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

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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. 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. 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. 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. 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. 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.

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. 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.

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.

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.

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.

**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.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Frequency (%)</th>
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<tbody>
<tr>
<td>40-59</td>
<td>128 (85.3)</td>
</tr>
<tr>
<td>60-79</td>
<td>13 (8.7)</td>
</tr>
<tr>
<td>80 and above</td>
<td>9 (6)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>

**Table 1. Age distribution**

Males predominated, 105 (70%).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>105 (70)</td>
</tr>
<tr>
<td>Female</td>
<td>45 (30)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
</tr>
</tbody>
</table>

**Table 2. Gender 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. 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. 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.

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%. 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.

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.

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.

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.

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. 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%. 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


