Pharmacoeconomics of Propofol Versus Thiopental for Induction of Anaesthesia in Short Procedures

Sandy H.L. Hsu and Stephen J. Shalansky

ABSTRACT
This study compared the costs and benefits of using propofol/fentanyl versus thiopental/fentanyl for induction of anaesthesia in short procedures. A prospective, cohort trial was conducted in conjunction with a patient survey. The study population included a consecutive sample of American Society of Anaesthesiologists, Class I or II patients who underwent short operative procedures and who were given one of the studied anaesthetic regimens. Isoflurane/N₂O was used for maintenance of anaesthesia in all cases. Propofol patients showed a significantly shorter time to eye opening (p = 0.0025); orientation to date of birth, place, and day of week (p = 0.0002); time to consciousness (p = 0.0019); and time in recovery room (p = 0.013); but not time to tolerating 50 mL of oral fluid (p = 0.06). Nausea and vomiting occurred in 41% of thiopental patients and 19% of propofol patients (difference 22%; 95% C.I., -1% to 44%). Based on survey results, propofol patients subjectively reported fewer side effects upon returning home and were able to resume daily activities earlier than thiopental patients. With the current staffing and patient load at our institution, an estimated 4.8 hours of nursing time per day would be made available if propofol were used in place of thiopental for induction of anaesthesia in these procedures. If propofol were used for all daycare surgery patients in our institution, the annual acquisition cost is projected to be $60,331.28 versus $8,079.68 for thiopental. In conclusion, the use of propofol for induction of anaesthesia in short procedures is more expensive than thiopental but may yield qualitative advantages including more rapid recovery, less nausea and vomiting, and less burden on recovery room nursing staff.

Key Words: pharmacoeconomics, propofol, thiopental.

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INTRODUCTION

Propofol’s rapid onset of action, short duration of effect, and low incidence of side effects make it well suited for anaesthesia in short surgical procedures. While many studies have demonstrated advantages of propofol for total anaesthesia,1-11 propofol has also been shown to reduce recovery time and adverse effects when used strictly for induction.12-21 The high acquisition cost of propofol compared to that of traditional anaesthetic agents raises questions about its cost-effectiveness. Several authors have examined this issue;8-11 however, these studies have all utilized regimens in which propofol was used for both induction and maintenance. We designed this study to compare the costs and benefits of propofol and thiopental for induction of anaesthesia in short procedures. Specifically, we looked at recovery times, incidence of nausea and vomiting, and nursing hours per patient. Through a patient survey, we also assessed side effects after discharge and the ability to resume daily activities.

METHODS

Propofol was compared to thiopental for induction of anaesthesia in short daycare procedures in a prospective, cohort study. The study included a consecutive sample of patients undergoing short procedures between September 21 and December 24, 1992. Patients were included in the study if they were classified as ASA I or II (as per the American Society of Anaesthesiologists guidelines22); underwent cystoscopy ± pyelogram, laparoscopic tubal ligation, dilation and curettage, or termination of pregnancy; were given propofol/fentanyl or thiopental/fentanyl for induction of isoflurane/N₂O maintained anaesthesia; and were older than 19 years. Patients were excluded if they did not meet the criteria listed above. The choice of the anaesthetic was at the discretion of the anaesthetist.

After the procedure, patients were discharged to the post anaesthetic recovery unit (PAR) where nursing staff, who were unaware of the anaesthetic agents used (anaesthetic records were not available in PAR), recorded the patient’s recovery time from the end of surgery in terms of: time to spontaneous eye opening; orientation to date of birth, place, and day of week; time when the patient could tolerate 50 mL of clear oral fluid; time to consciousness defined as achieving a Steward scale23 of 6; and total time spent in recovery. The number of nausea and vomiting episodes experienced in PAR was also recorded. Patients were requested to complete a questionnaire at approximately 24 hours after their procedure to document side effects experienced at home including nausea, vomiting, difficulty sleeping, headache, and weakness. The survey also included patients’ estimates of when they were able to eat, resume leisure activities, and return to work. Finally, the questionnaire asked whether the patient had undergone previous surgery, whether they would choose the same anaesthetic if they required subsequent surgery, and asked for any additional comments.

A minimum required sample size of 14 patients per group was estimated to detect a 15% difference in time to eye opening (α = 0.05, β = 0.20) based on recovery results from previous studies where propofol and thiopental were used for induction.3,6,7,12,19,24 The group comparability and length of recovery times calculated from the end of the procedure were analyzed statistically using descriptive statistics and multiple regression analysis, where appropriate. Each nausea and vomiting episode was estimated, based on nursing experience, to consume 5 minutes of nursing time to account for patient monitoring, clean up, and medication administration. Comments on the returned patient questionnaires were summarized to identify patients’ subjective opinions regarding the agent they received. Cost calculations were based on a propofol acquisition cost of $8.88/200mg ampoule and $7.88/2.5g vial of thiopental. All costs are in Canadian dollars. Annual cost projections assume 8726 patients per year which was the number of daycare operations done at our institution from April 1, 1992 to March 31, 1993.

