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Commonest Position of the Vermiform Appendix among Sudanese: Cadaveric study

Elghazaly A. Elghazaly ^{1,2}

¹Department of Anatomy, Faculty of Medicine and Health Sciences, Omdurman Islamic University, Sudan.

²Department of Anatomy, Faculty of Midence, University of AL-Baha, KSA

*E-mail: gazaly518@yahoo.com

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ABSTRACT

The appendicular signs and appendicectomy are associated with its anatomical location. Therefore, good knowledge about the location of the appendix will contribute to reducing diagnostic and surgical errors. Several studies have shed light on this topic in different populations using different methods, but still, the commonest position of Vermiform Appendix (VA) is a subject of debate among researchers, whether in living individuals or cadavers. The current study aims to determine the commonest position of VA to provide a complete understanding of anatomical variations in both genders, using dissection. 122 bodies (92 males and 30 females) were dissected in a mortuary in 10 Sudanese medical schools, between January and September 2022, using Cunningham's dissection method. The dissection was evaluated for various anatomical locations of the free end of the VA in both genders. The most common position of the VA in both genders was (40.2%) retrocaecal followed by (23.9%) pelvic. The incidence of retrocaecal position in both genders was about the same, while pelvic was greater in males. The commonest location of VA in Sudanese was retrocaecal followed by pelvic. No statistically significant association between males and females with the position of the appendix in dissected cadavers. Cadaveric dissection is the best method for detecting the different positions of the VA, it gives wide scope for follow up its free end.

INTRODUCTION

Anatomical variations are usually found in some body structures in different forms and represent an essential part of anatomy. Awareness of anatomical variations is important in medical issues; it may help reduce surgical and diagnostic errors (Sudha K, S *et al.*, 2017). One of the most common organs in terms of anatomical positional variations in the abdominal region is the vermiform appendix (VA). The location of the free end of VA is still controversial, whether studied in living individuals or cadavers. Therefore, good anatomical knowledge of the VA will allow the surgeon to practice the appendectomy with minimum risk (Jayasree Ch, C & Kishan Reddy 2018).

The VA is a small, worm-shaped pouch attached to the cecum below the connection of the small and large (Gray H 2008; Moore K.L *et al.*, 2010; Anne, M.R *et al.*, 2009). It has a constant base; identified by the junction of taeniae coli of the cecum, which lies deep to McBuney point on the spinoumbilical line, whereas its tip can be found varying in clockwise rotation (McBurney CN 1894; Ellis H 2006). There are some common variations concerning the tip of the VA (Constantin M *et al.*, 2023).

Retrocecal Appendix: In which the VA is located behind the cecum, it is considered the most common anatomical variation found in the literature review. Pelvic Appendix: In which the VA descends into the pelvic cavity, lying adjacent to the bladder or rectum (Gray H 2008). Subcecal Appendix: In which the VA is located below the cecum, extending towards the pelvis. Preileal/Prececal Appendix: In which the appendix lies in front of the ileum or cecum, respectively. Paracecal Appendix: In which the VA is located adjacent to the cecum, but not firmly attached to it (Hodge BD *et al.*, 2023; Ghorbani A *et al.*, 2014).

Previous studies showed different results in the positions of the appendix. Some studies found that the most common position of the VA was retrocecal followed by pelvic, and the preileal position is less (Rajasree G *et al.*, 2022; Mukul Sarma *et al.*, 2022; Ehab, El-Amin *et al.*, 2015; Singh R *et al.*, 2014). Others found that the pelvic position was the most common followed by retrocecal, and the preileal position was the least common or not found (Gray H 2008; Aysegul Altunkas *et al.*, 2022; Mohammad Ashfaqur Rahman *et al.*, 2019; Govinda Rajan Manivasagam, Anandaramajayan Nallathambi 2023; Hina Jabeen *et al.*, 2022). Some studies have found different results, postileal was more common, and preileal was least common (Hodge BD *et al.*, 2023; Kowit Chaisiwamongkol *et al.*, 2010). Regarding differences in appendicular position between males and females, some studies found that retrocaecal was more common in males and females (Mukul Sarma *et al.*, 2022; Ehab, El-Amin *et al.*, 2015). While others found that pelvic position was common in both sexes (Jayasree Ch, C Kishan Reddy 2018; Aysegul Altunkas *et al.*, 2022; Rahman MM *et al.*, 2006). On the other hand, no association was observed between sex and the anatomical position of VA (Tofighi H *et al.*, 2013).

