Review Article

Role of Red Blood Cell Distribution Width (RDW) and Neutrophil Lymphocyte Ratio (NLR) in Diagnosis of Appendicitis in Paediatric Patients in H. Adam Malik Medan Central General Hospital

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INTRODUCTION

Acute appendicitis in paediatric patient is among the causal of abdominal emergency which requires immediate operation (Victor, et al, 2012; Ballester et al., 2009; Huckins et al., 2013). The incidence of acute appendicitis in paediatric patient in the world ranges from 1 to 8 % of all pediatric patients coming to the Emergency Department (ED) with acute abdominal pain (Jangra et al., 2013). Appendicitis is rare in children under 5 years, and very rare in the first year of life. In some instances, boys are more than girls around 55% to 65% of patients (Stevenson, Edward, 2003). The incidence rate of perforated appendicitis in the age group of children is about 30% to 40%. Appendicitis in the neonate is very rare, and the surgeon should be careful of the accompanying conditions, such as Hirschsprung's disease and necrotic enterocolitis. (Stevenson, Edward, 2003).

Laboratory findings could help in diagnostic, but misinterpretation of laboratory values is still very common. A slight increase in leukocyte counts (11,000 - 16,000 / mm3) was the most frequent finding. A significant increase in leukocyte counts indicates perforation. However, normal leukocyte counts also do not exclude an appendicitis (Al-Gaithy, 2012; Sahbaz et al., 2014; Sahu et al., 2014; Shawn, 2010; Xharra et al., 2012). One of the signs of inflammation are red blood cell distribution width (RDW) and neutrophil to lymphocyte ratio (NLR). Red blood cell distribution width (RDW) is a measurement of circulating erythrocyte size variations (Bujak K. et al., 2015). Children with appendicitis either perforated or not, have a significant increase in red blood cells compared to those without appendicitis (p <0.001), but there is no significant difference in red blood cells in children with simple or perforation appendicitis (p = 0.081) (Official Journal of the Japan Pediatric Society Pediatrics International (2016) 58, 202-205). Neutrophil and lymphocyte levels are derived from differential leukocytes count which is one of the components of routine blood examination. Various studies have shown an increase in neutrophil counts (neutrophilics) and a decrease in lymphocyte counts

(lymphocytopenia) immediately after tissue injury (Riley LK and Rupert J. 2015). Based on Markar et al., lymphocytopenia that associated with a clinical history may have more precise accuracy than either WBC or CRP in the diagnosis of acute appendicitis. The aim of this study is to find out how the role of RDW and NLR counts in diagnosis of appendicitis severity towards paediatric patients in H. Adam Malik Medan General Hospital.

METHODS

The design of this study is a diagnostic study. Samples were collected through medical record with inclusion criterias were paediatric patients under 18 years old who suffered abdominal pain and diagnosed with appendicitis and had undergone appendectomy at H. Adam Malik Medan Central General Hospital during the period from 2012 to 2017. Patients with incomplete medical record were excluded. Sampling is done by consecutive sampling. The minimum number of samples calculated by the formula:

$$n = \frac{(Z\alpha)^2 Sen(1 - Sen)}{d^2 P}$$

Information:

n   = sample size

Sen   = desired tool's sensitivity = 85% (Satria, 2015)

d   = precision = defined by researchers by 15%

P   = prevalence of appendicitis in children = 4.5% (Jangra et al., 2013)

Based on the above formula, the minimum sample size of this study is 27 people.

The collected data will be presented descriptively in the frequency distribution table. The datas between haematologic components (RDW and NLR) and histopathologic results were then analyzed bivariately with Mann-Whitney test. Each parameter will be re-analyzed using the ROC curve to determine the cut-off point with sensitivity and specificity.

RESULTS

Sample Characteristics

A total of 138 patients consisting of 69 (50%) boys were participated in the study. All of them had undergone appendectomy with pathologic results of complicated appendicitis in 93 (67,4%) patients. The mean ± SD of patient's age was 11.09 ± 4.3 years with most group among age 6 to 12 years as many as 65 (47.1%) patients.

Table 1 Characteristics of Research Sample

Characteristics		n Mean±SD (Median)	%
Sex	Boys	69	50
	Girls	69	50
Diagnosed with Appendicitis	Simple	45	32.6
	Complicated	93	67.4
Age		**11.09±4.3**	
	Infants and Toddlers (<5 yo)	17	12.3
	Children (6-12 yo)	65	47.1
	Teenagers (13-18 yo)	56	40.6
Haematologic Parameters	**RDW (%)**	13.84±1.85 (13.3)	
	Leukocytes (x10³)	15.91 ± 6.99 (14.53)	
	Neutrophils (/mm³)	75.83±11.80 (14.53)	
	Lymphocytes (/mm³)	14.45±9.25 (11.9)	
	NLR	7.8±5.33 (6.58)	

Table 2 Analysis of Various Hematologic Parameters and Diagnosis of Appendicitis

Haematologic Parameters	Simple Appendicitis Mean±SD (Median)	Complicated Appendicitis Mean±SD (Median)	P*
RDW	13,70±1,59 (13,4)	13,91±1,96 (13,3)	0,764
Leukocyte (x10³)	13,11±6,02 (11,49)	17,26±7,06 (16,2)	<0,0001
Neutrophils	69,77±13,33 (72,8)	78,76±9,79 (81)	<0,0001
Lymphocytes	18,59±10,76 (15,6)	12,45±7,73 (10,7)	<0,0001
NLR	5,80±4,70 (4,46)	8,77±5,37 (7,63)	<0,0001

*Mann-Whitney Test

In table 2, it can be seen that the hematologic parameter values of all leukocyte derivatives are statistically significantly different between simple appendicitis and complicated appendicitis. The RDW values between the two groups did not show values that statistically different.

