ORIGINAL ARTICLE

Can the Systemic Immune-Inflammation Index Predict the Risk of Postoperative Atrial Fibrillation in Patients with Low Ejection Fraction Undergoing Coronary Artery Bypass Grafting?

Sistemik İmmün-İnflamasyon İndeksi, Düşük Ejeksiyon Fraksiyonuna Sahip Koroner Arter Baypas Greftleme Uygulanan Hastalarda Postoperatif Atriyal Fibrilasyon Riskini Öngörebilir mi?

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ABSTRACT

Aim: This study aimed to investigate whether the preoperative Systemic Immune-Inflammation Index (SII) can predict the development of postoperative atrial fibrillation (PoAF) in patients undergoing coronary artery bypass grafting (CABG) with low ejection fraction (EF).
Methods: Between January 2023 and January 2024, 100 patients undergoing CABG with low EF (<40%) were included in the study. Preoperative SII values of the patients, along with their demographic characteristics and operative variables, were compared.
Results: Among the 100 patients with reduced EJ included in the study, PoAF was identified in 10 cases. No significant differences were observed in the demographic and perioperative data of the patients. The SII levels were found to be higher in 10 patients developing PoAF, demonstrating a correlation (p=0.008). PoAF patients experienced a longer stay in the hospital although statistically insignificant (p=0.059).
Conclusion: Preoperative SII levels may be effective in predicting PoAF in coronary bypass patients with low EJ.

Keywords: Atrial fibrillation, cardiopulmonary bypass, coronary artery bypass, inflammation

ÖZ

Amaç: Bu çalışmanın amacı, düşük ejeksiyon fraksiyonu (EF) ile koroner arter baypas greftleme (CABG) uygulanan hastalarda, preoperatif dönemde belirlenen Sistemik İmmün-İnflamasyon İndeksi'nin (SII), postoperatif atriyal fibrilasyon (PoAF) gelişimini öngörmedeki potansiyel rolünü araştırmaktır.
Yöntem: Ocak 2023 ile Ocak 2024 tarihleri arasında düşük EF (%40'ın altında) ile CABG uygulanan toplam 100 hasta çalışmaya dahil edilmiştir. Çalışmada, hastaların preoperatif SII değerleri ile demografik özellikleri ve operasyonel değişkenleri karşılaştırılmıştır.
Bulgular: Düşük ejeksiyon fraksiyonuna sahip 100 hasta arasında, postoperatif atriyal fibrilasyon 10 olguda tespit edilmiştir. Demografik ve perioperatif değişkenlerde anlamlı bir farklılık saptanmamıştır. Bununla birlikte, PoAF gelişen 10 hastada SII seviyelerinin anlamlı derecede yüksek olduğu ve bu durumun bir korelasyon gösterdiği belirlenmiştir (p=0,008). PoAF gelişen hastaların hastanede kalış süresi, istatistiksel olarak anlamlı olmamakla birlikte, daha uzun bulunmuştur.
Sonuç: Preoperatif SII seviyelerinin, düşük ejeksiyon fraksiyonuna sahip koroner arter baypas greftleme uygulanan hastalarda postoperatif atriyal fibrilasyon gelişimini öngörmede potansiyel bir belirteç olarak işlev görebileceği düşünülmektedir.

Anahtar Kelimeler: Atriyal fibrilasyon, inflamasyon, kardiyopulmoner baypas, koroner arter baypas

Introduction

Postoperative atrial fibrillation (PoAF) is the most frequently observed heart rhythm disorder following cardiac surgery (1). Studies have shown that its occurrence rates widely vary from 10% to 65% (2,3). Despite this high incidence, PoAF has not typically been considered harmful due to its perceived reversibility. Evidence from prospective randomized trials suggests that most patients after coronary artery bypass grafting (CABG) surgery return to NSR within 60 days (4). In contrast, non-randomized studies have shown that PoAF can lead to adverse outcomes in the postoperative period, including cerebrovascular events, hemodynamic instability, prolonged hospital stays, renal failure, and both short- and long-term mortality (5,6). The pathophysiology of POAF after CABG is multifactorial, inflammation and oxidative stress play a significant role (7). Surgical revascularization exacerbates the systemic inflammatory response in the postoperative period, attributable both to surgical stress and the effects of the cardiopulmonary bypass (8).

The correlation between biochemical markers of systemic inflammation and PoAF has consistently been a focal point of scholarly interest. SII, a parameter gaining popularity recently, has been demonstrated through various studies to be associated with complications

following cardiac surgery (8) and survival in cancer patients (9).

