

## UNION OF THE UMBILICAL ARTERIES IN THE ANTERIOR WALL OF THE ABDOMEN AND ITS CLINICAL AND SURGICAL SIGNIFICANCE: CASE REPORT

---

### *Daniel Arantes de Oliveira*

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0009-0006-3434-2166>

### *Filipe Virgilio Ribeiro*

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0000-0002-1091-6624>

### *Mariana Apostolos Dagios*

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0009-0004-7091-3769>

### *Ariane da Costa Goular*

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0009-0002-6716-1610>

### *Sarah Andrade Reis de Oliveira*

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0009-0001-0592-8786>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



***Henrique Malta Guimarães***

Students of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0009-0007-6899-2826>

***Camila Albuquerque Melo de Carvalho***

Professor of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0000-0003-2325-2844>

***Edson Donizetti Verri***

Professor of medicine course at: ``Centro  
Universitário Barão de Mauá``, Ribeirão  
Preto, São Paulo  
<https://orcid.org/0000-0002-2403-3953>

**Abstract: Introduction:** The umbilical artery is the first branch of the anterior trunk of the internal iliac artery, giving rise to the superior vesical artery and continuing anteriorly, leaving the pelvic cavity and ascending on the internal surface of the anterior abdominal wall to the navel. This article aims to provide an anatomical description of the union of the umbilical arteries in the anterior abdominal wall of a cadaver, aiming to add to the body of literature a better understanding of the anatomical aspects of the structures in this region. Case report: During a routine analysis of an anatomical examination at the Anatomy Laboratory of the Centro Universitário Barão de Mauá in Ribeirão Preto, São Paulo, it was observed the presence of an anatomical variation of the umbilical arteries in a female cadaveric piece, where the junction of the medial and median umbilical ligaments, forming a single ligament that reaches the lower edge of the Umbilical Ring (AU). Commonly, the umbilical artery is the first branch of the anterior trunk of the internal iliac artery, which originates the superior vesical artery and runs anteriorly, leaving the pelvic cavity and ascending on the internal surface of the anterior abdominal wall to the navel, differently from what occurs in this case, where an obliteration occurs in the anterior region of the AU. Conclusion: Knowledge of anatomical variations, specifically of the umbilical arteries, is essential to prevent and avoid clinical and surgical complications and possible postoperative complications, due to the various implications inherent to the umbilical region.

**Keywords:** umbilical arteries, obliteration, surgical application

## **INTRODUCTION**

The umbilical cord is an essential structure for the life of the fetus, being characteristically made up of three blood vessels: two arteries (venous blood transport) and a vein (arterial blood transport). However, it is estimated that

in approximately 0.5-2.5% of all pregnancies, a single umbilical artery (SUA) occurs. Previously it was considered an anatomical curiosity, however it is the most common true umbilical cord anomaly. It is possible to find UAU alone, or associated with malformations, given that around 30% of children with this condition have associated congenital structural anomalies. (1)

The umbilical artery is the first branch of the anterior trunk of the internal iliac artery, giving rise to the superior vesical artery and continuing anteriorly, leaving the pelvic cavity and ascending on the internal surface of the anterior abdominal wall to the navel. In the fetal period, the umbilical artery is responsible for carrying blood from the fetus to the placenta, however, after birth, it becomes a fibrous cord, distal to the origin of the superior vesical artery, called the medial umbilical ligament (LUM), the which generates a fold of peritoneum called the medial umbilical fold. (2)

Generally, in the anterior abdominal wall, the LUMs run towards the umbilical ring (AU) laterally to the median umbilical ligament (urachus) and medially to the lateral umbilical ligaments (inferior epigastric vessels), (3). Although this characterization elucidates the most common anatomy of the LUM, some important variations have been described, although literature regarding the anatomy of the umbilical ligaments is scarce in scientific circles. However, it is worth highlighting that they are of crucial importance for understanding their clinical and surgical implications.

Based on the shape and morphological relationships with the umbilical ligaments, and using as a basis a classification system previously developed by Chang-Seok et al. (4), Fathi et al. classified AU into 5 main types, as shown in Table 1(5). In this study, the anterior abdominal wall of 24 adult cadavers embalmed in the anatomy laboratory of Case

Western Reserve University was evaluated. Among these, in only 1 cadaver (4.1%) the junction of the medial umbilical ligaments with the median, forming a single ligament that reached the lower edge of the UA.

Therefore, this article aims to provide an anatomical description of the union of the umbilical arteries in the anterior wall of the abdomen of a cadaver, aiming to add to the body of literature a better understanding of the anatomical aspects of the structures in this region. Furthermore, correlate this knowledge with possible clinical and surgical implications, which may be fundamental for the practice of health professionals in their areas of activity.

