Association Between Neutrophil-Lymphocyte Ratio in Coronary Artery Bypass Grafting and Acute Kidney Injury at H. Adam Malik General Hospital Medan

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ABSTRACT

Background: Acute Kidney Injury (AKI) is a notable postoperative complication in patients undergoing Coronary Artery Bypass Grafting (CABG). The Neutrophil-Lymphocyte Ratio (NLR) is an inflammatory marker that may be associated with postoperative AKI. This study aimed to evaluate the relationship between NLR and AKI in CABG patients at H. Adam Malik General Hospital Medan.

Methods: This retrospective cohort study included 60 patients who underwent on-pump or off-pump CABG. Preoperative NLR and postoperative AKI were obtained from medical records, and AKI was assessed using AKIN criteria. Statistical analysis was performed to evaluate the association between NLR and AKI, with a significance level of $p<0.05$.

Results: Most patients had normal NLR values (83.3%), and AKI occurred in 15% of cases. The mean NLR was 2.36 in the on-pump group and 2.47 in the off-pump group. There was no significant association between NLR and AKI ($p=0.417$). There was also no significant association between surgical technique and AKI ($p=0.723$).

Conclusion: There was no significant relationship between NLR and AKI in CABG patients, and the type of surgical technique did not influence AKI incidence.

Keywords: Neutrophil-Lymphocyte Ratio; Acute Kidney Injury; CABG; on-pump; off-pump.

Introduction

The global rise in the elderly population has increased the prevalence of coronary artery disease, including in Indonesia, where the number of elderly individuals and coronary cases continues to grow (Bappenas, 2019; Kemenkes, 2014). In the United States, a significant proportion of coronary artery disease occurs in older adults, contributing to a high volume of Coronary Artery Bypass Grafting (CABG) procedures performed

annually (American College of Cardiology, 2016; AHA, 2018). A similar trend is evident at H. Adam Malik General Hospital Medan, where CABG procedures have increased over recent years (Ginting, 2017).

Despite advances in surgical techniques, including on-pump and off-pump CABG (Aikawa et al., 2013), postoperative Acute Kidney Injury (AKI) remains a major complication. The Neutrophil-Lymphocyte Ratio (NLR) is a simple inflammatory marker that may help identify patients at risk of AKI. However, data regarding the association between NLR and AKI in CABG patients in Indonesia are limited. This study aims to evaluate the relationship between preoperative NLR and AKI among patients undergoing CABG at H. Adam Malik General Hospital Medan.

Methods

This retrospective cohort study included 60 patients with coronary artery disease who underwent on-pump or off-pump Coronary Artery Bypass Grafting (CABG) at H. Adam Malik General Hospital Medan. Preoperative Neutrophil-Lymphocyte Ratio (NLR) and postoperative renal function data were obtained from medical records, and Acute Kidney Injury (AKI) was diagnosed using AKIN criteria on postoperative day one and two.

The minimum required sample size was calculated using Lemeshow's formula with a presumed AKI prevalence of 15%, resulting in a minimum of 48 subjects. A total of 60 patients met the eligibility criteria and were included in this study.

Inclusion criteria were elective on-pump or off-pump CABG with available preoperative renal function and NLR data. Exclusion criteria included combined cardiac procedures, pre-existing renal dysfunction (serum creatinine >1.2 mg/dL), history of hemodialysis, and incomplete medical records.

Data analysis was performed using SPSS version 22. Categorical variables were expressed as frequencies and percentages, and numerical variables as mean and standard deviation or median when not normally distributed. The relationship between NLR and AKI, as well as between surgical technique and AKI, was assessed using chi-square and independent t-test or Mann-Whitney tests where appropriate. A p-value <0.05 was considered statistically significant.

Results

A total of 60 patients who underwent Coronary Artery Bypass Grafting (CABG) were included in this study. The majority of the patients were male, with 49 individuals (81.6%), while 11 patients (18.4%) were female. The mean age of the study population was 57.95 years, ranging from 43 to 74 years. The distribution of surgical techniques was equal, with 30 patients (50%) undergoing on-pump CABG and 30 patients (50%) undergoing off-pump CABG.

Regarding the inflammatory profile, most patients had a normal preoperative Neutrophil-Lymphocyte Ratio (NLR ≤ 3), accounting for 83.3% (n = 50), while 16.7% (n = 10) had elevated NLR values (> 3). The overall incidence of Acute Kidney Injury (AKI) was 15% (n = 9), whereas the majority of patients (n = 51, 85%) did not develop AKI.

Table 1. Baseline Characteristics

Variable	n	%
Age	57,95 (43-74)	
Sex		
Male	49	81,6%
Female	11	18,4%
Surgical Technique		
On-Pump	30	50.0%
Off-Pump	30	50.0%
NLR		
Normal (≤3)	50	83,3%
High (>3)	10	16,7%
AKI Incidence		
Yes	9	15.0%
No	51	85.0%

To evaluate the mean preoperative inflammatory marker levels, NLR values were analyzed in both surgical groups. The mean NLR among patients undergoing on-pump CABG was 2.36 (±0.417), while the mean NLR in the off-pump group was slightly higher at 2.47 (±0.449). These findings suggest that the inflammatory status prior to surgery was generally comparable between the two surgical techniques, and both values remained within the normal range.

