Procedural sedation for adult patients: an overview

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By relieving anxiety, reducing pain, and providing amnesia, sedation techniques have the potential to render potentially uncomfortable diagnostic and therapeutic procedures more comfortable and acceptable for patients. However, they also have the potential to cause life-threatening complications.1

This article aims to present to the reader an outline of the generic principles of adult procedural sedation, guidelines, and the main clinical areas where anaesthetists are likely to observe its use, including some of the techniques and likely future developments.

Sedation is a drug-induced depression of consciousness, a continuum culminating in general anaesthesia. The ASA defines three levels of sedation2 (Table 1).

Minimal sedation is a drug-induced state during which the patient responds normally to verbal commands. Cognitive function and physical coordination may be impaired, but airway reflexes, and ventilatory and cardiovascular functions are unaffected.

Moderate sedation describes a state where a purposeful response to verbal commands either alone (approximating conscious sedation) or accompanied by light tactile stimulation is maintained. Conscious sedation is defined in the UK as ‘a technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal contact with the patient is maintained throughout the period of sedation. The drugs and techniques used should carry a margin of safety wide enough to render loss of consciousness unlikely’.1 The endpoint is clearly defined and wide margins of safety stipulated. The airway is normally unaffected and spontaneous ventilation adequate.

Deep sedation describes a state where the patient cannot easily be aroused but responds purposefully to repeated or painful stimulation. It may be accompanied by clinically significant ventilatory depression. The patient may require assistance maintaining a patent airway and positive pressure ventilation.

In summary, passing along the sedation continuum from minimal through moderate to deep sedation, and ultimately to general anaesthesia, we see increasing depression of other physiological systems. The likelihood of adverse events increases, which if not managed promptly, and effectively, may progress to poor outcomes. The increasing depth of sedation is therefore accompanied by an escalation in the level of competency required to ensure safe sedation practice, as emphasized by the ASA position statement shown below:2

Because sedation is a continuum, it is not always possible to predict how an individual patient will respond. Hence, practitioners intending to produce a given level of sedation should be able to rescue patients whose level of sedation becomes deeper than initially intended. Individuals administering Moderate Sedation/Analgesia (‘Conscious Sedation’) should be able to rescue patients who enter a state of Deep Sedation/Analgesia, whilst those administering Deep Sedation/Analgesia should be able to rescue patients who enter a state of General Anesthesia. Rescue of a patient from a deeper level of sedation than intended is an intervention by a practitioner proficient in airway management and advanced life support. The qualified practitioner corrects adverse physiologic consequences of the deeper-than-intended level of sedation (such as hypoventilation, hypoxia and hypotension) and returns the patient to the originally intended level of sedation.

Aiming for Conscious Sedation as the target state, through careful titration to effect, airway interventions are not required, ventilation is normally adequate, and cardiovascular function is maintained. This is the rationale behind defining conscious sedation as a ‘safe’ target state.

UK guidance

In 2001, responding to concerns over the safety of sedation practice, the Academy of Medical Royal Colleges published guidance in the form of ‘Implementing and ensuring Safe Sedation...’
Practice for healthcare procedures in adults, calling for speciality-specific guidance aimed at promoting improved standards of training and practice in the use of defined sedation techniques, on the basis that ‘safety will be optimised only if practitioners use defined methods of sedation for which they have received formal training’. In response, the Dental Profession, British Society of Gastroenterology (BSG), and The Royal College of Radiologists published appropriate guidance. However, concerns over safety remain and further recommendations have been made to promote safer practice.

**Generic principles**

**Pre-assessment**

Sedation is often administered to the elderly who may have significant co-morbidity. Even in younger patients, the presence of heart disease, cerebrovascular disease, lung disease, liver failure, anaemia, shock, and morbid obesity may indicate dangerous risk factors. Inadequate pre-assessment is a recurring factor in sedation-related adverse events and poor outcomes, for all specialities. Hence, as for general anaesthesia, the importance of preoperative assessment and preparation of patients, focusing on medical, social, and psychological assessment and evaluation of risk, taking into consideration the limitations of the setting, cannot be overestimated. As for general anaesthesia, the patient’s airway should be assessed to identify features associated with increased risk of difficult intubation, ventilation, or both.

