

# Anaesthetic Guidelines for Rural Hospitals

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This series is also being produced as a booklet for the use of doctors in Rural Hospitals and is obtainable from SA Family Practice.

## ANAESTHETIC DRUGS I

### The series will have the following sections:

1. Introduction to anaesthetics and anaesthetic safety checklist
2. Anaesthesia, intubation and extubation
3. The pre-operative assessment
4. Anaesthetic drugs I
5. Anaesthetic drugs II
6. Spinal anaesthesia
7. Caesarean Sections
8. Paediatric anaesthesia
9. Complications during anaesthesia
10. Local and regional anaesthesia
11. Ventilation and breathing systems
12. Blood transfusion

### NO. 4

used to cause hypnosis and the loss of consciousness in patients. These drugs can be used for the induction of anaesthesia ("putting the patient to sleep"), or/and the maintenance of anaesthesia ("keeping the patient asleep").

It is important to be able to assess the depth of anaesthesia in a patient. A properly anaesthetised patient is relaxed, hypotonic and breathing comfortably. A patient who is not well anaesthetised may be moving, breathing irregularly, tachycardic and hypertensive. They are also prone to laryngeal spasm, coughing, vomiting, and other complications such as arrhythmias. In the paralysed patient, some of these signs may be absent, so it is essential that the anaesthetist is sure that the patient is fully unconscious. Being paralysed but conscious during an operation is a terrifying experience, and the patient will exhibit the normal physical signs of fear such as tachycardia, hypertension and sweating.

### A. INTRAVENOUS ANAESTHETIC AGENTS

#### KETAMINE

#### General properties

Ketamine is probably the safest anaesthetic if you are inexperi-

enced, and is ideal for understaffed situations. It is safe, easy to use and cheap. It can be used for most operations, and on adults or children.

Ketamine works by producing a specific type of anaesthesia that is called "dissociative anaesthesia". This produces an amnesic, trance-like state rather than a generalised depression of the CNS. The patient can therefore appear to be awake, or have his or her eyes open.

On regaining consciousness, emergence delirium may occur with restlessness, disorientation and agitation. Hallucinations and vivid nightmares may also occur for up to 24 hours after administration of the drug. These side-effects are much less common in young children and the elderly, and are reduced by avoiding verbal and tactile stimulation, and by the administration of opiates or benzodiazepines.

#### Effects:

**Nervous system:** Apart from producing "disassociative anaesthesia", Ketamine is an extremely potent analgesic, although it is less effective for visceral pain (eg for intra-abdominal surgery). Small doses of Ketamine may be used to provide analgesia without loss of consciousness (see below for dosage). Ketamine also causes an increase in cerebral metabolic rate and raises the intra-cranial pressure.

### INTRODUCTION

There are many anaesthetic drugs which essentially perform the same function as each other. The similarities within these classes of drugs are usually greater than their differences. For the part-time or untrained anaesthetist it is best to gain familiarity with a small number of drugs.

Although some anaesthetists are concerned that the "perfect" combination of drugs is given for each patient and each type of operation, most anaesthetics can be performed adequately and safely with a small number of standard drugs.

**It is best to know a few drugs really well than to know many drugs not so well.**

This chapter will be looking at the following anaesthetic agents: Ketamine, Thiopentone, Halothane and Enflurane. They are commonly

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**Cardiovascular system:** Ketamine is a sympathomimetic drug and may cause the arterial blood pressure and heart rate to rise by as much as 20%. For this reason, Ketamine is eminently suitable for the shocked patient.

**Respiratory system:** Ketamine may cause a transient period of apnoea after which ventilation is usually well maintained. Pharyngeal and laryngeal reflexes are also well maintained in comparison to other anaesthetic agents. For this reason, it is a safe agent for inexperienced anaesthetists, although one should still take the normal precautions for minimising gastric aspiration. Ketamine is also a potent bronchodilator, which makes a useful agent for asthmatics.

**Gastro-intestinal system:** Increased salivation is a troublesome side-effect of Ketamine, especially in children. This may be minimised by using an anti-cholinergic agent such as atropine.

**Musculo-skeletal system:** Ketamine provides no muscular relaxation. Therefore, it is not suitable for abdominal operations unless combined with muscle relaxants or with intercostal nerve blocks.

**Obstetrics:** Ketamine readily crosses the placenta and should ideally be avoided in caesarian sections until after the baby has been delivered. Because it causes the uterus to contract, it should not be used when fetal distress is present. If Ketamine is considered the safest option for a caesarian section, limit the dose to the bottom end of the normal range.

**Ocular system:** Ketamine causes an increase in intra-ocular eye pressure, and should therefore not be used in penetrating eye injuries.

## Dosage guidelines:

Ketamine is a quick-acting induction

agent, which works within 30 to 60 seconds of an intra-venous dose, and within 4 minutes of an intra-muscular dose. It has a duration of action of 15 to 25 minutes after a bolus dose, although amnesia often persists for up to one hour after recovery of consciousness. When used intra-venously, inject the dose slowly.

