

ORIGINAL ARTICLE

Medicine Science 2022;11(4):1516-20

How does the retrocecal anatomic localization of the appendix vermiformis affect the prognosis of acute appendicitis today? A comparative prospective study

Turgay Karatas¹, Engin Burak Selcuk², Mehmet Karatas³, Atilla Yildirim⁴

¹Inonu University Faculty of Medicine, Department of Anatomy, Malatya, Türkiye

²Inonu University Faculty of Medicine, Department of Family Medicine, Malatya, Türkiye

³Inonu University Faculty of Medicine, Department of Medical History and Ethics, Malatya, Türkiye

⁴Malatya Training and Research Hospital, General Surgery Clinic, Malatya, Türkiye

Received 30 August 2022; Accepted 14 September 2022

Available online 10.10.2022 with doi: 10.5455/medscience.2022.08.202

Copyright@Author(s) - Available online at www.medicinescience.org

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International.



Abstract

Appendix vermiformis is found in various anatomical localizations. Localization of the appendix vermiformis has been suggested to affect the clinical findings and outcomes of acute appendicitis. Aimed at investigating the effect of retrocecal localization of appendix vermiformis on the prognosis of acute appendicitis today. This study was started in August 2018 and finished in August 2021. Adult patients of both sexes who were operated in general surgery clinic with a pre-diagnosis of acute appendicitis were included in the study. Anatomic localization of appendix vermiformis were divided into two parts as retrocecal localizations and non-retrocecal localizations. The forms of appendicitis, postoperative complications, and length of hospitalization obtained from retrocecal and non-retrocecal localizations were compared and evaluated. A total of 776 patients were included in the study. Retrocecal localization was found in 15%, and non-retrocecal in 84.9% of the patients. The rate of acute appendicitis was 65.8% in retrocecal localization, 83.1% in non-retrocecal localization, perforated appendicitis at 31.6% in retrocecal localization and 11.2% in non-retrocecal localization. The perforated appendicitis rate was significantly higher in retrocecal localizations ($p=.0001$). Although postoperative complications were 5.1% in retrocecal appendicitis and 2.4% in non-retrocecal appendicitis, there was no significant difference between them in terms of postoperative complications ($p=.105$). The mean length of hospital stay was 2.4 days for appendicitis with retrocecal localization and 1.7 days for non-retrocecal localizations. The mean length of hospital stay was also significantly higher in retrocecal localizations ($p=.0001$). In conclusion, both perforated appendicitis rates and the mean length of hospital stay were higher in appendicitis with retrocecal localization. Therefore, appendicitis with retrocecal localization still negatively affects the prognosis of acute appendicitis today.

Keywords: Appendix localization, retrocecal appendicitis, perforated appendicitis, complicated appendicitis, appendicitis prognosis

Introduction

The appendix vermiformis arises from the posteromedial caecum near the ileocecal valve. The appendix vermiformis may be located posterior to the caecum and ileum, anterior to the ileum, inside the pelvis, and inside the hepatorenal recessus [1]. The appendix vermiformis is most commonly found in the retrocecal location (67.3%) [2].

In the United States population, the lifetime risk of appendicitis was found to be 8.6% in men and 6.7% in women [3]. Acute

inflammation parameters, scoring systems, ultrasonography, computed tomography, magnetic resonance imaging, and laparoscopy are used to diagnose acute appendicitis [4]. There has been a significant decrease in mortality due to acute appendicitis, but the perforation rate and negative laparotomy rate have not decreased despite advanced technology and diagnostic methods [5].

Right lower quadrant pain, anorexia, and nausea-vomiting are typical symptoms of acute appendicitis. However, the incidence of these classical symptoms is 50% [3]. The conditions that cause atypical symptoms and clinical findings are anatomical localizations of appendix vermiformis, childhood, pregnancy, and confusion [6]. The tip of the appendix vermiformis may show different locations in the abdominal cavity due to its variable length and position. It is atypical localization that the tip of the appendix

*Corresponding Author: Turgay Karatas, Inonu University Medical Faculty
Department of Anatomy, Malatya, Türkiye
E-mail: drkaratas44@hotmail.com

vermiformis is located behind the caecum. Symptoms seen in appendicitis with atypical localization may lead to misdiagnosis [7]. Atypical symptoms and clinical findings lead to the wrong and delayed diagnosis, which leads to complications. In particular, the diagnosis may be delayed due to atypical symptoms and signs of appendicitis in the anatomically retrocecal localization, and perforation and related complications may occur. The rate of perforation in retrocecal appendicitis is reported to be 60% higher [8].

