# The controversy of parasitic infection in pediatric appendicitis: a retrospective analysis

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***Background*** **Controversy still exists regarding the relationship between parasitic infections and acute appendicitis.**

***Aim*** **To investigate the role of parasitic infections in the etiology of acute pediatric appendicitis.**

***Patients and methods*** **A two-center retrospective study included 1500 pediatric and adolescent patients who had undergone surgical therapy for a diagnosis of acute appendicitis over a period of 8 years from January 2001 to December 2008 in the Suez Canal University hospitals and Alexandria Health Insurance Sporting Hospital for School Students and children. The patients' records were reviewed thoroughly to gather the demographic data on age, sex, and residence. Clinical data including the chief complaints on admission, duration of symptoms, history of similar attacks, previous hospitalization, and history of any chronic inflammatory diseases and drug history, if any, were analyzed. Laboratory and imaging studies were also reviewed. A thorough study of operative data was conducted, including a descriptive review of the operative findings during surgery. Postoperative complications, if any, and the histopathology reports of the removed appendices were also studied. Patients were divided into two groups according to the presence or the absence of parasites in the appendix lumen. In group I ($n=98$), parasitic infection was observed, whereas in group II ($n=1402$), no parasitic infection was present.**

***Results*** **Parasites were reported in 98 patients out of the 1500 patients included in the study (6.5%). Of those 98 parasitic infestations, 40 (40.8%) were *Enterobaisis*, 23 (23.5%) were *Schistosomiasis*, 15 (15.3%) were *Ascaris lumbricoides*, 12 (12.2%) were *Trichuris trichiura*, and eight (8.2%) were *Taenea saginata*. All patients showed a single parasitic infection. The percent of patients with suppurative, gangrenous, or perforated appendicitis was similar in both groups, with no statistical significance irrespective of the presence or the absence of parasitic infection.**

***Conclusion*** **Intestinal parasitic infection may not be considered as a risk factor for the development of acute appendicitis among the studied patients, and the low prevalence of parasites among the appendectomy specimens does not support the notion that parasites are a major cause of appendicitis in pediatric patients. However, parasitic infections could mimic the clinical picture of acute appendicitis, which need verification before the diagnosis of acute appendicitis.** ***Ann Pediatr Surg*** **8:15–18**
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## Introduction

Acute appendicitis is the most common acute surgical condition in children. It is usually caused by intraluminal obstruction and secondary infection of the appendix. Parasitic infections may cause symptoms mimicking acute appendicitis; however, their role in the causation of acute appendicitis remains speculative. Sporadic cases of appendicitis have been attributed to parasitic infections [1–3].

Parasitic infections are ubiquitous on a worldwide basis and are seen in high numbers in developing countries. Although the role of parasitic infections in relation to appendicitis is controversial, intestinal parasites may cause significant morbidity and mortality [4]. It has been documented that *Enterobius vermicularis* (pin worm) infections of the gastrointestinal tract occur in 4–28% of children worldwide [4–10]. Pin worms have been found in multiple locations in the gastrointestinal tract, including the appendix. Its most common manifestation is perianal pruritus [11–15]. The association of *E. vermicularis* infection with acute appendicitis varies from 0.2 to 41.8% worldwide [3]. Recent literature regarding appendiceal parasites focuses primarily on the pathologic changes induced by the presence of intraluminal parasites. The current retrospective study is aimed to assess the role of parasitic infections as an important factor in the etiology of pediatric appendicitis.

## Patients and methods

This is a retrospective study reviewing the medical files of all pediatric and adolescent patients who were admitted and surgically treated for acute appendicitis in the Suez Canal University Hospital and Alexandria Health Insurance Sporting's Students Hospital in the period of January 2001 to December 2008. The ethical considerations were fulfilled through the approval of the ethical committees in both centers. Data confidentiality was maintained through the whole study.

Patients' records were studied thoroughly to gather the demographic data on age, sex, and residence. Clinical data including the chief complaints on admission, duration of symptoms, history of similar attacks, previous hospitalization,

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and history of any chronic inflammatory diseases and drug history, if any, were analyzed. Laboratory and imaging studies were also reviewed.

