Patient-maintained propofol sedation as premedication in day-case surgery: assessment of a target-controlled system†

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We have assessed the efficacy and safety of a system which allowed 20 patients undergoing day-case anaesthesia to operate a target-controlled infusion of propofol to provide anxiolytic premedication. A target-controlled infusion of propofol was started with a target blood concentration of 1 µg ml⁻¹, and the patient was allowed to increase the target by 0.2 µg ml⁻¹ by operating a control button. There was a lockout time of 2 min and a maximum target concentration of 3 µg ml⁻¹. There were significant reductions in anxiety scores from pre-sedation baseline values and those measured at 15 min after the start of sedation. Values remained low until induction of anaesthesia. Median blood target concentration of propofol varied from 1.0 to 1.2 µg ml⁻¹ and mean propofol consumption was 50.3 (± 17.6) µkg kg⁻¹ min⁻¹.

No patient became oversedated and all remained cardiovascularly stable. Two individuals required low-dose supplementary oxygen for mild arterial oxygen desaturation but there were no instances of airway obstruction. Patient satisfaction with the system was high.

Keywords: anaesthesia, day-case; anaesthetics i.v., propofol; premedication, propofol

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Anxiolytic premedication for patients undergoing day-case surgery must be rapidly acting and have minimal effects on postoperative cognitive function. Propofol is a drug which has both sedative and anxiolytic properties1 and, given i.v., could provide such a rapid onset of effect. However, inter-individual dose requirements can vary widely, making titration to effect essential. Patient-controlled sedation systems which administer bolus doses of the agent have been studied by other investigators and found to be both effective2 and popular3 for patients undergoing surgery under regional anaesthesia. However, propofol is rapidly redistributed from the central compartment and a more constant level of sedation may be achieved by use of an infusion regimen.

A new technique, which allows the patient to control the delivery of a target-controlled infusion (TCI) of propofol, provided effective sedation for patients undergoing orthopaedic procedures under regional anaesthesia.4 We have studied the effectiveness and safety of this system when used to provide a patient-maintained propofol infusion for premedication in day-case patients.

Methods and results

After obtaining approval from the Local Ethics Committee and written informed consent, we studied 20 adult patients, ASA I or II, aged 16–70 yr, undergoing day-case procedures under general anaesthesia. Exclusion criteria included severe impairment of cardiorespiratory function, history of psychiatric illness, recent sedative medication, mental retardation or inability to understand or operate the equipment.

The experimental TCI system used for sedation consisted of a Graseby 3400 infusion pump, the rate of which was controlled by a backbar microprocessor programmed with pharmacokinetic data describing the distribution and elimination of propofol.5 By entering the patient’s age and weight (in kg) and the desired initial blood concentration of propofol, the system calculates the initial bolus and variable infusion rates required to achieve and maintain this concentration. The system also displays a calculated value for the effect-site concentration of propofol. Connection of a control button to the backbar enables the subject to increase the target concentration of propofol in increments of 0.2 µg ml⁻¹ by double pressing the button within 1 s. There is then a lockout period of 2 min during which no further target increases are possible and the maximum attainable target concentration is 3 µg ml⁻¹. If no successful demands are detected for a period of 6 min, there is a stepped reduction in the target concentration to a minimum of 0.2 µg ml⁻¹.

Before starting sedation, patients completed the state and

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trait parts of the Spielberger state trait anxiety inventory (STAI). State anxiety was also assessed using a 0–100 mm VAS and a short questionnaire on previous experiences of surgery, and premedication was completed. Measurements of non-invasive arterial pressure (NIAP), heart rate (HR), ventilatory frequency and arterial oxygen saturation ($S\text{p}O_2$) were made and a 21-gauge i.v. cannula sited. Patients were then instructed in the operation of the control button and told to double press it during the study whenever they felt anxious. A target-controlled infusion of propofol (1% with lidocaine 20 mg per 50 ml) was started at an initial target concentration of 1 µg ml$^{-1}$ and time allowed for the calculated effect-site concentration to reach within 0.1 µg ml$^{-1}$ of the set blood target concentration. The control button was then activated and the subject reminded to double press it whenever they felt anxious. No further encouragement to operate the button was given for the remainder of the study.

Heart rate and $S\text{p}O_2$ were monitored continuously, NIAP and ventilatory frequency every 5 min, and sedation scores, using a modified Steward sedation score, VAS anxiety scores and target concentration of propofol every 15 min after the start of sedation. In addition, the state component of the STAI was repeated at 15 min. $S\text{a}O_2$ <94% or ventilatory frequency <8 bpm was taken as clinically significant and treated with supplementary oxygen. A decrease in baseline NIAP or HR >30% or HR <50 beat min$^{-1}$ was recorded as significant and treated as deemed appropriate by the investigator.

