Institutional report - Coronary

Short- and medium-term survival following coronary artery bypass surgery in British Indo-Asian and white Caucasian individuals: impact of diabetes mellitus

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Abstract

Previous studies have suggested that South Asian (SA) ethnicity is a predictor of poorer outcome after coronary artery bypass grafting (CABG). Our aim was to identify potential reasons for the higher postoperative mortality in SA patients and investigate all these reasons. All individuals undergoing isolated CABG in a tertiary cardiac centre from April 2002 to September 2007. In total, there were 2897 subjects (2623 white subjects; 274 SA subjects) who were included in an observational study showing the effect of ethnicity on the medium-term survival following CABG. Survival at 30 days and survival up to five years (median 2.7 years) were measured. SA subjects undergoing CABG were younger (62 ± 9 vs. 66 ± 9 years, P < 0.001), less obese [body mass index (BMI) 26 ± 4 vs. 28 ± 4 kg/m², P < 0.001] and had a higher prevalence of diabetes mellitus (58% vs. 33%, P < 0.001) compared with white subjects. Thirty-day mortality was higher in SA subjects (2.6% vs. 1.0%, P = 0.02). Non-diabetic SA had similar 30-day mortality, five-year survival and life expectancy compared to non-diabetic white subjects. In contrast, diabetic SA had a higher 30-day mortality (3.8% vs. 1.4%, P = 0.01) and worse life expectancy compared to diabetic white subjects. The higher early postoperative mortality observed in SA patients is related to higher incidence of diabetes among them. SA diabetics have a significantly higher postoperative mortality and worse overall life expectancy. Ethnicity per se is not an independent predictor of short- or medium-term survival after CABG.

Keywords: Ethnicity; Coronary artery bypass grafting; Postoperative mortality; Five-year survival

1. Introduction

Previous studies have suggested that South Asian (SA) ethnicity is a predictor of a poorer outcome after coronary artery bypass grafting (CABG) [1–3]. The reasons for this are unclear. Although, a smaller size of the coronary arteries in SA making surgery more challenging has been proposed as a possible reason, Zindrou et al. [4] provided some evidence that this might not be the case. Yeo et al. [5] have clearly demonstrated that there are differences in the demographic and clinical characteristics of SA and white subjects undergoing CABG. Brister et al. [1] using propensity score analysis found that SA ethnicity per se is an independent predictor for two-fold higher in-hospital mortality.

With a growing SA community in the UK, it is important to study further the potential reasons for the higher postoperative mortality in these patients. It is also important to study the effect of ethnicity on the medium- and long-term survival following CABG. The aims of this study were to: identify potential reasons for the higher postoperative mortality in SA patients, and assess the effect of SA ethnicity on the medium-term survival following CABG.

2. Materials and methods

The tertiary cardiac centre at Glenfield Hospital, Leicester serves a population of approximately 2 million, with a substantial SA community residing in the city. For the purpose of this analysis, data were extracted from the Patient Analysis and Tracking System (PATS) and Hospital Episode Statistics (HES) hospital databases for the period 1 April 2002 to 30 September 2007 for all patients undergoing isolated coronary artery bypass surgery. The routine clinical notes have been conformed to the PATS system, which is used as the national standard for data collection and analysis in cardiac surgery. Medical officers are responsible for the accurate completion of the clinical notes on admission. A group of dedicated audit officers are responsible for the input of the data in the PATS system on a daily basis. Data on hospital stay and intensive care unit (ICU) stay and re-admission rates were extracted from the HES database, which is used as the national standard for NHS.
administration purposes. Out-of-hospital mortality data have been meticulously collected since 2002, via local registries, the national strategic tracing system and other administrative information technology systems. Patients were risk-stratified prior to CABG using logistic EuroSCORE [6]. The logistic EuroSCORE provides an estimate of 30-day and the in-hospital mortality in patients undergoing cardiac surgery, taking into account the patient’s age, left ventricular function, criticality of disease and co-morbidities (i.e. pulmonary and renal dysfunction, peripheral vascular disease, etc.) [6]. The logistic EuroSCORE is widely used in cardiac surgery and reliable risk-stratification data using the score have been routinely available in our centre since 2002. Ethnicity was based on self-report and extracted from data routinely collected at time of admission for surgery. We focused the analysis on subjects with reported SA ethnicity and as a comparator group subjects reporting a white Caucasian ethnicity (CC). The small number of subjects who reported other ethnicities were excluded.

