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Spinal anesthesia using hyperbaric prilocaine 2% in day case surgery

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Abstract

Spinal anesthesia has become increasingly popular for inpatient surgery, but, until recently, its use has been limited in ambulatory surgery due to the lack of a safe and licensed short acting local anaesthetic agent. An ideal intrathecal agent for ambulatory surgery should have a rapid onset of motor and sensory blockade, predictable regression within an acceptable time frame and a low incidence of adverse effects**. Objective:** Better achievement of efficient spinal anesthesia for day case surgery with short recovery time and minimal side effects.**Conclusion:** Hyperbaric prilocaine provides shorter duration of action, faster spinal block onset, and voiding, offering a quality of surgical anesthesia and overall satisfaction and earlier patient recovery in ambulatory surgery in day-case surgery, considering the potential advantage of faster rehabilitation, prilocaine may be a promising alternative to bupivacaine

Keywords:**Spinal anesthesia**, **hyperbaric prilocaine 2%**.

Introduction:

Outpatient or "ambulatory surgery" is becoming popular all over the world due to number of advantages to the patient, hospital and community. An ideal anaesthetic technique for ambulatory surgery should provide a rapid and smooth onset of action, intra-operative analgesia, good surgical condition and short recovery time free from side effects[(1)].

Spinal anesthesia has become increasingly popular for inpatient surgery, but, until recently, its use has been limited in ambulatory surgery due to the lack of a safe and licensed short acting local anaesthetic agent. An ideal intrathecal agent for ambulatory surgery should have a rapid onset of motor and sensory blockade, predictable regression within an acceptable time frame and a low incidence of adverse effects[(2)].

Prilocaine is an amide local anaesthetic with an intermediate duration of action after spinal administration. Recently, the old local anaestheticsprilocaine was reintroduced in the market. It is available in the hyperbaric form and provides anaesthesia for 75–90 min after spinal administration[(3)].

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Hyperbaric prilocaine 2% is increasingly used for spinal anesthesia in the ambulatory setting **Vagts et al.** [(4)], as it has the advantages of faster recovery times than hyperbaric bupivacaine[(5)].

Spinal Anesthesia

Spinal anesthesia is induced by the injection of local anesthetic into the subarachnoid space, and is generally regarded as one of the most reliable of regional block methods. It has the particular advantage that very small doses of local anesthetic produce profound effects so that systemic toxicity is not a problem. However, other drugs, such as opioids, co-administered by the same route to produce more prolonged pain control may have systemic effects. Spinal anesthesia is only performed in the lumbar spine used for surgical procedures involving the lower abdomen, pelvis, and lower extremities[(6)]**.**

Anatomical considerations of the vertebrae: (Figure 1).

With some notable exceptions most vertebrae have similar features: a vertebral body, two pedicles, and two laminae. The spinal canal is bounded anteriorly by the vertebral body, laterally by the pedicles and posteriorly by laminae[(7)].

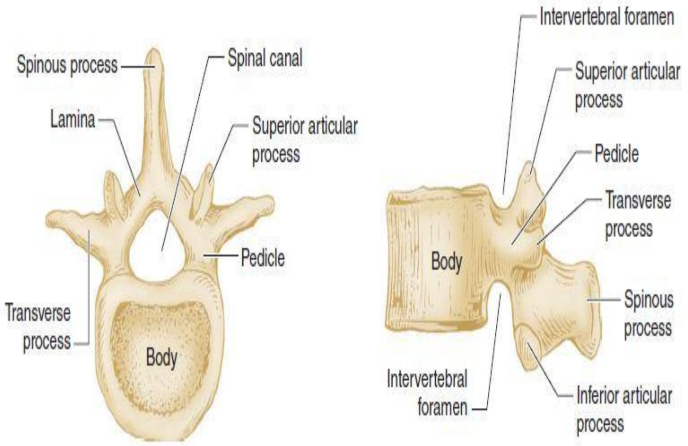

Figure (1): Individual lumbar vertebra[(8)].

