

## Mean platelet volume (MPV) in diagnosis of acute appendicitis among children: A case control study

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### Abstract

**Objectives:** To explore the diagnostic value of mean platelet volume for acute appendicitis among children.

**Study design:** The study design was a case control.

**Place and duration:** The study duration was 6 months (June 2012-November 2012) and conducted in Department of Surgery, P.A.E.C General Hospital, Islamabad.

**Subject & Methods:** A sample size of 140 was achieved using WHO formula with 80% power, SD 1.09, anticipated population 7.55 and 5% significance level with cases to control ratio of 1:1. A simple random sampling (lottery method) was used for selecting patients. Both groups were compared for continuous variables using t- test. A correlation test was performed to the relationship of MPV with other variables.

**Results:** The study includes 140 participants. Among the 70 (100%) cases, there were 30 (43%) males and 40 (57%) females. While among controls 70 (100%), there were 33 (47%) males and 37 (53%) females. The mean age was  $8.17 \pm 3.47$  years (1-15 years) among cases while controls had mean age  $8.77 \pm 3.62$  years (1-15 years). The specificity for elevated WBC and neutrophil values was 89% and 91% and sensitivity was 84% and 77% among cases. The specificity and sensitivity was 54% and 87% for reduction in MPV values.

**Conclusion:** Elevation in WBC and neutrophil counts detection is significantly associated with acute appendicitis. Paying more attention towards MPV values during blood counting is least expensive and time consuming for diagnosis of acute appendicitis among pediatric patients. The acute appendicitis among children is associated with reduced MPV level.

**Keywords:** Acute appendicitis, elevated WBC count, mean platelet volume (MPV), specificity, sensitivity, diagnostic value

### Introduction:

The acute appendicitis diagnosis among children is still problematic.<sup>1</sup> Delay in diagnosis of acute appendicitis among children leads to severe complications including perforation. While the negative exploration rate among children is found to be 20-30%.<sup>2</sup> Evidence exist that history of patient, clinical examination and routine laboratory test was not enough for confirmation of acute appendicitis diagnosis among children in last decades.<sup>3</sup> Acute appendicitis is associated with high rate of morbidity and mortality. It is a very common surgical condition that requires prompt diagnosis.<sup>4</sup> The acute appendicitis diagnosis is classically dependent upon history of abdominal pain, migration of pain to right iliac

fossa, nausea and signs of local peritonitis. Basically the diagnostic accuracy of these symptoms ranges from 70% to 80% among children.<sup>5</sup>

The diagnostic errors are found to be common, associated with 20% median incidence of perforation and negative laparotomy rate ranging from 2-30%.<sup>5</sup> In primary healthcare setting, the pre-operative laboratory test can be easily performed and they serve as aid for primary clinician to diagnose suspected acute appendicitis.<sup>6</sup> Evidence exist that there are several parameters for diagnosis of acute appendicitis that include C-reactive protein, lymphocyte, while blood cells (WBC), interleukin-6, interleukin-4, interleukin-10, interleukin-5, interleukin-12, endo-

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Table 1:MPV, Neutrophil, and WBC count among cases and controls

Parameters	Controls				cases				P - Value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
WBC ( $\times 10^9/L$ )	8.17	0.4	3.78	14.80	15.7	4.6	6.40	33.40	0.001
Neutrophil ( $\times 10^9/L$ )	4.12	1.8	1.05	8.99	10.7	3.5	4.17	20.34	0.001
PLT ( $\times 10^9/L$ )	380	87	172.01	663.01	303	86	87.00	552.00	0.001
MPV (fL)	8.99	1.2	6.12	11.90	7.56	0.8	6.01	10.41	0.001

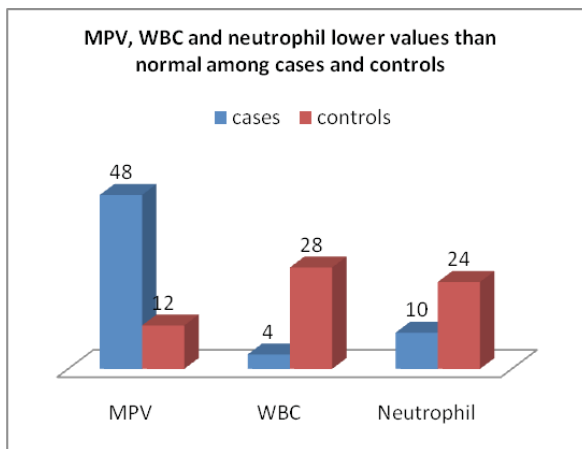


Figure 1: MPV, WBC and Neutrophil values lower than normal among cases and controls

toxin, erythrocyte sedimentation rate, alpha 2 macroglobulin, fibrinogen, alpha 1 antitrypsin and D-lactate.<sup>7</sup> Thus to distinguish non specific abdominal pain from acute appendicitis and to decrease the negative laparotomy rate, new methods are required.<sup>8</sup> Evidence exist that there were several studies conducted on diagnostic value of laboratory inflammatory markers but their results are quite conflicting.<sup>9</sup>

Mean platelet volume (MPV) is a clinical parameter used for measurement of platelet size during routine blood count. But unfortunately clinician did not pay too much attention on this parameter even despite of its well known importance regarding platelet activation and function. Platelet volume is found to be a marker that is determined from megakaryocytes during production of platelet.<sup>10</sup>

In Pakistan there is limited data available on di-

agnosis of acute appendicitis among children using mean platelet volume (MPV). This study will help in understanding proper diagnosis of acute appendicitis among children using mean platelet volume. The study aims to explore the diagnostic value of mean platelet volume for acute appendicitis among children.

