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Spinal Anaesthesia

By the perioperativeCPD team

Spinal anaesthesia is induced by injecting small amounts of local anaesthetic into the cerebro-spinal fluid (CSF). The injection is usually made in the lumbar spine below the level at which the spinal cord ends (L2). Spinal anaesthesia is easy to perform and has the potential to provide excellent operating conditions for surgery below the umbilicus.

If the anaesthetist has an adequate knowledge of the relevant anatomy, physiology and pharmacology, safe and satisfactory anaesthesia can easily be obtained to the mutual satisfaction of the patient, surgeon and anaesthetist.

The first spinal analgesia was administered in 1885 by James Leonard Corning (1855–1923), a neurologist in New York. He was experimenting with cocaine on the spinal nerves of a dog when he accidentally pierced the dura mater.

The first planned spinal anaesthesia for surgery in man was administered by August Bier (1861–1949) on 16 August 1898, in Kiel, when he injected 3 ml of 0.5% cocaine solution into a 34-year-old labourer.[6] After using it on 6 patients, he and his assistant each injected cocaine into the other's spine. They recommended it for surgeries of legs, but gave it up due to the toxicity of cocaine.

Physiology of Spinal Anaesthesia

Local anaesthetic solution injected into the subarachnoid space blocks conduction of impulses along all nerves with which it comes in contact, although some nerves are more easily blocked than others.

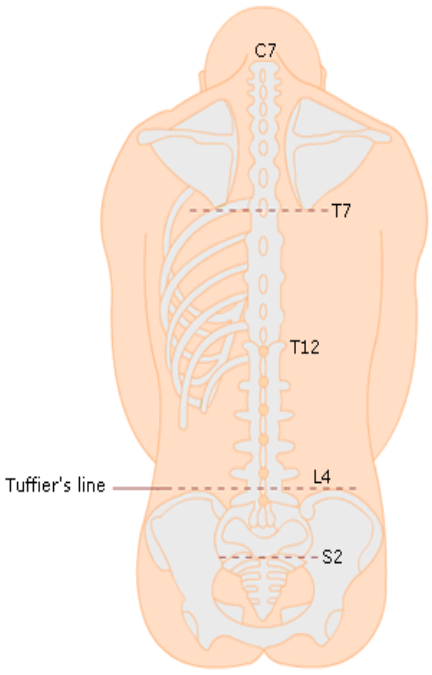
There are three classes of nerve: motor, sensory and autonomic. The motor convey messages for muscles to contract and when they are blocked, muscle paralysis results. Sensory nerves transmit sensations such as touch and pain to the spinal cord and from there to the brain, whilst autonomic nerves control the calibre of blood vessels, heart rate, gut contraction and other functions not under conscious control.

Generally, autonomic and pain fibres are blocked first and motor fibres last. This has several important consequences. For example, vasodilation and a drop in blood pressure may occur when the autonomic fibres are blocked and the patient may be aware of touch and yet feel no pain when surgery starts.

Anatomy

The spinal cord usually ends at the level of L2 in adults and L3 in children. Dural puncture above these levels is associated with a slight risk of damaging the spinal cord and is best avoided.

An important landmark to remember is that a line joining the top of the iliac crests is at L4 to L4/5 (Tuffier's Line)



Below are the structures that the needle will pierce before reaching the CSF

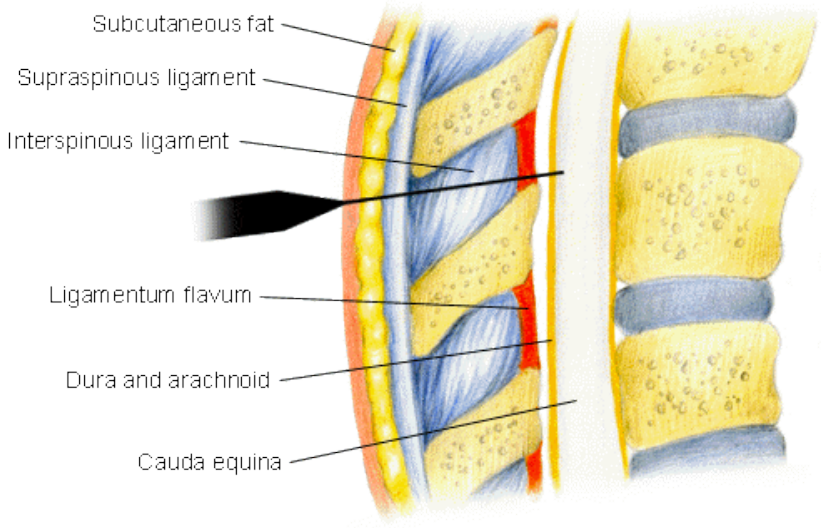
Skin. It is wise to inject a small volume of local anaesthetic into the skin before inserting the spinal needle.

Subcutaneous fat. This is of variable thickness. Identifying the intervertebral spaces is far easier in thin patients.

The **supraspinous ligament** which joins the tips of the spinous processes together.

