Combined spinal–epidural techniques

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Definition
The combined spinal–epidural technique (CSE) has become increasingly popular in recent years. It can be defined as the intentional injection of drug into the subarachnoid space and the placement of a catheter into the epidural space as part of the same procedure. The advantage of the CSE is that neuraxial block can be achieved rapidly using the spinal component while the epidural catheter can be used to prolong or modify the block.

Applications of the CSE
Non-obstetric surgery
CSE has been used for a wide variety of non-obstetric surgery in adults including orthopaedic, urological, vascular, gynaecological, and general surgical procedures. There have been reports of its use as the sole anaesthetic technique in patients undergoing sigmoid colectomy and abdominal aortic aneurysm repair. The technique has also been used for inguinal hernia repair in neonates.

Obstetrics
In the past decade, CSE has become increasingly popular, both as a method of providing analgesia in labour and as a method of providing anaesthesia for caesarean section. A survey of consultant obstetric anaesthetists in England in 2004 found that 65% used the CSE technique; a significant proportion performed more than 100 CSEs yr\(^{-1}\). The benefits of using CSE to provide analgesia in labour include the rapid onset of pain relief compared with a conventional epidural technique (particularly in late labour) and maintenance of the ability to ambulate. A recent Cochrane review of 14 randomized controlled trials comparing CSE with epidural analgesia in labour confirmed that CSE provides faster onset of effective pain relief along with a higher incidence of maternal satisfaction. However, the review found no difference between CSE and epidural techniques with regards to maternal mobility, the incidence of post-dural puncture headache, the rate of forceps delivery, or the rate of caesarean section.

Several studies have demonstrated the superiority of CSE over conventional epidurals for caesarean section in terms of reliability of analgesia and muscle relaxation. A lower total dose of local anaesthetic is required with CSE when compared with conventional epidurals for caesarean section. The benefits of CSE over a single-shot spinal anaesthetic for caesarean section have been more difficult to demonstrate. However, the CSE technique comes into its own in cases where surgery is predicted to outlast a single-shot spinal block.

Technique
Both midline and paramedian approaches can be used for each of the techniques described below.\(^3\)

Needle-through-needle
This is the most widely used CSE technique. An epidural needle is used to identify the epidural space. A spinal needle is then passed through the epidural needle into the subarachnoid space and the subarachnoid block performed. After the removal of the spinal needle, an epidural catheter is placed that can be used subsequently. Developments of this technique have included the design of epidural needles with ‘backeyes’ or holes in the greater curvature of the needles, which allow the epidural catheter to be inserted away from the dural puncture site, thus reducing the risk of inadvertent subarachnoid placement of the epidural catheter. Other developments include the design of spinal needles which lock onto the epidural needle after dural puncture, thus reducing the risk of spinal needle displacement during intrathecal injection and failure of spinal

Key points
Combined spinal–epidural (CSE) combines the rapidity of onset and predictability of a spinal block with the ability to modify and extend the block through an epidural.
CSE can be performed using a needle-through-needle technique or with two separate needles.
CSE has been shown to improve the quality of analgesia in labour and maternal satisfaction.
CSE has been shown to be as safe as an epidural or a spinal alone.
anaesthesia. Success rates of up to 99% have been reported with certain ‘locking’ needles, which is comparable with the reported success rates of 98% with conventional ‘non-locking’ needles used in some studies.

The needle-through-needle technique can also be performed by inserting a catheter into the epidural space before the spinal block. By carrying out the procedure in this order, the warning signs of misplacement of the epidural needle or catheter (such as paraesthesia) are preserved during the insertion of the CSE. However, this technique risks damage to the epidural catheter as the spinal needle is inserted.

### Separate needle

This technique uses two separate needles to perform the spinal and epidural components of the CSE. Both needles can be inserted at the same vertebral interspace or at two separate interspaces. Again, the spinal and epidural components of the CSE can be performed in either order. The advantages and risks of performing the epidural component first are the same as those described for the needle-through-needle technique above. The advantage of performing the spinal component first is that the almost instantaneous onset of analgesia reduces the risk of the patient moving during the subsequent insertion of the epidural needle.

Studies comparing the needle-through-needle technique with the separate needle technique have found a higher rate of failure of the spinal component with the needle-through-needle technique. Failure rates of 5–20% have been reported for the needle-through-needle technique (although in experienced hands this is as low as 1–5%), compared with <5% for the separate needle technique. On the other hand, the needle-through-needle technique is associated with greater patient satisfaction and may be quicker to perform.

### Double-barrelled needles

Certain CSE needles have been designed with two barrels: one for the performance of the spinal component and the other for the passage of the epidural catheter. These needles allow the separation of the sites of dural puncture and epidural catheter placement. However, there are few studies of the efficacy of these needles and they are not commonly used. This may change as new double-barrelled needle kits come onto the market.

### Complications

The complications of CSE (Table 1) can be divided into those related to the technique or those related to the drugs administered.

#### Failure of the spinal component

As mentioned above, failure of the spinal component of CSEs is more common with the needle-through-needle technique than with the separate needle technique. In the case of the needle-through-needle technique, failure of the spinal component can occur for a number of reasons. A short spinal needle may not protrude far enough beyond the tip of the Tuohy needle to pierce the dura. On the other hand, a long needle may be more difficult to handle. Deviation from the midline will also increase the epidural–dural distance and may result in the spinal needle missing the subarachnoid space laterally. If ‘loss of resistance to saline’ has been used to identify the epidural space, backflow of saline through the spinal needle may be mistaken for cerebrospinal fluid, which may contribute to failure of the spinal component.

