Dreams, images and emotions associated with propofol anaesthesia

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Summary
One hundred and twelve patients scheduled for day case varicose vein surgery were randomly allocated to one of three groups: total intravenous anaesthesia with propofol, propofol induction followed by inhalational anaesthesia with nitrous oxide and isoflurane or thiopentone induction followed by inhalational anaesthesia with nitrous oxide and isoflurane. Assessments were made in the recovery room of the incidence of dreaming, the content of the dreams and the emotional status of the patients. The groups differed significantly in reporting that they had been dreaming: patients who underwent total intravenous anaesthesia reported the most dreaming and patients who received thiopentone the least. However, despite the large number of case reports of sexual imagery following propofol anaesthesia and despite the two groups who had received propofol experiencing significantly greater happiness upon recovery than the thiopentone group, there were no appreciable differences in the sexual content of the dreams. Each group had only a small number of dreams even remotely related to sex.

Keywords Anaesthetics, intravenous; propofol. Complications; dreams, emotions.

There have recently been reports of sexual behaviour and hallucinations following anaesthesia with propofol [1–3]. Even small doses of propofol seem to produce verbal sexual disinhibition [4]. Boheimer & Thomas [5] recommended that patients should be warned about the possibility of amorous behaviour after propofol anaesthesia. The purpose of our study was to quantify the incidence and content of dreaming during anaesthesia of short duration. The content of dreams is particularly important as it might have psychological and medicolegal consequences.

In this study we compare the incidence of dreaming during two types of anaesthesia using propofol with a control anaesthetic consisting of thiopentone, nitrous oxide and isoflurane. A thiopentone control group was used because sexual hallucinations have been found with anaesthetics other than propofol. A 5% incidence of sexual hallucinations in men has been recorded in association with the use of midazolam [6]. The authors warned that amnesia may be hiding a higher prevalence. Sexual fantasies have been reported after benzodiazepine sedation [7, 8], with difficulty being experienced in persuading patients that nothing improper had happened. We rated any dreams for sexual content while making a further distinction between dreams whose content could be recalled and occasions when the patient was sure of having had a dream but could not recall any content. As dreams seem more likely to occur after short procedures [9], we studied patients having day case varicose vein surgery. Using published data from small-scale studies we performed a power calculation to determine the group size. We calculated that if 70% of patients do not dream, given an \( \alpha \) value of 5% and a \( \beta \) value of 80%, a sample size of 41 patients per group would be needed.

Methods
After local Ethics Committee approval, informed consent was obtained from 120 patients scheduled for elective varicose vein surgery in the day surgery unit. The title on the consent form was deliberately unspecified in order
to avoid suggesting to the patients that they might have thoughts or images on recovery from the anaesthetic.

The patients were randomly allocated to one of the following groups: total intravenous anaesthesia with propofol (TIVA group), propofol induction followed by maintenance of anaesthesia with nitrous oxide and isoflurane (propofol induction group) and thiopentone induction followed by maintenance of anaesthesia with nitrous oxide and isoflurane (thiopentone induction group). The propofol TIVA regimen used was: propofol 2 mg.kg^{-1} for induction and then a propofol infusion at a rate of 10 mg.kg^{-1}.h^{-1} for the first 10 min, 8 mg.kg^{-1}.h^{-1} for the next 10 min and then 5–8 mg.kg^{-1}.h^{-1} for the remainder of the operation. The propofol induction group received propofol 2 mg.kg^{-1} for induction and then 66% nitrous oxide in oxygen with isoflurane 1–1.5% inspired. The thiopentone induction group received thiopentone 4 mg.kg^{-1} for induction and then 66% nitrous oxide in oxygen with isoflurane 1–1.5% inspired. In addition to the above, all patients received alfentanil 1.0 mg at induction, local infiltration to the site of incision with 0.5% bupivacaine and diclofenac 100-mg suppositories.

All assessments were made by an investigator blinded to the anaesthetic technique. Pre-operative anxiety was scored on a 100-mm non-graduated visual analogue scale, graded from ‘not anxious at all’ (0 mm) to ‘very anxious’ (100 mm). The patient was asked how often he or she normally dreamed at home (scoring scheme: 0 = never, 1 = once a month, 2 = once a week, 3 = almost every night) as this frequency is known to affect the incidence of reporting dreams during both propofol and thiopentone/enflurane anaesthesia [10].

