Benefits of off-pump bypass on neurologic and clinical morbidity: a prospective randomized trial


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
Two methods of heart bypass, coronary artery bypass grafting (CABG) and off-pump coronary artery bypass grafting (OPCABG), were studied.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients attending the St. Francis Medical Centre, Honolulu for a first time elective operation, who had no significant renal dysfunction (creatinine less than or equal to 2.0 mg/dL). Further, all participants in the study had, in the opinion of the surgeons, to be able to undergo either procedure safely.

Setting
The setting was a tertiary care setting. The economic study was carried out in Hawaii, USA.

Dates to which data relate
The dates for the effectiveness analysis, resource use and prices were not reported, but the authors did state that the Institutional Review Board approved the study on 13 March 1999.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing, which appears to have been undertaken prospectively, was carried out on the same sample as that used in the effectiveness study.

Study sample
The sample size was not determined in the planning phase of the study. In addition, no power calculations appear to have been carried out retrospectively. The study sample was made up of all eligible members of the study population who agreed to be included in the study. The authors did not justify their choice of study sample. The study was made up of 60 patients, 30 in each of the two groups (CABG and OPCABG). Two surgeons performed all of the surgical procedures.
Study design
This could be described as a cohort study. The study was carried out in a single centre, the St. Francis Medical Centre, Honolulu. The patients were randomised to CABG or OPCABG on the day of surgery by way of sealed envelopes. The patients were followed up at 2 weeks and 1 year postoperation. The authors reported that bilateral monitoring was successful in 29 OPCABG patients (97%) and 28 CABG patients (93%). It would appear that unilateral monitoring was carried out in those cases where it was not possible to obtain a reliable bilateral signal. Preoperative and postoperative brain scanning was completed in 29 patients in each group. One patient in each group declined repeat postoperative testing. Neurocognitive function testing before the operation and 2 weeks after the operation was completed in 29 patients in the OPCABG group and 29 patients in the CABG group. Testing 2 weeks before, and 2 weeks and 1 year after the operation, was completed in 27 patients in each group. Follow-up was not completed because of death (1 patient), the patient moved away (3 patients), or the patient declined retesting (3 patients).

Analysis of effectiveness
It would appear that the intention was to perform the effectiveness analysis on an intention to treat basis, but it was not possible to carry out all the effectiveness tests on all of the patients. Therefore, the analysis may be considered to have been conducted on the basis of treatment completers only. The primary health outcomes used in the analysis were:

- clinical morbidity measures, including chest tube drainage, blood transfusions, fresh frozen plasma and duration of dopamine requirement;
- the number and pattern of microemboli released;
- postoperative brain perfusion;
- cognitive tests, including measure of auditory verbal learning and memory (using the Rey Auditory Verbal Learning Test, RAVLT); and
- anxiety state scores.

Effectiveness results
The main clinical morbidity results were that CABG, compared with OPCABG, was associated with more chest tube drainage (1,389 +/- 256 mL versus 789 +/- 586 mL; p=0.02), blood transfusions (3.9 +/- 5.8 U versus 1.2 +/- 2.2 U; p=0.02) and frozen plasma (3.0 +/- 6.0 U versus 0.5 +/- 2.2 U; p=0.03). CABG was also associated with a longer duration of dopamine requirement than OPCABG (16.3 +/- 21.2 hours versus 7.3 +/- 9.7 hours; p=0.04).

Patients underwent bilateral monitoring using a transcranial Doppler. A substantial reduction in discrete cerebral microemboli was seen in the OPCABG group compared with the CABG group. The median (+/- semi-interquartile range) was 575 (+/- 278.5) versus 16.0 (+/- 19.5). The authors reported that the pattern of microemboli release in the CABG group showed that the majority (473 +/- 270; 82%) of cerebral microemboli were associated with the performance of CPB, and not associated with any surgical manoeuvres. The second highest locus of emboli (46 +/- 44.6; 8.0%) was with the placement of the partial occlusion clamp onto the aorta. Microemboli release associated with other surgical events were of lower mean frequencies.

The authors noted that the pattern of microemboli release with OPCABG revealed that 10.5 (+/- 11) cerebral microemboli (66%) were not associated with any surgical manoeuvre. Also, a slight left-sided predominance to microemboli was in evidence (left, 8.0 +/- 10.2; right, 6 +/- 8).