The **interspinous ligament** which is a thin flat band of ligament running between the spinous processes.

The **ligamentum flavum** is quite thick, up to about 1cm in the middle and is mostly composed of elastic tissue. It runs vertically from lamina to lamina. When the needle is within the ligaments it will feel gripped and a distinct "give" can often be felt as it passes through and into the epidural space.



The **epidural space** contains fat and blood vessels. If blood comes out of the spinal needle instead of CSF when the stylet is removed, it is likely that an epidural vein has been punctured. The needle should simply be advanced a little further.

The **dura**. After feeling a "give" as the needle passes through the ligamentum flavum, a similar sensation may be felt when the needle is advanced a short distance further and pierces the dural sac.

The **subarachnoid space**. This contains the spinal cord and nerve roots surrounded by CSF. An injection of local anaesthetic will mix with the CSF and rapidly block the nerve roots with which it comes in contact.

Indications for Spinal Anaesthesia

Spinal anaesthesia is best reserved for operations below the umbilicus e.g. hernia repairs, gynaecological and urological operations and any operation on the perineum or genitalia. All operations on the leg are possible, but an amputation, though painless, may be an unpleasant experience for an awake patient. In this situation it may be kinder to supplement the spinal with generous sedation or a light general anaesthetic.

Spinal anaesthesia is especially indicated for older patients and those with systemic disease such as chronic respiratory disease, hepatic, renal and endocrine disorders such as diabetes. Most patients with mild cardiac disease benefit from the vasodilation that accompanies spinal anaesthesia except those with stenotic valvular disease or uncontrolled hypertension.

It is suitable for managing patients with trauma if they have been adequately resuscitated and are not hypovolaemic. In obstetrics, it is ideal for manual removal of a retained placenta (again, provided there is no hypovolaemia). There are definite advantages for both mother and baby in using spinal anaesthesia for Caesarean section.

Why is spinal anaesthesia a safe and popular technique for caesarean section?

It avoids complications associated with general anaesthesia in pregnancy such as:

- Acid aspiration
- Failed intubation
- Allows the mother to be awake, see and care for her baby
- It provides good pain relief in the first few hours post-op
- The baby is not sedated by drugs given to the mother
- Cheap and easy to perform

Spinal Anaesthesia in Preeclampsia

Years ago, spinal anaesthesia was considered contraindicated in patients with preeclampsia. The reason was a fear that the fast onset of anaesthesia would possibly produce an undue degree of hypotension in volume-depleted, vasoconstricted patients with preeclampsia. Possible adverse effects on the foetus owing to uncontrolled hypotension were feared. However, recent studies have found these concerns to be unfounded. It appears that blood pressure changes during spinal anaesthesia in patients with preeclampsia are not different from those that occur in normal patients, and treatment with standard vasopressor therapy is similarly effective for both groups.

Studies on neonatal well being after spinal anaesthesia for caesarean delivery in preeclampsia confirm the safety of this technique. The use of spinal anaesthesia in this patient population is of considerable benefit, as these patients present particular hazards with general anaesthesia, such as concerns for rapid airway control and cerebral blood flow alterations during induction of general anaesthesia and intubation.

Contra-indications to Spinal Anaesthesia

Most of the contra-indications to spinal anaesthesia apply equally to other forms of regional anaesthesia. These include:

Clotting disorders. If bleeding occurs into the epidural space because an epidural vein has been punctured by the spinal needle, a haematoma could form and compress the spinal cord. Patients with a low platelet count or receiving anticoagulant drugs such as heparin or warfarin are at risk.

Hypovolaemia from whatever cause e.g. bleeding, dehydration due to vomiting, diarrhoea or bowel obstruction. Patients must be adequately rehydrated or resuscitated before spinal anaesthesia or they will become very hypotensive.

Any **sepsis** on the back near the site of lumbar puncture.

Patient refusal. Patients may be understandably apprehensive and initially state a preference for general anaesthesia, but if the advantages of spinal anaesthesia are explained they may then agree to the procedure and be pleasantly surprised at the outcome. If, despite adequate explanation, the patient still refuses spinal anaesthesia, their wishes should be respected.

Uncooperative patients. Although spinal anaesthesia is suitable for children, their cooperation is necessary and this must be carefully assessed at the pre-operative visit. Likewise, mentally handicapped patients and those with psychiatric problems need careful pre-operative assessment.

Septicaemia. Due to the presence of infection in the blood there is a possibility of such patients developing meningitis if a haematoma forms at the site of lumbar puncture and becomes infected.

Anatomical deformities of the patient's back. This is a relative contraindication, as it will probably only serve to make the dural puncture more difficult.

Neurological disease. The advantages and disadvantages of spinal anaesthesia in the presence of neurological disease need careful assessment. Any worsening of the disease postoperatively may be blamed erroneously on the spinal anaesthetic. Raised intracranial pressure, however, is an absolute contra-indication as a dural puncture may precipitate coning of the brain stem.

