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Incidences of Acute Appendicitis Caused by Various Parasites within Kirkuk Province, Iraq

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ABSTRACT

Objective: *Acute appendicitis (AA) may initiate due to various agents including bacteria, parasites, mainly Enterobius vermicularis and others meanwhile studies on its etiology are so rare in Iraq.* ***Method:*** *This research involves 50 specimen undergone appendectomies presented with clinical symptoms of AA investigated for various parasites.* ***Results:*** *Four different parasites with various proportions were detected in the 50 appendectomies patients. Almost 27(54%) of cases were diagnosed negative or non-parasitic infection while only 23(46%) were diagnosed infected with various parasites e.g. Entamoeba histolytica, with highest prevalence 12(24%); followed by Enterobius vermicularis with 8(16%); Blantidium coli 2(4%) and finally Ascaris lumbricus 1(2%).* ***Novelty:*** *The percentage of infection by E. vermicularis denotes the highest international record as the main cause of acute appendicitis worldwide which might be interpreted as a most pandemic parasite in poor food hygiene conditions in Iraq. Appendicitis displayed almost no impact on blood parameters. Extra parameters should be adopted to monitor the hygiene of Iraqi local restaurants or takeaways serve the exposed food for public consumption.*

INTRODUCTION

While Charles Darwin, in his days, denied any role of the appendix in the body -the idea supported by the fact a person can live perfectly well without an appendix- the exact function of the appendix has never been clear meanwhile the debate continues[1]. Other scientists have confirmed its numerous vital functions and active role e.g. an alarm for any infection or disturbance of flora of gut bacteria or invasion by any other microbes i.e. parasites or viruses [2][3]. The main significant role of appendix in immune system can never be denied as a vital primary immune organ in health. Appendix serves as a haven for beneficial bacteria when diarrheal diseases like dysentery or cholera flush the intestines or when antibiotic drugs kill friendly "good" bacteria along with the pathogenic or "bad"[4]. Moreover, the appendix contains a higher number of immune cells (β-lymphocytes and T-lymphocytes). It is theorized that the appendix may play a role in preventing early diseases in the large intestine [5]. Appendicitis is the most common abdominal emergency and causes, annually over 40,000 admissions to hospital in the UK. Appendicitis is most common between the ages of 10-20 years, though there is no exception age. There also is a male majority, with a male-to-female ratio of 1.4:1[6]. Acute appendicitis is a common reason for abdominal surgery in children, but its etiology remains largely unknown.

Most cases of appendicitis are due to obstruction the appendix lumen or cavity, as a consequence of hardening and calcification of fecal matter or/and due to swelling of

the mucous tissue, the presence of stones, infection with parasites and foreign bodies[7]. Parasites cause blockage of the appendix cavity either by infecting its tissue with the parasite leading to the formation of scars in the spot of infection leading to penetration and ulcers in epithelial tissue develops further down to damage underneath tissue causing severe pains[2]. In terms of the parasites i.e. *Enterobius vermicularis*, *Entamoeba histolytica, Ascaris lumbricoides* and *Schistosomiasis* blockage may occur as a result of the worms gathering and blocking the opening of the appendix[8].

Intestinal parasite *Enterobius vermicularis*, the pinworm, is one of the most common helminth infections spread worldwide attacks mostly children at ages ranged between 1-16 years old causing acute appendicitis[9]. While often considered tropical, parasitic diseases are now seen more frequently in developed countries because of immigration and increased world travel. Most symptoms are minor i.e. "pruritus ani" and restless sleeping. People of every socioeconomic group may acquire pinworm infection and it remains quite prevalent at present. The exact role of the parasite in AA is controversial as the resected specimens show no evidence of histological inflammation[10]. The simple presence of *E. vermicularis* in the appendix usually produces symptoms which resemble AA although the mechanism does not involve mucosal invasion by the parasite[11]. More cases studied about the enterobiasis of the appendix presented with clinical features of AA where the parasitic infection of the appendix had caused by *Enterobius vermicularis.* The latter reprsents the commonest worm found in the appendix, where the infection invloved pathologic changes ranged from lymphoid hyperplasia to acute phlegmonous inflammation with life-threatening complications like gangrene and peritonitis[12]. Adult female pinworms live in the lower right quadrate portion of the intestinal tract, females often lay their eggs on the surface of the fecal mass or on the anal skin folds. As a result, the eggs are not well mixed within the feces and usually will not be detected in routine stool examinations. The latter may lead to detection of the eggs or during examination of fecal specimens which leads to misdiagnosis.

