### SPINAL OPIOIDS IN POSTOPERATIVE PAIN RELIEF 1: PHARMACOLOGY

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This is a two-part unit on using spinal opioids to manage postoperative pain. Part 1 outlines the pharmacology and adverse effects. For details on spinal anatomy and dose levels, plus a table that outlines the differences between spinal anaesthesia and analgesia, and epidural analgesia, see Portfolio Pages at nursingtimes.net.

**INTRODUCTION**

Good pain relief aids recovery after major surgery (Kehlet and Holte, 2001). Assessing patients’ pain systematically and managing it with multimodal techniques improves surgical outcomes, reduces morbidity and decreases hospital stay (Bonnet et al, 2007).

Spinal (intrathecal) anaesthesia is among the most commonly used regional anaesthetic techniques. It is relatively easy to perform, is reliable, has a low complication rate and can provide postoperative pain control (Viscomi, 2004).

Spinal anaesthesia is the suppression of sensation by a single injection of local anaesthetic into the cerebrospinal fluid (CSF). It can be used in patients undergoing lower limb, lower abdominal or pelvic surgery and those who may be considered unfit for general anaesthesia. It reduces the need for anaesthetic drugs.

Spinal analgesia involves a single bolus dose injection of opioids, either alone or in combination with local anaesthetics, as one procedure into the intrathecal space to provide intraoperative and postoperative analgesia (Rawal, 2003). Combinations of low-dose opioids and low concentrations of local anaesthetics provide superior analgesia than either component alone (Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine, 2005).

Morphine was the first opioid used for spinal analgesia and is the most commonly used drug worldwide for this (Rawal, 2003).

Opioid receptors are widely distributed within the peripheral and central nervous systems. Naturally occurring (endogenous) opioids such as enkephalins, endorphins and dynorphins control nociception (pain pathway and perception) by binding to opioid receptors in the same way as exogenous opioids (morphine, fentanyl).

Direct application of opioids at the spinal cord level can produce effective analgesia (Rathmell et al, 2005; Rawal, 2003).

Spinal opioid analgesia is established in managing patients undergoing a wide range of procedures including: gynaecological surgery (hysterectomy); orthopaedic surgery (hip and knee arthroplasty); urological (transurethral resection of the prostate, prostatectomy); and general surgical procedures (haemorrhoidectomy, inguinal hernia repair) (Ene et al, 2007; Rathmell et al, 2003; Riad et al, 2002).

**PHARMACOLOGY OF OPIOIDS IN SPINAL ANALGESIA**

Once within the CSF, the opioid binds to opioid receptors in the dorsal horn, inhibiting transmission of afferent nociceptive signals and inhibiting the release of substance P from dorsal horn neurons (Rathmell et al, 2005).

Analgesia is not derived solely at spinal cord level – it is also induced by cephalad migration of the drug within the CSF (Hindle, 2008). Opioid receptors in the brain are stimulated and some systemic opioid absorption occurs via the epidural fat and veins (Rawal, 2003). The lipophilicity (fat solubility) of the drug governs the rate at which it will cross the dura mater and hence its duration of action.

Lipophilic opioids rapidly penetrate the spinal cord and bind to non-specific sites within both the white matter and dorsal horn receptors. They enter the systemic circulation as they are cleared from the spinal cord (Rathmell et al, 2005). This rapid transfer from the CSF into the spinal cord and epidural fat accounts for the rapid onset and prompt decline in CSF opioid levels. This is also associated with a decrease in the plasma concentration (Stoelting and Hillier, 2006).

With short-acting opioids, rostral spread (diffusion upwards of the analgesia) is restricted and analgesia confined to limited dermatomal coverage (Rathmell et al, 2005).

Fentanyl is a lipophilic (fat-soluble) opioid. It is 75–125 times more potent than morphine (Stoelting and Hillier, 2006). It produces relatively short-lasting but excellent postoperative analgesia (Rathmell et al, 2004).

Hydrophilic (water-soluble) opioids such as morphine migrate across the dura mater less readily and have a more prolonged duration of action. The opioid undergoes a similar transfer to the spinal cord, epidural space and systemic circulation but the process is slower. There is limited binding to the fat within the epidural space and non-specific receptors in the spinal cord white matter (Rathmell et al, 2005). CSF concentrations decline more slowly.