Anatomical landmarks

The intercristal line (Tuffier's Line) is a horizontal line drawn across the highest points of both the iliac crests in an anteroposterior lumbar radiograph. This line most often intersects the body of L4 or its inferior endplate in men and the body of L5 or its superior endplate in women. In the general population, the intersection of the intercristal line may vary anywhere between the inferior end plate of the L4 to the superior endplate of the L5[(9)]**(Figure 2)**.

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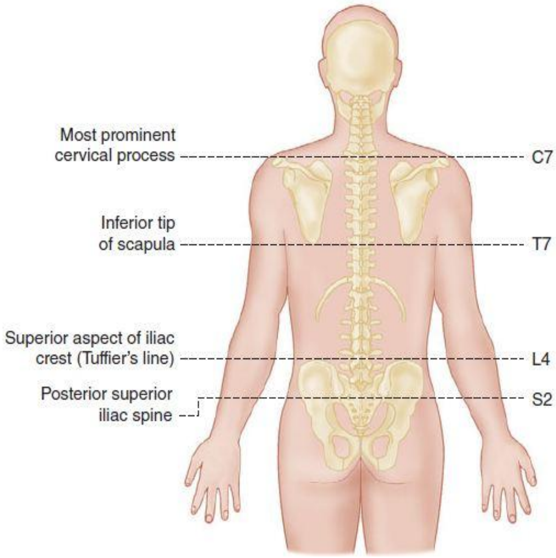

Figure (2): Surface anatomy and landmarks for neuroaxialblocks[8].

Pharmacologic Considerations:Drugs used[10]

AMIDE group	Clinical use	ESTER group	Clinical use
Lidocaine	(4 %): Onset of action occurs in 3 to 5 minutes with a duration of anesthesia that lasts for 1 to 1.5 hours	Procaine 1%	Spinal Peripheral nerve block infiltration topical
Bupivacaine 0.5%	(0.5%): One of the most widely used local anesthetics; onset of action is within 5 to 8 minutes, with a duration of anesthesia that lasts from 90 to 150 minutes.	Chloroprocaine 1%	infiltration
Prilocaine 2%	(2%): is a local anesthetic characterized by intermediate potency and duration and fast onset of action, its lower incidence of transientneurological symptoms with a duration of anesthesia lasts up to 90 minutes.	Tetracaine 0.5%	Spinal ,topical
Ropivacaine0.75%	One of the most widely used local anesthetics	Cocaine4.0-10%	i.v
Levobupivacaine. 0.5%	One of the most widely used local anestheticsintrathecal	Benzocaine up to 20%	topical
Mepivacaine3% .	A local anesthetic characterized by intermediate potency and duration		

Local anesthetics consist of a hydrophilic amine and a lipophilic aromatic ring connected by an intermediate chain. The structural bond in the intermediate chain determines whether the local anesthetic will be classified as an ester or an amide. Furthermore, the bond in the intermediate chain determines the pathway of metabolism of the compound. Ester local anesthetics are metabolised by plasma pseudocholinesterases, whereas the amides are metabolised in the liver by the cytochrome family of enzymes. Figure 12 illustrates the structure of an ester andamide local anesthetic showing clearly the bonds in the intermediate chains[11].

Mechanism of action of local anesthetics

Local anesthetic blocks the transmission of nerve impulses by reversibly blocking the fast voltage-gated sodium channels, thereby inducing analgesia and anesthesia .Physicochemically, local anesthetics are weak bases that are formulated in an acidic medium, hence containing a larger proportion of the drug in the ionised state. However, it is the unionised fraction that is able to cross the lipid bilayer neuronal membrane and block the voltage-gated sodium channels from the inside of the axoplasm. This blockade renders the sodium channel inactive, and hence, no further conduction of impulses occurs[12]**figure 13**.