Preoperative fasting for sedation is controversial and considered unnecessary by some authorities within dentistry and emergency medicine. However, most anaesthetists follow accepted fasting guidance.

**Patient management and choice of technique**

Drugs do not negate the need for good communication skills and a sympathetic manner. A clear explanation at every stage is essential to reassure the patient, particularly where sudden movements may compromise the procedure.

No one sedation technique is suitable for all patients/procedures. Adopting the principle of minimum intervention, the simplest and safest effective technique, based on patient assessment and clinical need, should be used. Careful consideration of the demands of the procedure being undertaken, particularly whether it is painful or not, is critical to success. For non-painful procedures, sedation alone is sufficient. Painful procedures require the administration of a specific analgesia agent. Many sedative and anxiolytic drugs, for example, benzodiazepines, have no analgesic properties and their use to control pain may result in significant overdose. For localized procedures, for example, dental or other minor procedures, local anaesthetic techniques can be used, once adequate sedation is achieved. For other procedures, for example, colonoscopy, systemic analgesic in the form of an opioid may be required. Hence, combinations of drugs, for example, sedatives and opioids, may be needed.

Titrating a drug/drugs to effect is critical to safely achieving a recognized sedation endpoint, avoiding inadvertent over-sedation or general anaesthesia. The initial dose must have taken full effect before an additional dose is given. Safe sedation demands the knowledge of each drug’s time of onset, peak effect, and duration of action.

**Multiple drugs and anaesthetic drugs/infusions**

As a general rule, single drugs are easier to titrate to effect and safer than concurrent administration of two or more drugs. Drugs in combination may produce synergistic effects, have differing times to onset and peak effect, and be unpredictable or difficult to titrate to effect. Safety margins may be narrowed, increasing the likelihood of overdose, loss of consciousness, respiratory depression, and the need for airway interventions. Where a combination of a benzodiazepine and an opioid is administered, the opioid should be given first and the benzodiazepine only given once the peak effect of the opioid is observed. Benzodiazepines may be up to eight times more potent after prior administration of an opioid and so must be titrated with care. Anaesthetic drugs and infusions (e.g. propofol) have a narrow therapeutic index and reduced margins of safety, increasing the likelihood of adverse events.

Multiple drug/anaesthetic drug techniques should only be considered where there is a clear clinical justification, having excluded simpler techniques, and may only be suitable for use in a setting equipped to a level identical to that found in NHS hospitals, that is, one providing full resuscitation and general anaesthetic facilities.

**Monitoring**

Clinical and instrumental monitoring to a degree relevant to the patient’s medical status and the sedation method should be used. Existing guidance identifies the need for pulse oximetry, ECG, and automated non-invasive arterial pressure monitoring. Regular communication with the patient in addition to putting them at ease.

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**Table 1 Continuum of depth of sedation: definition of general anaesthesia and levels of sedation/analgesia**

<table>
<thead>
<tr>
<th></th>
<th>Minimal sedation/ anxiolysis</th>
<th>Moderate sedation/ analgesia (‘Conscious sedation’)</th>
<th>Deep sedation/ analgesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>Normal response to verbal stimulation</td>
<td>Purposeful* response to verbal or tactile stimulation</td>
<td>Purposeful* response after repeated or painful stimulation</td>
</tr>
<tr>
<td>Airway</td>
<td>Unaffected</td>
<td>No intervention required</td>
<td>Intervention may be required</td>
</tr>
<tr>
<td>Spontaneous ventilation</td>
<td>Unaffected</td>
<td>Adequate</td>
<td>May be inadequate</td>
</tr>
<tr>
<td>Cardiovascular function</td>
<td>Unaffected</td>
<td>Usually maintained</td>
<td>Usually maintained</td>
</tr>
</tbody>
</table>

*Reflex withdrawal from a painful stimulus is NOT considered a purposeful response (excerpted from ASA with permission)
allows monitoring of the level of sedation. If verbal communication is lost, the patient requires the same level of care as for general anaesthesia. Monitoring should be continued through recovery until the discharge criteria are met.

