ORIGINAL ARTICLES

Early outcomes of patients after on-pump coronary artery bypass grafting at Mohammed Bin Khalifa Bin Salman Al Khalifa Cardiac Center, Bahrain Defence Force Hospital in the Kingdom of Bahrain

Kristianna Verhagen-Mostafa* Habib E. Tareif, FRCSI** Zaid Arekat, FRCSC*** Marwan Mostafa, MD***
*Final year medical student, AMA International University, College of Medicine, Kingdom of Bahrain
**Consultant Cardiothoracic and Vascular Surgeon, Head of Cardiac Surgery at Mohammed Bin Khalifa Al Khalifa Cardiac Centre, Kingdom of Bahrain
***Consultant Cardiothoracic Surgeon at Mohammed Bin Khalifa Al Khalifa Cardiac Centre, Kingdom of Bahrain

Correspondence to: kristoukini@hotmail.com

ABSTRACT

Background: Coronary artery bypass grafting (CABG) is increasingly performed on patients with acute coronary syndrome in Bahrain. Recognition of early outcomes associated with the procedure can provide members of the healthcare team with a better awareness of their occurrence, hence can impact on important decisions with respect to provision of monitoring, diagnosis, and further treatment.

Objective: The objective of this study is to determine the early outcomes of patients who have undergone on-pump CABG at Mohammed Bin Khalifa Bin Salman Al Khalifa Cardiac Center, Bahrain Defence Force Hospital (BDF) in the Kingdom of Bahrain.

Method: This is a retrospective medical record review of patients who have undergone on-pump CABG at BDF Hospital from January 1, 2010 to December 31, 2010. Data extraction was carried out by one investigator and cross checked.

Results: 150 patients were included in this study, 85.3% were between 40 and 59 years of age and 70% were male. 43.3% of patients stayed in the Intensive Care Unit (ICU) for 5 days. One patient had congestive heart failure and another one had stroke. Two patients had acute renal failure. Post-op ejection fraction at 30-40% was seen in 35% of patients. Blood loss in 25% of patients was estimated at 150cc. Post-operative wound complication occurred in 3 patients, and in one this necessitated sternal debridement.

Conclusion: On-pump coronary artery bypass grafting (CABG) is increasingly being undertaken for Bahraini men aged 40-59 years, with ejection fraction lower than normal levels who have multi-vessel disease. The relative safety of CABG was illustrated by the comparatively low mortality rate.

Keywords: Bahrain; coronary artery bypass grafting; cardiac surgery; ejection fraction; post-op complications; cardiopulmonary bypass

INTRODUCTION

The prevalence of ischemic heart disease has been reported at 174.4 per 100,000 and coronary events ranked number five as the leading cause of discharges at Salmaniya Medical Complex in 2005.[1] The second Gulf Registry of Acute Coronary Events covering the seven Middle East countries reported that out of 7,881 patients with acute coronary syndrome, 336 (4.2%) had a history of undergoing coronary artery bypass grafting.[2] In the Kingdom of Bahrain, cardiovascular deaths account for about 19.5% annually.

Coronary artery bypass grafting is well established as a treatment for ischemic heart disease. Traditionally, this is done using cardiopulmonary bypass (on-pump). The operative procedure creates new routes around narrowed and blocked arteries to allow adequate blood flow and the delivery of oxygen and nutrients to the heart muscle.[3]

The benefit of CABG in reducing morbidity and mortality has been recognized with excellent outcomes in the short-term and mid-term despite marked change in patient profiles and an increasing number of higher risk patients. Significant improvement has also been noted in survival for most cardiac surgical procedures, despite the increasing complexity of case-mix and an increasing proportion of elderly patients undergoing heart surgery.[4] The importance of recognizing outcomes following cardiac intervention has an impact on the healthcare team's clinical decision-making in terms of monitoring, diagnosis, and further treatment including long-term follow-up care. Outcomes following CABG can be classified into categories that reflect expected goals, and paramount among these are prolongation of life and improvement in physical functioning.

