Spinal Anesthesia

Lopa Misra DO

Introduction

Although the first spinal block was performed in the 1880s, spinal anesthesia did not gain popularity in the United States until the 1940s. However, because of reports of toxicity and neurologic concerns, there was a decline in the number of blocks performed until the 1980s when a large study performed by Clergue and colleagues demonstrated the relative paucity of such complications. When used in appropriate patients, advantages of spinal blocks include a decrease in thromboembolic events, cardiac morbidity and mortality, bleeding, and subsequent transfusion requirements. In addition, subarachnoid blocks decrease vascular graft occlusion and postoperative pulmonary compromise. Benefits of spinal anesthesia are multifactorial, including decreased hypercoagulable state, increased tissue blood flow, increased oxygenation, increased peristalsis, and decreased stress response. The mechanism of action of spinal anesthesia is attributed to the bathing of nerve roots within the subarachnoid space with local anesthetic. Effects of local anesthetics depend on size and myelin content of nerve fibers, concentration of agent, and duration of contact between the nerve and the local anesthetic. Loss of autonomic function occurs before sensory loss, which occurs before motor loss. This is because heavy myelinated fibers present in motor nerves are the most resistant to effects of local anesthetics. Autonomic block is two or more dermatomes ABOVE the level of skin analgesia, and motor block is two or more levels BELOW the level of skin analgesia (Fig. 98.1).

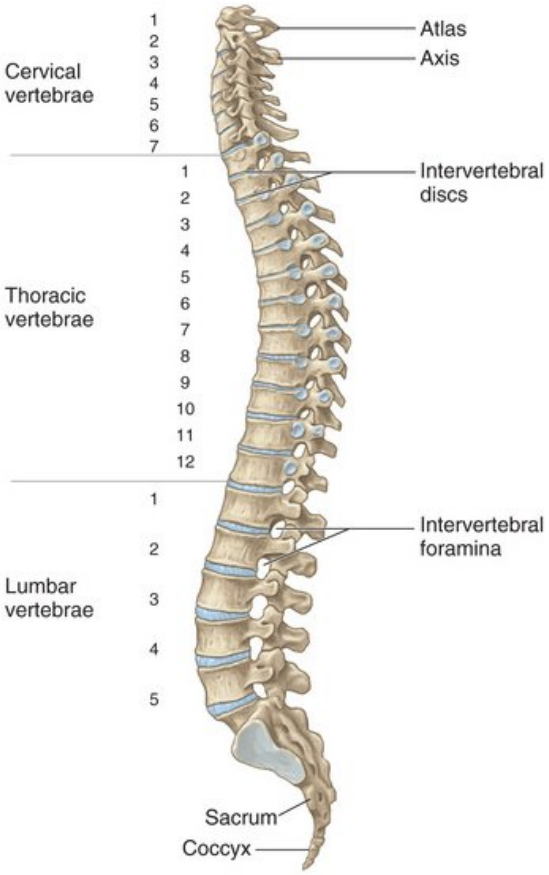

Fig. 98.1 The spinal column is seen from a lateral view. All of the vertebrae, intervertebral discs, and intervertebral foramina are shown.

Factors Affecting Block Level

Important factors affecting block level are baricity, patient positioning during and after placement, and local anesthetic dose. Additionally, specific gravity of local anesthetic as compared with the specific gravity of CSF determines which direction the local anesthetic will travel. For instance, hyperbaric local anesthetics travel "down" or gravity-assisted whereas hypobaric local anesthetics travel "up" or anti-gravity. Typically, isobaric solutions remain at the site of injection or have been shown in vivo to behave similar to hypobaric solutions. Other potential determinants of block height are injection site, patient height, spinal anatomy, and direction of needle bevel (Table 98.1).

TABLE 98.1

TABLE 98.1

Determinants of Local Anesthetic Spread in the Subarachnoid Space

PROPERTIES OF LOCAL ANESTHETIC SOLUTION
Baricity Dose Volume Specific gravity
PATIENT CHARACTERISTICS
Position during and after injection Height (extremely short or tall) Spinal column anatomy Decreased CSF volume (increased intraabdominal pressure caused by increased weight, pregnancy, etc.)
TECHNIQUE
Site of injection Needle bevel direction

CSF, Cerebrospinal fluid.

