Cost-effectiveness of minimally invasive coronary artery bypass surgery
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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
Minimally invasive techniques for coronary artery bypass surgery were compared with conventional coronary artery bypass (CCAB) surgery. The specific techniques assessed were minimally invasive direct coronary artery bypass (MIDCAB) without cardiopulmonary bypass (CPB) with a limited incision, and coronary artery bypass grafting without CPB with full sternotomy off-pump (OPCAB).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients who had one or two coronary bypass grafts.

Setting
The setting was secondary care. The study was set in the authors' institution (Minneapolis Heart Institute, Minneapolis, MN).

Dates to which data relate
The effectiveness data were collected between January 1997 and June 1998. The resource use and prices were collected for the same time period.

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

Link between effectiveness and cost data
The costing was carried out retrospectively on the same patient sample as that used in the effectiveness study.

Study sample
The study sample consisted of consecutive patients who had one or two coronary bypass grafts at the authors' institution between January 1997 and June 1998. Power calculations to determine the sample size were not reported to have been carried out. The sample was appropriate for the clinical study question since it involved patients who were treated with bypass grafts. In total, 44 patients received MIDCAB, 62 patients received OPCAB and 243 patients received CCAB.
Study design
The analysis used a retrospective cohort study, with the patients being divided into three groups according to which treatment they had received (as determined by the attending physicians or patient). The study was carried out in a single centre, the Minneapolis Heart Institute, Minneapolis (MN). The length of follow-up was not explicitly stated, although the authors appeared to only be interested in the immediate outcomes following surgery.

Analysis of effectiveness
All the patients included in the study were accounted for in the analysis. The primary health outcomes included postoperative length of stay, blood loss, and other complications such as the percentage occurrence of reoperative bleed, permanent stroke, perioperative myocardial infarction, new atrial fibrillation and operative mortality. There was a significantly higher occurrence of several preoperative variables in the MIDCAB and/or OPCAB groups compared with the CCAB group. For instance, age, predicted risk, reoperative status, renal failure, chronic obstructive pulmonary disease, congestive heart failure and prior cerebrovascular accident. A p-value of less than 0.05 was considered to be statistically significant. The proportion of females was 50% in the MIDCAB group, 58% in the OPCAB group and 54% in the CCAB group. Despite the significant difference in ages between the groups, no adjustment was made for age as a confounding factor.

Effectiveness results
Postoperative length of stay was 5.7 (+/- 3.5) days in the MIDCAB group, 7 (+/- 3) days in the OPCAB group and 7 (+/- 6) days in the CCAB group.

Blood loss was 291 (+/- 241) cm³ in the MIDCAB group and 401 (+/- 270) cm³ in the OPCAB group, versus 517 (+/- 295) cm³ in the CCAB group (p<0.001 and p=0.003, respectively).

The incidence of reoperation for postoperative bleeding was 6.8% in the MIDCAB group, 1.6% in the OPCAB group and 1.2% in the CCAB group, (p=0.01).

In terms of complications, there was no significant difference between the groups for the percentage occurrence of permanent stroke, perioperative myocardial infarction, new atrial fibrillation and operative mortality.

Clinical conclusions
The authors concluded that "in the hands of skilled surgeons, it has been demonstrated that both off-pump procedures can be performed without increased intra or postoperative complications".

Modelling
A logistic regression risk model was used to calculate the preoperative predicted risk for each patient group within the study.

Measure of benefits used in the economic analysis
There was no summary measure of health benefits. Hence, a cost-consequences analysis was conducted.

Direct costs
The costing was carried out from the perspective of the hospital. The authors seem to have been interested only in the costs of surgery and immediate postoperative care. Therefore, discounting was not carried out and was not relevant to the study. The costs and the quantities were not reported separately. The authors estimated fixed direct costs (administration and equipment costs), indirect costs (care and other services not directly related to patient care), and variable costs (labour and supplies necessary to care). The costs were estimated from two institutions on the basis of actual data. The patient costs were reported by day and by department. This allowed the authors to estimate preoperative cost, surgery cost, days of surgery cost, POD 1 (this abbreviation was not defined, but it can probably be
taken to mean postoperative day) to discharge cost, and surgery to discharge cost. The quantities were based on the resources used by patients during the effectiveness study (January 1997 to June 1998). A price year was not explicitly stated.

