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NEUTROPHIL-TO-LYMPHOCYTE RATIO INDEX AND PLATELET-TO-LYMPHOCYTE RATIO INDEX AS A PRECOCIOUS INDICATOR IN PROGRESSIVE AND NON PROGRESSIVE APPENDICULAR INFLAMMATION

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Abstract

Overview :Appendicular Inflammation is easily the most easy to miss progressive medical emergencies that needs the utmost attention. Early differentiation is trivial for speedy and effective clinical decision-making. NLR index and PLR index have emerged as precocious indicators to study various diseases especially appendicular inflammation. This investigation focuses on this aspect.

Study Protocol: A Hospital record based study was conducted on **100 patients (n-100) aged 5-60 yrs** who underwent operation. Statistical correlation was done based on the data obtained.

Results: Appendicular inflammation is more profound among young to middle-aged adults, particularly those aged **21–40 years**, with comparable mean ages between groups (**28.2 ± 10.1 vs. 26.5 ± 11.3 years, p = 0.58**). Progressive cases showed **higher leukocyte and platelet counts, pronounced neutrophil values, and lymphocyte values**, indicating systemic inflammation. **NLR >4.5 (OR: 4.32, p < 0.001) and PLR >210 (OR: 3.75, p = 0.002)** were deemed as strong independent predictors of disease progression.

Inflammatory markers were **significantly increased** in progressive cases: **CRP (42 ± 8 vs. 22 ± 6 mg/L, p < 0.001)**, **procalcitonin (0.75 ± 0.12 vs. 0.35 ± 0.09 ng/mL, p < 0.001)**, **serum bilirubin (1.5 ± 0.3 vs. 0.9 ± 0.2 mg/dL, p = 0.004)**, and **ESR (26 ± 4 vs. 15 ± 3 mm/hr, p < 0.001)**.

Conclusion: NLR and PLR index serve as useful adjuncts for distinguishing between simple and complicated appendicular inflammation. Their inclusion into routine clinical procedure for prognosis and diagnosis can help in minimizing surgical intervention.

Keywords: progressive appendicular inflammation, non-progressive appendicular inflammation, NLR, PLR, Prognosis

INTRODUCTION

Appendicular inflammation singularly remains one of the most common and easy to miss diagnosis of acute abdominal pain [1] [2]. Timely prognosis can help in preventing a full blown complicated appendicular inflammation [3] [4]. This disease has a perennial incidence of about 7%, with perforations occurring up to 20% of cases [5] [6]. Prognosis is a challenging affair in terms of this disease when compared to diagnosis [7] [8]. Nevertheless, clinical and imaging modalities have time and immemorial aided in their diagnosis [7] [9]. Though there has been countless screening and scoring tools such as Alvarado, RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis), and RIFT (Right Iliac Fossa Pain Treatment) scores they have been observed to depict low sensitivity and specificity in understanding the outcomes [10] [11] [12] [13] [14].

While unusually high **WBC counts** are frequently deemed instigators in appendicular inflammation [15] [16]. They miserably fail to distinguish between progressive and non-progressive type. **Serum bilirubin** and **C-reactive protein (CRP) also** has shown superior predictive value for perforation risk. But, there are no solid evidences [17].
Further exploration and scientific investigations have shown that **Neutrophil-to-Lymphocyte Ratio (NLR)** and **Platelet-to-Lymphocyte Ratio (PLR) index** as an invariable asset in assessing disease severity and prognosis [18].
NLR and PLR index provides the quintessential outlook for a potential marker to predict the varying grades of appendicular inflammation [19] [20]. Progressive (complicated) appendicular inflammation, often necessitates urgent surgical intervention, whereas non-progressive (uncomplicated) cases may be managed conservatively. Evaluating the prognostic utility of NLR and PLR index could enhance risk stratification, guide clinical decision-making, and potentially reduce unnecessary surgical interventions. Keeping this rationale in hand, the above mentioned investigation was conducted.