When the patients were orientated in time, place and person, they were asked whether they had any dreams or images during the anaesthetic or whether they thought they had had a dream but were unable to recall the content. Any details given about the dreams were recorded.

The patients were then asked whether they had any of the five feelings present on the Hall & van der Castle emotions scale [11] (angry, apprehensive, happy, sad, confused), to which we added the sixth feeling of ‘headache’. They were also asked whether they experienced any of the six bodily and biological states derived from the work of Zacny et al. [12] (sick, hungry, high, sedated, dizzy, light-hearted), to which we added ‘headache’. The validity and reliability of the emotions scale has been documented by Winget & Kramer [13]. These 13 feelings or emotions were each rated as absent or present. The amount of sexuality in the imagery report was rated according to Ben-Horin’s overt sexuality scale [14] (Table 1). If multiple dreams or events were reported, the highest score was recorded.

Analysis of the data was performed using analysis of variance for parametric data and Chi-squared tests for nonparametric data, with a probability value of less than 0.05 taken as significant. Bonferroni’s correction was applied to correct for repeated observations in the emotion and body status questionnaire; with 13 related questions a probability value of less than 0.0038 was taken as significant.

### Results

Completed questionnaires were obtained from 112 patients. There were 36 patients in the TIVA group, 37 patients in the propofol induction group and 39 patients in the thiopentone induction group.

There were no significant differences in age, weight or sex distribution between the three groups (Table 2). There were no significant differences between the groups in duration of anaesthesia, duration of surgery or in time to postoperative interview, i.e. the time from entry into the recovery room to adequate orientation for interview (Table 3). Mean (SD) drug doses for the TIVA group, propofol induction group and thiopentone induction group were 442.6 (165.1) mg, 172.7 (37.4) mg and 304.1 (79.5) mg, respectively.

There were no statistical differences in pre-operative anxiety between the groups. Mean (SD) visual analogue scale value of less than 0.0038 was taken as significant.

### Table 1 Ben-Horin’s overt sexuality scale [14].

<table>
<thead>
<tr>
<th>Score</th>
<th>Dream content</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Sexual intercourse; rape, marriage, being in love with explicit reference to sexual intimacy; pregnancy if the emphasis is on sexual intimacy; auto-erotic gratification</td>
</tr>
<tr>
<td>5</td>
<td>Intimate sexual contact, not implying intercourse</td>
</tr>
<tr>
<td>4</td>
<td>Fantasies or wishes of sexual intimacy only expressed verbally with no instrumental behaviour leading up to their gratification; also passive, descriptive reference to nudity without behavioural involvement</td>
</tr>
<tr>
<td>3</td>
<td>Heterosexual interaction of conventional and socially accepted nature</td>
</tr>
<tr>
<td>2</td>
<td>Minor feelings of attraction, admiration, or gratification suggesting erotic thoughts</td>
</tr>
<tr>
<td>1</td>
<td>Emotionally distant reference or encounters with a member of the opposite sex</td>
</tr>
<tr>
<td>0</td>
<td>No evidence of overt sexuality</td>
</tr>
</tbody>
</table>

### Table 2 Patient demographic data. Age and weight values are given as mean (SD).

<table>
<thead>
<tr>
<th></th>
<th>TIVA group</th>
<th>Propofol induction group</th>
<th>Thiopentone induction group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age; years</td>
<td>45.9 (11.5)</td>
<td>44.6 (9.1)</td>
<td>44.7 (11.6)</td>
</tr>
<tr>
<td>Weight; kg</td>
<td>71.4 (15.6)</td>
<td>66.3 (12.1)</td>
<td>68.4 (13.9)</td>
</tr>
<tr>
<td>Sex ratio; M : F</td>
<td>13:23</td>
<td>14:23</td>
<td>15:24</td>
</tr>
</tbody>
</table>

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analogue scores for the TIVA group, propofol induction group and thiopentone induction group were 35 (12–100) mm, 32 (0–100) mm and 43 (0–81) mm, respectively. There were no statistical differences in the frequency of dreaming at home. Median (range) dream scores for the TIVA group, propofol induction group and thiopentone were 1 (0–3), 2 (0–3) and 2 (0–3), respectively. The anaesthetist was male.