OBJECTIVES

To determine key factors which might have an impact on the early outcomes of patients who have undergone coronary

artery bypass grafting at Bahrain Defence Force Hospital (BDFH) in 2010. The following variables were considered:

1. Age and gender distribution
2. Ejection fraction
3. Number of grafts
4. Cross-clamp time and bypass time
5. Blood loss, post-operative complications, and mortality
6. Length of stay at the ICU and in the hospital prior to discharge

LITERATURE REVIEW

Results from the National Cardiovascular Network in 2000 reported that octogenarians had a significant in-hospital mortality rate when compared to younger patients. The same study noted that the incidence of post-operative stroke and renal failure was double that among the elderly as compared to younger patients.[5] A similar retrospective study in a government hospital in Saudi Arabia concluded that cardiac surgery has a higher risk in the elderly, although the procedure is considered to carry less risk these days. The study also indicated that the mortality rate and duration of stay in the intensive care unit post CABG varied markedly across age groups. The authors concluded that advanced age alone is not a deterrent for the procedure as long as the benefits outweigh the potential risk.[6]

A systematic review of sixty trials with meta-analyses and trial sequential analyses involving participants (mean age 63 years and involving 22% women), reported that the ejection fraction (EF) among 68% of these was <0.30. The same review indicated that in 19 trials, 1,232 patients had three-vessel disease.[7] The American Heart Association in its 2005 Scientific Statement which was based on a study comparing off-pump (OPCAB) and on-pump CABG (standard), reported that fewer grafts tend to be performed with OPCAB. The duration of hospital stay, mortality rate, cardiac outcome and long-term neurological function appeared to be similar in both groups.[8]

Ischemic preconditioning has been recognized to protect the heart during the procedure but there are institutions that do not do this routinely. Such preconditioning may be done by ischemia or the use of adenosine A1 receptor agonist. In a study of 30 patients, which reported the effect of ischemic and pharmacological preconditioning on myocardial necrosis after CABG, the mean bypass time was 91 ±11.6 (SD) min, and the mean ischemic time 33 ±5.5 (SD) min. The study also noted that there was no intergroup difference.[9]

Excessive blood loss and subsequent blood transfusion are important factors to consider after CABG. Reopening sternotomy, with the aim of controlling bleeding after CABG, may be a not infrequent requirement. Bleeding can generally be attributed to platelet dysfunction, impaired coagulation and problems associated with fibrinolysis. It has been reported that post-operative bleeding can substantially increase morbidity and mortality following cardiac surgery.[10]

Major complications including death may occur after CABG and these can also include myocardial infarction, wound infection, stroke, kidney injury and bleeding which may require transfusion or reopening. A study of in-hospital and 30-day mortality post-CABG among 252 patients at a Veterans Affairs medical center reported that the most frequent primary complications were myocardial infarction (4.8%) and congestive heart failure (4.8%). In addition, patients with prior history of cardiovascular disease and left ventricular ejection fraction (LVEF) ≤40% were independently associated with the occurrence of primary complications.[11]

METHODS

This study was a retrospective review of the medical records of 150 consecutive patients with acute coronary syndrome (ACS) who were admitted to the Bahrain Defence Force (BDF) Hospital from January to December 2010.

The research investigator and two trained medical students retrieved the medical records of patients who had undergone CABG at BDF Hospital. Cases of ACS were based on the doctors' diagnosis using clinical history and ancillary procedures. All patients with single to multiple-vessel disease who had undergone on-pump CABG after cardioplegy were included in the study. Excluded were those coronary patients who underwent off-pump CABG. Frequency and percentages were the statistical measures used to report the results of this study.

RESULTS

Out of 150 patients who had undergone on-pump CABG, the majority, 128 patients (85%) were in the age range 40-59 years. Thirteen patients (8.7%) were between 60 and 79, and 9 patients (6%) were above 80 years of age.

Age group (years)	*Frequency (%)*
40-59	128 (85.3)
60-79	13 (8.7)
80 and above	9 (6)
Total	**150**

Table 1. Age distribution

Males predominated, 105 (70%).

