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Evaluation of mean platelet volume as an inflammatory marker in patients with acute cholecystitis

Ersan Eroğlu

Department of General Surgery, Memorial Bahcelievler Hospital, İstanbul, Türkiye

ABSTRACT

Introduction: Acute cholecystitis (AC) is an acute inflammatory condition that involves the gallbladder wall with various degrees of severity. Studies investigating mean platelet volume (MPV) in AC are limited. The objective of this study was to evaluate the diagnostic role of MPV in patients with AC.

Materials and Methods: AC patients who had abdominal ultrasonography and laboratory findings were included in the study. A control group was created with age- and gender-matched healthy individuals who had laboratory findings in the medical records. All participants' demographic data such as age, gender, height, weight and body mass index, smoking, and alcohol consumption status, AST, ALT, hemoglobin, platelet distribution width, MCV, MPV, RDW, white blood cell (WBC), and PLT values were obtained from the medical records and compared between the patient and control groups.

Results: The mean age was found as 44.34±13.11 years in the patient and 40.04±9.56 years in the control group. WBC count was significantly higher in the patient group compared to the control group (p=0.001). The mean MPV value was statistically significantly lower in the patient group compared to the controls (p<0.001). There was a statistically significant difference between the patient and control groups in terms of the mean platelet counts (p<0.05). In the correlation analysis, MPV was negatively correlated with platelet count and plateletcrit (PCT).

Conclusion: Early diagnosis reduces the rates of morbidity and mortality in patients with AC. MPV that can be easily obtained through complete blood count can be used to support the diagnosis.

Keywords: Acute cholecystitis, Hemoglobin, Inflammatory markers, Mean platelet volume, Plateletcrit, Platelets, White blood cell

Introduction

Acute cholecystitis (AC) is an acute inflammatory condition that involves the gallbladder wall with various degrees of severity.[1] AC is the most common complication of gallstones, requiring hospital admission and prompt intervention.[2] In many AC cases, the etiology is the obstruction of the cystic duct with an impacted stone in the neck of the gallbladder or the cystic duct.[3] The reported mortality from AC is approximately 3%, but this rate increases with age and comorbidity of the patients. AC is diagnosed in approximately 200,000 people in the USA each year.[4] Early diagnosis and treatment of AC significantly decrease the rates of mortality and morbidity.

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Correspondence: Ersan Eroğlu, M.D., Memorial Bahçelievler Hastanesi, Genel Cerrahi Anabilim Dalı, İstanbul, Türkiye
e-mail: mdersaneroglu@gmail.com

Diagnosis is the starting point of the management of AC, and prompt and timely diagnosis should lead to early treatment and the lower rates of mortality and morbidity. Ultrasonography (US) examination is an effective diagnostic tool in patients with AC, especially when used on patients admitted for emergency surgery.[5] US is the most valuable diagnostic method in the diagnosis of AC with a reported sensitivity of 80–100% and specificity of 60–100%.[6]

Several laboratory parameters are used to support the diagnosis. These markers include white blood cell count (WBC), C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR).[7] Platelets are discoid cells, roughly 2–3 mm in diameter that serve mainly as regulators of hemostasis, but also play secondary roles in angiogenesis and innate immunity. In addition, there is accumulating evidence that they also play a critical role in immune responses and inflammation.[8] Platelets are activated to release inflammatory mediators after tissue injury.[3] In complete blood count (CBC), there are three components related to platelets including mean platelet volume (MPV), plateletcrit (PCT), and platelet distribution width (PDW). MPV is the best platelet marker, which can be easily measured by routine CBC.[9] The study of MPV can provide information on the course and prognosis in many inflammatory conditions. Platelets rapidly migrate to the site of inflammation where they undergo activation. This seems to explain the decrease in MPV in patients with ongoing inflammation.[10] MPV was previously investigated and found to have diagnostic value in detecting inflammatory disease such as rheumatoid arthritis, ankylosing spondylitis, celiac disease, ulcerative colitis, and acute pancreatitis.[9,11,12] However, studies investigating MPV in AC are limited. Therefore, the objective of this study was to evaluate the diagnostic role of MPV in patients with AC.

Materials and Methods

The study protocol was approved by the local ethics committee of Memorial Hospital with the 22/03/2022 dated and 33 numbered decision. Informed consent was waived due to the retrospective nature of the study. This study was conducted in line with the ethical principles of the Declaration of Helsinki revised in 2013.

