A multicentre comparison of the costs of anaesthesia with sevoflurane or propofol

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
Three strategies for day-case anaesthesia were compared. The first strategy consisted of induction of anaesthesia with intravenously (IV) administered propofol followed by IV propofol to maintain a state of anaesthesia. The second strategy induced anaesthesia with IV propofol and maintained anaesthesia with inhalation of sevoflurane. The third strategy both induced and maintained anaesthesia with inhaled sevoflurane.

Type of intervention
Anesthesia.

Economic study type
Cost-effectiveness analysis.

Study population
Patients were ASA I-II patients undergoing day-case anaesthesia of 15-90 minutes anticipated duration. Patients were also between 18 and 75 years old.

Setting
The setting was tertiary care. The study was conducted in four countries: Belgium, France, the Netherlands and the United Kingdom.

Dates to which data relate
No dates were reported for data on either clinical resource use or unit costs.

Source of effectiveness data
The assessment of effectiveness was based on a single study.

Link between effectiveness and cost data
Effectiveness and cost data were both based on one study population that was followed prospectively. The study was conducted in six centres, and patients included in one of the centres were subject to a more thorough assessment of costs than were the others.

Study sample
The authors did not report whether the sample size was based on power calculations. Patients were selected through assessment of all patients admitted to day-care anaesthesia at the six centres participating in the study according to the inclusion criteria. The sample therefore appears to have been representative and appropriate to the clinical study question. Baseline characteristics were also provided, which allows comparison with the study population. A total of
221 patients were recruited to the study. Two patients were withdrawn before randomisation because of changes to the planned surgical procedure. 74 patients were randomised to the propofol-propofol strategy, 73 to the propofol-sevoflurane strategy, and 72 patients were included in the sevoflurane only strategy.

**Study design**
This was a multi-centre, randomised, controlled trial (RCT) with patients as the unit of randomisation. Six centres in four countries contributed to the study. Follow-up was limited to the time during which the patient underwent anaesthesia and until discharge from hospital. The study was open-label, but the nurses who assessed the patients after surgery were blind to treatment allocation. Eight patients were lost to follow-up, 2 from group one, 3 from group two and 3 from group three.

**Analysis of effectiveness**
The analysis of costs and effectiveness was based on treatment completers only. The outcomes assessed were:

- induction time (time to patient stopping rhythmically tapping a finger and loss of eyelash reflex);
- duration of apnoea;
- and recovery time after discontinuing maintenance anaesthetic (removal of laryngeal mask airway (LMA), time to open eyes, time to recall date of birth, time to walk unaided, and time to be fit for discharge).

Other outcomes included the patient's willingness to have the same treatment again, and postoperative nausea and vomiting. The groups were stated not to have differed significantly in baseline characteristics, although p values were given. The authors also commented that patients did not differ significantly across the participating countries, apart from the observation that Dutch patients were slightly taller and that a higher proportion were ASA II class patients.

**Effectiveness results**
Statistical significance was indicated by a p value of less than 0.05. Induction of anaesthesia was significantly faster in the propofol induction groups compared with the sevoflurane induction group. It was stated that the mean time required for induction of anaesthesia for propofol was consistent between the countries. Mean (SEM) time to stopping fingertapping in the propofol only group was 40.9 (3.3) seconds, 38.5 seconds (3.4) in the propofol-sevoflurane group and 72.8 (3.4) in the sevoflurane group.

There was a significant difference in duration of apnoea: 6.4 (0.4) for propofol, 5.3 (0.4) for propofol-sevoflurane and 3.7 (0.4) for sevoflurane.

Recovery times were similar across the groups. The mean time from the end of anaesthesia until patients could walk unaided was significantly longer in the sevoflurane only group with a mean of 156 (9.6) minutes. The time to unaided walk was 134.6 minutes (9.3) in the propofol only group and 136.8 minutes (9.3) in the propofol-sevoflurane group.

Postoperative nausea occurred in 5.6% of patients in the propofol only group, 11.4% in the propofol-sevoflurane group and 31.9% of patients in the sevoflurane only group. Vomiting occurred in no patients in the propofol only group, 8.6% of the propofol-sevoflurane group and 17.4% of the sevoflurane group.

One patient in each of the propofol groups was unwilling to have the same anaesthetic in the future and 10.1% of patients were unwilling to have sevoflurane again in the future.

The ranges of outcome measures between countries were also given.

