International Journal of Cardiology Research
www.cardiologyjournal.in
E-ISSN: 2663-4112, P-ISSN: 2663-4104
Received Date: 02-03-2020 Accepted Date: 04-04-2020; Published: 13-04-2020
Volume 2; Issue 2; 2020; Page No. 06-09

Early outcome of concurrent mitral valve replacement and coronary artery bypass grafting

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DOI: https://doi.org/10.33545/26634104.2020.v2.i2a.24

Abstract
Concomitant coronary artery bypass surgery (CABG) in patients undergoing mitral valve replacement (MVR) has been shown to be an important risk factor for hospital mortality. We evaluated preoperative characteristics, postoperative complications, in-hospital mortality rate, and length of stay in hospital for patients undergoing concurrent CABG with MVR. Preoperative and postoperative clinical data from 175 patients undergoing concurrent CABG with MVR operation at BSMMC (Bangabandhu Sheikh Mujibur Rahman Medical College), Dhaka, Bangladesh from January to December 2019 were collected and entered into a database. Information was obtained by clinical and case note review as well as detailed questionnaires to physicians and patients. Mean age of patients was 57.95 ± 10.54 years and 51.4% were male. Among studied patients, 18.3% and 2.9% underwent aortic and tricuspid valve replacement, respectively. In-hospital mortality was 6.9% and 96.0% of patients were hospitalized ≥14 days. History of congestive heart failure (*P*=0.027) and postoperative brain stroke (*P*=0.004) were independent predictors for in-hospital mortality. Exact considering of congestive heart failure and postoperative brain stroke related to in-hospital mortality in concurrent CABG with MVR operation are necessary.

Keywords: coronary artery bypass grafting, mitral valve replacement, outcome, In-hospital mortality

1. Introduction
Patients who have both mitral valve dysfunction and atherosclerotic coronary artery disease (CAD) form a heterogeneous group in terms of origin of the valvular disease, extent of coronary atherosclerosis, left ventricular function, and hemodynamic status at operation [1]. In recent years, 15% to 30% of patients undergoing mitral valve replacement (MVR) or mitral valve repair for non-ischemic mitral valve disease have significant CAD [2]. Predictors of early mortality associated with combined coronary artery bypass grafting (CABG) and mitral valve placement include the need for replacement versus repair (in some but not all series); however, they may include other variables such as age, co-morbid conditions, the urgency of surgery, and left ventricular function [3]. The combination of MVR with CABG is generally considered to have a greater early and late mortality than either procedure alone. CAD is often associated with mitral valve disease, but may not be the cause of the valve dysfunction [4]. Although the incidence of concurrent CABG with MVR increased significantly from 1988 (18%) to 1997 (28%), the in-hospital survival rates for the same two periods were similar (89% versus 90%, respectively). Clearly, concomitant CABG in patients undergoing primary MVR has been shown to be an important independent risk factor for short- and long-term mortality [5]. A few studies are available about the outcome of concurrent CABG and valvular surgeries among our population. Therefore, we tried to consider early results of concurrent CABG and MVR and also determine main predictors of mortality among these patients.

2. Materials and Methods
Preoperative and postoperative clinical characteristics were collected and entered into a database from 175 patients undergoing concurrent CABG with MVR at BSMMC (Bangabandhu Sheikh Mujibur Rahman Medical College) Hospital, Dhaka, Bangladesh from January to December 2019. Information was obtained by clinical and case note review as well as detailed questionnaires to physicians and patients. The following variables were collected for statistical analysis including general characteristics, current smoking history (patient regularly smokes a tobacco product/products one or more times per day or has smoked in the 30 days prior to admission) [6], hypercholesterolemia (total cholesterol ≥5.0 mmol/l, HDL-cholesterol ≤ 1.0 mmol/l in men, or ≤ 1.1 mmol/l in women, triglyceride ≥2.0 mmol/l) [7], family history of CAD (first-degree relatives before the age of 55 in men and 65 years in women) [8], hypertension (systolic blood pressure ≥ 140 mmHg and/or diastolic ≥ 90 mmHg and/or on anti-hypertensive treatment) [9],

