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ORIGINAL ARTICLE

Impact of Glycemic Management on Non-Diabetic Adults Subjected to Mitral Valve Replacement Surgery at Department of Cardiology, BMU

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Abstract:

Background: The primary aim of this research was to investigate potential correlations between elevated post-operative blood glucose levels following cardiopulmonary bypass (CPB) and the incidence of morbidity and mortality.

Methodology: This cohort analysis was conducted at the Department of Cardiology, Bangladesh Medical University, between January 2023 and January 2024. A total of 75 non-diabetic adult patients undergoing mitral valve replacement (MVR) using CPB were enrolled based on predefined inclusion and exclusion criteria. Participants were stratified into two cohorts based on blood glucose concentrations measured within the first 60 hours post-operatively. Group A (unexposed) included patients with glucose levels ≤10.1 mmol/L, while Group B (exposed) included those with levels >10.1 mmol/L. Post-operative outcomes were monitored throughout the hospital stay.

Results: Of the 75 patients, 37 (49.3%) were in Group A and 38 (50.7%) in Group B. Post-operative morbidity was significantly higher in Group B (p = 0.001). Hyperglycemic patients experienced longer ICU stays (p = 0.001). Neurological complications (p = 0.04), renal dysfunction (p = 0.01), and surgical site infections (p = 0.04) were also significantly more frequent in Group B. Hospital stays were longer among hyperglycemic patients (p = 0.004). Mortality was higher in Group B but did not reach statistical significance (p = 0.31).

Conclusion: Post-CPB blood glucose levels exceeding 10.1 mmol/L are significant predictors of adverse post-operative outcomes and increased morbidity in non-diabetic patients undergoing MVR.

Keywords: Non-diabetic; Mitral valve replacement; Post-operative glycemic control.

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Introduction:

The global prevalence of diabetes mellitus has increased markedly over recent decades in both developed and developing countries.[1] Diabetes is well recognized for its association with adverse outcomes following cardiac surgery, including increased risks of infection, ischemia, neurological deficits, renal failure, and mortality.[2] However, dysregulation of glucose metabolism after surgery is not confined to diabetic patients.[3] Up to 80% of patients undergoing cardiac surgery develop stress-induced hyperglycemia, and a similar proportion of critically ill ICU patients demonstrate elevated blood glucose levels despite no prior history of diabetes.[4,5]

Evidence suggests that hyperglycemia is strongly associated with increased hospital complications, often conferring a higher relative risk in non-diabetic individuals than in patients with known diabetes[4,5] Current ICU guidelines recommend maintaining blood glucose levels between 7.8 and 10.0 mmol/L (140–180 mg/dL) in most

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critically ill patients.[4] Elevated post-operative glucose levels have been shown to predict infection, prolonged hospitalization, and mortality.[6]

Several studies have demonstrated that early implementation of intravenous insulin protocols reduces post-operative infection rates and improves survival following cardiac surgery.[7,8] Intensive insulin therapy has also been shown to reduce septicemia and mortality in surgical ICU populations.[8] While these benefits are well documented in diabetic patients.[9,10] emerging evidence indicates similar advantages in non-diabetic populations.[11]

Hyperglycemia following CPB is attributed to insulin resistance, pancreatic â-cell dysfunction, hypothermia, and systemic inflammatory response syndrome (SIRS).[12] Acute hyperglycemia promotes osmotic diuresis, electrolyte imbalance, oxidative stress, endothelial dysfunction, and inflammatory activation, all of which contribute to organ dysfunction and poor surgical outcomes.[13,14] Given these mechanisms, optimizing perioperative glycemic control has become an important therapeutic target in cardiac surgery patients.[15]

Materials and Methods:

Study Design and Setting

This prospective observational study was conducted at the Department of Cardiology, Bangladesh Medical University, from January 2023 to January 2024. Ethical approval was obtained from the Institutional Ethical Review Committee. Written informed consent was obtained from all participants.

Inclusion Criteria

- Adult non-diabetic patients undergoing elective mitral valve replacement using CPB
- Development of post-operative hyperglycemia

Exclusion Criteria

- Age <18 or >65 years
- Known diabetes mellitus
- Emergency surgery
- Left ventricular ejection fraction <30%
- Redo valve surgery
- Left atrial thrombus
- Congestive heart failure or cardiomyopathy
- Renal failure or prior stroke
- Prolonged CPB time (>120 minutes)

Study Population

A total of 75 patients fulfilling the study criteria were enrolled.

Patient Grouping

- Group A (n = 37): Post-operative blood glucose d”10 mmol/L
- Group B (n = 38): Post-operative blood glucose >10 mmol/L

Anesthesia and Surgical Technique

All patients underwent standardized anesthetic and surgical management. Non-pulsatile CPB was performed with a flow rate of 2.4 L/min/m² and mean arterial pressure maintained between 50–60 mmHg. Moderate hypothermia (28–32°C) and intermittent antegrade cold-blood cardioplegia were used. Mechanical bi-leaflet valves were implanted in all cases.

Glucose Measurement and Management

Venous blood glucose was measured using an enzymatic colorimetric method (DIMENSION X-PAND PLUS, Siemens). Patients with glucose levels >10 mmol/L were treated using a sliding-scale insulin protocol according to Bojar (2011), aiming to maintain glucose <10 mmol/L.

Outcome Measures

Recorded variables included ventilation time, ICU stay, hospital stay, neurological complications, renal dysfunction, surgical site infection, and mortality.

