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LITERATURE REVIEW

Management of Failed Spinal Anesthesia

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ABSTRACT

The management of failed spinal anesthesia is a significant challenge in surgical procedures. Spinal anesthesia failure can occur either partially or totally, often leading to conversion to general anesthesia, which adds clinical risks and potential complications. The aim of this study is to evaluate the factors contributing to spinal anesthesia failure and identify effective management strategies. The study found that factors such as patient positioning, anesthesiologist experience, the number of attempts, and patient BMI significantly influenced spinal block success. Total spinal anesthesia failure often requires conversion to general anesthesia, whereas partial failures can be managed with adjuvant medications or repeated procedures. Understanding the management of failed spinal anesthesia is essential for providing safe and effective care.

Keywords: Anesthesia complications, management, spinal anesthesia, spinal anesthesia failure, regional anesthesia

INTRODUCTION

Spinal anesthesia is a commonly used regional anesthesia technique, offering effective analgesia and muscle relaxation for various surgical procedures. Although effective, spinal anesthesia is not always successful and can fail (failed spinal anesthesia). This failure is defined as the inability to achieve an adequate level of sensory block or sufficient duration of analgesia to complete the surgical procedure.[1,2] The incidence of failed spinal anesthesia varies, ranging from 1% to 15% depending on the patient population, type of surgery, and definition of failure used5. The impact of this failure includes patient discomfort, delayed surgery, increased costs, and potential medical complications. Therefore, a comprehensive understanding of the causes, risk factors, and management strategies is essential to ensure patient safety and satisfaction.[3,4]

Research on spinal anesthesia failure is still limited, especially in the context of identifying risk factors and effective managerial approaches to address such failures. Therefore, a deeper understanding of the causes of spinal anesthesia failure and ways to manage it better is crucial to improving patient safety, reducing complications, and enhancing the quality of care. This background highlights the importance of further study on the management of spinal anesthesia failure and efforts to optimize anesthesia techniques in order to achieve better and safer outcomes for patients.[4,5]

Spinal Anesthesia

Spinal anesthesia is a widely used technique for administering anesthesia for abdominal and lower extremity surgical procedures and is believed to be effective and adequate for surgical procedures after the proper administration of local anesthesia into the subarachnoid space. Spinal anesthesia offers the advantage of avoiding the respiratory complications that often occur with general anesthesia, while allowing the patient to remain conscious during the surgical procedure.[6]

Spinal anesthesia works by injecting local anesthesia into the subarachnoid space containing cerebrospinal fluid (CSF), which then spreads to block the transmission of nerve impulses from the body to the brain. Various types of local anesthesia such as bupivacaine, lidocaine, and levobupivacaine are used in spinal anesthesia, each with different durations and effects.[6] The main advantages of spinal anesthesia are its rapid and effective onset, as well as its ability to provide complete motor and sensory anesthesia.[4] Although effective, spinal anesthesia is not always successful and can fail (failed spinal anesthesia). [1,2]

Spinal Anesthesia Failure

Spinal anesthesia failure refers to a condition in which the spinal anesthesia procedure does not produce the expected effects, either in terms of loss of sensation or motor inhibition. This failure can be total, where the anesthetic block is not achieved at all, or partial, where only part of the desired area is blocked. This can be caused by various technical or physiological factors. Spinal anesthesia failure can be risky for patients, given that the procedure often requires conversion to general anesthesia, which carries additional risks for patients.[2]

Spinal anesthesia failure can be categorized into two main types, namely total failure and partial failure.

1. Total Failure:

This failure occurs when no sensory or motor block is achieved in the desired area of the body. Factors contributing to total failure include errors in injection technique, failure to reach the subarachnoid space, or the use of an anesthetic dose that is too low.

2. Partial Failure:

Partial failure occurs when only part of the desired area is blocked or the anesthetic block is not deep enough to achieve the desired effect. This failure may be due to uneven distribution of the anesthetic in the subarachnoid space, or the patient having anatomical abnormalities that affect the spread of the anesthetic.[2]

Risk Factors for Spinal Anesthesia Failure

A number of risk factors have been identified that may increase the likelihood of failed spinal anesthesia. These factors can be categorized

into several main groups:

1. Patient Factors:

a. Age: Several studies have shown a relationship between older age and an increased risk of failure. Degenerative changes in the spine can make needle placement more difficult.

b. Obesity: Obese patients have an increased risk due to difficulty in identifying spinal landmarks and may require higher doses of medication to achieve adequate block.

c. Gender: Some studies suggest that certain genders, such as females, may be at higher risk, although these findings are not always consistent.

d. Anxiety: Anxiety can affect a patient's tolerance for pain and perception of the block, which can lead to a higher failure rate.[7]