Respiratory depression may accompany the use of i.v. sedatives and opioid analgesic drugs. Oxygen, via nasal cannulae, should be administered from the commencement of sedation, through to readiness for discharge from recovery, particularly for patients with relevant medical conditions, where multiple drug techniques or anaesthetic drugs are used, or deeper levels of sedation administered. While administration of oxygen prevents hypoxia, it may mask hypoventilation. The monitoring of ventilation with continuous waveform capnography should be considered, particularly where:

- deep sedation is used;
- ventilation cannot be directly observed [e.g. magnetic resonance imaging (MRI)/computed tomography (CT)];
- multiple anaesthetic drug techniques are used;
- pre-assessment highlights increased clinical risk.

Setting

It is important to recognize the limitations of working in the relative ‘isolation’ of the non-theatre or non-hospital setting where the skilled assistance of an operating department practitioner/operating department assistant (ODP/ODA), and familiar equipment, may be lacking. Patient selection in advance of the procedure will determine whether the setting meets the requirements of the patient, intended procedure, and proposed sedation technique. Staffing and equipment must meet the needs of both the technique (including monitoring) and its possible complications. Appropriate recovery facilities and discharge criteria relevant to the patient’s destination are necessary. Resuscitation equipment must be checked, maintained, and include all the drugs necessary for life support. The management of sedation-related complications and medical emergencies should be regularly rehearsed as a team.

Speciality-specific techniques and considerations

As we shall see, sedation is increasingly being used within a wide range of specialities, mainly administered by non-anasthetists, many of whom have acquired considerable expertise in the use of sedation.

Gastroenterological procedures

Patients requiring gastroenterological interventions are often severely ill, elderly, have cardiorespiratory problems and poorly prepared. Careful pre-assessment and preparation are essential for safe practice. The British Society of Gastroenterologists, NCEPOD, and others have published recommendations for the use of i.v. sedation and analgesia for endoscopic procedures. Many upper gastrointestinal endoscopies are performed by physicians and surgeons using conscious sedation, commonly using i.v. midazolam. Systemic analgesia is not normally required. Local anaesthetic sprays are sometimes used, alone or in combination with a sedative, but combined use has been associated with a significant incidence of respiratory complications.

Lower gastrointestinal endoscopic procedures, for example, colonoscopy, are potentially uncomfortable. Systemic analgesia in addition to sedation may be required, sometimes using inhalation sedation with Entonox, or i.v. sedation/analgesia utilizing midazolam and an opioid. Similarly, endoscopic retrograde cholangiopancreatography (ERCP) frequently requires systemic analgesia. Where midazolam is given, it is sensible to give an initial dose of 2 mg (halved in the elderly or compromised patient), followed by a pause (≥2 min) to observe its effect, before giving further 1 mg increments, as necessary. Opioid analgesia, where required, should be given first and its full effect observed before administering a benzodiazepine. Doses in excess of fentanyl 100 μg (or meperidine 50 mg) are seldom required and should be reduced by half in the elderly.

Gastroenterological procedures are becoming technically more challenging and time-consuming, necessitating more prolonged, and sometimes deeper levels of sedation. There is increasing evidence that propofol can be used effectively to satisfy these requirements and draft guidelines for its administration for ERCP by individuals trained in its use have been drawn up by a joint working party of The Royal College of Anaesthetists and British Society of Gastroenterology. It is proposed that propofol sedation should be administered by anaesthetists possessing the minimum competencies identified for ‘Intermediate Level’ sedation training, or trained physicians’ assistants working under the supervision of a trained consultant anaesthetist. Propofol alone appears to provide excellent sedation for the majority of patients, but for painful procedures, additional opioid may be needed.

