

RELATIONSHIP BETWEEN *ENTEROBIUS VERMICULARIS* AND THE INCIDENCE OF ACUTE APPENDICITIS

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Abstract. The objective of this study was to evaluate the relationship between *Enterobius vermicularis* and the occurrence of acute appendicitis. Over a ten year period of time, all appendix specimens received by the department of pathology were reviewed for pathologic changes and the existence of *E. vermicularis*. Logistic regression was carried out to determine the odds ratio (OR) of the relationship between *E. vermicularis* and acute appendicitis. A total of 5,048 specimens were reviewed. *E. vermicularis* was found in 144 (2.9%) cases. After separating by sex and adjusting for age logistic regression analysis showed the OR of *E. vermicularis* appendiceal infestation was 1.275 (95%CI=0.42-3.9) for males and 1.678 (95%CI=0.61-4.65) for females. Age was an independent risk factor for acute appendicitis in males (OR=1.01, 95%CI=1.003-1.017) and females (OR=1.012, 95%CI=1.005-1.02).

INTRODUCTION

Human infestation with *Enterobius vermicularis* has been recognized for thousands of years (Fry and Moore, 1969). It is a nematode found in the environment. The prevalence of infestation in our district area (Kerman Province, Iran) in children was 15.6% (Kalantari *et al*, 1995). The terminal ileum, cecum and vermiform appendix are the common sites where mature worms live and reproduce (Symmers, 1950). The presence of the parasite in the appendix was first reported by Fabrius in 1634 (Fry and Moore, 1969). *E. vermicularis* is most commonly found in the lumen of the appendix (Sinniah *et al*, 1991). The role of parasitic infection in the etiology of acute appendicitis has been discussed for more than 100 years (Yildirim *et al*, 2005). In various reports, the association between *E.*

vermicularis infestation and acute appendicitis varies from 0.2-41.8% worldwide (Arca *et al*, 2004). *E. vermicularis* can cause symptoms resembling true appendicitis (Bredesen *et al*, 1988). Despite this fact, there is still controversy as to whether the parasites may cause appendicitis or not (Ajao *et al*, 1997). Our present study was an attempt to contribute to a better understanding of the relationship between *E. vermicularis* infestation and the incidence of appendicitis.

MATERIALS AND METHODS

Over a 10 year period, from 1993 to 2003, all the appendix specimens delivered to the department of pathology at the two teaching hospitals of Kerman medical school were evaluated. The appendices were preserved in 10% formalin then sectioned transversely and two longitudinal slices were evaluated. Each section was stained with hematoxylin and eosin and examined for inflammatory changes and the presence of *Enterobius vermicularis*. The grade of inflammation included: 1) normal tissue without any pathologic changes; 2)

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acute appendicitis; 3) exudative (suppurative) appendicitis; 4) gangrenous appendicitis; and 5) perforated appendicitis (Rosai, 2004). All blocks were reviewed by two pathologists. The reports were grouped by pathologic features: 1) normal appendix, and 2) acute inflammatory changes. The age, sex, signs and symptoms, and date of surgery for each patient were obtained from the hospital records. The information was analyzed using SPSS-12 software. Pearson's chi-square test was chosen as the primary test for comparing differences between patient groups. Student's *t*-test compared the mean age of patients between two groups, infested and non-infested. Logistical regression was used to obtain the odds ratio for *E. vermicularis* infestation and acute appendicitis. Analysis was performed by genders and adjusted for age by logistic regression. A p-value less than 0.05 was considered significant.

RESULTS

A total of 5,048 appendices were reviewed by the department of pathology. Table 1 shows the characteristics of patients who underwent appendectomy. *E. vermicularis* was found in 144 (2.9%) cases. In the cases of clinical appendicitis and *E. vermicularis* infection, the mean age of patients in the infested group was lower than the non-infested group (25±13.2 vs 20.4±11.7, p<0.0001). There was a relationship between the presence of *E. vermicularis* and sex, appendix pathology and season of operation (Table 2). It is important to note that *E. vermicularis* was not associated with mucosal invasion or granuloma formation. In addition, the relationship between sex and age distribution of appendix pathology was significant.

The mean age of those without infestation was lower than in the inflamed cases (23.8±13 vs 25.4±13.3, p<0.0001). The male:female ratio was 705:958 in the group with normal appendices and 2,032:1,353 in

Table 1
The characteristics of samples.