MATERIALS AND METHODS

This was conducted at a tertiary care hospital cum teaching institute from Jan 2024 to Jan 2025. A total of 100 cases aged 5–60 years were recruited. Participants were stratified into two groups **Group 1- Non Progressive Appendicular Inflammation patients (n-86)** and **Group 2: Progressive Appendicular Inflammation Patients (n-14)**. Documented participant agreement and ethical clearance was obtained. All the 100 cases were selected using purposive sampling. Each participant underwent a comprehensive evaluation that included recording a detailed history and performing a clinical examination. All who gave consent for the study and had underwent surgery were accommodated for the study. Exclusion criteria encompassed patients who had undergone surgery prior, pregnant and lactating women. All those who gave consent to the study were recruited.
The study's sample size was determined using prevalence of 20% [5] [6] . Using the values, p- 20% , d- 10, and a critical value of Z=1.96.

$$n=Z^2\times p\times(100-p)/d^2$$
$$=(1.96)^2\times 20\times(100\text{-}20)/(10)^2$$
$$\approx 61 \text{ (61 patients)}$$

Adjusting for a potential 2% nonresponse rate, final sample size: 63 patients,(n-100) patients were chosen.

Statistical interpretation

Data was interpreted using SPSS 22. Appropriate inferential and descriptive statistics were used based on the information obtained.

RESULTS

The age distribution of patients with appendicular inflammation indicates a higher prevalence among young to middle-aged adults, particularly in the 21–40-year range. The mean ages of both groups (28.2 ± 10.1 years vs. 26.5 ± 11.3 years) are statistically similar, as reflected in the non-significant p-value of 0.58 **(Table 1).**

Table 1: Age span of cases diagnosed with Appendicular Inflammation

Age span (Years)	*Progressive (n=14)*	*Non-Progressive (n=86)*	*Total (n=100)*
5–10	2 (14.3%)	8 (9.3%)	10 (10.0%)
11–20	3 (21.4%)	18 (20.9%)	21 (21.0%)
21–30	4 (28.6%)	22 (25.6%)	26 (26.0%)
31–40	3 (21.4%)	20 (23.3%)	23 (23.0%)
41–50	1 (7.1%)	12 (14.0%)	13 (13.0%)
51–60	1 (7.1%)	6 (7.0%)	7 (7.0%)
Mean Age (yrs)	28.2 ± 10.1	26.5 ± 11.3	**P=0.58**

Patients with progressive appendicular inflammation show elevated leukocyte and platelet counts, along with pronounced neutrophilia and lymphopenia, indicating heightened systemic inflammation. NLR and PLR are significantly higher in progressive cases ($p<0.001$) **(Table 2).**

Table 2: Correlation of blood parameters with grades of Appendicular inflammation

Parameter	*Progressive (n=14)*	*Non-Progressive (n=86)*	*p-value*
Hemoglobin (g/dL)	12.3 ± 1.5	13.1 ± 1.8	0.15
Total WBC Count (×10⁹/L)	12.8 ± 2.1	10.5 ± 1.7	0.002
PMN Count (×10⁹/L)	8.2 ± 1.5	6.8 ± 1.3	0.008
Macrophage Count (×10⁹/L)	1.3 ± 0.4	2.1 ± 0.6	0.002

Thrombocyte Count (×10⁹/L)	320 ± 40	290 ± 35	0.035
NLR	6.3 ± 1.2	3.2 ± 0.8	<0.001
PLR	246 ± 30	186 ± 25	<0.001

Multivariate regression analysis identifies **NLR >4.5** (OR: 4.32, p**PLR >210** (OR: 3.75, p=0.002) as strong independent predictors of disease progression. **Age >40 years** also shows a significant association (OR: 2.21, p=0.018), suggesting older patients may be at higher risk **(Table 3).**

Table 3: Multivariate Regression Analysis of Prognostic Factors

Parameter	***Odds Ratio (95% CI)***	***p-value***
NLR (>4.5)	4.32 (2.15-8.34)	<0.001
PLR (>210)	3.75 (1.89-7.21)	0.002
Age (>40 years)	2.21 (1.11-4.36)	0.018

Patients with progressive appendicular inflammation exhibit significantly elevated inflammatory markers compared to non-progressive cases. **CRP (42 ± 8 vs. 22 ± 6 mg/L, p<0.001)** and **procalcitonin (0.75 ± 0.12 vs. 0.35 ± 0.09 ng/mL)** show marked increase, indicating heightened systemic inflammation. **Serum bilirubin** is notably higher, suggesting possible hepatic involvement or tissue damage. **Elevated ESR** further supports increased inflammatory activity **(Table 4).**