Reluctant surgeon. If a surgeon is unhappy operating on an awake patient or if he is relatively unskilled, spinal anaesthesia may be better avoided.

The Advantages of Spinal Anaesthesia

Cost. Anaesthetic drugs and gases are costly and the latter often difficult to transport. The costs associated with spinal anaesthesia are minimal.

Patient satisfaction. If a spinal anaesthetic and the ensuing surgery are performed skilfully, the majority of patients are very happy with the technique and appreciate the rapid recovery and absence of side-effects.

Respiratory disease. Spinal anaesthesia produces few adverse effects on the respiratory system as long as unduly high blocks are avoided.

Patent airway. As control of the airway is not compromised, there is a reduced risk of airway obstruction or the aspiration of gastric contents. This advantage may be lost with too much sedation.

Diabetic patients. There is little risk of unrecognised hypoglycaemia in an awake patient. Diabetic patients can usually return to their normal food and insulin regime soon after surgery as there is less sedation, nausea and vomiting.

Muscle relaxation. Spinal anaesthesia provides excellent muscle relaxation for lower abdominal and lower limb surgery.

Bleeding. Blood loss during operation is less than when the same operation is done under general anaesthesia. This is as a result of a decreased blood pressure and heart rate, and improved venous drainage which results in less oozing.

Splanchnic blood flow. Because of its effect on increasing blood flow to the gut, spinal anaesthesia reduces the incidence of anastomotic dehiscence.

Visceral tone. The bowel is contracted by spinal anaesthesia and sphincters relaxed although peristalsis continues. Normal gut function rapidly returns following surgery.

Coagulation. Post-operative deep vein thromboses and pulmonary emboli are less common following spinal anaesthesia.

Disadvantages of Spinal Anaesthesia

With an inexperienced anaesthetist it can take considerably long that a general anaesthetic. Once competent, however, spinal anaesthesia can be very swiftly performed.

It may be impossible to locate the dural space and obtain CSF and the technique has to be abandoned. Rarely, despite an apparently faultless technique, anaesthesia is not obtained.

Hypotension may occur with higher blocks and the anaesthetist must know how to manage this situation with the necessary resuscitative drugs and equipment immediately to hand.

Some patients are not psychologically suited to be awake, even if sedated, during an operation. They should be identified during the preoperative assessment.

Even if a long-acting local anaesthetic is used, a spinal is not suitable for surgery lasting longer than approximately 2 hours. If an operation unexpectedly lasts longer than this, it may be necessary to convert to a general anaesthetic.

There is a theoretical risk of introducing infection into the subarachnoid space and causing meningitis. This should **never** happen if equipment is sterilised properly and an aseptic technique is used.

A postural headache may occur postoperatively. This should be rare.

Local Anaesthetics for Spinal Anaesthesia

Bupivacaine (Marcaine) is the local anaesthetic most commonly used, although lidocaine (lignocaine), tetracaine, procaine, ropivacaine, levobupivicaine, prilocaine and cinchocaine may also be used.

Local anaesthetic agents are either heavier (hyperbaric), lighter (hypobaric), or have the same specific gravity (isobaric) as the CSF. Hyperbaric solutions tend to spread below the level of the injection, while isobaric solutions are not influenced in this way. It is easier to predict the spread of spinal anaesthesia when using a hyperbaric agent. Isobaric preparations may be made hyperbaric by the addition of glucose. Hypobaric agents are not generally available.

Bupivacaine (Marcaine). 0.5% hyperbaric (heavy) bupivacaine is the best agent to use if it is available and it has 80 mg/ml glucose (specific gravity 1.026) added to make it hyperbaric. 0.5% plain bupivacaine is also popular. Bupivacaine lasts longer than most other spinal anaesthetics, usually 2-3 hours. The normal volume is 2-4mls of 0.5% bupivacaine depends on the surgery and the level/depth of the block required. A volume of 2-3 mls of 0.5% hyperbaric (heavy) bupivacaine is usual for a caesarean section.

Lignocaine (Lidocaine/Xylocaine). Lidocaine is more likely than bupivacaine, prilocaine or procaine to induce transient neurological symptoms (TNS) when used for spinal anaesthesia. These symptoms have been described as pain and dysesthesia in the buttock, thighs or calves, occurring after the recovery from spinal anaesthesia, usually within 24 hr and resolving within 72 hr.

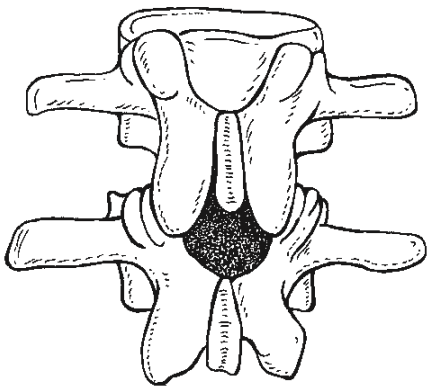
Drugs to Improve the Quality of Block or for Postoperative Pain Relief

It is possible to improve the quality of the block or provide postoperative pain relief with adjuncts. Only sterile and preservative free drugs that are not neurotoxic should be used.

