

Approach to failed spinal anaesthesia for caesarean section

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ABSTRACT

Failure of spinal anaesthesia for caesarean section may have deleterious consequences for the mother as well as the newborn baby. In this article, we discuss the mechanisms of failure of spinal anaesthesia as well as the approach to a failed block. We performed a literature search in Google Scholar, PubMed, and Cochrane databases for original and review articles concerning failed spinal anaesthesia and caesarean section. Strategies for a failed spinal anaesthetic include manoeuvres to salvage the block, repeating the block, epidural anaesthesia or a combined spinal-epidural (CSE) technique, or resorting to general anaesthesia. Factors influencing the choice of these alternative options are discussed. A "failed spinal algorithm" can guide the anaesthesiologist and help reduce morbidity and mortality.

Key words: Caesarean section, failed spinal, general anaesthesia, repeat spinal, safe practice

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INTRODUCTION

Neuraxial anaesthesia is the commonest, safest, and most logical choice of anaesthesia for caesarean section. Various options include spinal anaesthesia, epidural anaesthesia, or combined spinal epidural (CSE) anaesthesia. Of all these, single-shot spinal is the most widely practiced mode of anaesthesia in both elective as well as emergency situations. Although spinal anaesthesia is considered to be the most reliable form of anaesthesia, occasional failures are not unknown. It is essential to recognize that the failure of spinal anaesthesia during caesarean section has detrimental implications on the wellbeing of both the parturient and the neonate. Therefore, the failure must be viewed more critically in obstetric compared with nonobstetric settings. We performed a literature search in Google Scholar, PubMed, and Cochrane databases for original and review articles concerning failed spinal anaesthesia and caesarean section.

The Saving Mothers Report,^[1] which assessed the deaths of 92 parturients in South Africa, between 2008 and 2010, revealed that 73 (79%) patients died due to spinal anaesthesia. Out of these, 10 deaths were related to the complications of a subsequent

general anaesthesia administered when spinal anaesthesia proved inadequate for surgery. Lack of clinical experience and inappropriate approach to failure were responsible for maternal mortality. As there are very limited options to approach the failure, utmost vigilance is warranted while performing spinal anaesthesia to minimise both failure rate as well as maternal or foetal complications. With careful performance of technique, a failure rate as low as 1% is attainable though various studies have quoted failure rate up to 17%.^[2,3]

WHAT CONSTITUTES FAILURE?

Broadly speaking, pain or discomfort during caesarean section necessitating the need to undertake additional measures to continue surgery is regarded as failed spinal anaesthesia. The failure can be defined as

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“failure to provide satisfactory surgical conditions and/or maternal comfort and satisfaction during caesarean section with or without conversion to general anaesthesia.”

MECHANISMS OF FAILURE

As early as in 1922, Gaston Labat made a statement:^[4] “Two conditions are, absolutely necessary to produce spinal anaesthesia; Puncture of the dura mater and Subarachnoid injection of an anaesthetic agent.” Inability to achieve these two primary goals due to any cause leads to failure of spinal anaesthesia. The failure could be operator, technical, or equipment related [Table 1]. Meticulous attention to the following ten points will help reduce the failure rate of spinal anaesthesia.

Dural puncture

Inability to either puncture the dura (dry tap) or obtain free flow of cerebro-spinal fluid (CSF) after alleged dural puncture is one of the obvious causes of failure of spinal anaesthesia. The main reasons are blocked needle, poor patient positioning, and faulty needle placement technique. Obesity, anatomical abnormalities, and an anxious patient will often add to the misery.

It is prudent to check the patency of the needle prior to insertion and not to advance the needle without the stylet in place. Bent or crooked needles should be discarded. The patient should be positioned on a firm flat surface with maximal flexion in order to open the lumbar spine, avoiding lateral curvature of the spine.