**IV Induction:** 1 to 4 mg/kg (on average 2mg/kg).

**IM Induction:** 8 to 10 mg/kg.

**IV Maintenance:** Bolus doses of 1.5 mg/kg IV every 5 to 10 minutes

**Ketamine drip:** Make a solution of 1mg/ml. For example, add 500mg of Ketamine to a 500ml bag of Dextrose or Saline. For induction, start the drip at about 2 drops per minute per kilogram weight. Once surgical anaesthesia has been reached, slow the drip to about one drop per minute per kilogram weight (the equivalent of 4mg/kg/hr). If the patient has been paralysed and is being ventilated, the drip can be slowed down to half a drop per minute per kilogram weight. Stop the drip about 10 minutes before the operation ends.

**Analgesia without loss of consciousness:** 0.25 to 0.5 mg/kg, or, an infusion of 50 mcg/kg/min.

## Situations for which Ketamine is ideal

- The patient with shock or hypovolaemia
- The patient with bronchospasm
- Patients requiring minor procedures which are painful such as changing of burns dressing
- The inexperienced anaesthetist

## Absolute contraindications:

- Upper airway obstruction. Although the airway is well maintained with Ketamine compared

to other agents, inhalational agents should be used for anaesthetic induction if airway obstruction is anticipated

- Raised intra-cranial pressure
- Uncontrolled hypertension (DBP > 100)
- Penetrating eye injuries

## Relative contraindications

- Pregnancy-induced hypertension
- Ischaemic heart disease
- Patients with glaucoma

## THIOPENTONE

### General properties

Thiopentone is a fast acting intravenous induction agent which produces anaesthesia in less than 30 seconds (there may be a delay in patients with a low cardiac output). Following an induction dose, the patient will start to wake up after about five minutes.

Never use Thiopentone for the maintenance of anaesthesia. Having induced the patient with Thiopentone, it is common to maintain anaesthesia with another agent such as Halothane.

**In sick, elderly and shocked patients, Thiopentone has a small safety margin and can be fatal.**

### Effects:

**Nervous system:** Thiopentone causes good hypnosis but no analgesia. It is also a very good anti-convulsant which can be used to abolish status epilepticus. Because it causes a reduction in intra-cranial pressure, it is a good anaesthetic agent for head injury patients.

**Cardiovascular system:** Thiopentone causes peripheral vasodilatation and myocardial depression. If large doses are administered, or if injection is rapid, profound hypotension may occur. This is particularly

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the case in patients with hypovolaemia and cardiac disease, or in elderly patients. For this reason always give Thiopentone carefully, ensure the patient is not hypovolaemic, and monitor the blood pressure regularly.

**Respiratory system:** A short period of apnoea is common after which spontaneous respiration resumes at a lower rate and tidal volume. If the patient is inadequately anaesthetised with Thiopentone, laryngeal spasm may be precipitated by surgical stimulation, or if secretions, blood or foreign bodies are present in the pharynx or larynx.

**Musculo-skeletal system:** Thiopentone causes poor muscle relaxation, so that movement in response to surgical stimulation is common when it is used on its own.

**Obstetrics:** Thiopentone crosses the placenta, and excessive doses may result in fetal cardio-respiratory depression, especially if the interval between induction and delivery is short.

## Dosage guidelines:

Thiopentone should only be administered as a 2.5% solution. The dose required to induce anaesthesia is variable. Pre-medication with an opiate or a benzodiazepine for example will reduce the required dosage. The dosage for obese patients should be based on lean body mass, and not on total body mass. Unless you are performing a rapid sequence intubation, you should titrate the amount of Thiopentone according to the patient's response. Administer the dose over 15-20 seconds

*In healthy adults:* 4-6 mg/kg, given over 15-20 seconds.

*In children:* 6 mg/kg/

*In elderly, hypovolaemic or shocked patients:* as little as 1-2 mg/kg.

## Side effects:

- Hypotension (see above).
- Tissue necrosis may follow if Thiopentone is accidentally injected outside the vein. It is therefore advisable to give a 2ml test-dose to make sure the iv cannula is properly sited.
- Intra-arterial injection can cause severe ischaemia and gangrene to those parts distal to the injection site. The patient will feel severe pain in his/her arm almost immediately. If this happens, look up the specific measures required to treat this problem.
- Laryngeal spasm.
- Respiratory depression may occur if excessive doses are used, or if opiates are used concurrently.
- Allergic reactions are rare.

## Situations for which Thiopentone is ideal

Because it is fast-acting, Thiopentone is the induction agent of choice for rapid sequence tracheal intubations and "crash inductions".

## Contraindications:

- Cardiovascular disease – for the reasons mentioned above.
- Shock or hypovolaemia.
- The elderly and the frail.
- Renal and hepatic disease. A normal dose may be administered but should be given very slowly.

