Patient-Controlled Sedation

Chandra Rodrigo, MBBS, FRCA, FFARCSI, FHKCA, FHKAM (Anaesthesiology)
Faculty of Dentistry, University of Hong Kong, Hong Kong, China.

Patient-controlled sedation was utilized in patients aged 15 to 85 yr who were undergoing surgery under local or regional anesthesia. Midazolam, propofol, and methohexitone were used, either by themselves or in combination with fentanyl or alfentanil. Sedation was mild to moderate in the majority of patients, and operating conditions were good. The sedation method provided patients the ability to control the sedation and to vary the degree of sedation according to the environment and to the stress of the procedure. Sedation of the elderly, which tends to be problematic, was made easy using this method, and the elderly patients appeared to enjoy the option. The problems encountered were oversedation, respiratory depression, pain during injection, and postural hypotension.

Key Words: Patient-controlled sedation; Review.

In sedation, one or more drugs are used to depress the central nervous system in order to decrease the patient's awareness of the surroundings, which enables treatment to be carried out without interference from anxious patients. Sedation may be conscious sedation or deep sedation. During conscious sedation, the patient maintains verbal contact throughout the period of sedation, whereas during deep sedation, the patient may be conscious at times and unconscious at other times, drifting from one state to the other.

Sedation is usually carried out using one or more drugs administered by various routes. Substances that cannot be titrated can be used for sedation by administering them orally, nasally, sublingually, subcutaneously, intramuscularly, and rectally. Unfortunately, with these methods, some people are undersedated and some are oversedated. Oversedation is a bigger problem than undersedation, because there is no way to decrease the degree of sedation. Thus, it may take a long time for oversedated patients to recover to a degree of sedation that is suitable for the procedure to be carried out. This leads to a delay in carrying out the procedure and in discharging the patient.

Titratable sedation can be administered via either by inhalational or intravenous (IV) routes. Of these two, many people prefer IV sedation because the drug can be titrated according to the response of the patient and because the patient can often be sedated to a degree deeper than is possible with inhalational sedation. IV sedation is usually carried out by a qualified individual, who either administers the drug according to a milligram per kilogram of body weight basis or who administers the drug in increments up to a clinical end point. The latter method is the preferred method, because the response of patients to drugs may differ from patient to patient and because the former method may result in oversedation of certain patients. Though administering the drug according to the response of the patient and terminating the supply of the drug at a predetermined end point will suit the operator, the main aim of sedation is to satisfy the patient. Patient satisfaction can be difficult to provide because of the pharmacokinetic and pharmacodynamic variability, different interpatient requirements, poorly defined patient expectations, and changing intraoperative conditions.[1] These same problems are an issue in the postoperative period, and patient-controlled analgesia, in which patients obtain a dose of analgesic by pressing a button, was used to meet postoperative analgesic requirements.[2] Similarly, patient-controlled sedation has been studied to determine whether it may provide a means to overcome the above-mentioned problems.[1,3–30]

During patient-controlled sedation, an infusion pump attached to a reservoir provides the sedative drug. When the patient presses a button, the pump is activated and a predetermined bolus of the drug is injected into the

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Address correspondence to Dr. Chandra Rodrigo, Block 1, 23 Sha Wan Drive, Pokfulam, Hong Kong.

