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Comparative Analysis of Neutrophil-to-Lymphocyte Ratio (NLR) in Typhoid Fever and Appendicitis Patients at Anutapura General Hospital, Palu

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ABSTRACT

The neutrophil-to-lymphocyte ratio (NLR) is a simple, rapid, and cost-effective hematological biomarker used to assess systemic inflammation. Typhoid fever and appendicitis are prevalent infectious diseases that cause acute inflammatory responses, yet comparative studies regarding NLR values between these two conditions are lacking.

The study purpose was to analyze and compare the NLR values in patients with typhoid fever and appendicitis and to evaluate the clinical significance of these findings

Materials and methods. This study employed a quantitative design with a cross-sectional approach at Anutapura General Hospital in Palu. Consecutive sampling was used, involving 54 typhoid fever patients and 57 appendicitis patients. Secondary data were analyzed using the Mann-Whitney and Chi-Square statistical tests.

Results. Typhoid fever was most commonly observed in females (53.7%) and children aged 6-11 years (46.3%). Appendicitis predominantly affected males (54.4%) and late adolescents aged 18-25 years (80.7%). A normal NLR was found in 59.3% of typhoid patients, whereas 94.7% of appendicitis patients exhibited elevated NLR. The mean NLR in typhoid patients was 3.92, and most appendicitis patients had NLR values greater than 3. A statistically significant relationship was found between NLR and appendicitis ($p = 0.039$), but not with typhoid fever ($p=0.076$).

Conclusions. NLR elevation is more pronounced and statistically significant in appendicitis than in typhoid fever, suggesting its stronger role as an inflammatory indicator for appendicitis. NLR can be considered a supportive tool in the early differentation of typhoid fever and appendicitis in acute abdominal cases.

Keywords: Typhoid fever. appendicities, neutrophils, lymphocytes, NLR, Inflammation

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INTRODUCTION

Typhoid fever and appendicitis are two common acute infectious diseases frequently encountered in hospitals and primary care centers, especially in developing countries. Both can present with overlapping abdominal symptoms, making early clinical differentation challenging (Snyder, Guthrie, & Cagle, 2018)

Typhoid Fever is a systemic infection caused by *Salmonella Typhi* or *Salmonella Paratyphi*, transmitted through contaminated food or water. In Indonesia, the disease is endemic with an incidence rate of 81.7 per 100,000 population (WHO, 2018). The Indonesian Health Profile (2018) recorded over 41,000 hospitalized cases of typhoid fever, with 279 deaths. School-aged children (6-11 years) are particularly vulnerable due to poor hygiene practices and unsafe food consumption (Gunawan, Ardilla, & Marini, 2022)

Conversely, appendicitis is an inflammation of the vermiform appendix and is the leading cause of acute abdominal pain requiring surgical intervention. In Indonesia, the incidence of appendicitis reaches 95 per 1,000 people, with an estimated 10 million cases annually making it the highest in southeast asia (Dinas Kesehatan Provinsi Sulawesi Tengah, 2018). Delayed diagnosis can results in complications such as perforated appendicitis, increasing morbidity and mortality (Becker, Fichtner-Feigl, & Schilling, 2018)

The inflammatory response in both conditions involves alterations in hematological iimune components, particularly an increase in neutrophil counts and a decrease in lymphocytes. The neutrophil to lymphocyte ratio (NLR has been introduced as a crucial biomarker for evaluating systemic inflammation. NLR is calculated as the ratio between neutrophil and lymphocyte counts and has demonstrated potential in various clinical conditions, including infections, cardiovascular diseases, and malignancies (Raharjo, Sari, & Mufida, 2021).

NLR is advantageous because it is derived from routine complete blood count tests, requires no advanced technology, and supports clinical decision making, especially in resource limited settings (Dhinakaran, Sreeramulu, & Srinivasan, 2019). Previous studies reported elevated NLR values in both perforated appendicitis and systemic infections such as typhoid fever, yet direct comparative studies between the two remain scarce.

Therefore this study aims to compare NLR values in patients with typhoid fever and appendicitis at Anutapura General Hospital, Palu, and to evaluate NLR potential as an early diagnostic marker in acute abdominal infections.

MATERIALS AND METHODS

Study participants

The population consisted of all patients diagnosed with either typhoid fever or appendicitis, as recorded in the hospitals medical records. The typhoid fever group included 273 recorded cases during 2021-2023, with a total sample of 54 patients selected using the consecutive sampling technique. The appendicitis group included 141 recorded cases, from which 57 patients were selected using the same consecutive sampling method.

Inclusion criteria:

- Patients diagnosed with typhoid fever or appendicitis based on ICD-10 diagnosis codes and laboratory findings.
- Complete laboratory results available, including neutrophil and lymphocyte counts.
- Age between 1 and 35 years.
- Patients with no other major comorbid conditions

Exclusion Criteria:

- Incomplete or missing laboratory data
- Patients with hematological disorders or immunosuppressive therapy history.

Study organization

This research was a quantitative analytic study using cross-sectional design, aimed at comparing the neutrophil-to-lymphocyte ratio (NLR) in patients diagnosed with typhoid fever and appendicitis. The study was conducted in the Medical record department of Anutapura General Hospital, palu, Central Sulawesi, Indonesia, located at jl. Kangkung, Donggala Kodi, Ulujadi District. Data collection was carried out retrospectively from January 2021 to October 2023.