Table 1: Mechanism of failure

| |
|---|
| Operator related failure |
| Inadequate drug dose or volume |
| Improper assessment of block |
| Inappropriate positioning |
| Failure to counsel and communicate |
| Seniority and personal experience |
| Technique related failure |
| Faulty technique |
| Difficult back (anatomical deformities) |
| Obesity |
| Misplaced injectate |
| Pseudo puncture |
| Equipment or drug related failure |
| Blocked needle |
| Use of pencil point needles |
| Drug potency |
| Wrong drug |
| Drug resistance |

Though the sitting position is often easier, there is no difference between the lateral and sitting positions in terms of failure rate.^[5] The risk of traumatic or failed spinal block may be reduced by the use of ultrasound guidance.^[6]

Pseudosuccess of dural puncture must be identified. This is most likely due to excess local anaesthetic solution infiltrated before the procedure or attempting spinal after a prior epidural analgesia has failed. Very rarely, puncture of a congenital arachnoid cyst may yield CSF-like fluid.^[7]

Intrathecal deposition of the entire volume

Leakage of injected volume can occur due to poor connection between the needle and the syringe. Ensuring that the needle tip does not get displaced while trying to firmly secure the syringe or during drug injection can prevent the injectate loss during drug administration. Routine aspiration of CSF before injecting and just before completion of injection of local anaesthetics is one way of confirming intrathecal delivery of the drug. Use of finer pencil point needles can be technically challenging as CSF aspiration through finer needles, for example, 29 G is difficult. If this needle with side opening is placed incorrectly across the dura, part of the injectate will be lost in the epidural or subdural space. Sometimes, a small dural flap formed during the procedure may act as a “flap” valve. CSF can be aspirated freely but during injection, an inward displacement of the flap leads to loss of injectate between the dura and the arachnoid mater.^[8]

Injection of the correct drug

Prevention of injection of wrong drug is of utmost importance. Apart from failure, wrong drug injection can cause maternal mortality (e.g., tranexamic acid).^[9] Such errors are unpardonable and must be avoided by double checking of drugs before injection, use of prefilled syringes, and use of luer-lock connection.^[10]

Injection of the correct dose and volume

The speed of onset, quality, and duration of the block are solely determined by the dose of the local anaesthetic. The spread and therefore the level of sensory block is determined by the density/baricity of the solution, the local anaesthetic volume, and patient’s position.^[11] The spread of isobaric local anaesthetic is far more unpredictable than hyperbaric solutions used routinely. Hypobaric solution has potential benefit when injected in the sitting position, but not

without the risk of hypotension. Use of adjuvants may hasten the onset, prolong the duration, and improve the quality of motor block but may not prevent failure. According to the study by Ginosar *et al.*,^[12] ED50 of bupivacaine is 7.5 mg and ED95 (surgical success) is 11 mg. Anatomical factors like Kyphosis and/or scoliosis are responsible for the technical difficulty and interference with spread. Unilateral block may be caused by supporting ligaments within the theca acting as a longitudinal barrier. Very rarely, inadequate spread or failure may be explained by asymptomatic neurological pathology within the vertebral canal.^[13]

Facilitating action of the drug on the nerve roots

The efficacy and potency of the drug can get altered by various factors such as prolonged exposure to sunlight, excessive dilution of the drug, chemical incompatibility after mixing with other drugs, or altered pKa due to interaction with the alkaline CSF. In such conditions, even if the entire drug reaches the nerves, the desired action may not be obtained. Mixing of two drugs may cause precipitation or lowering of the pH altering the movement of local anaesthetics across the neuronal membrane. Local anaesthetic resistance due to mutation of sodium channel has been reported as a cause of ineffective drug action in few patients.^[14]

Enough time for the block to establish

An extremely anxious parturient who perceives every stimulus as pain and an anaesthesiologist who does not allow adequate time for the block to establish can precipitate pseudofailure of spinal anaesthesia. Sufficient time should be given for the block to establish before labeling it as failed spinal. However, the maximum time limit for the onset of action after drug deposition into the intrathecal space is 15–20 minutes. The drug is unlikely to produce desired action after this time period.^[8] The slower the onset of either sensory or motor component of the block, the more likely an inadequate block will result.

