cromaffin cells of the medulla in later stages of gestation. Later stages of 12 week fetus reveal the differentiation of fetal adrenal medulla into loose connective tissue (medullary parenchyma) and chromaffin cells. Newly differentiated chromaffin cells have pale staining irregular morphology with pyknotic nuclei. A very significant observation is that medullary sinusoidal capillaries are not developed at this stage.

16 weeks (Fig. 1D): Cortex and medulla are completely differentiated. Chromaffin cells now have

Light-micrograph of the medulla of suprarenal gland (H & E stain)

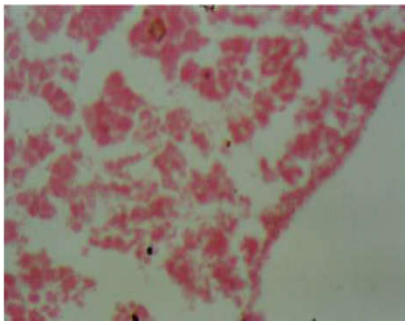

Fig. 1a: 8 weeks: cortex & medulla not differentiated 100x

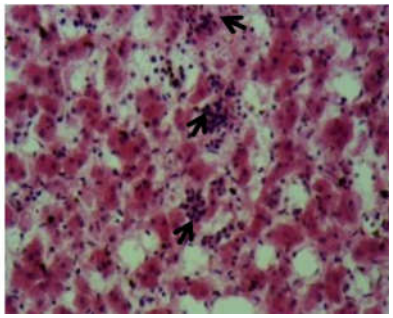

Fig. 1b: 12 weeks: collection of undifferentiated cells (arrow) & scattered cells of the cortex 200x

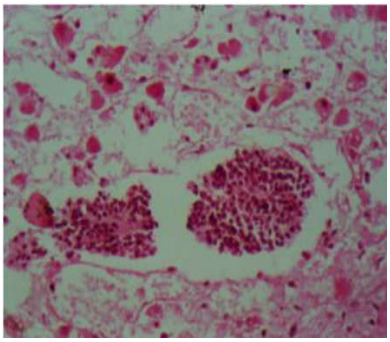

Fig. 1c: 12 weeks: collection of undifferentiated cells & loose connective tissues & scattered cells of the medulla 200x

a regular, pale staining and more distinct appearance. Medullary sinusoidal capillaries can easily be seen. Examination under high magnification reveals that chromaffin cells are in close association with the endothelial cells of the sinusoids. This explains and confirms the endocrine nature of these cells and the activation of sympatho-adrenal system at 16 weeks of gestation. Ganglionic cells have not yet appeared in the fetal adrenal medulla. Moreover, chromaffin cells do not show any delineation into adrenal or nor-adrenal secreting types.

22 weeks (Fig.1E, F & G): Most significant observation

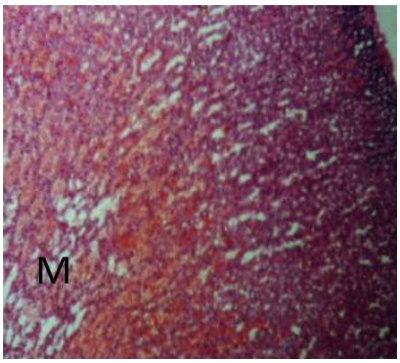

Fig. 1d: 16 weeks: development of medulla showing large number of sinusoidal capillaries 100x

at this stage of gestation is the differentiation of chromaffin cells into adrenaline secreting cells (ASC) and nor-adrenaline secreting cells (NASC). ASCs are large light staining cells with pale staining nuclei. NASCs are large light staining cells with dark staining nuclei. Cytoplasm of both the cells appears to be rough in nature signifying the presence of secreting granules in both the cells. Another significant finding at this stage is the appearance of clumps of sympathetic ganglionic cells. These ganglionic cells are seen to have dark staining, round nucleus with scantily stained cytoplasm. It's important to notice that these cells do not show any peripheral processes like axons and dendrites (Figure 1).

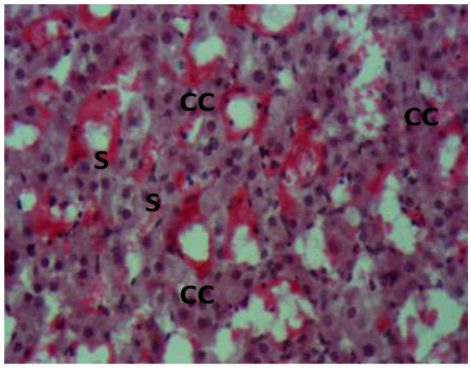

Fig. 1e: 22 weeks: the chromaffin cells (CC) & sinusoides (s) are present 200x

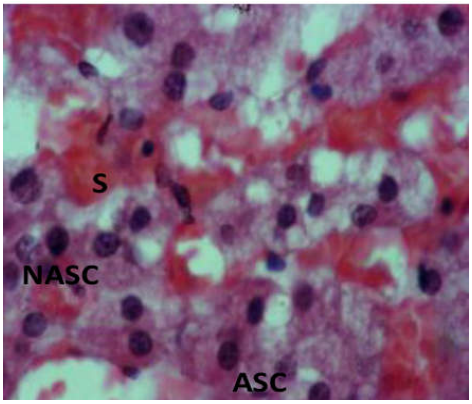

Fig. 1f: 22 weeks: Adrenaline (ASC, pale appearance) and non adrenaline secreting cells (NASC, dark appearance) 400x

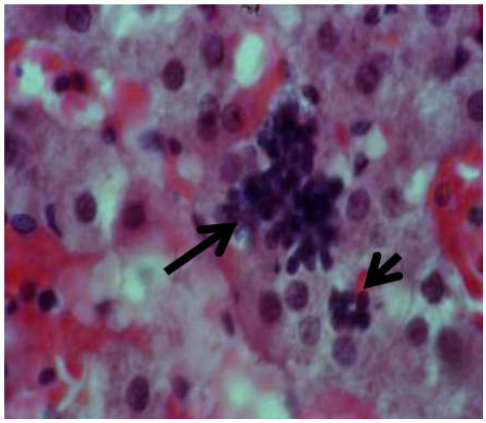

Fig. 1g: 22 weeks: collection of sympathetic ganglion cells (arrow) along with both types of chromaffin cells 400x

Discussion

Extensive comparative analysis of the development of human adrenal medulla is intricate for the authors of this research because of paucity of literature on embryological development of human medulla. Most of the research work in literature on adrenal medulla has been performed on various animals and that too concentrating on adrenal cortical development. This study shows that the adrenals become an apparently visible structure at 8th week of gestation and attain the size of the corresponding kidney at a later stage of 22nd weeks of gestation. Keene and Hewer [9] on the other hand reported that at 6 weeks the gland is a clearly defined organ situated on the upper pole of the kidney and by 8 weeks its maximum cross-section equals that of the kidney. We confirm the presence of a highly vascular central core and a comparatively less vascular, pale peripheral cortical rim as also reported by Keene and Hewer. The gland

shows a steady increase in weight throughout fetal life and regresses in size after birth. Our study showed that on an average the adrenals weighed 0.4 gms at 8 weeks and 2.0 gms at 22 weeks of gestation. Keene and Hewer reported a similar weight ratio in the initial weeks of gestation but charted a much lower weight of 1.0 gm at 22 weeks of gestation. This might be possible because of varying fetal weights due to environmental, maternal and genetic differences. Keene and Hewer reported that the sympatho-chromafil elements can easily be distinguished at 8 weeks of gestation with a positive chromaffin reaction at 22 weeks. They suggested that these cells can be seen invading the adrenal cortex at 8 weeks. Two types of these cells were recognized and accompanying nerve fibers were also sometimes seen. The more numerous of the two types of cell were small with a darkly staining nucleus and very little protoplasm; possibly these were neuroblasts. The second type of cell was larger than the neuroblast and had a vesicular nucleus but was considerably smaller than the cells of the foetal cortex. These were the so called para-sympathetic cells. Both types of cell persist throughout foetal life, and are the precursors of cells (other than large ganglion cells) found in the post-natal medulla. Our study on the contrary suggests that sympathoblasts derived from the migrating neural crest cells can first be identified only at 12 weeks of gestation and that they differentiate into chromaffin and non-chromaffin elements during the late stages of the 12th week. Zuckerkandl [10] on the contrary suggested that the human adrenal medulla is entirely developed from a single type of sympathetic anlage. This study confirms the presence of sympathetic ganglionic cells only at a very late stage of 22 weeks of gestation. We also confirm that chromaffin cells differentiate into two cellular elements only at 22nd week namely ASCs and NASCs. This research work did not find any evidence to confirm the reporting of Cooper [11] suggesting that the sympatho-chromophils gave rise to the ganglionic cells as they invaded the medulla.

Conclusion

This study defines the development of different elements of human adrenal medulla chronologically. We provide allometric data from a considerable number of human fetuses which will aid in histological and ultrasonographic studies of the adrenal gland in future. It is imperative to have precise knowledge of adrenal medullary development to correctly diagnose and manage adrenal developmental anomalies in new born infants.

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Original Article

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A Study on the Morphometry of Occipital Condyles and Suboccipital Muscles in Human Dry Skulls and its Clinical Significance

Swetha B.[1], Hema N.[2]

Abstract

Introduction: The base of the human skull presents Occipital condyle which articulates with the atlas vertebra forming Atlanta-Occipital joint. Keeping the head in inclined posture to engage in actions may play major role in architecture of facet. Maintenance of a particular posture demands more activity from muscles concerned. In this context the role of muscles in terms of traction to maintain a desired posture cannot be ruled out. More anatomical facts on the condyle facets will play an additional boon for the day to day surgeries. *Materials & Methods:* One hundred adult South Indian skulls were examined using the scale, divider and the transparent centimeter reticule in the present study. The shape, size, the anterior-posterior diameter (length) and transverse diameter (width), surface area of occipital condyles on both sides were estimated. The location and number of extra facets were also noted. The surface area of suboccipital muscles were measured in search of the functional relation. *Results:* Mean anteroposterior (length) and transverse diameter(width) of occipital condyles were 2.12cm & 1.1 cm on right side and 2.2 cm & 1.2 cm on left respectively. Mean Surface areas of the facet were 1.76 square centimeter (sq cm) on right and 1.9 sq cm on left which was significant. 22 extra facets were present maximally on the posteromedial aspect of the left occipital condyles. Its mean anteroposterior and transverse diameter were 0.52cm & 0.44 cm on right side and 0.45 cm &0.36 cm on left respectively. Mean surface areas (sq cm) of suboccipital muscles - rectus capitis minor, rectus Capitis major and Obliquus Capitis Superior were 4.9, 5.05 and 10.56 on left side and 4.96,5.37 and 10.82 on right side respectively. Statistically the valued proved to be significant. *Conclusion:* The present study provides anatomical knowledge on the measurements of the occipital condyles serves as a guide in various head and neck procedures for the Neurosurgeons and the Orthopaedicians. The incidence of the facets and the measurements of impressions of the suboccipital muscles on the occipital bone mentions the tilting posture of the humans on one side.

Keywords: Occipital Condyles; Extra Facets; Suboccipital Muscles.

Introduction

Occipital condyles are normally oval in shape and placed in the oblique manner so that anterior end is nearer to midline [1]. The condyles of occipital bone is unique in nature as it connects cranium to the vertebral column. Occipital condyle with the atlas forms the Atlanto- occipital joint, a true synovial joint. Its main movement is flexion and extension of the head which is innervated by C1 ventral ramus [2]. The joint also involved with postural maintenance, balance & weight transmission. The development of bone runs parallel to the stresses imposed on them [3]. Later it is appended that these stresses are transmitted from one bone to other through joints, which may bring about changes in morphology of articular surfaces [4].

In humans the neural arch of pro-atlas divides it into anterior and posterior segments which form occipital condyles and rostral facets on the atlas vertebra [5]. Developmentally abnormal immigration and lack of separation of the features of the cervical vertebrae and base of the skull leads to formation of Occipital Condyle. Precondylar facets develop in response to the primordial dens or odontoid process failing to move down from its primordial position with the foramen magnum, leaving tip of the dens and the atlas anterior border articulating with the rim of the occipital bone [6].

Author's Affiliation: [1]Associate Professor, Department of Anatomy, BGS GIMS, BGS Health and Education City, DR. Vishnuvardhana main Road, Kengeri, Bengaluru, Karnataka 560060, India. [2]Associate Professor, Department of Anatomy, ESIC-Medical college & PGIMSR, Rajajinagar, Bengaluru, Karnataka 560010, India.

Corresponding Author: Hema N., Associate Professor, Department of Anatomy, ESIC-Medical college & PGIMSR, Rajajinagar, Bengaluru, Karnataka 560010, India.
E-mail: hemanesi@gmail.com

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Two canals anterior and posterior condylar canals are related to occipital condyle which transmits important structures. Anterior condylar canal or hypoglossal canal transmits rootlets of hypoglossal nerve. Posterior condylar canals transmit largest emissary vein to the sigmoid sinus, nerves and meningeal branches of occipital artery. During transcondylar approach the condyles should be resected partially or completely to protect these neurovascular structures.

The direction, angle and position of the instruments should be manipulated in various procedures depending on the morphometric measurements of the occipital condyles. Transcondylar surgeries in cranio-vertebral junction requires anatomical knowledge of occipital condyles. Hence prior knowledge of these condyles is compulsory before intervention. So, present study adds a light on the anatomical knowledge of the occipital condyles and the facets.

Posture of the head is maintained by the tension of the extensor muscles. Here study has been made on the surface area of the suboccipital muscles in search of the correlation with the straight / tilted postures of the head.

Materials & Methods

One hundred adult south Indian skulls of unknown age and sex were examined using the scale, divider and the transparent centimeter reticule in the present study. The shape, size, the anterior-posterior diameter and transverse diameter, surface area of occipital condyles on both sides were estimated.

Anterior- posterior diameter (length) is measured between the anterior tip to posterior tip of occipital condyle. Transverse diameter (width) is measured between the midpoint of the left and right margins of the condyles. It is measured using a divider and scale and measured in millimeters (mm) (Fig. 1).

Fig. 1: Measurement using scale and divider

Results

Articular surface areas were calculated using a superimposed square centimeter transparent reticule. 1&>1 sq = 1 UNIT. (Fig. 2)

Statistical analysis was done using unpaired tests on mean and standard deviation results.p value is calculated.

Mean Anteroposterior and transverse diameter of occipital condyles were 21.2mm & 11 mm on right side and 22 mm & 12 mm on left respectively. Mean Surface areas of the facet were 1.76 sq cm on right and 1.9 sq cm on left which was significant (Table 1).

22 extra facets were present maximally on the posteromedial aspect of the left occipital condyles (Fig. 5). Its mean Anteroposterior and transverse diameter were 5.2cm & 4.4 mm on right side and 4.5mm & 3.6 cm on left respectively (Table 3). p value was significant on the left side.

Table 1: Mean Diameter and Surface Area of Occipital condyles

	Anteroposterior (length) [mm]	Transverse (width) [mm]	Surface Area [in sq mm]
Right	21.2	11	17.6
Left	22	12	19

p <0.01, highly significant on left side

Table 2: Mean Diameter of extra facets in mm

	AP diameter	Transverse diameter
Right	5.2	4.4
Left	4.5	3.6

Two different shapes of occipital condyles- globular and hour-glass shaped were observed (Fig. 3,4).

Mean surface areas (sq cm) of suboccipital muscles -rectus capitis minor, rectus Capitis major and Obliquus Capitis Superior were 4.9, 5.05 and 10.56 on left side and 4.96,5.37 and 10.82 on right side respectively (Fig. 6). p valve was highly significant on the right side.

Observations were also made on the number, location and surface area of additional facets.

Our study showed 22 extra facets, 12 on left side and 10 on right Side. Its position was onpostero-medial aspect (20) and 2 were located medially. Measurements were made on these extra facets which showed more values on right side (Table 3).

Table 2: Comparision of occipital condyles paramaters with other studies

Sl. No	Author	Year	Occipitalcondyles								
			No. of occipital condyles	Length		Width		Height		AICD (anterior intercondylar distance)	PICD = (posterior intercondylar distance)
				Rt	Lt	Rt	Lt	Rt	Lt		
1.	Present study	2018	200	21.2	22	11	12	---	---	---	---
2	Divya P[10]	2017	110	22.9	22.8	12.7	12.3			19.2	39.3
3	Deepa Somanath et al.[11]	2017	100	24.9	23.9	11.4	10.1	5.3	4.5	15.22	7.7
4	Sandeep Saluja[25]	2016	228	22.90	22.60	9.32	12.97	9.32	9.12	17.81	38.91
5	Anil kumar et al. [26]	2014	100	23.88	24.99	12.97	14.11	8.64	9.32	17.63	42.02
6	S. Kavitha et al. [27]	2013	290	21.97	22.34	13.05	13.30	---	---	---	---
7	Avic.E et al.[28]	2011	60	23.7	24	12.2	12.4	9.6	9.5	9.9	26.7
8	Divya Mahajan et al.[29]	2011	300	22.61	22.36	13.72	13.96	7.01	6.95	---	---
9	Archana et.al.[30]	2016	200	21.83	22.19	11.07	11.42	8.25	8.19	21.28	40.61
10	Naderi et al.[12]	2005	404	23.6	23.3	10.6	10.6	9.2	9.2	21	41.6

Fig. 2: Measurement using Transparent reticule

Fig. 4: Shape of the condyle – Globular

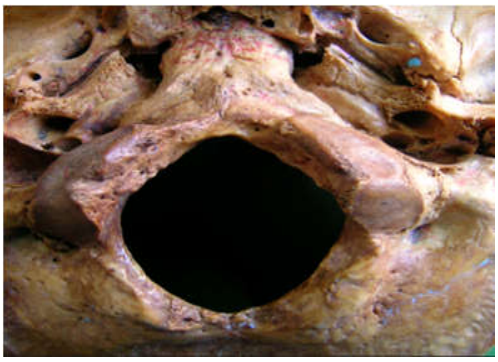

Fig. 3: Shape of the condyle – Hourglass

Fig. 5: Shape and position of the extra facets

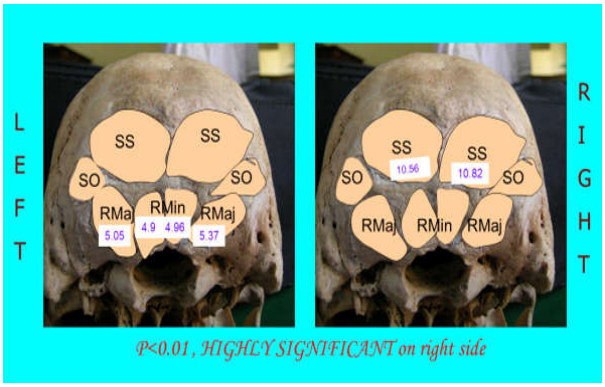

Fig. 6: Mean Surface area of muscles (In cms2)

Discussion

The entire weight of the head falls on the atlanto occipital joint. Any variation in the shape and size will disturb this function. The condylar parts of occipital bone flank the foramen magnum. Lesions closeto foramen magnum can be approached through transcondylar approach which is performed by piercing occipital condyles above occipital junction [7]. Dorsal aspect is most preferred at craniovertebral junction [8]. It is important to plan and calculate the bone extent to be resected [9].

Most of the researchers conducted morphometry of occipital condyles in dry skulls, though a few investigators studied cadaveric specimens and CT scans which can yield variable results. A comparative study has been done with our findings (Table 3). In our study mean length of occipital condyles were found 21.2mm right and 22.2 mm left which are in accordance with the findings of other authors with a difference range of 1-2 mm. The values were found more on the left side which is in conformity with the length reported by other authors except Divya. P [10] and Deepa Samarth [11], Naderi Mahajan et al.[12] mentioned more on right side of measurement 1-2 mm (Table 3). Mean width of occipital condyles in our studies revealed 11 mm on right and 12 mm on left side. The values were almost same with other authors with a variable range of 1-2mm. Comparatively, higher values were found on the left side which are coinciding with the findings of other authors with a exception of findings of Deepa Samarth and Divya. P where the difference is about 1-2mm more (Table 3). Probably the slight difference of measurements among the authors may be due to racial variations and the difference in the methodology. Naderi [12] classified length of occipital condyles as Type-1. Short Condyles- shorter than 20mm, Type-2. Moderate Condyles- between 20–26 mm and Type-3. Long Condyles longer than 26mm.

Based on the above classification, the occipital condyles in the present study falls in Type-2. moderate condyles.

Most of the cranio-vertebral approaches necessitate either partial or complete resection of occipital condyles [13].

Our study showed 70% globular shaped and 30% hourglass shapedoccipital condyles in South Indian population. This was different from other previous studies done by Fetou H [14] and Parvindokht [15] which showed reniform shaped in Egypt population and in Iran population respectively. Jose study showed S and 8 types to be more common in Brazilian population [16].

The suboccipital region is one the most complicated anatomical areas of human body [17]. The sub-occipital muscles act to functionally maintain the stability of the head while allowing delicate control of movement of atlanto-occipital and atlanto-axial joint with a weak sustained force [18]. Unilateral contraction of these muscles results in head rotation, were as bilateral contraction results in head extension [19].

Muscle strength is proportional to cross sectional area of muscle fibres [10]. Our study showed the values of surface areas of suboccipital muscle to be highon the right side compared to left side (Fig. 6). This shows that the muscle strength is more on right side. Cross-sectional areas of neck muscles is proportional to height and weight of an individual [21].

The proprioceptive inputs from the cervical musculature play an important role in head-eye co-ordination and postural process [22]. Atrophy of sub-occipital muscles following whiplash is involved in marked, chronic neck pain and reduced standing balance [23]. Hence association between these muscles and headache cannot be ruled out. Our study on surface areas of these muscles provides clinical significance in relation to the headache and neck pain.

Xiao-Ying Yuan et al. investigated the existence of second termination originating from sub-occipital muscles and relation between various types of To Be Named Ligament (TBNL) [24].

Extra facets were observed in 10-12% skulls studied. Majority of them were located posterior to occipital condyles.

The above findings perhaps suggest an adaptation for tilted head posture on the left side.

Conclusion

This study provides anatomical data on occipital condyles and the accessory facets. These morphometric parameters will be helpful for planning the appropriate surgical approach.

12% of the skulls showed extra facets posteriorly. Probably this suggests a "secondary adaptation" to maintain the erect posture of the head countered by the tonus of extensor muscles (sub occipital muscles). More surface area on the right side may probably due to tilted head.

Acknowledgement

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Original Article

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Morphological Variations of Circle of Willis: A Human Cadaveric Study

Nandhini Venkatachalam[1], Manimegalai S.[2]

Abstract

Background & Objectives: The Circle of Willis is a large arterial anastomosis in the base of the brain between carotid and vertebrobasilar system. There is considerable individual variation in the pattern and caliber of these vessels. Aim is to study the configuration of CW and its variations. *Materials and Methods:* This study was carried out in 50 brain specimens obtained from embalmed human cadavers. The CW was studied in detail in each specimen with reference to its formation and variations. *Results:* In this study, completeness of the CW was noted in 45 (90%) brai n specimens out of 50. The circle was found to be incomplete in 5 (10%) out of 50 specimens. Anterior part of the circle was incomplete in 4 brains (8%), whereas the posterior part of the circle was found deficient in 1 specimen (2%). Symmetry was seen in 27 (54%) of the 45 circles, the circle was found asymmetrical in 18 specimens (36%). Asymmetry was due to abnormal anterior part in 7 specimens (14%) and abnormal posterior part in 11 specimens (22%). Fetal PCA was found in 9 specimens (18%). PCoA was absent in 1 (2%), hypoplastic in 1 specimen (2%). Single median ACA was noted in 2 brains (4%). A1 was missing in 1 specimen (2%). ACoA was missing in 4 specimens (8%), double ACoA was observed in 2 circles (4%) and was plexiform in 1 brain (2%). *Interpretation & Conclusion:* Complete symmetrical CW was seen in 27 specimens (54%). The circle was incomplete in 5 specimens (10%), most frequently in the anterior part of the circle accounting for 8%. The circle was anomalous in 18 brains (36%), observed most frequently in the posterior part of the circle accounting for 22%. Variations noted were absence, hypoplasia and duplication of the vessels forming CW.

Keywords: Circle of Willis; Morphology; Symmetry; Anterior Cerebral Artery; Posterior Cerebral Artery; Communicating Arteries.

Introduction

Circle of Willis CW is a circle of arteries between internal carotid system and vertebrobasilar system that supply blood to the brain. The CW is a large arterial anastomosis which unites the internal carotid and vertebrobasilar systems. It lies in the subarachnoid space within the interpeduncular cistern and surrounds the optic chiasma and infundibulum. The carotid arteries and their branches (referred to as the anterior circulation) supply the anterior portion of the brain while the vertebrobasilar system (referred to as the posterior circulation) supplies the posterior portion of the brain. Arterial circle is formed anteriorly by the two ACA derived from the ICAs are linked by the small ACoA, posteriorly by the two PCA formed by the division of the basilar artery, they are joined to the ipsilateral ICA by a PCoA. It is not truly a circle but a polygon [8].

From the arterial circle and the principal cerebral arteries, two types of branches arise, central and cortical forming two distinct systems. Every cerebral artery has evolved from a primitive vascular network enveloping the brain. From this net, channels have become enlarged in response to the demands of the parts they supply.

Materials and Methods

This study was carried out in 50 brain specimens obtained from embalmed human cadavers. The brains

Author's Affiliation: [1,2]Assistant Professor, Department of Anatomy, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu 636030, India.

