Mean Platelet Volume is Reduced in Acute Appendicitis

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SUMMARY

Objectives

Acute appendicitis (AA) is the most common indication for emergency abdominal surgery, although it remains difficult to diagnose. In this study, we investigated the the clinical utility of mean platelet volume in the diagnosis of acute appendicitis.

Methods

The medical records of 241 patients who had undergone appendectomy between June 2013 and March 2014 were investigated retrospectively. Sixty patients who had undergone at least one complete blood count during preoperative hospital admission and who had no other active inflammatory conditions at the time the sample was taken were included in the study. Mean platelet volume and leukocyte count values were determined in each patient at hospital admission and during active acute appendicitis. Age, sex, mean platelet volume and leukocyte counts were recorded for each patient.

Results

The mean age of patients was 33.15±10.94 years and the male to female ratio was 1.5:1. The mean leukocyte count prior to acute appendicitis was 7.42±2.12×10^3/mm^3. Mean leukocyte count was significantly higher (13.14±2.99×10^3/mm^3) in acute appendicitis. The optimal leukocyte count cutoff point for the diagnosis of acute appendicitis was 10.10×10^3/mm^3, with sensitivity of 94% and a specificity of 75%. The mean platelet volume prior to acute appendicitis was 7.58±1.11 fL. Mean platelet volume was significantly lower (7.03±0.8 fL) in acute appendicitis. The optimal mean platelet volume cutoff point for the diagnosis of AA was 6.10 fL, with a sensitivity of 83% and a specificity of 42%. Area under the curve for leukocyte count diagnosis was 0.67 and 0.69 for the diagnosis of AA by mean platelet volume.

Conclusions

Mean platelet volume was significantly decreased in acute appendicitis. Mean platelet volume can be used as a supportive diagnostic parameter in the diagnosis of acute appendicitis.

Key words: Acute appendicitis; diagnosis; mean platelet volume.

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Introduction

Acute appendicitis (AA), remains the most common indication for emergency abdominal surgery with a lifetime incidence of 7%.[1] Although AA can occur at any age, onset of infection is most common between the ages of 10 and 20 years . AA is more common in males, with a reported male to female ratio of 1.4:1. The cause of AA is unknown and is likely to be multi-factorial; luminal obstruction, dietary, and familial factors have all been proposed as potential contributors to AA.[2] The diagnosis of AA can be difficult due to the the absence of a pathognomonic signs or symptoms and the poor predictive value of associated laboratory testing.[3] Inflammation plays an important role in the pathology of AA.[4] Laboratory indicators that have been associated with AA include leukocytosis, left shift, and elevated markers of inflammation such as C-reactive protein and erythrocyte sedimentation rate.[5] Mean platelet volume (MPV) is a measure of platelet size generated by full blood count analyzers as part of the routine complete blood count test.[6] Although MPV is not generally taken into consideration by clinicians, it may be a marker of platelet activation. Large platelets are more reactive, produce more pro-thrombotic factors, and aggregate more easily.[7] Mean platelet volume is one of the most widely used surrogate markers of platelet function and has been shown to reflect inflammatory burden and disease activity in several diseases including pre-eclampsia, acute pancreatitis, unstable angina, myocardial infarction, and systemic inflammation such as ulcerative colitis and Crohn's disease.[8]

The aim of this study is to investigate the supporting role of MPV in the diagnosis of AA. In the present study each patient's previous MPV and leukocyte count (LC) values, collected under non-inflammatory conditions, were compared with laboratory values from samples taken at the time of AA.

Material and Methods

This study was designed and conducted at Sakarya University Education and Research Hospital. We retrospectively reviewed the medical records of 241 patients who had undergone appendectomy in the General Surgery Unit between June 2013 and March 2014. The primary analysis in this study was the comparison of the patient MPV and LC values that at the time of AA to data collected prior to the operation. In this study, laboratory and clinical data were obtained from the digital medical records database of the hospital. All patients included in the study had confirmed AA noted in the surgical report.