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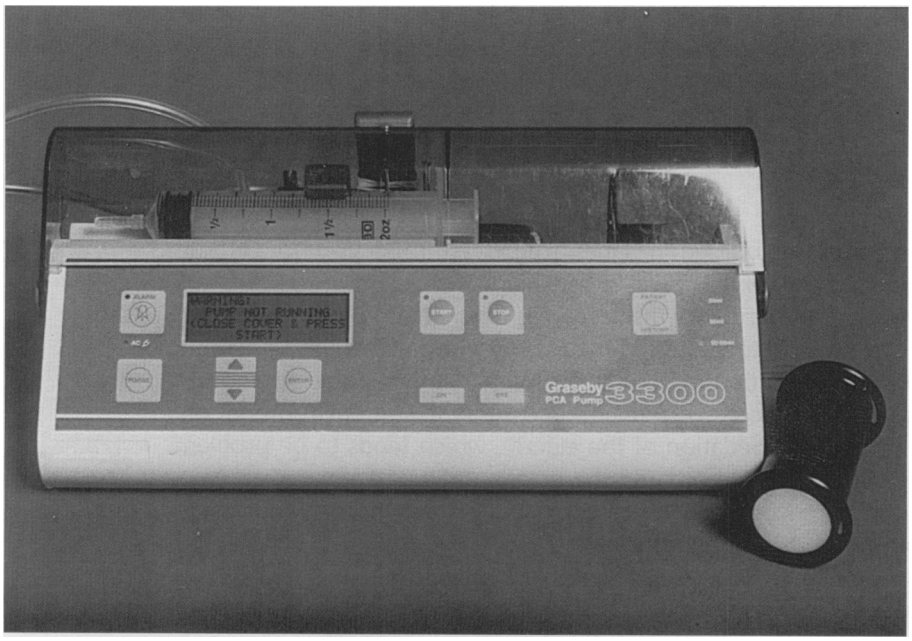

Figure 1. Graseby Medical PCA Pump (Graseby Medical, Wakford, UK).

patient. After the administration of this increment, there is a minimum cutoff interval or a lockout period. If the patient presses the button during this time, he or she will not receive any of the drug. Following the lockout period, the patient can obtain another bolus of the drug by pressing the button. The end point of sedation is when the patient thinks the sedation is sufficient for him or her to tolerate the operative procedure.

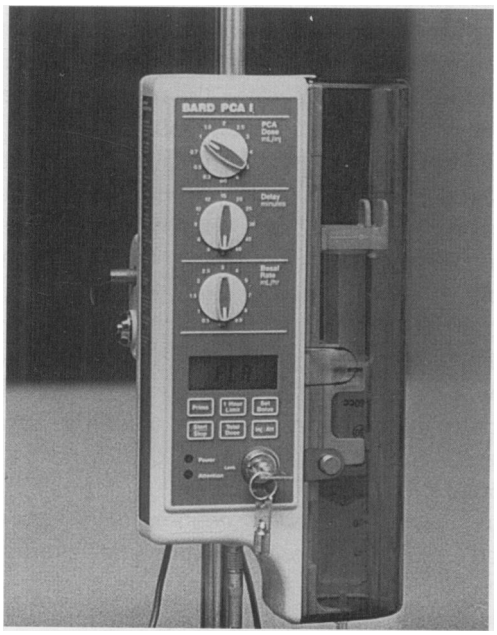

Figure 2. Bard PCA 1 Pump (C. R. Bard Inc., North Reading, MA, USA).

PUMPS

The infusion pumps used in patient-controlled sedation were pumps that were initially designed for patient-controlled analgesia; namely the Graseby Medical PCA pump (Figure 1),[1,6,7,9,10,16,22,25] the Bard PCA pump (Figure 2),[4,11,12,14] the Abbott Lifecare PCA infuser,[3,5,7] the Ohmeda 9000 syringe pump with a modified back bar containing additional computer hardware,[8,13,17] and the Baxter Intermate LV250 infusor with patient control module.[20,29,30] The Graseby Medical and Bard PCA pumps have a similar basic design, but in the Bard PCA pump, the minimum lockout period is 3 min. Both pumps have a syringe containing a certain concentration of the drug fitted to the pump. The pump is able to provide a great degree of flexibility for the doctor, because it is programmed to be able to deliver any quantity desired of initial bolus dose and any basal infusion. It also provides flexibility for the patient, because it can deliver any increments that the patient requests by pressing the button. The pump can also be programmed to set a lockout period if this is required. The maximum infusion rate of the Graseby Medical PCA pump is 200 ml/hr. The Ohmeda 9000 infusion pump can be programmed to function like the Graseby pump. The Ohmeda 9000 differs from the other two pumps in that the computer can be programmed to make the infusion pump deliver the drug at a much faster rate, up to 1200 ml/hr. The Baxter Intermediate LV250 infusor is a non-electronic device with an elastomeric bladder that acts as a reservoir. Its outflow tubing is connected to a pa-

tient-control module for delivery of the drug. This module incorporates a flow restrictor, built into the delivery tube, which determines the lockout period. The flow rates with normal saline and with 1% propofol have been 260 and 170 ml/hr, respectively.[20]

