# A guide to epidural management


## Abstract

Epidural analgesia is a key component in the management of inpatient pain relief, particularly in surgical and trauma patients, and those with comorbidities. When used appropriately epidurals can decrease a patient's opiate consumption, as well as reducing the risk of adverse cardiorespiratory outcomes. To non-anaesthetists, or those not versed in their usage, epidurals can appear complex and intimidating, and the potential complications, although rare, can be catastrophic if not picked up on in a timely fashion. This article demystifies the epidural for hospital clinicians, looking at the anatomy and pharmacology, helping to identify patients who may benefit from epidural analgesia, highlighting some common pitfalls and questions posed by nursing staff, and providing a framework via which junior clinicians can detect, manage and appropriately escalate epidural-related problems and complications. Epidural analgesia is an invasive and high-risk intervention; as such it should always be managed by a multidisciplinary team, including anaesthesia and acute pain services.



Key words: Epidural; Management; Analgesia; Complications; Red flags; Motor block

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Steve McLaren[1]

Megan Hughes[2]

Catherine Sheehan[1]

Jagdish Sokhi[3]

Author details can be found at the end of this article

Correspondence to:
Steve McLaren; steve.mclaren@nhs.net


## Introduction

Epidurals were first inserted almost 100 years ago (Franco and Diz, 2000), and they continue to provide high quality analgesia in a variety of clinical settings. Junior doctors from a broad variety of specialties will manage patients with epidurals.

In 2009, the Royal College of Anaesthetists published their 3rd National Audit Project, focusing on complications from central neuraxial block. Perioperatively, 98 000 epidurals were performed, excluding obstetrics, and significant complications were rare (Cook et al, 2009). When complications occurred, delays in recognition and escalation contributed significantly to morbidity and mortality. This article discusses the theory behind epidurals and provides a practical trouble-shooting guide.

## Basics of an epidural

### Insertion

Under aseptic conditions and using local anaesthetic, a fine bore catheter is inserted into the epidural space via a Tuohy needle, using a loss of resistance technique. The epidural is typically sited at the midpoint of the surgical dermatomes involved, but site position can be influenced by other factors such as body habitus or abnormal anatomy. The anaesthetist will document the length of catheter inserted at the skin. This will act as a reference point, should there be problems later with the epidural (Table 1).

| Table 1. Common potential causes of inadequate epidural anaesthesia |
|---|
| Inadequate dose administered, either iatrogenic or equipment failure |
| Incorrect insertion of catheter (eg subcutaneous) |
| Catheter migrated or dislodged |
| Altered spinal or epidural anatomy |
| Sacral sparing |
| Alternative pathology |
| Unrealistic expectations |




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In contrast to a spinal or lumbar puncture, the dura is not breached, so no CSF should be seen, either on insertion of the Tuohy needle or upon aspiration of the epidural catheter. If CSF is seen, this is known as a 'dural tap', and requires specialist management by the anaesthetist.

## Pharmacology

An epidural block is a spectrum, ranging from analgesia to anaesthesia, which is primarily determined by the concentration of local anaesthetic used. For bupivacaine this ranges from 0.125% (analgesia, with good sensory and minimal motor blockade) to 0.5% (surgical anaesthesia, both motor and sensory block). To block a larger number of dermatomes, a larger volume of the same concentration of local anaesthetic is required. In the UK, the most commonly used epidural solution for analgesia is a pre-made bag of bupivacaine 0.125% with fentanyl (2 mcg/ml or 4 mcg/ml). The addition of an opioid produces a 'denser' block by acting on the spinal cord opioid receptors in the dorsal horn, particularly in the substantia gelatinosa.

There are various dosing regimens – boluses, continuous infusions or patient-controlled epidural analgesia. Boluses are often used to initiate or top up a block, while continuous infusions maintain analgesia.

## Anatomy and physiology

The epidural space lies outside the dural sac, and contains the corresponding spinal nerves from each vertebra. Epidural analgesia produces non-selective blockade of the spinal nerves travelling through the epidural space. Spinal nerves contain both motor and sensory fibres. Higher concentrations are required to block nerves with larger diameters (Figure 1).