Assessment of the block before allowing the skin incision

Formal testing of the block prior to commencement of surgery is the key to success. The level of the block must be checked bilaterally and documented properly on the anaesthesia chart without fail. There is no consensus as to the best practice about checking the block. However, three modalities like, sensation of cold (ice cubes or ethyl chloride spray), light touch (cotton swab), and loss of motor power are used commonly.^[15] Use of pinprick method is not

recommended. It must be understood that adequate level of the block does NOT guarantee its quality. Although level of block needed for abolishing somatic pain during caesarean section is T10 dermatome, a block as high as T4 is required to abolish visceral pain and discomfort.^[16,17] Cold sensation felt at T4 or lower, light touch sensation felt at T8 or lower, and poor motor block in lower extremities after 10 minutes are causes of concern about adequacy of the block.

Postprocedure position

A slight head low position with 15° left lateral tilt allows adequate spread of the local anaesthetic avoiding aortocaval compression. Higher spread may be achieved by turning patient on left side with head down, to obliterate lumbar lordosis. Maneuvers like flexing the hip or knee–chest position may not be feasible.

Communication skills

Communication before and during the procedure with the parturient explaining the need for correct positioning and cooperation is very vital. If the patient is in active labor, it is very difficult for her to cooperate and maintain proper position. One must allay their anxiety of pain during the procedure by informing about local infiltration before the actual injection. Apart from proper positioning of the parturient after the block and testing of the level of anaesthesia before the skin incision, positive communication with the anxious parturient is vital in order to prevent pseudofailure. The onset of level of anaesthesia should not be assessed too soon or too frequently as it might introduce doubt or anxiety in the mind of the parturient. Patient's expectations play a major role and if their anxiety and concerns are not allayed, they are more likely to claim that the anaesthesia has not worked leading to increased litigation.^[8]

Personal experience of the clinician

Spinal anaesthesia with 25/27 or 29 G spinal needles have relatively higher failure rate due to technical issues that can be improved upon only with practice. An experienced anaesthesiologist will do proper preoperative assessment, check the equipment, and perform the procedure in a calm, unhurried manner, winning the patient's confidence and cooperation, and hence improving success rate.^[14]

TYPE OF FAILURE

Clinically, the failure may range from no block at all to failure despite a proper block. There can be complete

absence of both sensory and/or motor block or a good sensory motor block with inadequate cephalad spread, unsuitable for surgical anaesthesia. One may also encounter unilateral block either because of positioning or anatomical barrier due to presence of longitudinal ligament blocking the even spread. Inadequate or partially misplaced dose may result in patchy block or reduced duration of block causing failure of the block to last the duration of surgery.

HOW TO APPROACH INADEQUATE REGIONAL BLOCK

Failure of a spinal anaesthetic is associated with serious clinical, psychological, and medico-legal consequences, especially if the failure becomes evident after starting the surgery. The Royal College of Anaesthetists, UK, suggest that the conversion rate from spinal to general anaesthesia should be <1% in elective and <3% in emergency caesarean section.^[18] While dealing with inadequate block, one must remain calm and appear to be in full control. Frequent testing may increase anxiety and result in loss of rapport. Salvage of the block should be the priority avoiding the general anaesthesia as far as possible. If parturient complains of pain after the surgery has started, surgery should be stopped immediately. Further steps involve reassuring the patient, assessing the type of failure, and trying to maximize the comfort with the best alternative available under the circumstances. Table 2 summarizes the various strategies to deal with a failed spinal during caesarean section.

OPTIONS FOR MANAGEMENT OF FAILURE

Revive or salvage the block

Prior to initiation of surgical procedure, the failing block can be revived by physical manoeuvres like placing the patient on her side (left lateral) along with head low, limited hip flexion to straighten the back and obliterate the spine curvature, and valsalva manoeuver, or coughing (epidural volume expansion), to facilitate cephalad spread. If an epidural catheter is in place, cephalad spread may be achieved with additional doses of local anaesthetics or saline [Table 3].

