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Role of Neutrophil-to-Lymphocyte Ratio in Diagnosing Acute Appendicitis: Insights from a Tertiary Care Hospital in Pakistan

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ABSTRACT

Background: Acute appendicitis is a typical surgical emergency and a leading cause of acute abdominal pain. Despite the availability of well-established clinical symptoms, early diagnosis remains challenging due to variable presentations and overlapping features with other conditions. Radiological investigations, while effective, are costly and time-consuming, and clinical scoring systems lack complete reliability. The neutrophil-to-lymphocyte ratio (NLR), a simple and inexpensive marker derived from routine blood tests, has emerged as a potential diagnostic tool. However, local evidence supporting its use is limited, necessitating further exploration. This study aimed to determine the frequency of acute appendicitis among patients with an elevated NLR (≥ 3.0) at Sandeman Provincial Hospital, Quetta.

Methodology: The study design was a cross-sectional study that took place at the Department of General Surgery, Sandeman Provincial Hospital, Quetta, within six months (January 20, 2022, to July 19, 2022). A total of 130 patients aged 18–40 years presenting with right iliac fossa pain and an elevated NLR (≥ 3.0) were included in the study. All patients underwent appendectomy, and the diagnosis of acute appendicitis was confirmed via histopathology. Subgroup analyses were conducted based on age, gender, symptom duration, socioeconomic status, and comorbid conditions (diabetes and hypertension). Data were collected after obtaining written informed consent.

Results: The mean age of the patients was 27.7 ± 6.9 years, with a male-to-female ratio of 1.3:1. Histopathological confirmation of acute appendicitis was achieved in 116 (89.2%) patients. Subgroup analysis revealed no statistically significant differences in confirmation rates across age, gender, symptom duration, socioeconomic status, or comorbid conditions.

Conclusion: Elevated NLR (≥ 3.0) was strongly associated with histopathologically confirmed acute appendicitis in 89.2% of cases, supporting its use as a reliable, cost-effective diagnostic tool. This marker holds significant potential for aiding risk stratification and managing 'patients presenting with right iliac fossa pain' in surgical settings, especially where advanced diagnostic resources are limited.

Keywords: Acute Appendicitis, Neutrophil-to-Lymphocyte Ratio, Diagnostic Marker, Surgical Emergency

Introduction

Acute appendicitis is a prevalent surgical emergency and a major cause of acute abdominal pain requiring prompt intervention [1]. Despite its common occurrence, achieving an early and accurate diagnosis can be challenging due to its variable presentation and overlap with other abdominal conditions [2, 3]. Classic symptoms, right lower quadrant pain, nausea, and fever, are not always definitive, especially in atypical cases or among patients with comorbidities. This diagnostic uncertainty often leads to delays in treatment, which can increase the risk of complications, including perforation and peritonitis [4, 5].

Diagnostic modalities such as ultrasound and computed tomography (CT) scans have become standard tools for confirming appendicitis. While these imaging techniques offer high sensitivity and specificity, they are often expensive, time-consuming, and unavailable in resource-limited settings. Moreover, their reliance on operator expertise and access to advanced facilities may limit their utility in many healthcare environments [6]. Thus, there is a pressing need for alternative diagnostic approaches that are both accessible and cost-effective.

The neutrophil-to-lymphocyte ratio (NLR), a readily available parameter derived from routine complete blood counts, has emerged as a potential marker for systemic inflammation. It reflects the balance between neutrophilic activation during an inflammatory response and lymphocytic suppression, often seen in acute inflammatory conditions [7, 8]. Elevated NLR has been proposed as a reliable and economical marker for predicting acute appendicitis, particularly in settings where advanced diagnostic tools may not be available.

Although international studies have shown promising results regarding the diagnostic value of NLR, there is limited data from local populations to support its routine use. Given the differences in healthcare infrastructure and patient demographics, evaluating the utility of NLR in specific clinical settings is critical. Exploring this marker's diagnostic accuracy in a tertiary care hospital in Pakistan could provide valuable insights into its role in improving appendicitis management.

