ANATOMICAL VARIATIONS IN THE HUMAN BODY: EXPLORING THE BOUNDARIES OF NORMALITY

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DEDICATED

Dedicated to Late ***Dr Ifshan Afzal Khanday*** *my brother and mentor for his moral support, teaching, strong motivation and unconditional love; to my parents and younger brother* ***Rauf Afzal Khanday*** *for their valuable support and to my husband* ***Dr. Yasir Ali Malik*** *and our son* ***Kyrauan Yasir*** *for their support, understanding and patience.*

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DECLARATION CERTIFICATE

I hereby declare that this Ph.D. thesis entitled **"ANATOMICAL VARIATIONS IN THE HUMAN BODY: EXPLORING THE BOUNDARIES OF NORMALITY"** was carried out by me for the degree of Doctor of Philosophy under the guidance and supervision of **Dr. Ahmed Younis, Dr. Dimitra Nikoletou,** St Georges University of London and The Faculty of Health Social Care and Education, Kingston University, UK. The thesis was co guided by Professor Dr. **Hafez Ahmed,** Dubai Medical College**.** The interpretations put forth are based on my reading and understanding of the original papers published in peer-reviewed journals. The other books, articles and websites, which I have made use of are acknowledged at the appropriate locations in the text. For the present thesis, which I am submitting to the University, no degree, diploma, or distinction has been conferred on me before, either in this or in any other University

Date: 11/12/2018 Signature

Place: Dubai **Dr. Shifan Khanday**

LIST OF CONTENT

ABSTRACT

Aim: The aim of this thesis is to collate and reflect on my published studies exploring the variations within the anatomic, clinical, anthropometric and other aspects of different structures of the human body.

Background: The anatomy of living organisms is diverse within each species, including the humans. The scope of anatomical variations cannot be just limited to variants or anomalies; it encompasses the interesting field of "normal variations" among individuals. Anatomical variations need to be considered as an integral component of anatomy teaching because the knowledge of common variants reflects the ability to recognise the diverse clinical reality of anatomy with important surgical and other medical implications.

A series of scientific papers published by myself and my colleagues addresses different variations in the human body morphology and function. Therefore, the proposed work scrutinises and critically appraises the published work in the above-mentioned area of interest. The objective (or main theme) in this thesis is to understand and address the implications that the identified variations in structure and function might have in health and clinical management.

Methods:

A common introduction to the published work which focuses on the anatomical and functional morphology and the related variations is presented using selected published articles and case reports. The material and methods section of all the selected papers are reviewed and the salient findings highlighted. Four key themes have been identified in my published work. These are:

Theme 1: variations in the foramina of human skull and case reports related to the head and neck region.

Theme2: variations in muscles, knee menisci and height prediction in musculoskeletal system.

Theme 3: variations and case reports related to organs.

Theme 4: variations and case reports related to blood vessels of circulatory system.

Discussion: One question that is often asked today is whether publications and studies of anatomical variations have relevance and clinical significance for medicine and biology of the 21st century, or do they rather represent an exhausted topic with little insignificant implications. The main themes in this thesis discuss the objective response to this valid question and highlight the fact that medical progress needs more accurate knowledge of the variability of the human morphology to improve diagnosis and therapeutic management. Moreover, the advances in the new imaging and surgical techniques (Echography, MRI, CT, Endoscopy, and reconstructive, minimal invasive surgery) have opened new fields of research for the descriptive anatomy that is considered promising. Anatomical variations will always have relevance and applications in the medical and biological fields and developments.

As variant anatomy, at least in part contributes to a significant number of malpractice claims, there is a need to improve the basis of anatomical knowledge among practicing physicians and surgeons. This thesis highlights the importance of carefully assessing the quality and reviewing and scrutinising the designs, interpretation and conclusions made, in the light of the clinical interest and clinical implications.

1. INTRODUCTION

The anatomy of organisms, including humans, is diverse within each species. The scope of anatomical variation cannot be just limited to variants or anomalies; it encompasses the interesting phenomenon of normal variations among individuals within the reference range of normality. Anatomical variations have to be considered as integral part of anatomy teaching because the knowledge of common variants reflects the ability to recognize the diverse clinical reality of anatomy. Many anatomical variations are frequent and can be anticipated, as they have been seen in several encounters, over a long period by many examiners, in several groups and within different research activities. These varieties come from our genetic heterogeneity, which is a legacy from our ancestors.

The use of the terms anomaly or abnormality conveys an impression of pathology, something unexpected or strange, probably unlikely to be seen again. Many or most variations are totally benign and compatible with normal life. Some of them result from errors of embryologic developmental timing error or persistence of an embryologic condition. Some of these variations may seriously compromise parts of the muscular, vascular, nervous, skeletal or other organ systems. They are all fascinating because they teach us about our development and our genetic heritage, (Bergman et al, 2011, updated 2018)

1.1 Historical aspects of anatomy and views on variations:

'The development of anatomy' began with Aristotle (384–322 BC) who named the subject *anatome*, meaning 'cutting up'. Herophilus of Chalcedon (*c.*300 BC), 'The Father of Anatomy', was the first to dissect human bodies in public and recognize the brain as the central organ of the nervous system. Galen (*c.*AD 150–200) elaborated a system of pathology based on the ideas of Hippocrates. His work was the standard text until the 16th century when Andreas Vesalius (1514–64), produced his masterpiece, "*On the Fabric of the Human Body".* William Harvey (1578–1657) and Marcello Malpighi (1628–94) described the anatomy of the heart and blood vessels in further details.

Singer credits Eustachius (1520-1574) with the introduction of the study of human anatomical variability. However, there is no doubt that his works actually postdate that of Vesalius entitled “Humani Corporis Fabrica” (1542), which are full of references to anatomical variations of bones, muscles and vessels; and of course, those of Galen and another ancient anatomist (Vesalius, 1542; Straus and Temkin, 1943; Singer, 1956; Hast and Garrison, 2000).

In the middle of 1800s, comparative anatomy flourished as a science and it was used to explain the appearance of human anatomic variants. However, the lessons learned suggest that we, as humans, carry a significant, not always desirable, number of excess developmental redundancy in our DNA from some prehistoric periods.

The anatomic structures that are described as "normal” even though they may differ from the usual or common, are found in "normal" long-lived individuals, and they are statistically predictable. Human beings are not machine made but are more subjectively fashioned, with developmental and environmental factors intervening in the process and impacting on it, (Anatomy atlasis, 2018).

The problem of anatomic variability is historically of academic interest for anatomists and physicians. Galen (150AD) concluded that the human body has been created in the best possible way, which reflects the perfection of the Creator. He added that variations are the result of imperfect or un-natural development and that any variance in the structure or arrangement can only be for the worst. It follows logically that these are outside the anatomic standards representing the Creator's perfect human, i.e., Man being created in God's image. It is thought that even Vesalius (1542) believed in a "canon" of the human body and this is revealed by a passage of the Fabrica where he details some of his pedagogic principles. After discussing some rare variations of the azygos vein, he concludes "*they should be judged like a sixth finger or any other monstrosity*". Vesalius passed over variations in public dissections in order to prevent students from believing that they occur in all bodies. He reported that "*it is a disadvantage for students to attend such a dissection, which varies very much from the canon of Man, unless they have frequently witnessed dissections of perfect and not monstrous cadavers*".

Vesalius (1542 [cited in Garrison and Hast, 2003]) described several skulls that varied from each other and concluded "*all but one was to be considered unnatural*". He also described an extremely rare anomaly, in fact, one of the most exotic of all skeletal aberrations, "*the Os Vesalianum carpi*" (Straus and Temkin, 1943). According to these same authors, "typical" is considered normal. This definition is probably too limited a view of phenomenon of variability. From the work of Galen, the idea of the normal or perfect Man was adopted by Vesalius and, faced with the phenomenon of human variation; Vesalius had to decide what was perfect, natural or normal. We are not entirely sure what is normal as it is still not exactly clear what the word normal means in terms of human anatomy. Vesalius used the terms always, most frequently, frequently, usually, sometimes, rarely, very rarely and other terms to describe variation magnitudes without speculation as to significance or quantitation of the degree or magnitude.

1.2: Some definitions that apply to terms that are commonly used in the literature, books and papers may be useful are provided here.

Variation- The capacity to vary. The act of varying or the extent to which something has varied a measurable change or modification within some normal range of variance.

Normal- A statistical measure of usually observed structures, typical, or representative type.

Anomaly- Outside the norm, inconsistency, irregularity, or abnormality. Any structure, function, or state outside the usual range of variation from the norm. However, one might argue that a precise norm has not and probably might not, be determined.

Teratology- The study of abnormal development. Particularly, it is the study of causes, mechanisms, and manifestations of abnormal development, whether genetically, gestationally, or post natally induced, and whether expressed as

lethality, malformation, growth retardation, or functional aberration. The issue of "abnormal development" is the focus here.

Teratism- The process or processes of abnormal embryogenesis by which malformed structures arise.

Aberration- Abnormally deviant, abnormality, abnormal variant.

Abnormal- Any state, structure, or function that differs substantially from the norm of its kind, exhibiting abnormality.

The number of ways viable (however imperfect or monstrous by Galen's and Vesalius' definitions) and functional human beings can be assembled is very limited, hence viable variations are not unlimited, but rather finite in number and, as such, they are "normal." Viability clearly limits variability and permits the term variation to be applied in a useful way. The entire mechanism of human development is not inflexible but rather pliable. Because variations are finite, one can assume it is possible to catalog "all" the variants and have a true, meaningful, and much broader concept of human anatomy than commonly found in modern textbooks.

Because of the extensive, worldwide, literature available to us, one could assume that the relevant data on human variations should be extracted from the vast literature to be used for the best of Mankind.

1.3: Most modern textbooks of anatomy are inaccurate, incomplete, and potentially dangerous as they portray the disturbing concept that there is a "normal" or prototypic standard anatomy while they disregard, in most cases, the equally important clinically useful variant anatomy. In the broad sense, they focus on the study of the structure of the human body in connection with its development and vital activity that include human anatomy, embryology, and histology. In the narrow sense, the focus is on the branch of physical anthropology that studies the variations of age, sex, and ethno-territorial, constitutional, occupational, and other features of the human body and of its individual parts and organs.

Methods of morphological research are used in ethno-physical anthropology and in the study of anthropogenesis. Without morphological data it is impossible to determine properly the similarities and differences between human races or to understand the history of the formation of races. It would also be impossible to evaluate the relationship between contemporary man and his fossil ancestors. (*The Great Soviet Encyclopedia*, 2018)

Human morphology is conventionally divided into two subdivisions: "Merology", or anatomical anthropology, which studies the variations and relationships of individual organs and tissues, and "Somatology", which studies the variation and the interdependence of structural features of the entire living human body. Merology usually studies the integuments of the human body, the external parts of the sense organs, the viscera, teeth, vessels, muscles, the skeleton and skull, and the brain. Somatology studies the total dimensions of the body (height and weight, chest circumference, surface area and volume) and their interrelationships, body proportions, external forms of individual parts of the body, sex characteristics, certain blood characteristics, and constitutional features. (The Great Soviet Encyclopedia, 2018)

In the 1960's and 1970's extensive research was conducted on human age morphology, especially the problem of acceleration. The use of physical and chemical analysis in morphological research makes it possible to obtain data on the body composition, that is, on the tissue components that constitute the body of a living human being. The relation between morphological features and biochemical, physiological, and endocrinological characteristics, the genetics of morphological features, and the influence of environmental factors on human morphology are also being studied. Morphological data are widely used in anthropological standardization and in biotechnology, for example, in the design of consumer goods for size and scale and in the planning of work areas for optimal convenience and maximum utilization.

The present thesis aims to explore human anatomical and functional variations through critically appraising a series of studies and case reports related to the

variations in the human body morphology and functions that have been published by me during the course of ten years and discuss these in the light of other publications in the field.

RATIONALE FOR THE STUDY

Suboptimal anatomical knowledge has been linked to an increase in medico-legal claims, many of which have been related to "damage to underlying structures" and viewed as a threat to patient safety (Ellis, 2002; Regenbogen et al., 2007). Cahill and Leonard (1999),Yammine (2014) have reported that 10- 13 % of clinical malpractice can be attributed to ignorance of anatomical variations. Many believe that malpractice due to suboptimal knowledge of anatomy is under reported; not every "anatomical" complications are documented (Kernt and Neu, 2011), and even in the event of documentation, they are not necessarily reported or published (Leppäniemi and Clavien, 2013; Slankamenac et al., 2013). Evidence-Based Anatomy (EBA), first proposed by Yammine (2014), is a concept which aims to apply the evidence-based principles and techniques which are commonly used in other medical sciences to the field of anatomy.

This may be at large part due to poor anatomical knowledge with respect to variations among practicing clinicians. This knowledge gap may be attributable to changes in undergraduate medical education, which have reduced the number of curriculum hours and faculty members devoted to gross anatomy (Cottam, 1999). However, regardless the cause, as variant anatomy contributes to significant number of malpractice claims, there is a need to improve the basis of anatomical knowledge among practicing physicians by enhancing the methods through which anatomical information is synthesised and presented to the medical community, (Brandon et al, 2016)

The present study will address the need to analyze the morphology and report as many structural variations as possible in the human body on principles of evidence-based anatomy.

