Predictive Value of Neutrophil–Lymphocyte Ratio, Platelet–Lymphocyte Ratio, and Lymphocyte–Monocyte Ratio for Systemic Inflammatory Response Syndrome and Sepsis Following Percutaneous Nephrolithotomy: A Single-Center Study in Medan, Indonesia

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Abstract

Background: Systemic inflammatory response syndrome (SIRS) and sepsis are major complications following percutaneous nephrolithotomy (PNL). Early detection remains difficult due to nonspecific clinical presentation. This study aimed to evaluate neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and lymphocyte-to-monocyte ratio (LMR) for predicting SIRS and sepsis after PNL.

Methods: Adult patients undergoing PNL at a tertiary center were analyzed. NLR, PLR, and LMR were calculated from preoperative blood counts. SIRS was defined based on standard clinical criteria, while sepsis was defined as SIRS with confirmed infection. Associations between inflammatory markers and outcomes were evaluated, and cut-off values were determined using ROC analysis.

Results: SIRS occurred in a proportion of patients, with a smaller subset developing sepsis. SIRS was associated with higher NLR, higher PLR, and lower LMR (all $p<0.05$). NLR showed strong predictive value, with a cut-off around 2.03. PLR (>110.62) and LMR (<3.23) were also significantly associated with SIRS.

Conclusion: NLR, PLR, and LMR were significantly associated with SIRS and sepsis following PNL. NLR is simple and rapidly obtainable, while PLR and LMR provide additional inflammatory stratification. These markers may support early identification of high-risk patients.[1–4]

INTRODUCTION

Percutaneous nephrolithotomy (PNL) is a minimally invasive procedure commonly used for the treatment of large or complex renal stones. Although it provides high stone-free rates, PNL is associated with postoperative complications, particularly systemic inflammatory response syndrome (SIRS) and sepsis.

SIRS is defined by the presence of at least two of the following criteria: leukocyte abnormalities, abnormal body temperature, tachycardia, or tachypnea. Early detection of SIRS remains challenging due to its nonspecific presentation. If not promptly recognized, SIRS may progress to sepsis, septic shock, and multi-organ failure, contributing to increased morbidity and mortality.

Inflammatory biomarkers derived from routine blood tests, such as neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and lymphocyte-to-monocyte ratio (LMR), have been increasingly studied as predictors of systemic inflammation. These markers reflect the balance between inflammatory activation and immune regulation. This study aimed to evaluate the role of

NLR, PLR, and LMR in predicting SIRS and sepsis following PNL at Haji Adam Malik General Hospital, Medan.[1–4]

METHODS

This was an analytic observational study conducted between October 2024 and October 2025 at a tertiary referral hospital. Adult patients (≥18 years) undergoing PNL with complete clinical and laboratory records were included, while patients with major hematologic disorders, unrelated systemic infections, or incomplete data were excluded.

NLR was defined as the ratio of absolute neutrophil count to absolute lymphocyte count, PLR as platelet count divided by lymphocyte count, and LMR as lymphocyte count divided by monocyte count. SIRS was diagnosed when at least two standard clinical criteria were present, while sepsis was defined as SIRS with confirmed infection.

Statistical analysis was performed using appropriate parametric or nonparametric tests, with $p<0.05$ considered statistically significant. Receiver operating characteristic (ROC) analysis was used to determine optimal cut-off values for each parameter.[1,2]

RESULTS

Patients undergoing PNL were analyzed, with SIRS incidence consistent with previous reports (16.7–27.4%) and sepsis occurring in a smaller proportion (0.3–4.7%).

SIRS was significantly associated with higher preoperative NLR and PLR values and lower LMR values (all $p<0.05$). Patients with SIRS had higher mean NLR compared to non-SIRS patients. Elevated PLR and decreased LMR were also significantly associated with inflammatory complications.

ROC analysis demonstrated that NLR had a cut-off value of approximately 2.03 with moderate sensitivity. PLR cut-off was approximately 110.62, while LMR cut-off was approximately 3.23. Patients exceeding these thresholds had a higher risk of developing SIRS.1–4

DISCUSSION

In this cohort, NLR, PLR, and LMR were strongly associated with SIRS and sepsis following PNL. Among these, NLR showed the strongest predictive performance. These findings are consistent with previous studies demonstrating the role of inflammatory markers in postoperative complications.

The pathophysiological mechanism involves inflammatory mediator release, including interleukin-6, interleukin-8, tumor necrosis factor-alpha, and granulocyte colony-stimulating factor, leading to neutrophilia and systemic inflammatory activation. At the same time, lymphocyte suppression reflects impaired immune regulation. Platelets contribute to inflammatory signaling, while monocytes regulate systemic immune responses.

NLR, PLR, and LMR are advantageous because they are inexpensive, easily obtainable, and routinely available in clinical practice. However, this study is limited by its single-center design

and lack of external validation. Further multicenter studies are needed to confirm these findings and refine cut-off values.[1–4]

CONCLUSION

NLR, PLR, and LMR were significantly associated with SIRS and sepsis following PNL in this study. NLR provides a simple and rapid bedside marker, while PLR and LMR offer additional inflammatory insight. These parameters may support early risk stratification and improve postoperative management in patients undergoing PNL.

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