Original Article

Relationship Between Plasma B-type Natriuretic Peptide and Postoperative Atrial Fibrillation in Patients Undergoing Cardiac Surgery

Muhammad Saleem, Muhammad Aqib, & Muhammad Umer

ABSTRACT

Objective: To compare the mean B-type natriuretic peptide (BNP) levels in patients with and without atrial fibrillation in postoperative cardiac surgery.

Methodology: After ethical approval, a prospective cohort study was conducted at the Cardiac Surgery Department, Punjab Institute of Cardiology, Lahore from January 2024 to January 2025. A total of 79 patients aged 45-60 years who underwent coronary artery bypass grafting (CABG) or valvular surgery and had no preoperative history of atrial fibrillation were included using non-probability consecutive sampling. All subjects underwent electrocardiography (ECG) before and after the procedure to assess atrial fibrillation until discharge. BNP levels and routine blood chemistry were also recorded preoperatively.

Results: Atrial fibrillation (AF) occurred in 18 patients (22.8%). The mean preoperative B-type natriuretic peptide (BNP) level in patients who developed AF was 614.22 ± 1.26, compared to 443.32 ± 1.15 in those without AF ($p < 0.001$). Gender was significantly associated with the occurrence of AF with 5 (11.6%) males and 13 (36.1%) females diagnosed ($p=0.015$).

Conclusion: Preoperative B-type natriuretic peptide (BNP) levels predict postoperative AF in patients undergoing cardiac surgery. BNP levels could be used to better stratify patients in this respect.

KEYWORDS: Atrial Fibrillation, BNP, CABG, Cardiac Surgery

INTRODUCTION

Atrial fibrillation is a common condition occurring in about 60% of patients within 72 hours after cardiac surgery.[1]Although most episodes are brief and resolve on their own, it is significantly associated with the incidence of stroke. Advanced age, low ejection fraction and electrolyte imbalance are predictors of postoperative atrial fibrillation.[2] Other factors including heart failure, large left atrial volume, hypertension and chronic obstructive pulmonary disease (COPD) also impact incidence of AF.[3] Recent research has found that B-type natriuretic peptide is linked with atrial fibrillation.[4] BNP levels are a predictor of recurrent atrial fibrillation as seen after direct current (DC) cardioversion in mild heart failure. Elevated B-type natriuretic peptide (BNP) levels at discharge predict higher rates of cardiovascular events, such as atrial fibrillation.[5] It is important to analyze the postoperative survival factors, especially in high-risk patients.

Latest literature reports that new-onset atrial fibrillation (NOAF) is a common condition occurring in 3-22% of patients with acute ST-elevation myocardial infarction (STEMI).[6] NOAF is associated with elevated risk of heart failure, stroke and mortality. Although the exact etiology of NOAF remains unclear, possible causes include elevated left atrial pressure, ischemia, increased left

Muhammad Saleem,[1] *MBBS, FCPS, FRCS (Glasgow), FRCS(CTh)-England*
Associate Professor
Muhammad Aqib,[2] *MBBS*
Ex-Resident
Muhammad Umer,[3] *MBBS, MPH*
Medical Officer
[1]Cardiac Surgery, Faisalabad Institute of Cardiology, FSD, PAK.
[2]Punjab Institute of Cardiology, LHR, PAK.
[3]Fatima Memorial Hospital, LHR, PAK.

Correspondence
Dr. Muhammad Saleem
drsaleem6001@hotmail.com

ventricular (LV) end-diastolic pressure and impaired atrial perfusion. Plasma BNP levels are independently associated with adverse outcomes in patients with STEMI and can lead to low LV ejection fraction and adverse LV remodeling.[7]

This study was conducted to compare the mean BNP levels in patients with and without atrial fibrillation following cardiac surgery.

METHODOLOGY

A prospective cohort study was conducted at the Cardiac Surgery Department, Punjab Institute of Cardiology, Lahore from January 2024 to January 2025. A total of 79 patients aged 45-60 years who underwent coronary artery bypass grafting (CABG) or valvular surgery and had no preoperative history of atrial fibrillation were included using non-probability consecutive sampling. The required sample size was estimated using the sample size calculator for a 95% confidence level, a margin of error of 9% and an anticipated frequency of atrial fibrillation of 21%. Patients with thoracic deformities, a body mass index (BMI) greater than 32 kg/m^2, a history of previous cardiothoracic surgery, patients who underwent emergency procedures and those with ejection fraction below 30% were excluded. The ethical review committee of the hospital approved this study (Reference No: RTPGME-Research-381) and all participants signed an informed written consent.

