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Sacral Spinal Anesthesia with Hypobaric Bupivacaine (0.25%) In Sitting Position for Lower Limbs' Surgery

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***Abstracts*:**
Background And Objectives: *Hemodynamic instability, being the commonest and most undesirable complication of the conventional spinal anesthesia approached in lumbar region with hyperbaric local anesthetic, makes it unfavorable and undignified to be the method of choice for lower limbs' surgeries. To offer it hemodynamic stability during lower limbs' surgeries in elderly patients, this study was undertaken to deposit hypobaric local anesthetic(0.25%) intrathecally through the dorsal foramen of sacrum in sitting position.*
Methods: *50 patients of physical status ASA II and III were submitted to sacral spinal anesthesia with 4ml of 0.25% of injection bupivacaine through the 2nd dorsal sacral foramen in sitting position.*
Results: *All patients developed sensory block extending to the tenth thoracic dermatome with motor block in both lower limbs without hemodynamic instability.*
Conclution: *Hypobaric bupivacaine (10 mg) produces both motor and sensory block of both legs without hemodynamic disturbance when administered through the 2nd dorsal foramen of sacrum in sitting position of patients.*
Keywords: *Local anesthetic, hypobaric, bupivacaine, hemodynamic, nerve injury*

I. Introduction

Spinal anesthesia is an excellent regional intrathecal anesthetic procedure with provision of profound and reversible nerve block in a larger part of the lower portion of body by relatively simple injection of small amount of local anesthetic. However, most frequently, it has been undignified and remarked as the most unpredictable and unreliable anesthetic technique with variable duration and extension of block. Over all, most frequently, conventional spinal anesthesia with hyperbaric local anesthetic is alleged to produce hypotension during intrathecal procedure. This hemodynamic related allegation makes spinal anesthesia controversial to be the best and most acceptable technique of anesthesia for more than lower half of the body. Our usual predetermined intention was to minify the hemodynamic instability with help of hypobaric local anesthetic through the 2nd dorsal sacral foramen (sacral spinal anesthesia)[1] in sitting position of patients and make it suitable and harmless for elderly patients.

So it was assumed that intrathecal use of hypobaric local anesthetic (0.25% injection bupivacaine) with the specific peripheral nerve block acting in the same surgical field of the lower limb may provide hemodynamic stability, prolongation of block and profound analgesia even after surgical procedure. That is, in short, unpredictable and unreliable spinal anesthesia undergoes conversion to predictable and reliable one with maximal hemodynamic stability. On the basis of such hypothesis, this study is undertaken to evaluate the advantages and disadvantages in connection of the use of sacral spinal anesthesia with hypobaric local anesthetic solution in sitting position and specific peripheral nerve block acting in the same surgical field.

II. Method

After acceptance of approval from medical ethical review broad and advanced informed consent from a group of 50 unselected patients belonging to ASA class II and III, were admitted for lower limb surgeries including knee replacement, hip replacement and knee arthroscopy in the period of June, 2013 to December, 2014. They were scheduled for surgery under the sacral spinal with local anesthetic 0.25% injection bupivacaine through its dorsal foramens. Their consents were signed after full explanation about the expected benefits and results, side effects and complications of the sacral spinal through its dorsal foramens. Every participant was subjected to preoperative visit to exclude the contraindication of the proposed procedure.

Patients with the history of Psychological disorders, coronary artery disease, uncontrolled hypertension, intracranial mass, head injury, any abnormality of the spine, cutaneous infection, local cellulitis at the site, coagulation disorders, allergy to local anesthetic, history of opioid dependence, or neurological disorders were excluded from the study.

Patients were scheduled for the lower limb orthopedic operations like the hip replacement, repairing of fracture on femur, tibia, knee joint and ankle joint, hemi-arthroplasty, knee replacement and foot.

In the O.T, peripheral infusion and non –invasive monitoring were started. Anatomical landmarks[2-10] were identified. We identified the spinous process of fourth lumbar vertebra (L_4) and tip of coccyx. Next, we located the mid-point of above two landmarks as third sacral vertebra (S_3). The first sacral vertebra (S_1) was located as mid-point of L_4 and S_3. The second sacral vertebra (S_2) is found at the mid-point between S_1 and S_3 and at the level of posterior superior iliac spine which is externally detected by dimple of skin. The spinous processes of S1 and S2 are found approximately 2.5 cm apart and their respective foramina lie 1.5 cm caudal and lateral to them. Similarly S3 foramina lie 1.5 cm caudal and lateral to S3 vertebra.

