

CONSCIOUS SEDATION WITH SEVOFLURANE ANAESTHESIA TUTORIAL OF THE WEEK 188

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QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article, together with an explanation.

1. What monitoring is required for sedated patients?
2. On which receptor does Sevoflurane act?
3. What is the definition of conscious sedation?

INTRODUCTION

Sevoflurane, first used in 1971, has been widely available in the United Kingdom for over ten years. It has become popular as a volatile anaesthetic due to its pleasant odour and rapid onset and offset times. In most developed countries it has largely replaced Halothane for inhalational induction of anaesthesia.

Although very familiar to anaesthetists as a vapour for induction and maintenance of anaesthesia, it is less commonly used to provide conscious sedation. More frequently intravenous drugs such as midazolam, propofol and remifentanyl, to name but a few, are used to decrease patient awareness and increase compliance and comfort when a sedative is required. Anaesthetists are most likely to come across Sevoflurane used for sedation in the paediatric dental and magnetic resonance imaging (MRI) lists.

This tutorial will briefly review the pharmacology of Sevoflurane before discussing the advantages and disadvantages of using it to provide conscious sedation in patients and the methods that may be employed to do so.

PHARMACOLOGY OF SEVOFLURANE

Sevoflurane is a fluorinated methyl-propyl ether that enhances gamma-aminobutyric acid (GABA) inhibitory neurotransmission via the GABA_A receptor. It is an inhalational anaesthetic agent with a minimum alveolar concentration that ranges from 3.3% in infants to 1.7% for adults over the age of 65 years.

Pharmacodynamics

Cardiovascular system

Decreases myocardial contractility and mean arterial pressure with minimal effect on heart rate.

Respiratory system

Non-irritant, sweet smelling bronchial smooth muscle relaxant. Increases respiratory rate without changing minute ventilation. Decreases response to hypoxia and hypercapnia.

Central nervous system

Sedative and amnesic. Increasing the depth of sedation with increasing concentration leads to a state of general anaesthesia. Some analgesic and amnesic effect. Raises intracranial pressure and decreases cerebral vascular resistance and cerebral metabolic rate.

Renal system

Decreases renal blood flow.

Pharmacokinetics

Rapid uptake and wash-out rate enabling a short onset and offset of action due to low blood-gas partition coefficient (0.68). It is metabolised by cytochrome P450 2E1 and the metabolites then undergo glucuronidation. Only around 3% of the absorbed dose is actually metabolised.

CONSCIOUS SEDATION

Conscious sedation is a state of sedation in which the patient remains aware of his or her person, surroundings, and conditions but without experiencing pain or anxiety.

The myriad of applications for conscious sedation include minor surgical procedures, in trauma and orthopaedic patients, whilst performing regional anaesthesia and nerve blocks or surgery under regional anaesthesia or nerve blocks, during the insertion of invasive lines and during endoscopic procedures.

Depression of the central nervous system enables treatment to be carried out, during which verbal contact with the patient and protective reflexes are maintained. There is good patient co-operation and rapid recovery time. Ideally the sedative would have minimal physiological effect on the cardiovascular, respiratory or gastrointestinal system. The drugs and techniques used to provide conscious sedation should carry a margin of safety wide enough to render loss of consciousness unlikely. Some of the drugs are known to have antagonists that can be used if loss of consciousness occurs but these are problematic due to different half lives and their own side effect profiles.

Anxiolysis and decreased arousal and awareness are the important effects but amnesia and analgesia are also helpful for patients undergoing many procedures for which sedation is required. Drugs with short half lives that enable quick changes in the level of sedation are ideal, however, the enormous variability in response requires the professional administering the agent to have the skills and equipment to react if an overdose is accidentally given. Benzodiazepines, propofol, opioids, alpha agonists, neuroleptics and volatile agents are all used in and outside the theatre environment, however the choice of agent is usually less important than the professionals knowledge and ability to use them.

All sedatives have caused problems and children aged 1-5 years are at greatest risk. Respiratory depression and obstruction are frequent causes of adverse events along with drug errors and inadequate monitoring.

SEDATION WITH SEVOFLURANE

Sedation with an inhalational anaesthetic agent is a useful alternative to intravenous administration of a sedative, especially in patients who are needle phobic. Sevoflurane can be used to provide conscious sedation as a sole agent in air or oxygen or in combination with nitrous oxide. If Sevoflurane is used alone an end tidal concentration of around 0.3 - 0.5 is reported to produce clinically significant sedation¹. This is well tolerated by patients² and easily titratable to the individuals requirement whilst maintaining verbal contact.

