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Neutrophil Lymphocyte Ratio as A Predictive Factor of Complicated and Uncomplicated Acute Appendicitis

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ABSTRACT

Background: Acute appendicitis is a common surgical emergency, but diagnosis remains challenging due to its similarity to other conditions. Several studies have used inflammatory biomarkers to diagnose acute appendicitis. One such biomarker is the neutrophil-lymphocyte ratio, which has demonstrated high accuracy in diagnosing appendicitis. The neutrophil-lymphocyte ratio is a simple comparison of the differential count of neutrophils and lymphocytes from peripheral blood tests. ***Methods:*** This study used an analytical observational diagnostic test using a retrospective cross-sectional study to determine the sensitivity and specificity of the neutrophil-lymphocyte ratio examination in cases of complicated appendicitis and uncomplicated appendicitis. ***Result:*** 65 patients were involved in this study. In this study, the Area Under Curve (AUC) was obtained at 0.89 with a Confidence Interval (95% CI = 0.81-0.97). The RNL cut-off point for complicated appendicitis > 6.8350 has a sensitivity of 81.81% and a specificity of 84.37%, a positive predictive value of 84.37% and a negative predictive value of 81.81%, a positive likelihood ratio of 5.2 and a negative likelihood ratio of 0.21. ***Conclusions:*** Studies on the neutrophil-lymphocyte ratio found that the sensitivity and specificity of the NLR examination in differentiating complicated appendicitis were excellent; this test can be easily performed in regional hospitals with limited facilities and resources.

Keywords: neutrophil lymphocyte ratio; complicated appendicitis; uncomplicated appendicitis.

INTRODUCTION

Appendicitis cases remain a challenge for surgeons, especially in remote areas with limited resources and facilities. Delayed diagnosis will result in complications for patients. Scoring systems are difficult to apply to children, women, and pregnant patients, making them difficult to diagnose in early cases, and unable to differentiate between simple and complicated appendicitis [1,11,12,13].

Neutrophils play a crucial role in the regulation of the adaptive immune system and are the primary effector cells in the systemic inflammatory response (SIRS). On the other hand, lymphocytes are responsible for the adaptive immune response. When the neutrophil differential count increases, it will result in an increase in the neutrophil-lymphocyte ratio (NLR). This condition can be found in bacterial or fungal infections, acute stroke, myocardial infarction, atherosclerosis, severe trauma, cancer, post-operative complications, and conditions where severe tissue damage occurs during the systemic inflammatory response (SIRS)[2].

The pathological process that initiates appendicitis is a blockage in the appendiceal lumen. This blockage can be caused by many things, including fecaliths, lymphoid hyperplasia, foreign bodies, parasites, primary or secondary malignancies (carcinoid, adenocarcinoma, Kaposi's sarcoma, and lymphoma), and tumor metastasis (colon and breast) [5,6,7,9].

The diagnosis of appendicitis is based on clinical findings and supporting examinations. The recommendations from the WSES Jerusalem 2020 divided the diagnosis based on risk stratification, and the scoring system is still used, taking this stratification into account [10].

METHODS

This study used an analytical observational diagnostic test using a retrospective cross-sectional study. To determine the diagnostic cut-off point, specificity and sensitivity parameters, positive predictive value, and negative predictive value of the NLR value. A Receiving Operating Characteristic (ROC) curve analysis was performed. The NLR cut-off point with the best sensitivity and specificity was determined by an area under the curve (AUC) value > 0.5.

RESULT

TABLE 1: Description of Subject Characteristics and Research Variables.

Variables	N = 65	Percentage (%)
Age		
0-10	3	4.6
11-20	11	16.9
21-30	10	15.4
31-40	11	16.9
41-50	15	23.1
51-60	8	12.3
61-70	7	10.8
Gender		
Man	33	50.8
Woman	32	49.2
Operation findings		
Complicated appendicitis	33	50.8
Uncomplicated appendicitis	32	49.2

TABLE 2: Descriptive Statistics of Neutrophil-Lymphocyte Ratio in Acute Appendicitis.

	N	Minimum	Maximum	Mean	Standard Deviation
Neutrophils	65	11.10	92.00	78.5138	11.35323
Lymphocytes	65	4.00	35.00	13.7323	6.41407
NLR	65	.42	22.00	7.1854	3.90322

Cut off point Neutrophil Lymphocyte Ratio for complicated appendicitis is 6.8350.

TABLE 3: Cross Tabulation of Neutrophil-Lymphocyte Ratio and Operative Findings.