diabetes mellitus (symptoms of diabetes plus plasma glucose concentration ≥ 11.1 mmol/l or fasting plasma glucose ≥ 7.0 mmol/l or 2-hp ≥ 11.1 mmol/l) [10], renal failure (creatinine > 355 μmol/l with a rise of > 44 units or urine output below 0.3 ml/kg for 24 h), recent myocardial infarction (an acute event with abnormal creatine phosphokinase and troponin levels). Bangladesh Heart Association score, arrhythmia, and left ventricular ejection fraction. We considered four criteria to a complicated postoperative short-term outcome: 1) in-hospital postoperative complications including existence of at least one of these complications: cardiac complications (heart block, cardiac arrest, or atrial fibrillation) and non-cardiac complications (re-intubation, brain stroke, renal failure, or ventilation ≥ 10 hours); 2) prolonged hospital stay before and after operation; and 3) in-hospital mortality rate (sometimes termed operative mortality) defined as death within 30 days of operation [11]. Results were reported as the mean ± standard deviation (SD) for quantitative variables and percentages for categorical variables. Effects of variables on in-hospital mortality were assessed using Pearson's χ^2-test. Predictors exhibiting a statistically significant relation in univariate analysis were taken for multivariate logistic regression analysis to investigate their independence as predictors. Odds ratio (OR) and 95% confidence intervals (CI) were calculated. *P* values of 0.05 or less were considered statistically significant. All the statistical analyses were performed using SPSS version 13 (SPSS Inc., Chicago, IL, USA) version 19.0 for Windows (SAS Institute Inc., Cary, NC, USA).

3. Results

There were 175 concurrent CABG with MVR operations performed on patients. The mean age of patients was 57.95 ± 10.54 years and 5.7% were under 40 years. Male/female ratio was 1.05 (male 51.4%, female 48.6%). The mean ejection fraction was 48.15 ± 10.14 and BMI ≥ 30 was 18.3%. The main preoperative patient characteristics are summarized in [Table 1]. Hypercholesterolemia, hypertension, and congestive heart failure were more common than other variables in concurrent CABG with MVR operation, whereas, infectious endocarditis, and left main disease were less common. In concurrent CABG with MVR operation, NYHA score II, III and IV were found in 46.2%, 32.7%, and 11.7% respectively. Also, mean NYHA score was 2.46 ± 0.84. Among all patients, 18.3% and 2.9% underwent aortic and tricuspid valve replacement, respectively. Also, 8.6% of patients underwent tricuspid reconstruction and annuloplasty, whereas, no aortic reconstruction and/or annuloplasty was performed.

Table 1: The main preoperative patient characteristics of patients underwent concurrent CABG and MVR (n=175)

Variables	%
Male gender	51.4
Age< 40 years	5.7
BMI ≥30	17.7
Cigarette smoking	28.2
Family history of CAD [a]	27.2
Diabetes mellitus	26.9
Hypercholesterolemia	54.9
Hypertension	55.7
Infectious endocarditis	2.9
Myocardial infarction	25.1
Congestive heart failure	56.0
Arrhythmia	20.7
Ejection fraction≤35%	13.7
Left main disease	9.1
NYHA [b] score II	46.2
NYHA score III	32.7
NYHA score IV	11.7
Mitral stenosis	46.3
Mitral insufficiency	88.9

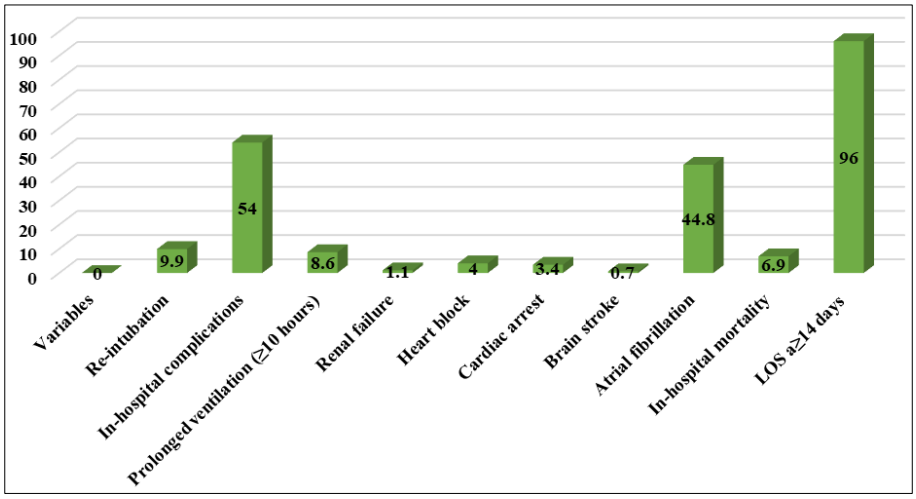

Fig 1: The main postoperative patient characteristics of patients underwent concurrent CABG and MVR (n=175)

