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Unilateral subarachnoid block for Anesthesia and analgesia in Elderly undergoing femoral thrombectomy

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ABSTRACT

Unilateral subarachnoid block (USAB) is a refined form of spinal anesthesia designed to limit the sensory and motor blockade to one side of the body. This selective distribution provides adequate surgical anesthesia while minimizing hemodynamic instability and reducing the spread of the block to the non-operative side. USAB has gained increasing interest in lower-limb surgeries, high-risk patients, and elderly populations because it offers better cardiovascular stability, lower incidence of hypotension, and faster postoperative recovery when compared with conventional bilateral spinal anesthesia. Several technical factors—such as patient positioning, injection speed, baricity of local anesthetic, and needle orientation—play critical roles in achieving a successful unilateral block..

Keywords: *Unilateral spinal anesthesia; Subarachnoid block; Selective spinal block; Hyperbaric local anesthetic; Patient positioning; Hemodynamic stability; Lower limb surgery*

1. INTRODUCTION

Unilateral subarachnoid block (USAB) is a refined technique of spinal anesthesia that aims to restrict the sensory and motor blockade to the operative side, thereby minimizing the physiological impact associated with conventional bilateral spinal anesthesia. Traditional spinal anesthesia frequently produces extensive sympathetic blockade, which may result in significant hypotension, bradycardia, and delayed postoperative recovery—particularly in elderly or high-risk patients. These concerns have led to increasing interest in selective spinal anesthesia techniques, especially unilateral block, as a safer and more hemodynamically stable alternative **(1).**

The success of USAB relies on multiple technical factors, including patient positioning, the use of hyperbaric or hypobaric local anesthetic solutions, needle direction, injection speed, and limiting the injected volume. Proper manipulation of these factors helps direct the anesthetic agent to the dependent side of the subarachnoid space, allowing the development of a predictable and unilateral sensory block **(2).**

Clinically, USAB has demonstrated several advantages, such as reduced incidence of hypotension, better cardiovascular stability, and improved postoperative recovery profiles. These benefits make it particularly useful in lower limb surgeries, outpatient procedures, and in patients with compromised cardiac reserve or advanced age. Multiple studies have confirmed that unilateral spinal anesthesia provides adequate surgical conditions with fewer complications compared to bilateral spinal anesthesia, while maintaining patient comfort and minimizing postoperative motor impairment **(3).**

Given these advantages, USAB continues to gain popularity as an effective, safe, and physiologically conservative regional anesthetic technique. Ongoing research supports its clinical value and encourages refinements in dosing strategies, baricity selection, and positioning protocols to improve block predictability and outcomes (4).

For all operations involving only one lower limb extremity, unilateral subarachnoid block is a suitable procedure. The aim is to limit spinal anesthesia side effect . To achieve this goal, low doses of local anesthesia , hyperbaric (or hypobaric) local anesthetic solutions, slow injection rate and placement of the patients in a lateral position are recommended (5).

Compared to conventional (bilateral) spinal anesthesia, the one-sided spinal anesthesia has the disadvantage of a slightly longer procedure time but offers the advantage of greater hemodynamic stability and faster mobility with better patient .

satisfaction postoperative (6).

Proper positioning is very important for the successful block, it tightens the skin and deep structures and flexes the lumbar spine causing the interspace open . After proper positioning of the patient ,the antiseptic measures must be done, starting at the region of planned injection and then move out. Identification of the anatomical landmarks should be carried out. "Tuffier's" line is a line drawn across the iliac crest which crosses the body of L4 or L4-L5 interspace **(7).**

Factors that influence the success of unilateral subarachnoid block:

Position of the patient (figure 1):

For obtaining unilateral subarachnoid block ,the injection of local anesthesia must be done while the patient in lateral decubitus position .Both hyperbaric and hypobaric solution can be used .The position of the patient at the time of the injection and shortly after the injection of the LA affects their spread in the subarachnoid space .Thus, using a solution with a different density than that of the CSF is, in fact, able to control the distribution of the spinal anesthesia . It is difficult to determine the most appropriate time desired for patient's immobility to ensure the unilaterality of the block; however, maintenance of the lateral decubitus for 15-30 minutes may restrict the surgical block to the side to be operated **(7).**