**Patient and Methods:**

The study was a case control study and conducted in Department of Surgery, P.A.E.C General Hospital, Islamabad. The study duration was 6 months (June 2012-November 2012). A sample size of 140 was achieved using WHO formula with 80% power, SD 1.09, anticipated population 7.55 and 5% significance level with cases to control ratio of 1:1. All cases who had been operated with preliminary diagnosis on the basis of laboratory findings and imaging methods, in whom diagnosis was confirmed, both genders and age 1-15 years were enrolled in this study. The healthy control group was chosen between age group 1-15 years. The patients who had heart failure, hematological disease, peripheral vascular disease, liver disease, acute or chronic disease and who had been using anticoagulants or steroids were excluded from study. A simple random sampling (lottery method) was used for selecting patients. Laboratory test was performed in hospital laboratory. After withdrawal of 4.5ml of blood from antecubital vein into tube that contain 15% ethylene diamine tetra acetic acid, a complete blood cell count was studied. Patient's recordings include white blood cell, neutrophil, MPV values and platelets count. The normal

values of WBC, platelet count, neutrophil and MPV include  $4-11 \times 10^9/L$ ,  $150-400 \times 10^9/L$  and  $2-8 \times 10^9/L$ ,  $8.9 \pm 1.29$  fL<sup>11</sup> respectively. Ethical approval was taken from ethical review board of General Hospital Islamabad and consent form was taken from all participants guardians. Both groups were followed for 4 months. Data was collected through pre tested questionnaire. Reliability of questionnaire was assessed after a pretest exercise of 10 questionnaires.

Statistical analysis: Data was analyzed using SPSS software version 20.0. Descriptive statistics (percentages, mean, SD) was used to describe the data. Results were reported in percentages, tables and charts for different variables according to nature of variable. Both groups were compared for continuous variables using t- test. A correlation test was performed to the relationship of MPV with other variables.

### Results:

The study includes 140 patients. Among the 70 (100%) cases, there were 30 (43%) males and 40 (57%) females. While among controls 70 (100%), there were 33 (47%) males and 37 (53%) females. The mean age was  $8.17 \pm 3.47$  years (1-15 years) among cases while controls had mean age  $8.77 \pm 3.62$  years (1-15 years). Both groups were found to be similar in terms of age and genders with no significant association ( $p=0.358$ ). The mean  $\pm$  SD, minimum and maximum value of neutrophil, WBC, MPV and platelet count were reported as shown in table-1. The cases were found to have higher values for white blood cells and neutrophil count among 33 and 23 subjects respectively while the values were normal and lower than normal among 4 and 10 cases respectively. In control group, the values of white blood cells and neutrophil count were found to be higher among 8 and 10 patients respectively while the values were found to normal or lower than normal among 28 and 24 patients respectively. There was a statistically significant association of white blood cells, neutrophil and cases as compared to controls ( $p<0.000$ ). The study found statistically significant reduction in platelet count among cases

( $p<0.001$ ). The study found a linear relationship between MPV and platelet count among cases determined by Pearson's correlation coefficient analysis. So the mean platelet volume decreases as the platelet count reduced. No such relationship was found among controls.

The study found that MPV values were found to be lower than normal values among 48 cases and higher than normal values among 22 cases. While among controls, the MPV values were found to be lower among 12 patients and higher than normal among 68 controls. There was a statistically significant reduction of MPV among cases than controls ( $p<0.001$ ).

The specificity for elevated WBC and neutrophil values was 89% and 91% and sensitivity was 84% and 77% among cases. The specificity and sensitivity was 54% and 87% for reduction in MPV values.

### Discussion:

Mean platelet volume is an important diagnostic step for most of inflammatory diseases. In Pakistan there are no studies reported on MPV diagnostic importance for acute appendicitis among children, most of studies have considered adult group.

In our study we found out MPV as marker of complete blood count and associated with platelet function and activation. While similar studies reported the same phenomenon for activation and functioning of platelet.<sup>10</sup> The study found out that with decrease in platelet count, MPV values decrease among cases than controls. Similar studies reported that with increase in platelet count there is reduction in MPV values because young platelet become more reactive and larger in size.<sup>12</sup>

The present study found out that MPV values were found to be lower among cases than controls. While a similar study also reported lowering of MPV value among cases but in adult age group.<sup>13</sup> However the pathogenesis related to reduction in MPV values is not fully explained but

Danese et al. reported it with consumption and sequestration of large active platelets in inflamed bowel.<sup>14</sup> The study have reported the specificity of MPV, WBC and neutrophil 54%, 89% and 91% among cases while similar studies reported specificity for WBC elevation as 31.9%.<sup>15</sup> The sensitivity of WBC elevation was reported as 85.8%.<sup>16</sup> In present study, while the sensitivity was found to be 84% and 77% respectively, for WBC ( $>11 \times 10^9/L$ ) and neutrophil ( $>8 \times 10^9/L$ ) count elevations among cases, the specificity was found to be 89% and 91% respectively. These results were found to be inconsistent with the literature.

**Limitations:** Due to small sample size study results were not generalizable to whole population.

#### **Conclusion:**

Elevation in WBC and neutrophil counts detection is significantly associated with acute appendicitis. Paying more attention towards MPV values during blood counting is least expensive and time consuming for diagnosis of acute appendicitis among pediatric patients. Our study conclude that acute appendicitis among children is associated with reduced mean platelet volume level (MPV).

**Conflict of interest:** None

**Funding source:** None

#### **Role and contribution of authors:**

Dr Amjad Hussain, conceived the idea of the article and wrote the initial writeup

Dr Ahsan Ali Mirza, collected the data and references and help in critically reviewing the article.

Dr Kashif Jameel, collected the references and data and helped in discussion and result writing and also help in critically reviewing the article.

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