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Variation in the Branching Pattern of the Internal Iliac Artery

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The purpose of this project is to report, analyze and interpret the anatomical variability of the branches of the internal iliac artery, while exploring clinical correlations and forming solutions to alleviate potential student confusion. Branching patterns were observed and recorded by medical students using anatomical variation data sheets (n=111). A meta-analysis of anatomy textbooks and atlases (n=20) was conducted to find out how often the variability of the internal iliac artery is mentioned or depicted. This provided proxy data on whether or not students might have had knowledge of possible variation, and if so what kind of information was given. Internal pudendal artery, inferior gluteal artery and middle rectal artery all variably share trunks with one or more of the other arteries. This variability was commonly found in research publications but was inconsistently explained or depicted in textbooks and atlases. When it was mentioned or shown, statistical evidence of frequencies was not used adequately. Providing students, clinicians and researchers with an accurate representation of the branching pattern will enable better understanding, improving educational and clinical outcomes.

VARIATION IN THE BRANCHING PATTERN OF THE

INTERNAL ILIAC ARTERY

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VARIATION IN THE BRANCHING PATTERN OF
THE INTERNAL ILIAC ARTERY

INTERNSHIP PRACTICUM REPORT

Presented to the Graduate Council of the

Graduate School of Biomedical Sciences

University of North Texas

Health Science Center Fort Worth, Texas

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Jeff Chase, B.S.

Fort Worth Texas

May 2016

Acknowledgements

Of the many people who have made this experience possible I would first and foremost like to thank the individuals and their families who have donated their bodies to the University of North Texas Health Science Center Willed Body Program. Through their generous donations, research and education such as mine is made possible. They have allowed for the continued progress of anatomical knowledge and education.

Second, I would like to thank my major professor, Dr. Claire Kirchhoff. Her tireless efforts to help, encourage, and teach me have been remarkable. I consider myself extremely lucky to have been under her guidance. She has expanded my ability to think critically, conduct statistics and properly research a topic. She has helped as an editor of my work, and has always provided constructive and valuable feedback. Dr. Kirchhoff is the epitome of a student advocate.

Next, I would like to thank my committee members, Dr. Rustin Reeves and Dr. Patricia Gwirtz. Although they both are very busy serving in demanding roles they agreed to contribute to my education and growth. Their feedback has been greatly appreciated throughout the last two years.

Lastly, I would like to thank the Texas College of Osteopathic Medicine students for voluntarily completing the data sheets. This information allowed me to have the statistics to test my hypotheses and make conclusions. Without their participation this research would not have been possible.

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CHAPTER I

INTRODUCTION

Anatomy resources may often overlook anatomical variations such as the branches of the internal iliac artery. The branching patterns are often explained and depicted using a variation that is perceived as "typical," but research on these arteries could show considerable variation in the possible branching patterns. Knowledge of these variations may be valuable for students' ability to master the material and has been shown to have importance in a clinical setting (17, 27, 37, 38, 46).

The hypothesis of this report is that the branching pattern of the internal iliac artery is variable, inconsistently reported in anatomy textbooks and that familiarity with the variability is crucial in a clinical setting. Better understanding of the frequencies of the different variations will lead to greater success for educators, students, and clinicians. To test this hypothesis, data have been obtained from 111 data sheets completed by first year medical students from the Texas College of Osteopathic Medicine (TCOM) at the University of North Texas Health Science Center (UNTHSC) in Fort Worth, Texas from 2013 to 2016. The data sheets include student observations made on cadavers donated to the University of North Texas Health Science Center Willed Body Program.

These data were analyzed for differences by side and sex using non-parametric tests, and summary statistics on variation frequency are presented and compared to previous research. A comprehensive meta-analysis of anatomy textbooks and atlases was done to test whether they account for the variability. Clinical correlations were sought to emphasize the relevance of the study of anatomical variation, and promote inclusion of anatomical variations in textbooks, classrooms, and labs. Chapter II reflects the findings of the research project and Chapter III describes the internship as a teaching assistant at UNTHSC.

CHAPTER II

PRACTICUM REPORT

Background and Literature Review

Branches of the internal iliac artery arise erratically (3), but Textbooks are hypothesized to represent the branches of the internal iliac artery with few illustrations, and little or no further explanation of possibly variation in the text (3, 13, 15, 28, 31, 40-42). Whether this is to avoid overwhelming students with additional information or is due to a lack of consensus between researchers is unknown. If variability is presented, it is hypothesized that little or no data will show the frequencies of the different branching patterns. If this is the case, information on variations would commonly be left out of students' and clinicians' curriculum and training, which may cause confusion when they are faced with a variation in cadaver lab or in practice. A lack of understanding of anatomical variation and of pelvic arteries specifically might cause them to be unprepared for clinical scenarios where knowledge of these patterns is applicable (17, 27, 37, 38).