The incidences of dreaming and recall of dreaming are shown in Fig. 1. There was a significant difference between the groups in whether patients reported that they had dreamt (p = 0.01). The TIVA group had more dreams that they could not recall the content of than did the propofol induction group, which had more dreams than the thiopentone induction group. If pairs of groups were compared there was only a statistical difference between the TIVA group and the thiopentone induction group. This difference held when patients who were nauseous were excluded. The TIVA group had a greater number of recalled dreams than did the propofol induction group and the thiopentone induction group. The results of the emotions and bodily states questionnaire are shown in Table 4. On awakening from anaesthesia, the groups were only significantly different in the emotions and bodily states ‘sick’ (p < 0.0038) and ‘happy’ (p < 0.0038). The TIVA group reported feeling slightly more sexual than the other two groups but this difference was not significant. When pairs of groups were compared, the TIVA and propofol induction groups were less sick than the thiopentone induction group. The TIVA group showed greater happiness than the propofol induction group and the latter were happier than the thiopentone group. The intergroup comparison showed a significant difference between the TIVA group and the thiopentone group.

Twenty-four (21.4%) of the patients were able to report the content of their dreams at recovery. Nineteen of the dreams were scored as zero on the overt sexuality scale, i.e. they showed no evidence of overt sexuality. There were five dreams not scored as zero. The TIVA propofol group had two dreams with sexual content, scored as 1 and 4. The propofol induction group had one dream scored as 1 and the thiopentone induction group had two dreams with sexual content, each scored as 1. Each of the dreams scored as 1 was only vaguely related to sex, e.g. two of them were of meeting people in a happy atmosphere. The score of 4 was for a dream in which a male patient reported being with his wife and wanting to have sex with her.

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**Table 3** Duration of anaesthesia and surgery and time from admission to the recovery room to interview. Values are mean (SD).

<table>
<thead>
<tr>
<th>TIVA group</th>
<th>Propofol induction group</th>
<th>Thiopentone induction group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of anaesthesia; min 29.0 (11.5)</td>
<td>27.5 (9.7)</td>
<td>31.7 (10.6)</td>
</tr>
<tr>
<td>Duration of surgery; min 23.9 (10.8)</td>
<td>21.8 (9.3)</td>
<td>25.7 (9.8)</td>
</tr>
<tr>
<td>Time to interview; min 12.2 (3.7)</td>
<td>13.2 (4.8)</td>
<td>14.8 (5.1)</td>
</tr>
</tbody>
</table>

**Table 4** Modified emotions scale and modified bodily states. Number of patients reporting the presence of each emotion or bodily state.

<table>
<thead>
<tr>
<th>TIVA group</th>
<th>Propofol induction group</th>
<th>Thiopentone induction group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angry 1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Apprehensive 1</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Happy 28*</td>
<td>22*</td>
<td>14*</td>
</tr>
<tr>
<td>Sad/crying 7</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Confused 7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Sexual</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Hungry 10</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Thirsty 13</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Sick 3*</td>
<td>7*</td>
<td>17*</td>
</tr>
<tr>
<td>High</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Dizzy</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Light-headed</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Headache 1</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

* p < 0.0038 between groups.

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**Figure 1** Frequency of dreaming with and without recall in the three study groups. (■) TIVA group, (□) propofol induction group, (□) thiopentone induction group.
Discussion

The occurrence of dreams during general anaesthesia is well documented, although the content of the dreams had not received much attention until the initial case reports of patients experiencing dreams with sexual content while under propofol anaesthesia [1, 2].

Forty-three per cent of patients receiving total intravenous anaesthesia with propofol and 13% of patients receiving thiopentone/enflurane anaesthesia whilst undergoing otorhinolaryngological surgery reported dreams when questioned as soon as verbal communication was established [9]. When questioned later these incidences reduced to 10% and 3%, respectively. The majority of patients who received propofol reported their dreams as being ‘very pleasant’, a sensation not reported by the thiopentone/enflurane group. Similarly, Oddby-Murbeck & Jakobsson found that 3 of 30 patients who received propofol and 1 of 30 patients who received isoflurane recalled dreaming during surgery; all the dreams were pleasant and were not related to the operation [15].

Contrary to these reports, Thompson & Knight [16] found no incidents of sexual dreams in a group of over 300 predominantly male patients anaesthetised with propofol and in a group of 40 patients just one male had a dream about his female anaesthetist. They suggested an increased dose of propofol might further decrease this incidence. Other authors [17] compared patients receiving propofol with those receiving thiopentone and found that the incidence of dreams was low and equal in the two groups. However, their interviews occurred 1 h after the operation and they admitted that this delay may have resulted in some loss of data. The two patients reporting unpleasant dreams were in the thiopentone group. The propofol group had a greater incidence of pleasant dreams than did the thiopentone group. A second study [18] found only four patients reporting vivid dreams out of 61 given propofol or propofol and alfentanil and found that only four out of 65 patients given thiopentone/enflurane reported vivid dreams.