Cardiology

Sedation techniques are also widely used for cardiological procedures, for example, cardioversion, transoesophageal echocardiography, angiography, and pacemaker insertion. However, published studies indicate that the choice of sedation can be highly variable and that a significant number of patients are over-sedated and verbally unresponsive, leading to concerns over airway safety and management of adverse events. Closer collaboration with anaesthetic colleagues has been recommended.

Conscious sedation in the provision of dental care

Conscious sedation has become a key tool for the management of dental pain and anxiety. The Department of Health has published guidelines laying down specific recommendations to all...
practitioners providing conscious sedation for the provision of dental care in general dental practice, community, and hospital settings. These guidelines refer to the use of Standard Conscious Sedation Techniques comprising:

- i.v. sedation using midazolam alone;
- inhalation sedation using nitrous oxide/oxygen;
- oral/transmucosal benzodiazepines.

These techniques, used as an adjunct to good-quality local anaesthesia and appropriate behavioural management, are effective for the majority of dental patients. However, a minority of patients may require referral for treatment using more advanced multiple/anaesthetic drug techniques or general anaesthesia (e.g. in the presence of dental infection, when establishing effective local anaesthesia proves difficult, prior administration of an opioid may be helpful).

The majority of dental sedation is administered in the primary care setting and the limitations of this environment must be fully understood, particularly when multiple drug or anaesthetic drug/infusion techniques are considered. Deep sedation is not permitted in the primary care setting.

The Royal College of Anaesthetists (RCoA) has published a PMETB-approved curriculum specifically relating to the competencies required for safe and appropriate administration of conscious sedation for dentistry by anaesthetists. Anaesthetists intending to provide conscious sedation for dentistry, who commenced training after August 2010, will be expected to demonstrate evidence of completion of appropriate RCoA-approved training.

Propofol, administered as a target-controlled infusion (TCI), can effectively provide conscious sedation for dentistry. Propofol is rapidly redistributed, metabolized, and eliminated. It is non-cumulative and as an infusion is suited to short or long procedures, with a rapid recovery profile. It has no analgesic properties and is used as an adjunct to effective local anaesthesia. Administered by TCI, the mean plasma target concentration of propofol required for conscious sedation is \(\approx 2.0 \, \mu g \, ml^{-1}\), with a demonstrably wide inter-individual variation in the dose required (1–4 \(\mu g \, ml^{-1}\)). The narrow margin between conscious sedation, deep sedation, and general anaesthesia and the potential for adverse events at target concentrations lower than the mean dose should be noted. Titrated to effect is important, starting with a target plasma concentration of \(\approx 1.5 \, \mu g \, ml^{-1}\) (reduced in the frail or compromised patient), increased or decreased in 0.2 \(\mu g \, ml^{-1}\) increments to produce the desired level of sedation. Synergistic effects must be considered when adjuvant drugs are administered, for example, benzodiazepines and opioids.

**Sedation for radiology**

The Royal College of Radiologists has published guidance on the use of sedation, analgesia, and anaesthesia within the radiology department.

The principle requirements for diagnostic and interventional radiological procedures are patient comfort and the ability to keep still. Most diagnostic radiological examinations are not uncomfortable and can be managed on cooperative patients without recourse to sedation or general anaesthesia. However, patients in the following groups may require sedation or general anaesthesia (particularly where airway protection is an issue):

- Those undergoing cross-sectional imaging (e.g. CT/MRI) suffering with severe anxiety or claustrophobia.
- Those with rheumatoid arthritis, or involuntary movements, unable to lie flat or still for the length of time required.
- Confusional states secondary to acute illness or long-term mental disability.

The ‘remoteness’ of the setting warrants specific consideration. For MRI, the problems associated with strong magnetic fields require that compatible equipment/monitoring be used. Patients may be out of the line of vision and, if sedated, additional monitoring of ventilation with continuous waveform capnography is advocated.