We aimed to determine whether the retrocecal location of the appendix vermiformis still negatively affects the prognosis of appendicitis in today's.

Materials and Methods

Our prospectively designed study was initiated after the approval (protocol no: 2018/79) from the Malatya clinical research ethics committee." This study was started in August 2018 and finished in August 2021. Adult patients of both sexes with a pre-diagnosis of acute appendicitis were included in the study. Cases with appendicitis, concomitant colon tumors and other malignant diseases were not included in the study. For the diagnosis of appendicitis in the preoperative period, physical examination, laboratory tests, and imaging methods (Ultrasonography or Abdominal CT) were used. The localization of the appendix vermiformis was determined visually in both open and laparoscopic methods during the perioperative period. Also, definitive appendicitis diagnosis was confirmed by pathology reports of the specimens. The patients who were operated on were followed up for a period of 3 months after the operation and complications were detected.

Gender, age, type of surgery, type of incision used, anatomical localization of the appendix vermiformis, pathology report findings, postoperative complications, distribution of pathology report findings and postoperative complications by gender, and length of hospital stay were recorded. We determined the localization of appendix vermiformis according to the caecum. Anatomic localization of appendix vermiformis were divided into two parts as retrocecal localizations and non-retrocecal localizations. Appendix vermiformis with paracecal, subcecal, preileal, subileal, and pelvic localizations were considered as non-retrocecal localization. The forms of appendicitis, postoperative complications, and length of hospitalization obtained from retrocecal and non-retrocecal localizations were compared and evaluated.

IBM SPSS Statistics 22.0 for Windows package program was used for the evaluation of the data. Mann-Whitney U test was used for statistical analysis. $P < .05$ values were considered significant.

Results

A total of 776 patients were admitted to the general surgery clinic with a preliminary diagnosis of appendicitis. 459 of the patients were men (59.1%) and 317 were women (40.8%). The age range of the patients was 17 to 80 years. The mean age of the patients was 30.9 years. Open appendectomy was performed in 698 (89.9%) patients and laparoscopic appendectomy was performed in 78 (10%) patients. Mc Burney incision was used in 594 patients (85.1%) and the right lower paramedian incision was used in 104 patients (14.8%).

Retrocecal localizations were found in 117 (15%) patients and non-retrocecal localizations were found in 659 (84.9%) patients. Appendix vermiformis was retrocecal localization in 72 (15.6%) men and in 45 (14.1%) women. The distribution of pathology report findings of appendectomy specimens of retrocecal, non-retrocecal, and all patients is given in Table 1.

As seen in table 1, the perforation rate in retrocecal appendicitis was found to be significantly higher than in non-retrocecal ($P = .000$).

Complications developed in 22 (2.8%) patients during the postoperative follow-up. Wound infection was found in 14 (1.8%) patients, intra-abdominal fluid collection in 6 (0.7%) patients, and ileus in 2 (0.2%) patients. The postoperative complication rate was 1.1% in acute appendicitis and 12.9% in perforated appendicitis. The distribution of the number and percentage of complications seen in the postoperative period in retrocecal and non-retrocecal appendicitis is given in Table 2.

Although the postoperative complication rate was higher in retrocecal appendicitis, no statistically significant difference was found between retrocecal localization and non-retrocecal localizations ($P = .105$).

Men had acute appendicitis in 364 (79.3%), gangrenous appendicitis in 6 (1.3%), perforated appendicitis in 78 (17.2%), appendix vermiformis mucocele in 1 (0.1%), and normal appendix vermiformis (negative appendectomy) in 10 (2.1%). Women had acute appendicitis in 261 (82.3%), gangrenous appendicitis in 3 (0.9%), perforated appendicitis in 33 (10.4%), appendix vermiformis mucocele in 1 (0.3%), and normal appendix vermiformis (negative appendectomy) in 19 (5.9%). Postoperative complications were seen in 13 men (2.8%) and 9 women (2.8%).

The findings of pathology reports and the distribution of postoperative complications in men and women are given in Table 3.