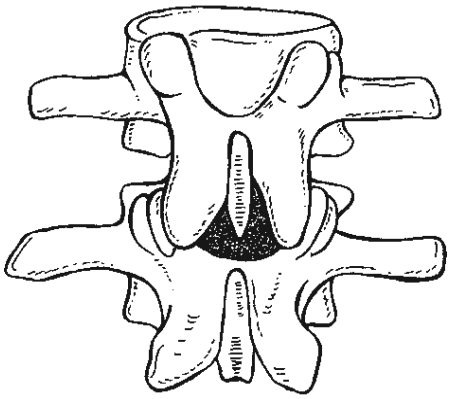
- Fentanyl (10-25 mcg) may improve the quality
- Morphine (100 mcg) or diamorphine (200-300 mcg) can provide pain relief after the block has worn off.

Positioning the Patient for Lumbar Puncture

Lumbar puncture is most easily performed when there is maximum flexion of the lumbar spine.

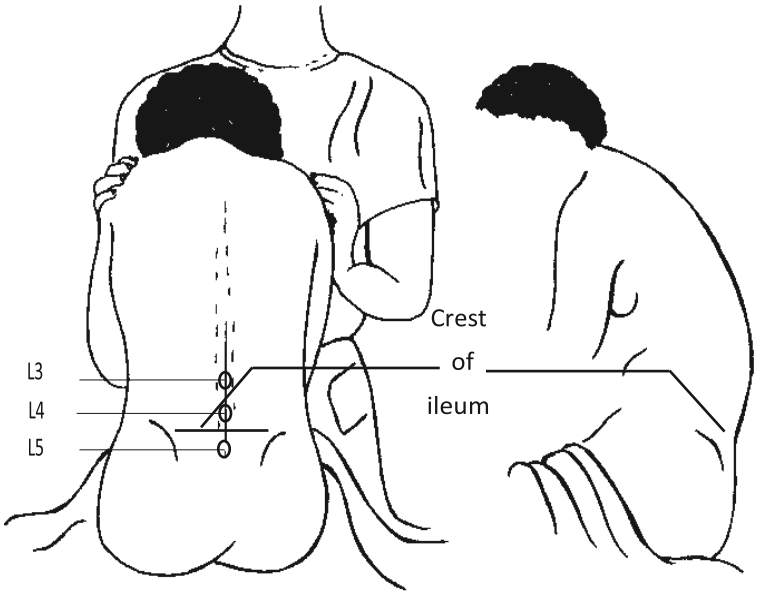


Flexion



Extension

This can best be achieved by sitting the patient on the operating table and placing their feet on a stool. If they then rest their forearms on a pillow or their thighs, they can maintain a stable and comfortable position.



Alternatively, the procedure can be performed with the patient lying on their side with their hips and knees maximally flexed. An assistant may help to maintain the patient in a comfortable curled position. The sitting position is preferable in the obese whereas the lateral is better for uncooperative or sedated patients. The anaesthetist can either sit or kneel whilst performing the block.

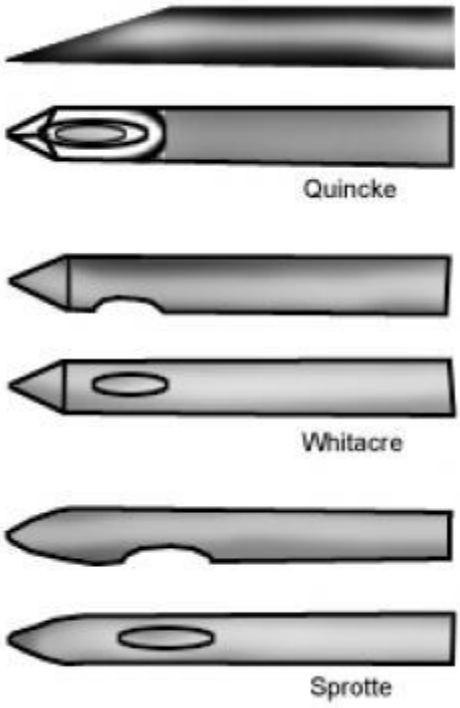
Preparation

Assemble the necessary equipment on a sterile surface. It will include:

A **spinal needle**. Needles are cutting or blunt tipped and usually 9cm long. The Quincke needle is an example of a cutting needle, with the opening at the end of the needle.

Blunt tipped needles (pencil point) decrease the incidence of postdural puncture headaches compared to cutting needles. Whitacre and other pencil point needles, have a rounded tip with a side port. Sprotte needles have a long opening, allowing for excellent CSF flow.

The lowest incidence of headaches is with fine, 25 or 27 gauge needles. Finer needles are, however, more difficult to use by the inexperienced anaesthetist.



An **introducer**, if using a fine gauge needle as they are thin and flexible, and therefore difficult to direct accurately.

A **5ml syringe** for the spinal anaesthetic solution.