Gender	*Frequency (%)*
Male	105 (70)
Female	45 (30)
Total	**150**

Table 2. Gender distribution

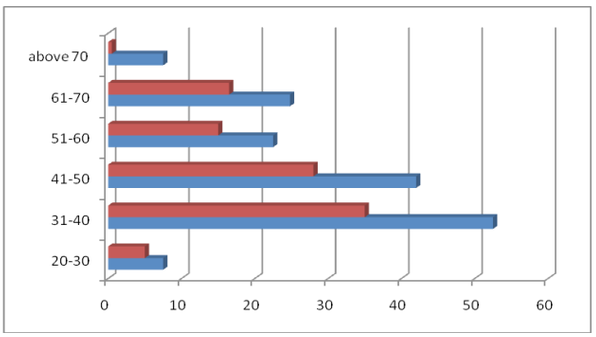

Figure 1. Preoperative ejection fraction distribution

The preoperative ejection fraction at 31-40% was seen in 52 (35%) patients. The ejection fraction at a range of 20-30% was seen preoperatively in 8 (5%) of the patients who eventually went through CABG. Sixty-eight (45%), less than half of the patients who underwent CABG, had EF 51% and above. The rest were below normal.

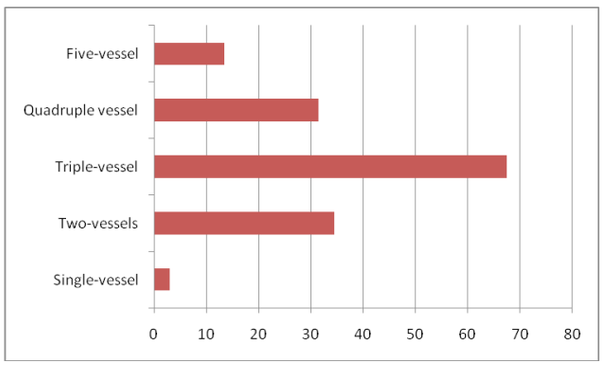

Figure 3. Number of grafts

Triple-vessel graft was carried out on 68 (45%) and double-vessel graft on 35 (23%) patients. Quadruple-vessel graft was done on 32 (21%) and quintuple-vessel grafting on 14 (9%) of the total number of cases.

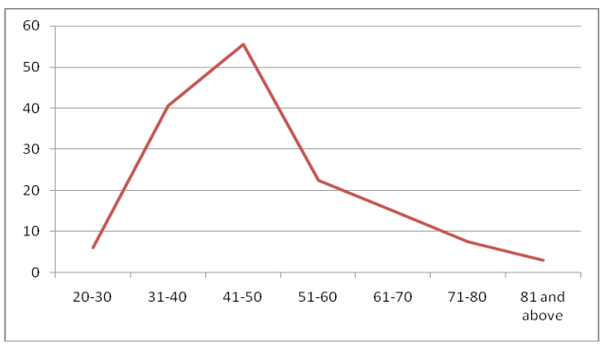

Figure 4. Cross-clamp time

During CABG, cardiopulmonary bypass is employed and the aorta is clamped off. In this study, cross-clamp time for 56 (37%) patients was between 41 and 50 minutes. The longest cross-clamp time at 81 minutes and above was used in just 3 patients.

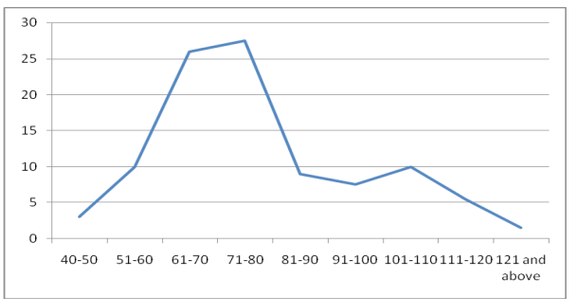

Figure 5. Bypass time

Total bypass time was 71-80 minutes for 41 (27.3%) patients and 61-70 minutes in 38 (25.3%) patients. Three patients had a total bypass time of 121 minutes and longer.

