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EDITORIAL

ChatGPT and Large Language Models: Impact on the Integrity of Academic Publishing

Varuni Tennakoon

Editor-in-Chief

Large language models (LLM) or AI (Artificial Intelligence) systems play an implausible role in evaluating and creating intelligence today, than ever. The LLMs are based purely on language and are the power banks of chatbots such as ChatGPT, Microsoft's Bing Chat and Google's Bard.

The OpenAI, a research laboratory in San Francisco California, released ChatGPT (Generative Pre-trained Transformer), in November 2022. It uses natural language processing to generate responses to user inputs. ChatGPT embraced significant attention in no time (100 million users in first two months) (1), for its many potential uses with a wide range of language-related tasks, as well as trepidation about what its rise means to humankind (2).

Of its many functions, ChatGPT summarizes articles, reviews scientific literature, performs statistical analyses and writes scholarly manuscripts, furthermore, it identifies research gaps, designs experiments, and conducts peer-reviews (3). A recent report claims that ChatGPT generated 50 research abstracts from an existing research publication, gained acceptance by the plagiarism checker, an AI-output detector and human reviewers (4). In January 2023, *Nature* reported two published articles with ChatGPT as co-authors (5).

Even though the most advanced LLM behind ChatGPT has nailed many academic and professional language-based performances, a strong consideration shall be given to its assistance to scientific publications.

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Gonzalez et al., reports that 'ChatGPT lacks the knowledge and expertise necessary to accurately and adequately convey complex scientific concepts and information' (6). The creators of ChatGPT themselves have confessed that it is challenging to rectify the dilemma of ChatGPT writing seemingly coherent and credible, but incorrect or nonsensical text (7).

Validity of references and citations is crucial to ensure the quality and integrity of research. In its scholarly writing, when prompted to generate citations, ChatGPT may provide references that are incorrect or non-existent (8). Additionally, text without appropriate attribution pose a significant risk for researchers for unintentional plagiarism. ChatGPT can also be biased depending on the datasets that it navigates. The scope and quality of datasets that ChatGPT is trained on, may be skewed in terms of time, geography, people, gender, vulnerability etc. producing inequitable text (9). On one hand, the extensive use of ChatGPT in research and publishing these deceitful articles by predatory journals may add large amounts of pseudoscience into scholarly literature. On the other hand, it remains unclear that who is accountable and owns copyrights for the generated text (10). Moreover, there are rising concerns over ethical issues such as data privacy and confidentiality when using ChatGPT in research. All in all, it is evident that ChatGPT adversely impact on the integrity of academic publishing, undermining its fundamentals.

How exactly do LLMs perform as they do, is a question yet to be answered – even by their own creators. This is because the LLMs behaviour is acquired through training processes and not on command by programmers. The LLMs are fed with massive piles of text, from which they learn through trial and error to predict the words in sentences, sentences in paragraphs and paragraphs in essays. These models also refine their performances according to the feedback from human trainers.

Understanding the LLMs true extent of capabilities, strengths and weaknesses. and the underlying mechanisms that drive them, is imperative. For instance, recommendation of a medicine is brought about with the observed safety and efficacy in clinical trials and understanding the mechanism of action, which allows the clinicians to predict its response in different contexts. Likewise, unravelling the mechanisms of action that drive LLMs behaviour would allow researchers to predict its responses, hence, to select only the beneficial outcomes/tasks.

Further, in light of this awareness, editors of academic journals must now revise their editorial policies to address the challenges that LLMs pose to academic publishing.

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REVIEW ARTICLE

Blended Learning in Human Anatomy Education in Undergraduate Medical Programmes: A Review

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Abstract

Objective: This review aims to evaluate the trends, teaching-learning practices, strengths, limitations, and outcomes of the blended-learning approach in Anatomy education in undergraduate programmes in Medicine.

Methods: An electronic search for literature was done in the MEDLINE database. Original research articles on blended learning in Anatomy, in undergraduate medical programmes, published in English, and available in full text were included, and narrative description and synthesis were done.

Results: Seventeen articles were reviewed, and the majority were published in 2021 and 2022. Blended learning was used in all components of Anatomy courses with different combinations of face-to-face and online teaching-learning methods. Commonly cited benefits of blended learning were higher knowledge acquisition and consolidation, improved self-directed learning, flexibility in time, place and pace of learning, increased motivation, higher level of engagement, and more opportunities to review. The main problems were related to connectivity and interactivity during online instruction. Blended learning courses have generally improved the course outcomes in terms of students' cognitive gain, especially at the knowledge and comprehension level.

Conclusion: Several recommendations were derived from this review. These include proper needs analysis and planning, increasing awareness and provision of training to students and teachers, developing support systems for students and teachers, and continuous monitoring and review of the courses. The need for collaborative planning and development of learning material and teaching-learning activities, with appropriate quality and quantity of the content, systematic and timely delivery and regular evaluation and review were recognized. These recommendations will be useful in planning and successful implementation of blended learning in Human Anatomy courses in medical undergraduate programmes.

Keywords: Blended-learning, Human Anatomy, Medical education

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Introduction

During the last few decades, there has been a pedagogical change in medical education shifting from a teacher-centered, classroom-based education to more student-centered and self-directed learning approaches with increasing use of technology, e-resources and online learning platforms for teaching, learning and assessment (1-3). The COVID-19 pandemic accelerated this transformation, in which most medical schools worldwide adopted online teaching and learning as a major form of curriculum delivery. The approaches and innovations during pandemic showed the possibility of utilizing online learning for the achievement of outcomes and objectives of medical education programmes more efficiently (4,5). However, the common argument is that medical education cannot be offered entirely online, because of the humanistic and practice-based nature of medical training (1). Therefore "blended learning" is becoming a norm in medical education, widely accepted as "the new normal" by medical educators worldwide (6).

Blended learning is described as the combination and integration of face-to-face and online instruction or learning experiences, which allows the use of multiple forms of instruction and communication to suit the different learning needs and learning styles of the community of learners (7). Recent systematic reviews and meta-analyses have shown the effectiveness of blended learning over traditional face-to-face teaching and learning in health professions education concerning educational and course outcomes (8,9). Another meta-analysis conducted in 2013 showed that there is no significant difference in the effectiveness of online learning over face-to-face instruction when offered in isolation, which highlighted the need for integration of face-to-face and online methods of instruction in a blended approach for a better educational outcome (10).

Over the years there has been a gradual decline in the number of course hours dedicated to Human Anatomy teaching (11). Resource constraints in terms of the number of anatomy teachers, student-teacher ratio, availability of space, and other educational materials such as human cadavers for dissections urged a transformation of instructional methods in Anatomy education. Anatomy curricula loaded with didactic lectures, dissections, and histology laboratory sessions are being converted to mixed-method of instruction with the integration of technology-based and online teaching-learning methods (11,12). The COVID-19 pandemic compelled Anatomy teachers to use online-learning methods to substitute or complement face-to-face instruction, which accelerated this pedagogical transformation (13,14). Considering the situational demands for the increasing use of blended-learning in human anatomy education in undergraduate programmes, it is important to review the current practices and their outcomes, prior to any form of curriculum reform to incorporate these blended-learning approaches. Therefore, we conducted this review to evaluate the teaching-learning practices, the strengths and limitations as perceived by the students and teachers, and the outcomes of the blended-learning approach in Human Anatomy education in undergraduate programmes in Medicine.

Methods

An electronic search for literature was done in February 2023, in MEDLINE database in PubMed (https://pubmed.ncbi.nlm.nih.gov) using the keywords and parentheses as specified in Table 1.

Table 1: Literature search syntax in PubMed Advanced Search Builder

Search: ((((((((((("Basic sciences"[Title/Abstract]) OR (anatomy[Title/Abstract])) OR (histology[Title/Abstract])) OR (embryology[Title/Abstract])) OR ("developmental-anatomy"[Title/Abstract])) OR ("microscopic-anatomy"[Title/Abstract])) OR (neuroanatomy[Title/Abstract])) OR (neuroscience[Title/Abstract])) OR ("radiological-anatomy"[Title/Abstract]))) AND ((((((((((("blended learning"[Title/Abstract]) OR ("blended-learning"[Title/Abstract])) OR ("Hybrid learning"[Title/Abstract])) OR ("Hybrid-learning"[Title/Abstract])) OR ("Combined learning"[Title/Abstract])) OR ("Combined-learning"[Title/Abstract])) OR ("Mixed learning"[Title/Abstract])) OR ("Mixed-learning"[Title/Abstract])) OR ("Mixed-method learning"[Title/Abstract])) OR ("mixed method learning"[Title/Abstract])) OR ("Mixed-mode learning"[Title/Abstract])) OR ("Mixed mode learning"[Title/Abstract]))

Only the articles published in English were retrieved. Literature was not filtered by the year of publication, as the review aimed to identify the trends in publications related to blended learning. Titles and abstracts of the retrieved literature were screened first to exclude the publications that are not relevant to the scope and objectives of the review. Only the research articles with primary data were selected. Review articles, commentaries, viewpoint articles and book chapters were omitted in the initial screening. Full text of the articles selected after initial screening were retrieved and screened to identify the literature that is suitable for inclusion in the review.

During the title and abstract screening and full-text screening, articles that are not on undergraduate medical education, not on human anatomy education, or not having direct reference to Human Anatomy education, or not on blended learning (i.e., only on online learning or only comparing online vs. offline learning) were excluded. Extraction of data from the selected articles was done using a data extraction form prepared in Microsoft Excel. Data were summarized in graphical format and into tables, and a narrative review was done.

Results

A total of 79 publications were retrieved by initial database search. Forty-seven articles and 15 articles were excluded in the first and second stages of screening respectively. Seventeen original research papers were selected for the review (Figure 1).

Characteristics of the selected articles are presented in Table 2. Majority of the articles (n=12) were published in the year 2021 and 2022. All the reports were from single-center studies, which were mostly from medical schools in Asia (n=12). Majority of the studies were descriptive studies (n=14), among which nine studies compared the blended learning approach with a conventional

(face-to-face) and/or entirely online approach, either in a different group (intake) of students or in the same group of students at different points within the MBBS course. Three studies were experimental or interventional in design. The reports described the use of the blended-learning approach in different content areas within the Human Anatomy curriculum that include gross anatomy, histology, embryology, radiological anatomy and neuroscience (Figure 2).

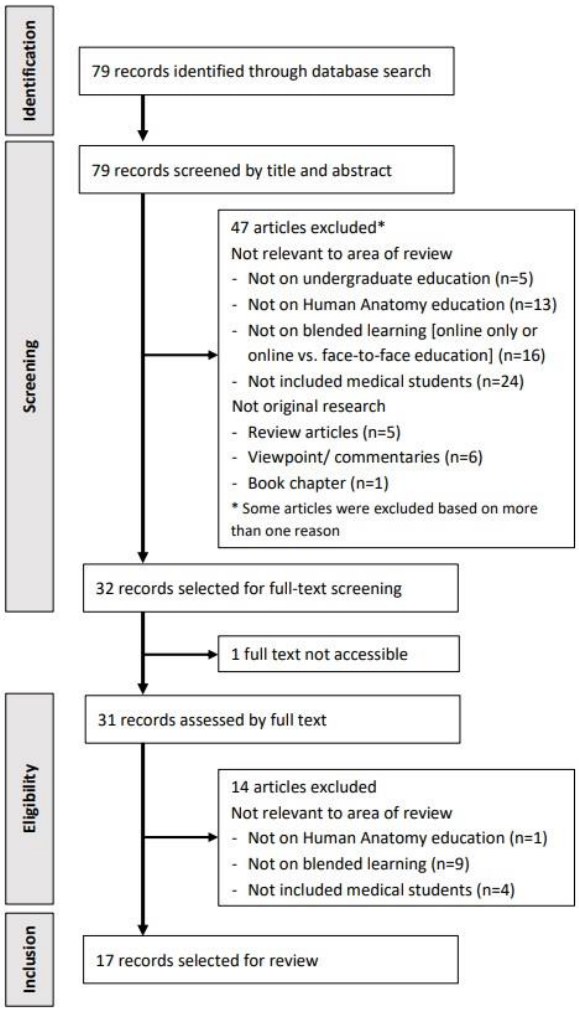

Figure 1: PRISMA flow diagram of the literature review process

A variety of computer-based and online methods have been used in combination with the traditional, face-to-face instructional methods such as lectures, cadaveric dissections and laboratory sessions, tutorials, small group discussions, problem-based learning and case-based learning sessions. The computer-assisted and online methods used in the blended approach in human anatomy education showed a wider range that included recorded lectures, videos, web-based resources, online quizzes, web-based online modules and massive open online courses in Anatomy.

Different face-to-face and online teaching-teaching methods utilized in the blended approach in Human Anatomy education in these studies are presented in Figure 2.