A **2 ml syringe** for local anaesthetic to be used for skin infiltration.

A **selection of needles** (incl. a filter needle) for drawing up the local anaesthetic solutions and for infiltrating the skin.

A **gallipot** with a suitable dyed antiseptic for cleaning the skin, e.g. chlorhexidine, iodine, or methyl alcohol.

Or chlorhexidine spray for the back. This eliminates any chance of the antiseptic and local anaesthetic getting mixed up.

Sterile gauze swabs or for skin cleansing if using liquid antiseptic.

A **sticking plaster** to cover the puncture site.

The local anaesthetic to be injected intrathecally should be in a single use ampoule. **Never use local anaesthetic from a multi-dose vial for intrathecal injection.**

Spare equipment and drugs should be readily available if needed.

Performing the Spinal Injection

1 Place a large bore IV line in the patient's vein and connect fluids.

2 Position the patient (lateral or sitting).

3 Identify and mark relevant lumbar interspace (L3/4 or L4/5) and the midline.

4 Put on theatre hat and mask, scrub up and put on sterile gown and gloves.

5 Prepare the skin with a suitable skin preparation.

6 Draw up intrathecal drugs using a filter needle.

7 Infiltrate the skin with 2-5 ml lidocaine using a 25 g needle at the midpoint of the interspace.

8 Insert the introducer of the spinal needle until it is firmly gripped in the interspinous ligament.

9 With the aperture directed cephalad (facing towards the patients' head) carefully insert the spinal needle identifying the anatomical layers by "feel" during insertion.

10 If bone is encountered before the ligamentum flavum, remove the needle and withdraw the introducer almost to the skin then redirect either upwards or downwards before inserting the spinal needle.

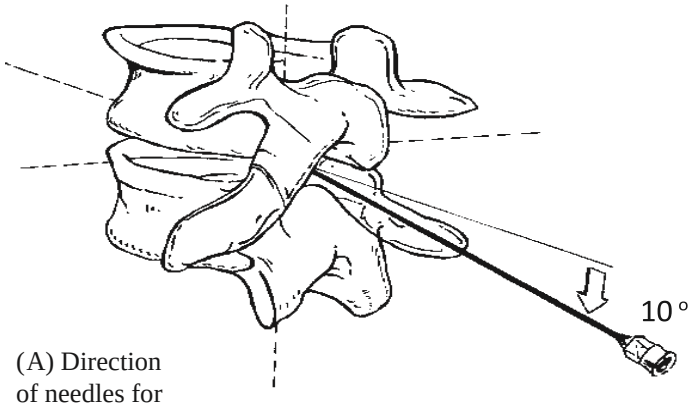
11 When the ligamentum flavum is felt, push the needle forwards a couple more millimeters until a gentle pop is felt.

12 Remove the stylet of the spinal needle - appearance of CSF in the hub of the needle confirms correct placement.

13 Stabilize the needle with the back of the hand holding the needle braced against the patient's back.

14 Confirm CSF by gently aspirating on the syringe just before injection.

15 Remove syringe, needle and introducer as one at the end of the injection.



(A) Direction of needles for midline approach

Practical Problems

The spinal needle feels as if it is in the right position but no CSF flows. Wait at least 30 seconds, then try rotating the needle 90 degrees and wait again.

Blood flows from the spinal needle. Wait a short time. If the blood becomes pinkish and finally clear, all is well. If blood only continues to drip, then it is likely that the needle tip is in an epidural vein and it should be advanced a little further or angled more medially to pierce the dura.

The patient complains of sharp, stabbing leg pain. The needle has hit a nerve root because it has deviated laterally. Withdraw the needle and redirect it more medially away from the affected side.

Wherever the needle is directed, it seems to strike bone. Make sure the patient is still properly positioned with as much lumbar flexion as possible and that the needle is still in the mid-line. If you think that you are not in the midline check with the patient which side they feel the needle. Alternatively, if the patient is elderly and cannot bend very much or has heavily calcified interspinous ligaments, it might be better to attempt a lateral approach to the dura.

This is performed by inserting the spinal needle about 1cm lateral to the mid line at the level of the upper border of a spinous process, then directing it both cephalad and medially. If bone is contacted it is likely to be the vertebral lamina. It should then be possible to "walk" the needle off the bone and into the epidural space, then advance through it to pierce the dura.