2.1. Statistical analysis

Statistical analysis was performed with SPSS version 8.0. Data between groups were analysed with one-way ANOVA or \( \chi^2 \)-analysis where appropriate. Logistic multiple-regression analysis was conducted in two steps. Initially, a model with a number of independent variables, selected on clinical grounds, was tested. Then a forward, conditional stepwise model was used in order to exclude irrelevant variables and improve the model. The probability for stepwise entry in the model was chosen as 0.05 and the probability for removal 0.10. Results are expressed as mean ± standard deviation (S.D.) or error, where appropriate. Follow-up data were analysed with Kaplan–Meier and log-rank test. Cox multiple regression analysis was used to identify risk factors for long-term mortality. Statistical significance was assumed if \( P \leq 0.05 \).

3. Results

Altogether 2623 CC patients and 274 SA patients underwent isolated CABG during the period of the study. In the CC group, 865 (33.0%) patients were diabetic while in the SA group 160 (58.4%) patients were diabetic (\( P < 0.001 \) between the groups). A greater proportion of SA diabetics were insulin treated compared to their CC counterparts (47% vs. 34\%, \( P = 0.03 \)). The demographic, clinical and surgical features of the CC and SA patients partitioned by diabetes status are shown in Table 1. Both diabetic and non-diabetic SA were younger than their CC counterparts. There was no difference in the proportion of women (20%–24\%) between the groups. Body mass index (BMI) was higher in CC compared with SA patients. CC diabetics were also significantly more obese than Caucasian non-diabetics (CC-ND). Other preoperative co-morbid conditions and features were similarly distributed between the four groups. Logistic EuroSCORE was not significantly different between the groups. There were a greater proportion of urgent operations in both diabetic groups compared with the non-diabetic groups and a longer stay in ITU and total stay in hospital following surgery. Diabetic patients had a significantly lower use of either internal mammary artery (IMA) grafts and a higher proportion of both CC and SA diabetic patients had only vein grafts compared with non-diabetics.

Overall 30-day mortality was higher in SA patients compared with CC patients (2.6\% vs. 1.0\%, \( P = 0.02 \)). The difference was more marked between SA and CC diabetic (3.8\% vs. 1.4\%, \( P = 0.01 \). But identical between SA and CC-ND patients (0.9\% vs. 0.9\%). Table 2 shows a logistic multiple-regression analysis on the predictors of the 30-day mortality following CABG. This showed that the 30-day mortality was significantly predicted by the logistic EuroSCORE and the presence of diabetes. Ethnicity, age and BMI were not independent predictors for the 30-day mortality.

A comparison of the medium-term survival to five years (median 2.7 years) is shown in Fig. 1. Although ethnicity did not significantly affect survival (Fig. 1a, \( P = 0.44 \)), diabetes mellitus had a highly significant effect (Fig. 1b, \( P = < 0.001 \)). A comparison of the survival between non-diabetic CC and SA showed no difference (\( P = 0.77 \)). Also, the five-year survival between diabetic CC and SA showed no difference (\( P = 0.99 \)) (Fig. 1c). Table 3 shows a Cox multiple regression analysis on factors affecting medium-term survival. Age, at surgery, logistic EuroSCORE and diabetes were all significant (\( P = < 0.001 \)) predictors of medium-term survival. Ethnicity per se was not an independent predictor (\( P = 0.55 \)). Because the SA subjects were significantly younger than the CC subjects at the time of surgery, we also analysed life expectancy following surgery. Fig. 2 shows the life expectancy of the four groups. The life expectancy did not differ between non-diabetic CC and SA patients. However, the life expectancy of the diabetic SA patients was significantly worse (\( P = 0.03 \)) than that of the diabetic CC patients.

