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Mean Platelet Volume versus Alvarado Score as Predictor of Acute Appendicitis

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ABSTRACT

Background: For assisting in the early identification of acute appendicitis (AA) and its prompt therapy, several grading systems have been utilized. Because it takes into account the patient symptoms, findings, and laboratory assessment, the Alvarado score was chosen. Mean platelet volume (MPV) variations could be a sign of production of platelet in addition, a sign of changes in the severity of a number of disorders.

Objective: This study aimed to compare MPV and Alvarado score to assess the predictive value for acute appendicitis.

Patients and Methods: At the Emergency Hospital Mansoura University, Egypt, a prospective observational cohort research was conducted. 118 participants from both sexes who had right iliac fossa (RIF) pain suggestive of appendicitis participated in this study.

Results: when compared to the histological findings, the Alvarado score exhibited a sensitivity and specificity of 67.6% and 61.5% respectively, with an accuracy of 58.5% in diagnosing appendicitis. With an accuracy of 79.7%, ultrasonography demonstrated a sensitivity and specificity of 80.4% and 76.9% in detecting appendicitis respectively. When compared to those without appendicitis, the MPV in cases with AA was statistically considerably smaller. The optimum MPV cutoff point for detecting appendicitis cases was less-than 8.92 with a sensitivity of 78.3%, specificity of 61.5%, and accuracy of 66.2%.

Conclusion: While the Alvarado score and the combination of the two exhibited lower accuracy, the MPV had a greater accuracy for diagnosis than the Alvarado score. The sensitivity and accuracy of diagnosing acute appendicitis were significantly improved by combining the Alvarado score with the ultrasound examination.

Keywords: Mean platelet volume, Alvarado score, Acute appendicitis.

INTRODUCTION

Among the most frequent causes of abdominal surgical emergencies in children and adolescents is AA. For morbidity and occasionally death prevention brought on by side-effects like gangrene, perforation, and abscess formation, the majority of healthcare professionals advise early diagnosis and prompt surgical intervention. In populations of men and women, it has an incidence of 1.5–1.9/1000, respectively. The disorder is challenging for diagnosis, particularly in the early stages when the traditional symptoms and indicators are frequently modest [1].

Acute appendicitis is mostly diagnosed clinically based on symptoms, signs, and test results. These clinical and laboratory variables taken together could be inaccurate in as many as 40% of cases. As numerous gastro-intestinal illnesses mimic acute appendicitis, this typically yields an unacceptable high negative appendectomy rate. Atypical presentation, on the other hand, is typical among female adolescents and comparatively younger youngsters. This may present a challenging diagnostic conundrum that could delay action and, as a result, increase the likelihood of problems [2].

Acute appendicitis is challenging to diagnose, and small children and the elderly are more likely to experience severe drawbacks. To diagnose AA clinically, and neither laboratory nor radiographic techniques are completely accurate. Delay in identification and treatment may raise expenses and morbidity. The early detection and management of acute appendicitis have received a lot of attention [3].

Investigation includes clinical scoring, imaging methods, and diagnostic markers to lower the negative appendectomy rate (WBCs CRP, mean platelet volume, IL-6, urine 5-hydroxyl indole acetic acid). The most effective and non-invasive method for diagnosing acute appendicitis is still ultrasound [4].

For assisting in the early identification of acute appendicitis and its prompt therapy, several grading systems have been utilized. The use of scoring systems can help distinguish between nonspecific abdominal discomfort and acute appendicitis [5]. The Alvarado score was selected because it takes into account the patient's symptoms, observations, and laboratory assessment and has recorded accuracy rates for acute appendicitis between 78% and eighty-two percent [6]. A platelet production marker, as well as a sign severity changes of a number of illness situations, including sepsis, thrombosis, and even respiratory distress syndrome (RDS), are changes in MPV [7]. In order to test MPV predictive value and the Alvarado score, this study evaluated MPV as a predictor of AA.

PATIENT AND METHODS

At the Emergency Hospital Mansoura University, Egypt, a prospective observational cohort research was conducted. The research was carried out between November 2021 and June 2022.

Inclusion criteria: Patients over the age of eighteen of both sexes who had right iliac fossa pain suggestive of appendicitis.

