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Original Research Article

THE EFFECT OF INTRA-AORTIC BALLOON PUMP IN PATIENTS WITH LOW EJECTION FRACTION UNDERGOING CORONARY ARTERY BYPASS GRAFTING

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Abstract: *This study aimed to assess risk factors that predict the length of stay and 30-day mortality in subjects undergoing CAGB to evaluate the impact of IABP support in patients with low ejection fraction. The prospective study was conducted in the Cardiology Department of Punjab Institute of Cardiology Lahore from January 2022 to January 2023. A total of 315 patients were included in the study. The sample was divided into a study group (n=110, having LVEF ≤ 30%) and a control group (n=205, having EF > 30%). Pre-operative and intraoperative data of the patients were recorded. Post-operative complications were recorded, including LOS in the hospital and 30-day mortality. Patients in the study group required more emergency CABG (P = .005), and IABP was also used more frequently in patients having EF< 30% (P<.001). LOS in hospital (P<.001) and ICU (P<.001) and 30-day mortality (P=.009) were higher in the study group. According to multivariate logistic regression analysis, in the study group history of cerebrovascular disease (P = .018), peripheral vascular disease (P = .004), congestive heart failure (P = .027), and IABP use (P = .002) were associated with the rate of 30-day mortality. Moreover, the increased length of hospital stay in these patients was associated with an increase in age (P<.001), hypertension (P=.040), and IABP use (P=.009). Based on the results, it can be concluded that the low ejection fraction positively affects increased LOS and 30-day mortality in subjects undergoing CABG; IABP insertion is a significant predictor of increased LOS and 30-day mortality and increases post-operative complications.*

Keywords: Coronary artery bypass grafting, Left ventricular ejection fraction, Intra aortic balloon

Introduction

Intra aortic balloon pump (IABP) effectively supports declining circulation in subjects at high risk of post-operative cardiovascular events. Research has also shown its survival benefits in subjects with low ejection fraction (Escutia-Cuevas et al., 2020; Heuts et al., 2023; Iliuta et al., 2022). However, IABP use is associated with complications like infection, paraplegia, stroke, hemolysis, aortic or iliac dissection bleeding, and limb ischemia; moreover, it's intensive care treatment and is costly (Chen et al., 2020; He and Gao, 2019).

Survival benefits of IABP in CABG patients with majorly depressed left ventricular function are relatively known; nevertheless, it is important to determine factors that affect survival in these patients. Additionally, the outcome of IABP in these patients is not well established. This study aims to assess risk factors that predict the length of stay and 30-day mortality in CAGB patients and evaluate the impact of IABP support in patients with low ejection fraction.

Methodology

The prospective study was conducted in the Cardiology Department of Punjab Institute of Cardiology Lahore from January 2022 to January 2023. The study included patients who were undergoing CABG. Patients who underwent concomitant surgery (cardiac or non-cardiac) were excluded. A total of 315 patients were included in the study. Informed consent of the participants was taken. The ethical board of the hospital approved the study. The sample was divided into a study group (n=110, having LVEF ≤ 30%) and a control group (n=205, having EF > 30%). The ejection fraction was determined through angiographic reports. Age, gender, BMI, pre operative risk factors (triglyceride ≥ 2.0 mmol/l, total cholesterol ≥ 5.0 mmol/l, HDL-cholesterol ≤ 1.1 mmol/l in women or ≤ 1.0 mmol/l in men(Piepoli et al., 2020), systolic blood pressure ≥ 140 mmHg and diastolic ≥ 90 mmHg(Anh Hien et al., 2020), renal failure, cerebrovascular or chronic lung disease), pre-operative cardiac history (myocardial infarction, NYHA score, previous PCI or CABG, arrhythmia, number of defective vessels) and pre-operative hemodynamic status was recorded.

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Operative data including surgery type (emergency or elective), use of IABP and internal mammary artery as graft was recorded.