2.Technical Factors:

- Operator Experience. The operator's skills and experience play an important role in the success of spinal anesthesia. Lack of experience can increase the risk of failure.
- Needle Insertion Technique. Proper needle insertion technique and accurate identification of landmarks are essential. Failure in technique can result in improper needle placement.
- Patient Position. Optimal patient positioning is crucial for proper needle placement. Poor positioning can make it difficult to identify landmarks and perform the puncture.
- Equipment Use. The use of the appropriate needle and equipment is very important. Needle size can affect the success of the puncture. Smaller needles can reduce the risk of cerebrospinal fluid (CSF) leakage and post-dural puncture headache (PDPH), but may be more difficult to insert in certain patients.[7]

3. Drug Factors:

- Drug Dosage. Inadequate dosage of local anesthetic may result in insufficient block.8
- Adjuvants. The use of adjuvants, such as opioids or alpha-2 agonists, can affect the quality and duration of the block, but can also increase the risk of side effects.[8] The use of adjuvants such as pethidine, fentanyl, and morphine together with local anesthetics for intrathecal injection can reduce spinal anesthesia failure. It is known that the failure rate of spinal anesthesia increases approximately fivefold when adjuvants are not used compared to when adjuvants are used.[3]

Causes of Spinal Anesthesia Failure

The causes of failed spinal anesthesia can be divided into several categories:

1. Incorrect Needle Placement. Improper placement of the needle into the subarachnoid space is the most common cause.[2,7] This can occur for various reasons, including difficulty identifying spinal landmarks, obesity, or poor puncture technique. Improper placement of the spinal needle can cause blood to mix with the CSF. The incidence of spinal anesthesia failure in blood-mixed CSF is approximately 8 times higher than in clear CSF. A study conducted in South Africa found that the presence of bloody cerebrospinal fluid (CSF) during the initial attempt at spinal anesthesia was closely associated with block failure.[2]
2. Inadequate Drug Distribution. Inadequate drug distribution in the subarachnoid space can result in insufficient block. This can occur due to patient position, inadequate medication volume, or anatomical factors.
3. Anatomical Factors. Abnormal spinal anatomy, such as spinal stenosis, can complicate needle placement and drug distribution.[7]
4. Physiological Factors. Physiological changes, such as pregnancy or anemia, can affect the response to local anesthetic drugs. [9,10]
5. Inadequate Medication. Inadequate medication dosage or incorrect use of local anesthetics can cause insufficient blockage.8 The use of intrathecal bupivacaine ≤ 10 mg is known to experience failure 3 times greater than those using a dosage of ≥17.5 mg. Additionally, the use of hyperbaric local anesthesia can result in failure approximately three times more often than the use of isobaric local anesthesia.[2]

Complications of Spinal Anesthesia Failure

Spinal anesthesia failure can cause various complications that can directly impact patient safety and comfort, as well as add challenges for the medical personnel performing the procedure. These complications can occur both during and after the procedure, and some of them can affect the outcome of the surgery or the patient's recovery. These complications can involve physical and psychological problems in patients.

a. Postoperative Pain

One of the most common complications resulting from spinal failure is post-operative pain. Failure to achieve adequate anesthesia during the procedure can cause significant pain during or after surgery. This requires the use of additional analgesics, such as opioids or local analgesics. If not treated properly, post-operative pain can interfere with the recovery process and reduce patient satisfaction with the procedure.

b. Post-Dural Puncture Headache (PDPH)

Spinal failures often involve the use of more than one puncture attempt, which increases the risk of Post-Dural Puncture Headache (PDPH). PDPH is a headache caused by cerebrospinal fluid leakage after the puncture needle hits the subarachnoid space or penetrates the dura mater. This complication can be very painful and interfere with the recovery process of patients.

c. Anxiety and Psychological Trauma

Failure of spinal anesthesia is often accompanied by anxiety and psychological trauma in patients. The discomfort caused by ineffective anesthesia, along with concerns that the procedure will have to be repeated or changed to general anesthesia, can increase psychological stress. Patients may also feel worried or fearful about the experience, which can affect their long-term psychological well-being.

d. The Need for Conversion to General Anesthesia

One result of spinal failure is the need to convert to general anesthesia. This is often done when the spinal block fails completely to provide the necessary anesthesia. Conversion to general anesthesia increases the risk of respiratory complications, such as aspiration or difficulty with intubation, and requires more complex procedures to maintain the patient's airway.

e. Spinal Procedure Infections

If not performed with proper aseptic technique, it can cause infection at the puncture site. Although infection is rare, the risk increases if the procedure must be repeated multiple times after spinal failure, or if there is trauma to the dural or subarachnoid space.[5]