Corresponding Author: Manimegalai S., Assistant Professor, Department of Anatomy, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu 636030, India.
E-mail: doctormani2007@gmail.com
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were removed en-mass and gross examination of the arterial circle was done. Magnifying lens was used wherever necessary. Drawings were made for each specimen for further correlation.

The CW was studied in detail in each specimen with reference to its formation and variations. The completeness, symmetry, presence and absence of the components of the circle, other variations like doubling, fenestration etc. were noted.

Results

Circle Morphology

Completeness

In the present study, completeness of the CW was noted in 45 (90%) brain specimens out of 50. The circle was found to be incomplete in 5 (10%) out of 50 specimens [Chart 1].

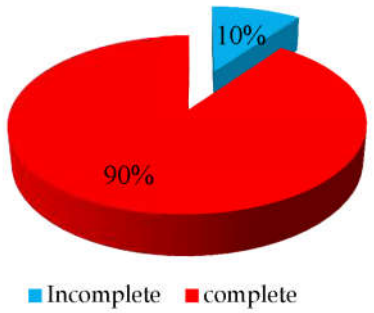

Chart 1: Completeness of CW

Incomplete CW

Anterior part of the circle was incomplete in 4 brains (8%), whereas the posterior part of the circle was found deficient in 1 specimen (2%) [Chart 2].

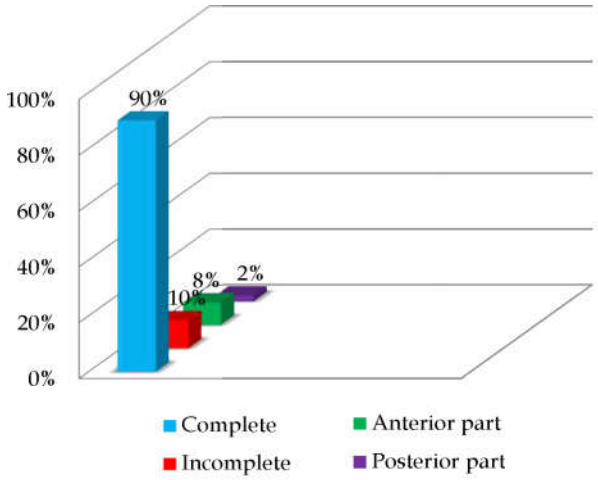

Chart 2: Circulus Arteriosus

Symmetry

Symmetry was seen in 27 (54%) of the 45 complete circles, the circle was found asymmetrical in 18 specimens (36%) [Table 1].

Table 1: Symmetry of CW

Symmetry	No. of specimens	%
Asymmetrical	18	36
Symmetrical	27	54
Total	45	90.0

Asymmetric CW

- Asymmetry was due to abnormal anterior part in 7 specimens (14%)
- Asymmetry was due to abnormal posterior part in 11 specimens (22%) [Table 2].

Table 2: Asymmetric CW

Asymmetric CW	Specimens	%
Anterior part	7	14
Posterior part	11	22

Types of CW found in the study

Typical Pattern

Of the 50 specimens examined, 27 (54%) conformed to the aforementioned typical pattern being symmetrical and complete [Figure 1].

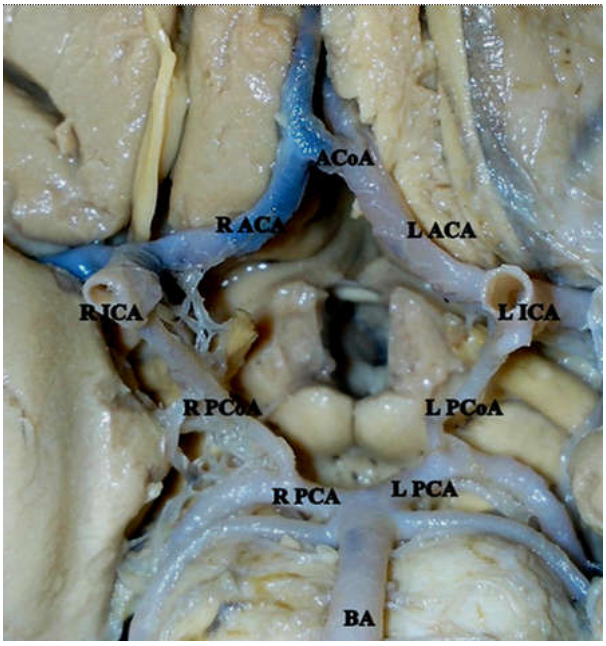

Fig. 1: Complete and symmetrical circle

Deficient Circle

The CW was said to be deficient if there was complete absence of a component vessel breaking the continuity of the circle.

In the present study the circle was deficient in 5 instances (10 %).

It was due to absence of

i. ACoA in 3 specimens (6%);
   - It was due to single median ACA in 2 brains (4%)
   - Due to communicating ACA walls in 1 specimen (2%)

ii. Proximal part of an ACA up to its union with ACoA in 1 instance (2 %);

iii. PCoA in 1 specimen (2 %). [Chart 3]

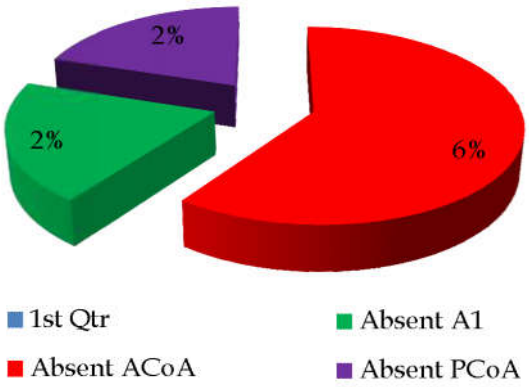

Chart 3: Deficient circle

PCA: It was present in all 50 specimens on both the sides. It was found abnormal in 9 specimens. Embryonic type of PCA was found in all cases (4 on right side, 2 on left side and 3 bilateral). The proximal part of the PCA was abnormal and the distal part was normal, which was the continuation of PCoA. The PCoA on the affected side was larger than normal. [Figure 5, 7]

PCoA: It was found in 49 specimens out of 50 specimens examined. It was absent bilaterally in one brain specimen (2%) thus providing no communication between the carotid and basilar systems. It was hypoplastic in 1 specimen (2%). [Figure 6]

ICA: They were present universally in all specimens examined both on right and left side.

ACA: Single median or azygous ACA was seen in 2 specimens (4%). A1 segment was absent in 1 specimen (2%). ACA walls were communicating in 1 brain (2%) in the absence of ACoA. [Figure 2, 3, 4]

ACoA: It was absent in 4 specimens (8%). Duplication was seen in 2 specimens (4%). Plexiform ACoA was seen in 1 brain (2%). [Figure 2, 5, 8]

Thus the CW was mostly complete and symmetrical. Incompleteness of CW was found commonly in the anterior part. Asymmetric or anomalous circle was frequent in the posterior part of CW.

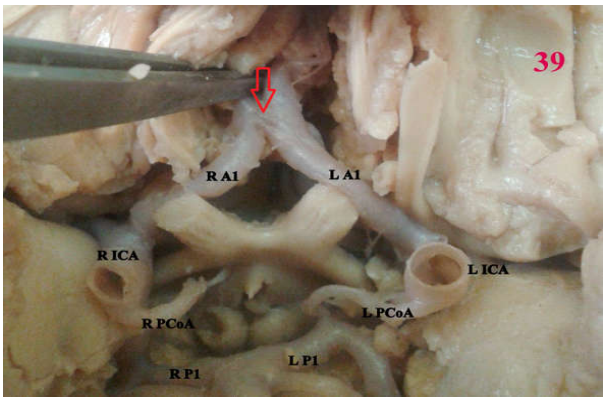

Fig. 2: Absent ACoA

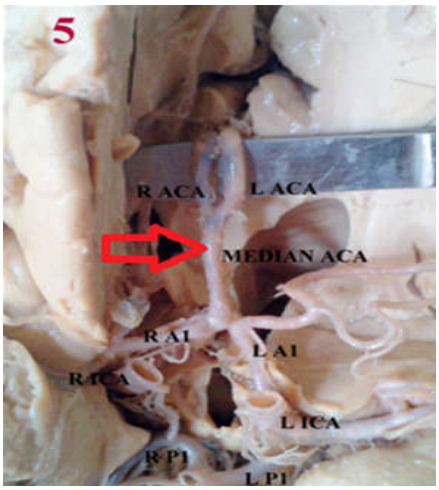

Fig. 3: Single median ACA

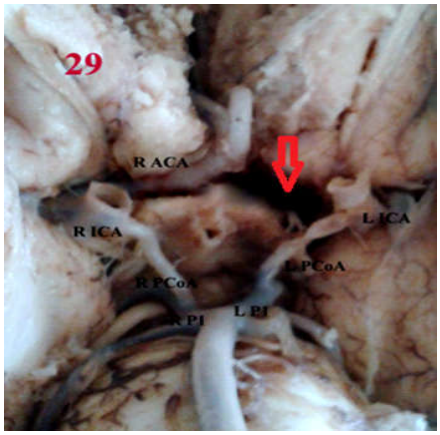

Fig. 4: Absent L A1 segment

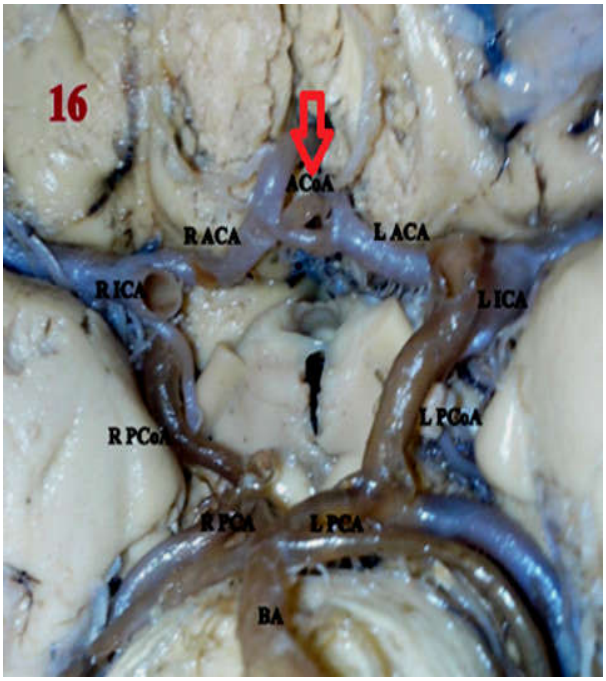

Fig. 5: Double ACoA and Fetal PCA

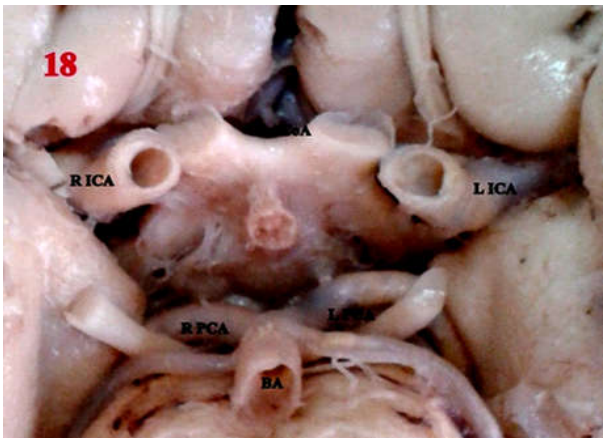

Fig. 6: Bilateral absence of PCoA

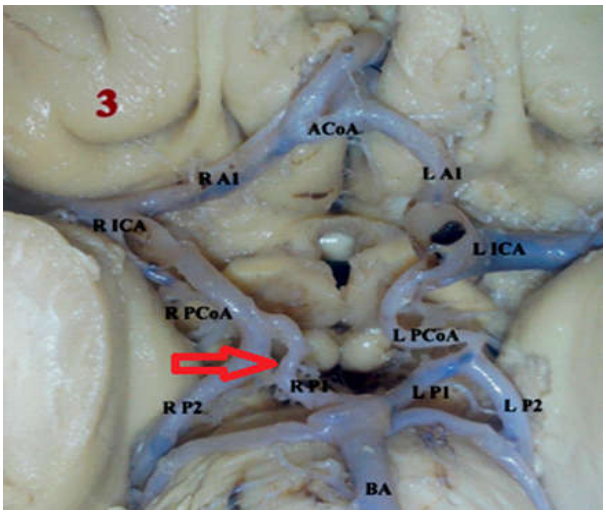

Fig. 7: Fetal R PCA

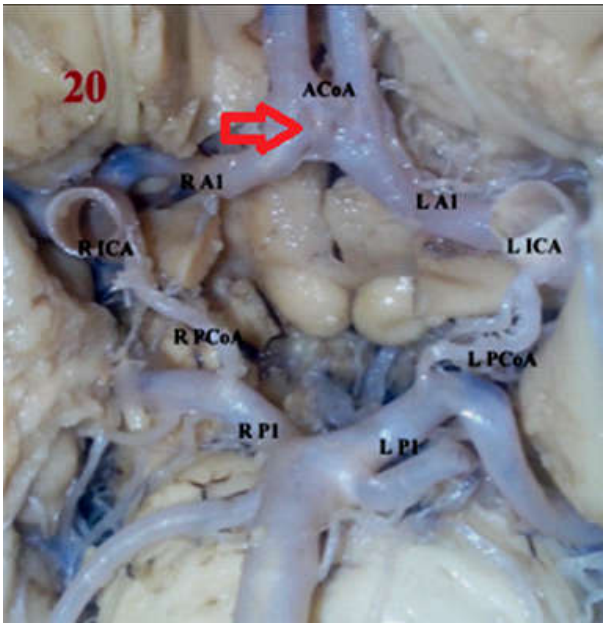

Fig. 8: Plexiform ACoA

Discussion

Circle Morphology: Completeness

Kapoor et al examined 1000 specimens, noted complete in 96.8%, 452 (45.20%) confirmed to be aforementioned typical pattern and was found deficient in 32 instances (3.20%) [2]. In a study conducted by Fawcett, it was complete in 673 cases (96.1%) and incomplete in 27 cases (3.8%) out of 700 [3]. Eftekhar et al., reported 31.5% of cases where the CW was normal [4]. Windle in 1887 reported that 59.5% circles had normal arrangement of arteries in the CW [5]. Ghanbari et al. noted the anatomical patterns of CW in 100 male east Azarbaijanian individuals, they found complete CW in 89% and incomplete CW in 11% [6]. In a study done by Roopashree et al., out of 30 brain specimens, it was found that the CW was complete in 76.66% of the cases and incomplete in 23.34% of the cases. The circle was symmetric and normal in 33.33% [7]. [Chart 4].

In the present study, 45 specimens (90%) were complete CW and 5 specimens (10%) were incomplete CW.

Incomplete CW

Kapoor et al. has reported that incomplete circle (3.20%) was due to absence of

i. ACoA in 18 specimens (1.80%);

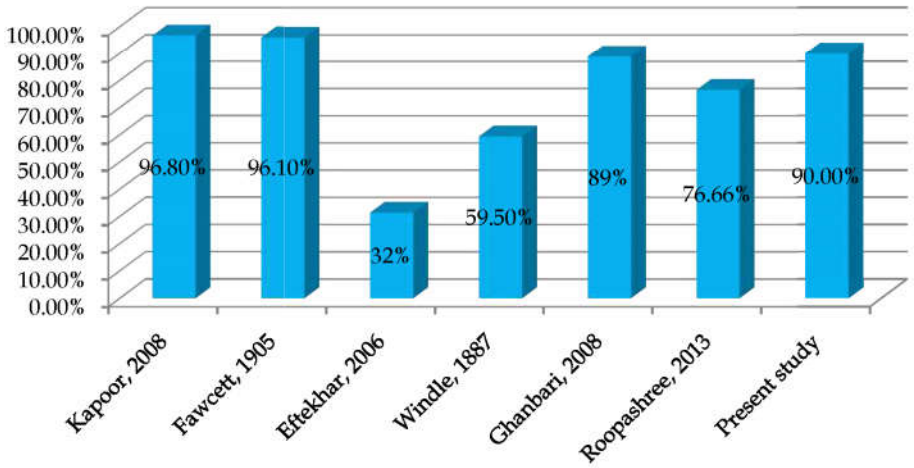

Chart 4: Comparison of completeness of CW Kapoor 2008 Present study

ii. Proximal part of an ACA up to its union with ACoA in four instances (0.40%)

iii. PCoA in 10 specimens (1%) [2].

In the present study, anterior part of the circle was incomplete in 4 brains (8%), whereas the posterior part of the circle was found deficient in 1 specimen (2%).

It was due to absence of ACoA in 3 specimens (6%) single median ACA in 2 brains (4%) and communicating ACA walls in 1 specimen (2%), absence of proximal part of an ACA up to its union with ACoA in 1 instance (2 %) and absent PCoA in 1 specimen (2 %). [Chart 5].

Symmetry of CW

Fawcett 1905 found symmetrical CW in 514 (73.4%) and asymmetrical in 186 cases (26.5%) out of 700.[3] In the present study, CW was symmetrical in 27 specimens (54%) and was asymmetrical in 18 specimens (36%) [Chart 6].

Anomalous CW

Previous studies have found that the anomalies of the circle are more common in the posterior part. Kapoor et al in 2008 documented in their study, that anterior half was abnormal in 234 (23.4%) and posterior half was found abnormal in 314 (31.4%) [2]. Saeki et al. in 1977 reported the anomalies of the posterior part of the circle as 49% of the cases [8]. Out of 35 circulus arteriosus, anomalous formation was found in 3 cases, 8.6% by Poudel et al. [9]. The posterior part of the circulus arteriosus was incomplete in 16.66% by Roopashree et al in 2013 [7].

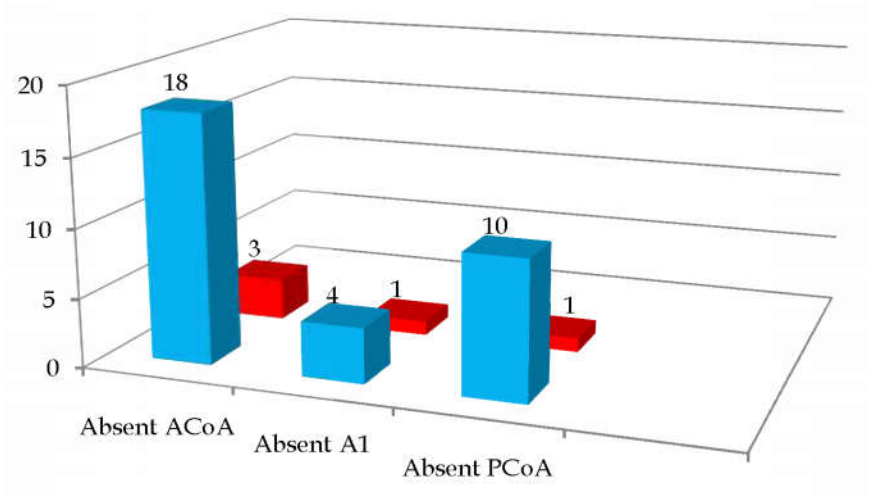

Chart 5: Comparison of specimens with incomplete CW

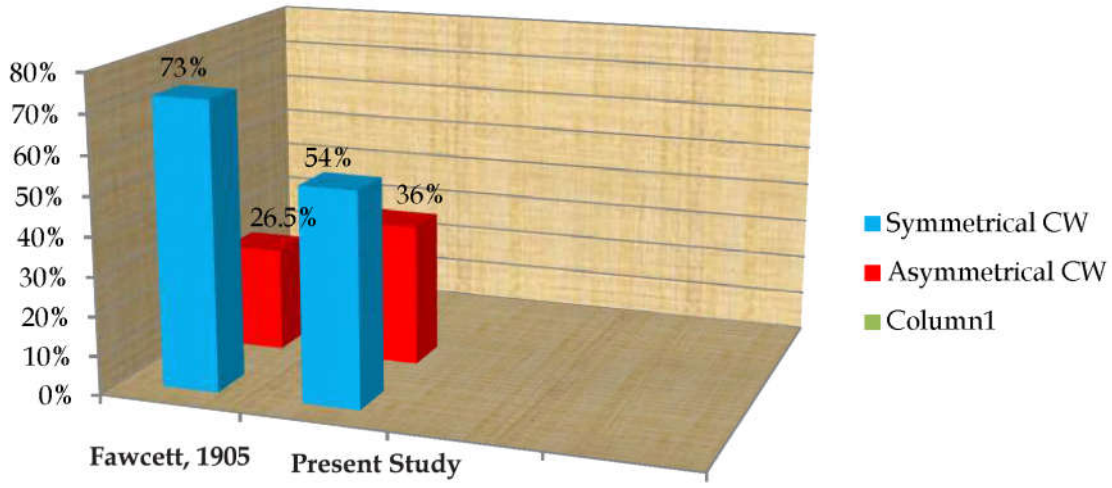

Chart 6: Comparison of symmetry of CW

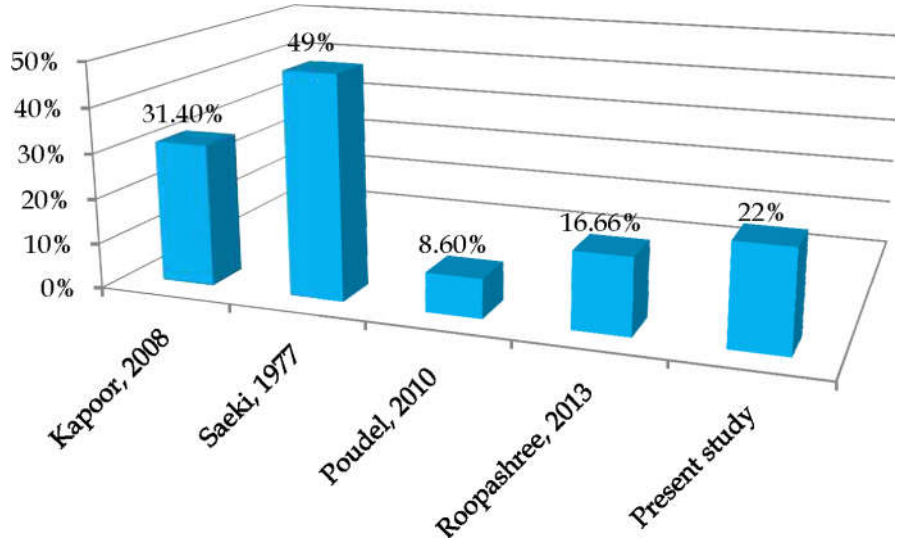

Chart 7: Comparison of anomalous posterior part of CW

In the present study anomalous circle was noted in 18 specimens (36%). Posterior part accounted for major anomalies being found in 11 specimens (22%) followed by anterior part which was abnormal in 7 specimens (14%) [Chart 7].

Altered cerebral blood flow has been demonstrated in regions supplied by variant CW vessels. Their central hypothesis was that CW anomalies correlate with alterations in cerebral hemodynamics and contribute to migraine susceptibility and ischemic complications of migraine. Dysregulation of cerebral blood flow may allow relative ischemia to develop in the setting of increased metabolic demand related to neuronal hyperexcitability, may trigger cortical spreading depression, and may predispose individuals with migraine to ischemic lesions and stroke [10].

Conclusion

Completeness of the CW was noted in 45 (90%) brain specimens out of 50. The circle was found to be incomplete in 5 (10%) out of 50 specimens. Complete and normal circle was found in 27 (54%) and complete anomalous circle in 18 specimens (36%). Thus the CW was mostly complete and symmetrical. Incompleteness of CW was found commonly in the anterior part. Asymmetric or anomalous circle was frequent in the posterior part of CW.

In the study variations like

- Deficient circles due to absence of ACoA, A1 segment, PCoA
- Hypoplastic communicating arteries
- Fetal PCA
- Double ACoA etc.. were observed.

The knowledge of such variations, anomalies and its significance in causing cerebrovascular accidents will be of great importance for the physicians, neurologists, neurosurgeons, radiologists in arriving at a diagnosis and managing the patient accordingly.

List of Abbreviations Used

ACA- Anterior Cerebral Artery

ACoA - Anterior Communicating Artery

A1- Anterior Cerebral Artery before ACoA

A2 - Anterior Cerebral Artery after ACoA

BA- Basilar Artery

CW- Circle of Willis

ICA - Internal Carotid Artery

L- Left

PCoA - Posterior Communicating Artery

PCA - Posterior Cerebral Artery

R - Right

Acknowledgement

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Original Article

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Variations in Branching Pattern of External Carotid Artery

Naveen Kumar S.[1], Naveen Kumar K.[2]

Abstract

Common Carotid arteries (CCA) provides major sources of blood to head and neck by giving two terminal branches, external and internal carotid arteries, at the level of superior border of thyroid cartilage in carotid triangle. During routine dissection in Department of Anatomy, Shadan institute of Medical Sciences, Dr VRK Womens Medical college and we observed variations in three specimens. In one specimen we observed a higher division of External Carotid artery (ECA), near to the angle of mandible and in two specimens, we observed linguofacial trunk bilaterally. Knowledge of such variations are important for surgeries during plastic and reconstructive surgeries of head, neck and face to avoid iatrogenic injuries and for radiologists for interruption of angiograms of face and neck regions.

Keywords: Common Carotid Artery; External Carotid Artery; Anatomical Variation.

Introduction

The common carotid arteries (CCA) provide the major source of blood to the head and neck. Normally it gives two terminal branches, external (ECA) and internal carotid arteries (ICA) at the level of superior border of thyroid cartilage in carotid triangle [1]. External carotid artery extends from the level of upper border of lamina of thyroid cartilage to a point behind neck of mandible [2].