**Statistical analysis of costs**
The costs were assessed through a univariate analysis.

**Indirect Costs**
No indirect costs were included.

**Currency**
US dollars ($).

**Sensitivity analysis**
No sensitivity analysis was carried out.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness Results' section.

**Cost results**
The preoperative cost was $8,055 (+/- 9,418) in the MIDCAB group, $6,305 (+/- 6,240) in the OPCAB group and $4,505 (+/- 4,633) in the CCAB group. These differences were not statistically significant.

The surgery costs were $6,273 (+/- 3,527) in the MIDCAB group, $5,597 (+/- 2,154) in the OPCAB group and $9,509 (+/- 2,299) in the CCAB group, (p<0.001).

The costs incurred on the day of surgery were $3,987 (+/- 2,454) in the MIDCAB group, $2,928 (+/- 879) in the OPCAB group and $3,212 (+/- 1,549) in the CCAB group. These differences were not statistically significant.

The POD 1 to discharge cost was $7,177 (+/- 9,464) in the MIDCAB group, $6,988 (+/- 5,777) in the OPCAB group and $6,829 (+/- 6,058) in the CCAB group. These differences were not statistically significant.

The surgery to discharge cost was $17,438 (+/- 12,285) in the MIDCAB group, $15,514 (+/- 6,600) in the OPCAB group and $19,551 (+/- 7,421) in the CCAB group, (p=0.005).

**Synthesis of costs and benefits**
Not applicable.

**Authors' conclusions**
Minimally invasive direct coronary artery bypass (MIDCAB) without cardiopulmonary bypass (CPB) with a limited incision, and coronary artery bypass grafting without CPB with full sternotomy off-pump (OPCAB) were safe and did not increase the occurrence of mortality or morbid events. The total hospital costs reflected the effectiveness of the approaches.

**CRD COMMENTARY - Selection of comparators**
The choice of the comparators was well justified. MIDCAB and OPCAB were relatively new treatment options, whilst
CCAB was reported to be the 'gold' standard treatment. It was unclear which of these represented common practice in the authors setting. You should decide if this is a widely used health technology in your setting.

**Validity of estimate of measure of effectiveness**
The analysis used a retrospective cohort design. This was appropriate for the study question, which referred to reviewing the authors' experience with the treatment alternatives of interest. As acknowledged by the authors, a randomised study would have had greater validity in showing treatment differences. The study sample consisted of patients who had received one or two coronary bypasses, and so was representative of the study population. The patient groups were compared at analysis, but were shown to be statistically different in terms of several baseline variables. This could seriously bias the results. The authors did not make any adjustments for the potential confounding due to differences in age. The authors provided a variety of outcome measures allowing the reader to compare effectiveness on different grounds.

**Validity of estimate of measure of benefit**
There was no summary measure of benefit.

**Validity of estimate of costs**
The authors estimated the costs from the perspective of the hospital and included direct, indirect, fixed and variable costs. The total costs were presented in a variety of ways, which enabled the reader to better understand the use of resources throughout the patient's treatment pathway. The focus was on the short-term costs. The inclusion of longer-run costs may have impacted on the relative costs of the three treatment alternatives. The costs and the quantities were not reported separately. No statistical or sensitivity analysis of the prices or quantities was reported.

**Other issues**
The authors, appropriately, presented the findings of other studies, allowing the reader to judge the comparability of the results for themselves. The issue of generalisability to other settings was not addressed. The authors did not present the results selectively. The conclusions drawn by the authors accurately reflected the scope and design of the study. Some limitations were acknowledged. First, the non-randomised nature of the study, which could potentially lead to a biased study sample. Second, the unsophisticated information systems, possibly resulting in misleading costs.

**Implications of the study**
The authors acknowledge the difficulties involved in making recommendations and therefore do not present an explicit recommendation for policy or practice. However, they appear to favour the newer minimally invasive techniques. Further work, including continued evaluation of the techniques, specifically with a longer time horizon, and focusing on lower-risk populations is advised.

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None stated.

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**Other publications of related interest**
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**MeSH**
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