4. Discussion

Our study confirms that in contemporary practice SA patients undergoing CABG have a higher postoperative mortality compared with white patients. Our analysis suggests that this is most likely due to the higher proportion of diabetics in this group. SA diabetics had a significantly higher postoperative mortality compared to any other subgroup, including non-diabetics, SA non-diabetic (SA-ND) and diabetic CC. Allowing for diabetes, SA ethnicity by itself did not affect 30-day mortality.

Although the higher incidence of diabetes mellitus in SA patients is well known [5], the reason for the higher postoperative mortality in SA diabetics is not clear. The cross-clamp time, the cardiopulmonary bypass (CPB) time and the number of distal anastomoses did not differ in comparison with other patients. A noticeable difference was the higher proportion of SA diabetic patients who had only vein conduits compared to the rest (17\% vs. 12\%, \( P = 0.05 \)). This may be an indication that the quality of the native coronaries, and/or the quality of the conduits, may differ between the CC and SA diabetic patients. Zindrou et al. [4] failed to demonstrate a difference in the coronary diameter between CC and SA patients undergoing CABG; however, they excluded diabetic patients. Other studies have shown that SA patients do have smaller calibre coronaries [7, 8].

An alternative explanation may be the susceptibility of the SA diabetic patients to more severe postoperative
infections. The relationship between hospital-acquired infections and diabetes is well recognized, particularly among postoperative cardiac and critically ill surgical patients [9]. Diabetes mellitus is associated with impaired immune responses and insulinopenia may be associated with susceptibility for infections [10, 11]. Brister et al. [1] observed a significantly higher incidence of sternal wound infections in SA patients. It is interesting that in their study the incidence of infections was still high among SA patients even after correction for confounding factors, including diabetes. This led the authors to conclude that ethnicity per se is an independent risk factor for infections. A limitation of their analysis was the assumption that the diabetic characteristics were identical between CC and SA patients.

Our study suggests that certain characteristics differ between CC and SA diabetics undergoing CABG. The relevance of these differences, if any, to the higher postoperative mortality in SA diabetics following CABG remains to be determined. CC diabetics were older and significantly more obese but the requirement for insulin treatment among them was lower. Interestingly, CC diabetics had the highest ICU re-admission rate. This is because they were significantly overweight and suffered significantly higher rates of postoperative chest infections. The postoperative stay for these patients was also longer for the same reason [12, 13]. Overall, diabetics stayed longer in the ICU due to either respiratory problems or perioperative renal injury or both.

Medium-term survival following CABG did not differ between CC and SA patients. Multiple regression analysis showed that the risk factors for medium-term mortality were old age, logistic EuroSCORE, urgency and diabetes. Ethnicity was not an independent risk factor for medium-term survival following CABG.
Fig. 1. Five-year survival following first-time isolated coronary artery bypass grafting. Ethnicity did not affect the five-year survival (a). Diabetes mellitus was associated with a poorer five-year survival (b). The five-year survival did not differ between non-diabetic Caucasian (Group 1) and non-diabetic South Asians (Group 3). Also, the five-year survival did not differ between diabetic Caucasian (Group 2) and diabetic South Asians (Group 4).

Fig. 2. Life expectancy following first-time isolated coronary artery bypass grafting. The life expectancy did not differ between non-diabetic Caucasian (Group 1) and non-diabetic South Asians (Group 3). However, the life expectancy differed between diabetic Caucasian (Group 2) and diabetic South Asians (Group 4).

was reasonably large to investigate the effect of ethnicity of outcomes after CABG. There was extensive collation of preoperative and surgical data on each patient to assess the effect of other relevant factors on outcomes. However, in any observation study of this type the effect of other unmeasured factors cannot be excluded. One of the weaknesses of the study is that it does not identify the reason why SA patients with diabetes have a worse short-term outcome after CABG. A final limitation is that the follow-up is only to medium-term and whether there are longer term differences in outcome after CABG between CC and SA patients remains to be investigated. In this retrospective, observational, study the completeness of revascularization was not evaluated for logistic reasons.

The conclusion is that the higher early postoperative mortality observed in SA patients undergoing CABG is related to a higher incidence of diabetes among them. Diabetes is also an important determinant of medium-term outcome.
after CABG but ethnicity per se is not an independent predictor of medium-term survival after CABG.

References


