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Posterior Spinal Hemi-Anaesthesia for Tendon Transfer in Patient with Foot Drop: Case Report

Geetanjali Singhal[1], S P Sharma[1], Satyabrata Mohanty[2]

Abstract

In surgery for foot drop, regional anaesthesia, with selective sensory block and preserved motor function, can be of immense benefit to the surgeon.

It allows patient to move foot on command, thus helping in identifying functional tendons, and determine the efficacy of transplanted tendon intraoperatively.

We describe a simple and effective technique to achieve this, using hypobaric local anaesthetic drug for spinal anaesthesia and keeping the patient prone in jack-knife position for 15 minutes This allows only sensory posterior nerve roots to be blocked, sparing the motor anterior nerve-roots.

Keywords: Levobupivacaine, Baricity, Anaesthetic local, Density, Motor sparing block, Tendon transfer, Spinal anaesthesia

Introduction

Foot drop, resulting in inability to dorsiflex the foot, can result from nerve or muscle damage due to injury, stroke or any other disease.

Tendon transfer for foot drop involves transferring of a functional tendon from its normal anatomical location to a non-functional tendon of foot in order to restore its normal movement [1].

The ability to retain the motor function intraoperatively, with only sensory loss, is an added advantage for the surgeon in this procedure. In this case report we will discuss how this can be engineered, keeping in mind certain normal anatomical and physiological considerations of spinal anaesthesia and applying them to our advantage to achieve a selective and targeted block. This was achieved by spinal hemianaesthesia. Spinal hemianaesthesia can be explained as achieving an asymmetrical distribution of subarachnoid block which could be either unilateral or only posterior [2].

Our fall back option, in case the above technique failed, was to perform the surgery under ankle block with local infiltration around incision site. However a clear avascular field would have been difficult to achieve without the application of a tourniquet.

Case Report

The patient was a 33-year-old female, American Society of Anaesthesiologists (ASA) grade 1, who incurred foot drop following foot trauma a few years back. She was listed for tendon transfer. The surgical team requested for awake anaesthesia, preserving the motor power, so that verbal commands could be followed introperatively.

This would facilitate identification of functional tendons and evaluation of the efficacy of tendon placements intra-operatively. Therefore, our aim was to provide sensory spinal anaesthesia with motor sparing.

Anaesthesia technique

Posterior spinal hemianaesthesia with hypobaric drugs.

Rationale: Posterior spinal nerve roots are sensory and anterior are motor, separated by a distance of 10-15 mm. Hypobaric drugs will block the posterior sensory radicles if the patient is made to lie prone following spinal injection of local anaesthetic (LA).

Technique: After receiving the patient into operating room, written informed consent was checked, Intravenous cannulation with 18G cannula was done and IV fluid started. ASA standard monitoring comprising of pulse-oximetry, electrocardiogram, noninvasive blood pressure were applied and baseline vitals including heart rate, blood pressure, oxygen saturation were noted. All emergency medicines and anesthesia work station were checked. Spinal anaesthesia was administered in right lateral decubitus position at L2 -3 interspace and patient was immediately made prone in Jack knife position with 10 degree head down tilt for 15 minutes, following which, patient was turned supine for the surgery. Intrathecal drugs used were preservative free isobaric levobupivacaine (0.5%, 2 ml) along with sterile water for injection (1ml)to make it hypobaric. Fentanyl (25 mcg), which is also hypobaric with respect to CSF was used as adjuvant [3-7]. Out of this 3.5 ml solution, only 2 ml was injected slowly intrathecally. Injection midazolam (1 mg) was administered intravenously to allay anxiety. This was followed by injection ondanseteron (4 mg) and dexmedetomidine infusion at 50 mcg/hr. Infusion of dexmedotimidine was administered to provide arousable

[1]Department of Anaesthesia, JNUIMSRC, Jaipur, Rajasthan, India.
[2]Department of Plastic Surgery, JNUIMSRC, Jaipur, Rajasthan, India.

Address of Correspondence
Dr. Geetanjali Singhal,
Department of Anaesthesia, JNUIMSRC, Jaipur, Rajasthan, India.
E-mail: singhalgeetanjali@yahoo.com

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sedation without impairment of cognitive functions while maintaining hemodynamic stability. It also prolongs the time taken for sensory regression and delays requirement of rescue analgesia [8]. The outcome was selective sensory loss with motor sparing. The intra op period was uneventful with negligible haemodynamic fluctuations. The duration of surgery was one hour. Intraoperative fluid used was ringer lactate and total volume of 250 ml was infused over the one hour period of surgery. Postoperatively patient was given injection paracetamol when the VAS score was 3 (after 150 minutes of spinal anaesthesia).

