Topical Review

Sedation in outpatient bronchoscopy

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Bronchoscopy is a procedure that is likely to provoke anxiety as the patient is surrounded by monitoring and bronchoscopy equipment, and care is administered by strangers who perform intimate, invasive, and sometimes, painful procedures. Sedation is needed, therefore, to allay anxiety and reduce stress, improve patient comfort and co-operation, provide amnesia and facilitate the bronchoscopic procedure. In this review we try to summarize the current knowledge on currently used sedation protocols with special reference to the commonly used pharmacological agents. We believe sedation should be used routinely in fiberoptic bronchoscopy in order to achieve a safe and pleasant procedure for both the patient and the pulmonologist.

Key words: sedation; fiberoptic bronchoscopy; benzodiazepines; opiates; topical anaesthesia; analgesia.

Introduction

Sedation may be defined as a state of lessened functional activity resulting in greater patient comfort, or ‘a state in which pre-existing anxiety is removed or lessened or in which signs of anxiety do not develop in circumstances in which they would be expected to do so.’ (1). The bronchoscopy suite is likely to provoke anxiety. The patient is surrounded by monitoring and bronchoscopy equipment, and care is administered by strangers who perform intimate, invasive, often painful procedures. A recent study (2) showed that most patients (62%) undergoing fiberoptic bronchoscopy are anxious and fear pain and breathing difficulties that might be experienced during the procedure. Explanations about the procedure and previous personal experience of an endoscopic procedure had little impact on allaying the fears of patients. In another study (3), fear of the possible diagnosis of cancer, and dyspnoea or asphyxiation was the main cause of anxiety in 68% of the patients. Sedation may therefore allay anxiety and reduce stress, improve patient comfort and co-operation, provide amnesia and facilitate the bronchoscopic procedure. Since in some cases repeated bronchoscopies are necessary, achieving the above mentioned goals may increase the willingness of patients to attend another bronchoscopy.

It is important to discriminate between sedation and analgesia. As suggested by Sutherland (4), it is not the awareness but the pain that makes the bronchoscopy so unpleasant. During bronchoscopy, pain is caused mostly by the passage of the bronchoscope through the nose and to some extent through the glottis area. Analgesics should therefore be administered specifically to relieve pain. A successful sedation regimen may augment methods of analgesia by reducing the emotional component of pain. It is therefore not surprising that sedation and analgesia are often combined conceptually as they are intertwined pharmacologically. Several studies confirm the common practice of considering sedation with or without analgesia for bronchoscopic procedures:

- In 1983, a postal survey (5) of bronchoscopic practice in the United Kingdom indicated that of the 227 physicians performing fiberoptic bronchoscopy, only 6% did so without routinely using any sedative drugs. Of the 227 physicians performing fiberoptic bronchoscopy, only 6% did so without routinely using any sedative drugs. Of the 227 physicians performing fiberoptic bronchoscopy, only 6% did so without routinely using any sedative drugs.

- In 1989, a postal survey (6) of bronchoscopic practice in North America indicated that of the 761 physicians performing fiberoptic bronchoscopy, most of those using two drugs used an opiate–benzodiazepine combination. There was no association between overall complications and any particular sedative combination.

- In 1992, results from a Scottish multi-centre prospective study (7) of bronchoscopy indicated that of the 500 physicians performing fiberoptic bronchoscopy, sedation was used rarely by 24%, sometimes by 23% and routinely by 51%. Midazolam and diazepam were the most commonly used agents for fiberoptic bronchoscopy.

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and droperidol, oral temazepam or intra-muscular pethidine.

- In 1997, a similar survey that was performed in Israel (8) found that most centres used pethidine or morphine i.m. and midazolam i.v. for sedation. One centre used general anaesthesia and three centres admitted the patients routinely to the ward for bronchoscopy.

The necessity, however, for any sedation for fiberoptic bronchoscopy has been questioned (9-10). Good patient satisfaction has been reported where only local anaesthesia was used with no sedation (9,11,12). Hatton et al. (9) reported that although physicians found the procedure easier with midazolam, the drug was not significantly better than placebo in making patients comfortable or willing to have the test repeated. Moreover, opiate sedation conferred no advantage over placebo in patient perception of comfort, but reduced willingness to have a repeat bronchoscopy, a finding attributed to the dysphoric effects of opiates and to the high incidence of nausea and vomiting associated with these drugs. Nevertheless, these studies were criticised (10) for the lack of objective assessment of sedation—like the Ramsay score (14)—to titrate the level of sedation (Table 1). In fact, as suggested by Parker et al. (10), the failure of physicians to identify whether active treatment had been given suggests that many patients were not sedated. The dose of midazolam used in Hatton’s study (9) was 0.07 mg kg⁻¹. Williams et al. (15) showed that when higher (0.24 mg kg⁻¹) doses of midazolam were administered, complete amnesia was achieved and only one of the 123 patients was not prepared to have the procedure repeated.

