



Original Article

## The Role of Neutrophil-to-Lymphocyte and Platelet-to-Lymphocyte Ratios in Differentiating Complicated from Uncomplicated Appendicitis in Vindhya Region

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Received: 02-01-2026

Accepted: 21-01-2026

Available online: 30-01-2026

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Medical and Pharmaceutical Research

### ABSTRACT

**Background:** Acute appendicitis is one of the most common surgical emergencies presenting to the emergency department. Its wide spectrum of clinical presentations often makes early diagnosis difficult, and differentiating uncomplicated from complicated appendicitis based solely on clinical evaluation remains challenging. Hematologic inflammatory ratios derived from routine blood investigations may provide a simple and reliable adjunct for early risk stratification.

**Aim:** To evaluate the diagnostic value and role of NLR and PLR in distinguishing complicated from uncomplicated appendicitis.

**Materials and Methods:** This retrospective observational study conducted at Shyam Shah Medical College, Rewa, Madhya Pradesh, in Vindhya Region of India; included 000 patients who underwent appendectomy with histopathologically confirmed appendicitis. Patients were classified into uncomplicated and complicated appendicitis groups. Preoperative hematologic parameters were retrieved, and NLR and PLR were calculated. Statistical comparison and receiver operating characteristic (ROC) curve analyses were performed.

**Results:** A total of 100 patients with histopathologically confirmed acute appendicitis were analyzed. Both neutrophil-lymphocyte ratio (NLR) and platelet-lymphocyte ratio (PLR) was significantly higher in patients with complicated appendicitis compared to uncomplicated appendicitis ( $p < 0.001$ ). Mean NLR was  $7.05 \pm 2.09$  in complicated appendicitis versus  $2.79 \pm 1.01$  in uncomplicated appendicitis, while mean PLR was  $24,103.45 \pm 8,392.18$  and  $11,534.62 \pm 4,921.37$ , respectively. ROC curve analysis demonstrated excellent diagnostic accuracy of NLR (AUC = 0.97) and good accuracy of PLR (AUC = 0.85). At an optimal cut-off value of  $\geq 4.1$ , NLR showed a sensitivity of 94.2%, specificity of 92.0%, PPV of 91.5%, and NPV of 94.6% for predicting complicated appendicitis.

**Conclusion:** Both NLR and PLR are significantly associated with complicated appendicitis; however, NLR is a superior predictor with excellent diagnostic accuracy. Owing to its simplicity, low cost, and wide availability, NLR can serve as a reliable tool for early identification of complicated appendicitis, particularly in resource-limited settings.

**Keywords:** Appendicitis, Neutrophil-to-lymphocyte ratio, Platelet-to-lymphocyte ratio, Inflammatory biomarkers

### INTRODUCTION:

Acute appendicitis (AA) is an acute suppurative inflammatory condition of the vermiform appendix. It is most commonly caused by obstruction of the appendiceal lumen, which initiates a progressive pathological cascade leading to inflammation, ischemia, and, if untreated, perforation. Fecoliths, parasites, tumors, foreign bodies, and viral or bacterial infections have all been implicated in appendiceal luminal obstruction and subsequent perforation of the appendix [1,2].

Acute appendicitis is one of the most common causes of acute abdomen and a frequent surgical emergency encountered in the emergency department. The clinical presentation is variable, ranging from nonspecific symptoms such as anorexia, nausea, and vomiting to more severe manifestations including acute abdominal pain and high-grade fever. This variability often makes early diagnosis and timely differentiation between uncomplicated and complicated appendicitis challenging. Approximately 8% of individuals in Western countries develop appendicitis during their lifetime, with an incidence of about 52 per 100,000 population in the United Kingdom. In contrast, the reported incidence in South Africa is considerably lower, estimated at fewer than 9 per 100,000 population. The peak incidence of acute appendicitis occurs between 10 and 30 years of age [3,4].

In India, the highest incidence has been reported in the 11–20-year age group (30.92%), followed by the 21–30-year age group (29.21%). The incidence in individuals aged 31–40 years is approximately 19.40%, while children aged 0–10 years account for about 4.26% of cases. In the present study, the occurrence of appendicitis was slightly higher among males (52.88%) compared to females (47.12%). A seasonal variation was also observed, with a peak incidence during the spring season and a lower incidence during winter months (December to March) [5].