I	Round or oval UR, RL arising from the top of the UR, MnL between the MdLs reaching the UR inferiorly.
II	Obliterated or slitted UR, RL arising from the top of the slit, MnL between the MdLs reaching the slit inferiorly.
III	Round or oval UR, RL extends to the lower edge of the UR, MnL between the MdLs reaching the UR inferiorly.
IV	Round or oval UR, RL forked and reaching the side edges of the UR, MnL between the MdLs reaching the slit inferiorly.
V	Round or oval UR, RL arising from the top of the UR, MdLs and MnL merge and form a single ligament before reaching the UR inferiorly.

**Table 1-** Umbilical Classification

Abbreviations: UR: umbilical ring; RL: Round ligament of liver; MdL, medial umbilical ligament; MnL, median umbilical ligament.

Table adapted from Fathi et al.2012. (5)

## CASE REPORT

During a routine analysis in an anatomical examination at the Anatomy Laboratory of the Centro Universitário Barão de Mauá in Ribeirão Preto, São Paulo, the presence of an anatomical variation of the umbilical arteries in a female cadaveric specimen was observed, as shown in Figure 1, where the junction of the medial and median umbilical ligaments, forming a single ligament that reaches the lower edge of the Umbilical Ring (AU).

Commonly, the umbilical artery is the first branch of the anterior trunk of the internal iliac artery, which originates the superior vesical artery and runs anteriorly, leaving the pelvic cavity and ascending on the internal surface of the anterior abdominal wall to the navel, differently from what occurs in this case, where an obliteration occurs in the anterior region of the AU.



Figure 1 - View of the internal surface of the anterior abdominal wall, details of the anatomical structures present.



Figure 2 - View of the internal surface of the anterior abdominal wall and the origin of the umbilical arteries, details of the anatomical structures present.

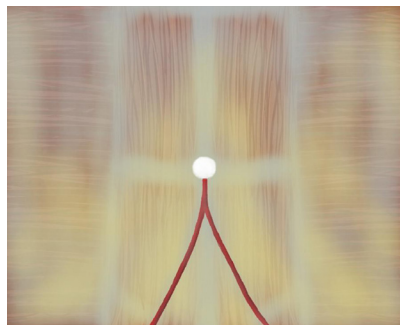


Figure 3 - Illustration of the view of the internal surface of the anterior abdominal wall.

## DISCUSSION

The navel is a structure directly related to the urinary, cardiovascular and digestive systems. In newborns, the navel can be a route for surgically performing a Fredet-Ramstedt pyloromyotomy in cases of pyloric stenosis, as well as a possible site for a colostomy in children with an imperforate anus. It is also noteworthy that it is clinically important as it is the preferred entry point for laparoscopic surgeries, as this approach is considered safe and minimally invasive, resulting in small scars(6).

The navel also represents a relatively weak point on the anterior abdominal wall that is prone to hernia or bulging as a result of increased intra-abdominal pressure. Furthermore, most abnormal conditions observed in the navel are attributed to developmental disorders. (7)

Thus, focusing on the development of the umbilicus and its congenital anomalies and correlating these conditions with clinical findings are necessary. Most books and works in the literature have discussed the navel in many systems, such as the urinary, digestive, and cardiovascular systems. (6)

One of the complications caused by the obliteration of the umbilical arteries is the blood supply. The blood supply to the medial region of the anterior abdominal wall, including the umbilicus, is provided by the branches of the superior and inferior epigastric arteries. The superficial anatomy of these vessels is lateral to the navel (8). The two epigastric arteries anastomose together on each side and form an important alternative channel for blood flow in cases of aortic coarctation (9). The superficial veins form a venous radiating from the navel. Some small veins called paraumbilical veins connect this network with the portal vein through the navel and along. This connection forms an important portosystemic venous anastomosis. (10)

The navel is also a location recommended by most surgeons for laparoscopic surgery and provides a safer way to introduce a surgical instrument, in addition, it promotes better healing. (11)

A systematic review with meta-analysis of 66,483 patients over 65 years of age highlights benefits in laparoscopic colorectal surgery when compared with open surgery in relation to morbidity (19.3% in laparoscopy and 26.7% in open approach), mortality (2.2% in laparoscopy and 5.4% in open surgery), pulmonary complications (3.9% in laparoscopy and 6.3% in open surgery) and cardiac complications (4.7% in laparoscopic surgery and 7.7% in open surgery), (12)

In cases of inguinal hernia, one of the main disadvantages of laparoscopic surgery is the higher rate of recurrence of the condition, which varies from 0.83% to 4.1%, when compared to open surgery, with a rate of 1.2%. Therefore, the study carried out by Chen et al divided 482 laparoscopies performed on 428 children of random ages into group A, in which patients received the repair without closing the opening, resulting in 4.18% recurrence, and group B, in which patients received repair with medial or median umbilical ligament closing the hole, resulting in 0.00% recurrence. Therefore, this study proved that covering the opening of the hernia internally using the medial or median umbilical ligament prevents the recurrence of the condition, enabling greater safety of the repair through closure and, in case of increased intra-abdominal pressure, keeping the sac collapsed (13).

