Archives of Current Medical Research
Arch Curr Med Res 2023;4(1):40-46

Received: 06 July 2022
Revised: 19 August 2022
Acccepted: 13 September 2022
DOI: 10.47482/acmr.1141714

ORIGINAL ARTICLE

Clinicopathological evaluation of parasitic infections in appendectomy specimens

Murat Kartal[1] **Tolga Kalaycı**[2] **Yaşar Çöpelci**[3] **Ali Kurt**[4]

1 Ataturk University Faculty of Medicine, Department of General Surgery, Erzurum, Turkey
2 Ağrı İbrahim Çeçen University Faculty of Medicine, Department of General Surgery, Ağrı, Turkey
3 University of Health Sciences, Erzurum Regional Education and Research Hospital, Department of General Surgery, Erzurum, Turkey
4 University of Health Sciences, Erzurum Regional Training and Research Hospital, Department of Pathology, Erzurum, Turkey

Abstract

Background: This study aimed to determine the incidence of parasitic infections in adult patients who underwent appendectomy and to compare the clinicopathological features of parasitic infections in appendectomy specimens.

Methods: Patients with pre-diagnosis of acute appendicitis who underwent appendectomy between January 2018 and December 2019 and reported parasitic infection in appendectomy specimens were evaluated retrospectively. Demographic data, comorbidities, clinical and radiological findings, laboratory results, surgical methods, length of hospital stay, postoperative complications, and histopathological examination reports were analysed.

Results: 939 adult patients underwent appendectomy with a pre-diagnosis of acute appendicitis. Upon detecting parasitic infection in the histopathological examination, thirty-one (3.3%) patients were included in this study. Twenty (64.5%) patients were women, and the overall mean age was 31.9 years (18-70 years). Twenty-three (74.2%) patients had Enterobius vermicularis, and 8 (25.8%) patients had Taenia saginata. On laboratory examination, the mean percentage of monocytes was only higher in the Taenia saginata group (0.80 vs 0.66; p=0.039). Both ultrasonography findings and tomography findings were similar in both groups. The morbidity rate of the study was 12.9% (n=4). There was no difference between the two groups regarding the length of hospital stay or morbidity.

Conclusions: Parasitic infections may cause symptoms mimicking acute appendicitis. It should be kept in mind that even in patients with a diagnosis of parasitic intestinal infection, symptoms may have been caused by acute appendicitis, not solely due to parasitic infection.

Keywords: Appendectomy, Enterobius Vermicularis, Taenia Saginata.

Cite this article as: *Kartal M, Kalaycı T, Çöpelci Y, Kurt A. Clinicopathological evaluation of parasitic infections in appendectomy specimens. Arch Curr Med Res. 2023;4(1):40-46*

Corresponding Author:
Tolga Kalaycı, Ağrı İbrahim Çeçen University Faculty of Medicine, Department of General Surgery, Ağrı, Turkey
E-Mail: dr.tolgakalayci@gmail.com

INTRODUCTION

Acute appendicitis (AA) is the most common cause of emergency abdominal surgery (1). Although it is mainly seen in the 7-35 age range, it can be encountered in any age group (2). Abdominal pain, anorexia, nausea/vomiting, and elevation of serum inflammatory markers are typical findings of AA. The standard gold treatment for AA is appendectomy (3). It has been reported that fecalith and lymphoid hyperplasia may predispose the development of AA by obstructing the lumen of the appendix vermiformis (AV). Vegetable/fruit seeds, tumours, and parasites are rarely included in AA aetiology (4).

Intestinal parasitic infections can be seen at all ages, especially in children. Although the prevalence varies according to geography and socioeconomic level, it has been reported at a high rate of 44.6% (5). Parasitic intestinal infections most frequently affect the colon in the gastrointestinal system, a parasitic infection of the AV is rare. Intestinal parasites can mimic AA, and the diagnosis is usually made by histopathological examination of appendectomy specimens (6). The most common parasites associated with appendicitis are *Enterobius vermicularis (EV)*, *Ascaris lumbricoides*, *Entamoeba histolytica*, *Taenia saginata* (TS) and *Schistosoma sp*. Although the role of parasites in AA aetiology has not been fully clarified, it is thought that they cause the development of AA by both occluding the lumen of the AV and creating inflammatory reactions (7).