### Failure of the epidural component

There are few studies on the rates of failure of the epidural component. Occasionally, problems may be encountered with inserting an epidural catheter following the spinal, resulting in a significant delay between the spinal and epidural components of the CSE. Such delays may result in the spinal component of the block becoming ‘fixed’ before the anaesthetist has had a chance to position the patient. Furthermore, significant side-effects of the subarachnoid block (e.g. hypotension) may occur at a time when the anaesthetist’s attention is centred on attempting to insert the epidural catheter.

### Subarachnoid placement or migration of the epidural catheter

When the epidural component of the CSE is performed after the spinal component, there is a risk of the epidural catheter being accidentally inserted into the subarachnoid space via the hole in the dura created by the spinal needle. This is a rare complication. The risk is greatest with a needle-through-needle technique in which the spinal needle and the epidural catheter emerge from the same opening of the Tuohy needle. ‘Backeyes’ may reduce the incidence of this complication, as does a separate needle technique. Migration of the epidural catheter through the dura after the CSE has been performed is an ever rarer event. Nevertheless, because of these potential complications, epidural top-ups should always be given with care, keeping this complication in mind.
Damage to the spinal needle or epidural catheter

There is a theoretical risk of friction between the spinal and epidural needles with needle-through-needle CSE. This may generate metallic fragments, which can then be introduced into the epidural or subarachnoid spaces. These fragments are unlikely to cause any clinically significant problems. More seriously, kinking of the spinal needle during needle-through-needle CSE can very rarely occur with the potential for the spinal needle tip to be sheared off completely. If an epidural catheter is placed before introduction of the spinal needle, there is risk of damage to the catheter from contact with the spinal needle during its insertion.

Subarachnoid spread of epidurally administered drugs

With the CSE technique, a dose of local anaesthetic given epidurally will produce a higher dermatological block than expected because of subarachnoid spread of the drug. However, this is not usually a clinically significant problem unless the dura has been breached by the epidural needle, or large epidural boluses are used. When the epidural component is performed after the spinal component of CSE, epidural test doses should be interpreted with caution because of this subarachnoid spread.

Neurological damage

It is difficult to estimate the incidence of neurological complications with CSE because of the rarity of such complications. In one retrospective survey, the rate was estimated to be 1.14 per 1000 cases of CSE. The vast majority of these complications are minor with no long-term effects. Injury to the conus from spinal component of a CSE placed above the L2 spinal level, has been described. Paraesthesia on spinal needle insertion occurs more commonly but, again, is rarely associated with any long-term neurological damage. There have been reports of more serious complications after CSE (e.g. subdural haematoma, cauda equina syndrome, aseptic meningitis), but the establishment of a direct causal link between CSE and each of these complications has been difficult. The same complications have certainly been reported after conventional epidural anaesthesia.

Post-dural puncture headache

Reported rates of post-dural puncture headache with CSE have ranged from 0.8 to 2.5%. These rates are similar to those reported for conventional epidurals. It would be expected that CSE would be associated with a higher incidence of headache because of cerebrospinal fluid leak from the site of intentional dural puncture. However, the subsequent injection of drugs into the epidural space may minimize this leak. CSE may also be associated with a lower incidence of accidental dural puncture when compared with conventional epidurals although the mechanism of this is unclear. Small gauge atraumatic pencil-point needles should be used to perform the spinal component of CSEs in order to minimize the risk of headache.

Infection

There have been fears that CSE may be associated with a higher risk of infection than either epidural or spinal block alone as the technique involves inserting a potential source of infection (the epidural catheter) close to a site at which the protective barrier formed by the dura has been deliberately breached. There have been case reports of bacterial meningitis, epidural abscess, and subdural abscess after CSE; the majority of these occurred after the use of CSE in labour. Organisms that have been implicated as the cause of these infections have included Staphylococcus aureus, β-haemolytic Streptococci, Pseudomonas, and Streptococcus salivarius. However, similar infective complications have also been reported after both spinal and epidural blocks, performed as single procedures. There is, as yet, no evidence that CSE is associated with a higher relative risk of infection than either epidurals or spinals alone. There is also no evidence that one particular CSE technique is better than another in terms of risk of infection.

Although serious infective complications are rare after CSE, the importance of taking strict aseptic precautions when performing CSE cannot be overemphasized. This should include the wearing of facemasks given that organisms found largely in the oral cavity such as Streptococcus salivarius have been isolated in some of the cases of bacterial meningitis.

Drug-related complications

These complications are beyond the scope of this review and will not be discussed further. However, it is worth noting that lower doses of drug are generally used with CSE compared with conventional epidurals, and the incidence and severity of drug-related side-effects should therefore be lower for CSE.

Future developments

Epidural volume extension

It has been shown that a low subarachnoid block can be extended significantly in a cephalad direction by an epidural ‘top-up’ of 10 ml of normal saline given within 5 min of the subarachnoid block. This effect is known as epidural volume extension (EVE). The mechanism of this effect is probably related to compression of the subarachnoid space by the saline in the epidural space, resulting in cephalad spread of local anaesthetic within the subarachnoid space. EVE allows CSE to be performed with small initial intrathecal doses of local anaesthetic and, as saline is used for the epidural ‘top-ups’, the total dose of local anaesthetic used is reduced. EVE has been used successfully to provide anaesthesia for elective caesarean section and may be associated with faster recovery of motor function in the postoperative period compared to single shot...
spinal anaesthesia. However, the technique is not practised widely and requires further evaluation.

References


Please see multiple choice questions 6–9