In previous research by Adachi (1), Braithwaite (6), Lipshutz (20), and Roberts & Krishinger (35), they reported inferior gluteal and internal pudendal arteries sharing a trunk in 51.2% (N=118), 60.9% (N=169), 40% (N=180), and 54% (N=167) of cases respectively. This is evidence for a high degree of variation, because the majority arrangement only occurs around half of the time. There may be a disconnect between what is observed in the body by researchers and what is shown and explained in textbooks. Because researchers have demonstrated this variability for almost a century (20), explanation and diagrammatic depiction of these arteries in educational resources should be common. This project examines whether anatomy textbooks and atlases reflect what is actually occurring in the body. Providing information on variations in commonly used reference materials would improve validity and accuracy, potentially helping to eliminate confusion and improve patient outcomes.

Pelvic arterial variations were first categorized into five types by Adachi (1) in 1928. Many researchers and clinicians have used this classification system since then (6, 27, 20, 35, 38). Type I depicts the internal pudendal and inferior gluteal arteries sharing a trunk. In Type II, the superior gluteal artery shares a trunk with the inferior gluteal artery. Type III depicts the inferior gluteal, superior gluteal and internal pudendal arteries all arising independently of each other from the "hypogastric" artery (this is a previously-used term for the internal iliac artery). In Type IVa, the inferior gluteal and internal pudendal arteries share a trunk, and this trunk has a common trunk with the superior gluteal artery. In Type IVb, the inferior gluteal and superior gluteal arteries share a trunk, and this trunk gives rise to the internal pudendal artery before it branched. In Type V, the internal pudendal and superior gluteal arteries share a trunk, with the inferior gluteal artery arising independently. This method of typing the branching patterns will not be used in this project because it does not include the middle rectal artery. The middle rectal artery is a highly variable and clinically relevant branch (27, 46) of the internal iliac artery. This project instead focuses on the relationship between inferior gluteal, internal pudendal and middle rectal arteries. Comparisons are possible with previous research that used Adachi types by analyzing which types match the criteria from this study.

Knowledge of pelvic artery variation has been shown to be relevant for the treatment of benign prostatic hyperplasia with arterial embolization (27, 46). Partial embolization of the arterial supply to the prostate causes it to atrophy slightly. This relieves pressure placed on the urethra by the prostate. Moreira (27) retrospectively analyzed radiographic images from 143 patients and categorized their branching patterns into types after the classification system of Adachi (1). Since accuracy in identifying the correct artery to embolize is essential, knowledge of the anatomy of these arteries is a crucial component of the procedure. The branching pattern of the patient being treated affected not only where the embolism was placed but also the type of procedure, risks, and tools involved. Incorrect identification could cause the physician to embolize the wrong artery, leading to complications such as ischemia of the bladder, rectum, or penis. The procedure is done under anesthesia and uses angiography; therefore identifying the arteries in a timely manner can prevent sacral radiodermatitis, and decrease radiation exposure. This shows a working knowledge of the variation of the internal iliac artery as an essential component for optimal patient outcomes.

Branching patterns can also have an impact on erectile function (17, 37). Kawanishi, (17) analyzed 145 men (290 hemipelves) with erectile dysfunction to see if there was a correlation between the branching patterns of their internal iliac arteries and their onset of erectile dysfunction. The men were placed under anesthesia to eliminate psychological factors and given an intracavernosal injection of Prostaglandin E. Observations were then made regarding whether or not the injection caused a complete erectile response. The results showed that men with non-type I (1) branching patterns had a predisposition for developing erectile dysfunction about 10 years before the type I males. Those with an accessory internal pudendal artery appeared to have an even later onset, but more subjects with this variation are required in order to draw any definitive conclusions. This study shows the effect anatomical variation can have on physiology.

The possibly conflicting information between commonly used textbooks and previous research as well as the clinical implications of pelvic arterial variation indicates that further investigation of these structures has value. Developing more effective methods of informing students and clinicians about pelvic artery variation can potentially enhance the learning experience and clinical outcomes. This could increase students' and clinicians' ability to apply this knowledge in an educational or healthcare setting.

Specific aim

The first goal for this project is to report the variation in the branching pattern of the internal iliac artery from the UNTHSC Willed Body Program. Second, the results will be compared to similar research publications. The third goal is to evaluate anatomical resources descriptions and depictions of this variation and compare them to the results of this project and similar projects.

