

## The safe spinal anaesthetic

*Spinal anaesthesia is not without its complications and should only be performed for the correct indications.*

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Spinal anaesthesia is relatively easy to perform and can potentially be excellent for below the umbilicus. However, it can also give rise to serious side-effects and complications. To perform a safe procedure, the anaesthetist must have adequate knowledge of the indications and contra-indications, and of the relevant anatomy, physiology and pharmacology of spinal anaesthesia. The patient must be assessed before administration of the spinal anaesthetic and the theatre must be correctly prepared. The anaesthetist must be familiar with the correct technique. After administration of the anaesthetic, the patient must be monitored so that side-effects and complications are recognised immediately and treated early. Sedatives

must be titrated with care. During the postoperative period the patient should be admitted to the recovery room and monitored.

### A spinal anaesthetic should only be performed for the correct indications.

#### Indications and contra-indications

A spinal anaesthetic should only be administered for the correct indications. If relative contra-indications exist, extreme caution should be taken, and if there are absolute contra-indications, it should be

avoided. Indications and contra-indications are listed in Table 1.

#### Physiology

Local anaesthetic solution injected into the subarachnoid space blocks conduction of impulses along all nerves with which it comes in contact. It acts mainly at spinal nerve roots, although some effect is possible at the cord itself. Smaller autonomic and sensory fibres are blocked more easily than motor fibres. Consequently, it produces a rapid sympathetic block, which causes peripheral vasodilatation and hypotension, and the patient may be aware of pressure or movement but feel no pain when surgery starts.

**Table 1. Indications and contra-indications for spinal anaesthesia**

#### Indications

Surgical procedures to the lower body below the umbilicus  
Caesarean section  
Respiratory disease (avoid high blocks)  
Pain relief

#### Relative contra-indications

Aortic stenosis/mitral stenosis (fixed cardiac output states)  
Systemic sepsis  
Neurological disease (medicolegal implications)  
Anatomical deformities of the patient's back  
Difficult airway  
Long operating time  
Children

#### Absolute contra-indications

Inadequate drugs and equipment  
Clotting disorders/anticoagulation  
Refusal  
Severe hypovolaemia or shock  
Localised sepsis  
Increased intracranial pressure

## Preoperative assessment and premedication

The preoperative assessment of the patient should be done as for a general anaesthetic. It is important to explain the procedure, side-effects and possible complications to the patient and to obtain informed consent. It should be explained that although a spinal anaesthetic eliminates pain, the patient may be aware of some sensation in the relevant area and that the patient's legs may become weak. Patients should be reassured that if they feel pain they will be given a general anaesthetic. The usual 'nil by mouth' rule (i.e. no solids for 6 hours and no clear fluids up to 2 hours before anaesthesia) must be observed unless the operation is urgent. Premedication is often unnecessary, but if a patient is apprehensive, hydroxyzine may be given orally 2 hours before the operation.

## Preparation of theatre, instruments and drugs

Facilities for resuscitation and progression to general anaesthesia must be available. Make sure that a reliable anaesthesia machine is available, as well as suction and intubation equipment, and standard anaesthetic and resuscitation drugs.

**Table 2. Factors affecting the spread of the local anaesthetic solution**

Factor	Mechanism
Baricity of the local anaesthetic solution	Blocks can be better controlled with hyperbaric solutions
Position of the patient	Level of the block may change if the patient's position is altered
Concentration of and volume injected	A higher concentration produces a denser block; a larger volume produces a block over a larger area
Speed of injection	Rapid injection produces eddy currents within the CSF and a less predictable spread
Increased abdominal pressure	Leads to engorgement of the epidural veins and reduction in CSF volume

## Intravenous access and preloading

Obtain IV access before starting the block. A large bore is recommended, preferably an 18G IV catheter. It seems that no amount of fluid preloading can prevent hypotension in all cases, but 500 - 1 000 ml is advantageous. Crystalloids are more effective than no fluids and colloids are more effective than crystalloids in preventing hypotension.<sup>1</sup> No differences were detected for different doses, rates or methods of administering colloids or crystalloids.<sup>1</sup>