Statistical analysis

Data analysis was performed using Univariate analysis to describe the distribution of demographic and NLR values. Bivariate analysis using: Mann-Whitney U Test to compare NLR values between

two diagnostic groups and Chi-Square test to assess the association between NLR Category (Normal vs Elevated) and diagnosis type. All statistical analyses were conducted using SPSS (for appendicitis data) and JASP (for typhoid fever data). A p-value <0.05 was considered statistically significant.

Results

A total of 111 patients were included: 54 with typhoid fever and 57 with appendicitis. Table 1 represent the comparison of key clinical and laboratory characteristic

Table 1: Comparison of NLR in Typhoid Fever and Appendicitis

#	Parameter	Typhoid Fever	Appendicitis
1	**Sample Size**	54	57
2	**Gender – Male (%)**	46.3	54.4
3	**Gender – Female (%)**	53.7	45.6
4	**Most Affected Age Group**	6-11 years (46.3%)	18-25 years (80.7%)
5	**Normal Neutrophil (%)**	57.4	10.5
6	**Abnormal Neutrophil (%)**	42.6	89.5
7	**Normal Lymphocyte (%)**	57.4	8.8
8	**Abnormal Lymphocyte (%)**	42.6	91.2
9	**Normal NLR (%)**	59.3	5.3
10	**Abnormal NLR (%)**	40.7	94.7
11	**Mean NLR**	3.92	>3
12	**Statistical Significance (p-value)**	0.076	0.039

In typhoid fever, females slightly outnumbered males (53.7% vs 46.3%), while in appendicitis, males predominated (54.4%). this aligns with findings from Erianto et. al. (2020), which reported that appendicitis is more prevalent in males due to anatomical and behavioral factors, such as higher consumption of fast food and delayed healthcare-seeking behavior. In contrast, typhoid fever often affects females, possibly due to hygiene-related exposures (Mustofa, Rafie, & Salsabila, 2020)

Children aged 6-11 years were most affected by typhoid fever (46.3%), which is consistent with studies indicating school aged children are highly exposed to contaminated food and drinks (Gunawan et al., 2022). Appendicitis, on the other hand, was most prevalent in late adolescents (18-25 years, 80.7%), which supports the findings of Hartawan et al. (2020). That lymphoid hyperplasia in adolescence may predispose to appendiceal obstruction.

Neutrophila was found in 89.5% of appendicitis patients, whereas 57.4% of typhoid patients showed normal neutrophil levels. This aligns with Dhinakaran et al. (2019), who found that appendicitis triggers a strong neutrophilic response due to acute inflammation. Lymphopenia, observed in 91.2% of appendicitis cases, corroborates with salim et al. (2021), who noted lyphocyte suppression in severe infections. In contrast, typhoid fever exhibited a more balanced leukocyte profile.

NLR was elevated in 94.7% of appendicitis patients compared to only 40.7% in typhoid fever. this pattern mirrors findings by Wismaya (2018), who reported significantly elevated NLR in acute and perforated appendicitis. Yuvela (2022) also observed a near normal NLR in most typhoid paients, although with a high mean value (3.92), nearing the upper limit of normal (0.78-3.53).

The statistical analysis further emphasizes this distinction: NLR showed significant association with appendicitis ($p = 0.039$), while no significant correlation was found with typhoid fever ($p = 0.076$).

This reinforces previous findings that NLR has high sensitivity (93.7%) and specificity (82.9%) in diagnosing appendicitis (Putra et al., 2021; Akyuz et al., 2020).

Discussion

The difference in NLR patterns between the two diseases can be attributed to the pathophysiological mechanism underlying the infections. Appendicitis induces localized peritonitis, which causes an immediate surge in neutrophils and concurrent lymphocyte suppressions (AK et al., 2019). Typhoid fever, being systemic and often subacute, leads to more gradual immune activation, with variability in leukocyte response depending on host immunity and bacterial load (Nurmansyah et al., 2023)

From a clinical standpoint, these results suggest that NLR is a more reliable inflammatory marker for appendicitis than typhoid fever. NLR could assist in early triage, especially in facilities lacking imaging modalities. However, due to the overlap in early disease presentations, NLR should not replace clinical judgment or other diagnostic tools such as abdominal ultrasound, Alvarodo scoring, or culture tests (Becker et al., 2018)

Moreover the findings emphasize that although both conditions are inflammatory, the degree and direction of immune cell shifts vary, potentially allowing NLR to serve as part of differential diagnostic algorithm in febrile patients with abdominal complaint

CONCLUSIONS

This study compared the neutrophil to lymphocyte ratio (NLR) in patients diagnosed with typhoid fever and appendicitis at Anutapura General Hospital, Palu. The findings highlight distinct hematological profiles between the two conditions:

1. Typhoid fever was more common in children aged 6-11 years and showed predominantly normal neutrophil and lymphocyte values, with a mean NLR close to the upper limit of normal.
2. Appendicitis was more prevalent among late adolescents (18-25 years), with marked neutrophilia and lymphopenia, and consistently elevated NLR in 94.7% of cases.
3. A statistically significant association was observed between eelevated NLR and appendicitis ($p = 0.039$), whereas no significant association was found with typhoid fever ($p = 0.076$)

These findings suggest that NLR is a more reliable inflammatory biomarker for appendicitis and can be considered a valuable diagnostic adjunct in clinical settings where imaging and advanced diagnostics may not be immediately available. However, NLR should not be used in isolation and must be interpreted in conjunction with clinical evaluation and other diagnostic modalities.

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