Significance

Including anatomical variations in textbooks and atlases is important in order to provide an accurate depiction of what is occurring in the human body. This will enhance a student's ability to master the topic and provide clinicians the ability to apply this knowledge in practice. In order to achieve this, recording the occurrences of the various branching patterns in percentages and through diagrammatic representation is imperative. This will provide students and clinicians with all the information necessary to be informed and successful.

Hypotheses

Hypothesis 1

It is hypothesized that the most common variation will be inferior gluteal and internal pudendal artery sharing a trunk, but that it will occur in less than 50% of cases. This means that the hypothesized major variation where inferior gluteal and internal pudendal artery share a trunk is not found in the majority of cases.

Hypothesis 2

It is hypothesized that the meta-analysis on depictions of the variability in the branching pattern of the internal iliac artery, and more specifically the internal pudendal, inferior gluteal and middle rectal arteries, will reveal that less than half of textbooks mention variation either in text or in diagrammatic representation. Of those that do mention variability, none will provide a statistical breakdown of the frequency of the different variations.

Research Design and Methodology

Anatomic Variation Data Collection Sheets

In 2013-16, data were collected from 176 hemipelves (94 female, 82 male), from cadavers donated to the University of North Texas Health Science Center Willed Body Program. Medical students made observations on their completed dissections using data sheets with multiple-choice questions. Student participation in data collection was entirely voluntary, and students received no compensation for their involvement, nor penalties for lack thereof. The study did not fall under the jurisdiction of the UNTHSC Internal Review Board because data for this project are from (deceased) donors to the Willed Body Program only, and the project therefore does not constitute human subjects research. Blank data sheets or sheets with conflicting responses were excluded.

The data collection sheet read as follows:

Which of the following best describes the relationship between internal pudendal, middle rectal, and inferior gluteal arteries?

a. Middle rectal and internal pudendal share a trunk
b. Internal pudendal and inferior gluteal share a trunk
c. Middle rectal and inferior gluteal share a trunk
d. Other

The frequencies of the medical students' observations were tabulated in Microsoft Excel. Non-parametric tests in SPSS (16) were used to find possible differences between sexes, sides and years. These data were then compared with published research.

Meta-analysis

Meta-analysis of anatomical textbooks was conducted using the Gibson D. Lewis Health Science Library at UNTHSC and the UNTHSC anatomy faculty's personal textbooks (N=20). No prior knowledge of the textbooks' description or diagrammatic reference was fully understood or remembered in detail prior to the start of data collection. Textbooks were selected based on their availability to students and their potential to be used for reference. These textbooks and atlases are commonly used in undergraduate, graduate and professional settings. Authors of texts may appear multiple times if they authored multiple texts with different titles (designed for different audiences), but only a single edition of any title was included. The anatomy books were physically searched for four aspects concerning the variability of the internal iliac, inferior gluteal, internal pudendal and middle rectal arteries. First, does it mention variability directly? Second, does it show variation either in drawing, picture or any other diagrammatic fashion? Third, are there any statistics on the different variations presented? Fourth, is there any language used that would lead the reader to understand that variation occurs? This would include but is not limited to, words such as: occasionally, sometimes, may, or, often and can. These broad criteria were designed to give the references ample opportunity to represent variation in any way possible.

Results

Variation study

One-hundred and seventy-six (176) hemipelves, (82 = male, 94 = female) were observed by first year medical students from the Texas College of Osteopathic Medicine (TCOM) at the University of North Texas Health Science Center (UNTHSC). There were not sex (x^2=3.964, df=4, p=0.411) or side (x^2=1.405, df=4, p=.843) differences for the relationship between internal pudendal, middle rectal and inferior gluteal arteries. All data from these hemipelves were therefore considered as a single sample, regardless of side or sex, for the purposes of this analysis.

Of the observed specimens, 48.3% (85/176) were observed with inferior gluteal and internal pudendal arteries sharing a trunk, 23.86% (42/176) were observed to have middle rectal and internal pudendal arteries sharing a trunk, 7.95% (14/176) were observed to have middle rectal and inferior gluteal arteries sharing a trunk, 1.14% (2/176) reported middle rectal, inferior gluteal, and internal pudendal arteries sharing a trunk and other was selected in 18.75% (33/176) cases (Figure 1).

