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Comparison of Clinical Findings of Acute Appendicitis and Mesenteric Lymphadenitis in Children with Acute Abdominal Pain

A. Asadi Amoli [1], S. Mehrabani (MD)[*2], M. Esmaeili Dooki (MD)[2], M. Nikpour (PhD)[2], A. Hadipour (MD)[2], M. Pournasrollah (MD)[3], M. Mohammadi (MD)[2]

1.Student Research Committee, Babol University of Medical Sciences, Babol, I.R.Iran.

2.Non-Communicable Pediatric Diseases Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran.

3.Clinical Research Development Unit of Amirkola Children's Hospital, Babol University of Medical Sciences, Babol, I.R.Iran.

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ABSTRACT

Background and Objective: Mesenteric lymphadenitis is an inflammatory process that has similar clinical symptoms to appendicitis among diseases associated with acute abdominal pain. Therefore, the aim of this study was to compare clinical and paraclinical findings in children with appendicitis and mesenteric lymphadenitis.

Methods: This cross-sectional study was conducted on 214 children who were admitted to Amirkola Children's Hospital in 2011-2021 with the diagnosis of appendicitis (112 people) or mesenteric lymphadenitis (102 people). Appendicitis and mesenteric lymphadenitis were diagnosed based on pathology and ultrasound, clinical symptoms, laboratory parameters and ultrasound of children were compared in two groups.

Findings: Out of 214 children, 112 (52.15%) were girls and the mean age of the children was 7.53±3.19 years. Children with appendicitis compared to children with mesenteric lymphadenitis were more likely to have tenderness (42.2% vs 85.7%, p<0.001), rebound tenderness (40.2% vs 4.9%, p<0.001), vomiting (79.5% vs 61.8%, p=0.004) and pain shift (11.8% vs 25%, p<0.013). Also, WBC (9774.51±3971.35 vs 15358.04±4635.20, p<0.001), neutrophil (63.42±17.05 vs 77.02 ± 10.51, p<0.001), ESR (19.73±18.56 vs 38.57±27.29, p<0.001) and CRP (18.00±27.98 vs 52.77±40.30, p<0.001) were significantly higher in children with appendicitis. Ultrasound sensitivity (0.73-0.88) was 80.4% in diagnosing appendicitis and rejected mesenteric lymphadenitis with 100% probability.

Conclusion: The results of the study showed that some clinical symptoms with leukocytosis, neutrophilia and high CRP can help differentiate appendicitis from mesenteric lymphadenitis. But ultrasound can have a more definitive result in this regard.

Keywords: *Appendicitis, Mesenteric Lymphadenitis, Ultrasound, Abdominal Pain*.

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[*]Corresponding Author: S. Mehrabani (MD)
Address: Non-Communicable Pediatric Diseases Research Center, Amirkola Children's Hospital, Babol, I.R.Iran.
Tel: +98 (11) 32346963. **E-mail:** mehrabanisanaz@yahoo.com

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Introduction

Abdominal pain is a very common complaint that causes patients to visit the emergency department, and it accounts for approximately 5-10% of emergency department visits (1). This statistic is reported to be about 9% in children (2). Right Lower Quadrant Pain (RLQP) constitutes a significant part of this population. Acute appendicitis is the most common cause of RLQP, and patients with this problem have to go to the operating room (3). However, apart from acute appendicitis, there is a wide variety of disease processes in the abdomen and pelvis that can have presentations similar to acute appendicitis with RLQP (4). Since the mesenteric lymph nodes are usually located in the right lower quadrant, inflammation of these lymph nodes can produce a clinical picture similar to appendicitis, except that the pain caused by mesenteric lymphadenitis is more diffuse (5).

Mesenteric lymphadenitis is a primary or secondary inflammatory process (6) that has a self-limiting course (7) and among the diseases associated with acute abdominal pain, it has more similar clinical symptoms to acute appendicitis, which shows the importance of the need to differentiate between the two diseases (7, 8). The most common gastrointestinal symptoms common between mesenteric lymphadenitis and appendicitis include acute abdominal pain, nausea and vomiting, fever, and diarrhea (9). The benefits of differentiating between mesenteric lymphadenitis and acute appendicitis include increasing the patient's quality of life in the future, reducing the risk of wrong appendectomy, reducing the rate of perforation of the appendix, shortening the hospitalization period, accelerating the recovery period, and reducing surgical complications (10).

