

## The labour epidural: troubleshooting

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### Summary

- Labour epidural failure rate is 9-12% and can be multifactorial
- Poor insertion technique (multiple needle passes), needle mal-placement (off midline), inadequate loading dose and/or infusion rate, catheter migration and rapid labour progression are the commonest causes of labour epidural failure
- Anatomical factors such as previous spinal surgery can affect placement and subsequent epidural failure
- Immediate identification of intrathecal and intravascular catheters are vital
- Continuous active management of epidurals is required, with a low threshold to replace inadequately functioning catheters.

### QUESTIONS

**Before continuing, try to choose an appropriate neuraxial technique with justification for each case. Discussion can be found at the end of the article.**

#### Case 1

A 30-year-old primigravid patient, with prolonged first stage, now fully dilated. Requesting an epidural. She is in severe distress with pain, although it appears that she will tolerate sitting still for the procedure.

#### Case 2

A 38-year-old multiparous patient, G3P2, had previous uneventful vaginal deliveries with epidurals. She went into labour at home 2 hours ago and is now fully dilated. She is requesting an epidural but reports she cannot sit down due to sacral pressure or stay still due to pain.

#### Case 3

A 24-year-old primigravid patient is 4cm dilated. She has received multiple intramuscular doses of pethidine (meperidine). You are requested urgently for an epidural. On your arrival, the parturient is on her knees crying in pain. She is very distressed, requesting an epidural. You manage to get her onto the bed, but despite this she is moving around the bed constantly. She is intermittently drowsy with medical nitrous oxide and oxygen gas mixture (50:50), which she will not stop using.

#### Case 4

A 32-year-old multiparous patient, G2P1, is 3cm dilated. She has a BMI of 35 and gestational hypertension. Previous prolonged second stage requiring assisted vaginal delivery.

### INTRODUCTION

The incidence of labour epidural failure is approximately 9-12%.<sup>1</sup> Epidurals fail for many reasons, however knowledge of the potential causes can allow anaesthetists to troubleshoot and potentially salvage inadequately functioning epidural catheters.

### WHY LABOUR EPIDURALS FAIL

#### Inadequate epidural activation or maintenance dose

Adequate volumes and concentrations of local anaesthetic must be administered to establish an adequate epidural block for labour. Once an epidural block is established an adequate maintenance dose is required. The maintenance dose may be administered via physician or midwife led boluses, patient

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controlled epidural analgesia (PCEA) or programmed intermittent boluses (PIB). A range of local anaesthetic concentrations from 0.0625-0.1% with additional opiate (discussed later in the article) are used in larger volumes for establishing the epidural for labour. The method of providing the epidural maintenance doses and the institutional guidelines will determine the concentration, volume and time interval for administration of maintenance local anaesthetic.

### Incorrect needle and/or catheter placement

There are several sites an epidural can be erroneously placed, some more easily identified than others: subcutaneous, subdural, intrathecal (IT) and intravenous.

Subcutaneous placement of epidural catheters will result in complete block failure.<sup>2</sup> This is the most common cause of complete block failure, that frequently occurs with a false loss of resistance (loss of resistance prior to entering the epidural space), most commonly in parturients with a raised BMI.

The subdural space is a potential space between the dura and pia-arachnoid mater. Insertion into the subdural space would imply advancement beyond the epidural space, piercing the dura mater but not entering the subarachnoid space. The effects of subdural placement can range from complete block failure, to a patchy asymmetric block, with delayed or minimal motor and autonomic blockade.<sup>6</sup> Intrathecal catheter placement can occur after unintentional dural puncture with the needle or catheter. It is identified by cerebrospinal fluid (CSF) flowing through the Tuohy needle, or during catheter aspiration, or it may not be identified until the patient displays symptoms or signs.<sup>2</sup> Intrathecal placement can occur at the time of catheter insertion or due to migration from the epidural space. Rapid onset of motor blockade following a test dose should alert the anaesthetist of IT catheter placement. In the case of unintentional dural puncture there are several management options. The epidural catheter can be threaded intrathecally and used to provide low-dose

**Table 1:** Reasons for epidural failure

Reasons for epidural failure
Inadequate activation dose (volume and/or concentration) and maintenance dose
Incorrect needle and/or catheter placement
Migration of epidural catheter
Altered anatomy (e.g. previous spinal surgery)
Sacral sparing
Precipitous labour
Unrealistic patient expectations and low pain thresholds

continuous spinal analgesia<sup>7</sup>, or the catheter can be removed and re-sited in the epidural space.