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Exclusion criteria: Patients who had undergone prior abdominal surgery, generalized peritonitis, ruptured appendix, chronic appendicitis, gynecological or urological disorders and masses in the right iliac fossa, or those who had been released without undergoing surgery.

Methods:

We asked every patient about his name, age, gender, presenting symptoms, analysis of symptoms (onset, course, duration, what rises, what reduces, and relationships), current medical history, including systemic comorbidities, and any prior surgical procedures. Symptoms include RIF pain, nausea, vomiting, and anorexia. Every patient underwent a general examination that included taking their temperature, blood pressure, pulse, and general appearance. The abdominal examination involved checking for distension, movement with breathing, previous scars, and hernia orifices, palpating for tenderness and rebound tenderness, using percussion to find free intraperitoneal fluid, and auscultation to listen for bowel sounds (to avoid ileus caused by perforation). In suspected cases, roving, obturator, and psoas symptoms were elicited.

Laboratory investigations:

CBC, LFT, creatinine level in the serum, coagulation profile (including BT and INR), urinalysis to rule out urinary tract infection as a potential source of abdominal pain, and pregnancy tests in females of childbearing age to rule out ectopic pregnancy were among the lab tests that carried out.

Samples collection and analysis:

With minimal tourniquet pressure and clean venipuncture, blood was drawn from the antecubital fossa. Needles were between nineteen and twenty-one gauge. The specimens weren't kept in a water bath, on ice, or in a refrigerator; they were kept at ambient temperature (20 to 25.8 °C). Tubes were kept capped upright and at room temperature without being subjected to severe shaking, mixing, or agitation. Any samples that showed signs of clotting were discarded. For the full blood count (CBC), anticoagulant ethylenediamine tetra-acetic acid (EDTA) is present in two samples of two milliliters of venous blood in standard tubes. An automated analyzer was used to measure MPV and additional blood count values.

Radiological Investigations

An abdomen X-ray was taken in both the upright and supine positions as part of the radiological investigations. Using a linear array transducer of five MHz or 7.5 MHz and a conventional technique encompassing graded compression, longitudinal, and transverse pictures of the RLQ, sonographic tests were carried out in each case by competent sonographers. It was mandated to support the appendicitis diagnosis and rule out any other potential causes of abdominal surgery. On a five-point scale, the ultrasonography results indicative of acute appendicitis were reported and rated. The first two grades of the results were categorized as negative, whereas 3 and five were categorized as positive for acute appendicitis.

Table (1): Ultrasound appendicitis score [8, 9].

Score	Findings
1	Represents normal appendix identification
2	Shows that the appendix cannot be visualised, yet there were no inflammatory changes or obvious signs of loose fluid.
3	Identifies the presence of secondary appendicitis symptoms, like a fecalith, pericecal fluid, or enhanced pericecal echogenicity compatible with mesenteric fat infiltration, even while the appendix cannot be visualized.
4	Represents the detection of a potentially enlarged appendix (5-6 millimeters)
5	Swollen, non-compressible appendix with an outside diameter larger than six millimeters, which is a sign of acute appendicitis.

Alvarado scoring system:

Table (2): Alvarado score was only done for the study purpose, and it was done for all patients. A score of 7 was taken as high probability of AA. Alvarado scoring system [10].

Feature	Score
Migration of pain	1
Anorexia	1
Nausea	1
Tenderness in right lower quadrant	2
Rebound pain	1
Elevated temperature	1
Leukocytosis	2
Shift of white blood count to the left	1

The surgical Procedure:

After considering all the results of the clinical, lab, and radiological investigations, the surgeon's clinical judgement alone was what ultimately determined whether or not to perform an appendectomy.

Histopathological examination:

To confirm the diagnosis, the pathology laboratory received all of the excised specimens. The operated case's histopathology findings were obtained and linked with both scores. In the current investigation, the histological findings were regarded as the gold standard to diagnose, and we only relied on the gross shape of the appendix because appendicitis can exist in a grossly normal appendix.