A thorough study of operative data was conducted, including a descriptive review of the operative findings during surgery. Postoperative complications, if any, and the histopathology reports of the removed appendices were also studied.

The collected data were tabulated and analyzed statistically. All statistically analyzed data were categorical and were tested using the $\chi^2$-test and Yate's correction when necessary. A $P$-value of $< 0.05$ was considered significant.

## Results

Patients ($N = 1500$) were divided into two groups according to the presence or the absence of parasites in the appendix lumen. In group I ($n = 98$), parasitic infection was observed, whereas in group II ($n = 1402$), no parasitic infection was present. The age of our patients ranged from 1 to 17 years, with a mean age of $7.8 \pm 2.3$ years.

Out of a total of 1500 patients, 822 (54.8%) were girls and 678 (45.2%) were boys, with an F/M ratio of 1.2 : 1. The percentage of parasitic infections was almost the same among patients living in urban and suburban areas (6.6%) and in those living in rural areas (6.5%) (Table 1).

One-thousand three hundred and thirty patients (88.7%) complained only of lower right quadrant abdominal pain. In contrast, the remaining 170 patients (11.3%) complained of right lower quadrant pain in association with diarrhea in 93 patients (54.7%); 32 patients (18.8%) had associated vomiting and fever, and 45 patients (26.5%) suffered from associated attacks of constipation preceded by diarrhea.

Open appendectomy was performed in 1387 patients (92.5%), whereas 113 patients (7.5%) underwent laparoscopic appendectomy. The operative findings showed acute edematous congested appendix in 1250 patients (83.3%), perforated appendix in 33 patients (2.2%), obstructed appendix in 41 patients (2.7%), gangrenous appendicitis in 46 patients (3.1%), and apparently normal appendix in 130 patients (8.7%). The operative time ranged from 22 to 94 min, with a median of 31 min.

The associated intra-abdominal findings included Meckel's diverticulum that was not inflamed in six patients (0.4%), perforation of the appendix with Ascaris worm seen in the peritoneal cavity in three patients (0.2%), pin worm perforation of the appendix in four patients (0.3%), and ovarian cyst torsion in four patients (0.3%).

Postoperative complications included pelvic collection in seven patients (0.5%), wound infection and dehiscence in 35 patients (2.3%), and postoperative chest infection in three patients (0.2%).

## Histopathology results

In 548 specimens (36.5%), the appendix showed an acute catarrhal inflammation. Eosinophilic infiltration was seen microscopically in 43 specimens that also showed different parasitic infiltration, whereas neutrophil infiltration was noted in 1343 specimens (89%).

Six hundred and eighty specimens (45.3%) showed acute diffuse suppuration of the appendix. In 23 specimens (1.5%), different parasitic and eosinophilic infiltrations were recorded.

The appendix was found to be normal in 157 (10.5%) of the studied specimens and acutely gangrenous in 115 specimens (7.7%).

A total of 98 (6.5%) specimens showed parasitic infection. Out of these specimens, 66 (67.3%) were histopathologically proved to be acute appendicitis. The 98 appendiceal specimens with parasitic infection included Enterobaisis in 40 (40.8%) specimens, Schistosomiasis in 23 (23.5%) specimens, *Ascaris lumbricoides* in 15 (15.3%) specimens, *Trichuris trichiura* in 12 (12.2%) specimens, and *Tinea saginata* in eight specimens (8.2%). All patients showed a single parasitic infection, with no mixed parasitic infections. (Tables 2–4).

Normal Appendix (on histopathological examination) was significantly more common in cases associated with parasitic infection (group I) than in cases without parasitic infection (group II), as more than 90% of the patients without parasitic infections had inflamed appendices, whereas only 67% of the patients with parasitic