After the surgery has started, the options are limited. Systemic sedation and/or analgesia with intravenous opioid (fentanyl), or anxiolysis (midazolam) may be helpful for the breakthrough pain. Inhalation of entonox or local infiltration of the wound may be an option to consider depending upon the situation.

Sedation leading to loss of consciousness, or general anaesthesia without securing the airway is NOT RECOMMENDED. If more than one option to salvage the block is unsuccessful, accept failure.

Repeat the regional block

For a failed spinal anaesthesia, repeating the block is a sensible option if feasible. The ease with which the dura was punctured in the first attempt should guide the clinician to decide whether to consider the patient for repeat spinal.^[19] After waiting for 20 minutes to avoid pseudofailure, a different interspace must be tried to avoid the anatomic distortions. If no effect is seen after 20 minutes following the injection, it seems reasonable to repeat the block with full dose. In partial failure, there must be some amount of local anaesthetic in the CSF; hence, reduction in the dose by 25%–30% may be necessary if the block is close to T10 [Table 4].^[8,20] If the circumstances permit and expertise is available, consider using a CSE technique with a reduced intrathecal dose and epidural catheter as backup.

Table 2: Management options; 3Rs

| | Option | Clinical Situation |
|---|---------------------------------|---|
| R | Repeat block | Non-urgent Caesarean section Total or partial failure Difficult airway or inadequate starvation |
| R | Revive block | Urgent, Category 1 Caesarean section Skin is already incised Technically difficult spinal |
| R | Recourse to general anaesthesia | Revival fails No time to repeat the block Patient request |

Table 3: Measures to revive the block

| |
|--|
| Before skin incision |
| Slight head low position |
| Left lateral position with head down |
| Limited hip flexion |
| Valsalva manoeuver, coughing |
| Epidural volume expansion with saline or local anaesthetic |
| After skin incision |
| Systemic analgesia |
| Local anaesthetic infiltration |
| General anaesthesia |
| Reassurance and communication |

Table 4: Repeating the block

| Type of failure | Clinical assessment | Dose adjustment |
|------------------|--|--|
| Complete failure | No sensory or motor block at all | Repeat the block, USE Full dose of local anaesthetic |
| Partial failure | Inadequate level, patchy or unilateral block | Repeat the block, BUT Reduce dose by 25%-30% Consider CSE, technique or placing an epidural catheter |

Evidence in the literature regarding safety of repeat spinal anaesthetic is conflicting.^[21,22] Repeating spinal anaesthesia after a failed neuraxial block is not without concerns. Unpredictable reliability and quality of the resulting block may lead to a high or total spinal anaesthesia. Sometimes, the repeat block worsens the haemodynamics without improving the block. Exposure of high concentration of drugs on the nerve roots due to restricted spread may cause cauda equina syndrome. Multiple attempts can increase risk of postdural puncture headache or vascular injury leading to epidural haematoma. As the adjacent nerve tissue is already affected by local anaesthetic action, risk of nerve damage due to direct needle trauma is a theoretical possibility [Table 5]. If the repeat spinal fails to produce desired block, general anaesthesia is the safest option.

Failed spinal in combined spinal epidural

Inadequate spinal block in CSE can be approached by injecting saline or incremental doses of local anaesthetic through the epidural catheter (volume expansion theory) to increase the block height by squeezing the intrathecal space.^[23] If spinal block is not apparent within 15–20 minutes of injection, epidural catheter can be used to establish surgical anaesthesia.

Recourse to general anaesthesia

The recourse to general anaesthesia should be done after a prompt and through assessment of the situation using common sense and clinical experience, without compromising parturient’s safety or comfort. Converting to general anaesthesia in a parturient is not without risks like hypotension on induction, aspiration, and potentially difficult airway, especially under unfavorable environment when dealing with foetal distress, or if failure becomes apparent after the skin incision.