Management of Spinal Anesthesia Failure

Management of spinal anesthesia failure depends on the type and degree of failure that occurs. Some approaches that can be applied include:

1. Assessment of Spinal Anesthesia Failure

The first step in failure management is a careful assessment of the patient's anesthetic status. The anesthesiologist must evaluate whether the failure is total or partial. Total failure is characterized by the inability to achieve adequate block, while partial failure includes situations where anesthesia is insufficient to eliminate pain during the procedure.[5]

2. Approach to Total Failure

If total failure occurs, several management options may be considered:

a. Repeat Spinal Anesthesia

If the first intrathecal injection fails completely, namely, with no measurable effect including on the sacral dermatome, there is likely no additional risk in repeating spinal anesthesia with a normal dose. If there is a partial effect with spinal anesthesia, a warning should be given about administering a second spinal anesthesia. If repeating the spinal injection, ensure that sufficient time (20 minutes) is allowed to ensure that no blockade develops. Because if the second injection is performed after the first successful procedure but develops slowly, total spinal block may occur.[6]

In a randomized clinical trial on repeat spinal injections after failed spinal anesthesia, the use of 12 mg of hyperbaric bupivacaine significantly increased the incidence of high spinal block, hypotension, bradycardia, and respiratory distress compared to 10 mg. In cases of repeat injections, the addition of opioids should be

avoided. There were no reports of cardiac arrest in repeated spinal anesthesia and only one incident in a patient with spinal anesthesia after failed epidural in the 7th National Audit Project (NAP7) in the UK. Nevertheless, the authors recommend the use of strategies to reduce the risk of high block when using a second neuraxial technique.[11]

To increase the chances of success, the injection should be performed by a senior anesthesiologist, ensure that the cerebrospinal fluid flow is smooth before injecting the drug, use barbotage, try different intervertebral spaces with lower doses of local anesthesia, and avoid excessive downward tilting of the head on the table. [2]

b. Conversion to General Anesthesia

If spinal anesthesia cannot be administered effectively, conversion to general anesthesia is an alternative to ensure that the patient remains awake during the procedure.11 However, caution is needed when converting from spinal anesthesia to general anesthesia because it can increase mortality and morbidity. It is more recommended to add analgesics and mild sedation than general anesthesia due to associated cardiopulmonary disorders and airway complications.[2]

3. Approach to Partial Failure

In cases of partial failure, when the patient still experiences some pain or discomfort, the approach is differentiated as follows:

a. Inadequate spinal block

Potential causes include local anesthesia wearing off during injection (e.g., leakage at the syringe connection), lumbar puncture being too low in the lumbar space, or anatomical barriers preventing anesthesia diffusion.

Manipulating body position and utilizing gravity can overcome these difficulties. If a hyperbaric formulation is used, the patient should be placed in the Trendelenburg position with the hips and knees flexed. This will flatten the lumbar lordosis, allowing the injection to travel cephalad. Changing position after isobaric bupivacaine injection is unlikely to be successful.

b. Unilateral block

The most common problem is patient positioning, although anatomical barriers to spread formed by the longitudinal ligaments can cause unilateral spinal anesthesia.

Bilateral block spread can be encouraged by moving the patient so that the unblocked side is facing down (although again, position changes tend not to help when conventional solutions have been used). A unilateral block should be sufficient for ipsilateral lower limb surgery, but surgeons should be warned that the other limb is not anesthetized.[6]

c. Inadequate block

This describes a block that appears to have spread adequately but whose quality is inconsistent with varying degrees of sensory and motor blockade. There are several possible explanations, but the most common is inadequate administration of anesthetic drugs, either due to insufficient dosage or a solution that does not reach the target. Additional sedation and opioid analgesia may prove successful, especially if anxiety is a prominent factor. Alternatively, conversion to general anesthesia may be necessary.[6]

d. Inadequate duration

The most likely cause is inadequate administration of local anesthesia. The only realistic solution is additional intravenous analgesia, sedation, or general anesthesia.6

CONCLUSION

Spinal anesthesia failure is a complication that can occur in regional anesthesia practice. The incidence of failure varies, and many factors can contribute to this failure, including patient factors, technical factors, and drug factors. Management of spinal anesthesia failure requires a systematic approach, including careful evaluation, identification of the cause, and appropriate management options.

Management strategies include observation, repeating spinal anesthesia, or switching to general anesthesia. The choice of management strategy should be based on the level of failure, patient factors, type of surgery, and availability of resources. Effective communication with patients, surgeons, and other medical teams is essential to ensure optimal results.

By understanding the risk factors, causes, and management strategies for spinal anesthesia failure, it is hoped that the success of spinal anesthesia and patient comfort can be improved.

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