Bronchoscopy is a brief procedure often performed on an outpatient basis and, except for the use of very short-acting drugs, routine use of sedation may prolong hospital stay and increase the cost related to the procedure. Although sedation may facilitate the bronchoscopist’s work, the patient should be involved in whether they wish to have sedation. Sedation can be administered only in units in which the medical team has had specific training, monitoring and resuscitation facilities are available, as well as continuous nursing supervision for those patients who take time to wake up.

**Table 1. Ramsay sedation levels (14)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awake</td>
<td>Patient anxious and agitated or restless or both</td>
</tr>
<tr>
<td>1</td>
<td>Patient co-operative, oriented, tranquil</td>
</tr>
<tr>
<td>2</td>
<td>Patients responds to commands only</td>
</tr>
<tr>
<td>Asleep</td>
<td>Dependent on the patient’s response to light glabellar tap or loud auditory stimulus</td>
</tr>
<tr>
<td>4</td>
<td>Brisk response</td>
</tr>
<tr>
<td>5</td>
<td>Sluggish response</td>
</tr>
<tr>
<td>6</td>
<td>No response</td>
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</tbody>
</table>

**Agents for premedication and sedation during bronchoscopy**

There is a wide choice of sedative drugs and drug combinations routinely used by bronchoscopists (Table 2). The intent of this section is to be a comprehensive review of some of the agents used for sedation in an outpatient setting of fiberoptic bronchoscopy. Only agents that have been evaluated are included in this review: topical lidocaine for local anaesthesia; anti-cholinergic drugs for reducing secretion, inhibition of vasovagal responses and for bronchodilatation; codeine phosphate for its anti-tussive properties; benzodiazepines for sedation—hypnosis, anxiolysis and amnesia; propofol for sedation—hypnosis; opioids for analgesia; clonidine for sedation, improving haemodynamic stability and reducing the requirements for other sedating agents. In addition, the benzodiazepine’s and opiate’s antagonists, flumazenil and naltrexone, respectively, are discussed. These two antagonists should be readily available in every bronchology unit in which sedation is provided.

**TOPICAL ANAESTHESIA**

Most centres use direct application of local anaesthetics on mucous membranes during fiberoptic bronchoscopy (15-19). Lidocaine 2–10%, benzocaine (20%), tetracaine (1%), and cocaine (4%) are commonly used.

Lidocaine is the most commonly used local anaesthetic for fiberoptic bronchoscopy. It is short-acting, has a wide margin of safety and tissue toxicity is rare. When applied on mucous membranes in the upper airway, peak serum lidocaine concentrations are 25–50% lower than if the same dose had been given intravenously. However, the administration of lidocaine solution to the lower bronchial tree may result in significant serum concentrations (61). A recent study (62) confirmed the safety of lidocaine administered at a dose that did not exceed 7 mg kg⁻¹. Central nervous system and cardiac toxicity should be expected only when higher doses are used. Lidocaine can be sprayed onto the tongue, oropharynx and pharynx, and can be applied directly through the bronchoscope to the visualized glottis. Nebulization can also be used just prior to the procedure. Superior laryngeal nerve block and transtracheal anaesthesia (through the cricothyroid membrane) are very effective but are rarely used today in most centres.

Intravenous lidocaine has also been shown to prevent cough as well as to reduce bronchial hyperreactivity (15). Systemic side-effects, however, may occur.

Aerosolized benzocaine (20% solution) was commonly used in the past but its action is short. Tetracaine (1%) and cocaine (4%) are seldom used due to toxicity of the first and the possible addictive effect of the latter.