Justification: Due to scanty information about parasitic infections, as a cause of acute appendicitis in Iraq, particularly, within Kirkuk Governorate in particular, this research was designed to investigate the incidence of appendicitis and to identify the extent of parasite types in the appendices.

RESEARCH METHOD

This study investigates the types and prevalence of intestinal parasites in 50 cases undergone appendectomy at both Kirkuk General Hospital and Azdi Teaching Hospital for the period of 4 months (January 2024 to April 2024). The NIH swab, cellophane swab and scotch tape swab methods were used to collect the eggs from the perianal skin and for collection of specimens consists of a glass rod at one end of which a piece of transparent cellophane is attached with a rubber band[13]. The glass rod is fixed on a rubber stopper and kept in a wide test tube. The cellophane part is used for swabbing by rolling over the perianal area, returned to the test tube and sent to the laboratory, where the cellophane piece is separated, spread over a glass side and examined microscopically.

Alternatively, the adults were sought in stool or toilet paper, though the ova and larvae are rarely present in either the stool or urine. The age range of the patients was from 5-50 years old all had suffered from acute appendicitis (AA). Diagnosis of pinworm infection is usually based on the recovery of typical eggs by means of the transparent cellophane (Scotch) tape preparation[14]. After the preparation of stool specimens, where the fecal samples prepared using the iodine-stained direct smear method, the parasites visualization and counting were performed and analyzed under light microscopy (Leica Micro-systems) using an oil immersion objective (1,000x magnification). Specimens were collected over a 4-month period (January-April 2024), in both Kirkuk Republican General Hospital and Azadi for ages ranged 4-50 years and above. Different types of parasites were found.

RESULTS AND DISCUSSION

Results

Out of a total of 50 samples of acute appendicitis (AA) involved almost 87.5% of the patients from rural areas and only 12.5% were from urban. A proportion of 54% were diagnosed negative or non-specific parasitic infection while 46% were infected positive with various parasites. Symptoms ranged between constant severe pain in Lower Right Quadrant Abdomen (LRQA), severe itching in the anal areas, loss of appetite with constipation, intermittent nausea and frequent vomiting without fever, fatigue or/and dizziness without fever.

Only 4 different types of intestinal adault parasites were identified as the cause of acute appendicitis amongst the 23 patients diagnosed infected; with the highest infection represnted by *Entamoeba histoltica* 12(24%), causing dysentry followed by pinworms, *E. vermicularis,* with 8(16%); *B. coli* 2(4%) *and Ascaris lumbricus* (1(2%). Additionally, parasitic infection with other parasites e.g. *Amoeba dysentery* and *Amoeba coli* had, in some cases, appeared in vegetative phase while the cyst phase appeared in others (Table-1).

Table 1. Prevalence of different appendicial parasites of a total of 23/50 cases of infection studeid in Kirkuk province.

	The appendicial parasites	**Percentage of infection (%)**
1.	*Entamoeba histolytica*	12(24%)
2.	*Enterobius vermicularis*	8(16%)
3.	*Balantidium coli*	2(4%)
4.	*Ascaris lumbricus*	1(2%)
5.	*Amoeba dysentery*	Vegetative
6.	*Amoeba coli*	Vegitative

A significant differences ($p \leq 0.05$) in appendicitis was detected between male and female cases as the females were twice more susciptable (20%) than men (10%) for infection by parasites, hence, appendicitis. Age-wise, the parasite *Enterobius vermicularis* had the highest impact in causing appendicitis in young patients (<10 years old) and

gradually decreased in older ages; while *Entameoba histolotica* found with higher proportion in older ages in comparison with the former parasite. However, the parasites *Balantidum coli* and *Ascaris lumbaricus* were found rarer and made only 1 case (2%) in patients with age ranged between 20-30 years old, respectively (Table-2).