The majority of the studies (n=14) included in this report have evaluated the perceptions of the students regarding the blended-learning approach in Human Anatomy courses through feedback surveys. Perceived strengths and benefits of blended learning in Anatomy education can be grouped into three common themes; namely, the strengths/benefits related to the acquisition and development of learning competencies, related to the learning process, and the instructional material. The most commonly reported benefits of blended learning were the improvement of anatomy knowledge and knowledge consolidation (16,17,19,25-28), promotion of self-directed learning (16,20,22,25,27), flexibility in time, place and pace of learning (16,18,20,22,24,25,27),

Table 2: Characteristics of the articles selected for the review

Reference	Country	Type of study	Subject area	Study population/samples	Sample size (No. of students in the comparison group)
Shaffer and Small, 2004 (15)	USA	Descriptive - comparative	Radiological anatomy	Year 1 medical students (3 intakes - 2 blended)	171 + 169 (168)
Schmidt et al., 2011 (16)	Germany	Descriptive	Microscopic anatomy	Year 1-3 medical students [+dental and molecular medicine]	275 [total 369 students]
Anwar et al., 2017 (17)	Saudi Arabia	Descriptive - comparative	Neuroscience	Year 2 medical students (2 intakes - 1 blended group)	197 (160)
Singh and Min, 2017 (18)	Malaysia	Descriptive - comparative	Gross anatomy of the heart	Year 1 medical students (2 intakes - 1 blended)	200 (197)
Pickering and Swinnerton, 2019 (19)	United Kingdom	Descriptive	Abdominal, gastrointestinal and urinary system anatomy	Year 1 medical students	192
Yoo et al., 2020 (20)	South Korea	Descriptive - comparative	Gross anatomy	Year 3 (pre-clerkship) medical students (2 intakes- 1 blended group)	108 (104)
Nagaraj et al., 2021 (21)	India	Descriptive	Radiological anatomy	Year 1 medical students	150
El Sadik and Al Abdulmonem, 2021 (22)	Saudi Arabia	Descriptive - comparative	Musculoskeletal anatomy	Year 1 female medical students (2 intakes – 1 blended group)	49 (46)
Nathaniel and Black, 2021 (23)	USA	Descriptive	Neuroscience	Year 1 medical students	102

Nathaniel et al., 2021 (24)	USA	Descriptive - comparative	Neuroscience	Year 1 medical (2 intakes - 1 blended)	102 (102)
Sarkar, Sharma and Raheja, 2021 (25)	India	Descriptive	Gross Anatomy	Phase 1 medical students	125
Aristotle, Subramanian and Jayakumar, 2021 (26)	India	Experimental	Histology	Year 1 medical students	150
Bhat et al., 2022 (27)	India	Randomized, interventional	Anatomy of the heart	Phase 1 medical students (3 groups; conventional, online and blended)	150
Guo et al., 2022 (28)	China	Descriptive-comparative	Embryology	International medical students in the preclinical phase	43 (48)
Zhong et al., 2022 (29)	China	Descriptive - comparative	Histology	Year 1 medical students (3 groups; 2 blended)	93 + 146 (89)
El-Din et al., 2022 (30)	Bahrain	Descriptive - comparative	Gross anatomy	Same group of medical students at Year 1 (face-to-face), year 2 (online) and year 3 (blended)	187
Gong et al., 2022 (31)	China	Experimental	Embryology	Year 1 medical students	83 (85)

more opportunities for revision (19-21), and increased motivation (16,18,25,30), and higher level of engagement and participation (18,19,25,30). Learning materials that were user-friendly, clear and focused (15,16,22,25,27), and the material that were clinically oriented (21,25) were perceived beneficial in learning. Higher accessibility of the learning material in the online format was another reported benefit in blended learning (21,27). Commonly reported problems in the blended learning approach were related to connectivity (15,21,27) and interactivity (18,20,27) during online instruction.

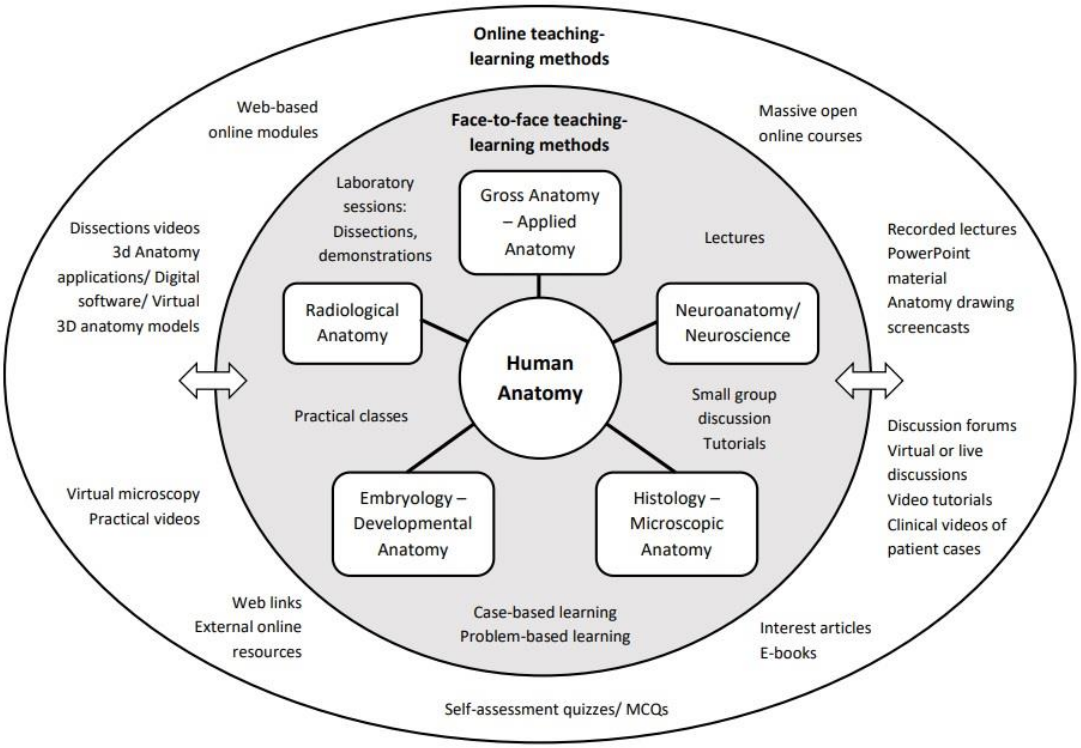

Figure 2: Teaching-learning methods used in blended approach in human anatomy education

Problems related to course structure such as inadequate time allocation (15,25) and higher workload (22), and poor quality of instructional material (15) were also reported. The strengths and benefits, and problems of the blended learning approach in Anatomy education as perceived by medical students are summarized in Table 3. Only two studies have assessed the teachers' perceptions regarding the blended learning approach, which reported positive attitudes of Anatomy teachers and perceived benefits in developing online teaching skills (22,27).

Thirteen studies have evaluated the learning outcome of the blended learning approach in Human Anatomy education, mainly in terms of knowledge gain. Most of the studies reported improved students' performance in blended learning, reflected in higher grades, scores or pass rates in formative and/or summative assessments in Anatomy (17,18,20-23,26-29,31). Two of these studies reported improved performance in the assessment of higher level (i.e., application and analysis) in the cognitive domain (22,31).

Discussion

This review recognized the increasing trend of using a blended learning approach in Human Anatomy education in undergraduate medical curricula, as evidenced by the majority of reports published in 2021 and 2022 during the COVID-19 pandemic. We observed the possibility of using computer-based and online learning resources to supplement the traditional face-to-face teaching-learning

Table 3: Strengths and benefits, and problems in blended learning approach in Human Anatomy education, as perceived by undergraduates in medical courses

Strengths and benefits of blended learning
Related to acquisition and development of learning competencies • Knowledge acquisition and consolidation (16,17,19,25-28) • Self-directed, and active learning (16,20,22,25,27) • Deep learning (25) • Self-development, self-control and accountability in learning (27)
Related to the learning process • Flexibility in time of learning (18,20,25,27) • Self-paced learning (18,21,22,27) • Flexibility in place of learning (16,18,27) • Learning according to individual learning style (20,26,29) • Increased motivation (16,18,25,30) • Participation, engagement and interaction (18,19,25,30) • Repeated review and revision (19-21) • Self-evaluation (22) • Goal setting (19) • Improved attention (25) • Better retention and memory (26)
Related to study material • User-friendliness (15,16,22,27) • Higher accessibility (21,27) • Clarity (15,16,25) • Relevance and focus (15,25) • Clinical orientation (21,25) • Variety (27)
Problems in blended learning
• Lack of interactivity (18,20,27) • Poor connectivity (15,24,27) • Inadequate time allocation (15,25) • Poor quality of online material (15) • Unpreparedness/ fear of independent learning (22) • Higher perceived workload (22) • Procrastination (18)

activities in all the different components/subjects in Human Anatomy curricula. However, the comparative analysis of the effects and outcomes of different combinations of face-to-face and online teaching-learning methods was beyond the scope of this review. Such a comparison will be inappropriate considering the difference in study methodologies (such as study design, control/comparison groups) and the outcomes evaluated in these studies.

In most of the studies reported, the shift to the blended approach in Anatomy teaching was driven by the constraints and demands on medical schools to continue the teaching programmes during the COVID-19 pandemic. Still, this pedagogical transformation has provided added benefits in enhancing students' learning autonomy by promoting self-directed learning, providing flexibility in learning and motivation for learning, in addition to the benefits in knowledge acquisition and consolidation. Integration of face-to-face teaching-learning methods with online methods resulted in increased participation and engagement in learning, with increased communication and interaction with teachers and peers beyond the boundaries of classrooms and timetables, in a relaxed, non-threatening environment. These findings of the review are in agreement with the assertion of a previous review, that blended learning in Human Anatomy education facilitates the development of transversal competencies of the students providing more opportunities for the achievement of overall outcomes of the undergraduate medical education programmes (32). However, the lack of interactivity was reported as a problem in the blended learning

approach in Human Anatomy education in some studies (18,20,27), mainly due to the replacement of some physical teaching-learning activities with online activities, reducing the time for face-to-face interaction with teachers and peers. This highlights the need for careful selection, planning and delivery of online teaching-learning activities and online learning material in a way that promotes communication and interaction among students and with the teachers. Most of the studies reported the continuation of the traditional practice of gross anatomy, histology, radiological anatomy and living anatomy laboratory sessions with instructor-led discussions, small group discussions and small group laboratory activities that provided opportunities for collaboration and communication, and these were well-received by the students in the blended learning courses (15-19,21-24,26,28,29). Several studies reported the use of online discussions forums to compensate for reduced time allocation for in-class interactions (18,22,24,31), and possibility of using social networking and messaging applications to improve communication and interaction in the blended learning approach was also shown (20). Another study reported that educational value of the online discussion forums was increased by the presence of the teacher, compared to the discussion forums that are entirely driven by the students (31). Other issues related to students' participation identified in this review includes unpreparedness and fear of independent learning (22) and procrastination (18). Conducting student's awareness sessions to promote accountability, monitoring students' participation and progression, and personal mentoring and coaching for students were recommended to address these challenges in blended learning (22,25,27).

One of the objectives of the blended learning in anatomy education is the effective utilization of the limited time allocated for Anatomy teaching and learning in the medical curricula nowadays. However, few studies reported the higher perceived workload and time requirement by the students in the blended Anatomy courses (15,22,25). Some studies provided recommendations for delivering the online content earlier and well ahead of the face-to-face teaching-learning activities (24,25), and reduction of duration and information density of the online sessions (15,25).

The review describes the positive impact of blended learning in human anatomy education in terms of learner satisfaction, and learning outcomes mainly in the lower levels of cognitive domain (i.e. knowledge and comprehension). Two studies reported that the medical students who followed blended learning courses in Anatomy performed better in questions designed at the application and analysis level (22,31). More research has to be conducted to evaluate the effect of blended learning in the achievement of higher-level learning outcomes in the cognitive domain and the higher level of the Kirkpatrick's evaluation model (i.e., behavior and results) (33). There are contrasting evidence regarding the impact of students' level of engagement with online content on their performance, and it is likely that not only the course-related factors, but also some external factors affect the students' level of engagement in online content, having

an indirect effect on the student's performance (19,34). One of these factors commonly cited in literatures was the problems related to access to online content, mainly due to the problems in connectivity (15,24,27), which has to be considered in designing the online material and deciding on the timeframe for online activities.

There is a scarcity of information related to attitudes and perceptions of teachers, and the challengers they encounter in the blended Human Anatomy courses. We recognized the need for future research to evaluate teachers' perspectives of blended learning in Human Anatomy education, which is vital for the planning and implementation of blended learning courses.

Based on the experience on blended learning in Human Anatomy education at many medical schools worldwide, several key points for the successful implementation of blended learning can be identified. First, a comprehensive needs analysis and an analysis of the contextual factors influencing the successful implementation should be conducted. A suitable model of blended learning has to be selected considering the needs and the contextual factors at each institution, and the overall programme and the curriculum structure and timeline. Awareness and training sessions should be conducted for the students, teachers and administrators of the courses to increase receptiveness, preparedness, and acceptance of the new models. Students' engagement, progression and achievement of learning goals should be continuously monitored. A formal mechanism for mentoring and coaching should be established. Regular feedback from the students and teachers should be obtained and there should be a continuous review and evaluation of the programme. Moreover, there should be training opportunities and a support system for teachers/instructors in the blended learning programmes. Several recommendations with regard to the course material development, and the delivery of teaching-learning activities for blended learning courses in Anatomy originated from this review. Course material and teaching-learning activities should be planned and delivered in a way that promotes collaborative learning and communication. The type and amount of information and the quality of the material should be carefully reviewed by a panel of teachers and the timing of delivery should be carefully planned. Continuous reviewing, evaluation and obtaining students feedback on learning material were recommended. There should be regular and frequent formative assessments and other activities for self-evaluation and feedback.