This study aimed to determine the incidence of parasitic infection in adult patients who underwent appendectomy with a pre-diagnosis of AA and to compare the clinicopathological features of parasitic infections in appendectomy specimens.

MATERIALS AND METHODS

Patients' Selection and Searched Parameters

Patients who underwent an appendectomy in a tertiary health centre with a pre-diagnosis of AA and reported the presence of parasitic infection in appendectomy specimens were evaluated retrospectively. All adult patients who met the criteria between January 2018 and December 2019 were included in the study. All surgeries and histopathological examinations were performed at the same clinics. Incidental appendectomies, patients younger than 18, and patients whose detailed data could not be accessed were excluded from the study.

Demographic data, comorbidities, preoperative clinical and radiological findings, laboratory results, surgical methods, length of stay in hospital (LOS), complications, and histopathological examination reports were analysed hospital data management system of Sisoft (Sisoft Healthcare Information Systems, Turkey) and patient files retrospectively. Appendectomy specimens with reported parasitic infections were re-examined pathologically by a consulting pathologist. Thus, the diagnosis of parasitic infections and parasite types was re-confirmed.

Statistical Analysis

Statistical data analysis was performed using SPSS (SPSS Inc. v23.0, USA). Mean and standard deviation were used in descriptive statistics for quantitative variables, and numbers and percentages were used for qualitative variables. The normal data distribution was evaluated with the Shapiro-Wilk and Kolmogorov-Smirnov tests. If the data showed normal distribution, data were analysed with an independent samples t-test, and independent qualitative data were analysed with chi-square. If the normal distribution assumption was not met, the Mann-Whitney U test was used for independent quantitative data, and the Wilcoxon test was used for dependent quantitative data. The significance level was accepted as 0.05.

Ethical Approval and Patient Consent

Data collection and analysis for the study were initiated after the study was deemed ethically appropriate by the Ethics Committee of University of Health Sciences, Erzurum Regional Training and Research Hospital (Decision no: 2021 / 06-136, Decision date: 15.03.2021). Since it is a retrospective study, patient consent is not required.

RESULTS

Nine hundred thirty-nine adult patients underwent appendectomy with a pre-diagnosis of AA between January 2018 and December 2019. Thirty-one (3.3%) patients were included in the study upon detecting parasitic infection in their histopathological examination and meeting the other inclusion criteria. Of 31 patients, twenty (64.5%) were women, and eleven (35.5%) were men. The mean age of all patients was 31.9 years (18-70 years).

Three (9.7%) patients had at least one comorbid disease or previous surgical history. Medically treated chronic obstructive pulmonary disease (COPD) and diabetes mellitus (DM) were found as comorbidities in one patient. Two (6.4%) patients had a history of total thyroidectomy. Both patients received hormone replacement therapy and were euthyroid during the perioperative period.

Physical examination of all patients showed tenderness and defence in the right lower quadrant. On laboratory examination, the mean percentage of monocytes was only higher in the Taenia saginata group (0.80 vs 0.66; p=0.039). The mean value of other complete blood count parameters was similar in both groups. A comparison of the complete blood count parameters according to parasite type is shown in **Table 1**.

Table 1. Comparison of the complete blood count parameters according to parasite type.

