

Epidural analgesia in labour

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Key points

Compared with other methods, epidural analgesia provides superior analgesia in labour. However, it is not always associated with improved maternal satisfaction.

Epidural analgesia does not increase caesarean section rates.

The risk of postpartum back pain is not increased.

Combination of local anaesthetic and opioids is particularly effective.

Since epidural analgesia was introduced four decades ago for pain relief in labour, controversy has persisted about its effect on the labour process. As a result of this, considerable research has been performed and findings have led to changes in practice. Epidurals have been credited with prolonging labour; increasing oxytocin requirements, instrumental and operative delivery rates; and causing maternal pyrexia and postpartum back pain. There is increasing evidence that refutes some of these claims.

Despite ongoing controversies, epidural rates have increased; ~25% of women in the UK and 66% of women in the USA receive epidural analgesia in labour. The following statement from the American College of Obstetricians and Gynecologists summarizes the background to these figures: 'labour results in severe pain for many women. There is no other circumstance where it is considered acceptable for a person to experience untreated severe pain, amenable to safe intervention, while under a physician's care.'

Effect of epidural analgesia on labour and outcome

Though women who receive epidural analgesia during labour are more likely to require instrumental or caesarean delivery, there is little evidence to suggest that the epidural itself is to blame. There is an association between epidural analgesia and labour outcome, but this is probably not causative.

Study design is significant when assessing the evidence. In a retrospective analysis, the analgesic technique and type of delivery are reviewed following delivery. In this type of study, there is inevitable selection bias, as women with long painful labours, with increased risk of intervention, are more likely to request epidural analgesia, and those women deemed at high risk are actually recommended or encouraged to have an epidural. Impact studies involve observing labour outcome before and after the introduction of an epidural service or a marked increase in epidural rate within an individual unit. Such studies are of

interest because of the large number of patients but the methodology has been criticized: confounding factors, such as changing practice over time, can influence results. Though randomized controlled trials (RCT) are considered the gold standard for research, in labour they can be difficult to blind and therefore, there is potential for observer bias. RCTs were perceived to be difficult to accomplish in labour because of problems with consent, recruitment and high crossover rates. However, there have recently been a number of well-designed RCTs of epidural vs non-epidural analgesia that seem to have finally addressed some of the issues surrounding epidural analgesia in labour.

Quality of analgesia

Epidurals have consistently been shown to provide superior analgesia when compared with non-epidural analgesia for labour pain, although this is not always associated with greater maternal satisfaction. Maternal satisfaction is an important measure but is influenced by many other factors, including outcome of labour, support and interaction with staff, and control over pain rather than its amelioration.

Effect on Caesarean section rate

Several recent large RCTs comparing epidural with non-epidural analgesia during labour have shown that epidural analgesia does not increase the caesarean section rate, whether attributable to dystocia or fetal distress. These findings are supported by a meta-analysis of impact studies in which a dramatic increase in the epidural rate had no impact on operative delivery rates.

Effect on instrumental vaginal delivery (forceps and vacuum deliveries)

The use of epidural analgesia does appear to have an effect on the instrumental delivery rate. A meta-analysis of RCTs comparing epidural with non-epidural analgesia during labour found that instrumental vaginal deliveries were more common in those receiving epidural analgesia, with an odds ratio of 2.19 (95% CI 1.32–7.78). This included 10 studies and 2369 patients of

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mixed parity. On the other hand, a more recent meta-analysis of 9 impact studies, including over 37 000 patients, found no increase in instrumental vaginal deliveries when the epidural rate increased by more than 25%. The type of epidural analgesia might influence spontaneous vaginal delivery rates (see COMET study).

Effect on duration of labour and labour augmentation

In the same meta-analysis of RCTs of epidural vs non-epidural analgesia, epidural analgesia was found to prolong labour, though only modestly. The first and second stages of labour were prolonged by 42 and 14 minutes, respectively. The clinical relevance of this is unclear. The definition of prolonged second stage in women who have received regional analgesia has been revised by the American College of Obstetricians and Gynecologists (i.e. >3 h for primigravidae and >2 h for multigravidae). This could be considered an arbitrary number if the fetus and mother are both well. There is a theoretical risk of damage to the neurological structures within the pelvis with longer labours, but this is difficult to quantify.

