Unilateral Versus Bilateral Spinal Anesthesia - A Comparative Study

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Abstract:

Background: A restricted sympathetic block during spinal anaesthesia may minimize the intra- and postoperative hemodynamic changes. **Aims:** To compared unilateral and bilateral spinal anaesthesia with and complications of each technique. **Methods:** This study was conducted in the Department of Anaesthesia, Analgesia and Critical Care, Combined Military Hospital (CMH), Chattogram. Study was carried out over a period of one year from January 2018 to December 2018. Total 80 patients were included in this study and were randomly divided into two groups, Group-U (Unilateral spinal anaesthesia group) and Group-B (Bilateral spinal anaesthesia group). Patients with ASA grade 1 & 2, aged 18-50 years were included**.** Spinal anaesthesia was induced with 0.5% hyperbaric bupivacaine and a 25-G Quincke needle in two groups of patients who had been admitted for orthopedic andgeneral surgeries. In group-U, dural puncture was performed with the patient in the lateral decubitus position with 1.75ml of hyperbaric bupivacaine and 25 µgFentanyl. The speed of injection was 1 ml/30 sec, and the duration of time spent in the lateral decubitus position was 15 minutes and then placed in supine position. In group-B, dural puncture were also performed with the patient in the same lateral decubitus position using the same dose, i.e 1.75 ml of hyperbaric bupivacaine with 25 µg Fentanyl but patients were then placed in the supine position as quickly as possible. **Results:** The demographic data were similar in both groups. The time to the onset of the sensory and motor block was significantly shorter in group-B ($p<0.05$). The duration of motor and sensory block was shorter in group-U ($p< 0.05$). The success rate for unilateral spinal anaesthesia in group-U was 94%. In two patients, the spinal block spread to the non-dependent side. The incidence of complications (nausea, headache, and hypotension) was lower in group-U. **Conclusion:** When unilateral spinal anaesthesia was performed using a low-dose, low-volume and low-flow injection technique, it provides adequate sensory-motor block, stable hemodynamic parameters, faster time to micturition, early ambulation, more patients satisfaction as opposed to the conventional bilateral approach. Furthermore, this technique avoids unnecessary paralysis on the non-operated side.

Indexing words: Spinal anesthesia, Unilateral, Bilateral, Bupivacaine

Introduction:

Conventional spinal anaesthesia (bilateral) is an effective alternative to general anaesthesia when the surgical site is located on the lower extremities, perineum (eg, surgery on the genitalia or anus), or lower body wall (eg, inguinal herniorrhaphy). Cesarean deliveries are routinely performed under spinal anaesthesia, as are total hip arthroplasty and total knee arthroplasty**.**[1] Unilateral spinal anaesthesia may be performed for all procedures involving the lower limb both orthopaedic and vascular, some operations in the perineal area and some general surgical procedures such as inguinal herniarepair,varicose vein ligations etc.[2]

Unilateral spinal anaesthesia was first achieved in 1947 by subarachnoid injection of a hypobaric solution with the patient placed in the lateral position.[3] The term unilateral spinal anaesthesia is used when block is of operative side only with absence of block on non-operative side.[4] There are many benefits to this technique including fewer hemodynamic changes, less urinary retention, more satisfied patients, better motility during recovery and the restriction of selective nerve block to the relevant limb.[5] Several factors are required for successful unilateral spinal anesthesia, including: the type of needle and its bevel direction, the speed of injection, volume, baricity, the concentration of local anesthesia as well as the position of the patient on the operating table.[6]

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Cardiovascular system may be profoundly affected by spinal anesthesia due to unavoidable sympathetic blockade. Numerous studies have been conducted to see the cardiovascular effects of spinal blockade.[7] In conventional bilateral spinal anesthesia it is not possible to limit the accompanied sympathetic block that normally exceeds the sensory block by 2-6 segments. The cardio accelerator fibres originate from T1-T4 so the level of spinal anesthesia affecting these dermatomes may cause bradycardia.[8] Unilateral spinal anesthesia has been claimed by many as an alternative technique, to restrict the undesired sympathetic block.[9] This study was undertaken to evaluate the benefits of unilateral as compared with bilateral spinal anaesthesia.

Methods:

This study was conducted in the Department of Anaesthesia, Analgesia and Critical Care, Combined Military Hospital (CMH), Chattogram. Study was carried out over a period of one year from January 2018 to December 2018. Total 80 patients were included in this study and randomly divided into two groups, Group-U (Unilateral spinal anesthesia group) and Group-B (Bilateral spinal anaesthesia group). Patient age ranged from 18 to 50 years and the patients were in ASA grade I or II. The duration of nil by mouth time and the sedation regimen were the same in both groups. Patient who had a history of cardiovascular disease, hypertension, neuropathy, addiction, or smocking, surgery requiring over 2 hour was excluded from the study. Required approval for this study was taken and Informed consent was also obtained from each patient to ensure that he or she understood that the technique.An iv cannula was inserted, then a 10 ml/kg intravenous infusion of lactated Ringer's solution was administered over 20 min. All patients underwent standard monitoring, including electrocardiography, non-invasive blood-pressure measurements and pulse oximetry.