HANDLE WITH BUTTON

The handle with the button that patients press is small in the Bard pump and in the new Graseby PCA pumps, compared with the big handle with button in the old Graseby pump. The bigger handle with button appears to be better for patient-controlled sedation, as a stronger grip is necessary to hold the big handle.[16] When a patient is deeply sedated, the patient loses the muscle tone necessary to grip the handle and the handle falls,[11,16,19] providing a safety mechanism to prevent excessive administration of the drug, which could result in loss of consciousness. Furthermore, the buttons require the use of some pressure to activate them. Patients who are deeply sedated are unable to exert sufficient pressure to activate the buttons, providing a further safety mechanism to prevent excessive administration of the drug.

PATIENT SELECTION

The patients included were of physical status ASA Grade I to III. Patients were between the ages of 15 and 85 yr, and all could understand and carry out the instructions given to them. During selection, the use of patient-controlled sedation and the technique being offered to them was explained to the patients so that those who were strongly opposed to having control of the sedation could decline.[13]

PREMEDICATION

No premedication was used for the majority of patients. In some studies, patients were premedicated with triazolam[18] or with 5–10 mg of diazepam and/or 5–10 mg of morphine[5,23] either orally or intramuscularly 1 hr prior to the operation. In some studies, patient-controlled sedation was used to premedicate patients undergoing minor or major surgery.[4,7] This practice might more accurately be termed patient-controlled anxiolysis.

INSTRUCTIONS

All patients were told the purpose of sedation and were given instructions preoperatively.[16] They were informed that the sedation would help them tolerate the operative procedure and that they would have to press the button in order to get a dose of the sedative. Further, patients were told that although they would be sedated, they should still be able to respond to the commands of the surgeon and they should not go to sleep. Patients were instructed not to press the button in response to pain, because pressing the button does not relieve pain. Patients were informed that they should instead inform the surgeon, who would give more local anesthesia to relieve the pain.[11,16,19]

DRUGS

Drugs used for patient-controlled sedation were midazolam (Table 1), propofol (Table 2), and methohexital.[25] Midazolam and propofol were also used in combination with either fentanyl or alfentanil.

Midazolam

In some studies, midazolam was used as the sole sedative agent, either with a bolus dose at the start[11,12,14] or without a bolus dose.[3,5,8,10,16,19,22,27] Midazolam was used successfully for sedation in doses of 0.1 mg without a lockout period or in doses of 0.5 or 1 mg with a 1-min lockout period. In one study, a basal infusion was used.[14] Thus, that study cannot be considered as an example of patient-controlled sedation.

Midazolam and Opioid

In some studies, fentanyl or alfentanil was used in combination with midazolam.[5,8,10] Usually this combination is unnecessary in the case of midazolam, as the sedation produced by midazolam is sufficient for patients to undergo the surgical procedures under regional or local anesthesia. However, when regional anesthesia is not complete and the patient retains some perception of pain or when the surgical procedure lasts longer than 2 to 3 hr, with the patient lying in one position for a long period, the patient may tend to become restless with midazolam sedation only. In this situation, supplementation with a narcotic such as fentanyl was suggested.[5]

Propofol

Some studies used propofol as the sole sedative agent, either with a bolus dose at the start,[1,6,18] or without a bolus dose.[8–10,13,17,22] Doses that were successfully used in more recent studies were 18 mg of propofol with a lockout period of 1 min[13] and 3.3 mg of propofol without a lockout interval.[10,22] Varying doses and lockout in-