Variable	Frequency	Percent
Sex		
Male	2,737	54.2
Female	2,311	45.8
Age ^a	mean±SD	24.8±13.2 ^a
Season		
Spring	1,249	24.7
Summer	1,149	22.8
Autumn	1,224	24.2
Winter	1,426	28.2
Pathology		
Normal	1,663	32.9
Acute	1,465	29.1
Exudative	1,475	29.2
Gangrenous	360	7.1
Perforated	85	1.7

^aMean±SD

the patients with acute inflammation ($\chi^2=139.736, p<0.0001$).

As shown, sex and age were significant factors associated with *E. vermicularis* infestation and appendix pathology. Logistic regression by sex was performed. On multivariate analysis adjusting for age, appendix infestation with *E. vermicularis* was not a significant risk factor for the incidence of acute appendicitis (Table 3).

DISCUSSION

Enterobius vermicularis was identified in 2.9% of appendices from patients with clinical appendicitis in our study. The prevalence of *E. vermicularis* in children under age 14 years has been reported as 0.9% (Agarwala and Liu, 2003), 1.4% (Arca *et al*, 2004), 1.5% (Williams and Dixon, 1988), 2.7% (Budd and Armstrong, 1987), 3.14% (Sterba *et al*, 1985), 3.4% (Dahlstrom and Macarthur, 1994), 3.8% (Yildirim *et al*, 2005), 4.1% (Wiebe, 1991), 6.03% (Sterba and Vlcek, 1984), and 12.5% (Bredesen *et al*, 1988).

Table 2
Sex, season and pathology distribution of *E. vermicularis*.

		Absence	Presence	χ^2	p
Sex	Male	2,675	62	7.443	0.006
	Female	2,229	82		
Season	Spring	1,119	50	12.988	0.005
	Summer	1,111	38		
	Autumn	1,194	30		
	Winter	1,400	26		
Pathology	Normal	1,595	68	13.68	<0.0001
	Acute inflammation	3,309	76		

Table 3
Odds ratio of factors associated with acute appendicitis in logistic regression.

	OR	95% CI	p
Male			
<i>E. vermicularis</i>	1.275	0.42 - 3.9	0.671
Age	1.01	1.003 - 1.017	0.007
Age* <i>E. vermicularis</i>	0.95	0.91 - 0.99	0.03
Female			
<i>E. vermicularis</i>	1.678	0.61 - 4.65	0.313
Age	1.012	1.005 - 1.02	0.001
Age* <i>E. vermicularis</i>	0.958	0.91 - 1.003	0.07

There was a significant difference in the incidence of *Enterobius vermicularis* in males and females; females had a higher rate of infestation. The mean age of the infested group was significantly lower than the non-infested group. Infestation was more frequent in females than in males in other studies (Sterba and Vlcek, 1984; Sterba *et al*, 1985; Budd and Armstrong, 1987; Bredesen *et al*, 1988; Wiebe, 1991; Dahlstrom and Macarthur, 1994). Bredesen *et al* (1988) reported that the infestation occurred in lower ages, especially in the pediatric age group. Our findings showed a highly significant difference in the incidence of *Enterobius vermicularis* in normal appendices and in inflamed appendices. Wiebe (1991) believe this may indicate that 1) the presence of *E. vermicularis* in the appendix can give the symptoms of acute appendi-

titis, or 2) *E. vermicularis* leaves or does not enter an inflamed appendix.

Upon first analysis without separation by sex and adjustment for age, it seemed that *Enterobius* infestation of the appendix is a protective factor for acute inflammation. But after usage of multivariate analysis and application of logistic regression, it was determined that age is a risk factor for appendicitis and it has an interaction with *Enterobius* infestation in both sexes. Infestation with pinworm had and Odds Ratio over 1 but this was not significant (Table 3). We conclude that parasites in the appendix may produce symptoms which resemble acute appendicitis, but parasitic infection rarely causes acute appendicitis; these are similar to other study findings (Dahlstrom and Macarthur, 1994; Arca *et al*, 2004; Yildirim *et al*, 2005). *Enterobius* is not directly involved

in the inflammatory process, but its presence evokes irritation.

It has been shown that *Enterobius vermicularis* is more common in temperate and cold climates than in the tropics (Dahlstrom and Macarthur, 1994). There was statistically significant seasonal variability of *E. vermicularis* in appendices in this study. The presence of *E. vermicularis* in the appendix may be related in the first instance to an appendiceal syndrome with pain in iliac fossa. Although appendectomy is clinically justified in these cases, the appendix appears histologically normal (Budd and Armstrong, 1987). In conclusion, *Enterobius vermicularis* was more often associated with normal than inflamed appendices, and therefore it seems unlikely that this parasite causes acute appendicitis. However, *Enterobius vermicularis* may cause symptoms resembling appendicitis.

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