Original Article

The diagnostic value of RDW in appendicitis

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Abstract

Introduction: Diagnosis of acute appendicitis is based on clinical manifestation .Some patients have atypical clinical symptoms, and diagnosis is difficult. Red blood cell distribution width (RDW) is a measure of heterogeneity in the size of circulating red blood cells. The aim of this study was to evaluate RDW values in diagnosis of appendicitis.

Methods: This is a retrospective case-control study, in which 399 patients with pathological diagnosis of appendicitis were divided into two groups of acute appendicitis and complicated appendicitis and compared with 400 healthy controls for appendicitis. RDW, white blood cell (WBC), platelet count (PLT), and hemoglobin changes were compared in three groups of patients.

Results: In all three groups, the ratio of men was significantly higher than women ($P < 0.05$). WBC ($P = 0.00$), PLT ($P = 0.01$), and RDW ($P = 0.01$) had a significant difference between the three groups. However, there was no significant difference in the hemoglobin level between the three groups ($P = 0.3$). RDW level was significantly higher in complicated appendicitis compared to acute ($P = 0.09$) and control group ($P = 0.012$).

Conclusion: The results of this study showed that RDW value in three groups were significantly different. However, these values are not clinically useful for detecting appendicitis due to the slow progression of RDW value in patients.

Introduction

Diagnosis of acute appendicitis is always based on clinical symptoms. About 50% of patients present the current typical history, but in some cases clinical findings are not compatible with appendicitis criteria.[1] The pain in acute appendicitis is initially colicky, which gradually becomes persistent during 24 hours and is localized in the right lower quadrant (RLQ) area. In many cases low fever, nausea, and anorexia are the clinical symptoms. Increasing the number of neutrophils (75%) and leukocytosis are common laboratory findings.[2-9]

Red blood cell distribution width (RDW) is a routinely measured parameter in complete blood count (CBC), which shows the variability of size of erythrocytes. The normal RDW level in adults is between 11.6% and 14.6%.[10,11] Different diseases affect the RDW values. The more variable red blood cell size, the more RDW value. Iron deficiency anemia, B12 deficiency, and thalassemia are common causes of RDW increasing. If the red blood cells are the same size and shape, the RDW value is more narrowed, which occurs in certain cases of microcytic and macrocytic anemia.[12,13] Inflammatory conditions in the body rapidly affect the size and shape of the red blood cells, leading to a change in RDW level. For this reason,

RDW is used as an inflammatory marker. Increasing the RDW level in various inflammatory processes, such as sepsis, rheumatoid diseases, pancreatitis, cholecystectomy, and appendicitis was observed.[14-19] The RDW level in acute appendicitis has controversial results.[20-22] So far, the diagnostic value of RDW in patients with acute appendicitis has not been determined. For this reason, it is not clear that RDW values in patients with appendicitis can be effective in early diagnosis and reduce its complications.

Methods

This study was carried out in the first half of 2017 in Imam Reza and Sina hospitals of Tabriz University of Medical Sciences using data from patients' files referring to the emergency department. In this retrospective case-control study, patients with appendicitis, detected during the pathologic examination, were enrolled to the study. Patients in the control group were selected from the emergency responders, who were healthy for appendicitis, and their blood sample had been taken for CBC for other reasons.

The case and control groups were matched in terms of age and sex by pair matching method. People with recent

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history of blood transfusion, chronic hematologic disease, chronic inflammatory disease, and acute diseases such as pancreatitis, cholecystitis, and sepsis were excluded from the study.

Data from 399 patients with appendicitis were extracted. The patients were divided into two groups of patients with acute and complicated appendicitis according to the surgeon vision and pathological result. 400 patients were also examined in the control group due to the lack of exclusion criteria. Demographic characteristics of the study and control group, as well as RDW, White blood cell (WBC), hemoglobin and platelet level were extracted in three groups using CBC findings and compared between the groups.

