

Office-based anaesthesia

Successful office-based anaesthesia requires a particular set of skills and a knowledge base.

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Newer surgical and anaesthetic techniques have allowed a greater number of invasive procedures to be performed in non-hospital settings. Economic advantages and practitioner and patient convenience have driven the rapid growth of office-based surgery (OBS) and office-based anaesthesia (OBA). The advantages of OBS are personal attention, service, aftercare, ease of scheduling, greater privacy, lower cost, increased efficiency, decreased nosocomial infection, and consistency in nursing personnel. In the USA 17 - 24% of all elective ambulatory surgery is performed in the office setting. Data for South Africa are lacking, but there seems to be consistent growth in this area, as anaesthetists and sedationists are called upon more frequently to provide office-based services.

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Despite the allure of OBS and OBA, it is not suitable for every surgeon or appropriate for every patient or surgical procedure. OBA requires a different approach to anaesthesia in a hospital-based practice, and not all anaesthesia providers have the skill, knowledge base or personality to deal with the OBA environment. Compared with hospitals, office-based facilities currently have few or no regulations, little oversight, and insufficient control. The anaesthesiologist must carefully examine each practice to ensure safe perioperative care. It must be continuously emphasised that the standard of care in an office surgical suite should be no less than that in a hospital. Adequate informed consent is mandatory.¹

Sedation v. anaesthesia

Therapeutic sedation is a seamless continuum of an altered state of consciousness, varying from mild anxiolysis to anaesthesia. Patients may rapidly and often unpredictably move from one level to another with top-up doses, continuous infusions, combinations of drugs, or changes in level of stimulus. There is a wide intra- and inter-patient variation in response to a given dose of a given drug or drug combinations.

The South African Society of Anaesthesiologists (SASA) sedation guidelines (adult and paediatric) were published in 2002.^{2,3} Levels of sedation tabulated in Table I are easier to describe than to achieve. It is unusual for any patient to remain at one level of sedation for the entire duration of a procedure. Other terms have therefore replaced these rigid categories and reflect the continuum from anxiolysis to general anaesthesia as well as the importance of the analgesic component. Sedation is perhaps best termed 'sedation-analgesia' or 'monitored anaesthesia care' (MAC). These terms allow for the imprecision of sedation but, at the same time, demand a practitioner with sufficient skill to deal with the entire continuum of MAC and guidelines identical to those for the administration of general anaesthesia (GA).

There are wide indications for conscious sedation. These include procedures performed under loco-regional anaesthesia, lesser degrees of ophthalmic surgery, and painless diagnostic and therapeutic radiological procedures – particularly where co-operation, e.g. breath-holding, is required. The advantages are physiological stability and maintenance of airway patency and control. There are, however, circumstances better suited to deep sedation or GA, e.g. procedures with substantial fluctuating levels of stimulus (anal dilatation, uterine dilatation and curettage (D&C));

Table I. The continuum of sedation

	Anxiolysis	Light sedation (no opioid)	Deep sedation (or with opioid)	Anaesthesia
Responsiveness	Response to verbal stimuli	Purposeful response to verbal or tactile stimuli	Purposeful response only after repeated or painful stimuli	Unrousable
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

a procedure where patient resistance may reduce its success (endoscopy, reduction of dislocations); and procedures, even painless ones, on pre-adolescent children and patients with cognitive impairment.

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Tools of the trade

Personnel. A suitably trained sedationist, who may be the operator, is required. A dedicated anaesthetist is necessary for deeper sedation, high-risk patients, and other special cases. A suitably trained assistant is essential to monitor the patient, especially in major procedures – this person should do nothing else.

Monitoring and resuscitation equipment. This is necessary in the treatment and recovery areas – pulse oximetry, blood pressure, and ECG (in patients with cardiac disease or major cardiovascular risk factors). Intravenous access via a flexible cannula is mandatory. An operating surface that can be tilted, a defibrillator, oxygen, suction, equipment for the maintenance of airway, breathing and circulation, and emergency drugs are required.