**ANTI-CHOLINERGIC DRUGS**

Routine use of anti-cholinergic drugs as premedication for fiberoptic bronchoscopy is generally recommended to dry
<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose and route</th>
<th>Onset</th>
<th>Duration</th>
<th>Effect</th>
<th>Side-effects</th>
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<tbody>
<tr>
<td><strong>Anti-cholinergic</strong></td>
<td></td>
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<tr>
<td>Atropin</td>
<td>i.m. 0.4–1 mg</td>
<td>30–60 min</td>
<td>Variable</td>
<td>Reduce secretion, reduce vagal tone</td>
<td>Tachycardia, tachydysrhythmias, AV dissociation, urinary retention, dry mouth</td>
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<tr>
<td><strong>Local anaesthetics</strong></td>
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<tr>
<td>Lidocaine</td>
<td>1–10%, topical or by inhalation. Maximum dose 5–7 mg kg⁻¹</td>
<td>5–10 min</td>
<td>30–60 min</td>
<td>Cough suppression, local anesthesia</td>
<td>Early bronchospasm, dizziness, seizures in high dose. Toxic reactions when plasma levels exceed 5 µg ml⁻¹.</td>
</tr>
<tr>
<td><strong>Sedation</strong></td>
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<tr>
<td>Midazolam</td>
<td>i.v. 2.5–10 mg (0.05–0.075 mg kg⁻¹)</td>
<td>1–3 min</td>
<td>2 h</td>
<td>Amnesia, sedation</td>
<td>Respiratory depression</td>
</tr>
<tr>
<td></td>
<td>i.v. 0.05–0.75 mg kg⁻¹</td>
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<tr>
<td>Diazepam</td>
<td>i.v. 2–7 mg (0.1 mg kg⁻¹) p.o. 5–10 mg</td>
<td>1–3 min</td>
<td>2–8 h</td>
<td>Amnesia, sedation</td>
<td>Respiratory depression, thrombophlebitis, pain on injection</td>
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<tr>
<td></td>
<td>i.v. 0.1 mg kg⁻¹</td>
<td>15–30 min</td>
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<td><strong>Narcotics</strong></td>
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<tr>
<td>Meperidine</td>
<td>i.v./i.m. 20–75 mg (1 mg kg⁻¹)</td>
<td>i.v. 1–3 min</td>
<td>2–4 h</td>
<td>Analgesia</td>
<td>Respiratory depression, nausea, Urinary retention, Respiratory depression, nausea, itching, bronchospasm, bradycardia, biliary spasm</td>
</tr>
<tr>
<td></td>
<td>i.v. 1–3 min i.m. 15–30 min</td>
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<tr>
<td>Codeine/ Mephedrine</td>
<td>i.v. 20–120 mg</td>
<td>30 min</td>
<td>2–4 h</td>
<td>Cough suppression</td>
<td>Respiratory depression, nausea, Urinary retention</td>
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<tr>
<td></td>
<td>i.v. 20–120 mg (0.1 mg kg⁻¹)</td>
<td>i.v. 5 min</td>
<td>2–6 h</td>
<td>Analgesia</td>
<td>Respiratory depression, nausea, Urinary retention</td>
</tr>
<tr>
<td>Morphine</td>
<td>i.v./i.m. 2–10 mg (0.1 mg kg⁻¹)</td>
<td>i.v. 5 min</td>
<td>2–6 h</td>
<td>Analgesia</td>
<td>Respiratory depression, nausea, Urinary retention</td>
</tr>
<tr>
<td></td>
<td>i.v. 5 min i.m. 15–30 min</td>
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<tr>
<td>Fentanyl</td>
<td>i.v. 50–100 µg (1 µg kg⁻¹)</td>
<td>2 min</td>
<td>30–60 min</td>
<td>Analgesia</td>
<td>Respiratory depression, nausea, Urinary retention, Respiratory depression, nausea, itching, bronchospasm, bradycardia, biliary spasm</td>
</tr>
<tr>
<td>Alfentanil</td>
<td>i.v. 250–1000 µg (10 µg kg⁻¹)</td>
<td>1 min</td>
<td>15–30 min</td>
<td>Analgesia</td>
<td>Respiratory depression, nausea, Urinary retention, Respiratory depression, nausea, chest wall rigidity, bradycardia, biliary spasm</td>
</tr>
<tr>
<td>Propofol</td>
<td>i.v. 50 µg kg⁻¹ min⁻¹ (10–30 mg)</td>
<td>30 sec</td>
<td>8–10 min</td>
<td>Sedation</td>
<td>Respiratory depression, hypotension</td>
</tr>
<tr>
<td>Antagonists</td>
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<td>Naloxone</td>
<td>0.8–0 mg titrated to effect q 2–3 min</td>
<td>1 min</td>
<td>Dose dependent, lasting 20–60 min</td>
<td>Reversal of opioid effect</td>
<td>Tachycardia, hypertension, dysrhythmias, CNS excitation, nausea, residual sedation</td>
</tr>
<tr>
<td>Flumazenil</td>
<td>0–4–1 mg</td>
<td>2 min</td>
<td>1 h</td>
<td>Reversal of benzodiazepine effect</td>
<td></td>
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</tbody>
</table>
secretions and to prevent bradycardia and bronchoconstriction (25,26). Until recently it was regarded as a standard preparation for the procedure (5,6,23,24). Several studies have questioned the use of prebronchoscopy atropine. In a group of patients who did not receive atropine, bronchoscopy was safely and efficiently carried out (12,25). In particular, after performing more than 1000 bronchoscopies without atropine premedication, Makker et al. (26) did not note any excessive secretions or bradycardia. A recent study (27) reported that atropine premedication was not of clinical benefit compared to placebo when parameters of bronchociliation, secretions, tracheo-bronchial bleeding, desaturation and arrhythmias were investigated. Moreover, atropine premedication might cause dry mouth, blurred vision, glaucoma or tachycardia. Since myocardial ischaemia has been reported to occur during the procedure (28), tachycardia should be avoided and therefore the routine administration of prebronchoscopy atropine should be reconsidered.

