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Reappraisal of the variational anatomy of the vermiform appendix and their possible clinical applicability: a cadaveric analysis

Apurba Patra[1], Harsimarjit Kaur[2], Usha Chhabra[2], Adil Sghar[3], Krzysztof Balawender[4], Artur Pasternak[5], Jerzy A. Walocha[5]

[1]*Department of Anatomy, All India Institute of Medical Sciences, Bathinda, India*
[2]*Department of Anatomy, Government Medical College, Patiala, India*
[3]*Department of Anatomy, All India Institute of Medical Sciences, Patna, India*
[4]*Department of Normal and Clinical Anatomy, Medical University of Rzeszow, Rzeszów, Poland*
[5]*Department of Anatomy, Jagiellonian University Medical College, Kraków, Poland*

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Background: *The anatomical variations in the position, length, arterial supply and extension of mesoappendix of the vermiform appendix (VA) are pivotal to establishing a standard pattern in the study population of known ethnicity and their clinical applicability.*

Materials and methods: *The present study was conducted on 47 adult human cadavers, thirty-five males and twelve female subjects of North Indian ethnicity.*

Results: *Retrocaecal appendix was found in 23 cases (48.9%) followed by pelvic in 13 (27.7%), three cases each of pre-ileal, post-ileal, and promontoric (6.4%), one case (2.1%) each of paracaecal and subcaecal reported. The length of VA varied from three to ten centimetres, averaging about 7.37 ± 1.67 cm, both the shortest (2.9 cm) (female) and longest (10 cm) (male) were of retrocaecal type. The main appendicular artery (MAA) showed a widely varied branching pattern within the mesoappendix, ranging from three to seven. Fourteen cases (29.78%) showed the accessory appendicular artery (AAA) or dual arterial supply, arising from the ileocolic artery in ten (21%) and in four from the post-caecal (9%). In the specimens with dual arterial supply, the estimated portions of the VA supplied by the MAA also vary with distal ¾th being supplied in 57.14%. In ten cases (21%), the mesoappendix failed to reach the tip of the VF.*

Conclusions: *Knowledge of anatomical diversities in position, length, course, arterial supply, branching pattern, and mesoappendix is potentially crucial in avoiding surgical catastrophes. Atypical positions of the organ can cause diagnostic confusion and result in delayed treatment. VF supplied by an end artery is one of the causes of the occurrence of appendicitis and mesoappendix not reaching the tip making the organ more vulnerable to necrosis. Vascular variations and anomalies involving the main or accessory appendicular artery are critical to prevent haemorrhage or faulty ligatures.* (Folia Morphol 2024; 83, 3: 716–726)

Keywords: vermiform appendix, variation, cadaveric study, anatomy

Address for correspondence: Prof. Jerzy A. Walocha, Department of Anatomy, Jagiellonian University Medical College, ul. Kopernika 12, 31–034 Kraków, Poland; e-mail: jwalocha@poczta.onet.pl

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INTRODUCTION

The vermiform appendix (VA) constitutes a cul-de-sac structure found exclusively in men, specific anthropoid apes, and the wombat, a nocturnal burrowing marsupial indigenous to Australia [33]. Its historical presence dates back to ancient times, with early observations possibly extending as far back as the Egyptian civilization circa 3000 B.C. Notably, during mummification practices, abdominal components were extracted and preserved within Coptic jars, bearing inscriptions that denoted their contents as the "worm of intestines" [17].

In terms of embryological development, the VA originates as a caecal diverticulum, manifesting in the sixth week of embryonic gestation as a protuberance along the anti-mesenteric border of the mid-gut loop [37]. Subsequently, it becomes posterior-medially attached to the caecum, positioning itself approximately 2 cm below the junction of the ileum and caecum [48]. This intricate developmental trajectory underscores the unique anatomical characteristics and historical relevance of the VA in the realm of biological and medical sciences. Within the spectrum of abdominal viscera, the VA stands out as an organ characterized by a notable degree of variability. If its length exceeds typical parameters, the VA has the capacity to extend into various regions of the abdomen [2]. The positioning of the VA exhibits a wide range of possibilities, with retrocaecal placement being the most prevalent, followed by pelvic, post-ileal, sub-caecal, pre-ileal, paracaecal, and promontoric configurations [2, 48]. This diverse array of positional permutations has led some, such as Maingot [23], to assert that the VA possesses a unique status among bodily organs due to its lack of fixed anatomical positioning.

