Enterobius Vermicularis: A Cause or an Incidental Finding in Pediatric Appendicitis?

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Abstract

**Purpose:** The role of Enterobius Vermicularis (E. vermicularis) in the etiology of acute appendicitis is controversial. We aimed to investigate the incidence of E. vermicularis in appendectomy specimens and its contribution in the pathogenesis of appendicitis.

**Methods:** The files of patients who had E. vermicularis in appendectomy specimens between June 2016 and June 2022 were reviewed retrospectively. The samples of patients whose appendectomy specimens showed E. vermicularis were analyzed in 3 groups according to the results of histopathological evaluation, as reactive lymphoid hyperplasia, acute appendicitis, and perforated appendicitis.

**Results:** The files of 1334 patients were examined and E. vermicularis was found histopathologically in 24 (1.8%) of them. Fifteen of the patients were boys, 9 were girls, and the mean age was 11.17±2.91 (min: 7 years, max: 17 years). Histopathological examination of appendectomy specimens revealed reactive lymphoid hyperplasia in 15, acute appendicitis in 6, and perforated appendicitis in 3. Only neutrophil counts were significantly different in patients with reactive lymphoid hyperplasia and acute appendicitis (p<0.05).

**Conclusion:** The high rate of histopathologically reactive lymph nodes in appendectomy specimens with E. vermicularis suggests that this parasite was found incidentally in the appendix. Differentiating enterobiosis from true appendicitis may prevent unnecessary appendectomies.

Introduction:

Appendicitis is the most common surgical emergency in children. Appendicitis develops as a result of obstruction of the appendix vermiformis lumen, most commonly due to fecaliths and lymphoid hyperplasia, and less frequently owing to intestinal parasite infections and tumors [1].

The most common parasites encountered in appendectomy specimens are *Enterobius, Schistosoma, Taenia* and *Ascaris* [2, 3]. Occlusion of the appendix lumen due to the presence of parasite eggs, cysts and trophozoites may cause right lower quadrant pain [4, 5].

*Enterobius vermicularis* (*E. vermicularis*), also known as pinworm, affects more than 200 million people around the globe and is more common in children than adults [6]. *E. vermicularis* is transmitted by the fecal-oral route and settles in the gastrointestinal tract of the human host.

The role of *E. vermicularis* in the etiology of acute appendicitis is controversial; some authors advocate that the presence of *E. vermicularis* in the appendix may clinically imitate acute appendicitis, but it is most likely incidental [7]. A careful histopathological examination may reveal helminths and their eggs in appendectomy specimens [8]. In previous systemic reviews and meta-analyses, the prevalence of *E. vermicularis* in acute appendicitis samples was 4% (95% CL, 2–6) [9].
In this study, we aimed to investigate the incidence of *E. vermicularis* in appendectomy specimens and its role in the pathogenesis of appendicitis.

**Methods:**

After obtaining the approval of the Harran University clinical research ethics committee, the files of the patients who underwent appendectomy between June 2016 and June 2022 were reviewed retrospectively. In patients whose histopathological evaluation revealed *E. vermicularis* were included in the study. Patients who underwent incidental appendectomy were excluded from the study. White blood cell (WBC), neutrophil, lymphocyte, eosinophil count, C-reactive protein (CRP) values and histopathological evaluation results of the patients were compared. The samples of patients whose appendectomy specimens showed *E. vermicularis* were analyzed in 3 groups according to the results of histopathological evaluation, as reactive lymphoid hyperplasia, acute appendicitis, and perforated appendicitis (Picture 1). Albendazole treatment was started in patients with *E. vermicularis* according to the outcome of pathology.

Statistical analysis was performed using IBM SPSS 23.0 (SPSS Inc. Chicago, IL). Descriptive analysis was expressed as mean and standard deviation. Because the sample size was small, the Shapiro-wilk test was used to evaluate the normal distribution. One-way Anova and student-t test were used for comparison between groups. P < 0.05 was considered statistically significant.

**Results:**

In this study group comprised of 1334 patients who were operated on with the clinical diagnosis of acute appendicitis and *E. vermicularis* was detected histopathologically in the appendectomy specimens in 24 (1.8%) of them. Fifteen (62.5%) patients were male, and 9 (37.5%) patients were female. The mean age of the patients was 11.17 ± 2.91 (min: 7 years, max: 17 years). There was a significant difference between the ages of the patients and their pathological diagnoses (p < 0.05).