Post-operative complications were determined based on the following criteria: I) Prolonged LOS-ICU after surgery, II) Increased hospital stay, III) At least one of these hospital complications: cardiac(arterial fibrillation, tamponade, cardiac arrest, heart block), non-cardiac (multisystem failure, acute limb ischemia, pneumonia, pulmonary emboli, urinary tract infection, renal failure, brain stroke, prolonged ventilation≥10 hours and continuous coma≥ 24 hours) and IV) 30-day mortality. Data were analyzed using SPSS version 23.0. Quantitative data were expressed as mean and standard deviation and categorical as frequency and percentage. T-test was used to compare continuous variables, and the chi-square test was used for categorical variables. Covariance analysis was used to evaluate the length of hospital stay difference between groups. Predictors showing statistically significant association with prolonged LOS and 30–day mortality under univariate analysis were passed through multivariate logistic regression analysis to investigate their independence. *P* values ≤ 0.05 was considered statistically significant.

Results

The difference between both groups was not statistically significant regarding mean age, hypertension, and family history of CAD Obesity (*P* < .001) and hypercholesterolemia (*P* < .001) were more in the control group, and other risk factors were more prevalent in the study group. The frequency of three-vessel disease was significantly higher in the study group *(P* < .001). Patients in the study group required more emergency CABG (*P* = .005), and IABP was also used more frequently in patients having EF< 30% (P<.001). According to echocardiographic findings, the control group had more tricuspid valve insufficiency, and all other valvular disorders were more frequent in the study group. Both groups had similar rates of revascularization (*P* = 0.342). Prolonged ventilation, renal failure, cardiac arrest, and heart block were frequent in the study group; however, the difference between the groups regarding other post-operative complications was not statistically significant. LOS in hospital (P<.001) and ICU (P<.001) and 30-day mortality (P=.009) were also higher in the study group. According to multivariate logistic regression analysis, in the study group history of cerebrovascular disease (*P* = .018), peripheral vascular disease (*P* = .004), congestive heart failure (*P* = .027), and IABP use (*P* = .002) were associated with the rate of 30-day mortality (Table I) Moreover, increased length of hospital stay in these patients was associated with an increase in age (P<.001), hypertension (P=.040) and IABP use (P=.009)(Table II). Early complications with and without IABP use are summarized in Table III.

Table I Multivariate analysis of the factors associated with 30-day mortality in subjects with EF < 30%

Variables	OR (95% CI)	P value
Cigarette smoking	.217 (.042-1.32)	.070
Arrhythmia	4.856 (.693-34.044)	.112
Congestive heart failure	5.248 (1.201-22.865)	.027
Cerebrovascular disease	6.948 (1.396-34.628)	.019
Left the main disease	2.001 (.302-13.198)	.472
Peripheral vascular disease	18.874 (2.481-143.522)	.004
Perfusion time	1.012 (.992-1.032)	.292
IABP	9.818 (2.286-42.152)	.002

Table II Multivariate analysis of the factors associated with increased LOS in hospitals in subjects with EF < 30%

Variables	OR (95% CI)	P value
Female gender	1.614 (.911-2.867)	.101
Hypertension	1.645 (1.021-2.651)	.040
Diabetes Mellitus	1.353 (.841-2.171)	.213
Peripheral vascular disease	1.631 (.554-4.814)	.375
Congestive heart failure	1.369 (.856-2.188)	.191
Emergency surgery	1.211 (.687-2.134)	.510
Age	1.048 (1.021-1.076)	<.001
Perfusion time	1.006 (.998-1.017)	.081
IABP	2.461 (1.245-4.867)	.009

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Table III Comparison of complications with and without IABP use

Characteristics	Patients who did not receive IABP (n=80)	Patients who receive IABP (n=30)	P value
Prolonged Ventilation	1 (1.25%)	23 (76.6%)	<.001
Arterial fibrillation	5 (6.25%)	3 (10%)	.146
Heart block	1 (1.25%)	1 (3.3%)	.827
Renal failure	1 (1.25%)	2 (6.6%)	.009
Urinary tract infection	0 (0%)	1 (3.3%)	.016
Pneumonia	0 (0%)	1 (3.3%)	.128
Brain stroke	1 (1.25%)	1 (3.3%)	.293
30-day mortality	1 (1.25%)	4 (13.3%)	<.001
LOS >12 days	49(61.2%)	24 (80%)	<.001