Notably, while the VA has often been considered vestigial in humans, lacking specific functions, its exceptional mobility and the absence of a definitive "normal position" bestow upon it a notable potential for surgical significance [13]. Recognizing the extreme mobility of the VA, certain authors have drawn attention to the critical relationship between its location and the manifestation of acute appendicitis [14]. Depending on its relative position, the clinical signs and symptoms of appendicitis may deviate from the expected symptomatology. For example, pelvic appendicitis can mimic urinary symptoms, retrocaecal appendicitis may induce low back pain, and pre-ileal appendicitis might present with symptoms resembling diarrhoea [14]. Given the considerable anatomical variability associated with the VA, it is imperative for physicians to exercise heightened vigilance when assessing cases involving abdominal pain. Appendicitis should be regarded as at least a secondary consideration, owing to the potential for atypical presentations and the variable anatomical configurations of the VA [27]. This underscores the need for a comprehensive and nuanced approach to clinical evaluation in cases involving the VA.

Furthermore, it is imperative to acknowledge the well-established correlation between concealed locations of the Vermiform Appendix (VA), including the post-ileal, pelvic, and retroperitoneal positions, and the onset of complications in cases of appendicitis. For instance, in cases where the VA assumes a retrocaecal position, compression of its associated blood vessels has been documented [51]. This compression can contribute to an increased incidence of organ necrosis, and gangrene, and ultimately, lead to perforation [49, 51].

The supply of blood to the VA is predominantly facilitated by the appendicular artery. However, it is worth noting that a consensus has not been reached concerning the precise origin, number, and anastomotic patterns of these arteries [40]. Divergent statements regarding the number of arteries supplying the VA can be found in published literature and standard textbooks [48]. Additionally, the presence of the accessory appendicular artery (AAA), typically branching from the ileocolic artery (ICA) or the posterior caecal artery (PCA), is a common occurrence that necessitates distinct ligation when present [36].

The mesoappendix plays a critical role by connecting the VA to the lower section of the ileum's mesentery, encompassing the main appendicular artery (MAA) [50]. However, it is noteworthy that the terminal part of the MAA lies on the wall of the appendix, rendering it susceptible to thrombosis during episodes of acute appendicitis, ultimately culminating in gangrene and subsequent perforation. A shortened or incomplete mesoappendix positions the main appendicular artery (MAA) closer to the appendix wall. During inflammation, especially in acute appendicitis, the VA can swell, potentially compressing or blocking the MAA. This disruption in blood flow in MAA's as an end artery is devastating. Consequently, this compromised blood flow can result in tissue ischaemia and necrosis within the appendix. Untreated, this condition can lead to severe complications, including gangrene and perforation. Therefore, the presence and integrity of the mesoappendix are pivotal in assessing the risk of vascular compromise and subsequent necrosis in cases of appendiceal inflammation. [44].

Nonetheless, it is imperative to recognize that the conventional anatomical norm should be viewed as an idealized scientific model. In clinical practice, anatomical variations must be taken into account [44]. Variations in VA position and arterial vascularization yield a clinical presentation of appendicitis that is notoriously inconsistent [29]. Despite significant advancements in modern radiographic imaging and diagnostic laboratory techniques, the diagnosis of appendicitis remains fundamentally clinical, requiring a blend of observations, clinical judgment, and surgical expertise, underpinned by a comprehensive understanding of anatomical variations [6]. With this contextual backdrop, the present study endeavours to elucidate variations in anatomical positioning, length, arterial supply, and mesoappendix of the VA, with a keen eye toward their substantial clinical implications.