Branches of ECA develop centripetally starting from arterial network of that territory and the preferred routes are formed in accordance with the local hemodynamic need, may result in various types of variation in branching pattern of ECA [3].

The knowledge of carotid arterial system is useful to minimise the post operative complications in bloodless surgical field. The variations in branching pattern of ECA are important for surgeons during plastic and reconstructive surgeries of head, neck and face to avoid iatrogenic injuries and it is also important for radiologists for interpretation of angiograms of face and neck regions [4].

Materials & Methods

Specimen chosen for dissection are the 40 cadavers kept for dissection for I MBBS students from 2014-2017. Anomalous, tortuous and dilated CCA were discarded for the study. All specimens were well preserved in formalin and dissected according to Cunningham's manual. Variations were well documented.

Observations & Results

Eighty specimens were evaluated for this study. Table 1 shows variations in origin of ECA.

We observed normal branching pattern of ECA in 16 specimen. In one specimen, we observed a higher division of ECA, division occurred near to angle of mandible and also showed linguo facial trunk which later divided in to lingual and facial arteries. We

Author's Affiliation: [1]Associate Professor, Department of Anatomy [2]Associate Professor, Department of ENT, Shadan Institute of Medical Sciences and Research Centre, Hyderabad, Telangana 500008, India.

Corresponding Author: Naveen Kumar S., Associate Professor, Department of Anatomy, Shadan Institute of Medical Sciences and Research Centre Hyderabad, Telangana 500008, India.
E-mail: drsnaveen@gmail.com
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Table 1:

Level of origin	Right	Left	Total percent
At the angle of mandible.	06 (7.5%)	03 (3.75%)	5.62%
At hyoid bone	12 (15%)	09 (11.25%)	13.12%
Upper border of thyroid cartilage	19 (23.75%)	15 (18.75%)	21.25%

observed linguo facial trunks in 2 cadavers which were bilaterally present.

In another specimen, we observed superior thyroid artery arising from CCA and also a linguo facial trunk.

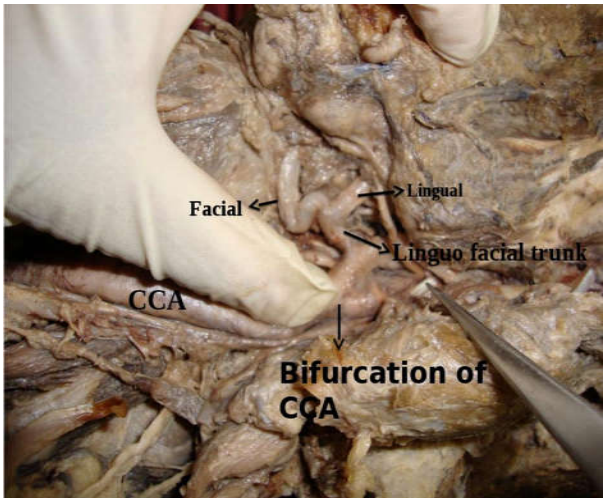

Fig. 1:

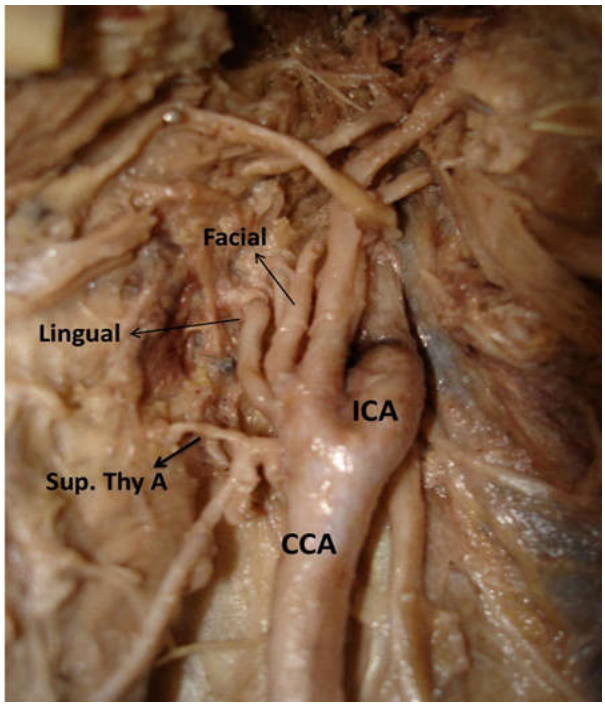

Fig. 2:

Discussion

The ECA is one of the terminal branches of CCA usually given off at the level of the upper border of thyroid cartilage, corresponding to C3-C4 vertebral level 12. It is anteromedial to the internal carotid artery at its origin in the carotid triangle and ascends to the parotid gland and terminates into maxillary and superficial temporal arteries at the level of the neck of the mandible. It gives off superior thyroid, lingual, facial, ascending pharyngeal, occipital and posterior auricular arteries in the neck. In a radiological study in different age groups, it is reported that the origin of ECA can be anywhere between C2-C6 vertebral level (From last article in the folder). According to Inamasu & Guiot, CCA bifurcation may be an individual variation which may occur due to differences in level of embryological origin of ECA.

Thwin et al reported a higher bifurcation at the level of hyoid bone [5]. Kishve et al reported a higher level of origin where ECA originated about 1cm above hyoid bone [6]. In this study, we observed a still higher level of bifurcation, near to the level of angle of mandible.

Sanjeev et al observed that superior thyroid artery is a direct branch of CCA in 35.14% of cases. According to Al- Rafiah et al, superior thyroid artery branched from CCA in 18.3% of cases [7]. In this study, we observed origin of superior thyroid artery from CCA in one specimen.

Sanjeev et al. found linguo facial trunk in 18.92% of cases. Ozgur et al observed linguo facial trunk in 7.5% of cases. In the present study, we observed linguo facial trunk in 2 specimens unilaterally. In one specimen with linguo facial trunk, we observed superior thyroid artery coming from CCA.

Conclusion

The branches of the external carotid artery are the key landmarks for adequate exposure and appropriate placement of cross clamp on carotid arteries. Knowledge of variations in branching pattern and its position is mandatory to avoid

complications during various surgical procedures for ENT surgeons and radiologists for interpreting radiographs.

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Original Article

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Horse Shoe Kidney Horse Shoe Kidney

P. Venkateswara Rao[1], A. Hemalatha Devi[2]

Abstract

Horse shoe Kidney was first recognized during an autopsy De Carpi in 1521. This anomaly consisits of two distinct renal masses lying vertically on either side of midline and connected at their respective lower poles by a parenchymatous or fibrous isthmus that crosses the mid plane of the body. This isthmus lies at the level of 4th lumbar vertebra just beneath the origin of inferior mesenteric artery in about 40% of cases. Fusion of upper poles instead of the lower poles results in an inverted horse Shoe Kidney which constitute 5-10% of all Horse-Shoe kidneys, (i.e. in 95% of HSK, fusion is at lower poles). HSK is found more commonly in males by a 2:1 margin. *Summary & Conclusion:* The abnormality originates between 4th and 6th weeks of gestation, after the ureteral bud has entered the renal blastema. Boyden (1931) postulated that at the 14 mm stage (4.5 weeks) the developing metanephric masses lie close to one another, any disturbance in their relation ship may result in joining at their inferior poles. Usually the fusion of the both kidneys occurs before they have rotated on their long axis ,thus pelvis and ureters of HSK are being usually placed anteriorly. Rarerly, fusion occurs after some rotation had already taken place in which case the pelves are anterimedialy placed.

Keywords: Horse Shoe Kidney; Unilateral Fused Kidney; Nephrolithisis; Autopsies.

Inroduction

Horse Shoe Kidney was first recognized during an autopsy by De Carpi in 1521. This anomaly consists of two distinct renal masses lying vertically on either side of the mid line and connected at their respective lower poles by a parenchymatous or fibrous isthmus that crosses the mid plane of the body. This isthmus lies at the level of 4th lumbar vertebra just beneath the origin of inferior mesenteric artery in about 40% of cases. Fusion of upper poles instead of the lower poles results in an inverted horse Shoe Kidney which constitute 5-10% of all Horse-Shoe kidneys, (i.e. in 95% of HSK, fusion is at lower poles). HSK is found more commonly in males by a 2:1 margin .

Author's Affiliation: [1]Associate Professor, Department of Anatomy [2]Professor & Head, Department of Physiology, Katuri Medical College, Guntur, Andhra Pradesh 500019, India.

Corresponding Author: P. Venkateswara Rao, Associate Professor, Department of Anatomy, Katuri Medical College, Guntur, Andhra Pradesh 500019, India.
E-mail: vrpotu@gmail.com

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The comparative statement of the incidence of HSK is as follows:

Name of the worker (s)	Incidence	Method Adopted
Morris (1901)	1:1000 (0.18%)	Autopsy
Joly (1940)	1:750 (0.13%)	Autopsy
5 Zees & Beenighan (1954)	1:700(0.14%)	Autopsy
Hugo delgaard (1964)	1:500 (0.20%)	Excretion Urography
Cambell (1970)	1:425(0.23%)	Excretion Urography
Pitte's et al (1975)7	1:250(0.40%)	Excretion Urography

Aim of the Study

- An attempt has been made to know the various anomalies.
- The study has been taken up with the fond hope of helping the clinician, sinologist, and urographers,surgeons during their routine work.
- To apply this knowledge to the incoming post graduates in their research works.

Embryological Basis & Kidney Anomalies

The abnormality originates between 4th and 6th weeks of gestation, after the ureteral bud has entered the renal blastema of theembryogensis. Boyden (1931)

8 postulated that at the 14mm stage (4.5 weeks) the developing metanephric masses lie close to one another, any distaurbance in their relationship may result in joining at their inferior poles. A slight aileration in the position of the umbilical or common iliac artery could change the orientation of migrating kidneys thus leading to contact and fusion. In 1941 Dees (Nation 1945, Bell 1946, Gleen 1959, Campbell 1970) described horse-shoe kidney disease occurrence in 0.25% of the population or about 1 in 400.

Review & Literature

- De Carpi in 1521 first recognized horse- shoe kidney during an autopsy.
- Morgaani in 1820 the first diseased horseshoe kidney and since then more has been written about this condition than about any other renal anomaly. Almost every renal disease has been described in the horse-shoe kidney.
- Wilmar in 1938 described kidneys located to one side that from which its ureter inserts into the bladder, crossed ectopia, fusion anomalies are logically categorized.
- Beer & Menches in 1938 observed incomplete duplication of kidney. In their series 85.5% were unilateral and 14.5% were bilateral.
- Wayroucech in 1939 [9] found 5 laterally facing kidneys in his series of 23 cases of malrotation of kidney .
- Joly in 1940 stated the incidence of horse shoe kidney in 1:750, whereas Campbell (1963) reported the same a 1:425.
- In 1940 Dees (Nation 1945 [10,11] Bell 1946, Gleen 1959, Campbell 1970) Described horse shoe kidney disease occurrence in 0.25% of the population or about 4 in 400.

Materials & Methods

- During routine dissections in KMC, Guntur. male aged 60 years presented H.S.K Kidney.
- It should be emphasized once again that the incidence of congenital anomalies varies greatly depending upon the methodology adopted for the study. For xample Hollinshed (1956) and K.Mortan (1958)observed renal anomalies in 2-3% of all operations and 0.5 to 1% in all autopsies.

The present study was conducted

a. 76 adults cadavers.
b. 20still born fetuses of kidney specimens of 40.
c. 60 Kidneys from Patients attending generak outpatient department of Radiology, GGH, Vijayawada
   - Screening of the patitents for any renal anomalies, who were attending to the urological out patients departments:
   - Sonograms of 60 kidneys were obtained and parameters and anomalies were noted .
     a. SL. NO.
     b. External appearance
     c. Sex of the patient
     d. Parameters – crown rump and down heel length and weight of the fetus.
     e. Anomalies.

Cadavers from Anatomy Dissection Hall and Autopsy

- 78 specimens were studied and the study of upper urinary tract was under taken in detail, after noting the Sl.No, Sex, Parameters. Anomalies were studied and photographs were taken.

Unclaimed Still Born Fetuses

- 32 Specimens were studied after noting the following particulars.
  a. SL. NO.
  b. Approx. Age of fetus
  c. Sex of the patient
  d. Parameters
  e. Anomalies

Procedure

The abdomen was opened by right paramedian incision and two parallel transverse incisions, which were taken at the ends. Of the right paramedian incision. The superficial viscera were studied in detail and noted the anomalies if any present. Next the coils of small intestine and large intestines were removed from abdominal cavity to get a clear view of the posterior abdominal organs. The size, shape and position of the kidney were recorded. The hilum of the kidneys and the structures in relation to it were noted down. Next the pelvic viscera, diaphragm, great vessels were examined for any anomalies.

Fig. 1: Showing Fusion of Lower Poles of the Kidneys

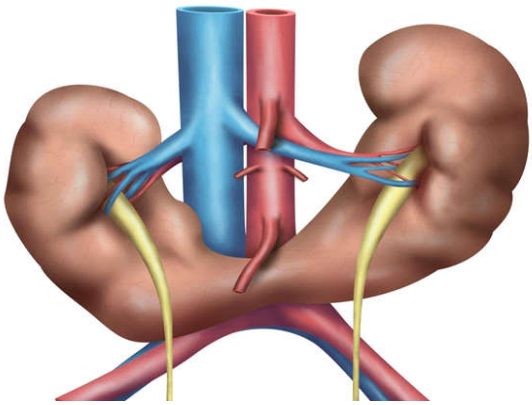

Fig. 2: Diagram showing Large vessels behind the horse-shoe kidney

Results

Most (90%) of the cases of horse shoe kidney are asymptomatic.Horseshoe kidneys are sometimes at a greater risk than normal kidneys for obstruction, usually at the uretero pelvic junction, as well as for vesico ureteral reflux, infection, urolithiasis and malignancy. The presence of horse shoe kidney is technically demanding during renal surgeries, renal transplants, or surgical and endovascular procedures on the aorta because of the anomalous complexity of the kidney, its collecting system, and renal blood vessels. Hence its morphological structure and variations are important factors to be considered. The bulky isthmus located anterior to the abdominal aorta and it's bifurcation, in the horse shoe kidney can cause considerable difficulty in medical and surgical management.

Discussion

In the present case review, the horse shoe kidney is the result of an anomalous fusion of the inferior pole to form the parenchymatous isthmus. Its characteristics include a lower position (L1-L4 vertebrae), an isthmus at the level of the fourth lumbar vertebra, an anterior facing hilum, the ureters on the anterior surface of horse shoe kidney, and the abnormal blood vessels, appearance of which are similar to the previous studies 17-20.

Summary & Conclusion

- The abnormality originates between 4th and 6th weeks of geststion, after the ureteral bud has entered the renal blastema. Boyden (1931) postulated that at the 14mm stage (4.5 weeks)the developing metanephric masses lie close to one another, any disturbance in their relationship may result in joining at their inferior poles.
- Usually the fusion of the both kidneys occurs before they have rotated on their long axis, thus pelvis and ureters of HSK are being usually placed anteriorly. Rarely, fusion occurs after some rotation had already taken place in which case the pelvis are antiromedially placed.
- Usually in this anomaly, the ascent is incomplete and the kidneys lie lower in the abdomen than normal. The ascent is also prevented by the origin of Inferior mesenteric artery obstructing the movement of the isthmus.
- The blood supply to HSK is numerous and variable. The isthmus and adjacent parenchyma masses may receive a branch from each main renal artery or directly from aorta originating either above or below the level of the osthmus. Sometimes this area may be supplied by the branches of IMA. HSK is frequently accompanied by other anomalies of CNS and cardiovascular systems.
- Fusion of upper poles instead of the lower poles results in an inverted Horse Shoe Kidney which constitute 5-10% of all Horse Shoe Kidneys, (i.e, in 95% of HSK, fusion is at lower poles). HSK is found more commonly in males by a 2:1 margin.

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M.B.B.S. Undergraduate Learner's Perspective Regarding Embryology Teaching Learning Methodologies

Sheetal V. Pattanshetti[1], Daksha Dixit[2], Shilpa Bhimalli[3], R.D. Virupaxi[4]

Abstract

Introduction: The most challenging aspect in anatomy curriculum is to understand, imagine and learn the concepts in human embryology because of the complexities involved in the events and processes in the development of an embryo. It is always a challenge for the teacher to act as a facilitator and unveil the human embryology topic to the students and instigate a learning process. *Materials and Methods:* A questionnaire with 12 questionswas prepared for 200 students of the class of phase I MBBS and administered after their preliminary practical and viva-voce exam. It was informed that the questionnaire based study would be undertaken for analysis of students' views and would be used in planning effective teaching learning strategies and also for research purpose in medical education. *Results:* The feedback questionnaires were compiled and analysed. *Conclusion:* Students prefer more of interactive and clinically relevant teaching of embryology which would make learning embryology more effective. Animations and videos should be incorporated in lectures which help in assimilating of the sequence of events in human development in 3-Dimentional form which definitely improves retention of embryological knowledge better.

Keywords: Embryology; Teaching Learning Methodologies; 3D Animations and Videos.

Introduction

Medical education is a continuously evolving arena with scope of specific structured curricula to compress and concise the vast subject course content of pre-clinical subjects in the limited 10 months duration allotted to Phase I MBBS. The most challenging aspect in Anatomy curriculum is to understand, imagine and learn the concepts in human embryology because of the complexities involved in the events and processes in the development of an embryo. It is always a challenge for the teacher to act as a facilitator and unveil the human embryology topic to the students and instigate a learning process.

Embryology is often difficult to teach because of the rapid, three-dimensional changes that occur simultaneously on a microscopic scale. Knowledge of normal and abnormal human development is important for understanding pathophysiology, clinical treatment and surgical repair of malformations [1].

Most medical colleges in India rely on the traditional teaching learning method of didactic lectures to impart education in embryology. The learning process in embryology is assessed by short answer questions in both interval and summative assessments. Practical evaluation of students includes identification of various models on embryology and a viva voce. The reduction in time frame for Phase I MBBS course without a corresponding reduction in the syllabus has resulted in severe time constraint for the teaching faculty in completing syllabus and translates into a heavy academic burden for the students. Very few students have a full grasp of embryology and its application in the clinical field [2].

It is necessary to know the views of the students while revising the curriculum and to know the best teaching methodology which will facilitate learning process [3]. The concept of medical education has changed as knowledge is no longer restricted to textbooks and lectures. Nowadays access to internet, electronic journals, educational videos and conferences are the newer concepts of teaching.

Author's Affiliation: [1]Associate Professor [2,3]Professor [4]Professor and Head, Department of Anatomy, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Belagavi, Karnataka 590010, India.

Corresponding Author: Sheetal V. Pattanshetti, Department of Anatomy, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Belagavi, Karnataka 590010, India.
Email: sheetalrprabhu@gmail.com

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Through feedback we can identify the areas of strength and /or weakness of teaching methodology used so that steps can be taken to rectify deficiencies and to evolve the curriculum and achieve intended goal [4].

It is always difficult for the teacher who has gathered the knowledge after years of reading many books and reference journals to concise the essence of the topic from a undergraduate learner point of view in one hour class, more so, over 45 minutes of attention span of the student. Our aim should be to grab the attention of each every student so that essentials of the topic are presented in an interesting and effective manner, catering to the entire class rather than just lecturing to an interested and attentive few, amongst the audience. Traditional didactic lecture can be made more interesting and effective by employing newer teaching learning and assessment strategies as perceived by the learners themselves.

This was the sole reason for undertaking this study, to facilitate and ensure that the learning process is actually occurring effectively, as it was intended for to be, for the learners.

Materials and Methods

After the end of the academic year, where Human Embryology Curriculum was covered over 30 lecture classes and 2 revision classes for embryology models, it was planned to evaluate the students' perspective regarding teaching methodology and effective learning strategies. The embryology lectures taken were didactic with incorporation of audio-visual aids basically power points on LCD supplemented with black board teaching to explain relevant details and also for shifting focus and increasing concentration of students.

With permission from the Principal to conduct the study, the institutional ethical clearance obtained and the students were informed about study andtheir consent was taken. A questionnaire with 12 questionswas prepared for students and administered after their preliminary practical and viva voce exam. It was informed that the questionnaire based study undertaken for analysis of students' views and used in planning effective teaching learning strategies would be used for research purpose in medical education.

Feed-back response forms were gathered from 200 students of MBBS phase-I class of MBBS which comprised of points relating to the present Embryology curriculum, teaching methodology and assessment techniques, preference for teaching aids in embryology classes, preferred periodic evaluation pattern with the intention of incorporating learner's perspectives in further classes.

Results

The feedback questionnaires were compiled and analysed. There were total 12 questions with multiple choices to answer, in the questionnaire.

Question 1: Time allotted to embryology teaching in the academic year 32 classes [Figure 1].

Question 2: Preferred teaching module for embryology [Figure 2].

Question 3: Table wise discussion (in small groups of 10) of embryology models (in preparing for embryology viva)

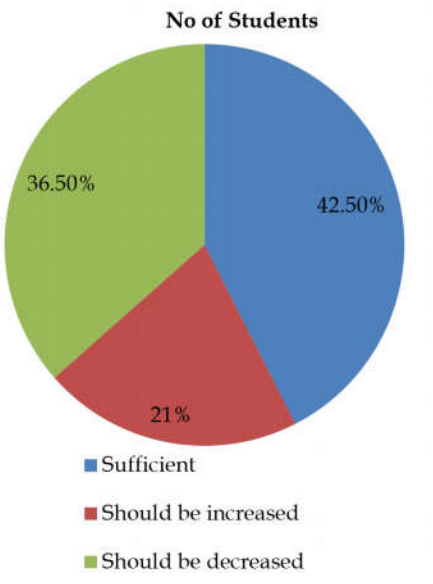

Fig. 1:

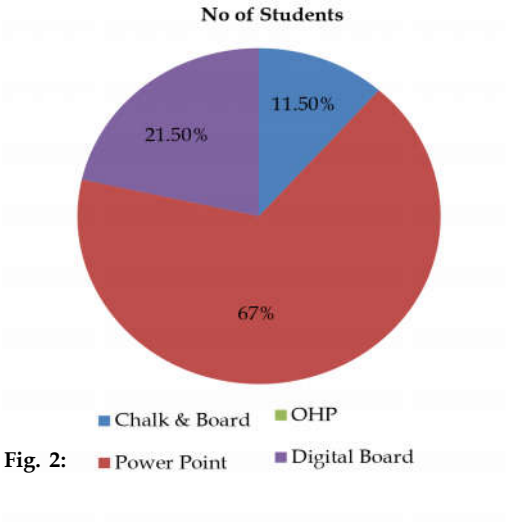

Fig. 2:

a. Beneficial 89%
b. Not beneficial NIL
c. No idea/neutral 11%

Question 4: Intercollegiate quiz planned during the academic year was

a. Beneficial 81.5%
b. Not beneficial NIL
c. No idea/neutral 18.5%

Question 5: During lecture classes Incorporation of Case scenarios and problem based learning in embryology as employed in the quiz (more of clinical orientation)

a. Beneficial 76%
b. Not beneficial 1.5%
c. No idea/neutral 22.5 %

Question 6: Teacher asking questions to recapitulate things taught during previous class

a. Beneficial 61.5%
b. Not beneficial 4.5%

Question 7: Use of More of animations and videos in embryology during lectures

a. Beneficial 97%
b. Not beneficial 1%
c. No idea/neutral 2%

Question 8: More of group activities to make embryology learning easier and interesting

a. Beneficial 79.5%
b. Not beneficial 3.5%
c. No idea/neutral 17%

Most interesting Group activities of your choice: please tick

- Models discussion with peers 79%
- Short seminars 1.5%
- Quizzes 3%
- Case discussion in groups 16.5%

Question 9: Teacher asking questions at the end of the lecture to increase attentiveness and focus

a. Beneficial 68.5%
b. Not beneficial 4%
c. No idea/neutral 27.5%

Question 10: Recommended module for assessment of students compliance in reading embryology on regular basis

Recommended module

a. MCQ test 35.5%
b. Written test (short essays and short notes) 18%
c. Embryology Models viva voce 46.5%

Regular basis

- Fortnightly 3.5%
- Monthly 32%
- Only during internal assessments 64.5%

Question 11: Teacher mentioning every important topic as frequently asked short note, short answer, MCQ, viva- voce questions

a. Beneficial 96.5%
b. Not beneficial 2.5%
c. No idea/neutral 1%

Question 12: Drawing more of embryology diagrams in embryology record books

a. Beneficial 43.5%
b. Not beneficial 24.5%
c. No idea/neutral 27%

Discussion

Anatomy has been the core subject of First year medical education curriculum; always recognized as an essential foundation for clinical sciences. It has been the keystone of medical education for years together. It provides a platform of knowledge indispensable to all branches of medicine. However, there is a continuing debate on how much to teach, when to teach and how to teach anatomy [5]. The embryology lectures at present in our country still are taken as didactic lectures with incorporation of audio-visual aids power points on LCD supplemented with black board to explain relevant details.

