Section: General Surgery

Original Research Article

A HOSPITAL BASED PROSPECTIVE STUDY TO ASSESS THE UNILATERAL SPINAL ANAESTHESIA WITH 6 MG OF 0.5% HYPERBARIC BUPIVACAINE AND 90µG OF BUPRENORPHINE USING LOW DOSE SLOW INJECTION TECHNIQUE

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ABSTRACT

Background: Low dose of anaesthetic solution, low speed of drug administration and lateral position of patient helps in unilateral distribution of spinal anaesthesia. The aim of this study to assess Success rate of unilateral spinal anaesthesia using very low dose of 1.2 ml (6mg) of 0.5%(H) bupivacaine and 0.3 ml (90µg) of buprenorphine using low dose–slow injection [0.5ml/min] technique. **Materials and Methods**: This prospective study was conducted among 40 patients undergoing unilateral lower limb surgeries. Spinal anaesthesia was given with 1.2ml (6mg) of 0.5% (H) bupivacaine and 90 µg buprenorphine at the rate of 0.5 ml/min in lateral decubitus position. After 20 minutes patients were turned supine and level of sensory and motor block was noted. Temperature difference was noted in both lower limbs; before and 20 minutes after subarachnoid block. Difference in blood pressure and heart rate was noted before and after 20 minutes of subarachnoid block. Intraoperative requirement of atropine, ephedrine and episode of post-operative nausea and vomiting were recorded. Duration of motor block, time for micturition was noted post-operatively. **Result:** Successful unilateral spinal block was achieved in 72.5% patients. Majority of the patients (55%) achieved T12-L1 level and highest level of sensory block achieved on dependent side was T6 in 2.5% patients. Average fall in SBP before and after block is 9 mm of Hg while average fall in DBP before and after subarachnoid block is 12 mm of Hg. While difference in heart rate before and after block is 14 bpm only. Motor recovery was achieved in 2.5-5.5 hours. None of the patients had urinary retention post operatively. Incidence of nausea was noted in 2.5% patients but none of the patients had vomiting. **Conclusion**: With this technique the success rate of unilateral spinal anaesthesia was 72.5%.

INTRODUCTION

Spinal anaesthesia is simple, fast, reliable anaesthetic technique.[1] It is the most common regional anaesthesia technique, practiced worldwide. Spinal anaesthesia provides better postoperative analgesia than general anaesthesia.[2] However, spinal anaesthesia is associated with side effects like hypotension, bradycardia and also post-operative nausea and vomiting, urinary retention and shivering.[2]

Unilateral block is beneficial during unilateral lower limb surgeries as it minimizes cardiovascular effects reduces motor blockage of non-operative side and also ensures early discharge of patient.[3,4]

Unilateral spinal anaesthesia is used when block is desirable on operative side with absence of block on non-operative side.[5] Success rate of unilateral spinal anaesthesia can be increased by restricting block at operative side.1 Low dose of anaesthetic solution, low speed of drug administration and lateral position of patient helps in unilateral distribution of spinal anaesthesia.[3]

Several factors contribute to successful unilateral spinal anaesthesia including needle shape, needle size, bevel direction, site of injection of anaesthetic, volume, baricity, concentration of anaesthetic solution, position of patient as well as appropriate

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degree of inclination of operating table.[4] However patient position is most important in determining level of anaesthetic spread mostly when hyperbaric anaesthetic solution is used.[4]

Enk et al,[6] in his study a "low-dose, low-volume, low-flow" technique including maintenance of the lateral decubitus position for 5–30 min is the best means in producing unilateral spinal anaesthesia.

Hence low dose of anaesthetic solution when administered has many advantages as it facilitates selective block on operative side, No or reduced motor and sensory blockade on non-operative side, better limb mobilization during post-operative period, lower incidence of post-operative urine retention and good patient satisfaction.[4]

Local Anaesthetic with opioid when administered together intrathecally has potent synergistic analgesic effect. Intrathecal opioids enhance subtherapeutic dose of local anaesthetic.[7] Hyperbaric solution allows low dose of anaesthetic agent and helps in achieving pain relief only at specific site.[8]

Use of large dose of bupivacaine is associated with haemodynamic instability, urinary retention, delayed recovery of motor function.[9] Bilateral and unilateral spinal anaesthesia require different dose and volume of Bupivacaine.[10]

Hence in present study we intend to find the success rate of unilateral spinal anaesthesia using very low dose of 1.2 ml (6mg) of 0.5% (Hyperbaric) bupivacaine and 0.3 ml (90 µg) of buprenorphine using low dose – slow injection [0.5ml/min] technique.

