Epidural drug delivery and spinal infection

Karen H Simpson FRCA
Yassin Said Al-Makadma FRCA

Key points
In each case, potential benefits of epidural drug delivery (EDD) must be considered against risks such as infection.

Units should develop local recommendations for EDD to optimize prevention, diagnosis, and management of spinal infections.

Spinal infections may be difficult to detect; neurological signs are often a late feature.

Early MRI scanning of the whole spine is essential if infection is suspected.

Delay in diagnosis of infection more than 36 h significantly worsens the chance of neurological recovery after decompression.

Many studies support the use of epidural drug delivery (EDD) for acute pain. Epidural analgesia is more effective for reducing pain in labour than non-regional analgesic methods. EDD reduces risk of chest infections and number of days of ventilation in patients with multiple rib fractures. Several studies support the use of EDD for postoperative pain management. EDD improves outcomes after major abdominal surgery. Thoracic EDD, given for more than 24 h postoperatively, reduces the incidence of myocardial infarction.

When EDD is used, blood loss and the risk of DVT are reduced after hip and knee arthroplasty. There is less risk of graft occlusion after vascular surgery with EDD. In chronic pain, epidural administration of corticosteroids is moderately effective for sciatica, with a number-needed-to-treat (NNT) of 7.3 for greater than 75% pain relief in the short-term (1–60 days), and an NNT of 13 for greater than 50% pain relief in the long-term (12 weeks to 1 yr).

These studies need to be balanced against others that have not demonstrated overall benefit for EDD. In a large multi-centre RCT concerning EDD in 888 high-risk patients undergoing major abdominal surgery, there was no significant difference in mortality at 30 days or in overall morbidity; of the eight morbidity end points studied, only one (respiratory failure) occurred less frequently in patients managed with EDD. Other large RCTs have showed similar results.

Therefore, health care professionals and patients need to consider the individual benefits of possibly improved pain relief and reduced adverse outcomes with EDD against the (rare) risk of complications such as paraplegia, nerve injury, haematoma, and infection. Serious neuraxial infections after EDD have traditionally been considered as rare, however, some prospective studies have found a higher incidence than expected (0.015–0.05%), and more recent work has suggested an even higher an incidence of 0.1–0.125%.

Management of EDD
Patients having EDD are most appropriately managed by a multi-professional team working to agreed recommendations within a care setting that is usually hospital-based; some EDD may occur in a community palliative care setting. Primary care teams also need to be aware of the risks of EDD as some infections are only apparent after the patient has been discharged from hospital. The hospital team will usually have a consultant in anaesthesia, pain medicine, or both, pharmacists, and clinical nurse specialists in pain management. It is important that the team is adequately resourced and has established relationships with the teams who are responsible for the day-to-day care of the patient either in hospital or if appropriate in the community.

Patient consent
We believe that consent for EDD must be written and according to local guidelines that should adhere to recommendations from appropriate regulatory bodies, e.g. Seeking patients’ consent: the ethical considerations, General Medical Council, November 1998. This process should be supported by written information given in a form that the patient can understand. Common complications and rare, but serious, adverse effects must be discussed; infection must be specifically mentioned. Patients should be given adequate time to consider the benefits and burdens of the technique prior to consenting to treatment; it is most appropriate that this occurs at pre-assessment. When there are specific issues concerning the benefits and burdens of EDD for individual patients, then these should be discussed and documented.

Patient selection
EDD should be considered as part of a pain management strategy when its use offers clear advantages and it can be delivered safely in the available context; this is a clinical judgment. Patients at increased risk of spinal infections should be identified, e.g. those with:
• Immune compromise, diabetes, or intravenous drug abuse (the second commonest risk factor for epidural infection);
• Local or systemic sepsis, e.g. chest or urinary infection or at more distant sites such as leg ulcers, pressure sores, furuncles, paronychia;
• Alcoholic liver disease;
• Long-term indwelling vascular access, e.g. haemodialysis catheters;
• Difficult epidural access or a bloody tap;
• Degenerative disease or other disruption of the spinal column, e.g. trauma, surgery, and instrumentation; these factors may render epidural catheterization more difficult;
• Prolonged preoperative hospital stay;
• Long duration of epidural catheterization; however, in one series three out of nine infections occurred after the catheters had been in situ for only 3 days.

Assessment and investigations
Patients must be assessed regarding their general fitness to undergo local anaesthesia, general anaesthesia, or both. An infection screen may be needed in some cases if sepsis is suspected; e.g. FBC, ESR, CRP, swabs, and blood cultures. Individual units need to develop policies and practices relating to MRSA that depend on local circumstances. There is probably no specific need to screen patients for MRSA just because EDD is being considered. If a patient is known to have been previously colonized with MRSA, then they should be treated according to local guidelines. This usually means that if the patient has had topical MRSA prophylaxis within the past 6 months, then no action is needed. If not, then they require 5 days of nasal Mupiricin and daily Aquasept skin wash. Guidance from microbiology and infection control departments is essential.