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Spinal Anesthetic Agents

The most commonly used solutions are hyperbaric or isobaric bupivacaine (12–15 mg). However, tetracaine, ropivacaine, procaine, and 2-chloroprocaine have also been used. Historically, lidocaine had been used for spinal anesthesia because of its rapid onset, dense blockade, and short duration of action. However, secondary to several case reports in the 1990s of cauda equina syndrome with hallmark signs of bowel or bladder dysfunction after the use of 5% lidocaine through microcatheters and later, transient neurologic symptoms (TNS), a painful condition of the buttocks and thighs with possible radiation to the lower extremities beginning as soon as a few hours after spinal anesthesia and lasting as long as 10 days, caused lidocaine use within spinal anesthesia to fall out of favor. It should be noted that all local anesthetics can cause TNS. However, lidocaine and mepivacaine both have a relative risk for TNS that is 7x that of bupivacaine, prilocaine, and procaine. Recently, 2-chloroprocaine has re-emerged as a spinal anesthetic for use within ambulatory surgical populations (e.g., outpatient orthopedics) because of a shorter duration of action than bupivacaine, but with potential for less risk for TNS than mepivacaine or lidocaine. Quality and duration of blocks may be enhanced by adding vasoconstrictors (e.g., epinephrine) and opioids. Less commonly, clonidine, magnesium, and neostigmine have also been trialed because they may also have some analgesic properties; however, the benefits of increased onset time and

time to recovery of spinal block need to be balanced against potential dose-related side effects from use of these adjuvants.

Cardiovascular Effects

Spinal anesthesia results in a sympathectomy which, in turn, leads to hypotension and bradycardia in addition to reduced cardiac contractility. Treatment includes fluids, vasopressors, and atropine.

Risks for bradycardia (< 50 beats/min) are as follows:

- -Baseline HR below 60 beats/min
- -ASA I physical status
- -B-blockers
- -Sensory level above T6
- -Age < 50 years
- -Prolonged PR interval

Pulmonary Effects

Pulmonary effects, although uncommon, may also occur as a result of spinal blocks despite gas exchange being a relatively passive process. The diaphragm is innervated by the phrenic nerve, which is composed of C3–C5 fibers typically unaffected by spinal blockade. However, in cases of high thoracic spinal levels, there is a reduction in vital capacity because of loss of abdominal and accessory respiratory muscle function despite tidal volume remaining unchanged. In severe chronic lung disease, patients rely on accessory muscles for respiration. Therefore caution is advised in this group when considering spinal anesthesia. In general, all patients should be on supplemental oxygen because acute airway closure, hypoxia, and atelectasis may occur. In cases of total spinal or high spinal, the resulting apnea and hypotension are usually caused by brainstem hypoperfusion *not* direct local anesthesia blockade. Treatment includes supporting blood pressure with vasopressors, fluids, and securing the airway if needed.

Gastrointestinal Effects

Because of the resultant sympathectomy accompanying spinal blocks, a small, contracted gut with peristalsis ensues. This is a result of enhanced vagal activity. Additionally, hepatic blood flow may be reduced secondary to a decrease in mean arterial pressure.

Genitourinary Effects

There is minimal effect on renal blood flow from spinal blockade because renal blood flow is autoregulated. If a spinal is placed at the lumbar or sacral level, one can see loss of autonomic control of bladder function resulting in urinary retention, which resolves when the block dissipates.

Cerebral Blood Flow

Cerebral blood flow is maintained during spinal anesthesia. However, if mean arterial pressure is less than 60 mm Hg, cerebral blood flow will decrease resulting in hypoxia, nausea, and vomiting. In these episodes of "spinal-induced hypotension," a head-down/Trendelenburg position may help increase mean cerebral arterial pressure (however, use caution with hyperbaric solutions). In addition, fluids and vasopressors (e.g., phenylephrine as a bolus or an infusion) may be used to restore blood pressure to adequate values.

Contraindications to Spinal Anesthesia

Absolute contraindications include coagulopathy, elevated intracranial pressure (except in those with pseudotumor cerebri), unclear neurologic disease, severe hypovolemia, infection at the injection site, and patient refusal. Sepsis away from site of puncture and unclear surgical duration are considered relative contraindications to subarachnoid blocks.

Emerging Concerns in Neuraxial Anesthesia

With routine practice of postoperative deep vein thrombosis (DVT) prophylaxis with heparin and warfarin, and more recently, the advent of newer direct oral anticoagulants (DOACs) there is an additional layer of complexity in choosing spinal anesthesia. This may be attributed to lack of familiarity with newer agents and the intricacies of individual medical pharmacokinetics. Four DOACs are in use both in the United States and in other countries. These include dabigatran, apixaban, edoxaban, and rivaroxaban. At this time, dabigatran (direct thrombin inhibitor) is the lone DOAC with a reversal agent; however, renal clearance of dabigatran makes this DOAC less ideal for those patients with renal insufficiency. Hence, familiarizing oneself with their

pharmacokinetics of DOACs, warfarin, and heparin formularies is of utmost importance when considering surgery with or without spinal anesthesia. In general, specialty groups such as the American Society of Regional Anesthesia and Pain Medicine (ASRA) have recommended waiting two to three half-lives since last dose of oral anticoagulants when performing neuraxial anesthesia in low-risk patients. In high-risk patients, waiting 5 half-lives is recommended.