Parameters (mean)	EV Group (n=23)	TS Group (n=8)	P-value
White blood cell (103/mm3)	10.35 (4.9-18.10)	13.40 (5.20-20.79)	0.46*
Red blood cell (106/mm3)	4.96 (3.90-6.41)	5.13 (3.99-5.54)	0.47*
Hemoglobin (g/dL)	13.7 (10.10-17.00)	14.8 (10.10-16.90)	0.97*
Haematocrit (%)	40.15 (30.40-52.90)	43.10 (31.80-49.00)	0.87**
Mean cell volume (fL)	82.70 (75.50-91.40)	83.00 (63.10-88.50)	0.16**
Mean corpuscular haemoglobin (pg)	28.50 (25.30-32.10)	29.31 (18.80-31.60)	0.17*
Mean corpuscular haemoglobin concentration (g/dL)	34.25 (30.60-36.10)	34.30 (29.80-35.80)	0.39**
Platelet count (10^3/mm^3)	282000 (64000-442000)	266000 (193000- 815000)	0.19**
Reticulocyte distribution width (%)	13.25 (10.80-16.00)	13.39 (12.10-18.10)	0.20*
Platelet distribution width (%)	16.30 (9.60-20.90)	16.00 (10.60-17.60)	0.41*
Mean platelet volume (fL)	8.52 (6.20-10.00)	8.96 (6.60-10.60)	0.61*
Neutrophil #	7.55 (2.60-16.90)	8.30 (2.50-18.28)	0.63**
Lymphocyte #	1.54 (0.70-4.10)	2.15 (1.14-3.90)	0.38**
Monocyte #	0.66 (0.10-1.20)	0.80 (0.30-7.50)	**0.039****
Eosinophil #	0.17 (0.01-0.42)	0.20 (0.07-0.53)	0.30**
Basophil #	0.02 (0.00-1.00)	0.11 (0.00-0.90)	0.26**

EV: Enterobius vermicularis, TS: Taenia saginata. *Independent samples t-Test, **Mann Whitney U test.

Ultrasonography (USG) examination, the first diagnostic imaging tool, was performed on all patients included in the study during emergency room admissions. 58.1% of all patients (n=18) had USG findings compatible with AA. The calculated mean diameter of the AV was 8.23 mm. Seven (22.6%) of these 18 patients also had mesenteric heterogeneity on the right upper quadrant on USG. Computed tomography (CT) was planned for only one of the patients with mesenteric heterogeneity on USG because of the suspicion of a simultaneous cecum tumour. Still, no tumoral mass was seen on the CT scan of this patient. However, an additional imaging tool was not needed in patients with other mesenteric heterogeneity. On the other hand, AV was not seen on USG in 13 (41.9%) patients. Because AV could not be seen on USG, CT was planned for these 13 patients (negative USG). Findings consistent with AA were reported in 11 (35.5%) of 14 patients who underwent CT examination. The mean diameter of the AV was reported as 9.3 mm on CT. Mesenteric heterogeneity was reported in only three patients, and in one of them, heterogeneity was said to be accompanied by abscess formation. The distribution of evaluated USG and CT parameters was similar in both groups. Clinicopathological features according to parasite type and a comparison of these features are shown in **Table 2**.

Table 2. Clinicopathological features according to the type of parasite.

	General N=31	EV Group N=23	TS Group N=8	P-value
USG findings (n=31)				
Appendix vermiformis visualisation				0.228*
· *Yes*	18 (58.1%)	15 (83.3%)	3 (16.7%)	
· *No*	13 (41.9%)	8 (61.5%)	5 (38.5%)	
Mean appendix diameter	8.23 mm	8.09 mm	8.77 mm	0.652**
Mesenteric heterogeneity				0.576*
· *Yes*	9 (29%)	7 (77.8%)	2 (22.2%	
· *No*	22 (71%)	16 (72.7%)	6 (27.3%)	
CT findings (n=14)				
Appendix vermiformis visualisation				NE
· *Yes*	11 (78.6%)	9 (81.8%)	2 (18.2%)	
· *No*	3 (21.4%)	3 (100%)	0 (0%)	
Mean appendix diameter	9.3 mm	9 mm	11 mm	0.250***
Mesenteric heterogeneity				NE
· *Yes*	3 (21.4%)	3 (100%)	0 (0%)	
· *No*	11 (78.6%)	9 (81.8%)	2 (18.2%)	
Histopathological examination				
Presence of acute inflammation				0.698*
· *Yes*	17 (54.8%)	12 (70.6%)	5 (29.4%)	
· *No*	14 (45.2%)	11 (78.6%)	3 (21.4%)	
Mean length of appendix vermiformis	70 mm	63 mm (22-100)	80 mm (55-100)	0.210***
Mean diameter of the appendix	8 mm	7.5 mm (5-20)	9 mm (5-10)	0.960***
Length of stay in hospital (day)	2.32 (1-7)	2.12 (1-7)	3 (1-6)	0.510***
Postoperative complications				1.000*
· *Yes*	4 (12.9%)	3 (75%)	1 (25%)	
· *No*	27 (87.1%)	20 (74.1%)	7 (25.9%)	