Preparation of drugs
Continuous infusions
Many manufactured ready-to-use solutions for epidural infusion are commercially available; these products should be used wherever possible. If this is not feasible, then drugs must be produced in a pharmacy aseptic facility; these solutions have a 24-h limit on their use. It is not appropriate to prepare infusion solutions for EDD in clinical areas, apart from in an urgent situation or in the most exceptional circumstances based on a documented risk benefit assessment. In this situation, the solution must be prepared in a theatre environment using an aseptic technique; these solutions will also have a 24-h limit on their use. They must be prepared immediately prior to use, never in advance, and they must not be stored in a ward areas.

Bolus injections
Epidural bolus dosing should, wherever possible, be performed using a pump within a closed system. Drugs for epidural bolus injections, e.g. for chronic pain, that are of necessity prepared in a theatre environment, must be prepared using aseptic technique. The operator should be scrubbed, gowned, and gloved and the drugs drawn up onto a sterile field from an assistant who is trained in aseptic practices. The same recommendations apply to the preparation of drugs for epidural bolus injection to be used in other areas, e.g. radiology. In exceptional circumstances, epidural boluses may be given in other environments, e.g. in the wards or palliative care units. This should only occur when analgesia cannot be achieved via the closed system. The same standard of full asepsis should be observed in this situation. Such patients are at high risk of infection and this should occur only through necessity and not convenience.

Techniques
Each unit must standardize techniques for EDD. Those inserting EDD systems must be familiar with their local policies and practices concerning infection control, e.g. hand washing, facemask and glove usage. Assistants must be appropriately trained in infection control pertaining to EDD. There is no evidence for the use of prophylactic oral or topical antibiotics for epidural catheter insertion. There is good evidence that the incidence of central venous catheter (CVC) infections can be reduced by the use of maximal sterile precautions. Therefore, it would seem logical to apply similar standards to epidural catheterization, epidural steroid injection, and any other procedures that breach the closed EDD system, e.g. bag changes, disconnection, and line changes.

Skin preparation is important. Chlorhexidine (0.5%) in its alcoholic solution is bactericidal in 15 s and this should probably be the standard preparation prior to EDD. In those with chlorhexidine sensitivity, alcoholic povidone iodine should be used. Solutions must be allowed time to work and allowed to dry. Although single dose preparations have theoretical advantages for sterility, the use of open containers of these on trolleys should be avoided. The risks of contamination of the equipment or inadvertent injection of antiseptic spinally are too great. Dressings around epidural catheter sites are important; they act as fixators and protect the site from contamination. At present, there is no clear evidence about dressing types. The use of transparent semi-permeable dressings is advisable, as it allows visual inspection of the catheter site without removing the dressing.

There is no evidence for placing disinfectants, e.g. iodine-based powder, at the catheter entry site; we do not recommend this as it may stop the dressings from adhering. Once the epidural pump has been connected (usually in theatre or PACU), the EDD system must remain closed. Accessing the external epidural tubing and pumps should be avoided. Any access must be as infrequent as possible, and performed with meticulous asepsis. Filters and
infusion lines should be changed infrequently (no more often than every 72 h) unless there is an indication e.g. leakage. Lines should be labelled with the date and time of change. Accessing the epidural system must be managed in the same way as accessing a CVC. Hands must be decontaminated, sterile gloves worn; all external hubs and connections must be cleaned with 70% alcohol and 0.5% chlorhexidine wipe or spray that is allowed to dry properly. Ideally, epidural infusions should be from bags and infusion pumps rather than syringe drivers. There is evidence that the use of syringe drivers increases the risk of infection; this may be due to the need to breach the system more often.8

There must be a policy for dealing with accidental disconnection of the EDD system between the patient and the filter. Unless there is a brief witnessed disconnection, where there is no possibility that the line has been contaminated, the best option is reinserterion of a new epidural catheter. However, in some circumstances, e.g. when epidural catheterization has been very difficult, then reconnection may be clinically justified. As a routine, epidural catheters should probably only remain in situ for ≤3 days unless there is a strong clinical indication for longer catheterization. The clinical benefits should be considered against the potential risks in each case. If epidural catheters are used for prolonged infusions, there should be a risk assessment of the situation at 3 days and daily thereafter.

