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Preoperative risk factors in 10 418 patients with prior myocardial infarction and 5241 patients with prior unstable angina undergoing elective coronary artery bypass graft surgery

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Editor's key points

- It is currently recommended that coronary artery surgery should be avoided, if possible, for 10 days after an acute coronary event.
- Timing of coronary artery surgery must balance the risks of instability *vs* the consequences of a delay in definitive treatment.
- This retrospective analysis of a large UK dataset found no evidence of a relationship between postoperative cardiovascular events and timing of surgery.
- A previous myocardial infarction (MI) >3 months old should not be discounted as a risk factor for coronary artery surgery.

Background. The EuroSCORE associates coronary artery bypass graft (CABG) surgery with higher perioperative risk in the first 3 months after a myocardial infarction (MI). The optimal scheduling of CABG surgery after unstable angina (UA) is unknown. We investigated the preoperative predictors of adverse outcomes in patients undergoing CABG with prior MI or UA and investigated the importance of time interval between the cardiac event and CABG.

Methods. The Hospital Episode Statistics database (April 2006–March 2010) was analysed for elective admissions for CABG. Independent preoperative patient factors influencing length of stay, readmission rates, and mortality, were identified by logistic regression and presented as adjusted odds ratios (ORs).

Results. A total of 10 418 patients with prior MI (mortality 1.8%) and 5241 patients with prior UA (mortality 2.2%) were included in the respective cohorts. Multiple risk factors were identified in each population including liver disease and renal failure. The time interval from cardiac event (MI or UA) to elective CABG surgery did not influence perioperative outcomes when analysed as a continuous measure or using the arbitrary
3-month threshold [MI, OR 1.1 (0.78–1.57) and UA, OR 0.65 (0.39–1.09)].

Conclusions. Our hypothesis generating data suggest that the increased risk currently allocated in the EuroSCORE for an interval of 3 months between MI and CABG should be critically re-evaluated. Furthermore, prior MI should not be discounted as a risk factor if it is more than 3 months old.

Keywords: cardiac anaesthesia; cardiovascular anaesthesia; heart, ischaemia

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The main indications for coronary artery bypass graft (CABG) surgery are left main and/or multi-vessel coronary artery disease in patients with intermediate to high SYNTAX scores.[1 2] The presence of cardiac disease, diabetes mellitus, low left ventricular ejection fraction and as a rescue therapy following failed percutaneous intervention are other important indications.[3] Timing of surgery is a decision based on the patient's desire for treatment and the risk/benefit ratio of the treatment at that time. Early surgery may decrease the likelihood of another cardiac event but also, may be associated with higher surgical mortality and complication rates. While a delay in surgery may offer a safer perioperative period, it is perhaps at the expense of an increased likelihood of recurrent cardiac ischaemia before the operation. Well-developed scoring systems such as the EuroSCORE[4] and the Society of Thoracic Surgeons risk score[5] aid judgement of perioperative risk for CABG surgery. Both scores include the time interval after MI as a variable. Indeed current

recommendations suggest that surgery should be avoided, if possible, for 10 days post-cardiac event.[6 7] However, a 3-month threshold is included in the EuroSCORE indicating that CABG surgery conducted within 3 months of an MI is higher risk than an older MI. In apparent contrast, it is known that cardiac events exert a prolonged period of risk regardless of whether subjects have surgery[8] or not.[9] This study sought to identify whether the risk of adverse perioperative outcomes after elective CABG surgery varied with the time interval between previous MI and surgery, with particular emphasis on the 3-month threshold used in the EuroSCORE scoring system. We chose to focus on elective surgery as there is greater prospect of altering the timing of the operation if an evidence base for this is established.

Neither the EuroSCORE[4] nor the Society of Thoracic Surgeons risk score[5] include the time interval from the incident episode of UA and CABG surgery as part of the scoring system. Here, we tested whether we could identify a timing threshold for increased perioperative risk from elective CABG after UA. As the procedures were scheduled as elective surgery we consider that the patients have been treated in accordance with guidance for a conservative management strategy in the initial phase; hence, it is important to consider this analysis as entirely exploratory and non-definitive. This is also important as different rationale can be presented for whether a short-time interval may be beneficial (for example by reducing the time for further iscahemic events and also providing ischaemic preconditioning).[10 11] or harmful (for example, due to increased perioperative inflammation).[12] Hence, we sought to provide an exploratory, secondary analysis on the scheduling of CABG surgery after UA.

