



HEMATOLOGICAL INDICES AND ACUTE KIDNEY INJURY IN CARDIOTHORACIC SURGERY

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Abstract:

Acute renal failure describes as a syndrome by rapid decline in the ability of the kidney to eliminate waste products, regulate acid–base balance, and manage water homeostasis. When this impairment is prolonged and entered chronic phase, erythropoietin secretion by this organ is decreasing and toxic metabolic accumulates and causes hematological changes include decrease of HCT, MCV and RBC and platelet counts.

Keywords: AKI, anemia, NLR.

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Introduction:

The Kidney Disease Improving Global Outcomes (KDIGO) consensus group defines AKI as an increase in serum creatinine (SCr) of ≥ 0.3 mg/dl or $> 50\%$ of the baseline within a 48-hour period or a 7-day time or decrease in urine output <0.5 ml/kg/hour for 6 hours (1).

Cardiothoracic surgery-associated acute kidney injury (CSA-AKI) incidence was previously stated at 5–42% (2).

Patients undergoing cardiac surgery (CS) are particularly exposed to AKI because of the related oxidative stress, inflammation, and ischemia-reperfusion damage. The rate of AKI was higher (59%) in aortic surgery, compared to isolated coronary artery bypass surgery (CABG) (37%), valve surgery (49%) and thoracic surgery (33%) (3).

The exact pathogenesis of CSA-AKI is not fully understood; however, systemic inflammatory response was considered to play an important role in the development of CSA-AKI (4).

The platelet/lymphocyte ratio (P/LR) can be obtained from a routine blood test and may potentially be utilized as an independent indicator of AKI following cardiac surgery (5).

The neutrophil/Lymphocyte ration (N/LR) and platelet-lymphocyte ratio (P/LR) are low-cost systemic inflammatory markers that are easily calculated from a complete blood count. Recently, some correlations between elevated N/LR or P/LR and the outcomes of some critical illnesses (such as septic shock) have been reported (6).

Neutrophil-to-lymphocyte ratio

The neutrophil-lymphocyte ratio (NLR) is an easily calculated marker of systemic inflammation that has been recently demonstrated to effectively predict AKI in multiple settings. In a retrospective cohort of 590 patients undergoing cardiovascular surgery, postoperative elevated NLR was significantly associated with an increased risk of postoperative AKI and mortality, Parlar et al. also demonstrated that an increased NLR was associated with postoperative AKI in patients undergoing cardiovascular surgery with cardiopulmonary bypass, An elevated preoperative NLR was also documented as a predictor of AKI in burn surgery patients, in whom a cut-off value of 11.7 was optimal for postoperative AKI prediction (OR 1.094 (1.064–1.125), $p < 0.001$) (7)

The NLR was associated with an increased risk of contrast-induced AKI, defined as an increase in SCr of 0.5 mg/dl within 3 days, in 1162 patients submitted to an emergency percutaneous coronary intervention (OR 1.105 (1.044–1.169), $p = 0.001$),

In patients with sepsis, NLR at admission has been demonstrated as an important predictor of AKI in two retrospective cohorts, Indeed, the systemic inflammation associated with septic-AKI is vital in the development of multi-organ failure (8).

In a retrospective study of 13,678 critically ill AKI patients, Fan et al. demonstrated that an NLR higher than 12.14 was a predictor of all-cause mortality (HR 1.83 (1.66–2.02), $p < 0.0001$), Although a standardized cut-off value for the NLR has not been defined, this easily calculated marker could be promising in the early diagnosis of AKI and as a prediction of worse outcomes (9).

Platelet volume

As described above, platelets have a significant role in the hemodynamic and inflammatory mechanisms of AKI. Thus, several studies have focused on platelet parameters as predictors of AKI and outcomes. Han et al. demonstrated that mean platelet volume (MPV) ≥ 10.2 fL was a significant prognostic risk factor for 28-day mortality in a retrospective analysis of 349 AKI patients requiring continuous renal replacement therapy (CRRT) (HR 1.08 (1.010–1.155), $p = 0.023$), An increased MPV reflects increased platelet activity and turnover, which could reflect more severe inflammation and a risk factor for overall vascular mortality (10).

Li et al. developed the mean platelet volume/platelet count ratio (MPR) from a retrospective cohort of critically ill AKI patients CRRT. In this study, $MPR > 0.099$ was a significant predictor of mortality [AUROC 0.636 (0.563–0.708), $p < 0.001$] (11).

Neutrophil, lymphocyte, and platelet ratio

Koo et al. developed the neutrophil, lymphocyte, and platelet ratio (NLPR) in the setting of AKI after cardiovascular surgery, The NLPR is calculated as follows: (Neutrophil count $\times 100$) / (lymphocyte count \times platelet count). In their retrospective study of 1099 patients, higher perioperative NLPR were associated with postoperative AKI (NLPR ≥ 64 OR 2.18 (1.20–3.98), $p = 0.011$) and 5-year mortality (NLPR > 3 HR 3.54 (2.00–6.28), $p < 0.001$). This study demonstrated that adding platelet count to the NLR improved the predictive efficacy when compared to NLR or thrombocytopenia alone (12).

Platelet-to-lymphocyte ratio

In recent publications, platelet-to-lymphocyte ratio (PLR) has been reported as new poor prognostic marker. Hudzik et al. reported an association between higher PLR and risk of developing contrast-induced AKI in a

retrospective analysis of diabetic patients with ST-elevation myocardial infarction, In this study, a PLR higher than 110 had a 71% sensitivity and 63% specificity for predicting AKI,(13).

The predictive ability of PLR was also demonstrated in a study by Sun et al. including also non-diabetic patients with ST-elevation myocardial infarction undergoing percutaneous coronary intervention, Sun et al. demonstrated that a PLR of 127.5 or higher had 76.8% sensitivity and 69.2% specificity to predict AKI (14).

Interestingly, in a retrospective cohort of 10,859 critically ill AKI patients, Zheng et al. identified that both low and high PLRs were associated with an increased mortality risk, A lower PLR could result from the presence of thrombocytopenia which is also correlated with a worse prognosis in critically ill patients (15).

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