Use of a lower concentration of local anaesthetic reduces the blockade of the larger motor fibres, resulting in the 'walking epidural'. A dense motor block after insertion should raise immediate suspicions of inadvertent subarachnoid (spinal) block (Table 2). With prolonged use a degree of motor block can occur, but this should always subside when the epidural is stopped. The aim is inhibition of the A**δ** and C fibres of the afferent nerves, which prevent painful stimuli reaching the spinal cord and subsequently the cerebral cortex without any motor blockade. Pain and temperature are conducted via the spinothalamic track, thus 'cold spray'

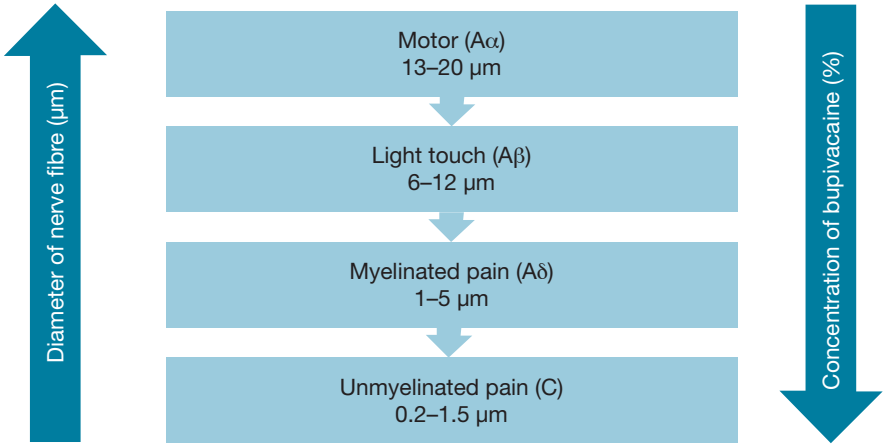


**Figure 1.** Diameter of different nerve fibres, with concentration of bupivacaine needed to produce blockade.

| Table 2. Red flag signs of epidural pathology |
|---|
| Motor block on insertion |
| Motor block in the presence of a thoracic epidural |
| Dense motor block with low dose epidural solution |
| Increasing motor block in the absence of further administered medications |
| Motor block that fails to recede after cessation of infusion |

(ethyl chloride) is used to test temperature sensation as a proxy for pain. The height of the epidural block often refers to the dermatome levels at which temperature sensation is abolished.

The autonomic nerves, primarily the preganglionic sympathetic chain, lie adjacent to the spinal nerves. Depending on block height, varying degrees of sympathetic blockade occur resulting in possible complications (Table 3). Typically, a higher block results in more complications, as more nerves are affected.

## Evidence

Grade 1 evidence (Freise and Van Aken, 2011; Harrington and Nimmo, 2014) suggests that, compared to systemic opioids, epidural analgesia provides:

- Improved analgesia
- Reduced systemic opioid use (and associated complications)
- Reduced pulmonary complications
- Reduced thromboembolic events
- Reduced cardiovascular complications
- Reduced incidence of ileus.

These findings are likely multifactorial, including reducing the stress response to surgery, minimising use of systemic opioids, and better analgesia resulting in improved mobility and preservation of lung function.

Epidurals can be used for surgeries involving the thorax, abdomen and lower limbs. As mentioned, the higher the level of epidural block the more significant the complications.

With the advent of enhanced recovery and newer regional blocks, the need for epidural analgesia has been questioned. A systematic review and meta-analysis assessed analgesic options in patients undergoing enhanced recovery open abdominal surgery. They concluded that epidurals provide superior analgesia compared to patient-controlled analgesia and regional blocks, but this did not translate into quicker recovery or reduced morbidity (Hughes et al, 2014). Careful patient selection is therefore vital, with the following cohorts most likely to benefit:

- Those with significant cardiorespiratory disease
- Those undergoing major operations associated with large incisions across multiple dermatomes
- Patients with severe acute pain, chronic pain or neuropathic pain
- Patients with contraindication to opioids.