Ethical approval: Mansoura University Faculty of Medicine Institutional Review Board (IRB) and the regional ethical committee both approved the study. Patients have the right to request to leave the trial at

any time. Patient privacy was protected, and only scientific uses were made of the data that was gathered. All participants gave written consents after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical Analysis: SPSS version 22 software (SPSS Inc., Chicago, ILL Company) was used to tabulate and analyse the gathered data. Quantitative data were expressed as mean, standard deviation, median, and range, whilst categorical data was shown as numbers and percentages. Categorical variables were analyzed using the Fisher's exact test (FET) or the chi square test (X^2). Using the Student "t" test if the quantitative data was regularly distributed or the Man Whitney U test if it wasn't, the Shapiro-Wilks test was used to determine whether the quantitative data was normally distributed. Assuming normality at $P > 0.05$.

RESULTS

118 patients were involved in this investigation. The range of the included cases' ages was 19- 53 with a mean age of 34.69 ± 11.96 years. There were fifty girls (42.4%) and 68 males (57.6%) among the participants. The majority of patients (83.1%) reported having anorexia, followed by nausea (73.7%) and migrating pain (54.2%). Regarding the observed indicators, raised fever was reported in 72.9% of patients, while abdominal discomfort and rebound tenderness were found in 57.5% and 75.4% of patients, respectively. Leucocytic shift to the left was found in 55.1% of our patients, while leukocytosis was found in 71.2% of patients (Table 3).

Table (3): The study cases demographic data, symptoms and signs

Variables		Study subjects N = 118	
Age (years)	**Mean ± SD**	34.69 ± 19.96	
	Median (Range)	32 (19-53)	
		Number	**Percent**
Gender			
Male		68	57.6
Female		50	42.4
Symptoms and signs			
Migration of pain		64	54.2
Anorexia		98	83.1
Nausea		87	73.7
Tenderness in the lower right quadrant		68	57.6
Rebound tenderness		89	75.4
Elevated temperature		86	72.9
Leukocytosis		84	71.2
Shift of WBC count to the left		65	55.1

Mean ± SD and median (range) for continuous data expression, Number (%) for categorical data expression.

Regarding CBC parameters, hemoglobin had a mean value of 11.43 gm/dl, while platelets had a mean value of 276.34 x10^3/ml. In addition, leucocytic count ranged between 6.3 and 20.2 x10^3/ml with a mean of 12.59 ± 2.62 x 10^3/ml (Table 4).

Table (4): Laboratory findings in the cases of the study.

Variables		Study subjects N = 118
Hemoglobin level (gm/dl)	**Mean ± SD**	11.43 ± 0.88
WBCs (x10^3/ml)	**Mean ± SD**	12.59 ± 2.62
Platelets (x10^3/ml)	**Mean ± SD**	276.34 ± 28.89
MPV (fL)	**Mean ± SD**	8.23 ± 1.13

Mean ± SD and median (range) for expression of continuous data Number (%) for categorical data expression.

Alvarado score measurements indicated a mean value of 6.72 (interquartile range, 1–10). When it was broken down into groups, 36.4% of patients had a moderate risk for appendicitis, compared to 10.2% of patients with a low risk. In addition, appendicitis was a serious danger for the remaining 53.4% of patients. In accordance with the prior score, 53.4% of patients had appendicitis, compared to 46.6% of patients who did not (Table 5).

Table (5): Risk stratification and incidence of appendicitis according to ALVARADO score in the cases of the study.

Variables		Study subjects N = 118	
Alvarado score (years)	Mean ± SD	6.72 ± 1.83	
	Median (Range)	7 (1-10)	
		Number	**Percent**
Risk categories			
Low risk of acute appendicitis		12	10.2
Moderate risk of acute appendicitis		43	36.4
High risk of acute appendicitis		63	53.4
Incidence of appendicitis			
No appendicitis		55	46.6
Appendicitis		63	53.4

Mean ± SD and median (range) for continuous data expression, Number (%) for categorical data expression.

According to US research, 80 patients had appendicitis (67.8%), compared to 38 patients who had no appendicitis. 8.5%, 23.7%, 25.4%, 26.3 %, and 16.1 %, respectively, expressed scores of 1, 2, 3, 4, and 5 risk categories. 78% of the appendices that were removed underwent histopathological investigation and were found to have appendicitis, whereas the remaining instances lacked any pathological signs of appendicitis. In patients with appendicitis, 34 cases of suppurative appendicitis and 47 cases of catarrhal appendicitis were found. Eleven people remained with gangrenous appendicitis (Table 6).

Table (6): Incidence of appendicitis based on US results and histopathological findings in the study's case studies.