Table 1. Dosages of Midazolam Used in Patient-Controlled Sedation

Premedication	Opioid	Basal Infusion (mg/hr)	Bolus (mg)	Increments (mg)	Rate of Infusion (ml/hr)	Age (yr)	Lockout Interval (min)	Reference
—	—	—	—	0.1	200	—	0	22, 27
—	Alfentanil 200 μg × 3	—	—	0.1	200	—	0	10
—	—	—	—	0.25	—	—	8	3
Diazepam 5–10 mg ± Morphine 5–10 mg	Fentanyl 25-μg increments	—	—	0.5	—	—	5	5
—	Fentanyl 0.7 μg/kg	—	—	0.5	1200	—	1	8
—	—	—	Sedate until Verrill's sign	0.5	—	—	3	12
—	—	1	2–3	0.5	—	50–60	5	14
—	—	1	2–3	0.65	—	61–80	5	14
—	—	1	2–3	0.75	—	81–90	5	14
—	—	—	—	1	200	—	1	16, 19, 27
—	—	—	2	1	—	—	3	11

tervals have been used according to the age of patients (Table 1). Some studies have used basal infusions of propofol and thus cannot be considered to be methods of patient-controlled sedation.[29,30]

Propofol and Opioid

In some studies, 0.7 μg of fentanyl was given before the patient received the first increment of propofol.[8,13] In another study, the propofol was supplemented with alfentanil.[10,24]

Propofol and Midazolam

In one study, midazolam was given as a basal infusion at a rate of 4 mg/hr, and patients obtained increments of 10 mg of propofol at 1-min intervals if they needed additional sedation.[23]

Methohexital

In some studies, methohexital was used as the sole sedative agent and was given in 2.5-mg increments without a lockout interval.[25]

LOCKOUT PERIOD

In the majority of studies there was a lockout period or cutoff interval, varying from 1 to 8 min, to prevent the patients from overdosing themselves (Tables 1 and 2). In some studies, a 3-min lockout period was used for midazolam.[11,12,29,30] Grattidge[9] used a 3-min lockout period for propofol, and Pizzarini et al[18] used a 5-min lockout period for propofol. However, because of the results of these previous studies, many subsequent studies have shortened the lockout period to 1 min.[1,6,8,13,16,19,23,27] For elderly patients, researchers have used a 3-min lockout period for propofol[26,28] and a 5-min lockout period for a mixture of midazolam and fentanyl.[5] In critical care settings, midazolam has been used with a lockout period of 8 min.[3] In a recent study, the lockout interval was varied according to the age group.[17] One study's authors describe the method they employed as true patient-controlled sedation, as there was no lockout period in their method.[10] However, a recent report found that when there is no lockout period, patients receive far less than the amounts they demand because the pump is unable to infuse the drug at the rate the patients require, thus imposing an automatic lockout period.[27] This suggests that the so-called true patient-controlled sedation may be a misnomer. Many studies using small concentrations of drugs have used no lockout period.[10,20,22,25,27] However, in all of these studies, an automatic lockout

Table 2. Dosages of Propofol Used in Patient-Controlled Sedation

Premedication	Opioid	Basal Infusion (mg/kg/hr)	Bolus (mg)	Increments (mg)	Rate of Infusion (ml/hr)	Age (yr)	Lockout Interval (min)	Reference
			—					
—	—	—	—	3.3	200	—	0	22
—	Alfentanil 200 μg × 3	—	—	3.3	200	—	0	10
—	—	—	—	10	1200	≥60	1.5	17
—	—	—	—	12	1200	50–59	1.20	17
—	—	—	—	15	1200	40–49	1.10	17
—	—	—	—	18	1200	15–39	1	17
—	Fentanyl 0.7 μg/kg	—	—	18	1200	—	1	13
—	Fentanyl 0.7 μg/kg	—	—	20	1200	—	1	8
—	—	—	—	0.3/kg	—	—	3	26, 28
—	—	0.5	—	0.5/kg	—	—	3	29, 30
Triazolam	—	—	0.5/kg	0.5/kg	—	—	5	18
—	—	—	—	0.7/kg	—	—	3	9
—	Fentanyl 0.7 μg/kg	—	0.5/kg	0.7/kg	—	—	1	1, 6

period exists that depends on the drug concentration and on the rate of infusion of the pump.

The lockout period appears to be a safety feature preventing administration of excessive doses of the sedative drugs, which would lead to a loss of consciousness. With small doses of midazolam and no lockout period, loss of consciousness was reported in an elderly patient.[22] Thus, for the elderly, a lockout period is recommended even for small doses.