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Differential spinal block

Definition

A differential block refers to the clinical phenomenon that nerve fibers with different functions have different sensitivities to local anesthetic blockade. This is well proven in both neuraxial and peripheral nerve blocks. **Classically, it was taught that small diameter axons (ex. C-fibers) are more susceptible than larger diameters, but this is not true – there are probably multiple reasons for differential blockade** (ex. length of each nerve in thecal space, depth of nerve fiber, distribution of Na+ and K+ channels on each nerve, etc.).

Despite the elusive nature of the cause, with regard to neuraxial blocks **sympathetic nerve fibers are blocked by the lowest concentration of local anesthetic followed by nerve fibers responsible for pain, touch and finally motor function**.

This relative sensitivity of certain nerve fibers is displayed by a spatial separation (i.e. the sympathetic block will be approximately 2-4 dermatomes beyond the motor block, the pain/touch will be 2-3 dermatomes beyond the motor block). The presumed etiology is as the local anesthetic gets further from injection site it is present in a lower concentration and sympathetic nerve fibers do not require the same concentration to be blocked as do motor nerve fibers (as stated above).

Differential Block (a NORMAL phenomenon)

- Sympathetics: most sensitive to local anesthetic agents (2-4 levels beyond motor)
- Pain/touch: moderately sensitive (2-3 levels beyond motor)
- Motor fibers: least sensitive

Epidural Anesthesia

Rochelle J. Molitor MD, Emily E. Sharpe MD

Epidural anesthesia has clinical applications in three main areas: Surgery, obstetrics, and chronic pain relief.

Applied Anatomy of the Epidural Space

The epidural space, a potential space surrounding the spinal meninges, contains fat, nerve roots, and vascular plexuses. The anatomy of the spine, ligaments, meninges, and blood flow throughout the spinal cord are described in detail in Chapter 42. Knowledge of surface anatomy (Fig. 99.1) and key anatomic features of the cervical, thoracic, and lumbar spinal regions (Box 99.1) are critical to the performance of safe and reliable epidural needle placement.

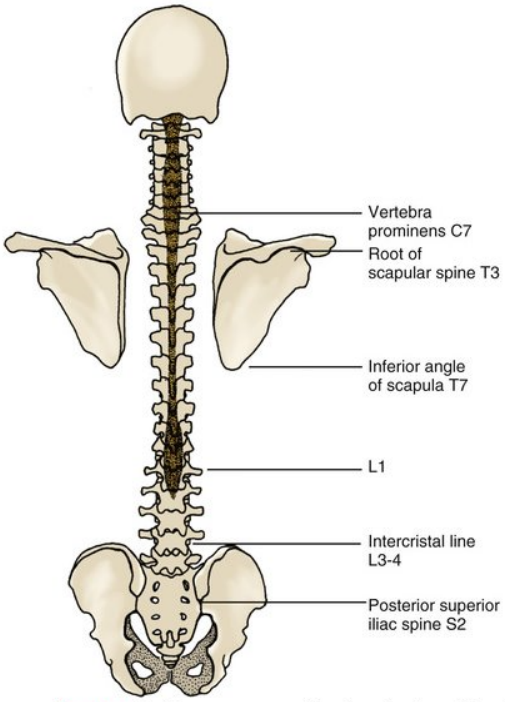

Fig. 99.1 Surface anatomy and landmarks for epidural blockade. Termination of the spinal cord is at L1 in adults. The dural sac terminates at S2. Needle placement between C7 and T1 is different because of the narrow epidural space. Between T1 and T7, a paramedian approach is recommended to bypass angled spinous processes. Below T7, needle placement becomes progressively similar to that for L2–L3. (Modified from Bromage PR. *Epidural Analgesia.* Philadelphia: WB Saunders; 1978:8.)

Box 99.1

Anatomic Features of Cervical, Thoracic, and Lumbar Spine Regions

Lumbar Spine

- The epidural space is widest (i.e., 5–6 mm).
- Needle insertion below L1 (in adults) avoids the spinal cord.
- The *ligamentum flavum* is thickest in the midline in the lumbar area.
- The s[Highlight | Note]light downward angulation.
- The epidural veins are prominent in the lateral portion of the epidural space.

Thoracic Spine

- The epidural space is 3–5 mm in the midline, narrow laterally.
- The *ligamentum flavum* is thick but less so than in the mid-lumbar region.
- The spinous processes have extreme downward angulation; the paramedian approach is recommended.