## Managing an epidural on the ward

### General information

Patients with epidurals are defined as high risk and so should be managed in an appropriate environment, by trained doctors and nurses. This will be dictated by local trust policy. Any problems with an epidural should be immediately escalated to the on-call pain team and/or anaesthetist, depending on trust policy.

### Drug safety and epidural connectors

Because of the high-risk nature of the epidural (or potentially intrathecal) route, it is imperative that only those with appropriate training administer medications or flushes

**Table 3. Levels of epidural blocks and associated complications**

| Level of block | Nerves effected | Complications |
|---|---|---|
| Cervical | Phrenic (C3–5) | Diaphragmatic paresis |
| High thoracic | Cardio-acceleratory fibres (T1–4) | Bradycardia and negative ionotropy |
| Thoracic | Intercostal nerves (T1–12) | Difficulty breathing: intercostal nerve paresis |
| | Sympathetic chain (T1–12) | Vasoplegia and hypotension |
| Lumbar | Sympathetic chain (L1–2) | Vasoplegia and hypotension (less than thoracic epidurals) |

via this route. Previously, drug administration errors have led to epidural infusions being accidentally connected to the intravenous route causing toxicity and patient harm (National Patient Safety Agency, 2011). Administration errors prompted the National Patient Safety Agency to issue multiple alerts and updates, culminating in an NHS Improvement Patient Safety Alert (National Patient Safety Agency, 2011). As such, all epidurals should have a unique connector (NRFit), colour system (yellow) and should be very carefully labelled.

## Epidural problem solving

Epidural care on the ward can be fraught with questions and concerns, particularly for those not experienced in their management. Epidural trouble-shooting can be broken down into three main categories: block issues, functional issues and side effects.

### Block issues

Motor: As previously mentioned, a degree of motor block is to be expected with prolonged epidural use, even with low dose solution. However, a profound motor block should always raise concerns of more sinister pathology.

The consequences of an epidural haematoma or abscess can be so catastrophic that it is imperative that neurological impairment is recognised and diagnosed in a time-critical fashion. Epidural red flags (Table 2) should result in prompt intervention, escalation and investigation. Local trusts should all have their own guidelines in place for the management of these red flags (Figure 2). As a general rule, stop the epidural infusion and escalate urgently to the on-call anaesthetics team. Optimal timing for surgical decompression is unknown, because of the rarity and paucity of available evidence, but in a case review of 647 patients, those in whom decompression was delayed for more than 12 hours had worse neurological outcomes (Bos et al, 2018).

Ascending block: Ascending or high sensory block is of concern because of the potential for respiratory weakness or central neurological side effects (Table 1). If a block higher than the T3 dermatome is detected, full neurological examination and accurate documentation is required. If the patient is stable, alert and comfortable, the infusion should be stopped until the block has regressed to an acceptable level, and can then be restarted – ideally at a lower rate. If the patient is showing signs of neurological, cardiovascular or respiratory compromise,

