Diagnostic Accuracy of Red Cell Distribution Width In Acute Appendicitis

Sidrah Masoom,[1*] Syed Ali Haider,[1] Syeda Sarah Kazmi,[1] Muhammad Zubair [1]

ABSTRACT

Objective — *To evaluate the diagnostic accuracy of red cell distribution width in acute appendicitis keeping histopathology as gold standard.*

Study design — *Cross-sectional study.*

Place & Duration of study — *Department of Surgery, Dr. Ruth K. M. Pfau Civil Hospital and Dow University of Health Sciences Karachi, from October 2018 to April 2020.*

Methods — *All patients diagnosed as acute appendicitis on the basis of modified Alvarado score were included. Preoperatively, red cell distribution width test was also sent. After surgery the histopathological reports were analyzed to confirm the findings of acute appendicitis and relate it to the clinical diagnosis. Frequency of acute appendicitis and the relationship with red cell distribution width test were determined. SPSS version 23 software was used for data entry and analysis.*

Results — *A total of 211 patients were diagnosed as having acute appendicitis. The diagnostic accuracy of red cell distribution width was 27.48% in acute appendicitis keeping histopathology as gold standard.*

Conclusion — *The red cell distribution width indices are not accurate indicator for acute appendicitis.*

Key words — *Acute Appendicitis, Modified Alvarado score, Erythrocyte indices, Diagnostic accuracy, Acute abdomen.*

INTRODUCTION:

In general surgery acute appendicitis is among the most frequent conditions presenting in emergency room.[1] The estimated worldwide incidence of acute appendicitis is 86 cases annually/100,000 population.[2] Early diagnosis is essential to minimize complications that may occur with the advanced stage of the dseases.[3] Atypical clinical presentation of acute appendicitis is also reported. The estimated rate of finding normal appendix on histopathological samples after appendectomy is around 9.5%. Negative appendectomies are associated with higher a morbidity.[4] Accurate and timely diagnosis of acute appendicitis is of utmost importance.

Acute Appendicitis is a clinical diagnosis, but diagnostic accuracy is still fairly low even after adding baseline laboratory tests.[5,6] The additional hematological and biochemical markers such as total leucocyte count, neutrophil percentage, C-reactive protein (CRP) concentration and several imaging modalities like an abdominal CT scan, ultrasonography or MRI are recommended.[5] However, no consensus is reached yet. The red cell distribution width (RDW) test is one of the diagnostics aid.[6] It is as an indicator of inflammation and mortality with prognostic value in other inflammatory conditions.[7-9]

[1] Department of Surgery Dr. Ruth K. M. Pfau Civil Hospital & DUHS Karachi

Correspondence:
Dr. Syed Ali Haider [1*]
Department of Surgery
Dr. Ruth K. M. Pfau Civil Hospital &
Dow University of Health Sciences Karachi
E-mail: dralihaider@gmail.com

This test is also used in the diagnosis of simple and complicated appendicitis.[10-13] However, there is an obvious a gap in the literature regarding the value of RDW as a diagnostic aid. This study was planned to validate the role of red cell distribution width in acute appendicitis which is a part of routine CBC test and widely available as well as cost effective.

METHODS:

Study design, place & duration: This cross sectional study was conducted in the Department of Surgery, Dr. Ruth K. M. Pfau Civil Hospital and Dow University of Health Sciences Karachi, from October 2018 to April 2020.

Ethical considerations: This is a dissertation-based article. Approval of the synopsis was obtained from the REU of the College of Physicians & Surgeons Pakistan. Written informed consent was taken from the patients.

Sample size estimation: The calculator of sensitivity and specificity of studies was used to compute the sample size, using confidence interval of 95%, sensitivity 47%, specificity 67%,[11] desired precision of 10% and prevalence of 59.70%.[13] The sample size was estimated to be 211. Non-probability consecutive sampling technique was used.

Inclusion & exclusion criteria: All patients between 18 years – 70 years of age of either gender, presenting with clinical suspicion of acute appendicitis on the basis of modified Alvarado Score of 7 or more were included in the study. Patients with appendicular mass and/or abscess formation, perforated appendix, and those with the history of any chronic inflammatory disease, were not excluded.

Study protocol: Patients with right iliac region pain were examined and modified Alvarado Score was calculated. After preoperative preparations including baseline investigations an open appendectomy procedure under general anesthesia was performed. Specimens were sent to histopathology department. Patients received standard postoperative care and after discharge followed up in outpatient department. Final outcomes were determined by the presence of appendicitis on histopathological report along-with the levels of red cell distribution width recorded preoperatively.

Data were entered on a pre-designed forms. It included demographic features, clinical assessment findings, the modified Alvarado score, values of red cell distribution width and histopathology reports showing presence or otherwise, the features of acute appendicitis

Statistical analysis: Data analysis were done by using SPSS version 23. Numerical variables like age and red cell distribution width levels were represented by mean and standard deviation. Categorical variables like gender, histopathological findings; inflamed or normal, were analyzed by using frequency and percentages. Final outcome, the mean+SD levels of RDW comparison between inflamed and non-inflamed appendix, were also determined. Independent sample t-test was employed to detect the statistical significance between the mean RDW level of inflamed and non-inflamed appendix. A p-value of <0.05 was considered as statistically significant. Effect modifiers like age, gender, modified Alvarado scores were rectified by implementing stratification. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy (DA) were calculated for red cell distribution width using histopathology as gold standard.