Cervical Spine

- The epidural space is narrow, only 2 mm at C3–6.
- The *ligamentum flavum* is thin.
- The spinous process at C7 is almost horizontal.

All segments of the spinal canal from the base of the skull to the sacral hiatus are accessible to epidural injection. Epidural anesthesia, provided either alone or in combination with general anesthesia, may be adapted to almost any surgical procedure that takes place below the level of the patient's chin. Ideally, needle and catheter placement should occur at the level of the surgical incision (e.g., lumbar placement for lower extremity operations and thoracic placement for thoracic/abdominal operations) to allow for block of only the parts of the body that fall within the surgical field. However, a lumbar technique may be used for even upper abdominal procedures, although it would result in a complete sympathectomy, including potentially blocking the cardiac accelerator fibers. Assessment of the dermatomal sensory level enables the anesthesiologist to determine approximate level of sympathectomy and anticipate the resulting hemodynamic effects (Table 99.1).

TABLE 99.1

TABLE 99.1

Sensory Level of Epidural Blockade Required for Surgical Procedures

Cutaneous Landmark	Segmental Level	Type of Operation	Significance
Fifth finger	C8		All cardioaccelerator fibers (T1–T4) blocked
Nipple line	T4–T5	Upper abdominal	Possibility of cardioaccelerator blockade
Tip of xiphoid	T6	Lower abdominal	Splanchnics (T5–L1) blocked
Umbilicus	T10	Hip	Sympathetic blockade to lower extremities
Lateral aspect of foot	S1	Leg and foot	No lumbar sympathectomy
Perineum	S2–S4	Hemorrhoidectomy	

Identification of the Epidural Space

The epidural space may be approached using a midline or a paramedian needle insertion (Fig. 99.2). The epidural space is identified by the passage of the needle from an area of high resistance (*ligamentum flavum*) to an area of low resistance (epidural space). After the needle is positioned in the *ligamentum flavum*, a syringe with a freely movable plunger is attached, and continuous pressure is applied to the plunger. If the needle is positioned correctly in the ligament, the syringe should not inject when pressure is applied to the plunger. As the needle passes into the epidural space, a sudden loss of resistance in the plunger will be felt, and the air or fluid will easily inject. At this point, a flexible nylon catheter may be advanced 3 to 5 cm through the needle into the epidural space to allow repeated and incremental injections or infusions. Preinsertion ultrasound imaging has been demonstrated to accurately identify the level of the vertebrae and to estimate the depth of the epidural space (Fig. 99.3).