MATERIALS AND METHODS

A hospital based prospective study done on 40 cases patients (18-65 years of age) classified under ASA grade I and II patients posted for unilateral lower limb surgical procedures under subarachnoid block in anesthesia department in government Medical College, Dholpur, Rajasthan, india during one-year period.

Exclusion Criteria

- Patients with Autonomic neuropathy & Vascular pathology
- Patient on Anticoagulants
- Patients with Scoliosis
- History of Spinal surgeries
- Pregnancy
- Obese patient (BMI>35Kg/m2).

Methods

The patients who satisfied the above inclusion criteria were selected for the study. Informed consent was taken from all the patients who are included in the study.

The participating patients are patients between age group 18-65 years of either sex with ASA Grade I-II. Patient were shifted to operation theatre. Non-invasive blood pressure, Heart rate, electrocardiography and pulse oximetry were monitored. The room temperature was kept constant (23 ± 0.5ºC).

A peripheral vein was cannulated, and intravenous infusion of crystalloid was started at 20ml/kg/hr. Patient shifted to lateral decubitus position with operative limb as dependent limb on operating table which was held in strictly horizontal position. L3-4 /L4-5 space was palpated based on line connecting superior iliac crest.

#Under strict aseptic precaution, lumbar puncture was performed at L3-4 /L4-5 space, free flow of CSF appeared on hub, the needle was rotated so that bevel face towards the side of operative limb.

The total dose of 1.2 ml (6 mg) of 0.5% (Hyperbaric) bupivacaine in combination with 0.3 ml (90 µg) buprenorphine was injected intrathecally using 25 G quincke spinal needle at the rate of 0.5 ml/minute.

The lateral decubitus position was maintained for 20 minutes to allow local anaesthetic to fix and to prevent unfixed drug to affect contralateral limb after the injection. The patient was shifted to supine position after 20 minutes of spinal anaesthesia.

The sensory dermatomal level of the sensory block was evaluated bilaterally after 20 minutes of spinal anaesthesia from caudal to cephalad and analgesic level was defined as the cephalad most dermatome at which patient has decreased sharp sensation. The highest sensory level achieved was noted.

The motor block on each side was assessed 20 minutes after injection of intrathecal drug using a modified bromage scale.

Table 1: Modified Bromage Scale,[4,11]

Scale	Description
Grade 0	No Weakness
Grade 1	Inability to raise extended leg
Grade 2	Inability to flex knee
Grade 3	Inability to move any joint in leg

Temperature was noted on medial aspect of knee in both dependent and non-dependent side before and after 20 minutes of injecting intrathecal drugs.

Surgery was started after 20 minutes of giving intrathecal block and assessing patient for sympathetic, sensory and motor blockade on both dependent and non-dependent limb.

Successful unilateral sensory block is defined as loss of sensation to pinprick at L1 dermatome on dependent site with intact sensation (no loss to pin prick) on non-dependent site.

Successful unilateral motor block is defined as loss of motor power (modified bromage scale grade 3) with intact motor power on non-dependent site. (modified bromage scale grade 0) Successful

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unilateral sympathetic block is defined as temperature increase in the leg of 0.5ºC or greater from baseline temperature after 20 minutes. If none of the dependent or non-dependent leg exhibit a temperature increase of at least 0.5ºC, absence of any sympathetic denervation was assumed.

So, successful unilateral spinal anaesthesia is defined as sensory, motor and sympathetic block limited to dependent side without affecting nondependent side.

Oxygen saturation was recorded continuously by pulse oximetry. Blood pressure and heart rate at 20 minutes was noted and difference was recorded.

If the spinal anaesthetic was unsuccessful for any reason, the operation was performed under general anaesthesia. If the block was not possible due to anatomical reasons, the patient was excluded from further analysis. If the block was initially successful but insufficient for the entire procedure, general anaesthesia was induced, but the patient was still evaluated for incidence of unilateral spinal anaesthesia, haemodynamic fluctuation and other adverse events.