The primary objective of our study is to evaluate the prognostic value of preoperative SII indices in predicting the onset of PoAF in patients with low EF undergoing on-pump CABG.

Materials And Methods

After obtaining ethical approval from our institution (AEŞH-BADEK-2024-674), a retrospective examination was performed on a cohort of 1159 patients, during the period between January 2023 to January 2024, from which one hundred individuals with an EF equal or below 40% were selectively enrolled in the study. Exclusion criteria were; concomitant surgery, emergency surgery, off-pump surgery, chronic kidney disease, chronic liver disease, acute infection, and auto-immun disorders. SII was calculated from preoperative hemogram tests using the formula: platelet count x neutrophil count/lymphocyte count. PoAF is defined as the presence of atrial fibrillation rhythm for at least 30 minutes during the postoperative period in patients with preoperative normal sinus rhythm, necessitating pharmacological or electrical cardioversion. All patients diagnosed with POAF during the postoperative period were included in the study, regardless of whether the diagnosis was made through close monitoring in the intensive care unit, telemetry in the hospital unit, or based on symptomatic presentation. Only patients with normal sinus rhythm were included in the study.

The demographic characteristics of patients, along with data regarding CPB and cross-clamp durations, as well as SII values, were subjected to retrospective analysis through assessment of hospital records.

Statistical Analysis

Kolmogorov Smirnov test was used for analyzing the normal distribution of the data. Normally distributed continuous variables were expressed as mean ± SD, or median values if abnormally distributed. Categorical variables were expressed as numbers and percentages. Demographic characteristics and perioperative variables were compared using "independent samples t-test" or "Mann-Whitney-U test" for continuous variables and "chi-square test" or "Fisher's exact test" for categorical variables between patients PAOF and non-POAF after surgery. Patients were compared between groups in terms of demographic data, intraoperative data,

postoperative data, and SI index. In all statistical tests, p-value <0.05 was accepted as significant. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (Armonk, NY: IBM Corp.).

Results

Data from 100 patients were analyzed in this study. The mean age of the patients was 62.16 8.52(42-78). There were no statistical differences in age between the groups. The demographic characteristics of the patients are detailed in Table 1. No statistically significant differences were observed in the demographic characteristics between the two groups. The perioperative characteristics of the patients are presented in Table 2. Although hospital stays were longer for the PoAF group, this difference was not statistically significant. No significant differences were identified between the two groups concerning other perioperative and postoperative characteristics. No valvular pathology requiring surgical intervention was observed in the patients. Additionally, there was no significant difference in left atrial diameters between patients with POAF and those without.

Table 1. Demographic Characteristics of the Patients

Demographic characteristics				
	All patients (n=100)	PoAF (n=10)	No-PoAF (n=90)	p
Age (years)	62.16±8.52 (42-78)	69.4±7.22 (57-78)	60.35±7.90 (42-77)	0.578
Gender				
Male	89 (89%)	8	81	0.338
Female	11 (11%)	2	9	
BSA (kg/m²)	1.92±0.16 (1.64±2.24)	1.92±0.16	1.93±0.17	0.086
Comorbidities				
Active Smoking	22 (22%)	3	19	0.198
HT	48 (48%)	3	45	0.676
DM	60 (60%)	5	55	0.851
COPD	16 (16%)	0	16	0.242
CVA	3 (3%)	0	15	0.762
CKD	8 (8%)	1	7	0.656
EF	33.5±2.73 (25-35)	33.2±2.29	32.2±2.59	0.264
STS score	7.77±5.29 (3.68-29.6)	6.19±2.88	8.36±5.70	0.111

BSA: Body surface area, HT: Hypertension, DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, CVA: Cerebrovascular accident, CKD: Chronic kidney disease, EF: Ejection fraction

Table 2. Perioperative characteristics of the patients.

Perioperative characteristics				
	All patients (n=100)	PoAF (n=10)	No-PoAF (n=90)	p
X-clamp time (min)	72.6±32.6 (23-218)	79.0±24.3	73.89±37.13	0.624
CPB time (min)	117.1±45.5 (42-313)	115.2±33.4	114.7±53.3	0.969
Duration of surgery (min)	232.4±50.30 (150-427)	240.3±57.3	230.4±48.9	0.216
IABP	23	1	22	0.428
Defibrillation after X-clamp	26	3	23	0.943
ICU stay (days)	5.04±5.0 (1-25)	2.71±1.11	6.27±6.02	0.123
Hospital stay (days)	5.66±8.51 (1-25)	8.5±5.12	5.4±2.7	0.184
Hospital mortality	7	2	5	0.862

CPB: Cardiopulmonary bypass, IABP: Intra-aortic balloon pump, ICU: Intensive care unit,

As demonstrated in Table 3, preoperative SII levels were found to be significantly elevated in patients developing PoAF (p=0.008).