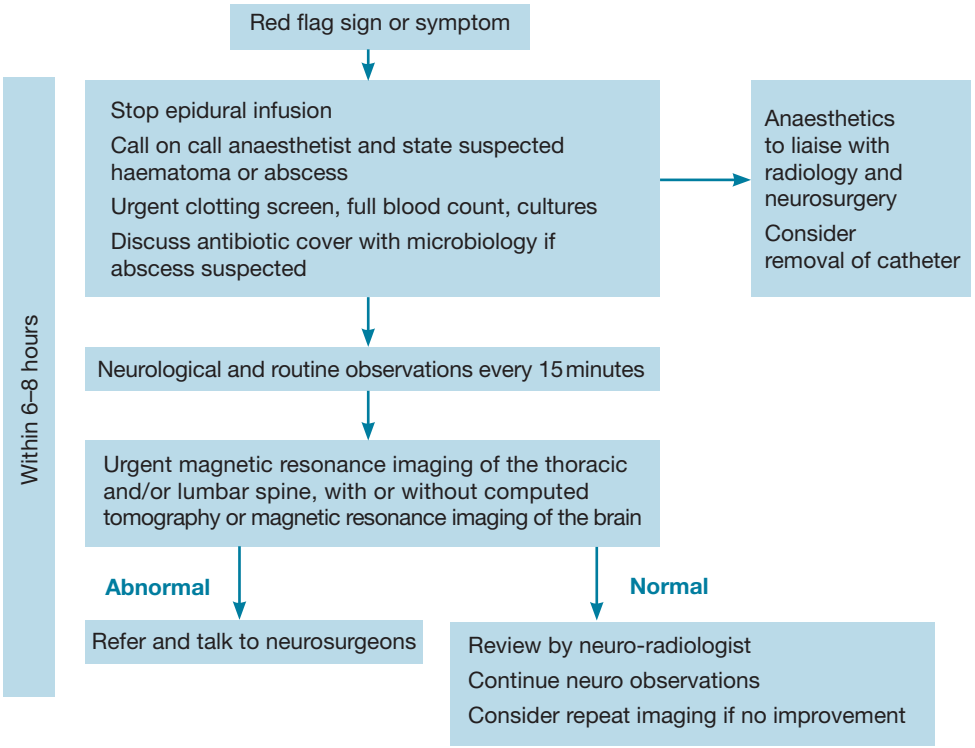


**Figure 2.** Algorithm for management of motor red flag signs. Adapted with permission from Chelsea and Westminster Hospitals NHS Foundation Trust.

adopt an ABCDE approach, involving high-flow oxygen and fluids or ino-/chronotropic support. The on-call anaesthetist and intensive care team should be contacted immediately.

Patchy or inadequate block: An inadequate block can signal inadequate spread of infusate, breakthrough pain or alternative pathology. An appropriate history and examination should be undertaken alongside relevant testing for other potential aetiologies. Once sinister sources of pain are excluded, both the epidural and patient's analgesia regimen should be assessed. There are multiple reasons for a failure in epidural efficacy (Table 1). In cases of epidural failure, clinician-led top ups, catheter repositioning, and higher dose concentrations or adjuncts can be used. It is worthwhile exploring oral, intravenous or topical analgesia regimens as adjuncts. Paracetamol and non-steroidal anti-inflammatory drugs should be administered regularly if not contraindicated. If the epidural solution contains an opioid, adding an additional systemic opioid must be discussed with the on-call pain team.

### Functional issues

Epidurals can become disconnected, increasing the risk of infection. Any disconnections downstream of the filter (ie filter and catheter disconnected) will require a new epidural because of the risk of infection and potential epidural abscess or bacterial meningitis. Disconnection upstream of the filter (filter with catheter attached) is remedied by cleaning and reconnection. Other common function issues are pump failures (batteries or power supply), and kinks or air bubbles in the catheter.

### Side effects and their management

Side effects from epidurals are common, including itchiness, hypotension, nausea, fever and urinary retention. However, these can often mask more sinister complications that require further investigation (Table 5). Complications of epidurals include headaches, paraesthesia, epidural haematoma or abscess formation, causing significant motor blockade.

Postdural puncture headaches are the most common of the worrisome headaches, and are difficult to diagnose. Postdural puncture headache is classically a fronto-occipital headache occurring 24–48 hours after insertion (Leibold et al, 1993). The pathophysiology, although not fully understood, is of a CSF leak, resulting in a pressure difference in the spinal cord and brain, causing traction of the meninges and compensatory vasodilatation. The pressure change is highest on standing, hence the postural nature of the headache. Milder cases will resolve with simple analgesia and hydration. More severe cases may require a blood patch (patient's own blood administered via a new epidural), and as such these patients will need to be assessed and consented by the anaesthetist.

## Nursing considerations and removal

Patients with epidurals should be cared for on wards with nurses who have undergone specific training and are competent to manage epidurals, including identifying potential problems.

Most hospitals will have specific documentation for epidural care, but the minimum nursing observations should include heart rate, blood pressure, respiratory rate, temperature, sedation, pain, and motor and sensory block. Nurses should be aware of their local policy to ascertain the frequency of observations but they should be recorded more frequently during the first 12 hours of a patient receiving epidural analgesia, after changes of rate or after receiving a bolus dose, and in the incidence of clinical instability (Dougherty and Lister, 2015).