OPERATIVE PROCEDURES

Patient-controlled sedation was useful in procedures for cataracts,[22,26] in craniotomies for seizures,[29,30] and in dental,[1,8,11–14,16,19,20,25] lower abdominal,[5,10,15,17,23] orthopedic,[5,9,28] urological,[5,23] and vascular procedures[5] carried out under local or regional anesthesia. The majority of studies were conducted in third molar extractions because of the unique crossover design, which makes these procedures especially suitable for the testing of sedative drugs.

FACILITIES FOR RESUSCITATION

Many authors have stressed the importance of having resuscitation equipment and resuscitation drugs, including flumazenil and naloxone, if benzodiazepines and opioids are used, available in places where patient-controlled sedation is to be carried out. Staff skilled in airway management and resuscitation should also be available.[11]

OXYGEN SUPPLEMENTS

Oxygen supplements have been given in the majority of studies with propofol,[1,6,8–10,23] but in many of the studies that used midazolam, no oxygen supplements were given.[11–13,16,17,19] For young and healthy patients who undergo conscious sedation with midazolam, oxygen supplements appear to be unnecessary.[11] Nevertheless, not using oxygen may be contradictory to standards of conscious sedation in the United States, where supplementary oxygen is mandatory. Even though routine oxygen supplements may not be necessary, oxygen should be readily available in any place where patient-controlled sedation is being carried out. However, in studies on elderly or disabled patients, oxygen supplements were used with all drugs.[5,22,26,28]

INTRAVENOUS FLUIDS

In some studies, 1 L of fluid was given preoperatively to patients undergoing operative procedures under patient-controlled sedation. This choice was most common in studies in which propofol was being used.[1,8,13] The fluid was administered to prevent postural hypotension. In several studies in which midazolam has been used, the added fluid has been deemed unnecessary.[11,16,19]

MONITORING

Patients have been monitored from the beginning of the sedation procedure until recovery. All of the studies routinely recorded blood pressure, pulse, and oxygen saturation.[1,3–27] Additionally, some studies also monitored

the patient's electrocardiogram[1,8,9,13,17,22,28–30] and respiratory rate.[5,26,28–30] The respiratory rate was monitored through capnographic sampling from the mask.[28]

OPERATION OF THE TECHNIQUE

Patients do not find it difficult to understand and carry out the instructions. Initially some may be cautious. In studies where patients had the opportunity to operate the technique for a second time, they were able to control the sedation better the second time.[16,19] In many studies, the demand for the drug far exceeded the successful attempts of delivery.[6,14] In later studies with propofol, however, there were more successful attempts than unsuccessful ones.[8,13] In the so-called true patient-controlled sedation,[10] patients' demands far exceed the amount of drugs they receive because of the inability of the pump to infuse the drug at the rate requested.[27] It has also been observed that when patients require an increment during the procedure, some press the button many times because they are so eager to receive the drug as soon as possible and to get to a deeper level of sedation. Thus the lockout period, whether imposed by the sedationist or imposed simply by the inability of the pump to infuse the drug at the rate demanded, appears to be a safety mechanism in preventing patients from becoming unconscious. A few patients prefer not to control the sedation themselves.[11,13,14] Presumably, all of these patients would be eliminated before the start of the procedure, as they would be expected to decline the use of patient-controlled sedation when its use was explained and offered to them.[13] Once patients agree to have their operations carried out under local or regional anesthesia, supplemented with intravenous sedation, very few decline the use of patient-controlled sedation, and in no studies have they expressed regret after using the technique.