Patients were clinically examined; medical history was recorded and laboratory tests were performed before surgery. All subjects underwent electrocardiography (ECG) before and after the procedure to monitor for atrial fibrillation until discharge. Atrial fibrillation (AF) was defined as an abnormally fast heart rate of 110-160 beats per minute occurring within 72 hours postoperatively. BNP levels and routine blood chemistry were also recorded preoperatively. Cardiac activity was monitored consistently throughout the hospital stay, and any abnormal rhythm was confirmed by daily 12-lead ECGs during 72-hours follow-up period.

The data were analyzed using SPSS version 25 registered for Microsoft windows. The results were expressed as mean ± standard deviation (SD) for quantitative variables such as age, ejection fraction, plasma BNP levels, left atrial (LA) diameter, and body mass index (BMI). Qualitative variables such as gender, presence of atrial fibrillation (AF), and type of surgery were summarized as frequencies and percentages. BNP levels were compared between patients with and without AF using t-test.

RESULTS

A total of 79 patients who met the predefined inclusion and exclusion criteria were enrolled to compare the mean BNP levels between those who developed atrial fibrillation and those who did not following cardiac surgery. The age distribution revealed that 7.6% (n=6) of the participants were between 45 and 50 years of age, whereas 92.4% (n=73) fell within the 51–60-year age group. The overall mean age of the cohort was 55.56 ± 2.78 years. The mean body mass index (BMI) of the study population was 25.91 ± 3.54 kg/m². Of these, 54.4%(n=43) were male and 45.6% (n=36) were females. The mean ejection fraction was 42.10± 0.87, the mean plasma BNP levels was 482.26± 72.14 pg/ml and the mean left atrial (LA) diameter was 4.39±0.10 cm. A total of 53.2% (n=42) of patients underwent coronary artery bypass grafting (CABG), while 46.8% (n=37) underwent valvular heart surgery (Table I).

Atrial fibrillation occurred in 18 patients (22.8%). The mean BNP level in patients with AF was 614.22±1.26 pg/ml, compared to 443.32±1.15 pg/ml without atrial fibrillation ($p < 0.001$) (Table II).

The incidence of atrial fibrillation was stratified for age, gender, BMI and type of surgery (Table III). None of the patients aged 45-50 years developed AF, however, 18 (24.7%) patients aged 51-60 had AF (p=0.328). Eight (28.6%) patients with BMI of 17-25 kg/m^2 and 10 (19.6%) patients with BMI greater than 25kg/m^2 developed AF (p=0.364). Gender was significantly associated with

occurrence of AF, with 5 (11.6%) males and 13 (36.1%) females diagnosed, (p=0.015). Among patients, 9 (21.4%) who underwent CABG and 9 (24.3%) who underwent valvular surgery had AF (p=0.759).

B-type natriuretic peptide (BNP) levels were also stratified according to age, gender, BMI and, type of surgery (Table IV). Patients aged 51-60 years with AF had significantly higher BNP levels compared to those without AF (614.22 ± 1.26 vs 443.38 ± 1.14; p=0.00). Patients in both BMI groups with AF had significantly higher BNP levels than those without it (p=0.00). Similarly, both male and female patients with AF had significantly higher BNP levels than those without AF (p=0.00). Among patients who developed AF after either coronary artery bypass grafting (CABG) or valvular surgery also demonstrated significantly elevated BNP levels compared to those without AF (p=0.00).

Table I: Demographic and clinical information of patients

Variables	N (%)
Age	
Mean age	55.56±2.78 years
45-50 years	6 (7.6%)
51-60 years	73 (92.4%)
Gender	
Male	43 (54.4%)
Female	36 (45.6%)
Mean ejection fraction (%)	42.10 ± 0.87
Mean plasma BNP levels (pg/ml)	482.26 ± 72.14
Mean LA diameter (cm)	4.39 ± 0.10
Mean BMI	25.91± 3.54
Type of surgery	
CABG	42 (53.2%)
Valvular	37 (46.8%)

