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Original Research Paper

The value of red cell distribution width in the diagnosis of acute appendicitis.

Medicine

KEYWORDS: Red cell distribution width; Appendicitis; Marker; Inflammatory

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ABSTRACT

BACKGROUND&OBJECTIVE: Acute appendicitis is a frequent surgical emergency and the more objective data the less unnecessary operations. The aim of this study is to evaluate the role of red cell distribution width (RDW) in the diagnosis of acute appendicitis. **MATERIAL&METHODS:** This retrospective study was conducted in a tertiary clinical setting. Patients underwent acute appendectomy between January 1st, 2012 and December 31st, 2013 were scanned from hospital database. Demographics, ultrasound reports, pathology reports, and RDW as well as biochemical results were recorded from patient charts. Data were recorded by principal investigators and then checked by two blinded researchers for accuracy. **RESULTS:** A total of 1502 subjects (n=744 for appendicitis and n=758 for control group) were included in the study. RDW levels were different between appendicitis and control groups (13.99 ± 1.86 vs. 12.62 ± 1.4, respectively) (p<0.001). Area under the curve for RDW was 0.779. White blood cell count and neutrophil counts were higher in appendicitis group. However, mean platelets volume and lymphocyte counts were higher in control group. **CONCLUSION:** We concluded that RDW can be a good indicator in the diagnosis of acute appendicitis but it must be combined with a detailed clinical assessment.

Introduction:

Acute appendicitis is one of the most common surgical emergencies and its diagnosis is still challenging. Misdiagnosis of acute appendicitis has been reported as high as 16-25.7% (1, 2). However use of preoperative CT decreased negative operation rates from 23.0% to 1.7%, under convenient clinical assessment, white blood cell count (WBC) and C-reactive protein (CRP) can be as sensitive as CT (1, 3). In some resource limited emergency services, obtaining CT can be challenging and simple diagnostic tools such as complete blood count (CBC) can be valuable.

Red cell distribution width (RDW) is a component of CBC and basically has been being used in the differential diagnosis of iron deficiency and thalassemia minor. (4, 5) Recent studies showed that RDW could be a valuable tool in the prediction of mortality (6-17) and also have been associated with sepsis and systemic inflammation (18, 19). On the basis of these data, many studies have been conducted on RDW and it was reported as a marker in the diagnosis of many inflammatory gastrointestinal (GI) tract diseases such as inflammatory bowel disease (20-22), celiac disease (23-28), Crohn disease (29, 30) and irritable bowel syndrome (31). We hypothesized that as an inflammatory disease of GI tract, RDW can be used in the diagnosis of acute appendicitis.

The aim of this study is to evaluate the value of RDW in the diagnosis of acute appendicitis in adult patients. We conducted a retrospective observational study and obtained pathological reports for the gold standard of diagnosis.

Material and methods

This is a retrospective case-control study. Study protocol was approved by local ethical committee. A retrospective data screening was performed by principal investigators via hospital database. All the patients who had appendectomy between January 1st, 2012 and December 31st, 2013 were scanned for eligibility. All the adult patients (>18 years) with sufficient data were included in the study. Age, gender, WBC, RDW, mean platelet volume (MPV), lymphocyte ratio, neutrophil ratio, platelet count, fibrinogen, and CRP values

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were recorded from patient charts. Pathology reports were recorded as the gold standard of appendicitis diagnosis. Only the principal investigators screened the data and they recorded them without any personal information of the patients. Control groups was composed of adult patients who admitted to our hospital in the same time period without any inflammatory disease, anemia, and/or bone marrow associated malignancy and CBC results were recorded from hospital database. Fibrinogen and CRP levels could not be reached for control group because they were not studied in routinely in patients without any inflammatory disease diagnosis. Once all the data collected and recorded, 10% of the data were cross-checked by two blinded researchers.

According to routine protocol of our hospital, RDW and hemoglobin values are measured with ABX Pentra XL 80 Hematology Analyzer (Horiba Instruments Inc., California, USA) as a component of CBC. Normal range of RDW in our laboratory is between 11.7% and 14.6%.
Statistical analyses

Descriptive statistics were presented as frequency (percentage) for categorical variables, whereas continuous data were presented as mean ± standard deviation (SD) for normally distributed data. Primary and secondary data were compared with Student's t-test and chi-square test for acute appendicitis and control groups. Receiver operating characteristic (ROC) curve analysis was performed for the diagnostic utility of the studied parameters on acute appendicitis. Statistical analysis was performed by Statistical Package for the Social Sciences (SPSS) version 15.0 (SPSS Inc., Chicago, IL). A p value of < .05 considered as statistically significant.

Results
A total of 744 appendicitis patients, of which diagnosis was confirmed by pathological examination reports as the gold standard, and 758 control patients were enrolled in the study. Two groups did not show any difference in gender (p=0.947). Twenty one of the acute appendicitis group patients were reported as perforated appendicitis (2.8 %).

Primary outcome
While mean RDW levels were 13.99 ± 1.86 in acute appendicitis group, in control group it was 12.62 ± 1.4 and there was statistically difference between these two groups (p < 0.001). (Table 1) Area under the curve (AUC) value for RDW was 0.779.