Uterine activity appears to be unaffected by induction of regional block. Fluid preloading has been shown not only to be ineffective in preventing the modest reductions in blood pressure associated with low dose epidurals, but also associated with a decrease in uterine contractions, which may last up to 1 h. The meta-analysis did show more frequent use of oxytocin to augment labour in the epidural group. This may merely reflect the fact that women with complicated, painful labours might request epidural analgesia more often.

Association with back pain

Several recent, well-powered RCTs confirm that epidural analgesia during labour is not associated with an increased incidence of back pain after childbirth. Back pain is common after childbirth with almost 50% of women reporting it 6 months after delivery and 28% of back pain occurring for the first time postpartum. After childbirth there is no difference in the incidence of long-term back pain, disability or movement restriction between women who have epidurals and those who have not.

Effect on the fetus and neonate

No consistent differences have been identified in neonatal arterial pH or APGAR scores in babies who are born to mothers with epidurals. Some studies report benefits for the neonate, including a reduction in the incidence of low APGAR scores at 5 min and in the need for naloxone. Other workers have reported transient alterations in fetal heart rate, particularly bradycardias, after initiation of epidural analgesia. Various explanations have been proposed, including opioid-induced uterine hyperstimulation and placental hypoperfusion (secondary to a fall in maternal blood pressure and unopposed norepinephrine secretion related to rapid onset analgesia and an ensuing rapid fall in maternal epinephrine concentrations). Once again, the clinical importance of these

isolated reports is unclear. However, monitoring of the fetus remains important.

Effect on maternal temperature

Epidural analgesia is associated with maternal pyrexia (temperature $\geq 38^{\circ}\text{C}$), with an odds ratio of 4.0 (95% CI 2.0–7.7). The degree of this pyrexia increases with the duration of labour. Nulliparity and labour longer than 12 h were also independent predictors for maternal pyrexia. The main concern is that this pyrexia leads to unnecessary investigations for mother and baby, and a greater use of antibiotics. The cause of the pyrexia is not fully understood but appears to be independent of infection.

Epidural technique

Bearing in mind the above, how can we optimize labour epidural analgesia to ensure superior analgesia while minimizing the effects on labour?

Low dose vs traditional epidural analgesia

In the Comparative Obstetric Mobile Epidural Trail (COMET) published in 2001, 1054 primigravidae were randomized to receive traditional bupivacaine 0.25% top-ups or one of two mobile techniques: (i) combined spinal-epidural (CSE) with intermittent low-dose local anaesthetic and opioid top-ups; or (ii) epidural low-dose infusion (LDI). Both mobile techniques were associated with a 25% reduction in instrumental vaginal delivery compared with the traditional epidural group, and this was without an increase in caesarean section rate. Presumably this is the result of the preservation of muscle tone and the bearing down reflex. The message from the COMET trial is that low-dose techniques offer the best chance of a spontaneous vaginal delivery (SVD) with satisfactory analgesia. The authors conclude that the continued use of 'traditional' epidurals 'might not be justified'. In a drive to decrease instrumental deliveries, ever-lower dose regimens have been studied and found to provide effective analgesia.

Traditionally, concentrated local anaesthetic (LA) solutions were used in the initial dose to establish epidural analgesia, but lower concentrations of LA and opioid have been shown to establish good analgesia within a satisfactory time scale. Epidural opioids have a LA dose-sparing effect in labour analgesia. The combination of low concentration LA (e.g. bupivacaine 0.1%) and epidural opioids provides good analgesia with less motor block and higher maternal satisfaction rates than LA alone.

Local anaesthetic drugs

The ideal local anaesthetic for labour analgesia would produce a reliable sensory block, no motor block and be safe in overdose or when inadvertently administered i.v. Traditionally, bupivacaine has been the most widely used LA in the UK. Bupivacaine provides effective analgesia epidurally but produces dose-dependent motor block and has a poor safety profile, causing life-threatening cardiovascular and neurological sequelae in overdose.

Levobupivacaine is a single enantiomer LA and a stereoisomer of bupivacaine. It is equipotent to bupivacaine with a minimal local analgesic concentration (MLAC) ratio of 0.98. Levobupivacaine is less cardiotoxic than bupivacaine, with approximately a 50% greater safety margin in animal trials. Toxicity concerns may seem irrelevant when low dose techniques are used, but during protracted labours, the total amount of LA may be high, and large boluses may be required for operative delivery. Given the choice, it would seem preferable to use the drug with the best safety profile, although this will have cost implications.

