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Comparative Evaluation of the Clinical and Paraclinical Diagnosis in Patients with Acute Appendicitis

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ABSTRACT

Aims Acute appendicitis is the most common emergency surgery; thus, its diagnosis requires high accuracy. This study aimed to determine the agreement between clinical and paraclinical diagnoses in patients with acute appendicitis.

Instrument & Methods This descriptive study was performed on patients referred to Shahid Beheshti Hospital in Yasouj with suspicion of acute appendicitis in 2018. After considering the inclusion criteria, the files of 200 patients were included in the study by purposive sampling. Age, sex, main problem, symptoms, clinical signs, white blood cell count, and ultrasonography and pathology report were extracted from the patients' files, and the Modified Alvarado Score was calculated based on their information.

Findings The mean age of the patients was 24.3±13.2 years, and the most common symptoms were anorexia and abdominal tenderness. The Modified Alvarado Score was 4-6 in 126 (63%) and 7 or higher (37%) in 74 patients. In addition, 182 patients (91%) had a positive pathology for appendicitis. There was a statistically significant relationship (p=0.03) between Modified Alvarado Score and pathology; however, there was no statistically significant relationship (p=0.43) between Modified Alvarado Score and ultrasonography. There was a significant relationship (p=0.0001) between pathology and ultrasonography. The ultrasonography sensitivity was 37.1%, specificity was 87.2%, positive predictive value was 96.8%, and negative predictive value was 11.7%.

Conclusion There is an agreement between the Modified Alvarado Score and ultrasonography in diagnosing acute appendicitis with the pathology as the gold standard in the diagnosis of appendicitis; however, there is no agreement between the Modified Alvarado Score and ultrasonography.

Keywords Appendicitis; Pathology; Ultrasonography

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Introduction

Acute appendicitis is the most common emergency surgery [1]. Appendicitis occurs at all ages, but it mostly occurs during puberty, so that most patients with acute appendicitis are under 30 years of age and are considered a disease of young people [2]. The primary cause of appendicitis is an obstruction in the lumen of the appendix, which can be caused by a fecalith, lymphoid follicular hyperplasia, viral or bacterial infections, fibrosis, neoplasia fecalith (carcinoid, adenocarcinoma, and mucosal), and parasites. Following this obstruction, the appendix is filled with mucus, and the intraluminal and intramural pressure of the appendix wall increases, leading to thrombosis in small vessels, and eventually, ischemia and necrosis of the appendix [3-7]. These events cause bacteria to leak through the appendix wall, causing the appendix to be filled with pus. If this process continues, the appendix ruptures and leads to peritonitis, phlegmon, or abscess [8, 9]. Eventually, if left untreated, the patient progresses to sepsis, which causes the death of at least 68% of appendicitis patients without surgical treatment. Therefore, appendicitis should be diagnosed immediately, and appendectomy should be performed [8, 10].

In general, the diagnosis of acute appendicitis is based on clinical symptoms, and classically, it is diagnosed based on history and physical examination. In the history-taking of these patients, anorexia, fever, nausea, and vomiting after the onset of pain and other gastrointestinal symptoms, including pain around the umbilicus and lower right quadrant, are noted [11, 12]. On physical examination, tenderness and rebound tenderness are usually found in the lower quadrant and right abdomen. In addition to history taking and examination, laboratory tests and radiology can help diagnose appendicitis [12, 13]. Alvarado's standard is obtained by the combination of taking and physical examination and laboratory tests, which is a scoring system based on which the probability of appendicitis in the patient is measured [12]. Despite this standard, due to the presence of different forms of acute appendicitis in different people and the lack of a classic diagnostic pattern in some patients and despite the significant prevalence of appendicitis, its diagnosis is controversial in many cases [14]. Only 50% of patients have typical acute appendicitis symptoms when they refer to the emergency room.

In most cases, appendectomy is performed to reduce the risk of perforation in patients with suspected acute appendicitis, while the patient may not have appendicitis [15]. Accordingly, in 10 to 30% of cases, the normal and healthy appendix is mistakenly operated [12, 16, 17]. Studies have shown that ultrasonography for diagnosing acute appendicitis is not more valuable than examination and has not been able to reduce the rate of surgery in these patients [18].