This review is based on articles retrieved by searching a single database, therefore may have not produced an exhaustive list of relevant articles. A secondary search for cited references in selected articles and a search for grey literature were not done. We have followed the standard process of literature search and screening for systematic review but intended to produce a narrative review of the literature to provide an overview of the current practices, trends, strengths, and limitations of the blended learning approach in Human Anatomy education.

Conclusion

The review recognized the prevailing trend in using a blended learning approach in Human Anatomy education in medical undergraduate programmes, in many different settings both in Asia and the West. Possibility of employing blended learning in the delivery of all the components in Anatomy courses was observed, and various combinations of many different face-to-face and online instructional methods were used simultaneously or sequentially. Blended learning in Anatomy education was well-received by the students, citing many strengths or advantages, despite the problems in connectivity and interactivity experienced in some settings. Outcomes of the blended learning were generally positive, in terms of the students' satisfaction and cognitive gain, however the need for the evaluation of higher levels of course outcomes were recognized. Moreover, there is a requirement to evaluate teachers' perspectives in blended Human Anatomy courses. Several recommendations were derived from the discussion of findings of the reviewed articles. These include the conducting needs analysis, proper planning, increasing awareness and provision of training to students and teachers, developing support systems for students and teachers, and continuous monitoring and review of the courses. The learning material and teaching-learning activities have to be developed collaboratively, with appropriate quality and quantity of the content, delivered systematically in a timely manner, and should be regularly reviewed and adapted based on feedback. The findings and recommendations of this review will be useful in planning and successful implementation of blended learning in Human Anatomy courses in medical undergraduate programmes.

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Authors' contributions: CSP carried out the literature survey and drafted the manuscript. KNM critically revised the manuscript and approved it. All authors read and approved the final manuscript.

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ORIGINAL RESEARCH

Students' perception on cadaveric dissection in learning gross anatomy for clinical application: Development of a tool using DELPHI technique

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Abstract

Anatomy remains key for learning other disciplines in medicine and forms the basis for good clinical practice. Gross Anatomy is an integral part of anatomy curriculum which is taught through different teaching methodologies including cadaveric dissection. This method has many advantages as well as limitations. Since the attendance for gross anatomy practical is compulsory for the students for medical institutions such as that of University of Jaffna, Sri Lanka, the actual perception of students towards dissection is not known. In addition, perception of students towards application of learnt gross anatomy in the clinical setting is important in designing / reviewing the anatomy curriculum. Thus, the main objective of this study was to develop a tool to measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application.

A two round - DELPHI survey was chosen to develop a tool by establishing consensus among experts. Extensive literature survey was carried out to obtain relevant input to prepare the draft of the research tool. The participated experts were professors in anatomy, surgery, English language and medical education. A six – point Likert scale tool was finalized subsequent to two rounds of DELPHI technique, and its subsequent application among thirty recent graduates. Anonymity was maintained throughout the whole process.

Key words: Cadaveric dissection, perception, DELPHI, tool

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Introduction

Anatomy is a basic medical science remains key for learning other disciplines in medicine and forms the basis for good clinical practice. A general course in this subject, involving dissection of the whole body, should be taught for the first-year medical students. Further, this course should be able to yield sufficient understanding of anatomy to the medical students while addressing its importance and complexities (1). Conventionally, anatomical science in the allopathic medical curriculum comprises the topographical (also known as gross or macroscopic) anatomy, histology and developmental anatomy. The topographical anatomy can be divided into surface anatomy, neuroanatomy, regional anatomy, endoscopic and imaging anatomy (2). The contemporary anatomy curriculum is enriched with relatively newer areas, for example, the genetics (3, 4, 5).

The macroscopic anatomy is taught through different teaching methodologies such as cadaveric dissection, demonstration with prosected specimens and plastic models, didactic lectures / tutorials (chalk and board method, power point presentation etc.), plastinated human bodies, three-dimensional imaging via computer programmes (e.g., virtual dissection models), audio visual materials (e.g., pre-recorded videos on dissection), body painting, and ultrasound imaging etc. (6, 7). As each method has its own advantages and limitations, medical institutions choose methods appropriate for them to teach anatomy subjected to their curriculum, financial allocations, and availability of qualified staff etc. Criteria for body donation established in many medical faculties of Sri Lanka, if not all, highlights the importance given for cadaver – based education in the country.

Cadaveric dissection

Cadaveric dissection can be described as the "systematic exploration of a preserved human cadaver by the sequential division of tissue layers and the liberation of certain structures by removal of the regional fat and connective tissue with the aim of supporting the learning of gross anatomy by visual and tactile experience" (8). The practice of cadaveric dissection had its roots in 3rd century BC in ancient Greece but disappeared during the Middle ages due to religious and popular beliefs, and subsequently revived in early 14th century in Italy. Since then, its evolution in Europe and United States of America occurred over the centuries (9). Cadaveric dissection is regarded as an essential and valuable tool in the pedagogy of macroscopic anatomy as it permits the students to observe, palpate and move different parts of the human body (10).

Granger (2004) denoted that the "anatomy dissection laboratory is often where the process of professional acculturation is initiated, fostering knowledge, skills, attitudes, values, and behaviors that will enable physicians to function appropriately within their chosen discipline" (11). It provides a superlative opportunity for students to create a three-dimensional mental image on the organization of the human body consistent with gender and age. Cadaveric dissection permits hands on experience and exploration of different body parts (organs / structures,

tissues etc.) and acquiring manual dexterity. The pre-registration house officers (PRHOs) viewed that the cadaveric dissection should form an important part of any medical curriculum (12).

A thorough anatomical knowledge is fundamental to perform clinical examination (such as hepatomegaly, splenomegaly etc.), interpretation of radiographs, and for surgical management. Medical procedures such as pleural aspiration, blood gas sampling, femoral venepuncture also demands basic anatomical knowledge for their safe execution.

The learning experience gained through the cadaveric dissection sessions likely develop many important practical skills and qualities which are required for a future medical practitioner for a safe and efficient medical practice. The advantages of cadaveric dissection include but not limited to: 1. Development of eye-hand coordination, and training on proper use of instruments during dissection sessions tend to develop personal practical skills, for example that of surgical skills (11, 13) in a stress-free environment; 2. It enables teaching of whole-body pathology (14); 3. It is an opportunity to teach moral and ethical issues to the students (14) by addressing their emotional responses towards their cadavers and their first (for many) confrontation with death and dying of human beings (11); 4. Enhancing critical and logical thinking (13); 5. Enabling the students to come to grips with mortality (15); 6. Enabling the students to appreciate the anatomical variations (12) in order to differentiate them from pathological abnormalities (15); and 7. Early introduction to team work (12) enable them to work as a team in their future clinical practice. In addition, cadavers are also utilized for medical research and to train medical students in medical procedures.

Cadaveric dissection has its own limitations as related to teaching macroscopic anatomy. Apparently, it is not the best choice for teaching certain essential areas, for example, anatomy of skeletal system, muscular system (i.e., when in the contracted state), nervous system (especially the smaller nerves), lymphatic system (particularly lymphatics), and of small or indistinct organs (e.g., the adrenal gland, the parathyroid glands, the pineal gland etc.). Another important constraint is related to studying surface anatomy (14). Moreover, it is a time-consuming exercise which demands a considerable allocation of teaching hours in the busy medical curriculum, and the undesirable effects of preservatives.

Cadaveric dissection in the Anatomy curriculum

The last revision of the undergraduate medical curriculum of the Faculty of Medicine, University of Jaffna, Sri Lanka resulted in significant reduction (25.5%) of anatomy curriculum from 659.5 hours (older curriculum) (16) to 491 hours (revised curriculum) (17, 18). Prior to the curricular revision, anatomy contributed 44.8 credits to the medical curriculum which is approximately 15.9% of the total credits of the overall medical curriculum. Moreover, this (i.e., 44.8 credits) was the highest academic credit offered by an academic department in the said institution. It is noteworthy that the

participants (recent graduates) included in the validation of the tool had studied anatomy in the older curriculum.

The teaching / learning process of macroscopic anatomy in the older curriculum encompasses pre-dissection lectures /discussions, dissection sessions, and post-dissection tutorials. The revised curriculum does involve lectures and tutorials but fails to emphasize the time of delivery in connection with the dissection. Most importantly, in the older curriculum, the practical hours allocated to teach macroscopic anatomy were solely utilized by cadaveric dissection exercise (318 hours). But in the revised curriculum, along with dissection other methods namely "learning through prosected specimen (LPS)" and "small group discussion (SGD)" are also included in the practical hours designated for macroscopic anatomy (222 hours). The didactic lectures on gross anatomy, radiology, and applied anatomy are common features of both curricula.

Attendance for the tutorial (including gross anatomy), and gross anatomy practical is mandatory where students should have at least 80% overall attendance (all four terms collectively - in both categories separately) to qualify to sit for the Phase 1 examination while attendance for didactic lectures including pre-dissection lecture (/discussion) is not considered to determine the eligibility.

At present, Sri Lanka has neither a core curriculum (18) nor a national guideline to standardize the method and period of teaching different components of anatomical science (including cadaveric dissection) among the Universities in Sri Lanka. At this circumstance, since the attendance for cadaveric dissection was made compulsory for the expected participants of the study, the actual perception of students towards dissection (i.e., interest, views on its advantages, disadvantages, importance of the dissection, alternate methods, allocated time etc.,) is not known. As alternate or complementary methods for dissection are being suggested and / or implemented, it is important to measure the student's perception on cadaveric dissection in learning gross anatomy for clinical application. It will enable the medical educators to review and define the contribution of dissection in the modern medical curriculum for teaching anatomy.

Requirement of a research tool

To our best of knowledge, there is no standardized tool to measure the student's perception on cadaveric dissection in learning gross anatomy for clinical application. Therefore, by employing DELPHI method a six-point Likert scale research tool was developed for such purposes. This tool would be beneficial not only for the medical faculty of the University of Jaffna but also for other medical institutions which follow different curriculums involving various extent of cadaveric dissection. The objective of this study was to develop a tool using DELPHI technique to measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application.

Materials and methods

Extensive literature survey was performed to obtain relevant input for the DELPHI study and based on which draft of the research tool ("draft tool") was prepared. Ethical clearance for the study was obtained from the ethics review committee (ERC) of the Faculty of Medicine, University of Jaffna, Sri Lanka. The study was conducted in Sri Lanka.

In case of draft tool, the format of a six-point level Likert scale was derived where Likert item is coded with a numerical notation assigning 1 to strongly disagree, 2 to disagree, 3 to slightly disagree, 4 to slightly agree, 5 to agree and 6 to strongly agree. It had three main categories; 1. Learning gross anatomy, 2. Reflection of skills and perceptions, and 3. Suggestions. Each category had different number of statements / questions (total of 27) drafted in accordance with the objectives of the study based on the literature survey. Experts were expected to place their observation on the tool. All the Likert items are open ended in order to accommodate possible comments from the respondents on a particular statement / question and, adequate space was also provided at the end of the draft tool for any other suggestions. All unattended statements were considered as accepted.

The DELPHI method

The DELPHI method, a common technique used to achieve consensus among experts on a specific problem, was used in this study. The structured DELPHI procedure described in the scientific literature (19,20) was adopted in accordance with the objectives of the study to reach consensus among the panelists through the process of information feedback and iteration.

Table 1: Experts selected for the DELPHI technique

Classification	Expertise	Description	Gender	Qualifications
Group 1	Senior anatomists	One expert from three different medical institutions in Sri Lanka	Male: female = 2:1	Professor or Senior Professor or Professor Emeritus
Group 2	Consultant surgeons	Three experts from two different medical institutions in Sri Lanka	All males	
Group 3	Senior academics in English Language	One expert from two different Universities in Sri Lanka	Male: Female = 1:1	
Group 4	Medical educationist	One expert	All males	

Selection of DELPHI panel

The expert panel for the DELPHI technique comprised a group of senior anatomists, consultant surgeons, senior academics in English language and a medical educationist from different state universities in Sri Lanka. The experts were selected based on their expertise in the relevant field considering their academic and professional qualifications, experience in teaching and their research capacity, and other applicable qualifications. Details pertaining to the selected experts are given on table 1.

At the commencement of the study, the request to serve as an expert in the DELPHI procedure was forwarded via the electronic mail (e-mail) to all the potential experts – individually – in order to obtain their consent for participation in the study. Further clarification related to the study was made via email and / or over the phone whenever requested by the experts. All except one expert gave their consent for their participation in the study. Subsequently, suitable replacement was made after obtaining informed consent. Anonymity was maintained throughout the DELPHI study by communicating the participants individually through their respective email address. Provision for feedback and opportunity to revise earlier responses obviously requires that the technique has at least two rounds.

In the first round, the draft of the tool was circulated among the consented experts through e. mail individually (e [electronic] DELPHI survey). The panelists were requested to forward their responses before a stipulated date. However, only 3 out of 9 panelists responded prior to the date specified. Recirculation of tool was carried out to many of remaining experts in order to obtain the responses. The observations forwarded by the experts were summarized and critically analysed by the investigators. All appropriate opinions or suggestions or recommendations were addressed and considered in amending the tool.

