

# Study of Mean Platelet Volume in Individuals Suffer from Acute Appendicitis in Comparison with Healthy Ones

Hamzeh Shahmoradi Gohari<sup>1\*</sup>, Maryam Kouhestani Parizi<sup>1</sup>, Firouzeh Abolhasani Zadeh<sup>2</sup>

<sup>1</sup>Department of General Surgery, Afzalipour Hospital, Kerman University of Medical Sciences, Kerman, Iran.

<sup>2</sup>Department of General Surgery, Bahonar Hospital, Kerman University of Medical Sciences, Kerman, Iran.

Received: 2019/01/27 Accepted: 2019/03/18 Published: 2019/06/15

## Abstract

**Background:** The aim of this study was to evaluate the mean platelet volume (MPV) levels in patients with acute appendicitis in comparison with healthy people referring to educational hospitals of Kerman University of Medical Sciences. **Materials and Methods:** This case-control study was conducted on 150 patients (75 cases, 75 controls). The inclusion criteria were aged over 15 years old who had undergone abdominal pain and appendicitis diagnosis. The number of white blood cells, percentage of neutrophils, MPV and C-Reactive Protein were checked. The control group included individuals who were referred for elective surgery after age and gender adaptation with the control group, complete blood count and MPV were checked for them. Finally, the data were analyzed by SPSS 25. **Results:** The results of this study showed that MPV level in the case group was  $7.1 \pm 1.68$  and in the control, the group was  $9.8 \pm 1.17$ , which was significantly lower in the case group ( $P$ -value=0.001). The sensitivity and specificity of MPV in detecting acute appendicitis were 81% and 87% which were statistically significant. **Conclusion:** Overall, the results of this study showed that MPV is considered as an important parameter in the diagnosis of acute appendicitis. It is essential that more studies be done to find specific and reliable biomarkers for their use in detecting acute appendicitis.

**Keywords:** Mean Platelet Volume, Acute Appendicitis, Healthy People

## Introduction

Appendicitis is one of the most prevalent reasons for the patients' referral to the surgical emergency and appendectomy is the most popular emergency surgery of appendicitis. Appendicitis occurs during adolescence and 41% of the suffered individuals are in the age range of 10-29 years old. The amount of appendicitis in men and women is respectively 12% and 20%, and 7% of people undergo appendectomy surgery during their life for acute appendicitis (1). The percentage of appendicitis diagnostic error in women is significantly higher in comparison to men and the amount of negative appendectomy is high in women at the age range of 40-49 years old which equals 23.2%. The highest amount of negative appendectomy has been reported in women above 80 years old (2). Given the side

effects resulted from the unnecessary surgical operation, anesthetic side effect and also imposition of cost on the health care system, it seems that improvement of diagnosis is of clinical importance. As was mentioned, acute appendicitis is one of the most prevalent reasons for emergency surgery in acute abdomen. However, the amount of negative laparotomy or laparoscopy can be decreased by 30% by improving the diagnostic methods (3). In efforts to prevent the application of unnecessary surgery, the surgeons look for reliable biomarkers for exact diagnosis of acute appendicitis (4). Although the exact medical history, physical examination, and conventional laboratory parameters are of significant importance, the existence of a reliable biomarker can considerably help the physician in final decision-making. So far, many biomarkers have been introduced; but, none of them have been accepted. Therefore, we

### \*Corresponding Author:

Hamzeh Shahmoradi Gohari, Department of General Surgery, Afzalipour Hospital, Kerman University of Medical Sciences, Kerman, Iran.