Given the high frequency of appendicitis and the fact that by identifying the effective clinical and paraclinical factors in the diagnosis of appendicitis, surgical complications and costs can be minimized, diagnostic factors in the definitive diagnosis of acute appendicitis are of great importance.

Merhi *et al*. assessed 232 appendectomy children and reported that the positive predictive value (PPV) of clinical judgment was 86.4%, the rate of negative appendectomy based on pathology was 13.6%, the reliability of Alvarado score was 80.7%, and negative appendectomy was 11.3%. Anorexia, neutrophil increase, and rebound tenderness showed a significant relationship with a definitive diagnosis of the appendix [19].

Martin *et al*. compared three scales of Raja Isteri Pengiran Anak Saleha Hospital (RIPAS), Appendicitis Inflammatory Response (AIR), and Alvarado score. Alvarado showed a sensitivity of 87.2% and a specificity of 27.6%, AIR showed a sensitivity of 81.9% and a specificity of 89.5%, and RIPASA had similar results to the Alvarado score. All tests had a diagnostic accuracy of over 80%. Accordingly, Alvarado and RIPASA had good sensitivity, but AIR had more specificity and accuracy for diagnosing acute appendicitis [20].

Several studies have been conducted on the PPV, sensitivity, and specificity of various modalities, such as history and examination, ultrasonography, CT scan, etc., to diagnose acute appendicitis. However, it is not certain that to what extent the calculation of the Alvarado score and performing diagnostic ultrasonography in a patient with possible acute appendicitis is consistent with definitive appendicitis diagnosed by pathology. No study was found on the agreement between pathology (definitive criterion for appendicitis diagnosis) and preoperative diagnostic factors, such as clinical (MAS) and paraclinical (ultrasonography) factors in acute appendicitis. Therefore, to determine the correlation between clinical and paraclinical diagnostic factors in the diagnosis of acute appendicitis and also to assess the epidemiological evaluation and value of diagnostic indicators of acute appendicitis in Yasuj, this study assessed the correlation between clinical and paraclinical diagnosis in patients with acute appendicitis and also clinical and paraclinical evaluation of acute appendicitis in patients referring to the emergency department.

Instrument and Methods

In this descriptive study, the records of patients who were referred to Shahid Beheshti Hospital in Yasouj, Iran in 2018 (218 patients) with suspicion of acute appendicitis were examined, of whom 200 patients who were admitted with a diagnosis of appendicitis and underwent appendectomy surgery and had complete records in terms of history and examination and their results of blood cell count, abdominal

ultrasonography (for appendicitis), and pathology of appendicitis tissue were available were included in the study by purposive sampling.

The patients' data recorded in their files were used to collect data, and their information, such as age, gender, major problem, symptoms, clinical signs, white blood cell count, and ultrasonography and pathology, were noted in the considered forms. Also, the MAS as an approved scoring system in diagnosing appendicitis was calculated for all patients. Because leukocytosis was not reported in the records of patients with low neutrophil counts or those with granulocyte left shift, the MAS was determined as follows [21]: abdominal pain migrating to the right abdomen: 1 point, anorexia: 1 point, nausea, and vomiting: 1 point, lower and right quadrant tenderness: 2 points, rebound tenderness: 1 point, fever: 1 point, leukocytosis: 2 points and the total MAS was 9.

Obtaining ethical approval from Yasouj University of Medical Sciences and the necessary permission to access hospital records and the confidentiality of information was considered. Frequency and percentage of age and gender, pathology (positive or negative), ultrasonographic (diagnostic or non-diagnostic), clinical symptoms (lower right abdominal quadrant tenderness, leukocytosis, fever, nausea and vomiting, anorexia, rebound tenderness, and abdominal pain migrating to the right abdomen) were calculated. The relationship between the pathology and MAS, ultrasonography and MAS, pathology and ultrasonography, and sensitivity, specificity, PPV, and NPV of ultrasonography in the diagnosis of appendicitis was examined.