Patient files and records between 2018 and 2022 were screened for the diagnosis of AC. AC patients who had abdominal US and laboratory findings were included in the study. Patients with thrombocytopenia, cardiovascular disease, hypertension, peripheral vascular disease, metabolic disease, kidney or liver disease and those with malignancy were excluded from the study. In addition, patients receiving medications that may affect platelet functions such as anticoagulants or nonsteroidal anti-inflammatory drugs were also excluded from the study. A control group was created with age and gender matched healthy individuals who had laboratory findings in the medical records.

Patients' admission complaints, duration of hospitalization, complications, and operation time were recorded. In addition, all participants' demographic data such as age, gender, height, weight and body mass index, smoking and alcohol consumption status, AST, ALT, Hemoglobin, PDW, MCV, MPV, RDW, WBC, and PLT values were obtained from the medical records and compared between the patient and control groups.

The diagnosis of AC was established through a physical examination involving pain in the right quadrant, laboratory findings including elevated ESR and WBC, positive CRP and US findings. All ultrasonographic examinations were performed by the same radiologist.

Reference range values for CBC data according to local calibration of our laboratory were: Platelets – 150–400 $\times 10^3/\mu L$; PDW 15–17; PCT – 0.1–0.3%; and MPV 6–11 femtoliters (FL).

Statistical Analysis

Data obtained in this study were statistically analyzed using the SPSS version 25.0 (SPSS, Statistical Package for the Social Sciences, IBM Inc., Armonk, NY, USA) statistical package. Normality of the variables was tested using the Kolmogorov–Smirnov method. A Student's t-test was used for the statistical comparison of data that matched normal distribution and the Mann–Whitney U-test was used for the statistical comparison of the groups when data were not distributed normally. Continuous variables are expressed as mean±standard deviation and categorical variables as frequency and percentage. The Pearson correlation analysis was used to determine the correlation between MPV, PLT, PCT, and PDW. A multiple linear regression analysis was used to determine the prognostic factors that may affect MPV. $P<0.05$ values were considered statistically significant.

Results

A total of 186 patients were included in the study. Of all patients, 103 (55.38%) were in the patient and 83 (44.62%) were in the control group. The mean age was found as 44.34±13.11 years in the patient and 40.04±9.56 years in the control group. No statistically significant difference was found between the groups in terms of age (p=0.13). There were 39 males and 64 females in the patient group and 48 males and 35 females in the control group. Again, no significant difference was found between the groups in terms of gender. The descriptive characteristics of the groups are given in Table 1.

The mean WBC value was found as 7.81±2.60 × 10^3/µl in the patient group and 6.73±1.66 × 10^3/µl in the control group. WBC count was significantly higher in the patient group compared to the control group (p=0.001). The mean hemoglobin value was found as 13.36±1.97 g/dL in AC patients and 13.82±1.58 in the control group. No statistically significant difference was found between both groups in terms of hemoglobin values (p=0.084).

The mean MPV value was 9.12±1.05 FL in the patient and 9.41±0.77 FL in the control group. The mean MPV value was statistically significantly lower in the patient group compared to the controls (p<0.001). The mean platelet count was found as 256.12±112.2 × 10^3/µL in the patients with AC and 249.56±110.25 × 10^3/µL in the control group. There was a statistically significant difference between the patient and control groups in terms of the mean platelet counts (p<0.05).

The mean PDW value was found as 15.65±1.20 FL in the patient group and 16.02±0.42 FL in the control group. The mean PDW value was statistically significantly higher in the patient group (p<0.001). The mean PCT value was found as 0.26±0.31 in the patient and 0.24±0.04 in the control group with a significant difference in favor of the patient group (p=0.004) (Table 2).

In the correlation analysis, MPV was negatively correlated with PLT count and PCT (Table 3).

Discussion

In the present study, we investigated the diagnostic value of MPV and PLT in patients with AC. AC results from

Table 1. Descriptive characteristics of the patient and control groups

	Patient (n=103)	Control (n=83)	p
Gender			
Male	39 (37.86%)	48 (57.83%)	0.007
Female	64 (62.14%)	35 (42.17%)	
	Mean±SD	Mean±SD	
Age	44.34±13.11	40.04±9.56	0.13
Height	170.78±8.01	171.40±9.58	0.631
Weight	72.64±10.58	74.71±14.80	0.268
BMI	24.85±2.67	25.22±3.29	0.398
Smoking	28 (27.18%)	11 (13.25%)	<0.001
Alcohol	2 (1.94%)	1 (1.20%)	<0.001

Table 3. Correlations of MPV with the other platelet components

MPV	PLT	PCT	PDW
Pearson correlation	−0.402	−0.176	0.086
Sig. (two-tailed)	0.001	0.038	0.276

MPV: Mean platelet volume.

