ORIGINAL ARTICLE

Evaluating the Effectiveness of Unilateral Spinal Anaesthesia Compared to Bilateral Spinal Anaesthesia for Unilateral Lower Limb Surgery

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ABSTRACT

Background: Unilateral spinal anaesthesia offers a number of advantages over the bilateral spinal technique which includes better haemodynamic stability and patient's satisfaction.
Method: Sixty four (64) patients were randomly assigned to two groups, unilateral spinal anaesthesia, (U group) and conventional bilateral spinal anaesthesia, (B group) .The 'U'group received 2ml of 0.5% bupivacaine made up to 3ml with distilled water while, 3ml of 0.5% bupivacaine was administered to 'B' group. Patients in the 'U' group had the procedure in the lateral decubitus position and remained in that position for 20 minutes, while those in group B had the spinal injection in sitting position and were immediately positioned supine.
Results: All the 64 patients had their surgeries done under the chosen technique successfully. There were more patients in group 'B' that attained Bromage score of IV at 5min than those in group 'U' an indication that motor block was faster in the bilateral group. The haemodynamic parameters were comparable between the study groups at 5, 10, 20, 30 and 50 minutes. There was a statistically significant difference in pulse rate between the two groups at 30 minutes (p=0.04)
Conclusion: Unilateral spinal anaesthesia was more effective compared to bilateral spinal anaesthesia. However, the duration of sensory blocks was shorter and the less haemodynamic disturbances in unilateral spinal anaesthesia compared to the bilateral spinal anaesthesia for lower limb surgery.

KEYWORDS: Effectiveness, Spinal Anaesthesia, Unilateral, Haemodynamic stability, Lower Limb Surgery

Introduction

The use of spinal anaesthesia has become an established and reliable method of providing anaesthesia for lower abdomen and lower limb surgeries.[1]It is usually associated with adequate intraoperative muscle relaxation, good analgesia and less blood loss.[2] Spinal anaesthesia involves the use of local anaesthetic agents injected into the subarachnoid space.

There are various factors that affect the spread of local anaesthetics after injection into the subarachnoid space. The understanding of these factors has led to modifications in the spinal anaesthesia technique. Among these factors is position of the patient during and immediately after the spinal anaesthesia and this influences the spinal distribution of the drugs. Baricity of the local anaesthetic agent (isobaric, hypobaric or hyperbaric) in relation to the cerebrospinal fluid is another

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important factor that influences its distribution. Understanding of these factors is manipulated to achieve the desired level of block and also establish a unilateral block.

Unilateral spinal anaesthesia is a special technique for lower limb surgeries involving the block of only one side that is not commonly performed in our setting. The technique offers some advantages to the patient, anaesthetist and the nursing staff. Apart from the general anxiety usually associated with being awake when the block is being instituted, the patient usually feels a sense of control with the ability to move the other non-blocked limb after the surgery and during transfer.[3] In addition, it has the advantage of lower incidence of hypotension, faster recovery from the blockage and increased patient's satisfaction.

As with any form of anaesthesia, spinal anaesthesia is associated with adverse effects and complications hypotension, bradycardia and post-dural puncture headache among others.[4] the hypotension and bradycardia is thought to be as a result of preganglionic sympathetic, sensory and motor blockades by the local anaesthetic.

The main differences between the unilateral and bilateral spinal anaesthetic techniques are the low dose of local anaesthetic and the time the patient remains in the lateral decubitus position immediately after the procedure.[4]

This study is aimed at evaluating the effectiveness of unilateral spinal anaesthesia compared to the bilateral spinal anaesthesia techniques for unilateral lower limb surgery in our centre.

Materials and Method

This was a prospective interventional randomized double blinded study conducted at Federal Teaching Hospital, Gombe. Following approval by the Research Ethics Committee and 64 adult patients who consented to participate in the study were enrolled.

The procedure was explained and discussed with the patients and informed consent was obtained from those that accepted to be part of the study. All patients had pre-anaesthetic assessment after which 10 mg of Diazepam was given orally and nil per os instituted from midnight. On arrival at the operating room, the patients were assigned to be in either group U (unilateral spinal) or B (bilateral spinal) by random balloting.