Mechanism of Spinal Anesthesia

Injection of local anesthetics into the spinal CSF allows access to sites of action both within the spinal cord and the peripheral nerve roots. The traditional concept of spinal anesthesia causing complete conduction block is simplistic. There are multiple potential actions of local anesthetics within the spinal cord at different sites. For example, within the dorsal and ventral horns, local anesthetics can exert sodium channel block and inhibit generation and propagation of electrical activity[13]**.**

Indications of spinal anesthesia :

Spinal anesthesia is in common use for surgical procedures involving the lower abdomen, pelvis, perineal and lower extremities; it is beneficial for procedures below the umbilicus. There needs to be patient counseling regarding the procedure, and signed informed consent is necessary. Since the procedure is usually performed on awake or slightly sedated patients, the indication for spinal anesthesia and what to expect during placement of neuraxial, risks, benefits, and alternative procedures are some of the discussions that can help allay anxiety. It is crucial to let patients understand that they will have little or no ability to move their lower extremities until the resolution of the block. Spinal anesthesia is best for short procedures. For more extended procedures or procedures that would compromise respiration, general anesthesia is usually preferable[14]**.**

Pre-operative preparation:

Before the induction of neuraxial anesthesia, a thorough history and physical examination should take place. Pertinent in history is an understanding of previous exposure to anesthetic medication, review of allergies, family history of any anesthetic problems. The physical exam generally focuses on the site of spinal anesthesia placement. The back should be full examined. A check for systemic or local skin infections, spine abnormalitiesabnormalities (e.g., scoliosis, spinal stenosis, previous back surgery, spina bifida, history of tethered cord), the pre-procedural neurological exam for strength and sensation are also crucial for

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assessment and documentation. A procedural time-out should be performed, confirming the patient's identity, planned procedure, allergy, check for consent, and verbal statement of coagulation status[15].

Technique[16]

Once the patient has undergone appropriate selection, the optimal patient position for the procedure must be established. The procedure is usually carried out with the patient in the sitting or lateral decubitus position. The patient's comfort is tantamount. The goal of positioning is to help establish a straight path for needle insertion between the spinal vertebrae. The most commonly used position is the sitting position (figure3).

With the patient positioned in the sitting position and leg hanging from the side of the bed, he/she should be encouraged to maintain a flexed spine position to help open up the interspace. The sitting position is appropriate for spinal anesthesia with a hyperbaric solution. Either left or right lateral decubitus positions are viable options as well (figure 4).

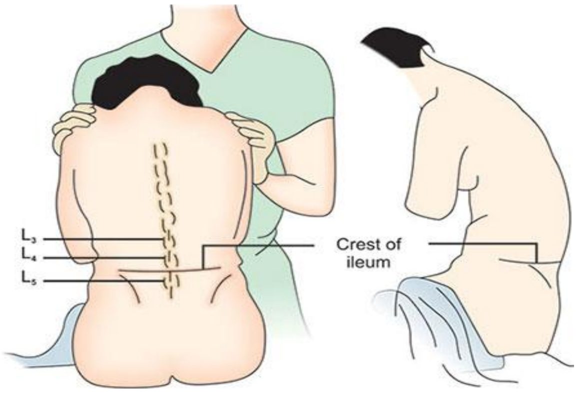

Figure (3): Ideal sitting position for neuraxialblockade[17]

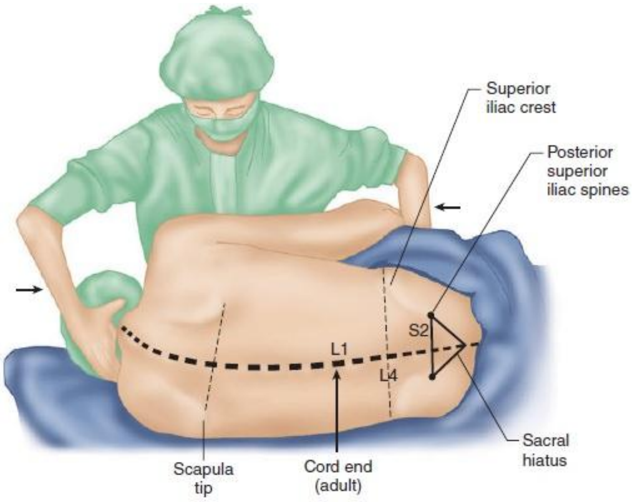

Figure (4): lateral decubitus positions for neuraxialblockade[17]

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After the patient is in the proper position, the access site is identified by palpation. This is usually very difficult to achieve with obese patients because of the amount of subcutaneous fat between the skin and the spinous process. The space between 2 palpable spinous processes is usually L3-4 or L4-5 at the level of tuffy line of the site of entry. The patient should wear a hat or cover for his/her hair to maintain asepsis**[18]**.