MATERIALS AND METHODS

The material for the study comprised 47 adult human cadavers (thirty-five males and twelve female) aged between 45 to 70 years (approximately), of north Indian ethnicity. Cadavers with history of abdominal surgery or injury were excluded from the study. The abdomen of the embalmed cadavers was opened by a midline incision starting from the xiphoid process up to the symphysis pubis extending laterally along the iliac crest for dissection of the appendix and its arterial supply. Skin flaps, superficial fascia, aponeurosis of external oblique muscle, internal oblique muscle, transversus abdominis, transversalis fascia and parietal peritoneum were incised and reflected laterally as a single flap, thereby giving access to the peritoneal cavity. After identifying the terminal ileum, three taeniae on the external surface of the colon and caecum were traced up to the root of the appendix. The base of the VA was thus identified. The appendices were examined in situ. A line diagram showing the pattern was also made before the position and vessels were disturbed. The position, length and arterial supply of the appendices were examined in situ and any abnormalities found in the appendix or in vessels of the VA were noted in the approved proforma. The appendicular artery and its branches were closely examined with the aid of magnifying glass. The position of the VA was studied in relation to the caecum, the terminal parts of the ileum and the direction of the tip of the VA according to the hand of the clock. The length was measured with the help of silk thread after stretching it from the base of the VA attached to the posteromedial wall of the caecum to its tip without undue strain. Then the thread was measured over the measuring scale and the reading was noted in centimetres. The measurement was taken by two observers and three times by each observer. The means of all observations were taken as the final value. Intra-observer and inter-observer agreement were examined for reliability. A thorough dissection of the appendicular artery, its branches and its anastomoses were studied. The origin, no. of branches, the portion of the VA supplied by the main appendicular artery, the presence of the accessory appendicular artery and its source were examined and noted.

After completing the dissection and noting its position and length in situ, the VA was taken out along with the caecum, terminal ileum, mesoappendix along with the blood vessels, taking care to avoid any undue strain during the collection of the specimen. Then, the distribution and pattern of branching of the main artery were examined. First, we examined the mesoappendix to note whether intact or not or was present up to the tip of the VA or not. Then, we gently separated the layers of the mesoappendix and traced the branches of the MAA from their point of origin up to the wall of the VA with the help of magnifying glass.

The main appendicular artery is defined as one which runs in the crescentic fold of the mesoappendix to the tip of the VA; and the accessory appendicular artery as one which supplies other parts of the VA except the tip.

RESULTS

Position of the base of the VA

Total 47 cases were studied, out of them, 35 were male (74%) and 12 were female (26%). We have reported all the various positions of the VA as described. The most common position was retrocaecal found in 23 cases (48.9%) followed by pelvic in 13 cases (27.7%), three cases each of post ileal, preileal and promontoric (6.4%), one case (2.1%) each of paracaecal and subcaecal. The course of the VA also varied, 41 (87%) showed straight VA whereas six (13%) were tortuous (Fig. 1).

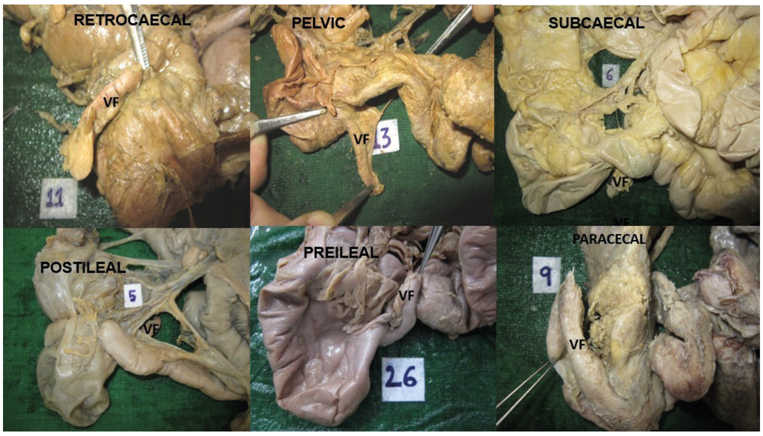

Figure 1. Various positions of the vermiform appendix (VF).

Table 1. Position and length of the VA among males and females.