Drugs for sedation and analgesia

Benzodiazepines. Midazolam is most commonly used owing to its rapid onset and short duration of action. Its elimination half-life is 1.5 - 3 hours. Amnesia is pronounced, even at sub-hypnotic doses. Suppression of respiratory drive occurs. Flumazenil is a competitive antagonist at the benzodiazepine receptor. Incremental doses of 0.2 - 1.0 mg IV are usually effective for reversal of all the effects of benzodiazepines. The duration of action varies from 15 minutes to 140 minutes, with re-sedation being a risk especially if longer-acting benzodiazepines are used. This short duration of action correlates well with that of midazolam.

Propofol. Propofol is increasingly being used owing to its very rapid onset and short duration of action. The half-life β is 30 - 60 minutes, but a third compartment with slower elimination half-life is also present, indicating the possibility of accumulation after very long infusions. The blood concentration for sedation is 1.0 - 2.5 $\mu\text{g/ml}$, and for anaesthesia 3.0 - 6.0 $\mu\text{g/ml}$. The recommended maintenance infusion rate of propofol varies between 100 and 200 $\text{mg}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ for hypnosis and 25 - 75 $\text{mg}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ for sedation. A 14%

incidence of excitatory phenomena is seen. Amnesia is not pronounced. Its anti-emetic effects are very advantageous, especially where opiates are used concomitantly. There is usually dose-related cardiovascular depression, and a combination with potent opioids may cause resistant bradycardia.

Ketamine. Ketamine is an *N*-methyl-*D*-aspartate (NMDA) receptor antagonist, causing dissociative anaesthesia, currently making a comeback in OBA owing to excellent analgesic properties with a low incidence of respiratory depression. It has a very wide therapeutic range. Laryngospasm is potentially a dangerous complication, but is rare and usually transient. Psychic side-effects may be troublesome, but can be minimised by the co-administration of a benzodiazepine or a similar hypnotic. Recovery may be delayed, especially if more than 2 mg/kg or 150 mg is given.

Opioids. Opioids are used primarily to provide analgesia in procedural sedation and analgesia. Although all these agents cause varying degrees of sedation, the effect is inconsistent, depending on the route and speed of administration and the agent used, and responses can vary greatly among individual patients. These agents are best considered as analgesics with the potential to supplement other primarily sedating drugs, such as the benzodiazepines. Although morphine and pethidine have both been used as analgesics in this setting, they have been largely replaced by shorter-acting opioids, particularly alfentanil (Rapifen) and remifentanil (Ultiva). They can cause severe respiratory depression, bradycardia and muscle rigidity. Nausea and vomiting is often a problem.

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Nitrous oxide. Although not very useful at relatively high altitudes inland, it is widely used for sedation. Nitrous oxide has an onset of action of 3 - 5 minutes, with a duration of action of 3 - 5 minutes. It can be self-administered as a 50/50 $\text{N}_2\text{O}/\text{O}_2$ mixture. Nausea and vomiting occurs in 10 - 15% of patients. Another concern is diffusional hypoxia during the recovery phase.

Alpha₂agonists. These provide preoperative sedation and anxiolysis and decrease intraoperative anaesthetic requirements. Dexmedetomidine (PreceDEX) has a half-life of 2.3 hours. A unique type of sedation may be produced in which patients can be

aroused readily and then return to a sleep-like state when left alone. Higher infusion rates may, however, lead to complete loss of responsiveness. Amnesia develops at higher infusion rates. Their use in diagnostic or therapeutic settings in which a state of 'conscious sedation' is desirable has, however, yet to be studied rigorously. The only approved sedative indication for dexmedetomidine is for the intensive care treatment of postoperative surgical patients for up to 24 hours. Because of its sympatholytic and vagomimetic actions, dexmedetomidine is approved with a warning about hypotension, bradycardia and sinus arrest and can be used only in a monitored situation.