The complete blood counting (CBC) analysis involves another direct diagnostic method prior appendectomy. The arithmetic mean counts of leucocytes (WBC±SD) in blood of patients infected with *E. Histolytica,* (18,080±3100x10^9) was significantly higher than those of *E. vermicularis* (15,300±1,250x10^9) μL. The significant general elevation of WBC counts in *E. histolytica* is higher than *E. vermicularis* in causing appendicitis in all ages above 10 years old.

Table 2. The prevalence rates of parasites causing appendicitis out of 50 cases while WBC counts reflect the diagnostic sign of infection.

Parasite	WBCx10^9±SD/μL	≤10 year	10-30 year	≥ 30 year
Entameoba histologica	18,080±3100	2(4%)	4(8%)	6(%)
Enterobius vermicularis	15,300±1250	4(8%)	3(6%)	1(2%)
Balantidum coli	4,190±650	0(0%)	1(2%)	1(2%)
Ascaris lumbricus	9.5±580	0(0%)	1(2%)	0(0%)
Total number	23	6(12%)	9(18%)	8(16%)

Discussion

One of the most common diseases that affect human health may be appendicitis that causes a sudden inflammation or enlargement of the appendix. Appendicitis occur as a result of parasitic, bacterial, viral or food infections[15]. Despite the development of diagnostic technology with many common symptoms of appendicitis; however, appendectomy remains at the top of the list of emergency operation in hospitals round the world. Generally, in appendicitis, an accurate diagnosis may deem difficult due to overlapping symptoms, signs and exact causes of the disease with other health conditions[16]. Some of those who undergo appendectomy operations had their appendices free of inflammation, according to the histological diagnosis of the appendages excised[2][17]. Hence, the exact cause(s) of appendicitis sustain difficult to determine while the severe LRQA pain remains predominate. However, the likelihood of pathophysiology of appendicitis, in general, stems from obstruction of the appendiceal orifice while the cause of obstruction may vary between different age groups with other causes. Hence, the etiology of appendicitis may be multifactorial due to involvement of many other causes in AA. Increase in WBC counts detected from CBC analysis refers that the latter blood analysis deems necessary to be carry out to as an extra test to confirm the appendicitis status prior appendectomy.

The presence of parasites in the appendix may cause appendiceal colic even without eliciting an acute inflammation which is explained by the hypothesis of appendiceal lumen obstruction[3]. The parasitic infection can cause pathologic changes range from lymphoid hyperplasia to acute phlegmonous inflammation with life-threatening

complications like gangrene and peritonitis[17]. The symptoms of AA may extend from lymphatic hyperplasia which leads to inflammation, local ischemia, perforation, and the development of a contained abscess or frank perforation with resulting peritonitis. The blockage of the appendix may also lead to swollen lymph nodes, parasitic infections, stool, or benign or malignant tumors[1]. The latter would cause appendicitis, where it leads to an increase in intraluminal and intramural pressure, leading to occlusion of small blood vessels and lymphatic stasis detected in appendix sections[3]. Once blocked the appendix lead to fill it with mucus and becomes distended. Next, as lymphatic and vascular compromise progresses, the appendix wall becomes necrotic causing extreme pains. Both aerobic and anaerobic bacterial overgrowth occurs in the obstructed appendix, in early appendicitis in the course i.e. *Escherichia coli, Streptococcus aureus, Bacteroides, and Pseudomonas*[19]. Once significant inflammation and necrosis have occurred, the appendix is at risk of perforation, leading to local abscess and sometimes frank peritonitis[2]. Hence, appendectomy remains the only medical decisive and definitive solution to stop severe pain in the patients while other remedy solution remains, yet, open.