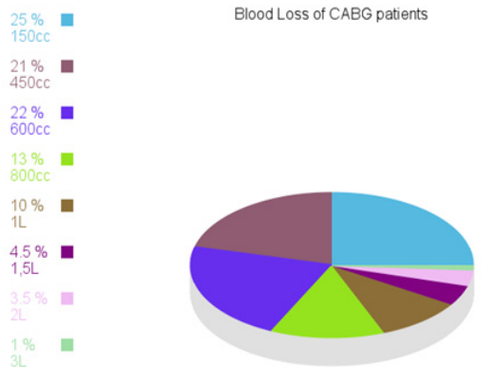

Figure 6. Blood loss

One quarter, 38 patients, had blood loss estimated at 150 cc, which was the least seen in this group of patients. The greatest volume of blood loss at 3 liters was noted in only 2 of the patients. Wound complications were noted in 3 (2%) patients, one of whom required sternal debridement. The 2 other patients had superficial wound infection. Post CABG mortality accounted for 4 patients due to acute renal failure (2) and due to stroke and congestive heart failure, one each. ICU stay was one day for 82 patients (54.7%), and sixty-eight of these stayed in the ICU for an additional two days. Duration of hospitalization was 5 days for 65 (43.3%) of the patients. There were 10 patients (6.67%) who stayed in the hospital for a total of 10 days. The remaining half of patients (75) stayed in the hospital between 6-9 days.

DISCUSSION

Most of the patients who underwent on-pump coronary artery bypass grafting in 2010 at BDFH were between 40 and 59 years of age, and 70% of these were males. These demographic data are similar to those reported in a study done in Saudi Arabia at a government hospital in which the mean age was 60.3 ±1.03 years. Bahraini men with a mean age of 57.3 ±13 years had a history of coronary events as reported in a study conducted in 2005.[2] This age and gender distribution corresponds to that found in developed countries in which the prevalence of cardiovascular diseases

and diabetes continues increasing. Age consistently predicts mortality after CABG.[12] The Practice Guidelines developed by ACC/AHA state that while elderly patients run the risk of the likelihood of morbidity and a particularly high risk of stroke compared with the general population, age in itself should not be considered an exclusion criterion for CABG especially in the absence of prohibitive co-morbidity.[13]

The ejection fraction (EF) expressed in terms of percentage determines how well the heart pumps with each beat. The left ventricular ejection fraction (LVEF) is often referred to as ejection fraction. The normal EF is at 55-70%[14]. About 45% of the patients who proceeded with the CABG had EF below normal levels. These values indicate that many of these patients were confirmed cases of heart failure. A few of the cases were indeed at risk of life-threatening arrhythmias. In the setting of markedly reduced ejection fraction, selecting patients for CABG is often problematic. CABG in itself carries a risk in this category of patients.[15] Characteristics of patients included in this study are not too different when compared with the patients reported in the Gulf RACE 2 study in which the patients who underwent CABG had multi-vessel disease and had severe left ventricular dysfunction. A corresponding study done in Saudi Arabia on 61 patients also showed that most had more than 3 grafts done. The ACC/AHA Guidelines also associated poor LV function with early mortality post-CABG.

Because of the emergence of other means to induce ischemic phenomenon, attention to aortic cross-clamp (XCL) times have been diminishing. But patients with impaired contractility evidenced by low LVEF continue to be at increased risk perioperatively because of the higher susceptibility to myocardial ischemia. In this study, the XCL times ranged from a low 20 minutes to high 80 minutes and above. Although certain studies point to XCL being an independent predictor for mortality among patients with EF >40%, XCL patients with < 40% EF run the same or higher risk for mortality at XCL times of 1-30 minutes than at 91-120 minutes.[16]

Total bypass time (or surgery time) in this study ranged from 40 to more than 120 minutes. Although most studies do not indicate acceptable total bypass time as a predictor of better outcomes post-operatively, a review on coronary artery bypass surgery in elderly people reported that long cardio-pulmonary bypass time is intra-operatively a predictor of a poor outcome after CABG.[17]