**Clinical conclusions**
In summary, propofol and propofol-sevoflurane produced faster induction than sevoflurane, although the period of apnoea was shorter and recovery quicker in terms of ambulation for sevoflurane. However, there was much variability.
Measure of benefits used in the economic analysis
There was no summary measure of benefit and this was therefore a cost-consequences analysis.

Direct costs
Only drug acquisition costs were included in the cost analysis. The authors recorded information on the amount of sevoflurane used (ml per minute) and the amount of propofol dispensed and used (ml). The estimation of quantities and cost were based on actual data from the clinical study. Resource quantities were reported separately from the cost estimates. Dates for unit cost data were not provided. Costs were not discounted, but this would not have been appropriate given the short timeframe of the study. Patients in one study centre were subjected to a more in-depth cost analysis of sevoflurane administration. In this centre, costs were calculated by accurately recording the duration and volume of sevoflurane administration.

Statistical analysis of costs
The authors reported that continuous variables were analysed using analysis of variance. Presumably this was used in the comparison of mean costs between the groups.

Indirect Costs
Indirect costs were not included in this study.

Currency
The costs were recorded in the original national currencies but were converted to US dollars ($).

Sensitivity analysis
No sensitivity analysis was carried out.

Estimated benefits used in the economic analysis
Please refer to the effectiveness results reported earlier.

Cost results
Only mean costs were reported. The mean (range between countries) total cost of anaesthetic drug was significantly higher in the propofol only group at $31.9 (range: 23.3 - 38.2) compared to $19.70 (range: 15.5 - 23.4) in the propofol-sevoflurane group, and $18.8 (range: 11.5 - 23.7) in the sevoflurane only group. This estimate included wastage of propofol that was dispensed but not used during anaesthesia. When these costs were excluded the average cost of propofol-only anaesthesia dropped from $27.6 (range 17.6 - 35.91) to $18.7 (range: 14.10 - 22.20).

Synthesis of costs and benefits
Not applicable.

Authors’ conclusions
The authors concluded that "total intravenous anaesthesia with propofol was more expensive than anaesthesia induced with propofol followed by sevoflurane, but was associated with few clinical benefits in terms of speed and quality of recovery". The use of sevoflurane for both induction and maintenance of anaesthesia also reduced costs, but was associated with a significant increase in postoperative nausea and vomiting, delay in ambulation and reduction in patient satisfaction.
CRD COMMENTARY - Selection of comparators
The authors stated that they had compared the most frequently used alternative anaesthetics for day-care surgery in their study. The comparators therefore appear to have been appropriate for the purpose of this analysis. However the reader of this study should judge whether these are widely used technologies in their own setting.

Validity of estimate of measure of effectiveness
The measure of effectiveness was based on a prospective randomised trial that appeared appropriate for the study question. The inclusion criteria were broad and the study sample appears to have been representative of the study population. Patient groups were reported to be comparable. The study was reported in a transparent manner that facilitates an assessment of the study validity and relevance to other settings. A range of outcomes was recorded and analysed, which might have increased the risk of detecting false positives because of multiple statistical testing.

Validity of estimate of measure of benefit
No summary measure of benefit was reported in this cost-consequences analysis. It is difficult to say what the implication of the various measures of outcome would be in terms of quality of life. Decision-makers would have to make the trade-offs between the various measures.

Validity of estimate of costs
The cost estimate was based on direct drug acquisition costs only. Costs were reported in a transparent manner and unit costs were appropriately reported separately from resource use. Drug costs were estimated for both dispensed and used drugs. However the protocol did not permit propofol ampoules dispensed for one patient being re-used for another patient, and this may have resulted in a higher cost estimate for propofol than would be realistic in a clinical practice setting. The scope for the costing study was somewhat limited, as it focussed on acquisition costs only. The study might have benefited from taking a broader view by including costs such as cost offsets for more rapid patient recovery, and cost of staff care time.

Other issues
The authors compared their results with those from other studies and pointed out similarities and differences. It is not clear whether the comparison studies were representative of relevant studies. The authors did not explicitly address the issue of generalisability to other settings. However this was a multinational study and the authors have used the opportunity to report the range and variation in costs and effectiveness differences across the countries participating in the study. The authors do not seem to have reported their results selectively. However, the conclusions reached by the authors may not entirely reflect the findings of the study that, overall, propofol has similar acquisition costs to sevoflurane but more advantageous effectiveness and patient satisfaction profiles.

Implications of the study
The authors stated that the cost-effectiveness of the use of sevoflurane, used for either induction or maintenance of anaesthesia in day-care surgery, should be further investigated.

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