A unilateral block can occur when the catheter is located in the lateral aspect of the epidural space. This can sometimes be improved by withdrawing the catheter 1-2cm, with the aim of positioning the catheter midline in the posterior epidural space.

Intravascular placement of an epidural catheter is a potentially life threatening complication and can occur in up to 3-7% of placements with nylon catheters.<sup>5</sup> This can be identified if blood is aspirated via the epidural catheter, however there is a high false-negative rate.<sup>8</sup> The intravascular catheter can either be withdrawn (1cm at a time then flushed with saline and aspirated) until no more blood is aspirated, or it can be totally removed and replaced. The gravid uterus compresses the vena cava causing epidural vein distension increasing venous cannulation risk.<sup>2</sup> Lateral positioning for placement, not advancing the needle or catheter during a contraction, limiting the depth of catheter insertion to ≤5cm, and using a soft tipped flexible epidural catheter may reduce the risk of intravascular placement.<sup>9, 10</sup>

Intravenous injection of local anaesthetic can lead to Local Anaesthetic Systemic Toxicity (LAST), which can cause cardiac

**Table 2:** Potential sites for incorrect epidural catheter placement and their associated complications

Location of Catheter Placement	Incidence 2,3,4,5	Speed of Onset	Motor Block	Complications
Subcutaneously	Unknown	Never	No block	No analgesia Local tissue swelling
Subdural	1-13%	5-15minutes	Minimal motor block with sympathetic sparing	High sensory block (including cervical with Horner's syndrome) Patchy block
Intrathecal	1.5%	2-5 minutes	Dose dependent	Haemodynamic instability Respiratory compromise High/total spinal Fetal bradycardia Post dural puncture headache (PDPH) Infection
Intravenous	3-7% (with rigid catheters)	Immediate signs and symptoms	No Block	LAST Haemodynamic collapse

PDPH = post dural puncture headache; LAST = local anaesthetic systemic toxicity

arrest. Key treatment of any symptoms or signs of LAST is to immediately stop administering the epidural bolus and/or infusion and commence treatment with intravenous lipid emulsion (Intralipid®) in conjunction with advanced life support, if required.

### **Migration of the catheter**

Migration of epidural catheters can occur despite correct placement initially.

Migration of the catheter through the intervertebral foramina laterally may produce a unilateral block.<sup>11</sup> The catheter can also migrate into the IT and subdural spaces.

Epidural catheters can migrate posteriorly into subcutaneous tissue, more commonly in parturients with high BMI, or in patients where the catheter has not been secured in place effectively.

The incidence of epidural catheter migration can be minimized by leaving 5cm or less in the epidural space and attention to fixation only after repositioning the patient from a flexed position to an extended position (sitting upright, or lying with hips extended). Epidural catheter fixation devices and flexible catheters may help prevent migration. Subcutaneous migration of the catheter is more likely to be seen if less than 3cm is left in the epidural space, and unilateral analgesia is more likely if greater than 5cm of the catheter is left in the epidural space.<sup>12</sup>

### **Previous spinal surgery**

Spinal surgery does not preclude a parturient from receiving neuraxial anaesthesia. However, patients with previous spinal surgery are at increased risk of difficult epidural insertion, inadequate analgesia and increased unintentional dural puncture.<sup>2</sup> Post-operative scarring and obliteration of the epidural space distorts normal anatomy and may interfere with normal loss of resistance and spread of local anaesthetic solution.

### **Sacral sparing**

During labour, afferents innervating the vagina and perineum cause somatic pain (S2-4 nerve roots). The S2-4 nerve roots are covered with thick dura mater, have a large diameter and are further away from the tip of the epidural catheter than the roots transmitting pain in the first stage of labour (T10-L1). These factors in addition to the normal propensity for local anaesthetic solution to travel cephalad can reduce diffusion to sacral nerve roots leading to sacral sparing and failure of labour analgesia in the second stage.<sup>2</sup>

A subarachnoid block (spinal) in conjunction with epidural (combined spinal and epidural - CSE) reduces sacral sparing.<sup>2</sup>

### **Precipitous labour**

Labour epidurals alone may fail with rapid progress of labour and a precipitous delivery due to insufficient time to establish effective analgesia; a CSE is an alternative technique that can be used in these situations.