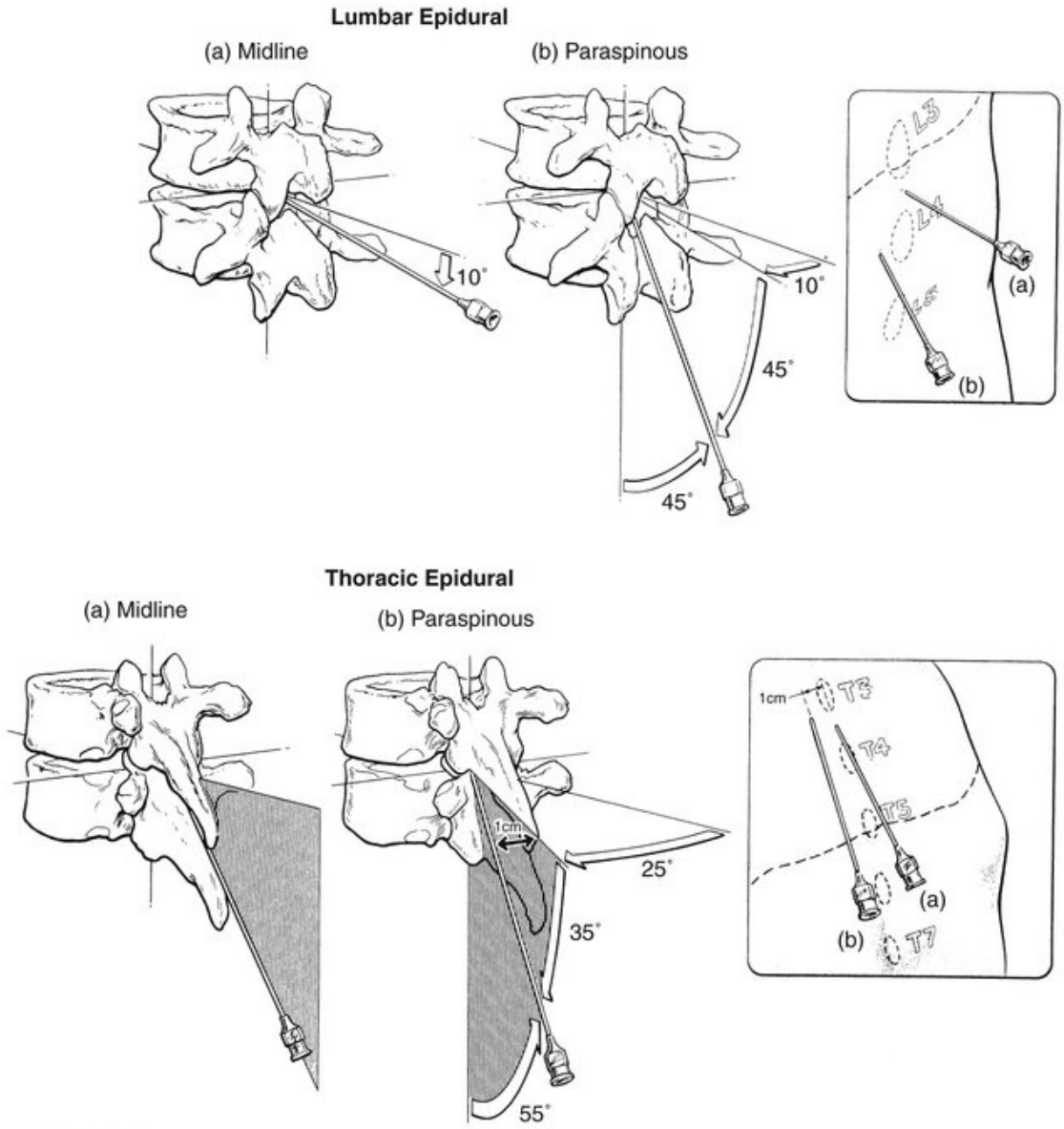

Fig. 99.2 Epidural block: sites of needle insertion. *Upper panel:* Lumbar epidural: *(a)* midline—note insertion closer to the superior spinous process and with a slight upward angulation; *(b)* paraspinous (paramedian)—note insertion beside caudad edge of "inferior" spinous process, with 45° angulation to long axis of spine below. *Lower panel:* Thoracic epidural: *(a)* midline—note extreme upward angulation required in midthoracic region—paramedian approach may be technically easier; *(b)* paramedian—note needle insertion next to caudad tip of the spinous process above interspace of intended level of entry through *ligamentum flavum*—upward angulation is 55° to long axis of spine below and inward angulation is 10°–15°.

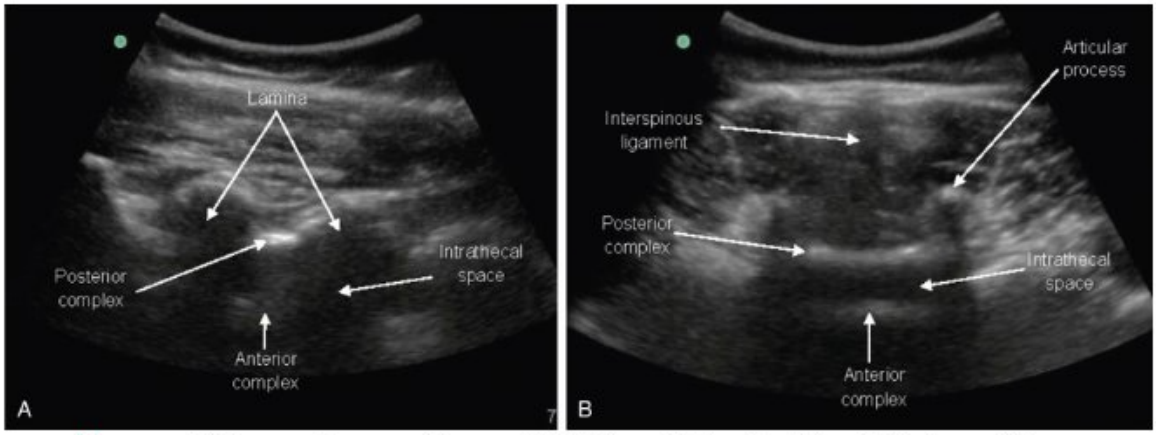

Fig. 99.3 Ultrasound paramedian saggital oblique **(A)** and midline **(B)** views of the lumbar spine. In the paramedian saggital oblique view, the ultrasound probe is placed parallel and slightly lateral to the midline of the spine. In this view, the lumbar laminae appear as hyperechoic structures in a classic "sawtooth" pattern. The ligamentum flavum, posterior epidural space, and dura are often not individually distinguishable, appearing as a single hyperechoic structure, referred to as the posterior complex. Similarly, the anterior complex also appears as a single hyperechoic structure and is composed of the anterior epidural space, anterior dura, posterior longitudinal ligament, and posterior aspect of the vertebral body.