### Interventional radiological procedures

Most percutaneous interventions require local anaesthesia. Nearly all vascular interventions can be performed under local anaesthesia alone, without need for systemic analgesia, though sedation may improve the patients’ experience. However, embolization of organs and tumours may cause severe pain, necessitating sedation and systemic analgesia, utilizing patient-controlled analgesia for post-procedural pain. Non-vascular interventions, particularly hepatobiliary and renal, tend to cause more pain than vascular interventions and require sedation and systemic analgesia, perhaps also necessitating regional analgesia (e.g. intercostal blocks for hepatobiliary procedures).

### Emergency medicine

Procedural sedation is used in the majority of emergency medicine departments within the UK to facilitate the management of short painful procedures, including wound exploration, suturing, incision and drainage of abscesses, and manipulation of fractures and dislocations. Commonly used drugs for adults include benzodiazepines (midazolam) and opioids (morphine and fentanyl), principally administered by emergency medicine clinicians. The College of Emergency Medicine now requires all emergency medicine trainees, commencing training after June 2010, to complete a 3 yr Acute Care Common Stem (ACCS) training, before entry to higher specialist training, that includes the core anaesthetic competencies necessary to satisfy the Initial Assessment of Competence and optional training in the safe and appropriate use of procedural sedation.
The role of anaesthetists and ensuring safe sedation practice

Concerns over the safety of sedation practice persist. The competencies required for safe sedation, and crucially, rescue from sedation-related adverse events, must be the same irrespective of a practitioner’s educational background. There should be one standard for all, but the educational requirements to attain a common standard will vary for different health-care groups.

The role of the operator–sedationist, both administering sedation and performing the procedure, is frequently questioned. It would seem reasonable that the administration and monitoring of propofol or multiple drug sedation for increasingly technical and challenging procedures should be the responsibility of appropriately trained dedicated practitioners, possessing the competencies for safe administration of sedation and management of sedation-related complications.

Anaesthetists, as experts in the use of anaesthetic drugs and management of the unconscious patient, should be qualified to provide sedation services. It would seem likely therefore that in the future, anaesthetists might increasingly become involved in providing sedation for diagnostic and therapeutic procedures. Indeed, the ASA has defined a specific anaesthetic service for diagnostic or therapeutic procedures called Monitored Anesthesia Care (MAC). MAC may include varying levels of sedation, analgesia and anaesthesia, as necessary, allowing maximum flexibility, matching sedation to the needs of the patient/procedure. At first sight, MAC appears a satisfactory option. However, serious problems have been highlighted. In 2006, the ASA published a closed claims analysis of MAC, demonstrating that respiratory depression, after overdose of sedative drugs, opioid drugs or both, was the most common specific damaging mechanism in MAC claims, principally related to the use of combinations of two or more drugs. Recurring themes included inexperience of anaesthetists administering MAC, poor pre-assessment, failure to appreciate the potential for respiratory depression associated with sedative drugs, particularly multiple drug techniques, inadequate monitoring, delayed recognition of adverse events, and inexperience in resuscitation. Though anaesthetists, by virtue of their training, possess most of the competencies required to engage in this activity, the evidence suggests that anaesthetists define training in the use of sedation techniques.

In the UK, few anaesthetists have received formal training in the use of sedation techniques, sedation not having until recently been included in the anaesthetic curriculum. Accordingly, the Royal College has developed a curriculum detailing the competencies, training, and assessment necessary for safe and appropriate use of sedation techniques by anaesthetists. Initially developed for conscious sedation for dentistry, the curriculum has been extended to cover the use of sedation in all other relevant clinical areas and, approved by PMETB, came into effect in August 2010. Issues relevant to patient safety and appropriate use of sedation by anaesthetists have been addressed.

The new sedation curriculum will ensure that future anaesthetic trainees receive necessary formal instruction, becoming better qualified to provide safe and appropriate sedation for patients under their care, and will also help anaesthetists to play a vital educational role, helping improve the quality of sedation training and practice in other specialities. Successful implementation and delivery of the curriculum will however depend on close collaboration with experts in those specialities utilizing sedation.

Declaration of interest

None declared.

References

5. The Royal College of Radiologists. Safe Sedation, Analgesia and Anaesthesia within the Radiology Department. 2003.

Please see multiple choice questions 5–8.