Secondary outcomes
There was not any differences in RDW levels between perforated and non-perforated appendicitis cases (p=0.735). In the comparison of markers between acute appendicitis and control groups, WBC and neutrophil counts were higher in acute appendicitis group but MPV, lymphocyte, and platelet counts were lower than the controls. This difference was statistically significant (p<0,05). (Table 1) ROC curves were given in figure 1 and AUC values for RDW, neutrophil ratio, lymphocyte ratio, platelet count, and MPV are 0.779, 0.896, 0.096, 0.448, and 0.326, respectively.

Discussion
Our study indicated that RDW can be a valuable tool in the diagnosis of appendicitis and this finding seems compatible with the current literature.

In their retrospective study, Narci et al reported that, RDW levels were lower in appendicitis group than healthy control group but had no diagnostic value (32). However, Tanrikulu et al reported that RDW and platelet counts were not different in patients with appendectomy compared to healthy subjects (33). According to our findings, RDW values were higher in appendicitis group than the controls supporting the study of Narci et al. All of these studies are retrospective and cannot give a cut-off value for RDW in the diagnosis of appendicitis. So, current data suggest that RDW cannot be used as an independent diagnostic tool but if it is not in normal ranges that can give a clue to the physician additional to physical examination and should be considered just an additional laboratory finding especially in the conditions that further imaging modalities such as CT are not available.

CT has several contraindications and for younger people it can increase future malignancy rates as well as increasing kidney failure rates for elder patients with contrast medium infusion. Additionally, obtaining CT scans can cause some reimbursement problems and increase ED waiting time. At this point, as a cheap, fast, and relatively harmless parameter, RDW can be valuable in the diagnosis of acute appendicitis.

RDW has been reported as a valuable marker in the diagnosis of inflammatory bowel disease (20-22), celiac disease (23-28), Crohn disease (29, 30) and irritable bowel syndrome (31). Nevertheless, inflammatory changes in appendicitis occur in a tiny part of intestines, our findings show that it can trigger the changes in RDW levels.

Conclusion:
We concluded that RDW can be a valuable marker in the diagnosis of acute appendicitis. Especially in the conditions that CT is not available, or contraindicated, it can be assessed besides WBC as a component of CBC. Prospective studies on this subject especially for special patient groups such as children and elderly can be promising.

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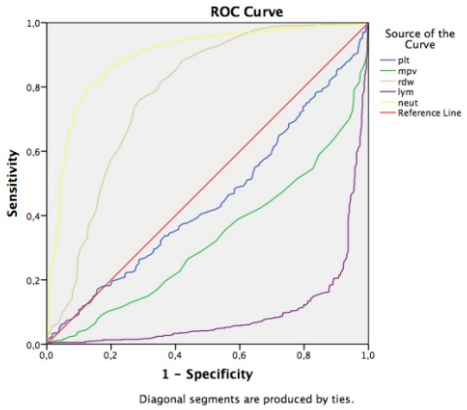
Tables and Figures:
Table 1: Comparison of the acute appendicitis and non-appendicitis groups.

	Control group (n=758) Mean±SD, (%95 CI)	Appendicitis group (n=744) Mean±SD, (%95 CI)	p
Age	23.1 ± 5.8 (22.7- 23.5)	31.7 ± 12.3 (30.8-32.5)	< 0.001*
Gender (female)	224 (29.6 %)	219 (29.4%)	.947**
WBC (x10^3 /mm^3)	12.76 ± 4.41 (11.69 - 13.84)	14.21 ± 3.79 (13.93- 14.48)	.003*
RDW (%)	12.62 ± 1.4 (12.52- 12.73)	13.99 ± 1.86 (13.86- 14.12)	< 0.001*
MPV (fL)	8.6 ± 1.12 (8.48-8.64)	7.86 ± 1.25 (7.7-7.9)	< 0.001*
Lymphocyte (%)	29.5 ± 9.1 (28.8 – 30.1)	13.68 ± 8.41 (13.07- 14.29)	< 0.001*
Neutrophil (%)	59.9 ± 111.7 (59.1- 60.8)	78.88 ± 10.6 (78.11- 79.78)	< 0.001*
Platelet (x103 /uL)	261,9 ± 61.4 (257.5- 266.2)	254.3 ± 74.4 (248.9 – 259.7)	.031*
Fibrinogen (mg/dL)	NA	293.3 ± 154.3 (257- 304)	NA
CRP (mg/dL)	NA	1087 ± 3916 (1276- 2682)	NA

SD: Standard deviation, CI: Confidence interval, NA: Not applicable, WBC: White blood cell count, RDW: Red cell distribution width, MPV: Mean platelet volume, CRP: C-reactive protein, *: Student's t-test for independent samples, **: Chi-square test

Figure 1: Receiver operating characteristic curves (ROC) of seven main parameters commonly used in the diagnosis of appendicitis. (WBC: White blood cell count, RDW: Red cell distribution width, Lymp: Lymphocyte ratio, Neut: Neutrophil ratio, MPV: Mean platelet volume, CRP: C-reactive protein,)



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