This study aimed to assess the diagnostic utility of NLR in patients presenting with right lower quadrant pain. Specifically, the objective was to determine the frequency of histopathologically confirmed acute appendicitis in patients with elevated NLR (≥ 3.0) at Sandeman Provincial Hospital, Quetta. By addressing this gap, the study seeks to contribute to the growing body of evidence on the role of NLR in guiding clinical decision-making for suspected acute appendicitis.

Methodology

This cross-sectional study was conducted in the Department of General Surgery at Sandeman Provincial Hospital, Quetta, Pakistan. Following approval of the research synopsis, it was carried out over six months, from January 20, 2022, to July 19, 2022.

A total of 130 patients were included in the study. Eligible participants were adults aged 18 to 40 years presenting with right iliac fossa pain and an elevated neutrophil-to-lymphocyte ratio (NLR ≥ 3.0). The sample size was calculated to ensure statistical reliability in assessing the frequency of acute appendicitis among these patients. A sample size of 130 cases was calculated with a 95% confidence level and 7.0% margin of error. The expected frequency of appendicitis was 79.0% among patients with elevated neutrophil-to-lymphocyte ratio [9].

Inclusion criteria 'consisted of male and female patients under the age of 18-40 years'. Range who presented with acute appendicitis in this study was determined based on specific clinical and diagnostic criteria. Patients were included if they presented with moderate to severe pain localised to the right iliac fossa for at least 12 hours, accompanied by tenderness in the same region on clinical examination. Additionally, ultrasonographic findings consistent with acute appendicitis were required, including a non-compressible, aperistaltic, and dilated appendix with an outer diameter of ≥ 6 mm. These criteria ensured the accurate identification of patients with suspected acute appendicitis and an elevated NLR ≥ 3.5 . Patients with previous abdominal surgeries, known inflammatory conditions, or other comorbidities that could confound the diagnosis were excluded from the study. Pregnant women and those with incomplete medical records were also excluded.

After obtaining informed consent, demographic and clinical data, including age, gender, duration of symptoms, and comorbid conditions, were recorded for each patient. Blood samples were collected upon admission to measure the neutrophil-to-lymphocyte ratio. All patients underwent appendectomy, and the excised appendices were sent for histopathological examination to confirm the diagnosis of acute appendicitis.

The primary outcome was the frequency of histopathologically confirmed acute appendicitis

in patients with an elevated NLR. Secondary outcomes included the distribution of confirmed cases across demographic and clinical subgroups, such as age, gender, symptom duration, and comorbidity status.

Data were analysed using statistical software. Continuous variables, such as age and duration of symptoms, were expressed as mean \pm standard deviation, while categorical variables were presented as frequencies and percentages. The chi-square test was used to compare histopathological confirmation rates across subgroups. A p-value <0.05 was considered statistically significant.

Results

The study included 130 patients aged 18 to 40 years and an average age of 27.7 ± 6.9 years. The majority (63.1%) were under 30 years old, highlighting that acute appendicitis predominantly affects younger individuals. Regarding gender distribution, there was a slight male predominance, with males constituting 56.2% and females 43.8%, resulting in a male-to-female ratio of 1.3:1. The duration of symptoms varied from 12 to 48 hours, with an average of 27.5 ± 10.3 hours. Slightly more patients (51.5%) presented after 24 hours of symptom onset, reflecting the variability in the time to seek medical care. Socioeconomic analysis revealed that 42.3% of patients were from the lower socioeconomic class, 35.4% from the middle class, and 22.3% from the upper class, suggesting that appendicitis affects individuals across various socioeconomic groups. A notable proportion of patients had comorbidities, with 36.2% being diabetic and 39.2% hypertensive.

Table 1: Demographic Characteristics of Patients with Suspicion of Acute Appendicitis on Elevated Neutrophil-to-Lymphocyte Ratio (NLR ≥ 3.0)

Characteristics	Participants (n=130)
Age (years)	27.7 ± 6.9
• <30 years	82 (63.1%)
• ≥ 30 years	48 (36.9%)
Gender	
• Male	73 (56.2%)
• Female	57 (43.8%)
Duration (hours)	27.5 ± 10.3
• <24 hours	63 (48.5%)
• ≥ 24 hours	67 (51.5%)
Socioeconomic Status	
• Lower Class	55 (42.3%)
• Middle Class	46 (35.4%)
• Upper Class	29 (22.3%)
Diabetes Mellitus	
• Yes	47 (36.2%)
• No	83 (63.8%)
Hypertension	
• Yes	51 (39.2%)
• No	79 (60.8%)

Histopathological examination confirmed acute appendicitis in 89.2% of patients, demonstrating a strong correlation with the elevated neutrophil-to-lymphocyte ratio (NLR) used for initial diagnosis. Only 10.8% of cases had alternative diagnoses, representing a low negative appendectomy rate. These findings emphasise the reliability of NLR as a diagnostic

marker for acute appendicitis, particularly in 'settings where advanced imaging may not be readily available'.