Hypotension is defined as systolic blood pressure lower than 30% of the baseline value or a mean arterial pressure below 60 mmHg and was treated with IV fluids and Injection ephedrine 6mg.

A heart rate below 50 per minute, associated with hypotension, was treated with atropine 0.6mg. Time for regression of motor block on dependent limb was noted. Time of micturition was noted postoperatively. Episodes of nausea and vomiting were noted. Intraoperative use of Injection ephedrine or atropine was noted.

Statistical Analysis

All the post-op parameters were summarized using frequency and percentage. Descriptive and inferential statistical analysis has been carried out in the present study. Significance is assessed at 5 % level of significance. The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data.

RESULTS

Our study showed that mean weight was 68.19 kg, mean age was 47.28 years and mean BMI was 23.56 kg/m2. Male to female ratio was 4:1 (table 2).

Average fall in SBP before and after block is 9 mm of Hg while average fall in DBP before and after subarachnoid block is 12 mm of Hg. While difference in heart rate before and after block is 14 bpm only (table 3). Average of motor recovery time in dependent limb seen is between 2.5 hours to maximum 4.5 hours (table 4).

Highest level of sensory block on dependent side seen is T6 in only 1 patient. While maximum no of patients achieved T12-L1 block (22 patients) (table 5).

Table 2: Demographic Data of patients studied

Variables	Mean ± SD
Height (cm)	165.25±6.63
Weight (kg)	68.19±13.46
BMI (kg/m^2)	23.56±3.04
Age in years	47.28±15.32
Gender M/F	32/8
ASA score I/II	16/24

Table 3: Hemodynamic variables

Variables		Median (Min-max)	P value vs Baseline
SBP (mm Hg)	Before Block	137 (97-190)	<0.001
	After Block	128 (80-176)	
DBP (mm Hg)	Before Block	85 (40-120)	<0.001
	After Block	73 (45-100)	
Heart Rate (bpm)	Before Block	88 (50-124)	<0.001
	After Block	74 (56-120)	

Table 4: Motor block on dependent side & non-dependent side

Motor block on dependent side (Modified Bromage Scale)	Patients (n%)	Motor block on non- dependent side (Modified Bromage Scale) Patients (n%)
0	1 (2.5%)	32 (80%)
1	1 (2.5%)	1 (2.5%)
2	14 (35%)	5 (12.5%)
3	24 (60%)	2 (5%)

Table 5: Level of sensory block on dependent side & non-dependent side

Upper level of sensory block Dependent side	Patients (n%)	non- dependent side Patients (n%)
Nil	0 (0%)	32 (80%)
T6	1 (2.5%)	0 (0%)
T8	4 (10%)	0 (0%)
T9	0 (0%)	0 (0%)

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T10	8 (20%)	4 (10%)
T11	2 (5%)	3 (7.5%)
T12	10 (25%)	1 (2.5%)
L1	12 (30%)	0 (0%)
L3	3 (7.5%)	0 (0%)

Table 6: Post-operative Nausea and Vomiting

		No. of patients (n=40)	%
Nausea	**No**	39	97.5
	Yes	1	2.5
Vomiting	**No**	40	100.0
	Yes	0	0.0

DISCUSSION

Unilateral spinal anaesthesia is used when block is needed only on operative side. When surgery involves only one lower limb, such type of anaesthesia is advantageous, and it minimizes hemodynamic changes associated with conventional spinal anaesthesia. It also enables faster recovery, good cardiovascular stability and early discharge.

Enk and associates6 in their study "low-dose, low-volume, low-flow" technique have observed that maintaining of the lateral decubitus position for 5–30 min is the best means in producing unilateral spinal anaesthesia. New spinal anaesthetic techniques focus on the possibility to control the spread of intrathecal drug, thereby restricting the distribution of spinal block just to the area which is necessary for the surgery.