Other agents such as scopolamine and glycopyrrolate may also be used as drying agents. These agents, however, may cause disorientation (scopolamine) and urinary retention (glycopyrrolate). Today, in many centres, these agents have been abandoned.

CODEINE PHOSPHATE

Codeine phosphate has an anti-tussive effect in patients undergoing bronchoscopy under local anaesthesia and midazolam sedation (29). Codeine (20–120 mg) can be given orally or intra-muscularly as a premedication. In patients who received codeine (oral, 0.4 mg·kg⁻¹) 60 min before bronchoscopy, the dose of supplemental local anaesthetic requirements and the degree of desaturation were significantly lower compared to placebo (30).

BENZODIAZEPINES

The three benzodiazepines (lorazepam, diazepam and midazolam) are commonly used as premedication and sedative agents for bronchoscopy (24,25,31,32). These drugs provide anxiolysis, sedation, hypnosis and amnesia. When used alone they have limited effects on cardiorespiratory function. However, very often these agents are combined with opioids, which potentiates the respiratory depression effects of both classes of agents (24,25,30,31).

Lorazepam (32) may be given either intravenously or orally. It is approximately four times as potent as diazepam. The onset of action is slower and the duration of action is longer with lorazepam. Unlike diazepam, lorazepam is not transformed to a pharmacologically active metabolite. The efficacy of oral lorazepam (2 mg) as premedication for bronchoscopy has been evaluated by Maltais et al. (32). Although patient’s co-operation during the procedure and immediate patients’ perception of the bronchoscopy were not significantly improved, the patient’s final impression (24 h later) was more favourable with the use of lorazepam. Most patients who received placebo (65-3%) described the procedure as difficult, compared to 38% of the patients in the lorazepam group. The authors attributed this finding to the anterograde amnestic effect of lorazepam. No adverse effect was noted with this sedative regimen and patients were able to leave the bronchology unit 30 min after the procedure.

Diazepam (33) has a relatively protracted duration of action related to both the parent compound and, more importantly, active metabolites produced following hepatic metabolism. Moreover, diazepam is diluted in propylene glycol solution, which produces pain on injection and high incidence of thrombophlebitis. The potency of diazepam for sedation seems to be about 50% to 25% that of midazolam. For an adult weighting 70 kg, intravenous injection of 10–20 mg of diazepam provides effective sedation. This dose should be reduced by 10% per decade (20 years old and above). Oral administration requires at least 1 h before the onset of measurable sedative or anxiolytic effects. A randomized trial (34) comparing intravenous diazepam (10 mg) with saline after intramuscular atropine reported that both bronchoscopist and patients noted a significant sedative effect and fewer coughs with diazepam. Recently, Putiniati et al. (25) found, in 100 patients undergoing diagnostic bronchoscopy, that tolerance to the procedure was better in patients sedated with intravenous diazepam compared to non-sedated patients. The tolerance score was much lower when rated by patients than by the bronchoscopist. This might highlight, as the authors suggested, the under-estimation of patient’s discomfort by the bronchoscopist. The availability of a shorter-acting, water-soluble anxiolytic such as midazolam has decreased dramatically the popularity of diazepam.