Statistical Analysis

Data were analyzed using SPSS software. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. Intergroup comparisons were performed using t-tests and ANOVA. A p-value <0.05 was considered statistically significant.

Results:

Table-I

Age Distribution (N = 75)

Age (years)	Group A (n = 37)	Group B (n = 38)	Total (n = 75)	p-value
20–30	8 (21.6%)	10 (26.3%)	18 (24.0%)	
31–40	21 (56.8%)	21 (55.3%)	42 (56.0%)	
41–50	8 (21.6%)	7 (18.4%)	15 (20.0%)	
Mean ± SD	36.4 ± 6.7	35.3 ± 6.2	35.9 ± 6.5	0.34 (ns)

Table-II

Gender Distribution (N = 75)

Sex	Group A (n = 37)	Group B (n = 38)	Total (n = 75)	p-value
Male	17 (45.9%)	18 (47.4%)	35 (46.7%)	
Female	20 (54.1%)	20 (52.6%)	40 (53.3%)	
Total	37 (100%)	38 (100%)	75 (100%)	0.84 (ns)

Table-III

BMI and BSA Status (N = 75)

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
BMI (kg/m²)	21.4 ± 1.7	21.5 ± 1.4	0.82 (ns)
BSA (m²)	0.7 ± 0.1	0.7 ± 0.1	0.91 (ns)

Table-IV

Pre-operative Biochemical Parameters (N = 75)

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
HbA1c (%)	5.22 ± 0.35	5.22 ± 0.38	0.98 (ns)
Serum Creatinine (mg/dL)	0.78 ± 0.08	0.81 ± 0.07	0.10 (ns)
RBS (mmol/L)	6.24 ± 0.59	6.36 ± 0.57	0.30 (ns)

Table-V

Echocardiographic Findings (LVEF) (N = 75)

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
LVEF (%)	52.29 ± 5.01	52.36 ± 4.46	0.93 (ns)

Table-VI

Per-operative Variables

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
CPB time (min)	85.07 ± 8.46	88.65 ± 14.42	0.04 (s)
Cross-clamp time (min)	57.21 ± 6.03	60.05 ± 6.66	0.02 (s)

Table-VII

Stress-Induced Hyperglycemia Distribution (N = 75)

Glycemic Status	Frequency (%)
Hyperglycemic (≥7.80 mmol/L)	57 (76.0%)
Normoglycemic (d 7.80 mmol/L)	18 (24.0%)
Total	75 (100%)

Table-VIII

Peak Post-operative Blood Glucose (N = 75)

Parameter	Group A	Group B	p-value
Peak glucose (mmol/L), Mean ± SD	9.12 ± 1.42	14.18 ± 2.24	0.001 (s)

Table-IX

Ventilation Time and ICU Stay (N = 75)

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Mechanical ventilation (min)	8.94 ± 2.47	13.02 ± 10.42	0.02 (s)
ICU stay (days)	1.47 ± 0.50	2.00 ± 0.66	0.001 (s)

Table-X

Post-operative Complications (N = 75)

Complication	Group A No. (%)	Group B No. (%)	p-value
Neurological	2 (5.4%)	8 (21.1%)	0.04 (s)
Renal dysfunction	2 (5.4%)	9 (23.7%)	0.01 (s)
Surgical site infection	3 (8.1%)	8 (21.1%)	0.04 (s)
Hospital stay (days), Mean ± SD	8.89 ± 1.81	10.38 ± 3.28	0.004 (s)
Mortality	1 (2.7%)	2 (5.3%)	0.31 (ns)

Table-XI

Adverse In-hospital Outcomes (N = 75)

Outcome	Group A No. (%)	Group B No. (%)	p-value
Present	3 (8.1%)	16 (42.1%)	0.001 (s)
Absent	34 (91.9%)	22 (57.9%)	

Table-XII

Peak Glucose vs. Hospital Outcome (N = 75)

Outcome	Mean Peak Glucose ± SD (mmol/L)	p-value
Adverse outcome (n = 19)	15.18 ± 3.05	0.001 (s)
Good outcome (n = 56)	10.44 ± 2.12	

Discussion:

This study demonstrates a strong association between post-operative hyperglycemia and adverse in-hospital outcomes in non-diabetic patients undergoing mitral valve replacement with CPB. Despite comparable baseline characteristics, patients with peak glucose levels >10 mmol/L experienced significantly higher morbidity.

The observed incidence of stress-induced hyperglycemia (76%) aligns with previous reports in cardiac surgery populations.[4] Prolonged ICU stay, increased ventilation time, neurological complications, renal dysfunction, and wound infections were all significantly associated with elevated glucose levels, supporting findings from prior studies.[1,14,18]

Although mortality was higher among hyperglycemic patients, statistical significance was not achieved, likely due to limited sample size. Nonetheless, the strong association between elevated glucose levels and adverse outcomes highlights the importance of perioperative glycemic control.

Conclusion:

Post-operative blood glucose levels ≥10.1 mmol/L following CPB are associated with increased perioperative morbidity in non-diabetic patients undergoing mitral valve replacement. Effective glycemic management may reduce complications, ICU duration, and hospital stay. Larger multicenter studies are recommended to further evaluate the impact of glycemic control on mortality.

Limitations:

The study utilized purposive, non-random sampling, which may introduce selection bias. The relatively small sample size limits generalizability. Future large-scale studies are required to define optimal glucose targets in non-diabetic cardiac surgery patients.

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