The golden roles of ambulatory anaesthesia were to provide safe and effective anaesthesia, minimal postoperative side effects and safe, rapid, and early home discharging. The conventional spinal anaesthesia was unsuitable for ambulatory anaesthesia because it was not fulfilling the previous criteria, and there were residual motor block and delayed voiding.[12]

Major reasons for inducing unilateral spinal anaesthesia are to prevent hemodynamic changes and induce short motor block time to improve patients' comfort. Several factors influence spinal anaesthetic spread: CSF volume, local anaesthetic baricity, patients' position during and after injection, anaesthetic dose and injection site. The distance between the left and right nerve roots in the lumbar and thoracic regions is about 10-15cm, which makes it possible to achieve unilateral spinal anaesthesia.[13]

There is paucity of literature mentioning 6mg of 0.5% bupivacaine and 90 µg of buprenorphine used for unilateral spinal anesthesia. So, we have chosen buprenorphine along with bupivacaine as drug of choice for unilateral spinal anaesthesia. In literature there is a variation in the success rate for the unilateral spinal anaesthesia. The success rate reported is from 31% to 94.45%.2,6 The results for these variations could be the change in the dose, technique or criteria for defining unilateral spinal anaesthesia. Our results of successful unilateral spinal block were 72.5% which also falls within this range.

Bergmann et al,[2] in their study have found complete unilateral sympathetic block to be 86% while sympathetic, sensory and motor block to be 91%, 94%, 98% respectively But in their study the criteria for a successful unilateral block were reduction of strength in the knee joint of the block side by at least one MRC grade, with no change on the opposite side or an increase in the difference in skin resistance between the two feet of at least 10% and loss of sensation to pin-prick only on the block side.

Enk and associates,[6] have compared unilateral spinal anaesthesia in two groups with different rate of injection technique with group 1 (0.5ml/min) and group 2 (7.5ml/min). Their criteria for sympathetic block were defined as a temperature increase of more than 0.5°C at the foot. Any reduction in the ability to move the hip, knee, or ankle as well as loss of temperature discrimination and/or pinprick even in one dermatome on the nondependent side was considered as a bilateral block. They found out that unilateral motor paralysis (92% in group I v 68.4% in group II), unilateral sensory block (48.0% v 10.5%), and unilateral sympathetic block (72% v 42.1%). Strictly unilateral spinal anesthesia was found to be significantly more frequent in group I (40% v 5.3%). Significant hemodynamic differences between the groups were not detected.

Jorg Meyer and associates,[14] found the success rate of strict unilateral spinal anaesthesia using 1.4 ml of 0.5% (Hyperbaric) bupivacaine is 31%. For all patients unilateral sympathetic and complete motor block is found to be 72% and 90% respectively. However, they found out that strict unilateral sensory block was only 41%. While many studies have focused only on sensory and motor components of spinal anaesthesia, there are very few studies who have included sympathetic block also as criteria for successful unilateral spinal anaesthesia.

There are only two studies which have used skin temperature as modality for measuring sympathetic block and have concluded temperature difference between dependent limb and non-dependent limb post subarachnoid block alone is not a reliable estimation of sympathetic block.[6,14] Hence dermal resistance technique would have been ideal real time monitor for sympathetic block.[2]

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Although pre-ganglionic sympathetic B-fibres are less sensitive to local anaesthetic than A- alpha or A-delta fibres, they respond more rapidly and are thus well-suited to real-time monitoring. A decrease in sympathetic tone causes a rapid reduction in the secretion of the plantar eccrine sweat glands, with a concomitant rapid increase in skin resistance. Bergman et al,[2] used these changes in skin resistance to titrate the dose of the local anaesthetic. Skin temperature is also indirectly influenced by sympathetic blockade and, although it responds more slowly and less reliably than electrical dermal resistance, some researchers have employed it as a target parameter.

Measuring skin temperature has been described for direct detection of sympathetic denervation.15 The assessment of gravity-dependent spread of sympathetic denervation during conventional spinal anaesthesia has proven to be very complex, since temperature changes of the trunk are difficult to measure with accuracy. So, in our study we have also considered skin temperature as indirect parameter for sympathetic blockade.

Loss of motor function was defined as the inability to raise the leg, flex the knee, and flex the ankle and was assessed using a modified Bromage score. Failure of unilateral motor block was defined as any motor blockade at the non-dependent side. Bergmann et al,[2] in his study reported motor block to be strictly unilateral in 98% patients while sensory block to be strictly unilateral in 94% patients but their criteria for strict unilateral motor block were reduction of strength in knee joint of the block side by at least one MRC grade, with no change on the opposite side while the criteria for strict unilateral sensory block is loss of sensation to pin-prick only on the block side.