The medical records of 241 patients who underwent appendectomy for AA were investigated. Exclusion criteria and the number of excluded patients are listed in Table 1.

A total of 103 patients were excluded from study. Records for the remaining 138 patients were examined retrospectively using the computerized medical records database of the hospital. This evaluation included all records dated withing the previous 6 years. In 78 patients no blood sample data prior to the onset of AA were available. Twenty three patients had a diagnosis of tonsillitis, 18 patients had gastroenteritis, 11 patients had pneumonia, 10 patients had soft tissue infection, 9 patients had renal colic, 5 patients had bone fracture and 2 patients had a diagnosis of acute cholecystitis. As a result, these patients were excluded from study. According to the medical records 60 patients had provided least one blood sample was taken during a previous non-inflammatory state. These patients were included in the study. The clinic where each patient was admitted prior to onset of AA, the diagnosis at this clinic, gender, and the number of patients are shown in the Table 2.

Previous MPV and LC values corresponding to the non-inflammatory state were determined in all 60 patients (Group 1). Mean platelet volume and LC values of the same patients at the time of AA were also determined (Group 2). These values were obtained from the first blood samples collected after onset of AA. Age, sex, MPV and LC values were recorded.

The LC and MPV analyses were performed using a commercially available analyzer (CELL-DYN 3700, Abbott Diagnostics, Abbott Park, IL, USA) in the laboratory. The upper limits of the reference interval for LC was 4600-10200/μL. The expected MPV values in our laboratory ranged between 7.0 and 12 fL.

Statistical Analysis

Statistical analyses were performed using SPSS software (SPSS: An IBM Company, version 16.0, IBM Corporation,

Table 1. Exclusion criteria and number of excluded patients

Exclusion criteria	Number of excluded patients
Patients under the age of 18	2
Pregnant women	9
A history of additional diseases and chronic drug use	19
Patients that had no any hospital admission before operation	73

Table 2. Referenced clinics, diagnoses, gender and number of patients that previous blood samples were taken during an non-inflammatory state

Referenced clinic	Diagnosis	Gender
Cardiology	Nonspecific chest pain	Male: 8; Female: 10
Blood bank	Blood donation	Male: 9
Internal medicine	Dyspepsia, constipation	Male: 6; Female: 5
PTR	Myalgia	Male: 2; Female: 2
Psychiatry	Depression and anxiety	Male: 1; Female: 3
Neurology	Benign positional vertigo	Male: 3; Female: 1
Chest diseases	Dyspnea	Male: 2; Female: 1
Urology	Infertility and BPH	Male: 2
Otorhinolaryngology	Tinnutus and NSD	Male: 2
Obstetrics	Infertility	Female: 1
İnfectious diseases	Tick bite	Male: 1; Female: 1

PTR: Physical Therapy and Rehabilitation; BPH: Benign Prostatic Hypertrophy; NSD: Nasal Septum Deviation.

and Armonk, New York, USA). All data are expressed as the mean±standard deviation. The Student's *t*-test was used to compare continuous variables between the control and the patient groups. The Pearson correlation analysis was carried out to examine the linear relationships among the variables. The cut-off values for discrimination of the groups were determined using Receiver Operating Characteristic (ROC) curve analysis. The areas under the ROC curves (AUC) were calculated and the specificity, sensitivity and accuracy of the LC and MPV for predicting AA were calculated for various cut-off points.

Results

A total of 60 patients were included in the final study group The mean age of the patients was 33.15±10.94 years (range: 19 to 70 years); 36 patients were male and 24 patients were female. The male to female ratio was 1.5:1.

The mean LC was 7.42±2.12×10^3/mm^3 in group 1 and 13.14±2.99×103/mm^3 in group 2. There was a significant difference between group 1 and group 2 with respect to LC (p=0.02). Receiver operating characteristic curve analysis indicated that the best cutoff point for LC in the diagnosis of AA was 10.10×10^3/mm^3, which had a sensitivity of 94% and a specificity of 75%. Area under curve for LC was 0.67 (Figure 1).