Determining the variations of the appendicular positions has been a topic of interest for anatomists and medical personnel, the reason that the VA is the most common

organ in terms of anatomical positional variations in the abdominal region. Previous studies have dealt with this topic in different populations using different methods, but still, the commonest position of the VA is a matter of disagreement among researchers, whether in living individuals or in cadavers. The current study aims to determine the commonest position of VA to provide a complete understanding of anatomical variations in both genders, using dissection. Good knowledge about the location of the appendix will contribute to reducing diagnostic and surgical errors.

MATERIALS AND METHODS

This is a descriptive cross-sectional study carried out on 122 adult Sudanese cadavers, 92 males and 30 females, in the period between January and December 2022. The specimens were obtained from dissected cadavers used for anatomical courses, in 10 Sudanese medical schools.

Inclusion Criteria: Formaldehyde-fixed abdominal region cadaver specimens from the dissection rooms of medical colleges.

Exclusion Criteria: The study excluded cadavers that were macerated or damaged by the students, which showed intra-abdominal infections (in the right lower quadrant), gaseous distension of the intestine, and decomposing corpses before data collection. The cadavers were dissected using natural anatomical dissection tools and methods that were used for the studies of medical students. The dissection was evaluated for various anatomical locations of the free end of the VA in both genders. The abdomen was opened using Cunningham's dissection method to expose the cecum and the ileocecal recess (Rachel Koshi. 2017). When the cecum and ileocecal recess were exposed, we followed the junction of Teniae coli for identification of the base of the VA, and then traced from the base to determine the anatomical positions of the free end related to the caecum and terminal part of the ileum were it defined as follows:

- Retrocecal (11th o'clock): when the free end course upward behind the cecum.

- Pelvic (5th o'clock): when the free end is directed downward, on the psoas major muscle.
- Preileal (2nd o'clock): when the free end is located anterior-superior to the terminal ileum.
- Postileal (2nd o'clock): when the free end is found posterior-superior to the terminal ileum.
- Subcecal (7th o'clock): when the free end is found under the cecum, resting on the right iliac fossa.
- Paracecal (9th o'clock): when the free end is found laterally to the cecum and the ascending colon.
- Subhepatic (12th o'clock): when the free end is found to be vertically upward toward the long axis of the ascending colon.
- Promontory (subileal) (4th o'clock): when the free end is found directed downward to the left, on the sacral promontory.

Data Analysis: The Statistical Package for Social Sciences (SPSS) software, version 20.0 (IBM SPSS Inc., Chicago, IL), was used for data analysis. frequencies and percentages were taken, and then a chi-square test was performed to identify the relationship between demographic characteristics compared to the positions of the vermiform appendix among males and females gender.

The p-value less than 0.05 was considered a significant result.

RESULTS

In the current study, 122 cadavers were dissected, 92 (75.4%) males and 30 (24.6%) females, with their age range from 20 to 100 years, (Table 1). Retrocecal was found (40.3%) in males and (40.0%) in the females. Pelvic was found (25.0%) in males and (20.0%) in the females (Figure 1). Preileal was found (3.3%) in the males and (3.4%) in the females, (Figure 2). Postileal was found (7.6%) in the males and (10.0%) in the females. subcecal was found (15.2%) in males and (10.0%) in females. practical was found (5.4%) in the males and (6.7%) in the females. Promontory/subileal was found (3.3%) in the males and (6.7%) in the females (Figure 3). subhepatic was found (0.00% in men and (3.2%) in females, (Table 2). The most observed appendicular position in the present study was retrocecal (40.2%) followed by pelvic (25.9%), while less observed was subhepatic (0.8%) in the dissected cadavers, (Table 2). The incidence of the retrocaecal position in both genders was about the same, while pelvic was greater in females. No statistically significant association between males and females with the position of the appendix in dissected cadavers.

Table 1: Demographic characteristics the frequencies and percentages among dissected cadavers (N=122).