Hydrophilic drugs spread to cover more dermatomes but have a greater potential for cephalic spread, which can result in late onset respiratory depression (Hindle, 2008).

Other factors that can affect onset, spread and duration include the patient’s position, dose, speed of injection, obesity and spinal curvature (Coventry, 2007).

**LEARNING OBJECTIVES**

1. Know the differences between spinal anaesthesia, spinal analgesia and epidural analgesia.
2. Understand the importance of postoperative monitoring.
ADVERSE EFFECTS

While opioids provide effective postoperative analgesia, they may also produce adverse effects (Rawal, 1999). Spinal opioids can theoretically produce similar adverse effects to opioids administered via other routes.

In practice, nausea and vomiting, pruritus, and respiratory depression are particularly associated with spinal opioids (Hindle, 2008). Other adverse effects include sedation, pupillary constriction, urticaria and urinary retention caused by an increase in smooth muscle tone in the urinary tract.

Opioids can cause a reduction in depth and rate of respiration by decreasing the sensitivity of the brainstem respiratory centre to carbon dioxide. Depression of the cough reflex can also occur. Opioid-induced nausea and vomiting is mediated centrally by stimulation of the chemoreceptor trigger zone in the area postrema of the brainstem and peripherally by gastric stasis.

Constipation is a common effect of long-term use of opioids. It is caused by an increase in smooth muscle tone and decrease in gut motility, increasing the absorption of fluid and electrolytes. Establishing the optimum dose of opioids involves balancing the risk of adverse effects, notably respiratory depression, against those of unrelieved postoperative pain. Under-treatment of pain constitutes poor medical practice with many adverse effects (Brennan et al, 2007). Atelectasis, chest infection and hypoxia, tachycardia, hypertension, muscle spasm and a higher stress response to surgery can all occur if postoperative pain is not managed effectively.

DRUG COMPLICATIONS

Neurological damage may occur by the accidental administration of incorrect solutions into the intrathecal space. It is imperative that only trained anaesthetic staff undertake the procedure and systems are in place to double-check all drugs administered. Post-dural puncture headache (PDPHa) may occur if CSF leaks from the subarachnoid space. The incidence is low and has been reported to be below 3% (Neal, 1998). PDPHa is more common with epidural than spinal analgesia, as epidural needles are of a larger diameter than spinal needles and any CSF leak will be greater (Candido and Stevens, 2003).

This headache is usually exacerbated by sitting upright. Treatment usually consists of lying flat and administering simple analgesics (Candido and Stevens, 2003). Resolution usually occurs with time; Janowski (2002) suggested that up to 90% of PDPHAs resolve within 10 days.

If the headache does not resolve, the anaesthetic team may consider inserting an autologous epidural blood patch over the tear. This involves injecting some of the patient’s own venous blood into the epidural space to cover the hole (Safa-Tisseront et al, 2001).

Since the spinal needle is inserted “blind”, that is, it is not under direct vision, there is always a possibility of damage to blood vessels. Haematoma formation can result in spinal cord compression, ischaemia or both.

In patients who have received a prophylactic dose of low molecular weight heparin, the spinal anaesthetic should not be given for at least 12 hours after the last dose (ANZCA, 2005). Similar considerations apply to patients with thrombocytopenia and other clotting disorders. Patients’ coagulation status should be optimised at the time of the spinal anaesthetic.

Vigilance in monitoring is crucial to allow early evaluation of any neurological dysfunction and prompt intervention should a haematoma develop (Horlocker, 2003).

The potential to introduce any infection into the proximity of the spinal cord is inadvisable. Local sepsis is an absolute contraindication to spinal anaesthetic whereas systemic sepsis is a relative contraindication (Coventry, 2007).

DOSE

Opioid doses for spinal injection are much smaller than those required for the epidural or intravenous route (see Table 2 in Portfolio Pages). Spinal opioid administration bypasses the blood-brain barrier and the cerebrospinal fluid is in direct contact with the opioid receptors in the dorsal horn.

The optimal dose of spinal morphine for postoperative analgesia after major surgery is unclear because a wide variety has been used. It varies according to type of surgery and degree of patient function after surgery.

For a summary of the optimal doses used in published studies and a discussion on them, see Table 3 in Portfolio Pages.

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KEY REFERENCES


The full reference list for this unit is available in Portfolio Pages at nursingtimes.net.

Part 2, to be published in next week’s issue, explores patient selection and associated nursing care post surgery.