RESULTS

Fifty-two propofol and 22 thiopental patients were included over the three-month study period. All patients enrolled in the study were used in the data analysis. Patients received an average dose ± SD of 2.29 ± 0.45 mg/kg of propofol or 4.32 ± 0.73 mg/kg of thiopental for induction, and nitrous oxide in oxygen with isoflurane 0 to 4% for maintenance. Patients also received succinylcholine, vecuronium, and/or d-tubocurarine. Twenty-seven patients received 20 to 50 mg of lidocaine prior to the propofol to reduce pain on injection.

The differences in patient age, weight, sex, ASA grouping, fentanyl or thiopental/fentanyl for induction of anaesthesia; and were older than 19 years. Patients were excluded if they did not meet the criteria listed above. The choice of the anaesthetic was at the discretion of the anaesthetist.

Based on the average doses of propofol and thiopental quoted above, a mean patient weight of 68 kg (Table I), and the annual daycare surgery patient load at our institution, the annual drug acquisition cost for the procedure was $230,000.
Table I: Group Comparability

<table>
<thead>
<tr>
<th></th>
<th>Propofol n=52</th>
<th>Thiopental n=22</th>
<th>Difference (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, yrs (SD)</td>
<td>43.7 (15.94)</td>
<td>50.4 (18.94)</td>
<td>6.7 (-2.3 to 15.7)</td>
</tr>
<tr>
<td>Sex, % male</td>
<td>25.0</td>
<td>13.6</td>
<td>-11.4 (-29.9 to 7.2)</td>
</tr>
<tr>
<td>Mean weight, kg (SD)</td>
<td>67.63 (14.05)</td>
<td>67.97 (14.22)</td>
<td>0.34 (-6.72 to 7.40)</td>
</tr>
<tr>
<td>ASA I/II</td>
<td>37/15</td>
<td>13/9</td>
<td></td>
</tr>
<tr>
<td>Mean length of surgery, min (SD)</td>
<td>8.83 (6.019)</td>
<td>13.86 (8.061)</td>
<td>5.03 (1.28 to 8.77)</td>
</tr>
<tr>
<td>Mean fentanyl dose, mcg/kg (SD)</td>
<td>1.12 (0.499)</td>
<td>0.87 (0.260)</td>
<td>-0.25 (-0.42 to -0.08)</td>
</tr>
</tbody>
</table>

Procedures:
- Laparoscopic tubal ligation 1 (2%) vs 3 (14%)
- Pregnancy termination 12 (23%) vs 2 (9%)
- Dilatation and curettage 19 (36%) vs 7 (32%)
- Cystoscopy 3 (6%) vs 3 (14%)
- Cystoscopy and pyelogram 17 (33%) vs 7 (32%)

Table II: Recovery Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Propofol Mean SD</th>
<th>Thiopental Mean SD</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(n = 52)</td>
<td>(n = 22)</td>
<td></td>
</tr>
<tr>
<td>Time to eye opening</td>
<td>7.00 4.30</td>
<td>10.91 4.83</td>
<td>0.0025</td>
</tr>
<tr>
<td>Time to consciousness</td>
<td>8.25 4.64</td>
<td>13.32 6.03</td>
<td>0.0019</td>
</tr>
<tr>
<td>Time spent in recovery room</td>
<td>111.46 26.36</td>
<td>142.55 49.95</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(n = 52)</td>
<td>(n = 13)</td>
<td></td>
</tr>
<tr>
<td>Time to orientation</td>
<td>9.30 6.01</td>
<td>14.5 6.91</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>(n = 43)</td>
<td>(n = 14)</td>
<td></td>
</tr>
<tr>
<td>Time to tolerating 50 mL of oral fluid</td>
<td>53.79 26.61</td>
<td>76.07 30.49</td>
<td>0.06</td>
</tr>
</tbody>
</table>

DISCUSSION
Propofol has been used for induction and maintenance of anaesthesia in a large number of trials investigating its impact on recovery and side effect profile. Most of these studies have shown shorter recovery times and fewer side effects compared to traditional anaesthetics. Investigators have also compared propofol to traditional induction agents when inhalation anaesthetics are used for maintenance. While the majority of these trials have demonstrated a reduced recovery period, the observations suggest that propofol may offer several advantages in terms of patient comfort and recovery time.
Our study is the first to investigate the cost-benefit of propofol versus thiopental when used strictly for induction of anaesthesia in short procedures. Propofol patients showed significantly shorter recovery than thiopental patients. We believe the induction agent was primarily responsible for the differences in the measured recovery times based on the results of multiple regression analysis which indicated that age, sex, weight, ASA class, length of surgery and fentanyl dose did not influence recovery times. The proportion of patients undergoing each procedure was similar between the two study groups (Table I). Our results also suggest that the use of propofol is associated with less nausea and vomiting than thiopental.