A final VAS was recorded in the anaesthetic room before induction. All patients then received a total i.v. anaesthetic with TCI of propofol and remifentanil. One hour after recovery, a short questionnaire was completed to assess patient satisfaction with premedication.

VAS and STAI scores were analysed relative to pre-sedation levels using the non-parametric Wilcoxon signed rank test for paired data. In all cases, $P<0.05$ was taken as statistically significant. The computer package used for all calculations was Minitab (version 11).

Twenty patients were recruited and completed the study. Mean age was 40.4 (range 16–67) yr, mean weight 62.5 (45–85 kg) kg and the male:female ratio was 6:14. Seventeen patients were undergoing varicose vein surgery and three patients other minor operations. There were significant reductions in anxiety state scores, as assessed by both STAI at 15 min and VAS at all times after sedation (Table 1). Median target concentrations of propofol varied from 1.0 to 1.3 µg ml$^{-1}$ (Table 1) and the overall range of target concentrations recorded in the anaesthetic room was 0.2–1.8 µg ml$^{-1}$. Mean propofol use was 50.3 (sd 17.6) µg kg$^{-1}$min$^{-1}$.

The deepest level of sedation recorded corresponded to the subject being rousable to speech, obeying commands and having a clear unsupported airway. There were no instances of airway obstruction but two patients, aged 63 and 67 yr, developed $S\text{p}O_2$ values of 92% and 90%, respectively, breathing room air (pre-sedation $S\text{p}O_2$ values were 96% and 95%, respectively). However, these values returned rapidly to greater than 94% with administration of low-flow nasal supplementary oxygen. There were no clinically significant decreases in heart rate or NIAP. One patient complained of mild discomfort with initial infusion but this did not require cessation of TCI.

In the postoperative questionnaire, all rated the premedication as either excellent (70%) or good (30%) on a four-point scale. Of the 15 patients who had previously had an operation, 66.7% felt that the premedication was superior this time. All expressed a wish to have the same premedication for a future operation.

**Comment**

To be useful clinically, any sedation system must be effective, safe and practical. Our system was effective in rapidly reducing patient anxiety; anxiety scores were reduced significantly at 15 min and remained so until induction. Patients generally remained only lightly sedated but with a high degree of anxiolysis. A system delivering patient-controlled bolus doses of midazolam has been evaluated against midazolam infusion for premedication in day surgery. However, despite a reduction in drug dose, the authors believed that the added expense of patient control relative to simple infusion could not be justified. We found that the feedback loop provided by the patient-controlled element appeared to function well to prevent over-sedation and we would suggest that in the case of propofol this added safety is important.

The median value for the target concentration of propofol recorded in the anaesthetic room of 1.2 µg ml$^{-1}$ was higher than the median value of 0.8 µg ml$^{-1}$ found by Irwin, Thompson and Kenny in their study in orthopaedic patients. Their study also reported an incidence of arterial oxygen desaturation, breathing room air, of 22% compared with our 10%, but similarly, there were no episodes of clinically detectable airway obstruction. The older population and 1980, 20:105–110.

### Table 1 Anxiety state scores from time 0 (before sedation) related to time and target blood propofol concentration (Target propofol). Results are expressed as median (interquartile range).

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Anxiety state score</th>
<th>VAS (0–100 mm)</th>
<th>Target propofol (µg ml$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>41 (34–51)</td>
<td>47 (33–62)</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>26 (23–30)</td>
<td>24 (7–34)</td>
<td>1.0 (0.8–1.4)</td>
</tr>
<tr>
<td>30</td>
<td>17 (1–24)</td>
<td>17 (0.6–1.4)</td>
<td>1.2 (0.8–1.4)</td>
</tr>
<tr>
<td>45</td>
<td>15 (0–18)</td>
<td>13 (0.6–1.6)</td>
<td>1.2 (0.8–1.4)</td>
</tr>
</tbody>
</table>
increased numbers of ASA grades II and III in the orthopaedic study probably account for these differences. We would suggest, therefore, that supplementary oxygen therapy is prudent, especially in older patient groups. Also, close clinical supervision, especially with regard to ventilatory frequency and effort, should be mandatory for the system to be operated safely until further assessments have been made. From a practical standpoint, at present this would limit the use of the system to the operating suite.

In summary, we found that patient-maintained sedation with propofol was an effective and popular form of anxiolytic premedication for our group of patients undergoing day-case anaesthesia. Further comparative, controlled studies of the system are required to assess its potential relative to other premedicant drugs.

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