Positions	Male (n)	Female (n)	Total (n) [%]	Ranges [cm]	Mean length [cm]
Retrocaecal	14	9	23 (48.93)	2.9–10	7.20 ± 2.27
Pelvic	9	3	13 (27.65)	5.8–9.5	7.63 ± 2.83
Post-ileal	3	–	3 (6.38)	7.8–8.7	8.10
Pre-ileal	3	–	3 (6.38)	4.6–9.3	6.06
Promontoric	3	–	3 (6.38)	3.9–6.7	5.83
Paracaecal	1	–	1 (2.12)	NA	8.91
Subcaecal	1	–	1 (2.12)	NA	5.9

Length of the VA

The length of the VA varies from 2.9 to ten centimetres, the average being about 7.37 ± 1.67 cm. The mean length was 7.60 ±1.62 cm in male, while in females it was 6.71 ± 1.57 cm. A minimum length of 2.9 cm was observed in one female cadaver and a maximum length of 10 cm was observed in one male cadaver. Table 1 summarizes the length of the appendices based on their anatomical position. Both the shortest (2.9 cm) and longest (10 cm) was of retrocaecal type (Tab. 1).

Arterial supply of the VA

In all cases, the main appendicular artery was arising from the ileocolic artery. The MAA pursued an arcuate course in the crescentic fold of the mesoappendix, approaching the VA as it extended to the tip. MAA terminated at the tip in 43 cadavers, but in four cases, it turned round the tip and continued on the free border of the organ for a certain distance.

The MAA while in the free edge of the mesoappendix gave off a number of branches, varying from three to seven. Five cases (10.6%) showed three branches, 12 cases (25.5%) showed four branches, eight cases (17.0%) with five branches, 16 cases (34.0%) showed six branches and six cases (12.8%) had seven branches. These branches were parallel to and approximately equidistant from one another. All primary branches are divided into two encircling branches on reaching the VA. In all the specimens, these branches were divided into fine ramifications on the walls of the VA and anastomosed freely. The terminal part of the main appendicular artery supplying the tip was usually an end artery with no anastomosis with other branches.

The accessory appendicular artery was found in 14 cases, in ten (21%), the source of the accessory artery was ileocolic and in four from the post-caecal (9%).

In cases where the VA received more than one arterial blood supply, the estimated portions of the VA supplied by the MAA also vary. In 8 cases (57.14%), it supplied the distal ¾th, in 3 (21.42%) supplied the distal half, in two (14.28%) supplied the whole length and in one (7.14%), supplied the distal 1/4th (Fig. 2).

Mesoappendix

The extension of the mesoappendix was not uniform in all the cases, in 36 (76.59%) it was reaching up to the tip and in eleven (23.40%) mesoappendix

Figure 2. The sources of the accessory appendicular artery. AAA — accessory appendicular artery; ICA — ileocolic artery; MAA — main appendicular artery; PCA — posterior caecal artery.

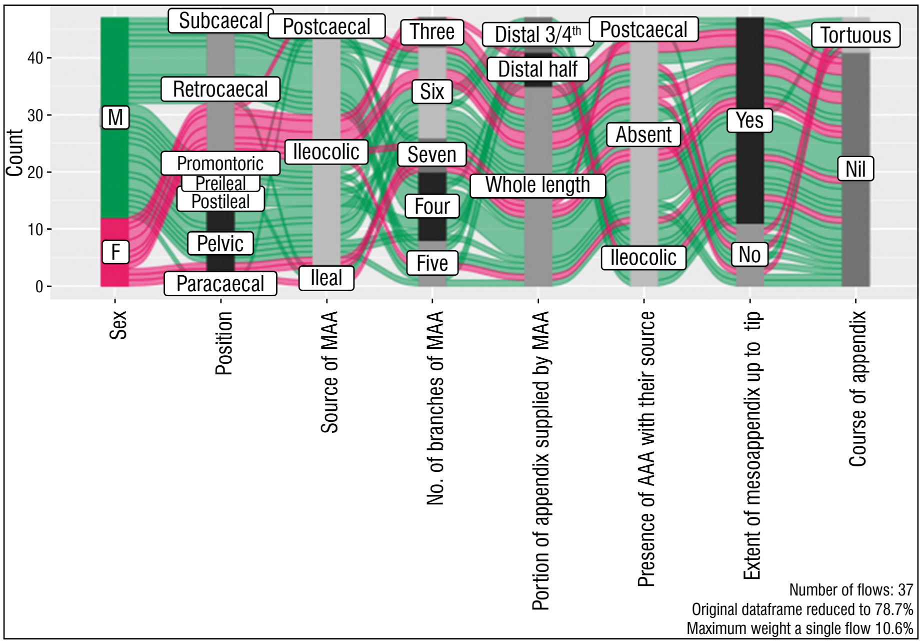

Figure 3. Alluvial diagram of distribution of characteristics of appendix in the present sample.

