Original Article

Comparison between Modified Alvarado Score and Mean Platelet Volume as a Diagnostic Tool for Acute Appendicitis

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Abstract

Background: Acute appendicitis (AA) is a common surgical emergency. Accurate diagnosis and timely intervention reduce morbidity and mortality but diagnosis is still a great challenge. Modified Alvarado score (MAS) is helpful in minimizing unnecessary appendectomies and mean platelet volume (MPV) is a significant biomarker in the differential diagnosis of acute appendicitis but there is no study on comparison between modified Alvarado score and mean platelet volume as a diagnostic tool for acute appendicitis. **Objectives:** This study was conducted to investigate the diagnostic value of MPV in comparison with MAS for early diagnosis of acute appendicitis. **Methods:** 100 cases of clinically diagnosed acute appendicitis were taken in this study. MAS was calculated and MPV was estimated in all cases. Appendicectomy had done in all cases. Diagnosis has confirmed by histopathology. According to histopathology report cases are divided into two groups [Acute appendicitis (AA) 82 cases and Normal appendix (NA) 18 cases] then two groups were compared. Diagnostic value of MPV and MAS were analyzed using receiver operating characteristic (ROC) analysis and diagnostic value of MPV was compared with that of MAS. **Results:** Median MAS and median MPV values were found to be significantly higher in AA group (7, range: 6–8 vs. 4, range: 3–5; and 9.0 fL, range: 8.5–9.5 vs. 8.0 fL, range: 6.5–8.5) (P=0.005 and 0.001). There was no statistically significant difference regarding diagnostic value of MAS and MPV (P = 0.629). Sensitivity and specificity of MAS and MPV for recommended cut-off values were 82.9%, 77.8% and 79.3%, 61.1% respectively and combined sensitivity, specificity, positive predictive value and negative predictive value of MAS and MPV were 91.5%, 50.0%, 89.3% and 56.3%, respectively. **Conclusions:** The diagnostic value of MAS and MPV are same for AA but increased MPV may be used as a supportive parameter along with MAS for the diagnosis of AA.

Keywords: Modified Alvarado score. mean platelet volume, acute appendicitis.

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Introduction

AA is one of the most common causes of surgical emergency. Timely diagnosis is crucial. Diagnostic delay is associated with increased risk of perforation and consequently potential peritonitis, sepsis and death [1]. On the other hand, negative appendicectomy is associated with unnecessary risks and costs [2]. MAS consisting of clinical history, physical examination and some laboratory tests was used for diagnosis of acute appendicitis. Im¬aging modalities like ultrasonography and comput-er¬ized tomography, as well as diagnostic laparoscopy have been increasingly used for fast and accurate diagnosis [3]. Although advanced diagnostic tests and imaging modalities have

been developed, false diagnosis rate is still high (about 15-30% of cases) [4]. Therefore, easy, widely avail¬able, cheap, and time-saving new laboratory methods are needed.

Platelet count (PC) is a part of complete blood count (CBC) and one of the most commonly used laboratory tests. There are three CBC parameters related to platelets; plateletcrit (PCT), mean platelet volume (MPV) and plate¬let distribution width (PDW). MPV is a machine-calculated measurement of the average size of platelets found in blood and is included in blood tests as part of the CBC. MPV is the most well-known of these parameters and is a marker of platelet function and activation. It has been studied as an inflammatory marker in various diseases including AA. MPV is higher when there is destruction of platelets. This may be seen in inflammatory bowel disease, immune thrombocytopenic purpura, myeloproliferative diseases and Bernard-Soulier syndrome. It may also be related to pre-eclampsia, and recovery from, transient hypoplasia. Abnormally low MPV values correlate primarily with thrombocytopenia when it is due to impaired production as in aplastic anemia.

Tanrikulu et al. and Bilici et al demonstrated decreased MPV in AA in their studies but Narci et al. and Recep Aktimur et al. showed increased MPV in AA in their studies [5, 6].

Objectives

This study was conducted to investigate the diagnostic value of MPV and compare the diagnostic accuracy of MPV with that of MAS.