MATERIALS AND METHODS

The present study is a collation and review of the best of a collection of papers, which is compiled in chapters or themes. The study highlights the clinical, anthropometric and comparative aspects of different structures of the human body. A common introduction to the published work which mainly focuses on anatomical morphology, variations and case reports is presented. The material and methods section of all the selected papers are reviewed and the salient findings are highlighted as well as the study designs used, the populations studied, clinical relevance and outcomes of such reports. Papers published on cadavers and live subjects are included for critical appraisal and comparisons. The data analysis sections of all papers are revisited, and conclusions are reconsidered in the light of other recent publications in the field.

The publications included in the review process thesis are as follows:

1. **Shifan Khanday et al** (2013). Morphological and Morphometric study of Jugular foramen in the South Indian population. International Journal of Anatomy and Research, Vol 1(3):122-27.

2. **Shifan Khanday** (2014). Morphology of the brachialis muscle. International Journal of Anatomy and Research, Vol 2(1):184-86.

3. Ashfaq ul Hassan and **Shifan Khanday** (2014). A rare case of omental infarction with special emphasis on anatomy and embryogenesis of the omentum. Asian Journal of Science and Technology, Vol. 4, (12):52-54.

4. Dr Ashfaq ul Hassan and **Dr Shifan Khandey (2014)**. The unusual hernias: Anatomical and surgical perspective. International Journal of Advanced Research. Volume 2, (2): 702-704

5. Dr. Ashfaq ul Hassan, **Dr. Shifan Khanday** and Dr. Zahida Rasool (2014). Gastrinoma: Importance of localization. Anatomical, surgical and

diagnostic perspective. International Journal of Development Research, Vol. 4, Issue, 4, pp. 912-914.

6. Dr. Ashfaq Ul Hassan, **Dr. Shifan Khanday**, Dr. Farhana Ahad, Dr. Zubaida Rasool, Dr. Zahida Rasool., (2014) Teratomas: The Unique masses: Embryological, Histopathological and Clinical Perspective.
Journal of applied medical sciences, 2(2A):551-55.

7. Dr. Ashfaq Ul Hassan, **Dr. Shifan Khanday**, Dr. Zubaida Rasool, Dr. Obaid Ashraf, Dr. Zahida Rasool. (2014). Acoustic Neuromas: The Anatomic, Histopathological and Radiological Perspective Scholars Journal of Medical Case Reports; 2(3):122-124.

8. Dr Ashfaq Ul Hassan, Dr Zahida rasool, **Dr Shifan Khanday**, Dr Riyaz Malik, Dr Sajid Shafi (2014). Dandy Walker Malformation a rare Case with review of literature, International journal of medical science and clinical invention, Volume 1 issue 1-page no.57-60.

9. Anant rani and **Shifan Khanday** (2012), "Anomalous Trunkus Brachiocephalicus and its clinical significance", Journal of Clinical and Diagnostic Research. May (Suppl-1), Vol-6(3):469-471.

10. Dr. Ashfaq Ul Hassan, **Dr. Shifan Khanday**, Muneeb ul Hassan, Dr. Zahida Rasool (2015). The rare case of Monier Kuhn syndrome or the tracheobronchomegaly syndrome. Medico research chronicles, 2 (1), 0104).

11. Ashfaq ul Hassan, **Shifan Khanday**, Aijaz Rather, Muneeb ul Hassan (2015). Open Lip Schizencephaly with Agenesis of Corpus Callosum: A Rare Embryological Defect in Combination. International Journal of Anatomy and Research; 3(1): 838-840.

12. Ashfaq ul Hassan, **Shifan Khanday**, Aijaz Rather, Obaid, Muneeb ul Hassan. (2015). Pacchygyria: A Rare Neuronal Migration Defect. Scholars Journal of Medical Case Reports; 3(1):47-48.

13. **Shifan Khanday**, (2015). Duplication of Inferior Vena cava. A case report. International Journal of Scientific Engineering and Applied Science.Volume-1, Issue-7.

14. **Shifan Khanday** (2016). Morphology and morphometry of foramen magnum International Journal of Current Research Vol. 8, Issue, 03, pp. 27765-27767.

15. J. Pranu chakravarthy and **Shifan Khanday** (2016). Correlation of Height with the length of long bones in adult females. International Journal of Current Research, March, Vol. 8, Issue, 03.

16. J. Pranu chakravarthy and **Shifan Khanday** (2018) Morphology and morphometry of knee menisci International Journal of Current Research Vol. 10, Issue, 07, pp.921-934.

17. **Shifan Khanday** et al (2013). The Anatomical and Surgical Importance of Hepatobiliary Triangle of Calot. International Journal of Advanced Research Volume 1, Issue 8, 856-858

ETHICAL CONSIDERATIONS

This research was performed with the clinical application of the studies Involved in mind. The anonymised data has been carefully interpreted .Risks and benefits from the study was clearly identified and assured no harm to participants.

Ethical clearance has been obtained for all studies .Since most of the papers included for appraisal are cadaver-based special care was taken according to governance and code of ethics. The ingredients of ethical conduct adhered to in these studies are respect, proper care of human parts, reporting the work honestly, accurately, efficiently and objectively.

Government regulations, institutional policies were also adhered to with a personal conviction.

Confidentiality, anonymity and beneficence were observed throughout the process of data collection and publication of the material.

GENERAL THEMES

Anatomy is not engineering — it is wetter and sloppier. (Paul Ingraham 2018). Even the best and most modern anatomical diagrams depict average anatomy only. Strange, wonderful, and problematic anatomical variations occur in humans all the time. Anatomical variations may influence predisposition to diseases, symptomatology, clinical examination, investigation and patient management including operative surgery (Willan and Humpherson, 1999).

Accordingly, accurate and comprehensive knowledge of variability in human morphology is important to improve diagnostic and interventional procedures especially against the background of contemporary imaging techniques such as echocardiography, magnetic resonance imaging, computerized tomography, endoscopy, open and laparoscopic surgery (Jones et al., 2002).

Indeed, many journals, such as Clinical Anatomy, have devoted a whole section - compendium of anatomical variations - to this subject although nearly all possible human anatomical variations have been reported and catalogued by Bergman et al in-Anatomy Atlases in tandem with this a compilation of variations and case reports is presented as chapters or themes according to regions in the human body.

Scheme of the Themes

Four themes have been identified for the present study:

Theme 1: Variations in the foramina of human skull and case reports related to head and neck region.

Theme 2: Variations in muscles, knee menisci and height prediction in musculoskeletal system

Theme 3: Variations and case reports related to internal organs.

Theme 4: Variations and case reports related to blood vessels of circulatory system.

Theme 1: **Variations in the foramina of human skull and case reports related to Head and Neck region**.

Paper 1. Morphological and morphometric study of Jugular foramen in south Indian population.

Paper 2. Morphology and morphometry of the foramen magnum.

Paper 3. Pacchygyria: A rare neuronal migration defect

Paper 4 Dandy Walker malformation: a rare Case with review of the literature.

Paper 5. Open lip schizencephaly with agenesis of corpus callosum: A rare embryological defect in combination.

Paper 6. Acoustic neuromas: The anatomic, histopathological and radiological perspective.

Theme 2: Variations in muscles and height prediction in Muscular-skeletal System

Paper 1. Morphology of Brachialis muscle.

Paper 2. Correlation of height with the length of long bones in adult females.

Paper 3. Morphology and morphometry of Knee menisci

Theme 3: Variations and case reports related to organs.

Paper 1. A rare case of omental infarction with special emphasis on anatomy and embryogenesis of Omentum

Paper 2. Gastrinoma: Importance of localization.

Paper 3. Teratomas: The Unique masses: Embryological, Histopathological and Clinical Perspective
Calot.

Theme 4: Variations and case reports related to blood vessels of Circulatory system.

Paper 1. "Anomalous Trunkus Brachiocephalicus and its clinical significance"

Paper 2: Duplication of Inferior vena cava. A case report.

THEME 1. VARIATIONS IN THE FORAMINA OF THE SKULL AND CASE REPORTS RELATED TO HEAD AND NECK AND CNS.

Introduction to the Theme:

Head and neck region varieties including the central nervous system (CNS) are detailed very often. A need to collect and report the greater part of these is the need of the hour. Surgeons especially Neurosurgeons, ENT and ophthalmology surgeons, and clinical investigators such as radiologists are required to have prior information of varieties and aberrations before undertaking any diagnostic or interventional procedures to avoid stressful emergency situations that could be life threatening.

Paper 1. MORPHOLOGICAL AND MORPHOMETRIC STUDY OF JUGULAR FORAMEN IN SOUTH INDIAN POPULATION.

Background: The jugular foramen, the bony opening on the base of skull, is an opening through which pass the ninth, tenth, and eleventh cranial nerves, two dural sinuses, and the meningeal branches of the occipital and ascending pharyngeal arteries. The increasing use of modern diagnostic procedures and new surgical approaches has created a need for much more detailed anatomical studies and explanations. This article reveals some additional features.

Material and Methods: 324 jugular foramina of skulls of persons of unknown age and gender were examined. The morphological characteristics of all the investigated jugular foramina were described, measured, and compared, taking into consideration their side.

Results: Jugular foramina were studied for a review of its morphology, morphometry and its comparison with previous studies. Different shapes and sizes of Jugular foramen were seen. Laterality was also noticed; compartmentation was also observed which was found to be statistically significant. The Jugular foramen is difficult to locate and to access surgically. The difficulties in exposing this foramen are created by its deep location and the surrounding structures such as carotid artery anteriorly, the facial nerve laterally, hypoglossal nerve medially and vertebral artery inferiorly.

The size and shape of the jugular foramen is related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb sigmoid sinus. The right foramen is usually larger than the left. The difference in size of the two internal jugular veins is already visible in the human embryo at the 23mm stage and probably results from differences in the pattern of development of the right and left brachiocephalic veins.

Standard text books suggest that the superior sagittal sinus drains into the right transverse sinus but there is a very wide variation in the anatomy of the intra cranial venous sinuses which accounts for variation in size and shape of Jugular foramina.

Observation: The Morphometric analysis of the present study revealed the following observations. The data were statistically analyzed and tabulated. Dome: In 20% of the studied skulls the dome was present bilaterally. Present on right side in 40% and 29% left sides. The dome was absent in 11%.

Length (latero-medial) measurement: On right side the mean length was 1.46 cm and for left side 1.39 cm.

Width-anteroposterior measurement: The mean width on right side was 1.006 and left side 0.89

Height: The mean height on right side is 1.01cm and 0.9mm on left side. Area: The mean area on right side is 1.18cm and 0.9mm on left side.

Presence of septations: Of the total 648 analyzed foramina it was noticed that in 13 foramina complete septation were seen on Right side, incomplete septations in 24. On left side 9 foramina showed complete and 15 foramina showed incomplete septation. No bony septa were observed in 284 foramina on the right side nor in 294 foramina on left side.

Separate Opening for IPS (Inferior petrosal sinus): Out of 324 skulls 28(8.6%) showed separate openings for IPS (Inferior petrosal sinus) and 32 (9.8%) on left side.

Bony bridges or spicules: These were present in 53 skulls on right side and 22 skulls in left side.

Tripartate jugular foramen: 2 skulls had a tripartate jugular foramen.

Tripetal type of Jugular foramina was seen which a rare finding is. Contracted jugular foramina: 2 skulls showed contracted jugular foramina (almost slit like).

Conclusion: A detailed examination of the jugular foramen anatomy was undertaken. The main types of jugular foramina and the frequencies of bipartite or tripartite divisions were documented. Several dimensions of the parts of the jugular foramen were measured. In conclusion variations in the size, shapes and compartments of Jugular foramen might be a part of the ongoing evolutionary process.

During the past few decades, biological consideration of discrete cranial traits such as their ontogeny, asymmetry, sex differences and intertrait association have been addressed to assess a possible genetic background. Knowledge of morphology, compartments and arrangement of structures within the foramen helps in deducing position of various structures from the available data of jugular foramen depicted by this study. The knowledge may also be utilized by the clinicians to understand clinical presentations and progression of the lesions of the jugular foramen lesions and planning for the possible approaches for the operations. Existence of genetic factors in the expression of the bridging trait is known, the bridging trait can thus be studied in anthropological studies in different study populations. These findings will also be of help to understand the involvement /sparing of neurovascular structures in the Jugular foramen lesions and the interpretation of images of the jugular foramen.

Paper 2. MORPHOLOGY AND MORPHOMETRY OF FORAMEN MAGNUM

Background: Foramen magnum also known as foramen primum is the largest foramen of the skull. Its position and structures passing through it make it an important landmark in anatomy and physiology. After pelvis the skull is an important bony structure which exhibits gender differences. The foramen magnum demonstrates gender differences owing to which it becomes an area of interest for anthropometry, forensic sciences, anatomy and neurosurgery.