Simultaneously, as premedication, each and every participant was administered peripheral nerve block like the femoral nerve block [3,10] was advocated for the surgeries on the hip, femur and knee joint whereas popliteal fossa block [4] was advocated for the surgeries on tibia, fibula, ankle joint and foot with deposition of 30 ml of 0.5% injection rupivacaine through the nerve stimulator needle by lateral approach.[11-13]

After identification of S2 dorsal sacral foramen and local infiltration with 6 ml of 1% inj xylocaine over sacrum, Quincke type spinal needle (Spinocan © Spinal Anesthesia Needles 27G × 3.5 inches, B Braun) was introduced obliquely towards midline through 2nd dorsal foramina of sacrum in sitting position of patient. The spinal needle in the most of the cases touched the bone and then the needle was withdrawn slightly and redirected either cephalad or caudal to enter the expected foramina and to penetrate the dural sac. After flow of clear CSF, 4ml of 0.25% bupivacaine was injected through the needle. After intrathecal deposition of local anesthetic in sitting position, patient was turned to lateral decubitus keeping the surgical side up for another fifteen minutes to develop motor and sensory block on the both lower limbs.

Heart rate, blood pressure, respiration, and oxygen concentration were recorded every three minutes for first 10 minutes after which they were recorded at every ten minutes interval. In cases of lower limb surgeries, upper level of sensory block was assessed by pinprick and motor block by modified Bromage scale which was estimated as follows: 0 = lifting up extended leg, 1 = flexed knee with full ankle movement, 2 =no knee movement, partial ankle movement, 3 = complete paralysis. We also recorded the onset time of sensory and motor block as the time gap between the epidural injection and bilateral loss of sensation and loss of motor activity of the lower limbs respectively. Similarly, we calculated the duration of the sensory and motor block and sent all collected data for statistical analysis using Graphpad Prism 5. Supplementary oxygen supply was administered at the rate of 3l/min through nasal route.

III. Results

50 (fifty) aged patients (69.37±6.08) of male female ratio 26:24 were successfully anesthetized for lower limbs' surgical procedures with help of the combination of sacral spinal anesthesia, depositing hypobaric local anesthetic (0.25% bupivacaine) at the bottom of dural sac through the 1st or 2nd sacral dorsal foramen and specific peripheral nerve block acting on the same surgical field. The demographic profile is cited in the table no 1. The onset time of sensory block at the level of T12 dermatomes (15.54±4.12 minutes) and that of motor block of lower limbs (12.15±3.15 minutes) were needed to develop anesthesia for surgery. The motor block of lower limbs lasted for the period of (245±8.12) minutes and that of sensory block lasted for the period of 345±4.81 minutes that was enough sufficient for surgery with provision of postoperative analgesia of (15.82±2.35) hours. The nerve block profile and analgesic profile are cited at table no 1.

The most striking feature of this study was the hemodynamic profile cited on the table no 1. This technique is infrequently associated with hypotension and bradycardia with reduced amount of parental fluid replacement that carries important value in the old age. The hemodynamic stability makes it suitable as the method of choice for the surgery of old age in lower limbs.

IV. Discussion

Excruciating pain at fracture site and its exaggeration on movement during transport and intrathecal procedure are the main culprits for increasing stress, strain and mental agony of the patients. Profound analgesia is the essential component of anesthesia to control surgical stress response both during and after surgery. The systemic analgesics are usually undesirable particularly in elderly patients to avoid central depression and associated hypoxia. The use of fascia iliac compartment block (FICB) in case of hip to knee surgeries or sciatic nerve block at the level of popliteal fossa in case of surgeries below knee before the administration of intrathecal procedure act as analgesic before, during and after operation without central depression and hampering hemodynamic status[3,4,10].

FICB provides analgesia of high quality.[14-16] The analgesic property of FICB is superior to systemic oipoid [17,18] but inferior to epidural analgesia with fewer complications.[19] Of course, FICB is a very low profile risky procedure to block the femoral, obturator and lateral cutaneous nerve of thigh. Post-operative analgesia with femoral nerve block after surgery on knee joint improves satisfactory. [20] The potential danger of intravascular injection, systemic toxicity of local anesthetic and mechanical nerve damage is extremely rare. The chance of infection is also rare with good aseptic preparation of the site. Large volume of local anesthetic needed for FIRB ensures good spread and reduces the risk of failure, however, the chance of drug toxicity is always present. So closed observation with monitoring at least for the first 15 minutes is essential and mandatory. The hemodynamic stability along with profound and prolonged analgesia before, during and after surgical procedure is the most interesting characteristic feature of combined sacral spinal anesthesia [8,9,10] with preoperative popliteal fossa block for below knee surgery. Preoperative popliteal fossa block induces analgesic effect at the fracture site and contributes comforts to patients at the time of positioning the patient for administration of sacral spinal anesthesia. It acts as adjuvant to spinal anesthesia like intrathecal administration of fentanyl or clonidine with central depression. The combined anesthesia of spinal and preoperative specific peripheral nerve block acting at the same surgical field offers the advantages of both components by minimizing their respective disadvantages, resulting in hemodynamic stability, rapid onset of block and provision of profound prolonged analgesia during and after surgery. This combination is able to abolish completely the neural transmission in block area.