A test dose containing either a local anesthetic alone, or a combination of a local anesthetic and epinephrine (typically 3 mL of lidocaine 1.5% and epinephrine 1 : 200,000), is then injected to detect both inadvertent intravascular or subarachnoid placement. An increase in systolic blood pressure of at least 15 mm Hg or an increase in heart rate of at least 10 beats/min represents intravascular injection when utilizing an epinephrine containing solution, whereas a change in lower extremity sensation (with or without a decrease in blood pressure) denotes subarachnoid injection.

Selection and Dose of Local Anesthetic Agent

When injected in the epidural space, local anesthetics act primarily at the level of the spinal nerve

roots, where the dura is relatively thin. Only a small amount of local anesthetic agent actually diffuses across the dura into the subarachnoid space.

A local anesthetic agent, and dosing thereof, should be selected on the basis of indication (analgesia, primary anesthetic, or supplementation to general anesthesia), desired speed of onset, degree of motor blockade required, and duration of the surgical procedure (Table 99.2). Local anesthetic dose may be calculated by the following formula: dose equals 1 to 1.5 mL of local anesthetic agent per segment blocked. The dose may need to be significantly reduced in parturients and in obese and elderly patients because of altered local anesthetic metabolism in these patients. Incremental dosing is an effective method of avoiding serious complications. A second dose of approximately 50% of the initial dose will maintain the original level of anesthesia if injected when the blockade has regressed 1 or 2 dermatomes (see Table 99.2).

TABLE 99.2

Clinical Effects of Local Anesthetic Solutions Commonly Used for Epidural Blockade

Drug	Time Spread to ± 4 Segments ± 1 SD (min)	Approximate Time to 2-Segment Regression ± 2 SD* (min)	Recommended Top-up Time From Initial Dose* (min)
Lidocaine, 2%	25 ± 5	100 ± 40	60
Prilocaine, 2%–3%	15 ± 4	100 ± 40	60
Chloroprocaine, 2%–3%	12 ± 5	60 ± 15	45
Mepivacaine, 2%	15 ± 5	120 ± 150	60
Bupivacaine, 0.5%–0.75%	18 ± 10	200 ± 80	120
Ropivicaine, 0.75%–1%	20.5 ± 7.9	177 ± 49	120
Levobupivacaine, 0.5%–0.75%	20 ± 9	200 ± 80	120

*Note that top-up time is based on duration +/− 2 SD, which encompasses the likely duration in 95% of the population. In a conscious cooperative patient, an alternative is to use frequent checks of segmental level to indicate the need to top-up. All solutions contain 1:200,000 epinephrine.

Reprinted with permission from Veering BT, Cousins MJ. Epidural neural blockade. In: Cousins MJ, Carr DB, Horlocker TT, Bridenbaugh PO, eds. *Neural Blockade in Clinical Anesthesia and Management of Pain*. 4th ed. Philadelphia: Lippincott Williams & Williams; 2009:241–295.

The addition of epinephrine can prolong the duration of lidocaine nerve block by up to 50%. Less dramatic results are usually observed when bupivacaine or ropivacaine is used. The addition of vasoconstricting agents reduces blood flow in the richly vascularized epidural space, reducing systemic absorption; because more of the drug remains in proximity to the nerve, the onset of block is quicker and the duration of action is longer. Confirmation of this concept comes from studies

demonstrating that the peak plasma levels of various agents are lower when epinephrine is present. Epinephrine also acts on α-adrenergic receptors located in the central nervous system, modulating central pain processing at those sites.

Complications

One of the most common complications of epidural analgesia is a postdural puncture headache (PDPH), which may occur when the dura is inadvertently punctured during placement. The risk of an unintentional dural puncture is approximately 1%. Of those who suffer an accidental dural puncture, 50% to 75% may develop a PDPH. Risk factors for PDPH include young age, female sex, pregnancy, larger gauge needle, cutting needles, and multiple dural punctures.

The risks of severe or disabling neurologic complications are rare with the use of epidural anesthesia. In a systematic review of studies published between 1995 and 2005, the risk of serious neurologic complications ranged from 0.3 to 3.9 per 10,000. Of note, the reported incidence varied depending on the inclusion of the obstetric population; the risk was higher in the general population (2.8 to 3.9 : 10,000) than the obstetric population (0.3 to 0.6 : 10,000). In order of most to least common, neurologic complications included neuropathy (2 : 10,000), cauda equina syndrome (0.2 : 10,000), paraplegia (0.1 : 10,000), and intracranial event such as meningitis and abscess (0.09 : 10,000). Spinal anesthesia portends a greater risk for peripheral neuropathy than epidural anesthesia.