A total of 60 skulls were observed and measurements were taken by means of Vernier calipers. Diameter, area and shapes were recorded.

Observation:

The mean for anteroposterior diameter was 3.68 cm and mean for transverse diameter was 3.09 cm. Height had an average mean of 0.9 cm and area was 5.76 cm. The male skull foramen magnum was larger as compared to female skull. It was proved to be statistically significant in this study (p=0.02). The fact is revealed that the foramen magnum dimensions vary significantly between males and females, so it can be a useful indicator for gender identification in forensic studies. Supporting all major researches which have found the same variation. Accuracy of determinations depends mainly on the kind of bones available and their condition. The foramen magnum was used since it is a regular structure and less prone to major morphological changes (Williams et al., 1989; Radhakrish et al., 2012).

In year 2000 Wescott and Morre Jansen reported that length of the foramen magnum is one of the most reliable measurement for sex determination in African-American population (Scheuer and Black, 2004). Expression of sexual dimorphism within the foramen magnum area in relatively modern populations is limited to a level of approximately 70% (Teixeira, 1982). The morphometry of the skull and jaw are methods for the assessment of sexual dimorphism that can assist in the determination of gender (Uysal et al., 2005; Gapert et al., 2009).

Babu et al., and Radhakrishna et al reported significant differences between males and females for length and breadth of foramen magnum which demonstrated statistically (Babu et al., 2012). Catallina-Hercera indicated that sagittal and transverse dimensions of the foramen magnum were significantly higher in men's skull (Catalina- Hercera, 1987). (Krogman and İşcan, 1986) reported close to 100% accuracy of sex determination in 750 intact skulls using the dimensions of foramen magnum. The maximum sex determination accuracy of the whole skull alone was found to be 90% (Krogman and İşcan,1986) or accuracy of 81% (Uysal et al., 2005) which was at higher sensitivity than that of Gapert et al. of 2009, who used British skulls of 18th and 19th centuries (Gapert et al., 2009). Holland suggests that the measurements of the region of occipital condyles and the foramen magnum are useful for determining the sex, with an accuracy of 70–90% (Holland, 1986).

Conclusion: A detailed examination of foramen magnum was performed. The main forms of foramen were established. Some new data could provide important information about the anatomy of the Foramen Magnum for reliable surgical interventions in this area. The data are important to neurosurgeons when they are operating in the posterior cranial fossa and to radiologists in the interpretation of radiographic and CT scan films. Such studies are important to minimize operative inadvertent damage to the arteries and nerves. Since the morphometric data are usually population specific, more such studies in different populations are recommended.

Paper 3. PACCHYGYRIA: A RARE NEURONAL MIGRATION DEFECT.

Background: A three-week old newborn presented with recurrent seizures. The child was borne of normal parents with non-consanguineous marriage. There was no history of any ailment of mother during pregnancy and she was not on any drugs. She was euthyroid, normo glycemic and normotensive. The baby was borne by normal delivery and the CT scan of the head showed "Pacchygyria" especially in the frontal lobes. The blood investigations were normal as was the metabolic profile.

Discussion: The cortical development is a multi-stage process involving the steps of stem cell differentiation, migration into the cortex and organization into cortical layers. This whole process is coordinated by multiple pathways. Errors in any step can lead to defective cortical formation. Mostly the defect arises because of abnormal neuronal migration. The cells eventually involved in formation of cerebral cortex are derived from spaces around the ventricles of the brain. There are multiple waves of migration, and the migrating neurons are guided by programmed events as well as certain neuromodulators and chemicals. Any change in signal levels of these substances can lead to gyral malformation. In severe cases there may be agyria. The brain tends to be smooth and pacchygyria can also be termed as "partial lissencephaly". There may be related problems like microcephaly, developmental delays, recurrent seizures, feeding problems, swallowing problems, poor muscle tone. The symptomatology of defects differs and depends on the extent of disease and the cortical areas involved. There are mutations in alpha tubulin gene. Other

etiological factors are vascular compromise during embryogenesis and viral infections. It may be associated with Walker Warburg syndrome, Apert syndrome, Lowe syndrome, Gorlin syndrome, Aicardi syndrome, Shapiro's syndrome or may be inherited as an autosomal trait as well.

CT/ MRI are both of value but MRI because of its specificity to delineate white matter and grey matter is a better technique for investigation. The ultimate treatment is a multimodality approach.

Conclusion: Although pacchygyria is not a common event but the subsequent development of a child with such defects is a source of multiple problems to the child in the form of non-development, mental retardation, recurrent seizures with the added fact that mostly they are associated with other syndromes. As such they are a source of potential concern for the child as well as parents who find huge difficulties in raising such children should they survive.

Paper 4. DANDY- WALKER MALFORMATION A RARE CASE WITH REVIEW OF LITERATURE. EMBRYOLOGICAL AND CLINICAL PERSPECTIVE.

Background: Dandy Walker malformation is a rare clinical entity usually detected incidentally in the first few months of life. Early recognition of this syndrome is of prime importance as children with this abnormality have severe developmental and intellectual problems.

A case of a 12-month-old female baby who was brought to a pediatric clinic with increasing head size and delayed milestones in her development. She did not have any history of trauma or any significant maternal medication or infections acquired during pregnancy. She was born full term, parents had a non-consanguineous marriage. There were no other physical abnormalities except the increased head size and delayed milestones.

Discussion: The malformation was first described by Sutton in 1887. It belongs to the group of disorders related to abnormal development of hind brain and posterior cranial fossa but can also be associated with other defects of the nervous system.

The development of nervous system begins at 17 days of gestation when the neural tube begins to form which is subsequently followed by development of three brain vesicles namely the prosencephalon, mesencephalon and rhombencephalon. At the same time cavities form within these three vesicles. The rhombencephalon is concerned with the development of hind brain. The cerebellar vermis begins to develop in the ninth week of gestation. There is disproportionate growth between cerebrum and cerebellum and the rate of growth of cerebellar hemispheres lags behind the cerebral hemispheres. The primary mechanism is excessive increase in production of CSF leading to hydrocephalus with dilatation of ventricles and consequent hypoplasia of cerebellar vermis. The association between hydrocephalus and Dandy Walker malformation is of immense significance as the severity of hydrocephalus is related to the agenesis of cerebellar vermis. Congenital anomalies of the posterior fossa, including the Dandy-Walker syndrome, the Chiari malformation, and encephalocele, are prominently associated with ataxia because of their destruction or replacement of the cerebellum. The Dandy walker malformation comprises of a cystic expansion of the fourth ventricle in the posterior cranial fossa, which results from a developmental failure of the roof of the fourth ventricle during embryogenesis.

The condition is more common in females. Approximately 90% of patients have hydrocephalus, and a significant number of children have associated anomalies, including agenesis of the posterior cerebellar vermis and corpus callosum. Infants usually present with a rapid increase in head size and a prominent occiput. Transillumination test of the skull may be positive. Most have a prominent, cerebellar ataxia, and delayed motor and cognitive milestones, probably owing to the associated structural anomalies. It may be associated with cleft palate, high arched palate, clinodactyly, hypertelorism, myopia, brachycephaly, lobulated ears. Fortunately, this case did not have any of these associations. The intelligence quotient is usually reduced with most children having moderate to severe abnormalities in memory functions. Visual problems like strabismus, visuospatial abnormalities, visual field defects, and optic atrophy with decreased acuity secondary to increased intracranial pressure.

Usually the investigation of a child with hydrocephalus begins with the history. Familial cases suggest X-linked hydrocephalus secondary to aqueductal stenosis.

A past history of prematurity with intracranial hemorrhage, meningitis, or mumps encephalitis is important to ascertain. Trans-illumination of the skull may be positive with massive dilatation of the ventricular system or in the Dandy-Walker syndrome. Inspection of the eyes is mandatory because the finding of chorioretinitis suggests an intrauterine infection such as toxoplasmosis as a cause of the hydrocephalus. Papilledema is observed in older children but is rarely present in infants because the cranial sutures separate as a result of the increased pressure. Plain skull films typically show separation of the sutures, erosion of the posterior clinoids in the older child, and an increase in convolutional markings with longstanding increased intracranial pressure. The CT scan and/or MRI along with ultrasound in the infant are the most important studies to identify the specific cause of hydrocephalus.

Conclusion: The MRI scans suggest a large posterior cranial fossa with cystic enlargement, hypoplasia of cerebellar hemispheres and vermian hypoplasia. It has been proven beyond doubt that MRI is the diagnostic modality of choice in detecting Dandy Walker malformation. Therapy for hydrocephalus depends on the cause. Medical management, including the use of acetazolamide and furosemide, may provide temporary relief by reducing the rate of CSF production, but long-term results have been disappointing. Most cases of hydrocephalus require extra cranial shunts, particularly a ventriculoperitoneal shunt.

The major complication of shunts is bacterial infection, usually due to Staphylococcus epidermidis. Prognosis depends on the cause of the dilated ventricles. Hydrocephalic children are at increased risk for a variety of developmental disabilities. In view of this fact early recognition of this condition and effective means to control the development of hydrocephalus are the primary modalities in treatment strategy.

Paper 5. OPEN LIP SCHIZENCEPHALY WITH AGENESIS OF CORPUS CALLOSUM: A RARE EMBRYOLOGICAL DEFECT IN COMBINATION.

Background: The corpus callosum is an important commissure of brain. It connects the two central hemispheres and maintains coordination between the two hemispheres. Its anomalous development is usually associated with other developmental defects. Schizencephaly is other developmental defect in which there is defective grey matter development. Both these conditions are not often found in combination. The article presents a rare case where both these conditions co-exist. Fibres, which connect all areas of the two central hemispheres, except the right and left temporal poles. It consists of rostrum, genu, body and splenium. The fibres which connect the prefrontal regions pass through the genu and anterior part of the body of the corpus callosum and make an arch as soon as they cross the middle line; this arch is called the Forceps anterior (minor). The fibres, which connect the occipital poles, pass through the splenium and the posterior part of the body. And to make an arch as soon as they cross the middle line; this arch is called Forceps posterior (major). The fibres in the middle part (body) of Corpus callosum pass transversely but after they cross the middle line they pass upwards and down.

Discussion:

Normal Anatomy: corpus callosum is the largest and the chief commissure and wards in the white matter of the hemisphere to reach the different areas of the cortex. The occipital part of the corpus callosum forms the roof and lateral wall of the posterior horn of the lateral ventricle and is called the tapetum.

Agenesis of corpus callosum is seen in certain new borns and they cannot coordinate the activity of both sides. This may be associated with Dandy Walker Syndrome, Chiari II Malformation Holoprosencephaly, lipoma of corpus callosum. The embryological development of Corpus Callosum occurs between 16 to 20 weeks. It needs proper migration.

Schizencephaly is seen to appear as a CSF filled cleft extending into the lateral ventricle with surrounding dysmorphic grey matter. The lateral ventricle is the cavity of the cerebral hemisphere. Each cerebral hemisphere contains a large "lateral ventricle" which tubular space shaped like the letter C. Each lateral ventricle has a body, an anterior, a posterior and an inferior horn. The anterior horn lies in

the frontal lobe, the posterior horn in the occipital lobe and the inferior horn in the temporal lobe.

These clefts can be of varied sizes. The open lip type of schizencephaly presented in this case has separate lips and cleft extending into lateral ventricles. It has been observed that a vascular defect during embryogenesis is the main cause. An infarction in the area of germinal matrix layer of the cerebrum during seventh week causes vascular compromise and the result is grey matter lined CSF cleft extending from lateral ventricle. There may be added insult resulting from defective stem cell differentiation, concurrent metabolic defects and other cortical developmental defects like lissencephaly, Pacchygyria as well as polymicrogyria. There may be multiple associated causations like infective factors, genetic factors, associated syndromes, mutations in genes. MRI appears to be the modality of choice because of ability to differentiate grey matter and white matter better. Associated agenesis of corpus callosum is not an uncommon occurrence. It can result in incoordination, macrocephaly, visual impairment, mental retardation and seizures. It may be associated with Apert syndrome, Lowe syndrome, Gorlin syndrome, Fryns syndrome, Trisomies (Trisomy 18, Trisomy 13), Aicardi syndrome, Shapiro's syndrome.

Conclusion: Though the combination of Open lip Schizencephaly with agenesis of Corpus Callosum is a rare event but the subsequent development of child with such defects are a source of multiple problems to the child in the form of nondevelopment, mental retardation, recurrent seizures with the added fact that mostly they are associated with other syndromes. As such they are a source of potential concern for the child as well as parents who find huge difficulties in raising such children should they survive.

