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ORIGINAL ARTICLE

Outcome of Coronary Artery Bypass Graft Surgery with Low Preoperative Ejection Fraction

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ABSTRACT

Background & objectives: Numerous studies have shown very good results of coronary artery bypass graft (CABG) surgery in patients with coronary artery disease with relatively well-retained myocardial function. However, for patients with low left ventricular ejection fraction (manifested as left ventricular ejection fraction ⩽ 40%), concerns about increased operative mortality and diminished long-term survival, have made it difficult to assess the benefit of coronary artery bypass surgery (CABG) in these patients. The aim of the present study was, therefore, to evaluate the influence of low ejection fraction on postoperative outcome in patients undergoing CABG.

Methods: This retrospective study was conducted on 1030 patients who underwent CABG surgery in the Department of Cardiac Surgery, Ibrahim Cardiac Hospital & Research Institute, Dhaka between September 2006 and July 2010. After excluding 14 patients whose preoperative EF was not found in the record, 1016 patients were included. The patients were divided into Group-I (EF ⩽ 40%) and Group-II (EF > 40%). Early outcome consisted of morbidity and mortality occurring from any cause within the first 30 postoperative days.

Result: More than 50% of the patients in both Group-I and Group-II were in their 5th decade of life with mean ages being 55.8 and 55.7 years respectively. Males were predominant in both the groups. Around two-thirds of the patients in either group had diabetes, hypertension and/or dyslipidemia. Over 40% of the patients were smoker. All these risk factors were almost identically distributed between groups ($p > 0.05$). All the complications in both groups were similar except post-operative bleeding which was higher in Group-I (16.2%) than that in Group-II (10%) ($p = 0.010$). Mortality was almost similar in both groups (3.1% vs. 4.4%, $p = 0.352$).

Conclusion: The study concludes that CABG can be done in patients of low EF (⩽ 40%) with almost comparable outcome (in terms of efficacy and safety) with those having EF > 40%.

Key words: CABG, low ejection fraction, postoperative outcome.

Introduction

Despite improvement in medical therapies and surgical techniques, the management of patients with coronary artery disease and a low ejection fraction (EF) remains challenging. Current treatment options for this cohort include intensive medical therapy, surgical revascularization, ventricular remodeling, and heart transplantation. Medical treatment alone is not optimal because of limited long-term survival.[1-5] Besides, medical management of these cases requires repeated hospital admissions and lowers the quality of life. Heart transplantation offers excellent results with a 65.6% 5-year survival rate; however, the scarcity of donor organs makes this option not a practical one.[6] In addition, many places around the world do not have facilities for heart transplantation. More over postoperative management of transplant patients is costly.

On the other hand, with recent improvements in anesthesia, surgical technique, myocardial protection, and perioperative support, CABG can be done in these patients with acceptable safety.[7-10] Nevertheless in patients with a low EF, coronary

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artery bypass grafting (CABG) is associated with higher postoperative morbidity and mortality than those in patients with preserved left ventricular function.[11,12] The present study was undertaken to compare the risk factors and early outcomes of patients who underwent CABG with and without preoperative low ejection fraction in our hospital.

Methods

This retrospective single surgeon study was conducted on 1030 patients who underwent coronary artery bypass graft (CABG) surgery in the Department of Cardiac Surgery, Ibrahim Cardiac Hospital & Research Institute, Dhaka between September 2006 and July 2010. After excluding 14 patients whose preoperative EF was not found in the record, 1016 patients were evaluated.

The global EF was determined with one or both of following methods: calculation with 2-dimensional echocardiography via the biplane apical method and the modified Simpson's rule,[13] and/or ventriculo-graphic evaluation performed by an independent surgeon and an independent cardiologist. The patients were divided into 2 groups as follows: Group-I, EF $\leqslant$ 40% (n = 229) and Group-II EF>40% (n = 787).

All patients received short-acting anesthetic drugs to facilitate early extubation. Extracorporeal circulation was performed via a hypothermic nonpulsatile flow. Cold crystalloid cardioplegia ("St. Thomas solution") was used according to the surgeon's preference to induce and maintain cardioplegic arrest. Early outcome consisted of complications. Mortality was defined as death that occurred from any cause within the first 30 postoperative days.

Result

Over half of the patients in both Group-I and Group-II were in their 5th decades of life with mean age of the patients being 55.8 and 55.7 years respectively. Males were predominant in both groups, but their presence was significantly more in the Group-I (91.7%) than that in the Group-II (84.6%) (p = 0.006) (Table I). Around two-thirds of the patients in either group had diabetes, hypertension and/or dyslipidemia. Over 40% of the patients in both groups were smoker.