## The preoperative assessment of the patient should be done as for a general anaesthetic.

### Positioning the patient, anatomy, and factors affecting spread of local anaesthetic

Patients should be sitting or lying on their side. Back flexion opens the intervertebral spaces. The spinal cord terminates at L1/2 and the subarachnoid space at S2 in adults. It is advisable to enter the lumbar subarachnoid space below the termination of the cord, usually between vertebrae L4 and L5. The line joining the iliac crests is at L3/4 and is called Tuffier's line. Aim to identify the L3/4, L4/5 or L5/S1 interspace. Considering the inaccuracy of clinical means of identifying lumbar interspaces, the tendency of anaesthetists to err upwards,<sup>2</sup> and the uncertainty of the length of the spinal cord, even in normal individuals,<sup>3</sup>

it is recommended that spinals should not be inserted above L3/4. Several cases of trauma to the conus are documented in the literature,<sup>4</sup> mostly involving spinal insertion believed to be above L3/4. Evidence suggests that injection of fluid into the cord may not always be involved, and that simple needle trauma is sufficient to produce a syrinx resulting in foot drop, numbness and sometimes urinary problems. It is recommended not to inject once pain is experienced, but the damage may already have been done.

A number of factors affecting the spread of the injected local anaesthetic solution within the CSF and the ultimate extent of the block are given in Table 2.

### Local anaesthetics

Any anaesthetic technique must produce adequate surgical anaesthesia of sufficient duration and with minimal side-effects. The main side-effect of spinal anaesthesia is a reduction in blood pressure. Reducing the dose of intrathecal local anaesthetic will improve cardiovascular stability but may not provide adequate surgical anaesthesia. The anaesthetist needs to decide which local anaesthetic to use and the dose.

Some preparations of local anaesthetics contain additives such as preservatives and are not suitable for intrathecal administration. Bupivacaine has a faster onset and longer duration (2 - 3 hours) of analgesia and motor block than both ropivacaine and levobupivacaine. The duration of action of lignocaine may be too short to guarantee adequate surgical time

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**Table 3. Guideline for local anaesthetic volume (not applicable to pregnant patients)**

Type of block	0.5% hyperbaric bupivacaine
Saddle block	1 ml
Lumbar block	2 - 3 ml
Mid-thoracic block	2 - 4 ml

and it has a higher incidence of transient radicular irritation.<sup>5</sup> A guideline for the volume of local anaesthetic to be used is given in Table 3. The lower volumes should generally be given to small individuals.

**Facilities for resuscitation and progression to general anaesthesia must be available.**

### Fixation time, assessing the block and the level

About 15 - 20 minutes after injection of a local anaesthetic into the subarachnoid space, the level of the block is fixed to a certain degree. However, it can take more

than 60 minutes to fix finally.<sup>6</sup> If the patient is unable to lift his/her legs from the bed, the block is at least up to the mid-lumbar region. Test for a loss of temperature sensation.

### Problems with the block

- No block. 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.
- The block is one-sided. Position the patient on the side that is inadequately blocked for a few minutes.
- The block is not high enough. Tilt the patient slightly head-down or flatten the lumbar curvature by raising the patient's knees.
- The block is too high. Do not tilt the

patient head-up. See treatment of a high or total spinal anaesthetic below.

### Monitoring

Establish full monitoring before administering a spinal anaesthetic, including blood pressure monitoring (preferably with an automatic oscillometric monitor), an electrocardiogram and pulse oximetry. Confirm the alarm levels for every patient before starting the anaesthetic.

### Side-effects and complications

The side-effects and complications of spinal anaesthesia are shown in Table 4.

### Treatment of hypotension

Hypotension is due to vasodilatation and a functional decrease in the effective circulating volume. This should be treated by reversing the vasodilatation with vasoconstrictor drugs and increasing the circulating volume by giving IV fluids.

Phenylephrine is probably the vasoconstrictor of choice. It is a pure peripheral vasoconstrictor ( $\alpha_1$ -agonist) available in 10 mg ampoules and must be diluted before use. It can be administered as 50 - 100  $\mu$ g

**Table 4. Side-effects and complications of spinal anaesthesia**

Side-effect/complication	Mechanism	Treatment
Hypotension	Sympathetic block causes vasodilatation	Vasoconstrictor drugs and IV fluids
High or total spinal	High level of block	See treatment of a high or a total spinal anaesthetic below
Respiratory depression	Severe hypotension, high level of block or sedatives	Treat hypotension and support ventilation
Toxicity	Cardiotoxicity Neurotoxicity	Intralipid Anticonvulsants
Nausea and vomiting	Hypotension or related to opioids	Treat hypotension and administer anti-emetic medication
Pruritus	Related to opioids	Naloxone 50 - 100 $\mu$ g IV or an antihistamine
Headache	Continuing loss of CSF through the hole made in the dura by the spinal needle	Hydration, analgesics, caffeine and an epidural blood patch
Epidural haematoma	Bleeding with haematoma formation	Urgent CT/MRI scan and neurosurgical management
Epidural abscess	Introduction of bacteria with infection and abscess formation	Urgent CT/MRI scan and neurosurgical management plus antibiotics
Nerve injury	Damage to the nerve, or injection of inappropriate drugs	Assessment by a neurologist
Urinary retention	Block of sacral autonomic fibres or related to opioids	Catheterisation