Role of RDW and NLR in Diagnosis of Appendicitis

The values of RDW and NLR to the diagnosis of appendicitis were then analyzed using ROC to obtain the cut-off point with the highest sensitivity and specificity. The ROC curve and the diagnostic test values of both parameters are presented in Figures 1 and Table 3.
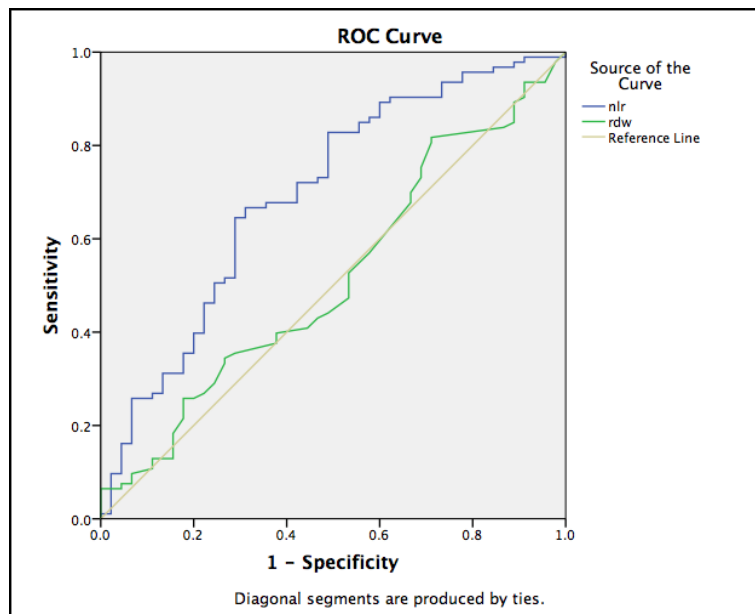
Figure 1. ROC Curve of RDW and NLR to Diagnosis of Appendicitis in Paediatric Patients

Table 3. Values of Area under the Curve of RDW and NLR Parameters to Diagnosis of Appendicitis in Paediatric Patients

Parameters	Area Under the Curve (AUC)	p	Sensitivity	Specificity
RDW	51.6%	0.764	-	-
NLR	69.6%	<0.0001	66.7%	68.9%

On the ROC curve, the area under the curve of the RDW is 51.6% but that value does not provide a significant diagnostic value ($p = 0.764$).

On the ROC curve of the NLR, the area under the curve is 69.6% with a diagnostic value that statistically significant (p <0.0001). The highest sensitivity and specificity for the NLR are 66.7% and 68.9% at the cut-off point 5.95.

DISCUSSION

This study assessed the relationship of RDW and NLR to the severity of appendicitis in paediatric patients. In the previous study, it was suggested that RDW played a role in the diagnosis of acute appendicitis in adults. Researchers only found a study of Bozlu et al (2016) who examined RDW in paediatric appendicitis. In that study, it was proposed that RDW was significantly different in paediatric patients with appendicitis compared to normal appendix. The value of RDW in paediatric patients with appendicitis found in that study was 13.63±1.08%. However, the RDW value can not distinguish simple and complicated appendicitis ($p = 0.081$). That results are consistent with this study. The overall value of RDW of paediatric appendicitis in this study ranged from 13.84±1.85%. However, after being analyzed with Mann-Whitney test, there is no significant differences between simple and complicated appendicitis (13.7 ± 1.59% and 13.91 ± 1.96% ($p = 0.764$)). The value of ROC analysis to RDW also showed insignificant results, ie with AUC 51.6%. Thus, researchers were no longer looking for cutting point against

RDW to determine sensitivity and specificity.

Yazici in 2010 examined the role of NLR in the diagnosis of appendicitis in paediatric patients and found that a NLR score greater than 3.5 is a more accurate as a predictor factor when compared with total leukocytes. In this study the researchers found the appropriate value of NLR in all appendicitis patients is 7.8 ± 5.33. However, there was no previous research has determined the value of NLR that distinguished simple and complicated appendicitis. In this study the researchers found that the NLR values were also statistically different in each group, ie 5.80 ± 4.7 and 8.77 ± 5.37 (p <0.0001). The researchers then performed ROC test at that value and obtained the area under the curve (AUC) 69.6%. The highest sensitivity and specificity for the NLR were 66.7% and 68.9% at the cut-off point 5.95. Thus, it can be concluded that the value of NLR is a promising predictive factor not only for diagnosing appendicitis, but also for determining the severity of appendicitis in paediatric patients.

CONCLUSION

RDW values were not statistically significant in the diagnosis of appendicitis in paediatric patients. The researchers found that the NLR values were statistically different in the simple and complicated appendicitis group, ie, 5.80 ± 4.7 and 8.77 ± 5.37 (p <0.0001). The ROC test value shows the area under the curve (AUC) of 69.6%. The highest sensitivity and specificity values for the NLR were 66.7% and 68.9% at the cut-off point 5.95. Thus, it can be concluded that the value of

NLR is a promising predictive factor not only for diagnosing appendicitis, but also for determining the severity of appendicitis in paediatric patients.

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