Update in
Anaesthesia

Obstetric spinal anaesthesia

S S Harsoor* and S Bala Bhaskara
*Correspondence email: harsoorss@hotmail.com
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Summary

Caesarean section is the most frequently performed obstetric surgical procedure, and spinal anaesthesia is a common anaesthetic technique used across the world. It produces rapid, dense, predictable block, is relatively easy to perform with a definite end point and has a very high success rate.

However, there are contraindications to its use, and complications associated with spinal anaesthesia, which all patients should be counselled about. Spinal anaesthesia is inevitably associated with hypotension and it is important to manage this to avoid adverse outcomes in the foetus.

INTRODUCTION

Caesarean section is the most frequently performed obstetric surgical procedure and may be performed under spinal (intrathecal), epidural or general anaesthesia. This article will focus on spinal anaesthesia, discussing the preoperative evaluation and preparation of patients, the indications and contraindications for spinal anaesthesia, and potential complications of the procedure.

Caesarean delivery rates vary significantly throughout the world, with around 140 million Caesarean sections performed globally during 2015.[1] Rates vary from 4% in West and Central Africa to around 23% in the U.K, almost 32% in the USA and over 44% of all deliveries in Latin America and the Caribbean.[1-3] The World Health Organisation (WHO) suggests that at a population level, Caesarean delivery rates of up to 10-15% are associated with decreases in maternal and neonatal mortality, but rates above this are not associated with reduced mortality.[4]

The risks of mortality in those women who undergo Caesarean section also vary widely. A recent systematic review and meta-analysis has shown a mortality rate of 7.6 per 1000 women who undergo Caesarean sections in low- and middle-income countries (LMICs), with the highest mortality rate of 10.9 per 1000 women in sub-Saharan Africa.[5] To compare, the risk of mortality following Caesarean section in the UK is around 8 per 100,000 women, showing an approximate 100-fold increase in risk of death following Caesarean section for those living in LMICs.

Table 1. Indications for Caesarean section

Indications for Caesarean Section
Previous Caesarean section
Obstructed labour or failure to progress
Pre-eclampsia or eclampsia
Placenta praevia or abruption
Foetal compromise
Malpositions of the foetus e.g. breech or transverse lie
Multiple pregnancy
Cord prolapse
Worsening of pre-existing maternal condition e.g. cardiac
Maternal choice

Indications for Caesarean Section

Caesarean section may be undertaken for the benefit of the mother, the baby or both. The most common indications are that of failure to progress in labour

SS Harsoor *MD*
Gadag Institute of Medical Sciences
Gadag
Karnataka
INDIA

S Bala Bhaskara *DA, DNB*
Professor of Anaesthesiology
Vijayanagar Institute of Medical Sciences
Bellary
INDIA

Table 2. Classification of Caesarean section

Category	Classification of Urgency of Caesarean section
1	Immediate threat to life of woman or foetus
2	Maternal or foetal compromise which is not immediately life-threatening
3	Requires early delivery but no maternal or foetal compromise
4	At a time to suit the woman and maternity team

and prior Caesarean section, and further indications can be found in Table 1 overleaf.

Urgency of Caesarean section

Knowledge of the indication for the Caesarean section is important as it often determines the urgency of delivery of the baby. Caesarean delivery can be classified as elective – usually performed around 39 weeks gestation at atime to suit the mother and maternity team, or emergency – performed at an unplanned time. As 'emergency' is a very broad term, a further classification of Caesarean section has been made by Royal College of Obstetrician and Gynaecologists, in order to help guide management of patients and resources, and is shown in Table 2.

There is much debate as to the maximum time to delivery for each of the suggested classifications, and there is little evidence base for this. However, delivery within 30 minutes of the decision to operate is usual for Category 1 Caesarean sections, where prolonged periods of intrauterine hypoxia may be associated with adverse foetal outcomes.