In group-U (unilateral spinal), the patients were placed in the lateral decubitus position. The L3-L4 intervertebral space was detected and then spinal anaesthesia was performed with a 25-G Quincke spinal needle. After the confirmation of intrathecal needle placement, 1.75 ml of hyperbaric bupivacaine 0.5% with 25 µgfentanyl was injected at a speed of 1 ml every 30 sec. The bevel of the needle pointed downward during the injection. The patients were kept in the lateral position for 15 min and then placed in the supine position for surgery.

In group-B (bilateral spinal), spinal anaesthesia was also performed with the patient in the lateral decubitus position at the L3-L4 interspace using a 25-G Quincke spinal needle in sterile condition. Once intrathecal placement had been confirmed, 1.75 mL of hyperbaric bupivacaine 0.5% with 25 µg fentanyl was injected. The patient was then placed in the supine position as quickly as possible. To reduce anxiety, 2.5 mg midazolam was injected iv to each patient.

Hemodynamic variables such as blood pressure and heart rate were checked before spinal anesthesia and then every 5 min in both groups. If blood pressure decreased by more than 25% of baseline and heart rate dropped to less than 50 beats/min, the patient was considered to suffer from hypotension or bradycardia, respectively.

The hypotension was managed by rapid iv infusion of 250 ml of normal saline. If the hypotensive patient did not respond to treatment, ephedrine 5 mg iv was injected. Bradycardia was managed using 0.6 mg of intravenously administered atropine.

A visual analog scale ranging from 0 to 10 was used for evaluation of nausea and the number of vomiting episodes was used to evaluate the extent of patient vomiting.To check the level of sensory block, a cold object was held in contact with the skin. The Bromage scale was used to check the accuracy of the motor block (Table 1).[10]

Table 1: Bromage Score

Grade	Criteria	Degree of Block
I	Free movement of legs and feet	Nil (0%)
II	Just able to flex knee with free movement of the feet	Partial (33%)
III	Unable to flex knees but with free movement of the feet	Almost complete (66%)
IV	Unable to move the legs or feet	Complete (100%)

The clinical data including the onset of sensory and motor block, hemodynamic changesand the duration of sensory and motor block and the complications of spinal anaesthesia were evaluated using SPSS version 19.6.In this statistical analysis, a *p* value of <0.05 was considered as significant.

For statistical analysis of the hemodynamic changes, the paired t-test was used. The independent t-test was used to compare the efficacy of the sensory and motor blocks. The Mann-Whitney U-test was used to evaluate the level of patient satisfaction.

Results:

There were no significant differences in age, sex, height, weight, duration of surgery and type of surgery between both groups (Table 2).

Table 2: Demographic data, duration of surgery, type of surgery according to group (Mean ± SD)

Specifications	Group-U (Unilateral group. N=40)	Group-B (Bilateral group. N=40)	*P*-value
Age (years)	36.2 ± 5.8	32.4 ± 6.2	0.308
Sex (male/ female)	22/18	23/17	0.358
Height (cm)	152.8 ± 6.5	156.2 ± 6.7	0.656
Weight (Kg)	56.7 ± 3.5	60.2 ± 9.4	0.364
Duration of surgery(min)	72.2 ± 10.4	78.6 ± 11.2	0.765
Type of surgery(orthopedics/ general surgery)	21/19	22/18	0.356

T10-T12 anesthesia was achieved in both groups. The average time to onset of sensory block in the unilateral group (Group-U) was 3.48 ± 0.11 min. In the bilateral group (Group-B), this value was 2.12 ± 0.31 min (*p* value = 0.028).Duration of motor and sensory block were 118.35 ± 32.38 min and 137.27 ± 17.07 min in unilateral group respectively. Duration of motor and sensory block was 146.11 ± 17.42 min and 174.11 ± 17.41 min in bilateral group. These differences were statistically significant (p <0.05).Time to reach Bromage score 4 was achieved at 6.57 ± 2.34 min in unilateral group and 5.02 ± 1.54 min in bilateral group (Table 3). The average time to voiding after spinal anesthesia was 430 ± 94 min in the unilateral group and 519 ± 109 min in the bilateral group (*p* =0.18). The time to ambulation was 332.4 ± 1.08 min in unilateral group and 353.5 ± 78.9 min in bilateral group(p=0.690).