Parameter		Frequencies	Percentages
Sex	Males	92	75.4%
	females	30	24.6%
Age	20-30 years	14	11.5%
	31-40 years	43	35.3%
	41-60 years	35	28.6%
	61-80 years	18	14.7%
	81-100 years	12	9.9%

Table 2: Positions of the Vermiform Appendix in male and female dissected cadavers (N=122)

Position of the Vermiform Appendix	Males (No. %)	Females (No. %)	Males& females (No. %)	p-value
Retrocecal (11 th o'clock)	37 (40.3%)	12 (40.0%)	49 (40.2%)	0.270*
Pelvic (5 th o'clock)	23 (25.0%)	6 (20.0%)	29 (23.9%)	0.804*
Pre-lead (2 nd o'clock)	3 (3.3%)	1 (3.4%)	4 (3.3%)	0.6001*
Postileal (2 nd o'clock)	7 (7.6%)	3 (10.0%)	10 (8.1%)	0.100*
Subcecal (7 th o'clock)	14 (15.2%)	3 (10.0%)	17 (13.9%)	0.301*
Paracecal (9 o'clock)	5 (5.4%)	2 (6.7%)	7 (5.7%)	0.941*
Subileal/Promontory (4 th o'clock)	3 (3.3%)	2 (6.7%)	5 (4.1%)	0.0615*
Subhepatic (12 th o'clock)	0 (0,0%)	1 (3.2%)	1 (0.8%)	0.57*
Total	92 (100%)	30 (100%)	122 (100%)	

*, a P value >0.05 is considered statistically insignificant. **, P value <0.05 is considered statistically significant.



Fig. 1: A photograph of the vermiform appendix found in the present study to be in the pelvic position, 1. cecum, 2. ileum.

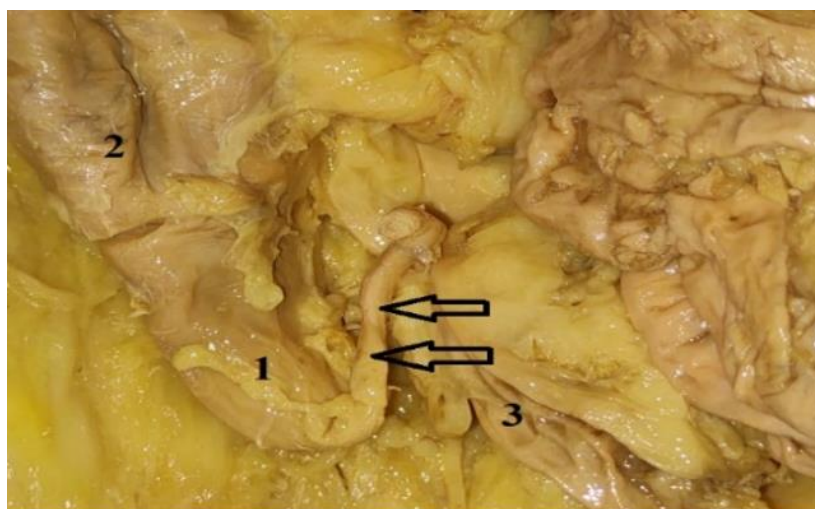


Fig. 2: A photograph of the vermiform appendix found in the present study to be in the preileal position, 1. cecum, 2. ascending colon, 3. Ileum.

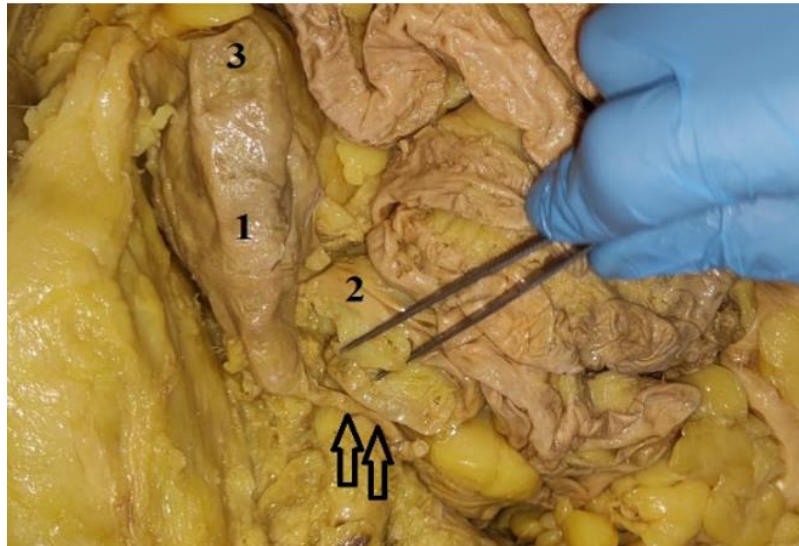


Fig. 3: A photograph of the vermiform appendix found in the present study to be in the Subileal/Promontory position, 1. cecum, 2. ileum, 3. ascending colon.