The mean MPV 7.58±1.11 fL in group 1 and 7.03±0.8 fL in group 2. Mean platelet volume was significantly lower in the group 2 relative to group 1 (p=0.01). Receiver operating characteristic curve analysis suggested that the optimal cut-off point for MPV in the diagnosis of AA was 6.10 fL, which had a sensitivity of 83% and a specificity of 42%. Area under curve for MPV was 0.69 (Figure 2).

Discussion

Acute appendicitis is one of the most common indications for emergency surgery.[9] Appendicitis occurs in patients of all ages, although it is more common among patients 10 to 30 years old.[10] AA is more common in men, with a male to female ratio of 1.4:1.[2] In our study group the mean age of the patients was 33.15±10.94 years (range: 19 to 70 years), and the male to female ratio was 1.5:1, findings that are consistent with the current literature.

Several reports have suggested that elevated LC is typically the first laboratory measure to indicate inflammation of the appendix, and most patients with AA present with leukocytosis.[11,12] In several published studies, the sensitivity and specificity of LC in the diagnosis of AA has been reported as 67%-97.8% and 31.9%-80%, respectively.[13,14] The present study found that LC was significantly higher in AA, and the sensitivity and specificity of LC were 94% and 75%, respectively.

Elevated MPV has been associated with chronic inflammatory disease. Elevated MPV has been correlated with coronary artery disease severity[15,16] as well as acute pancreatitis remission,[17] chronic sinusitis,[18] arterial erectile dysfunction,[19] varicocele,[20] and chronic hepatitis B infection.[21] Elevated MPV reflects augmented production of platelets and an increased number of large, hyperaggregable platelets.[22] Reduced MPV has been associated with acute inflammatory disorders. Reduced MPV has been recently demonstrated in rotavirus gastroenteritis,[23] as well as exacerbation of chronic obstructive pulmonary disease,[24] active pulmonary tuberculosis,[25] and acute pancreatitis.[8] Similar to these these studies, we found significantly lower MPV in patients with AA. A number of previous studies have reported varying results regarding the

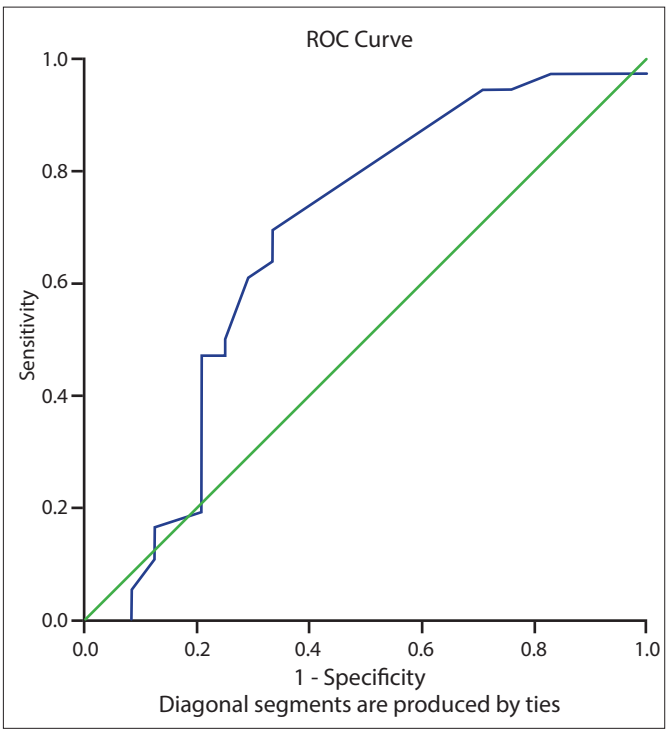

Figure 1. Receiver operating characteristic curve of leukocyte count.

