Inhalation versus total intravenous anesthesia for lumbar disc herniation: comparison of hemodynamic effects, recovery characteristics, and cost

Ozkose Z, Ercan B, Unal Y, Yardim S, Kaymaz M, Dogulu F, Pasaoglu A

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
The use of an anaesthetic technique based on propofol induction, alfentanil analgesia and maintenance, with continuous infusion of propofol and alfentanil with oxygen/air (TIVA). This technique was compared with two standard inhalation alternatives, sevoflurane and isoflurane, for inpatient lumbar laminectomy and discectomy procedures.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population included patients scheduled for inpatient laminectomy and/or discectomy, who were classified as type I or II according to the American Society of Anaesthesiologists (ASA). Patients with cardiovascular, respiratory, renal, hepatic or metabolic disease, a history of mental disorders, malignant hyperthermia or adverse reaction to one of the anaesthetics used, were excluded. Patients undergoing treatment with antihypertensive and sedative drugs were also excluded, as were those with serious, life-threatening respiratory or cardiovascular diseases.

Setting
The setting was a hospital (tertiary care). The economic study was carried out in Ankara, Turkey.

Dates to which data relate
The dates during which the effectiveness and resource use data were obtained were not explicitly reported. The price year was 2000.

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

Link between effectiveness and cost data
The costing was undertaken prospectively on the same sample of patients as that used in the economic analysis.

Study sample
Sixty patients, aged 20 to 60 years, were included in the study. These were prospectively randomised to one of the three standard methods of anaesthesia used in the study. There were no prior power calculations to determine the sample size.
Study design
The study was a randomised controlled trial carried out in a single centre. The duration of the follow-up was the time spent in surgery and the post-anaesthesia care unit. No losses to follow-up were reported. A random assessment according to computer-generated random numbers was prepared in advance. The study was randomised and controlled during surgery, and was double-blinded in the post-anaesthesia unit.

Analysis of effectiveness
The basis for the analysis of effectiveness (intention to treat or treatment completers only) was not stated. However, as all of the patients were included in the analysis it was, in effect, intention to treat. The primary health outcome measures used in the study were:

- the haemodynamic characteristics such as blood pressure and heart rate;
- the recovery time after anaesthesia, such as time to extubation, spontaneous eye opening and verbal response;
- postoperative pain, as measured using a visual analogue scale (VAS), rescue analgesia, postoperative nausea and vomiting, and rescue anti-emetic.

The authors reported no statistically significant differences in the demographic characteristics of the three groups included in the study. These characteristics were age, gender, weight, height, ASA type (I or II), operating time and anaesthesia time.

Effectiveness results
Although anaesthesia was uneventful for the different groups included in the study, the mean arterial pressure and heart rate among groups showed significant differences.

The heart rate and mean blood pressure were significantly lower in the TIVA group after induction of anaesthesia than in the two other groups (sevoflurane and isoflurane), (p<0.05). Nevertheless, the TIVA group experienced a faster recovery in terms of the time to extubation, spontaneous eye opening and verbal response, (p<0.05), and also lower postoperative pain scores, (p<0.05).

None of the patients in the TIVA group required an analgesic during this period, (p<0.05), or a rescue anti-emetic. There was a greater incidence of postoperative nausea and vomiting in the isoflurane (60%) and sevoflurane (50%) groups than in the TIVA group (5%), (p<0.05).

Clinical conclusions
TIVA with the combination of propofol and alfentanil provided the most rapid recovery and fewer postoperative side effects, compared with volatile anaesthetic agents such as sevoflurane and isoflurane, when they were evaluated in patients undergoing laminectomy and discectomy.

Measure of benefits used in the economic analysis
No summary health benefit was used in this study. The authors therefore performed a cost-consequences analysis. See the 'Effectiveness Results' section.