DISCUSSION

Appendicular signs and appendectomy are associated with anatomical location, therefore, good knowledge about the different types of appendicular locations will contribute to reducing diagnostic and surgical errors (Hodge BD *et al.*, 2023). Previous studies described different types regarding the position of the VA, but the commonest position of the VA is still a matter of disagreement among researchers, whether in living individuals or cadavers.

In many studies, retrocecal has been described as the most common position of the VA followed by pelvic (Rajasree G *et al.*, 2022; Ehab, El-Amin, *et al.*, 2015; Sanjay Kumar Sinha, Vipin Kumar 2014), while in others, pelvic was described as the most common followed by retrocecal (Aysegul Altunkas *et al.*, 2022; Jayasree Ch, C Kishan Reddy 2018). In this study, the most common type of presentation of the appendix was found to be retrocecal type (40.2 %) followed by the pelvic (23.9%) of the cadavers. The findings of this study agree with the findings of (Rajasree G *et al.*, 2022; Ehab, El-Amin, *et al.*, 2015; Sanjay Kumar Sinha, and Vipin Kumar 2014) and disagree with the findings of (Aysegul Altunkas *et al.*, 2022; Jayasree Ch, C Kishan Reddy 2018). Add to that, our findings are consistent with the information in

reference books, in which retrocecal is more common than pelvic (Gray H 2008; Moore K.L *et al.*, 2010; Anne, M.R *et al.*, 2009; Ellis H 2006). This confirms that retrocecal is the most common position of the VA among all types. If the tip of the appendicular was viewed in relation to the caecum, in dissection in accordance with the rotation of the o'clock, as; such as; (retrocecal 11th o'clock, subhepatic 12th o'clock, preileal / postileal 2nd o'clock, promontory/ subileal 4th o'clock, pelvic 5th o'clock, subcecal 7th o'clock, paracecal 9th o'clock) positions, in such a case there is no doubt that it will give better results instead of studied in another methods. We think cadaveric dissection is the best method for detecting the anatomical variation of the VA, it gives wide scope for trace the free end of VA. Although there is a higher incidence of retrocecal VA position, it is believed to have more complications, making appendectomy more challenging due to its deep location, because it is crammed into a narrow space between the cecum and the psoas muscle.

The most common position of the VA among males and females varies. It has been reported that the retrocecal is the most common in both genders in the reports of (Mukul Sarma *et al.*, 2022; Ehab, El-Amin *et al.*, 2015), while the study of (Tofighi H *et al.*, 2013) found that the pelvic position was most

common in both sexes. On the other hand, no association was found in both sexes with respect to the anatomical position of VA in the study (Rachel Koshi 2017; Mubeena Shaikh et al., 2018). In this study, the incidence of retrocecal in the males and females was about the same, while pelvic was greater in males in cadavers. This is consistent with the results of (Mukul Sarma *et al.*, 2022; Ehab, El-Amin, *et al.*, 2015), who found no association in retrocecal position among males and females and is not consistent with the results of (Maria Yousaf *et al.*, 2023) who found males and females are more likely to have a pelvic location. Variation in the location of the appendix between males and females may refer to a small sample size of females compared to males in all studies. we noted that the percentage of females is lower than the percentage of males in most of the previous studies. **Conclusion:** The most common location of VA in Sudanese was retrocecal followed by pelvic. No statistically significant association between males and females with the position of the appendix in dissected cadavers. **Recommendation:** Cadaveric dissection is the best method for detecting the different positions of the VA, it gives wide scope for following up its free end.

Declarations:

Ethical approval: Written Ethical approval was obtained from the institutional review board at the medical colleges and heads of the departments of anatomy, with permission from Sudan medical authorities.

Limitation(s): This study was limited to 122 Cadavers due to the declining number of cadavers in anatomy departments because of the current Sudan securtery distrbances, after which it was difficult to obtain more specimens.

Conflict of interests: The authors declare no conflict of interest.

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Availability of Data and Materials: All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.

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