Paper 6. ACOUSTIC NEUROMAS: THE ANATOMIC, HISTOPATHOLOGICAL AND RADIOLOGICAL PERSPECTIVE

Background: Acoustic neuromas are relatively uncommon tumors usually found along the course of the eighth cranial nerve (vestibule cochlear) particularly in relation to cerebellopontine angle. The incidence of acoustic neuromas is rising and

has been associated with increased use of mobile phones, though recent studies have found out that there was no increase in risk of acoustic neuroma with ever regular use of a mobile phone or for users who began regular use 10 years or more before the reference date. Elevated odds ratios observed at the highest level of cumulative call time could be due to chance, reporting bias or a causal effect. As acoustic neuroma is usually a slowly growing tumour, the interval between introduction of mobile phones and occurrence of the tumour might have been too short to observe an effect, if there is one. (Cardis et al)

They are usually benign, but their anatomic location is getting diversified as many cases are being located in different regions. These tumors have been found in middle cranial fossa, posterior cranial fossa, mediastinum as well as thoracic cavities. Hence there is a need for proper assessment of any mass in these anatomic locations for a diagnosis of acoustic neuroma.

In the Kashmir Valley twenty cases of acoustic neuromas have been detected till 2012 from two major hospitals and most of the patients presented with difficulty in hearing and tinnitus. Hearing loss, tinnitus, headache and vertigo were the chief complaints. Most of the cases were males (17 cases). Acoustic neuromas represent less than 10% of primary intracranial tumors. They are usually located in relation to cerebellopontine angle but bilateral vestibular Schwanommas are seen in Neurofibromatosis. Their incidence seems to be rising partly due to newer diagnostic techniques of CT and MRI scans.

Discussion:

A true acoustic neuroma is strictly a benign tumor involving cells of the myelin sheath that surrounds the eighth cranial nerve. Acoustic neuromas are often called vestibular schwannomas because usually they are tumors that arise from the Schwann cells of the myelin sheath that surrounds the vestibular nerve. Acoustic neuromas are considered benign tumors since they do not spread to other parts of the body. Upon histological examination, the acoustic neuroma presents two distinctive architectural patterns, designated Antoni A and Antoni B. Both are created by spindle cells with elongated nuclei and fibrillated cytoplasm,

predominantly those of Schwann cells. The two tissue patterns differ in cellular weave and density.

Antoni A tissue is compact, with a prominence of interwoven fascicles. Antoni B tissue is porous and less structured. The cells are dispersed randomly about blood vessels, microcysts, collections of xanthomatous cells and sites of previous hemorrhage. Lymphocytes attest to antecedent degenerative events within Antoni B tissue. The degree of nuclear pleomorphism varies considerably among acoustic neuromas as well as between different areas within the same tumor. This pleomorphism often contributes a random population of large, bizarre nuclei that taunt the pathologist with thoughts of anaplasia: however, fortunately, malignant transformation is of a rarity that permits individual case reports. Mitotic figures are most infrequent. Necrosis is commonly present but most often testifies to the meagerness of native blood vessels and their compression by tumor expansion within a restricted compartment. This is a result of origin from transition point between Schwann cells and glial cells called as Obersteiner Redlich zone.

Radiologically the acoustic neuromas are well demonstrated by CT, MRI. CT may demonstrate widening or sometimes erosion of the internal auditory canal with variable density. They may be confined to labyrinth or may grow laterally. Extracanalicular extension is commonest via path of least resistance towards Cerebellopontine angle leading to an ice cone appearance.

MRI may demonstrate hypo intense lesions or rarely cystic lesions at cerebello pontine angle. Aberrant course of facial nerve or Internal carotid artery or high riding Jugular bulb can pose a problem during surgery and should be well defined by imaging techniques.

CONCLUSION OF THEME 1

This theme is devoted to the normal variations in foramina of the skull base. Because these foramina can simulate fractures, lytic lesions, and cephaloceles based on their location, one can recognize the importance of being familiar with these variants. Although these foramina can be particularly prominent and problematic in younger children, their persistence in adults can cause confusion. Therefore, the intent and methodology utilized here are to follow the normal anatomy and staying power of these variants from the pediatric to adult ages.

Information on skull foramina size and symmetry is increasingly important because of the advancements in radiologic techniques such as magnetic resonance imaging (MRI) and computed tomography (CT). These methods are making difficult diagnoses of pathologic conditions of skull foramina possible for reliable surgical interventions in this area.

The data are important to neurosurgeons when they are operating in the posterior cranial fossa and to radiologists in the interpretation of radiographic and CT scan films. Such studies are important to minimize operative inadvertent damage to the arteries and nerves. Since the morphometric data are usually population specific, more such studies in different populations are recommended.

Though developmental anomalies like Pacchygyria, Dandy Walkers and Open lip Schizencephaly are not a common event but the subsequent development of child with such defects are sources of multiple problems to the child in the form of nondevelopment, mental retardation, recurrent seizures with the added fact that mostly they are associated with other syndromes. As such they are a source of potential concern for the child as well as parents who find huge difficulties in raising such children should they survive.

Modern surgical skill / Investigation aptitudes request to have an evidence-based verification as identified with anatomical case reporting. An information storage facility or data pool that a specialist/investigator can depend on before investigating the zone and keep away from any surgical complication and diagnostic misinterpretations.

THEME 2: VARIATIONS IN MUSCLES, KNEE MENISCI AND HEIGHT PREDICTION IN MUSCULO -SKELETAL SYSTEM.

INTRODUCTION TO THEME 2.

Anthropometry plays a vital role in unfolding the mysteries of evolution. A clear knowledge of musculoskeletal variations will be of immense help in practical use in the clinical practice and in medico-legal, orthopedic and anthropological studies. The present theme will include variations reported on cadavers and study done on living subjects to reveal the prevalence of variation and anatomical correlation.

Paper 1. MORPHOLOGY OF BRACHIALIS MUSCLE: VARIATION AND CLINICAL SIGNIFICANCE

Background: Though rare but variations of brachialis muscle insertion have been reported.

Material and Methods: The study was conducted on 115 upper limbs of cadavers over a period of 4 years. The dissection of arm and forearm was done carefully to preserve all minute details, observing the morphology of insertion pattern and nerve supply.

Observation: Out of 115 specimens, 2 specimens showed insertion of brachialis into bicipital aponeuroses. Accessory slips were seen in 4 specimens which are mixed with main fibers at insertion point. Rarest of all was insertion of an accessory brachialis muscle on radial tuberosity in 2 specimens. The muscle originated from lateral border of shaft of humerus and shared a few fibers with main brachialis muscle. The muscle was inserted into radius just below the radial tuberosity.

Conclusion: The identification of an inter-nervous plane may allow for improvement in the current anterior and anterolateral surgical approaches to the humerus. This could be one of a possible etiology of Radial tunnel syndrome.

Paper 2. HEIGHT PREDICTION BY MEASURING ULNAR LENGTH IN FEMALES

Background: Stature estimation is frequently required by the forensic science experts which more often is done on the skeletal remains. Since 1950`s the long bones in the human body for eg., humerus, ulna, femur and tibia are used for stature identification. Arm span, nose length has also been used for height prediction. A study was needed to find out such a correlation in females as few studies have been conducted.

Objective was to formulate an equation or a mathematical model for estimation of stature in living adult females by the measurement of their ulna bone.

This study was conducted in Sri Ramchandra Medical College Chennai and Dubai Medical College for girls. Female participants who were chosen from faculty and students. Crown to heel measurement and ulnar length measurements (From tip of olecranon process to tip of styloid process) were done.

Observations: In the study, the average height in 100 females was seen to be 162 cm, the average length of right Ulna was 25.7cm and average length of left Ulna was 25.4 cm. The correlation coefficient(r) of the height and the length of the left Ulna was (0.85) and that for the right Ulna (0.81). The value of r implied that there was a positive correlation. A check was done on the formula for determination of stature Stature = 6.46 x ulnar length$\pm$2 which was found to be accurate in most of the obsevations.

Conclusion: Being a percutaneous bone Ulna can be easily palpated and measurements for length can be taken reliably. A relation between height and length can be studied easily, which will be beneficial for Anatomist, clinicians and anthropometry studies.

Paper 3. MORPHOLOGY AND MORPHOMETRY OF KNEE MENISCI.

Background: To study the morphological and morphometric study of the menisci of the knee joint and its clinical significance.

Objectives: To estimate the incidence of different shapes of the medial and lateral menisci and the incidence of discoid meniscus. To evaluate the morphometric variations in the menisci.

Materials and Methods: The study was carried out over a period of three years in the Department of Anatomy, Sri Ramachandra Medical College and Research Institute, Sri Ramachandra University, Chennai.

Materials: The following materials were used for the study:
Human adult knee joints, available in the anatomy dissection hall, were used for the present study. The study included 116 menisci from 58 knee joints of adult cadavers. Among them, 31 were right-sided and 27 were left sided isolated lower limbs.

Methods

1. **Morphological Study:** After the dissection of the skin and muscles, the approaches to the menisci were performed, opening anteriorly by a longitudinal incision on each side of the joint capsule, cutting the patellar ligament and the collateral ligaments transversely. In order to expose the menisci clearly, the joint capsule and the intra-articular ligaments were cut, and the condyles were circumferentially detached from their soft tissue attachments and removed, exposing the tibial plateau. All dissections were performed in a systematic fashion and the data were recorded on a standardized collection sheet. Morphological variants of the shapes of the menisci were macroscopically noted and classified. The medial menisci (MM) were sub-grouped as sickle shaped, sided U shaped, sided V-shaped, crescent-shaped and C-shaped. The lateral meniscus (LM) was sub-grouped as crescent (semilunar)-shaped, C-shaped and discoid-shaped. When the meniscus covers the tibial plateau circularly, the meniscus is said to be a discoid type. Menisci, which had thin anterior and posterior horns and thin bodies, were defined

as crescent (semilunar) types. Menisci, which had thin anterior, posterior horns and thick bodies, were defined as sickle-shaped types. Menisci which resembled sided U, sided V and C were named as sided U, sided V and C shaped respectively. Menisci that showed any structural changes, such as injuries or advanced degenerative changes were excluded.

Morphometric Study: To measure the length of the menisci, a line was positioned from the apex of anterior horn to the apex of posterior horn of the meniscus. The distance of the line was measured with Vernier Caliper. The width of menisci was determined by establishing three points: anterior third (a), medium third (b) and posterior third (c). From each point, one line was drawn from the peripheral margin to the central margin of meniscus. The values were recorded. The thickness of the meniscus was determined using the same width points, between the top and bottom edge in outer circumference only. The data were tabulated and statistically analyzed.

Discussion: The present study was undertaken in 116 adult menisci from 58 adult cadaveric knee joints. Menisci were studied for a review of its morphology, morphometry and comparison of results with previous studies. The main findings were:

Five morphological types of menisci were identified.

Out of 58 medial menisci studied, 54.6% were crescent shaped; 34.6% were V shaped; 10.8% were U shaped but no discoid medial menisci were found. Out of 58 lateral menisci studied, 41.6% were crescent shaped; 56.4% were C shaped; 2% discoid lateral menisci were found. Morphometry revealed the following results: The length of lateral meniscus is smaller than that of the medial meniscus; the width of the lateral meniscus is more than that of the medial meniscus; the medial meniscus is thicker when compared to lateral meniscus in both the left and right-side knee. Difference in shape and size of menisci in the same knee as well as with different knees of different cadavers were observed. The obtained results presented variations regarding some parameters when compared to the previous studies.

Conclusion: The present study will provide support to the meniscal anatomy, concerning the surgical procedures and arthroscopy of the knee joint. The study has provided additional information on different shapes of the medial and lateral

meniscus with contribution to a better delineation of meniscal anatomy and implications in regard to allograft meniscus transplantation. Therefore, health professionals that work with the treatment of meniscal injuries should be aware of the possible anatomical variations that may exist in the meniscus facilitating the rehabilitation process.

CONCLUSION OF THEME 2.

Variation may confuse surgeons during shoulder and arm surgery leading to iatrogenic injury. Further, it may cause compression of neurovascular structures because of their close relationship with other neurovascular structures Understanding variations of muscles and peripheral nerves is important in the diagnosis of unexplained clinical signs and symptoms as well as during nerve blocks and surgical procedures.

Anatomical variation is of both surgical and academic interest and is particularly important when studying entrapment syndrome and reconstructive surgery in patients with musculoskeletal conditions as complex issues and injuries involving the musculoskeletal system are usually handled by a physiatrist, (specialist in physical medicine or rehabilitation) or an orthopedic surgeon. A thorough knowledge of the anatomy of the musculoskeletal system, normal variations, abnormalities and its dynamic changes is essential to prevent performance of unnecessary invasive procedures. Muscles are subject to variation and books have been written about their variations.

The theme is highlighting variation in the musculoskeletal system and anthropometric measurement of humans which will contribute to knowledge in the teaching of gross and comparative anatomy. Anatomical variations are of both surgical and academic interest and important when studying entrapment syndrome and reconstructive surgery in patients with musculoskeletal conditions.

Conducting research on morphological features of the human skeleton aims to improve the procedures for determining the individual variability of the human population, it is also worth remembering various factors (external and internal) affecting human development, e.g. population differences resulting from different living conditions.

Each human body is different, and each reacts differently to genetic and environmental factors while maintaining at the same rate of development.

THEME 3. VARIATIONS AND CASE REPORTS RELATED TO INTERNAL ORGANS.