Direct costs
Discounting was not undertaken, but it was irrelevant due to the short timeframe of the study (less than one year). When calculating the basic costs, the prices for all the drugs used in the study and the resources applied were taken from the authors' hospital pharmacy. The authors included the costs of anaesthetic drugs, anaesthetic gases, anaesthetic equipment, intravenous fluids and the recovery room drugs. The costs of oxygen, staff and disposable were not included in the analysis. The prices and the quantities used were reported separately for all three groups. The total drug costs
were expressed as the mean costs with standard deviations. The price year used was 2000.

**Statistical analysis of costs**
The costs of the anaesthetic drugs (isoflurane and sevoflurane) and the anaesthetic gases (nitrous oxide and air) were calculated using the formulae provided in the paper. The continuous variables were analysed using an analysis of variables (with Bonferoni multiple tests comparisons), while changes in the continuous variables were assessed using paired t-tests. The descriptive variables were analysed using chi-squared tests. P values of less than 0.05 were considered to be statistically significant.

**Indirect Costs**
The indirect costs were not included.

**Currency**
US dollars ($). The conversion from Turkish lira (TL) was carried out using the exchange rate for November 2000, $1.00 = TL690,000.

**Sensitivity analysis**
No sensitivity analysis was performed.

**Estimated benefits used in the economic analysis**
A cost-consequences approach was adopted in the analysis. See the Effectiveness Results' section.

**Cost results**
The total drug costs in the TIVA group (52.73 +/- 10.82) were significantly higher, (p<0.01), than in the sevoflurane (29.99 +/- 8.42) and isoflurane groups (24.14 +/- 6.1), (p<0.05).

The TIVA group did not require any additional drugs in the post-anaesthesia care unit. Hence, this group of patients had the lowest drug costs in relation to the isoflurane group (0.70 +/- 0.21) and the sevoflurane group (0.61 +/- 0.22).

**Synthesis of costs and benefits**
The estimated benefits and costs were not combined Although the cost of total intravenous anaesthesia (TIVA) was higher in relation to the sevoflurane and isoflurane techniques, the costs in the post-anaesthesia care unit were significantly lower in this first group. These patients also experienced less side effects and pain, compared with those who received the other two anaesthetic techniques. Therefore, fewer drugs were required. TIVA was associated with the highest costs but it allowed the most rapid recovery from anaesthesia, with the lowest side effects in terms of nausea, vomiting and pain.

**CRD COMMENTARY - Selection of comparators**
The choice of the comparators was justified. Propofol used for TIVA, as well as new volatile agents such as sevoflurane and isoflurane, are currently used in clinical practice. You should decide if these anaesthetic techniques are relevant to your own setting.

**Validity of estimate of measure of effectiveness**
The analysis used a single study. It is likely to have been valid given the randomisation and double-blinding, which tends to limit the influence of confounding variables. However, the sample size was not determined by power calculations, thus weakening the statistical validity of the results.
Validity of estimate of measure of benefit
The authors of this study did not derive a summary measure of health benefit in the economic analysis. Therefore, this was a cost-consequences analysis. The benefits are those associated with the effectiveness outcomes, as reported earlier in the abstract.

Validity of estimate of costs
The indirect costs, such as social insurance payments, were not included in the economic analysis. Other relevant direct costs, such as staff, disposables and costs for oxygen, were also omitted. These omitted costs may have a tendency to bias the results. However, a statistical analysis of the unit costs was undertaken, the price year was given, and the costs and the quantities were reported separately. These features increase the internal and external validity of the cost results.

Other issues
The authors compared their results with those from similar studies. A limitation of the study, as the authors acknowledged, was that there are many factors (for example, regional variability, hospital variability and drug market) affecting the costs of propofol and the other two techniques, although the cost analysis adopted was comprehensive. The cost results are not likely to be generalisable to other settings, as this issue was not addressed in the paper and no sensitivity analysis was performed.

Implications of the study
The study findings suggest that, although TIVA for laminectomy or discectomy patients shows higher operating costs in relation to other anaesthetic techniques, it leads to better recovery in terms of time and side effects such as postoperative nausea and vomiting.

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