The main postoperative characteristics are summarized in [Figure-1]. Among postoperative complications, in-hospital complication and atrial fibrillation were more frequent than other complications. Also, in hospital stay ≥14 days was reported in 96% of patients. In-hospital mortality in concurrent CABG with MVR was 6.9%. Multivariate stepwise logistic regression analysis showed that among preoperative characteristics, only history of congestive heart failure (OR: 12.085, 95% CI: 1.021-143.007, P = 0.027) was associated with in-hospital mortality rate. Among postoperative characteristics, postoperative brain stroke (OR: 214.703, 95% CI: 6.287-415.213, P = 0.004) and re-intubation (OR: 159.170, 95% CI: 16.094-999.99, P<0.001) had a significant relation with in-hospital mortality.

4. Discussion

Various studies have reported the profound effect of CAD on survival after mitral valve replacement [12, 16]. Increases in the incidence of significant CAD leading to MVR combined with CABG has a significant impact on the eventual patient outcome, so that in-hospital mortality rates for these high-risk patients may range from 7% to 24% [5]. The impact of etiology of associated mitral disease and a valve procedure on operative and long-term outcomes after coronary bypass grafting surgery is yet to be clearly defined. Several studies have shown that severe CAD, acute myocardial infarction, low ejection fraction, ischemic mitral regurgitation, advanced heart failure symptoms, failure to use internal mammary artery, valve replacement surgery and emergency operations are important predictors of operative mortality [14, 17, 18]. We found that mean NYHA score in patients undergoing concurrent CABG with MVR operation was 2.46, whereas in Akins *et al* study, mean score was 3.4 [13]. In our study, NYHA score II, III and IV were found in 46.2%, 32.7%, and 11.7% of patients undergoing concurrent CABG with MVR operation, respectively; whereas these scores were reported elsewhere as 12%, 54%, and 29%, respectively [16]. We also found that mitral stenosis and insufficiency in these patients was 46.3% and 88.9%, respectively, but these frequencies were 24% and 76% in Disesa *et al*. study [15]. We showed that among preoperative criteria, only congestive heart failure (CHF) was a risk factor for in-hospital mortality of concurrent CABG with MVR operation, whereas age, history of other major predisposing factors for CAD, and NYHA score did not influence on in-hospital mortality. However, in isolated MVR operation, NYHA score ≥ 3 was associated with in-hospital mortality. Similar to our study, in Garcia *et al*. [19] and Stahle *et al*. [20] studies, CHF was a major risk factor for in-hospital mortality of concurrent CABG with MVR operation. On the other hand, several studies obtained results contrary to ours, reporting high NYHA score as a risk factor for in-hospital mortality in concurrent CABG with MVR operation [14, 19]. The other important result of our study was the role of re-intubation as a risk factor for in-hospital mortality in this type of operation. It seems that mortality caused by re-intubation is more related to complications of re-intubation. Patients requiring re-intubation have a poor prognosis, with hospital mortality exceeding 30 to 40%, although the reason remains unclear [21]. Ebstein *et al*. showed that both cause for extubation failure and time to re-intubation were independently associated with in-hospital mortality [21]. In another study, compared with the first intubation and re-intubation, the estimated risk for nosocomial pneumonia has been shown to be 8 times higher and the increase for mortality increased 6- to 12-fold [22]. However, our study had some limitations. First, although other studies did not show that the incidence of in-hospital mortality of concurrent CABG with MVR operation was influenced by the operative characteristics, we were not able to determine operative variables and technique effects on complications and outcome. Second, according to the presumably strong relation between re-intubation and in-hospital mortality, other studies are necessary for confirmation of this result.

5. Conclusion

In conclusion, based on the outcome of this research, among postoperative characteristics, re-intubation and congestive heart failure were associated with in-hospital mortality after concurrent CABG with MVR operation. Therefore, exact considering and control of these characteristics before and after CABG and MVR are necessary.

Conflict of interests: The authors declare that they have no competing interests.

[**Abbreviations:** CABG, coronary artery bypass grafting; MVR, mitral valve regurgitation; CAD, coronary artery disease.

Abbreviations: CABG, coronary artery bypass grafting; MVR, mitral valve regurgitation; LOS, length of stay]

6. References

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