

COMPARISON OF RIPASA AND ALVARADO SCORES FOR THE DIAGNOSIS OF  
ACUTE APPENDICITIS (COMPARATIVE STUDY)Ahmad Ibrahim Othman<sup>\*1</sup>, Samir Kanaan<sup>2</sup> and Ahmad Saad<sup>3</sup><sup>1</sup>Department of General Surgery, Tishreen University, Faculty of Medicine, Lattakia, Syria.<sup>2</sup>Department of General Surgery, Professor, Tishreen University, Faculty of Medicine, Lattakia, Syria<sup>3</sup>Department of General Surgery, Professor, Tishreen University, Faculty of Medicine, Lattakia, Syria.

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## ABSTRACT

**Background:** Acute appendicitis represents the most common cause of acute abdomen surgery. However, patients with negative appendicitis might undergo unnecessary appendectomy which is considered a problem in clinical practice. **Objective:** The aim of this study was to compare performance of RIPSA and Alvarado score in diagnosis of appendicitis. **Patients and Methods:** A comparative analytic study conducted for the period fifteen months (September 2021- December 2022) at Tishreen University Hospital in Lattakia-Syria. The study included patients who diagnosed with acute appendicitis and underwent surgery. **Results:** A total of 232 patients with mean age  $26.31 \pm 10.7$  of years were included in the study. Age group <40 years represented the most age group (87.9%) and 53.9% of the patients were males. The most common presenting symptom was pain in right iliac fossa (100%), while tenderness in right iliac fossa was the most common sign (98.7%). Abdominal ultrasound was positive in 58.19% of the study population, while CT-scan was positive in all cases which was performed (7 cases). RIPSA score was positive in 91.8% of the cases and Alvarado score was positive in 81.5%. RIPSA score exhibited sensitivity (98.13%) and specificity (88.23%) in diagnosis of appendicitis, whereas Alvarado score had a sensitivity and specificity of 95.81% and 82.35% respectively. After age- and sex adjustment, RIPSA score was superior to Alvarado score in detecting presence of acute appendicitis. **Conclusion:** The current study results indicated that RIPSA score has higher diagnostic accuracy in distinguishing patients with acute appendicitis compared to Alvarado score. **Keywords:** Acute, Alvarado, appendicitis, diagnostic, RIPSA.

## INTRODUCTION

Acute appendicitis is defined as an inflammation in the vestigial vermiform appendix.<sup>[1,2,3]</sup> It is considered one of the most frequent indications for an emergency abdominal surgical procedure worldwide particularly among young adults and children.<sup>[4,5]</sup> It is caused by obstruction of appendiceal lumen from a variety of etiologies which causes increased appendiceal wall tension, leading to necrosis and perforation.<sup>[6,7,8,9]</sup> There are constellation of the clinical manifestations and abdominal pain represents the most common symptom, which might be combined with anorexia, nausea, vomiting, fever, and generalized malaise. Abdominal pain is typically periumbilical in nature with subsequent migration to the right lower quadrant as the inflammation progresses.<sup>[10,11,12]</sup> The most specific physical findings include rebound tenderness, pain on percussion, rigidity and guarding.<sup>[13,14,15]</sup> Appendicitis is suspected in patients who present with acute right lower quadrant pain, presence of leukocytosis with suggestive radiological findings but confirmation of diagnosis is only by histological findings of surgical specimens.<sup>[16]</sup> Despite

diagnostic and therapeutic advancement in medicine, appendicitis remains an emergency so that early diagnosis and treatment as early as possible is considered crucial due to high morbidity and mortality that associated with delayed diagnosis.<sup>[17,18]</sup> Several clinical scoring systems have been developed for diagnosis of appendicitis. Among these, the Alvarado and RIPSA have been studied with determining the ability of such scoring systems to improve diagnostic outcomes and reduce negative appendectomy rate.<sup>[19,20]</sup> Absence of the local studies prompted us to conduct this study, therefore the aim of our study was to elucidate differences between Alvarado and RIPSA in diagnosis of acute appendicitis compared to gold standard of diagnosis represented by pathology.