SPSS software (version 16) was used for statistical analysis. $P < 0.05$ values were considered significant. Data were reported as descriptive (frequency and percentage) and mean ± SD. Chi-square test was used to compare qualitative variables and independent t-test was used for quantitative variables. In this study, ethical considerations were observed under the Helsinki Declaration.

Results

The control group including healthy subjects was matched in age and sex with the study group. The mean age of participating patients was 30 ± 12 years. There was no significant difference in age between the three groups ($P = 0.713$). A total of 399 and 400 patients were included in the study and control groups, respectively. Of 399 patients diagnosed with appendicitis, 333 (83.5%) patients were diagnosed with acute appendicitis. 66 (16.5%) patients were diagnosed with complicated appendicitis after surgery. 57.6% of all people were men and 42.4% were women. Gender was also examined by groups. Study group contains 56.2% men and 43.8% women ($P = 0.025$). 57.5% of control group were men and 42.5% were women ($P = 0.003$). Also, in the complicated group, 65.2% were men and 34.8% were women ($P = 0.014$).

The mean of WBC, hemoglobin, platelet, and RDW was evaluated by the groups of patients and compared between the three groups of patients. Also, the variables were compared statistically between two groups, which are shown in Table 1. Figure 1 shows the red cell distribution width in the groups.

Discussion

In this study, RDW changes in the patients with appendicitis were studied. The patients were divided into two groups of study and control. The study group included patients diagnosed with appendicitis based on pathologic outcomes and surgeon's vision. The control group included healthy subjects who were matched for age and sex in the study group. On the other hand, the study group was divided into two groups, 333 patients were diagnosed with acute appendicitis, and 66 patients were diagnosed with the complicated appendicitis.

Table 1. RDW, WBC, PLT and HB changes in three groups of patients

Group	Mean	SD	Between groups	P value
Study (WBC)	11964	7351	Study vs. control	<0.0001
Control	10053	3694	Study vs. complicated	<0.0001
Complicated	16424	4496	Control vs. complicated	<0.0001
Study (PLT)	235375	64891	Study vs. control	0.69
Control	239479	68924	Study vs. complicated	0.009
Complicated	262909	84624	Control vs. complicated	0.028
Study (RDW)	13.9	1.97	Study vs. control	0.53
Control	13.8	1.96	Study vs. complicated	0.77
Complicated	14.1	1.4	Control vs. complicated	0.4
Study (Hb)	13.33	1.33	Study vs. control	0.37
Control	13.21	1.05	Study vs. complicated	0.09
Complicated	13.66	1.10	Control vs. complicated	0.012

RDW: Red blood cell distribution width; WBC: White blood cell; PLT: Platelet Count; HB: Hemoglobin.
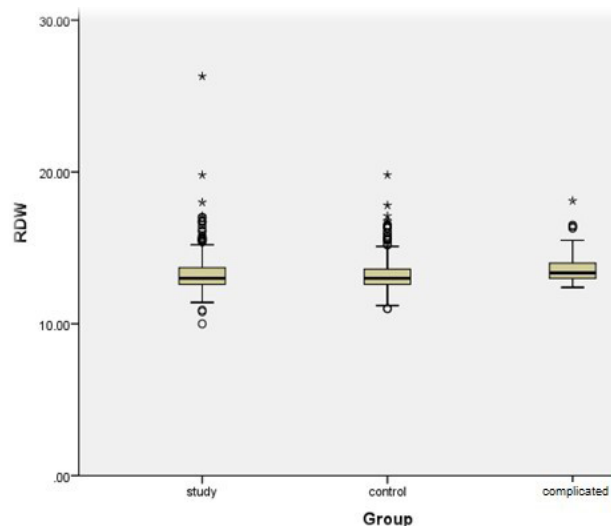
Figure 1. Red cell distribution width distribution in the groups