### **Patient expectations and pain thresholds**

Managing individual patient expectations are vital. Current labour epidural infusions consist of a low concentration of local anaesthetic plus low dose narcotic and it is expected that parturients may feel

contractions as a pressure sensation. Pain thresholds and response to local anaesthesia can vary between individuals and also between different labour processes and fetal positions.

### **WHAT TO DO IF THE EPIDURAL CATHETER FAILS?**

An incomplete block can range from a missed segment, a patchy block, a unilateral block, sacral sparing, not dense enough block, or complete failure. There are a number of techniques that can be employed to rescue an inadequate block.

A thorough assessment should be carried out prior to any intervention of an inadequate block, which includes:

1. History from the patient – pain score, location of pain (abdominal vs perineal), type of pain (pressure?), has a bolus dose helped?
2. Examination – check the position of the catheter (compare with what was documented at the time of placement), check sensory/motor block.
3. Optimise the patient's position.
4. Assess effectiveness of a bolus dose (if not already done) prior to catheter manipulation and/ or further boluses with increased local anaesthetic concentration ± supplemental epidural narcotic (fentanyl).

### **Physician epidural-top-up**

Inadequately functioning epidural catheters can be topped-up by a physician-bolus of local anaesthetic. A large volume of low concentration (e.g. 10ml 0.125% bupivacaine), or a small volume of high concentration (e.g. 5ml 0.25% bupivacaine) local anaesthetic can be administered depending on whether spread or density is required. A physician-administered bolus is effective in approximately 70% of cases.<sup>13</sup>

### **Catheter manipulation**

Epidural catheters can pass cranially, caudally, laterally or into the anterior epidural space.<sup>11</sup> Withdrawing catheters 1-2cm (in a sterile fashion) and giving an additional dose of local anaesthetic can improve the block in 77% of patients.<sup>13</sup>

### **Epidural opioids**

Morphine, diamorphine, sufentanil and fentanyl can all be administered epidurally. Fentanyl is the commonest opioid used for labour analgesia.<sup>14</sup> Epidural fentanyl is commonly used in the UK, whereas sufentanil is often used in the US.

Fentanyl is a lipophilic drug with an epidural onset time of 10 minutes. Epidural fentanyl has been shown to be three times more effective than IV fentanyl in labouring women, suggesting a spinal mechanism of action.<sup>15</sup> A common concentration of epidural infusion solution contains 2mcg/ml fentanyl combined with local anaesthetic.

Epidural fentanyl can be administered as an initial loading dose and/or for breakthrough pain (50-100mcg) to improve the quality of analgesia.<sup>14</sup> It can also be administered to manage sacral sparing or as a supplement when converting labour analgesia to surgical anaesthesia for operative delivery.

Sufentanil is more potent than fentanyl. An appropriate epidural loading dose is 10mcg and 0.4mcg/ml for an infusion combined with local anaesthetic.

### Positioning the patient

Another potential rescue measure for asymmetrical blocks is to alternate the position of the parturient between the right and left lateral positions prior to local anaesthetic top-ups.

### WHEN TO RE-SITE THE LABOUR EPIDURAL?

Inadequate labour analgesia despite the above interventions (and if more than two physician boluses are required) should prompt the anaesthetist to consider replacement of the epidural catheter.<sup>16</sup>

### Can the epidural be topped up for caesarean section?

Active management of epidurals throughout labour is vital to ensure adequate pain relief, maternal satisfaction and the ability to convert labour analgesia to surgical anaesthesia if required for caesarean section.

The following criteria should be satisfied before topping-up a labour epidural for surgery:

1. There is no suspicion of an intrathecal or intravascular catheter
2. Parturient has had adequate labour epidural analgesia, and had resolution of pain from any intervention(s) performed, i.e. catheter withdrawal and/ or physician bolus

Topping up an inadequately functioning epidural catheter risks failure and conversion to general anaesthetic during caesarean section. Options for managing a non-functioning epidural prior to caesarean section include: replacing the epidural and topping it up, performing a single shot spinal (SSS) or a CSE. Depending on intrathecal dosing, care needs to be taken to avoid high spinal blockade or conversely a low surgical sensory block. Although a more involved procedure, a CSE in this setting is a more titratable technique avoiding the risk of a low or high block.