USG: ultrasonography, CT: computed tomography, NE: not evaluated. *Chi-square test, **Independent samples t-Test, ***Mann Whitney U test.

Laparoscopic appendectomy was performed in 23 (74.2%) patients, and conventional appendectomy was completed in 8 (25.8%) patients. There was no conversion from laparoscopy to conventional appendectomy or any reported perioperative complications. Perioperative drains were placed in six patients due to purulent fluid collection in the pelvic region during surgery.

The mean length of stay (LOS) was 2.3 days (ranging from one day to seven-day), and the morbidity rate of the study was 12.9% (n=4). None of the patients required intensive care follow-up, and postoperative mortality was not observed. The most prolonged LOS was seen in patients with postoperative complications.

Postoperative complications were seen in 4 (12.9%) patients, surgical site complications in 3 (9.7%) patients, and ileus in one (3.2%) patient. Patients with surgical site complications were as follows: A 70-year-old male patient with multiple comorbid diseases (COPD, DM) and presence of abscess formation on preoperative CT (Length of stay (LOS): 6 days) had left pararectal redness and port-side seropurulent fluid collection on the tenth postoperative day. A 63-years-old male with DM (LOS: 7 days) had a port-side abscess on the thirteenth postoperative day. In addition, a 22-year-old female patient with no other disease (LOS: 5 days) had a port-side seroma on the third postoperative day. All surgical site complications were treated with drainage and daily cleaning. The patient with postoperative ileus was treated with conservative treatment with nasogastric decompression. All patients with postoperative complications had a history of perioperative drain placement. There was no difference between the two groups regarding the length of hospital stay or morbidity. Additionally, a perioperative haemorrhage occurred in a 27-year-old male patient (LOS: 7 days) without any other illness.

In appendectomy specimens, twenty-three (74.2%) patients had Enterobius vermicularis, and 8 (25.8%) patients had Tenia saginata. The mean length of AV was 70 mm, and the mean AV diameter was 8 mm. Presence of lymphoid hyperplasia was reported in 11 (35.5%) patients. Histopathologically, 17 (54.8%) specimens had signs of acute inflammation, while 14 (45.2%) specimens did not have signs of inflammation consistent with AA. In specimens with acute inflammation, the lumen of the AV was occluded with parasites in thirteen specimens and fecalith in four specimens. Luminal obstruction due to lymphoid hyperplasia was not detected. Parasitic infections in appendectomy specimens were most common in May with five cases, followed by four cases each in April and June. All patients were given mebendazole or albendazole after the histopathological examination revealed parasitic infections.

DISCUSSION

Acute appendicitis (AA) is the most common cause of acute abdominal pain. Anorexia, nausea, vomiting, abdominal pain migrating to the right lower quadrant, and mild leukocytosis are frequently observed signs/symptoms and findings. In addition to the anamnesis and physical examination findings, the diagnosis of appendicitis is supported by laboratory tests and imaging methods such as USG and CT (8).

AA is commonly considered to develop due to obstruction of the AV. While faecalis or lymphoid hyperplasia is frequently found in the aetiology, foreign bodies and parasitic causes are rarely encountered (1,9). The presence of parasitic infections up to 6.4% has been shown in appendectomies (10). The most common parasite is *Enterobius vermicularis* (EV). Rarely, *Entamoeba histolytica*, *Schistosoma sp.*, *Taenia saginata* (TS), *Ascaris lumbricoides*, and *Balantidium coli* can also be detected (7). Only adult patients were included in our study, and parasitic infection was found in 31 (3.3%) of 939 appendectomy specimens. EV was identified in 23 (2.45%) specimens and TS in 8 (0.85%).