Strict aseptic technique is always necessary, achievable with chlorhexidine antiseptics with alcohol content, adequate hand-washing, mask and cap. Cleaning always starts from the chosen site of approach in circles and then away from the site. Allow time for the cleaning solution to dry. In the spinal kit, the drape placement is on the patient's back to isolate the area of access. Local anesthetic (usually about 1 ml 1% lidocaine) is used for skin infiltration, and a wheal is created at the site of access chosen, either midline or paramedian**[19]**.

Midline approach (figure 5A)

The spinal approach to the intrathecal space is midline with a straight line shot. After infiltration with lidocaine, the spinal needle is introduced into the skin, angled slightly cephalad. The needle traverses the skin, followed by subcutaneous fat. As the needle courses deeper, it will engage the supraspinous ligament and then the interspinous ligament; the practitioner will note this as an increase in tissue resistance. Next later will be the ligamentumflavum, and this would present like a "pop." On popping through this ligament, is the approach to the epidural space, which is the point of placement for epidurally-administered medications and catheters. This also presents the point where the loss of resistance is felt to the injection of saline or air. For spinal anesthesia, the clinician proceeds with needle insertion until penetration of the dura-subarachnoid membranes, which is signaled by free-flowing CSF. It is at this point that the administration of spinal medication takes place**[20]**.

Paramedian approach (figure 5B)

The skin wheal from the local anesthetic is placed about 2 cm from the midline, and the spinal needle advances at an angle toward the midline. In this approach, the supraspinous and interspinous ligaments are usually not encountered. Hence, there is little resistance encountered until reaching the ligamentum flavum[16]**.**

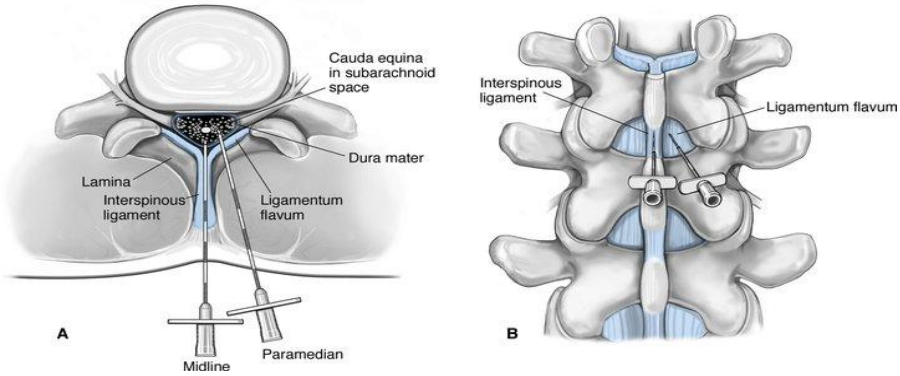

Figure (5): Spinal anesthesia via Midline and Paramedian approach. A: transverse view, B: posterior view[17]

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Contraindications

There are major known contraindications to neuraxial anesthesia (spinal and epidural).

Absolute contraindications:

- Lack of consent from the patient
- Elevated intracranial pressure (ICP).
- Infection at the site of the procedure (risk of meningitis).
- Severe dehydration (hypovolemia)

Relative contraindications:

- Preexisting neurological diseases (particularly those that wax and wane, e.g., multiple sclerosis)
- Severe dehydration (hypovolemia), due to the risk of hypotension - risk factors for hypotension include hypovolemia, age greater than 40 to 50 years, emergency surgery, obesity, chronic alcohol consumption, and chronic hypertension.
- Severe mitral and aortic stenosis and left ventricular outflow obstruction as seen with hypertrophic obstructive cardiomyopathy.
- Thrombocytopenia or coagulopathy (especially with epidural anesthesia, due to the risk of epidural hematoma).In the setting of coagulopathy, the placement of neuraxial block requires re-evaluation.