INTRODUCTION TO THEME 3:

Variations regarding the presentation and functioning of the abdominal organs are important in different abdominal surgeries including liver and kidney transplantation, oncologic resections, and various interventional radiological procedures in the abdominal region. The present theme will include variations reported on cadavers and case reports from living subjects to reveal the prevalence of variation and variability.

Paper 1. A RARE CASE OF OMENTAL INFARCTION WITH SPECIAL EMPHASIS ON ANATOMY AND EMBRYOGENESIS OF OMENTUM

Background: A 45-year-old female presented to emergency with severe intermittent, worsening abdominal pain. These symptoms were indicative of acute abdomen. Preliminary investigations were not helpful but in due course, Computer Tomography imaging established findings indicative of omental infarction. Patient was discharged from hospital two weeks later, having made a satisfactory recovery following successful conservative treatment without any surgical intervention.

Normal anatomy: The greater omentum is a very important anatomical structure which looks like an apron like sleeve hanging down from the greater curvature of stomach and covering the loops of intestine. It normally does not undergo infarction and in very rare circumstances can undergo infarction. We describe the normal anatomy of omentum with embryogenesis and a rare case of omental infarction.

The greater omentum is called the policeman of abdomen as it limits the spread of infection by moving to the site of infection and sealing it off from the surrounding areas. In response to intraperitoneal inflammation, the omentum provides the major source of peritoneal macrophages and aids in removal of foreign material and bacteria. The anterior two layers descend and fold upon themselves to form posterior two layers which ascend to the anterior surface of head, anterior border of body of pancreas. The folding is such that 1st layer becomes the 4th layer and the 2nd layer becomes the 3rd layer. The part of the peritoneal cavity (lesser sac) between the 2nd and 3rd layers gets obliterated except a small part below the greater curvature. Contents are the right and left gastro- epiploic vessels. Omentum has also been found useful in operative procedures on the genitourinary tract and in vascular

reconstruction. After hepatic resection or trauma to the liver or spleen, an omental patch aids in hemostasis and in sealing of biliary leaks. In addition, with the advent of microvascular surgery, there are reports of the use of omental transplants to improve cerebral vascularity and in chest wall reconstruction. The capability of the omentum to wall off infection and its rich vascular and lymphatic supply have led to many uses of omentum in a wide variety of disorders. Omentum has been used as a protective wrapping for intestinal anastomoses to prevent anastomotic leak and promote healing.

Embryogenesis: In the early embryonic life as the peritoneal cavity develops, the splanchnic mesoderm covers the developing gut. Eventually, most of the ventral mesentery is resorbed except for that portion between the liver and the stomach that persists as the gastrohepatic ligament or the lesser omentum. The dorsal mesentery remains intact but changes markedly in size and position as the gastrointestinal tract elongates and rotates. In the gastric region, the cardia of the stomach rotates to the left and the pylorus moves to the right. The dorsal mesogastrium grows with these changes but does so more than is necessary to accommodate the positional changes in the stomach. The mesogastrium elongates and forms a sac, the omental bursa, which eventually extends caudal over the transverse colon. The omentum fuses with the transverse mesocolon, and the two layers of the omental bursa fuse to become one layer. These four layered aprons of dorsal mesogastrium is called the greater omentum. The intestine begins to elongate during the early fifth week of development and forms a loop that extends into the umbilical cord, with the superior mesenteric artery extending from the apex to the loop. This is Stage I of midgut development. Stage II involves return of the duodenum to the abdominal cavity with its 270-degree counterclockwise rotation around the superior mesenteric artery. In Stage III, the right half of the colon returns to the abdomen and rotates 270 degrees in a counterclockwise direction to lie on the right side anterior to the superior mesenteric artery. This stage is completed with fixation of the intestine and its mesenteries. By the twelfth week of development, rotation is finished but fixation may not be completed until birth. The greater and lesser omenta and the intestinal mesentery are rich in lymphatics and blood vessels.

Sequestration or obstruction of lymphatic vessels leads to various clinical entities, depending on anatomic location. When in contact with a foreign body or inflamed area, the omentum can adhere firmly. In response to intestinal inflammation, the lymph nodes of the mesentery enlarge and may become symptomatic. The cause of this disorder is presumed to be viral, and it occurs primarily in children.

The cause of omental infarction is usually torsion of the omentum upon itself. Torsion of the omentum may be primary or secondary. Primary torsion is rare, and the cause is unknown. Secondary torsion may be due to adhesions, omental cyst, or tumor. The right side of the omentum is involved more than the left, and the torsion generally occurs around two fixed points. Patients often present with signs and symptoms compatible with appendicitis, acute cholecystitis, or a twisted ovarian cyst. Sometimes a diagnosis of pancreatitis is made on clinical grounds and it most often mimics pancreatitis. Omental infarction is a rare entity and may follow trauma or may be associated with collagen vascular disease. The right side is more vulnerable because of more chances of venous stasis, thrombosis and more stretch on omental veins. Less velocity of blood flow in right gastroepiploic artery is also contribution. Secondary causes for omental infarction include hypercoagulability, vasculitis, polycythemia, and for omental torsion, cysts, tumors, and adhesions. Primary causes, or contributing factors, to omental torsion encompass obesity, local trauma, heavy food intake, coughing, sudden body movements, laxative use and hyperperistalsis. CT scan has been proving to be an effective modality for recognizing this clinical entity. In view of the rarity with which this condition occurs no comparative and detailed studies as far as its treatment are concerned are listed. But a conservative approach with vital monitoring is preferred over surgical, laparoscopic or omental necrosectomy.

Conclusions

Omentum is an important structure and a detailed knowledge of Anatomy is important for any Gastro surgeon. Besides the infarction of Omentum is itself a rare entity and should always be considered in differential diagnosis of unrelenting and severe abdominal pain. With the advent of CT scan more cases of Omental infarction are seen but still it continues to be a rare entity.

Paper 2. GASTRINOMA: IMPORTANCE OF LOCALIZATION. ANATOMICAL, SURGICAL AND DIAGNOSTIC PERSPECTIVE

Background: Gastrinomas are rare tumors in patients with intractable peptic ulcer disease, recurrent ulceration, ulceration at atypical sites and failure to respond to medical therapy. The article presents an anatomical, surgical and diagnostic perspective of these rare tumors which can undergo a malignant transformation.

Anatomical and surgical perspective

Following the first report of an islet cell tumor of the pancreas associated with peptic ulcer disease by Sailer and Zinninger in 1946, Zollinger and Ellison in 1955 described two patients with florid peptic ulcer disease and pancreatic islet cell tumors. The diagnostic triad proposed for this syndrome at that time included

a. The presence of primary peptic ulcerations in unusual locations.
b. Gastric hyper secretion of very high proportions that persists despite adequate therapy.
c. The identification of an islet cell tumor of the pancreas.

In the intervening decades, much information has accumulated regarding these gastrin secreting tumors and the associated Zollinger-Ellison syndrome. Gastrinoma is also commonly called as Zollinger-Ellison syndrome. It accounts for about 15-20% of pancreatic neuroendocrine tumors. In these tumors there is excessive and overproduction of the hormone gastrin, leading to excessive secretion of gastric acid. The patients suffer from multiple and recurrent peptic ulcers that are in most cases resistant to medical treatment or that are in uncommon locations.

In most cases these tumors are small, having a distribution that is diverse and difficult to detect complicated with the fact that patients present with varied clinical signs and not detected or diagnosed at early stages. As such a high suspicion about gastrinoma should always be there once a patient fails to respond to proton pump therapy in case of refractory peptic ulcer disease. Despite extensive preoperative localization studies and meticulous surgical exploration, some patients with Gastrinoma have no tumor demonstrable at laparotomy

Paper 3. TERATOMAS: UNIQUE MASSES, EMBRYOLOGICAL, HISTOPATHOLOGICAL AND CLINICAL PERSPECTIVE.

Background: Teratomas are unique types of tumors which can be either benign or malignant. They may contain components of germ layers either mesodermal, endodermal, ectodermal or mixed elements. They can be grossly confusing to a radiologist or a pathologist depending upon their constitution. The complexity of Teratomas is a result of its components which can range from neural elements, connective tissue elements, epithelial elements, and rarer tissues like thyroid tissue. The location of teratomas is also wide and can present in any site like mediastinum, ovary, heart, liver, presacral region. They present unique challenges to embryologists, radiologists and clinicians.

The embryological basis of teratomas starts with the formation of germ layers like ectoderm, endoderm, and mesoderm. The first germ layer to be formed is the endoderm during the first week of followed by ectoderm and the last layer is the mesoderm. This process of gastrulation gets completed by three weeks when the germ disc is fully formed. The teratomas are embryological formed from any of the component or the mixed component. They usually contain components of two or three embryonic layers that may include teeth, skin, and hair (ectodermal), cartilage and bone (mesodermal), or bronchial, intestinal, or pancreatic tissue (endodermal). The brain, respiratory and intestinal mucosa, cartilage, bone, skin, teeth, or hair may be seen in the neoplasm. The constituent tissues are not limited to those normally present in the area of origin and can be diverse. Histologically they may range from well differentiated to poorly differentiated or malignant lesions. Arising from the totipotent cells they may be gonadal or extra gonadal.
Vital structures such as trachea, esophagus, and thoracic duct can be compressed or eroded in case of invasion.

For mediastinal tumors, especially the therapy for mature, benign teratomas is surgical resection, which confers an excellent prognosis.

Histologically any component of germ layers may be present. In rare instances, teratomas may undergo malignant transformation and contain a focus of carcinoma.

These malignant teratomas also known as teratocarcinomas are locally aggressive. Often diagnosed at anunresectable stage, they respond poorly to chemotherapy and in a limited manner to radiotherapy; the prognosis is uniformly poor.

Ovarian teratomas are one of the most common ovarian tumors in children. They may be a completely silent condition or present as an emergency. The patient may simply present with a mass or abdominal pain due to torsion of the tumor. Benign teratomas of ovary present usually as cystic masses which can contain hair, thick sebaceous cheesy material. Microscopically, usually skin elements dominate, including dermal appendages such as hair follicles and sebaceous glands. In most cases, however, structures of endodermal (respiratory and gastrointestinal epithelia) and mesodermal (muscle, fat, cartilage) origin are present. The rarer ovarian teratomas may also contain thyroid tissue and are then called as struma ovarii. Grossly, immature teratomas are usually solid neoplasms with minimal cystic change. Microscopically, they are composed of immature (poorly differentiated) elements derived from all three germ layers. Primitive neuroectodermal (neuroblastic) elements are especially common. Mature teratomas usually contain well differentiated tissues and are benign, whereas immature teratomas contain varying amounts of immature neuroepithelium or blastemal tissues. Immature teratomas can be graded from 1 to 3 based on the amount of immature neuroglial tissue present. Tumors of higher grade are more likely to have foci of yolk sac tumor. Malignant germ cell tumors usually contain frankly neoplastic tissues of germ cell.

Teratomas at other sites: Heart is an organ with lesser chances of malignancies. The unusual benign lesions of the heart include fibromas, lipomas, angiomas, teratomas, and cysts. Lipomas have been rarely reported in the heart. In addition, pericardial teratomas are also rare lesions that can cause symptoms from compression of the right atrium with obstruction of venous return. Most of these occur in children and can be up to 10 cm in diameter.

Tumors occurring in the retro- rectal space are rare. This specific anatomical region lies between the upper two thirds of the rectum and the sacrum above the recto sacral fascia. It is bound by the rectum anteriorly, the presacral fascia posteriorly, and the

endopelvic fascia laterally. The retro rectal space contains multiple embryologic remnants derived from a variety of tissues
(neuroectodermal, notochord, and hindgut). Tumors that develop in this space are often embryologically and developmentally heterogeneous. Congenital lesions are most common, comprising almost two thirds of retro-rectal lesions. The remainders are classified as neurogenic, osseous, inflammatory, or miscellaneous lesions. Malignancy is more common in the pediatric population than in adults, and solid lesions are more likely to be malignant than are cystic lesions.

Sacrococcygeal teratomas (SCT) are the most common tumor in newborns. Because cells from the primitive streak are pluripotent, the tumors contain various types of tissue derived from all three germ layers. They are three to four times more frequent in girls than in boys and usually presents as a large mass extending from the sacrum in the newborn period. The mass may be as small as a few centimeters in diameter or as massive as the size of the infant. The tumor has been classified based on the location and degree of intrapelvic extension. Lesions that grow predominantly into the presacral space often present later in childhood. The differential diagnosis consists of neural tumors, lipoma, and myelomeningoceles. SCT are derived from all three germinal layers of germinal disc and contain neural elements, squamous and intestinal epithelium, skin appendages, teeth and, at times, calcium. Their inheritance may be sporadic but, occasionally, autosomal dominant. They are more common in girls but are more often malignant in boys. About fifteen percent have associated congenital anomalies like imperforate anus, sacral bone defects, duplication of uterus or vagina, spina bifida and meningomyelocele (scimitar sacrum, anorectal malformation and presacral mass forming Currarino's triad). The radiological diagnosis is usually suspected when a calcified mass is noted in the pelvis on plain x-ray of the abdomen. CT scan can confirm this impression and may detect liver and retroperitoneal lymph node involvement in malignant cases. Operative excision, lymph node biopsy (both pelvic and retroperitoneal), peritoneal washings and biopsy, and omentectomy followed by combination chemotherapy result in a favorable outcome.