Table II: Incidence of atrial fibrillation and BNP levels in association with AF

Incidence of atrial fibrillation	N (%)	BNP levels	P value
Yes	18 (22.8%)	614.22 ± 1.26	0.000
No	61 (77.2%)	443.32 ± 1.15	

Table III: Stratification for atrial fibrillation with respect to age, BMI, gender and type of surgery

Age group	Atrial fibrillation		Total	p value
	Yes	No		
Age				
45-50 years	0 (0%)	6 (100%)	6 (100%)	0.328
51-60 years	18 (24.7%)	55 (75.3%)	73 (100%)	
BMI				
17-25kg/m2	8 (28.6%)	20 (71.4%)	28 (100%)	0.364
>25kg/m2	10 (19.6%)	41 (80.4%)	51 (100%)	
Gender				
Male	5 (11.6%)	38 (88.4%)	43 (100%)	0.015
Female	13 (36.1%)	23 (63.9%)	36 (100%)	
Type of surgery				
CABG	9 (21.4%)	33 (78.6%)	42 (100%)	0.759
Valvular	9 (24.3%)	28 (75.7%)	37 (100%)	

Table IV: Stratification for BNP levels in both groups with respect to age, BMI, gender and type of surgery

	Mean ± SD	P value
Age		
45-50 years		
With AF	-	
Without AF	442.83 ± 1.16	
51-60 years		
With AF	614.22 ± 1.26	0.00
Without AF	443.38 ± 1.14	
BMI		
18-25 kg/m2		
With AF	614.37 ± 1.18	0.00
Without AF	443.35 ± 1.08	
>25 kg/m2		
With AF	614.10 ±1.37	0.00
Without AF	443.31 ± 1.19	
Gender		
Male		
With AF	614.00 ± 1.41	0.00
Without AF	443.23 ± 1.19	
Female		
With AF	614.31 ± 1.25	0.00
Without AF	443.47 ± 1.08	
Type of surgery		
CABG		
With AF	614.22 ± 1.64	0.00
Without AF	443.51 ± 0.97	
Valvular		
With AF	614.22 ± 0.83	0.00
Without AF	443.11 ± 1.31	

DISCUSSION

In the current study, we compared the mean BNP levels in patients with and without atrial fibrillation following cardiac surgery. The incidence of atrial fibrillation was 22.8% after the procedure. BNP levels in patients with AF was 614.22 ± 1.26 and 443.32 ± 1.15 without atrial fibrillation (p=0.000). Previous studies agree with our study findings.[2, 3, 8] Arslan et al. also reported a 19.86% frequency of postoperative atrial fibrillation in patients who underwent on-pump and off-pump CABG.[9] The incidence of AF was higher after on-pump procedure. The risk factors for AF were reported as type of surgery, advanced age, hypertension, longer hospital stay, sleep apnea, increased surgical duration, use of vasopressors, and number of coronary artery grafts.

Herrmann et al. reported a similar incidence of AF after CABG i.e. 30%.[10] The slightly higher frequency of atrial fibrillation in that study can be attributed to the higher median age of 71 years. In a 7-year follow-up, a 6.7% recurrence rate of AF was found which was associated with heart failure, hemorrhage, prolonged hospital stay, and the need for anticoagulant therapy. In contrast, Bianco et al. reported a significantly higher incidence of 35.2%, which was independently associated with heart failure–related mortality and hospital read-mission.[11] A local study also reported a very high frequency of 58.7% of postoperative AF associated with diabetes, male gender and hypertension.[12]

Our study shows that patients with atrial fibrillation, regardless of other risk factors, had significantly higher levels of BNP. A meta-analysis of 20 studies also reported that both BNP and NT pro-BNP levels were elevated in patients who developed postoperative atrial fibrillation follow-ing cardiac surgery.[13] However, BNP levels were found to be associated with only valvular surgery, whereas in our study, they were related to both CABG and valvular surgery. Mladenović et al. showed contrasting results, indicating that BNP levels were not associated with postoperative atrial fibrillation.[14]

CONCLUSION

Preoperative BNP levels have been widely recognized as a significant predictor of posto-perative atrial fibrillation in patients undergoing cardiac surgery. Therefore, BNP measurement may serve as a useful tool for better risk stratification and management of such patients.