In one study, 64% students indicated that problems in understanding embryology stemmed from an inability to visualize, comprehend the sequence of events which characterize developmental process, particularly 3D and inadequate time and sequence followed in lectures [6]. In another study by Reenu Kumari et.al., students faced specific problem in understanding embryology due to inability to visualize, inability to comprehend sequence of events and inadequate time, they find use of more audiovisual aids (56%), simplified information (24%). With regards to evaluation methods, the students found that the grand stage test taken at the end of each system is the most useful method in preparing for the final university examination [7]. In a study by Nayak et al., have concluded that integration of newer teaching modalities and modern technology will encourage interest and retention of anatomical knowledge and its clinical relevance. They state that combined medical teaching (classical black board based and audiovisual assisted teaching) was the most effective method. Particularly for embryology classes use of 3D animations were very helpful in understanding and igniting curiosity in the minds of students [8]. An obvious advantage of anatomical 3D models is the ability to demonstrate the spatial relationships between structures. During classroom presentations, some items such as the spatial structure of morphogenetic changes of the human embryo or the connecting pathways between certain brain regions are usually hard to represent graphically on the blackboard or by projected illustrations, and often histological material or schematics diagrams are required for further demonstration [9].

In another study evaluation questionnaire established that a large majority of student respondents thought that use of power point teaching on LCD was the ideal teaching methodology for future classes and this was one of the most encouraging findings (66.6% students preferred LCD teaching for embryology lectures). When asked about the reason for their preference students opined that embryology lectures had 3D images to understand the whole morphology of the developing embryo, some videos on different stages of development in respective systems were shown which was very informative and cross- sectional study of embryos were better understood by LCD than black board teaching [10]. Similarly a study opined, an overall 98% students strongly agreed that the e-learning em-bryology module was a highly innovative, interactive and useful method of learning embryology. About 64% stu-dents opined that the computer based e-learning module was much better than traditional method of didactic lec-tures. The mean score favouring the e-learning resource in comparison to the traditional didactic lecture was 4.58 (±0.65) out of scale 5 [2]. The use of multimedia-supported teaching will open new horizons to shift to more problem-based and independent learning, integrative learning or even distance learning [11]. Virtual three-dimensional models and animations are becoming more widely used in medical education. They allow students to visualize in greater detail the spatial relationships between embryonic structures and their development over time [12].

In present study 134 (67%) students opined use of power point lectures for teaching embryology. All the students were exposed to Small group teaching (in groups of 10) in dissection hall, 15 minutes at the end of routine dissection time of two hours, about development of related structures, at least once a week with demonstration of embryology models. When asked about student's view on incorporating small group teaching as a supplementary teaching to increase their understanding and recapitulation of things taught in class, 178 (89%) found it to be beneficial and increased their confidence for appearing the viva - voce.Another noticeable observation in our study was that More than 75% students were opinion of, following were beneficial, [a] Table wise discussion of embryology models with peers (89%); [b] Intercollegiate quiz on embryology (81.5%); [c] Clinical scenario & problem based learning (76%); [d] Use of animations & videos (97%); [e] Small group activity with models (79%) and [f] Teacher mentioning about the probable question in exams (96.5%).

In fact in a study the authors have opined that the weightage given to embryology in summative assessments is relatively meagre, accounting for a paltry 5-7% of the total marks in a theory exam. Most students end up learning just a few topics only with exam point of interest .Eventually the entire exercise undermines the learning objectives [2].

In our Institution, weightage for Embryology in Human Anatomy University examination is one short note of 5 marks, one short answer of 3 marks and 3 MCQs, (i.e. in each of the two written papers) which amounts to 22 marks out of 200 marks theory paper and in practical just one spotter on embryology model of 2 marks out of 10 marks and viva-voce one station on embryology of 10 marks out of 4 stations. Therefore embryology amounts to 34 marks which summate

up to 10% out of total marks. Entire embryology is covered over 30 teaching hours (genetics is an additional 8 marks taught in over 5 teaching hours).

Traditional teaching methods are unable of creating motivation and positive attitude in learners: therefore, identification of new, innovative and even exciting methods seems necessary. While application of methods like PBL in education has been highlighted in recent years, it seems, however, that because of abundance of information and necessity of teaching various materials of one subject in medical sciences, this method and group discussions are not enough. Thus it is suggested that well-known methods be used with appropriate changes [13]. With regards to evaluation methods, the students found that the grand test taken at the end of each system is the most useful method in preparing for the final university examination [14].

Blended learning strategies have been shown to improve students' academic performance, motivation, attitude, and satisfaction, and to provide convenient and flexible learning. Implementation of blended learning strategies has also proved cost effective [15].

Conclusion

Students prefer more of interactive and clinically relevant teaching of embryology which would make learning Embryology more effective. As medical students in our undergraduate time, teachers of embryology have actually struggled to explain the concepts of embryology by black board teaching and even the diagrams in the texts being black and white then. But now, with the actual improvised audio-visual aids with coloured diagrams and animated videos it is much easier for the teachers to make the students understand embryology and clinical manifestations which instantly get captured by the visual memory and immensely prove beneficial during recall.

Animations and videos should be incorporated in lectures which help in assimilating of the sequence of events in human development in 3-Dimentional form which definitely improves retention of Embryological knowledge better.

In my personal opinion as for students who find embryology tough a friendly suggestion is after reading other subjects throughout the day, Embryology can be interesting and easy if one reads it for at least fifteen minutes before one sleeps, like a bed time story daily, so one can recapitulate diagrams and embryology animations till one falls asleep and the next day discuss the same amongst their study group with friends which help in better retention and easier recollection in exams and viva voce.

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Accessory Renal Arteries: A Cadaveric Study

T. Sumalatha[1], N. Pushpamala[2]

Abstract

Introduction: Each kidney is supplied by a single renal artery originating from abdominal aorta at the level of L1 vertebra. Accessory renal arteries are common, they derive from the persistence of embryonic vessels formed during ascent of the kidney. We present, bilateral double renal vessels and unilateral accessory renal arteries discovered during a routine dissection of abdomen at department of Anatomy, Osmania medical college, during 2014-2018. *Materials and Methods:* Case1- We found 2 renal arteries running parallel to each other towards the hilum of the right kidney, both are derived from abdominal aorta. Case 2 -Accessory renal artery originating from main renal artery entering the lower pole of the left kidney crossing superficial to hilar structures. Case 3- There is a crossing of the left renal artery over the renal vein disrupting the order of hilar structures. Case 4- Left Accessory renal artery arising from abdominal aorta below the renal artery supplying the lower pole of the kidney superficial to renal vein. Case 5- Left accessory renal artery arising from abdominal aorta, supplying the lower pole of the kidney passing below the renal vein. Case 6- Arterial trunk originating from right renal artery and supplying the suprarenal gland and diaphragm. *Conclusions:* The study was carried out among 60 cadavers and we found the variations in 14 cadavers . The incidence of the anomalies is 23.3%. Awareness of the variations of the renal artery is necessary for surgical management during renal transplantation, repair of abdominal aorta aneurysm, urological procedures and angiographic interventions.

Keywords: Accessory Renal Artery; Aberrant Renal Artery; Kidney.

Introduction

Each kidney is usually supplied by one renal artery which arises from the abdominal aorta. Near the hilum of the kidney, renal artery divides into anterior and posterior divisions and they further divide into segmental arteries supplying the respective vascular segments of the kidney in 70% of individuals [1].

Accessory renal arteries are common in 30% of the individuals, they usually arise from the abdominal aorta above or below the renal vessels, they are regarded as persistent embryonic lateral splanchnic arteries [2].

Author's Affiliation: [1]Associate Professor, Department of Anatomy, Govt. Medical College, Mahbubnagar, Telangana 509001, India. [2]Associate Professor, Department of Anatomy, Osmania Medical College, Hyderabad, Telangana 500095, India.

Corresponding Author: T. Sumalatha, Associate Professor, Department of Anatomy, Government Medical College, Mahabubnagar, Telangana 509001, India.
E-mail: slathadoc123@gmail.com
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Rarely they may arise from renal artery and run towards the hilum, or from common iliac artery, superior mesenteric artery, or inferior mesenteric artery [3]. Variations in the number, source, branches and course of the renal arteries are very common.

An accessory renal artery is one that is accessory to main artery and accompanies the main artery while entering the kidney at the hilum. Aberrant renal artery is the one that supplies the kidney without entering the hilum [4].

Renal artery variations are divided into two groups, early division and extra renal arteries.

Early division is one where the branching of the main renal arteries into segmental branches occurs more proximally than the renal hilum.

Extra Renal Arteries are divided into hilar or accessory, and polar or aberrant arteries

Hilar or accessory arteries enter the kidney through the hilum, whereas polar arteries enter the kidney from the capsule outside the hilum [5].

Knowledge about the Variations of the renal arteries helps the surgeon in planning the renal

transplantation, urological procedures and angiographic intervention and repair of abdominal aorta aneurysms. In the present study we present unusual variations of the renal arteries.

Materials and Methods

During routine dissection of abdomen, as a part of undergraduate curriculum, the study was conducted at the department of Anatomy, Osmania medical college, Hyderabad.

The kidneys, along with their arteries were explored in detail, and morphological variations of the renal arteries were noted. During the dissection, various abdominal viscera were removed and preserved as specimens for teaching purposes. 60 Cadavers constituted materials for our study.

We Studied the accessory renal arteries in accordance to the nomenclature of Merklin and Michels [6].

Results

In a female cadaver we noticed that the right kidney is supplied by two renal arteries running parallel to each other towards the hilum of kidney as seen in Fig.1. Both are arising from abdominal aorta below the level of superior mesenteric artery.

In a male cadaver there was a left renal artery variation.The accessory renal artery originated from the main left renal artery and entered the lower pole of kidney, crossing anterior to hilar structures. Inferior suprarenal artery originated from accessory renal artery (inferior polar artery) as seen in Fig. 2.

There is crossing of the left Renal artery over the the renal vein disrupting the order of hilar structures the vein, artery and pelvis from before backwards.We found accessory renal artery arising from left renal artery, passing anterior to left renal vein and supplying the lower pole of the left kidney as seen in Fig. 3 and Fig 4.

Left Accessory renal artery arising from abdominal aorta below the renal artery supplying the lower pole of the left kidney passing superficial to renal artery, as seen in Fig. 5.

Left Accessory renal artery is found arising from left renal artery, supplying the lower pole of the kidney while passing anterior to renal artery.

Arterial branch is seen originating from right renal artery and supplying the suprarenal gland and diaphragm.

In two cases, left sided accessory renal artery is found originating from left renal artery and supplied the lower pole of left kidney.

Bilateral accessory renal arteries are found originating from main renal artery on each side. The accessory renal arteries are found supplying upper

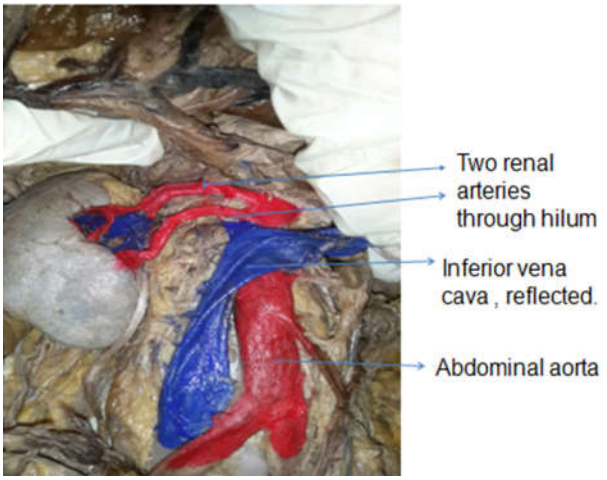
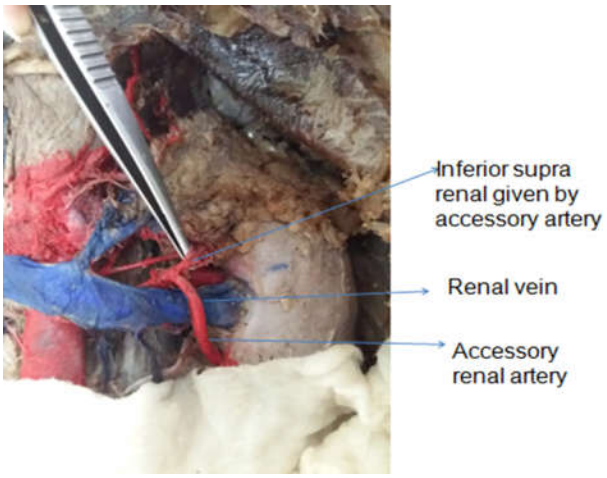


Fig. 1:



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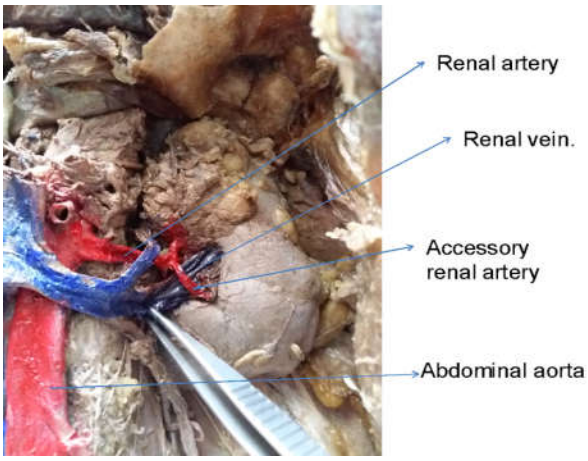

Fig. 3:

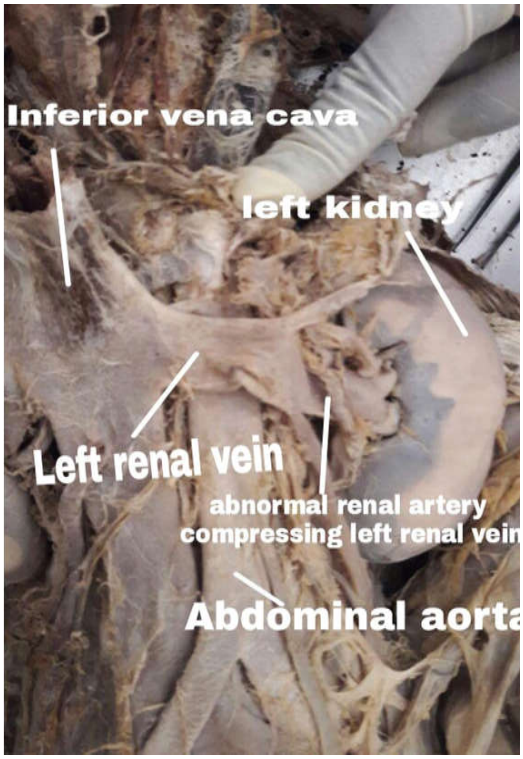

Fig. 4:

and lower poles of respective kidneys. The left renal artery is traced passing in front of the renal vein at the hilum. On the right side, two accessory renal arteries are found arising from main renal artery, supplying both upper and lower poles.

Bilateral accessory renal arteries are seen (a) On the right side, two accessory renal arteries are arising from main renal artery.One accessory artery is found supplying the upper pole and the other accessory artery supplying the lower pole. (b) On the left side, one accessory renal artery is found originating from abdominal aorta supplying the upper pole of the kidney as seen in Figure 6.

Fig. 5:

Bilateral accessory renal arteries originating from abdominal aorta.

Bilateral double renal veins are found and on the left side, superior and inferior polar arteries are seen arising from abdominal aorta as shown in Figure 7.

Discussion

In humans, Metanephric kidney develops in the lumbosacral region. It is retained as a permanent kidney. At first, metanephric kidney lies in the pelvic cavity opposite the sacral segment. It receives blood supply from median sacral artery. Gradually the kidney ascends and reaches the iliac fossa and it is supplied by common iliac and internal iliac arteries. Finally it reaches the under surface of the diaphragm and the ascent is arrested by suprarenal gland[7]

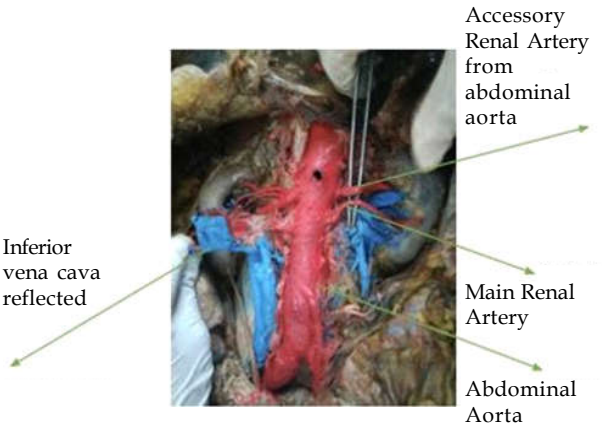

Fig. 6:

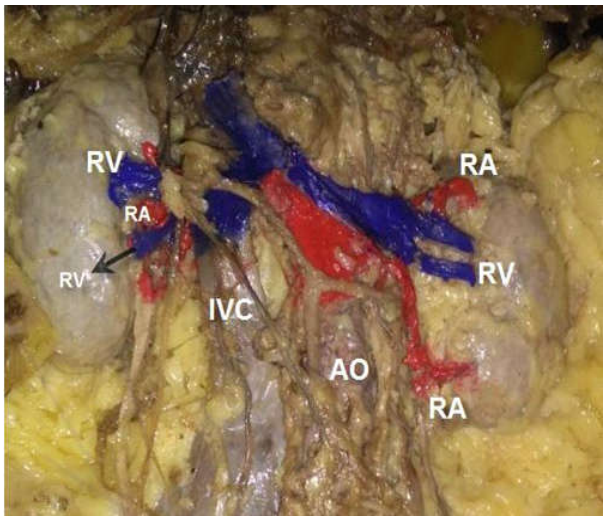

Fig. 7:

Most of the abnormalities of the renal arteries are due to its changing position as a part of normal development [8]. Aberrant renal arteries do not enter the hilum of the kidney, rather they perforate the substance of the kidney [4].

The various types of accessory, additional, supplementary and aberrant renal arteries have been reported but precise terminology has not been unified by majority of authors. Merklin and Michels classified supernumerary renal arteries depending on the origin as those arising from aorta, main renal artery and other arterial sources [6].

Embryological explanation has been given by Felix. In an 18mm fetus, there are 9 pairs of lateral mesonephric arteries arising from dorsal aorta. They are divided into three groups, 1st and 2nd arteries as cranial, 3rd to 5th arteries as middle and 6th to 9th arteries as caudal group. The middle group gives rise to renal arteries. Persistence of more than one artery of the middle group results in multiple renal arteries [8]- According to Talovic et al., in 30.7% of cases supernumerary artery originated from aorta, 12.8% of cases, it originated from renal arteries [9]. In present study, 14 out of 60 cadavers had renal artery anomalies. The incidence is 23.3%. Out of 14 anomalous renal artery, accessory renal artery originated from aorta in (4/60) incidence being 6.6% and accessory renal artery originated from renal artery in (7/60) incidence being 11.6%.

K.S Satyapal in 2001 found that out of 130 renal angiograms and among 32 cadavers included in study, 23.2% had one additional renal artery and seen more commonly on left side (32%) and right side had 23.3% [10]. In present study, right sided accessory renal arteries were seen in (5/60) incidence being 8.3%

Hemanth kommuru et al studied 182 kidneys and found one additional renal artery in 34 kidneys,2 additional renal arteries in 18 kidneys [11].

Loukas et al found that accessory renal arteries may be associated with other vascular variations [12]. In the present study, accessory renal artery originating from the right renal artery supplied the suprarenal gland and diaphragm.

Satheesha et al found an inferior polar artery on the left side [13]. In the present study there was an inferior polar artery supplying the lower pole on the left kidney. According to Weinstein BB et al., the incidence of incidence of inferior polar accessory arteries is twice to the superior polar artery [14].

Patasi et al found that an Accessory renal artery crossing and compressing the ureter can lead to hydronephrosis [15]. In the present study, accessory renal artery supplying the lower pole of left kidney was passing superficial to renal vein.

Knowledge of renal vascular anatomy is essential especially in kidney transplantation. Kidney with multiple arteries is associated with more chances of infarction and hemorrhage [16], acute tubular necrosis and rejection episodes [17], postoperative hypertension and calyceal fistula formation.

It has been described that failure to restore circulation in accessory renal artery during surgery, may cause ischemia or necrosis of renal tissue [18].

Conclusions

Knowledge about the variation of the renal arteries is important for renal transplantation, abdominal aortic aneurysms, endoscopic renal surgeries and angiographic interventions. The present study found the incidence of accessory renal arteries as 20%. Therefore considering the increase in incidence of accessory and multiple renal arteries,the anatomical knowledge of such anomalies is important for academic, surgical as well as radiological procedures. The present study attempts to highlight the same .

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Voluntary Body Donation: A Study of Awareness and Willingness Regarding Organ / Body Donation in Population of Kalaburagi

Charmode Sundip Hemant[1], Kadlimatti Huchchesha Shivappa[2], Pujari Dinanath Keshavbhat[3]

Abstract

Background: The purpose of this study is to assess the awareness and willingness regarding organ and body donation in population of Kalaburagi region followed by counseling session to encourage them towards organ and body donation. *Aim:* To study the awareness and willingness towards Organ and Body donation in population of Kalaburagi. *Material and Methods:* Across-sectional studyusing a specially designed, validated questionnaire containing mcq's was done amongst Medical, Dental, Ayurveda and Nursing students, staff and patients of ESIC Institute Gulbarga after taking their informed consent. It was followed by a counseling session where queries regarding organ and body donation were solved and procedure of registration for the same was explained. *Results:* Amongst the 1000 study participants surveyed, 1.) 511 participants (63.39%) amongst total 806 participants shown awareness towards organ donation. 2.) 565 participants (70.09%) amongst total 806 participants shown awareness towards body donation. 3.) 317 participants (39.33%) amongst total 806 participants shown willingness for organ donation. 4.) Only 137 participants (16.99%) amongst total 806 participants shown willingness towards body donation. *Conclusions:* 1.) Highest awareness was observed amongst medical students for organ and body donation compared to other categories of study participants. 2.) Least awareness was observed amongst general public/patients for organ and body donation compared to other categories of study participants. 3.) Female respondents of all categories have shown higher degree of awareness towards organ/body donation compared to their male counterparts. 4.) Female respondents of all categories also showed more willingness for organ donation than male participants.

Keywords: Awareness; Organ Donation; Body Donation; Acquiantedness; Willingness; Participants.

Introduction

Human Anatomy is the principal basic subject for medical student, both under-graduates, post-graduate and teaching fac-ulties. Cadaveric dissection is the principal teaching tool and the best method to learn anatomy. Aside from anatomy classes, cadavers are also used for practicing surgical skills and developing new technique in various hands-on workshops. With rising number of intake of medical students and medical colleges and different streams of medical science, there has been a rise in the need of cadavers, which can't be fulfilled by supply of unclaimed bodies only. The cadaver to medical/dental student ratio in various teaching institutes of India is 1:25, optimal being 1: 10 [1]. The situation is even worse in medical colleges which are not attached to government hospital. Moreover, the awareness regarding body donation in Gulbarga region is extremely low, this can be safely said by looking at the cadaver status of all the medical, dental and ayurvedic colleges in Gulbarga. Weestablished a Body Donation Society at Department of Anatomy in ESIC Medical College Gulbarga on 08.02.2018. The purpose of our study is to access the awareness and willingness regarding body donation in population of Kalaburagi region, followed by counseling session to encourage them towards this gracious act of body donation.

The conclusions emerging from this study will help us to set goals for our Body donation society towards changing the perspective of population of Kalaburagi towards organ / body donation, eventually leading to improvement in medical training and services.

Author's Affiliation: [1]Assistant Professor [2]Professor and Head [3]Associate Professor, Department of Anatomy, ESIC Medical College, Gulburga, Karnataka 585106, India.

Corresponding Author: Kadlimatti Huchchesha Shivappa, Professor and Head, Department of Anatomy, ESIC Medical College, Gulburga, Karnataka 585106, India.
E-mail:sundip.charmode@yahoo.com
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Materials and Methods

The present study is a specially designed, self-administered questionnaire based cross-sectional study, containing 18 points testing the awareness, attitude, knowledge and willingness towards body / organ donation followed by counseling session conducted in Kalaburagi region within 1000 participants.The questionnaire (prepared in English and Kannada) was circulated among the medical, dental, nursing students, staff and daily OPD patients of ESIC Institute of Gulbarga from 1st February 2018 to 31st May 2018.

The study targeted ground level population which includes general public, patients, staff and the students. Doctors and faculties were deliberately excluded from the study owing to their awareness regarding body and organ donation.The questionnaire comprised mostly of multiple choice questions and option for personal reason/opinion was given for almost every question.

The questionnaire was pilot tested first amongst 40 random people for:

i. The clarity of the questions included in it and

ii. Time period required to fill it. A time duration of 15 minutes was given for completing the questionnaire.

No discussion amongst each other was allowed. Our questionnaire thus got validated after minor modifications. Our research team, after taking informed consent distributed the pretested / validated questionnaire to students and staff at counseling room and patients and their relatives at OPD. One of the researcher always accompanied the participants during filling of questionnaire. Duly filled and signed questionnaire were collected.

All participants were requested for a counseling session about Body/organ donation concept and its registration procedure. The complete procedure of registration of body donation was explained to them and their doubts regarding organ and body donation were clarified.

The participants were categorized in three age groups as follows:

1. *Based on Age [2]*:

- Young age group : 15-24 yrs
- Middle age group : 25-44 yrs
- Older age group : 45 yrs and above.

2. *Based on Familarity with Cadaveric dissection*:
   - Acquainted group
   - Lesser acquainted group
   - Not acquainted group
3. Based on Sex:
   - Male
   - Female

Sampling Technique

From all the categories of population i.e. Student, Staff, Patient and General public; taken together, 1000 participants after taking informed consent were selected through Simple random sampling method.