So far, few studies around the world have compared clinical and paraclinical findings between these two diseases. Due to the lack of studies on mesenteric lymphadenitis and the importance of differentiating it from acute appendicitis and reducing unnecessary laparotomies in children, the present study was conducted with the aim of comparing the results of tests and its role in differentiating these two diseases along with clinical symptoms and radiological imaging.

Methods

This cross-sectional study was approved by the ethics committee of Babol University of Medical Sciences with the code IR.MUBABOL.HRI.REC.1400.038 and was conducted on children referred to Amirkola Children's Hospital in 2011-2021 who were admitted with the diagnosis of acute appendicitis and mesenteric lymphadenitis. Sampling method was carried out in the form of a census from the files of hospitalized patients during the study period and according to the inclusion criteria. Inclusion criteria included children aged 3 to 18 years, history of first hospitalization with a diagnosis of acute appendicitis or mesenteric lymphadenitis in a children's hospital, and the absence of chronic disease in children. Exclusion criteria included defects in patient file information and repeated hospitalization with the diagnosis of mesenteric lymphadenitis.

The data were collected by a medical student from the files of children hospitalized in Amirkola Children's Hospital during a 10-year period from March 2011 to February 2021, who were referred to the hospital with acute abdominal complaints and were diagnosed with acute appendicitis and mesenteric lymphadenitis. All children referred to the hospital with acute abdominal pain were visited by pediatric gastroenterology specialist and their clinical symptoms, laboratory parameters and ultrasound were checked. Then, according to the specialist’s diagnosis and clinical and paraclinical results, the diagnosis of appendicitis or mesenteric lymphadenitis was approved. If the presence of at least 3 lymph nodes with a

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short axis length of more than 5 mm was detected in ultrasound, children were diagnosed with mesenteric lymphadenitis (11). Children who underwent laparotomy with the suspicion of acute appendicitis and their appendicitis pathology results were positive for appendicitis were included in the group of children with appendicitis.

Children's clinical symptoms including tenderness, rebound tenderness, fever, nausea, vomiting, diarrhea, cough, rhinorrhea, anorexia and abdominal pain were evaluated. In the ultrasound, the number of lymph nodes and their locations were recorded. Ultrasound was performed with the same ultrasound device (Ultrasonix Sonix SP) and calibrated by a radiologist at the Children's Hospital. To evaluate laboratory parameters, 5 cc of blood was collected from all children and ESR, CRP, RBC WBC, platelet, hemoglobin, lymphocyte and neutrophil were measured. The tests were performed at Amirkola Children's Hospital.

Data were analyzed using SPSS software (Version 22.0, Chicago, IL, USA) and using descriptive and analytical indices. Chi-square and t-tests were used to evaluate the differences in clinical and paraclinical symptoms between the two study groups (appendicitis and mesenteric lymphadenitis). In addition, the sensitivity and specificity of ultrasound in the diagnosis of appendicitis and mesenteric lymphadenitis were also calculated and $p<0.05$ was considered significant.

Results

A total of 214 children who visited Amirkola Children's Hospital during the study period were included in the study, of which 112 (52.3%) had appendicitis and 102 (47.7%) had mesenteric lymphadenitis. The mean age and weight of the studied children were 7.53±3.19 years and 26.94±12.49 kg, respectively. Children with mesenteric lymphadenitis compared to children with appendicitis had significantly lower age (6.75±3.44 vs 8.31±2.95, $p=0.001$) and weight (24.75±11.34 vs 29.14±13.64, $p=0.014$). In addition, out of 214 children, 112 (52.15%) were girls and 102 (47.75%) were boys, but no statistically significant difference was found between the two groups in terms of gender.

The results of the study showed that in children with appendicitis, tenderness (42.2% vs 85.7%, $p<0.001$) and rebound tenderness (40.2% vs 4.9%, $p<0.001$) were significantly higher than children with mesenteric lymphadenitis. Furthermore, vomiting and pain shift in children with appendicitis were significantly higher than mesenteric lymphadenitis (vomiting: 79.5% vs 61.8%, $p=0.004$, pain shift: 11.8% vs 25%, $p<0.013$). However, no significant difference was found between the frequency of fever, nausea, diarrhea, cough, rhinorrhea, anorexia and abdominal pain between the two groups of children (Table 1).