Table 2: Confirmation of Diagnosis of Acute Appendicitis on Histopathology

Diagnosis on Histopathology	Frequency (n)	Percentage (%)
Acute Appendicitis	116	89.2%
No	14	10.8%
Total	130	100.0%

Subgroup analysis showed no statistically significant differences in histopathological confirmation rates across various patient characteristics. Among patients younger than 30 years, 89.0% had confirmed appendicitis, compared to 89.6% in those aged 30 years or older. Similarly, male and female patients exhibited almost identical confirmation rates of 89.0% and 89.5%, respectively. The duration of symptoms also had no significant impact, with confirmation rates of 88.9% for those presenting within 24 hours and 89.6% for those presenting later. Socioeconomic status did not influence the diagnosis, as confirmation rates were comparable across lower (89.1%), middle (89.1%), and upper (89.7%) classes.

Table 3: Comparison of Histopathologically Confirmed Acute Appendicitis Across Subgroups

Subgroups	n	Acute Appendicitis on H/P n (%)	P-value
Age			
• <30 years	82	73 (89.0%)	0.921
• ≥30 years	48	43 (89.6%)	
Gender			
• Male	73	65 (89.0%)	0.937
• Female	57	51 (89.5%)	
Duration			
• <24 hours	63	56 (88.9%)	0.903
• ≥24 hours	67	60 (89.6%)	
Socioeconomic Status			
• Lower Class	55	49 (89.1%)	0.996
• Middle Class	46	41 (89.1%)	
• Upper Class	29	26 (89.7%)	
Diabetes Mellitus			
• Yes	47	41 (87.2%)	0.581
• No	83	75 (90.4%)	
Hypertension			
• Yes	51	45 (88.2%)	0.769
• No	79	71 (89.9%)	

In summary, the elevated NLR (≥ 3.0) demonstrated consistent diagnostic accuracy for acute appendicitis across all evaluated subgroups, including variations in age, gender, symptom duration, socioeconomic status, and comorbidities. This supports its utility as a reliable, cost-effective tool for diagnosing acute appendicitis, particularly in resource-limited environments.

