Original Article

OPEN ACCESS

Frequency of Anatomical Variations in Appendix Position in Appendectomy

Syed Irfan Raza Arif[1], Toqeer Ahmed Iqbal[2], Saira Jawed[3], Sohaib Haider[4], Taimoor Ahmed[5] Munazzah Aziz[6]

[1,2] Associate Professor, Farooq Teaching Hospital/Akhtar Saeed Medical College, Rawalpindi.
Associate Professor HBS Medical and Dental College, Islamabad.
Associate Professor, Akbar Niazi Teaching Hospital/IMDC, Islamabad.
Senior Registrar, Akbar Niazi Teaching Hospital/IMDC, Islamabad.
Assistant Professor, Akbar Niazi Teaching Hospital/IMDC, Islamabad.

Authors Contribution

[1,2]Provided concept/research design, data collection, project management, Provided concept/research design, data collection, project management, takes the responsibility and is accountable, [3]Did critical revision of the manuscript for important intellectual content. [4]Provided concept/research design, data collection, project management, [5,6]Did statistical analysis and manuscript writing

Funding Source: None
Conflict of Interest: None

Received: Aug 19, 2023
Accepted: Dec 21, 2023

Address of Correspondent
Dr Toqeer Ahmed Iqbal Associate Professor, Farooq Teaching Hospital/Akhtar Saeed Medical College, Rawalpindi
drtoqeer@hotmail.com

ABSTRACT

Objective: To determine the age and gender distribution of various anatomical positions of the appendix in patients underwent appendectomy.

Methodology: This descriptive cross-sectional study was done at Farooq Teaching Hospital and Akbar Niazi Teaching Hospital, Islamabad over a two years period from March 2021 to March 2022, involving 350 appendectomy patients. The anatomical location of appendix was analyzed in patients underwent appendectomy across various age groups and genders. The appendix length was measured from its base to tip using a nylon thread. The length of thread was measured using a vernier caliper. The appendix external diameter was measured at its widest point using vernier caliper.

Results: The patient's average age was 36.6 years, with 58% males and 42% females. There were more males than females in the study. The appendix anatomical positions were observed as follows: retrocecal was most common, found in 50% of cases, followed by pelvic in 26%, retroileal in 10%, subcecal in 7.4%, paracecal in 6%, and subhepatic in 0.6% of cases. The highest incidence was observed in 21 to 40 years age group (56.6%). The association was observed significantly among appendix length and various age groups. The mean appendix length was 58 mm in males and 52 mm in females. The mean appendix external diameter was 75 mm in males and 69 mm in females.

Conclusion: The retrocecal position was the most frequently observed location in this study. Given that appendix is the organ in the abdomen with the greatest variability, these findings are valuable for surgeons' performing appendectomy.

Keywords: Anatomy; Appendectomy; Appendix; Variations.

Cite this article as: Arif SIR, Iqbal TA, Jawed S, Haider S, Ahmed T, Aziz M. Frequency of Anatomical Variations in Appendix Position in Appendectomy. Ann Pak Inst Med Sci. 2023; 19(4): 557-560. doi. 10.48036/apims.v19i4.1243

Introduction

Vermiform appendix is situated in the right lower quadrant of the abdomen and appears as a slender, worm-like tube. It extends from posteromedial wall of cecum, typically 2 cm or less beneath the termination of ileum. The appendix is usually located where the three taeniae converge on the cecal surface. Its length usually ranges from 7 to 9 cm.[1]

While the base of appendix remains consistently attached to cecum, its tip can vary in position. These positional variations are classified into six types: pelvic, retrocecal, subcecal, subhepatic, retroileal, and paraileal.[2] The structure that evolves into cecum and appendix is referred to as cecal diverticulum or 'bud of cecum'. This structure is located in distal segment of umbilical loop.[3]

Variations in appendix length are crucial for radiologists and surgeons, as an inflamed appendix with a shorter-than-average tip may lead to diagnostic uncertainty. Such cases can result in delays, increasing the risk of early perforation and gangrene. Variable appendix lengths can lead clinicians to make incorrect decisions or misdiagnose other conditions.[4] A delayed diagnosis can result in appendix perforation, which may then lead to the formation of an abscess or peritonitis. Therefore, precise

knowledge of appendix's anatomical location can enhance the prognosis of disease.[5] Thus, studying the different positions of appendix in patients undergoing appendectomy is essential.

The study objective was to determine the age and gender distribution of various anatomical positions of the appendix in patients underwent appendectomy.

Methodology

This descriptive cross-sectional study was done at Farooq Teaching Hospital and Akbar Niazi Teaching Hospital, Islamabad, from March 2021 to March 2022. Ethical approval was granted, and informed consent forms along with patient information sheets were obtained. This study involved 350 patients diagnosed with acute appendicitis who underwent appendectomy. The sample size was determined using the WHO formula for sample size, incorporating the following parameters: a 95% confidence interval, a 5% significance level, and a retrocecal appendix percentage of 62%.[6] The study included patients across all age ranges and genders. Patients who declined to participate, those with appendicular adhesions, chronic appendicitis, gangrene, or perforations were excluded from the study. Patients were selected using non-probability consecutive sampling method.