Sample Selection

Inclusion criteria:

1. Those who are born and brought up in Gulbarga region.
2. Above 18 years of age.
3. Those who have given consent.

Exclusion Criteria

1. Doctors and faculty members of ESIC Medical, Dental and Ayurveda colleges were excluded.
2. Those born and brought up outside Gulbarga.
3. Those who refused to give consent.

Data Collection Procedure

A specially designed, self-administered questionnaire containing 18 multiple choice questions testing the awareness, attitude, knowledge and willingness. It has been prepared in English and Kannada.

Data Analysis Procedure

Parameters which were studied were age, gender, acquainted and non-acquainted participants. Analyzed with SPSS software. Percentage was calculated. Chi square test was used. Data was represented graphically.

Results

Amongst the student, staff and patient/public group, 1000 participants, were randomly selected for the study. Duly filled and signed questionnaires

were collected from them after taking informed consent. This was followed by personal counseling. Out of 1000, 194 questionnaires were found to be incomplete. During the counseling session, these 194 participants withdrew their consent and their questionnaires were discarded from the study. After analyzing the questionnaires, the general observations were as follows:

1. 511 participants (63.39%) amongst total 806 participants shown awareness towards organ donation.
2. 565 participants (70.09%) amongst total 806 participants shown awareness towards body donation.
3. 317 participants (39.33%) amongst total 806 participants shown willingness for organ donation.
4. Only 137 participants (16.99%) amongst total 806 participants shown willingness towards body donation.

The data collected from filled questionnaires collected from 806 study participants was classified into various categories and the observations were tabulated (seven tables) and graphically represented.

Study observed that, among 806 participants, 360 (44.7%) were male and 446 (55.3%) were female. there were 320 (39.7%) general public and patients, 201 (24.9%) medical students, 118 (14.7%) ayurveda students, 80 (9.9%) non-medical staff, 50 (6.2%) nursing students and 37 (4.6%) dental students (Table 1).

Study observed that, maximum number of awareness about organ and body donation in males was medical students 79 (91.8%) and 81 (94.2%) respectively. General public and patient have less awareness about organ and body donation 56 (35.0%) and 76 (47.5%)

Study reveals that, there was statistically very highly significant difference of awareness about organ and body donation in male participants with respect to faculty of participants ($p<0.001$)

Study reveals that, there was no statistically significant difference of willingness about organ

Table 1: Sex and faculty wise distribution of study participants

Faculty of Study participants	Male		Female		Total	
	No.	%	No.	%	No.	%
Medical students	86	42.7	115	57.3	201	24.9
Dental students	09	24.3	28	75.7	37	4.6
Ayurveda students	33	27.9	85	72.1	118	14.7
Nursing students	18	36.0	32	64.0	50	6.2
Non-medical Staff	54	67.5	26	32.5	80	9.9
General public / patient	160	50.0	160	50.0	320	39.7
Total	360	44.7	446	55.3	806	100.0

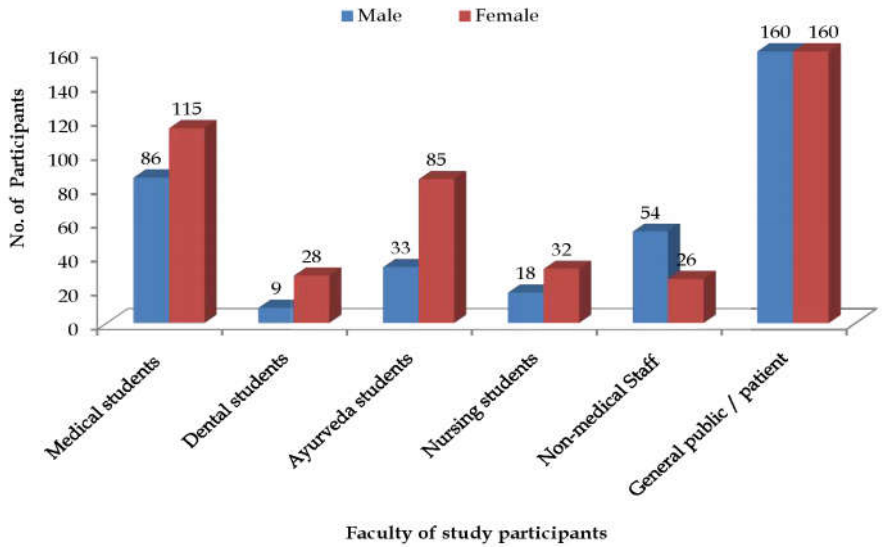


Fig. 1: Multiple bar diagram represents Sex and faculty wise distribution of Study participants

donation and body donation among the female participants (p>0.05)

Study reveals that, there was no statistically significant difference of willingness about organ donation and body donation among the male participants (p>0.05)

Study observed that, highest percentage of willingness about organ donation in males was nursing students 11 (61.0%), followed by medical students 48 (55.8%) and highest percentage of willingness about body donation was 20 (37.0%) non medical staff.

Study reveals that, there was statistically highly significant difference of willingness about organ and body donation in male participants with respect to faculty of participants (p<0.01).

Study reveals that, there was statistically significant difference of willingness about organ donation and body donation among the male participants (p<0.05)

Willingness about organ donation had given significantly more number of participants as compare to willingness about body donation in males.

Study observed that, maximum number of awareness about organ and body donation in females was medical students 111 (96.5%) and 104 (94.8%) respectively. General public and patient have less awareness about organ and body donation 58 (36.1%) and 66 (41.5%)

Table 2: Faculty wise comparison of male participant's awareness of organ and body donation

Faculty of Study participants	Awareness about organ donation		Awareness about body donation		Total
	Yes No (%)	No No (%)	Yes No (%)	No No (%)	No (%)
Medical students	79 (91.8%)	07(8.2%)	81(94.2%)	05(5.8%)	86 (100.0%)
Dental students	05 (55.5)	04 (44.5%)	07 (77.8%)	02 (22.2%)	09(100.0%)
Ayurveda students	25 (75.7%)	08 (24.3%)	27 (81.8%)	06 (18.2%)	33(100.0%)
Nursing students	16 (88.9%)	02 (11.1%)	16 (88.9%)	02 (11.1%)	18(100.0%)
Non-medical Staff	34 (63.0%)	20 (37.0%)	31 (57.4%)	23 (42.6%)	54(100.0%)
General public / Patient	56 (35.0%)	104(65.0%)	76 (47.5%)	84 (52.3%)	160(100.0%)
Total	215 (59.7%)	145 (40.3%)	238 (66.1%)	122 (33.9%)	360(100.0%)
ANOVA test P-value & significance	F= 18.76 P<0.001 VHS		F= 12.82 P<0.001 VHS		---
Chi-square test P-value & significance	Comparison of willingness about organ donation and body donation $\chi^2 = 3.19$, P>0.05, NS				

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

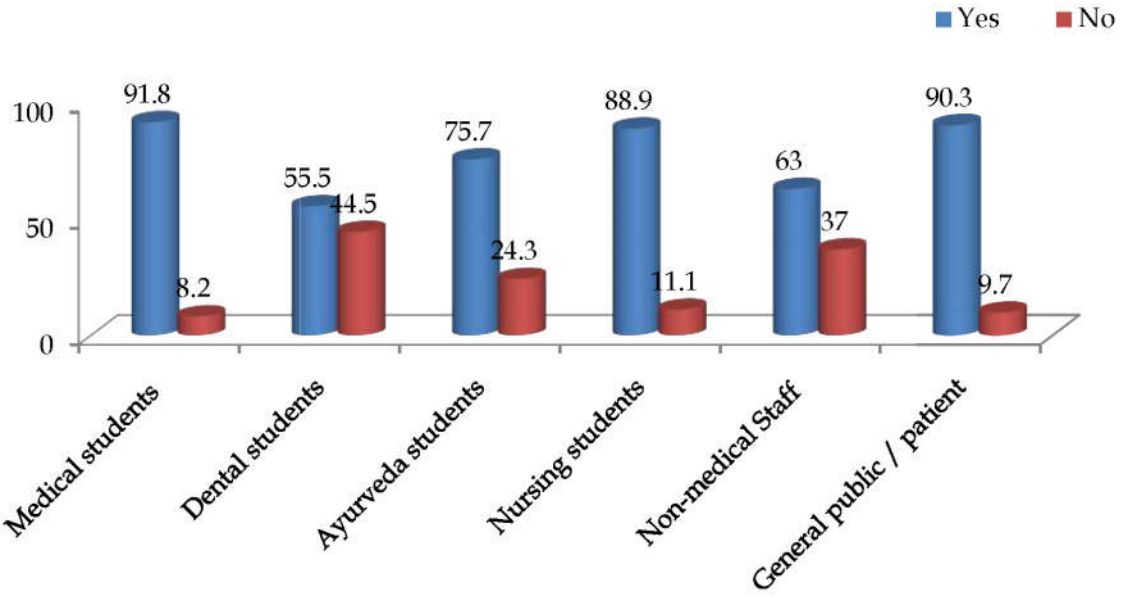


Fig. 2: Multiple bar diagram representsFaculty wise comparison of male participant's awareness of organ donation

Table 3: Faculty wise comparison of male participant's willingness for organ and body donation

Faculty of Study participants	Willingness about organ donation		Willingness about body donation		Total
	Yes No (%)	No No (%)	Yes No (%)	No No (%)	No (%)
Medical students	48 (55.8%)	38 (44.2%)	18 (20.9%)	68 (79.1)	86 (100.0%)
Dental students	02 (22.2%)	07 (77.8%)	03(33.3%)	06(66.7%)	09(100.0%)
Ayurveda students	09 (27.3%)	24 (72.7%)	08 (24.2%)	25 (75.8%)	33(100.0%)
Nursing students	11(61.1%)	7 (38.9%)	05(27.8%)	13 (72.2%)	18(100.0%)
Non-medical Staff	26 (48.1%)	28 (51.9%)	20 (37.0%)	34 (63.0%)	54(100.0%)
General public / Patient	37 (23.0%)	123 (77.0%)	15 (9.1%)	145 (90.9%)	160(100.0%)
Total	133 (36.9%)	227 (63.1%)	69(19.2%)	291(80.8%)	360(100.0%)
ANOVA test P-value & significance	F= 7.92 P<0.001 VHS		F= 4.21 P<0.003HS		---
Chi-square test P-value & significance	Comparison of willingness about organ donation and body donation $\chi^2 = 9.696$, P<0.05, S				

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

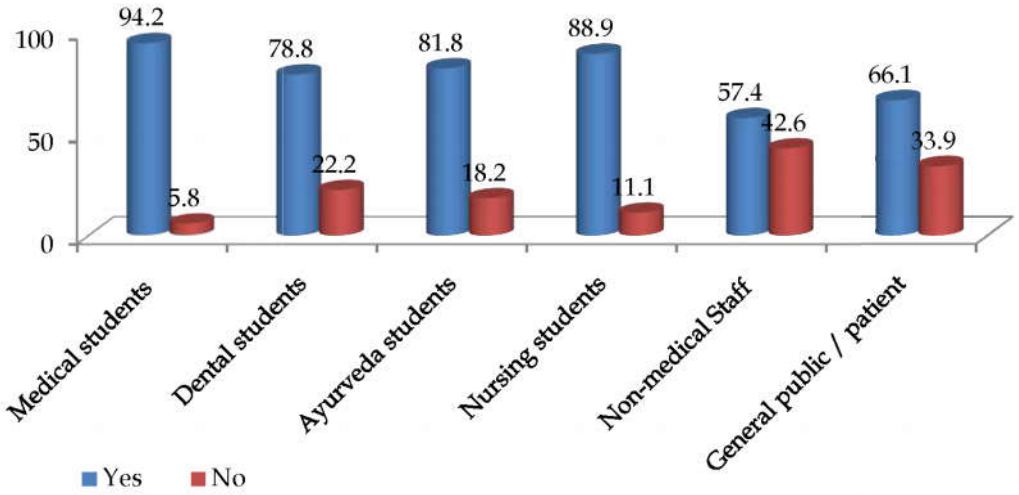


Fig. 3: Multiple bar diagram representsFaculty wise comparison of male participant's awareness of body donation

Study reveals that, there was statistically very highly significant difference of awareness about organ and body donation in female participants with respect to faculty of participants (p<0.001).

Study reveals that, there was no statistically significant difference of willingness about organ donation and body donation among the female participants (p>0.05).

Table 4: Faculty wise comparison of female participant's awareness for organ and organ donation

Faculty of Study participants	Awareness about organ donation		Awareness about body donation		Total
	Yes No (%)	No No (%)	Yes No (%)	No No (%)	No (%)
Medical students	111 (96.5%)	04 (3.5%)	104 (94.8%)	06 (5.2%)	115 (100.0%)
Dental students	19 (67.8%)	09 (32.2%)	22 (78.6%)	06 (21.4%)	28 (100.0%)
Ayurveda students	71 (83.5%)	14 (16.5%)	83 (97.6%)	02 (2.4%)	85 (100.0%)
Nursing students	21 (65.6%)	11 (34.9%)	27 (84.4%)	05(15.6%)	32 (100.0%)
Non-medical Staff	16 (61.5%)	10 (38.5%)	20 (76.9%)	6 (23.1%)	26 (100.0%)
General public / Patient	58 (36.1%)	102 (63.9%)	66 (41.5%)	94 (58.5%)	160 (100.0%)
Total	296(66.4%)	150(33.6%)	327 (73.3%)	119 (26.7%)	446(100.0%)
ANOVA test P-value & significance	F= 7.537 P<0.001 VHS		F= 6.171 P<0.001 VHS		---
Chi-square test P-value & significance	Comparison of awareness about organ donation and body donation $\chi^2 = 4.27$, P>0.05, NS				

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

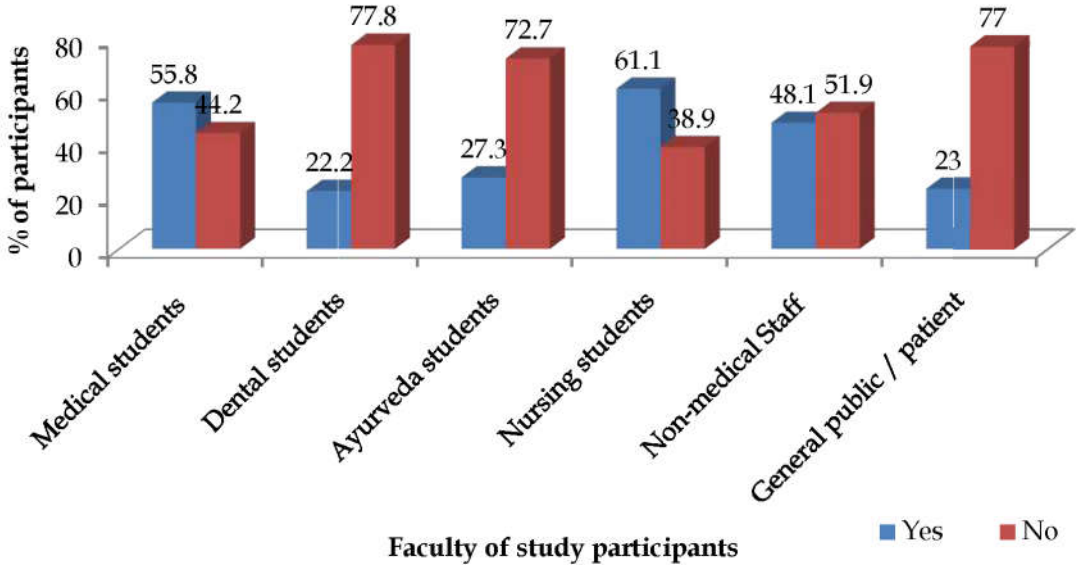


Fig. 4: Multiple bar diagram representsFaculty wise comparison of male participant's willingness of organ donation

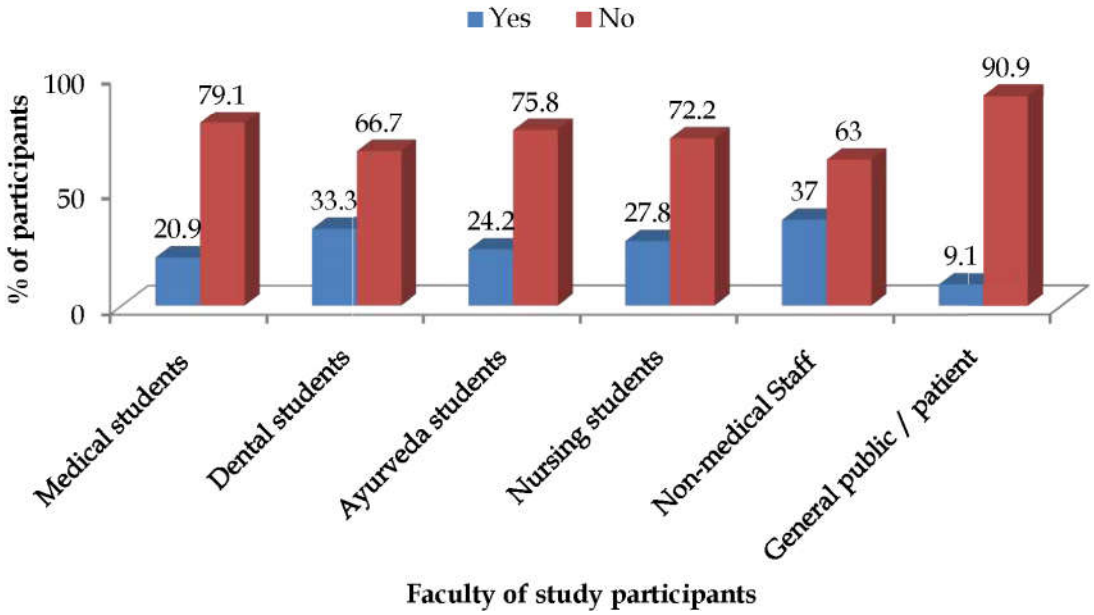


Fig. 5: Multiple bar diagram representsFaculty wise comparison of male participant's willingness of body donation

Study observed that, highest percentage of willingness about organ donation in female was non-medical staff 18 (69.2%), followed by medical students 79 (68.7%) and highest percentage of willingness about body donation was 12 (46.1%) non medical staff.

Study reveals that, there was statistically highly significant difference of willingness about organ and body donation in female participants with respect to faculty of participants ($p<0.01$)

Study reveals that, there was statistically highly significant difference of willingness about organ donation and body donation among the participants ($p<0.01$)

Willingness about organ donation had given significantly more number of participants as compare

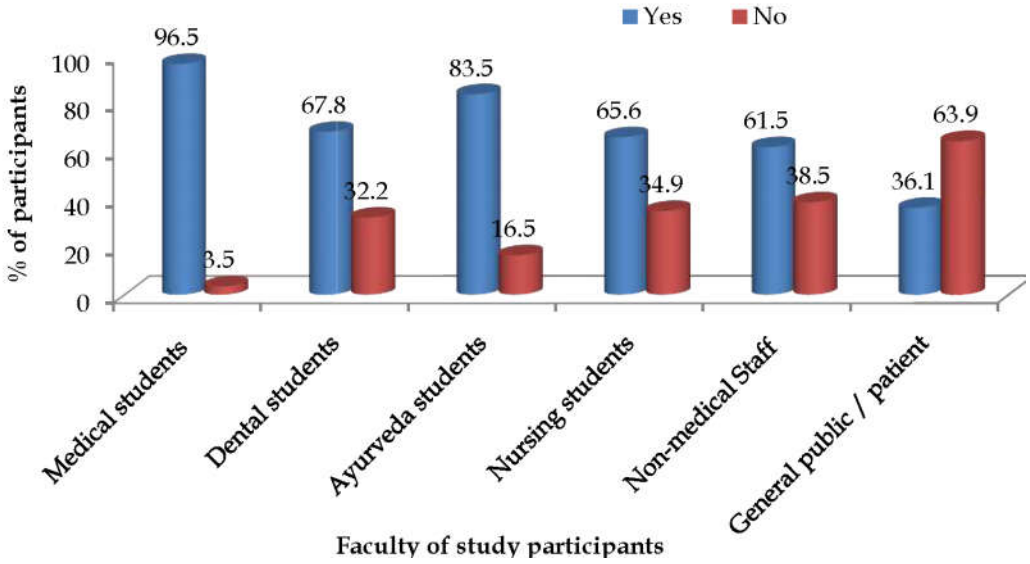


Fig. 6: Multiple bar diagram represents Faculty wise comparison of female participant's awareness of organ donation

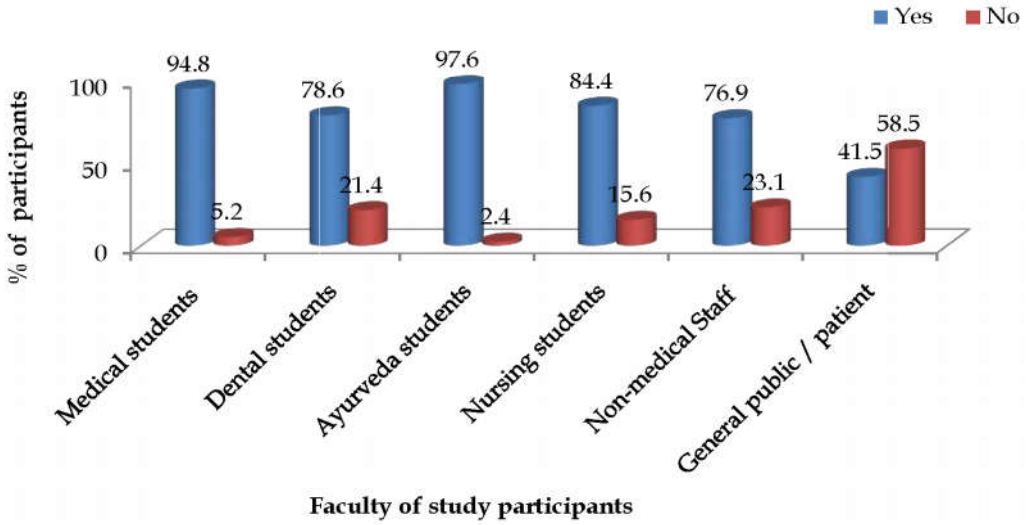


Fig. 7: Multiple bar diagram represents Faculty wise comparison of female participant's awareness of body donation

Table 5: Faculty wise comparison of female participant's willingness for organ and body Donation

Faculty of Study participants	Willingness about organ donation		Willingness about body donation		Total
	Yes No (%)	No No (%)	Yes No (%)	No No (%)	No (%)
Medical students	79 (68.7%)	36 (31.3%)	22 (19.1%)	93 (80.9%)	115 (100.0%)
Dental students	05 (17.8%)	23 (82.2%)	02 (7.2%)	26 (92.8%)	28 (100.0%)
Ayurveda students	32 (37.6%)	53 (62.4%)	15 (17.6%)	70 (82.4%)	85 (100.0%)
Nursing students	16 (50.0%)	16 (50.0%)	03 (9.4%)	29 (90.6%)	32 (100.0%)
Non-medical Staff	18 (69.2%)	08 (30.8%)	12 (46.1%)	14 (53.9%)	26 (100.0%)
General public / Patient	34 (21.1%)	126 (78.9%)	14 (8.6%)	146 (91.4%)	160 (100.0%)
Total	184 (41.3%)	262 (58.7%)	68 (15.2%)	378 (84.8%)	446(100.0%)
ANOVA test P-value & significance	F= 15.23 P<0.001 VHS		F= 3.54 P<0.006 HS		---
Chi-square test P-value & significance	Comparison of willingness about organ donation and body donation $\chi^2 = 13.85$, P<0.001, HS				

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

to willingness about body donation in females.

Study observed that, the commonest source of information for the participants was from medical professionals 395 (49.0%), followed by media i.e. TV, Internet, radio and newspaper 322 (39.9%).

Study observed that, the commonest reason for showing unwillingness towards organ/body donation was objection from family members 363 (45.0%), followed by other reasons (27.0%) which included no reason, not aware of any such donation and religious barrier was 177 (22.0%).

Statistical data analyzed by IBM SPSS 20.0 version software. Data scored yes was as 1 and no was 0, for quantitative data analysis applied ANOVA test and for qualitative data analysis applied chi-square test for statistical significance. If p value was less than 0.05 considered significant.