Complications

Appropriate patient selection and care should be established to help obviate common complications associated with neuraxial anesthesia[21]:

- Backache (more common with epidural anesthesia)
- Postdural puncture headache (PDPH) (as high as 25% in some studies). A non-cutting needle should be utilized for patients with high risk for PDPH, and the smallest gauge needle available is the recommendation for all patients[22]
- Nausea, vomiting
- Hypotension
- Low-frequency hearing loss
- Total spinal anesthesia (most feared complication)
- Neurological injury
- Spinal hematoma
- Arachnoiditis[23] Transient neurological syndrome (especially with lidocaine)[22]

Manifestation of local anesthetic toxicity

The earliest symptom is usually the metallic taste, followed by circumoral numbness, lightheadedness, dizziness, visual disturbances, disorientation, tinnitus and agitation. During this period, signs of toxicity include shivering, muscular twitching, tremor and

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generalisedtonicclonic convulsion. The generally accepted explanation for this sequence of events is that the inhibitory neurons are the first to be blocked by local anesthetics leaving the activity of the excitatory neurons unopposed[24].

Management of local anesthetic toxicity

The management of cardiovascular toxicity is based on sound understanding and implementation of the basic principle of cardiopulmonary resuscitation. The steps for effective management of CNS toxicity of local anesthetics include:

- Stop injection or infusion of the agent.
- Call for help and start basic life support.
- Airway management: administer 100% O_2 to prevent hypoxaemia, ventilate the patient to prevent hypercarbia, and acidosis which potentiate the CNS toxicity of local anesthetics. Ensure the patency of airway: if the patency of the airway is compromised or patient is unable to maintain the airway, securing the airway endotracheal tube and subsequent ventilation is recommended.
- Suppress seizures with the use of benzodiazepines or induction of a full general anesthesia .
- In case of a cardiovascular collapse, effective chest compression as the advanced cardiac life support (ACLS) guideline should commence. Clinicians need to be aware that CPR in a setting of local anesthetics cardiac toxicity will require prolonged effort and dosage adjustment (limit epinephrine bolus doses to <1 mcg/kg which is far less than in a classic CPR protocol).
- Avoid vasopressin, calcium channel blockers, beta blockers or local anesthetic in the management of cardiac arrhythmia.
- 20 % of intralipid should be used without delay along with the initial resuscitative measures as the practice guidelines of the American Society of Regional Anesthesia (ASRA)[25]:

1- A bolus of 1.5 mL/kg IV for 1 min followed by an infusion of 0.25 mL/kg/min. Repeat bolus once or twice for persistent cardiovascular collapse.

2- Double the infusion rate to 0.5 mL/kg/min if blood pressure remains low.

3- Continue infusion for at least 10 min after attaining circulatory stability.

4- Recommended upper limit: approximately 10 mL/kg lipid emulsion over the first 30 min[25].

Day-Case Surgery

The National Health Service (NHS) Modernisation Agency produced an operational guide detailing the facilities available in, and the management of, day surgery units. This was refined in the 'Ten High Impact Changes' document in which the principle of treating day surgery as the default option for elective surgery was set out. The NHS Institute for Innovation and Improvement has produced a document focusing on day case laparoscopic

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cholecystectomy. Although this document is specific to one procedure, many aspects of the ideal patient pathway are equally applicable to a wide range of day surgery procedures. Effective pre-anesthetic assessment and preparation with protocol-driven nurse-led discharge are fundamental to safe and effective day surgery[26].

Several publications provide useful advice on establishing and running a service. The British Association of Day Surgery has produced a directory of procedures that provides targets for day surgery rates covering many different procedures. These procedure-specific targets serve as a focus for clinicians and managers in the planning and provision of elective day surgery and illustrate the high quality of service achievable in appropriate circumstances[27].

Day surgery anesthesia should be a consultant-led service. However, as day surgery becomes the norm for elective surgery, consideration should be given to the education of trainees as recommended by RCoA. This requires appropriate training and provision of senior cover, especially in stand-aloneunits[28].

CONCLUSION

Hyperbaric prilocaine provides shorter duration of action, faster spinal block onset, betterhaemodynamic stability and voiding, offering a quality of surgical anesthesia and overall satisfaction and earlier patient recovery in ambulatory surgery in day-case surgery, considering the potential advantage of faster rehabilitation, prilocaine may be a promising alternative to bupivacaine.

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