failed to reach the tip (ended between the middle and distal third).

Alluvial Diagram of distribution of characteristics of VA in the present sample (Fig. 3).

DISCUSSION

Various authors have studied the gross anatomy of the VA and its blood supply. Some authors have studied the VA in situ. While others have studied after removing the VA from the cadavers.

The observations were compared with similar works done by other workers regarding the VA's position, length and arterial supply variations.

The most common position of the VA observed in this study was retrocaecal, accounting for almost half of the cases (48.9%). The high prevalence of the retrocaecal position aligns with previous studies that have reported similar findings. The findings of the present study are in consonance with those of Wakely [48], Solanke TF [40], Delic [14], Clegg-

Table 2. Comparison of different positions of vermiform Appendix of the present study with previous studies.

Author, year	Specimens	Retrocaecal [%]	Pelvic [%]	Pre-ileal [%]	Post-ileal [%]	Sub-caecal [%]	Paracaecal [%]	Promontoric [%]
Wakeley, 1933 [48]	10,000	65.28	31.01	1	0.40	2.26	–	–
Shah et al., 1945 [38]	405	45.6	21.5	27.4		5.4	–	–
Solanke, 1970 [40]	125	38.4	31.2	12.0	4.0	11.2	2.4	–
Katzarski et al., 1979 [21]	103	20.3	43.6	–	–	–	–	–
Ajmani et al., 1983 [2]	100	58	–	–	10	–	–	–
Delic et al., 2002 [14]	50	60	32	–	–	8	–	–
Golalipur et al., 2003 [16]	117	32.4	33.3	18.8	2.6	12.8	–	–
Clegg Lamptey et al., 2006 [9]	1358	67.3	21.6	4.9	3.8	–	2.4	–
Rahman et al., 2006 [30]	100	22	47	10	–	–	–	–
Ahmed et al., 2007 [1]	303	20.1	51.2	3.0	22.1	–	3.6	–
Corzo et al., 2009 [10]	100	41	28	4.0	9.0	11.0	7.0	–
Chaisiwamongkol et al., 2010 [8]	102	19.6	11.76	2.94	37.25	18.62	2.94	–
Tofighi et al., 2013 [45]	400	7	55.8	1.5	12.5	19	–	–
Mwachaka et al., 2014 [24]	48	27.1	25.0	–	18.8	4.2	2.1	–
Souzaa et al., 2015 [42]	377	43.5	9.5	2.4	14.3	24.4	5.8	–
Sumi et al., 2019 [43]	70	62.9	31.4	–	4.3	1.4	–	–
Present study	47	48.9	27.7	6.4	6.4	2.1	2.1	6.4

Lamptey [9], and Corzo [10] with retrocaecal as the commonest (Table 2). In a post-mortem study of 10,000 cases, Wakeley [48] found the retrocaecal position to be most common as in our study and suggested that the high frequency of a retrocaecal VA could be explained on the basis of the embryological development of the caecum and VA. He stated that the caecum undergoes helicoidal torsion during its development as a result of which the appendiculo-caecal junction is displaced upwards, backwards and to the left and that the VA is successively displaced in a similar manner to lie behind the caecum ultimately.

Following retrocaecal, the second most common position found was pelvic, which constituted 27.7% of the cases. Contrary to our findings of Katzarski [21], Golalipur [16], Rahman [30], Ahmed [1] and Tofighi [45] reported pelvic as the most common position of the VA.