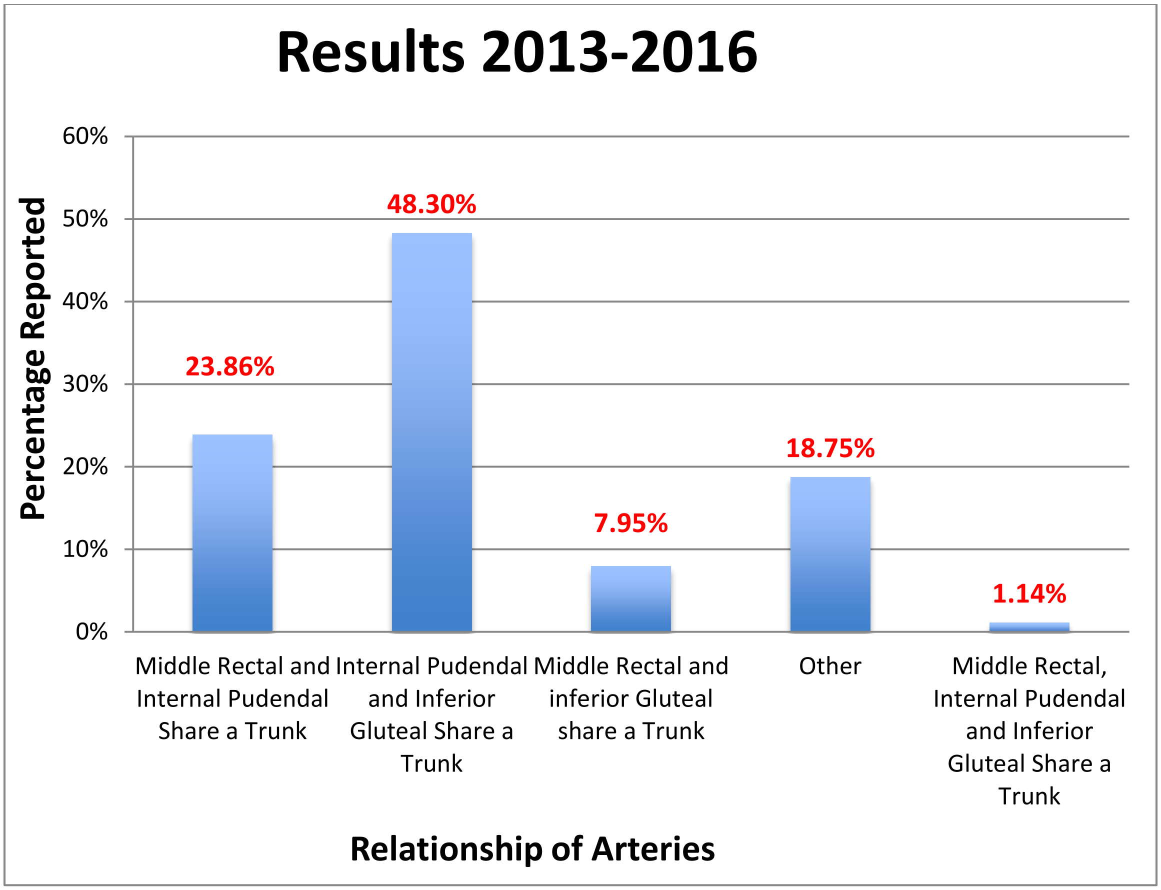

Figure 1: Frequency of variations in 176 cases from UNTHSC

The most frequent variation from this study, in which the internal pudendal and inferior gluteal arteries share a trunk, was compared to six previously published research studies (Table 1). This was accomplished by using research that reported the frequency of Adachi's Type I and IVa branching patterns (1). When compared to the other research, the results of this study were within the interquartile range and the studies as a group were consistent with one another (σ = .55). results from previous studies could therefore be combined with data from this study, making it possible to calculate the frequency with which the inferior gluteal and internal pudendal arteries shared a trunk: 642 of the 1217 cases (52.75%).

Author	Year	N=	% internal pudendal & inferior gluteal share common trunk
Adachi (1)	1928	118	51.2
Braithwaite (6)	1952	169	60.9
Chase & Kirchhoff	2015	128	48.3
Kawanishi (17)	2008	290	53
Lipshutz (20)	1918	181	40
Roberts & Krishinger (35)	1967	167	56.4
Sakthivelavan (38)	2014	116	63.2

Table 1: Comparison to six previous research publications

Meta-analysis

Even with the broad nature of the criteria used in this study to provide opportunity for the texts to describe variation, most did not (Table 2, Figure 2). Of the textbooks searched, variation in the arteries was mentioned in 25% (5/20) of them. Only 1 textbook or atlas showed a variation in a diagram or picture (26). These variations were shown using two pictures, one showing inferior gluteal artery coming from the anterior division of the internal iliac artery and one picture showing inferior gluteal artery coming from the posterior division of the internal iliac artery. While this showed variability, it failed to include multiple representations of the internal pudendal and the middle rectal arteries. None of the resources contained any statistics to show the different variations' prevalence. Of the 20 books, 30% (n = 6) of the textbooks and atlases contained language suggesting that more than one variation could be found. This included but is not limited to descriptions that used words such as: may, occasionally, sometimes, and can.