When using single-photon emission computed tomography scanning (SPECT), no significant differences between the baseline studies of the two groups were found. However, the authors reported that CABG postoperative brain perfusion was significantly reduced compared with baseline, to the bilateral occipital and cerebellar lobes, both precunei and thalami, and the left temporal lobe, (p <= 0.01). OPCABG postoperative brain perfusion was found to be statistically unchanged from baseline. The authors reported that, postoperatively, neither group had areas of significantly increased SPECT activity.
A multivariate analysis of variance for neurocognitive function showed that there were no statistically significant cognitive changes in the CABG group for any test performed. However, compared with baseline, the OPCABG group performed significantly better at both 2 weeks and 1 year in the RAVLT Total and Recognition scores, \((p<=0.05)\). At both testing intervals significant improvements were observed in the anxiety state scores for both treatment groups, \((p<=0.05)\).

It was also reported that a new minor stroke was detected in one CABG patient.

**Clinical conclusions**
The authors concluded that, compared with CABG, OPCABG may reduce neurologic and clinical morbidity.

**Measure of benefits used in the economic analysis**
No summary measure of benefits was used in the economic analysis. In effect, a cost-consequences analysis was performed.

**Direct costs**
The resource quantities and the costs were not reported separately. The authors reported that the direct hospital costs for each patient were calculated and included in the analysis. They stated that these costs included all patient services and supplies. It appears that the costs have been extracted from the hospital computer database and were thus based on actual data. A model was not employed to extrapolate to a longer timeframe or to different settings. Although not explicitly stated, the time period of the study was probably too short to make discounting relevant. The study reported the mean costs. The dates to which the price data referred were not reported.

**Statistical analysis of costs**
No statistical analysis of the costs was reported.

**Indirect Costs**
The indirect costs were not included in the analysis.

**Currency**
US dollars ($).

**Sensitivity analysis**
No sensitivity analysis was reported.

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

**Cost results**
The mean cost (\(+/-\) standard deviation) of CABG was $23,053 \(+/- 5,320\) compared with $17,780 \(+/- 4,390\) for OPCABG, \((p<0.0001)\).

No further cost results were reported.

**Synthesis of costs and benefits**
Authors' conclusions
The authors felt that their findings supported the hypothesis that off-pump coronary artery bypass grafting (OPCABG), as well as reducing the cost, may be less injurious to the neurologic system than coronary artery bypass grafting (CABG).

CRD COMMENTARY - Selection of comparators
Although the choice of the comparator was not explicitly justified, it would appear to represent current practice in many settings. You should decide if this is a widely used health technology in your own setting.

Validity of estimate of measure of effectiveness
This was a cohort study which, although not inappropriate for the study question, does not in itself provide sufficient evidence on which to recommend changes in clinical practice. There was no evidence to suggest that the study sample was not representative of the study population. The patient groups were shown to be comparable at analysis. The analysis of effectiveness appears to have been handled credibly.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The analysis was, in effect, a cost-consequences study.

Validity of estimate of costs
It appears that all the relevant categories of cost have been included in the analysis. Details of the costs included in each category were not reported. In addition, the unit costs were not reported separately from the resource quantities. Resource use was also not reported. A sensitivity analysis of the prices was not conducted, nor was any further analysis. Charges were not used to proxy prices. The date to which the prices related was not reported.

Other issues
The authors appear to have made appropriate comparisons of their findings with those from other studies. However, the issue of generalisability to other settings was not addressed. The authors do not appear to have presented their results selectively and their conclusions appear to reflect the scope of the analysis. In terms of further limitations to the study, the authors reported that although randomisation was by sealed envelope, it is possible that participants selected for CABG had more severe coronary artery disease than participants in the OPCABG group.

Implications of the study
The authors reported that there was no increase in recurrent angina or interval infarction with OPCABG in the short term, but suggested that longer term data on these end points are needed. The authors also suggested that reduced left temporal lobe perfusion may underlie the relatively poorer performance on the RAVLT of those patients undergoing CABG. Further study in this area is warranted.

Source of funding
Supported by a grant from the Hawaii Community Foundation Black Fund (grant number #961573).

Bibliographic details