Table 3. Correlation of SII levels and PoAF

	PoAF (n=10)	No-PoAF (n=90)	p
SII	1188±447	657±1137	0.008

PoAF: Postoperative Atrial Fibrillation, SII: Systemic Immune-Inflammation Index

Discussion

The main finding of our study is that preoperative SII values are directly associated with the development of PoAF in patients with reduced ventricular ejection fraction (EJ) undergoing CABG. In our analysis, traditional risk factors for PoAF, such as X-clamp time, age, and gender, did not show statistically significant associations, likely due to the study's relatively small sample size.

PoAF is the most commonly encountered supraventricular arrhythmia following open heart surgery, attributable to a multifactorial etiology (10). Despite advances in prophylactic measures and surgical techniques, PoAF remains the most frequent complication of cardiac surgery (11,12). CABG and valvular surgeries hold the greatest risk of developing POAF at 60–80%; they cause a greater scale of damage to the structural integrity of the heart via fibrosis and dilation of the valves and subsequently of

the heart's chambers (13). Male gender, advanced age, hypertension, chronic obstructive pulmonary disease, and low EF are the well-known risk factors for PoAF (14). The occurrence of PoAF leads to extended ICU and hospital stays, resulting in increased healthcare costs. Although our study observed longer hospital stays among patients developing PoAF, no statistically significant difference was detected between the groups.

Moreover, contemporary research continues to propose new hypotheses regarding the pathophysiology of PoAF, which remains incompletely understood to date. The inflammatory response secondary to surgical trauma and the inflammatory effects of cardiopulmonary bypass frequently play a significant role in the pathophysiology of PoAF (10). However, these hypotheses still do not fully explain its occurrence. Therefore, researchers are investigating the effects of preoperative inflammatory status on the pathophysiology of PoAF as well. Originally utilized in oncological contexts, the Systemic Immune-Inflammation Index (SII) is a relatively new addition to prognostic inflammatory metrics and has more recently been investigated in cases of infective endocarditis, coronary artery disease, and various other cardiac pathologies (9,15). To our knowledge, limited research has explored the relationship between preoperative SII values and PoAF in CABG patients with low EJ.

It is well-established that patients' preoperative inflammatory status significantly influences the postoperative inflammatory response, which is an anticipated aspect of the surgical stress process (16). Additionally, the intensity of this inflammatory response has been associated with adverse postoperative outcomes, particularly arrhythmic complications (10). In this study, patients' preoperative inflammatory status was quantified using the SII. A comparative analysis revealed that patients developing PoAF had significantly elevated preoperative SII values, suggesting that inflammatory profiling could enable preoperative identification of patients at elevated risk for PoAF. This observation underscores a potential predictive role for elevated preoperative systemic inflammation in the pathogenesis of PoAF and indicates that patients with higher inflammatory markers are at increased risk of developing atrial fibrillation postoperatively.

Thus, identifying individuals with high preoperative SII levels could become an essential clinical strategy, potentially facilitating targeted interventions aimed

at modulating inflammatory responses before surgery. Such interventions may help reduce the incidence of PoAF, ultimately contributing to improved postoperative outcomes and a decreased healthcare burden associated with arrhythmic complications.

To mitigate the systemic inflammatory response, various strategies—such as the use of statins, vitamins, N-acetylcysteine, colchicine, and corticosteroids—have been explored in the preoperative period (17,18). Some studies have reported a reduced PoAF incidence, particularly in patients using statins for seven days before surgery (17). Nevertheless, further investigations are warranted to substantiate and broaden these findings in clinical practice.

Limitations

The retrospective design of the study and the relatively small sample size are the primary limitations. Furthermore, due to the retrospective nature of the study, additional analyses involving inflammatory markers, such as interleukin-6, could not be performed, constituting another limitation.

Conclusion

The levels of preoperative SII may effectively predict the development of PoAF in patients undergoing CABG with reduced EJ. Elevated SII values indicate an increased risk for PoAF, highlighting the potential for early identification of at-risk patients. This could facilitate targeted preoperative interventions aimed at improving postoperative outcomes. Further research is needed to clarify the relationship between preoperative inflammatory markers and PoAF and to explore strategies for mitigating this risk.

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