Table I. Comparison of demographics between patients with low and normal LVEF.

Demographic variables	LVEF Group-I (n=229)	LVEF Group-II (n=787)	p-value
Age# (yrs)			
< 50	48(21.0)	175(22.2)	
50-60	120(52.4)	401(51.0)	
≥ 60	61(26.6)	211(26.8)	
Mean ± SD	55.8	8.6 55.7 8.6	0.922
Sex			
Male	210(91.7)	666(84.6)	0.006
Female	19(8.3)	121(15.4)	

Figures in the parentheses denote corresponding percentage.
Data were analysed using Student's t-Test and were presented as mean±SD.

Table II. Distribution of co-morbidities/risk factors between groups.

Co-morbidities/ Risk factors#	LVEF Group-I (n=229)	LVEF Group-II (n=787)	p-value
Diabetes	144(62.9)	544(69.1)	0.075
Hypertension	162(70.7)	573(72.8)	0.538
Dyslipidemia	144(62.9)	466(59.2)	0.318
Smoking	99(43.4)	315(40.1)	0.373

Figures in the parentheses denote corresponding percentage.

Table II. Comparison of outcome/complications between groups.

Complications developed	LVEF Group-I (n=229)	LVEF Group-II (n=787)	p-value
Arrhythmia*	0(0.0)	3(0.4)	0.464
Bleeding#	37(16.2)	79(10.0)	0.010
Reopening for bleeding#	17(7.4)	58(7.4)	0.978
Heart failure#	3(1.3)	5(0.6)	0.554
Pleural effusion#	4(1.6)	20(2.5)	0.486
Pneumonia#	5(2.2)	13(1.7)	0.801
ARDS*	1(0.4)	3(0.4)	0.641
Prolonged ventilation#	31(13.5)	87(11.1)	0.302
CVA#	3(1.3)	5(0.6)	0.554
Hepatic dysfunction#	7(3.1)	25(3.2)	0.927
Septicemia#	8(3.5)	24(3.0)	0.735
Multiorgan failure#	2(0.9)	10(1.3)	0.887
Death#	7(3.1)	35(4.4)	0.352

Figures in the parentheses denote corresponding percentage;
#Data were analysed using χ^2 Test; *data were analysed using Fisher's Exact Test.

All of the co-morbidities/risk factors were almost equally distributed between groups ($p > 0.05$) (Table II). Complications developed following CABG are illustrated in Table III. None of the complications, except incidence of bleeding, which was significantly higher in Group-I (16.2%) than that in Group-II (10%) ($p = 0.010$).

Discussion

Although it is commonly considered that patients with the low ejection fractions are at greater risk of surgical complications and mortality,[14-16] the result of our study suggests that early outcome of coronary surgery is favourable in patients with left ventricular dysfunction (EF $\leqslant$ 40%) in terms of their functional status and 30-day mortality. As the baseline demographic characteristics, comorbidities and risk factors profile were almost similar between the study groups and there was no statistically significant difference in outcome between patients with ejection fraction $\leqslant$ 40% and those with EF > 40%, the role of preoperative EF on postoperative complications and mortality is negligible. A long-term follow up study showed that benefits of surgery in patients with severe left ventricular dysfunction outweigh the somewhat increased short-term hazards.[17] But in our study we did not find any difference in mortality between patients with ejection fraction $\leqslant$ 40% and those with EF > 40% (3.1% vs. 4.4%, $p = 0.352$).

Various studies have put forward different results on the initial effect of isolated CABG on mortality in patients with a low EF. Soliman Hamad and associates[18] noted that the early mortality rate in patients with an EF < 35% was more than 6 times higher than that in patients with an EF > 50% (10.5% vs. 1.6%). Di Carli and colleagues[19] reported a 9.3% 30-day mortality rate in patients with an EF < 40%. Christakis and colleagues[20] demonstrated a 9.8% operative mortality rate in patients with an EF < 20%, and a study by Carr and colleagues[21] demonstrated an 11% perioperative mortality rate in patients with an EF between 10% and 20%. However, more recent reports have shown lower operative mortality rates. In a review of the New York State database[22], the early mortality rate of patients with an EF of < 20% was 4.6%. Another report showed an in-hospital mortality rate of 4% in patients with an EF of < 30%.[23] In an earlier report, we found approximately the same in-hospital mortality rate (4%) in 75 prospectively studied patients with an EF of < 40%.[24] The decline of those mortality rates over time showed a statistically significant improvement from the double-digit rates reported in the 1980s. This decline in mortality seems to be due to improvements in cardiac anesthesia, perioperative care, surgical techniques, emergency cardiac care, and postoperative management. However, Alderman et al[1] demonstrated that the benefit of surgery in patients with low ejection fraction was partially confined to patients who had angina as the predominant symptom and there was negligible relief of symptoms in patients whose symptoms are primarily caused by heart failure.