CHOOSING APPROPRIATE OPTIONS FOR FAILED BLOCK

Primary factors to consider while approaching failure are as follows: first, if the skin incision is already

made, and second, how urgent is it to deliver the baby. Communication and cooperation between the anaesthesiologist and obstetrician is crucial in choosing safe anaesthesia technique for the parturient.^[24] Starvation status, difficult airway, ease of performance of regional block, and comorbid condition of the parturient are secondary factors to be considered while choosing the correct option to approach the failure.^[19] A simple algorithm as described in Figure 1 may be followed to choose the best possible option under the circumstances.

In case of failure before skin incision is made and there is no urgency to deliver in <30 minutes, repeating the regional block may be the safest option for the parturient

In case of failure before skin incision is made and there is urgency to deliver in <30 minutes, make a quick assessment of situation. If performing the spinal block has been easy and the patient is cooperative, quick attempt at repeating a spinal may be considered. If that is not feasible, try to salvage the block while getting ready for recourse to general anaesthesia without any further delay. Avoid any compromise on maternal or foetal safety.

In case of failure after skin incision is made and there is no urgency to deliver in <30 minutes, revive the block with various options appropriate to the circumstances. Though attempts should be made to avoid general anaesthesia, especially in anticipated difficult airway, it may be the only option to safely carry on surgery without further delay once the skin is already incised. In this situation, a positive decision on the choice of anaesthesia must always be made prior to the uterine incision.

In case of failure after skin incision is made and there is urgency to deliver in <30 minutes, recourse to general Anaesthesia in the best interest of maternal and foetal safety.

KEY POINTS TO SAFE PRACTICE

- ABC of safe practice is summarised in Table 6 below;
1. Avoid excessive and multimodal sedation: “A Bit of this plus a Bit of that is a classic recipe for DISASTER!”
 2. Be prepared: Be honest to yourself and your patient, accept failure, be ready to convert to general anaesthesia

| Table 5: Complication of repeat spinal injection |
|--|
| High spinal or total spinal |
| Hypotension |
| Cauda equina syndrome |
| PDPH |
| Nerve injury |
| Epidural haematoma |
| PDPH – Postdural puncture headache |

3. Communication: Reassure and explain the situation. If possible, include the parturient in the discussion about how to proceed in case of failure giving various options
4. Documentation: Meticulous documentation of the testing and level of the block achieved. Every attempt at reviving the block, including reasons why particular decisions were made, and its effectiveness must be documented. When general anaesthesia is offered, the timing along with patient's response must be recorded clearly in notes, especially if it was declined by patient
5. Explanation and postoperative follow-up: Provide an honest explanation of what happened and answer any questions or concerns they may have, including implications for future pregnancy.

Proper documentation and good communication are keys to prevent medico-legal problems.

Table 6: Key points to safe practice

| | | |
|---|-------------|---|
| A | Avoid | Excessive and multimodal sedation Compromised airway |
| B | Be prepared | To accept failure With safe options to proceed |
| C | Communicate | Listen to the complaint of pain or discomfort Stop surgery and provide reassurance Discuss various options to proceed |
| D | Document | Assessment and level of block Every attempt to revive the block Patient's response |
| E | Explain | Honest explanation and information Probable reasons for failure Future implication Postoperative follow-up and written summary |