Midazolam (35) is a water-soluble, short-acting benzodiazepine that does not produce pain or thrombophlebitis on injection. The metabolites of midazolam have negligible effects. It provides profound procedural amnesia and sedation, and since it can be given by various routes (oral, intramuscular, intravenous), it is now used extensively for sedation in outpatient bronchoscopy. Administration of midazolam for premedication should be taken cautiously in the elderly, who are more sensitive to sedation. The dose must therefore be tailored to each patient: 0.07–0.15 mg·kg⁻¹ midazolam usually provides effective sedation in young patients. Sedation is effective for 20–40 min. Williams et al. (27) reported the use of high dose (0.24 mg·kg⁻¹) intravenous midazolam for sedation during fiberoptic bronchoscopy. Although this dose provided total amnesia, it took a long time for the patients to wake up and to be discharged (on average 1 h and 2.5 h, respectively). Moreover, 9-8% of the patients required flumazenil to reverse the effects of midazolam. In a subsequent study, Williams et al. (34) reported 2 years of experience with midazolam sedation for bronchoscopy. Midazolam was administered intravenously over several minutes till the patient was judged to be lightly asleep. The mean dose of midazolam used was 0.16 mg·kg⁻¹. Patients took 1 h to wake up and 8% were given flumazenil to reverse sedation. Only nine patients (total 337 patients) had some memory of the procedure. Similar doses of midazolam were used in other studies (27,29,35).
Flumazenil, the competitive antagonist with high affinity for the benzodiazepines receptors (36), may be used to reverse respiratory depression and haemodynamic effects of the benzodiazepines. It must be administered by repeated bolus injections or continuous infusion because of its short duration of action. Patients may become obtunded later when the flumazenil wears off. For this reason, the use of flumazenil requires an extended observation period before a patient can be declared no longer under the influence of the benzodiazepines. Flumazenil has been given in large oral and intravenous doses with remarkably few toxic reactions. Recently (37), flumazenil (0.1–0.2 mg in incremental doses) has been shown to be safe and effective in aiding recovery from diazepam-facilitated bronchoscopy. Patients in the flumazenil group showed significantly greater proficiency with psychometric tests. The importance of flumazenil in reducing the risk of respiratory depression and hypoxia during benzodiazepine-facilitated bronchoscopy cannot be overstated.

**PROPOFOL**

Propofol (31), an alkyl-phenol, is a sedative–hypnotic agent that has a rapid onset and short duration of action. It produces a dose-dependent level of sedation, varying from conscious sedation to general anaesthesia. It is only available for intravenous administration. Propofol by continuous infusion provides a readily titratable level of sedation and a rapid recovery once infusion is terminated, without the need for expensive antagonist agents. From a clinical point of view, it is necessary to acquire experience to adjust the dosage of propofol to the individual patient, since there is a wide variability in the response of the patients to the drug (38). Two studies (35,39) compared midazolam with propofol for sedation in outpatient bronchoscopy and reported that propofol allowed faster onset of action and recovery than midazolam. Also, memory and motor reaction times did not differ from baseline in the propofol group, but were significantly impaired in the midazolam group 60 min after the end of the procedure (32). Incidence of oxygen desaturation and the level of patient’s satisfaction were comparable between the groups.

**OPIATES**

Because benzodiazepines and propofol provide only sedation and amnesia and have little, if any, analgesic effects, they are often used in conjunction with opioids. A common side-effect of all these agents is respiratory depression, the risk of which increases with the dose and the rate of administration, and with the co-administration of sedative agents (40). Other common side-effects of opiates include nausea, vomiting, urinary retention, chest wall rigidity, mental clouding, dysphoria and pruritus. Because bronchoscopy frequently lasts less than 30 min, the long-acting opioids (morphine and meperidine) do not seem to be ideal drugs for providing analgesia during the procedure. These agents might leave the patient at risk for adverse effects such as respiratory depression for a significant period of time. Other shorter acting opioids such as fentanyl, alfentanil or remifentanil should therefore be considered.