Histopathological examination of appendectomy specimens revealed reactive lymphoid hyperplasia in 15 (62.5%), acute appendicitis in 6 (25%), and perforated appendicitis in 3 (12.5%). The histopathological results and demographic characteristics of the patients are shown in Table 1.
Table 1
Demographic and laboratory characteristics of the patients

<table>
<thead>
<tr>
<th></th>
<th>Reactive Lymphoid Hyperplasia</th>
<th>Acute Appendicitis</th>
<th>Perforated Appendicitis</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (m/f)</td>
<td>9/6</td>
<td>3/3</td>
<td>3/0</td>
<td>0.357</td>
</tr>
<tr>
<td>Age</td>
<td>12.27 ± 3.08</td>
<td>9 ± 1.41</td>
<td>10 ± 1</td>
<td>0.044</td>
</tr>
<tr>
<td>WBC (10^3/µL)</td>
<td>8.70 ± 3.21*</td>
<td>12.74 ± 4.89*</td>
<td>24.87 ± 0.30**</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Neutrophil (10^3/µL)</td>
<td>4.70 ± 1.40*</td>
<td>9.88 ± 1.38**</td>
<td>21.74 ± 0.36***</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Lymphocyte (10^3/µL)</td>
<td>3.07 ± 0.06*</td>
<td>2.05 ± 1.14**</td>
<td>0.54 ± 0.01***</td>
<td>0.004</td>
</tr>
<tr>
<td>Eosinophil (10^3/µL)</td>
<td>0.18 ± 0.01*</td>
<td>0.24 ± 0.18*</td>
<td>0.01 ± 0.0*</td>
<td>0.84</td>
</tr>
<tr>
<td>CRP (mg/dl)</td>
<td>0.51 ± 0.42*</td>
<td>1.15 ± 1.22*</td>
<td>6.06 ± 0.06**</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

In the complete blood count parameters of the patients, the WBC value was 8.70 ± 3.21x10^3/µL and within normal limits in patients with reactive lymphoid hyperplasia, 12.74 ± 4.8x10^3/µL in patients with acute appendicitis and 24.87 ± 0.30x10^3/µL in patients with perforated appendicitis. While there was no significant difference between patients with reactive lymphoid hyperplasia and patients with acute appendicitis, WBC was significantly higher in patients with perforated appendicitis (p < 0.05).

The neutrophil level was 4.70 ± 1.40x10^3/µL in patients with reactive lymphoid hyperplasia, 9.88 ± 1.38x10^3/µL in patients with acute appendicitis, and 21.74 ± 0.36x10^3/µL in patients with perforated appendicitis. Neutrophil values were statistically significantly different between all 3 groups (p < 0.001).

When lymphocyte values were compared, it was found 3.07 ± 0.06x10^3/µL in patients with reactive lymphoid hyperplasia, 2.05 ± 1.14x10^3/µL in patients with acute appendicitis, and 0.54 ± 0.01x10^3/µL in patients with perforated appendicitis. There was a significant difference between the groups (p < 0.05).

The eosinophil values of the patients were 0.18 ± 0.01x10^3/µL in patients with reactive lymphoid hyperplasia, 0.24 ± 0.18x10^3/µL in patients with acute appendicitis, and 0.01 ± 0.0x10^3/µL in patients with perforated appendicitis. There was no significant difference between the groups (p > 0.05), but when we compared the groups among themselves, there was no significant difference between patients with reactive lymphoid hyperplasia and patients with acute appendicitis, while it was found to be significantly lower in patients with perforated appendicitis compared to the previous two groups (p < 0.05).

When CRP values were compared, it was measured as 0.51 ± 0.42 mg/dl in patients with reactive lymphoid hyperplasia, 1.15 ± 1.22 mg/dl in patients with acute appendicitis, and 6.06 ± 0.06 mg/dl in
patients with perforated appendicitis. There was an exceedingly significant difference between the groups (p < 0.00). When we the groups were compared among themselves, there was no significant difference between patients with reactive lymphoid hyperplasia and patients with acute appendicitis, but it was found to be significantly higher in patients with perforated appendicitis compared to the previous two groups (p < 0.00). 0.05).

All patients detected with *E. vermicularis* in appendectomy specimens were treated with 200 mg 2 doses of albendazole daily with 1-week intervals. An appointment in the first week after was scheduled for all the patients in the pediatric surgery outpatient clinic setting after the appendectomy, and in case of any complaints that would arise afterwards they were recommended to admit to the emergency service anytime. Thus far we had a late complication in one only patient who was operated on for perforated appendicitis in which an intra-abdominal abscess was detected in the third week after the operation, and it was treated with percutaneous drainage with appropriate antibiotic therapy. *E. coli* was found in the abscess culture, and no *E. vermicularis* was detected in direct microscopy.

**Discussion:**

*E. vermicularis* is an endemic disease seen in developing countries and especially in rural areas [10]. *E. vermicularis* is one of the most common helminthic infection in humans, and approximately half of the children aged between 5 and 10 years of age are affected, and 4% of these children have appendix infestation [11]. In this study, 62.5% of the patients were younger than 10 years old.

In a review study by Taghipour et al., the frequency of *E. vermicularis* in appendectomy specimens was found to be in the range of 2–8% [9]. In several studies involving pediatric patient groups, the rate of *E. vermicularis* was reported as 1.07%-7% [12–15]. In this study, we found a rate of 1.8% similar to the literature. In addition to the articles stating that *E. vermicularis*is encountered equally common in both genders, there are also studies stating that it is more common in girls [16, 17]. In this study, it was found 1.6 times more frequently in males, akin to the study of Yıldız et al. [14]. This is because the city where the study was conducted is in a rural area and boys are more involved in life.

