The age of the adult cardiac surgery population has been increasing in recent years. In 2002 the average life expectancy for men and women in the UK was 76 years and 81 years respectively. The leading cause of death in those aged 65 years and older remains circulatory disease [1] A recent publication of UK cardiac surgery activity has shown an 8% increase in the proportion of patients aged 75 years and over undergoing cardiac surgery.[2]

There are a number of reasons for an increased risk associated with cardiac surgery in the elderly. These include;

- Greater incidence of significant co-existing cardiac disease
- Greater incidence of non cardiac co-morbidities
- Less robust general physical and mental health
- Convalescence and medium term care problems

Assessing the degree of risk has always been problematic. A number of risk scores have been devised. However, one of the most popular worldwide, and one used almost exclusively in the UK, is the Euroscore. A comparison of Euroscore with others (Parsonet, Cleveland Clinic, French, Pons, Ontario Province) showed Euroscore to be the most accurate, and the logistic Euroscore takes into account interaction between variables.[3]

The elderly population are therefore at greater risk, not only because increased age features as an independent variable in every score, but because of the increased comorbidities in this age group.

In order to assess outcomes in this group we conducted a review of our outcomes that was specifically designed to do the following;

- compare the preoperative and perioperative characteristics and post operative survival of patients
  - age 75 years and older with a younger cohort age 60-74 years
- identify factors associated with early (30 day) and late (1 year) mortality
- Identify the effect of age 75 years and older on these factors.

The study included consecutive patients, aged 60 years and older undergoing isolated primary CABG surgery with use of cardiopulmonary bypass () between August 1999 to December 2005.

The data is part of the dataset maintained by the Society for Cardiothoracic Surgeons of Great Britain and Ireland (SCTS), and were collected prospectively according to definitions provided in the SCTS database.

In a study of this nature, complex statistical processing is required. This included the following:
- Significant differences between the groups was tested using Pearson’s Chi-squared statistic (p>0.05).
- Variables were treated as categorical and are presented as numbers and percentages. Changes in mortality rates over time were examined using the Cochrane-Armitage test for trend.
- Kaplan-Meier curves are used to depict survival.
- Cox regression was used to assess the association between variables and early and late mortality separately. Data is presented as risk ratios (RR) and 95% confidence intervals (CI).
- A multivariate Cox regression model was constructed to identify independent risk factors for early and late mortality. All variables significant at p<0.05 were included in the separate models and discounted using backward stepwise analysis. Tests for interaction between age and the other independent variables in the models were performed to identify whether age had a modifying effect.

**Results:**

There were 3683 patients in this analysis of which 18% (659) were aged 75 years or older. The overall one year mortality in the elderly group (≥75 age) was 9% compared to 4% in the 60-74 age group. The rate of population decline (mortality) stabilised in both groups after the early postoperative period.
Although the Kaplan-Meier curve shows the significant (early and late) survival difference between the two groups, over 90% of elderly patients were alive one year after their cardiac surgery.

From 2000-2005, the proportion of patients aged 75 years and older undergoing primary CABG nearly doubled (13%-23%). There was a slight decrease in the proportion of patients aged 60-74 years undergoing primary CABG surgery. The crude total 1 year mortality rates for those aged 75 years and over significantly decreased from 15% in 2000 to 7% in 2005 (test for trend p=0.01). In patients aged 60-74 years mortality rates fluctuated between 2-4% over this period, (test for trend p=0.66).

In comparing the preoperative data set, a number of important features were found:

- There were significantly more women in the ≥75 age groups
- The ≥75 year age group had a significantly greater proportion of patients with more severe cardiac symptoms such as heart failure (NYHA 3-4), angina (CCS 3-4), impaired ejection fraction (30-50%) and arrhythmia compared to the younger group.
- The prevalence of arteriopathy, carotid bruits and renal impairment was higher in the older age group.
- Multiple co-morbidities (>5) were significantly higher 17% in the of ≥75 age group compared to 12% in the younger group (p<0.001)
- The age adjusted Euroscore confirms the higher prevalence of risk factors in the older age group with 28% having a medium to high risk score (>4) compared to 14% of the younger group, despite removing the contribution of age from the overall risk score.
- The ≥ 75 age group had a significantly greater number of patients who required emergency treatment (e.g. ventilation, intravenous nitrates, inotropes, heparin or intraaortic balloon pump) prior to surgery
- Only 62% of surgery in the ≥ 75 age group was elective compared to 77% in the younger cohort (p<0.001).

Overall, we found that the proportion of patients aged ≥75 years increased by 10% over five years. One year mortality in the elderly showed a significant linear decrease from 15%-7% (p=0.01) while mortality in the younger cohort remained static at 2-4%. Early mortality in the elderly group was 5% compared to 1.8% in the younger group (p<0.001), while late mortality was 4.1% versus 1.8% respectively (p<0.001).

Factors independently associated with early mortality were age ≥75 years RR 2.0 (95% CI 1.28, 3.11), female gender, angina (CSS III-IV), cardiopulmonary bypass duration >97 minutes.

In the late mortality model age was not significant, but ventricular ejection fraction<30%, non-elective surgery and arteriopathy were significant factors. Arrhythmia and renal impairment were common to both early and late mortality.

**Discussion:**
Previous studies have shown a variety of results. Retrospective analysis of 42 consecutive nonagenarian patients who underwent open-heart procedures over a 10-year period (1993 to 2002) showed a 7% in-hospital mortality [4]

A much larger study of 990 elderly patients (> or = 70 years) who underwent coronary revascularisation, 219 (22.1%) with off-pump surgery, showed that early but not mid-term mortality is higher in patients aged 75 or more years when compared with those aged 70-74 years. Off-pump coronary artery bypass surgery is safe and effective in the elderly population. [5]

A study of 1746 patients undergoing CABG surgery, including 155 pts >80 yrs old compared to 1591 patients < 80 years, showed that patients >80 yrs undergoing CABG required increased resources, had higher morbidity (postoperative renal failure, neurologic complications) and 30- day mortality. Age > 80 years was an independent predictor of increased resource utilization, postoperative morbidity, and mortality. [6]

Finally, a recent analysis of 54,397 patients undergoing isolated CABG surgery found that patients > 85 yrs more likely to have intraoperative and postoperative morbid events. The authors concluded that although very elderly CABG patients have more
comorbidities and more acute presentation than younger patients and their in-hospital mortality rate is high, their long-term survival is surprisingly good. [7]

**Conclusion:**
Cardiac surgery, in particular primary CABG surgery, has shown some of the greatest improvements in outcome in recent years. Although good outcomes are achievable, in-hospital morbidity and mortality, and increased costs, appear unavoidable.

**References:**
1. The Office for National Statistics. www.statistics.gov.uk
2. Fifth National Adult Cardiac Surgical Database. Society of Cardiothoracic Surgeons, UK, 2003
3. Geissler HJ et al
   Risk stratification in heart surgery: comparison of six score systems