	Study subjects (N = 118)	
Ultrasound score	**Number**	**Percent**
Incidence of appendicitis		
No appendicitis	38	32.2
Appendicitis	80	67.8
• **Risk categories**		
Score 1	10	8.5
Score 2	28	23.7
Score 3	30	25.4
Score 4	31	26.3
Score 5	19	16.1
Histopathological findings		
Incidence of appendicitis		
No appendicitis	26	22
Appendicitis	92	78
Histopathological results		
Normal appendix	26	22
Catarrhal appendicitis	47	39.8
Suppurative appendicitis	34	28.8
Gangrenous appendicitis	11	9.3

Mean ± SD and median (range) for continuous data expression, Number (%) for categorical data expression.

When compared to the histological findings, the Alvarado score had diagnostic sensitivity and specificity of 67.6% and 61.5% for appendicitis, respectively. 29.1% NPV and 84.4% PPV were recorded. In detecting appendicitis, US had sensitivity and specificity of 80.4% and 76.9% when compared to histological findings. Its respective PPV and NPV were 92.5% and 52.6%. It was clear that the sensitivity and accuracy of diagnosing patients with appendicitis were significantly improved by combining US findings with those from the Alvarado score. Prior to it, each of the parameters were 96.7% and 88.2% . The relative PPV and NPV were 89% and 83.3% (Table 7).

Table (7): Predictive value of ALVAADO score in detection of appendicitis as compared to histopathology, US in detection of appendicitis as compared to histopathology and combined ALVARADO and US in detection of appendicitis as compared to histopathology.

	Histopathology				χ^2	**P**	**Sensitivity**	**Specificity**	**Accuracy**	**PPV**	**NPV**
	No appendicitis (n= 26)		**Appendicitis (n= 92)**								
	No	**%**	**No**	**%**							
ALVARADO score					2.986	0.084	67.6%	61.5%	58.5%	84.1%	29.1%
No appendicitis (N=55)	16 (TN)	61.5	39 (FN)	42.4							
Appendicitis (N= 63)	10 (FP)	38.5	53 (TP)	67.6							
Ultrasound					10.549	<0.001*	80.4%	76.9%	79.7%	92.5%	52.6%
No appendicitis (N=38)	20 (TN)	76.9	18 (FN)	19.6							
Appendicitis (N= 80)	6 (FP)	23.1	74 (TP)	80.4							
Combined ALVARADO and Ultrasound					46.459	< 0.001*	96.7%	57.7%	88.2%	89%	83.3%
No appendicitis (N=18)	15 (TN)	57.7	3 (FN)	3.3							
Appendicitis (N= 100)	11 (FP)	42.3	89 (TP)	96.7							

$\chi 2$: Chi-square test *: Statistical significance

Table (8) showed that when compared to cases without appendicitis (9 ± 0.7), the mean MPV in the appendicitis group was 8.02 ± 1.14, which was statistically substantially lower (p=0.025). The optimum MPV cutoff point was < 8.92 for detecting appendicitis cases with a sensitivity of 78.3%, specificity of 61.5%, and accuracy of 66.2%.

Table (8): Analysis of MPV in the two study groups according to the histopathological results and diagnostic ability of MPV to identify cases with appendicitis.

	Appendicitis (Proven by histopathology (N=26)	**No appendicitis (Proven by histopathology) (N=92)**	**Test of significance**	**P-value**
MPV (fl)	8.02 ± 1.14	9 ± 0.7	t = - 3.192	0.025*
Diagnostic criteria of MPV				
AUC			0.650	
Cut off point			< 8.92	
Sensitivity			**78.3 %**	
Specificity			**61.5 %**	
PPV			**62.4 %**	
NPV			**74.3 %**	
Accuracy			**66.2 %**	
P			0.009*	

t: Independent samples t-test, *: Statistical significance (p< 0.05)

Table (9) compared the diagnostic efficacy of various diagnostic techniques for identifying appendicitis (as revealed by pathology). The highest accuracy was recorded by a combination of ALVARADO and ultrasound, with MPV coming in second and ultrasound score coming in third.

Table (9): Comparison of Alvarado score, ultrasound, combined ALVARADO and ultrasound and MPV in detection of appendicitis as compared to histopathology.