Conclusion: The clinical presentation of teratomas differs depending on the site. The thoracic teratomas usually present as an anterior mediastinal mass. They are

not present in middle or posterior mediastinum. The ovarian teratomas present as abdomino-pelvic masses, which can be silent or often with acute symptoms of torsion, bleeding, or rupture.

Retroperitoneal teratomas may present as a flank or abdominal mass. Mediastinal teratomas It has been observed that the teratomas are the most common type of mediastinal germ cell tumors and accounting for 60 to 75% of such tumors. They are usually benign mature teratomas. In the mediastinum, they can cause compression of mediastinal structures and cause mediastinal syndrome in case of rapid growth. Vital structures such as trachea, esophagus, and thoracic duct can be compressed or eroded in case of invasion.

Any clinician should suspect the possibility of teratomas when a peculiar feature of a mass with different components is observed especially in mediastinum, ovary, presacral region or rarely heart, liver, pericardium, testis or brain

Paper 4. THE RARE CASE OF MONIER KUHN SYNDROME OR THE TRACHEOBRONCHOMEGALY SYNDROME

Background: A case of a 50-year-old male who presented with infection of the chest several times in the last two years. He presented with dyspnea and cough. Despite repeated doses of antibiotics, his condition did not improve. Sputum and cultures were negative. A CT scan demonstrated "Tracheobronchomegaly". For the previous ten years, he was having recurrent chest infections and was taking erratic antibiotics. Despite repeated doses of antibiotics, his condition did not improve. Lab investigations reported:

Temperature: 98.60 F, blood pressure: 126/78 mm Hg, respiratory rate: 12/min, pulse 82 bpm, haemoglobin: 11.7 gm/dl, white blood cells: 7200 / ul, platelets: 230,000/ul (Normal 150,000-400,000), Anti CCP (cyclic citrullinated peptide) antibodies: Positive, sodium: 144mmol/l (Normal 135-145), potassium: 4 mmol/l (Normal 3.5-5)

Normal histology: The walls of the trachea are formed of four layers:

1. Mucosa 2. Submucosa 3. Fibro cartilaginous coat 4. Fibrosa.

Mucosa: is formed of epithelium lining the trachea is typical respiratory epithelium (ciliated pseudo stratified columnar), which, like the nasal epithelium, contains numerous Goblet cells. Loose connective tissue (the lamina propria) makes up the tracheal mucosa containing blood vessels, nerves and lymphatics.

Submucosa: There are sero-mucous glands or tracheal glands plus solitary lymphatic follicles, blood vessels and nerves. The mucosa is separated from the submucosa by a layer of longitudinal elastic fibers.

Fibro cartilage coat is made of C-shaped rings of hyaline cartilage which help to keep the lumen of the trachea from collapsing.

Fibrosa: Is the outermost layer of connective tissue is the adventitia or fibrosa.

The trachea ends by dividing into two main bronchi.

The extra pulmonary bronchi are similar to the trachea, while the intra pulmonary bronchi differ from the trachea in having narrow lumen, highly folded mucosa, less goblet cells, complete smooth muscle coat. They also have irregular cartilage plates instead of C shaped cartilage.

The lung consists of bronchi, bronchioles, respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli.

Features of bronchi are:

1. Bronchi are two in number with open lumen.
2. Mucosa is folded and lined by pseudo-stratified columnar ciliated epithelium with goblet cells.
3. The adventitia contains lymphoid follicles.
4. Irregular cartilaginous plates are present.
5. Muco-serous glands are present

Features of bronchioles are:

1. Bronchioles are many in numbers.
2. Mucosa is folded and lined by simple columnar ciliated epithelium with no goblet cells.
3. The adventitia contains no lymphoid follicles
4. Irregular cartilaginous plates are not present.

5. Muco-serous glands are not present, and the respiratory bronchioles are lined by simple cuboidal epithelium. Alveolar ducts are lined by simple cubical epithelium. The alveoli and alveolar sacs are lined by simple squamous epithelium separated by CT septa called inter alveolar septa.

Histopathology: The histopathology of tracheo-bronchomegaly involves lack of smooth muscle and elastic connective tissue in trachea and bronchial tree with sacculations in between the cartilaginous parts. There is subsequent dilatation of the trachea as well as main stem bronchi. The condition is seen to be associated with other conditions like Ehler-Danhlos syndrome, Marfans syndrome, ankylosing spondylitis, cutis laxata. However, sporadic cases are also seen. The clinical symptoms range from severe and recurrent chest infections to asymptomatic clinical condition not detected until late. Histopathological examination can reveal either atrophy and/or absence of longitudinal elastic fibers in the airway wall, thinning of muscularis mucosa, absent myenteric plexus, absence of cartilaginous elements or variations in all these changes.

Conclusion: A rare condition can be a cause of recurrent chest infections and can be included in a differential diagnosis of recurrent chest infections and should be borne in mind.

PAPER 5: THE UNUSUAL HERNIAS IN SURGERY: ANATOMICAL AND SURGICAL PERSPECTIVE

Background and review: Hernias in general are a common surgical problem. In contrast to common types like inguinal or femoral hernias other hernias are not that common and present atypically as diagnostic dilemmas. The article presents both anatomic and surgical perspectives of some rare types of hernias. In general hernias are most commonly predisposed by risk factors.

Risk factors are:

- Suture material absorbable (catgut) suture carries higher risk.
- Method of suturing: interrupted suture.
- Drainage: drainage directly from wound.

- Incision (in order of risk): Median >Para median>Transverse.
- Etiology of operation. Operation on pancreas or for obstruction.
- Other precipitating factors are: uremia, sepsis, liver failure, malnutrition, diabetes, corticosteroid therapy, anaemia.

Epigastric hernia: Linea Alba is a midline raphe connecting the abdominal muscles and their aponeurosis of right side with the left side. The external abdominal oblique muscle is the largest and thickest of the flat abdominal muscles and the muscle gives way to a flat, strong aponeurosis at about the midclavicular line, and it inserts medially into the linea alba. The internal abdominal oblique muscle fibers course perpendicular to the fibers of the external oblique and also gives way to a flat aponeurosis medially, which splits to enclose the rectus abdominis muscle. The aponeuroses reunite medial to the rectus and insert into the linea alba. The transversus abdominis muscle also gives way to a flat aponeurosis that inserts into the linea alba. The rectus abdominis muscles are held close together near the anterior midline by the linea alba. The linea alba narrows considerably below the umbilicus so that the medial edge of one rectus muscle may actually overlap the other. Hernias of the linea alba occur more commonly above the umbilicus than below. These hernias are usually small and can be difficult to diagnose especially in obese patients. Mostly the patients complain of a painful, pulling sensation at the midline upon reclining. These hernias can usually be repaired with simple suture closure. The surgeon should be aware that these hernias are frequently multiple, and adequate exposure at the linea alba adjacent to the hernia may reveal additional occult hernias.

Richter's Hernia: For a hernia to be considered a Richter hernia, the antimesenteric border of the intestine must protrude into the hernial sac, but never to the point of involvement of the entire circumference of the intestine. The symptoms and clinical course vary widely, depending on the degree of obstruction related to the portion of bowel circumference involved. Strangulation can occur, presenting with a painful mass, nausea, vomiting, and abdominal distention. Conversely, a small, asymptomatic Richter's hernia may remain unrecognized until the time of operation. A Richter's hernia can occur within any type of abdominal wall hernia, but the most common location is at the site of a femoral hernia. Richter's

hernias have received increased attention with the dramatic increase in the use of the laparoscopes. Anecdotal reports have described Richter's hernias at trocar incisional hernias. Repair of a Richter's hernia is based on the location of the hernia. Critical to the repair of a Richter hernia is an adequate evaluation of the intestine for viability. In some situations, it is impossible to adequately assess or treat the compromised bowel through the incision for hernia repair. In these cases, an additional midline incision may be indicated to perform an adequate exploratory laparotomy. Diagnostic laparoscopy can be used as an alternative to exploratory laparotomy to evaluate the intestine.

Littre's Hernia: The presence of a Meckel's diverticulum as the sole component of the hernia sac defines a Littre's hernia. This rare entity can be extremely difficult to diagnose due to the frequent lack of obstructive symptoms. Strangulation of the Meckel's diverticulum can occur, resulting in abscess or fistulation as the presenting complaint. Surgical management includes repair of the hernia with or without resection of the Meckel's diverticulum. A symptomatic or strangulated Meckel's diverticulum should be resected. The elective resection of an asymptomatic Meckel's diverticulum should be based on the patient's age and overall clinical condition.

Spigelian Hernia: A hernia through the fascia along the lateral edge of the rectus muscle at the space between the semilunar line and the lateral edge of the rectus muscle is a Spigelian hernia. Most commonly, Spigelian hernias occur inferior to the semicircular line of Douglas. The lack of posterior rectus fascia below the line of Douglas contributes to inherent weakness in this area. Many patients presenting with Spigelian hernias are obese, and preoperative diagnosis is correct in only 50% of patients. Spigelian hernias may be found incidentally by ultrasonography or computed tomography (CT). Spigelian hernias are usually successfully repaired at the initial operation. Approximation of the tissues adjacent to the defect with interrupted sutures is adequate in most patients. However, if the defect is large or the tissues attenuated, prosthetic mesh reinforcement may be indicated.

Obturator Hernia: The obturator canal is covered by a membrane pierced by the obturator nerve and vessels. Weakening of the obturator membrane and enlargement

of the canal may result in the formation of a hernia sac, which can lead to intestinal incarceration and obstruction. The obturator canal, which is 2 to 3 cm. long, may contain a fat pad, considered by many surgeons to be pathologic. The patient may present with evidence of compression of the obturator nerve, resulting in pain in the medial aspect of the thigh. This was described by John Howship in 1840 and independently by Moritz Heinrich Romberg in 1848. Surgical repair of obturator hernias has been performed through various approaches. The abdominal approach, open or laparoscopic, is preferred when compromised bowel is suspected. The retro pubic (extra-peritoneal) approach is preferred by many surgeons when there are no signs of obstruction or intestinal involvement. The obturator, inguinal, and combination approaches have been described. Regardless of the approach, reduction of the contents and inversion of the hernia sac are the initial steps in the surgical treatment of obturator hernias. Gentle manipulation of the obturator nerve with a blunt nerve hook may facilitate reduction of the fat pad from the canal into the pelvis. The fat pad can then be dissected free from the canal, thus relieving the pressure on the obturator nerve.

Lumbar (Dorsal) hernia: Lumbar or dorsal hernias can occur in the lumbar region through the posterior abdominal wall.

Grynfeltt's hernia appears through the superior lumbar triangle, whereas **Petit's hernia** occurs through the inferior lumbar triangle. Diffuse lumbar hernias, a third type, are most often iatrogenic. Most diffuse lumbar hernias occur following flank incisions for kidney operations. Lumbar hernias usually enlarge in size and become progressively and cosmetically troublesome. Simple suture repair of small hernias is feasible. With larger hernias, reconstruction is challenging. Overlapping and imbricating suture repairs are possible in some patients. However, patients with large hernias or those presenting with extremely attenuated tissues may require mesh reinforcement, pedicle flaps, or free flaps.

Sciatic Hernia: The greater sciatic foramen can be the site of hernia formation. These extremely unusual hernias are difficult to diagnose, and the patient may be symptom free until intestinal obstruction occurs. Other patients present with a mass in the gluteal or infragluteal area, which causes discomfort when standing. Sciatic

nerve pain is rarely caused by pressure from a sciatic hernia. These hernias can be surgically repaired Trans-abdominally or through a Trans-gluteal approach.

Perineal Hernia: Perineal hernias caused by congenital or acquired defects are very uncommon. These hernias may occur following abdominoperineal resection, prostatectomy, or removal of the pelvic organs. A myocutaneous flap or mesh reinforcement is frequently required to repair a perineal hernia.

Paper 6: THE ANATOMICAL AND SURGICAL IMPORTANCE OF HEPATOBILIARY TRIANGLE OF CALOT.

Background: Cholecystectomy defined as surgical removal of gall bladder is indicated in symptomatic gall stones or any underlying gall bladder pathology. Two surgical methods for this very purpose are laparoscopic cholecystectomy and open cholecystectomy. The latter one is becoming obsolete since it requires a wider exposure through the surgical incision and post-operatively patients are prone to the development of infections. Laparoscopic cholecystectomy is gaining phenomenal acceptance, being the standard and preferable approach. The challenging aspect of this surgery is safeguarding the structures forming the boundaries of Calot's triangle and then carrying out safe dissection of its contents.