	Authors	Mentions Variability	Shows Variability	Contains statistics	May/Occasionally etc.
1	**A.W. Rogers (36)**	No	No	No	No
2	**Chase (9)**	No	No	No	No
3	**Crouch (10)**	**Yes**	No	No	No
4	**Grants (3)**	No	No	No	No
5	**Grays (15)**	No	No	No	**Yes**
6	**Grays (13)**	No	No	No	No
7	**Larsen (19)**	No	No	No	**Yes**
8	**Marieb (21)**	No	No	No	No
9	**Marieb (22)**	No	No	No	No
10	**Mckinley (23)**	No	No	No	No
11	**McKinley (24)**	No	No	No	No
12	**Moore (26)**	**Yes**	**Yes**	No	**Yes**
13	**Moore (25)**	**Yes**	No	No	**Yes**
14	**Moses (28)**	No	No	No	No
15	**Netters (31)**	No	No	No	No
16	**Slaby (39)**	No	No	No	No
17	**Snell (41)**	No	No	No	**Yes**
18	**Snell (40)**	**Yes**	No	No	**Yes**
19	**Snell (42)**	**Yes**	No	No	No
20	**Tortora (44)**	No	No	No	No

Table 2: Meta-analysis results from 20 commonly used textbooks and atlases from the Gibson D. Lewis Health Science Library at UNTHSC and the private collections of UNTHSC anatomy faculty.

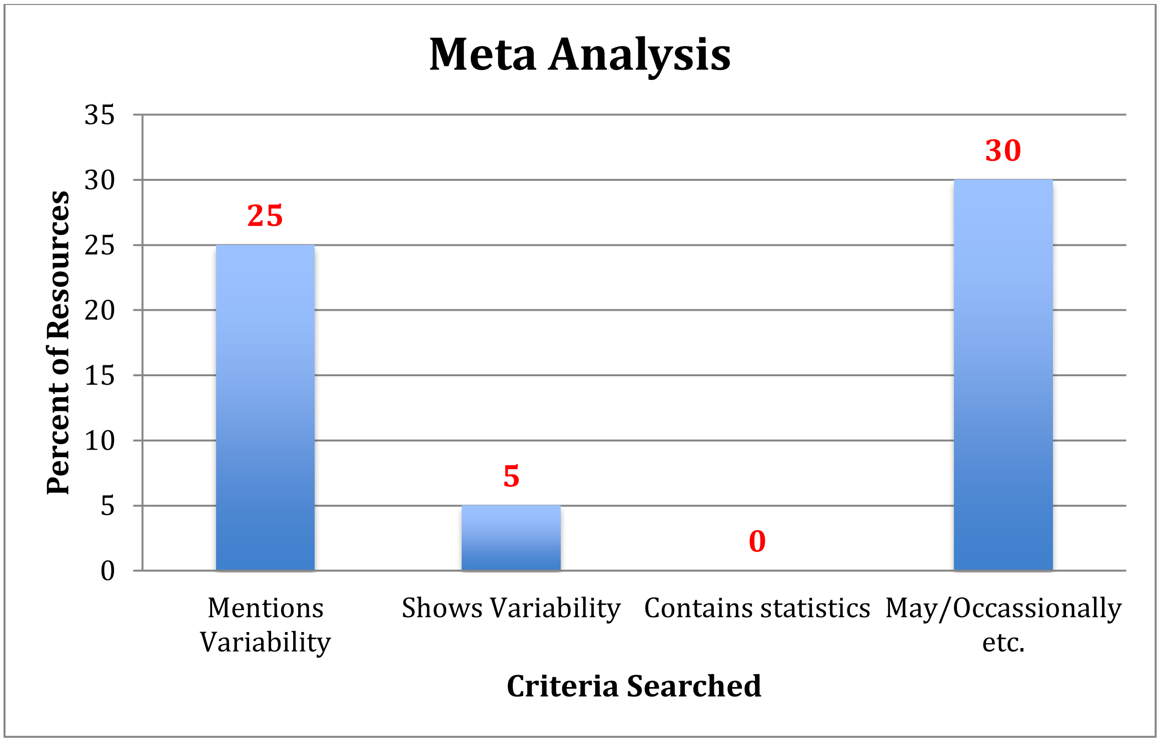

Figure 2: Meta-analysis results from 20 commonly used textbooks and atlases from the Gibson D. Lewis Health Science Library at UNTHSC and the private collections of UNTHSC anatomy faculty.