NLR	Operation findings		N
	Complicated Appendicitis	Uncomplicated Appendicitis	
> 6.8350	27	5	32
≤ 6.8350	6	27	33
N			65

Sensitivity = 27 / (27+6) = 81.81%
Specificity = 27 / (5+27) = 84.37%
Positive predictive value = 27 / (27+5) = 84.37%
Negative predictive value = 27 / (6+27) = 81.81%
Positive likelihood ratio = sensitivity: (1-specificity) = 5.2
Negative likelihood ratio = (1-sensitivity): specificity = 0.21

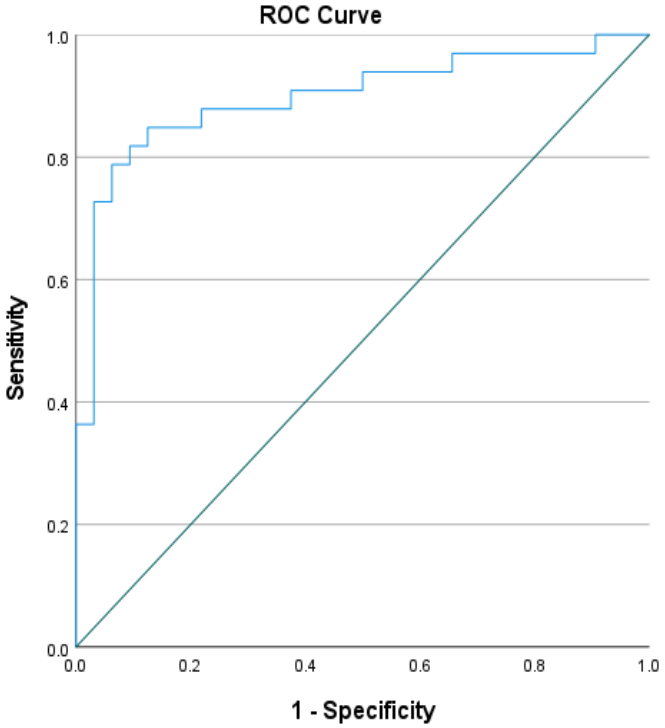

FIGURE 1: Diagnostic ROC Curve of Neutrophil-Lymphocyte Ratio in Complicated and Uncomplicated Appendicitis.

DISCUSSION

Appendicitis cases remain a challenge for surgical specialists. Especially in remote areas with limited resources and facilities, delayed diagnosis will result in complications for patients. From our research, we wanted to determine the value of the neutrophil lymphocyte ratio (NLR) as a predictive factor in the occurrence of complicated and uncomplicated appendicitis. The Receiving Operating Characteristic (ROC) NLR curve shows good results if the curve is far from 50% and close to 100%. In this study, the Area Under Curve (AUC) was obtained at 0.89 with a Confidence Interval (95% CI = 0.81-0.97). The NLR cut-off point for complicated appendicitis > 6.8350 has a sensitivity of 81.81% and a specificity of 84.37%, a positive predictive value of 84.37% and a negative predictive value of 81.81%, a positive likelihood ratio of 5.2 and a negative likelihood ratio of 0.21.

From several previous studies on the Neutrophil Lymphocyte Ratio in the diagnosis of acute appendicitis, we tried to compare it with a study conducted by Prasetya, Dedi et al in 2019 on pediatric appendicitis patients. From the study, the results obtained a Cut-off point for complicated appendicitis was 6.59 with an AUC of 0.79, sensitivity of 84.6%, specificity of 56.5%, positive predictive value of 35.5% and negative predictive value of 92.2%, Odds Ratio (OR) 7.15 (95% CI = 2.28-22.4) [1].

Another study conducted by Mirantika et al. in 2021 showed that an NLR >5 had an 11.78 times greater risk of perforated appendicitis compared to an NLR $\leq$ 5 (PR: 11.78, $p < 0.05$)[8]. A study in 2014 by Kahramanca et al. showed that an NLR >5.78 was associated with complicated appendicitis with a sensitivity of 70.8% and a specificity of 48.5% [3].

We tried to compare this study with a systematic review and meta-analysis conducted by Hajibandeh Shahab et al in 2019, from 17 studies involving 8914 patients, the results of NLR 8.8 were obtained as the cut-off point for complicated appendicitis with a sensitivity of 76.82% and a specificity of 100% with an AUC of 0.91 [4].

Finally, we compared this study with two studies of complicated appendicitis in pediatric patients. The first, conducted by Anastasakis, Michail et al. in 2024, found that an NLR >7.92 was associated with perforated appendicitis, with a sensitivity of 62.5% and a specificity of 74.2% [13]. The second study, conducted by Miguel-Carlos Delgado et al. in 2019, found that an NLR >10.5 was associated with peritonitis in pediatric patients with appendicitis, with a sensitivity of 85% and a specificity of 75.2% [14].

Several studies on the neutrophil-lymphocyte ratio found that the sensitivity and specificity of the NLR examination in differentiating complicated appendicitis were excellent, with a cutoff point range of 5-10.5. Meanwhile, our study found a cutoff point for complicated appendicitis of >6.8350.

CONCLUSION

The study concluded that the Neutrophil-Lymphocyte Ratio test can be used as a predictor of complicated

appendicitis in cases of acute appendicitis, with a cutoff point of 6.8350, a sensitivity of 81.81%, and a specificity of 84.37%. This test can be easily performed in regional hospitals with limited facilities and resources.

NLR examination, when combined with clinical examination (appendicitis score), inflammatory biomarkers, and supporting examinations such as USG, CT scan, and MRI, will be very helpful in establishing the diagnosis and assessing complications of acute appendicitis.

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