Anterograde amnesia isn't profound with Sevoflurane but a study by Hall et al³ showed that 40-70% nitrous oxide and 0.6- 0.8% Sevoflurane produced comparable amnesia and sedation with female subjects exhibiting better memory and significantly less amnesia than males.

Advantages of Sevoflurane to provide conscious sedation

- Rapid onset and recovery times
- Easily titratable for controllable effect
- Some protection from respiratory depression due to decreased administration as respiratory rate decreases
- Amnesic effect¹
- Some analgesic effect²

Disadvantages of Sevoflurane for provision of conscious sedation

- Odour may be intolerable to some patients
- Can induce nausea
- Environmental pollution if waste gases are not scavenged
- Trigger for Malignant Hyperthermia

Sevoflurane is not infrequently used in Intensive Care Units, especially for those patients that would benefit from the bronchodilatory effects of the drug. It's minimal physiological disruption make it a good choice and it's use is probably limited by the availability of adequate equipment for administration rather than it's suitability.

SEVOFLURANE IN PAEDIATRICS

The greatest volume of evidence for the use of Sevoflurane for sedation comes from paediatrics, in particular in dental paediatrics and sedation for MRI. Nitrous oxide inhalation sedation and analgesia is safe and well established but there is good evidence that Sevoflurane at low concentrations (0.1-0.3%), added to nitrous oxide (40%) in oxygen, at the very least, improves patient satisfaction⁴ whilst leaving a margin of safety that is unlikely to render loss of consciousness⁵.

In both paediatrics and adult specialities, intravenous (IV) midazolam has gained widespread popularity outside the theatre environment in due to it's haemodynamic stability and short duration of action. Caution still remains, however, due to the unpredictability of response with subsequent loss of consciousness or apnoea. Oral midazolam is proving both safe and effective and is widely used in paediatrics throughout the world, however, it is not always a viable alternative for prolonged procedures.

A randomised control trial of paediatric dental patients comparing Group A (incremental IV midazolam) with Group B (40% nitrous oxide in oxygen and incremental IV midazolam) and Group C (0.3% Sevoflurane and 40% nitrous oxide in oxygen with incremental midazolam) concluded that there was a clear support to use the combination of all three agents to improve the tolerance of the children from 54% in Group A to 93%⁶. Clearly increasing the complexity of a sedation regimen, especially in children, increases the chance of a drug error. There is, however, a group of paediatric, and adult, patients in whom anxiety is high, or the procedure being undertaken is extensive, such that, in order to avoid general anaesthesia, they may benefit from a more complex sedation regimen.

ADMINISTRATION TECHNIQUES

Obviously the Heath Robinson nature of anaesthetists has produced a plethora of administration techniques to maximise patient compliance and comfort when delivering inhalational sedation. The important principles remain that there should be full monitoring and resuscitation equipment as for any general anaesthetic as well as end tidal carbon dioxide and anaesthetic agent monitoring.

The concentration of Sevoflurane for conscious sedation is patient and procedure dependent, however it is recommended that delivery should begin between 0.3 and 0.5% and titrated up if required in order to avoid loss of consciousness.

Philip et al⁷ have described one technique if a circle breathing system and a standard anaesthetic delivery system are available. Sedation is commenced with 2 litres a minute of oxygen and the Sevoflurane vapouriser set at 2%. Once the patient reports comfortable drowsiness then the surgery or procedure may begin and the concentration of Sevoflurane is reduced to 1%. Further titration of the agent is carried out throughout the procedure depending on the patient's requirements. Using this technique verbal contact can be maintained throughout the procedure and their mean end tidal Sevoflurane was 0.52.

Although originally designed for halothane and enflurane, it has also been demonstrated that Sevoflurane can be reliably administered using an Oxford Miniature Vapouriser (OMV)⁸ although the delivered concentration is higher than the set concentration.

SUMMARY

Sevoflurane has many advantageous properties that make it a suitable choice for sedation in many patients, either alone or in conjunction with other agents. There is some evidence to suggest that it has amnesic and some analgesic properties that improve patient compliance and comfort. In the theatre environment where the equipment and monitoring is available this is a technique that should be considered alongside the use of propofol, midazolam or other sedative agents.

ANSWERS TO QUESTIONS

1. Full monitoring is required for conscious sedation; ecg, sats, BP. If using Sevoflurane, end tidal CO₂ and agent monitoring equipment should also be used. As with general anaesthesia, resuscitation equipment should be immediately available as should skilled assistance as there is always the potential for patients to become unconscious and lose their airway reflexes.
2. Sevoflurane acts via the GABA_A receptor to enhance GABA inhibitory neurotransmission.
3. Conscious sedation is a state of sedation whereby a patient remains aware of their person, surroundings and conditions but without experiencing pain or anxiety. Verbal contact is maintained throughout.

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