According to the statement by the ACC/AHA, on-pump CABG entails lesser blood loss and the need for blood transfusion. Regarding the use of blood or blood products following CABG, it has been illustrated in many studies that the risk of stroke post-operatively is increased. The higher the volume of blood loss intra-operatively, the higher the need for blood transfusion would be. In this study the biggest blood loss was 3 liters seen in 1% of patients. Mikkola, et al. reported that stroke occurred post-operatively in 2.4% of 2,226 patients who underwent CABG. The number of packed red cells transfused was significantly associated with post-operative stroke.[18]

Abnormalities in the central nervous system after CABG are feared complications. The ACC/AHA reports that incidence of these abnormalities can range from 0.4% to nearly 80%. This may be attributed to emboli, hypoxia, bleeding and metabolic disorders.[19] This one-year study carried out among Bahrainis with ACS revealed that there were four deaths; two were due to renal failure, one due to stroke, and one due to congestive heart failure. Infection involving the deep sternum has been noted in certain studies occurring between 1% and 4% after CABG and this carries a mortality rate of about 25%.[20] The low number of sternal infections in this study reflect the very effective sterilization methods as well as the effects of prophylactic antibiotics that are taken preoperatively and postoperatively.

CONCLUSION

The early outcomes for patients with acute coronary syndrome who have undergone CABG at Bahrain Defence Hospital in 2010 are similar in many aspects to those in the Gulf RACE 2 study and other studies done elsewhere. CABG is increasingly being undertaken and more frequently among men in the 40-59 year age group. Most of these patients had multi-vessel disease and were subjected to on-pump CABG. Less than half of the patients had pre-op EF lower than normal levels.

One of the principal limitations of this study is that the data are solely based on the patients' medical records.

Implications for clinical practice

Events that may trigger the onset of acute renal failure in this particular set of ACS patients need to be carefully monitored. Precipitating factors for stroke and congestive heart failure, e.g. fluid overload following blood transfusion, should also be monitored very cautiously during and after the procedure.

Implications for research

Baseline characteristics of patients like existence of co-morbidity, pre-operative ejection fraction, glycemic levels and bleeding parameters may be included in future studies to correlate their possible influence on early outcomes post-CABG. History of prior CABG, use of statins and anti-thrombotic drugs may also be investigated with respect to their influence on outcomes. Correlation studies may be carried out in further studies to evaluate strength of associations.

REFERENCES

1. Fadhil I, Al-Sayyad AS, Jawad JS. Coronary events in Bahrain: descriptive study. Bahrain Med Bull. 2011 Dec;33(4):185-87.
2. Al-Aqeedi R, Sulaiman K, Al Suwaidi J, Alhabib K, El-Menyar A, Panduranga P., et al. Characteristics, management