Discussion

The data from this study revealed that the most common variation was the inferior gluteal and internal pudendal arteries sharing a trunk, which occurred less than half of the time, (48.3%) supporting hypothesis 1. These data, along with previous comparable research, comprises seven studies and 1217 hemipelves (Table 1). In none of these studies did the most common variation occur in even two-thirds of the cases. The cumulative mean of the seven studies revealed that the inferior gluteal and internal pudendal arteries share a trunk in approximately half of cases (52.75%). This lack of consistency in branching patterns suggests that the inclusion of different branching patterns in both textbooks and atlases would have value.

The results of the meta-analysis (Table 2, Figure 2) showed that 25% (5/20) of the commonly used resources mentioned variability, 5% (1/20) showed a variation diagrammatically, and none contained any statistics. These results provide strong support for hypothesis two. The data from this study, as well as many similar studies (1, 6 17, 20, 35, 38), revealed vast inconsistency in the branching pattern, yet the meta-analysis showed that it is seldom portrayed in any aspect in commonly used resources. This could be because it is very difficult to include the many possible variations or it could be because including all the variations would be overwhelming, especially for students learning anatomy for the first time. With further incorporation and discovery of clinical correlates, textbooks and atlases will need to evolve as well in order to provide students, clinicians, and researchers with adequate information to gain competency.

As research continues to demonstrate variability and discover new clinical correlations, textbooks, atlases, and other anatomical resources must improve their presentation of the material. This is imperative in order to fulfill the purpose of these resources, to provide accurate and pertinent information to their users. Anatomical resources need to be reflective of the human body and the many variations that can be found from person to person in order to accurately represent what is occurring. There is a discrepancy between the research that has been conducted for nearly a hundred years (Table 1) and current textbook portrayals (Table 2, Figure 2) of the internal iliac artery. Incorporating research on variations into commonly used resources would be useful to students and clinicians. Students would be prepared for dissections and gain proficiency over the topic more easily with the ability to reference accurate information. Clinicians would be able to apply their anatomical knowledge in procedures and settings that require efficient and accurate identification of the arteries.

While this variability has been documented, there have not been an overwhelming number of studies on the branching of the internal iliac artery. The lack of a vast amount of research could be a reason for its lack of inclusion in commonly used resources. With innovative teaching and clinical technologies, anatomical variation could become a well-studied and pertinent aspect of education and medicine.

Conclusion

This study showed that the branching pattern of the internal iliac artery is indeed highly variable. With the most common variation occurring less than half of the time, and comparable research revealing similar results, the branching pattern of the internal iliac artery has shown to be consistently inconsistent. Related research for over a hundred years supports this claim by reporting similar results, yet the meta-analysis of commonly used resources intended for undergraduate, graduate and clinical uses showed an inadequate representation of the branching patterns. With most resources not mentioning, describing or showing the variability, students and clinicians may not be properly informed about the branches of the internal iliac artery. Further investigation into clinical applications and obtaining student feedback could provide more motivation for textbook and atlas authors to include anatomical variations in their work.

Limitations

The limitations of the study include the way the data were collected and the population on which the study was conducted. This study relied on first year medical students from the Texas College of Osteopathic Medicine (TCOM) at the University of North Texas Health Science Center (UNTHSC) to record observations of their cadaveric dissections of the branches of internal iliac artery. This introduced the potential for inter-observer error and/or unreliable data from inexperienced reporters. This limitation was mitigated by the availability of UNTHSC anatomy faculty to answer questions and the use of a multiple-choice data sheet question rather than an open-ended question.

The second limitation is the population on which the study was conducted. Although both sexes were well represented, with 94 female and 82 male body donors, the geographic population was mostly limited to those from the Fort Worth area. This makes drawing conclusions about a broader population difficult. This study accounted for this by seeking other studies that were done in various countries for comparison. They revealed very similar results, indicating that this concern is a minor limitation.

A third limitation of this study is that results from research published in languages other than English were not compared to the current study. This would potentially be a fruitful direction for future investigation.

CHAPTER III

INTERNSHIP EXPERIENCE

Description of Internship Site and Experience

I was fortunate to be able to conduct my internship at the Human Anatomy Lab in the Center for Anatomical Sciences at the University of North Texas Health Science Center (UNTHSC) in Fort Worth, TX. Internships such as this one, and the educational experience for me and hundreds of other students, is made possible by the generosity of the body donors and their loved ones. Their impact on my pursuit of knowledge and medicine has been truly amazing.