**Table 1 Sociodemographic data of the studied patients**

| Sociodemographic | With parasite | Without parasite | Total | $\chi^2$ | $P$ |
|---|---|---|---|---|---|
| Age in years | | | | | |
| 2–6 | 33 | 478 | 511 (34.1%) | 0.00 | 0.980 |
| >6–17 | 65 | 924 | 989 (65.9%) | | |
| Sex | | | | | |
| Male | 44 | 664 | 708 (47.2%) | 0.14 | 0.713 |
| Female | 54 | 738 | 792 (52.8%) | | |
| Residence | | | | | |
| Rural | 23 (6.6%) | 328 (93.4%) | 351 (23.4%) | 0.01 | 0.915 |
| Urban and suburban | 75 (6.5%) | 1074 (93.5%) | 1149 (76.6) | | |

**Table 2 Distribution of parasitic infestation in the studied patients**

| Type of parasitic infestation in appendicitis | No (%) |
|---|---|
| *Enterobiasis* | 40 (40.8) |
| *Schistosomiasis* | 23 (23.5) |
| *Ascaris lumbricoides* | 15 (15.3) |
| *Trachuris trachiura* | 12 (12.2) |
| *Tinea saginata* | 8 (8.2) |
| Total parasites | 98 (100.0) |

**Table 3 Comparison of the prevalence of parasitic infestation between appendicitis cases and normal appendix**

| Parasites | Appendicitis No (%) | Normal appendix No (%) |
|---|---|---|
| *Enterobius* | 27 (40.9) | 13 (40.6) |
| *Ascaris* | 5 (7.6) | 10 (31.3) |
| *Schistosomiasis* | 16 (24.2) | 7 (21.9) |
| *Trichuris trichiura* | 10 (15.2) | 2 (6.2) |
| *Tenia saginata* | 8 (12.1) | 0 (0.0) |
| Total infestation | 66 (100.0) | 32 (100.0) |

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**Table 4 Comparison of the prevalence of parasitic infestation between cases of catarrhal appendicitis and suppurative appendicitis**

| Parasite | Catarrhal appendicitis No. (%) | Suppurative appendicitis No. (%) |
|---|---|---|
| *Enterobius* | 17 (39.5) | 10 (43.5) |
| *Ascaris* | 2 (4.7) | 3 (13.0) |
| *Schistosomiasis* | 8 (18.6) | 8 (34.8) |
| *Trichuris trichiura* | 9 (20.9) | 1 (4.3) |
| *Tenia saginata* | 7 (16.3) | 1 (4.3) |
| Total infestation | 43 (100.0) | 23 (100.0) |

**Table 5 Comparison of parasitic infection in inflamed or uninflamed appendices**

| Exposure (parasites) | Positive inflammation | Negative inflammation | Total |
|---|---|---|---|
| Positive | 66 | 32 | 98 |
| Negative | 1298 | 104 | 1402 |
| Total | 1364 | 136 | 1500 |

Yates corrected $\chi^2$: 46.48.
*P*-value (two-tail) $<0.0001$.
Risk ratio: 0.7449 (0.6482, 0.8559).

infections had inflamed appendices (Table 5). This observation suggests that parasitic infections may mimic appendicitis in a considerable number of patients, who may not need appendectomy.

## Discussion

Gastrointestinal infection due to parasitic infection occurs worldwide. Its role in the etiology of acute appendicitis has been controversial.

The annual report of the two local referring health centers during our study period showed the prevalence of common parasite infections to be 46.3% among children between 1 and 18 years old. The percentages of parasite types were as follows: *E. vermicularis* in 22.9%, *A. lumbricoides* in 19.8%, Schistosomas in 10.2%, whereas *T. trichiura* and Taenia spp. showed a percentage of 1.4%. *E. vermicularis* (pin worm) is considered to be the most common helminthes infection [16]. It has been documented to infect the gastrointestinal tract in 4–28% of children worldwide [4–10].

There was no difference in the percentage of parasitic infections between rural, urban, and suburban patients. This may be interesting, with the expectation to find a high percentage of parasitic infections in those living in the rural areas of a developing country, due to the better health services in urban and suburban areas, which help in diagnosing many cases that may be missed or neglected in the rural areas.

In the current study, 98 appendices with parasites were recorded out of a total of 1500 appendectomies. It was present in 66 (4.4%) inflamed appendiceal specimens and in 32 (2.1%) specimens of apparently normal appendices. These data are contradicted by Dorfman, who reported parasitic infection with a normal appendix in 7.2% and with an inflamed appendix in 8.9% [16].

