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DIFFERENTIATING APPENDICITIS TYPES: THE ROLE OF NEUTROPHIL SUBTYPES

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ABSTRACT

Background: Recent studies have highlighted the significance of inflammatory markers in diagnosing appendicitis; however, the specific roles of stab and segmented neutrophils in assessing disease severity remain poorly understood. **Objective:** This study aims to analyze the relationship between the types of appendicitis (complicated and uncomplicated) and neutrophil counts (stab and segmented), along with demographic variables such as age and gender, to evaluate their diagnostic significance. **Methods:** A retrospective, descriptive study was conducted on 48 appendicitis patients treated at Gatot Soebroto Army Central Hospital during 2020–2021. Data were analyzed using the Mann-Whitney U test, with a significance threshold set at $p<0.05$. **Results:** Neutrophil segment counts demonstrated a statistically significant difference between complicated and uncomplicated appendicitis cases ($p=0.000$), with higher levels observed in complicated cases. In contrast, neutrophil stab counts, age, and gender did not show statistically significant differences ($p>0.05$). **Conclusion:** Neutrophil segment counts serve as a reliable marker for assessing appendicitis severity, while neutrophil stab counts and demographic factors such as age and gender lack predictive value. Further research is warranted to investigate the temporal dynamics of neutrophil levels and their integration with other inflammatory markers.

INTRODUCTION

Appendicitis is one of the leading causes of acute abdominal pain requiring emergency surgical intervention. This condition has a high incidence among young individuals, particularly between the ages of 10 and 30 years[1]. Identifying acute appendicitis is often challenging due to its variable and nonspecific symptoms. Thus, various assessment tools, including inflammatory markers, have been utilized to enhance diagnostic accuracy[2].

Globally, appendicitis has an incidence rate of approximately 100 cases per 100,000 people annually. Studies indicate that appendicitis is more common in males than females, with a male-to-female ratio of 1.4:1[3]. Mortality rates from acute appendicitis are relatively low in developed countries; however, complications such as perforation are more prevalent in cases with delayed identification[4].

Appendicitis begins with obstruction of the appendix lumen, which may be caused by fecaliths, lymphoid hyperplasia, or foreign bodies. This obstruction increases intraluminal pressure, disrupts blood flow, and leads to ischemia. The ensuing inflammatory process triggers neutrophil infiltration into the appendix wall, resulting in tissue destruction. If left untreated, appendicitis may progress to gangrene or perforation, significantly increasing the risk of peritonitis[5].

Neutrophils play a key role in the immune response to acute inflammation. In appendicitis, the peripheral blood neutrophil count often rises in response to localized inflammation in the appendix. Further analysis distinguishes between stab neutrophils (immature forms) and segmented neutrophils (mature forms), both of which are critical inflammatory markers[6].

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Changes in the proportion of stab and segmented neutrophils can reflect the severity of appendicitis. In uncomplicated acute appendicitis, segmented neutrophils are predominantly elevated. Conversely, in complicated cases such as gangrenous or perforated appendicitis, stab neutrophils show a significant increase. This highlights the potential of neutrophil subtypes as indicators of disease severity[7].

The evaluation of acute appendicitis often relies on inflammatory markers; however, the specific roles of stab and segmented neutrophils in evaluation and severity assessment remain underexplored. This study aims to analyze the relationship between types of appendicitis and stab and segmented neutrophil counts, evaluating their potential as more specific indicators.

METHODS

This study utilized a retrospective, descriptive, non-experimental design to investigate the relationship between the type of appendicitis (complicated or uncomplicated) and neutrophil stab values, neutrophil segment values, patient age at diagnosis, and gender (male or female). Data were obtained from the medical records of patients hospitalized and treated with appendectomy at Gatot Soebroto Army Central Hospital during the period 2020–2021.

The sample was selected using a purposive sampling technique based on predefined inclusion and exclusion criteria.

The inclusion criteria consisted of patients diagnosed with either complicated or uncomplicated appendicitis who had complete medical records containing the relevant study variables. Uncomplicated appendicitis refers to cases without associated complications, whereas complicated appendicitis is defined by the presence of clinical complications such as perforation, peritonitis, abscess, or severe inflammation. According to the established clinical guidelines applied in this study, the normal reference ranges for neutrophil subsets are defined as 50–70% segmented neutrophils and 2–6% band (stab) neutrophils in peripheral blood.

Data were collected using a standardized data collection form developed by the researchers. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 22.0. The confidence level was set at 95%, with a margin of error of 5%. Data normality was assessed using the Shapiro-Wilk test. Since the data were not normally distributed, comparisons were conducted using the Mann-Whitney U test.

RESULT

A total of 48 patients met the inclusion criteria, of whom 18 were diagnosed with complicated appendicitis.

Table 1: Patient Characteristics Based on Type of Appendicitis

Category	Group	Type of Appendicitis	
		Uncomplicated (N=30)	**Complicated (N=18)**
Age	≤15	4 13.3%	2 11.1%
	≥16	26 86.7%	16 88.9%
Gender	Male	13 43.3%	11 61.1%
	Female	17 56.7%	7 38.9%
Neutrophil stab	Normal	30 100.0%	18 100.0%
Neutrophil segment	Normal	23 76.7%	3 16.7%
	High	7 23.3%	15 83.3%

After conducting the normality test using the Shapiro-Wilk test, the results revealed that only the neutrophil segment variable exhibited a normal distribution (p-value > 0.05), while the remaining variables failed to meet this criterion. Since the majority of the data do not conform to a normal distribution, the Mann-Whitney test is considered suitable for further analysis.