The presence of parasites in the appendix lumen may cause various pathological conditions, including lymphoid hyperplasia mimicking an appendicitis [17, 18]. Previous studies have described the phenomenon of “appendix colic”, in which physical obstruction of the appendix lumen by *E. vermicularis* causes symptoms and signs like those seen in acute appendicitis [13].

In recent years, lymphoid follicles have been accepted as a part of functional appendix histology due to their important role in the intestinal immune system [19]. It was assumed that *E. vermicularis* instigated appendicitis by blocking the lumen, although only 23–71% of the pathology samples showed inflammation histologically [11]. In the study of Sousaj et al., they concluded that *E. vermicularis* causes neutrophils to accumulate in the submucosa and muscularis mucosa, possibly leading to pain symptoms and clinical suspicion of an appendicitis [12]. Also, they detected the presence of inflammation in the 64.8% of pathology samples, however in our series, the rate of inflammation, (acute and perforated
appendicitis) detected in the pathology samples with *E. vermicularis*, was only 37.5%. Again, in our study, patients with reactive lymphoid hyperplasia had normal WBC, neutrophil count and CRP values, which are common inflammation markers. This suggests that inflammation in appendectomy specimens is due to secondary causes such as fecalith and bacteria rather than the presence of *E. vermicularis* invading the appendix lumen. The perforation rate of 12.5% that we found in our patients was similar to that of Alameyehu et al. [20].

If *E. vermicularis* is detected during appendectomy or in the examination of pathology specimens, anthelmintic treatment should promptly be initiated [7]. It is important to diagnose and treat this clinical entity, especially after perforated appendicitis, as there is an elevated risk of *E. vermicularis* contamination of the abdominal cavity [12]. In this study, *E. vermicularis* was not detected in the direct microscopy of the abscess fluid obtained from the percutaneous drainage fluid of our patient who developed intra-abdominal abscess three weeks after an appendicitis perforation. This leads us to believe that the abscess formation is rather a bacterial infection secondary to a perforation than an *E. vermicularis* infestation.

Common medical treatment modalities for *E. vermicularis* are mebendazole, albendazole (200 mg doses, single dose-one week apart) and pyrantel pamoate (10 mg/kg single doses-two weeks apart). These are safe and effective drugs with 90–100% cure rates [21]. As suggested in the literature we followed the same protocol and gave albendazole 200 mg single doses and repeat after one week to our patients and did not see any complications related to *E. vermicularis* in the postoperative period.

The study has a few limitations, such as being a retrospective review, small sample size, and sample evaluation of pathology specimens by different pathologists. Increasing the number of samples, working with a single pathologist, and long-term follow-up of patients may provide us with more detailed information in future studies.

**Conclusion:**

The high rate of reactive lymphoid hyperplasia in appendectomy specimens with *E. vermicularis* makes us assume that this parasite is found in the appendix by chance rather than being a solid factor in the etiology of appendicitis. Since *E. vermicularis* can be treated with oral anthelmintic drugs, distinguishing Enterobiasis from true acute appendicitis in patients presenting with right lower quadrant pain may prevent unnecessary appendectomies. Furthermore, non-operative treatment has recently come to the fore in the treatment of acute appendicitis. With an early diagnosis of *E. vermicularis* in such patients, the addition of anthelmintic drugs to medical treatment may increase the success of management.

**Declarations**

**Author contributions:** Conceptualization: Osman Hakan Kocaman; Methodology: Osman Hakan Kocaman, Ali İhsan Anadolu; Formal analysis and investigation: Gonca Gerçel, Cansu Yol; Writing -
original draft preparation: Osman Hakan Kocaman; Writing - review and editing: Ali İhsan Anadolulu, Gonca Gerçel. All authors read and approved the final manuscript.

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**Conflict of interest:** The authors have no conflict of interest to declare.

**Ethical approval:** Approval for this study was obtained from the ‘clinical research ethics committee’ of Harran University (protocol no: 22.19.16). The procedures used in this study adhered to the tenets of the Declaration of Helsinki.

**Consent to participate:** The requirement for signed informed consent was waived because of the retrospective study design and the use of deidentifed data.

**References**


Figures
Figure 1

Enterobius vermicularis infestation in the appendix. A, B) E. vermicularis (red arrow) detected in the lumen of the appendix showing reactive lymphoid hyperplasia. (H&E x40, H&E x100). C) In a case of phlegmonous appendicitis characterized by dense neutrophilic infiltration throughout the whole wall, E. vermicularis (red arrow) was observed in the submucosa of appendix. (H&E x40). D) High power images of cross section of adult female E. vermicularis with presence of alae (blue arrow), intestine (yellow arrow) and eggs (green arrow) contained ovary (red star) (H&E x200). E) Gangrenous appendicitis characterized by intense neutrophilic infiltration and necrotic destruction in all wall layers (H&E x200). F) E. vermicularis (red arrow) invading the appendix wall in a case of gangrenous appendicitis (H&E x40).