The remaining positions, including pre ileal, post ileal and promontoric, each accounted for 6.4% of the cases, followed by one case each of para caecal and sub caecal positions, representing 2.1% of the cases each. While the occurrence of these positions was relatively infrequent in the sample, they highlight the anatomical variability that can exist in the positioning of the VA.

It is worth mentioning that the results of this study may not be fully representative of the general population, as they are based on a specific sample size. However, they provide valuable insights into the distribution of VA positions within the observed cases. Further research with larger sample sizes would be beneficial to validate these findings and gain a more comprehensive understanding of the VA's anatomical variations. Understanding the different positions of the VA is crucial for medical professionals, as it can have implications for the diagnosis and treatment of appendicitis. The knowledge of VA positions can guide surgeons during appendectomies, helping them anticipate the location of the VA and perform the procedure effectively.

Length of VA is also variable in different persons varying from 2–20 cm with an average length of 9 cm.

In the present study, the length of the VA varies from 2.9–10 centimetres, the average being about 7.37 ± 1.67 cm. The average length of VA in male cadavers was 7.65 cm while in female cadavers the average length was 6.52 cm. The minimum length of 2.9 cm was observed in one female cadaver and the maximum length of 10 cm was observed in one male cadaver.

In the present study, the average length of VA in males was more than in females which is similar to the results of studies by Katzarski [21], Ajmani [2] and Golalipur [16]. But Bakheit [4] and Rahman [31] reported that the length of the VA in females was more than males, so it could be different in variable races (Tab. 3).

The length of the VA can exhibit significant variability among individuals. While the normal range of VA length is typically between 5 to 10 centimetres, it can extend beyond these limits. Unusually long appendices may be more prone to torsion or kinking, which can result in obstruction and contribute to appendicitis. Knowledge of the length variations can aid in identifying such anatomical anomalies and guide appropriate management. Research suggests that a longer VA may be associated with an increased risk of developing appendicitis. Therefore, understanding the length of the VA can help clinicians in assessing the likelihood of appendicitis in patients presenting with abdominal pain. The length of the VA can impact the surgical procedure. A longer VA may require a more extensive surgical approach, including a larger incision or the use of advanced techniques such as laparoscopic or robotic surgery. Surgeons need to be aware of the length of the VA to plan and perform the procedure effectively. In some cases of appendicitis, complications can arise, such as perforation or the formation of abscesses. The length of the VA may influence the likelihood of complications. Research suggests that a longer VA is associated with an increased risk of appendiceal perforation. Perforation can lead to more severe infections and longer recovery times. Therefore, understanding the length of the VA can provide insights into the potential complications and prognosis for patients with appendicitis.

Table 3. Comparison of the length of the vermiform appendix of the present study with previous studies.

Author, Year	Average length in males [cm]	Average length in female [cm]
Katzarski et al., 1979 [21]	12.0	11.4
Ajmani et al., 1983 [2]	9.5	8.7
Bakheit et al., 1999 [4]	8.9	9.4
Golalipur et al., 2003 [16]	6.61	6.06
Rahman et al., 2007 [31]	7.56	7.9
Tofighi et al., 2013 [45]	9.12	8.03
Mwachaka et al., 2014 [24]	7.65 ± 2.36	
Souza et al., 2015 [42]	11.4	
Present study	7.65	6.52

There is no unanimity in the literature about the origin of the main appendicular artery. Some workers claim that it arises solely from the ileocolic artery [7, 22, 35] while others claim that it comes off one of the branches of the ileocolic artery [12, 18, 39]. Beaton and Anson (1953) [5] in their study of 200 specimens noted that the main appendicular artery arose in 48.5% of cases from the ileocolic artery, in 35.0% from the ileal branch and in 5.0% from the posterior caecal branch of the ileocolic artery. In the present study, MAA was arising from the ileocolic artery in all the cases and was not in agreement with any previous studies (Tab. 4).

The comparison with the previous studies showed that the most common origin of MAA is the ileocolic artery except in one instance. The findings of Hosmani et al. [17] reported the ileal branch of the SMA as the most common source of MAA.