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## ANSWERS TO CASES

### Case 1

A 30-year-old primigravid patient, with prolonged first stage, now fully dilated. Requesting an epidural. She is in severe distress with pain, although she will tolerate sitting still for the procedure.

#### COMBINED SPINAL EPIDURAL (CSE)

This parturient is likely to be suffering perineal and pelvic pain as she is fully dilated. The spinal component will provide immediate analgesia with increased likelihood of blocking the S2-4 somatic afferents.

She is a primip with a prolonged first stage. A rapid second stage is unlikely and she is at risk of an instrumental delivery. The epidural component of the CSE will allow continued analgesia throughout labour and provide the option of anaesthesia for an assisted or operative delivery if required.

An epidural alone takes time to establish adequate analgesia and there is risk of sacral sparing.

A single-shot spinal may not provide an adequate duration of analgesia.

### Case 2

A 38-year-old multiparous patient, G3P2, had previous uneventful precipitous vaginal deliveries with epidurals, is fully dilated. She went into labour at home 2 hours ago. She is requesting an epidural but reports she cannot sit down due to the pelvic pressure or stay still due to the pain.

#### SINGLE SHOT SPINAL (SSS) IN THE LATERAL POSITION

This parturient is a multip and requires fast-acting analgesia. She is unable to sit due to sacral pressure, likely from a low-lying fetal head. Performing the neuraxial procedure in the lateral position has a number of benefits: improved patient comfort and increased probability of the patient remaining still during the procedure.

Primarily, blockade of the S2-4 somatic afferents is required for analgesia, which will take time to achieve with an epidural. A SSS will provide immediate effective analgesia. A CSE could be performed but it is unlikely she will need the epidural component, exposing her to unnecessary procedural risk. Intravenous opiates can be considered if there is no time for a SSS. The paediatricians must be informed of potential fetal respiratory depression.

### Case 3

A 24-year-old primigravid patient is 4cm dilation. She has received multiple doses of pethidine (meperidine). You are requested urgently for an epidural. On your arrival, the parturient is face down on the floor of the room, on her knees crying in pain. She is very distressed, asking you

to take her pain away. You manage to get her onto the bed, but despite this she is moving around the bed constantly. She is intermittently drowsy with the use of medical nitrous oxide and oxygen gas mixture (50:50), which she will not stop using.

#### CSE or SSS IN THE LATERAL POSITION FOLLOWED BY SITTING EPIDURAL

This scenario poses a challenge to even an experienced obstetric anaesthetist. This parturient is unlikely to tolerate labour without any form of neuraxial analgesia, however it can only be provided for her in an environment that is safe. The risk of complications in a poorly compliant, moving and distressed parturient are high. In addition, the anaesthetist needs to consider that a number of factors may impact the patient's capacity to consent: understanding of the procedure, ability to understand risks and benefits. Junior anaesthetists with concerns that it is unsafe to proceed with the procedure should call for senior help.

Focusing on breathing control improves the effectiveness of Nitrous oxide/oxygen and a calm explanation from the anaesthetist may help. The patient may be more comfortable in the lateral position (especially if they are drowsy), but this needs to be balanced with the familiarity of the anaesthetist with this position. A rapid SSS in the lateral position may provide enough analgesia to calm the patient and allow a longer term epidural to be established in a calm, safer environment.

A patient may require IV narcotics to help pain control and the ability to stay still during neuraxial analgesia placement.

### Case 4

A 32-year-old multiparous patient, G2P1, is 3 cm dilation. She has a BMI of 35 and gestational hypertension. Previous prolonged second stage, requiring assisted vaginal delivery.

#### EPIDURAL

Epidural-alone is an appropriate choice of neuraxial technique in this case. In view of gestational hypertension the platelet count should be checked prior to epidural insertion and removal. Early insertion of epidural catheters in patients with a high BMI is recommended. Placement can be challenging in obese patients, therefore it is easier to place it in a controlled situation rather than in an emergency situation, such as in an urgent caesarean section for example. Intubation can also potentially be more difficult in obese patients, therefore having a catheter in-situ and time to ensure it is functioning well, may avoid the need to perform general anesthesia in an emergency situation. Epidurals also reduce the stress response from labour, which can improve blood pressure control.