Absorption of excessive amounts of local anesthetics can lead to local anesthetic systemic toxicity (LAST). Lipid emulsion (20%) therapy (bolus 100 mL in patient > 70 kg and 1.5 ml/kg in patient < 70 kg) should be available whenever regional blocks are performed.

Acknowledgment

The authors wish to thank Dr. Teresa Horlocker for her contributions to previous versions of this chapter.

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Combined Spinal-Epidural Blockade

Lindsay Warner MD, Katherine W. Arendt MD

Combined spinal-epidural (CSE) blockade was first described in 1937 but was not commonly used until the early 1980s. CSE blockade combines the rapid onset and reliability associated with subarachnoid blocks with the flexibility of dosing, duration, and analgesic-level control of an indwelling epidural catheter. CSE block is used primarily for obstetric analgesia and anesthesia, but its use has been described for a variety of applications, including general surgery, orthopedic and trauma surgery of the lower limb, urologic surgery, and gynecologic surgery.

Applied Anatomy

The essence of a CSE block is single-shot administration of intrathecal anesthetic or analgesic agents along with placement of a catheter into the epidural space (Fig. 100.1). The applied anatomy of a CSE block is the same as that for subarachnoid and epidural blockade (see Chapter 99, Epidural Anesthesia, Fig. 99.1).

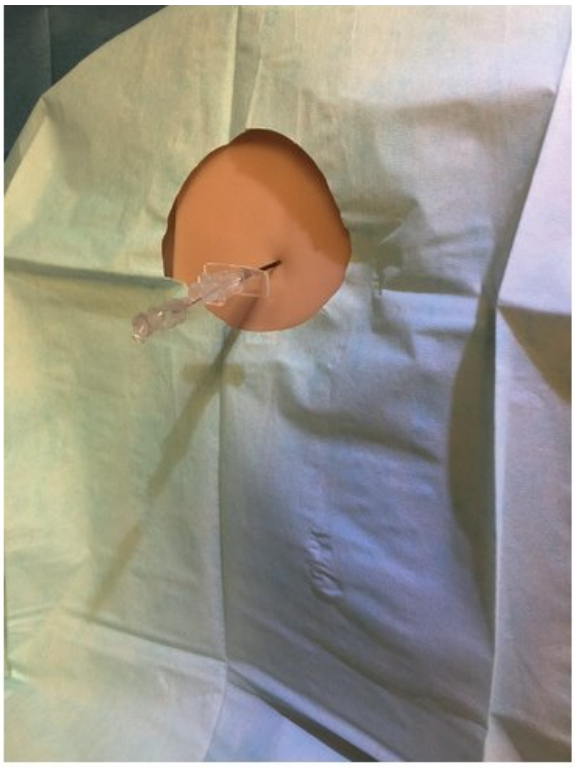

Fig. 100.1 The combined spinal epidural.

Indications

CSE blockade can be utilized in patients in whom a neuraxial technique is indicated and would benefit from combining the density of block and rapid onset achieved with spinal anesthesia/analgesia with the ability to provide prolonged anesthesia/analgesia (as is usually done with a continuous infusion of medication through an epidural catheter). In obstetric anesthesia, CSE is used for both labor analgesia and Cesarean anesthesia.

A common application for labor analgesia is a multiparous parturient at an advanced cervical dilation requesting neuraxial pain relief. The intrathecal fentanyl (typically about 15 mcg) provides a rapid onset of visceral pain relief. The intrathecal bupivacaine (typically about 2.5 mg) provides coverage of the sacral nerve roots thereby providing relief from the intense somatic pain of second stage. The catheter can provide epidural analgesia if the parturient is still laboring after the spinal dose wears off, or can provide anesthesia if the parturient proceeds to Cesarean delivery.

CSE for Cesarean anesthesia would be a consideration in a patient presenting for a complex Cesarean delivery that may require prolonged surgical time. In these cases, intrathecal medication administration provides density and reliability and the epidural catheter can be utilized if the length of the surgery outlasts the spinal block.

Contraindications for CSE block are the same as those for all neuraxial blocks (Table 100.1).

