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(Accepted 12 October 2001)

## Time trends in survival and readmission following coronary artery bypass grafting in Scotland, 1981-96: retrospective observational study

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Improvements in coronary revascularisation techniques and an increase in the use of percutaneous interventions<sup>1</sup> have led to a rise in the number of coronary artery bypass grafting operations in older patients with more severe cardiac disease and worse comorbidity and who have previously undergone revascularisation procedures.<sup>2,3</sup> Advances in surgical and anaesthetic techniques have prevented a worsening risk profile from being translated into an increase in perioperative deaths.<sup>2,3</sup> The aim of our study was to examine time trends in major outcomes up to two years after coronary artery bypass grafting.

### Participants, methods, and results

We used the Scottish morbidity record (SMR1) system to identify all operations for coronary artery bypass grafting performed in Scottish NHS hospitals from

1981 to 1996. We excluded operations that included other procedures. Information was obtained on age, sex, urgency of the operation, and Carstairs socioeconomic deprivation category derived from postcode of residence.<sup>4</sup> Record linkage to subsequent SMR1 and registrar general records provided follow up information on readmission, repeat procedures, and death, both inside and outside of hospital, up to two years after the operation.

The study cohort comprised 25 229 coronary artery bypass operations; 19 687 (78%) were performed in men and 5542 (22%) in women. The number of operations overall increased from 68 to 490 per million population per year (see table A on the *BMJ's* website for details). The percentage of operations performed on patients aged over 65 increased from 2% to 30% in men (7/289 *v* 582/1950,  $P < 0.0001$ ) and from 16% to 45% in women (10/61 *v*

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*BMJ* 2002;324:201-2



See the *BMJ's* website for more data on coronary artery grafts 1981-96

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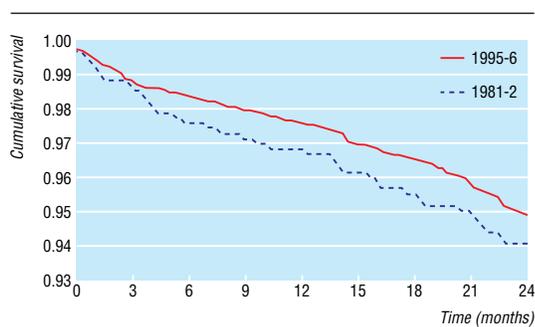
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Age adjusted cumulative survival in men up to two years after coronary artery bypass grafting in 1981-2 and 1995-6

266/586,  $P < 0.0001$ ). No significant time trends in deprivation category or urgency were found. After adjustment for age in a Cox proportional hazards model, the risk of all cause mortality up to two years after the operation significantly declined in men over the study period (figure; see equivalent graph for women on website). Readmission for a principal cause of ischaemic heart disease also declined in men over the period ( $P < 0.0001$ ), whereas repeat coronary angiography increased ( $P < 0.0001$ ; see table B on website). There was no obvious trend in repeat coronary revascularisation procedures. Similar time trends were seen in women, but only the time trend in repeat coronary angiography reached significance ( $P < 0.0001$ ).

## Comment

During 1981-96 the risk of death within two years of coronary artery bypass grafting and the need for readmission decreased significantly in men after data had been adjusted for age. The age of patients undergoing coronary artery bypass grafting has significantly increased; this agrees with previous studies.<sup>2 3 5</sup> These improvements are likely to reflect developments in surgical technique, such as increased use of internal mam-

mary artery grafts and of secondary prevention.<sup>2 3 5</sup> The failure of the results to reach statistical significance in women may simply reflect the fact that fewer procedures are carried out in women. The number of repeat coronary angiography procedures increased significantly in both sexes. However, the number of readmissions for ischaemic heart disease declined and there were no obvious increases in repeat coronary revascularisation; thus the increase in repeat angiography is more likely to reflect a reduced threshold for investigation than deteriorating outcomes.

Because the study was based on routine data, we were unable to adjust for possible changes in comorbidity or severity of cardiac disease. However, studies from Europe, the Far East, and the United States have consistently shown worsening risk profiles in relation to both of these.<sup>2 3 5</sup> Therefore, failure to adjust for these is likely to have led to an underestimate of the improvements made.

Contributors: SC had the idea of studying survival trends. JPP developed the idea, reformatted and analysed the data, produced the first draft and made the necessary revisions. DW extracted the linked SMR1/GRO data; JPP, ARF, and JHB helped with the extraction specification. KM helped with the analysis and produced the figures. All authors contributed to interpretation of the results, commented on the first draft, and approved the final version. JPP is the guarantor.

Funding: British Heart Foundation.

Competing interests: None declared.

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(Accepted 25 June 2001)

## Endpiece

### Letter to Georgiana Morpeth, 16 February 1820

Dear Georgiana,

Nobody has suffered more from low spirits than I have—so I feel for you. Here are my prescriptions.

1st Live as well as you dare.

2nd Go into the shower-bath with a small quantity of water at a temperature low enough to give you a slight sensation of cold.

3rd Amusing books.

4th Short views of human life—not further than dinner or tea.

5th Be as busy as you can.

6th See as much as you can of those friends who respect and like you.

7th And of those acquaintances who amuse you.

8th Make no secret of low spirits to your friends, but talk of them freely—they are always worse for dignified concealment.

9th Attend to the effects tea and coffee produce upon you.

10th Compare your lot with that of other people.

11th Don't expect too much from human life—a sorry business at the best.

12th Avoid poetry, dramatic representations (except comedy), music, serious novels, melancholy sentimental people, and every thing likely to excite feeling or emotion not ending in active benevolence.

13th Do good, and endeavour to please everybody of every degree.

14th Be as much as you can in the open air without fatigue.

15th Make the room where you commonly sit, gay and pleasant.

16th Struggle by little and little against idleness.

17th Don't be too severe upon yourself, or underrate yourself, but do yourself justice.

18th Keep good blazing fires.

19th Be firm and constant in the exercise of rational religion.

20th Believe me, dear Georgiana, your devoted servant, Sydney Smith

From Auden WH, ed. *Selected writings of Sydney Smith*. London: Faber and Faber, 1967