Routine anaesthetic check was done and the availability of resuscitation equitment was ensured. Monitors were attached and basic vital signs were taken, intravenous access were secured with large bore cannula with either 16G or 18G and 15 ml/kg of Ringers lactate was given as preload over 10-15 minutes before the procedure and intraoperative fluid management continued, while equipment and drugs for resuscitation were checked and kept ready.

Group B: patients were positioned sitting at the edge of the operating table and the back of each patient was cleaned and draped. A skin wheal was raised with 1 ml of 2% lidocaine at the place of needle puncture at L_3/L_4 intervertebral space. A lumbar puncture was performed at the same level with a 25 gauge disposable Quincke spinal needle. After free flow of clear cerebrospinal fluid was seen, an injection of 0.5% hyperbaric bupivacaine (Marcaine by AstraZeneca) 3 ml was administered intrathecally over 30 s using a 5 ml syringe with the bevel of the spinal needle downwards. The needle was removed at once and the puncture site covered with sterile gauze and secured in place with adhesive plaster. The patient was positioned supine immediately. Sensory and motor testing was started from 5 minutes until sensation was

lost in the appropriate dermatomes before the surgery was commenced.

Group U: patients were placed in the lateral decubitus position with the surgical side down (dependent) on the edge of the operating table, ensuring that the vertebral column was kept as horizontal as possible by placing a pillow under the shoulder. The back of the patients were cleaned and draped under aseptic condition. A skin wheal was raised with 1 ml of 2% lidocaine at the site of needle puncture at L_3/L_4intervertebral space. A lumbar puncture was performed at the same level with a 25 gauge disposable Quincke spinal needle. After free flow of clear cerebrospinal fluid was seen, 2 ml of 0.5% hyperbaric bupivacaine (Marcaine by AstraZeneca) and 1 ml of distilled water added was injected intrathecally slowly over 60 s using a 5 ml syringe without further aspiration maneuvers with the spinal needle bevel facing the dependent side. The needle was withdrawn at once and the puncture site covered with sterile gauze and secured in place with adhesive plaster. The patient was kept in this position for 20 minutes, and then patient was turned supine for the procedure and monitored continuously.

This frequent monitoring of vital signs using multi-parameters monitor (ANDROMEDA, Model: Nova 3M) was to allow for early detection of complications like hypotension and bradycardia which must be treated promptly.

In all patients, 3-5 minutes after institution of the block, the level of sensory block was assessed by a pin prick starting from foot upwards. This was done at various time intervals of 5, 10, 15, and 20 minutes and was documented.

Motor block was assessed using the modified Bromage scale at various time intervals of 5, 10, 15, and 20 minutes and was documented.

In both groups the assessment of the sensory block, motor block and haemodynamic parameters were done by a blinded assistant, different from the anaesthetist that performed the block. The contra- lateral side was assessed for block before the start of surgical procedure in those who received the unilateral block. This was done at 5 and 10 minutes after the block. Surgeries were allowed to commence only when the level of block reached above T_{10}. Complications were anticipated and they were treated when they occurred.

The spinal anaesthesia was considered effective by sensory and motor assessment. Either of the techniques was termed failed if patients felt pain on the blocked limb on surgical stimulation. If this happened despite good technique, another form of appropriate anaesthesia like general anaesthesia was given to the patient and such a patient was withdrawn from the study.

After observing the patients in the recovery room for 60 minutes, and if there were no complications or complaints, patients were transferred to the ward with clear instructions to the nurses for continuous close monitoring of vital signs and for documentation of any complaints. Data were analyzed using EPI Info™ 7 (2007). They were expressed as absolute numbers of mean ±SD and as percentages. The chi-squared analysis was used to compare the discrete variables, while Student t- test was used to analyze continuous variables. A level of significance was set at $p \leqslant 0.05$.