TABLE 100.1

Absolute	Relative
Patient refusal	Preexisting neurologic disease
Bacteremia/sepsis	Severe psychiatric disease or dementia
Increased intracranial pressure	Aortic stenosis
Infection at needle insertion site	Left ventricular outflow tract obstruction
Shock or severe hypovolemia	Various congenital heart conditions (absolute contraindication if severe)
Coagulopathy or therapeutic anticoagulation	Deformities or previous surgery of the spinal column

Advantages

Some studies have indicated that catheters placed during a CSE technique are less likely to fail than are epidural catheters placed during an epidural-only technique, because the epidural space is verified by the return of cerebrospinal fluid through the spinal needle. However, a systematic review comparing CSE and epidural labor analgesia found no evidence for differences in the rate of epidural catheter replacement or the rate of epidural top-ups (Heesen, 2014). The CSE technique, however, does offer some benefits for labor analgesia:

- • The onset of anesthesia or analgesia is faster.
- • The total dose of local anesthetic agent required to achieve analgesia/anesthesia is smaller than the dose necessary with an epidural-only technique, thus reducing the risk of local anesthetic toxicity. This may ultimately result in lower systemic and fetal (if used for labor and delivery) concentrations of local anesthetic agents.
- • Intrathecal opioids can be administered as the sole agent, without the addition of local anesthetic drugs, providing about 90 m of analgesia for the first stage of labor with no motor block.
- • Subsequent epidural dosing may provide greater sacral nerve root coverage and a lower incidence of unilateral block. Recent studies evaluating the technique of dural puncture epidural (DPE) indicate that these advantages may occur as a result of translocation of epidural local anesthetic into the intrathecal space through the dural hole. A DPE is the needle-through-needle CSE technique without administration of intrathecal medications.
- • More rapid cervical dilation is associated with the use of CSE versus epidural labor analgesia.
- • In anesthesia for cesarean delivery, a CSE (with a full surgical intrathecal dose) results in lower incidence of block failure necessitating general anesthesia and greater maternal comfort than an epidural-only technique and, if the epidural catheter is left in place, it provides an option for providing continued postoperative analgesia.

Disadvantages

Possible disadvantages of using a CSE technique, in comparison with an epidural technique, include the following:

- • Determination of the reliability of the epidural catheter for surgical anesthesia may be delayed.
- • Intrathecally administered opioids can cause pruritus.
- • Theoretically, the risk of infection may be increased because the subarachnoid space is accessed.
- • When used for labor analgesia, intrathecally administered opioid medications may increase the incidence of post analgesia fetal heart rate decelerations; however, this disadvantage is controversial, and the complex discussion is beyond the scope of this chapter.

Equipment and Technique

CSE blockades are typically performed via a needle-through-needle technique with traditional epidural and spinal needles. When the needle-through-needle technique is performed, a sterile field is created at the procedure site, the skin and subcutaneous tissue are infiltrated with a local anesthetic agent, and an epidural needle is inserted into the *ligamentum flavum*. Loss of resistance with air or saline is used to identify the epidural space. A spinal needle is then advanced through the epidural needle into the subarachnoid space. The spinal needle must be longer than the epidural needle to allow dural puncture, projecting 13 to 17 mm beyond the tip of the epidural needle. Following the appearance of cerebrospinal fluid, the intrathecal anesthetic or analgesic agent is injected, and the spinal needle is removed. Finally, a catheter is advanced through the epidural needle into the epidural space, and the epidural needle is removed.

Another CSE technique involves performing separate passes, either in the same or different interspaces, for the spinal followed by the epidural. This technique can be used for parturients who are in such distress from labor pain that they are unable to stay still for the epidural needle insertion. Performing the spinal first to increase comfort may allow for optimal patient positioning and may decrease the risk of an inadvertent dural puncture with a large gauge needle. A disadvantage of this technique is the patient may be exposed to the remote risks associated with performing a neuraxial technique on nerves that are surrounded by local anesthetic agent. If the epidural catheter is inserted first, then there may be the very remote risk of damaging the epidural catheter with the spinal needle.

Epidural Test Doses

The timing of the epidural test dose in a CSE technique is controversial. If a local anesthetic agent has been injected into the intrathecal space, detecting an intrathecal catheter with injection of a test dose of local anesthetic agent through the catheter may be difficult. Furthermore, a successful test dose does not guarantee a properly placed epidural catheter because the catheter could conceivably migrate after the test dose is administered but before the catheter is loaded. On the other hand, it may not be convenient to wait until the spinal block from the initial intrathecal injection of drug has worn off before administering a test dose through the catheter. Many anesthesiologists recommend the early use of test doses of local anesthetic agents with epinephrine to confirm catheter position.

Complications

In comparison with an epidural technique alone, the CSE technique is not associated with an increased frequency of anesthetic complications, including postdural puncture headache. Potential complications of the CSE technique are the same as those for spinal and epidural techniques and include postdural puncture headache, total spinal anesthesia, hypotension, bradycardia, meningitis, spinal abscess and hematoma, intravascular injection, intrathecal catheter migration, and nerve injury and, when used for labor analgesia, fetal bradycardia.

Suggested Readings

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