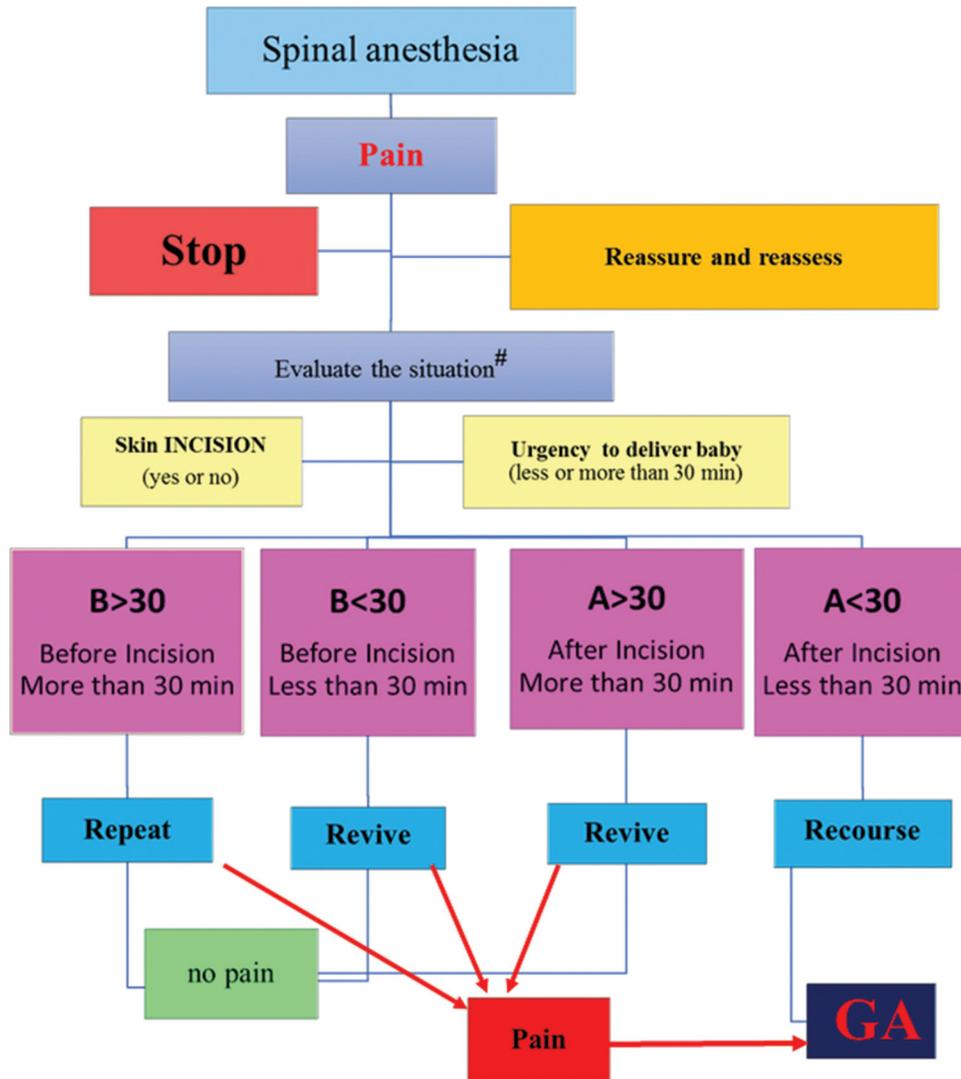


Figure 1: Algorithm: safe approach to failed spinal anaesthesia.

#Assess: Difficult Airway, Starvation Status, Technical Difficulty in performing SA, Co-morbidity. GA=General anaesthesia

SUMMARY

The recipe for successful spinal anaesthesia is “correct dose, correct drug, correct place.” Failed spinal anaesthesia is associated with significant maternal morbidity and mortality. Due to restricted rescue options to salvage the block, meticulous attention to prevent the failure is prudent. The first choice in dealing with the failure is to salvage the block without hastily converting it to general anaesthesia. Choice of inappropriate option or overzealous use of systemic analgesia and sedation to approach failure can dangerously compromise parturient safety. Despite controversies, repeat intrathecal injection performed by an experienced anaesthesiologist under vigilance is a very good option. A “failed spinal” algorithm guides the anaesthesiologist to approach “failures,” reduces maternal and foetal morbidity and mortality, and addresses pursuant litigation.

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Conflicts of interest

There are no conflicts of interest.

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