Table 2. CBC parameters of the patient and control groups

Parameter	Patient (n=103) Mean±SD	Control (n=83) Mean±SD	p
WBC (×10^3/UL)	7.81±2.60	6.73±1.66	0.001
Hb (g/dL)	13.36±1.97	13.82±1.58	0.084
MPV (fL)	9.95±1.05	9.41±0.77	<0.001
PLT (×10^3/µL)	256.12±112.2	249.56±110.25	<0.001
PCT (%)	0.26±0.31	0.24±0.04	0.004
PDW (fL)	15.65±1.20	16.02±0.42	<0.001

CBC: Complete blood count.

obstruction of the cystic duct, usually by a gallstone, followed by chemical or bacterial inflammation of gallbladder.[13] The cause of AC is uncertain and may be multifactorial, including increased susceptibility to bacterial colonization of the gallbladder bile. Signs and symptoms of AC include progressing right upper quadrant abdominal pain with bloating, tenderness over the abdomen, food intolerance, increased gas, nausea/vomiting, and fever.[14] Signs and symptoms of AC usually occur after a large or fatty meal.

A gallbladder US is the best test to evaluate gallbladder disease initially. A thickened gallbladder wall and gallstones are common US findings in AC.[15,16] Ultrasonographic findings include positive sonographic Murphy's sign, thickened gallbladder wall (>4 mm), enlarged gallbladder, debris echo, incarcerated gallstone, sonolucent layer in the gallbladder wall, pericholecystic fluid collection, and striated intramural lucencies.[17]

In addition, laboratory findings such as WBC, ESR, and CRP are used to support the diagnosis. Local and systemic findings of inflammation with imaging findings are diagnostic. Local findings include right upper quadrant pain and tenderness, while systemic findings involve elevated ESR, CRP, WBC, and fever.[17] However, ESR and CRP have some disadvantages in the diagnosis of AC. ESR may be influenced by age and gender of the patient and other non-inflammatory conditions such as renal failure or anemia. CRP begins to rise 48 h after symptoms onset and have similar limitations.

These limitations have prompted the researcher to seek other inflammatory markers to help the diagnosis of AC. Recent studies have focused on MPV for this purpose. MPV is a machine calculated measurement of the average size of platelets that are vital components of normal homeostasis and can release several inflammatory cytokines. MPV has been used to represent the inflammatory load and disease activity in various diseases.[3] Studies have shown that MPV can provide important information on the course and prognosis in many pathological conditions, such as cardiovascular diseases, rheumatoid arthritis, juvenile systemic lupus erythematosus respiratory diseases, Crohn's disease, diabetes mellitus, and the majority of neoplastic diseases.[18-22]

In the present study, the mean MPV value was significantly lower in patients with AC than in the control group. Similarly, Sayit et al. found the lower MPV values in the AC group.[3] In a study by Seker et al., MPV values were found to be significantly lower in the AC group when compared to those in chronic cholecystitis and control groups.[7] Our finding is consistent with the literature. On the other hand, in our study, there were significant differences between the groups in terms of PLT, PCT and PDW values. In addition, MPV was significantly correlated with PLT and PCT in the negative direction. This might be attributed to the migration of the platelets to the site of inflammation, where they undergo activation and wear.

The major limitations of our study are its retrospective nature and relatively small number of patients. In addition, other laboratory parameters could be compared between the groups. However, given the scarcity of studies on this issue, we believe that our findings will be guiding for more comprehensive studies with larger series of patients to be conducted in the future.

Conclusion

Early diagnosis reduces the rates of morbidity and mortality in patients with AC. In addition to the other laboratory parameters, MPV that may be easily obtained through CBC can be used to support the diagnosis. However, further studies are needed to draw more definitive conclusions on the diagnostic value of MPV.

Disclosures

Ethichs Committee Approval: The study protocol was approved by the local ethics committee of Memorial Hospital with the 22/03/2022 dated and 33 numbered decision.

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Conflict of Interest: None declared.

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