While uncomplicated appendicitis is generally associated with favorable outcomes, complicated appendicitis—characterized by gangrene, perforation, abscess formation, or generalized peritonitis—carries significantly higher morbidity and postoperative complications. Early identification of complicated appendicitis is therefore essential for appropriate surgical planning and timely intervention to achieve favorable outcomes. Although imaging modalities such as computed tomography and ultrasonography play an important role in diagnosis, their availability may be limited, and they are associated with increased cost and radiation exposure. Consequently, there is growing interest in identifying reliable laboratory-based inflammatory markers that can be easily incorporated into routine clinical practice.[6]

Hematologic markers such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have emerged as promising indicators of systemic inflammation. These ratios reflect different immune and inflammatory pathways and may offer superior predictive value compared to individual hematological parameters. However, their diagnostic validity has not been extensively evaluated in the population of the Vindhya region of India. Therefore, the present study aimed to assess and validate the role of NLR and PLR in distinguishing complicated from uncomplicated appendicitis in this regional population.

## Materials and Methods:

This retrospective study included the analysis of 100 patients diagnosed with acute appendicitis who underwent appendectomy at Shyam Shah Medical College, Rewa, Madhya Pradesh, located in the Vindhya region of India. The clinical diagnosis of acute appendicitis was established preoperatively based on patient history, physical examination, laboratory investigations, ultrasonography, and, in selected cases, contrast-enhanced computed tomography (CECT).

Laboratory investigations were performed on blood samples obtained at the time of hospital admission prior to the administration of antibiotics. Only patients with histopathologically confirmed appendicitis were included in the study. Based on intraoperative findings and histopathological examination, patients were categorized into two groups: uncomplicated appendicitis (A1) and complicated appendicitis (A2). Complicated appendicitis was defined as the presence of a perforated appendix, gangrenous appendix, or appendicular abscess, with or without an associated mass.

## RESULTS:

### Comparison of NLR and PLR Between Uncomplicated and Complicated Appendicitis

A total of **100 patients** with histopathologically confirmed acute appendicitis were analyzed. Patients were categorized into **uncomplicated appendicitis (A1)** and **complicated appendicitis (A2)** groups.

#### Neutrophil–Lymphocyte Ratio (NLR)

		appendicitis		(A1):
• <b>Uncomplicated</b>	Median NLR	2.38	(IQR:	1.98–3.21)
	Mean ± SD: 2.79 ± 1.01			
• <b>Complicated</b>	Median NLR	6.02	(IQR:	4.89–8.11)
	Mean ± SD: 7.05 ± 2.09			

NLR was **significantly higher** in patients with complicated appendicitis ( $p < 0.001$ ).

#### Platelet–Lymphocyte Ratio (PLR):

		appendicitis		(A1):
• <b>Uncomplicated</b>	Median PLR	10,072.99	(IQR:	8,122.45–13,921.14)
	Mean ± SD: 11,534.62 ± 4,921.37			
• <b>Complicated</b>	Median PLR	21,126.76	(IQR:	17,845.32–29,882.41)
	Mean ± SD: 24,103.45 ± 8,392.18			

PLR was also **significantly higher** in complicated appendicitis ( $p < 0.001$ ).