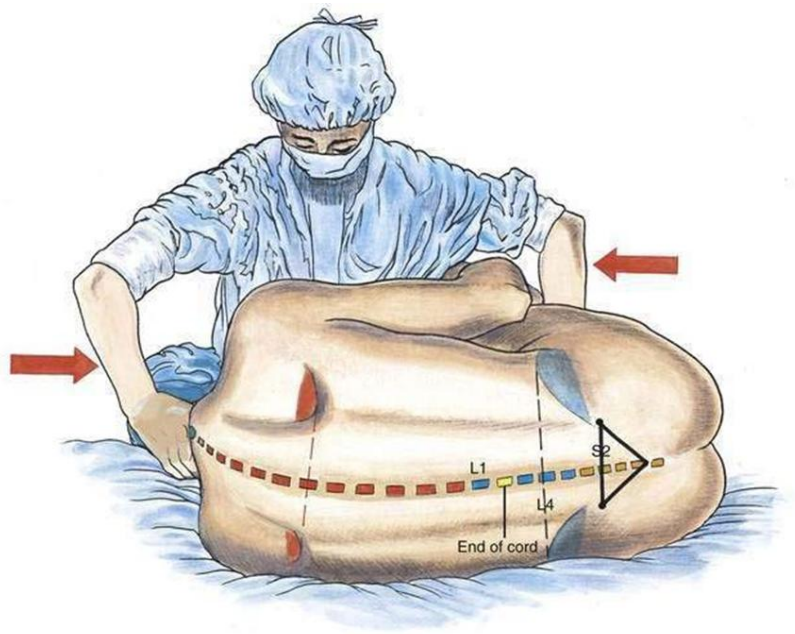

Figure 1: Lateral decubitus for unilateral spinal anesthesia (7).

Selection of the spinal needle:

Pencil-point needles (e.g Sprotte or 27G) are often used to achieve a unilateral subarachnoid block, as they are thought to cause less trauma and promote a more localized spread. The gauge and type of needle may affect the intra thecal spread of LA **(8).**

Baricity of the local anesthesia:

The difference in density between the CSF and local anesthesia is a factor that should be considered to restrict the movement of solutions within the CSF. Unilateral subarachnoid block could be done by injecting either hypobaric or hyperbaric solutions into the CSF, while the patient is lying in the lateral decubitus position, so that the solution forms a separate layer above or below the midline if hypobaric or hyperbaric solutions are used, respectively **(9).**

When comparing a same volume of hyperbaric anesthetic solution with the same volume of the hypobaric one, the volume of the hypobaric solution resulted in an uncontrolled anesthetized area, due to the higher spread of the hypobaric solutions in the CSF, this may be the reason for the preference of using hyperbaric solutions in unilateral subarachnoid block **(8).**

Dosage of the local anesthesia:

Minimal effective doses of hyperbaric or hypobaric solutions (7.5mg-10 mg) are sufficient to obtain a unilateral subarachnoid block **(10).**

Speed of administration of the Local Anesthesia:

The speed of injection can cause a turbulent flow inside the CSF if it exceeds a certain rate. A turbulent flow leads to a direct mixture of the solution with the CSF leading to a homogenous mixture and a bilateral spinal block. The slow injection is used with a greater precision to obtain a unilateral spinal block **(8).**

Unilateral Subarachnoid Block has the advantage of reducing respiratory morbidity, less hemodynamic instability and providing postoperative analgesia.

2. CONTRAINDICATIONS:

The absolute contraindications for unilateral spinal anesthesia are :patient refusal, coagulopathy, skin infection at the injection site, hypovolemia, shocked patient and allergy for the anesthetic agent. **The relative contraindications** are prolonged surgery, respiratory failure and peripheral neuropathy.Preoperative Physical examination and laboratory tests as haemoglobin level and coagulation profile must be done for early detection of any contraindication **(11).**

Complications of Unilateral subarachnoid block:

Hypotension owing to sympathetic system blockage, post dural puncture headache, backache, cardiac arrest - very rare, spinal cord hematoma , epidural abscess might present as (meningitis or an abscess with low back pain) , hypothermia and lower limb neurologic affection as well as loss of bladder/GIT functions **(11).** So intraoperative monitoring is very important by pulse oximetry, ECG and blood pressure, post-surgical monitoring for early detection of any complications and early management . The complications of traditional spinal and selective spinal anesthesia are nearly the same but the incidence and severity of hypotension is lower with selective spinal anesthesia **(12)**.

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