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boluses or as a continuous infusion of 0.5 - 3.0 µg/kg/min. A reflex bradycardia may occur.

Other vasoconstrictors that can be used include etilefrine, ephedrine and low doses of a diluted adrenaline solution.

### Treatment of respiratory depression

If the patient complains of feeling suffocated, of experiencing difficulty breathing or of not being able to raise their voice easily, immediately measure the blood pressure, the SpO<sub>2</sub> and the level of the spinal anaesthetic. If the patient is hypotensive, take measures to raise the blood pressure. Serious respiratory depression or apnoea often happens because the medullary respiratory centre does not function well, secondary to hypoxia in the brain stem caused by profound hypotension. When the level of anaesthesia is above T2 and the tidal volume decreases, supplementary oxygen must be provided per facial mask. If the patient suffers severe respiratory depression or respiratory arrest, artificial ventilation must be commenced immediately. Endotracheal intubation is

not always necessary if artificial ventilation with a mask or an LMA device is possible and if there is no risk of regurgitation and aspiration.

### Treatment of a high or total spinal anaesthetic

Although rare, total spinal anaesthesia can occur rapidly and result in death if not quickly recognised and treated.

The warning signs that high or total spinal anaesthesia is developing are:

- Hypotension – nausea may be the first sign. Large volumes of fluid and repeated doses of vasopressors may be necessary.
- Bradycardia – administer atropine.
- Increasing anxiety – reassure.
- Numbness or weakness of the arms – the block has reached the high thoracic or cervical region.
- Difficulty breathing – if the intercostal nerves are blocked patients may feel that they cannot take a deep breath. If the phrenic nerves (C3 - 5), which supply the diaphragm, are blocked, the patient will initially only be able to whisper and will then stop breathing.
- Loss of consciousness.

Call for help:

- ABC resuscitation.
- Intubate and ventilate the patient with 100% oxygen.
- Treat hypotension with IV fluids, vasopressors and atropine. If treatment is not started quickly the combination of hypoxia, hypotension and bradycardia may result in cardiac arrest.

- Once the airway has been controlled and the circulation restored, consider sedating the patient as consciousness may return before muscle power.
- Continue ventilation until the spinal block recedes and the patient is able to breathe unaided.

### Sedation

Surgery is often stressful for patients and even when pain free after successful spinal anaesthesia, they often request some sedation. Too much sedation may lead to hypoventilation, hypoxia or silent regurgitation of gastric contents. The optimal level of sedation can be difficult to judge. As a general rule, it should be possible to easily arouse the drowsy patient and to maintain verbal contact. In the event of an inadequate spinal anaesthetic it is preferable to electively administer a light general anaesthetic and safeguard the airway than to over-sedate.

### Postoperative care

The patient should be admitted to the recovery room as is the case with any other anaesthetised patient. The level of anaesthesia can take more than 90 minutes after insertion of the spinal anaesthetic to fix finally<sup>6</sup> and it is recommended that the patient be carefully observed during this period. Patients should be given an indication of the duration of the spinal block and told to remain in bed until full sensation and muscle power have returned.

References available at [www.cmej.org.za](http://www.cmej.org.za)

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- A spinal anaesthetic should only be performed for the correct indications.
- Facilities for resuscitation and progression to general anaesthesia must be available.
- Obtain IV access before starting the block.
- Establish full monitoring before administering the spinal anaesthetic.
- Spinal anaesthesia should not be administered above L3/4.
- The principal side-effect of spinal anaesthesia is hypotension.
- The treatment of hypotension is with vasoconstrictor drugs and IV fluids.
- Total spinal anaesthesia can occur rapidly and result in death if not quickly recognised and treated.
- If the spinal anaesthesia is inadequate, rather administer a light general anaesthetic than to over-sedate a patient.
- The block can take more than 60 minutes to fix finally.