During the second round of DELPHI technique, the amended tool was circulated again among all the experts for their observations, suggestions (if any). The concerns / suggestions / recommendations of all the responded experts were summarized. All the valuable views were considered in revising the amended tool for the development of final (DELPHI) version of the tool.

The DELPHI tool was finalized subsequent to its administration among 30 recent graduates of the Faculty of Medicine, University of Jaffna. Informed consent was obtained from the recent graduates prior to their recruitment in the study. Their valid observations / suggestions were considered in preparing the final research tool (Table 2).

Results

The act (and art) of cadaveric dissection has the potential to deliver anatomical knowledge, practical skills, and moral and ethical values central for the medical profession. Its importance in teaching/learning anatomy has been widely accepted and advocated. But it is not without its limitations. Its known disadvantages, along with reduction in the

Table 2: Tool to measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application

No.	Response	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
A.	**Learning Gross Anatomy**						
1.	1.1. Cadaveric dissection in general **(performed as a group)** enhanced my understanding of gross anatomy						
	1.2. Cadaveric dissection **performed by me (**in the group**)** enhanced my understanding of gross anatomy						
2.	Pre-dissection lectures enhanced my learning of gross anatomy						
3.	Cadaveric dissection provided an opportunity to comprehend three-dimensional gross anatomy						
4.	Cadaveric dissection helped me recall gross anatomy that is required to solve clinical problems during the clinical appointments.						
5.	Cadaveric dissection enabled me to obtain the basic skills required in learning surgery						
6.	Cadaveric dissection expanded my understanding of the anatomical basis of traumatic injury						
7.	Cadaveric dissection expanded my understanding of medical emergency procedures						
8.	Cadaveric dissection made medical education interesting for me						
9.	My absence (if any) from a few dissection sessions had a negative impact on my learning of gross anatomy						
10.	Demonstrations during dissection sessions improved my understanding of gross anatomy						
B.	**Reflection of Skills and Perceptions related to cadaveric dissection.**						
11.	It made me respect the generosity of the individual who donated the body						
12.	I am satisfied with the way it was carried out						
13.	It improved my communication skills						
14.	It improved my abilities to work in a team						
15.	I had experienced great physical discomfort during the cadaveric dissection						
16.	The smell was unpleasant to me						
17.	It made me spend more time to learn gross anatomy compared with other methods						
18.	It was very stressful to me						
19.	It is difficult to correlate the macroscopic features of structures in the cadaver with those of the patients.						
20.	I was worried about the possible health hazards due to the chemicals used as preservatives.						
21.	It made me think about death						
C.	**Suggestions related to cadaveric dissection**						
22.	It should be completely **removed** from the medical curriculum						
23.	It should be **preceded** by pre-dissection lectures						
24.	It should be **replaced** by lectures aided with visuals						
25.	It should be **facilitated** by good computer programs (e.g., 3D Atlas, Videos)						
26.	It should be **replaced** by prosected gross specimens						
27.	It should be considered as the best method of learning gross anatomy						
28.	It should be **followed by** post- dissection tutorials						
29.	It should be **facilitated** with prosected gross specimens						
30.	It should be **replaced** by plastic models						
31.	It should be **facilitated** with plastic models						

Any other suggestions / comments:

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anatomy teaching hours and introduction of alternate methods, leads to confusion among the contemporary anatomists in determining the best educational tool for anatomy education.

First round

All experts (100%) responded to the first round of DELPHI. An expert stated as "good tool to assess the perception of the students, can be accepted without any modifications". Two other experts gave suggestions and also indicated as "please proceed and administer the questionnaire" (expert 1) and "looks like an interesting study" (expert 2). Some statements / questions were even criticized as "non-specific" and "very vague". An expert suggested reordering of questions/ statements along with other observations. The amended tool, irrespective of individual observations, was circulated to all the experts individually.

Second round

For the second round, the response rate was 44.44% (4 out of 9). One expert notified along with his suggestions as "now no need to show me again, proceed with your work" whereas another expert expressed his or her difficulty due to sickness. Available feedback was analyzed and necessary amendments were made to finalize the (DELPHI) tool.

Recent graduates

Thirty recent graduates participated in the DELPHI study. Their valid observations / suggestions were considered in finalizing the tool. As per the observations made in their perfected tools certain modifications were made, for example, removing open space for individual questions / statements. The tool was finalized (table 2).

Discussion

The finalized research tool (table 2) is organized into three sections: 1. Learning Gross Anatomy 2. Reflection of skills and perceptions related to cadaveric dissection; and 3. Suggestions related to cadaveric dissection. Each section is made up of 10, 11 and 10 statements / questions respectively. The tool follows the force – number Likert scale which avoids the middle response scale (21) which is appropriate for the purpose of the tool, therefore remain unchanged. Adequate space is provided at the end of the tool for any other suggestions / comments.

The instruction for the intended participants, included in the finalized tool (table 2), is as follows: "Dear participant, Thank you very much for your consent to participate in the study titled as "Measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application by developing a tool and determine the factors associated with students' perception on cadaveric dissection". The following self-administered research tool is used to measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application. Please express your own opinion on the following statements / questions regarding the Gross Anatomy / Cadaveric dissection performed during the Phase 1 (Pre-clinical studies) of the Medical Curriculum of the Faculty of Medicine, University of Jaffna.

Please indicate your single opinion by inserting a (√) in the relevant cage".

The Nominal Group Technique (NGT) and the DELPHI method were the two common methods that can be used to attain an expert consensus on a research problem (20). The former method was not considered due to it is limitations as related to this study. Thus, the tool was developed through DELPHI method as described. The e-DELPHI method provided opportunity to include experts live across diverse locations in the country. The strict maintenance of anonymity among the experts throughout the study would prevent dominance over others' opinion resulting from professional status, seniority, administrative superiority and strong verbalization of any panelists. It enables the individual experts to change their opinion in the future rounds of DELPHI method based on others opinion without publicly admitting their stand.

One of the advantages of the study is all the experts recruited were professors or senior professors or professor emeritus who are expected to have sufficient knowledge in their area of expertise. On the other hand, response time for giving their consent, and thereafter in presenting their views in both rounds consumed more time than expected for some experts likely due to their academic and / or professional commitments. As this study was based on e-mail communications, their non-verbal reflections could not be recorded unlike other qualitative methods (22).

Conclusion

A six – point level, Likert scale, self-administered research tool was prepared through two rounds of DELPHI study, and its subsequent administration among thirty recent graduates. This tool can be used to measure the students' perception on cadaveric dissection in learning gross anatomy for clinical application at medical institutions where cadaveric dissection is at least a part of curriculum.

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ORIGINAL RESEARCH

Assessment of Overweight, Obesity and Malnutrition Status of *Purana* (old) Population Residing in Sigiriya, Sri Lanka.

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Abstract

Objective: The "*Purana*" population in Sri Lanka, a genetically distinct group with origins in the Sinhalese Kings of the 5th century A.D, lives near the Sigiriya Bolder Garden complex. Limited evidence exists on the prevalence of overweight and obesity among this population. This investigation aims to study the prevalence of overweight and obesity among adult "*Purana*" individuals.

Methods: *Purana* villagers in Talkote, Pidurangala, Diyakepilla, and Nagalaweva, near the Sigiriya Bolder Garden complex were selected for the study and 107 men and 199 women were recruited to the study based on ancestry, with *Purana* pedigrees traced back at least three generations. Informed consent was obtained from participants. A single observer recorded height, weight, and mid-waist circumference measurements of selected individuals. Each measurement was repeated three times and mean values were taken. BMI values were calculated. Obesity, overweight, malnutrition of each individual was determined by using calculated BMI and waist circumference based on global and South Asian cutoff values.

Results: 33.6%, 55.1%, 9.3% and 1.9% of the male adult population was underweight, normal weight, overweight and obese respectively concerning global BMI cutoffs. 33.6%, 43%, 20.6% and 2.8% of male adult population was underweight, normal weight, overweight and obese respectively concerning Asian BMI cutoffs. 17.6%, 62.3%, 17.6% and 2.5% of female adult population was underweight, normal weight, overweight and obese respectively concerning global BMI cutoffs. 17.6%, 49.7%, 24.1% and 8.5% of female adult population was underweight, normal weight, overweight and obese respectively according to Asian BMI cutoffs. 28% of males were obese while 47.2% of females were obese with reference to waist measurements.

Conclusions: In comparison to the urban populations in Sri Lanka, the male and female *Purana* inhabitants of Sigiriya showed a low prevalence of overweight and obesity.

Keywords: Obesity; Overweight; "*Purana*" population; Sigiriya; Sri Lanka

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Introduction

Over 4 million people die each year as a result of obesity and overweight, which pose health risks because of excessive fat buildup in body tissues and are of epidemic proportions (1). Overweight and obesity rates in adults and children increased from 4% to 18% globally from 1975 to 2016, with children and adolescents aged 5-19 experiencing a four-fold increase (1). The double burden of malnutrition includes obesity, and today, everywhere but sub-Saharan Africa and Asia, more people are obese than underweight (1). Overweight and obesity are increasing rapidly in low- and middle-income countries, especially urban areas. The majority of overweight or obese children are in developing countries, where the rate is over 30% higher than in developed countries (1).

Malnutrition involves deficiencies, excesses, imbalances, and impaired nutrient utilization, causing undernutrition, overweight, obesity, and diet-related noncommunicable diseases, posing a double burden (2). Obesity is a growing health problem in both developed and developing countries including Sri Lanka (3). Excess body fat is linked to an elevated metabolic risk, therefore measuring it is crucial for both therapeutic and preventive health treatments (4). Body Mass Index (BMI) is a common and widely utilized measurement technique used all over the world to determine obesity and malnutrition (4,5). According to WHO guidelines, a body mass index (BMI) of over 25 is generally regarded as overweight, and a BMI of over 30 is regarded as obese (1). Indigenous (*Vadda*) population in rural areas and a new generation of *Vadda* people in urban areas and other urban populations residing in different major cities of Sri Lanka on obesity and malnutrition, it was reported that obesity and diabetes were substantially less common among *Vadda* people than in the rest of the country and a third of this population has a BMI of less than 18.5 kgm^2(6). According to a study conducted in Sri Lanka between 2013 and 2014, the high prevalence rates of overweight and obesity in working-age males are a dangerous indicator for the country (7). Another Study shows a higher prevalence of overweight and obesity among higher-income individuals (8). Research on obesity and malnutrition prevalence in Sri Lanka's urban, rural, and *Vadda* population groups has shown limited progress. A study in Colombo district for the metropolitan population regarding the prevalence of obesity and overweight found 8.1% underweight males and 7.4% females, according to global and Asian cut-off values (3).

With higher rates of noncommunicable diseases like diabetes, hypertension, and heart disease, the *Purana* community is a genetically isolated middle-class population in the suburbs of Sigiriya. In order to better understand their health risks and potential interventions to manage or prevent these conditions, this study aims to evaluate their level of overweight, obesity, and malnutrition. The study seeks to close a knowledge gap and enhance the health outcomes and quality of life for the *Purana* community by identifying and evaluating their health status.

The Sigiriya Bolder garden complex is home to a small *Purana* population that dates back to the Sinhalese Kings of the 5th century A.D. (1,450 YBP). They are currently recognized by their *'Purana'* surnames, such as "Aluthgedara, Gamagedara, Undiyagedara, Beddegedara, Millagahagedara, Kongahagedara" etc. They maintain a caste system through intermarriages within the community and are considered isolated breeding units with extended family endogamy (9).

The *Purana* community in rural villages in Sigiriya, Sri Lanka, faces potential risks of inheritance genetic disease, noncommunicable disease, and nutritional defiance disorders. Limited information exists on predisposing factors like lifestyle patterns, nutrition status, overweight, obesity, and malnutrition. This study aims to study the overweight, obesity, and malnutrition status of the *Purana* population in Talkote, Pidurangala, Diyakepilla, and Nagalaweva.

Materials and Methods

A cross-sectional survey was conducted in 2018 on a randomly selected sample of one hundred and seven (107) males and 199 females adult *Purana* inhabitants living in the four *Purana* villages who belong to *Purana* pedigrees to determine the obesity and malnutrition status of adults in *Talkote, Diyakepilla, Pidurangala* and *Nagalaweva* at Sigiriya suburbs. The sample size was calculated using the Cochrane formula for the unknown population ($n=(z^2pq)/d^2$). An updated electoral register obtained from the Grama Niladhari division was used as the sampling reference. The *Purana* individual selection was based on the *Purana* pedigree recorded in the survey conducted at *Purana* villages in Sigiriya suburbs in 1981. The selected pedigrees such as *Gamagedara, Aluthgedara, Undiyagedara, Liyanagedara* and *Beddedara* which represented the *Purana* population in *Talkote, Pidurangala* and *Diyakepilla* villages were traced back to at least three generations. *Millagahagedara, Kongahagedara* and *Aluthgedara* pedigrees which represented the *Purana* population in *Nagalaweva* village also were traced back to three generations. The selected individual was marked in the updated electoral register obtained from each Grama Niladhari division and They were randomly selected for the study. The selected individual was given the opportunity to give their informed consent before being enrolled in the study.