Table 4: Inflammation Markers in Appendicular Inflammation

Markers	***Progressive (n=14)***	***Non-Progressive (n=86)***	***p-value***
C-Reactive Protein (CRP) (mg/L)	42 ± 8	22 ± 6	<0.001
Procalcitonin (ng/mL)	0.75 ± 0.12	0.35 ± 0.09	<0.001
Serum Bilirubin (mg/dL)	1.5 ± 0.3	0.9 ± 0.2	0.004
ESR (mm/hr)	26 ± 4	15 ± 3	<0.001

DISCUSSION

Acute appendicitis remains one of the most common emergencies in clinical practice. The clinical dilemma, whether to observe the patient until the clinical picture becomes undeniably clairvoyant or to intervene surgically at an early stage to thwart complications, has been the unsolvable riddle .

This nuanced interplay between the urgency of intervention and the risks associated with premature surgery underscores the importance of refining diagnostic criteria. Enhancing early diagnostic accuracy could enable more targeted decisions.

In our study, the age profile of appendicular inflammation revealed that nearly half of the cases were concentrated among young and middle-aged adults (ages 21–40). Both progressive and non-progressive groups exhibit similar mean ages (28.2 ± 10.1 vs. 26.5 ± 11.3, p = 0.58). On the contrary, Rajalingam et al [20] found the average age for patients with uncomplicated cases was 30.74 ±14.35, while for those with complicated cases, it was 40.69 ±17.55. Also, Ayneni et al [21]and Siu Chang et al [22] had different findings due to the majority study population being paediatric cases.

In this investigation it was ascribed that patients with progressive appendicular inflammation exhibited increased white blood cell and platelet counts, accompanied by marked neutrophilia and lymphopenia. Notably, both the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) are significantly higher ($p < 0.001$). Similarly, Ayeni et al [21] found higher NLR, PLR and CRP values 14.54±8.60, 280.06±172.13, 111.80±83.91 in progressive appendicular inflammation. Çelik B et al [23] also found increased PLR and NLR index in progressive appendicular inflammation. On contrary, Prasetya et al [24] in his study on acute appendicitis in children found that mean WBC and neutrophil measured were 14.33±6.56×103/µl and 76.16±14.41%, respectively. Neutrophil and NLR were significantly higher in non progressive appendicular inflammation (76.17±14.41 vs. 62.43±15.9%, p=<0.0001; and 8.44±6.63 vs. 3.38±2.84, p=<0.0001, respectively. Also, Ha SC et al [22] had identical findings.

Asafo-Adjei et al [25] found that The NLR was more sensitive in diagnosis of acute appendicitis. On the other hand, when compared to CRP, the NLR was more specific but less sensitive for the diagnosis of grades of acute appendicitis. And concluded that CRP was more reliable and raised in progressive appendicular inflammation. Yu et al [26] also reported of similar findings.

Also, Kucuk et al [27] suggested that even though NLR index had lower diagnostic accuracy than leukocyte count, but it was good in being a supportive indicator of non-progressive appendicular inflammation. Yu et al [26] declared that CRP was more efficient in diagnosing appendicular inflammation especially if the disease is progressive.

Ha SC et al [22] and Heriaynto JM et al [28] in paediatric and adult patients noted CRP to be a strong contender in diagnosing progressive appendicular inflammation. Parameters commonly found concordant and increased were WBC, neutrophils, NLR, and PLR index.

Several inflammatory markers have been linked to appendicular inflammation, yet their routine assessment remains impractical due to technical and logistical limitations. In contrast, **NLR** and **PLR** serve as cost-effective, readily accessible biomarkers, offering a reliable reflection of underlying inflammatory activity in appendicular inflammation [18].

CONCLUSION

Growing evidence underscores the **NLR and PLR index** as a pivotal prognostic marker in appendicular inflammation, with elevated levels aiding in assessing disease severity [18]. Given their accessibility and strong associations with hematological parameters, **NLR** and **PLR** serve as practical adjuncts for routine screening and risk stratification. However, further research is warranted to refine predictive accuracy, expedite prognostic assessments, and enhance the reduction of complications.

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