In the majority of cases, the main appendicular artery arises directly from the ileocolic artery. This is considered normal anatomy. However, in some cases, the main appendicular artery may originate directly from the superior mesenteric artery instead of branching from the ileocolic artery [41]. This variation is less common but has been reported in the literature. The main appendicular artery may arise from the right colic artery in rare instances. This variation indicates an aberrant course of the main appendicular artery [26].

Table 4. Comparative study of origin of main appendicular artery with previous studies.

Author, Year	Number of specimens	Ileocolic [%]	Ileal branch [%]	Posterior caecal branch [%]	Ascending colic branch [%]	Anterior caecal branch [%]
Beaton and Anson et al., 1953 [5]	200	48.5	35.0	5.0	–	–
Solanke, 1968 [40]	100	50	32	–	3.0	1.0
Hosmani et al., 2012 [17]	52	18.75	28.13	–	–	–
Vasantha et al., 2014 [47]	50	32	–	2.0	–	–
Swathipriyadarshini et al., 2022 [44]	60	80	13.33	6.67	–	–
Present study	47	100	–	–	–	–

These variations in the source of the main appendicular artery can exist among individuals. Hence, it is important for surgeons and radiologists to be aware of these variations, as they can have implications for surgical procedures involving the VA, such as appendectomy.

Understanding the source of the main appendicular artery is particularly relevant in surgical procedures because it is necessary to ligate and divide the artery to ensure adequate blood supply to the VA is interrupted during an appendectomy. Failure to identify and ligate the artery properly can lead to complications such as bleeding or incomplete removal of the VA.

The distribution and pattern of branching of the MAA within the mesoappendix vary. However, little information is available in the literature about this.

After its origin, the main appendicular artery courses within the mesoappendix, supplying branches to the VA. These branches form an intricate network of vessels that penetrate the appendiceal wall, providing oxygenated blood to the organ, variations in the branching pattern of the main appendicular artery within the mesoappendix can involve differences in the number, size, or location of the arterial branches. For example, the main appendicular artery may give rise to additional branches or exhibit variations in its trajectory or termination points within the VA.

It's worth noting that these variations are typically of anatomical interest rather than clinical significance. Surgeons and anatomists study these variations to gain a better understanding of the vascular supply to the VA, which can be important during surgical procedures involving the removal of the VA (appendectomy).

From a clinical standpoint, the recognition of the clinical importance of the small branches of the appendicular artery lies in their role in determining the severity and complications of appendicitis. Radiological imaging techniques, such as computed tomography (CT) scan or ultrasound, may help visualize these small vessels and assess the degree of inflammation or occlusion. This information can guide the appropriate management, whether it be conservative treatment with antibiotics or surgical removal of the VA.

However, very little information is available in the literature about the distribution and pattern of branching of the appendicular arteries. In 1968, Solanke et al. [40] injected barium sulphate suspension into the superior mesenteric artery, and studied the pattern of distribution of MAA branches by radiological examinations in Nigerian populations. The number of branches they reported varies from one to ten, six being the most common in 24 cases (24%). We have also examined the pattern of branching of MAA in north Indian cadavers and reported that these vary from three to seven, six being the most common in 16 cases (34%).

By definition, the accessory appendicular artery is the one which supplies other parts of the VA except for the tip. Various authors have reported the presence of AAA, which varies widely from 6% [46] to 80% [40]. However, the most commonly reported incidence varies between 21 to 40% [2, 19, 21, 38] and the most commonly reported source of the AAA was also reported to be the ileocolic artery followed by the post-caecal artery.

Katzarski et al. [21] studied the blood supply and position of the VA in Zambians and reported AAA in 39.8%, whereas, 43.6% of VA pelvic. According to them, the prevalence of the dual blood supply and the pelvic position may partly explain the recorded rarity of appendicitis among Africans. Similarly, Solanke et al. [40] also studied the blood supply of the VA in Nigerian populations and reported the presence of AAA in 80% of cases along with the presence of arterial anastomosis within the mesoappendix in 33.3%. According to them also, the presence of the dual blood supply to the VA and the arterial anastomoses in the mesoappendix may partly explain the recorded rarity of appendicitis in Africans.