Several opioids have been used for analgesia during outpatient bronchoscopy. A study (25) that compared midazolam, alfentanil and a combination of both for sedation for fiberoptic bronchoscopy found that there was significantly less cough, and the need for additional lignocaine was significantly less, in patients treated with alfentanil compared to the other two groups. In addition, those who received the combination of midazolam and alfentanil had a greater drop in oxygen saturation when compared with each drug given alone. In this study the average duration of procedure was very short (~6 min) and the average dose of midazolam and alfentanil used was 5 mg and 0.6 mg, respectively. A significant reduction in cough count was also noted with alfentanil sedation when compared with diazepam and papaveretum (41). The level of discomfort was not significantly different between the two groups. In a prospective, randomized study (42), we compared sedation for fiberoptic bronchoscopy provided by alfentanil–propofol with meperidine–midazolam. These two methods were compared in terms of haemodynamics, frequency of desaturation, bronchoscopist acceptability and patient comfort. Significant elevations in blood pressures were observed only in patients sedated with meperidine–midazolam. There were no significant differences between the two groups in oxygen desaturation episodes or in the mean lowest oxygen saturation. The results of the questionnaire completed by the patients and the bronchoscopist indicated similar levels of satisfaction in each group. We concluded that compared to sedation with alfentanil–propofol, sedation with meperidine–midazolam gives equally good operating conditions, provides comparable levels of patient’s comfort and satisfaction, produces satisfactory amnesia, and is safe. Since alfentanil–propofol sedation attenuated the blood pressure response, this regimen might be a more appropriate technique for use in ‘high risk’ cardiac patients. The combination of midazolam and alfentanil, however, has not been evaluated.

Naloxone (40), the opioid antagonist, may be used to restore ventilation in patients who breathe inadequately after opioid overdose. The administration of naloxone, however, may be accompanied by significant side-effects. Naloxone can cause nausea, hypertension, arrhythmias and acute pulmonary oedema, and therefore opioid reversal is best avoided in patients in whom increases in blood pressure and heart rate could be detrimental, i.e. patients with coronary artery disease or cerebrovascular disease, patients with pheochromocytoma or with chromaffin tissue tumours. Onset of action after intravenous administration of naloxone is rapid (1–2 min) and the half-life and duration of effect are short. Attempts to compensate for naloxone’s short duration of action by increasing the dose risked increasing the incidence and severity of unwanted side-effects. Most often, titration to effect in 0.5–1 μg kg⁻¹ boluses every 2–3 min will restore adequate spontaneous ventilation. Recurrence of respiratory depression after naloxone is due in part to the agent’s short half-life. Patients therefore should be held under the supervision of
trained nursing staff. Because short-lasting opioids (alfentanil, remifentanil) rarely pose a danger of renarcotization, these agents seem to be the most appropriate agents to use when analgesia is needed for short procedures such as bronchoscopy.

**CLONIDINE**

The centrally acting \(\alpha_2\)-agonist clonidine attenuates stress-induced sympathoadrenal responses to painful stimuli, improves intra-operative haemodynamic stability, reduces the incidence of perioperative myocardial ischaemic episodes in patients with suspected or documented coronary artery disease and decreases anaesthetic requirements during surgery (43–47). Moreover, clonidine has also been found to blunt the stress response to endotracheal intubation (48–50). Therefore, oral clonidine seems well suited as premedication for fiberoptic bronchoscopy. Recently, we evaluated (51) the effects of clonidine (orally, 150 to 300 \(\mu\)g) premedication on alterations of blood pressure, heart rate, and oxygen saturation during fiberoptic bronchoscopy in a randomized, double-blind, placebo-controlled study. Significant increases in blood pressure and heart rate were observed only in the control group. Clonidine 150 \(\mu\)g blunted the haemodynamic response to fiberoptic bronchoscopy. Significant reductions in systolic blood pressure (< 90 mmHg) were observed in all patients premedicated with 300 \(\mu\)g clonidine. Incidence of oxygen desaturation was comparable between the groups. We concluded that premedication with 150 \(\mu\)g oral clonidine attenuates haemodynamic responses to fiberoptic bronchoscopy, without causing excessive haemodynamic depression and sedation. Since cardiac arrhythmias and myocardial ischaemia may develop during the procedure (28,52,53), these data encourage the administration of clonidine as premedication in patients undergoing fiberoptic bronchoscopy, particularly in those with, or at risk for coronary artery disease.