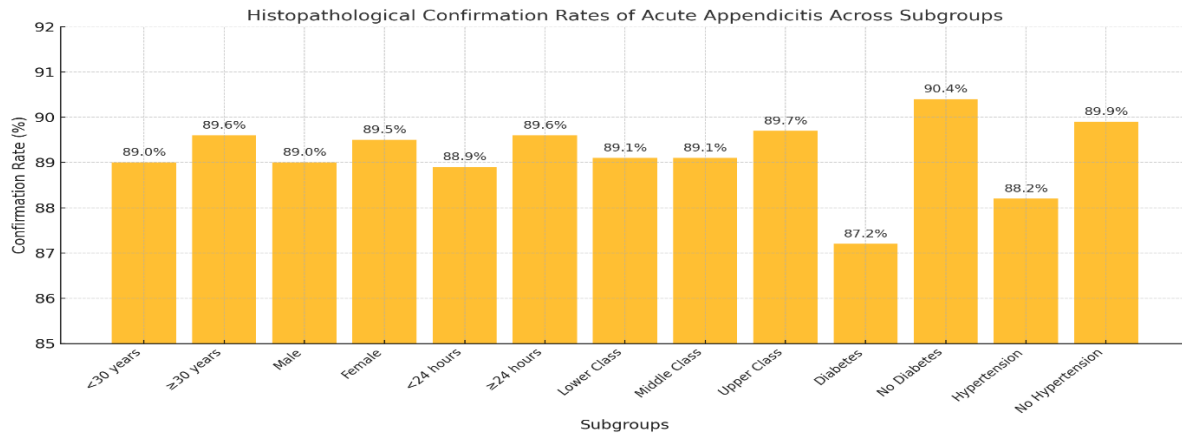


Figure 1 illustrates consistently high histopathological confirmation rates of acute appendicitis across all subgroups, ranging from 87.2% to 90.4%. Age, gender, symptom duration, socioeconomic status, and comorbidities such as diabetes and hypertension showed negligible variations in confirmation rates, all above 87%. This consistency underscores the reliability of an elevated neutrophil-to-lymphocyte ratio ($NLR \geq 3.0$) as a diagnostic marker, regardless of patient characteristics.

Discussion

This study evaluated the diagnostic utility of an elevated neutrophil-to-lymphocyte ratio ($NLR \geq 3.0$) in predicting acute appendicitis among patients with right iliac fossa pain. The findings revealed a histopathological confirmation rate of 89.2% among patients with elevated NLR, highlighting its reliability as a diagnostic marker. These results align with national and international studies suggesting NLR as a simple, cost-effective, and accessible tool for early diagnosis of acute appendicitis [10-12].

The confirmation rates across various subgroups, including age, gender, duration of symptoms, socioeconomic status, and comorbidities, were consistently high, ranging from 87.2% to 90.4%. This consistency underscores the robustness of NLR in diagnosing acute appendicitis, irrespective of demographic or clinical variations. These findings are comparable to studies that reported a histopathological confirmation rate of 50-90% in patients with $NLR > 3.5$ [13-15] and Ahmad et al., who found a similar rate of 90.2% in their cohort [16]. Such strong correlations suggest that NLR can reliably guide clinical decision-making, especially when advanced imaging modalities are unavailable or limited.

The lack of statistically significant differences in confirmation rates across subgroups further supports the universal applicability of NLR. Patients with symptom duration of less than 24 hours had a confirmation rate of 88.9%, while those with longer durations exhibited a rate of 89.6%. This indicates that NLR remains a stable and effective marker, even in patients with varying symptom durations. Similarly, male and female patients demonstrated almost identical confirmation rates (89.0% and 89.5%, respectively), suggesting that gender does not influence the diagnostic performance of NLR. These findings agreed with studies that observed no gender-based discrepancies in NLR's diagnostic accuracy [17-19].

Interestingly, patients with comorbid conditions of diabetes and hypertension showed slightly lower confirmation rates (87.2% and 88.2%, respectively) compared to those without these conditions. However, the differences were not statistically significant, indicating that NLR maintains its diagnostic reliability even in patients with underlying health conditions. This observation was consistent with studies that found that NLR remained a strong diagnostic marker in diverse patient populations, including those with comorbidities [20, 21].

One of the key advantages of using NLR is its accessibility and cost-effectiveness. Unlike imaging modalities such as CT and ultrasound, which require specialised equipment and trained personnel, NLR can be calculated from a simple blood test. This makes it particularly valuable in resource-limited settings, the one in which this study was conducted. The results of this study further emphasise that adopting NLR as a routine diagnostic marker could reduce the need for unnecessary imaging and the associated healthcare costs.

The study's low negative appendectomy rate of 10.8% reflects the accuracy of clinical and NLR-based diagnostic pathways. This is a significant improvement compared to earlier diagnostic approaches that relied solely on clinical scoring systems or imaging, which often resulted in higher rates of unnecessary surgeries. By incorporating NLR into routine practice, surgeons can make more informed decisions, potentially reducing the risk of complications and healthcare resource utilisation.

Despite its strengths, this study has certain limitations. As a single-centre study, the findings may not be generalisable to other populations or healthcare settings. Additionally, while the study focused on histopathological confirmation, future research could explore the role of NLR in predicting complications of appendicitis, such as perforation or abscess formation. Expanding the study to include larger, multicenter cohorts would further validate these findings and enhance their applicability.

Conclusion

This study reaffirms the diagnostic value of an elevated NLR in identifying acute appendicitis. The high histopathological confirmation rates across diverse subgroups highlight its reliability as a simple, cost-effective, and universally applicable diagnostic tool. Incorporating NLR into clinical practice could significantly 'improve diagnostic accuracy and patient outcomes, particularly in resource-limited settings'.

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