

# Acute pain management and perioperative drugs used in low-resource settings

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## Abstract

The choice of drugs used during the perioperative period in low-resourced settings is dictated by numerous factors. The lack of a reliable supply of essential medications coupled with limited provision of trained staff and necessary equipment are the main causative factors. Drugs used may be unfamiliar to anaesthetists from well-resourced settings and those available can vary greatly from day-to-day. For this reason, it is important to develop an understanding of these drugs and their delivery. The management of acute pain benefits from a structured approach such as that used in the RAT model (recognize, assess, treat) from the Essential Pain Management course. This article provides an understanding of the choice of anaesthetic and analgesic drugs used in a low-resourced setting with a focus on those used less commonly in a well-resourced setting.

**Keywords** Acute pain; drugs; low-resource setting; perioperative

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In 2015 The Lancet Commission on Global Surgery published a report stating that five billion people worldwide do not have access to safe and affordable surgical or anaesthetic care.<sup>1</sup> The reasons for this are numerous but the lack of a reliable supply of essential medications is one of the key factors. Drug supply can be disrupted at each stage from production to patient use. Drug costs, disrupted cold chains, inequitable distribution to health facilities, poor infrastructure, and the lack of staff designated to replenish stocks are some of the factors. Even when there seems to be a wide selection of anaesthetic agents available, some may be of poor quality,<sup>2</sup> out of date or in short supply.

The principles of delivering anaesthesia in a low-resource setting remain the same as in a well-resourced setting, but the unpredictability of drugs and equipment available, even day-to-day in a single healthcare facility, can be challenging. For those trained in well-resourced settings, it is beneficial to develop a flexibility of practice which allows you to adapt your techniques to fluctuating drug availability as well as drugs which are no

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## Learning objectives

After reading this article, you should be able to:

- list commonly used perioperative drugs in low-resourced settings
- have a greater understanding of why these drugs are used
- demonstrate an awareness of the pharmacology of these drugs
- describe how to approach the management of acute pain in low-resourced settings

longer commonly used where you work. For this reason, it is important to develop an understanding of these drugs and their delivery.

Both the choice of drugs used for, and the safety of, an anaesthetic are greatly influenced by available equipment. Despite the tireless work of Lifebox, who have delivered more than 20,000 pulse oximeters to over 100 countries, more than 70,000 operating theatres have no oxygen monitoring.<sup>3</sup> Without end-tidal monitoring of gases, it is important clinically to ensure the correct placement of airway devices by assessing for chest wall movement and auscultating the chest.<sup>4</sup> Infusion pumps are rare, but infusions can be delivered by counting drops from a giving set,<sup>5</sup> and the volume to be delivered controlled with a burette. The presence of arterial or central venous monitoring is also rare.

## Induction and maintenance of anaesthesia

Although many agents will be familiar, others are less commonly encountered in a well-resourced setting and warrant further explanation.

Ketamine is widely available in low-resource settings, and increasingly popular in well-resourced settings. It has a favourable haemodynamic profile, and airway reflexes, airway tone and spontaneous ventilation can be maintained with its use. Even in centres with variable practitioner skill, provision of anaesthetic equipment and available monitoring, the use of ketamine is associated with a low rate of complications.<sup>6</sup> Ketamine is a dissociative anaesthetic which can be given intravenously or intramuscularly to induce sedation or general anaesthesia. Ketamine can also be used to provide sedation on ICU, for painful procedures, including burns dressing changes, and in the treatment of acute pain and bronchospasm. As airway reflexes are preserved, it is important not to use supraglottic devices when ketamine is given in the absence of muscle relaxation.<sup>7</sup>