In spite of encouraging outcomes of CABG in patients with compromised left ventricular function, few cardiac surgery centers worldwide undertake coronary artery bypass grafting (CABG) in high-risk patients with severe left ventricular (LV) dysfunction, preferring to maintain them on medical management.[25-29] However, medical management of these cases requires repeated hospital admissions and lowers the quality of life. In addition, many places around the world do not have facilities for heart transplantation. Besides, postoperative management of transplant patients is costly and donors may be scarce, especially in developing countries.

Conclusion

Finally, experience gleaned from the present study of a large sample, suggest that CABG could be done in patients of low EF ($\leqslant$ 40%) with fairly comparable outcome (in terms of morbidity and mortality) with those having EF > 40%.

Reference

1. Alderman EL, Fisher LD, Litwin P, Kaiser GC, Myers WO, Maynard C, Levine F, Schloss M. Results of coronary artery surgery in patients with poor left ventricular function (CASS). Circulation. 1983; 68: 785-95.
2. Scott SM, Deupree HL, Sharma GVRK, Luchi RJ. VA study of unstable angina. 11-year results show duration of surgical advantage for patients with impaired ejection fraction. Circulation. 1994; 90(suppl II): 120-3.
3. Zubiate P, Kay JH, Mendez AM. Myocardial revascularization for the patient with drastic impairment of function of the left ventricle. J ThoracCardiovasc Surg. 1977; 73: 84-6.