Telephone Number: +98-9137469451

Email Address: dr.hamzeh\_shah@yahoo.com

ORCID: 0000-0002-4388-0197



need a biomarker with the capability of easy, cheap and effective measurement for exact diagnosis of acute appendicitis (5). Mean platelet volume (MPV) is a parameter that is usually reported in Complete Blood Count (CBC). Generally, the physicians' purpose from CBC is for diagnosis of acute appendicitis, white blood count (WBC) and Neutrophil count for Leukocytosis evaluation with neutrophilic predominance; and the other findings of CBC are disregarded in the diagnosis of appendicitis. MPV biomarker is usually used for surveying the performance and production of platelet. Furthermore, this biomarker reflects the amount of inflammation, too. The amounts of MPV are affected in most of clinical states that is indicative of disease activity in systematic inflammation, acute pancreatitis, unstable angina and myocardial infarction (6). Some studies have confirmed the use of this biomarker in the diagnosis of acute appendicitis. A study revealed that the amount of MPV in children with acute appendicitis is lower in comparison to the control group (7). Another study showed that the amount of MPV in them has been significantly decreased in comparison to the control group (8). Given that incorrect diagnosis of acute appendicitis can result in the side effects, morbidity and mortality, the existence and use of further diagnostic biomarkers with the capability of early detection can help the early diagnosis of acute appendicitis and reduce the side effects and consequently reduce the costs of health care systems. This research studies the value of diagnostic parameters in acute appendicitis diagnosis. Furthermore, in as much as few studies have been done in case of diagnostic value of MPV level in the appendicitis diagnosis, the present research studies the MPV in the individuals suffer from acute appendicitis in comparison to the healthy ones.

## Materials and Methods

The present research was a case-control study done on 150 members (75 cases and 75 controls) for determining the MPV in acute appendicitis. The sample size and its calculation method was determined based on a similar previous study with 0.05% Alpha and a study power of %80 for every group (75 members). The statistic population included individuals with appendicitis diagnosis that referred to the educational hospitals of Kerman University of Medical Sciences during 2017 and 2018. The inclusion criteria for the study included the individuals above 15 years old with acute abdomen and appendicitis diagnosis that were volunteered for surgical operation by final confirmation of appendicitis pathologist; and the WBC, neutrophil percentage, MPV and C-Reactive Protein (CRP) of the patients were studied. The exclusion criteria included the provision of individuals who suffered from appendicitis with medical treatment, proposal of other pathologies during the operation, imperfect information existing in the file

and lack of tendency to participate in the mentioned research. The control group included the individuals who have referred for an elective surgery that were selected after the age and sex concordance and CBC and MPV of them were measured. The number of platelets and MPV of the blood samples with regard to CBC test obtained at the first day of hospitalization were gathered in the pipes including EDTA (Ethylene Diamine Tetra Acetic acid), they were analyzed and measured by automated hematology analyzers and the normal range for MPV was determined 7.4 to 10.4 in the laboratory. Furthermore, Pars Azmoon Kit was used for the quantitative measurement of CRP. Finally, after the operation, the relationship between MPV and the other factors with the pathology report was studied. The data were analyzed by SPSS version 25 software after the collection, Student T-Test was applied for intergroup comparison and the Mann-Whitney U test was used in case of non-normal distribution of data.

## Results

The research results revealed that the mean age of participants in the case group and control group was respectively  $31.85 \pm 5.65$  and  $33.54 \pm 6.17$  that this difference was not statistically significant. The mean white blood count in the case group and control group was respectively  $13464 \pm 651645$  and  $8818 \pm 8456 \mu\text{l}$ , respectively that this amount in the case group was significantly more than the control group (P-value= 0.003). The mean neutrophil percentage of the participants in the case group and control group was respectively  $79.33 \pm 7.87$  and  $64.55 \pm 4.17$  that this amount in the case group was significantly more than the control group (P-value= 0.004). Furthermore, the number of platelets of the participants in the case group and the control group was respectively  $231.84 \pm 7.84$  and  $253.83 \pm 6.49$  that this amount was not statistically significant. The research results revealed that the mean platelet volume of the participants in the case group and control group was respectively  $7.1 \pm 1.68$  and  $9.8 \pm 1.17$  that this amount in the case group was significantly lower than the control group (P-value= 0.001) (Table 1). Furthermore, the results showed that the sensitivity and specificity of white platelet count in appendicitis diagnosis were respectively 85% and 74%; the sensitivity and specificity of neutrophil percentage in appendicitis diagnosis were 70% and 83%, respectively; and the sensitivity and specificity of MPV in appendicitis diagnosis were respectively 81% and 87% that all these amounts were statistically significant (Table 2).

