Three-year outcome after coronary stenting versus bypass surgery for the treatment of multivessel disease


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Patients with multi-vessel coronary disease (MVD) were treated with either stent implantation or coronary artery bypass grafting (CABG).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients with MVD who were considered suitable candidates for either stent implantation or CABG. For example, patients could have stable or unstable angina, but they needed to have at least two new lesions located in different vessels and territories (not including the left main coronary artery) which were potentially amenable to stent implantation. Patients were excluded if the left ventricular fraction was less than 30%, or if they had left main stenosis, or a history of cerebrovascular accident (CVA) or transmural myocardial infarction (MI) in the previous week. Also excluded were patients who had severe hepatic or renal disease, or who needed concomitant major surgery. All patients gave written informed consent. Full details of the study population were given in another study (Serruys et al. 2001, see 'Other Publications of Related Interest' below for bibliographic details).

Setting
The setting was secondary care. The economic study was carried out in Rotterdam, the Netherlands.

Dates to which data relate
The effectiveness and resource use evidence referred to 1997 to 2001. The price year was not given.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The same patients provided both the effectiveness and the cost data. It would appear that the costing was carried out prospectively.

Study sample
Full details of the study sample and power calculations were reported elsewhere (Serruys et al. 2001).
Six hundred patients in each group were required to reject the null hypothesis that at 1 year the difference in event-free survival in favour of bypass surgery would not exceed 7 percentage points. The actual sample size achieved a power of 92% with the assumption of a two-sided type I error of 0.05. Patients were recruited into the study when a surgeon and a cardiologist agreed that the same degree of vascularisation could be achieved by either CABG or by stenting. The initial sample size was 1,205 patients, of which 600 patients (77% male) were randomly assigned to stent implantation and 605 (76% male) to CABG. The mean age of the patients was 61 (+/- 10) years in the stent group and 61 (+/- 9) years in the CABG group.

**Study design**

This was a multi-centred randomised controlled trial (RCT) in which patients were randomly assigned to one of the two treatments and were followed up for 3 years. Five of these patients chose to withdraw from the allocated treatment and continue with pharmacological treatment, three died waiting for surgery, and some patients assigned to a particular treatment received the alternative treatment. One patient was lost to follow-up.

**Analysis of effectiveness**

It was unclear whether the analysis of the clinical study was conducted on an intention to treat basis or for treatment completers only, although the authors reported that all analyses were based on intention to treat. The primary health outcome was the absence of major adverse cardiac and cerebral events (MACCEs). A MACCE was defined as death, CVA, Q-wave MI, non-Q-wave MI, CABG, or repeat revascularisation. The EQ-5D questionnaire was used to assess the patients’ general health status.

A 2-step approach, including univariate and multivariate logistic regression analysis, was followed to identify predictors of the primary end point at 1 and 3 years.

The patients in the two groups were shown to be similar at baseline.

**Effectiveness results**

At 1 year, the number of deaths was 15 (2.5%) in the stent group and 17 (2.8%) in the CABG group (relative risk, RR=0.89, 95% confidence interval, CI: 0.45 - 1.77). After 3 years it was 22 (3.7%) in the stent group and 28 (4.6%) in the CABG group (RR 0.79, 95% CI: 0.46 - 1.37).

The repeat revascularisation rates were 21.2% and 26.7% at 1 and 3 years, respectively, in patients allocated to a percutaneous coronary intervention (PCI), compared with 3.8% and 6.6% in patients allocated to CABG, (p<0.0001).

The number of patients experiencing any event at 1 year was 159 (26.5%) in the stent group and 73 (12.1%) in the CABG group (RR 2.20, 95% CI: 1.71 - 2.83). At 3 years it was 205 (34.2%) in the stent group and 103 (17.0%) in the CABG group (RR 2.01, 95% CI: 1.63 - 2.47).

The incidence of angina at 3 years was 12.8% in the CABG group and 18.4% in the stent group, (p=0.011).

At 3 years there was no significant difference in quality of life between the two groups, as assessed by the EQ-5D questionnaire.

Kaplan-Meier curves were drawn to compare the results for the 208 diabetic patients with those of the 997 non-diabetic patients. These showed similar outcomes for both groups of patients assigned to stenting or CABG. However, in diabetics assigned to stenting, the need for repeat revascularisation was higher within the first year and between 1 and 3 years (15.2% additional reinterventions in diabetics versus 7.7% in non-diabetics; p=0.023). Consequently, the clinical outcome of diabetic patients assigned to stenting was worse at 3 years.

Diabetes, (p<0.0009), and maximal pressure for stent deployment, (p<0.002), were the strongest independent predictors of events at 3 years after PCI. Left anterior descending coronary artery grafting, (p<0.006), was the best predictor of events at 3 years after CABG.
Clinical conclusions
The authors concluded that the main difference in outcomes in the two treatments at 3 years was the larger need for repeat revascularisation in the stent group, notably in diabetic patients.