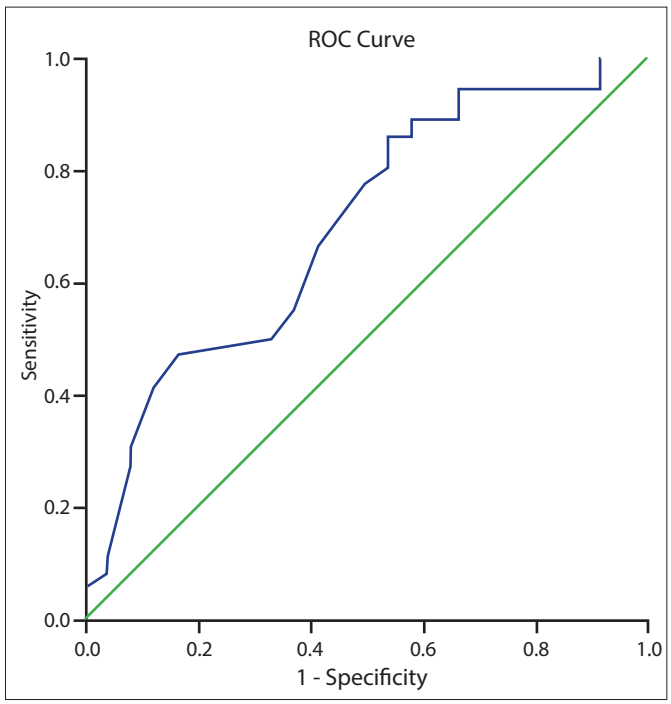

Figure 2. Receiver operating characteristic curve of mean platelet volume.

association between MPV and AA. Uyanik *et al*.[26] found no significant decrease in MPV in AA patients, but Narci and colleagues reported significantly higher MPV in AA patients.[27] Similar to the present study, Albayrak,[28] Tanrikulu,[29] Bilici[30] and their coworkers reported a significant decrease in MPV in AA patients relative to healthy control subjects. In all of these studies the control group was composed of distinct patients with no symptoms, including patients admitted to outpatient centers for routine exams. Inter-individual platelet responsiveness to a variety of agonists is highly variable.[31] This may introduce bias into certain study designs. Our study is therefore more meaningful because control and AA groups data were obtained from the same patients and there was no intra-individual differences between patients in terms of MPV. The present study thereofore has excellent clinical applicability.

Albayrak *et al*. reported sensitivity of 73%, and specificity of 84% using an MPV cut-off of 7.6 fL in the diagnosis of AA.[28] Tanrikulu *et al*. Reported sensitivity of 45% and specificity of 89% using an MPV cutoff point of ≤7.3 fL in the diagnosis of AA.[29] Additionally, Bilici *et al*. Reported specificity of 54% and sensitivity of 87% using an MPV cut-off of <7.4 fL to diagnose AA.[30] Comparable to these studies, we found specificity of 42% and sensitivity of 83% using an MPV cut-off of 6.10 fL in the diagnosis of AA. Sensitivity and specificity of LC were higher than the MPV. This may be attributable to physician preference for LC over MPV in the diagnosis of AA. In the present study, the area under curve for MPV was 0.69 and 0.67 for LC. Bilici *et al*. reported AUC of 0.80 for MPV and 0.94 for LC.[30] Tanrikulu et al. reported AUC of 0.71 for MPV and 0.87 for LC.[29] According to these results, LC has greater diagnostic accuracy for AA than MPV. However, MPV is a useful-supportive parameter in the diagnosis of acute appendicitis.

Limitations

It was impossible to exclude the presence of undocumented inflammatory conditions in patients at the time when the baseline blood sample was collected. This was the most important limitation of this study. The relatively small number of patients included in the study may also represent a limitation.

Conclusion

Acute appendicitis is the most common indication for emergent abdominal surgery and remains difficult to diagnose. The current study indicates that mean platelet volume is decreased in acute appendicitis. Mean platelet volume has lower diagnostic accuracy than leukocyte count in acute appendicitis, although it can be used as a supportive parameter in the diagnosis of acute appendicitis.

Conflict of Interest

The authors declare that there is no potential conflicts of interest.

Ethics Committee Approval

Due to the retrospective nature of this study ethics committee approval was waived.

Informed Consent

Due to the retrospective nature of this study informed consent was waived.

Financial Disclosure

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