Diagnostic criteria	**ALVARADO score**	**Ultrasound score**	**Combined ALVARADO and ultrasound**	**MPV**
Sensitivity	67.6%	80.4%	96.7%	78.3 %
Specificity	61.5%	76.9%	57.7%	61.5 %
PPV	84.1%	92.5%	89%	62.4 %
NPV	29.1%	52.6%	83.3%	74.3 %
Accuracy	58.5%	79.7%	88.2%	66.2 %

DISCUSSION

Although AA is the most common acute abdomen cause, it is still difficult to diagnose because it is primarily a clinical diagnostic with numerous clinical images [11]. When appendices are removed solely based on clinical characteristics, normal appendices may also be removed (negative appendectomy). However, postponing required surgery for patients with suspected appendicitis could result in catastrophic side effects [12].

The current study was conducted to evaluate MPV as a predictor of acute appendicitis and for comparing the MPV and Alvarado score to assess the predictive value. The current study included 118 patients whose ages ranged between 19 and 53 years (mean = 34.69 ± 19.96 years). 68 men (57.6%) in addition to 50 women (42.4%) with a slight male predominance. According to some writers, men are more likely than women to have appendicitis, with a lifetime incidence of 8.6% compared to 6.7% for men (male-to-female ratio of 1.4:1) [13].

In the current study, TLC had a mean value of 12.59 $x10^3$/ml (range, 6.30 - 20.20). Previous research has demonstrated that WBC counts more than 10,500 cells/μL are seen in 80–85% of persons with appendicitis [14].

In our current study, histopathological examination of the excised appendices revealed appendicitis in 78% while the remaining cases did not show any pathological features of appendicitis. Our negative appendectomy rate was 22%. This is congruent with the rates reported in the literature of eight to thirty-three percent [15]. The negative appendectomy rate was reported to be 12% in an earlier Egyptian study at Mansoura University [16], which is lower than our findings. Additionally, **Al Awayshih *et al.*** [11] observed that the appendix was normal or unremarkable in twenty individuals (fourteen females and six men), translating to a twenty percent negative appendectomy rate, which is comparable to our findings. The reported negative appendectomy rates are expected to vary slightly between studies. That might vary depending on the method (clinical judgement, or scores employed) used to diagnose an appendicitis. In the current study, Alvarado score had sensitivity and specificity of 67.6% and 61.5% in diagnosing appendicitis when compared to the histopathological findings. It had 84.4% PPV and 29.1% NPV.

According to a previous systematic review, the Alvarado score has a moderate specificity (all studies 81%, men 57%, women 73%, and children 76%) and a moderate to high sensitivity (men 88%, women 86%, and children 87%), suggesting it is not accurate enough to rule in or rule out surgery [17]. **Elsherbiny *et al.*** [16] reported that the sensitivity of Alvarado score was 56.8%, while its specificity was 91.7% in detecting patients with appendicitis. Its accuracy was 61%. **Farooq *et al.*** [18] reported that sensitivity, specificity, PPV, NPV, and accuracy of Alvarado score were 94.1%, 33.3%, 88.8%, 50% and 85% respectively when evaluating patients with suspected appendicitis.

In the current study, ultrasound had sensitivity and specificity of 80.4% and 76.9% respectively in identifying appendicitis. Its PPV and NPV were 92.5% and 52.6% respectively. According to certain studies, ultrasound can diagnose acute appendicitis with a sensitivity of 49 to 90%, a specificity of 47 to 100%, a PPV of 84 to 93%, and an overall accuracy of 72 to 94% [19]. Our provided results fall within the predefined intervals. An earlier study with parameters similar to ours found that, when compared to the gold standard of histological investigation, ultrasonography had sensitivity, specificity, and accuracy of 71.6%, 79.2%, and 72.5% respectively in diagnosing individuals with appendicitis [16].

Farooq and his coworkers [18] reported that ultrasound had sensitivity and specificity of 80% and 60% when evaluating patients with suspected appendicitis. In addition, PPV, NPV, and accuracy were 93.3%, 30%, and 77.5% respectively. In an additional study, sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 75% and 69.2% respectively [20]. Other authors reported higher diagnostic capabilities of ultrasound when evaluating appendicitis cases. **Mathews *et al.*** [21] reported that US sensitivity and specificity were 90% and 88.13% respectively, while the same values were 100% and 89% in the study performed by **Puylaert and his colleagues** [22].