RESULTS:

This study comprised of 211 patients of 18 years to 70 years of age. Mean age was 26.68±10.87 years. Most of the patients (n=130 - 61.6%) were between 18 years – 25 years of age. There were 169 (80.1%) males with 4:1 male to female ratio. The RDW level was between 10% - 28.4% with the mean of 13.82±1.99%. A value of less than 14.5 % was considered as normal. Histopathological evaluation of appendiceal specimen revealed acute appendicitis in 203 (96.2%) cases. The mean red cell distribution width in patients with acute appendicitis was 13.91±1.97 that was statistically significant. (p=0.001). The diagnostic accuracy of RDW was 27.48% in acute appendicitis, when histopathology is taken as gold standard. The details of sensitivity, specificity, PPV, NPV and accuracy are shown in table I.

Mean RDW levels in patient of age group 18 - 25 years was 4.02%, for age group 26 - 45 years 14.01% and for age group 46 -70 years 14.30%. Mean RDW levels in female patients was 14.95% and in males 13.64%. Mean RDW levels in patients with Alvarado score of 7 was 13.57%, with score of 8 it was 13.76%, with 9 it was 14.33% and with score of 10 it was 14.18%. The accuracy of diagnosis was 24.26% and 40.47% for red cell distribution width in acute appendicitis with gold standard being histopathology in males and females respectively. The diagnostic accuracy was 24.61%, 28.35% and 50% for red cell distribution width with gold standard being histopathology in acute appendicitis in age groups 18 - 25 years, 26 - 45 years and 46 - 70 years respectively. The diagnostic accuracy was

Table I: Diagnostic Accuracy of Red Cells Distribution Width

Red Cells Distribution Width	Acute Appendicitis on Histopathology	No Acute Appendicitis on Histopathology		
>14.5% (positive)	50 (TP)	0 (FP)	Sensitivity specificity	24.63% 100%
<14.5 (negative)	153 (FN)	8 (TN)	PPV NPV DA	100% 4.96% 27.48%

24.61%, 28.35% and 50% for red cell distribution width with gold standard being histopathology in acute appendicitis in age groups 18 - 25 years, 26 - 45 years and 46 - 70 years respectively. The diagnostic accuracy was 19.69%, 20.47%, 33.33% and 40.47% for red cell distribution width with gold standard being histopathology in acute appendicitis for modified Alvarado score of 07, 08, 09 and 10 respectively

DISCUSSION:

Clinical history, examination and inflammatory markers have been used for the diagnosis of appendicitis.[14] The result of this study revealed that the average red cell distribution width levels in subjects with acute appendicitis was 13.91%. This was more than the average levels of red cell distribution width levels in patients without acute appendicitis. In literature it is reported that mean RDW levels can play a role as diagnostic marker in patients with acute appendicitis. In a study by Haghi et al figures of 57.79%, 56.00%, 86.07% and 21.98% were reported for the sensitivity, specificity, positive and negative predictive value respectively. The mean RDW of patients with normal appendix was 13.42±1.97 and acute appendix of 13.05±1.09.[15] In a meta-analysis of 5222 cases no difference in values of RDW in subjects with and without acute appendicitis and RDW were found.[16] Unlike the literature, the present study showed mean RDW in patients with acute appendicitis to be significantly greater than the mean RDW in patient without acute appendicitis.

Gulzar et al reported that the clinical assessment is the best criteria to make a diagnosis.[17] In this regard, scoring systems have been used. Previous studies also showed a significant relationship between the Alvarado score with appendicitis.[18] In this study, no statistically significant difference was found between RDW levels and different modified Alvarado scores. However, with higher Alvarado score the mean RDW levels also increased. In index study no significant changes were observed between RDW levels in different age groups. However, a significant change was recorded between RDW levels in male and female patients with p-value of <0.00. Our results are consistent with the studies done earlier.

The literature search revealed a low diagnostic value of RDW test. Different researchers have suggested changes to improve its sensitivity and specificity. CBC test accuracy may be affected by certain pre-analysis and intra-analysis circumstances. These include environmental temperature of where specimens are kept, delay between sampling time and analysis, reagents used for the preservation, and physical atmosphere of storage facility.[19] Combination of other variables along with RDW test may improve its predictive value.[10]

Limitations of the study: This was a single center observational study. Standardization of sampling technique, storage of samples and immediate testing are important factors that may be addressed for future studies on the subject.

CONCLUSION:

RDW indices were not accurate independent marker for the diagnosis of acute appendicitis. The accuracy of RDW was also not high.

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Sidrah Masoom: Conception & design, data collection, analysis and interpretation of results, manuscript drafting & revising, final approval, agreement to be accountable.
Syed Ali Haider: Conception & design, data collection, analysis and interpretation of results, manuscript drafting & revising, final approval, agreement to be accountable.
Syeda Sarah Kazmi: Data collection, analysis and interpretation of results, manuscript drafting & revising, final approval, agreement to be accountable.
Muhammad Zubair: Conception & design, data collection, analysis and interpretation of results, manuscript drafting & revising, final approval, agreement to be accountable.

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