Discussion

IABP insertion is a well-known risk factor in subjects undergoing CABG (Vickneson et al., 2019). However, long-term prognosis, morbidity, and mortality in patients having low EF who undergo concomitant IABP and CABG are not as encouraging as subjects with normal EF, and it is important to assess outcomes among such patients. In the current study, peri-operative mortality in subjects with EF < 30% was 1.5%, significantly higher than in subjects with EF > 30%, and IABP significantly influenced this mortality rate. A previous study reported that IABP application was a significant predictor of death in patients undergoing cardiac surgery (Samanidis et al., 2021). Another study reported that the mortality rate in patients who required IABP application during cardiac surgery was 52.7%, and the early mortality rate in these patients was high (Liang et al., 2020). Though studies have shown the benefits of IABP in patients who undergo CABG (Escutia-Cuevas et al., 2020; Jannati and Attar, 2019), it is important to determine factors that may impact IABP-associated mortality in patients with low EF. In the current study, IABP application was associated with increased LOS. It may be related to post-operative complications which require hospital treatment. In the current study, the thirty-day mortality rate was not different for both genders. It was in line with a previous study that reported no relationship between gender and 30-day mortality (Sun et al., 2020). In contrast, another study reported that female gender significantly predictor 30-day mortality (Lorusso et al., 2022). Contributing factors in females include comorbidities, smaller body areas, advanced age, and disease.

In the current study, congestive heart failure was a significant risk factor for thirty-day mortality in subjects with left ventricular dysfunction. A previous study has shown that congestive heart failure is associated with a four times higher mortality risk in patients undergoing CABG (Guan et al., 2020). In the current study, females had higher LOS in hospitals, which was in line with the previous study's findings (Lee and Jang, 2020). Previous studies reported female gender as an independent predictor of LOS in hospitals (AbuRuz et al., 2019; Ram et al., 2022). The most common causes of increased LOS in hospitals in women have increased incidence of post-operative complications and pre operative risk factors in females compared to males (AbuRuz et al., 2019). Thus, these risk factors must be controlled in females before operation. The limitation of our study is the small sample size; a larger multi-center study is suggested to confirm the results of our study.

Conclusion

Low ejection fraction positively affects LOS and 30-day mortality in subjects undergoing CABG; IABP insertion is a significant predictor of increased LOS and 30-day mortality and increases post-operative complications.

Conflict of interest

The authors declared absence of conflict of interest.

References

AbuRuz, M. E., Al-Dweik, G., and Al-Akash, H. Y. (2019). Checking the moderating effect of perceived control on the relationship between anxiety and post-operative hospital length of stay among coronary artery bypass graft patients. *International journal of general medicine*, 79-85.

Anh Hien, H., Tam, N. M., Tam, V., Van Minh, H., Hoa, N. P., Heytens, S., Derese, A., and Devroey, D. (2020). Estimation of the cardiovascular risk using world health organization/international society of hypertension risk prediction charts in Central Vietnam. *Plos one* **15**, e0242666.

Chen, Y.-W., Chen, Y.-H., Su, C.-S., Chang, W.-C., Wang, C.-Y., Liu, T.-J., Hung, Y.-P., Lin, T.-

[Citation: Khan, T., Ashraf, T., Roomi, F. (2023). The effect of intra-aortic balloon pump in patients with low ejection fraction undergoing coronary artery bypass grafting. *Biol. Clin. Sci. Res. J.,* **2023***: 214.* doi: https://doi.org/10.54112/bcsrj.v2023i1.214]

H., Chen, W.-J., and Lee, W.-L. (2020). The characteristics and clinical outcomes of rotational atherectomy under intra-aortic balloon counterpulsation assistance for complex and very high-risk coronary interventions in contemporary practice: an eight-year experience from a tertiary center. *Acta Cardiologica Sinica* **36**, 428.

Escutia-Cuevas, H. H., Suárez-Cuenca, J. A., Espinoza-Rueda, M. A., Macedo-Calvillo, L., Castro-Gutiérrez, A., García-García, J. F., del Sol García-Ortegón, M., Robledo, R., and Mondragón-Terán, P. (2020). Pre-operative use of intra-aortic balloon pump support reduced 30-day mortality in a population with LVEF> 35% and high surgical risk after coronary artery bypass graft surgery. *Cardiology* **145**, 267-274.