The incidence of EV identification in appendectomy specimens ranges between 0.6-3.8% (6). This rate is 2.45% in the present study, similar to the literature. Although EV is frequently encountered in the pediatric age, it can also be detected in adults. Albendazole, mebendazole, and pyrantel pamoate are used in treatment. Since the risk of transmission among family members is very high, treatment and hygienic measures should cover the whole family (11). Although it is not possible and logical to establish a direct relationship between parasitic infection and the development of appendicitis with this limited data, we believe it may inspire further studies.

Another parasite diagnosed in appendectomy specimens in the present study is TS. The definitive host for TS is

human (12). Although most carriers are asymptomatic, they may cause symptoms such as nausea and loss of appetite. Very rarely, they can cause appendicitis (13). Our study identified TS infection in 8 (0.85%) appendectomy specimens. We believe that the incidence of TS infection in 0.85% of appendectomy specimens in the adult population will be important data for further studies.

Appendix vermiformis is reported as normal in 3-25% of the histopathological examinations of appendectomy specimens (14). In a cross-sectional study examining the presence of EV infection in appendectomy specimens, it was reported that no histopathology was found in them in 77.4% of the cases (6). In our study, the presence of acute inflammation was shown in 12 (52.1%) of 23 specimens with EV. In 5 (62.5%) of 8 specimens with TS, acute inflammation was present in histopathological examination. TS, whose relationship with appendectomies is rarely reported in case of reports or as an unusual finding in extensive studies (13,15), was written in 8 patients in our research, and it was found to cause a higher rate of acute inflammation compared to EV (52.1% vs 62.5%).

In the literature, in appendectomy specimens with EV infection, the mean length of AV was 61.6 mm, and the mean diameter of AV was 5.8 mm (6). In the current study, the average size of AV was 63 mm, and the mean diameter of AV was 7.5 mm in appendectomy specimens with EV infection. In specimens with TS infection, it is seen that the mean length of AV is 80 mm, and the mean diameter is 9 mm. Our study presented larger appendix diameters than those reported in the literature. We think that the higher rates of acute inflammation found in our study than the rates reported in the literature may be effective in the occurrence of the difference in appendix diameters (16).

A limited number of studies report that intestinal parasitisation is frequently encountered in the spring and summer (17,18). In addition to the literature, the current study evaluates the presence of parasitic infection in appendectomy specimens histopathologically instead of using sample tests and reveals that parasitic infection is most frequently encountered in appendectomies performed in May, followed by April and June. We believe further studies should be conducted to show seasonal differences in parasitic infection incidence in appendectomy specimens.

There are also limiting factors in our study. The retrospective design of the study is the main limiting factor. The number of specimens with parasitic infections and species was insufficient to allow for detailed and further statistical analysis.

Parasitic infections may cause symptoms mimicking AA. We believe that adult patients with acute abdominal pain in endemic regions for parasitic infection should be questioned in detail about the presence of a possible parasitic disease. Considering the high rate of acute inflammation, it should be kept in mind that even in patients with a diagnosis of parasitic intestinal infection, symptoms may have been caused by AA, not solely due to parasitic infection.

Declarations

The authors received no financial support for this article's research and/or authorship. There is no conflict of interest.

Data collection and analysis for the study were initiated after the study was deemed ethically appropriate by the Ethics Committee of University of Health Sciences, Erzurum Regional Training and Research Hospital (Decision no: 2021 / 06-136, Decision date: 15.03.2021). Since our study is a retrospective study, patient consent is not required.