Individuals with psychiatric/cognitive disorders or language barriers, individuals who were extremely debilitated or participated in the pre-test and pregnant or lactating mothers were excluded from data collection. The height and the weight of selected individuals were measured according to the methods described in NHANES (National Health and Nutritional Examination Survey, 2007) by using a stadiometer and digital weighing scale respectively. The body mass index (BMI) of each individual was calculated using the recorded height and weight of each individual.

The study population was grouped as underweight, normal weight, overweight and obese by applying the global cutoff values define underweight (BMI < 18:5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2),

overweight (BMI 25- 29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2) and Asian BMI cutoff values define underweight (<18.5kg/m^2), normal weight (BMI 18.5-22.9 kg/m^2), overweight (BMI 23-27.49 kg/m^2), and obese (BMI ≥ 27:5 kg/m^2).

Waist circumference was measured according to the WHO guidelines (WHO 2008a; WHO, 2008b), using a measuring tape. The measurement was taken at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest according to the WHO STEPS protocol for measuring waist circumference. With reference to WHO cut-off values, the population was grouped as overweight, obese or malnourish. Socio-demographic details were attained under the consent of the population which included age, sex, education level, marital status, household, employment, and income.

Ethical clearance was obtained from the ethical review committees of the Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka for the study. Permission to conduct the study was obtained from relevant authorities in the Grama Niladhari division and the Provincial government. An information sheet was provided prior to the invitation to participate in the survey and written consent was obtained from all participants.

Results and Analysis

The mean age of the male population was 51.17 years old, and female was 46.73 years old. The mean height and weight of the males were 1.6559m and 56.2337kg respectively and also the mean height and the weight of females were 1.5302m and 51.3769kg respectively. The mean BMI of the male population was 20.5038 kgm^{-2} and female was 21.9299 kgm^{-2}. 18.92% and 6.19% were obese and overweight without considering gender with reference to calculated BMI. The mean waist circumference of males was 0.9079m and females was 0.8628m.

Table 1: Distribution of male BMI values according to the global BMI cutoffs

	No	%	Valid %	Cum %
underweight	36	33.6	33.6	33.6
normal	59	55.1	55.1	88.8
overweight	10	9.3	9.3	98.1
obesity	2	1.9	1.9	100.0
Total	107	100.0	100.0	

*Cum % - cumulative percentage

A total of 33.6%, 55.1%, 9.3% and 1.9% of the male adult population was underweight, normal weight, overweight and obese respectively concerning global BMI cutoffs (Table 1). 33.6%, 43%, 20.6% and 2.8% of the male adult population was underweight, normal weight, overweight and obese respectively concerning Asian BMI cutoffs (Table 2). A 28% of males were obese concerning waist circumference (Table 3). 17.6%, 62.3%, 17.6% and 2.5% of the female adult population was underweight, normal weight, overweight and obese respectively concerning global BMI cutoffs (Table 4). 17.6%, 49.7%, 24.1% and 8.5% of the female adult population was underweight, normal weight, overweight and obese respectively according to Asian BMI cutoffs (Table 5).

47.2% of females were obese with reference to waist measurements (Table 6).

Table 2: Distribution of male BMI values according to the Asian BMI cutoffs

	No	%	Valid %	Cum %
underweight	36	33.6	33.6	33.6
normal	46	43.0	43.0	76.6
overweight	22	20.6	20.6	97.2
obesity	3	2.8	2.8	100.0
Total	107	100.0	100.0	

*Cum % - cumulative percentage

Table 3: Distribution of male waist circumference values

	No	%	Valid %	Cum %
<90cm	77	72.0	72.0	72.0
>90cm	30	28.0	28.0	100.0
Total	107	100.0	100.0	72.0

*Cum % - cumulative percentage

Table 4: Distribution of female BMI values according to the global BMI cutoffs

	No	%	Valid %	Cum %
underweight	35	17.6	17.6	17.6
normal	124	62.3	62.3	79.9
overweight	35	17.6	17.6	97.5
obesity	5	2.5	2.5	100.0
Total	199	100.0	100.0	17.6

Table 5: Distribution of female BMI values according to the Asian BMI cutoffs

	No	%	Valid %	Cum %
underweight	35	17.6	17.6	17.6
normal	99	49.7	49.7	67.3
overweight	48	24.1	24.1	91.5
obesity	17	8.5	8.5	100.0
Total	199	100.0	100.0	17.6

*Cum % - cumulative percentage

Table 6: Distribution of female waist circumference values

	No	%	Valid %	Cum %
<80cm	105	52.8	52.8	52.8
>80cm	94	47.2	47.2	100.0
Total	199	100.0	100.0	52.8

*Cum % - cumulative percentage

Discussion

According to this study, 62.3% of women and 49.7% of men have BMIs that are within the normal range when measured using global cutoffs, whereas 55.1% of men and 43% of women have BMIs that are within the normal range when measured using Asian cutoffs. Males of the *Purana* population are less likely to be obese (1.9% according to the global cutoffs and 2.8% according to the Asian cutoffs) than females (2.5% according to the global cutoffs and 8.5% according to the Asian cutoffs).

When compared to the study done on the "prevalence of obesity in Sri Lanka at the national level" survey with our results. The *Purana* adults' obesity and overweight without considering gender (Obesity 18.92% and overweight 6.19%) is lower than that of Sri Lankan adults (obesity 25.2% and overweight 9.2%) according to the Asian BMI cutoffs (7). Reported waist measurements of the urban population of Colombo revealed a high incidence of obesity in males (40.0%) and females (66.4%) respectively (3). However, the prevalence of male obesity in this study is 28% in adult males and 47.2% in adult females and figures are lower than that of the urban population living in Colombo.

Many researchers have attempted to reveal overweight and obesity in a variety of communities in Sri Lanka, mostly they focused on the *Vadda* and urban populations. According to a study conducted in 2016 among the indigenous (*Vadda*) population, males were 15% overweight and 2.5% obese, while females were 19.6% overweight and 3.9% obese according to the Asian BMI value. They found that the prevalence of overweight and obesity among the *Vadda* group was lower than that of Sri Lanka's rural population (6). With comparing to our study finding with *Vaddas* study findings, obesity and overweight of males and females of the *Purana* population (males - 20.6% overweight and 2.8% obese, females - 24.1% overweight and 8.5% obese) is higher than that of the *Vadda* community. As *Vadda* engages in a more active lifestyle in hunting and gathering that involves strenuous work in fields. They consume more energy for their daily activities, which increases the probability that they will have less overweight and obesity (6). As there will likely be a transition in the lifestyle of *Purana* Population from hunting and gathering to cultivation. In comparison to *Vedda*, *Purana* Population shows a higher prevalence of adult obesity and overweight.

One-third of the people of the city were overweight or obese, according to studies conducted in the urban suburbs of Colombo (3). 34.3% of people were overweight and 31.2% of people were obese based on Asian cutoff values. It was reported that overweight and obesity of males were 37.0% and 15.8%, respectively, according to the global BMI cutoffs and 34.3% and 31.2%, respectively, according to the Asian BMI cutoffs (3). However, in our study, 2.8% of males were obese and 20.6% of males were overweight according to Asian BMI cutoffs. In addition, 8.5% of females and 24.1% of females were obese according to the Asian BMI cutoffs. All of these obesity and overweight study results of this study are lower than those that were reported for the urban population (6). These two studies comparatively show that the prevalence of overweight and obesity is higher in urban populations. This may be due to different lifestyle factors such as lower levels of physical activity, poor nutrition, elevated levels of stress, and more convenient access to foods high in calories. This shows that, when compared to the metropolitan population, the *Purana* population's lifestyle is still advantageous for maintaining a low body weight.

According to a study done in the Central province of Sri Lanka in 2017 (8), a higher incidence of overweight and obesity among

working-age males in urban areas of Sri Lanka was reported. The prevalence rates of overweight and obesity among them were 31.8 and 12.3%, respectively (8). This study also presented prevalence rates of overweight and obese males were 20.6%, 2.8% which were lower percentages when considering the urban population (8). It suggests that the male *Purana* population lifestyle facilitates the reduction of overweight and obesity more than in the male urban population. However, our findings show that the prevalence of overweight and obesity in the *Purana* population (Obesity 18.92% and overweight 6.19%) is much lower than that of the reported values of the national level research (According to WHO Asian norms, Overweight, obese were 25.2%, 9.2%, respectively) (7).

Purana people's lifestyle aids in the reduction of overweight and obesity more than in the urban population. The reason for this is that the *Purana* population lives in an agricultural environment, whereas the urban population does not have access to this type of environment. Living in an agricultural environment may lead to a more active lifestyle, as the *Purana* population may engage in activities such as farming, animal husbandry, and other physically demanding tasks that involve manual labor such as chena cultivation, heavy home gardening, manual faddy cultivation, walking and cycling towards the *Kadamandiya* (a small collection of shops) which is located 5 km away from the village to purchase items for day-to-day consumptions etc. This type of lifestyle requires a lot of energy expenditure, which may lead to weight loss and a lower risk of obesity. On the other hand, the urban population tends to have a more sedentary lifestyle, with many people spending most of their day sitting in front of a computer or on a couch. This type of lifestyle requires much less energy expenditure, which can lead to weight gain and an increased risk of obesity.

Although our research primarily is focused on the impact of obesity and overweight in the *Purana* population of Sigiriya, Sri Lanka. This study reveals that the prevalence of being underweight is higher in males (33.6 % according to Asian cutoff values) than in females (17.6 % according to Asian cutoff values) in the *Purana* population. The study done in Colombo district regarding the prevalence of obesity and overweight showed that the percentage of underweight males was 8.1% and 7.4% in females according to both cut-off values (3). When comparing this study with our study, it is obvious that the percentage of the underweight population is higher in *Purana* population of Sigiriya than in the metropolitan population in Colombo district. According to the proposed World Health Organization cut-off values for BMI for Asians, there are only 30% of males and 27% of females are underweight in this *Vadda* population. (6). According to Asian BMI cutoffs, the prevalence of underweight in males was 8.1% and 7.4% in females in Sri Lanka's urban population (3). The prevalence of underweight status in the *Purana* population of male and females are low compared to the *Vadda* population but higher compared to the urban population.

The Indigenous *Vadda* population showed the BMI of males and females were 20.21 kgm^{-2}

(19-21.3 kgm^{-2}) and 20.4 kgm^{-2} (19.31-21.49 kgm^{-2}) respectively (8). Their BMI values are lower compared to *Purana* population's BMI values of male 20.5038kg/m^{-2} and female 21.9299 kg/m^{-2}. Furthermore, central obesity is higher in both males and females of the *Purana* population when compared with the national data (28% in males and 47.2% in females while the national percentage is 26.2%) (7).

Conclusion

According to this study, the male and female *Purana* population of Sigiriya has a lower prevalence of overweight and obesity than the metropolitan inhabitants living in Sri Lanka. The active way of life such as chena cultivation, heavy home gardening, manual faddy cultivation, walking and cycling towards the *Kadamandiya* (a small collection of shops) which is located 5 km away from the village to purchase items for the day today consumptions would be beneficial in reducing overweight and obesity in their population and maintaining average BMI.

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CASE REPORT

An interlobar ligament connecting the right and left lobes of the liver – A cadaveric case report

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Abstract

Several ligaments and peritoneal folds attach the liver to other organs and to the abdominal wall. These are the falciform ligament, ligamentum teres hepatis or round ligament, right triangular ligament, left triangular ligament, lessor omentum, and ligamentum venosum. We report a unique ligament connecting the right and left lobes of the liver, on its visceral surface near its inferior border. This ligament is seen forming a tunnel through which the ligamentum teres is seen to travel.

The knowledge can be used by the radiologists and clinicians in image interpretation and subsequent clinical diagnosis and by anatomists and embryologists for academic interests. Further, this ligament and the tunnel formed by it maybe a potential site for strangulation of abdominal content.

Key words: liver, ligaments, embryology, acute abdomen, radiology

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Introduction

Liver, being the largest and the most vascular organ in the human body occupies the right hypochondrial and most of the epigastric region. It weighs approximately 1500g and usually receives about 1500ml blood per minute via both the portal and systemic circulations. Morphologically, the liver is divided into two main lobes, the larger right and a smaller left lobe. These lobes are divided by the ligaments or peritoneal folds. Two smaller lobes, the caudate and the quadrate are considered as parts of the right lobe (1).

There are several ligaments and peritoneal folds associated with liver. The falciform ligament runs from the anterosuperior surface of liver to the anterior abdominal wall and the diaphragm. The Ligamentum teres hepatis or round ligament lies in the umbilical fissure While the ligamentum venosum lies within the fissure between the caudate and left lobes. The right triangular ligament runs from the right lateral surface of the liver to the diaphragm, while the left triangular ligament runs from the left lobe of the liver to the diaphragm. The lessor omentum suspends the lessor curvature of the stomach and the proximal duodenum from the fissure of the ligamentum venosum and the porta hepatis on the undersurface of the liver (2,3,4).

In this report we present a case where an additional interlobar ligament connecting the right and left lobes of the liver, and making a tunnel for the ligamentum teres, was observed during routine dissections at the department of Anatomy, University of Peradeniya.