Clinically diagnosed cases of acute appendicitis underwent a detailed clinical examination, laboratory tests, abdominal ultrasound (USG), and appendiceal specimen was submitted for histopathological analysis post-surgery. All patients in this study underwent an appendectomy performed by an experienced surgeon. A small incision was made in the lower right abdomen to remove the appendix. The anatomical position of appendix is categorized into six distinct types: pelvic, retrocecal, subcecal, subhepatic, retroileal, and paraileal. The anatomical position of appendix was determined based on visual inspection and documented. The appendix length was measured from its base to tip using a nylon thread. The length of thread was measured using a vernier caliper. The appendix external diameter was measured at its widest point using vernier caliper.

All data were analyzed using SPSS v 25. Categorical data were shown as frequencies and percentages, whereas continuous data were reported as means and standard deviations. Effect modification was assessed through stratification, and chi square test was applied to stratified data. The p value of ≤ 0.05 was rendered significant.

Results

This study involved 350 patients who underwent appendectomy. The patient's average age was 36.6 years, with 203 (58%) male and 147 (42%) female, there was a predominance of males. The mean hemoglobin level was 12.3±1.8 g/dl. The majority of patients were in the age range of 21–40 years, followed by those in the age range of 41–60 years (Table I).

Table I: Patient's distribution by age and gender. (n=350)

Age (years)	Gender		Total
	Male	Female	
≤ 10	11 (3.1%)	4 (1.1%)	15 (4.2%)
11–20	20 (5.8%)	14 (4%)	34 (9.8%)
21–40	112 (32%)	86 (24.6%)	198 (56.6%)
41–60	49 (14%)	35 (10%)	84 (24%)
≥ 60	11 (3.1%)	8 (2.3%)	19 (5.4%)
Total	203 (58%)	147 (42%)	350 (100%)

The anatomical position of appendix was as follows: retrocecal in 175 cases (50%), pelvic in 91 (26%), retroileal in 35 (10%), subcecal in 26 (7.4%), paracecal in 21 (6%), and subhepatic in 2 cases (0.6%) (Table II).

Table II: Distribution of patients based on gender and appendix position. (n=350)

Appendix position	Gender		Total
	Male	Female	
Retrocecal	112 (32%)	63 (18%)	175 (50%)
Pelvic	53 (15.1%)	38 (10.9%)	91 (26%)
Retroileal	21 (6%)	14 (4%)	35 (10%)
Subcecal	7 (2%)	19 (5.4%)	26 (7.4%)
Paracecal	8 (2.3%)	13 (3.7%)	21 (6%)
Subhepatic	2 (0.6%)	0	2 (0.6%)
Total	203 (58%)	147 (42%)	350 (100%)

The retrocecal position was the most common anatomical location in both sexes. The retroileal, pelvic, and subhepatic position followed in that order in both sexes. The subhepatic anatomical position was not observed in female.

In males, the appendix length ranged from 20–90 mm, while in females, it varied from 25 mm to 75 mm. The mean appendix length was 58 mm in men and 52 mm in women. In males, external diameter of appendix ranged from 30–150 mm, while in females, it ranged from 40 mm to 140 mm. The mean external diameter of the appendix was 75 mm in male and 69 mm in female.

The association was observed significantly among various age groups and appendix length ($p < 0.001$) (Table III). The longest appendix length was observed in individuals aged 21 to 40 years.

Table III: Relationship between appendix length and age in patients. (n=350)

Age (years)	Appendix length (mm)				Total	p-value
	≤ 40	41–80	81–120	> 120		
≤ 10	2	8	2	3	15	.001
11–20	4	21	7	2	34	
21–40	0	88	105	5	198	
41–60	4	28	49	3	84	
≥ 60	0	12	6	1	19	
Total	10	157	169	14	350	

Discussion

As noted by several authors, vermiform appendix is unique in human body for having several distinct anatomical positions. The appendix position varies from one individual to another. The appendix position is of significant interest due to its evolutionary importance, as well as its relevance in pathology and surgery. Appendicitis is a common medical issue affecting both men and women across all age groups, from childhood to old age.[7]

In this study, among 350 patients with appendicitis, the distribution of appendix positions was as follows: retrocecal in 50% of cases, pelvic in 26%, retroileal in 10%, subcecal in 7.4%, paracecal in 6%, and subhepatic in 0.6%. Acute appendicitis was most prevalent in individuals aged 21 to 40 years. The retrocecal position of the appendix was the most common, accounting for 50% of cases in this study. This finding is consistent with other studies by Azhagiri et al, Chaudhari et al, and Lamture et al, which also identified the retrocecal position as the most common.[8-10] The prevalence of retrocecal position ranged from 40% to 65% in these studies.