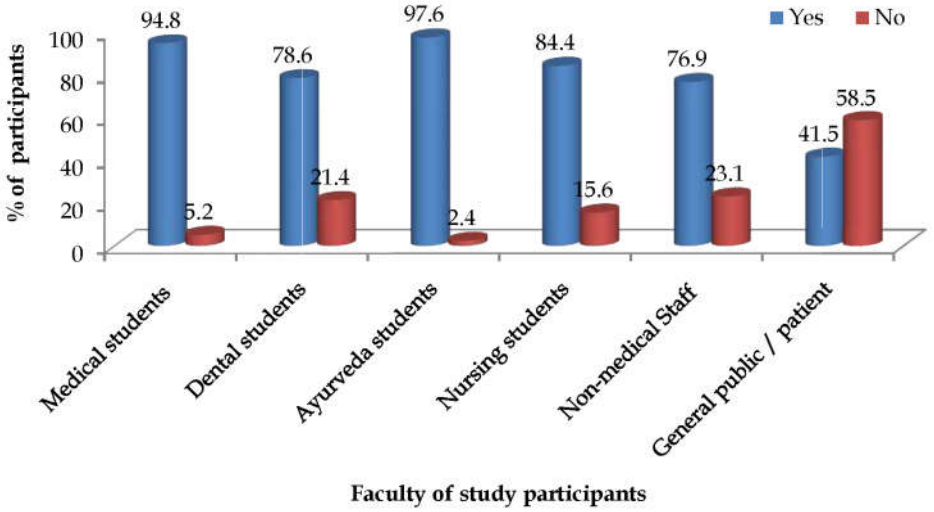


Fig. 8: Multiple bar diagram representsFaculty wise comparison of female participant's Willingness of organ donation

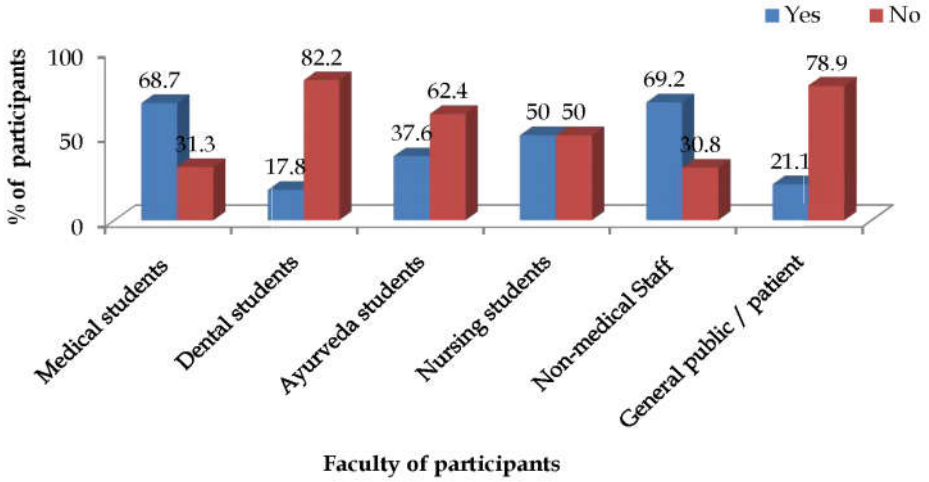


Fig. 9: Multiple bar diagram represents Faculty wise comparison of female participant's Willingness of body donation

Table 6: Source of information wise distribution of study participants

Reasons for unwillingness	Study participants	Percentage
Organ/body could be wasted	8	1.0
Unethical use of organ/body	16	2.0
Religious barrier	177	22.0
Objection from family members	363	45.0
Can't tolerate self dissection	8	1.0
Anxiety	16	2.0
Other reasons	218	27.0
Total	806	100.0

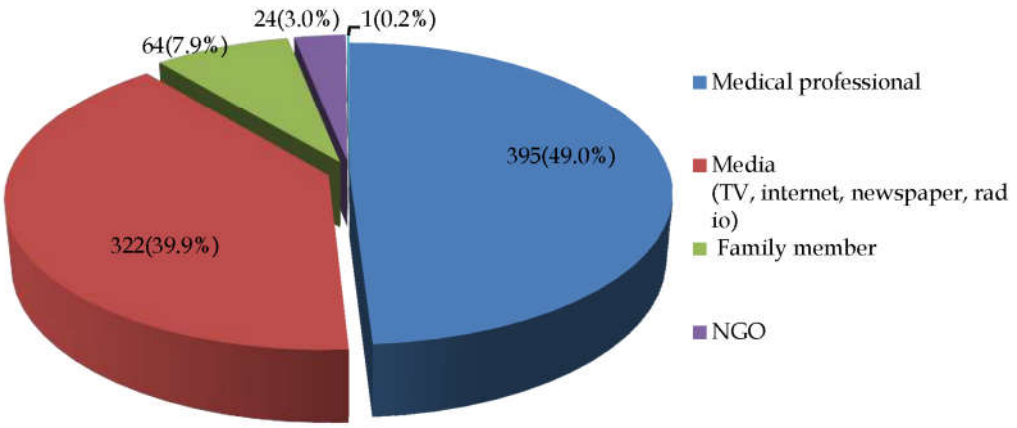
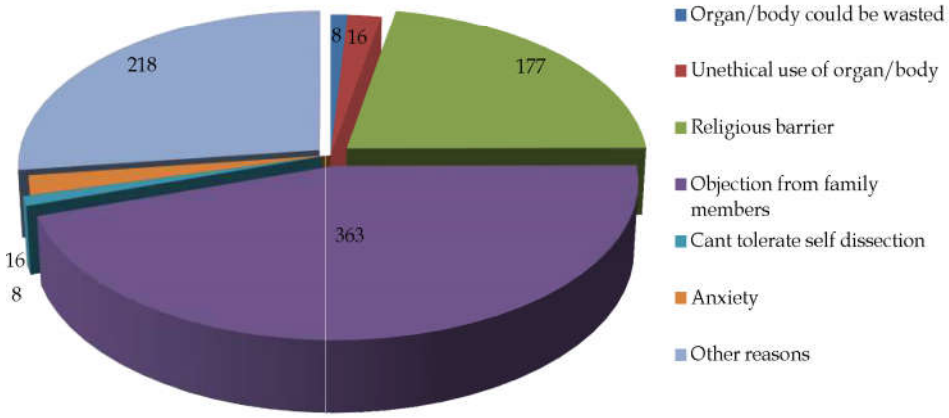


Fig. 10: Pie diagram represents Source of information wise distribution of study participants

Table 7: Reasons for unwillingness wise distribution of study participants

Reasons for unwillingness	Study participants	Percentage
Organ/body could be wasted	8	1.0
Unethical use of organ/body	16	2.0
Religious barrier	177	22.0
Objection from family members	363	45.0
Can't tolerate self dissection	8	1.0
Anxiety	16	2.0
Other reasons	218	27.0
Total	806	100.0



Discussion

To overcome the deficiency of supply of cadavers for academic purpose, Body Donation Society was established in Department of Anatomy in ESIC Medical College Gulbarga in the month of February this year. The drive to spread more awareness about organ/body donation led us to conduct this study to understand the thoughts of general public, patients, staff and students in Kalaburagi region about organ/body donation. In present study, overall awareness for organ donation was 63.39% and for body donation was 70.09%. This finding match with studies of Dope et al. [3] (68%), Pradnyesh Panshewdikar et al. [4] (76.84%) and Vaishaly Bharambe et al. [5] (78%).

In present study, Medical students showed more awareness about organ donation (91.86%) and body donation (94.18%) than any other group. These findings match findings from older studies of Chung CK, Ng CW et al. [6]. 2008 and P Burra, M De Bona et al. [7] 2005.

The commonest source of information for the participants were medical professionals (49.00%),

followedvery closely by media i.e. TV, Internet, radio and newspaper (39.95%). Vaishaly Bharambe et al. [5] in their study stated media as the source of information in 71% of cases.

Approaching medical, dental and nursing students for the study was easy as they were readily accessible in department during classes. Because of familiarity with them they didn't express much resistance and readily gave consent for their participation. Female students showed significant anxiety and had to be counseled considerably to convince them to participate in the study. In contrary to what expected, medical students, have shown least willingness for body donation (male - 20.93%, female -19.13%) compared to other students. Even dental, ayurvedic, nursing students and staff have shown more willingness than medical students.

Female medical students (19.13%) surprisingly showed more willingness towards body donation compared to other female dental (07.14%), nursing (09.37%) and ayurvedic (17.64%) students. Overall, female study particpants showed more awareness and willingness for organ and body donation compared to their male counterparts. This finding match with that of Bilgel H, Sadikoglu G et al. [8] (2006).

Most of the ayurvedic students denied to participate as they assumed that submitting the filled and signed questionnaire will obligate them towards body donation. Despite counseling, most of ayurvedic students didn't participate in study.

House keeping staff were the most resistant as they completely denied to participate in the study. So they were excluded.

Instead dealing with paramedical and ministerial staff was easier than expected. They showed lesser degree of awareness than students but still showed highest willingness for body donation. (Male– 37.03%, female – 46.15%) They were considerably mature in their thoughts towards organ and body donation. This can be attributed to their age as they were elder to the students group.

Another thing observed was that paramedical staff and ministerial staff attempted all questions whereas students had to be instructed repeatedly to do the same.

The commonest reason for showing unwillingness for organ and body donation was objection from family members (45.03%), followed by other reasons (27.07%) which included no reason, not aware of any such donation etc.

From the present study it is clear that medical, dental and other students were not agree to donate their body for dissection purpose despite being nicely aware. Older study among medical professionals showed that only 22% physicians are willing to donate their bodies for medical education, 85% believed that donated bodies were misused [9]. A study among Turkish anatomist is reported that 63.9% would not consider themselves to donate their bodies as they were not prepared. So, shortage of organ or body is not due to ignorance or misconception only, but it is the thought of getting self -dissected as a cadaver. Practice of honouring the cadaver by students and teachers from the commencement of medical course session should be followed as in Korea and Thailand [10,11]. Although religions across the world support and encourage the act of donation, the final decision is left to personal conscience. So, proper counselling and guidance is very much necessary by which we could signicantly turn the potential donor into an actual donor.

Conclusions

1. *Highest awareness*was observed amongst *medical students* for organ and body donation compared to other categories of study participants.
2. *Least awareness* was observed amongst *general public/ patients* for organ and body donation compared to other categories of study participants.
3. Nursing students showed the highest willingness for organ and body donation, whereas general public / patients expressed the least desire to donate their organ or body for academic purpose.
4. *Female respondents* of all categories have shown *higher degree of awareness* towards organ/body donation compared to their male counterparts.
5. *Female respondents* of all categories also showed *more willingness for organ donation* than male participants.
6. *Medical professionals and media (TV, Internet, radio, newspaper etc.*) was the main source of information about organ/body donation for all the study respondents.
7. Commonest reason for showing unwillingness for organ/body donation was anxiety and fear amongst family members and participants themselves for this act.

Suggestions

1. *Establishment of Body Donation Society* in each institution to address the issue of scarcity of

cadavers is the need of hour. Regular awareness seminars for medical faculty, students, staff and patients should be conducted under the society.

2. Compulsory inclusion of lectures on Human body donation and its necessity, its procedural details, information about 'Anatomy Act' for cadaver procurement and related legal implications in*1st MBBS syllabus* and *roratory compulsoryinterenship*.
3. *Special provisions like providing free medical services till death, offering free health insurance, giving first preference etc. for those who have registered for body/ organ donation*should be initiated to stimulate more people towards this gracious act.
4. *Frequent awareness programmes and camps* should be organized in rural areas especially old age homes, orphanages, schoolsetc.to convey the desperate need for organ and body donation.

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Original Article

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Study of Morphological Variations of the Suprascapular Notch in the Indian Population

V.D.S. Jamwal[1], Sushil Kumar[2], Alok Acharya[3], Shallu Jamwal[4]

Abstract

Anatomy of the suprascapular notch and its variations has clinical relevance in the fields of plastic and reconstructive surgery. The course followed by the suprascapular nerve predisposes it to compression in the suprascapular notch resulting in suprascapular nerve entrapment syndrome.This study is a descriptive study carried over a period of two years in the Department of Anatomy, Armed Forces Medical College Pune, Maharashtra. Ninety one dry completely ossified scapulae of undetermined age and sex available in the bone bank of the Anatomy department were studiedThe suprascapular notches were classified according to the classification given by Rengachary et al. In our study, Type III notch was the most commonly observed as per the Rengachary classification. Type IV was the least commonly observed morphological variation of the suprascapular notch. In six cases suprascapular ligament was completely ossified to convert it into a suprascapular foramen which is classified as Type VI. The measurement of the Superior transverse diameter and maximum depth was done by the Vernier's digital Calipers. In our study, type III suprascapular notch was the most common whereas type II and type IV turned out to be the least common as only one case of each type was reported. Knowledge in the variations of the morphology of suprascapular notch helps the surgeon attain adequate access to the suprascapular nerve. Adequate access is a prerequisite to effective decompression of this nerve in all cases of suprascapular nerve entrapment neuropathies.

Keywords: Suprascapular Notch; Suprascapular Nerve; Entrapment Syndrome.

Introduction

Anatomy of the suprascapular notch and its variations has clinical relevance in the fields of plastic and reconstructive surgery. The suprascapular nerve arises from the upper trunk of the brachial plexus in the lower part of the posterior triangle. Its root value is C5,6. It passes backwards and laterally to disappear beneath the border of the trapezius. It then passes through the suprascapular foramenand supplies supraspinatus. The nerve subsequently descends lateral to the scapular spine and supplies infraspinatus [1]. It also supplies the shoulder and acromioclavicular joints. It rarely has a cutaneous branch which pierces the deltoid close to the tip of acromian and supplies the skin of proximal third of the arm within the territory of the axillary nerve [2].

The course followed by the suprascapular nerve predisposes it to compression in the suprascapular notch resulting in suprascapular nerve entrapment syndrome. This syndrome was first described by Thompson and Kopell in 1959 [3].The other causes of the suprascapular nerve entrapment neuropathy include direct trauma, anterior shoulder dislocation [4], ganglion cysts [5], Ewing's Sarcomas and lipomas [6]. Moreover, iatrogenic injuries during surgical procedures on the shoulder constitute an important cause of suprascapular nerve entrapment neuropathy [7].

Aims & Objectives

Aim

To Study of morphological variations the suprascapular notch in the Indian population.

Author's Affiliation: [1]Associate Professor [2]Professor & Head [3]2nd Year Resident, Department of Anatomy, Armed Forces Medical College, Pune, Maharashtra 411040, India. [4]Gynaecologist, J&K Health Services, Jammu and Kashmir, India.

Corresponding Author: Sushil Kumar, Professor & Head, Department of Anatomy, Armed Forces Medical College, Pune, Maharashtra 411040, India.
E-mail: drsushilkumar@rediffmail.com

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Objectives

1. To Study etiological factors of suprascapular nerve entrapment from the available literature.
2. To compare the findings of our study to other studies done in various diverse population groups

Materials & Methods

This study is a descriptive study carried over a period of two years in the Department of Anatomy, Armed Forces Medical College Pune, Maharashtra. Ninety one dry completely ossified scapulae of undetermined age and sex available in the bone bank of the Anatomy department were studied. These scapulae were obtained from the body donors who had given the consent for using their dead bodies for dissection and research purposes. The suprascapular notches were classified according to the classification given by Rengachary et al.

The following measurements were done–

Superior transverse diameter (STD)

Maximum depth (MD)

The measurements were done using digital Vernier's calipers (Figure 1) and were expressed in millimeters. The data was expressed as range and mean values and analysed statistically.

Results

In our study, Type III notch was the most commonly observed as per the Rengachary classification. Type IV was the least commonly observed morphological variation of the suprascapular notch. In six cases suprascapular ligament was completely ossified to convert it into a suprascapular foramen which is classified as Type VI. The measurement of the Superior transverse diameter and maximum depth was done by the Vernier's digital Calipers. The distribution of the frequency and percentage of the different variations was tabulated in Table 1.

Graph box plot of Superior transverse diameter (STD) of various categories of suprascapular notch (Rengachary classification) is shown as graph 1. Analysis of variance was applied to all the categories and was statistically significant. This was followed by doing Post hoc analysis using Bonferroni method which showed statistically significant variation between type III and type V. Also, there was a statistically significant variance between type III and type VI categories.

Table 1: Frequency and percentage of different types ofsuprascapular notches (Rengachary Classification)

S. No.	Type of notch (Rengachary classification)	Frequency	Percentage
1	I	20	22
2	II	1	1
3	III	59	65
4	IV	1	1
5	V	4	4
6	VI	6	7

Fig. 1: Showing the measurement of superior transverse Diameter (STD) using digital vernier caliper

Discussion

Suprascapular nerve entrapment is caused by the fracture of the scapula with the involvement of the notch and blade of scapula or by the traction or compression of the nerve or the suprascapular notch. Variations in the morphology of the superior transverse scapular ligamenthave been identified and associated with suprascapular nerve entrapment. Ticker and associates classified the notches into two different types namely the U-shaped suprascapular notch, defined as having approximately parallel sides with a rounded base, and a V-shaped suprascapular notch, defined as having medial and lateral sides which converge toward a narrow base. They also observed the degree of ossification of the superior transverse scapular ligament classifying the notches into three groups: no ossification, partial ossification and complete ossification [8].

Rengacharry and colleagues proposed a classification system of the suprascapular notch based on the shape of the inferior border of the notch as well as the degree of ossification of the superior transverse scapular ligament, dividing the suprascapular notch intosix types [9,10].

The morphological variations of the superior transverse scapular ligament include partial or complete ossification and multiple bands. The complete ossification of the superior transverse scapular ligament is significant because it constitutes apotential predisposing factor for suprascapular nerve entrapment. This variation in the morphology of the superior transverse scapular ligament has been identified and associated with suprascapular nerve entrapment in several case reports [8,11,12].

In our study, type III suprascapular notch was the most common whereas type II and type IV turned out to be the least common as only one case of each type was reported. We also found a comparatively higher frequency of occurrence of complete ossification of suprascapular notch turning it into a foramen.A total of six cases of complete ossification of the superior transverse scapular ligament was found amounting to a 7 percent of cases.

We believe that this deviation could be due to a small sample size of our study. Moreover, genetic etiology of the complete ossification of superior transverse scapular ligament has been documented earlier [13].

Knowledge in the variations of the morphology of suprascapular notch helps the surgeon attain adequate access to the suprascapular nerve. Adequate access is a prerequisite to effective decompression of this nerve in all cases of suprascapular nerve entrapment neuropathies.

Conclusion

The knowledge of the anatomical variation of the suprascapular nerve is of immense importance for the surgical decompression of the nerve either by excision of the superior transverse scapular ligament alone or by excision of the ligament plus enlargement of the scapular notch [14,15].

Acknowledgements

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Original Article

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Histogenesis of Human Foetal Liver with Reference to Gestational Age: A study

G. Raja Sree[1], T.M. Sucharitha[2], S.V. Phanindra[3]

Abstract

Liver is the largest gland in the human body and foetal liver plays a vital role in the early period of development of human foetus. The objective of this study is to understand the age related histogenesis in the human foetal liver. This is achieved by dissecting the foetal liver and studying formalin fixed sections by normal histological staining.

Keywords: Kupffercells; Hepatocytes; Sinusoids; Portal Triad.

Introduction

The liver is the largest of abdominal viscera. As the body grows from infancy to adult hood the liver rapidly increases in size. The liver weight is about 4-5% of body weight in infancy. It is an important site of haemopoiesis in foetus [1].

The liver gall bladder and biliary duct system arise as a ventral outgrowth from the caudal part of the fore gut in the fourth week of intrauterine life. The hepatic diverticulam (Liver bud) extends into the septum transversum as a mass of splanchnic mesoderm between the developing heart and midgut. The proliferating endodermal cells give rise to interlacing cords of hepatic cells and to the epithelial lining of the intrahepatic portion of the biliary apparatus. The hepatic cords anastomose around endothelium lined spaces the primordial of the hepatic sinusoids. The fibrous and haemopoietic tissue and kupffer cells of the liver are derived from mesenchyme in the septum transversum [2].

The endodermal cells of hepatic bud give rise to the parenchyma of the liver and capillaries. The mesoderm of the septum transversum forms the capsule and fibrous tissue basis of the liver. The foetal liver is an important centre of blood formation (haemopoiesis). Large aggregations of blood forming cells are present between hepatic cells and blood vessels [3].

Author's Affiliation: [1]Assistant Professor [2]Associate Professor, Department of Anatomy [3]Professor & Head, Department of Forensic Medicine, Narayana Medical College, Chintharedypalem, Nellore, Andhra Pradesh 524003, India.

Corresponding Author: G. Raja Sree, Assistant Professor, Department of Anatomy, Narayana Medical College, Chintharedypalem, Nellore, Andhra Pradesh 524003, India.
E-mail: dr.galirajasree@gmail.com
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Aim of Study

- To study the Histogenesis of Human Fetal Liver in relation to gestational age of Foetus.

Material and Method

- The present work is conducted in the Department of Anatomy, S.V. Medical College, Tirupati with the fetuses providedby the Department of Obstetrics and Gynaecology, Government Maternity Hospital, Tirupati.

Collection of Specimens

- In the present study 51 human dead foetuses of 12 to 38 weeks gestational age of both sexes were studied. However, foetuses of more than 12 weeks of gestational age were only dissected for obtaining liver specimens (41). Abdominal cavity is opened (mid-line incision) and the ligamentum teres is separated from the anterior abdominal wall (umbilicus), the inferior vena cava, right and left triangular ligaments were separated and the liver is removed from the abdominal cavity. The livers thus removed were preserved by keeping in 10% formalin solution.

Grouping of Specimens

- 0 to 12 weeks, 12 to 20 weeks, 20 to 24 weeks, 24 to 28 weeks, 28 to 30 weeks, 30 to 34 weeks and 34 to 36 weeks.
- However livers of foetuses above 20 weeks are only dissected.

Procedure for Histological Studies

- Liver slides are prepared and grouped according to the gestational ages. All the slides are prepared by using Haemotoxyline and Eosin stains. Sections were observed under the microscope and are micro photographed.

Observations and Results

- The histological observations are categorized into 4 groups

Group I: - 20 – 24 weeks :- (Figure 1, 2 & 3)

Table 1: Gestational age (in weeks) of the foetuses

Gestational age (weeks)	No. of Subjects	Percentage
Less than 20	10	19.6
20 – 24	12	23.5
24 – 28	9	17.6
28 – 32	11	21.6
32 – 36	2	3.9
36 – 40	7	13.7
Total	51	100.0

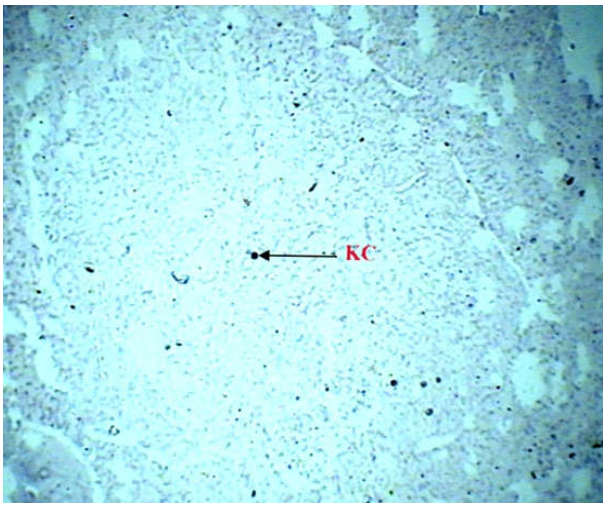

Fig. 1: 20 wks (4x) H & E stain, KC-Kupffer cell

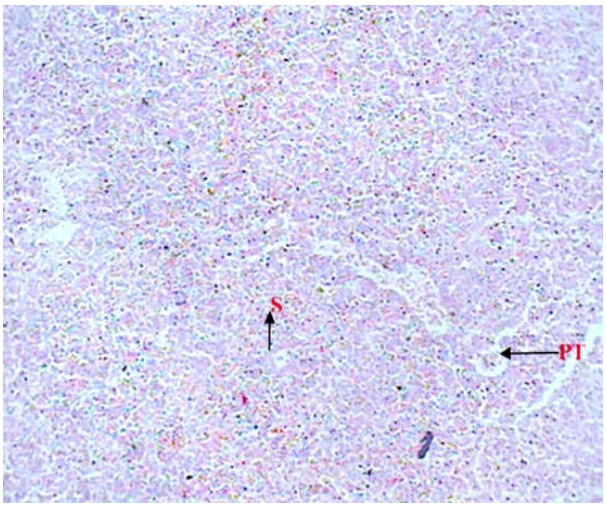

Fig. 2: 22 wks (10x) H & E stain, S-sinusoid, PT-Portal triad

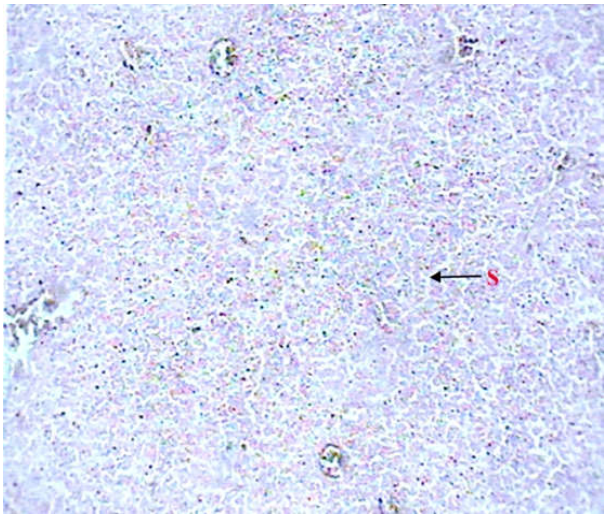

Fig. 3: 24 wks (10x) H & E Stain, S-sinusoids

- This category shows the presence of reticular fibers and kupffer cells (20 weeks), commencement of formation of sinusoids with areas of formation of portal triads (22 weeks), and portal triads at 24 weeks.