Furthermore, a case report highlights that, similar to what was previously discussed in this article, the closure (purse-string) of the internal opening with the umbilical ligament in cases of femoral hernias also contributes to positive results aesthetically and functionally. (14) Before From the above, it is necessary

to know the arrangement of the anatomical structures related to the umbilical region. Therefore, knowledge of anatomical variations, specifically of the umbilical arteries, is essential to prevent and avoid clinical and surgical complications and possible postoperative complications, due to the various implications inherent to the umbilical region.

## **INTEREST CONFLICTS**

The authors have no conflicts of interest to declare.

## **THANKS**

We would like to thank the ``Centro Universitário Barão de Mauá``, especially the Anatomy Laboratory for authorizing the analysis of the anatomical specimens.

## **ETHICAL DECLARATION**

The authors state that every effort has been made to follow all local and international ethical guidelines and laws that pertain to the use of human cadaveric donors in anatomical research (Iwanaga et al., 2022), (15)

## **FINANCING**

The authors declare that no funds, grants or other support were received during the preparation of this manuscript.

## **AVAILABILITY OF DATA AND MATERIALS**

Not applicable.



## REFERENCES

- <sup>(1)</sup>Araujo Júnior, E., Guimarães Filho, H. A., Pires, C. R., & Zanforlin Filho, S. M. Avaliação do cordão umbilical pelo ultra-som tridimensional. *Femina* 2006;34:417-422.
- <sup>(2)</sup>Drake, Richard L. *Gray's Anatomia Para Estudantes*. Elsevier Brasil; 2005
- <sup>(3)</sup>Tokar, Baran; Yucel, Ferruh. Anatomical variations of medial umbilical ligament: clinical significance in laparoscopic exploration of children. *Pediatric surgery international* 2009;25:1077-1080.
- <sup>(4)</sup>Oh, C. S., Won, H. S., David Kwon, C. H., & Chung, I. H. Morphologic variations of the umbilical ring, umbilical ligaments and ligamentum teres hepatis. *Yonsei medical journal* 2008; 49:1004-1007.
- <sup>(5)</sup>Fathi, Amir H.; Soltanian, Hooman; Saber, Alan A. Surgical anatomy and morphologic variations of umbilical structures. *The American Surgeon* 2012;78:540-544.
- <sup>(6)</sup>Hegazy, Abdelmonem A. Anatomy and embryology of umbilicus in newborns: a review and clinical correlations. *Frontiers of medicine* 2016;10:271-277
- <sup>(7)</sup>Abhyankar, A., & Lander, A. D. Umbilical disorders. *Surgery (Oxford)* 2004; 22(9):214-217.
- <sup>(8)</sup>Smith, Tim; Pinnock, Colin; Lin, Ted (Ed.). *Fundamentals of anaesthesia*. Cambridge: Cambridge University Press, 2009.
- <sup>(9)</sup>APRIL, E. W.; ERICKSON, A. *Anatomy: the National Medical Series for Independent Study*. In: A Wiley medical publication. 1990.
- <sup>(10)</sup>Snell, Richard S. *Clinical anatomy by regions*. 9<sup>a</sup> ed., Philadelphia: Lippincott Williams & Wilkins, 2011.
- <sup>(11)</sup>Fawcner-Corbett, D., Nicholson, J. A., Bullen, T., Cross, P., Bailey, D., & Scott, M. H. Anatomical variation in the position of the umbilicus and the implications for laparoscopic surgery. *International Journal of Surgery* 2010;8(7):540.
- <sup>(12)</sup>Chen, K., Xiang, G., Wang, H., & Xiao, F. Towards a near-zero recurrence rate in laparoscopic inguinal hernia repair for pediatric patients. *Journal of Laparoendoscopic & Advanced Surgical Techniques* 2011;21(5):445-448.
- <sup>(13)</sup>Antoniou, S. A., Antoniou, G. A., Koch, O. O., Pointner, R., & Grandrath, F. A. Laparoscopic colorectal surgery confers lower mortality in the elderly: a systematic review and meta-analysis of 66,483 patients. *Surgical endoscopy* 2015;29:322-333.
- <sup>(14)</sup>Ikossi, Danagra Georgia; Shaheen, Raymond; Mallory, Baird. Laparoscopic femoral hernia repair using umbilical ligament as plug. *Journal of Laparoendoscopic & Advanced Surgical Techniques* 2005;15:197-199, 2005.
- <sup>(15)</sup>Iwanaga, J., Singh, V., Takeda, S., Ogeng'ò, J., Kim, H.-J., Mory\_s, J., Ravi, K. S., Ribatti, D., Trainor, P. A., Sañudo, J. R., Apaydin, N., Sharma, A., Smith, H. F., Walocha, J. A., Hegazy, A. M. S., Duparc, F., Paulsen, F., Del Sol, M., Addis, P., ... Tubbs, R. S. (2022). Declaração padronizada para o uso ético de tecidos cadavéricos humanos em artigos de pesquisa em anatomia: Recomendações dos Editores-Chefes de Revistas Anatômicas. *Anatomia Clínica*, 1–3. <https://doi.org/10.1002/ca.23849>