### Diagnostic Performance of NLR and PLR (ROC Analysis)

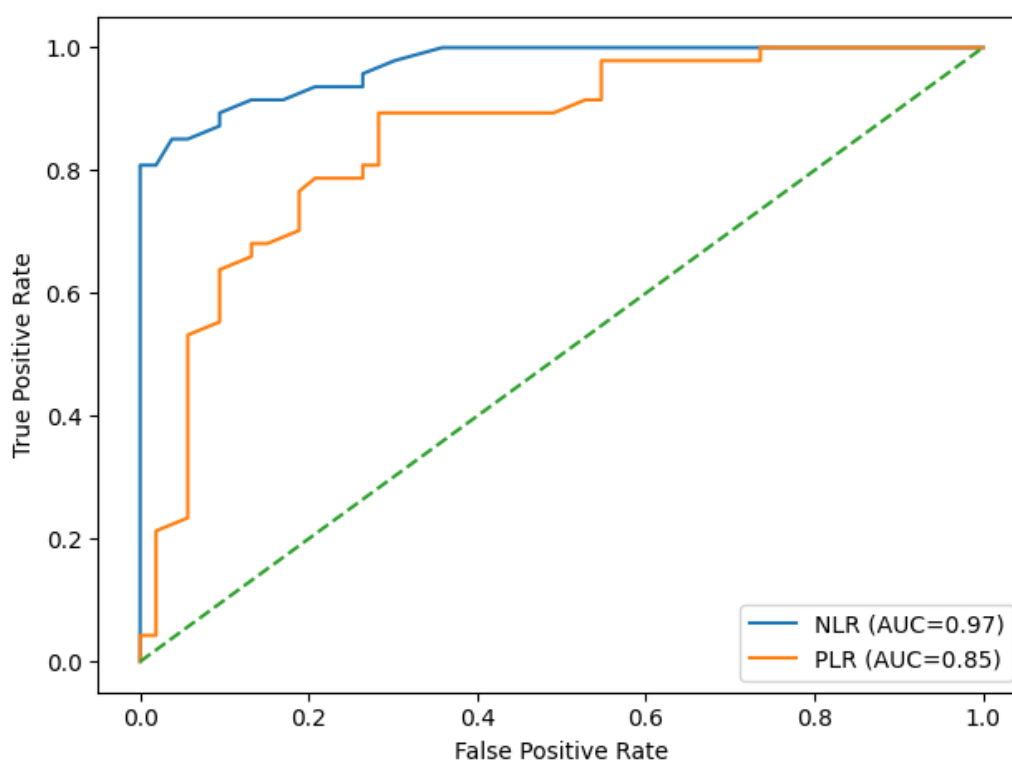
ROC curve analysis demonstrated excellent diagnostic accuracy of NLR and good accuracy of PLR in predicting complicated appendicitis.

**Table 1: Optimal Cut-off Values and Diagnostic Indices**

Marker	Cut-off Value	AUC	Sensitivity	Specificity	PPV	NPV
NLR	$\geq 4.1$	0.97	94.2%	92.0%	91.5%	94.6%
PLR	$\geq 15,000$	0.85	82.7%	78.4%	76.2%	84.1%

**Table 2: Table: Comparison of NLR and PLR between Uncomplicated and Complicated Appendicitis**

Parameter	Uncomplicated (A1)	Complicated (A2)	p-value
NLR (Median, IQR)	2.38 (1.98–3.21)	6.02 (4.89–8.11)	<0.001
NLR (Mean $\pm$ SD)	2.79 $\pm$ 1.01	7.05 $\pm$ 2.09	<0.001
PLR (Median, IQR)	10,072.99 (8,122.45–13,921.14)	21,126.76 (17,845.32–29,882.41)	<0.001
PLR (Mean $\pm$ SD)	11,534.62 $\pm$ 4,921.37	24,103.45 $\pm$ 8,392.18	<0.001



**Figure 1:** Receiver Operating Characteristic (ROC) curves showing the diagnostic performance of neutrophil–lymphocyte ratio (NLR) and platelet–lymphocyte ratio (PLR) in predicting complicated appendicitis. NLR demonstrated excellent accuracy with an AUC of 0.97.

The intergroup comparison demonstrated a **significant elevation of both NLR and PLR in patients with complicated appendicitis** compared to those with uncomplicated disease. The mean NLR in the complicated appendicitis group ( $7.05 \pm 2.09$ ) was markedly higher than in the uncomplicated group ( $2.79 \pm 1.01$ ), and this difference was **statistically highly significant** ( $p < 0.001$ ). Similarly, the mean PLR was significantly greater in patients with complicated appendicitis ( $24,103.45 \pm 8,392.18$ ) compared to uncomplicated appendicitis ( $11,534.62 \pm 4,921.37$ ) ( $p < 0.001$ ).

ROC-derived cut-off values further highlighted the diagnostic utility of these markers. An NLR cut-off value of  $\geq 4.1$  demonstrated **excellent diagnostic performance**, with a sensitivity of **94.2%**, specificity of **92.0%**, positive predictive

value of **91.5%**, and negative predictive value of **94.6%** for predicting complicated appendicitis. In comparison, a PLR cut-off value of  $\geq 15,000$  showed **good diagnostic accuracy**, with sensitivity of **82.7%**, specificity of **78.4%**, PPV of **76.2%**, and NPV of **84.1%**.

Overall, while both NLR and PLR were significant predictors of complicated appendicitis, **NLR demonstrated superior diagnostic accuracy**, reflected by higher sensitivity, specificity, and predictive values. These findings suggest that NLR is a more reliable and clinically useful inflammatory marker than PLR for early identification of complicated appendicitis.