Materials and Methods

This prospective observational study was conducted in the Department of Surgery of Satkhira Medical College Hospital, Satkhira, Bangladesh for the period May 2024 to September 2024. Total 100 cases were studied in this study by purposive sampling as per inclusion criteria of patients with provisional diagnosis of AA who underwent appendicectomy and exclusion criteria of patients with appendicular mass or abscess, generalised peritonitis due to appendicular perforation, appendix malignancies, pregnant women, and patients younger than 15 years.

MAS was calculated and MPV was estimated in all patients. Then all the patients underwent appendicectomies. Per operative findings were recorded. The appendicectomy specimen was sent for histopathological examination. The histopathology report was considered as the final diagnosis. According to histopathological assessment of the specimens, two groups were designed: the patients who have histopathologically confirmed diagnosis of acute appendicitis (AA group), and those with histopathological diagnosis of normal appendix (NA group).

Statistical analysis

Nonparametric statistics were used to present data. Consequently, medians with 25th and the 75th percentiles were given for descriptive statistics. Continuous variables were compared using Independent Samples Median Test and categorical variables were compared using Related Samples McNemar Test for two groups. MAS and MPV were found to be statistically different between groups, and they were analysed for their diagnostic value in AA with using ROC analysis. Recommended cut-off values of the parameters were determined for optimum sensitivity and specificity ratios of the diagnostic tests. And positive and negative predictive value (PPV and NPV) were calculated using recommended cut-off values. P value <0.05 was considered statistically significant. Statistical analysis was performed with the IBM SPSS Statistics 23.

Results

A total of 100 patients who underwent open or laparoscopic appendicectomies with a pre-

diagnosis of AA were included the study. There were 82 (82%) patients in AA group and 18 (18%) patients in NA group. No difference was found between the two groups with respect to age and gender of demographic characteristics but the median MAS and the median MPV values were found to be significantly higher in AA group (Table I).

The cut-off values of MAS and MPV for the diagnosis of AA were determined using receiver operating characteristic (ROC) analysis. At each value, the sensitivity and specificity for each outcome under study were plotted. Recommended cut-off values of the parameters were determined for optimum sensitivity and specificity ratios of the diagnostic tests. The diagnostic value of the recommended cut-off values of MAS and MPV and area under the curve were presented in Table II. ROC curves of MAS and MPV were shown in Figure 1.

Table I. Demographic characteristics and MAS and MPV values of the groups (n = 100).

Demographic characteristics	AA group (n = 82)	NA group (n = 18)	*p* value
Age (years) median (range)	25 (19 – 34)	28 (25 – 34)	0.055
Gender			
Male n (%)	45 (55)	13 (72)	1.00
Female n (%)	37 (45)	5 (28)	
MAS median (range)	7 (6 – 8)	4 (3 – 5)	0.005*
MPV (fL) median (range)	9.0 (8.5 – 9.5)	8.0 (6.5 – 8.5)	0.001*

MAS : Modified Alvarado score, MPV : Mean platelet volume, AA : Acute appendicitis, NA : Normal appendix, n : Number of patients, range: The range between the 25th and the 75th percentiles, *: Significantly different from the control value, $p < 0.05$

Independent Samples Median Test was used to test the significance of difference of AA group with NA group (control) and the significance level was at $p < 0.05$.

Table 2. The diagnostic value of the recommended cut-off values of MAS and MPV in the diagnosis of AA and area under the curve.

Recommended cut-off value	Sensitivity (n = 82)	Specificity (n = 82)	AUC	95% CI	*p* value
MAS value = 6	82.9	77.8	0.882	0.799–0.965	< 0.05
MPV (fL) = 8.5	79.3	61.1	0.775	0.654–0.896	< 0.05

MAS : Modified Alvarado score, MPV : Mean platelet volume, AA : Acute appendicitis, AUC : Area under the curve, CI : Confidence interval.

Combined sensitivity, specificity, positivepredictive value and negative predictive value of MAS and MPV for recommended cut-off values were 91.5%, 50.0%, 89.3% and 56.3%, respectively.