'Ketofol', a combination of ketamine and propofol, is also used for sedation and general anaesthesia. Their additive interaction allows for the dose of each drug to be reduced. Ratios of propofol to ketamine used range from 1:1 to 4:1, depending on the balance of anaesthesia and analgesia required, and the presence of a recovery area with trained staff. 'Ketofol' provides the benefits of each individual agent with a good haemodynamic profile, analgesia, little or no emergence phenomena, reduced emesis and spontaneous ventilation with simple airway management.<sup>8</sup>

Halothane is the most common inhalational agent encountered in low resource settings, other agents often being

prohibitively expensive. It is a clear, colourless liquid, which needs protection from light, has a sweet smell and can be used for the induction and maintenance of anaesthesia. Halothane has a MAC of 0.76 and its low solubility in blood produces a rapid onset of anaesthesia. Target concentrations include 2–4% for induction and 0.5–2% for maintenance.<sup>4,9</sup> Depth of anaesthesia can be determined by clinical response if vaporizers are not calibrated. Adverse effects of halothane include a risk of hepatitis and cardiovascular effects. In the absence of other options, these must be balanced with the need for surgery. Patients with exposure to halothane within the last three months, previous history of adverse reactions or a history of unexplained jaundice or pyrexia are at highest risk, and alternative options are preferable.<sup>10</sup>

Two relatively common side effects of halothane are profound hypotension and cardiac arrhythmias. The former is more likely when halothane is used to induce or maintain anaesthesia in the already hypovolaemic patient. This is mediated by vagal stimulation, reduced systemic vascular resistance and obtunding of the baroreceptor reflexes. It can be mitigated by reducing the inspired concentration, the addition of short-acting opioids if available, and appropriate fluid resuscitation, ideally prior to induction. Cardiac arrhythmias are particularly evident in the presence of hypoxia, hypercapnia and raised catecholamine levels. Management includes turning down the inspired concentration, intravenous lidocaine 1 mg/kg and hyperventilation to reduce CO<sub>2</sub>.<sup>4</sup> Co-administration of opioid or other anaesthetic agents can reduce the risk of awareness and laryngospasm.

Neuraxial blocks, usually in the form of spinal anaesthesia, are used frequently in low-resource settings.<sup>11</sup> They confer the benefits of an awake, self-ventilating patient, better immediate postoperative analgesia and faster recovery times. They must be used with caution in under-resuscitated or haemodynamically unstable patients, where a ketamine-based anaesthetic is preferable.<sup>4</sup> Always consult with local practitioners about what dose to use. Injecting your usual dose may lead to profound hypotension or a high spinal, both of which can be irrecoverable without adequate resuscitation drugs or equipment. In obstetrics, a lack of recommended vasopressors and rapid surgical times also favour a lower dose of spinal local anaesthetic. Diamorphine is not widely available, but fentanyl can be used in stable patients for prolonged postoperative analgesia, 25 µg being a reasonable dose. Regional nerve blocks are growing in popularity and not only avoid the need for general anaesthesia but provide enhanced postoperative pain relief. A landmark technique is most common, however, as access to ultrasound or nerve stimulators is not guaranteed.

Not all facilities will have muscle relaxants. For those that do, many agents, such as suxamethonium and atracurium, will be familiar. Others, such as pancuronium are used less frequently in well-resourced settings.

Pancuronium is an aminosteroid given by intravenous bolus. The recommended dose for adults is 0.05–0.1 mg/kg, with favourable intubating conditions reached within 90–150 seconds. It has a duration of 65–100 minutes, which can be maintained with bolus doses of 0.01–0.02 mg/kg. A higher initial dose may be required in patients with liver impairment, although duration of action will be extended. In contrast, doses

should be reduced in patients with renal impairment. When pancuronium is used in combination with halothane it reduces the MAC required and lessens the depressant effect halothane causes on blood pressure.<sup>9</sup>