Presentation and investigation of spinal infections

Extreme vigilance for spinal infection is needed for all patients who have had EDD. The symptoms and signs can be subtle, e.g. pyrexia, backache, or both are the most common, but are not invariable. Only 13% of patients with epidural abscess present with the classical triad of fever, back pain, and neurological change. Back pain is the initial symptom in 75% cases; therefore, one in four patients has no back pain. Fever occurs in only 66% of cases. Blood tests may help with the diagnosis, but they are non-specific; it is essential to monitor trends rather than to rely on single measurements. Only two out of three patients have a leucocytosis. A raised ESR (usually >30 mm) is more specific and is found consistently, even in those with no neurological deficit. There are little data about the effect of spinal infection on CRP; a normal CRP does not exclude spinal infection. However, it would seem reasonable to use this measure to detect and monitor infection.

Regular temperature monitoring and epidural catheter site checks are essential. If there is a suspicion of infection, a full infection screen and blood cultures are mandatory. Intercurrent infections such as chest or urinary tract infections may lead to a bacteraemia and subsequent epidural catheter infection, necessitating prompt assessment and treatment in patients with EDD systems. Superficial skin infection around the exit site of a catheter may be managed by appropriate intravenous antibiotic therapy; the system should always be removed immediately. The patient must be observed for any signs of progression of the infection as this can happen alarmingly rapidly.

The commonest microorganisms found in spinal infection are bacteria (90% cases), particularly Staphylococcus aureus. However, depending on the population being studied, a variety of other bacterial, mycoplasmal, fungal, and parasitic infections have been reported. Lumbar puncture gives no useful specific information in the diagnosis of epidural abscess and it may spread infection. There is a 14% risk of spinal coning, so it should probably be avoided in favour of radiological investigations.

MRI with gadolinium is the investigation of choice.9 It should be performed early and before neurological changes occur. The epidural skin entry point may be lumbar, but the catheter tip may be very proximal, therefore the whole spine should be scanned.

Diagnostic delay is common and compromises the chance of neurological recovery. Regular assessment and documentation of neurological status, e.g. by Bromage scores is essential. Any unexplained neurological signs should alert the health care team to the possibility of an epidural bleed or infection, e.g. low doses of local anaesthetic by infusion should not lead to profound and worsening motor block.

The neurological damage that occurs with epidural infection is not simply due to compression; its pathogenesis may also involve vascular compromise from ischaemia, thrombosis, or both. Thoracic abscesses tend to lead to more severe disability than those in the lumbar region. Patients with spinal stenosis do worse. Investigations must not be delayed while waiting for localized signs. Once muscle weakness is present, only about 20% patients regain full function, even after surgery. Finding pus, rather than granulation tissue, at surgery is a predictor for better outcomes. Poor recovery is predicted by patient age (poor outcome doubles with every increase in decade), extent of thecal compression, and duration of neurological symptoms (<36 h has better prognosis).10 Mortality from epidural abscess is now <10%.

Management of established spinal infections

Early advice is usually needed from radiology, microbiology, and surgical colleagues when managing patients with spinal infection. It is important to remove the epidural catheter as soon as there is a clinical suspicion of spinal infection; the catheter tip should be sent for culture. Although there may be a place for conservative management with antibiotics alone in carefully selected patients without neurological signs, this would be unusual and require careful monitoring. MRI with gadolinium will help to decide whether open or percutaneous drainage should be used. Rapid neurological deterioration, a large extra-spinal abscess, or loculated granulation tissue usually require open surgery. Early surgical decompression is needed involving removal of pus, debridement, and drainage; microscopy, culture/sensitivity, AAFB culture, and tissue histology are mandatory.

Initial antibiotic therapy should be empirical and then modified depending on the results of culture and sensitivity studies. Treatment must be guided by microbiology specialists. Drugs must
be active against *S. aureus*, with good bone penetration and the least toxicity possible. The likelihood of MRSA should be considered when instituting initial therapies. Parenteral antibiotics are required initially usually for 2–4 weeks, and in some cases oral antibiotics may be needed for a more prolonged period. There is no evidence for the use of steroids in the management of epidural infection; these are contraindicated. The clinical response should be monitored; WBC and CRP should be measured regularly looking at trends. Monitoring pain, function, inflammatory markers, and radiological changes can be used to assess response.

**Monitoring EDD**

The care and monitoring of patients who have had EDD should continue throughout their hospital stay and after their discharge back to the community. While an in-patient, the Acute Pain Team or the anaesthetist who inserted the epidural should be contacted immediately if there is an epidural catheter disconnection, or concerns about the epidural catheter site or spinal infection.

Patients may leave hospital with occult epidural infection that is only manifest in the community; there may be weeks or months of delay in making this diagnosis. In some cases, the patient will present to an A & E department or to the primary care team. It is important that the health care professionals in those areas are made aware that the patient has received EDD, and that the teams understand how to clinically assess and investigate a patient with suspected epidural infection. It is also important that they have clear instructions about whom to contact in case of suspected epidural infection.

**References**


Please see multiple choice questions 5–7