Table 1. Pathology report findings (numbers and percentages) in retrocecal, non-retrocecal and all patients

Appendix vermiformis pathologies	Retrocecal appendix vermiformis (n/%)	Non-retrocecal appendix vermiformis (n/%)	All patients (n/%)
Acute appendicitis	77/65.8	548/83.1	625/80.5
Gangrenous appendicitis	0/0	9/1.3	9/1.1
Perforated appendicitis	37/31.6	74/11.2	111/14.3
Appendix vermiformis mucocele	0/0	2/0.3	2/0.2
Normal appendix vermiformis (Negative appendectomy)	3/2.5	26/3.9	29/3.7

n: Number, %: Percentage

Table 2. Postoperative complications in retrocecal and non-retrocecal appendicitis

Postoperative complications	Retrocecal appendix vermiformis (n/%)	Non-retrocecal appendix vermiformis (n/%)
Wound infection	4/3.4	10/1.5
Intraabdominal fluid collection	2/1.7	4/0.6
Ileus	0	2/0.3
Total	6/5.1	16/2.4

n: Number %: Percentage

Table 3. Distribution of pathology reports findings and postoperative complications found in retrocecal and non-retrocecal appendix vermiformis in men and women

	Gender	Retrocecal appendix vermiformis (n)	Non-retrocecal appendix vermiformis (n)
Acute appendicitis	Men	45	319
	Women	32	229
Gangrenous appendicitis	Men	0	6
	Women	0	3
Perforated appendicitis	Men	27	51
	Women	10	23
Mucocele of appendix vermiformis	Men	0	1
	Women	0	1
Normal appendix vermiformis (Negative appendectomy)	Men	0	10
	Women	3	16
Postoperative complications	Men	3	10
	Women	3	6

n: Number

The mean hospital stay for all patients was 1.8 days, 3.9 days for perforated cases and 1.4 days for non-perforated cases. In addition, the mean hospital stay was 2.4 days for retrocecal appendicitis and 1.7 days for non-retrocecal appendicitis. Mean hospital stay was significantly higher in retrocecal localization than non-retrocecal localization ($P=0.000$).

Discussion

Acute appendicitis is a nonspecific purulent infection of the appendix vermiformis [9]. In general, the prognosis of acute appendicitis is good. However, late diagnosis causes complications such as gangrene, perforation, plastron, intraabdominal abscess, and generalized peritonitis. This leads to an increase in morbidity and mortality. The prognosis of acute appendicitis mostly depends on the complications of appendicitis [3]. While the mortality rate of non-perforated appendicitis is 0.1% and 3% in perforated appendicitis, this rate may increase to 15% in the elderly population [10].

Acute appendicitis is a disease of the young population [3]. It was reported that the mean age of acute appendicitis was 39.8 years [11]. Acute appendicitis is seen 2 or 3 times more in men [11,12]. In our study, the mean age of appendicitis was 30.9 years and acute appendicitis was seen mostly in men (59.1%).

Some studies in the literature have shown that age, race, gender, geographical region, and diet may affect the position of the appendix vermiformis [10]. Several studies have been conducted on the localization of appendix vermiformis. The general opinion about the anatomical localization of the appendix vermiformis is that the retrocecal localization is more. Retrocecal appendix

localization can be found in 26-70% of cases. Retrocecal localization is followed by paracecal and other localizations at different rates [9]. It is reported that retrocecal appendicitis is mostly observed in Bangladesh (65%), Pakistan (57%), and Ghana (67.3%) [13,14,15]. Ajmani et al reported the retrocecal appendix vermiformis rate is 58% [16]. The rate of retrocecal appendix was reported 75% in the study of Humes et al, while it was reported at 17% in the study of Grunditz et al [3,17]. In most studies, retrocecal localization has been reported at higher rates. In contrast to most studies in the literature, our rate of appendix with retrocecal localization was lower (15%).

Perforated appendicitis rates in all appendicitis cases vary between 22% and 25.8%. Appendix perforations are more common in children and elderly people [12]. Drake et al, reported that perforated appendicitis and negative laparotomy rate were 15.8% and 4% respectively [11]. In a study involving another 225 patients, the negative appendectomy rate was reported to be 7.11% [18]. In the study of Alhamdani et al, negative appendectomy rate was found at 9.5% and most of the negative appendectomies were found in women [19]. Our perforated appendicitis rate (14.3%) and negative appendectomy (3.7%) were lower than the literature findings. In this study, negative appendectomies were found to be more common in women, which is consistent with the literature.