In the absence of long-acting muscle relaxants, infusions of suxamethonium can be used to maintain muscle paralysis. An infusion of suxamethonium diluted to a concentration of 10mg/ml, infused at a rate of 2–15 mg/kg/hour will facilitate muscle relaxation for prolonged procedures.<sup>9</sup> The risk of an infusion, or repeated doses, of suxamethonium is that the usual phase 1 depolarization block changes to a phase 2 block;<sup>12</sup> this can result in an unpredictable block with fade and slower recovery.<sup>13</sup> An absence of nerve stimulators can make this more difficult to monitor. In addition, there is an increased risk of bradycardias with repeated doses of suxamethonium.<sup>12</sup> The occurrence of phase 2 blocks and bradycardias are dose dependent. It can be argued that safer options, especially in the absence of experience, are deepening anaesthesia and giving a suitable dose of opioid. These are also alternative techniques in the absence of any muscle relaxants.

The selection of opioids and simple analgesics will vary considerably. The opioid crisis and policy intended to thwart illegal drug transport has impacted on access to these essential medications.<sup>14</sup> Pethidine is used less commonly in well-resourced settings. It comes in tablet and liquid form, for intravenous and intramuscular injection, has an onset of 10–15 minutes and a duration of 2–3 hours. It shares many of the effects of morphine but causes less histamine release.<sup>9</sup>

### Emergency drugs

Emergency drugs may be limited to adrenaline and atropine. These should be drawn up prior to inducing anaesthesia, with the usual concentrations of 1:10,000 and 1:100,000 of adrenaline. An adrenaline infusion can be administered in the absence of infusion pumps using a drip count method. This involves adding a known amount of adrenaline to a bag of fluid, producing a known dose per millilitre. The packaging on giving sets should display a value for how many drips make up 1 ml. With this information you can set it to deliver a suitable dose before titrating it to the desired clinical effect.<sup>5</sup>

### Emergence from anaesthesia

At the end of anaesthesia you are unlikely to have a ready-made vial of reversal. This can be easily remedied by giving a combination of neostigmine (0.05–0.07 mg/kg) with an appropriate dose of anticholinergic, most often atropine.<sup>9</sup> Without a peripheral nerve stimulator, reversal can be given when signs of respiratory effort become apparent, although consideration should be given to the duration since muscle relaxation was last administered.

Providing a clear postoperative plan with discharge criteria and instructions to notify the anaesthetist in case of deterioration is vitally important, though fraught. Facilities often lack adequate monitoring to identify the deteriorating patient or equipment to manage common emergencies. It is wise to be mindful of this when planning your anaesthetic, aiming for an awake, comfortable and fully resuscitated and reversed patient.<sup>15</sup>

## Analgesia

Given that the majority of the world's population do not have access to safe and essential anaesthetic care, it is hardly surprising that more than 80% are denied treatment for moderate to severe pain.<sup>16</sup> The reasons for this are multifactorial and largely aligned with those which stand in the way of the provision of safe and essential surgery. Many of these factors will require action at a high level, but there are three simple areas which can be addressed by an individual working with limited resources. These are the recognition, assessment and treatment of pain.

The pain management model recognize, assess and treat (RAT) comes from the essential pain management (EPM) course.<sup>17</sup> The EPM course aims to improve pain management at a local level by improving knowledge and attitudes, and promoting the idea that treatments do not have to be complex or expensive. The simplicity of RAT is likened to that of ABC in the acutely unwell; it is easy to remember and applicable to all environments.

### Recognition

The recognition of pain is essential to its adequate treatment. Pain can be recognized from a combination of three main indicators: self-reporting, behaviour change and physiological signs.<sup>18</sup> Although useful, these familiar indicators may be complicated by various factors present in unfamiliar environments.

- A lack of expectation that pain can be treated will prevent a patient from reporting their pain.
- They may not be able to report their pain owing to language barriers.
- They may not feel able to speak directly to you owing to cultural boundaries.
- In some situations, the cost of treatment will preclude patients from reporting their pain.
- More familiar are communication barriers posed by age, cognitive impairment and education.
- Recognition of pain can also be affected by an overcrowded and understaffed ward.