Leukocytosis is always the key for detecting appendicitis. A study by Bickell et al showed that patients with appendicitis begin leukocytosis and shift to the left before the onset of clinical symptoms.[5] In fact, the first response to appendicitis begins with blood cells. Birchley, as well as Y Albayrak et al, after examining patients with appendicitis, concluded that the inflammation of the appendix resulted in the release of cytokines that trigger leukocytes to the site of inflammation. Subsequently, these leukocytes are released into the circulation.[7,10]

There are many problems with the diagnosis of appendicitis. Albayrak et al reported a prevalence of negative appendectomy up to 40%.[10] Leukocytosis has many causes and even pain causes leukocytosis. For this reason, recently, other laboratory factors were investigated in diagnosis of acute appendicitis. The RDW is one of the variables that have recently been considered as an available laboratory factor. Studies of Sack et al and Bozlu et al showed that RDW is an inflammatory factor. In

systemic inflammation, the levels of inflammatory factors such as interleukin 6 and C-reactive protein increase in the body. These factors have two different effects on erythrocytes. First, it reduces the time life of red blood cells, which stimulates erythropoiesis in the body and the release of new red blood cells in the peripheral blood increases. This leads to the increased RDW level in the peripheral blood. For this reason, various inflammatory diseases such as pancreatitis, cholecystitis, rheumatoid arthritis and coronary artery disease increase the RDW level in patients.[13,15]

Before our study, there were conflicting results about RDW level in patients with appendicitis. Some studies have reported that RDW values in appendicitis are lower in the normal population; however, the reason for that was not explained.[14,20] Other studies have indicated a significant increase in RDW values in appendicitis patients.[16,21,22] Despite very contradictory results in studies, all studies have shown low sensitivity and specificity, and therefore, reduced diagnostic value of RDW level in appendicitis. In this study, we found that RDW level was higher in patients with acute appendicitis compared to the control group, but this difference was not significant. On the other hand, comparison of patients with complicated appendicitis with the control group showed a significant difference in RDW value.

Finally, the results of this study showed that RDW is not able to distinguish healthy patients from acute appendicitis. But what is important is a significant increase in RDW in patients diagnosed with complicated appendicitis compared to the control group. Earlier, in the study of Anderson et al., it was found that initiation of RDW changes in patients was slower than leukocyte changes.[4] To start changes in RDW level, inflammation should first be started in the appendix. Following this, the inflammatory factors increase, and thereafter, changes occur in the RDW level.[18] For this reason, these changes are slow and inefficient to diagnose appendicitis effectively.

Gradual changes in RDW level, though might be valuable in chronic patients, are not clinically useful for the diagnosis of acute appendicitis. Fast diagnosis of appendicitis is very important in reducing morbidity and morbidity, so RDW cannot be used to diagnose suffering patients. However, in the present study, RDW levels in the patients with complicated appendicitis were significantly higher than that of the control group. But the main goal of the clinical and laboratory tests for the diagnosis of appendicitis is to prevent prolonged diagnosis and complications of appendicitis, which is not achieved through RDW measuring.

On the other hand, a wide range of diseases and even physiological conditions lead to changes in RDW level. Studies have shown that various types of anemia, thalassemia, a wide range of inflammatory diseases and cancers can cause changes in the RDW level.[12-15] For this

Study Highlights

What is current knowledge?

- The diagnostic value of RDW in patients with acute appendicitis has not been determined.

What is new here?

- RDW level is increased by the inflammatory conditions compared to the control group, but these increases were not significant.

reason, even if RDW is increased in appendicitis, its low specificity prevents effective application in appendicitis detection.

Conclusion

The results of this study showed that in patients with appendicitis, RDW level is increased by the inflammatory conditions compared to the control group, but these increases were not significant. On the other hand, although RDW values in patients with appendicitis are statistically significant compared to the control and study group, it does not seem to be beneficial in early clinical diagnosis.

Authors' Contribution
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Competing Interests
The authors declare that there is no conflict of interest.

Ethical Approval
The ethical approval which was attained from the local medical ethics committee of Tabriz University of Medical Sciences is IR.TBZMED.AC.IR.1395.945. Additionally, informed consent was obtained from all individuals participated in this study.

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