Highlights about proper exposure of Calot's triangle during laparoscopic cholecystectomy requires several small incisions in the abdomen to allow the insertion of operating ports, small cylindrical tubes approximately 5 to 10 mm in diameter, through which surgical instruments and a video camera are placed into the abdominal cavity. The camera illuminates the surgical field and sends a magnified image from inside the body to a video monitor, giving the surgeon a close-up view of the organs and tissues. The surgeon watches the monitor and performs the operation by manipulating the surgical instruments through the operating ports. The Calot's triangle, also known as cystohepatic triangle or the hepatobiliary triangle is an anatomic space bordered by the cystic duct, the common hepatic duct, and the inferior border of the liver. The right hepatic and cystic arteries are located within it, and anomalous structures often pass through it. Variations in

the anatomy of the gallbladder, the bile ducts, and the arteries that supply them and the liver are important to the surgeon, because failure to recognize them can cause iatrogenic injury to the biliary tract.

Observations:

Variation 1: The cystic duct may be long and more susceptible to damage by virtue of its length and it becomes essential for a surgeon to properly trace the full-length of the duct illustrating the need for its complete dissection.

Variation 2: The duct may pass behind the common hepatic duct to enter it on the posterior wall or on its left lateral aspect. An important point for surgeons as they can completely miss the structure and cause unintended damage in case of failure of recognition of the posterior course of cystic duct.

Variation 3: In chronic cholecystitis, the gallbladder may be small and shrunken, and the cystic duct may be absent or extremely short. In this circumstance, the common bile duct may easily be mistaken for the cystic duct as dissection proceeds from the gallbladder fundus toward the cystic duct.

Variation 4: A very long cystic duct may enter the common bile duct at a variable distance from the sphincter of Oddi and may be fused with the common duct, in which case the two ducts should not be separated because they share a common wall.

Variation 5: An accessory duct from the liver may enter the cystic duct or the common hepatic duct. Actually, this is not an accessory duct but an anomalous entry and course of either the right anterior or right posterior segmental duct from the liver. Such variations are reported with increasing incidence.

Variation 6: Small accessory ducts such as ducts of Luschka between the liver and gallbladder easily escape detection. Low extrahepatic right segmental duct insertions can also join the cystic duct. The latter injury has been recognized since the use of laparoscopic cholecystectomy.

Variation 7: Occasionally, liver parenchyma is partially embedded in the gallbladder and rarely one may encounter a completely intrahepatic gallbladder.

Variation 8: Passage of the cystic duct posterior and around the common hepatic duct to form a left-sided junction (spiral union), which occurs in less than 5% of persons. The cystic duct may also join the right or left hepatic duct or be absent. Rarely, major hepatic ducts drain separately into the gallbladder.

Variation 9: Common variations in the anatomy of the hepatic artery of relevance to biliary anatomy include a bend in the course of the hepatic artery, which can mimic the cystic artery origin, a short cystic artery takeoff from the right hepatic artery, dual cystic arteries, or an artery that courses anterior to the hepatic ductal system. A bend in the course of the right hepatic artery, throwing it into the configuration of a caterpillar hump, invites injury unless it is carefully dissected free. A very short cystic artery also puts the hepatic artery at risk.

Occasionally, the right hepatic artery courses anterior to the common bile duct. The cystic artery which courses through the triangle must be carefully avoided and properly identified by the surgeon. Dissection deep into the liver parenchyma may cause injury to intrahepatic ducts, and poor clip placement close to the hilar area or to structures not well visualized can result in a clip across a bile duct. Cancer of the gallbladder, which usually does not have a good five-year survival rate, spreads through the lymphatics, with venous drainage, and with direct invasion into the liver parenchyma. Lymphatic flow from the gallbladder drains first to the cystic duct node, which is also known as the Calot's node, then to the pericholedochal and hilar nodes, and finally the peripancreatic, duodenal, periportal, celiac, and superior mesenteric artery nodes. The gallbladder veins drain directly into the adjacent liver, usually segments IV and V, where tumor invasion is common. It has also been observed that lymph is produced within the liver and drains via the perisinusoidal space of Disse and periportal clefts of Mall to larger lymphatics that drain to the hilar cystic duct lymph node (Calot's triangle node), as well as the common bile duct, hepatic artery, and retro pancreatic and celiac lymph nodes. This is particularly important for resection of hilar cholangiocarcinoma, which has a high incidence of lymph node metastases.

Conclusion: Among the steps involved in laparoscopic cholecystectomy, the most important step is the identification of Calot’s triangle and all the normal structures first and the recognition of any variations in the biliary and extra hepatic biliary system which can exist there. After appraising the Calot’s triangle, cystic duct and cystic artery are separated and carefully clipped using titanium clips by the surgeon.

The safe and sound dissection or removal of the gall bladder via portals away from the liver bed, assisted by video camera placed in abdominal cavity can only be made possible by meticulous identification of the Calot's triangle boundaries. As a result, considerable reduction in morbidity and mortality can be achieved and hence the normal Anatomy and variations in Anatomy of structures within the Calot's triangle assumes great importance. Furthermore, the Calot's node in the Calot's triangle can be a marker or signal node for Cholangiocarcinoma.

Conclusion of theme 3.

An attempt in the collation of organ variations and review on different pathologies through these set of publications can add on to the knowledge and quick review by surgeons and clinicians.

There is a lot of scope in reporting organ variabilities and pathologies. Most of the papers in this theme are a review related to pathological conditions like tumors. This collation has main focus on revisiting the embryogenesis, histological as well as locating normal positions of structures.

Variations and pathologies may confuse the investigators, surgeons and pathologists during organ surgeries, transplant and reporting injury. Further, it may cause serious complications during procedures. Understanding variations and pathologies of organs is important in the diagnosis of unexplained clinical signs and symptoms as well as during diagnosis, reporting and surgical procedures.

THEME 4. VARIATIONS AND CASE REPORTS RELATED TO BLOOD VESSELS OF CIRCULATORY SYSTEM.

INTRODUCTION TO THEME 4:

Vascular variations regarding the branching patterns of the vessels are important in different laparoscopic surgeries, liver and kidney transplantation, oncologic resections, and various interventional radiological procedures in the abdominal region. The present theme will address variations reported in cadavers to examine the prevalence of various patterns of the important blood vessels.

Paper 1.THE ANOMALOUS TRUNKUS BRACHIOCEPHALICUS AND ITS CLINICAL SIGNIFICANCE.

Background: The brachiocephalic trunk is a major short artery from the arch of the aorta which supplies the right arm and head and neck. The anomalous course of the brachiocephalic trunk is significant because it can cause fatal hemorrhage during any midline neck surgery. The vascular sling can cause tracheal compression in infants. The present study points out the significance of the presurgical evaluation of the vascular pattern in the specified area.

Observations: A case of the aberrant origin and the course of the brachiocephalic trunk has been presented here. As the pre-tracheal region is frequently approached for life saving surgical procedures, the unnoticed vascular anomalies in this region may turn fatal. This case is of diagnostic importance because it is the commonest cause of airway compression by a vascular ring in children. The mere shifting of the origin of the brachiocephalic trunk may cause tracheal indentation.

During routine dissection of the neck in a 60-years old male cadaver (death due to cardiac arrest), a horizontally placed artery was noticed just below the thyroid isthmus. The artery was traced up to its origin and its termination. The adjacent and related structures were examined for ruling out any compression effects and haemodynamic changes.

The artery which crossed the trachea along the lower border of the thyroid gland was identified as the brachiocephalic trunk. The morphology of the artery was normal. Its origin was 2.2cms to the left of the midline. By an oblique course, it

crossed the trachea over the 4th and 5th tracheal rings and reached up to the 3rd ring. On reaching the right side, it divided into the right common carotid artery and the right subclavian artery. The level of its termination was 2.2cm above the right sterno-clavicular joint. The brachiocephalic trunk was 6.7cm long. The trachea did not reveal any signs of compression. The thyroid gland showed normal morphology. The heart did not show any haemo-dynamic abnormalities.

The brachiocephalic trunk is also called as the innominate artery. Normally, it arises from the convexity of the aortic arch, posterior to the centre of manubrium sterni. Its origin is anterior to the trachea and posterior to the left brachiocephalic vein. From the posterior part of the inferior portion of the manubrium sterni, the arterial trunk passes upwards to the level of the right sternoclavicular joint and it divides into the right subclavian artery and the right common carotid arteries. In our specimen, the origin of the brachiocephalic trunk was shifted to the left of the midline by 2.2cm. Neither the right nor the left brachiocephalic veins were anomalous.

A minimal shift in the origin to the left of the trachea is actually normal in children. The aberrant innominate artery which arises on the left side and crosses the trachea from the left to the right may cause tracheal indentation and pressure changes in the trachea. The syndrome of innominate artery compression of the trachea was first reported in 1948 by Gross and Neuhauser. The symptomatic innominate artery syndrome is more likely to arise in patients with a crowded superior mediastinum. One of the causes of tracheo-malacia is the extrinsic pressure which is caused by an aberrant artery, and one of the major causes of congenital vascular compression is an anomalous brachio-cephalic or innominate artery.

The symptomatic patients typically present with expiratory stridor, cough, recurrent bronco-pulmonary infections, and occasionally, apnoea. In our specimen, the trachea was apparently normal. By 3 years of age, the growth of the aortic arch causes the innominate artery to move cranially to the right, and anteriorly, away from the trachea. Other factors, including the continued growth of the supportive tracheal cartilage, thymic involution, and rib cage growth may also be partially

responsible for the decreased incidence of the tracheal compression with advancing age.

In the present case, we could not find out any haemodynamic changes in the heart, as it was reported in some other studies. The absence of the haemodynamic changes may be due to the oblique turning of the artery to the right instead of an acute bending. Our case showed an anomalous brachio-cephalic or innominate artery origin to the left side of the trachea, as well as a high crossing of the vessel over the fourth and fifth tracheal rings, reaching up to the lower border of the thyroid isthmus.

While some authors noticed a similar course, some others reported that the brachiocephalic trunk was positioned in an abnormally high level above the 2nd tracheal ring. The most probable cause of this abnormality in the course of the blood vessels of the aortic arch might be a disproportional elongation and increase of their diameter during the embryonic life. A genetic association of the chromosome 22q11 deletion and the aortic arch anomaly has been postulated
(McElhinney DB, et al.,2001)

The majority of the patients with brachio-cehalic (innominate) artery compression of the trachea are successfully treated with medical approaches. Arteriopexy, entailing the anterior suspension of the brachio-cephalic (innominate) artery to the sternum, and the re-implantation of the innominate artery to a more proximal site on the ascending aorta are the most commonly used methods of surgical repair for achieving symptomatic relief.

The high localization of the common carotid artery and the brachiocephalic trunk across the trachea increases the risk of injury to these vessels in percutaneous procedures and other surgeries, which are related to them, e.g., percutaneous dilatational tracheostomy (PDT), which is becoming increasingly popular in the present day critical care medicine. In contrast to the surgical approach, PDT involves a blind puncture and dilation of the pretracheal space, which may predispose to dangerous complications in patients with vascular anomalies. Many surgeons have reported both the peri-and post-operative complications of severe

bleeding which was due to aberrant pretracheal vessels. Post-operative hemorrhage may occur due to injury of a highly placed artery. A preoperative knowledge of these individual anatomical variations of the trajectory of vessels of the cervical region of the neck has clear clinical surgical importance.

The tracheal airway compression in children can be due to the anomalous brachiocephalic (innominate) artery syndrome. Obstructive respiratory symptoms occur in only a fraction of such cases, and symptomatic patients are most commonly detected in the first year of life. The tracheal indentation was found to be age-related. This syndrome is rarely seen in children who are older than 1.5 years of age. So, this anatomical variation plays a key role in the diagnosis and management of symptomatic airway obstruction. The recognition of vascular anomalies is necessary to avoid a potentially catastrophic hemorrhage or other complications during percutaneous and surgical procedures on the trachea or the neck. To avoid hazardous bleeding complications, we recommend at least an ultrasound scan prior to any surgical procedure.

Paper 2. DUPLICATION OF INFERIOR VENA CAVA.

Background: Though rare, the variations of inferior vena cava and renal veins have been reported.

Observation: During routine dissection on an adult male cadaver aged around 70, it was observed that the cadaver had double inferior vena cava, with one on either side of abdominal aorta, parallel to each other. The right and left inferior vena cavae joined by a transverse union or anastomosis at the level of left renal veins. There was no duplication of renal vessels and no malformation of the inter segmental lumbar veins. The right and left side common iliac veins continued upwards straight without joining at any other level. The Left renal vein and left common iliac vein joined on the left side of abdominal aorta before crossing in front of it. After

crossing the aorta, a common inferior vena cava was formed which travelled towards the liver like the normal course of the inferior vena cava.

Discussion: Understanding the variations in blood vessel courses and branching patterns is very crucial to clinical practice. Anatomical variations in any blood vessel can lead to misdiagnosis. Duplication of the inferior vena cava is a relatively rare vascular anomaly, with an incidence of 1.5% (range 0.2 to 3%). It has an association with retro aortic left renal vein, horse-shoe kidney, circumaortic renal collar, crossed fused ectopia, cloacal exostrophy, pelvi-ureteric junction anomalies and Dunbar syndrome.