## Discussion

While the parameters and criteria existing in CBC test such as high leukocyte count and or neutrophil percentage are routinely used for appendicitis diagnosis, the

effect of change of MPV amounts has been recently studied in a few numbers of studies with the purpose of appendicitis diagnosis. In some of these studies, the change of MPV has been suggested as the valuable diagnostic indicative, when it is used with WBC and neutrophil percentage. But the MPV change can be discussed separately; because some of the studies such as the one done by Albayrak et al. (8) have reported the reduction of MPV and some of them such as the one done by Tanrikulu et al. (9) have reported the increase of MPV. Furthermore, the results of the research done by Uyanik et al. (10) revealed that MPV has no effect on the diagnosis of acute appendicitis in children. The amounts of MPV is easily measurable in the CBC test and probably reveal the manner of performance and activation of the platelets and amount of their production from the megakaryocytes in a better way. The results of accomplished researches revealed that amounts of MPV in patients suffering from Sepsis in the study done by Beyazit et al. (11), in patients suffering from myocardial ischemia in the research done by Sarikaya et al. (12), and the ones suffering from cerebral-vascular dis-

eases in the study done by Li et al. (13) is significantly higher than the healthy individuals. Slavka et al., have reported 1.5 times mortality in the patients suffered from acute cordial ischemia with high MPV in comparison to the ones with lower MPV and concluded that an increase of MPV is indicative of increase of platelet activity (14). The results of different research have revealed that the amount of MPV in chronic and acute diseases is respectively increased and decreased (15). Furthermore, the results of some research showed that while the MPV amount is reduced in the acute phase of diagnosis, the MPV increase in the chronic phase is observed more than the MPV reduction in the acute phase (16). Kisacik et al. reported that the low MPV amount is naturally increased after the treatment in the patients suffered from ankylosing spondylitis and rheumatoid arthritis (15). In addition, it has been reported that in some inflammatory bowel diseases such as ulcerative colitis, the MPV amount is decreased by an increase in disease activity (17). Similarly, Kapsoritakis et al. also reported that the MPV amount in the patients suffered from active Crohn is lower in comparison to the ones

**Table 1.** Comparison of the mean and standard deviation of the studied variables separately sorted by two groups

Variable	Mean and standard deviation (case group)	Mean and standard deviation (control group)	P-value
Age	31.85±5.65	33.54±6.17	0.604
	15-45	16-54	
White platelet count	13464±1645	8818±8456	0.003
	3493-30595	4574-15845	
Neutrophil	79.33±7.87	64.55±4.17	0.004
	43-84	41-79	
Platelet	231.84±7.84	253.83±6.49	0.405
	84-653	80-695	
MPV	7.1±1.68	9.8±1.17	0.001
	5.10-6.7	3.9-4.11	

**Table 2.** Comparison of sensitivity and specificity in the studied variables

Variable	Sensitivity	Specificity	P-value
White platelet count	85%	74%	0.001
Neutrophil	70%	83%	0.001
MPV	81%	87%	0.001

with inactive Crohn (18). The value of high leukocyte count and neutrophils percentage as the biomarkers in acute appendicitis diagnosis has been widely accepted and they are routinely used by physicians. In fact, an increase in the number of leukocyte and neutrophils occurs along with an increase in inflammation severity (5). Birchley et al. recognized that high leukocyte count and neutrophils percentage is observed considerably higher in complicated appendicitis in comparison to the non-complicated one (19). Overall, the results of the present study revealed that MPV was recognized as an important parameter in acute appendicitis diagnosis. Furthermore, it was revealed that, in acute appendicitis diagnosis, MPV as a diagnostic biomarker has more and less sensitivity in comparison to neutrophil and leukocytes, respectively; while, its specificity is more than the neutrophil and leukocytes in acute appendicitis diagnosis. According to the mentioned results, it seems that further research is necessary for recognizing the specific and reliable biomarkers or their combination to be used in acute appendicitis diagnosis in addition to the studies concentrated on MPV.

### Acknowledgment

The present article has been derived from MS thesis with No. 20.1241 authorized by Kerman University of Medical Sciences with the ethics code IR.KMU.AH.REC.1397.103. I would like to express my gratitude to the authorities in charge and all the individuals helped us in doing the present research.

### Conflict of interest

The authors declare that they have no conflict of interest.