Furthermore, **Jeffrey *et al.*** [23] reported that the sensitivity and specificity of US were 96.2% and 89.9% respectively. Whereas, another study reported that the same two parameters were 86% and 89% respectively. Lower diagnostic parameters were reported by **Samudre and Munde** [24] who reported that abdominal US had sensitivity of 78.7%, specificity of 25.0%, PPV of 94.26%, and a NPV of 6.97% [25]. One should expect some differences between reports regarding the diagnostic ability of ultrasound in such cases. That would differ according to patient criteria (like obesity and ileus that hinders good US visualization), different radiological expertise, as well as difference in probe and machine criteria, which may affect the diagnostic performance.

To improve accuracy of diagnosis of Alvarado score and ultrasound examination, we used a combined method of both to assess for acute appendicitis. Since Alvarado score comprised clinical and biochemical parameters, we assumed that the addition of an imaging parameter like US may enhance the overall performance of the score. Current findings showed that combining ultrasound with Alvarado score findings led to a significant improvement of the sensitivity and accuracy in identifying patients with appendicitis. The previous two parameters were 96.7% and 88.2% respectively. PPV and NPV were 89% and 83.3% respectively. In previous studies, **Elsherbiny and his associates** [16] found that the detection of appendicitis had a sensitivity and specificity of 68.4% and 100% respectively when US was paired with the Alvarado score. Additionally, 71.9% of diagnoses were correct**.** According to **Yazar *et al.*** [4]**,** the US and Alvarado scores combined resulted in an accuracy of 87% and sensitivity and specificity of 85.36% and 90%, respectively. The respective PPV and NPV values were 96.67% and 24.55%.

In the current study, the mean MPV in the appendicitis group was 8.02 ± 1.14 that was statistically significantly lower compared to the cases with no appendicitis (9 ± 0.7) (p= 0.025). This is in line with the findings of a retrospective research that was done in Turkey. 100 patients with AA and 100 healthy controls made up the sample size. The study discovered that kids with AA had significantly lower MPV values (p <0.001) [26]. The current findings are in line with those of **Oktay *et al.*** [27] who split 207 pediatric patients into three groups (non-AA, uncomplicated AA, and complicated AA). The non-AA group had the greatest mean MPV, and there was a statistical significance in MPV across the groups (p = 0.047). In the similar vein, there was a Chinese prospective trial with 92 AA patients and ninty healthy controls. The study also revealed that, when AA were compared to healthy controls, the MPV levels were considerably lower in AA (p<0.001) [28]**.** In addition, **Dooki *et al.*** [29] investigated 100 patients in total (fifty with AA and fifty without AA). According to the study, there was a substantial (p<0.001) difference between the mean MPV values of children with non-AA and those with AA**.** The current findings are in contrast to those of **Uyanik *et al.*** [30]**,** who included 305 patients with AA and 305 healthy controls. There was no statistical significance difference in MPV levels between the two groups, according to the study (p > 0.05) **]**. A study was done for evaluation of the accuracy of US and the Alvarado scoring system in AA, which is the opposite of the present findings. There were two hundred individuals in the sample (180 AA and 30 non-AA). The study also revealed that there was no discernible difference in MPV scores between the two groups (p = 0.830) [4].

In Iran, a case-control research was carried out. There were sixty AA cases and sixty controls in the sample. According to the study, there was no discernible difference between the 2 groups reading MPV (p > 0.05) [31]. One hundred healthy children were among the 219 youngsters studied by **Bozlu and his colleagues** [32] (141 had AA, 46 did not, and 32 had perforated AA). The investigation discovered no statistically significant difference between the groups' MPV values (p = 0.663). A recent study involving 150 controls, 197 non-AA patients, and 254 patients with AA. The study discovered no discernible difference in the groups (MPVs) [33].

In the current study, the best cutoff point of MPV For identification of appendicitis cases was < 8.92 with 78.3% sensitivity, 61.5% specificity and 66.2% accuracy. The current results agree with **Dinc *et al.*** [34] who showed that the best cutoff point of MPV < 8.98 fL

had 29.5%, 49% specificity, 61.1% PPV and 20.1% NPV in identifying the cases with acute appendicitis. This low sensitivity and specificity result may came from the emergency surgery after the clinical history and physical examination.