Case report

During routine dissections at the department of Anatomy Peradeniya, an additional short ligament was observed in a formalin preserved cadaver of an adult female of Sri Lankan origin.

A short, roughly square shaped ligament was observed between the right and left lobes of the liver, on the visceral surface superficial to the ligamentum teres before it emerged from the inferior border of the liver. This ligament connected the right and left lobes. Ligamentum teres was freely movable inside the tunnel formed by this unique interlobar ligament. Figure 1 and 2 shows the liver, Ligamentum teres and interlobar ligament from the visceral surface and from the inferior border respectively.

No other additional ligaments were noticed on the liver and no other morphological variations, surgical scars or adhesions were noticed inside the abdominal cavity.

Discussion

Variations in the ligaments associated with the liver are uncommon and can be anomalies of liver development (5). During development, the falciform ligament forms from the ventral mesogastrium which is derived from the mesoderm of the septum transversum. When the liver bud starts to grow during the middle of the third week into the septum transversum, it becomes thin and ultimately forms the falciform ligament, lessor omentum and the peritoneum of the liver. The umbilical vein

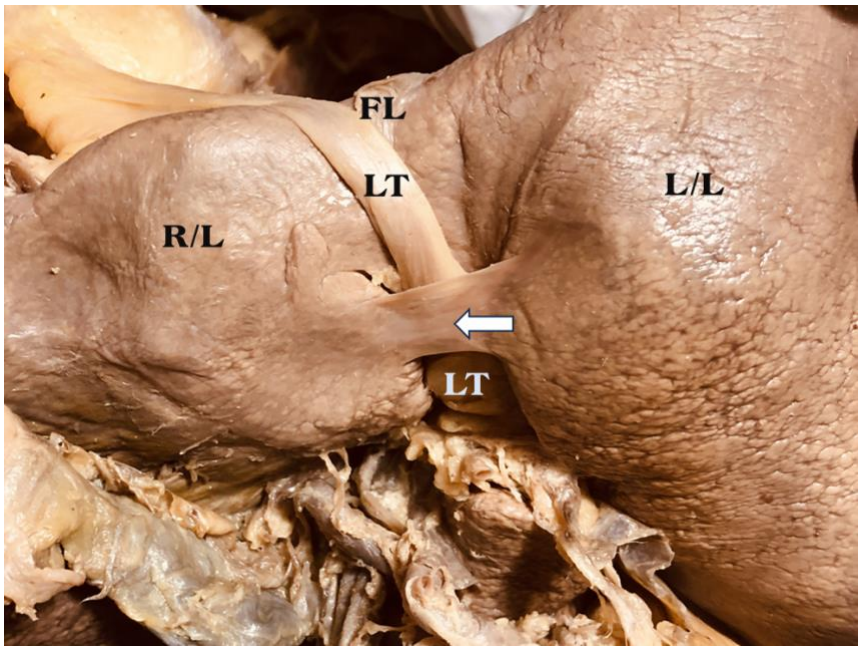

Figure 1: Liver, Ligamentum teres and interlobar ligament shown from the visceral surface. (White arrow – new interlobar ligament, FL – Falciform ligament, LT – Ligamentum teres passing through the tunnel, R/L – Right lobe of liver, L/L – Left lobe of liver)

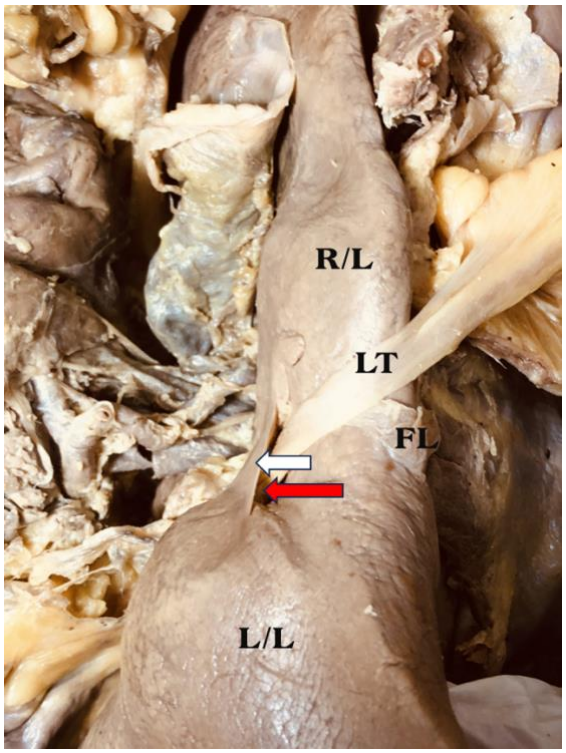

Figure 2: Liver, Ligamentum teres and interlobar ligament shown from inferior border. (White arrow – new ligament, Red arrow – tunnel formed by the new interlobar ligament, FL – Falciform ligament, LT – Ligamentum teres, R/L – Right lobe of liver, L/L – Left lobe of l

which runs along the free margin of the falciform ligament obliterates after birth and forms the ligamentum teres hepatis (6), (2). Therefore, this interlobar ligament can be a remnant of the septum transversum which develops into a ligament connecting the right and left lobes of the liver near the inferior border on the visceral surface.

The anatomical and pathological features of the ligaments can be detected by using radiological interventions such as ultrasound scanning/ endoscopic ultrasound scanning, computed tomography, and magnetic resonance imaging in a living person (2). Isolated infection and/or gangrene of the ligamentum teres and falciform ligament is among the rarest causes of acute abdomen (7). Idiopathic segmental infarction of the ligamentum teres can also present as acute abdomen and the diagnosis is usually made intraoperatively (8). Similar to ligamentum teres and falciform ligament, there is a possibility of the said ligament subjecting to infection and/ or gangrene resulting in acute abdomen.

Conclusion

In the index case, we observed an interconnecting ligament between the right and left lobes of the liver and the ligamentum teres was seen to be passing through the tunnel made by it. The knowledge and findings can be used by anatomists, embryologists, radiologists, and clinicians for research as well as in image interpretations and subsequent diagnosis of liver and abdominal pathologies. Further studies on embryological origin of this ligament are warranted.

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Conflicts of interests: The authors have no conflicts of interests.

Authors contributions: MJSJ was involved in conceptualization, resources, writing original draft, review and editing**,** HAA was involved in conceptualization, resources, supervision, writing, review and editing.

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CASE REPORT

Bilateral Absence of Musculocutaneous Nerve in a Cadaveric Specimen

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Abstract

Knowledge of the normal course and distribution of the nerves of the brachial plexus in the axilla and arm, and of its possible variations, is essential for the proper management of upper limb nerve injuries, which is a relatively common occurrence in the clinical setup. Bilateral absence of the musculocutaneous nerve was observed during routine dissection of a female cadaver. The muscles of the flexor compartment of the arm were supplied by the median nerve bilaterally.

The present case report should elucidate this variation and should aid in applying this knowledge in the clinical setup.

Key words – musculocutaneous nerve; cadaver; absent

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Introduction

The musculocutaneous nerve arises from the lateral cord of the brachial plexus, leaving it quite high in the axilla, subsequently running obliquely downwards to enter and supply the coracobrachialis (Figure 1). It then passes downwards and enters and supplies the biceps and brachialis and becomes the lateral cutaneous nerve of the forearm (1).

In this report a case of bilateral absence of the musculocutaneous nerve observed during the routine dissection of a cadaver in the Department of Anatomy, University of Sri Jayewardenepura is presented.

Case Report

During routine dissection of the upper limb by undergraduate students, absence of the musculocutaneous nerve (usually arising from the lateral cord of the brachial plexus) was observed bilaterally. The muscles of the flexor compartment of the arm i.e., biceps brachii, brachialis and coracobrachialis were instead supplied by branches of the median nerve, which arose as usual from its lateral and medial roots from the corresponding cords (Figure 2).

On the left, the median nerve formed 7cm from the outer border of the 1st rib, anterolateral to the brachial artery. It provided a branch to biceps brachii 16cm from the outer border of the 1st rib. Brachialis was supplied by a branch of the median nerve 19cm from the outer border of the 1st rib. This branch to brachialis continued as the lateral cutaneous nerve of the forearm (usually a continuation of the musculocutaneous nerve) lateral to the biceps tendon in the cubital fossa. The median nerve proper passed medial to the biceps tendon as usual.

On the right, the median nerve arose in a similar manner to that on the left, 4cm from the outer border of the 1st rib. It gave off 2 branches, one to the long head and the other to the short head of the biceps. The lateral cutaneous nerve of the forearm arose as a direct branch of the median nerve 19cm from the outer border of the 1st rib and passed posterior to the biceps tendon in the cubital fossa while, the median nerve passed medial to the biceps tendon.

Additionally, on the left side, the medial cutaneous nerve of the arm and forearm arose as a common trunk from the medial cord, with the medial cutaneous nerve of the arm arising 15cm distal to the common trunk.

Discussion

The anatomical anomalies of the nerves of the brachial plexus are of significance in the clinical diagnosis of nerve injuries. The musculocutaneous nerve usually supplies the muscles of the flexor compartment of the arm, while median nerve usually has no muscular innervation in the arm (1). However, in cases such as this, damage to the median nerve may present clinically with the inability to flex the arm, supinate the forearm and numbness/ paraesthesia of the lateral aspect of the forearm, in addition to the common symptoms of loss of pronation and flexion of the forearm and paralysis of the thenar muscles,

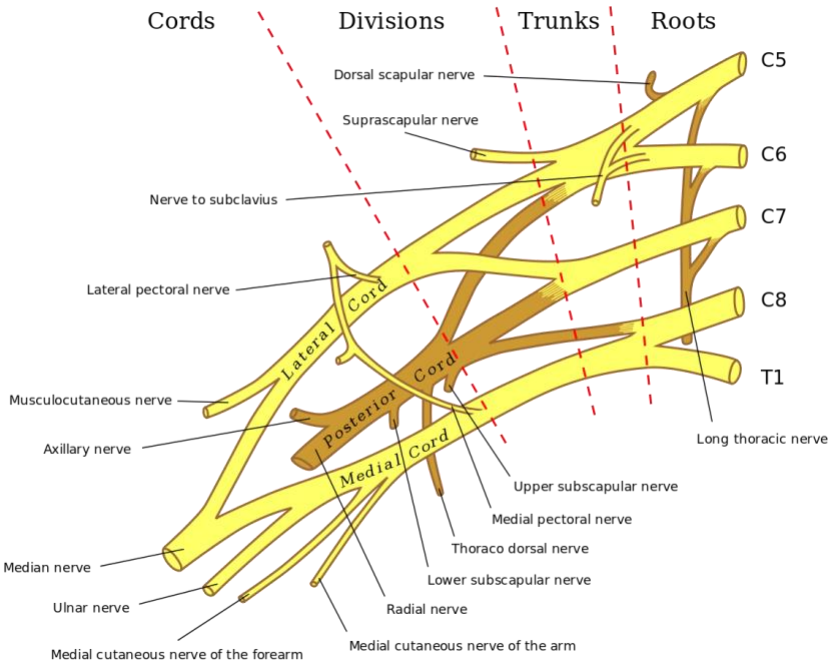

Figure 1: Normal anatomy of the brachial plexus

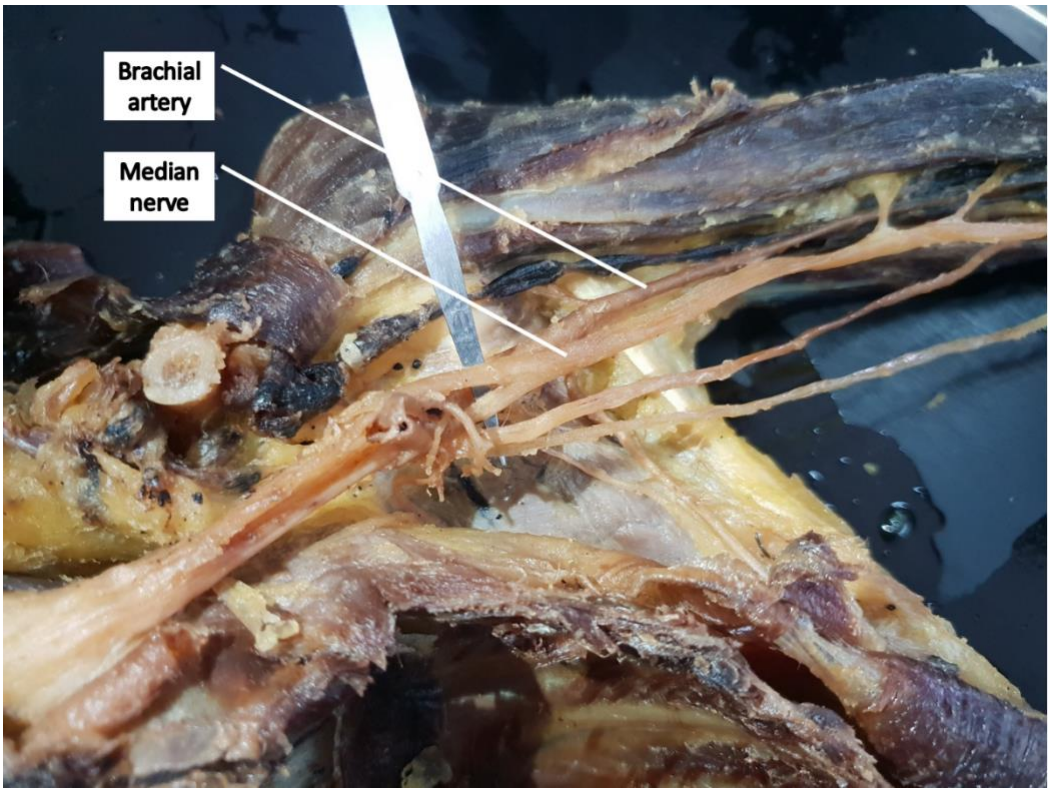

Figure 2: Absence of the musculocutaneous nerve (usually arising from the lateral cord of the brachial plexus) was observed bilaterally.

which is unusual and may be misdiagnosed as an injury to the lateral cord. It would be beneficial to investigate whether this variation in the musculocutaneous nerve affects the muscle power of the arm.