Techniques of sedation and analgesia

It is impossible to prescribe a generic approach to sedation-analgesia – procedure, patient and operator demand a unique approach. MAC remains more labour intensive and hands-on than most types of GA, because of the ease and rapidity of transition to lighter and deeper levels of sedation owing to the imprecision of the available monitors.⁴



Possible options are the following:

- intermittent physician/nurse-controlled bolus technique after an initial loading dose
- continuous infusion technique after a loading bolus or infusion
- target-controlled infusion (TCI)
- patient-controlled sedation (PCS)
- combinations of the above.

An intermittent bolus technique is probably the most frequently employed, particularly in brief procedures requiring no more than a few boluses. With prolonged surgery, this technique can become excessively tedious and labour intensive. Continuous infusions are applicable to

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virtually all commonly used agents. They are particularly indicated where drug boluses are associated with considerable adverse effects, e.g. dexmedetomidine and propofol (cardiovascular depression) and remifentanyl (respiratory depression). TCI employs a variety of algorithms and assumptions to construct a variable-rate infusion, designed to produce a constant plasma concentration of sedative agent. It is a more elegant technique than continuous infusion, but will only produce a perfect result in the prototype average patient. Some adjustment may still be required based on clinical or neurophysiological observation. PCS is a variant of the intermittent bolus technique.

Special monitoring in sedation-analgesia

Bispectral index monitoring. Numerous studies have been carried out in an attempt to correlate clinical sedation, hypnosis, amnesia and analgesia with neurophysiological indices, e.g. bispectral index monitoring (device that continually analyses EEG signals to assess level of consciousness). Bispectral index monitoring only describes the likelihood of sedation/non-responsiveness; there is no predictable relationship between bispectral index monitoring and analgesia.

Capnography. While pulse oximetry is a standard of care, it is really only an indicator of some forms of hypoxia. Desaturation may take some time to manifest in a patient with respiratory depression. Unfortunately, the shape of the oxygen-haemoglobin dissociation curve means that once hypoventilation-related hypoxia manifests, it evolves rapidly into a critical event. The inevitable co-existence of hypercarbia sets the scene for disaster via cardiac depression – predisposition to arrhythmias and a hyperadrenergic state.

Capnography produces an accurate real-time indication of arterial carbon dioxide. It is substantially more accurate than clinical observation or oximetry for the early detection of respiratory depression. Capnography is a standard of care in GA. However, it remains expensive, is fraught with technical limitations in the unintubated patient, and has remained peripheral to the clinical mainstream.



What to do with failed sedation?

It is in the nature of patients, procedures, and operators that a proportion of OBA will fail. An unco-operative, combative patient may be the result of inadequate or excessive sedation, or of the choice of a sub-optimal sedative approach for a stimulating procedure. The usual approach is to deepen sedation or add agents and, while this may be appropriate in the healthy young patient who requires a higher dose, it may be fatal in patients manifesting hypoxic or hypercarbic confusion from overdose. The question with failed sedation is whether to:

- Persist and risk patient dissatisfaction or injury and failure of the procedure.
- Deepen the sedation and complete the procedure and risk patient morbidity or death.

- Abandon the procedure, reverse the drugs, and re-schedule to an appropriate setting and methods. There really is only one correct answer, namely this final option.

Summary

While OBA is rapidly becoming more important in daily anaesthetic practice, one should remember that the main drive behind this is cost containment and patient comfort. It is our duty to ascertain that it is not done at the cost of reduced patient safety. Even pure conscious sedation requires the presence of a skilled and dedicated sedationist. The impact of a patient's physiological impairment on the kinetics of the drugs and of the drugs on the patient's physiology must be considered in advance, and a sedation-analgesia plan must be individualised.

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In a nutshell

- Different approach than that used in hospital-based practice.
- Potentially more risky environment.
- Standard of care in an office surgical suite should be no less than that in a hospital.
- Conscious sedation v. analgesia and monitored anaesthesia care must be considered.
- Monitoring and resuscitation equipment is essential.
- Midazolam is commonly used.
- Propofol is increasingly being used owing to its very rapid onset of action.
- Is ketamine making a comeback?
- Opioids provide analgesia, but can cause severe respiratory depression.
- Each procedure, patient and operator demand a unique approach.