In the present study, AAA was found in 14 cases (29.78%), in ten (21%), the source was ileocolic and in four from the post caecal (9%). Our findings were in agreement with the finding of Shah et al. [38] and Ajmani et al. [2]. In a retrocaecal position, the blood vessels may be compressed and folded by the caecum. Thus, when an inflammation of the VA occurs in this position, its blood supply may be compromised [2]. Presently, we reported retrocaecal as the most common position (48.93%), however only five (21.73%) of them were having dual arterial supply, making them highly prone to the development of advanced appendicitis, resulting in longer hospital stays and high incidence of gangrene and perforation.

The approximate portions of the VA supplied by the MAA also vary in cases with the presence of AAA. To date, there is only one study to report this detail, Solanke et al. [40] studied 100 Nigerian cadaveric appendices and reported AAA in 80 cases, out of which, in 8.7% MAA supplied the whole length, distal three-quarters in 53.7%, distal half in 26.3% and a distal quarter in 11.3%. Whereas in the present study, MAA supplied the distal ¾th in 53.2%, the distal half in 27.7%, the whole length in 10.6% and the distal 1/4th in four 8.5%.

The extension of the mesoappendix is responsible for the vascularization of the VA and severity during inflammation, as its failure to reach the tip of the VA may lead to gangrene and hence early perforation during inflammation [46]. Recently, the inclusion of the spread of appendiceal tumours in the mesoappendix and elective removal of mesoappendix during appendectomy, adds to the significance of studying its extent [3]. Moreover, it is the same mesoappendix which acts as a window for creating and clamping the stump during appendectomy [25, 34].

We meticulously dissected the mesoappendix to get an in-depth insight into its extension (whether it is reaching up to the tip of the VA or not) and reported that in 11 cases (23.40%), the mesoappendix failed to reach the tip and ended midway between the middle and the distal third. Swathipriyadarshini et al. [44] studied 60 formalin-fixed VA specimens to analyse the extent of attachment of the mesoappendix and reported that in 76.6%, it reached the tip. On reviewing the literature, Geethanjali et al. [15] in 2011 reported that 69.23%, of mesoappendix, reached the tip, whereas according to Anderson et al. [3], the mesoappendix reached the tip of the VA in 80% of the cases. Iqbal et al. [20], reported a long mesoappendix frequently extending up to the tip of the VA.

In the present study, the mesoappendix extended up to 2/3rd of the length of the VA in 23.3%. The study done by Geethanjali et al. have had an incidence of 30.77%, which is the nearest to the present study, where the mesoappendix failed to reach the tip [15]. This present study does not coincide with the study of Rahman MM in 2005 [32], where the extension of mesoappendix was 2/3rd of the VA in 45% of cases, half and whole extension of mesoappendix was found in 31% and 24% of cases, respectively.

While it is imperative to acknowledge the constraint imposed by the limited availability of cadaveric specimens, resulting in a comparatively smaller sample size, it is crucial to underscore that this study offers significant strengths. Notably, the findings illuminate a robust association between morphological variations, vascularity, and mesoappendix diversity. This underscores the substantive contributions of the study despite the sample size limitation.

CONCLUSIONS

Knowledge of the anatomical variations of the VA is crucial during surgical procedures, especially appendectomies. Locations of the VA, such as retrocaecal or pelvic, can influence the approach and technique used during surgery. The varied locations and lengths of the VA can pose challenges in diagnosing appendicitis. The retrocaecal VA, being the most common location, may present with atypical symptoms, leading to delayed or missed diagnosis. Understanding the branching patterns of the MAA and the presence of AAA is important for surgical planning. Surgeons should be cautious during procedures to avoid inadvertent injury to these blood vessels, which can lead to complications such as bleeding or ischaemia. Radiologists interpreting imaging studies, such as computed tomography (CT) scans, need to be familiar with the diverse anatomical variations of the VA, recognizing the different locations and lengths of the VA can aid in accurate interpretation and diagnosis of appendicitis or other appendiceal pathologies. The findings from this study emphasize the need to educate medical students, residents, and surgeons about the anatomical variations of the VA. Incorporating this knowledge into medical curricula and surgical training programs can enhance clinical skills and improve patient outcomes.

Conflict of interest

None declared.

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