Measure of benefits used in the economic analysis
The measures of benefits used were event-free survival at 1 and 3 years and survival without MI and/or CVA.

Direct costs
Only the direct medical costs were included in the analysis. The cost categories were diagnostic tests, devices and materials, diagnostic or therapeutic procedures, hospital days, medications and rehabilitation services. Discounting does not appear to have been carried out. The quantities and costs were not analysed separately in this paper. The quantities and costs were both derived from actual data. The unit costs were taken from the Dijkzigt Hospital, Rotterdam. Physician visits and hospitalisation were recorded from the Case Report form. No price year was given in this paper.

Statistical analysis of costs
Means +/- standard deviations were reported and compared using the Wilcoxon ranked test.

Indirect Costs
No indirect costs were estimated.

Currency
Euros (Euro).

Sensitivity analysis
No sensitivity analysis was carried out.

Estimated benefits used in the economic analysis
Event-free survival was 73.5% at 1 year and 65.8% at 3 years in the stent group, and 87.9% (1 year) and 83.3% (3 years), respectively, in the CABG group. Survival without CVA or MI was 90.5% at 1 year and 87.2% at 3 years in the stent group, and 91.4% (1 year) and 88.4% (3 years), respectively, in the CABG group.

For every 5.8 patients treated, CABG would have produced one additional event-free patient if the need for revascularisation was not regarded as an event.

Cost results
At 1 year, the total costs per patient were Euro 11,117 in the stent group and Euro 13,896 in the CABG group, (p=0.0001). The costs of adverse effects were dealt with.

At 3 years, the total costs per patient were Euro 14,302 in the stent group and Euro 16,100 in the CABG group, (p=0.0001). The costs of adverse effects were dealt with.

Synthesis of costs and benefits
The incremental cost for each additional event-free patient treated by surgery was Euro 19,257 (95% CI: 11,141 - 33,078) at 1 year and Euro 10,492 (95% CI: 3,722 - 20,772) at 3 years, including the need for revascularisation as an event.
The incremental cost of a patient alive without CVA or MI treated by surgery was Euro 307,145 (95% CI: 57,275 - infinity) at 1 year and Euro 142,391 (95% CI: 22,888 - infinity) at 3 years.

Authors’ conclusions
Although stenting remains less expensive at 3 years, surgery offers the most effective method of revascularisation and with similar quality of life. Coronary artery bypass grafting (CABG) was definitely superior to stents for diabetic patients, whereas for non-diabetic patients CABG was only definitely superior if the need for revascularisation was taken into consideration.

CRD COMMENTARY - Selection of comparators
The choice of the two treatments, CABG and coronary stenting, was implicitly justified by them representing current treatment for many patients with multi-vessel coronary disease. You should decide if the comparators chosen represent current practice in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness data were derived from a single study. The study design, an RCT, was appropriate for the study. The study sample is likely to have been representative of the study population since patients from multiple centres were included in the effectiveness analysis. In addition, the patient groups were shown to be comparable at analysis. Power calculations were reported and an appropriate sample size was used. These facts improve the internal validity of the effectiveness analysis.

Validity of estimate of measure of benefit
The measures of health benefits used were obtained from effectiveness estimates. The measures of benefit used, event-free survival at 1 and 3 years and survival without MI and/or CVA, were appropriate for the type of intervention under analysis. It would have been useful if the authors had carried out the survival analysis separately for diabetic patients.

Validity of estimate of costs
The perspective adopted in the economic analysis was not explicitly reported. Consequently, it was not possible to determine whether all the relevant categories of costs were included in the analysis. In addition, details of the cost components were not given in this paper. The costs and the quantities were not reported separately in this paper, thus the analysis could not be easily reworked for other settings. Discounting does not appear to have been carried out and this omission would have given CABG a cost-advantage, as the cost of revascularisation in future years would appear less expensive. The authors also noted that there was a trend for stenting to become less expensive over time, which will also make stenting more attractive from the cost perspective. The resource use quantities were taken from a single study, while the prices were taken from one of the hospitals participating in the trial. No other sources were used. In addition, no statistical, sensitivity or any other kind of analysis of the quantities or prices was carried out. The price year was not reported, which will hinder future reflation exercises.

Other issues
The authors made appropriate comparisons of their results with the findings from other studies. The issue of generalisability to other settings was not discussed and the authors did not discuss any differences in costs and effectiveness among the different trial centres that might have existed. The authors’ conclusions reflected the scope of the analysis. The authors reported some limitations of their study. They also noted that a much larger trial is needed to assess the two treatments for diabetic patients, and that the EQ-5D might not be the ideal way of assessing cardiac patients.

Implications of the study
The authors did not make explicit recommendations for changes in policy or practice. However, they did state that the
implications of the study depend on whether it is thought that the need for revascularisation should take place, in which case the results for bypass surgery are superior to stenting.

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None stated.

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**Other publications of related interest**

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