SPSS 23 software was used to analyze the data. Measures of central tendency and dispersion and tables were used to describe the data. Chi-square test was used to compare the relationship between MAS based on pathology, MAS based on ultrasonography, and pathology based on ultrasonography in patients with acute appendicitis.

Findings

Fifty-eight patients (29%) were under 15 years old, 88 patients (44%) were between 16 and 30 years old, and 54 patients (27%) were over 31 years old. The mean age of the patients was 24.3±13.2 years, with an age range of 4-80 years. Also, in terms of gender, 94 patients (47%) were female, and 106 patients (53%) were male.

MAS (the main clinical symptoms in the history, examination, and leukocytosis) of patients with acute appendicitis who underwent surgery with a diagnosis of appendicitis was evaluated, and the results showed abdominal pain in all patients. The highest MAS was observed in patients with anorexia and abdominal tenderness. Also, 182 patients (91%) had positive pathology for appendicitis (Table 1).

Table 1) The frequency of Alvarado score and the ultrasonography and pathology in patients with acute appendicitis (n=200)

Variable		No. (%)
First symptoms		
Fever	Positive	5 (2.5)
	Negative	195 (97.5)
Nausea and vomiting	Positive	151 (75.5)
	Negative	49 (24.5)
Anorexia	Positive	193 (96.5)
	Negative	7 (3.5)
Migration of abdominal pain	Positive	136 (68)
	Negative	64 (32)
Examination		
Abdominal tenderness	Positive	199 (99.5)
	Negative	1 (0.5)
Rebound tenderness	Positive	83 (41.5)
	Negative	117 (58.5)
Clinical symptoms		
Leukocytosis	Positive	116 (58)
	Negative	84 (42)
Ultrasonography	Positive	104 (52)
	Negative	96 (48)
Pathology	Positive	182 (91)
	Negative	18 (9)

Most of the patients had a MAS of 5. Also, most patients with appendicitis (126: 63%) had a total MAS of 4 to 6, and 74 cases (37%) had a score of 7 or higher. According to the Chi-square test, there was a significant relationship between MAS and pathology (p=0.03); but there was no significant relationship between MAS and ultrasonography (p=0.43). Also, there was a significant correlation between pathology according to ultrasonography (p=0.0001; Table 2). The sensitivity of ultrasonography in the diagnosis of appendicitis was 52.1%, its specificity was 94.4%, PPV was 98.9%, and NPV was 16.3%.

Table 2) Comparison of Alvarado score according to pathology and ultrasonography in patients with acute appendicitis using Chi-square test

Method	Scale	Positive No. (%)	Negative No. (%)	p-value
Pathology	4-6	111 (88.1)	15 (11.9)	
	7≤	71 (59.9)	3 (4.1)	0.03
	Total	182 (91)	18 (9)	
Ultrasonography	4-6	61 (48.4)	65 (51.6)	
	7≤	35 (47.3)	39 (52.7)	0.43
	Total	96 (48)	104 (52)	

Discussion

This study aimed to determine the agreement between the pathologic diagnosis (the definitive diagnosis of appendicitis) and the clinical diagnosis (MAS) and paraclinical diagnosis (sonography) of acute appendicitis in patients suspected of acute appendicitis referring to Shahid Beheshti Hospital in Yasuj, Iran, in 2018.

This study showed that most patients were in the age group of 16 to 30 years (44%), and the lowest prevalence of the disease was observed in the age group of more than 31 years (27%). Appendicitis mostly occurs in the second to third decade of life. The mean age of patients in this study was 24.3 years, the minimum age was 4 years, and the maximum age was 80 years. Ceresoli *et al.* assessed the

epidemiology and treatment of 16,544 patients with acute appendicitis in Italy and showed that the prevalence of appendicitis was higher in cases aged 14 to 25 years [2]. This finding was consistent with studies conducted in the East; for example, Lee *et al.* investigated the epidemiology of appendicitis and appendectomy in South Korea and found that it mostly occurs in the second and third decades of life [22]. Anderson *et al.* in the United States assessed the epidemiology and management of patients with appendicitis and showed that the highest prevalence of appendicitis is observed in the second and third decades of life [23]. The similarity of the present study and other studies shows that appendicitis occurs more frequently at a young age in all populations, and youth can be considered as one of the risk factors for appendicitis. One of these causes is considered to be the activity of appendix lymphoid tissue cells, which are more active at a young age [24].