## PATIENTS AND METHODS

This is a comparative analytic study of a group of patients attending the department of general surgery at Tishreen University Hospital in Lattakia-Syria during a fifteen-month period (2021-2022) with a diagnosis of acute appendicitis who underwent surgical management.

The exclusion criteria were presence one of the following: patients younger than 14 years of the age, pregnant women, and patients who underwent appendectomy due to another surgical intervention into the abdominal cavity. The following workup included history and physical examination including of measurements of vital signs and abdominal examination were performed. Laboratory investigations including complete blood count (CBC) and urine analysis were done for all patients on admission. Abdominal ultrasound was performed for all patients, whereas computed tomography (CT scan) was done for some patients due to limited availability. Alvarado score and RIPSAscore were calculated for all patients before surgical intervention. In addition to, appendectomy specimens were sent for pathology.

**Alvarado score:** Its components include the following factors right lower quadrant tenderness, migration pain to the right lower quadrant, anorexia, nausea or vomiting, temperature  $>37.3^{\circ}\text{C}$ , rebound tenderness, leukocytosis, and leukocyte left shift. A score of  $\geq 7$  indicates that the diagnosis is probable, 5 to 6 admission and monitoring of patient and  $< 5$  discharge of patient. RIPSAscore: It classifies patients with abdominal pain in right iliac fossa into the following groups; score  $< 5$  (diagnosis unprobable), 5-7.5 (low probability), 7.5-11.5 (high probability), and  $> 12$  (acute appendicitis).

**Ethical consideration:** All patients were provided a

complete and clear informed consent after discussion about the study. This study was performed following the Declaration of Helsinki.

**Statistical Analysis** Statistical analysis was performed by using IBM SPSS version 20. Basic Descriptive statistics included means, standard deviations (SD), median, Frequency and percentages. Diagnostic tests including sensitivity, specificity, positive predictive value and negative predictive value were calculated. All the tests were considered significant at a 5% type I error rate ( $p < 0.05$ ),  $\beta: 20\%$ , and power of the study: 80%.

## RESULTS

The baseline characteristics of the participants were as shown in (Table 1). Ages range from 15 to 87 years (mean  $26.31 \pm 10.7$  years) and the age group younger than 40 years represented the most frequent age group (87.9%) followed by  $\geq 40$  (12.1%). Females represented 46.1% of the study population and males 53.9%. Patients were divided into two groups according to the timing of symptoms initiation;  $< 48$  hours in 142 cases (61.2%) and  $> 48$  hours in 90 cases (38.8%). Pain was present in all patients (100%), followed by loss appetite (90.1%), pain migration (84.9%), and nausea or vomiting (84.1%). The most important physical examination finding is tenderness in right iliac fossa (98.7%), followed by rebound tenderness (91.4%), positive Rovsing sign (74.1%), fever (47.8%), and muscular defense in right iliac fossa (37.5%).

**Table 1: Demographic and clinical characteristics of the study population.**

Variable	Result
Age (years)	26.31 $\pm$ 10.7
Age groups (n,%)	
<40	204(87.9%)
$\geq 40$	28(12.1%)
Gender	
Male	125(53.9%)
Female	107(46.1%)
Time from symptom onset (hours)	
< 48	142(61.2%)
$> 48$	90(38.8%)
Clinical manifestations	
Pain in right iliac fossa	232(100%)
Loss appetite	209(90.1%)
Pain migration	197(84.9%)
Nausea or vomiting	195(84.1%)
Physical examination	
Tenderness in right iliac fossa	229(98.7%)
Rebound tenderness	212(91.4%)
Positive Rovsing sign	172(74.1%)
Fever	111(47.8%)
Muscular defense in right iliac fossa	87(37.5%)

As shown in table (2), laboratory investigations revealed presence of elevated count of white blood cell (WBC) in 145 cases (62.5%) and neutrophilia was present in 161 cases (69.4%) with positive urine analysis in 9.9%.