Spinal anaesthesia

Spinal anaesthesia is the commonest type of anaesthesia used for lower segment caesarean section (LSCS). Compared with epidural technique, spinal anesthesia is quicker and easier to perform, with a definite end point, and a high success rate. It produces rapid, dense and predictable block especially with hyperbaric solutions. There is minimal risk of regurgitation and aspiration of gastric contents. There is minimal transfer of drug across placenta to the foetus and even when transferred, there is minimal risk of foetal toxicity. The mother is awake and is able to enjoy the encounter with her baby.

Pre-operative evaluation

All patients undergoing Caesarean section should be assessed by the anaesthesia team. A thorough preanaesthetic evaluation is performed to elicit co-existing diseases, anaesthetic and obstetric history, contraindications to spinal anaesthesia such as those listed in Table 3, as well as a thorough examination of the patient including back and airway assessment.

Despite planning for spinal anaesthesia, the availability of equipment and medication to safely provide general anesthesia for an unanticipated emergency situation and difficult airway must always be considered.

In patients with pre-eclampsia and HELLP syndrome, both the platelet number and functionality may be poor. Although there is no strong evidence to specify the exact platelet count for safe spinal anaesthesia to avoid a spinal hematoma, in the absence of other additional coagulation risk factors, a platelet count of 50,000/µl is considered safe.[6,7] In addition to the actual number, the quality of platelet function should influence the decision to administer spinal anaesthesia. It must be noted that in pre-eclamptic patients, hyperactivity of the angiotensin II receptors causes hypertension and vasoconstriction and since spinal anesthesia does not influence the angiotensin system, it will cause lesser degree of hypotension in pre-eclamptic patients than in healthy patients.[8]

Care must be exercised in conditions like placenta praevia where spinal anaesthesia may have advantages of better uterine contractility as compared to general anaesthesia if the volume status is satisfactory.

Table 3. Contraindications to spinal anaesthesia. HELLP – haemolysis, elevated liver enzymes, low platelets.

Contraindications to spinal anaesthesia
Coagulation disorders (e.g. due to pre-eclampsia or HELLP Syndrome)
Thrombocytopaenia
Hypovolaemia from active bleeding
Systemic sepsis
Localised sepsis at needle insertion point
Patient refusal

Complications of spinal anaesthesia

The mother, who could be in labour and not able to clearly understand the implications of anaesthesia, should still have an explanation of the procedure and consent should be obtained. The potential complications are shown in Table 4, and these risks along with the possibility of failure of spinal anaesthesia and the need to convert to general anaesthesia should be clearly explained to the mother.

Preparation of the patient

Fasting during labour is a tradition that continues without any strong evidences of improved outcomes either for mother or newborn.[9] Hence it is suggested that, during an uncomplicated elective caesarean section, mother should undergo a fasting period for solids of 6 hours, but may have clear liquids up to 2 hours before anaesthesia. During emergency cases, all patients are assumed to be having full stomach. It is generally recommended that before any caesarean section an H_2-blocker and a nonparticulate antacid be given with or without metoclopramide.[10]

At term pregnancy the compression of the inferior vena cava by the gravid uterus in the supine position results in supine hypotension syndrome, and the resulting severe hypotension is not easily managed by treatment with vasopressors. The aortic compression is not too significant to be of consequence as previously thought. Twin and singleton pregnancies cause a similar degree of compression. Measures to avoid aortocaval compression should be continued on

Table 4. Potential complications of spinal anaesthesia

Potential complications of spinal anaesthesia
Hypotension (sympathetic blockade)
Urinary retention
Nausea and vomiting
Shivering
Respiratory depression or sedation (if intrathecal opioids are used)
High block or total spinal
Systemic local anaesthetic toxicity
Post dural puncture headache (PDPH)
Neuropathy – may be temporary or permanent
Epidural or spinal abscess or haematoma
Meningitis or arachnoiditis

the operating table and after spinal anaesthesia by providing either leftward tilt of table, or wedge under right buttock, or even by obstetrician manually displacing the uterus to left.