Results

A total of 64 adult patients (32 each in groups U and B) were studied. The mean ages were 39.28±15.30 and 43.84±16.91 years in group U and B respectively. There was no significant statistical difference in the gender between the two groups, with a male to female ratio of 2:1in each group (p=0.26). The socio-

demographic characteristics were evenly distributed within the study groups except for height which showed that patients in group B were taller (p=0.03). At 5 minutes 18(56.3%) and 17(53.1%) patients in group U and B had sensory block level of T_{12}respectively.Similarly, 14(43.8%) and 12(37.5%) patients in group U and B had levels of block at T_{10} respectively as shown in Table 1.

Bromage score of II was found in 5 (15.6%) and 2(6.3%) patients in group U and B at 5 minutes respectively. Similarly, at 5 minutes 20 (62.5%) and 14 (43.8%) patients in group U and B had a Bromage score of III, while 7(21.9) and 16(50%) patients in group U and B had a score of IV. While at 20 minutes, 1(3.1%) patient had Bromage score of III in U group compared to 2(6.3%) patients in B group; 31(96.9%) patients had Bromage score of IV in U group compared to 30(93.8%) patients in B group. The mean duration of analgesia in this study was 64±24 minutes in group U compared to100±37 minutes in group B (p=0.01) as shown in Table 2.

The haemodynamic parameters were comparable between the study groups at 5, 10, 20, 30 and 50 minutes. There was a statistically significant difference in pulse rate between the two groups at 30 minutes (p=0.04) as in Fig 1 and 2.

Table 1: Sensory levels among the study groups

Level	Time (min)	Group U	Group B	p-value
T_{12}	5'	18	17	0.76
	10'	19	20	0.11
	15'	25	28	0.10
	20'	23	30	0.30
T_{10}	5'	14	12	0.37
	10'	15	15	0.70
	15'	17	8	0.77
	20'	9	4	0.61

Table 2: Comparison of the motor (Bromage Scale) in the two study groups

Group	Scale	5'	10'	15'	20'	p-value
U	I	0	0	0	0	0
	II	5	1	0	0	0.32
	III	20	14	3	1	0.29
	IV	7	17	29	31	0.42
		5'	**10'**	**15'**	**20'**	
B	I	0	0	0	0	0
	II	2	0	0	0	0.2
	III	14	10	6	2	0.4
	IV	16	22	26	30	0.19