## B. INHALATION ANAESTHETIC AGENTS

There are a number of inhalational agents that are available. In the past, Ether was used commonly, but this has been replaced by drugs that are easier to administer such as Halothane, Isoflurane and Enflurane. These drugs which are

also referred to as volatile agents, are commonly used to maintain anaesthesia, and sometimes, to induce anaesthesia. In nearly all situations, they should be used with a mixture of oxygen and nitrous oxide.

## HALOTHANE

### General properties

Halothane is a non-irritant and relatively pleasant gas (unlike Isoflurane), and is therefore a good agent for *gas induction*. Gas induction means that the patient is "put to sleep" directly from breathing an anaesthetic gas. These days, most patients are induced with intra-venous agents such as Thiopentone. However, Halothane is a good induction agent especially for children. After induction of anaesthesia, Halothane can be used for the maintenance of anaesthesia.

### Effects:

**Nervous system:** Halothane causes a general depression of the CNS, hypnosis and loss of consciousness. It has a very poor analgesic effect.

**Cardiovascular system:** Halothane is a potent myocardial depressant, and also causes slight peripheral vasodilation. This results in hypotension. Bradycardia and benign arrhythmias are quite common. Serious arrhythmias can be precipitated by hypercapnia, hypoxaemia, adrenaline (do not use in concentrations of more than 1:100,000) and vagal nerve stimulation.

**Respiratory system:** Halothane depresses respiration, and causes a rapid loss of laryngeal and pharyngeal reflexes which leaves the airway unprotected from aspiration. It is an excellent bronchodilator, which can be used if the patient

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develops bronchospasm. Because it damages the mucociliary action of the airways, it should not be avoided in cases of prolonged anaesthesia.

**Musculo-skeletal system:** Halothane only causes moderate muscle relaxation.

**Liver:** Very rarely, Halothane causes hepatitis and jaundice, although the incidence of this in children is extremely low. However, repeated exposure to Halothane within three months should be avoided if possible.

**Obstetrics:** Halothane causes uterine relaxation and may contribute to post partum haemorrhage. It crosses the placenta and can cause fetal cardio-respiratory depression. For these reasons, the concentration of Halothane should be limited to 0.5% in caesarian sections, and in all procedures used to empty a uterus.

## Dosage guidelines:

The response to Halothane from one individual to another is variable. It is important to titrate the concentration of Halothane to the patient's response.

A concentration of 0.5 to 1% is often all that is required to keep a patient asleep provided that Nitrous Oxide is being used at the same time. However, at the start of an anaesthetic, you will need to use higher concentrations, for example 3%, for a period of 5 to 10 minutes. Once the patient is well anaesthetised, slowly reduce the concentration back down to 1%. After a couple of minutes, the surgical procedure can begin.

## Performing a gas induction:

This tends to be impossible in adults as they will not tolerate breathing Halothane, and will put up resistance as they begin to lose

consciousness. In children, gas induction is much easier especially if under the age of about twelve. Gas induction is particularly useful when you cannot insert an iv cannula into an uncooperative child. After the gas induction, an iv cannula can then be inserted.

There are two ways of performing a gas induction: slowly or quickly. The slow method is to start the patient breathing a mixture of  $O_2/N_2O$  and then to gradually increase the concentration of Halothane by 0.5% every three or five breaths. Continue to a concentration of 3% and then wait until the patient is well anaesthetised. The quick method is to start the Halothane concentration at 3% from the beginning and keep it there until the patient is asleep.

The slow method is said to be more pleasant, but may be difficult in an uncooperative child because it takes longer. The quick method is especially useful in a crying or uncooperative child, because it sometimes only takes three or five breaths before the child becomes drowsy and floppy.

## ENFLURANE & ISOFLURANE

### General properties

Enflurane and Isoflurane are alternative agents to Halothane and are only mentioned here briefly. Inexperienced anaesthetists are advised to stick to Halothane only

Both these agents cause a general depression of the CNS. Enflurane is relatively pleasant and can be used for *gas induction*. Isoflurane however is pungent and unsuitable for gas inductions.

### Effects

**Nervous system:** Enflurane produces epileptiform activity in the

brain and should be avoided in epileptic patients.

**Cardiovascular system:** Both Enflurane and Isoflurane can cause some myocardial depression and hypotension. Unlike Halothane, arrhythmias are not common with these two agents. Generally speaking, Isoflurane is said to have the most cardiovascular stability.

**Respiratory system:** Both Enflurane and Isoflurane cause some respiratory depression.

**Musculo-skeletal system:** Both agents only cause moderate muscle relaxation.

**Obstetrics:** Both agents cause uterine relaxation similar to that of Halothane.

## Dosage guidelines:

The response of one individual to another is variable. Therefore, titrate the concentration according to the patient's response. The same approach described for Halothane can be used for both these agents. For example, at the start of an anaesthetic use higher concentrations until the patient is well anaesthetised. Then, slowly reduce the concentration back down.