According to imaging workup, echography was positive in 135 cases (58.19%) and CT-scan was positive in all cases underwent imaging (7 cases).

**Table 2: Laboratory and radiological findings of the study population.**

Variable	Result
<b>Laboratory findings</b>	
Elevated levels of WBC	145(62.5%)
Elevated levels of neutrophils	161(69.4%)
Positive urine analysis	23(9.9%)
<b>Radiological findings</b>	
Positive echography	135(58.19%)
Positive CT-scan	7(100%)

Patients were classified according to RIPSA score as follows; 19 cases (8.2%) in the range 5-7, 95 cases(40.9%) in the range 7.5-11.5, and 118 cases(50.9%) with score>12. RIPSA score was positive in 91.8%. According to Alvarado score, 1.3% in the range<5, 17.2% in the range(17.2%) and 81.5% with score >6. Alvarado score was positive in 81.5%.

**Table 3: Assessment scores for diagnosis of appendicitis.**

Variable	Result
<b>RIPASA score</b>	
5-7	19(8.2%)
7.5-11.5	95(40.9%)
>12	118(50.9%)
<b>Alvarado score</b>	
<5	3(1.3%)
5-6	40(17.2%)
>6	189(81.5%)

According to the histopathological findings, 215 cases (92.7%) of the study sample were positive and 17 cases (7.3%) were negative. Negative cases were distributed as follows; lymphoid follicular hyperplasia (5.6%), mesenteric adenitis (0.4%), carcinoid of the appendix (0.4%), post inflammatory fibrosis (0.4%), without pathological changes in appendix in one case (0.4%). RIPASA score had a sensitivity (98.13%), specificity (88.23%), positive predictive value PPV (99.06%), negative predictive value NPV(78.94%) and accuracy (97.41%). In addition to, Alvarado score had a sensitivity (95.81%), specificity(82.35%), PPV(98.56%), NPV (60.86%) and accuracy (94.82%), table(4).

**Table 4: Comparison of scores with histopathological findings of appendix.**

Variable	Pathology		Total number
	Positive	Negative	
<b>RIPASA score</b>			
Positive	211	2	213
Negative	4	15	19
<b>Total number</b>	215	17	232
<b>Alvarado score</b>			
Positive	206	3	209
Negative	9	14	23
<b>Total number</b>	215	17	232

RIPASA score had a sensitivity (96.49%), specificity (81.81%), PPV(98.21%), NPV(69.23%) and accuracy

(95.2%) in males versus 98.01%,83.33%,99%, 71.43% and 97.19% respectively in females. Alvarado score had a sensitivity (95.61%), specificity (72.72%), PPV(97.32%), NPV(61.53%) and accuracy(93.2%)in males versus 97.02% ,66.67%, 98%, 57.14% and 95.32% respectively in females.

**Table 5: Comparison of scores with histopathological findings according to gender.**

Variable	Pathology Male		Pathology Female	
	Positive	Negative	Positive	Negative
<b>RIPASA score</b>				
Positive	110	2	99	1
Negative	4	9	2	5
<b>Total number</b>	114	11	101	6
<b>Alvarado score</b>				
Positive	109	3	98	2
Negative	5	8	3	4
<b>Total number</b>	114	11	101	6

RIPASA score had a sensitivity (98.42%), specificity (85.71%), PPV(98.94%), NPV(80%) and accuracy (97.54%) in patients younger than 40 years versus 92%, 100%,100%, 60% and 92.85% respectively in patients older than 40 years. Alvarado score had a sensitivity (97.36%), specificity(71.42%), PPV(97.88%), NPV(66.67%) and accuracy (95.58%) in patients younger than 40 years versus 88 %, 66.67%,95.65%, 40% and 85.71 % respectively in patients older than 40 years.