Compared to children with mesenteric lymphadenitis, children with appendicitis had higher WBC (9774.51±3971.35 vs 15358.04±4635.20, $p<0.001$) and neutrophil percentage (63.42±17.05 vs 77.02±10.51, $p<0.001$) but lower percentage of lymphocytes (33.35±16.73 vs 19.16±9.98, $p<0.001$). In addition, ESR (19.73±18.56 vs 38.57±27.29, $p<0.001$) and CRP (18.00±27.98 vs 52.77±40.30, $p<0.001$) were higher in children with appendicitis. However, there was no significant difference between the two groups in the levels of platelets, hemoglobin, RBC and Urine WBC (Table 2).

The results of Table 3 show that abdominal ultrasound in children with mesenteric lymphadenitis can significantly detect the swelling of lymph nodes ($p\leq0.001$). On the other hand, ultrasound had a sensitivity of 80.4% with a 95% confidence interval (0.73-0.88) in diagnosing appendicitis and rejected mesenteric lymphadenitis with 100% probability.

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Table 1. Frequency of clinical symptoms in studied children diagnosed with appendicitis and mesenteric lymphadenitis

Clinical symptoms	Appendicitis Number(%)	Mesenteric lymphadenitis Number(%)	p-value
Tenderness			
Yes	96(85.7)	43(42.2)	<0.001
No	14(12.5)	59(57.8)	
Rebound tenderness			
Yes	45(40.2)	5(4.9)	<0.001
No	65(58.0)	97(95.1)	
Abdominal distension			
Yes	2(1.8)	2(2)	0.925
No	110(98.2)	100(98)	
Abdominal pain			
Periumbilical pain	43(38.4)	49(48.0)	0.115
RLQ	69(61.6)	51(52.0)	
No pain	91(81.3)	77(75.5)	
Fever			
Yes	62(55.4)	41(40.2)	0.065
No	50(44.6)	59(57.8)	
Nausea			
Yes	68(60.7)	50(51.0)	0.086
No	44(39.3)	52(49.0)	
Vomiting			
Yes	89(79.5)	63(61.8)	0.004
No	23(20.5)	39(38.2)	
Hematemesis			
Yes	1(0.09)	1(99.0)	0.947
No	111(99.1)	101(1.0)	
Vomiting bile			
Yes	3(2.7)	-	0.096
No	109(97.3)	102(100)	
Constipation			
Yes	6(5.4)	3(2.9)	0.379
No	106(94.6)	99(97.1)	
Diarrhea			
Yes	21(18.8)	25(24.5)	0.306
No	91(81.2)	77(75.5)	
Pain shift			
Yes	28(25.0)	12(11.8)	0.013
No	84(75.0)	90(88.2)	
Cough			
Yes	21(18.8)	20(19.6)	0.873
No	91(81.3)	82(80.4)	
Rhinorrhea			
Yes	18(16.1)	22(21.6)	0.303
No	94(83.9)	80(78.4)	
Anorexia			
Yes	69(61.6)	50(49.0)	0.064
No	43(38.4)	52(51.0)	
Cervical lymphadenopathy			
Yes	-	2(2.0)	0.137
No	112(100)	100(98.0)	

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Table 2. Comparison of laboratory parameters in children with appendicitis and mesenteric lymphadenitis

Group Laboratory parameter	Appendicitis Mean±SD	Mesenteric lymphadenitis Mean±SD	p-value
WBC	15358.04±4635.20	9774.51±3971.35	<0.001
Neutrophil	77.02±10.51	63.42±17.05	<0.001
Lymphocyte	19.16±9.98	33.35±16.73	<0.001
Platelet	300.23±94.99	289.39±98.39	0.415
Hemoglobin	11.93±1.52	11.57±1.17	0.052
RBC	4.59±0.57	4.57±0.53	0.726
ESR	38.57±27.29	19.73±18.56	<0.001
CRP	52.77±40.30	18.00±27.98	<0.001
Urine WBC	2.42±2.63	2.01±1.80	0.187

Table 3. Comparison of ultrasound findings in children with appendicitis and mesenteric lymphadenitis

	Appendicitis Number(%)	Mesenteric lymphadenitis Number(%)	p-value
Swollen lymph nodes			
Yes	32(28.5)	102(100)	<0.001
No	80(71.5)	-	
Presenting appendicitis			
Yes	90(80.4)	-	<0.001
No	22(19.6)	102(100)	

Discussion

The results of the study showed that compared to mesenteric lymphadenitis, children with appendicitis are more likely to experience symptoms such as tenderness, rebound tenderness, vomiting, and pain shift. Furthermore, WBC, ESR and CRP were significantly higher in children with appendicitis.