SEDATION

The degree of sedation was monitored in different studies according to different scales. A simple scale that was used to monitor sedation is shown in Table 3. In most studies, the degree of sedation was mild to moderate, with patients responding to verbal command. The studies found that during patient-controlled sedation, some patients do not wish to be deeply sedated but wish to be only drowsy and to know what is happening, while others wish to be deeply sedated. If a sedationist carries out sedation, the degree of sedation depends on the predetermined end point and not on the level of sedation that the patient would have desired. Thus, patient-controlled sedation provides a method so that patients can titrate the drug to the level of sedation that they wish. It was noted that some patients were graded as deeply sedated.[8–11,16,19,27] Without a lockout period, even with small increments of midazolam or propofol, marked sedation was reported in some instances.[10,21,22,27]

Table 3. Sedation Scale

Grade	*Degree of Sedation*	*Description*
1	No	Fully awake
2	Mild	Drowsy
3	Moderate	Eyes closed, but rousable to command
4	Deep	Eyes closed, but rousable to mild physical stimulation
5	Over	Eyes closed, unrousable to mild physical stimulation

Whether the drug used was propofol or midazolam and whether the concentration of the drug was weak or strong, with patient-controlled sedation, patients were able to achieve the degree of sedation they required to undergo an operative procedure, either by taking more of a less potent drug or less of a more potent drug.

The Poswillo report of 1991 recommended guidelines for general anesthesia, sedation, and resuscitation in dentistry in the United Kingdom.[31] One of its recommendations was that simple intravenous sedation be limited to the use of one drug with a single titrated dose and an end point remote from general anesthesia. In patient-controlled sedation, the end point of sedation is determined by the patients themselves and it is the degree of sedation that the patient thinks is satisfactory to tolerate the operation. Therefore, the end point may vary from patient to patient. However, if the end point determined by the patient does not result in loss of consciousness, then the end point could be considered to be remote from general anesthesia. The total of incremental doses of the drug used to attain the end point can be considered as a single titrated dose similar to that in sedationist-controlled conscious sedation. In a study[19] to find out whether patient-controlled sedation could be carried out according to the recommendations of the Poswillo report, it was found that patient-controlled sedation prior to the operative procedure produced adequate relaxation of patients and good operating conditions. This indicated that patient-controlled sedation could be conducted according to the Poswillo report recommendations by a single operator/sedationist. However, when these patients were allowed to obtain increments during surgery, the majority did obtain increments during surgery and wished to do so in the future. With some of these patients, the handle fell out of their hands, and some were assessed to have marked seda-

tion, indicating the need for close monitoring if patients were given the opportunity to obtain increments during surgery. Thus, it was recommended that patients should be permitted to have increments of the drug during the procedure only if there is a sedationist to monitor the patient during the procedure.[19]

OVERSEDATION

In one study with midazolam and fentanyl (where no lockout period was used), one elderly patient did not respond to command and was given flumazenil to reverse the effect of the midazolam.[22] This result was reported to be caused by the stacking of the doses as a result of the slow onset time of midazolam and the slow circulation in the elderly. In another study, with 0.33-ml boluses of propofol (3 mg) and no lockout interval, two patients were unresponsive and five were deeply sedated.[21] Other than these two reports, in no other studies were patients so sedated that they did not respond to command, which suggests the safety of this method. Occasionally, however, patients did require mild stimulation before responding to commands.[8,9,28] In one study,[8] the addition of an injection of a dose of fentanyl prior to patient-controlled sedation with midazolam resulted in two patients being so deeply sedated that they had to be mildly stimulated to respond to command. The addition of fentanyl may be beneficial when sedating with propofol, because fentanyl may enhance the sedation and reduce the incidence of talkativeness that sometimes occurs with propofol. The fentanyl may be unnecessary with midazolam sedation. In one study,[10] increments of alfentanil were used during the operative procedure in patient-controlled sedation with midazolam; the patient required mild physical stimulation to respond to verbal command. Though in this study, alfentanil was given for the pain, it must be remembered that alfentanil potentiates the action of midazolam and should be used with care if it is to be given during patient-controlled sedation with midazolam.

The paradoxical reactions occasionally reported with midazolam administered by a sedationist have not been reported in patient-controlled sedation. This lack of unusual reactions may be caused by the positive psychological effect of allowing the patients to feel that they have some control over their situations.