The MPV value considerably decreased in participants with non-complicated appendicitis at a cutoff level of 9.9500×10^9/L, with sensitivity and specificity of 59% and 59.5% respectively. This is similar to **Ceylan *et al.* [35].** The optimal MPV level cutoff point for AA, according to a study by **Albayrak *et al.* [7],** was 7.6 fL, with sensitivity, specificity, PPV, and NPV of 73%, 84%, 84% and 74% respectively.

CONCLUSION

While the Alvarado score and the combination of the two exhibited lower accuracy, the MPV had a greater diagnostic accuracy than the Alvarado score. The sensitivity and accuracy of diagnosing acute appendicitis were significantly improved when the Alvarado score and US examination were combined. MPV by itself is unable to offer further instruments for clinical suspicion and diagnostic confirmation. The diagnosis of appendicitis is improved by combining a set of MPV with radiographic examinations and clinical characteristics.

RECOMMENDATIONS

The Alvarado score should be used with US when evaluating patients who arrive with right lower quadrant discomfort because ultrasound is frequently used in emergency situations. In appendicitis situations, MPV alone shouldn't be a standard investigation.

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REFERENCES

1. **Jones M, Lopez R, Deppen J (2021):** Appendicitis. Treasure Island (FL): StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK493193/
2. **Alvarado A (2018):** Diagnostic scores in acute appendicitis. Current Issues in the Diagnostics and Treatment of Acute Appendicitis. IntechOpen. DOI: 10.5772/intechopen.77230
3. **Abdelrahim M, Khair R, Elsiddig K (2016):** The validity of Alvarado Score in diagnosis of acute appendicitis among Sudanese patients. Surgery Curr Res., 6 (1): 256-61.
4. **Yazar A, Erdoğan S, Şahin C *et al.* (2018):** Reliability of ultrasonography and the Alvarado scoring system in acute appendicitis. The Turkish J of Pedia., 60 (2): 172-9.
5. **Rao K, Harika D, Narayana S *et al.* (2021):** A comparative study on RIPASA and modified Alvarado score in the diagnosis of acute appendicitis in tertiary care hospital. Int Surgery J., 8 (3): 943-8.
6. **Talukder D, Siddiq A (2009):** Modified Alvarado scoring system in the diagnosis of acute appendicitis. J of Armed Forces Medical College, Bangladesh, 5 (1): 18-20.
7. **Albayrak Y, Albayrak A, Albayrak F *et al.* (2011):** Mean platelet volume: a new predictor in confirming acute appendicitis diagnosis. Clinical and Applied Thrombosis/Hemostasis, 17 (4): 361-6.
8. **Kansakar N, Agarwal P, Singh R *et al.* (2018):** Evaluation of combined use of modified Alvarado score and US in predicting acute appendicitis: a prospective study. International Surgery J., 5 (11): 3593-7.
9. **Pacharn P, Ying J, Linam L *et al.* (2010)**: Sonography in the evaluation of acute appendicitis: are negative sonographic findings good enough? J of US in Medicine, 29(12): 1749-55.
10. **Ohle R, O'Reilly F, O'Brien K *et al.* (2011):** The Alvarado score for predicting acute appendicitis: a systematic review. BMC Medicine, 9 (1): 139-52.
11. **Al Awayshih M, Nofal M, Yousef A (2019):** Evaluation of Alvarado score in diagnosing acute appendicitis. The Pan African Medical J., 34: 15. doi: 10.11604/pamj.2019.34.15.17803
12. **Frountzas M, Stergios K, Kopsini D *et al.* (2018):** Alvarado or RIPASA score for diagnosis of acute appendicitis? A meta-analysis of randomized trials. Int J of Surgery, 56: 307-14.
13. **Addiss D, Shaffer N, Fowler B *et al.* (1990):** The epidemiology of appendicitis and appendectomy in the US. American J of Epidemiology, 132 (5): 910-25.
14. **Aji N, Aliyu S (2012):** Appendicitis and its surgical management experience at the University of Maiduguri Teaching Hospital Nigeria. Nigerian J of Medicine, 21 (2): 223-6.
15. **Al-Hashemy A, Seleem M (2004):** Appraisal of the modified Alvarado score for acute appendicitis in adults. Saudi Med J., 25 (9): 1229-31.
16. **Elsherbiny M, Emile S, Abdelnaby M *et al.* (2020):** Assessment of the diagnostic accuracy of alvarado scoring system combined with focused US in the diagnosis of acute appendicitis. J of British Surgery, 107 (12): 594-5.
17. **Ohle R, O'Reilly F, O'Brien K *et al.* (2011):** The Alvarado score for predicting acute appendicitis: a systematic review. BMC Medicine, 9 (1): 1-13.
18. **Farooq A, Zameer S, Khadim R (2020):** Diagnostic accuracy of ultrasound in acute appendicitis in comparison with alvarado score keeping histopathological correlation as gold standard. PAFMJ., 70 (3): 807-11.
19. **Pinto F, Pinto A, Russo A *et al.* (2013):** Accuracy of US in the diagnosis of acute appendicitis in adult patients: review of the literature. Critical Ultrasound Journal, 5 (1): 1-3.
20. **Parsijani P, Zarandi N, Paydar S *et al.* (2013):** Accuracy of ultrasonography in diagnosing acute appendicitis. Bulletin of Emergency & Trauma, 1 (4): 158-62.
21. **George M, Siba P, Charan P *et al.* (2002):** Evaluation of Ultrasonography as a useful Diagnostic Aid in Appendicitis. IJS Surg., 64: 436-9.
22. **Puylaert J (1986):** Acute appendicitis: US evaluation using graded compression. Radiology, 158 (2): 355-60.