Intravenous fluids

Preloading or co-loading with crystalloids before or during spinal anaesthesia is widely practiced in an attempt to reduce the incidence of spinal induced hypotension.[11] Ringers Lactate (alternatively called Hartmann's solution or Compound Sodium Lactate) is the most preferred crystalloid, both for preloading and for maintenance, since it is isoosmolar with plasma. It is also useful as a carrier for oxytocin. Intravenous Dextrose (5%)in water is not an ideal solution as a carrier, since it exhibits hypotonic properties in vivo and the use with oxytocin in dextrose can potentially lead to water retention. In addition, there is risk of foetal hyperglycaemia, acidosis and neonatal hypoglycaemia. However, dextrose can be used when there are clear indications such as in diabetic state.[12,13]

It is vital to avoid maternal hypotension following spinal anaesthesia, as placental blood flow is entirely dependent on maternal blood pressure. Other interventions to reduce the incidence of hypotension include the use of ephedrine, phenylephrine and lower limb compression.[14]

Administration of Spinal Anaesthesia

The intrathecal injection is performed either in sitting or lateral position. The sitting position is preferred when it is difficult to identify the landmarks, as in obese patients, or when combined spinal and epidural technique is attempted. The aim is to attain a sensory block up to T4-T6 segmental level. Sensory blockade beyond T4 segmental level can cause a sense of dyspnoea, as the feel of chest expansion and voluntary sigh are lost due to intercostal muscle paralysis. Quiet reassurance and encouragement to breathe deeply till extraction of foetus will be adequate and no sedative should be administered. Such sensation disappears once the baby is delivered, with improved respiratory movements as the uterus is empty and contracted. Pain associated with traction on peritoneum and exteriorization of uterus can be reduced by administration of analgesics such as fentanyl or alfentanil.

Table 5. Dosage ranges for different local anaesthetic agents and the additives

Drug	Dosage range (mg)	Duration (min)
Lignocaine (5%) Heavy	60–75	45–75
Bupivacaine (0.5%)	7.5–15.0	60–120
Ropivacaine (0.75%)	10-15	60-90
Levobupivacaine	8-12	60-120
Tetracaine	7.0–10.0	120–180
Procaine	100–150	30–60
Adjuvant drugs		
Epinephrine	0.1–0.2	—
Morphine	0.1–0.25	360–1080
Fentanyl	0.010–0.025	180–240

The choice of space for intrathecal injection is at the L3-L4 level to ensure that the needle is inserted well below the termination of the spinal cord. Thin gauge (sizes 25F to 27F), pencil-point needles (Sprotte or Whitacre type) are preferred, as they reduce the incidence of post dural puncture headache(PDPH) as compared to Quincke cutting tip needles. If pencil point needles are not available, the thinnest gauge Quincke needles may be used. Once the free flow of cerebrospinal fluid (CSF) is seen, the chosen local anaesthetic drug dose is injected.

The commonly used drugs and doses for spinal anaesthesia are shown in the Table 5. Inj. Lignocaine (lidocaine) 5% produces faster onset and moderate duration of action of about 45 to 75 minutes, but concerns of transient neurological symptoms(TNS) reported with hyperbaric lignocaine have limited its use. Inj. Bupivacaine is a popular agent with rapid onset, longer duration of action and satisfactory muscle relaxation. The optimum dose of intrathecal heavy bupivacaine 0.5% for the parturients is 10-12mg. Inj. Levobupivacaine, which is a pure S(-) enantiomer of racemic bupivacaine, when used in a dose of 4-12 mg, has the efficacy equivalent to that of heavy bupivacaine 0.5%. The opioids can be added to the neuraxial local anaesthetic, to provide postoperative analgesia after LSCS. Preservative-free morphine 0.10 to 0.25 mg may be added to intrathecal local anaesthetics to prolong postoperative analgesia for 18 to 24 hours. Recent reports indicate that 5mcg dexmedetomidine added to hyperbaric bupivacaine potentiates and prologs spinal anaesthesia without any untoward effects on neonate and hence can be used when it is appropriate[15].