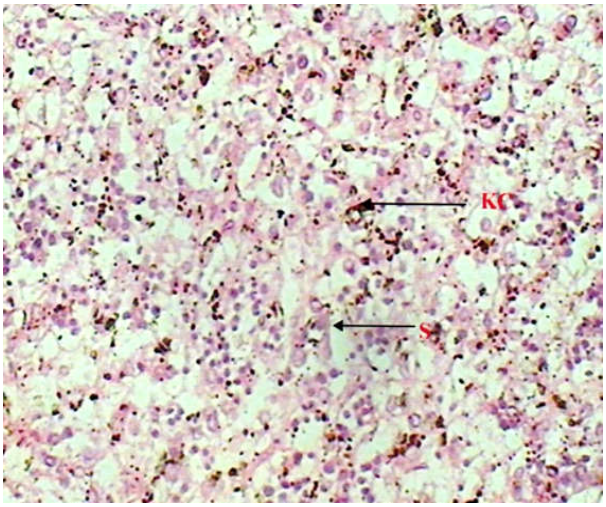

Fig. 4: 26 wks (40x) H & E Stain, S-Sinusoid, KC-Kupffer cells

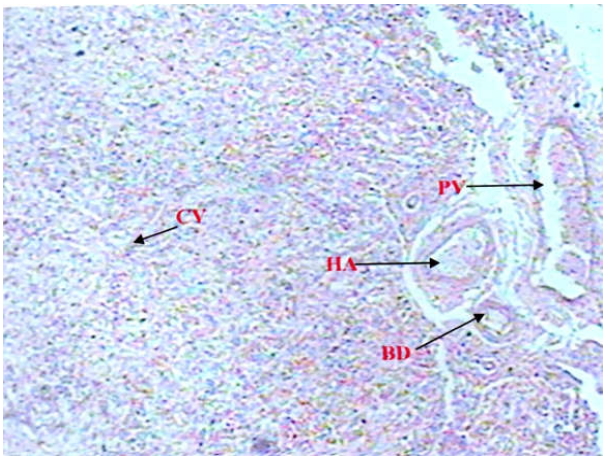

Fig. 5: 28 wks (4x) H & E stain PT-Portal triad, CV-Central vein

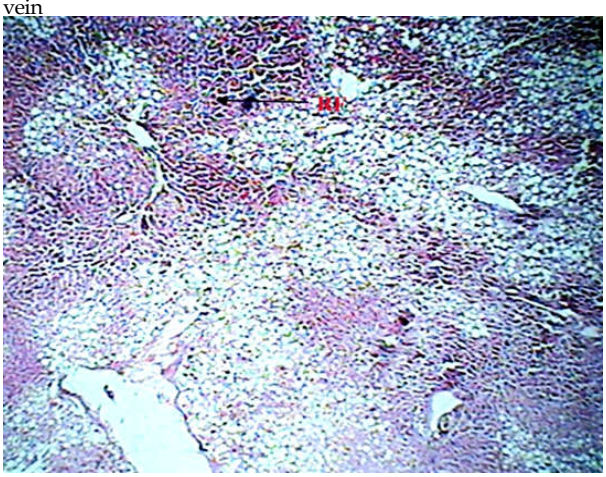

Fig. 6: 32 wks (4x) H & E stain RF-Reticular fibers

Group II: - 24 – 28 weeks :- (Figure 4 & 5)

- This category shows the presence of reticular cells, kupffer cells portal triads and sinusoids (26 weeks), increase pattern of lobulation with central vein (28 weeks).

Group III: - 28 – 34 weeks :- (Figure 6 & 7)

- The findings in this group are clear pattern of hepatic lobulation, portal triads, central vein, kupffer cells and sinusoids.

Group IV: - 34 – 38 weeks :- (Figure 8 & 9)

- The findings in this group are radiating cords of hepatocytes separated by sinusoids lined by kupffer cells with central vein and well organized portal triad.

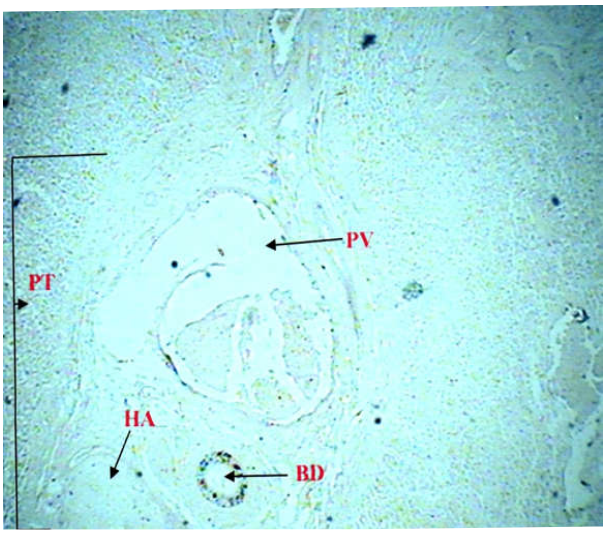

Fig. 6: 34 wks (4x) H & E stain PV- Portal Vein, BD-Bile duct, HA-Hepatic arteriole, PT-Portal tried

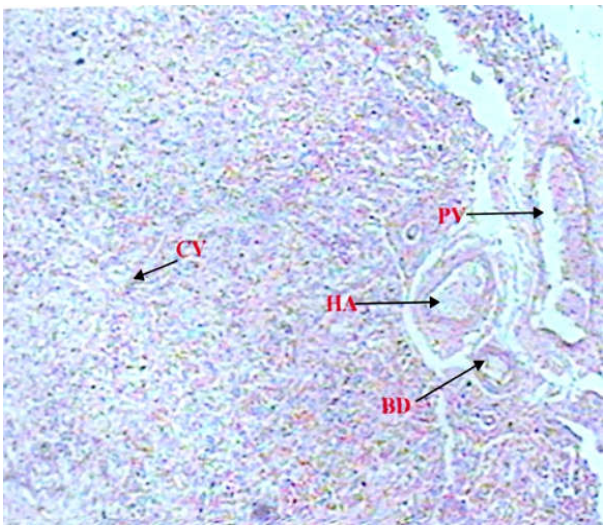

Fig. 8: 36 wks (10x) H & E stain Pv-Portal vein, BD-Bile duct, HA-Hepatic arteriole

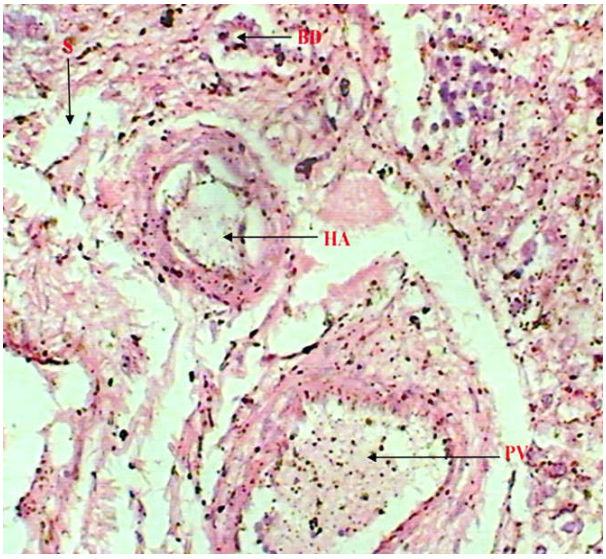

Fig. 9: 38 wks (40x) H & E stain PV-Portal vein, HA-Hepatic arteriole, BD-Bile duct, S-Sinusoid

Discussion

In the early weeks of gestation (20 – 24 weeks) there is abundance of Reticular fibres and Kupffer cells. As the gestational age progresses (24 – 32 weeks) there is appearance of portal triads and sinusoids with kupffer cells and reticular fibers. There are radiating cords of hepatocytes separated by sinusoids lined by kupffer cells with central vein and well organised portal triads (34 – 38 weeks).

In the study conducted by Sanjukta Sahoo, Arpan Haldar, Sanjay Kumar Giri specimen with 20 weeks of gestational age shows early stage of reticular fibres along with Kupffer cells. At 28 weeks of gestational age specimen shows increased reticular fibres with Kupffer cells. Portal triad, binucleated hepatocytes, Kupffer cells, portal canal, central vein and sinusoids were observed at 36 weeks of gestational age. The haematopoietic function decreased abruptly in 35-week-old foetus. Radiating cords of hepatocytes, Kupffer cells along with central vein were observed in a specimen at >36 weeks of gestational age [4].

According to Mohammed Mujahid Ansari, Anjalee G. Ovhal, Shyam Sunder Rao, central vein appears at around 16th to 17th weeks of gestation. Thereafter it shows increase in size. Portal tracts consist of the branches of portal vein, hepatic artery and bile ductule appear later during development at about 18th week of gestation. Kupffer cells around 22nd week of gestation. Kupffer cells appear in foetal liver and are seen to increase up to 34th week of gestation [5].

Hashmi IC, Wankhede HA observed that by16th to 17th week central veins appears. Sinusoidal walls lined by endothelial cells are also identified at this stage. Portal tract can be identified at 18thweek liver, but the clear-cut architectural pattern becomes evident only at 20th to 21st week of gestation. All the structures of classical liver can be identified clearly at 22nd week. The size of lobule increases thereafter [6].

In the study conducted by K. Satheesh Naik, S. Lokanadham, V. Subhadra Devi findings similar to this study were noted [7].

However, Bradley & Neil [8,9] stated that development of Kupffer cells and connective tissue cells begin at about 3rd month of gestational age. Gestational age of 24 weeks specimen shows portal triad with central vein and sinusoids surrounded by periportal connective tissue were observed. Blouin & Suyan [10,11] stated that periportal connective tissue surrounding the bile duct system observed during 8-12weeks of gestational age. There was delay in the formation of bile duct system.

Conclusions

The findings are correlating with Indian studies, however there is a delay in the formation of sinusoids and kupffer cells in relation to western studies.

A larger sample involving a larger area is recommended.

Conflicts of Interests: Nil.

Funding Agency: None.

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Original Article

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Ossification of Superior Transverse Scapular Ligament in an Indian Population

Dope Santoshkumar Ankushrao[1], Shivaji B. Sukre[2], Archana Kalyankar[3]

Abstract

The scapula is a flat bone, situated on the posterolateral aspect of the chest wall. Its superior border is thin and extends between superior and lateral angles. It presents suprascapular notch which is converted into a foramen called suprascapular foramen by superior transverse scapular ligament [STSL] [suprascapular ligament; a fibrous band]. The suprascapular vessels pass above STSL and suprascapular nerve passes below it, through the suprascapular foramen. Complete ossification of STSL converts suprascapular foramen into bony foramen & Suprascapular nerve is commonly entrapped in it. *Aims:* Aim of this study is to calculate & compare the incidence with other studies of the ossified superior transverse scapular ligament [STSL] in dry scapulae and to discuss its clinical significance. *Materials and Methods*: Ninty seven dried human scapulae of Indian population of Marathwada region of Maharashtra, 67 of male and 30 of female i.e. of known sex from the Anatomy Department of Government Medical College, Aurangabad were closely examined for the presence of ossified superior transverse scapular ligament. *Results*: It was found that complete ossification of STSL was 12 out of 97 scapulae of which 11 were males and one was female. 12.37% scapulae of known sex had completely ossified STSL, including nine scapulae of right side and three scapulae of left side. *Conclusions*: The present study showed 12.37% incidence of ossified STSL in Maharashtrian [Indian] population. Incidence of ossification of STSL varies in different populations. It may be influenced by mechanical stress on ligament, age, sex & genetic factors. The knowledge of STSL ossification may be helpful for anatomists, orthopedicians, radiologists, neurosurgeons & clinicians in diagnosis and treatment of suprascapular nerve entrapment syndrome.

Keywords: Superior Transverse Scapular Ligament [STSL]; Ossification; Suprascapular Notch; Suprascapular Foramen; Suprascapular Nerve.

Introduction

The shoulder blade [scapula] is a flat bone, situated on the posterolateral aspect of the chest wall [1]. Its superior border is thin and extends between superior and lateral angles. It presents suprascapular notch which is converted into a foramen called suprascapular foramen by superior transverse scapular ligament [STSL] [suprascapular ligament; a fibrous band]. The suprascapular vessels pass above the STSL [2,3] and the suprascapular nerve passes below it, through the suprascapular foramen [4]. Suprascapular nerve is a large branch of superior trunk of brachial plexus at Erb's point. It runs laterally deep to trapezius and omohyoid, enters the supraspinous fossa, through the suprascapular notch inferior to superior transverse scapular ligament [3,5]. The Suprascapular nerve [SSN] gives motor innervations to the supraspinatus and infraspinatus muscles and sensory innervations to the rotator cuff muscles, to the shoulder and acromioclavicular joint [5,6]. The STSL is a thin flat substantial band that bridges the suprascapular notch and is attached in between the base of the coracoid process and the lateral wall of the suprascapular notch [3]. Suprascapular foramen is the most common location of supra scapular nerve compression & injury. In some animals [7] the suprascapular notch is frequently bridged by bone converting it into a bony foramen, but in human beings , the STSL is sometimes ossified [3,8]. Studies on variations of the superior transverse scapular ligament include calcification,

Author's Affiliation: [1]Associate Professor, Department of Anatomy, Government Medical College, Latur, Maharashtra 413512, India. [2]Professor and Head [3]Associate Professor, Department of Anatomy, Government Medical College, Aurangabad, Maharashtra 431001, India.

Corresponding Author: Dope Santoshkumar Ankushrao, Associate Professor, Department of Anatomy, Government Medical College, Latur, Maharashtra 413512, India.
E-mail: drdopesantosh@yahoo.co.in

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partial or complete ossification and multiple bands [9]. Complete ossification of STSL converts suprascapular foramen into bony foramen & Suprascapular nerve is commonly entrapped in it [10,11]. Most important predisposing factor of supra scapular neuropathy is an ossified STSL [12]. Often the ossified STSL produces compression of the suprascapular nerves which result in symptoms like pain in the shoulder region, wasting and weakness of the supraspinatus and infraspinatus muscles [13]. Many studies on incidence of ossification of STSL with associated suprascapular nerve entrapment ,are seen published without reasoning the cause . So, purpose of this study was to compare the incidence of ossification of STSL in dry scapulae, to elucidate the reasons of ossification of STSL with its clinical importance.

Material and Method

The present study was carried out on 97 dried human scapulae of known sex obtained from the Department of Anatomy, Government Medical College, Aurangabad , Maharashtra. The scapulae included in this study were 67 of male and 30 of female. Each bone was closely observed for the presence of suprascapular foramen and the presence of complete ossification of the superior transverse scapular ligament. The bones showing suprascapular foramen [ossified superior transverse scapular ligament] were photographed. The scapulae with damaged superior margin were excluded from the study.

Results

Twelve (12) out of 97 [12.37%] scapulae of known sex had completely ossified STSL [Fig. 1] , including nine scapulae of right side [Fig. 2] and three scapulae of left side [Fig. 3]. Among 12 ossified STSL 11 out of 67 male scapulae [16.41%] & 1 out of 30 female scapulae showed ossification STSL [3.33%]. Nine scapulae [9.27%] of right side [Male=9 & Female=0] & three scapulae [3.09%] of left side[Male=2& Female=1] showed ossified STSL. Eighty five [87.62 %] scapulae were found with no ossified STSL.

Table 1: Shows the numbers of completely ossified STSL

Completely ossified STSL	**Right**	**Left**	**Total 12 out of 97** (12.37%)
Male (67)	9	2	11 (16.41%) Out of Male
Female (30)	0	1	01 (03.33%) Out of Female

Table 2: Incidence of completely ossified STSL in different populations

Sr. No.	**Study**	**Country**	**Year**	**No. of studied specimens**	**Incidence in %**
1	Edelson et al [7]	America [Washington, NY]	1995	1000	3.7%
2	Ticker et al [9]	America [Massapequa , NY]	1998	79	5%
3	Tubbs R S et al [13]	America [Birmingham,Alabama]	2013	104	5.7%
4	Dunkengrun et al [14]	America [New York]	2003	623	5%
5	Urgudin et al [15]	Turkish	2004	20	6%
6	Silva et al [16]	Brazil	2007	221	30.6%
7	Natsis et al [17]	Germany	2007	423	7.3%
8	Sinkeet et al [18]	Kenya	2010	138	2.9%
9	Wang et al [19]	China	2011	295	1.35%
10	Polguj et al [20]	Poland	2011	86	7%
11	S D Jadhav et al [21]	India [Maharashtra]	2012	350	10.57%
12	Mahato RK et al [22]	India[Andhra Pradesh]	2013	122	4.92%
13	Mistry P et al [23]	India [Surat]	2013	180	19.44%
14	Kalpana T et al [24]	India [Manipur]	2013	100	2%
15	Zahid A. et al [25]	Pakistan	2014	204	1.96%
16	Thammisetti P et al [26]	India [Madhya Pradesh]	2015	96	3.1%
17	Shiksha Jangde et al.[27]	India [C.G.]	2015	73	4.1%
18	Kirti Chaudhary at al [28]	India [Maharashtra]	2016	90	6.66%
19	Present study	India [Maharashtra]	2016	97	12.37%

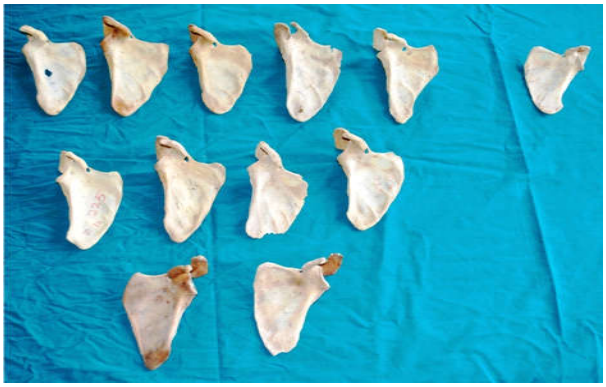


Fig. 1: Showing all completely ossified STSL
12 Scapulae of ossified STSL, 11 of male & 1 of female

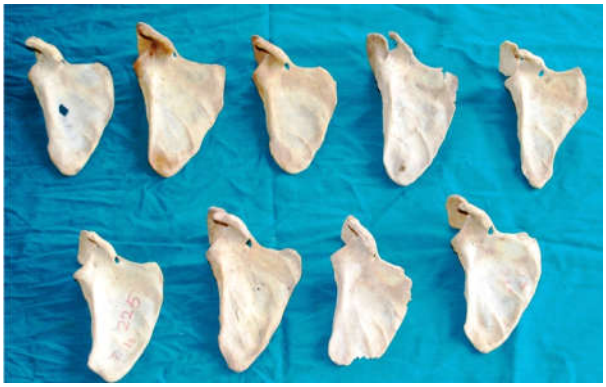


Fig. 2: Right sided scapula with completely ossified STSL
Nine Scapulae of ossified STSL of male & none of female

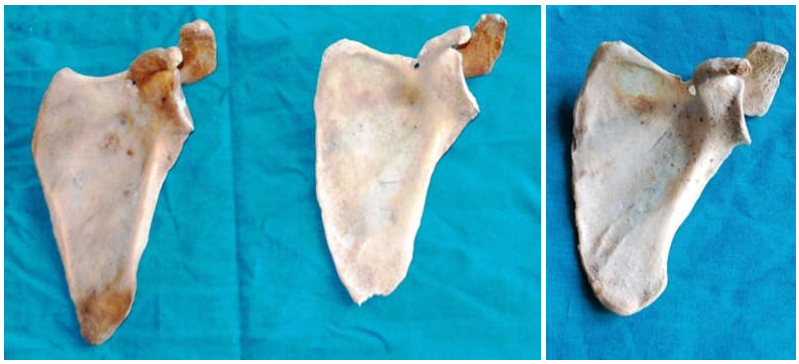
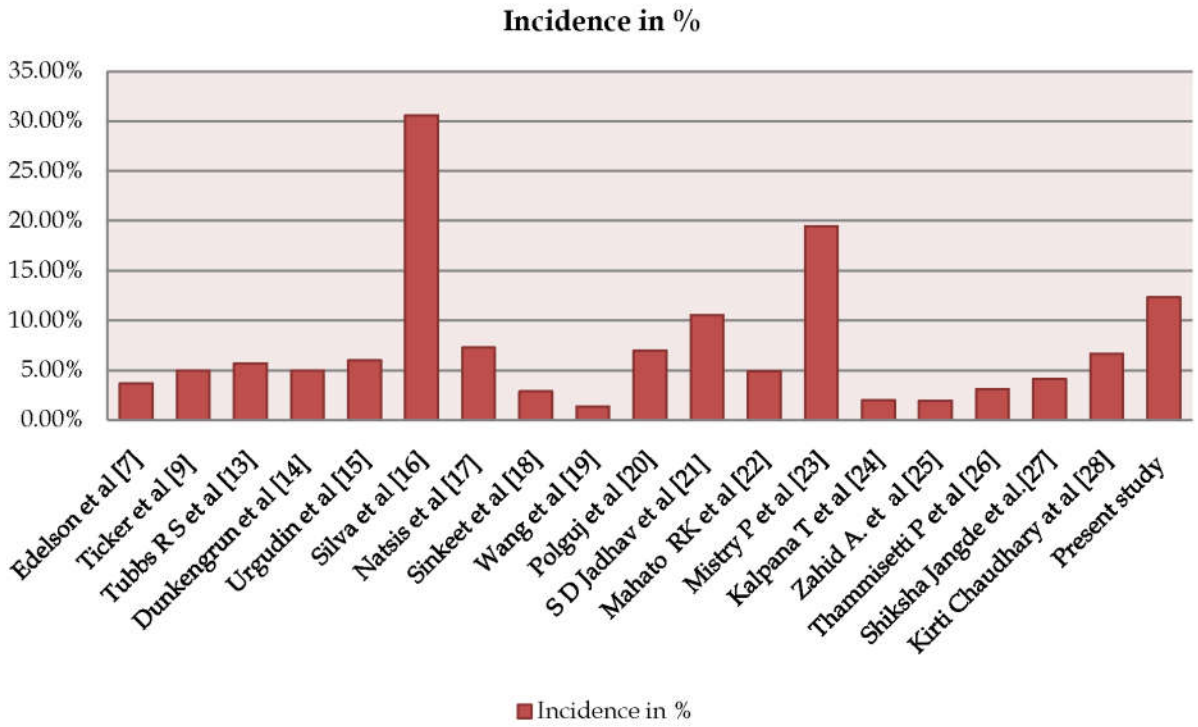


Fig. 3: Left sided scapula with completely ossified STSL.
Two Male Scapulae One Female Scapulae



Graph 1: Studies of different workers showing incidence of completely ossified STSL

Discussion

Incidence of ossification of STSL varies in different populations as shown in Table 1 and it may be influenced by many factors. Mechanical stress on ligament, age , sex & genetic factors may influence in formation of ossification of STSL [22].

The fractional area of calcified fibrocartilage increases with age [29]. Thus it can be considered that incidence of ossification of STSL is more in advanced aged people. This is supported by the fact that bony bridges [complete ossification of STSL] are more often seen with increasing age suggesting its relation to enthesopathic changes [30].

The quantity of uncalcified fibrocartilage at an enthesis [site of attachment] is well correlated to the extent of movement that occurs between ligament/ tendon and bone. Movement is the mechanical stimulus that triggers the metaplasia of fibroblasts to fibrocartilage cells [31]. So during shoulder and upper extremity movements the muscles [specially supraspinatus and its fascia which is attached with STSL] contraction is likely to cause torsion of the upper part of the scapula. Such twisting movements can create significant stress concentrations at the STSL entheses and even lead to small changes in insertional angle at both ends of the ligament. Near the medial margin of suprascapular notch, superior border of scapula also gives origin to omohyoid muscle which though weak, on contraction contributes to stress concentration at STSL due to its closeness to the ligament. The lateral end of STSL is also blends with the conoid part of coracoclavicular ligament, so force acting on coracoclavicular ligament is transmitted to STSL. Even in the absence of any connection between these two ligaments forces acting on the coracoid process are indirectly transmitted to the STSL due to its attachment to the base of coracoid process. This also adds to stress concentration at the STSL lateral enthesis [2,3].

The bony spurs are bony outgrowths that extend from bone to soft tissue of a ligament/tendon at its enthesis and represent a skeletal response to stress. They can occur in association with high levels of physical activity, are more common with increasing age and are more frequently found in males than in females [2,32]. Rasmussen [33] et al. reported that fibrocartilage developed from fibrous tissue in the os penis of rat, calcified with age under the influence of androgens. Glucksmann & Cherry [34] have shown that testosterone administered to female rats induces the development of an os clitoridis containing fibrocartilage. Hrdlicka [30] in his work has mentioned that bony bridges are found more in Caucasian males. These findings indicate that male predominance in ossification of ligaments may have some endocrinal basis and application of same for STSL ossification can be the topic for further research.

Some individuals have greater tendency to form bone than others, both at the margins of joints and at the entheses. Such individuals form bone at the levels of mechanical stress that do not trigger comparable osteogenesis in others due to their genetic predisposition to more bone formation [32]. Cohen [35] et al. have described a familial case of calcification of STSL causing entrapment neuropathy of the suprascapular nerve affecting both father and son, suggesting that the ossification of STSL may have a genetic basis.

Suprascapular nerve [c5, c6] arises at the Erb's point, which is present on superior trunk of brachial plexus. It goes towards the suprascapular notch through the posterior cervical triangle, under cover of trapezius and omohyoid and finally passes through the suprascapular foramen and enters the supraspinous fossa [3]. Suprascapular nerve entrapment neuropathy has also been described in clinical scenario without a visible ossification of STSL[11]. This is characterised by weakness of abduction and external rotation of the arm due to supraspinatus and infraspinatus muscle denervation, atrophy of these muscles and is frequently accompanied by ill-defined dull or burning pain on the posterolateral aspect of shoulder which exaggerate on activity. In some cases the pain radiates to the ipsilateral extremity, the side of the neck or the front of the chest.