The highest parasitic infection of children in rural areas in comparison with urban refers to the poorer environmental condition i.e. agricultural workers where they expose to the parasite found in the soil is greater than those who live in cities, where most of them are employees.

In the present work, the *Entamoeba histolytica* has been detected at a percentage of 14% cases. The *E. histolytica* is a common parasite and has a broad clinical spectrum from an asymptomatic disease to a life-threatening condition. In rare occasions, trophozoites can invade the appendiceal wall causing appendicitis. Incidence of *E. hystolotica* in stool at post appendectomy is found to be rare in Iraq. Through the statistics we conducted, it became clear to us that all people with entropion and *Entamoeba histolytica* had high WBC numbers, while it was noted that in people with *Balantidium coli*, there was no noticeable increase in WBC. This may be interpreted as *E. hystoltica* may cause more risk to the GIT than *B. coli,* although such a conclusion may not exactly be reliable 100% due to a small sample size and the lack of complete statistics to be followed up by the hospital on this matter.

Similar clinical manifestations of appendiceal pinworms in children investigated suggested presence of *Enterobius vermicularis* infestations with acute appendicitis, ruptured appendicitis, or with no significant clinical symptoms in children[21]. Another case study of a 15 yeras old female demonstrated the correlation of *Enterobius Vermicularis* infection in causing AA associated by producing its symptoms illustrated the association of this parasitic infestation with AA varied from 0.2%-41.8% worldwide[22]. The prevalence *Enterobius vermicularis* has been the maximum in school children between the age of 5-14 years[20]. There also was a highly significant difference in the incidence of *Enterobius vermicularis* in normal appendices and in inflamed[15]. There are many indicate that the presence of this parasite in the appendix can give the symptoms of acute appendicitis.

Humans are the only natural host of *Enterobius vermicularis*[23]. In the present work the incidence of AA in *Enterobius Vermicularis* was (16%) less than a most recent study that reached to 41% recorded in children that transmitted via the faecal-oral route[24]. The etiology for such high incidence of infection in female was not evidence at that time. However, it might be interpreted as if it was due to the skeletal appearance. This hypothesis was based on the principle of the worm's life cycle, which includes night migration, where the worm remains on its way and moves to the vagina of females, causing infection. This difference in proportions in the present work may be a result of the lack of time, the small size of the samples collected, and the lack of facilities provided by the hospitals with which we co-operated with. Due to geographical and environmental difference a rather broader investigation are due to expand prevalence and surveillance relevant to epidemiological aspects of *E. vermicularis* for appendicitis.

Furthermore, the surgical manifestations of abdominal ascariasis are varied and are attributed to the wandering nature of *Ascaris lumbricoides*. The pre-operative diagnosis of this condition continues to remain difficult, although the parasite can sometimes be observed inside the lumen during micro-pathological examination[25]. Appendicitis due to the migration of *Ascaris lumbrocoides* into the appendix is still debatable because the symptoms of this migration may simulate appendicitis, but rarely cause it[26]. The hypothesis that *Ascaris lumbricoides* is a major cause of appendicitis in children has been disproved[27]. This result may be in agreement with a low proportion of Ascaris lumbricoids in the present study.

CONCLUSION

Fundamental Finding : The parasite *E. vermicularis* deems one of the common infectious agents in causing acute appendicitis in Iraq while the socioeconomic conditions might have additional effects on its prevalence to confirm the impact of some parasites as a main etiology of appendicitis. **Implication :** This finding highlights the importance of re-considering the neglected role of parasites in some clinical cases such as appendicitis. **Limitation :** Incorporation of other diagnostic methods for intestinal parasitic infection might be better for confirmation i.e. stool and Scotch adhesive tape examination for intestinal parasites, especially for helminths. **Future Research :** Future studies are encouraged to employ complementary diagnostic approaches to verify parasitic involvement in appendicitis and to explore the socioeconomic factors influencing its prevalence.

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