Following injection of the spinal anaesthetic, the patient should be turned supine with a wedge under the right buttock, or a tilt on the operating table, to avoid supine hypotension.

Monitoring

Mandatory monitoring should consist of pulse oximetry, non-invasive blood pressure monitoring and electrocardiogram. The blood pressure should be checked every 2-3 minutes initially as rapid falls are anticipated, necessitating immediate intervention. The hypotension due to sympathetic block may be accentuated by aorto-caval compression caused by enlarged uterus in the supine position. Vasopressors such as ephedrine, phenylephrine, mephentermine or metaraminol should be drawn up in a syringe and kept ready before administering spinal anaesthesia. The infusions of phenylephrine (100mcg/min) are more effective in preventing hypotension. All patients should be monitored for incidences of tachycardia or bradycardia. Tachycardia associated with labour pain may continue for some time or it may occur due to hypotension. Intra-operatively bradycardia may occur because of higher levels of spinal blockade, or due to vagal stimulation caused by traction on peritoneum. Monitoring is especially important during the time when the uterine sinuses are open, until the suturing is complete, as there is risk of amniotic fluid embolism or venous air embolism. The risk of air embolism may be greater with exteriorization of uterus undertaken by some obstetric practitioners.

Blood loss

In low risk patients undergoing elective LSCS, the technique of spinal anaesthesia is associated with a lower risk of operative blood

loss when compared to general anaesthesia.[16] Inj. Oxytocin 5-10 IU should be administered by infusion after delivery of the baby, but may be associated with maternal hypertension and tachycardia. In cases of uterine atony, administration of intramuscular (IM) carboprost may be required, but the incidence of nausea, vomiting may increase and rarely, bronchospasm may be precipitated with its use. IM Methyl ergometrine ('methergine') has also traditionally been used as uterotonic , however it is associated with increased adverse effects such as hypertension, and nausea and vomiting.

In addition to uterotonic medications, the use of tranexamic acid (TxA) decreases postpartum blood loss and may reduce the incidence of post-partum haemorrhage (PPH) and blood transfusions following LSCS in women at low risk of PPH.[17] The World Maternal Antifibrinolytic (WOMAN) trial, has also demonstrated a significant reduction in deaths due to bleeding in patients who received intravenous TxA.[18]

Nausea and vomiting can be seen in some patients, which may be caused by hypotension or vagal reflexes due to visceral handling. The uterotonic drugs like misoprostol, carboprost or methergine have strong emitogenic potential. Intravenous use of antiemetics such as ondansetron, dexamethasone, droperidol, metoclopramide or combinations are tried with varying degrees of success.

Postoperative Care

Postoperative care should continue until the effects of spinal anaesthesia have completely receded. Further monitoring for PDPH should be continued for 48 hours. PDPH should be considered for any headache following spinal anaesthesia for LSCS. The cerebrospinal fluid (CSF) pressure is increased in pregnancy and any breach in dura mater is associated with greater loss of CSF and consequent fall of CSF pressure. The patient manifests with severe headache, neck stiffness, nausea, tinnitus and photophobia. The PDPH is usually self-limiting and may respond to conservative management, which includes regular analgesics, bed rest and oral or IV fluids. An epidural blood patch is considered the gold standard for managing PDPH,[19] when supportive measures fail. However, the procedure of epidural blood patch itself can lead to another inadvertent dural puncture and other adverse events can occur during a blood patch, such as meningitis or neurological deficits. The minimally invasive, simple procedure of bilateral greater occipital nerve block has been used for treating chronic headaches in patients with PDPH, or in patients who have failed conservative management.[20, 21] Transnasal sphenopalatine ganglion block (SPGB) has also been proposed for the management of postdural puncture headache.[22]

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