Nurses should regularly inspect and document the integrity of the line connections and bacterial filter. The insertion site should also be monitored regularly to ensure the catheter is securely fastened and there is no leakage, bleeding, catheter displacement or signs of local infection (Chumbley and Thomas, 2010). Working intravenous access is essential for all patients with an epidural in case of emergency (Royal College of Anaesthetists, 2010).

The decision to discontinue epidural analgesia is often multidisciplinary, but the bedside nurse usually removes the catheter. As such, nurses should be aware of the potential issues surrounding removal. Alternative analgesia should be prescribed and the nurse should be aware of the clotting status of the patient. The Association of Anaesthetists of Great Britain and Ireland et al (2013) provide a comprehensive guide to insertion and removal times for

**Table 5. Common side effects of epidurals with differential diagnoses and potential red flag signs and symptoms**

| Signs and symptoms | Differential diagnosis | Red flags |
|---|---|---|
| Headache | ■ Postdural puncture headache<br>■ Meningitis<br>■ Subarachnoid haemorrhage | Postural, neck stiffness, fever, photo/phonophobia, focal neurology |
| Backache | ■ Musculoskeletal pain<br>■ Epidural haematoma<br>■ Epidural abscess | Motor block, fever |
| Fever | ■ Sepsis | Cardiovascular or respiratory compromise, focal signs or symptoms, raised lactate level |
| Hypotension | ■ Sepsis<br>■ Haemorrhage<br>■ Local anaesthetic toxicity<br>■ High block | Tachycardia, overt bleeding, anaemia, as above for sepsis<br>Peri-oral tingling, seizures, arrhythmias, loss of consciousness<br>See *Table 3* |
| Itch | ■ Hypersensitivity<br>■ Early anaphylaxis | Airway or respiratory compromise, angioedema of face, widespread rash, cardiovascular compromise |
| Nausea and vomiting | ■ Gastroenteritis<br>■ Bowel obstruction<br>■ Diabetic ketoacidosis<br>■ Sepsis | Fever, absent bowel sounds, raised lactate level |
| Urinary retention | ■ Cauda equina syndrome<br>■ Benign prostatic hypertrophy<br>■ Constipation | Thoracic epidural, motor block |

epidurals for patients who are receiving anticoagulation. Upon removal, the nurse should inspect the catheter to ensure it is intact. This is done by identifying and visualising the catheter tip – an intact blue tip means that the catheter has been fully removed.

Nurses should also be aware of the importance of continuing motor and sensory block observations 24 hours post epidural removal in case epidural haematoma develops (Dougherty and Lister, 2015).

## Conclusions

Epidurals continue to provide high quality analgesia. Although their use is declining with newer techniques, a basic understanding of their use and structure in managing potential problems is still an important skill for junior doctors. Early recognition and prompt management, including escalation to anaesthetic services, remains imperative for patient safety. Further information and training should be available to staff locally through acute pain services and anaesthetic departments.


### Author details

[1]Department of Anaesthetics and Critical Care, West Middlesex University Hospital, Chelsea and Westminster NHS Trust, London, UK

[2]Department of Critical Care, St Thomas Hospital, Guy's and St Thomas' NHS Trust, London, UK

[3]Department of Anaesthetics and Critical Care, Chelsea and Westminster Hospital, Chelsea and Westminster NHS Trust, London, UK



### Conflicts of interest

The authors declare no conflicts of interest.

## Key points

- By definition, patients with epidurals are 'high risk'.
- Epidurals should only be managed by those who have undergone appropriate clinical training, in accordance with their trust's local policies.
- Help is always available from the pain team or, out of hours, the on-call anaesthetist.
- Closely monitor the neurological status of patients with epidurals.
- Prepare adequate pain relief before removing the epidural.

## Curriculum checklist

This article addresses the following requirements from the general internal medicine stage 1 training curriculum

- Communicates effectively and is able to share decision making, while maintaining appropriate situational awareness, professional behaviour and professional judgement
- Managing medical problems in patients in other specialties and special cases

And the following requirements from the intercollegiate surgical training curriculum:

- Post-operative care: Clinical Skills: Delivery of effective Analgesia

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