OPERATING CONDITIONS

In the majority of studies, the operators have assessed the operating conditions as good with good cooperation from patients.[1,6,11,13,16,19,20,22,23,25–28] In one study,[16] in which patients had the opportunity to sedate themselves twice, they did a better job of performing the sedation and provided better operating conditions during the second visit. During craniotomy for seizures, the incidence of intraoperative seizures has been greater under neuroleptic anesthesia than under patient-controlled sedation.[30]

AMNESIA

With midazolam, propofol, and methohexitone, the majority of patients were amnesic to intraoperative events.[1,6,11,12,25] However, those who wished to be lightly sedated were not amnesic during the operative procedure. One study recorded amnesia for postoperative events with midazolam/fentanyl but not with propofol/fentanyl.[8]

VITAL SIGNS

In the majority of patients, vital signs have been stable.

Respiration

The most common problem encountered during patient-controlled sedation is respiratory depression, observed as a decrease in the oxygen saturation and/or the respiratory rate. In some patients, especially deeply sedated patients, the oxygen saturation may fall as a result of airway obstruction. When this happens, it is important to request the patient to take a deep breath. If the patient fails to do so, one may have to administer oxygen. At times, oxygen may have to be given under positive pressure. In the majority of studies, the oxygen saturation was within normal limits. However, in one study,[21] the oxygen saturation fell to 84%, and in another study,[9] it fell below 95% in two patients who were undergoing sedation with propofol. In another study,[22] the oxygen saturation fell to 90% in an elderly patient who was breathing air. The situation was remedied by asking the patient to take some deep breaths. In another study,[5] despite supplemental oxygen of 3 L/min via a nasal cannula, the oxygen saturation fell to 90% in one patient who was undergoing sedation with a mixture of midazolam and fentanyl. In this case, the respiratory depression was due to fentanyl, leading to the question of whether it is necessary to add fentanyl to midazolam. A decrease in oxygen saturation to below 90% has been observed in patients undergoing sedation with midazolam and alfentanil.[24]

The possibility for a decrease in oxygen saturation emphasizes the need for close monitoring during pa-

tient-controlled sedation, particularly when opioids are added to the sedative agents. Transient respiratory rate depression has been seen in six patients, aged 65 to 78 yr, who were given propofol in one study.[28] A transient episode of apnea was detected in an elderly patient during two increments of propofol of 0.3mg/kg, 3 min apart.[26] In this case, stimulation of the patient successfully restarted spontaneous ventilation. A decrease in respiratory rate has also been observed with midazolam and alfentanil.[24] The danger of decreasing respiratory rate means that if patients are allowed to obtain increments during the procedure, then they should be monitored carefully by properly trained people.[27]

Circulation

In the majority of patients, stable cardiovascular parameters have been reported. In one study in the elderly, there were significant peak increases in blood pressure during surgery with propofol and normal saline but not with midazolam.[22] There have been no records of a severe drop in blood pressure with any studies. Intraoperatively, one patient who had been given propofol became bradycardic and hypotensive but responded to atropine.[17] Postoperatively, one patient fainted on sitting up following propofol sedation.[10] Though both midazolam and propofol may cause postural hypotension, it is more common with propofol. In some studies, 1 L of crystalloids was infused prior to sedation to prevent this problem.[1,8,13]

RECOVERY

There was no difference between the time needed to achieve street fitness following patient-controlled sedation with midazolam and propofol[10] and the time needed with propofol and methohexitone.[25] However, psychometric tests have shown a greater residual effect on cognitive function with midazolam.[8,10] In a study on the elderly,[22] there were no significant differences between the psychometric tests carried out with midazolam and those carried out with propofol. In one study, a patient who had propofol fainted, and a patient who had midazolam/alfentanil became nauseated postoperatively.[10] Midazolam on its own rarely produces nausea.

PATIENTS' ASSESSMENTS

When patients had the opportunity to experience patient-controlled sedation, the majority liked it, were relaxed, and were willing to experience the technique again.[1,6,8–11,16,17,19,23,24,26,30] The majority thought that they had injected themselves with the correct dose to tolerate the operative procedures.[10–12,16,19,20,25] The majority liked the idea of self-administration of sedation.[1,6,9,11,19,20,26,28,30] When they had the opportunity to sedate themselves again, the majority thought that they controlled the sedation procedure better the second time.[16,19]

In studies that compared anesthetist-controlled sedation with patient-controlled sedation,[5,6,11,28] some studies found that the patients were more comfortable with patient-controlled sedation,[5,6,28] while in another study,[11] almost an equal number preferred each technique. Of the patients who preferred anesthetist-controlled sedation, 50% did not want to be troubled with controlling the sedation, and the other 50% thought that the anesthetist could sedate them better. However, those who preferred patient-controlled sedation preferred it because they thought that they sedated themselves better than the anesthetist.