Guan, Z., Guan, X., Gu, K., Lin, X., Lin, J., Zhou, W., Xu, M., Wan, F., Zhang, Z., and Song, C. (2020). Short-term outcomes of on-vs off-pump coronary artery bypass grafting in patients with left ventricular dysfunction: a systematic review and meta-analysis. *Journal of cardiothoracic surgery* **15**, 1-12.

He, X.-Y., and Gao, C.-Q. (2019). Peri-operative application of intra-aortic balloon pumping reduced in-hospital mortality of patients with coronary artery disease and left ventricular dysfunction. *Chinese medical journal* **132**, 935-942.

Heuts, S., Lorusso, R., di Mauro, M., Jiritano, F., Scrofani, R., Antona, C., Dato, G. A., Centofanti, P., Ferrarese, S., and Matteucci, M. (2023). Sheathless Versus Sheathed Intra-Aortic Balloon Pump Implantation in Patients Undergoing Cardiac Surgery. *The American Journal of Cardiology* **189**, 86-92.

Iliuta, L., Andronesi, A. G., Diaconu, C. C., Panaitescu, E., and Camburu, G. (2022). Additional Prognostic Value of Tissue Doppler Evaluation in Patients with Aortic Stenosis and Left-Ventricular Systolic Dysfunction Undergoing Aortic Valve Replacement. *Medicina* **58**, 1410.

Jannati, M., and Attar, A. (2019). Intra-aortic balloon pump postcardiac surgery: A literature review. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences* **24**.

Lee, J., and Jang, I. (2020). Predictors affecting post-operative atrial fibrillation in patients after coronary artery bypass graft. *Clinical Nursing Research* **29**, 543-550.

Liang, M., Wang, C., Feng, K., Chen, G., Wang, K., and Wu, Z. (2020). Outcome analysis for prediction of intraaortic balloon pump support failure and long-term survival in high-risk patients undergoing mitral valve surgery. *Artificial Organs* **44**, 827-836.

Lorusso, R., Heuts, S., Jiritano, F., Scrofani, R., Antona, C., Actis Dato, G., Centofanti, P., Ferrarese, S., Matteucci, M., and Miceli, A. (2022). Contemporary outcomes of cardiac surgery patients supported by the intra-aortic balloon pump. *Interactive CardioVascular and Thoracic Surgery* **35**, ivac091.

Piepoli, M. F., Abreu, A., Albus, C., Ambrosetti, M., Brotons, C., Catapano, A. L., Corra, U., Cosyns, B., Deaton, C., and Graham, I. (2020). Update on cardiovascular prevention in clinical practice: a position paper of the European Association of Preventive Cardiology of the European Society of Cardiology. *European journal of preventive cardiology* **27**, 181-205.

Ram, E., Sternik, L., Moshkovitz, Y., Iakobishvili, Z., Zuroff, E., Peled, Y., Herscovici, R., and Raanani, E. (2022). Coronary artery bypass grafting following acute coronary syndrome: impact of gender. *In* "Seminars in Thoracic and Cardiovascular Surgery", Vol. 34, pp. 920-929. Elsevier.

Samanidis, G., Georgiopoulos, G., Bousounis, S., Zoumpourlis, P., and Perreas, K. (2021). Outcomes after intra-aortic balloon pump insertion in cardiac surgery patients. *Revista Brasileira de Terapia Intensiva* **32**, 542-550.

Sun, L. Y., Gaudino, M., Chen, R. J., Eddeen, A. B., and Ruel, M. (2020). Long-term outcomes in patients with severely reduced left ventricular ejection fraction undergoing percutaneous coronary intervention vs coronary artery bypass grafting. *JAMA cardiology* **5**, 631-641.

Vickneson, K., Chan, S.-P., Li, Y., Aziz, B. A., Luo, H. D., Kang, G. S., Caleb, M. G., and Sorokin, V. (2019). Coronary artery bypass grafting in patients with low ejection fraction: what are the risk factors? *The Journal of cardiovascular surgery* **60**, 396-405.

[Citation: Khan, T., Ashraf, T., Roomi, F. (2023). The effect of intra-aortic balloon pump in patients with low ejection fraction undergoing coronary artery bypass grafting. *Biol. Clin. Sci. Res. J.,* **2023***: 214.* doi: https://doi.org/10.54112/bcsrj.v2023i1.214]