Variation of origin and distribution of the musculocutaneous nerve has been described frequently in medical literature, as in the case described by Sarkar and Sahar where all the flexor muscles of the arm were supplied by the median nerve except coracobrachialis on the left, supplied by a twig from the lateral cord of the brachial plexus (2). Complete absence of the musculocutaneous nerve has also been described by Sud and Sharma (3), Sharmila Bhanu and Devi Sankar (4) and Ravishankar et al (5).

Other variations such as the unilateral absence of the musculocutaneous nerve due to the abnormal formation of the axillary artery, described by Meenakshi Sundaram (6) and multiple communications between the musculocutaneous nerve and the median nerve observed by Chauhan and Roy (7), highlight the high tendency for variation in the formation of the musculocutaneous nerve. The observation of Nasr (8) that states that in 3.3% of the cases of absent musculocutaneous nerve, all the flexor muscles of the arm are supplied by the median nerve is supportive of this study.

One possible explanation of the absence of the musculocutaneous nerve bilaterally could be due to the fact that the spinal nerve roots of the musculocutaneous nerve (C5-C7) passing through the relevant trunks and divisions of the brachial plexus, fail to aggregate and separate from the lateral cord and instead run with the fibres of the lateral root of the median nerve (which has a similar C5-C7 origin) to be incorporated into the median nerve (9). The cause of an anomaly of this nature, specifically its embryological basis needs to be studied further and understood to predict other possible variations and for use in clinical diagnosis.

Conflicts of Interest: All authors wish to declare that there are no conflicts of interest.

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CASE REPORT

Anatomical Variations of Gonadal Veins in Sri Lankan Cadavers: A Case Series

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Abstract

Objective: Gonadal veins carry venous blood from gonads. The right gonadal vein (RGV) drains into inferior vena cava (IVC) directly while left gonadal vein drains into the left renal vein (LRV). However, numerous anatomical variations of gonadal veins which accounts for pathological conditions such as varicocele and pelvic congestion syndrome have been reported. In this study we report such variations observed during a routine cadaver dissection for the first-year dental undergraduates.

Methods and material: Dissection was carried out in ten cadavers by the investigators following observation of the variations.

Results: Three cadavers out of ten were observed to have variations of the gonadal veins in relation to the number and site of drainage. There were right gonadal veins draining to right renal vein as well as double gonadal veins were observed.

Conclusion: A clear understanding of these variations is important for clinicians and radiologists in recognizing and avoiding complications in interventional procedures in the retroperitoneal region. Therefore, we recommend carrying out further studies using a larger sample of Sri Lankan population.

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Introduction

Gonadal veins (ovarian veins in female and testicular veins in male) drain the blood from the ovaries in female and testicles in male to the inferior vena cava (IVC) or the renal vein. Renal and gonadal vessels are among the most variable structures in the human body. However, gonadal veins are bilateral single veins, where the left gonadal vein drains into the left renal vein (LRV) and the right gonadal vein drains to the IVC directly.

The embryological development of the renal vein and IVC are both directly related to the development of the gonadal vein. The renal segment of the IVC is formed by the bilateral anastomosis of the supra- and sub-cardinal veins. The caudal portion of the sub-cardinal vein gives rise to the gonadal vein, which drains into the supra-sub cardinal anastomosis. Right gonadal vein often drains into the IVC because of the supra-sub cardinal anastomosis and the incorporation of a tiny section of the sub-cardinal vein into the creation of IVC on the right side. This supra-sub cardinal anastomosis creates a portion of the LRV where the left gonadal vein empties on the left side (1).

Even though there are studies around the world for abnormal gonadal drainage, case studies are lacking in Sri Lanka. Also, most of the literature shows the right gonadal vein variations are less common than of left. But here we report right gonadal vein variations encountered during cadaver dissections.

Materials and Methods

During the dissection practical sessions in the abdomen, conducted for dental undergraduates in the Department of Basic Sciences, Faculty of Dental Science, University of Peradeniya it was noticed to have variations in the gonadal vein drainage in number of cadavers. Therefore, fine dissection was carried out by staff members and photographed using a digital camera.

Observations

Among ten cadavers dissected, three cadavers showed variations in gonadal veins.

Case 1:

An 84-year-old female was having a right ovarian vein draining to the right renal vein (RRV). Although it is out of the scope of this article, it is interesting to report an observation of triple renal arteries on right side of this cadaver, in which two were superior to the RRV and the other one was running inferior to RRV and passing superficial to the IVC to join with the abdominal aorta (Figure 1).

Case 2:

A 68-year-old male cadaver was having bilateral variations. The right testicular vein was draining to RRV (Figure 2A). On left side, double testicular veins were observed, and both were draining to LRV (Figure 2B).

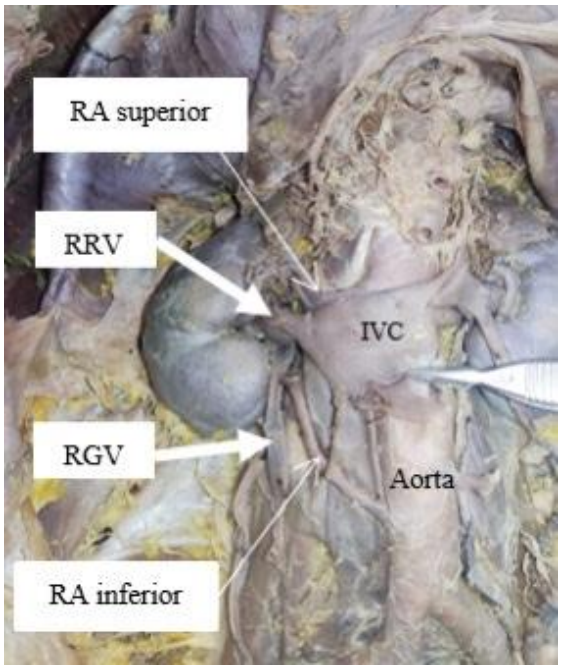

Figure 1: Variations of RGV and Right Renal Artery
Right ovarian vein drains to RRV and three RRAs were observed, two superior and one inferior to the RRV.

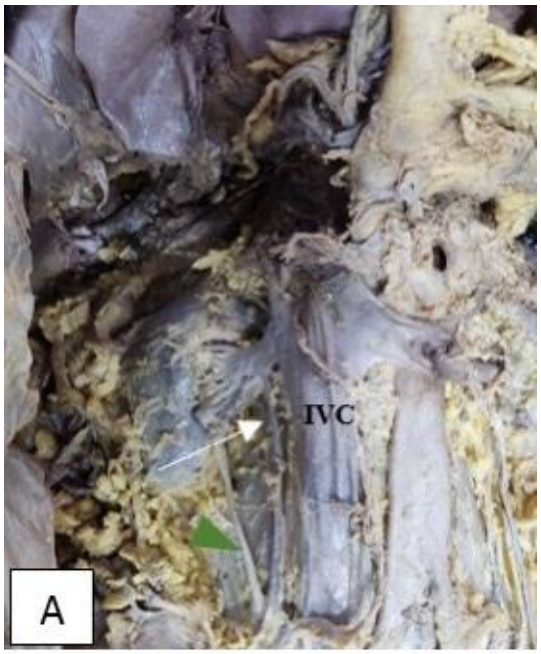

Figure 2A: Variations of RGV and Left Renal Artery

Right testicular vein drains to RRV

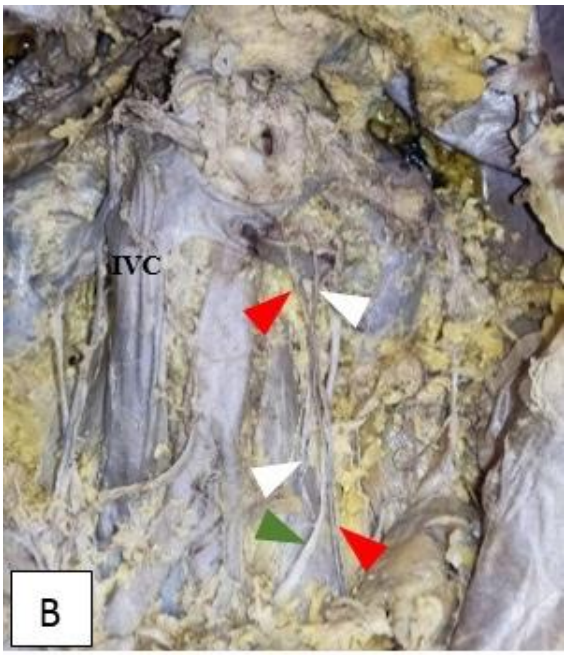

Figure 2B: Variations of RGV and Left Renal Artery

Two left testicular veins drain to LRV

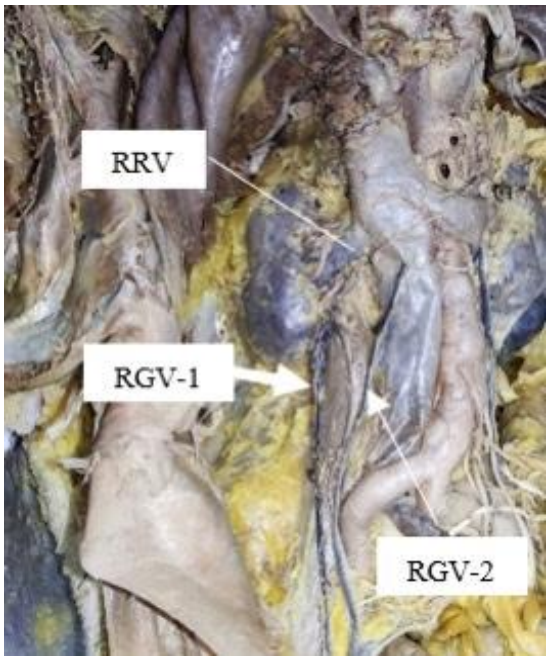

Figure 3: Double testicular veins on right side
One RGV drains to RRV and a second RGV drains to IVC

Case 3:

A 67-year-old male cadaver was having double testicular veins on right side, and one vein was draining to RRV and the other was draining to IVC (Figure 3).

Discussion

Literature reports that gonadal vessel variations are more common in veins than in arteries as well as the variations are more common in testicular veins and on left side (2, 3). R. Gupta *et al.,* (2015) has reported that they have observed no ovarian vein variations while 18 cases out of 60 cadavers had testicular vein variations. In addition, bilateral variations have been also reported (2,1). In our study two out of the three cadavers which have shown variations are of males however all three cadavers have shown variations on right side when only one cadaver having left side variations.

Studies have reported anatomical variations such as number of veins and differences in the location of drainage of these vessels. Asala *et al.,* (2001) has reported draining of right testicular vein into right renal vein in 2 out of 150 cadavers in his study (2). Lalwani *et al.,* (2017) has observed one right testicular vein draining into RRV and one left testicular vein draining to IVC out of 35 cadavers (3). Koc *et al.,* (2006) has reported 9.9% of right ovarian veins draining to RRV (4). Diwan *et al*., (2013) reports a case of a male cadaver with right testicular vein draining to RRV and Parasekvas *et al.,* (2012) also reports a case of right testicular vein draining to RRV (5,6). Phalgunan *et al.,* (2012) observed two male cadavers out of 20 with right testicular vein draining to RRV (7). In the current study 3 out of 10 (30%) cadavers have shown right gonadal vein draining to RRV. Although the literature suggests that left gonadal veins are having more variations R. Gupta *et al.,* (2015) also reports that variations on the location of drainage are more common with right gonadal veins, in which all the left gonadal veins drained into left renal vein while more than 83% of right gonadal veins were draining into the IVC (1). This supports our case presentations as in our study also all left gonadal veins were draining to LRV which is the normal anatomical location identified.

Double gonadal veins are also reported in literature. R Gupta *et al.,* (2015) has reported 30% on left side and 5% on right side double gonadal veins in a study done with 60 cadavers (1). In that right double testicular veins were draining to IVC and RRV whereas on left side both were draining to LRV. Diwan *et al.,* (2013) reports a case of left side double testicular veins and Parasekvas *et al.,* (2012) reports a case of a bifurcation of left testicular vein where one drains to LRV and the other to IVC (5,6). Luciano *et al.,* (2007) has observed 15% right double testicular veins in their study with 100 cadavers (8). Seven out of 15 were draining at the junction between RRV and IVC. On left side they have observed 82% single veins, 15% double veins and also 2% three veins and 1% four testicular veins, and regardless of the number all left veins were draining to the LRV. In the current study we observed double veins on right side (10%) and on left side (10%) and both were in male cadavers. The left side double veins were

draining to LRV whereas on right side, draining to both RRV and IVC was observed.