Ropivacaine is another single enantiomer LA. It has been promoted as having less motor blocking effect as well as a better safety profile than bupivacaine. However, it appears that the drugs are not equipotent. In MLAC studies, the relative analgesic potency of ropivacaine to bupivacaine was 0.6 and the motor blocking potency was 0.66. This would suggest that ropivacaine does not have a superior sensory-motor split when compared with bupivacaine. When used in equipotent doses (0.15% ropivacaine and 0.1% bupivacaine), the incidence of motor block is the same.

Chloroprocaine and lidocaine are also used in the obstetric setting; they are not suitable for analgesia. Chloroprocaine is an ester LA with an extremely rapid onset of action; it is widely used in the US to top up epidurals for operative delivery. It undergoes ester hydrolysis; minimizing placental transmission but its duration of action is too short for analgesia. Lidocaine 1.5–2% with epinephrine is used for the same purpose in the UK (chloroprocaine is unavailable). Lidocaine is not popular for labour analgesia as repeated doses cause tachyphylaxis.

Opioids

Opioids can be added to LA or used as a sole epidural or intrathecal agent to provide analgesia for labour (Table 1). Neuraxial opioids have been associated with pruritus, nausea and vomiting, hypotension, urinary retention, uterine hyperstimulation, fetal bradycardia and maternal respiratory depression. Of these, pruritus is the most common (up to 48%, 17% requiring treatment).

Morphine, a relatively long-acting opioid, is poorly lipid soluble and may accumulate in the CSF where it can spread cephalad, potentially causing late respiratory depression. Only preservative-free morphine should be used intrathecally. Greater lipid solubility theoretically means that diamorphine rapidly penetrates the cord, leaving little drug available for cephalad spread. It has a long duration of action (~8 h) and is useful for analgesia after delivery.

Fentanyl is perhaps the most commonly used opioid in the UK. It has a rapid onset and lasts for 1–2 h when given as a bolus. Dose finding studies show fentanyl 5 µg intrathecally to be as effective as

15 and 25 µg, with only a slightly shorter duration of action, but with significantly less pruritus. In the UK, a popular combination for epidural infusions or bolus top-ups is a solution of bupivacaine (0.1 or 0.065%) with fentanyl 2 µg ml⁻¹. Sufentanil is used extensively in the US. It is 4.5-times as potent as fentanyl epidurally. Sufentanil 1 µg ml⁻¹ added to LA provides better analgesia with a longer duration of action than fentanyl 2 µg ml⁻¹.

Epidural maintenance

Examples of typical epidural regimens are shown in Table 2.

Conventional midwife- or anaesthetist-administered top-ups

These are the traditional intermittent boluses of LA, typically bupivacaine 0.25–0.5%, either in response to discomfort or at timed intervals, after assessment of block height. This is labour intensive for staff, provides intermittent analgesia and can cause haemodynamic instability with each bolus.

Low dose top-ups

These also refer to intermittent boluses by the midwife or anaesthetist but with low dose LA, usually with fentanyl. The low-dose regimen provides effective, rapid onset analgesia and high maternal satisfaction rates when compared with traditional top-ups. With low dose top-ups, there is a reduction in total LA dose when compared with epidural infusions. Low dose top-ups are inherently safe; however a midwife should still be present. They do not last as long as traditional top-ups and may be inadequate for instrumental vaginal delivery.

Epidural low-dose infusions

Epidural low-dose infusions (LDI) are typically run at 8–16 ml h⁻¹ titrated to block height. In theory, LDI should decrease anaesthetic workload, provide more constant analgesia and better haemodynamic stability and sterility. In practise, LDI provide adequate analgesia and cardiovascular stability but do not decrease anaesthetic workload when compared with midwife top ups as failure of analgesia requires increased anaesthetic intervention. The total dose of LA and opioid is actually increased when compared with low dose top-ups. In the COMET study, women in the LDI group received twice as much fentanyl as the CSE group and more neonates required resuscitation.

Table 2 Example of typical epidural regimens

Epidural regimen	Dosage	Dose Interval
Low dose top-ups	Bupivacaine 0.0625–0.125%, 10 ml and fentanyl 2 µg ml ⁻¹	30–60 min
LDI	Bupivacaine 0.04–0.125% and 2 µg ml ⁻¹ fentanyl	8–16 ml h ⁻¹
PCEA	Bupivacaine 0.0625–0.125%, 3–5 ml and fentanyl 2 µg ml ⁻¹ (± background infusion)	10–15 min lockout
CSE	Intrathecal bupivacaine 2.5 mg and fentanyl 25 µg	As for LDI

LDI, low-dose infusions; PCEA, patient-controlled epidural anaesthesia; CSE, combined spinal–epidural anaesthesia.