### References

1. Sabiston DC, Townsend CM. *Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice*. Philadelphia: Elsevier; 2012.
2. Flum DR, McClure TD, Morris A, Koepsell T. Misdiagnosis of appendicitis and the use of diagnostic imaging. *J Am Coll Surg.* 2005; 201(6):933-9. Doi: 10.1016/j.jamcollsurg.2005.04.039
3. Prystowsky JB, Pugh CM, Nagle AP. Current problems in surgery. Appendicitis. *Curr Probl Surg.* 2005; 42(10):688-742. Doi: 10.1067/j.cpsurg.2005.07.005
4. Schwartz SI, Brunickardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, et al. *Schwartz's principles of surgery*. 7th ed. New York: McGraw-Hill; 2015.
5. Lawrence WW, Doherty G, Gerard M. *Doherty. Current surgical diagnosis and treatment*. 11th ed. New York: Mc Graw-Hill; 2003 .
6. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendectomy: A Contemporary Appraisal. *Ann Surg.* 1997; 225(3):252-61. PMID: 9060580
7. Bilici S, Sekmenli T, Göksu M, Melek M, Avci V. Mean Platelet volume in diagnosis of acute appendicitis in children. *Afr Health Sci.* 2011; 11(3):427-32. PMID: 22275934
8. Albayrak Y, Albayrak A, Albayrak F, Yildirim R, Aylu B, Uyanik A, et al. Mean platelet volume: a new predictor in confirming acute appendicitis diagnosis. *Clin Appl Thromb Hemost.* 2011; 17(4):362-6. Doi: 10.1177/1076029610364520
9. Tanrikulu CS, Tanrikulu Y, Sabuncuoğlu MZ, Karameran MA, Akkapulu N, Coskun F. Mean platelet volume and red cell distribution width as a diagnostic marker in acute appendicitis. *Iran Red Crescent Med J.* 2014; 16:e10211. Doi: 10.5812/ircmj.10211
10. Uyanik B, Kavalci C, Arslan ED, Yilmaz F, Aslan O, Dede S, et al. Role of mean platelet volume in diagnosis of childhood acute appendicitis. *Emerg Med Int.* 2012; 2012:823095. Doi: 10.1155/2012/823095
11. Beyazit Y, Sayilir A, Torun S, Suvak B, Yesil Y, Purnak T, et al. Mean platelet volume as an indicator of disease severity in patients with acute pancreatitis. *Clin Res Hepatol Gastroenterol.* 2012; 36:162-8. Doi: 10.1016/j.clinre.2011.10.003
12. Sarikaya S, Sahin S, Akyol L, Borekci E, Yilmaz YK, Altunkas F, et al. Mean platelet volume is associated with myocardial perfusion defect in diabetic patients. *Cardiovasc J Afr.* 2014; 25: 110-3. Doi: 10.5830/CVJA-2014-013
13. Li B, Liu X, Cao ZG, Li Y, Liu TM, Wang RT. Elevated mean platelet volume is associated with silent cerebral infarction. *Intern Med J.* 2014; 44:653-7. Doi: 10.1111/imj.12454
14. Slavka G, Perkmann T, Haslacher H, Greis-enegger S, Marsik C, Wagner OF, et al. Mean platelet volume may represent a predictive parameter for overall vascular mortality and ischemic heart disease. *Arterioscler Thromb Vasc Biol.* 2011; 31:1215-8. Doi: 10.1161/ATVBAHA.110.221788
15. Kisacik B, Tufan A, Makvandi HS, Rezaee A, Azadi M. Effectiveness of acceptance and commitment group therapy on the self-management of type 2 diabetes patients. *J Clin Psychology.* 2014; 5:55-62.
16. Yüksel O, Helvaci K, Başar O, Köklü S, Caner S, Helvaci N, et al. An overlooked indicator of disease activity in ulcerative colitis: mean platelet volume. *Platelets.* 2009; 20:277-81. Doi: 10.1080/09537100902856781
17. Järemo P, Sandberg-Gertzen H. Platelet density and size in inflammatory bowel disease. *Thromb Haemost.* 1996; 75:560-561. PMID: 8743178
18. Danese S, Motte Cd Cd, Fiocchi C. Platelets in inflammatory bowel disease: clinical, pathogenic, and therapeutic implications. *Am J Gastroenterol.* 2004; 99:938-45. Doi: 10.1111/j.1572-0241.2004.04129.x

19. Birchley D. Patients with clinical acute appendicitis should have pre-operative full blood count and C-reactive protein assays. *Ann R Coll Surg Engl.* 2006; 88:27-32. Doi: 10.1308/003588406X83041