Anatomical variation of the inferior vena cava occurs in 0.4-4% of the population. The most common variant is duplication of the inferior vena cava. Most of the variations are found during radiological procedures or during dissection of cadavers. To reduce misdiagnosis there need to be a thorough knowledge of all variations. It has been reported that variations can be confused with conditions like lymphadenopathy, aortic aneurysm, and retroperitoneal cysts, which often lead to unnecessary interventions.

It has also been shown that such anatomical variation can cause illness, in which cases it is considered an anomaly. Wang et al., (2005) described a case in which duplication of the inferior vena cava caused obstruction of the left ureter, leading to moderate hydronephrosis in a 21-year-old patient. Wartmann et al., (2011) described an 82-year-old woman whose post-prandial abdominal pain was attributed to the presence of a duplicated inferior vena cava positioned anterior to the aorta, at the level of the celiac trunk, which caused compression of the celiac trunk.

The duplication of the inferior vena cava can also be associated with the recurrence of pulmonary thromboembolism (PTE) when the anatomical variation goes undiagnosed and surgical procedures to prevent new episodes of PTE treat just one vein. It has an association with retro-aortic left renal vein, horse-shoe kidney,

circumaortic renal collar, crossed fused ectopia, cloacal exostrophy, pelviureteric junction anomalies and Dunbar syndrome.

Embryological background.

The development of inferior vena cava which in itself is a complex event starts by the 6th to 8th week in embryonic life. A series of anastomoses and regression takes place in the primitive trunk veins like posterior cardinal veins, sub-cardinal veins, and supra-cardinal veins. Non-regression of left supra-cardinal vein leads to the formation of a secondary embryonic vessel, which is generally positioned to the left of the aorta in adults. However, the configuration of this supernumerary vessel and thus its embryonic origin is quite variable. Some authors have described the duplication of inferior vena cava as complete and incomplete. Where complete, the most likely etiological cause is the persistence of the left supra-subcardinal anastomosis, of the post sub cardinal anastomosis, and probably of the inter sub cardinal anastomosis, which in turn results in the persistence of the left supra cardinal vein. Such a case may also be associated with an absence of iliac anastomosis (posterior distal inter cardinal anastomosis). In cases of incomplete duplication, in which the supernumerary vena cava to the left is smaller and sometimes irregular, the likely cause is inadequate regression of the supra cardinal vein.

In some cases, the left common iliac vein gives rise to the supernumerary vena cava, without any anastomosis between the common iliac veins. However, 41.7% of published descriptions refer to incomplete duplications. Literature reveals enormous variations in the inferior vena cava.

Conclusion: There is a high incidence of duplication of inferior vena cava amongst its all variations. It is highly recommended that a clinician should have a thorough knowledge of variations of Inferior vena cava and correlate it with clinical diagnosis. Radiological help coupled with the knowledge of variations can avoid misdiagnosis of retroperitoneal illnesses and will facilitate the procedures to prevent PTE (Pulmonary thromboembolism) in patients of deep vein thrombosis (DVT).

CONCLUSION OF THEME 4

Knowledge of variations in blood vessels is useful for appropriate radio diagnostic interventions and is helpful to decrease complications like vascular bleeding while ligating and anastomosing blood vessels, which is an integral part of many thoraco abdominal surgeries.

The importance of such anatomical variations in the clinical setting is based on the fact that they represent a variant of the normal presentation and as such, usually do not require therapeutic activities. They can, however, present diagnostic dilemmas or become symptomatic under certain conditions. Variations in the branching pattern or position and course of blood vessels can affect routine clinical procedures, such as blood pressure monitoring or intravenous drug application. They may provide grafting material for bypass surgeries but may as well create difficulties and necessitate changes in the selected surgical technique during complex interventions, such as catheterization of the cardiac cavities, flap surgery or amputations.

GENERAL CONCLUSION

The word normal is probably an inappropriate word to apply to the human body. A need to compile variations in human body as a single database or in novel terms evidence-based anatomy has arisen during the developing years of science and surgical technologies. Variation is the raw material for evolution, and it is ubiquitous both within and among populations. However, the balance between forces enhancing variation and forces eroding it likely differs among populations and species. Accordingly, the magnitude of morphological variation can differ markedly among species Darwin C (1859). As humans, how do we compare to other animals in terms of this variation? Taking a subjective look, morphological variation in a crowd of people might seem large compared to the apparent uniformity of an animal group, such as a flock of birds or a shoal of fish. But perhaps this apparent contrast between humans and other animals is simply a matter of our perception – that is, evolution has probably shaped animals to be more discriminating among individual conspecifics than among individual heterospecifics Pascalis O, Bachevalier J (1998).

Alternatively, contemporary human populations might indeed show greater morphological variation than other species. Possible reasons might include relaxed natural selection on some human traits Stephan CN, Henneberg M (2001) although perhaps not on others, the great diversity of conditions we can (and do) inhabit, and recurrent migration and gene flow Templeton AR (2002). among populations. Or perhaps humans instead show lower levels of variation – a point we will return to later.

The line between ―normal and abnormal is blurry. For every visible, superficial oddity, there may be an invisible internal one. Surgeon Sherwin Nuland writes: ‘Of the many hundreds of appendectomies I have done during a career of thirty five years, no two was the same. Although the configurations of human innards do not vary nearly as much as do those of our outards (external features), they nevertheless reveal unmistakable variations among individuals — and only surgeons ever find out about them’.

One question that could be asked today is if publication and study of anatomical variations has sense in the medicine and biology of the 21st century, or is, on the contrary, an exhausted topic (William and Humpherson, 1999). The answer is relatively easy: medical progress needs a more accurate knowledge of the variability of the human morphology to improve diagnosis and therapeutic performance. In other words, the advance in the new imaging techniques (echography, MRI, CT, endoscopy, etc.), surgery (reconstructive, minimal invasive surgery, etc.) and other areas, has opened a new field of research for the descriptive anatomy that we consider promising (Jones et al., 2002).

On the other hand, anatomical variations represent an embryological and comparative background for medicine and biology in order to understand the morphological aspect of the human body and its related structures. Finally, there is a point in commenting that a recent paper states that about 10% of clinical malpractice is due to the ignorance of the anatomical variations (Cahill and Leonard, 1999). It is not surprising that anatomical variations not only have not disappeared from the medical and biological background but have also been enclosed among the main aims to be considered in medical curricula in
Netherlands and USA (Educational affairs Committee of the AACA, 1996;
Griffioen et al., 1999).

Anatomical variations will always have a place in the medical or biological background; however, we must take care that the quality of the papers by means of careful review of previous publications and intent of explanation of its possible origin, without forgetting its clinical interest, prior to publishing a contribution (Fontaine, 2001).

There are many major or minor variations in human gross anatomy, which can significantly affect the outcome of medical procedures, or quite often can cause

different conditions in patients. Every single old content and references of life systems press upon a similar area, relations, numbers and highlights of the human body. As dismemberment isn't the main source and technique for marking structures, regions, relations we have to reclassify and refresh the knowledge frequently. There are reports that a substantial proportion of clinical malpractice may be attributed to ignorance of anatomical variations. This realization has informed inclusion of anatomical variations among the aims to be considered in medical curricula, renewed research interests and encouragement of anatomists to publish articles on this subject in the era of molecular biology and genetics (Sanudo et al., 2003).

The studies and case reports presented in the previous themes have contributed to our understanding of these variation as they showed clinical awareness of known and newly discovered anatomical variations, which can be achieved through a frequent review of the pertinent literature in specialized journals, is the key to a successful outcome in the clinical setting. The availability of such literature data, however, is in no small part a responsibility of specialists from various clinical disciplines and anatomists and surgeons in particular.

All old texts and references of anatomy press upon the same location, relations, numbers and features of the human body. As dissection is not the only source and method of labelling structures, areas, relations we need to redefine and update the present knowledge of Anatomy. So, what defines the boundary of normality, what defines that a particular set of features are normal, and rest are variations?

MY JOURNEY AND ASPIRATIONS AS A RESEARCHER.

Description

My all-encompassing objective of seeking a PhD by publication was to extend my insight into research methods and forms and have the capacity to create a unique and substantive contribution to research. It was a rather complex route that I took to achieve a PhD by published work, in the hope that it will help others consider this approach. The published work route was the right approach for me, given that I already had a collection of publications that I could bring together in a coherent manner.

I started observing variations and reporting them since 2009.While performing routine dissections and demonstration of cadavers to students I realized that no two cadavers were exactly the same. I first observed variations in the insertion of brachialis muscle; and reported it by presenting a paper in one conference. That was the motivation to find out more. In the course of these 10 years as a student, researcher and academic teacher I aspired for more and started to observe more of anthropometrical, radiological variations, and make more correlations and review based work. Over the period of time, I had 38 papers published in the field and a book named Quick Review of Anatomy.

My aim for conducting the work over the past years was to create a database for reporting variations and explore how it could change the investigative perspective worldwide which could improve our understanding in human anatomy. The challenging part was to collate similar studies or papers which could be presented under one heading. So out of 38 published articles, I could select only 17 which formed best combinations under the title “Exploring the Boundaries of

Normality". Presenting them under themes was a good initiative as it focused the attention on different anatomical regions or systems in Human body.

Feelings

I want to make a significant contribution to human scientific literature, not only in my final thesis compilation but also thereafter. This includes more peer reviewed publications that are essential for career progression within academia.

I am committed to producing high quality journal papers which would nurture my research and academic writing skills.

Besides its role in further developing me as an academic, having a PhD is a personal landmark that I have long sought. Aiming for a successful career in academia, having a PhD would be instrumental for two reasons: i) it is a sign of competence to handle intellectually challenging activities such as public speaking and intellectual reasoning; ii) it is a mark of exposure or knowledge of new trends which is an essential attribute for leadership. The major motivation for undertaking this research is not only because of the above stated purpose only but also how my research will influence the general body of research in the area of Anatomy. Overall, there are many reasons for undertaking this doctoral research but with a common theme; to learn new skills that are essential for my career progression.

Evaluation and analysis

SWOT (Strength, weakness, opportunity and threats) analysis of the research:

The underlying objective to do a PhD by publication requires not only commitment to the research program but also the ability to produce a focused original piece of research that could stand the process of peer review. However,

this process does not function in vacuum, rather it is influenced by a number of external factors such as the level and quality of supervision, family, finance, external engagements, age and health. All these factors would have a major influence throughout this journey to PhD as explained below in the SWOT analysis.

The SWOT analysis has four components: I) strengths, ii) weaknesses iii) opportunities iv) threats depicting.

Strengths:

While reflecting on writing and compiling the compendium for anatomical variations in gross, radiological, neuroanatomy, surgical anatomy, and case reports in clinical anatomy. I realized that I truly enjoyed the process, at least most of it, though I was uncertain how the final outcome would be like. Strengths of the papers include that they are

1. Evidence based with no hypothesis.
2. Basic and review based.
3. Backed by investigations like scans, reports and surgical outcome.
4. Direct accurate measurements are made that are not affected by the potential imperfections of indirect measurements.

Weakness

Less literature available. Poor publication reporting, whichever available are scattered in different journals of different specialties. Only anatomy atlases and Journal of Variations, European Journal of anatomical variations are putting efforts in cataloguing the variations. Unfortunately, continuous appreciation of variations is being undermined by current trends in the undergraduate medical

training characterized by reduced exposure to dissection and dissected specimens, increased use of plastic bones, computer generated images and 3D printed models

Opportunities.

A massive scope of creating a worldwide database of anatomical variations and ultimately creating a source for evidence-based anatomy, encyclopedia of anatomy. These will be a helpful tool for surgeons, neurosurgeons, etc and also will benefit humans in means of patient education and avoid unnecessary diagnosis and surgeries and mental trauma.

Threats.

Major threat to my objectives has been paucity of resources; less availability of human cadavers to correlate things actually rather than believing in already published material.

Therefore, knowledge of such of key importance for the proper diagnosis and therapy, since very often, if the conservative treatment of these symptoms fails, then surgical treatment will be indicated.

Conclusion

When enough research evidence is available, the clinical practice should be guided with it in conjunction with clinical expertise and keeping in mind patient values. The need of the hour is not only publications, reporting and writing books, (knowledge generators) only. A positive feedback from knowledge users (clinicians, investigators, surgeons) is also required to improve the outcome i.e. skill, equipment, reporting, diagnosis and surgeries.

Action plan, Scope and future.

The studies and case reports presented in the themes will definitely contribute to our understanding of these variations as they showed clinical awareness of known and newly discovered anatomical variations, which can be achieved through a frequent review of the pertinent literature in specialized journals.

I have revealed only a small part of data available to me, which I gathered during routine dissections or during writing articles related to embryology or variations. A bigger collaboration from fellow researchers is required in order to make a standard and successful collation in the clinical setting.

The availability of such literature data, however, is in no small part a responsibility of specialists from various clinical disciplines and anatomists and surgeons in particular, every medical specialist must contribute to a common database, evidence-based research groups to constantly improve the quality of reported work as we strive to provide better healthcare and to deepen our knowledge about the human body.

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