Methods

Local research ethics committee and Section 251 (formerly Section 60) National Information Governance Board for Health and Social Care approval were obtained. All non-duplicate elective admissions were extracted from the Hospital Episode Statistics database for CABG in England for the financial years April 1, 2006 to March 31, 2010. Patient identification and valid age, sex, and length of stay (LOS) were included. Hospital Episode Statistics is an administrative database covering all admissions to National Health Services (NHS; public) hospitals in England (including private patients treated in these hospitals). The International Classification of Diseases system version 10 (ICD-10) is used for diagnostic coding. Thirteen secondary diagnoses record co-morbidities and complications and 12 procedure fields use the classification of interventions and procedures of the Office of Population Censuses and Surveys (OPCS), that is unique to the UK.[13] Within Hospital Episode Statistics the primary diagnostic coding is 96% accurate from 2002 onwards[14] while operative coding is 97% accurate.[14 15] Secondary diagnostic coding however is less accurate with only 80% being comparable with clinical notes.[14] Models derived from data from Hospital Episode Statistics compare favourably with the national cardiac surgical database for predicting postoperative mortality in England (*c* statistic of 0.77 and 0.78 respectively).[16] Hence we considered Hospital Episode Statistics data sufficient for an exploratory analysis of this question. For the purpose of this study admissions ending in transfer to another hospital were linked together. The principal procedure of interest in this study was CABG (OPCS codes K25–K38, K40–K46, K49, K50, K75, K442, K456, K465).

Preoperative 'vascular events', including MI, UA, and stroke were defined as conditions that necessitated hospital admission. This provided a primary diagnosis code with known timing as we have used previously for non-cardiac surgery.[8] We looked retrospectively in the dataset for admissions within the 10 yr before the CABG date with the primary diagnosis of stroke (I61–I64 or I66), MI (I21, I22), and unstable angina (UA, I200). We looked throughout the preoperative admissions in case the stroke, MI, or UA occurred after transfer. The time (in days) from the MI or UA, to the index operation was noted. If a patient had more than one 'vascular event' then the date of the most recent was used. Two cohorts were established: patients with preoperative admission for MI and those with preoperative admission for UA. Unfortunately, data on type of MI (ST elevation—or non-ST elevation MI) are not available from ICD-10.

Other co-morbidities such as diabetes mellitus, liver disease, or renal failure were identified from the secondary diagnosis codes on admission for CABG as we have done for non-cardiac surgery (Supplementary Table S1).[8] Age was analysed as a continuous variable ('risk per additional single year'). In Table 1, an age threshold of 70 yr is displayed for illustrative purposes. The reference sex was male. We derived a set of co-morbidity variables representing risk factors for postoperative death based on our previous work (Supplementary Table S1),[8] ensuring that each co-morbidity was appropriately weighted. We also adjusted for area-level socioeconomic status using the population weighted Carstairs deprivation quintiles.[17] All co-morbidities such as, age, sex, and socioeconomic status were included in our final regression model. The data are presented as adjusted odds ratios (ORs) for each variable. Our primary endpoint was the adjusted OR of perioperative mortality (defined as inpatient death within 30 days of surgery); secondary endpoints were two surrogates of perioperative morbidity: prolonged LOS (above the upper quartile) and readmission within 28 days.

Statistical analysis

Analyses were conducted according to our published methodology.[8] Logistic regression models were fitted for mortality, prolonged LOS, and readmission with the following patient factors: age, sex, area-level deprivation score using Carstairs deprivation population-weighted quintiles,[17 18] co-morbidities (Supplementary Table S1) and time from MI or UA. Time was analysed as a continuous variable (odds per month) and with a threshold at 3 months (MI or UA less that 3 months *vs* >3 months before CABG). Other co-morbidities were included as indicator variables if they were recorded in at least 30