Many complications can develop at various rates after appendectomy, and this has a negative effect on the length of hospital stay. In one study, the postoperative complication rate was reported to be 5.2% and the mean length of hospital stay was 4.3 days [5]. In the study of Blackmore et al, the postoperative complication rate was 5.3 % and the mean length of hospital stay

was 3.5 days [20]. Our postoperative complication rate (2.8%) and the mean length of hospital stay of our patients (1.8 days) were lower. Wound infection is the most common complication after appendectomy. In the study of Iurii et al, the rate of wound infection in simple appendicitis was reported to be less than 5% and 20% in perforated and gangrene patients [9]. The most common complication in our patients was wound infection (1.8%), and this rate was lower than the literature values.

Different positions and associated symptoms of the appendix vermiformis are an enigma for clinicians. If the entire appendix is close to the anterior abdominal wall, there may be a great chance that it can be easily seen by radiologists and easily diagnosed and treated by surgeons [21]. Emergency physicians should consider that appendicitis may not always present with typical symptoms and signs and should not ignore the possibility of acute appendicitis in acute abdominal pain to avoid any delay in diagnosis [22].

Retrocaecal appendix was the commonest in patients presenting to an emergency as appendicitis (78%) [23]. Since the signs and symptoms of retrocecal appendicitis are atypical, the diagnosis can be made late. This leads to complicated appendicitis [8]. Ahmad et al, reported that the diagnosis of retrocaecal appendicitis is difficult, and that retrocecal appendicitis causes more gangrene, perforation and infection [24]. Kim et al, stated that the appendix perforation rate was 49% with abscess formation in retrocecal appendicitis [25]. In the study of Castro et al, perforation rate was reported to be 8% in anteriorly located appendicitis and 11.6% in retrocecal appendicitis [26]. We detected perforation rate of 31.6 % in appendicitis with retrocecal localization and 11.2 % in appendicitis with non- retrocecal localization. Perforated appendicitis rate was higher significantly in retrocecal localization ($P=.000$).

Postoperative complications of retrocecal appendicitis are more common [27]. Especially in complicated appendicitis, postoperative complication rate is reported as 15.8% [28]. The rate of postoperative complications in acute appendicitis is 3%, whereas this rate is 12% in perforated appendicitis [5]. In our study, the postoperative complication rate was 1.1% in acute appendicitis and 12.9% in perforated appendicitis. Although postoperative complication rates were higher in retrocecal appendicitis (5.1%) than non-retrocecal appendicitis (2.4%), no statistically significant difference was found ($P=.105$).

Patients with complicated appendicitis have longer length of hospital stay. Guidry et al reported that the mean length of hospital stay of appendicitis with retrocecal localization was longer [27]. It is reported that the mean length of hospital stay in complicated appendicitis is 4.4 days, whereas it is 1.9 days in uncomplicated appendicitis [29]. In our study, the length of hospital stay was 3.9 days in perforated appendicitis, and 1.4 days in non-perforated appendicitis. In addition, we found that the mean length of hospital stay was 2.4 days in retrocecal appendicitis and 1.7 days in non-retrocecal appendicitis. The mean length of hospital stay was significantly longer in appendicitis with retrocecal localization ($P=.000$).

Conclusion

Perforated appendicitis rate and mean hospital stay were found to be higher in retrocecal appendicitis, thus showing that retrocecal

appendicitis still negatively affects the prognosis of acute appendicitis today. Therefore, emergency physicians and surgeons should not ignore retrocecal appendicitis, which still negatively affects the prognosis of acute appendicitis, causing delay in diagnosis due to its atypical symptoms.

Conflict of interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical approval

Our prospectively designed study was initiated after the approval (protocol no: 2018/79) from the Malatya clinical research ethics committee.