The results of this study differed from those reported by other researchers. For instance, Jabeen et al found the pelvic position of appendix to be most common, at 50.8%, while Altunkas et al reported it at 32%.[11,12] The retrocecal position was most common in males, whereas the subcecal position was most common in females. These outcomes are consistent with Sarma et al, who found the retrocecal position to be most common in males, and Faisal et al, who reported the pelvic position as most common in females.[13,14]

In this study, subhepatic position was the least prevalent, observed in only 0.6% cases. This holds only in male patients. This finding correlates with a similar study by Siraj et al, which reported the subhepatic position as the least common, occurring in 1.6% of cases.[15] This research found a high percentage of subcecal appendix in females compared to males, which contrasts with the findings of Jayasree et al.[16]

A pelvic appendix may cause irritation to bladder or rectum, leading to symptoms such as pain during urination, suprapubic pain, or an increased urge to defecate. A retroileal appendix may cause irritation the ureter, potentially leading to testicular pain in some males.[17]

Conclusion

In acute appendicitis patients, the retrocecal position of appendix was most common in males, while the subcecal position was most prevalent in females. Therefore, the study concludes that understanding the various positions of the appendix can assist clinicians an earlier diagnosing of the disease and providing better treatment for patients with acute appendicitis.

References

1. Forouzesh M, Barzegar A, Ghadipasha M, Valiyari S. Position and Length of the Vermiform Appendix: A Study of 400 Cases in Iranian Population. Govaresh. 2023;27(3):174-178.
2. Liu HM, Tsai WM. Positions and Sizes of Normal Appendix: Results from a Single Center. J Radiol Sci. 2024;49(1):33-38.
3. Smith HF. A review of the function and evolution of the cecal appendix. Anat Rec. 2023;306(5):972-982. https://doi.org/10.1002/ar.24917
4. Monsonis B, Mandoul C, Millet I, Taourel P. Imaging of appendicitis: Tips and tricks. Eur J Radiol. 2020;130(9):109165. https://doi.org/10.1016/j.ejrad.2020.109165
5. Nupur N, Jena S, Singh M, Naik SK, Thipperudrappa TH, Mittal S. Position and Length of Appendix among Delhi Population-An Autopsy Based Study. EJMHS: Eur J Med Health Sci. 2024;6(1):73-77. https://doi.org/10.24018/ejmed.2024.6.1.1942
6. Kacprzyk A, DroS J, Stefura T, Krzysztofik M, JasiNska K, PĘdziwiatr M, et al. Variations and morphometric features of the vermiform appendix: A systematic review and meta-analysis of 114,080 subjects with clinical implications. Clin Anat. 2020;33(1):85-98. https://doi.org/10.1002/ca.23474
7. Rahman MA, Azim MA, Karim F. Anatomical positions of vermiform appendix in Bangladeshi people: a postmortem study. Am J Med Sci Med. 2019;7(3):64-66.
8. Azhagiri R, Anitha M, Hemapriya J. Prevalence of anatomical variations of the position of appendix in acute appendicitis by CT scan. Int J Anat Res. 2019;7(4.1):7051-7055. https://doi.org/10.16965/ijar.2019.304
9. Chaudhari ML, Kanani S. Anatomical variations of vermiform appendix in Gujarat. Int J Anat Res. 2018;6(1.1):4815-4818. https://doi.org/10.16965/ijar.2017.473

10. Lamture YR, Salunke B. Anatomical variations related to position of appendix. J Evol Med Dent Sci. 2018;7(46):5830-5834. https://doi.org/10.14260/jemds/2018/1119
11. Jabeen H, Romaiza MM, Kamran M, Ahmed H, Fahim S. Variations in Anatomical Position of Vermiform Appendix in Pakistani Population. Pak J Med Health Sci. 2022;16(05):22-23. https://doi.org/10.53350/pjmhs2216522
12. Altunkas A, Aktas F, Ozmen Z, Albayrak E, Demir O. The normal vermiform appendix in adults: Its anatomical location, visualization, and diameter at computed tomography. J Anat Soc India. 2022;71(3):225-233. https://doi.org/10.4103/JASI.JASI_135_19
13. Sarma M, Dutta M, Doley A. Different Positions of Vermiform Appendix in Human Cadavers: A Cross-sectional Study. Int J Anat Radiol Surg. 2022;11(3):29-32. https://doi.org/10.7860/IJARS/2022/52087.2809
14. Faisal L, Ajmal R, Rehman F, ul Islam Z, Qayyum SA, Athar S. Anatomical variations of vermiform appendix on plain MDCT and its association with acute appendicitis in adult urban population of Karachi, A tertiary care hospital experience. J Bahria Univ Med Dent Coll. 2022;12(02):77-82. https://doi.org/10.51985/JBUMDC2021118
15. Siraj F, Hassan B, Iqbal Z, Shamim R, Azhar F, Faruqui MU. Assessment of length, external outer diameter and positional variations in normal and inflamed appendix. Med Forum. 2020;3(11):159-162.
16. Jayasree C, Reddy CK. A Study of Anatomical Positions of Vermiform Appendix in Human Cadaver. J Cont Med A Dent. 2018;6(1):64-67.
17. Prada-Arias M. Appendicitis and related abdominal pain. In Features and Assessments of Pain, Anaesthesia, and Analgesia. 2022:189-199. Academic Press. https://doi.org/10.1016/B978-0-12-818988-7.00037-6