I have also had the pleasure to work with and be trained by many knowledgeable, experienced and gracious faculty members. On a nearly daily basis I have been able to interact with the anatomy faculty including, Dr. Claire A. Kirchhoff, Dr. Rehana Lovely, Dr. Rustin E. Reeves, Dr. Armando Rosales, and Dr. Geoffrey Guttmann. Under their guidance, teachings, and support I have gained valuable knowledge and skills that will help me be successful in medical school, residency, and practice.

In the fall, I took Neuroscience with the first year medical students from the Texas College of Osteopathic Medicine and an Anatomy Journal Club course. In Neuroscience I learned about the one area of anatomy and physiology not covered in the Medical Sciences curriculum. This gave me a complete background on the human body and furthered my preparation for medical school. Journal Club increased my ability to critically read and discuss current research. Making a habit of reading and analyzing an article every week drastically improved my ability to extract information and find strengths and weaknesses in different research designs. Being able to discuss the articles with other graduate students from different programs and backgrounds provided me with a variety of perspectives and helped me to see things from different angles.

For the spring 2016 semester I was an anatomy teaching assistant for the Master's in Medical Sciences students' at the UNTHSC. This is a cadaver-based course that required me to set up a station that I was assigned by Dr. Lovely, and oversee the station for 27 groups of students. Overseeing a lab station could mean teaching for the entire 8 minutes that a group was at my station, just answering any questions the students may have had or anything in between, depending on the design of the lab station. To conclude each lab session I cleaned and put away my station in accordance with laboratory policy.

Being able to teach driven masters students has provided me the opportunity to further my anatomical knowledge, improve my communication skills, and give back to the students the same experience that I was fortunate enough to have had. This has provided me with the opportunity to grow and prepare for my future endeavors like nothing else could. The repetition of teaching many different groups the same things has allowed me the opportunity to form long-term knowledge of the subject and pushed me to explain and show things in a way that different types of learners can understand. Reaching a student and providing clarity over a difficult subject has been a rewarding experience.

Being able to work with an experienced research professor like Dr. Claire A.

Kirchhoff has allowed me to gain perspective and experience for the research process. Having done research in chemistry as an undergraduate, I thought I was prepared for this portion of my curriculum. I soon found out anatomical and clinical research was much different and I would need to adapt. With Dr. Kirchhoff's relentless assistance I was able to understand what needed to be done, and how to best go about it. Being able to go to her with different ideas and problems I had and receiving constructive criticism and feedback is what made completing these projects possible. It also would not have been possible without the predecessors of my project, Toan Tran and Matthew Pombo, who laid the foundation for this project. I am also thankful for Mina Zilaie who piloted this anatomy track program in 2015 and provided me with valuable insight on what to expect this last year.

Journal Summary

Below (APPENDIX B) is a journal I was required to keep of the duties I was assigned and completed while I was a teaching assistant for the Masters' in Medical Sciences cadaver lab. I was provided in advance with the lab schedule and what my duties would be for the upcoming lab. I studied as needed to master the topic to which I was assigned. I did this by using the faculty's PowerPoint slides as well as various textbook and atlases. I have improved my anatomical knowledge with this experience, but mainly my communication and teaching skills have grown. The ability to pass on knowledge to interested students is an honor and responsibility that I took serious by working hard to provide the best educational experience I could.

APPENDICES

APPENDIX A: EXAMPLE UNTHSC ANATOMICAL DATA COLLECTION SHEET

(Complete sheet inserted on following pages. Original data sheet is a single-sided page; version presented here is reformatted to match the rest of the practicum report document).

Anatomical Variation Data Collection Sheet
Tank number
Sex of Donor

PELVIS

1. How would you describe the degree to which your dissection was complete as you begin filling out this data collection sheet?
   a) Completely done
   b) Mostly done
   c) Not sure
   d) Intended to use data sheet to help me decide
   e) Other, please describe:

2. Does superior vesical artery branch from umbilical artery?

Left:
   a) Yes
   b) No
   c) Other:

Right:
   a) Yes
   b) No
   c) Other:

3. Which of the following best describes the donor's pelvis?
   a) Donor is male
   b) Uterus present
   c) Partial hysterectomy (cervix present)
   d) Total hysterectomy (uterus removed but ovaries and uterine tubes present)
   e) Radical hysterectomy (uterus and adnexa removed, probably also superior vagina)
   f) Other (please describe)

4. Is the superior gluteal artery located between the lumbosacral trunk and S1?

Left:
   a) Yes
   b) No
   c) Other:

Right:
   a) Yes
   b) No
   c) Other:

5. Which of the following best describes the relationship between internal pudendal, middle rectal, and inferior gluteal arteries?