Discussion

The afferent sensory axons enter the spinal cord via dorsal roots while efferent motor axons exit the cord via ventral roots. Sensory and motor roots unite to form spinal nerves, which exit from spinal column through intervertebral foramen , and then divide into dorsal and ventral rami. The site of action of local anaesthetic in central neuraxial block is the spinal nerve roots and the dorsal root ganglion. The anterior motor and posterior sensory roots are separated by a distance of 10-15 mm [2].

Since the intrathecal spread of the injectate is mainly affected by its baricity and position of the patient, when a hypobaric local anaesthetic drug is allowed to fix in prone position (jack knife), only the posteriorly located sensory nerve roots are blocked and anterior motor roots are spared giving a selective sensory block [6, 9, 10].

This technique demonstrates that with optimal use of drugs, understanding the baricity with reference to CSF, using optimal volume, knowing the dermatomes involved and relating them to position, routine spinal can be used appropriately as targeted spinal anaesthesia for a specific surgery.

Injecting non-isobaric local anaesthetic, either hyperbaric or hypobaric, can produce unilateral spinal anaesthesia if patient is positioned in lateral decubitus position after administering the drug intrathecally. With hypobaric drug, the operative side is kept above while with hyperbaric drug operative side is kept dependent.

Posterior spinal hemi-anaesthesia can be obtained with hypobaric solution injected intrathecally at lumbar region and patient positioned in jack-knife position for approximately 15 minutes.

Dural puncture can be performed in prone or lateral position. With lateral position, patient is subsequently made prone in jack-knife position. To facilitate lumbar puncture in prone position, a pillow may be placed under the abdomen to obliterate the lumbar lordosis and widen the spinal interspace.

Important considerations for spinal hemianaesthesia are baricity of the LA drug, position of the patient, speed of drug administration, duration of stay in that position and dose, concentration, volume of LA mixture [2, 10].

The specific gravity of normal human CSF at 37° ranges from 1.0063 to 1.0075 depending upon age, sex, pregnancy etc [11]. A hypobaric local anaesthetic is therefore defined as a solution with a density more than 3 standard deviations (SD) below mean human CSF density [12, 13]. According to this definition, the upper limit of hypobaricity as per two oscillometry studies ranges from 1.00016 to 1.00037 mg/ml [14] or 1.00003 to 1.00023 mg/ml [15] at 37°. According to the results of laboratory study conducted by McLeod GA (2004) using oscillometric technology accurate to five decimal places, at 37°, the density of plain solutions of bupivacaine 0.5% was 0.99944 mg/ml, levobupivacaine 0.5% was 1.00024 mg/ml and ropivacaine 0.75% was 0.99953 mg/ml. As per the results of this study, all the tested concentrations of plain ropivacaine and bupivacaine were hypobaric at 37° [16]. Levobupivacaine 0.5% (1.00024 mg/ml) is slightly hypobaric at 37° according to the definition of Richardson and Wissler but may be regarded as isobaric with males and postmenopausal women according to the results of Lui and colleagues [14, 15]. However, addition of distilled water reduces the density further making isobaric solutions hypobaric [2]. Furthermore addition of opioids as adjuvants to local anaesthetics affects the baricity of the injectate. Opioid such as fentanyl are hypobaric (0.9933 mg/ml) and when mixed with LA will render the subsequent mixture even more hypobaric [17]. Although, changes in density may seem minimal but it has been found that even a change as low as 0.0006 mg/ml may affect the spread of LA drug [18].

Among the other factors influencing the spread of LA, speed of injection also holds relevance. Turbulent flow causes fast mixing of CSF and LA, producing a homogenous mixture that reduces the basic gradient between them, avoiding the migration of LA. Slow speed of injection leads to a better unilateral or posterior hemi-anaesthesia [18]. Dose and concentration also favour a preferential distribution [11, 12].

Conclusion

With optimal use of local anaesthetic drugs, understanding their baricity with respect to CSF, using optimal volume, knowing the dermatomes involved and relating them to position, routine spinal anaesthesia can be appropriately customised according to surgery.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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