The present study [Fig.1] reported 12.37% incidence of completely ossified STSL, which is slightly higher than S D Jadhav et al. 2012 [10.57%] [21]. The incidence of our study is significantly lower than Mistry P et al. 2013 [19.44 %] [23] & Silva et al. 2007 [30.6%] [16]. Silva et al. studied the prevalence of the ossified superior transverse scapular ligament on dry scapulae in Brazilian population. Complete ossification of superior transverse scapular ligament was rare in some population such as in Kenya [18], China [19], India [Manipur] [24] & Pakistan [25] native as 2.9%, 1.35%, 2% & 1.96% respectively. Sinkeet et al observed the incidence of completely ossified ligament in Keniyan while Wang et al in chinese population . Kalpana T et al. & Zahid A. et al. studied the incidence of ossified ligament is Indian & Pakistani population respectively . Tubbs R S et al 2013 [13] reported incidence of complete ossification of the ligament as 5.7% in American

population and according to study of Polugi et al in Poland population incidence to be 7% . Coexistence of suprascapular notch and suprascapular foramen a rare anatomical variation was found during radiological and anatomical investigations by Micha Polguj et al. [20]. In American population the incidence of complete ossification of the ligament was reported as 3.7 % by Edelson et al. [7], 5% each by Ticker et al. [9] and Dunkengrun et al [14]. Urgudin et al. [15] have been described complete ossification of superior transverse scapular ligament in Turkish population as 6%. While Natsis et al. [17] 2007 in German population as 7.3%. According to Raj Kishore Mahato 2013 [22] complete ossification of the ligament is 4.92% and also he describes that ossification may be influenced by age, mechanical load on ligament, sex and genetic factors and can be one of the risk factors for suprascapular entrapment neuropathy. In Indian population the incidence of complete ossification of the ligament was reported as 3.1% by Thammisetti P et al. [26] , Shiksha Jangde et al [27] & Kirti Chaudhary et al. [28] observed the incidence as 4.1% & 6.66% respectively.

Although anatomical knowledge of the course of the nerve and its possible sites of entrapment is essential for an early and correct diagnosis and management of the nerve entrapment syndrome; certain habits of life [abduction at shoulder] at utilization of the upper limb; the muscles, supraspinatus and levator scapulae transit in this region can be related to the STSL calcification. Also abduction associated external rotation predispose to neuropraxis due to suprascapular nerve compression [36]. It is hypothesized that repetitive overhead motion or trauma contributes to ossification of the ligament as the incidence of entrapment of the suprascapular ligament is largely increased with strenuous overhead motion [e.g., volleyball, baseball]. Cohen et al. [35] have described a familial case of calcification of superior transverse scapular ligament affecting a 58 year old man and his son, who had STSL calcification causing entrapment neuropathy of the suprascapular nerve, clinical symptoms of pain, weakness of the external rotation and abduction, and atrophy of the supraspinatus muscle . Treatment for compression of the suprascapular nerve begins with physical therapy to strengthen the rotator cuff musculature. If conservative treatment fails, surgical decompression of the suprascapular ligament is recommended. Arthroscopic decompression may facilitate a more rapid recovery especially when the entrapment is caused solely by the ossified ligament [37].

There are few limitations to this study. Because of the use of dry scapulae, clinical history of patients was not available as well as the effects of other soft tissue structures on suprascapular nerve could not be evaluated. Therefore the patient with ossified STSL might have suprascapular nerve entrapment neuropathy but without these details, it is hard to say that patient had suprascapular nerve entrapment neuropathy. Since the present study was performed with a limited number of dry bones, more clinical, radiological, surgical, histological and cadaveric studies need to be done.

Conclusion

The present study was performed with dry scapulae and showed 12.37 % incidence of ossified STSL in Maharashtrian [Indian] population . Incidence of ossification of STSL varies in different populations. So more clinical, radiological and cadaveric studies need to be done. The study provides precise data in diagnosis of the suprascapular nerve entrapment. So these facts should be in the mind of clinicians, radiologists and surgeons while dealing with a case of shoulder pain.

Conflict of Interest: Nil

Acknowledement

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Original Article

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Renal Anomalies with Accessory Renal Vessels

P. Venkateswara Rao, A. Hemalatha Devi[2], K. Madhu Babu[3]

Abstract

The Subject of Kidney anomalies including their incidents has created much interest to the scientists in late 1950 and 1960 with the aim of preventing and curing them as much as possible. Knowledge about their incidents Particularly helps us to know how frequently they are seen in the population and makes us to search the possible etiological factors for such high occurrence. An attempt has been made to know the various anomalies , detailed dimensions of specimens available from the cadavers. To apply this knowledge to the incoming post graduates in their research works. Renal vascular segmentation was originally recognized by John Hunter in 1794. The term accessory vessels denote two or more arterial branches supplying the same renal segment. As each segment is supplied by a single end artery. Evans et ai in 1951 and tuli in 1968 noted multiple congenital anomalies affecting nervous system, urogenital system and cardiovascular system resulting from acute folic acid deficiency during gestation in pregnant rates. Gleen in 1959 described in 30% of cases the blood supply from one renal artery to each kidney. Boatman et al. 1971, colin et al 1972 the blood supply may be internal iliac artery or external iliac artery or sacral arteries. Malfunction of renal and testicular veins – a case report from the journal of the anatomical society of india volume 54, No.2 (2005, 2206) authors Varma R., Kalaras and Rana K.

Keywords: Aberrent Vessel; Birth Defects Aorto Graphy Renal Parenchyma; Fornix.

Introduction

- The subject of kidney anomalies including their incidence has created much interest to the scientists in late 1950 and 1960 with the aim of preventing and curing them as much as possible.
- Knowledge about their incidence particularly helps us to known how frequently they are seen in the population and makes us to search the possible etiology factors for such high occurrence.
- Human kidney serve to filter more than 170 liter of blood per day into about 1 liter of highly specialized concentrated fluid called urine. In doing so the kidney excrete the waste products of metabolism, precisely regulates the body's concentration of water and salts, maintains the appropriate acid base balance, and serves as endocrine organ, secreting such hormones as erythropoietin, renin, and prostaglandins. The physiologic mechanism that the kidney has evolved to carrying out these functions requires a high degree of structural complexity.
- Embryology explains the etiological factors of many birth defects including the anomalies of the kidneys and among the explained many are due to various genetic and environmental factors teratogens such as Physical, Chemical, Nutritional and Biological causing mutations in the genes and affecting the development at various stages of growth it is the intricate action between the differentiation and maturation of the organ systems of the body.
- Kidney is one of the vital organs of the human body, which is effected by many known and unknown teratogens and thus a frequent site of anomalies.
- Now, the modern studies include in addition to the above mentioned, various imaging (Radio-diagnosis) procedures such as plain and contract X-rays , Ultrasound scanning and MRI etc. It is

Author's Affiliation: [1]Associate Professor, Department of Anatomy, [2]Professor & Head [3]Assistant Professor, Department of Physiology, Katuri Medical College, Guntur, Andhra Pradesh 500019, India.

Corresponding Author: P. Venkateswara Rao, Associate Professor, Department of Anatomy, Katuri Medical College, Guntur, Andhra Pradesh 500019, India.
E-mail: vrpotu@gmail.com

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important to note that the incidence of congenital anomalies vary greatly depending upon the methodology adopted for the study.

- Anomalies of Renal Vasculature.
  a. Aberrant, accessory or multiple vessels.
  b. Renal artery aneurysm.
  c. Renal Arterio Venus fistula.
- Aberrant, accessory, or multiple vessels are important to every urologic surgeon, and fortunately this subject lends itself to easy investigation. Anatomists were keenly interested in renal vascular patterns before the turn of the century, but the advent of Aorto graphy in the 1940s and 1950s sphere headed a systematic clinical approach to this topic. Most of the classic work was performed by investigators in the middle to late 1950s and early 1960s (Graves, 1954, 1956; Anson and Kurth, 1955; Merklin and Michele, 1958; Anson and Dascler, 1961; Coyer and pouasse.1962).
- The kidney is divided into various segments, each supplied by a single "end" arterial branch that generally courses from one main renal artery. Multiple renal arteries is the correct term to describe any kidney supplied by more than one vessel. The term anomalous vessels or aberrant vessels should be reserved for arteries that originate from vessels other than the aorta or main renal artery. The term accessory vessel denotes two or more arterial branches supplying the same renal segment.
- Between 71% Merklin and Michele, (1958) and 85% Geyer and poutasse,(1962) of kidneys have one artery that supplies the entire renal parenchyma. A slightly higher percentage of right - sided kidneys (87%) have a single renal artery compared with left sided organs Geyer and Poutesse, (1962). This figure does not seem to be influenced significantly by either sex or race. True aberrant vessels are rare expect in patients with renal ectopia with or without fusion and in individual with a horseshoe kidney.Venous drainage of the kidney has been carefully restudied by Sampaio and Aragao (1990a), who noted a close association between the inferior branch to the main renal vein and anterior inferior aspect of the renal pelvis in 40% of Kidneys. They cautioned that an endourologic incision of an obstructed ureteropelvic junction should be done laterally and posteriorly instead of anteriorly to avoid injury to this vessel.

Materials & Methods

- The present study has been under taken on 76 kidneys from cadavers and 60 from sonograms and 40 from fetal kidneys. The study was started and finished an a period of 2 years. The specimens from cadavers were obtained from Siddhartha medical college, Vijayawada and kakatiya medical college, Warangal. The sonograms are obtained from GGH, Vijayawada fromm the in and out patients attending to the radiology department.
- The parameters like weight, length of the kidney, breadth of kidney and breadth at the superior pole, inferior pole and at the hilum are taken with the help of electronic weighing machine, vernier calipers, the scale and thread are used. During the routine dissections the kidneys identified and the photographs are taken in situ wherever necessary. The parameters are taken, anomalies are noted and detailed diagrams are drawn.
- Screening of general population by non-invasive imaging procedures like plain X-ray of kidney ,ureter and bladder (KUB), ultra sound of the abdomen etc.
- Screening of patients attending to various out patient (op) departments of the hospitals.
- Looking for any renal anomalies during various genitourinary abdominal operative procedures and nothing down the incidence
- Cadaveric studies including fetal dissections, fetuses are obtained from G.G.H Vijayawada .
- It should be emphasized once again that the incidence of congenital anomalies varies greatly depending upon the methodology adopted for the study. For example Holinshed (1956) and K.Mortn (1958) observed renal anomalies in 2-3% of all operations and 0.5 to 1% in all autopsies.
- The present study was conduct on:
  a. 76 adult cadavers.
  b. 20 still born fetuses of kidney specimens of 40.
  c. 60 kidneys from patients attending general out patient department of radiology GGH, and Vijayawada

Screening of patients for any renal anomalies, who-where attending to the urological outpatients departments:

1. Anomalies

- *Cadavers of anatomy dissection hall and autopsy:* 76 specimens were studied and the study of upper urinary tract [11] was undertaken in detail, after nothing the Sl.No, Sex, Parameters. Anomalies were studied and photographs were taken:
- *Unclaimed still born fetus:* 40 specimens were studied after nothing the following particulars.
  - Sl.No
  - Approx age of fetus.
  - Sex of fetus
  - Parameters
  - Anomalies

Procedure: The abdomen was opened by right para median incision and two parallel transverse incisions, which were taken at the end of the right para median incision. The superficial viscera were studied in detail and noted the anomalies if any present. Next the coils of small intestines were removed from abdominal cavity to get a clear view of the posterior abdominal organs.

The size, shape and position of the kidney were recorded. The hilum of the kidneys and the structures in relation to it were noted down. Next the pelvic viscera, diaphragm, great vessels were examined for any anomalies.

Results

In the present study 176 specimens of kidneys were studied out of which 40 were fetal specimens and the rest were adult specimens consisting of both cadaveric and sonograms. The adult specimens from cadavers were 76 and 60 from sonograms .

The following observations were made:

Out of 40 fetal specimens 2 anomalies were observed .

1. Aberrant renal artery.
2. Aberrant renal vein.
3. Agenesis of left Kidney.

Out of 76 cadaveric specimens the following anomalies were observed

1. Aberrant renal arteries - 10
2. Double ureter - 1
3. Lobulated adults Kidneys - 5
4. Hypoplastic kidneys - 10
5. Testicular veins - testicular vein draining into renal vein.

Out of 60 sonograms of kidney,

1. Polycystic kidneys - 2
2. Hydro nephrosis - 10
3. Renal Calculi - 4

Table 1: Anomalies of the Kidney 9,10,11,15

Sl. No	Length In Cm	Breadth In Cm	Sup. Pole Length In Cm.	Inferior Pole Legth In Cm	Weight in Grams	Right or Left	Variations
1	5.60	5.60	4.04	4.74	126	Right - F	Inferior Pole, Aberrant artery. Length is short
2	8.63	5.73	5.41	5.18	115	Left - F	Left Superior pole, aberrant artery
3	9.53	5.82	4.51	4.15	145	Left - M	Left Superior pole, aberrant artery
4	8.48	4.88	4.11	4.15	145	Left - M	Left Superior pole, aberrant artery
5	10.0	4.56	5.29	4.52	157	Left - F	Aberrant artery, Superior pole.
6	10.6	3.23	5.64	3.77	126	Right - F	Inferior Pole, Aberrant artery. Length is short
7	9.19	4.36	5.64	4.09	106	Left - M	Aberrant artery, Superior pole.
8	9.80	5.40	4.50	3.60	145	Left - M	Aberrant artery, Superior pole.
9	10.6	4.5	3.3	3.40	110		Aberrant renal artery
10	11	4.00	2.50	3.25	105		Aberrant renal vein
11	13	8.2	4.50	5.50	208	Right	Aberrant renal vein from Superior pole.
12	3.07	1.75	1.10	4.42	9.2	Left - F	Lobulated with aberrant vein at right superior pole. Weight 1.6 k.g
13	4.22	2.32	2.32	2.18	10.58	Left - F	CRL: 35cm,Weight: 2.78 aberrant arteries to left. Superior pole
WET SPECIMENS (ADULT CADAVERS) 1							

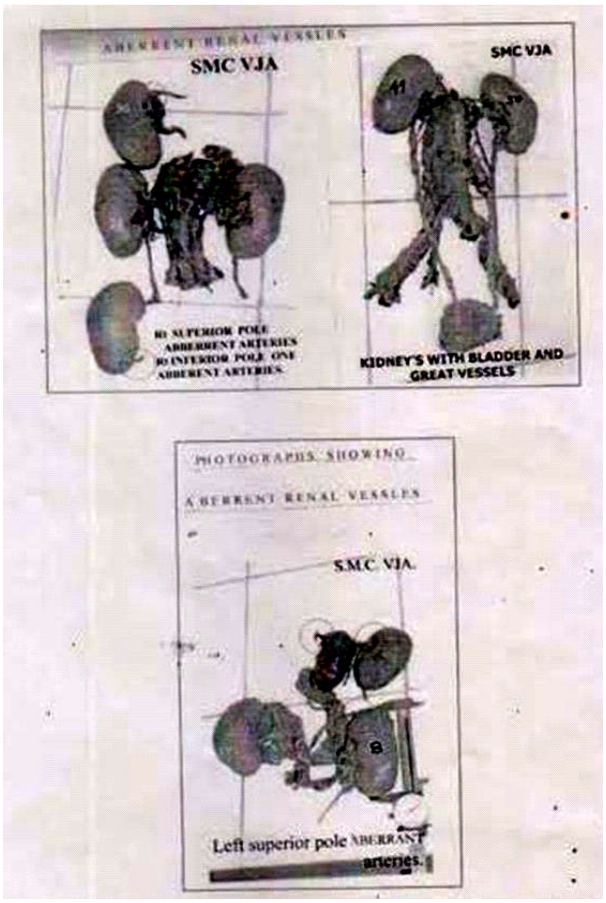

Diagram 1: Showing Accessory Renal Vessels Supplying the Poles of the kidney (Ref:-10,14,15)

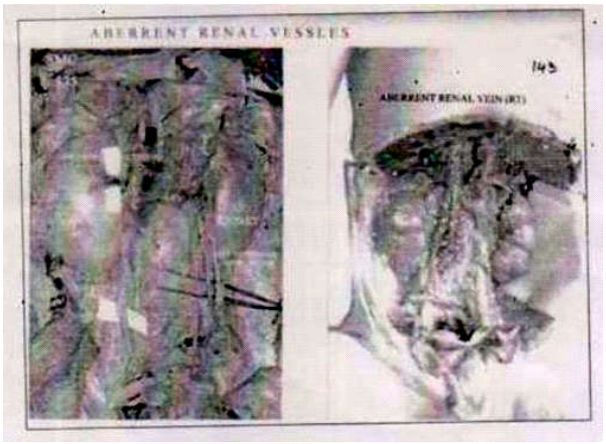

Diagram 2: Aberrent Renal Vessels **Diagram** 3:Aberrent Renal Vein

Discussion

The medial testicular vein [3] on right side was bifurcating into two divisions, the lateral one was connected with the lower renal vein where - as medial one was draining directly into the inferior vena cava.

- In normal case, there is one renal vein and one testicular vein on each side. On right side both renal and testicular veins [5] open directly into the IVC. The right renal vein is a mesonephric vein that originally drains into that portion of right sub cardinal veins which from part of IVC. The testicular veins are remnant of that part of sub cardinal vein [6] which lie below inter sub-cardinal anatomosis
- The reason for this observation could be attributed to early stages of development.
- Regarding anomalies of renal [12] vasculature the observations in the study were 14 aberrant vessels (10 in 76 cadaveric specimens and in 40 fetal specimens). According to Merklin and Michele, [13] (1958) 71% and according to Geyer and Poutasse, (1962) 85% of Kidneys have one artery that supplies the entire renal parenchyma.
- A slightly higher percentage i.e. 87% of right sided kidneys have single renal vessel was observed by Geyer and Poutasse (1962). In this present study it was observed that 12:168 (i.e. 7.14%) of which right - sided are 7 and left are 5. So as per the study single artery kidneys are 93%.

Conclusion

- It is of interest to note that congenital anomalies [13] were noted from as early as 460-377B.C. It is started that anomalies of the urinary tract rank third or fourth in position and they constitute 3 - 4% of total congenital anomalies and seen in 2-3% of population.
- The present study is confined mainly to study have been discussed in detail and comparative study has been made with the available data.
- In the present study, a rare anomaly, of right testicular vein joining the right renal vein is observed .
- In the present study, two adult polycystic kidney anomalies [14], are observed.
  - In the present study, 14 aberrant vessels are observed [15].
  - In the present study, 10 hypoplastic kidneys are observed.
  - In the present study, 10 specimens of hydronephrosis are 14 observed.
  - In the present study, 5 specimens of fetal specimens lobulations are observed.

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Case Report

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Flexor Digitorum Superficialis Annularis: A Unique Progressive Variation in the Forearm

Sangeetha Arumugam[1], Nandha Kumar Subbiah[2]

Abstract

Atypical separation of long flexor tendons of the forearm is contemplated as progressive variation. Flexor digitorum superficialis annularis muscle of the ring finger was observed in the superficial strata of the forearm flexor compartment. Its origin, insertion, nerve supply, morphology and morphometry are described in this report. Awareness about the incidence of such rare variant muscle is critical for operating surgeons and anatomists.

Keywords: Flexor Digitorum Superficialis; Flexor Digitorum Superficialis Annularis; Progressive Variation.

Introduction

The conventional anatomical description of the flexor digitorum superficialis (FDS) muscle states that it forms the intermediate layer of the forearm flexor muscle mass. It arises by two heads, the humero-ulnar head and the radial head, reunites and divides into four tendons in the distal third of the forearm. These tendons pass through the carpal tunnel and diverge towards the medial four digits. Close to the digits, each superficial tendon splits to allow the tendon of flexor digitorum profundus (FDP) to pass and insert on the base of middle phalanx of the respective finger [1]. Various retrogressive anomalies of the FDS and its tendons of the little [2] and index fingers [3] have been reported. Occasional separation (up to their origins) of individual muscle bellies of FDS has been considered a progressive variationin the phylogeny [4]. This report discusses a case of a flexor digitorum superficialis annularis (FDSA) muscle of the ring finger, an extremely rare progressive variation, which to our knowledge has not previously been reported in the literature.

Author's Affiliation: [1]Associate Professor [2]Assistant Professor, Department of Anatomical Sciences, Medical University of the Americas, St Kitts and Nevis, WI.

Corresponding Author: Nandha Kumar Subbiah, Assistant Professor, Department of Anatomical Sciences, Medical University of the Americas, St Kitts and Nevis, WI.
E-mail: n.subbiah@mua.edu

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Case Report / Observation

An independent, fleshy, muscle belly originating from the medical epicondyle of the right humerus was observed in a middle-aged male cadaver. The muscle was positioned between Palmaris longus (PL) and Flexor carpi ulnaris (FCU) in the superficial strata of the forearm (Figure 1) and supplied by a direct branch from the median nerve. Its tendon was found traversing under the flexor retinaculum along with tendons of FDSfor index, middle and little finger, Flexor Digitorum Profundus (FDP) and median nerve to reach the proximal phalanx of ring finger. Further,

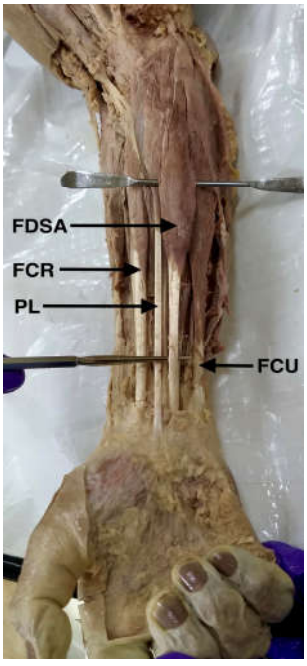

Fig. 1: Flexor digitorum superficialis annularis (FDSA) muscle positioned between Palmaris longus (FL) and Flexor carpi ulnaris (FCU) in the superficial strata of the forearm

it splits into two slips to allow the passage of tendon of the flexor digitorum profundus and gets inserted into the sides of the shaft of middle phalanx of the ring finger (Figure 2). The variant muscle therefore substituted completely for the slip to the ring finger from FDS, which was absent. The muscles of the flexor compartment of the right forearm and hand were carefully dissected and the variant muscle to the ring finger was measured using a flexible measuring tape. The muscle belly and its tendon measured 110 mm & 265 mm in length and 45 mm & 12 mm in width respectively. No such variation was observed on the left upper extremity.

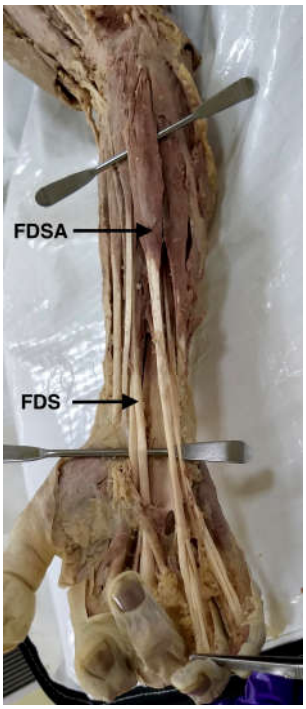

Fig. 2: FDSA tendon insert into the sides of the shaft of middle phalanx of the ring finger

Discussion

Anomalous forearm and hand muscles are rare. However, it is important to recognize these normal variants in order to facilitate diagnosis and appropriate management. The flexor digitorum superficialis (FDS) muscle has been shown to have several variations [4]. A review of published literature shows that the variations of the FDS are mainly associated with the tendon tothe little finger [5-6]. Reports of a rare accessory FDS indicis muscle have been described [7-8]. However, absence for FDS tendon to the ring finger and replacement of the same by an independent Flexor Digitorum superficialis annularis (FDSA) muscle has never been reported.

A summary of all FDS variations describes five concise categories [9].

Type 1: FDS tendon to FDS tendon attachment,

Type 2: Flexor retinaculum to FDS tendon attachment.

Type 3: Digastric muscle in the FDS tendon,

Type 4: Distal extension of the FDS muscle belly,

Type 5: Anomalies of the FDS in the forearm. But, none of the above categories fits into the variation that weobserved making ours unique.Recent observation of an unusual dual tendon and muscle belly arising from FDS and inserting individually on the right and left side of the middle phalanx of the ring finger respectively was reported [10]. For the same, use of a Type 6 category which includes variations that span along the distance of the FDS from forearm to digits wasrecommended [10]. FDSA muscle observed in the present study partially falls into Type 6 category except for the fact that it originates separately from the medial epicondyle of the humerus and not from FDS.

Anatomical variations can be classified into 3 types; progressive, retrogressive and atavistic [11]. The muscles which have a tendency to become increasingly complex, represent the progressive type of muscles. The deep flexor muscles of the forearm belong to the progressive group of variations. The muscles which undergo degeneration with a subsequent loss of functions represent the retrogressive type of muscles. Examples of this type are the palmaris longus and the plantaris muscles. The atavistic muscles are the muscular elements which have been lost completely, during the course of evolution and they make an abrupt appearance again. The axillary arch muscle, a remnant of the panniculus carnosus, is an example of the atavistic type of muscles. In the continuous process of human evolution, forearms and hands are currently in the transition from being essentially prehensile organs to specialized organs of dexterity. FDSA muscle showed extensive separation from FDS muscle and significant migration to the superficial strata representing progressive variations expected with evolution.

Presence of variant muscles can alter the normal anatomical relationship in the region. It is therefore essential to know the common and less common variant. Knowledge of FDSA muscle becomes imperative for surgeons while preforming fasciotomy for acute compartment syndrome, compression neuropathy, tendon transfer and repair of tendon lacerations [12].

Conclusion

Presence of anomalous muscle bellies in the forearm and hand represents retrogressive and progressive variations. Flexor digitorum superficialis annularis (FDSA) muscle reported in this report is unique and represents a progressive variation in the flexor group of muscles. Hence, this variant muscle has to be taken into account by the anatomist during cadaveric dissection and by surgeons during procedures involving the forearm and hand.

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