- Members of staff may not have had RAT training, feel that pain is inevitable and difficult to treat and may not be aware of the postoperative benefits of pain control other than patient comfort.

### Assessment

Once pain has been recognized, it can be assessed for severity and likely cause. There are a multitude of assessment tools available, such as numerical rating scales and the Wong Baker FACES pain-rating scale (Figure 1). It is advisable to employ a range of scales according to which is most appropriate, for example, whether the patients are adults or children or whether they are illiterate. It is important to also take into account the way in which a particular culture describes pain and to retain flexibility to accommodate local languages and levels of education.

The same reasons which prevent recognition of pain can also prevent the continual assessment of pain. By carrying out repeated assessments and documenting your findings in order to show response to treatment, the importance and benefits of continued assessment can be demonstrated. Problems faced while assessing pain and instituting effective treatments can be brought to the ward team for discussion, and troubleshooting used as an opportunity for informal education about pain management.

### Treatment

The treatment of pain will be dictated by the drugs available, but when so many patients do not receive any pain relief, even regular simple analgesics will provide great benefit. A multimodal approach, guided by the WHO pain ladder, should be followed with use of simple analgesics, available opioids, adjuncts and non-pharmacological strategies.

The ability to choose the most appropriate NSAID or opioid and route of administration may be limited. This may lead to omission altogether or inappropriate prescription, such as the use of modified release drugs for acute pain. When the intravenous route is not available and the oral route is not possible, intramuscular or subcutaneous doses can be given. Give the correct dose of opioid per weight, especially in situations where

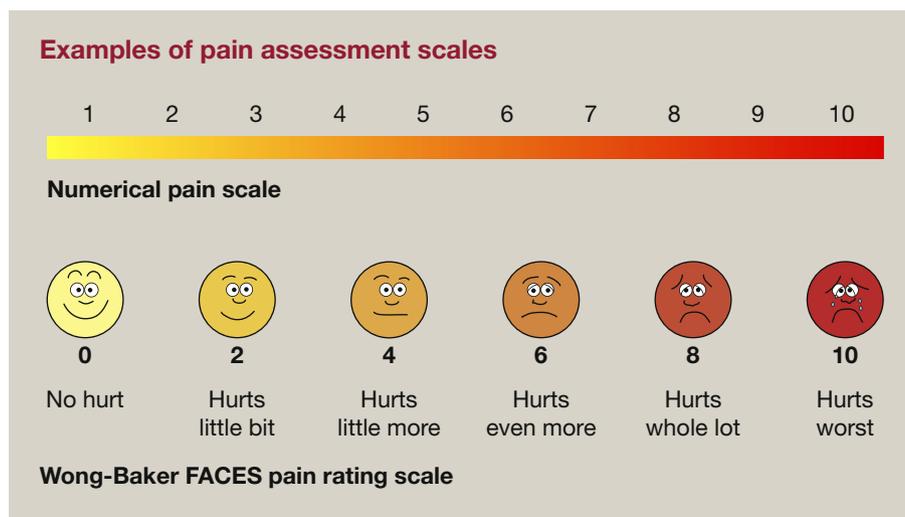


Figure 1

there is limited monitoring and a lack of nursing staff to carry out observations. Bolus doses of opioids should be carefully titrated and guided by local experience; some populations appear to be more opioid sensitive than others.

The widespread availability and use of ketamine in low-resource anaesthesia can be extended to intraoperative analgesia and the management of acute pain. Other adjuncts include infiltration of local anaesthetic to incisions and the use of perioperative peripheral nerve blocks.

Non-pharmacological means include physiotherapy, though access to a trained physiotherapist may be limited. Concepts such as rest, ice (or cold water in a glove or plastic bag) and elevation as well as providing psychological support, in the form of explanations, advice and reassurance, can be given with the help of interpreters and input from family members.<sup>17</sup> ◆

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