Diagnostic Value of the Neutrophil-Lymphocyte Ratio in Fracture-Related Infections: A Retrospective Analysis

Hans Enrique Lapica, Akshay V Daji, Miguel Cartagena, Josue Guillermo Layuno-Matos, Paul E Gerges, Scott Sandilands, Scott Sandilands

INTRODUCTION:

The neutrophil-lymphocyte ratio (NLR) is a proposed biomarker for infection in orthopedic surgery. A previously established threshold of 2.45 has been used to identify infections in total joint arthroplasty patients. This study aims to evaluate whether this threshold applies to fracture-related infections (FRI) by comparing NLR values in patients with biopsy-confirmed infection status.

METHODS:

A retrospective review was conducted on patients who underwent deep tissue or bone biopsy for suspected FRI at a single tertiary care center between January 1, 2018, and December 31, 2024. NLR values were calculated from complete blood counts and classified as septic and aseptic based on their associated biopsy result. Fisher's exact test was used to evaluate the association between an NLR >2.45 and biopsy-confirmed infection. The median NLR values were compared using the Mann-Whitney U test while the ROC analysis was used to determine the optimal NLR threshold for diagnosing FRI.

RESULTS:

Forty biopsies from 29 patients were included: 27 were septic and 13 aseptic. The median NLR was significantly higher in the septic group (4.79 (IQR [3.95–8.54]), compared to the aseptic group (1.78 IQR [1.50–2.15]). On Fishers exact test, an NLR>2.45 was strongly associated with infection, with 92.6% of septic and 27% of aseptic cases above this threshold (OR =150.0; 95% CI: 12.35-1,822.25). ROC analysis identified 2.52 as the optimal threshold, with 92.6% sensitivity (95% CI: 75.7-99.1), 92.3% specificity (95% CI: 63.97-99.8), and an AUC of 0.89 (95% CI: 0.74-1.00).
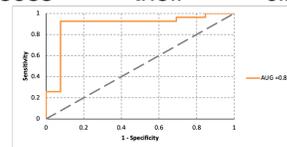
DISCUSSION AND CONCLUSION:

The NLR threshold of 2.45 appears to be a reliable diagnostic marker for FRIs. Future studies with larger cohorts are necessary to confirm these findings and assess their clinical utility.

Table 2. Contingency Tables for NLR and CRP

	Positive (NLR >2.45)	Negative (NLR ≤2.45)	Total
Septic	25	2	27
Aseptic	1	12	13
Total	26	14	40

	Positive (CRP >1 mg/L)	Negative (CRP ≤1 mg/L)	Total
Septic	14	13	27
Aseptic	6	7	13
Total	20	20	40

Biomarker	Group	Median	IQR (25th-75th percentile)	Range (Min-Max)	Mann-Whitney U	p-value
NLR	Septic	4.79	3.95–8.54	1.56–16.65	203.0	<0.0032
	Aseptic	1.78	1.50-2.15	1.00–7.06		
CRP (mg/L)	Septic	1.2	0.6–6.8	0.5–35.1	167	0.004
	Aseptic	0.8	0.5–3.5	0.5–15.4		

Metric	NLR (>2.45)	CRP (>1 mg/L)
Sensitivity (95% CI)	92.6% (75.7–99.1%)	51.9% (31–72%)
Specificity (95% CI)	92.3% (63.97-99.8%)	53.8% (25–80.8%)
Positive Predictive Value (PPV)	89.50%	70.00%
Negative Predictive Value (NPV)	90.90%	35.00%
Odds Ratio (95% CI)	150.0 (12.35–1822.3)	1.26 (0.37–4.32)
Fisher's Exact Test p-value	<0.0001	1
Area Under Curve (AUC, 95% CI)	0.89 (0.74–1.00)	0.68 (0.55–0.81)
ROC Optimal Threshold	2.52	1.1 mg/L

AUC =0.899