It is difficult to draw conclusions about the cost advantages of propofol as its benefits do not correspond to a direct dollar value. The reduced nursing time to attend to propofol patients cannot be projected to a cost-savings since staffing levels are predetermined and cannot fluctuate in small increments to adjust for reduced workload. In order to take advantage of the potential 4.8 hours per day of nursing time made available with the exclusive use of propofol for induction in the studied procedures, significant changes in the PAR staffing system would have to be implemented. Without such changes, this advantage would be limited to increasing the amount of nursing time available per patient. It may increase the capacity of the PAR; however, the number of operations performed per day also depends on the number of surgeons and the operating room capacity.

The results of the patient survey show that a higher percentage of propofol patients indicated that they would choose the same anaesthetic if they had another surgery. The decreased incidence of nausea and vomiting in this group probably contributed to this. It should be noted that the majority of patients in both groups had undergone previous surgery allowing an informed assessment of their anaesthetic experience. The patient survey results also indicate that propofol patients were able to resume leisure activities and return to work sooner than thiopental patients which would presumably hasten their return to normal productivity. The fact that more thiopental patients were retired may have influenced this result.

Our results should be interpreted with caution for several reasons. First, this was not a randomized trial and the choice of anaesthetic was not random. However, the results are not inconsistent with the available literature regarding the differences in adverse effects. Our results also differ in that more propofol patients indicated that they had another surgery. The decreased incidence of nausea and vomiting in this group probably contributed to this. It should be noted that the majority of patients in both groups had undergone previous surgery allowing an informed assessment of their anaesthetic experience. The patient survey results also indicate that propofol patients were able to resume leisure activities and return to work sooner than thiopental patients which would presumably hasten their return to normal productivity. The fact that more thiopental patients were retired may have influenced this result.

Regarding adverse effects have not been as consistent.

All of the published trials which have investigated propofol's cost-effectiveness compare regimens utilizing propofol for both induction and maintenance to more traditional regimens involving an injectable induction agent and inhalation anaesthetics for maintenance. While most of these studies showed benefits through a varied reduction in recovery time and adverse effects, one author concluded that the routine use of propofol for day-surgery patients was not justified.
the choice of anaesthetic agents used was at the discretion of the anaesthetist. Of the five anaesthetists involved in the cases studied, one was involved in a single case (thiopental was used), one used thiopental exclusively, and two used propofol exclusively. Only one anaesthetist selected between the two agents for these procedures. He tended to use thiopental for cystoscopy and pyelograms, while propofol was used for gynecological procedures. Despite this tendency, the overall proportion of urological versus gynecological procedures was similar between the groups (39% versus 61% for propofol, 45% versus 55% for thiopental). We tried to account for potential bias associated with the anaesthetist's selection of the induction agent through multiple regression analysis of group comparability parameters. The results indicate that none of the comparability parameters studied were associated with the measured differences in recovery times.

Another point worthy of comment was the incomplete documentation of one of our recovery time parameters: orientation (13/22 thiopental) and time to tolerating 50 mL of oral fluid (43/52 propofol, 14/22 thiopental). This could indicate serious bias. However, even if these results are ignored, there is still a statistically significant difference for three commonly measured recovery parameters. As well, the 95% confidence interval for nausea and vomiting included zero, which suggests the possibility of no difference between the groups for this parameter. On the other hand, the interval was very much skewed in favour of propofol and there was a large absolute difference (22%). Finally, the nature of the patient survey precluded statistical analysis and, therefore, no definite conclusions should be drawn from this information.

One should keep in mind that the procedures studied were very brief and may not represent a typical case load in all institutions which utilize propofol for induction of anaesthesia. At many institutions, longer and more diverse cases are being treated as outpatient procedures. The doses of propofol and thiopental used in this study were comparable to previous studies.6-21,25

The results of this study suggest that there may be advantages associated with the use of propofol in place of thiopental for induction of anaesthesia in short procedures, but these results should be validated with a randomized, blinded, prospective study. Whether these advantages justify the added expense of propofol should be an institution-specific decision including consideration of the quality of the patients’ experience and the amount of nursing care required in the recovery room.

REFERENCES

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