**Monitoring during bronchoscopy**

Although the morbidity and mortality associated with fiberoptic bronchoscopy are low, cardiac arrhythmias, as well as ischaemic episodes, have been reported to occur during the procedure in up to 70% and 17% of the patients, respectively (28,52,53). The usual haemodynamic response to bronchoscopy includes an increase in heart rate and blood pressure along with episodes of oxygen desaturation (42,51,54–56). In addition, with the introduction of sedation, hypercapnea may remain undetected by pulse oximetry and may lead to respiratory arrest, hypertension and cardiac arrhythmias. A recent study (57) showed that transcutaneous monitoring of \(P_{CO_2}\) provided evidence of hypoventilation during fiberoptic bronchoscopy.

Previous studies that evaluated different drugs for sedation did not use a recognized objective assessment of sedation to titrate the level of sedation. Investigators aimed for ‘light sedation’ or ‘heavy sedation’ by drug titration (9,21,24,27,34,35,41,57). Nowadays, several sedation-scoring systems have been developed to assist clinicians in determining the effectiveness of sedation. The commonest sedation score in daily use in the Ramsay score (13) (Table 1), but several others are also popular (59,60). Regardless of the scoring system used, the best assessment is continued observation of patient responsiveness. An evaluation of patient’s status should be performed every 2–3 min during the procedure and should be assessed into recovery. As the clinician performing the bronchoscopy is not in a position to monitor the patient, an experienced healthcare professional should be responsible for monitoring the patient’s status during the procedure. This is usually the responsibility of a registered nurse with special experience or training in sedation.

Care of the patient does not end when the procedure is completed. As the patient moves from the periprocedure area to the recovery area, monitoring of the patient must remain paramount for at least 30–60 min. During the recovery phase the patient should return to a preprocedure baseline of mental acuity, while keeping airway patency and protective reflexes, haemodynamic stability, and ambulatory and gait status. Only then can the patient be discharged home with minimal risk of complications.

**Is there an ‘ideal’ sedation?**

This review presents the reader with certain options and recommendations for the application of sedation in patients
undergoing outpatient fiberoptic bronchoscopy. Depending on the level of intervention (ranging from bronchoscopic airway examination to laser bronchoscopy and stenting), and human resources available in the bronchoscopic unit (nurses, assistants and anaesthesiologist), the clinician must make the decision as to whether intravenous sedation will be sufficient or if a deeper or general anaesthesia will be needed.

Currently, there is no such thing as ‘ideal sedation’ for fiberoptic bronchoscopy. We find that the i.v. administration of midazolam (in incremental doses of 2 mg) and alfentanil (for short procedures, 10 μg kg⁻¹) or pethidine (for longer procedures, 1 mg kg⁻¹) provides excellent operating conditions, produces satisfactory amnesia as well as patient’s comfort, and is safe. This is supplemented with pre-procedural application of topical anaesthesia (lidocaine 2–10%) of the airway. Premedication is required only in patients at risk for ischaemic heart disease and consists of oral clonidine 150 μg, which is given to the patients 90 min before the procedure. We currently do not use atropin.

### Complicated procedures

The current licensing requirement in most countries to have propofol administered and monitored by an anaesthetist, and the higher cost of propofol, makes sedation with midazolam preferable. Propofol, however, is an excellent drug and should therefore be reserved for complicated bronchoscopies (such as prolonged laser therapies, stents placements, etc.), in which general anaesthesia is required with or without maintenance of spontaneous ventilation, or for patients who became agitated and restless after the administration of midazolam. In the latter group of patients (un-co-operative ones), another option which will usually suffice is the intra-muscular administration of ketamine (3–5 mg kg⁻¹) with midazolam (2 mg, to negate the hallucinogenic effect of ketamine). Oral secretions are markedly stimulated by ketamine, and therefore co-administration of anti-sialogogue such as atropin is recommended in these cases.

### Summary

Several requirements must be met for the ideal sedation during day-care bronchoscopy. Firstly, it has to be both effective and safe. Furthermore, it should be easy to administer and monitor, short-acting and readily reversible. It should leave the patient with fewest side-effects while providing adequate analgesia and amnesia, without sedating to the point of airway compromise.

Although sedation today is quite satisfactory for both the patients and the pulmonologists, further studies are required to find the ‘ideal sedation’ for fiberoptic bronchoscopy.

### References

4. Sutherland FWH. Intravenous sedation is inappropriate in most minor procedures. *BMJ* 1995; 310: 872.