and outcomes of patients with acute coronary syndrome and prior coronary artery bypass surgery: findings from the second Gulf Registry of Acute Coronary Events. Interact Cardiovasc Thorac Surg. 2011 Dec;13(6):611-8.
3. Skinner JS, Farrer M, Albers CJ, Neil HA, Adams PC. Patient-related outcomes five years after coronary artery bypass graft surgery. QJM. 1999 Feb;92(2):87-96. PMID: 10209660.
4. Bridgewater B, Kinsman R, Walton P, Keogh B. Demonstrating quality: The sixth National Adult Cardiac Surgery Database Report. Reading, Berks; 2009. https://www.escholar.manchester.ac.uk/uk-ac-man-scw:140813 [Abstract]
5. Alexander KP, Anstrom KJ, Muhlbaier LH, Grosswald RD, Smith PK, Jones RH. Outcomes of cardiac surgery in patients ≥ 80 years: results from the National Cardiovascular Network. J Am Coll Cardiol. 2000 Mar 1;35(3):731-8.
6. Faydhi AA, Bahlas S, Ahmed MM, Al-Githmi I. Outcome of CABG in patients aged more than 50 years. Bahrain Med Bull. 2011 June;33(2):93-6.
7. Møller CH, Penninga L, Wetterslev J, Steinbrüchel DA, Gluud C. Clinical outcomes in randomized trials of off- vs. on-pump coronary artery bypass surgery: systematic review with meta-analyses and trial sequential analyses. Eur Heart J. 2008 Nov;29(21):2601-16.
8. Sellke FW, DiMaio JM, Caplan LR, Ferguson TB, Gardner TJ, Hiratzka LF, et al. Comparing on-pump and off-pump coronary artery bypass grafting: numerous studies but few conclusions: a scientific statement from the American Heart Association council on cardiovascular surgery and anesthesia in collaboration with the interdisciplinary working group on quality of care and outcomes research. Circulation. 2005 May 31;111(21):2858-64.
9. Teoh LK, Grant R, Hulf JA, Pugsley WB, Yellon DM. The effect of preconditioning (ischemic and pharmacological) on myocardial necrosis following coronary artery bypass graft surgery. Cardiovasc Res. 2002 Jan;53(1):175-80.
10. Hertfelder HJ, Bös M, Weber D, Winkler K, Hanfland P, Preusse CJ. Perioperative monitoring of primary and secondary hemostasis in coronary artery bypass grafting. Semin Thromb Hemost. 2005;31(4):426-40. PMID: 16149021.
11. Escabí-Mendoza J, Acevedo J, Rucabado E, Pérez CM, Rodríguez-Ospina L. Early postoperative complications after coronary artery bypass grafting at the San Juan Veterans Affairs Medical Center. P R Health Sci J. 2005 Jun;24(2):123-30. PMID: 16116929.
12. Edwards FH, Grover FL, Shroyer AL. Schwartz M, Bero J. The Society of Thoracic Surgeons National Cardiac Surgery Database: current risk assessment. Ann Thorac Surg. 1997 Mar;63(3):903-8.
13. Mickleborough LL, Walker PM, Takagi Y, Ohashi M, Ivanov J, Tamariz M. Risk factors for stroke in patients undergoing coronary artery bypass grafting. J Thorac Cardiovasc Surg. 1996 Nov;112(5):1250-8; discussion 1258-9.
14. HealthHub. Understanding your ejection fraction. Cleveland Clinic. Clinichttp://my.clevelandclinic.org/heart/disorders/heartfailure/ejectionfraction.aspx
15. Tawakol A, Gewirtz H. Does CABG improve left ventricular ejection fraction in patients with ischemic cardiomyopathy, and does it matter? J Nucl Med. 2001 Jan;42(1):87-90.
16. Doenst T, Borger MA, Weisel RD, Yau TM, Maganti M, Rao V. Relation between aortic cross-clamp time and mortality – not as straightforward as expected. Eur J Cardiothorac Surg. 2008 Apr;33(4):660-5.
17. Natarajan A, Samadian S, Clark S. Coronary artery bypass surgery in elderly people. Postgrad Med J. 2007 Mar;83(977):154-8.
18. Mikkola R, Gunn J, Heikkinen J, Wistbacka JO, Teittinen K, Kuttila K, et al. Use of blood products and risk of stroke after coronary artery bypass surgery. Blood Transfus. 2012 Oct;10(4):490-501.
19. Eagle KA, Guyton RA, Davidoff R, Ewy GA, Fonger J, Gardner TJ, et al. ACC/AHA guidelines for coronary artery bypass graft surgery: executive summary and recommendations: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1991 guidelines for coronary artery bypass graft surgery). Circulation. 1999 Sep 28;100(13):1464-80.
20. Loop FD, Lytle BW, Cosgrove DM, Mahfood S, McHenry MC, Goormastic M, et al. J. Maxwell Chamberlain memorial paper. Sternal wound complications after isolated coronary artery bypass grafting: early and late mortality, morbidity, and cost of care. Ann Thorac Surg. 1990 Feb;49(2):179-86; discussion 186-7.