**Table 6: Comparison of scores with histopathological findings according to age groups.**

Variable	Pathology <40		Pathology ≥40	
	Positive	Negative	Positive	Negative
<b>RIPASA score</b>				
Positive	187	2	23	0
Negative	3	12	2	3
<b>Total number</b>	190	14	25	3
<b>Alvarado score</b>				
Positive	185	4	22	1
Negative	5	10	3	2
<b>Total number</b>	190	14	25	3

**DISCUSSION**

This comparative analytic study in patients who underwent appendectomy assessed for efficiency of

RIPASA score compared to Alvarado score in diagnosis of acute appendicitis. This study showed the main findings: First, patients were of a wide range of ages and the age group <40 years represented the most age group. High frequency of appendicitis in this group might be related to lymphoid hyperplasia among adults and is responsible for increased incidence. There is slight male preponderance and approximately two-third of patients presented to hospital through 48 hours. Various clinical manifestations and signs were reported, in which pain and tenderness in right iliac fossa were observed more frequently. There were many abnormalities in laboratory investigations including elevated levels of WBC, neutrophils, and positive urine analysis. In addition to, echography was positive in approximately 60% of the patients. Histopathologically, appendicitis was present in 92.7% of the patients and RIPASA score is more efficient than Alvarado score in diagnosis of acute appendicitis.

These findings are comparable with results of previous studies. Rangel *et al* (2018) demonstrated in a study conducted in 100 patients with acute appendicitis that 58% of the patients were males and 42% were females with mean age 36.5±16.2 years. RIPASA score had a sensitivity (99%), specificity (71%), PPV (96%) and NPV (91%). Alvarado score had a sensitivity (91%), specificity (64%), PPV (94%) and NPV (60%).<sup>[21]</sup> Nancharaiiah (2018) demonstrated in a study included 150 patients with suspected acute appendicitis that RIPASA score had a sensitivity (98.6%), specificity (83.3%), PPV (93.3%) and NPV (71.4%).

Alvarado score had a sensitivity (76.39%), specificity (66.6%), PPV (89%) and NPV (10.5%).<sup>[22]</sup> Shehryar *et al* (2020) showed in a study conducted in 300 patients with suspected acute appendicitis who underwent surgical intervention that 58.6% of the patients were males and 41.3% were females with mean age 28±10 years. RIPASA score had a sensitivity (98.5%), specificity (90%), PPV (98.8%), NPV (87.10%) and accuracy (97.6%). Alvarado score had a sensitivity (68.10%), specificity (80%), PPV (96.8%), NPV (21.8%) and accuracy (69.3%).<sup>[23]</sup> Abouzeid *et al* (2020) demonstrated in a study performed in 100 patients with acute appendicitis that male represented 71% of the patients and females 29%. RIPASA score had a sensitivity (96.3%), specificity (68.4%), PPV (92.9%), NPV (81.25%) and accuracy (91%). Alvarado score had a sensitivity (91.7%), specificity (48.14%), PPV (82.7%), NPV (68.4%) and accuracy (80%).<sup>[24]</sup>

Majeed *et al* (2023) demonstrated in a study conducted in 200 patients with suspicion of acute appendicitis and underwent appendectomy that appendicitis was present in 78.5% of the patients according to pathological findings. RIPASA score had a sensitivity (93.6%), specificity (74.4%), PPV (93%), NPV (76.1%) and accuracy (89.5%). Alvarado score had a sensitivity (82.8%), specificity (65.1%), PPV (89.7%), NPV (50.9%)

and accuracy (79%).<sup>[25]</sup> By comparison previous studies with the current study, there was an agreement between studies regarding favorable results with RIPASA score in diagnosis of appendicitis. In summary, RIPASA score is considered as a cheap and efficient diagnostic tool for acute appendicitis in patients attending emergency department with pain in right iliac fossa to reduce negative appendectomy.

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