In the study of Gross et al., in line with our study, a significant difference was found in vomiting and pain shift between the two study groups (6), but contrary to the present study, anorexia was observed more in appendicitis compared to lymphadenitis, and a significant relationship between fever and lymphadenitis was observed compared to appendicitis. In a study by Zviedre, similar to our study, vomiting was higher in appendicitis subjects and no significant difference was observed in the incidence of rebound tenderness between appendicitis and mesenteric lymphadenitis (12). In the study of Toorenvliet et al., as in the present study, they observed a significant difference in rebound tenderness, vomiting, and pain shift (7), but unlike our study, nausea was more common in appendicitis. Researchers reported that the frequency of nausea in mesenteric lymphadenitis varies from 25 to 74% and vomiting from 25 to 48% (13, 14). Clinically, children with mesenteric lymphadenitis are symptomatic for a longer period of time before presentation and are likely to present with multiple manifestations and stay longer in the

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emergency department (6). The results of the present study and other studies show that there are many differences in the clinical symptoms of appendicitis and mesenteric lymphadenitis in different regions, which can be concluded that these two diseases cannot be differentiated by clinical symptoms alone.

Our findings showed that people with appendicitis have higher levels of leukocytosis, neutrophil, ESR and CRP compared to mesenteric lymphadenitis. In studies conducted by Gross et al. (6) and Toorenvliet et al. (7), similar to our study, WBC, neutrophil and CRP were higher in appendicitis patients. In a study conducted by Özdamar et al., it was observed that patients with appendicitis have the same total WBC count and CRP values as lymphadenitis patients (9), which is contrary to our findings. The significance of high number of white blood cells and the increase in CRP has already been shown in the diagnosis of acute appendicitis (15, 16). In addition, similar to the study of Gross et al. (6), we showed that in a patient with appendicitis manifestations, the presence of lymphocytosis is detrimental to the diagnosis of appendicitis and more in favor of mesenteric lymphadenitis. On the other hand, previous studies have shown the usefulness of the ratio of neutrophils to the number of lymphocytes in the diagnosis of acute appendicitis (17, 18).

Our findings showed that about 80% of appendicitis cases were correctly diagnosed by ultrasound. The use of graded compression ultrasound in the diagnosis of appendicitis was first described by Puylaert in 1986 and is now recognized as a first-line tool to aid in the diagnosis of appendicitis in children (19, 20). In a meta-analysis conducted by Fu et al., they evaluated the sensitivity and specificity of ultrasound to diagnose appendicitis as 77.2 and 60%, respectively (21). On the other hand, another meta-analysis conducted by Orr et al. evaluated the sensitivity and specificity of ultrasound as 84.7% and 92.1%, respectively (22). The sonographer's skill can be considered as the reason for the diversity in sensitivity and specificity in different studies. On the other hand, the present study showed that 100% of mesenteric lymphadenitis cases were correctly diagnosed by ultrasound. Toorenvliet et al. observed that radiological evaluation has a more reliable diagnostic function than clinical examination and laboratory findings for differentiating appendicitis from mesenteric lymphadenitis, reporting positive predictive value and negative predictive value of 0.96 and 0.96, respectively (7). This shows that the diagnosis of mesenteric lymphadenitis can be correctly confirmed or rejected by ultrasound in children, but more studies are needed for better conclusions.

Our findings showed that patients with appendicitis have a higher mean age compared to patients with mesenteric lymphadenitis. Similar to our finding, Toorenvliet et al. also observed that patients with appendicitis had a higher mean age (7). On the other hand, no significant difference in the age of patients was observed in other studies (6, 9, 12). The reason for the observed diversity is not clear, but it can be attributed to the sampling method or the study populations. In a study conducted by Rouzrokh et al., the mean age of patients was 7.9±2.9 years (23). In our study, as in similar studies, there was no significant difference in gender between appendicitis and lymphadenitis patients (6, 7, 12).

This study has several limitations. The first limitation is the retrospective nature of the study, which in case of reading patient files, there is a possibility for incomplete data. The next limitation is related to the sample size of patients, and with a higher sample size, more accurate results can be obtained.

The findings of the present study showed that despite the similarities between appendicitis and mesenteric lymphadenitis, clinical and laboratory features such as tenderness, rebound tenderness, vomiting, anorexia, leukocytosis and neutrophilia can contribute to correct diagnosis. However, the best way to differentiate these two diseases in the first step is to use ultrasound.

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