23. **Jeffrey R, Laing F, Townsend R (1988):** Acute appendicitis: sonographic criteria based on 250 cases. Radiology, 167 (2): 327-9.
24. **Adams D, Fine C, Brooks D (1988):** High-resolution real-time US: A new tool in the diagnosis of acute appendicitis. The American J of Surgery, 155 (1): 93-7.
25. **Samudre S, Munde A (2021):** Comparative study between clinical diagnosis using modified Alvarado score and ultrasound imaging in decreasing negative appendectomy rate. Int Surgery Journal, 8 (4): 1185-9.
26. **Bilici S, Sekmenli T, Göksu M *et al.* (2011):** Mean platelet volume in diagnosis of acute appendicitis in children. African Health Sciences, 11 (3): 427-32.
27. **Oktay M, Boğan M, Çolak S *et al.* (2020):** Evaluation of the diagnostic value of platelet indices in pediatric acute appendicitis. J of International Medical Research, 48 (9): 0300060520946515. https://doi.org/10.1177/0300060520946515
28. **Chen Y, Zhu J, Bai Z *et al.* (2020):** sB7H3 in Children with Acute Appendicitis: Its Diagnostic Value and Association with Histological Findings. J of Immunology Research, 20: 2670527. doi: 10.1155/2020/2670527.
29. **Dooki M, Nezhadan M, Mehrabani S *et al.* (2022):** Diagnostic accuracy of laboratory markers for diagnosis of acute appendicitis in children. Wiener Medizinische Wochenschrift, 172 (13-14): 303-7.
30. **Uyanik B, Kavalci C, Arslan E *et al.* (2012):** Role of MPV in diagnosis of childhood acute appendicitis. Emergency Medicine Int., 12: 823095. doi: 10.1155/2012/823095
31. **Nia A, Zareifar P (2018):** Mean platelet volume (MPV) in children with acute appendicitis. J of Pioneering Medical Sciences, 8 (1): 6-9.
32. **Bozlu G, Akar A, Durak F *et al.* (2019):** Role of mean platelet volume-to-lymphocyte ratio in the diagnosis of childhood appendicitis. Arch Argent Pediatr., 117 (6): 375-80.
33. **Duman L, Karaibrahimoğlu A, Büyükyavuz B *et al.* (2022):** Diagnostic value of monocyte-to-lymphocyte ratio against other biomarkers in children with appendicitis. Pediatric Emergency Care, 38 (2): 739-42.
34. **Dinc B, Oskay A, Dinc S *et al.* (2015):** New parameter in diagnosis of acute appendicitis: platelet distribution width. World J of Gastroenterology, 21 (6): 1821-26.
35. **Ceylan B, Aslan T, Çınar A *et al.* (2016):** Can platelet indices be used as predictors of complication in subjects with appendicitis? Wiener klinische Wochenschrift, 128: 620-25.