References

1. Deshmukh S, Verde F, Johnson PT, et al. Anatomical variants and pathologies of the vermiform appendix. *Emerg Radiol.* 2014;21:543-52.
2. Clegg-Lamprey JN, Armah H, Naaeder SB, Adu-Aryee NA. Position and susceptibility to inflammation of vermiform appendix in Accra, Ghana. *East Afr Med J.* 2006;83:670-3.
3. Humes DJ, Simpson J. Acute appendicitis. *BMJ.* 2006;333:530-4.
4. Walker S, Haun W, Clark J, et al. The value of limited computed tomography with rectal contrast in the diagnosis of acute appendicitis. *Am J Surg.* 2000;180:450-5.
5. Hale DA, Molloy M, Pearl RH, et al. Appendectomy: a contemporary appraisal. *Ann Surg.* 1997;225:252-61.
6. Celep B, Balı A, Özsoy M, et al. Abdominal tomography in the diagnosis of acute appendicitis. *Bozok Med J.* 2014;4:29-33.
7. Zacharzewska-Gondek A, Szczurowska A, Guziński M, et al. A pictorial essay of the most atypical variants of the vermiform appendix position in computed tomography with their possible clinical implications. *Pol J Radiol.* 2019;84:e1-e8.
8. Herscu G, Kong A, Russel D, et al. Retrocecal appendix location and perforation at presentation. *Am Surg.* 2006;72:890-3.
9. Iurii B, Vahtang G, Alin B. Acute appendicitis. *Moldovan Med J.* 2018;61:28-37.
10. Ghorbani A, Forouzes M, Kazemifar AM. Variation in anatomical position of vermiform appendix among Iranian population: an old issue which has not lost its importance. *Anat Res Int.* 2014;2014:1-4.
11. Drake FT, Mottey NE, Farrokhi ET, et al. Time to appendectomy and risk of perforation in acute appendicitis. *JAMA Surg.* 2014;149:837-44.
12. Körner H, Söndena K, Söreide JA, et al. Incidence of acute non-perforated and perforated appendicitis: age-specific and sex-specific analysis. *World J Surg.* 1997;21:313-7.
13. Paul UK, Naushaba H, Alam MJ, et al. Length of vermiform appendix: a postmortem study. *Bangladesh J Anat.* 2011;9:10-12.
14. Iqbal T, Amanullah A, Nawaz R. Pattern and positions of vermiform appendix in people of Bannu district. *Gomal J Med Sci.* 2012;10:100-3.
15. Clegg-Lamprey J, Naaeder S. Appendicitis in Accra: a contemporary appraisal. *Ghana Med J.* 2003;37:52-56.
16. Ajmani ML, Ajmani K. The position, length and arterial supply of vermiform appendix. *Anat Anz.* 1983;153:369-74.
17. Grunditz T, Ryden CI, Janzon L. Does the retrocecal position influence the course of acute appendicitis. *Acta Chir Scand.* 1983;149:707-10.
18. Genzor Ríos SJ, Rodríguez Artigas JM, Giménez Maurel T, et al. [Ultrasonography and the Alvarado score in the diagnosis of acute appendicitis: impact on the negative appendectomy rate]. *Emergencias.*

- 2016;28:396-9.
19. Alhamdani YF, Rizk HA, Algethami MR, et al. Negative Appendectomy Rate and Risk Factors That Influence Improper Diagnosis at King Abdulaziz University Hospital. *Mater Sociomed*. 2018;30:215–20.
 20. Blackmore C, Tanyingo D, Kaplan GG, et al. A comparison of outcomes between laparoscopic and open appendectomy in Canada. *Can J Surg*. 2015; 58:431–2.
 21. Nayak SB, Soumya KV. "Anterior appendix": a boon for clinicians and radiologists. *Surg Radiol Anat*. 2019;41:1387-9.
 22. Seyedhosseini-Davarani S, Akhgar A. Atypical Presentation of Acute Appendicitis: A 32-year-old Man with Gastroenteritis Symptoms; an Educational Case. *Adv J Emerg Med*. 2017;4;2:e21.
 23. Ali U, Noor A, Jan WA, et al. Position of appendix and its related morbidity. *JBKMC*. 2016;1:30-34.
 24. Ahmad M, Ahmad I, Gill KM. Retrocecal appendix. *Professional Med J*. 2002;9:135-8.
 25. Kim S, Lim HK, Lee JY, et al. Ascending retrocecal appendicitis: clinical and computed tomographic findings. *J Comput Assist Tomogr*. 2006;30:772-6.
 26. Castro BA, Novillo IC, Vázquez AG, et al. Impact of the appendiceal position on the diagnosis and treatment of pediatric appendicitis. *Rev Paul Pediatr*. 2019;37:161-165.
 27. Guidry SP, Poole GV. The anatomy of appendicitis. *Am Surg*. 1994;60:68-71.
 28. Lim SG, Ahn EJ, Kim SY, et al. A Clinical Comparison of Laparoscopic versus Open Appendectomy for Complicated Appendicitis. *J Korean Soc Coloproctol*. 2011;27:293-7.
 29. Dhupar R, Evankovich J, Ochoa JB, et al. Outcomes of operative management of appendicitis. *Surg Infect (Larchmt)*. 2012;13:141-6.