Regarding appendicitis-related symptoms and MAS in this study, the most common symptoms were lower back and right abdominal pain and tenderness (100%), anorexia (95%), and fever (93%). Similar to the results of the present study, Kumar *et al*. determined the sensitivity and specificity of MAS and ultrasonography in patients with acute appendicitis, and the highest prevalence of clinical symptoms was related to pain and tenderness in the lower and right abdomen, which was observed in 100% of patients [25].

Because the present study was retrospective research, due to the lack of neutrophil count in the records of most patients, the MAS was used to calculate the risk of appendicitis in patients [21]. After calculating this score, it was found that 63% of patients had a score of 4 to 6, and 37% had a score of 7 or higher. Al-Awayshih *et al*. evaluated the value of MAS in diagnosing acute appendicitis in 100 patients and reported that 52% Of patients had a MAS of less than 7 and 48% of patients had a MAS of 7 or higher [13]. Peyravesh *et al.* reported that 30.9% of patients with positive appendicitis had a MAS of 5-6, and 68.2% of patients who constituted the majority of patients had a MAS of 7-9 [21]. Ikramullah Khan *et al*. found that 52% of the patients had a MAS of 7 or higher, and 48% had a MAS of less than 7 [12]. However, in the present study, the highest MAS was between 4 and 6 (63%), and 37% had a MAS of 7 or higher. Perhaps the reason for this difference was the different number of specimens.

The definitive diagnosis of appendicitis is based on pathology specimens [14]. In this study, out of 200 samples referred to the initial diagnosis of acute appendicitis, 91% of patients had a positive sample for appendicitis, and only 9% had negative pathology. Rehman & Khan reported that 84.3% of their samples had positive pathology [12]. Seetahal *et al.,* in a 10-year study of 475,651 patients with appendectomy in the United States, found that 11.83% of patients were negative for appendicitis [16].

The sensitivity of ultrasonography in diagnosing a patient with suspected acute appendicitis was 52.2%, its specificity was 94.4%, PPV was 98.9%, and NPV was 16.3%. Hosseini *et al.* evaluated the accuracy of ultrasonography in diagnosing appendicitis in 540 patients with suspected appendicitis. They reported the sensitivity of 37.1%, specificity of 87.2%, PPV of 96.8% and NPV of 11.7% [18]. Nasiri *et al.* declared the sensitivity of 71.2%, specificity of 83.3%, PPV of 97.4%, and NPV of 25% for ultrasonography in diagnosing a patient with suspected acute appendicitis [26]. Our results were comparable with the results of these two studies, and perhaps the small differences between these studies and ours were due to differences between operators and the number of samples. Extensive studies have shown that ultrasonography is operator-dependent and does not appear to play a higher role than abdominal ultrasonography in diagnosing acute appendicitis, and in patients with suspected appendicitis, it is better to use other diagnostic methods [27].

In the present study, there was a significant relationship between the MAS and the pathology. This indicates that the MAS is consistent with the pathology and shows the value of the MAS in the diagnosis of appendicitis. Comparative studies in the present study showed that there was no significant relationship between the MAS and the ultrasonography report, which to some extent, it showed that ultrasonography could not be a good alternative to history and examination in patients with suspected appendicitis.

One of the research limitations was the performance of ultrasonography by different operators, which may reduce the necessary accuracy in determining the sensitivity and specificity of ultrasound. Another limitation was the reliance on the information in the files, which may have shortcomings. The small number of samples was another limitation. Therefore, it is suggested that in order to increase the accuracy of the study, in the next studies, more samples should be considered for comparative study of clinical and paraclinical diagnosis in patients with acute appendicitis.

Conclusion

There is an agreement between the MAS value and ultrasonography and the pathology in the diagnosis of acute appendicitis, which is the definitive criterion in diagnosing appendicitis. However, there is no agreement between MAS and ultrasonography.

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