REFERENCES

1. Tzoumas A, Nagraj S, Tasoudis P, Arfaras-Melainis A, et al. Atrial fibrillation following coronary artery bypass graft: where do we stand? *Cardiovasc Revasc Med*. 2022;40:172-179. doi:10.10 16/j.carrev.2021.12.006
2. Eikelboom R, Sanjanwala R, Le ML, Yamashita MH. Postoperative atrial fibrillation after cardiac surgery: a systematic review and meta-analysis. *Ann Thorac Surg*. 2021;111(2):544-554. doi:10.1016/j.athoracsur.2020.05.104
3. Seo EJ, Hong J, Lee HJ, Son Y-J. Perioperative risk factors for new-onset postoperative atrial fibrillation after coronary artery bypass grafting: a systematic review. *BMC Cardiovasc Disord.* 2021;21(1):418. doi:10.1186/s12872-021-02224-x
4. Omar A, Elshihy EM, Singer M, Zarif D. l. Perioperative risk factors predisposing to atrial fibrillation after CABG surgery. *Heart Surg Forum*. 2021. doi:10.1532/hsf.3759
5. Kerr B, Brandon L. Atrial Fibrillation, thromboembolic risk, and the potential role of the natriuretic peptides, a focus on BNP and NT-proBNP–A narrative review. *IJC Heart Vasc*. 2022;43: 101132. doi:10.1016/j.ijcha.2022.101132
6. Corica B, Romiti GF, Basili S, Proietti M. Prevalence of new-onset atrial fibrillation and associated outcomes in patients with sepsis: a systematic review and meta-analysis. *J Pers Med.* 2022;12(4):547. doi:10.3390/jpm12040547
7. Al Awadi M, Eltahlawi M, Gad M, Ismail H. Prognostic value of serum BNP in patients with NSTEMI and its correlation with extent of coronary artery disease. *Zagazig Univ Med J*. 2023;29(1):183-192. doi: 10.21608/zumj.2021.61535.2120
8. van de Kar MR, van Brakel TJ, van't Veer M, van Steenbergen GJ. Anticoagulation for post-operative atrial fibrillation after isolated coronary artery bypass grafting: a meta-analysis. *Eur Heart J*. 2024;45(29):2620-2630.https://doi.org/10.1093/ eurheartj/ehae267
9. Arslan G, Erol G, Kartal H, Demirdas E. The Incidence of Atrial Fibrillation after On-Pump Versus Off-Pump Coronary Artery Bypass Grafting: Effects of pump and off-pump CABG on postoperative atrial fibrillation. *Heart Surg Forum*; 2021. doi:10.1093/eurheartj/ehae267
10. Herrmann FE, Taha A, Nielsen SJ, Martinsson A.Recurrence of atrial fibrillation in patients with new-onset postoperative atrial fibrillation after coronary artery bypass grafting. *JAMA Network Open*. 2024;7(3):e241537-e. doi:10.100 1/jamanetworkopen.2024.1537
11. Bianco V, Kilic A, Yousef S, Serna-Gallegos D. The long-term impact of postoperative atrial fibrillation after cardiac surgery. *J Thorac Cardiovasc Surg*. 2023;166(4):1073-1083. e10. doi:10.1016/j.jtcvs.2021.10.072
12. Khan H, Azad N, Iftikhar S, Nafees S. Frequency of post-operative atrial fibrillation in patients undergoing CABG procedures. *Pak Armed Forces Med J*. 2021;71

13. Thet MS, Hlwar KE, Thet KS, Han KPP. Preoperative B-type natriuretic peptides to predict postoperative atrial fibrillation in cardiac surgery: A systematic review and meta-analysis. *Heart Lung Circ*. 2024;33(1):23-32. doi.org/10.1016/j.hlc.2023.10.015

14. Mladenović N, Zdravković R, Velicki L, Drljević-Todić V.Significance of galectin-3 and N-terminal pro-B-type natriuretic peptide in the prediction of atrial fibrillation after cardiac surgery. J Med Biochem. 2024;43(3):397. doi: 10.5937/jomb0-47001

Author Contributions:

Muhammad Saleem: Conceived the study designed, carried out the data collection and statistical analysis and drafted the manuscripts.

Muhammad Aqib: Participated in its design and coordination. drafted, read and approved the final manuscript.

Muhammad Umer: Participated in its design and coordination. Statistical analysis, drafted, read and approved the final manuscript.

All authors are equally accountable for research work

Date of Submission: 29-10-2025
Revised Date: 20-11-2024
Accepted Date: 5-12-2025