Left:
   a) Middle rectal and internal pudendal share a trunk
   b) Internal pudendal and inferior gluteal share a trunk
   b) Middle rectal and inferior gluteal share a trunk
   d) Other:

Right:
   a) Middle rectal and internal pudendal share a trunk
   b) Internal pudendal and inferior gluteal share a trunk
   c) Middle rectal and inferior gluteal share a trunk
   d) Other:

6. Where does the obturator artery originate? Please circle ALL that apply (you might circle B, and D, and E, and fill in E, for example).

Left:
   a) External iliac a.
   b) Internal iliac a.

Right:
   a) External iliac a.
   b) Internal iliac a.

c) Anterior division
d) Posterior division
e) It is a branch of: (indicate)

c) Anterior division
d) Posterior division
e) It is a branch of:

7. Was it necessary to perform any additional dissection to answer the variation questions?
   a) Yes b) No c) Other, please describe:

APPENDIX B

Medical Sciences Anatomy Teaching Assistant Journal Spring 2016

January 12th 2016 12:00 PM to 5:15 PM

- Explained features of the humerus and vertebral column
    - This included muscular attachments orientation and identifying features

January 15th 2016 12:00 PM to 5:15 PM

- Explained make and take station over the brachial plexus
    - Involved answering questions and improving student ability to formulate questions similar to those that will be asked on exams

January 19th 2016 12:00PM to 5:15 PM

- I supervised a self-study station on the muscles and spaces of the upper limb. I first pointed out features of the spaces to help the students identify them. I then helped facilitate and improve their discussion over the topic.

January 25th 2016 11:30 AM to 5:15 PM

- Tagged and oversaw a station regarding structures of the axilla. This included the axillary artery and its branches, the brachial plexus and associated musculature. I also answered questions and gave insight into studying this material.

January 29th 2016 8:00 AM to 12:30 PM

- I helped set up the practical exam by tagging structures related to questions that I was assigned. I then oversaw the students during the exam.

February 3rd 2016 11:30 AM to 5:15 PM

- I set up and ran a station that covered the anterior thigh and structures of the femoral triangle.

February 5th 2016 11:30 AM to 5:15 PM

- Set up and taught a station that covered the structures of the gluteal region including identification, innervation, blood supply and action.

February 9th 2016 11:30 AM to 5:15 PM

- Setup and oversaw a make and take quiz over structures of the foot. I helped students to tag structures and motivated them to produce well thought-out and challenging questions.

February 15th 2016 8:00AM to 12:30 PM

- Helped to set up for the practical exam. This involved me being given a structure and question to tag in a clear way. I then proctored the first group of students as they took the exam.

February 16th 2016 11:30 AM to 5:15 PM

- Set up station for the first day of lab covering the thorax and cardiopulmonary system. I taught a station that covered the different structures of the heart including chambers, valves and blood flow.

February 19th 2016 11:30 AM to 5:15 PM

- I did an overview over the heart vasculature. I found hearts with good examples of structures and challenged the students with more intricate questions.

February 22nd 2016 11:30 AM to 5:15 PM

- I was put in charge of a station that covered the blood supply and venous drainage of the heart. This was their third lab on this material so I went over a few of the more difficult structures first but gave them most of the time to ask questions and spend hands on time with the heart.

February 26th 2016 8:00 AM to 10:00 AM

- Assisted with setting up the practical that covered the thorax. I mainly tagged structures of the heart since I had been in charge of a heart station for every lab in this unit. I also helped review the structures that were tagged for the entire exam to ensure accuracy and clarity.

March 7th 2016 11:30 AM to 5:15 PM

- I was assigned a station designated to cover accessory digestive organs and the parts of the biliary tree. This was the student's first lab session over this material therefore, it required me to present the structures and explain their functions for most of the assigned time.

March 11th 2016 11:30 AM to 5:15 PM

- I set-up and oversaw a question and answer station over the gastrointestinal system. I needed to be prepared to handle a variety of questions that the students needed clarification over.

March 18th 2016 11:30 AM to 5:15 PM

- I was placed in charge of a station assigned to identify features of the kidney and describe their functions. This was the student's first lab covering this material, requiring me to be clear and deliberate with my explanations of the structures.

March 22nd 2016 11:30 AM to 5:15 PM

- For this lab I set-up and oversaw a station covering renal structures and functions. Since this was the second time the material was covered I encouraged a more interactive experience for the students. I asked them to find structures and explain more complex material.

March 29th 2016 11:30 AM to 5:15 PM

- For this lab I was given the responsibility of overseeing two stations. The first covered the path of sperm through the male reproductive tract. The second covered the path of an ovum through the female reproductive tract. I managed both stations by covering more difficult concepts and encouraging questions from the students.

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