A Related Samples McNemar Test was used for paired comparison between MAS and MPV. No significant difference was found between these two procedures (P value > 0.05). So, the two procedures (MAS & MPV) are same as a diagnostic tool for acute appendicitis.

Discussion

In spite of the common occurrence of the disease, advanced diagnostic tests, and imaging modalities, negative appendectomy rates are still high. Although, a lot of biomarkers or investigations have been suggested in the diagnosis of AA, most of them are expensive and

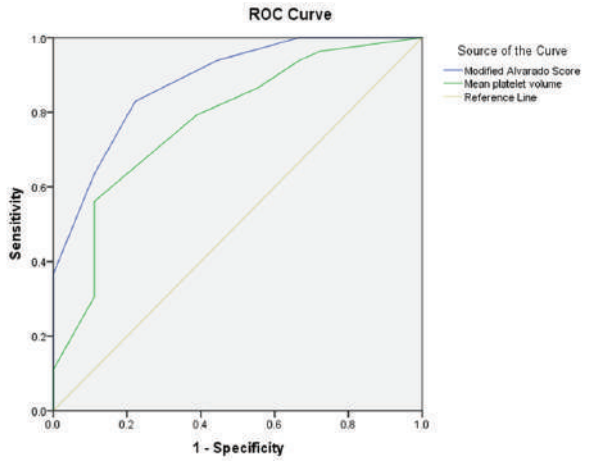


Figure I: Receiver operating characteristic (ROC) curves of Modified Alvarado scoreand mean platelet volume.

unavailable in most of the emergency departments. Therefore, as a cheap and commonly available diagnostic marker, inflammation-related CBC parameters and a clinical and laboratory-based scoring system MAS has been used. Detected value of MPV has been shown to be affected in many inflammatory disorders and it was shown that it could be used as a diagnostic marker for AA. Although MAS and MPV have been studied separately or with different combination but comparison between MAS and MPV has not yet been studied in the diagnosis of AA.

This study demonstrates a diagnostic value of MAS and MPV in the differential diagnosis of AA. The results of this study show that the two procedures (MAS & MPV) are same as a diagnostic tool for acute appendicitis. In AA group we found significantly higher MAS and MPV values. Platelet activation is reflected from the diseases which were prone to thrombosis and inflammation [5]. Previous studies have shown that, MPV values increases in cardio- and cerebrovascular disorders and low-grade inflammatory conditions which are prone to thrombosis [6]. On the contrary, in high-grade inflammatory diseases including rheumatoid arthritis (RA) and Crohn's disease (CD) lower MPV values are present. Tanrikulu et al. [5] demonstrated decreased MPV in AA patients. Albayrak et al. and Bilici et al [6] showed lower MPV values in AA patients with the comparison of healthy adults and pediatric individuals but our study shows increased MPV in AA patients. On the other hand, Uyanık et al. [7] reported no statistically significant difference in MPV between AA and control group of healthy children. They commented that this difference could have resulted from a possible statistical error, due to frequent occurrence of clinically occult inflammation in pediatric age group. Increased MPV in AA were reported in one study conducted by Narci et al [8]. They suggested that higher MPV values might guide the diagnosis of acute appendicitis, with 66% sensitivity and 51% specificity. And another study conducted by Recep Aktimur et al. [9]. They suggested that increased MPV values may be used as a valuable diagnostic tool of acute appendicitis, with 57.1% sensitivity and 60.7% specificity. In the present study, we have found higher MPV and MAS values in AA group, for recommended cut-off value of 8.5 fL, the sensitivity and the specificity for MPV were calculated as 79.3% and 61.1% and for recommended cut-off value of 6, the sensitivity and the specificity for MAS were calculated as 82.9% and 77.8%. Combined sensitivity and specificity of MAS and MPV for recommended cut-off values were 91.5% and 50.0%. Here combined sensitivity is high but specificity is low.

Conclusion

The results of this study, integrated with the understanding from the available literature indicates that MPV is increased in acute appendicitis. No difference was found between MPV and MAS in diagnosis of acute appendicitis. So, the diagnostic value of MAS and MPV are same but MPV may be used as a supportive parameter for the diagnosis of acute appendicitis.

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