Table 1 Dosages of commonly used opioids

Opioid	Intrathecal	Epidural
Fentanyl	5–25 µg	50–100 µg
Diamorphine	0.2–0.4 mg	2.0–3.0 mg
Morphine	0.1–0.2 mg	7.5–10 mg
Sufentanil	2.5–15 µg	25–50 µg

Patient-controlled epidural analgesia

Patient-controlled epidural analgesia (PCEA) has proved a safe and reliable technique. It provides effective analgesia and high maternal satisfaction rates, as mothers feel they are in control of their analgesia. Other advantages of PCEA compared with LDI include a reduction in total LA dose, improved mobility and delayed onset and less pronounced motor block. There is only a modest reduction in patients requiring anaesthetic intervention. No clear advantages have been demonstrated when compared with midwife administered low dose top-ups. In addition, there are equipment and cost issues to consider.

To walk or not to walk

It has been suggested that confining women to bed during labour may cause labour to be longer and more painful, and increase the incidence of malpresentations and therefore instrumental deliveries. Studies have shown that women who receive 'mobile epidurals' are able to ambulate safely. However, an effect on outcome of labour has not been shown. If women do ambulate, they should be accompanied at all times, as minor degrees of motor block and impaired proprioception may increase the risk of falling. Formal scoring methods, such as the Bromage score, straight leg raise or proprioception assessment, can be used to assess the mother's ability to walk safely. Maternal satisfaction may be increased by the fact that even if not ambulant, women are more mobile in bed.

Combined spinal–epidural (CSE) analgesia in labour

In the UK, 24% of obstetric units offer CSE for labour analgesia. Suggested advantages are very rapid onset of analgesia (with a similar time to set up and perform the block) and high maternal satisfaction rates. When compared with conventional epidural analgesia, the total LA dose is reduced with CSE and patients have less motor block over the course of labour, allowing them to ambulate if desired. CSE does not seem to decrease the number of anaesthetic interventions required, the duration of labour or the mode of delivery when compared with epidural analgesia. Disadvantages of CSE often cited are that they are more invasive and costly. Although there have been case reports of meningitis associated with CSE, a systematic review of CSE vs epidural analgesia did not suggest an increased incidence. The needle-through-needle technique may have a longer learning curve and a higher incidence of technical failure compared with single-shot spinal or epidurals. On the other hand, CSE may reduce accidental dural puncture rates. The potential hazards of intrathecal catheter migration, an untested epidural catheter and a marked increase in the incidence of postdural puncture headache have not been realized.

Other drugs

Intrathecal clonidine (α -2 agonist), in combination with fentanyl, provides effective analgesia in the first stage of labour without significant motor block. Clonidine has been used for analgesia,

in combination and alone, in doses of 30–200 μ g. However, its use is associated with sedation and hypotension and it is not widely used in obstetrics. Other drugs that have been investigated include epinephrine, ketamine, neostigmine, remifentanyl and midazolam.

Obstetric management

Whatever the influence of epidural analgesia on labour, it is obvious that obstetric management will have an impact on the mode of delivery. Variations in practice between obstetricians, even within a single obstetric unit, can and do result in widely different SVD and operative delivery rates. SVD rates vary enormously between studies of epidural vs non-epidural analgesia (30–81%). The use of 'active management of labour', which includes strict criteria for the diagnosis of labour, early amniotomy and the use of oxytocin both earlier and later in labour, has been shown to reduce the length of first and second stages of labour in those with regional analgesia. This is thought to be why epidural analgesia seems to have no effect on instrumental vaginal delivery rates in some studies. It is conceivable that as epidural analgesia becomes more refined, the effect of the obstetric management may overshadow that of the epidural analgesia. Good communication and a team effort are needed to reap the benefits of pain free labour, while minimizing the potential effect of epidural analgesia on labour outcome.

Conclusion

Factors contributing to the outcome of labour are multiple and complex. We have a duty to provide optimal analgesia during labour. This is clearly achieved with epidural analgesia. Epidurals do not increase caesarean section rates or the incidence of back pain. However we must strive to reduce any effect on duration of labour and instrumental vaginal delivery rates by minimizing motor block through the use of low-dose LA and opioid combinations. Further research in the form of well-designed RCTs is needed.

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See multiple choice questions 75–79.