Table 2. Mean Preoperative NLR by Surgical Technique

CABG	N	Mean (±Standard Deviation)
On-pump	30	2.3633(±0.41728)

Off-pump	30	2.4667(±0.44901)
Total	60	2.4150(±0.43290)

An analysis of AKI distribution showed that 4 patients (13.3%) who underwent on-pump CABG developed AKI, compared to 5 patients (16.6%) who developed AKI following off-pump CABG. Despite the slightly higher AKI incidence in the off-pump group, the difference between the two techniques was minimal.

Table 3. Incidence of AKI by Surgical Technique

CABG	Yes	No	Total
On-pump	4 (13.3%)	26 (86.6%)	30 (100%)
Off-pump	5 (16.6%)	25 (83.3%)	30 (100%)
Total	9 (15%)	51 (85%)	60 (100%)

To further assess whether NLR had predictive value for AKI, the patients were categorized into normal (≤3) and high (>3) NLR groups. Six of the 50 patients with normal NLR developed AKI (12%), whereas three of the 10 patients with elevated NLR developed AKI (30%). Although the proportion of AKI was higher among those with elevated NLR, statistical analysis revealed no significant association between preoperative NLR and AKI ($p = 0.417$).

Table 4. Association Between NLR and AKI

NLR	AKI (YES)	AKI (NO)	Total	p-value
Normal (≤3)	6	44	50	p = 0.417
High (>3)	3	7	10	
Total	**9**	**51**	**60**	

Similarly, the association between surgical technique and AKI incidence was evaluated. The chi-square test demonstrated no statistically significant association between the surgical approach on-pump or off-pump and AKI ($p = 0.723$).

Table 5. Association Between Surgical Technique and AKI

Surgical Technique	AKI (YES)	AKI (NO)	Total	p-value
On-Pump	5	25	30	0.723
Off-Pump	4	26	30	

Surgical Technique	AKI (YES)	AKI (NO)	Total	p-value
Total	**9**	**51**	**60**	

Discussion

This study assessed differences in Neutrophil-Lymphocyte Ratio (NLR) between on-pump and off-pump CABG and evaluated its association with Acute Kidney Injury (AKI). Most patients had normal NLR values, and the overall incidence of AKI was low. Statistical analysis showed no significant association between NLR and AKI, and no significant difference in AKI incidence between surgical techniques.

NLR is a simple hematologic marker that reflects systemic inflammation through the balance between neutrophils and lymphocytes. Although elevated NLR has been linked to postoperative inflammatory complications including AKI (Forget et al., 2017; Guthrie et al., 2013), most patients in this study presented with normal NLR values, which may explain the lack of significant association. Moreover, NLR is not a specific biomarker for renal injury; increased NLR does not necessarily predict AKI (Lang & Schiffl, 2021).

While cardiopulmonary bypass in on-pump CABG theoretically increases inflammatory activation and AKI risk (Lawton, 2012), off-pump CABG may reduce this response (Amano et al., 2001). Nevertheless, the absence of significant differences between the two techniques aligns with previous studies, including Diegeler et al. (2013) and the CORONARY trial (Lamy et al., 2012), which reported comparable renal outcomes.

The low AKI incidence in this study may be influenced by patient selection, stable preoperative renal function, and perioperative management factors such as fluid and blood pressure control. A small sample size particularly among those with elevated NLR may have also limited statistical power.

This study has limitations, including its single-center design, limited sample size, and absence of additional inflammatory markers such as CRP or IL-6. Despite this, NLR monitoring remains clinically relevant for evaluating systemic inflammation, and CABG technique selection can be individualized as AKI risk did not differ significantly.

Conclusion

Preoperative Neutrophil-Lymphocyte Ratio showed no significant association with Acute Kidney Injury in CABG patients, and AKI incidence did not differ between on-pump and off-pump techniques. NLR was not a reliable predictor of AKI in this study population.

References

Aikawa, P., Cintra A. R. S., Leite, C. A., Marques, R. H., Mackmillan da Silva, C.T. et al. (2013) 'Impact of coronary artery bypass grafting in elderly patients', Brazilian Journal of Cardiovascular Surgery, 28(1), pp. 22–28. doi: 10.5935/1678-9741.20130005.

Diegeler, A., Borgermann, J., Kappert, U., Breuer, M., Boning, A. et al. (2013) 'Off-pump versus on-pump coronary-artery bypass grafting in elderly patients', New England Journal of Medicine, 368(13), pp. 1189–1198. doi: 10.1056/NEJMoa1211666.

Forget, P., Khalifa, C., Defour, J.P., Latinne, D., Van Pel, M.C. and De Kock, M., 2017. What is the normal value of the neutrophil-to-lymphocyte ratio? BMC Research Notes, 10(1), p.12. https://doi.org/10.1186/s13104-016-2335-5

Guthrie, G.J.K., Charles, K.A., Roxburgh, C.S.D., Horgan, P.G., McMillan, D.C. and Clarke, S.J., 2013. The systemic inflammation-based neutrophil–lymphocyte ratio: experience in patients with cancer. Critical Reviews in Oncology/Hematology, 88(1), pp.218–230. https://doi.org/10.1016/j.critrevonc.2013.03.010

Lang, S. M., & Schiffl, H. (2021). The neutrophil to lymphocyte ratio: an ideal marker for early diagnosis and short-term prognosis of acute kidney injury?. *Kidney Diseases*, *7*(3), 241-243.

Lawton, J. S. (2012) 'Off-pump Coronary Artery Bypass Grafting', Missouri Medicine, 109(4), pp. 277–280.