In our study there was very little difference between the three groups in the number of dreams actually recalled and in the content of these dreams. The TIVA propofol group had a slightly greater tendency to report feeling sexual on waking than did the other two groups and was happier than the other groups but this seems not to have resulted in sexual dreams. Marsch et al. [10] hypothesised that, in contrast to the use of other anaesthetics, the rapid recovery from propofol anaesthesia might permit verbal communication before the patient had forgotten a dream. The rapid recovery from propofol is well documented [19–21] although the fact that amnesia can be caused by low-dose infusions of propofol should be noted [22]. Such dreaming might be related to the depth of anaesthesia or to different anaesthetic requirements of some patients [23], rather than being a direct effect of propofol. This might explain the finding in the study by Millar [18] that there were no differences in ‘vivid dreams’ when comparing propofol and thiopentone in a situation where clinical judgement was used for drug titration.

The three groups in our study did differ in the numbers reporting that they were sure they had had a dream but could not recall it, with the TIVA group reporting the highest incidence of this occurrence. The finding of a greater number of unrecalled dreams under propofol than thiopentone anaesthesia is similar to the findings of Oddby-Murbeck & Jakobsson [15] that patients receiving propofol were more likely to believe that they had heard soft music played to them than were isoflurane patients, regardless of whether music had been played or not. This might be related to the excitatory side-effects of propofol caused by suppression of the GABA_A inhibitory system [24] and seen in the increased sensation-seeking effect present during propofol recovery [17]. Alternatively, the difference in reporting that a dream had occurred may result because propofol caused less postoperative amnesia than other anaesthetics [20, 25–27]. Subanaesthetic doses of propofol do not affect immediate memory recall, although delayed recall is impaired [12].

Despite the large number of case reports of sexual imagery following propofol anaesthesia, we were unable to find any appreciable differences in this aspect of content between the three groups studied. Each group had only a small number of dreams even remotely related to sex. This result might in part derive from the nonsexual nature of the surgical procedure. Bricker [28] reported that 12% of women displayed amorous and disinhibited behaviour after minor gynaecological surgery with propofol anaesthesia but no such behaviour occurred after abdominal laparoscopy. Dundee [7] found that almost 50% of dreams had no relationship to the surgical procedure when benzodiazepine sedation was used. Some of the reports of sexual hallucinations with propofol do not arise during gynaecological procedures [3]. Future studies need to address the effect of controlling for the type of operation and the sex of the anaesthetist in order to clarify this issue.

We conclude that propofol per se did not induce sexual behaviour or hallucinations when compared to thiopentone and that warning of the possibility of sexual fantasies, as suggested by Thomas & Boheimer [5], might create more problems than it solves. None of the dreams was unpleasant. In comparison, Brimacombe & Macfie [29] found that nightmares occurred frequently in the middle of the first postoperative week after major surgery and were associated with rapid eye movement sleep.

These findings confirm previous reports of the beneficial
effects of propofol on mood compared to other anaesthetics. Zacny et al. [30] reported that 50% of their study population liked the effects of subanaesthetic propofol in a behavioural choice study and warned that it might have abuse potential. There is one report of an anaesthetist addicted to propofol [31]. Other authors have found that patients receiving propofol had a more adventurous mood than those receiving thiopentone [17] and have reported the clinical impression that patients receiving propofol often have signs of euphoria during recovery [15], felt more vigorous than thiopentone induction patients [32] and that propofol produced an enjoyable mood [26]. We found that patients who received propofol were less dizzy and sick than thiopentone controls which may contribute to their improved mood. Millar & Jewkes [18] reported a greater feeling of well-being at discharge after propofol than after thiopentone. Consistent with our results, two studies found no nausea or vomiting occurring after surgery with propofol and significantly less nausea and vomiting in a propofol group than in a thiopentone group [18, 33].

In conclusion we found that patients anaesthetised with propofol had more dreams than those anaesthetised with thiopentone. The incidence of dreams where the content could be recalled was also higher with propofol. Patients who received propofol were less nauseated, less sick and were happier than those who were given thiopentone.

References

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