Esmaogulu and associates16 in their study noted that with 7.5mg and 10 mg of 0.5% hyperbaric bupivacaine no hypotension has been observed. The incidence of side effects such as hypotension and bradycardia is lower with unilateral spinal anaesthesia than with conventional bilateral spinal anaesthesia.[17]

In our study, hemodynamic parameters were within safe ranges during the intraoperative and postoperative periods, and hypotension was observed in only 1 patient (2.5%) in whom we have administered 6mg of ephedrine only once intraoperatively. Unilateral spinal anaesthesia, using small doses of hyperbaric local anaesthetic solution and limiting the block only to the operative side provides higher hemodynamic stability and makes good option for elderly, compromised and ambulatory surgery patients.[11]

Borghi et al,[18] demonstrated faster recovery profile when 4 mg of hyperbaric bupivacaine was administered than when 6 mg or 8 mg dose were used. When producing unilateral spinal anaesthesia with 4 mg and 6 mg of hyperbaric bupivacaine, they reported complete unilateral motor block in 97% and 93% of the patients, respectively.

The use of low dose local anaesthetics while limiting the dose of the spinal block may result in an inadequate sensory block. For this reason, the addition of opioids to the local anaesthetics can enhance the analgesia and prolong the sensory block without affecting the motor block,[19] while Vinod et al,[27] in his study found out that unilateral spinal anaesthesia with 5 mg hyperbaric bupivacaine with 25 µg fentanyl is a better choice than 5 mg hyperbaric bupivacaine alone in short procedure of lower limb in orthopaedic surgery.

There is paucity of literature mentioning 6mg of 0.5% bupivacaine and 90 µg of buprenorphine used for unilateral spinal anaesthesia. So, we have chosen buprenorphine along with bupivacaine as drug of choice for unilateral spinal anaesthesia. The various doses studied in the literature varies from 3mg to 12.5mg of 0.5 % (Hyperbaric) Bupivacaine with or without opioids.[3,4] It has been observed that very low dose of local anaesthetic agent may lead to higher failure rate while high dose may result in the bilateral block.

In our study we have chosen 25G quincke spinal needle for all of our patient as method of intrathecal injection. The rate of injection studied varies from 0.33ml/min to 7.5ml/min.[2,6] It has been observed that lower the rate, higher is the possibility of successful unilateral spinal anaesthesia.

Patients' position, during and immediately after local anaesthetic injection, influences spinal drugs spread. When anaesthetic solutions is more or less dense than CSF are used, it is theoretically possible to control spinal block spread. The maintenance for a certain period may limit anaesthesia to the operated side only. The positioning of the patient during spinal anaesthesia affects the distribution of the drug in the subarachnoid space and therefore affects recovery and discharge.[16]

Hyperbaric bupivacaine had specific gravity 1.026 when injected very slowly preventing turbulence flow. As per study by Malyan et al,[20] they have suggested to maintain patients in lateral position for a time of 15–20 min after the administration of the local anaesthetic. Conversely, if low anaesthetic doses (5 to 8 mg of 0.5% hyperbaric bupivacaine) are used, 10 to 15 minutes in the lateral position are enough to prevent anaesthetic migration.[3,16,21]

A common side effect of spinal anaesthesia is urinary retention, which could be due to the fluid therapy used in the treatment of spinal anaesthesia-induced hypotension or due to bilateral blockade of the parasympathetic plexus, which innervates the detrusor muscle. However, urinary retention occurs rarely in unilateral spinal blocks, since function of the detrusor muscle has not been totally blocked.[22]

It has been reported that dose-dependent spinal opioids influence bladder function and may cause urinary retention.[22,23] Kamphuis and colleagues reported that voiding disturbance continues until the nerve block has regressed to the third sacral root. Atef et al4 reported no urinary retention after unilateral spinal anaesthesia with 5mg of hyperbaric

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bupivacaine, while in their study, after induction with 12.5 mg dosage, this complication observed in five percent of the subjects. So, it appears that a reduction in the bupivacaine dosage decreases the likelihood of urinary retention.

CONCLUSION

Unilateral sensory and motor block, a faster recovery profile, and a stable hemodynamic state can be achieved with doses of with 6 mg of 0.5% hyperbaric Bupivacaine and 90µg of Bupivacaine injected slowly through pencil-point directional needles in patients who are maintained in the lateral decubitus position for 20 minutes. Successful unilateral spinal anaesthesia was achieved in 72.5% of the patients.

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