4. Di Carli MF, Maddahi J, Rokhsar S, Schelbert HR, Bianco-Batlles D, Brunken RC, Fromm B. Long-term survival of patients with coronary artery disease and left ventricular dysfunction: implications for the role of myocardial viability assessment in management decisions. J Thorac CardiovascSurg. 1998; 116: 997-1004.
5. Passamani E, Davis KB, Gillespie MJ, Killip T. A randomized trial of coronary artery bypass surgery. Survival of patients with a low ejection fraction. N Engl J Med. 1985; 312: 1665-71.
6. John R, Rajasinghe HA, Chen JM, Weinberg AD, Sinha P, Mancini DM,Naka Y, Oz MC, Smith CR, Rose EA, Edwards NM. Long-term outcomes after cardiac transplantation: an experience based on different eras of immunosuppressive therapy. Ann Thorac Surg. 2001; 72: 440-9.
7. Kron IL, Flanagan TL, Blackbourne LH, Schroeder RA, Nolan SP. Coronary revascularization rather than cardiac transplantation for chronic ischemic cardiomyopathy. Ann Surg 1989; 210: 348-54.
8. Christakis GT, Weisel RD, Fremes SE, Ivanov J, David TE, Goldman BS, Salerno TA. Coronary artery bypass grafting in patients with poor ventricular function. J Thorac CardiovascSurg 1992; 103: 1083-92.
9. Mickleborough LL, Maruyama H, Takagi Y, Mohamed S, Sun Z, Lee J. Results of revascularization in patients with severe left ventricular dysfunction. Circulation 1995; 92(suppl): 73-9.
10. Kaul TK, Agnihotri AK, Fields BL, Riggins LS, Wyatt DA, Jones CR. Coronary artery bypass grafting in patients with an ejection fraction of twenty percent or less. J Thorac Cardiovasc Surg 1996; 111: 1001-12.
11. Zubiate P, Kay JH, Mendez AM: Myocardial revascularization for the patient with drastic impairment of function of the left ventricle. J Thorac Cardiovasc Surg 1977; 73(1): 84-6.
12. Christakis GT, Weisel RD, Fremes SE, Ivanov J, David TE, Goldman BS, Salerno TA: Coronary artery bypass grafting in patients with poor ventricular function. Cardiovascular Surgeons of the University of Toronto. J Thorac Cardiovasc Surg 1992; 103(6): 1083-1091.
13. Weiss JL, Eaton LW, Kallman CH, Maughan WL: Accuracy of volume determination by two-dimensional echocardiography: defining requirements under controlled conditions in the ejecting canine left ventricle. Circulation 1983; 67(4): 889-95.
14. Cohn PF, Gorlin R, Cohn LH, Collins IJ Jr, Left ventricular ejection fraction as a prognostic guide in surgical treatment of coronary and valvular heart disease. Am J Cardiol 1974; 34: 136.
15. Trachiotis GD, Weintraub WS, Johnston TS, Jones EL, Guyton RA, Craver JM: Coronary artery bypass grafting in patients with advanced left ventricular dysfunction. Ann Thorac Surg 1998; 66(5): 1632-9.
16. Bouchart F, Tabley A, Litzler PY, Haas-Hubscher C, Bessou JP, Soyer R: Myocardial revascularization in patients with severe ischemic left ventricular dysfunction. Long term follow-up in 141 patients. Eur J Cardiothorac Surg 2001; 20(6): 1157-62.
17. Alderman EL, Fisher LD, Litwin P, Kaiser GC, Myers WO, Maynard C et al. Results of coronary artery surgery in patients with poor left ventricular function (CASS). Circulation 1983; 68(4): 785-95.
18. Soliman Hamad MA, Albert HM van Straten, Jacques PAM Schonberger, Joost F ter Woorst, Andre M de Wolf, Elisabeth J Martens et al. Preoperative ejection fraction as a predictor of survival after coronary artery bypass grafting: comparison with a matched general population Journal of Cardiothoracic Surgery 2010; 5: 29, Available at: http://www.cardiothoracicsurgery.org/content/5/1/29.
19. Di Carli MF, Maddahi J, Rokhsar S, Schelbert HR, Bianco-Batlles D, Brunken RC, Fromm B: Long-term survival of patients with coronary artery disease and left ventricular dysfunction: implications for the role of myocardial viability assessment in management decisions. J Thorac Cardiovasc Surg 1998, 116(6): 997-1004.
20. Christakis GT, Weisel RD, Fremes SE, Ivanov J, David TE, Goldman BS, Salerno TA: Coronary artery bypass grafting in patients with poor ventricular function. Cardiovascular Surgeons of the University of Toronto. J Thorac Cardiovasc Surg 1992; 103(6): 1083-91.
21. Carr JA, Haithcock BE, Paone G, Bernabei AF, Silverman NA: Long-term outcome after coronary artery bypass grafting in patients with severe left ventricular dysfunction. Ann Thorac Surg 2002; 74(5): 1531-6.
22. Topkara VK, Cheema FH, Kesavaramanujam S, Mercando ML, Cheema AF, Namerow PB, Argenziano M, Naka Y, Oz MC, Esrig BC: Coronary artery bypass grafting in patients with low ejection fraction. Circulation 2005; 112(9 Suppl): I344-50.
23. Ascione R, Narayan P, Rogers CA, Lim KH, Capoun R, Angelini GD: Early and midterm clinical outcome in patients with severe left ventricular dysfunction undergoing coronary artery surgery. Ann Thorac Surg 2003; 76(3): 793-9.
24. Soliman Hamad MA, Peels K, Van Straten A, Van Zundert A, Schönberger J: Coronary artery bypass surgery in patients with impaired left ventricular function. Predictors of hospital outcome. Acta Anaesthesiol Belg 2007; 58(1): 37-44.
25. Thourani VH, Weintraub WS, Stein B, Gebhart SSP, Craver JM, Jones EL, et al. Influence of diabetes mellitus on early and late outcome after coronary artery bypass grafting. Ann Thorac Surg 1999; 67: 1045-52.
26. Yau TM, Fedak PWM, Weisel RD, Teng C, Ivanov J. Predictors of operative risk for coronary bypass operations in patients with left ventricular dysfunction. J Thorac Cardiovasc Surg 1999; 118: 1006-13.
27. Trachiotis GD, Weintraub WS, Johnston TS, Jones EL, Guyton RA, Craver JM. Coronary artery bypass grafting in patients with advanced left ventricular dysfunction. Ann Thorac Surg 1998; 66: 1632-9.
28. Baumgartner FJ, Omari BO, Goldberg S, Pandya AB, Pandya AB, Daland AM, et al. Coronary artery bypass grafting in patients with profound ventricular dysfunction. Tex Heart Inst J 1998; 25: 125-9.
29. Kaul TK, Agnihotri AK, Fields BL, Riggins LS, Wyatt DA, Jones CR. Coronary artery bypass grafting in patients with an ejection fraction of twenty percent or less. J Thorac Cardiovasc Surg 1996; 111: 1001-12.