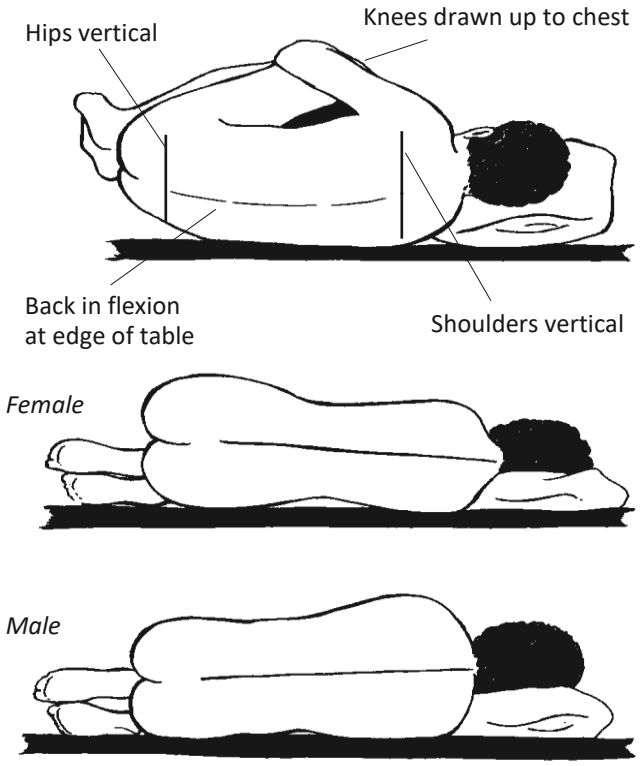
Factors Effecting the Spread of the Local Anaesthetic Solution

A number of factors affect the spread of the injected local anaesthetic solution within the CSF and the ultimate extent of the block obtained. Among these are:

- the baricity of the local anaesthetic solution
- the position of the patient
- the concentration and volume injected
- the level of injection
- the speed of injection

The specific gravity of the local anaesthetic solution can be altered by the addition of glucose. Concentrations glucose make the local anaesthetic hyperbaric (heavy) relative to CSF and also reduce the rate at which it diffuses and mixes with the CSF. Isobaric and hyperbaric solutions both produce reliable blocks. The most controllable blocks are probably produced by injecting hyperbaric solutions and then altering the patient's position.

If a patient is kept sitting for several minutes after the injection of a small volume of a hyperbaric solution of local anaesthetic, a classical saddle block of the perineum will result. The spinal column of patients lying on their side is rarely truly horizontal. Males tend to have wider shoulders than hips and so are in a slight "head up" position when lying on their sides, whilst for females with their wider hips, the opposite is true. Regardless of the position of the patient at the time of injection and whatever the initial extent of the block obtained, the level of the block may change if the patient's position is altered within twenty minutes of the injection.



The quantity of local anaesthetic (in milligrams) injected will determine the quality of the block obtained whilst its extent will also be determined by the volume in which it is injected. Large volumes of concentrated solutions will, thus, produce dense blockade over a large area.

Although the level of injection will obviously effect which dermatomes are blocked, spinal injections tend to be performed only in the lower lumbar region. The extent of the block is influenced more by the volume injected and the position of the patient than the actual interspace at which the injection occurs.

The speed of injection has a slight effect on the eventual extent of the block. Slow injections result in a more predictable spread while rapid injections produce eddy currents within the CSF and a somewhat less predictable outcome.

Finally, increased abdominal pressure from whatever cause (pregnancy, ascites etc.) can lead to engorgement of the epidural veins, compression of the dura and hence a reduction in the volume of the CSF. A given quantity of local anaesthetic injected into the CSF might then be expected to produce a more extensive block.

Positioning of the Pregnant Patient

Pregnant patients should never lie supine as the gravid uterus will compress the vena cava and, to a lesser extent the aorta (aorto-caval compression) resulting in hypotension. They should, instead, always lie with a lateral tilt. This can be achieved either by tilting the whole table or by inserting a wedge under the patient's right hip. The uterus is displaced slightly to the left and the vena cava is not compressed.

As hypotension commonly occurs despite fluid preloading, many anaesthetists routinely give a dose of vasoconstrictor intravenously. Ephedrine is the favoured vasoconstrictor as it does not cause constriction of the uterine blood vessels. If it is not available, one of the other vasoconstrictors discussed previously should be used as untreated hypotension can seriously damage the unborn infant.

Assessing the Block

Experienced clinicians may use very little formal testing, relying on early onset of lower limb weakness, expected cardiovascular changes and altered sensation over the proposed site of surgery. This is usually reliable as anaesthetists gain confidence after repeated use of a technique. .

Cold, most commonly applied as an ethyl chloride spray, is popular, but usually defines a level of block above the level of 'surgical' anaesthesia, and ethyl chloride is an atmospheric pollutant. Ice and alcoholic skin prep may be used as alternatives. Gentle pinprick has the advantages of being simple, repeatable, reproducible and applicable. It also allows discrimination between 'sharp' and 'dull' sensation and more closely indicates the level of 'surgical' anaesthesia. Pinprick testing should be performed using a sterile needle which does not need to pierce the skin and is compared to a non-anaesthetised part of the body (e.g. arm) so the patient can perceive the difference?

The adequacy of a block for Caesarian section can be tested as follows:

- The block reaches the lower part of the breast nipple (T4) to cold sensation and pin prick on both sides
- A block to light touch to the level of the xiphisternum on both sides
- The patient is unable to perform a straight leg raise due to a dense motor block
- A useful confirmation of a good sensory block is a firm pinch below the umbilicus - no pain should be felt.