In studies that compared a continuous infusion with patient-controlled sedation[11,12] with midazolam[12] and with propofol,[13] almost an equal number have preferred each technique.

In studies that compared no sedation with patient-controlled sedation in the elderly,[22,26] in the no-sedation group, the patients were more anxious during the operation.[22] In the sedation group,[26] patients were more comfortable with patient-controlled sedation. However, the majority in both groups were willing to undergo either procedure again.

In a study comparing 1- and 3-min lockout intervals with midazolam,[16] the majority of patients preferred to have midazolam increments at 1-min intervals rather then at 3-min intervals. When given the opportunity to administer patient-controlled sedation for a second time, the majority stated that they could control the sedation better the second time.

In another study, the benefits of patient-controlled sedation with midazolam permitted only prior to surgery were compared with those associated with sedation permitted throughout surgery. The patients were relaxed when they had midazolam sedation only prior to the procedure, but when given the opportunity, they preferred to obtain increments during the operative procedure.[19]

Many elderly patients appear to enjoy the option of controlling their own sedation. When elderly patients were given the opportunity to use patient-controlled sedation, some chose not to use it, as they thought that during that operation it was not necessary. However, many preferred to know that some form of intraoperative sedation was available if they desired to use it.[27]

BENEFITS

Patient-controlled sedation provides a degree of sedation according to the patients' requirements, and enables the patients to vary the degree of sedation according to the varying degree of stress associated with the procedure and the environment. It also helps to provide continuous sedation if the procedure is unintentionally prolonged due to an unforeseen problem. In procedures where sedation is not routinely required, patient-controlled sedation can be made available for use during the operation so that the patients can sedate themselves if they feel that sedation is required. During an operation, the audible sound emitted by pressing the demand button reassures the patient that he or she is receiving a dose of the drug to combat the stress encountered. Patient-controlled sedation also provides psychological support to the patient because it allows the patient to control or modify an unpleasant stimulus.[32]

Patient-controlled sedation provides the surgeon with a method in which the patient, though sedated, can communicate with the operator and the staff, thus allowing the surgeon to obtain the cooperation of the patient. The audible sound of a demand also alerts the operator and the staff to the level of the patient's discomfort, so that either the surgeon can modify the approach or the other members of the staff can offer appropriate support to the patient to overcome the discomfort. In this manner, sedation becomes a team approach rather than something that is of interest to the sedationist alone.[33]

PROBLEMS

The most common problem encountered during patient-controlled sedation is respiratory depression. Another problem encountered with propofol was pain at the infusion site, even when lidocaine was administered prior to injection of propofol.[9,10,25,28] Occasionally, oversedation, postural hypotension, and nausea were reported.

LIMITATIONS

In order to be able to carry out patient-controlled sedation, the patient should be able to understand instructions and should be prepared to carry out the instructions. The time to the start of surgery from the time of sedation may vary with different patients, drugs, and techniques used. This delay may not be suitable for very short procedures.

The need for additional equipment and the cost of this equipment is another limitation. There is a need for better response systems, which will provide the drug more rapidly to the patient.

CONCLUSION

Patient-controlled sedation has given patients the opportunity to sedate themselves to the degree they desire when they are undergoing an operation. Most patients, including the elderly, liked to control their own sedation and liked to know that they had the ability to negate stress during a surgical event.

There are many methods available for patient-controlled sedation, as long as the methods are carried out with good supervision and good monitoring. It is essential to continuously monitor the sedated patient, and it is imperative that the staff monitoring the sedation be skilled in airway management and resuscitation. Furthermore, oxygen, emergency drugs, and resuscitation equipment should be readily available in a location in which patient-controlled sedation is being carried out.

Patient-controlled sedation must be used with caution in the elderly, in whom the effect of bolus doses is less predictable. Thus, small doses with long lockout periods are advisable.

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