The sacral portion of the dural sac is the lowest access to communicate with the intrathecal space and to deposit the local anesthetic for motor and sensory block of the lumbosacral segments of the spinal cord. Generally, the dural space between 2nd sacral (S2) vertebra and 2nd lumbar (L2) vertebra is devoid of the spinal cord along with the segments for the autonomic outflow. On the other hand, it is packed with lumbosacral spinal nerve roots to exist through the specific intervertebral foramens to form nerves and plexus outside the vertebral canal. Deposition of hypobaric local anesthetic in this zone of dural sac through the 2nd or 1st dorsal sacral foramen causes involvement of nerves from below upward and sacral component gets the first chance to be sunk into the concentrated solution of local anesthetic. Next to the sacral component, the lumbar component gets chance to be sunk into the less concentrated solution of local anesthetic. Usually, fifth sacral (S5) to first lumber (L1) spinal nerve roots undergo both motor and sensory block in order with less extension of sympathetic involvement and get recovery in reverse way.

Preferential involvement of nerves in favor of nondependent side by intrathecal deposition of hypobaric local anesthetic in the lateral decubitus is responsible for frequent development of unilateral block in nondependent side. This asymmetrical distribution of block at dependent and nondependent sides is attributed by slight difference of densities between hypobaric local anesthetic (1.003 g/ml) and CSF (1. 006 g/ml). This disparity of density of two different solutions offers an appropriate and justifiable explanation to have a limited block on non-dependent side when patient is placed on lateral position and hypobaric local anesthetic is used. In the lateral position of patient, hypobaric local anesthetic travels both transverse and longitudinal directions and results with limited height of block and escape of sympathetic involvement.

In sitting position of patient, intrathecal deposition of hypobaric local anesthetic at the level of sacral dural sac travel in both transverse and longitudinal directions due to disparity of densities of hypobaric local anesthetic and CSF. Cephalad extension of sensory block to 12th thoracic dermatome supports the longitudinal migration of local anesthetic due to disparity of density of two solutions.[21-23] Deposition of local anesthetic in the bottom of dural sac at the level of 2nd sacral dorsal foramen is responsible for direct contact of concentrated local anesthetic with nerve fibers resulting motor and sensory involvement of both legs.

In course of time, utilization of local anesthetic by cephalad spread of local anesthetic with decrease of concentration of local anesthetic to equalize the disparity of densities of local anesthetic and CSF automatically takes place and determines the onset time of motor or sensory block. Complete distribution of drug to neural tissue restricts the upper limit of block.

The thoracic segments for sympathetic outflow are usually escaped from the involvement of local anesthetic administered intrathecally at the bottom of dural sac through the 2nd dorsal sacral foramen. The sacral spinal anesthesia with hypobaric local anesthetic contributes more hemodynamic stability to patients. This beneficial effect of spinal anesthesia with hypobaric local anesthetic is utilized for lower limbs surgeries particularly for aged patients with minimal organ reserve.

The peripheral nerve blocks like femoral or sciatic nerve block[2,3] acting in the same surgical field before operation relieve the pain from fracture site and help to offer a comfortable position for administration of spinal anesthesia. This block also potentiates the sensory block both during and after operation and contributes profound and prolonged post-operative analgesia. Specific peripheral nerve block acting on same surgical field when used before intrathecal procedure increases the duration of spinal anesthesia and becomes predictable. The combination of hypobaric spinal anesthesia and specific peripheral nerve block for lower limbs surgery offers hemodynamic stability, increases durability, and produces predictable profound and prolonged intra-operative and postoperative analgesia. Indirectly, these two blocks compensate their disadvantages with potentiating their advantages.

V. Conclusion

Sacral spinal anesthesia with hypobaric local anesthetic (0.25%) and the specific peripheral nerve block acting on same surgical field provides maximal hemodynamic stability, prolonged, profound intra and post-operative analgesia with increased durability and predictability of intrathecal procedure. It is seemed to be the most suitable, reliable and predictable intrathecal procedure for the elder patients in lower limb surgery.

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Table 1: Showing demographic profile, hemodynamic profile and analgesic profile of patients.

DEMOGRAPHIC PROFILE	
Age (years)	69.37±6.08
Height (Cm)	158.96±4.61
Weight (Kg)	57.04±4.02
Sex (M:F) **NERVE BLOCK PROFILE** Onset of sensory block T12 (min) Onset of motor block (min) Duration of motor block (min) Duration of sensory block (min)	26:24 15.54±4.12 12.15±3.15 245±8.12 345±4.81
HEMODYNAMIC PROFILE	
Systolic blood pressure (mmHg)	118.31±6.65
Heart beats (beats/min)	88.94±11.76
Oxygen saturation (%)	98.93±0.89
ANALGESIC PROFILE	
Postoperative analgesic(hours)	15.82±2.35