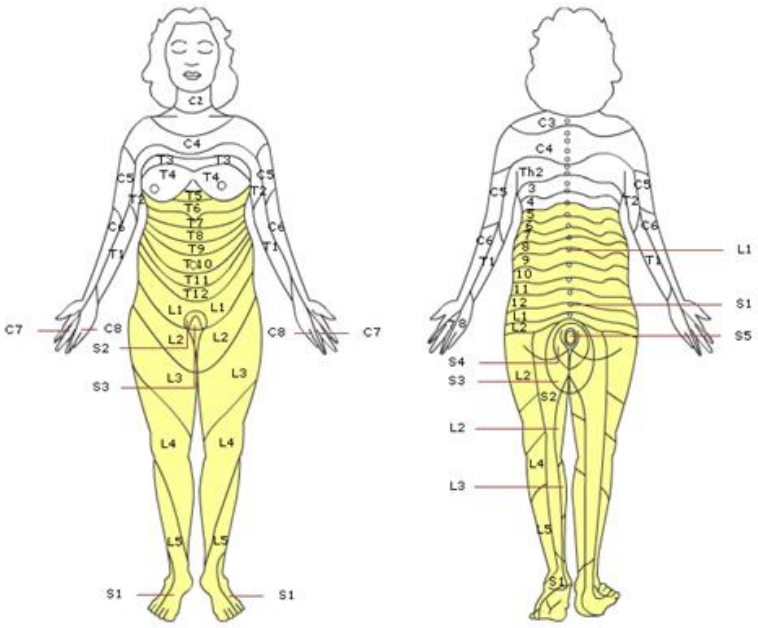


Diagram of dermatones

Problems with the Block

No apparent block at all.

If after 10 minutes the patient still has full power in the legs and normal sensation, then the block has failed probably because the injection was not intrathecal. Try again.

The block is one-sided or is not high enough on one side.

a). When using a hyperbaric solution, lie the patient on the side that is inadequately blocked for a few minutes and adjust the table so that the patient is slightly "head down".

b). When using an isobaric solution, lie the patient on the side that is blocked. (Moving a patient around in any way at all in the first 10-20 minutes following injection will tend to increase the height of the block).

Block not high enough.

When using a hyperbaric solution, tilt the patient head down whilst they are supine (lying on the back), so that the solution can run up the lumbar curvature. Flatten the lumbar curvature by raising the patient's knees.

Block too high.

The patient may complain of difficulty in breathing or tingling in the arms or hands. **Do not tilt the table "head up"** as this a lead to reduced cardiac output. (See later under 'Treatment of a total spinal.')

Nausea or vomiting.

This may occur with high spinal blocks which may be associated with hypotension. Check the blood pressure and treat accordingly. (See later)

Shivering.

This occurs occasionally. Reassure the patient and give oxygen by mask.

Treatment of Hypotension

The side effect of hypotension is easily managed with intravenous vasopressor use, mostly ephedrine and phenylephrine. Previous concerns about adverse effects of phenylephrine on uterine blood flow have proven unfounded, and this vasopressor combined with ephedrine has increased the flexibility of options for treatment of hypotension in the pregnant patient.

In addition, it had been thought that large volumes of intravenous hydration were required to prevent hypotension, but recent studies indicate that this is largely ineffective in otherwise normovolemic patients. Thus, smaller volumes of fluid are given, allowing the technique to be done faster and with less resulting peripheral edema.

Vasopressors

Ephedrine is probably the vasopressor of choice. It causes peripheral blood vessels to constrict and raises the cardiac output by increasing the heart rate and the force of myocardial contraction.

Ephedrine is generally available in 25 or 30 mg ampoules. It is best diluted to 10mls with water for injections and then given in increments of 1-2 ml (2.5-6mg) titrated against the blood pressure.

Phenylephrine. A pure peripheral vasoconstrictor which is available in 10mg ampoules. Dilute before use. Suitable adult doses for intravenous use are 100-200mcg which last about 15 minutes. A reflex bradycardia may occur.

Other Vasopressors

Metaraminol (Aramine). It is supplied in 10mg ampoules and should be diluted and used incrementally (1-5mg) as with ephedrine. It has a slower onset time (at least 2 minutes after intravenous injection) but lasts longer (20-60 minutes)

Monitoring

It is essential to monitor the respiration, pulse and blood pressure closely. The blood pressure can fall precipitously following induction of spinal anaesthesia, particularly in the elderly. Warning signs of falling blood pressure include pallor, sweating or complaining of nausea or feeling generally unwell.

A moderate fall in systolic blood pressure to, say, 80mmHg in a young fit patient or 100mmHg in an older patient is acceptable, provided the patient looks and feels well and is adequately oxygenated.

Bradycardia is quite common during spinal anaesthesia particularly if the surgeon is manipulating the bowel or uterus. If the patient feels well, and the blood pressure is maintained, then it is not necessary to give atropine. If, however, the heart rate drops below 50 beats per minute or there is hypotension, then atropine 300-600mcg should be given intravenously.