*E. vermicularis* infection with acute appendicitis varies from 0.2 to 41.8% worldwide [3]. It was often associated with uninflamed appendices and with inflamed appendices, and mucosal invasion was not seen; therefore, it seems unlikely that these parasites cause acute appendicitis. However, *E. vermicularis* may be a cause of symptoms resembling appendicitis, because a significantly higher proportion of patients with symptoms had *E. vermicularis* compared with patients who had an incidental appendicectomy [1–3]. Although seen in all ages and socioeconomic levels, it is most common in children aged from 5 to 14 years [3].

Of the parasitically infected patients, 66% were above the age of 6 years up to 17 years, whereas 34% were below the age of 6. *E. vermicularis* was reported in 40 cases (2.7%) out of a total of 1500 appendisectomized patients; this could be compared with some reported literature of 1549 appendectomies with 1.4% specimens containing *E. vermicularis*. It can also be compared with other published data [2] where parasites were present in 62 (7.46%) cases out of a total of 830 appendectomy specimens. Nevertheless, in the literature review of appendiceal *Enterobiasis* infections, it represented about 4.5% in appendectomies [16–21].

The cause of acute appendicitis is generally considered to be an obstruction at the base of the appendix. An appendix affected by *Schistosomiasis* shows considerable fibrosis, which may have led to the obstruction [22].

*Schistosomas* were seen in 1.5% of our studied specimens; this coincides with some published data that showed the percentage of *Schistosomal* appendicitis to be 1.6% [23]. It has been recorded to be only 0.2% in Hong Kong [24]. Others reported percentages of *Schistosomal* appendicitis recorded as 2.3 and 1.3%, respectively [25,26].

A percentage of 1.0 and 0.9% for *A. lumbricoides* and *T. trichiura* were respectively recorded. This can be compared with previous data of Dorfman *et al.* [16] which showed a similar percentage of 1.1%.

Except for *Taenia saginata*, the prevalence rate of parasitic infections is significantly higher among the normal appendix than in the Appendicitis group for every single species and for total infestation ($P < 0.01$). Prevalence of *T. trichiura* was still higher among the normal group with border-line significance (Table 3).

Laparoscopy was initiated to diagnose 43 (2.9%) patients with persistent abdominal pain out of a total of 113 who underwent laparoscopic procedures. It showed free pin worms in three patients and also free *Ascaris* in the abdominal cavity in one patient.

Moreover, laparotomy showed free pin worms in the peritoneal cavity due to appendiceal perforation in one patient. These data coincide with a literature report of three cases in which pin worms were set free into the abdominal cavity during laparoscopic appendectomy [27]. It has been recommended that surgeons should exercise caution when performing laparoscopic appendectomy, using the endoloop technique to ensure that the pin worms are not released into the peritoneum upon amputation of the appendix [3–28].

Parasitic infection of the appendix was found to be associated with acute appendicitis or even ruptured

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appendicitis, especially in cases of Enterobius and Ascaris infestation. These parasitic infections, however, have also been found in symptom-free patients. Although our patients did not receive any antiparasitic treatment during their hospital stay, it is imperative that patients with parasitic infections receive the appropriate antiparasitic treatment before being discharged from the hospital, because an appendectomy treats a consequence and not the root cause of the disease. Parasitic infection was found in patients with appendicitis, and yet, it does not prove that it caused the disease. However, a larger group of parasites may cause appendicitis as shown by the histological changes in the resected specimens. The presence of pin worms may be an incidental finding, as they may cause symptoms mimicking appendicitis as reported in other studies [3].

## Conclusion

In conclusion, intestinal parasitic infection may not be considered as a risk factor for the development of acute appendicitis among the studied patients, and the low percentage of parasites among the appendectomy specimens (6.5%) does not support the notion that parasites are a major cause of appendicitis in pediatric patients. However, the diagnosis of parasitic infections should be considered in any child with a right lower quadrant pain that is suspected to be appendicitis, especially in developing countries with limited resources. In these situations, a stool analysis should be performed as part of the routine investigatory tools.

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### Conflicts of interest

There are no conflicts of interest.

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