REFERENCES

1. Wagner M, Tubre DJ, Asensio JA. Evolution and Current Trends in the Management of Acute Appendicitis. Surg Clin North Am. 2018;98(5):1005-1023.
2. Ceresoli M, Zucchi A, Allievi N, Harbi A, Pisano M, Montori G, et al. Acute appendicitis: Epidemiology, treatment and outcomes- analysis of 16544 consecutive cases. World J Gastrointest Surg. 2016;8(10):693-699.
3. Téoule P, Laffolie J, Rolle U, Reissfelder C. Acute Appendicitis in Childhood and Adulthood. Dtsch Arztebl Int. 2020;117(45):764-774.
4. Yabanoğlu H, Aytaç HÖ, Türk E, Karagülle E, Calışkan K, Belli S, et al. Parasitic infections of the appendix as a cause of appendectomy in adult patients. Turkiye Parazitol Derg. 2014;38(1):12-6.
5. Yentur Doni N, Gürses G, Şimşek Z, Yıldız Zeyrek F. Prevalence and associated risk factors of intestinal parasites among children of farm workers in the southeastern Anatolian region of Turkey. Ann Agric Environ Med. 2015;22(3):438-42.
6. Hasan A, Nafie K, El-Sayed S, Nasr M, Abdulmohaymen A, Baheeg M, et al. Enterobius vermicularis in appendectomy specimens; Clinicopathological assessment: Cross sectional study. Ann Med Surg (Lond). 2020;60:168-172.

7. Zarbaliyev E, Celik S. Parasitic Appendicitis: A Novel Laparoscopic Approach for the Prevention of Peritoneal Contamination. Can J Infect Dis Med Microbiol. 2018;2018:3238061.

8. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020;15(1):27.

9. Tran N, Emuakhagbon VS, Baker BT, Huerta S. Re-assessing the role of the fecalith in acute appendicitis in adults: case report, case series and literature review. J Surg Case Rep. 2021;2021(1):rjaa543.

10. Charfi S, Sellami A, Affes A, Yaïch K, Mzali R, Boudawara TS. Histopathological findings in appendectomy specimens: a study of 24,697 cases. Int J Colorectal Dis. 2014;29(8):1009-12.

11. Wendt S, Trawinski H, Schubert S, Rodloff AC, Mössner J, Lübbert C. The Diagnosis and Treatment of Pinworm Infection. Dtsch Arztebl Int. 2019;116(13):213-219.

12. Flisser A, Viniegra AE, Aguilar-Vega L, Garza-Rodriguez A, Maravilla P, Avila G. Portrait of human tapeworms. J Parasitol. 2004;90(4):914-6.

13. Altun E, Avci V, Azatcam M. Parasitic infestation in appendicitis. A retrospective analysis of 660 patients and brief literature review. Saudi Med J. 2017;38(3):314-318.

14. Gelpke K, Hamminga JTH, van Bastelaar JJ, de Vos B, Bodegom ME, Heineman E, et al. Reducing the negative appendectomy rate with the laparoscopic appendicitis score; a multicenter prospective cohort and validation study. Int J Surg. 2020;79:257-264.

15. Emre A, Akbulut S, Bozdag Z, Yilmaz M, Kanlioz M, Emre R, et l. Routine histopathologic examination of appendectomy specimens: retrospective analysis of 1255 patients. Int Surg. 2013;98(4):354-62.

16. Luiz do Nascimento Junior P, Teixeira Brandt C, Petroianu A. Differences between inflamed and non inflamed appendices diagnosed as acute appendicitis. Ann Med Surg (Lond). 2021;62:135-139.

17. Soltani S, Salmanzadeh S, Soltani S, Kahvaz MS, Mobarak S, Hezarian M, et al. Prevalence of Intestinal Parasitic Infections in the Southwest of Iran: A Four-year Retrospective Study. Infect Disord Drug Targets. 2020;20(6):854-859.

18. González-Moreno O, Domingo L, Teixidor J, Gracenea M. Prevalence and associated factors of intestinal parasitisation: a cross-sectional study among outpatients with gastrointestinal symptoms in Catalonia, Spain. Parasitol Res. 2011;108(1):87-93.