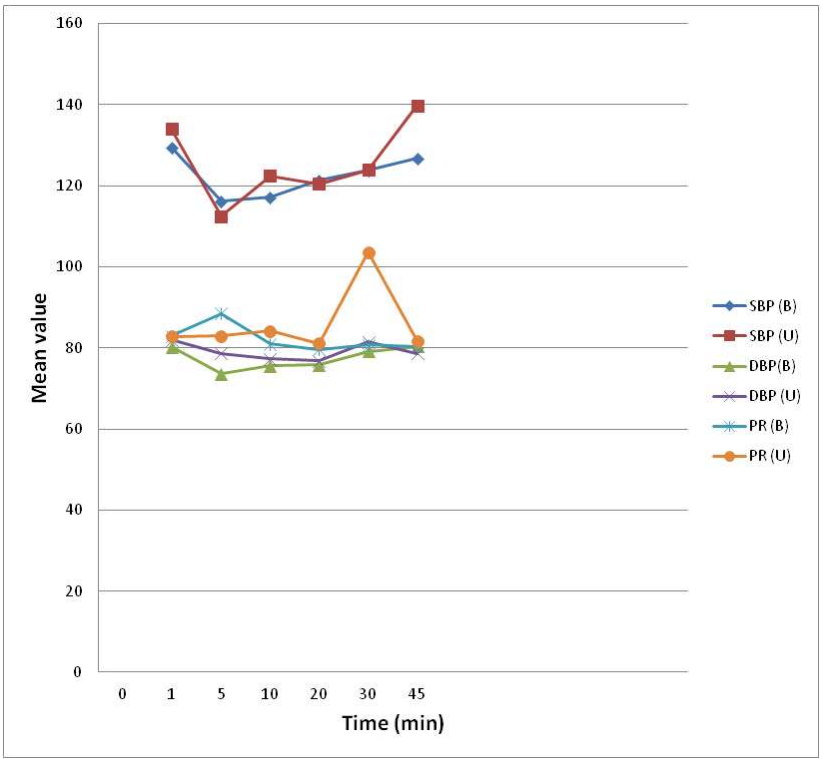

Figure 1: Haemodynamic changes in Groups B and U at different time intervals

Key: SBP= Systolic Blood Pressure DBP= Diastolic Blood pressure PR= Pulse rate

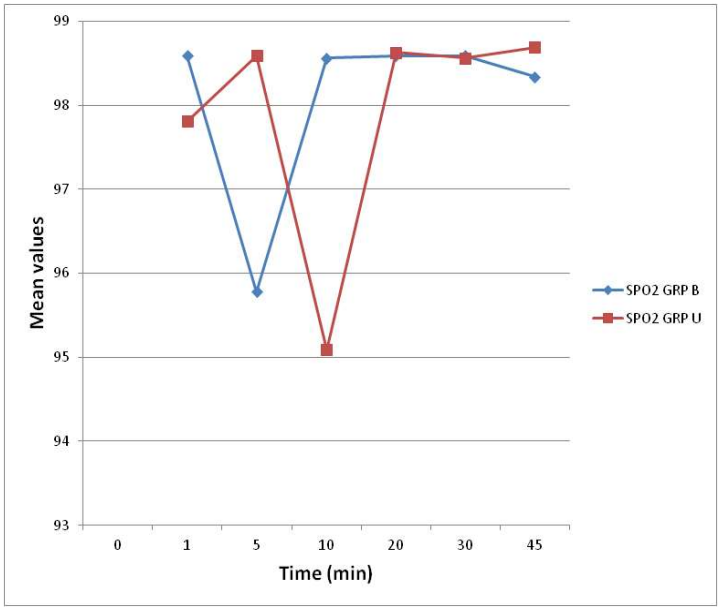

Figure 2: Intraoperative Oxygen Saturation at different time interval

Key: SPO_2 – Arterial Saturation of Oxygen GRP B – Group B GRP U - Group U

Discussion

This study found that the levels of sensory and motor blocks in the unilateral and bilateral groups were similar at 5, 10, 15 and 20 minutes. However, with better understanding of the factors that contributed to its effectiveness and safety, modifications that offer fewer complications are being adopted. A number of factors have been identified as those contributing to the spread of local anaesthetic agents after injection into the subarachnoid space, and hence been utilized to achieve unilateral spinal block which on many occasions anaesthetists require for procedures involving just one lower limb.[5]

We believe that the success and effectiveness of the unilateral spinal anaesthesia in our patients might have been due to prolong duration of positioning in the lateral decubitus position compared to the study conducted by Osinaike et al. [2]

The difference in duration of stay was to allow the local anaesthetics to take effect which usually takes longer with the unilateral technique. However, various researchers used different time periods in which patients remained in the lateral position during unilateral spinal anaesthesia. Determining the optimal time for keeping the patient in lateral position to achieve unilateral block is difficult. [5]Andrea et al [6]and Osinaike et al, [2] in their own study allowed the patients to remain in the lateral position for 15 minutes.
The optimum duration of lateral position during and immediately after injection of spinal anaesthesia is difficult to define, because baricity and dose of the local anaesthetics used also affects it. High doses (12 to 20 mg) leads to local anaesthetic migration even when the patient remains in the lateral decubitus position for 30 minutes to one hour.[7]

In this study there was 96.6% success rate for unilateral spinal anaesthesia which was higher than the 94 % obtained by Seyyed et al, [8] this may not be unconnected to the higher dose of 0.5% hyperbaric solution used, where 2mls was used instead of 1.5 mls used in their study.

However in clinical practice, the comfort of the patient as well as the operating room schedule must be taken into consideration. Therefore, it will be realistic to consider average time limit during which the patient can be left in the lateral decubitus position after injection.