Table 2. Mann-Whitney U Test Results

Category	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
Age	264.000	-0.223	0.824
Gender	222.000	-1.180	0.238
Neutrophil stab	218.000	-1.232	0.218
Neutrophil Segment	75.000	-4.156	0.000

The findings from the Mann-Whitney U test indicate that Age, Gender, and Neutrophil stab do not exhibit statistically significant differences between the groups analyzed, as evidenced by their respective p-values (0.824, 0.238, and 0.218), all of which exceed the conventional threshold of 0.05. This suggests that these variables may not play a critical

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role in differentiating the groups within this dataset. In contrast, the Neutrophil Segment category presents a significant difference, with a p-value of 0.000, indicating a strong statistical significance.

DISCUSSION

This study aimed to investigate the relationship between clinical and laboratory variables in patients with uncomplicated and complicated appendicitis. The findings reveal that among the variables analyzed (age, gender, neutrophil stab count, and neutrophil segment count), only the neutrophil segment count exhibited a statistically significant difference between the groups.

The lack of significant differences in age and gender between uncomplicated and complicated appendicitis groups suggests that these demographic factors do not strongly influence disease severity. These findings are consistent with prior research indicating that while the incidence of appendicitis is marginally higher in males, gender is not a reliable predictor of complication rates[8,9]. Similarly, the age distribution in this study—indicating a higher prevalence of appendicitis among older adolescents and young adults—reflects global trends but does not appear to correlate significantly with the likelihood of complications[10].

Contrary to expectations, neutrophil stab counts were within normal ranges for both uncomplicated and complicated appendicitis groups. Elevated stab counts are typically anticipated during acute infections; however, the absence of significant findings in this study may be attributed to the timing of blood sample collection relative to the disease's progression. This hypothesis aligns with findings by Sutton et al. (2020)[11] and Putri et al. (2021)[12], who noted that biomarker levels can fluctuate based on the inflammatory phase at the time of evaluation.

The observed significant difference in neutrophil segment counts between uncomplicated and complicated appendicitis aligns with previous studies. Elevated neutrophil segment counts (neutrophilia) are recognized as markers of severe inflammatory responses and are frequently observed in cases of complicated appendicitis. In this study, 83.3% of patients with complicated appendicitis exhibited high neutrophil segment counts compared to 23.3% in the uncomplicated group. These results corroborate findings from previous studies emphasizing the role of neutrophil segment counts as a potential biomarker for diagnosing and predicting the severity of appendicitis[1,13]. Similarly, Lestari and Nugroho (2017)[14] highlighted the diagnostic value of neutrophilia in acute inflammatory conditions, supporting its integration into routine clinical protocols. Furthermore, Andersson et al. (2018)[15] suggested that combining neutrophil counts with other inflammatory markers, such as C-reactive protein (CRP), could enhance diagnostic accuracy for complicated appendicitis.

The findings regarding neutrophil segment counts as a critical marker align with broader literature emphasizing its utility in clinical decision-making. Studies such as those by Santoso et al. (2020)[13] and Rivera-Chávez et al. (2022)[16] underscore the role of neutrophilia as an accessible and reliable biomarker, particularly in resource-limited settings.

The segment count provides an objective measure correlating with appendicitis severity, which is valuable for preoperative risk stratification, even though all patients ultimately underwent surgery. Logistic regression analysis by Kurniadi et al. (2023)[17] showed that neutrophil and lymphocyte counts, length of hospital stay (LOS), operation duration, ASA score, and surgical approach were significantly associated with the type of appendicitis. Furthermore, patients with complications tended to have a longer LOS, highlighting the clinical relevance of assessing disease severity.

In addition, WHO guidelines (2021)[18] recommend incorporating laboratory biomarkers alongside imaging modalities to optimize diagnostic and management strategies for appendicitis. Similarly, Widodo et al. (2018)[8] advocate for a multimodal approach, integrating laboratory and imaging data to improve diagnostic precision.

This study had limitations, including purposive sampling, incomplete medical records, and uncontrolled confounders such as comorbidities and medication use. These may affect external validity and result interpretation. Future prospective studies with larger, more representative samples are needed to confirm these findings.

CONCLUSION

The findings reinforce the utility of neutrophil segment counts as a critical diagnostic marker for appendicitis severity, while the lack of significance in

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neutrophil stab counts invites further exploration. Demographic factors such as age and gender appear less relevant in predicting complications. Future research should validate these results in larger cohorts and explore the temporal dynamics of neutrophil counts alongside other inflammatory markers.

ETHICAL APPROVAL

This research has undergone an ethical review by the Research Ethics Committee of the Yarsi University Research Institute, as documented in approval number 325/KEP-UY/BIA/XI/2022.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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All financial expenses incurred in this research are fully borne by the researcher.

AUTHOR CONTRIBUTIONS

Helman Kurniadi was responsible for conceptualization, methodology, supervision, project administration, and writing original draft preparation. Timbul Partogi Haposan Simorangkir contributed to investigation and data curation. Both authors participated in writing review and editing.

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