Treatment of Total Spinal

Although rare, total spinals can occur with frightening rapidity and result in the death of the patient if not quickly recognised and treated. They are more likely to occur when a planned epidural injection is, inadvertently, given intrathecally. The warning signs that a total spinal block is developing are:

Hypotension - treat as detailed above. Remember that nausea may be the first sign of hypotension.

Bradycardia - give atropine

Increasing anxiety - reassure.

Numbness or weakness of the arms and hands, indicating that the block has reached the cervicothoracic junction.

Difficulty breathing - as the intercostal nerves are blocked the patient may state that they can't take a deep breath. As the phrenic nerves (C 3,4,5) which supply the diaphragm become blocked, the patient will initially be unable to talk louder than a whisper and will then stop breathing.

Loss of consciousness.

Action:

Ask for help - several pairs of hands may be useful!

Intubate and ventilate the patient with 100% oxygen.

Treat hypotension and bradycardia with intravenous fluids, atropine and vasopressors as described earlier. If treatment is not started quickly the combination of hypoxia, bradycardia and hypotension may result in a cardiac arrest.

Ventilation will need to be continued until the spinal block recedes and the patient is able to breathe again unaided. The time this will take will depend on which local anaesthetic has been injected.

Once the airway has been controlled and the circulation restored, consider sedating the patient with a benzodiazepine as consciousness may return before muscle power.

Complications of Spinal Anaesthesia

Headache: a characteristic headache may occur following spinal anaesthesia. It begins within 12-24 hours and may last a week or more. It is postural, being made worse by raising the head and relieved by lying down. It is often occipital and may be associated with a stiff neck. It is frequently accompanied by nausea, vomiting, dizziness and photophobia.

It is more common in the young, in females and especially in obstetric patients. It is thought to be caused by the continuing loss of CSF through the hole made in the dura by the spinal needle. This results in descent of the brain and traction on its supporting structures.

The incidence of headache is related directly to the size of the needle used. A 16 gauge needle will cause headache in about 75% of patients, a 20 gauge needle in about 15% and a 25 gauge needle about 3%. It is, therefore, sensible to use the smallest needle available especially in high risk obstetric patients.

It is widely considered that pencil-point needles (Whiteacre or Sprotte) make a smaller hole in the dura and are associated with a lower incidence of headache than conventional cutting-edged needles (Quincke).

Other problems

As the sacral autonomic fibres are among the last to recover following a spinal anaesthetic, urinary retention may occur. If fluid pre-loading has been excessive, a painful distended bladder may result and the patient may need to be catheterised.

Permanent neurological complications are extremely rare. Many of those that have been reported were due to the injection of inappropriate drugs or chemicals into the CSF producing meningitis, arachnoiditis, transverse myelitis or the cauda equina syndrome with varying patterns of neurological impairment and sphincter disturbances.

If inadequate sterile precautions are taken, bacterial meningitis or an epidural abscess may result although it is thought that most such abscesses are caused by the spread of infection in the blood.

Finally, permanent paralysis can occur due to the "anterior spinal artery syndrome". This is most likely to affect elderly patients who are subjected to prolonged periods of hypotension and may result in permanent paralysis of the lower limbs.

Treatment of spinal headache:

Patients with spinal headaches prefer to remain lying flat in bed as this relieves the pain. They should be encouraged to drink freely or, if necessary, be given intravenous fluids to maintain adequate hydration. Simple analgesics such as paracetamol, aspirin or codeine may be helpful as may measures to increase intra-abdominal and hence epidural pressure such as lying prone.

Caffeine containing drinks such as tea, coffee or Coca-Cola are often helpful. Prolonged or severe headaches may be treated with epidural blood patch performed by aseptically injecting 15-20ml of the pateint's own blood into the epidural space. This then clots and seals the hole and prevents further leakage of CSF.

References

Ankorn C, Casey WF. Spinal Anaesthesia – a practical guide 2000; 12: 21-34

Brull R, MacFarlane AJR, Chan VWS. Spinal, epidural, and caudal anesthesia. In: Miller RD, ed. *Miller's Anesthesia*. 8th ed. Philadelphia, PA: Elsevier Saunders; 2015: chap 56.

Carl Gwinnutt, Matthew Gwinnutt. Clinical anaesthesia – 4th ed. Wiley-Blackwell. 2012

Liu SS, McDonald SB. Current issues in spinal anesthesia. Anesthesiology. 2001 May. 94(5):888-906.

Rachel Collis, T Wood; Spinal Anaesthesia in Obstetric Patients. http://www.e-safe-anaesthesia.org/sessions/08_04/d/ELFH_Session/7/resources.html; 2012.

Turnbull DK, Shepherd DB.Post-dural puncture headache: pathogenesis, prevention and treatment. Br J Anaesth 2003; 91(5): 718-29

Spoors C, Kiff K (eds) Training in anaesthesia. Oxford: Oxford University Press, 2010.

https://en.wikipedia.org/wiki/Spinal_anaesthesia.Acesssed 26/12/2016.