The 2 ml (10 mg) of 0.5% hyperbaric bupivacaine used in our study was able to provide adequate sensory block that lasted 64 minutes in the unilateral group which was significantly different from the bilateral group that lasted for 100 minutes (p=0.01). Reported duration of anaesthesia varies with the dose of local anaesthetics injected.[7] The lower duration in the unilateral group may be because of the smaller dose of 0.5% hyperbaric bupivacaine used (10 mg) compared to the dose of 15 mg used in the bilateral group.

Depending on the expected duration of surgeries, different doses of 0.5% hyperbaric bupivacaine can be used. But one must bear in mind that higher doses may be associated with a higher incidence of complications. Atefet al, [9] in a study to determine the ideal dose of 0.5% hyperbaric bupivacaine required for unilateral spinal anaesthesia during diagnostic knee arthroscopy found that 1 ml (5 mg) achieved unilateral sensory block in 90% of the patients. The period the patients remained in the lateral position was 20 minutes, similar to our study. Osinaike et al, [2] in their study also used 2 ml (10 mg) of 0.5% hyperbaric bupivacaine with which they achieved satisfactory block.

Effectiveness of block is assessed using sensory and motor assessment. Sensory blockade was assessed by using pin prick

starting from the feet upwards. One of the challenges of spinal anaesthesia is to control the spread of local anaesthetics through the cerebrospinal fluids (CSF) to provide anaesthesia that is adequate for the planned surgery with minimal extensive spread and increased risk of complications. Also, one needs to decide on the highest level of innervations that will need to be blocked for the proposed surgery. In this study, which involved only lower limb surgeries, T_{10} dermatome was determined to be the highest level to be blocked. At 5 minutes after the local anaesthetic was injected, sensory and motor assessment was done to determine the height of the block. At this time more patients 14(44%) in the unilateral had their block reach the target dermatome of T_{10} compared to 12(38%) patients in the bilateral group that had their block at T_{10}. This was not statistically significant (p=0.76).

This shows motor block was faster in the conventional bilateral group than in the unilateral group as evidenced by more number of patients in the bilateral group attaining. Bromage score of IV at 5 minutes. As the time increased, more patients were progressing to grade IV block which as observed was initially faster in the bilateral group. At 10 minutes, 22(69%) patients were at Bromage score IV compared to 17 at the same score in the unilateral group. By the time it was 15 minutes, majority of the patients had achieved grade IV block.

The near linear relationship between patient's sensory and motor blocks may be related to the mechanism of action of local anaesthetics as stated earlier. When local anaesthetic is injected into the spinal space, it may directly affect the nerves, neuromuscular junction or display a centralized effect that results in muscle paralysis and relaxation. Even though the doses given were not equal i.e. 10 mg in the unilateral group versus 15 mg in the bilateral group, it is possible that the difference in dose alone cannot account for the faster spread of local anaesthetic solution in the bilateral group.

Casati et al, [10] in their study using 30 ASA I – II patients scheduled for elective surgery showed that only patients in the conventional bilateral group had their mean arterial pressure and heart rate decreased from baseline and required colloid to treat the hypotension.

There was no significant difference in changes in the pulse rate, even though at 30 minutes after the injection there was an increase in pulse rate in the unilateral group of 104 beats per minute compared to 81 beats per minutes in the bilateral group (p=0.04). This significant difference in pulse rate at 30 minute may be related to change in position from unilateral to supine position with redistribution of blood. Also, at this time surgery had commenced and other factors like blood loss may contribute even though at this time the systolic and diastolic blood pressure was not significantly reduced (p=0.25 and 0.50 respectively). All our patients maintained satisfactory oxygen saturation of at least 95% and above, which differ with the previous study by Imbelloni et al, [12] this could be attributed to the higher block (T_4 dermatome) in their study.

Conclusion

The study showed that unilateral spinal anaesthesia with 2 ml of 0.5% bupivacaine was more effective than the bilateral spinal anaesthesia for unilateral lower limb surgeries. However, the duration of sensory block was shorter in the unilateral group compared to bilateral group and with significantly less haemodynamic disturbances in the unilateral spinal compared to the bilateral spinal anaesthesia.

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