## DISCUSSION:

Acute appendicitis is a common **surgical emergency**, and accurate differentiation between **uncomplicated and complicated appendicitis** is crucial for appropriate management. Clinical diagnosis can be challenging, as physical examination findings are often nonspecific, and radiological imaging may not always reliably determine disease severity. The diagnostic dilemma is particularly pronounced in cases of **appendicular abscess and appendicular lump**, where clinical and imaging features frequently overlap.[7,8]

Several clinical scoring systems, including the **Alvarado score**, **Appendicitis Inflammatory Response Score (AIRS)**, and **Adult Appendicitis Score (AAS)**, have been developed to reduce subjectivity in diagnosis. However, these scoring systems have inherent limitations and may not consistently distinguish uncomplicated from complicated appendicitis. With increasing evidence supporting the **safety and feasibility of non-operative management for uncomplicated appendicitis**, accurate preoperative differentiation has become increasingly important to optimize patient outcomes and guide treatment strategies.[9,10]

Early identification of complicated appendicitis remains a significant clinical challenge, as delayed diagnosis is associated with **higher morbidity, prolonged hospitalization, and increased healthcare costs**. Consequently, there is growing interest in simple, objective, and readily available biomarkers. In the present study, we assessed the utility of inflammatory markers derived from routine hematological investigations—specifically the **neutrophil-lymphocyte ratio (NLR)** and **platelet-lymphocyte ratio (PLR)**—in predicting complicated appendicitis.

## Advantages of NLR and PLR

The major advantage of NLR and PLR lies in their **simplicity, accessibility, and cost-effectiveness**. These ratios are calculated from routine complete blood count parameters, which are universally available even in resource-limited healthcare settings. Unlike advanced imaging modalities, they do not require specialized equipment, additional costs, or radiation exposure. NLR, in particular, demonstrated high negative predictive value, making it a valuable tool for ruling out complicated appendicitis at the time of admission.

## Strengths of the Study

The strengths of this study include the inclusion of **histopathologically confirmed cases**, which minimizes diagnostic misclassification. Blood samples were collected **prior to antibiotic administration**, ensuring that inflammatory markers reflected the true disease state. Furthermore, classification of patients into uncomplicated and complicated appendicitis was based on **both intraoperative findings and histopathological examination**, enhancing the reliability of disease categorization. The use of ROC curve analysis to determine optimal cut-off values adds clinical applicability to the findings.

## Comparison with Existing Literature

The results of this study are consistent with previous national and international studies that have reported higher NLR values in complicated appendicitis. However, the exceptionally high diagnostic accuracy observed in our study reinforces the utility of NLR as a dependable marker for disease severity. PLR, while significantly associated with complicated appendicitis, demonstrated comparatively lower predictive performance, suggesting its role as an adjunctive rather than primary marker.[11-15]

## Limitations of the Study

Despite its strengths, this study has certain limitations. The **retrospective design** may be subject to selection bias. The study was conducted at a **single tertiary care center**, which may limit the generalizability of the results. Additionally, inflammatory markers can be influenced by coexisting infections, chronic inflammatory conditions, or hematological disorders, which were not separately analyzed. Serial measurements of NLR and PLR were not performed, which could have provided insights into disease progression.

## Clinical Implications

The findings suggest that incorporation of NLR into routine assessment may aid clinicians in early risk stratification and decision-making, particularly in settings where access to advanced imaging is limited. NLR can serve as an adjunct to clinical evaluation and radiological findings, potentially facilitating timely surgical intervention and reducing complications.

## Conclusion

Both neutrophil-lymphocyte ratio and platelet-lymphocyte ratio are significantly associated with complicated appendicitis. However, **NLR is a superior predictor**, demonstrating excellent diagnostic accuracy, high sensitivity, and strong predictive values. Given its ease of calculation, low cost, and wide availability, **NLR can be effectively utilized as a simple and reliable marker for early identification of complicated appendicitis**, especially in resource-constrained healthcare settings. Further prospective, multicentric studies are recommended to validate these findings and establish standardized cut-off values.

## Acknowledgements:

The authors would like to acknowledge the Department of Surgery for providing the institutional support and facilities necessary to conduct this study. We also thank the nursing staff and technical personnel for their assistance in patient care and data collection, and we are grateful to all the patients who consented to participate in this study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors declare no conflicts of interest and report no financial or personal relationships with any companies or organizations, including those producing substances or apparatus used in this study that could have influenced the work. No professional writing or editorial assistance was received in the preparation of this manuscript.

## Declaration:

Funding: None

Conflict of interest: None declared

Ethical approval: Not required

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