Knowledge of such abnormalities are clinically important in radiological procedures, surgical procedures, retroperitoneal therapeutic and diagnostic procedures, and renal transplantations. (9). Gonadal vessels also play an important role in thermoregulation of testis. Therefore, variations in the drainage of gonadal vessels can interfere with the spermatogenesis and infertility in males (9). Anatomical variations of the gonadal veins limit the endovascular embolization techniques for varicocele. There was 8-30% failure in the standard protocol of embolization due to gonadal vessel variations (3).

Variation of ovarian vein drainage causes pelvic congestion syndrome and pelvic varices. Pelvic congestion syndrome (PCS) is a major cause of the chronic pelvic pain in females (10). However, presence of pelvic varices has not shown exact correlation with the right ovarian vein drainage abnormalities (4).

Literature also signifies the importance of ample knowledge on possible variations of gonadal veins. However, to the best of our knowledge there are no detailed studies done on vascular variations of this region in a Sri Lankan population. Although 30% is a considerable number of variations that we have reported, as of the small sample size this may not reflect the actual situation in the said population. Therefore, we recommend carrying out further detailed studies using larger samples in Sri Lankan population.

Conclusion

Gonadal vein variations are not uncommon and despite having advanced technologies, it is important to consider the anatomical variations to avoid surgical and therapeutic complications of Sri Lankan population.

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BRIEF COMMUNICATION

Balancing Information Load and Cognitive Load in Anatomy Education

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Anatomy, being a complex subject with vast content and interdependent components, requires effective teaching approaches to facilitate the successful integration of information into memory. Memory, consisting of sensory memory, working memory, and long-term memory, plays a crucial role in the learning process (1). Sensory memory briefly stores unlimited inputs from sensory organs, which, if actively attended to, are transferred to working memory. However, working memory has limited processing and storage capacity (approximately 20 seconds), necessitating the organization of information into manageable chunks known as schemas. These schemas are then encoded into long-term memory, which forms the basis of knowledge (2).

This article explores the concept of cognitive load theory, which aims to optimize teaching design by minimizing the cognitive demands on working memory, thereby promoting schema construction and integration into long-term memory.

Cognitive load theory focuses on designing teaching methods that prevent the overloading of working memory with excessive information (3). By reducing cognitive demands, this approach facilitates the creation of new schemas and their integration into long-term memory. The theory is based on five key principles that guide instructional design (4):

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- Principle #1: Long-term memory changes enable learning: Effective learning occurs when there are changes in long-term memory. Therefore, instructional strategies should aim to modify and expand students' existing knowledge (5).

- Principle #2: Leveraging existing knowledge: Utilizing knowledge acquired from teachers and peers, rather than relying solely on self-discovery, makes the process of reorganizing and integrating information more accessible and efficient (6).

- Principle #3: Integrating fundamental information first: To ensure a strong foundation for learning, it is crucial to integrate fundamental information into long-term memory before introducing new concepts or details (7).

- Principle #4: Incremental alteration of long-term memory: Alterations to long-term memory should be introduced gradually and incrementally to avoid disrupting previously constructed knowledge. This gradual approach allows for the seamless incorporation of new information (8).

- Principle #5: Utilizing long-term memory resources: When information is processed from long-term memory, working memory has virtually unlimited capacity. Thus, leveraging pre-existing knowledge in long-term memory can enhance the integration of new information (9).

In essence, this model emphasizes the importance of not overloading information until it is integrated into long-term memory and utilizing pre-learned information that is already encoded in long-term memory as a resource to build new memories. The leading universities have successfully incorporated cognitive load theory into their curriculum design. In the next half of this article, I am proposing the following changes to the anatomy teaching curriculum in Sri Lanka based on my experience participating in teaching anatomy in such universities.

1. <u>Reduce didactic lecture-based teaching:</u>

    - Didactic lecture-based teaching, while crucial for delivering organized (principle#2) and fundamental (principle #3) information, is known to saturate working memory quickly.

    - Leading universities have limited the number of lectures and shifted to online platforms, allowing students to listen at their own pace, take notes, and research difficult concepts, thus avoiding working memory saturation.

    - One face-to-face Q&A session per week can be incorporated to facilitate interaction and clarification.

2. <u>Vertical integration between subjects:</u>

    - Introduce clinical skills into the basic sciences stream to help students identify the end goals of learning anatomy and make it more engaging.

- Rotate clinicians and basic scientists in teaching, allowing students to retrieve knowledge from long-term memory to working memory, promoting integration (principle #5).

3. Introduce reverse learning approaches:

    - Implement problem-based learning or case-based learning, where students work backwards from clinical signs/symptoms to learn relevant anatomy.

    - Encourage the use of freely available resources such as the "Visible Human Project" and "Radiopaedia" to access 3D reconstructions and serial sections for understanding anatomical structures and their relationships.

    - This approach avoids abrupt shifts when transitioning from basic science to clinical streams (principle #4) and stimulates cognitive challenge, making learning more intriguing.

4. Incorporate active and self-directed learning:

    - Assign student groups to analyse clinical cases and present the anatomical basis, requiring them to research and explore key anatomical concepts. These presentations help consolidate newly learned knowledge.

    - Develop Kahoot quizzes based on student-generated multiple-choice questions, encouraging different perspectives and enhancing self-assessment skills.

    - Utilize gamification techniques, such as memory games and celebrity heads, to make learning fun and facilitate the effective integration of working memory into long-term memory. This also promotes self-directed learning.

5. Assess higher-order outcomes beyond recall:

    - Utilize viva assessments to evaluate students' organizational skills such as describing how structures in specific anatomical regions are organized into compartments.

    - Include clinical skills assessments to evaluate how students apply anatomical knowledge in clinical scenarios, such as localizing lesions based on patient presentations.

In conclusion, optimizing anatomy education involves balancing the information load and cognitive load placed on students. The principles of cognitive load theory emphasize the importance of avoiding information overload until it is integrated into long-term memory and utilizing pre-existing knowledge as a resource for constructing new memories. By implementing effective teaching strategies, such as leveraging prior knowledge, promoting active engagement, introducing reverse-learning approaches and integrating clinical learning at an early stage of medical education, educators can create an environment

conducive to effective learning and long-term retention of anatomical knowledge.

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LETTER TO EDITOR

Use of ChatGPT in Anatomy Learning: A Tool to be Used Wisely

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Artificial intelligence platforms are rapidly developing and are being utilized and incorporated into a multitude of fields including education. It is important for learners as well as educators to keep up with new technology to adapt to the ever-evolving demands of the world. ChatGPT (Chat Generative Pre-Trained Transformer), developed by Open AI is such a tool that has been trained on enormous data content to act as a conversational interface that understands and generates appropriate text (1). This tool gained wide popularity reaching one million users in just a few days following its launch (2). Though it gives prompt and seemingly authentic replies, ChatGPT itself mentions that it may produce inaccurate information about people, places, or facts which necessitates users to critically think when using it (3).

When looking upon ChatGPT for factual information on Anatomy, we are faced with wrong information as well as important omissions (4). When testing the ChatGPT for anatomy information I asked "Can you explain the ulnar paradox" which is defined as the claw hand produced by ulnar nerve injury at the elbow or above resulting in straighter fingers compared to more distal injuries (5). However, the response received though convincingly phrased was completely false as shown below.

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"The ulnar paradox refers to a situation where a person with an injured or compressed ulnar nerve experiences weak finger flexion (closing the fingers) but strong finger extension (opening the fingers) when attempting to grip an object. It occurs due to the complex innervation of the muscles involved in finger movement, with the ulnar nerve controlling both flexor and extensor muscles. When the ulnar nerve is compromised, the weaker flexor muscles are affected more, resulting in reduced grip strength, while the extensor muscles may remain unaffected or become overactive, leading to increased finger extension ability."

A recent article exploring the potential benefits of ChatGPT in medical education mentions that it can provide answers and explanations concerning anatomy, histology, and other medical subjects in an understandable and easily accessible manner (6). However, it is made evident by the above example that it is not wise to accept the responses received as factually correct. Especially in a field like medicine, where inaccurate knowledge could cost a life, it is essential that students know the proper and accurate sources of information.

ChatGPT could provide reliable study material and was able to give a comprehensive list of books that could be used to learn human anatomy. It was also able to provide a wide array of valid online resources to learn the human anatomy on request and it provided a detailed comparison as to accessibility, content, and resources available (articles, images, videos, three-dimensional models, animations) which would otherwise need detailed exploration into each.

This natural language processing tool provides a useful and efficient platform for creating lesson/study plans. It was surprisingly detailed and organised when asked to create a two-week study plan for the anatomy of the limbs. It gave daily tasks covering osteology, joints, muscles, nerves, and vessels leaving the last few days for review and practice. Although time was not allocated for studying clinical relevance and applications initially, it was easily included by a prompt. Which shows how we can plan and customize study plans to suit us. As the conclusion, it provided the following message which was considerate of the humane aspect of the student requesting the study plan.

"Customize the study plan based on your learning style and pace, and don't forget to take breaks and prioritize self-care to maintain a balanced and effective study routine."

Thus, this could be considered an effective and efficient tool to create study plans, which might save time and effort, though they should be carefully scrutinised to include all our requirements before being carried out.

Using its conversational ability, we can ask ChatGPT to test our Anatomy knowledge by questioning us. This could provide us with an interesting learning strategy as it could assist in keeping our focus during long study hours. However, it should be noted that we should not depend on it to give us the correct answers.

Thus, ChatGPT can be considered a beneficial tool in learning Anatomy, although caution and critical evaluation should be exercised in its use. With the rapid and wide engagement of artificial intelligence in the global setting it is

important to explore how it should be integrated in medical education. It may also be valuable to incorporate the intelligent and appropriate use of technological tools into medical curricular to ensure their proper use by the students.

The opportunity exists for the development of more focused artificial intelligence tools for learning medical subjects including anatomy which may revoke the shortcomings observed in ChatGPT which is a generalised language processing tool.

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RADIOLOGICAL ANATOMY QUIZ

Reconstructed coronal image from a computed tomography (intravenous) urogram

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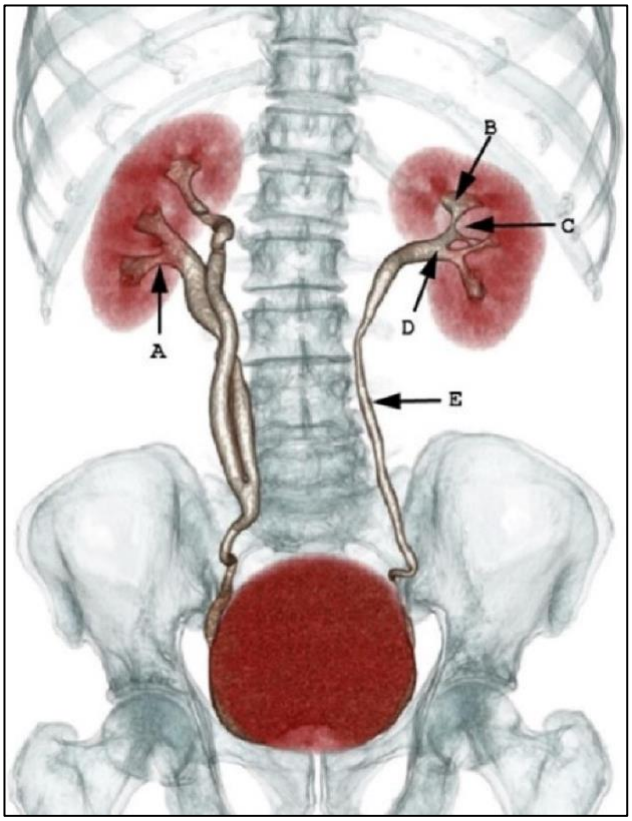

1. Identify the structures A- E.
2. What normal variant is present?
3. Mention the clinical significance of this variant

Answers

1. A. Infundibulum.
   B. Left upper pole major calyx.
   C. Renal papilla.
   D. Left renal pelvis.
   E. Left ureter.
2. Left side partial duplex ureter
3. Most duplicated systems are asymptomatic and are usually found incidentally. However, infections, ureteric reflux, or ureteric obstruction can be detected in some patients, especially those with complete duplex systems.

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an aid to studies on oral pre cancer. Oral Surg Oral Med Oral Pathol 1978; 46: 518-539.

Unpublished article

Barker DS. Lucas RB. Localized fibrous growth of the oral mucosa. J Dent Res 1965: in press.

Books and other monographs

Pindborg JJ. Atlas of diseases of oral mucosa. 5th edition. Copenhagen: Munksguard, 1992: 50-66.

Chapter in book

Boyde A. Amelogenesis and the structure of enamel. In: Cohen B. Kramer KH (eds). Scientific Foundations of Dentistry. William Heinemann Medical Books Ltd. London. 1976: 335-352.

No author given

International statistical classification of diseases and related health problems, 10th revision, vol 1. Geneva: World Health Organization, 1992; 550-564.

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