Table 3: Sensory and motor block characteristics (Mean ± SD)

Characteristics	Group-U (Unilateral group. N=40)	Group-B (Bilateral group. N=40)	*P*-value
Time to onset of sensory block (min)	3.48 ± 0.11	2.12 ± 0.31	0.028
Time to onset of motor block (min)	5.02 ± 1.14	4.21 ± 1.23	0.018
Duration of motor block (min)	118.35 ± 32.38	146.11 ± 17.42	0.027
Duration of sensory block (min)	137.12 ± 17.07	174.11 ± 17.41	0.039
Time to reach motor block Bromage scale 4 (min)	6.57 ± 2.34	5.02 ± 1.54	0.042
Time of first voiding (min)	430 ± 94	519 ± 109	0.18
Time to ambulation (min)	332.4 ± 1.08	353.5 ± 78.9	0.690

None of the patients in the unilateral group experienced nausea or vomiting. In the bilateral group, 09 patients had nausea and 01 of them experienced episodes of vomiting (*p* = 0.021). 03 patients in the unilateral group and 08 patients in the bilateral group had headaches (*p* = 0.032). None of the patients in the unilateral group had hypotension or bradycardia. In the bilateral group, 12 patients had hypotension and 07 of them bradycardia (p values 0.027 and 0.029 respectively). The level of patient satisfaction was 89.2% in the unilateral group and 84.3% in the bilateral group (*p*> 0.05).The rates of complications are presented in Table 4.

Table 4: Complications

Complications	Group-U (Unilateral group. N=40)	Group-B (Bilateral group. N=40)	*P*-value
Nausea and vomiting	0	10	0.021
Headache	3	8	0.032
Hypotension	0	12	0.027
Bradycardia	0	7	0.029

The success rate for unilateral spinal anesthesia in our study was 94%, in two cases, the anesthetic drug spread to the other side of the canal, resulting in bilateral anesthesia.

Discussion:

Spinal anaesthesia is an anaesthetic technique that is easy, fast and relatively inexpensive in comparison to general anaesthesia.But it produces some adverse effects, the commonest being the intraoperative hypotension and bradycardia and post-operative headache. Precipitous arterial hypotension due to high sympathetic block remains a common problem associated with conventional bilateral spinal anaesthesia, specially in high risk patients.[11] The haemodynamic effects of spinal anaesthesia are mainly a result of both the resistance and capacitance vascular changes induced by the block of pre-ganglionic sympathetic libres.[12]

The spinal anaesthesia is termed as unilateral when the sensory block was upto or above T12 level and modified Bromage score for motor block was >2 on the operative limb and no detectable sensory and motor block on the other limb. The simultaneous factors for unilateral spinal block are: lateral decubitus position during and subsequently after intrathecal injection, low dose of local anesthetic and slow speed of injection. Position of patient (lateral decubitus) with respect to baricity of local anaesthetic and duration of lateral position after intrathecalinjection are main determinants of distribution of spinal block to one side.[13,14]

One of the main advantage of unilateral block is more stable haemodynamic status. In agreement with previous investigators no significant fall in BP and heart rate was noted in any patient. Less hypotension is due to lower dose of anaesthetic and slow ascent of block. This allows patients to activate homeostatic vascular mechanism more efficiently.[15,16]

The optimum duration of lateral position is difficult to define as it is also related to local anaesthetic dose. When 5-10 mg of hyperbaric bupivacaine is used, maintaining lateral position for 15-20 minutes is enough to prevent anaesthetic migration to other side when the patients are turned supine.[17] As we used hyperbaric bupivacaine we positioned the patients in lateral position with operative side in dependent position and maintained this position for 15 minutes after spinal injection. Slow speed of injection minimizes mixing of local anaesthetic with CSF and thus facilitates unilateral block.[18]

In this study, we injected 1.75 ml of hyperbaric bupivacaine 0.5% with Fentanyl 25 µgto achieve unilateral spinal anaesthesia. The patient was kept in the lateral position for 15 min, which led to unilateral spinal anaesthesia in 94% of cases. In two cases, the anesthetic drug spread to the other side, resulting in bilateral spinal anaesthesia. In a study performed by Esmaoglu, the patient was in the lateral position for 10 min. This approach yielded an 85.7% success rate. This discrepancy in terms of the success rate seems to be dependent on the duration of time spent in the lateral position.[19]

None of the patients in the unilateral spinal anaesthesia group experienced hypotension, but twelve patients in the bilateral group had hypotension ($p< 0.05$). Chohan and Afshan administered unilateral spinal anaesthesia prior to lower-limb surgery in elderly patients with ASA classification of III or IV (average age, 60). The authors found no significant hemodynamic changes. They used hyperbaric bupivacaine 0.5% (1.1-1.8 ml).[20]

In our study, there was no bradycardia in the unilateral group, but in the bilateral group, 7 patients had bradycardia ($p = 0.029$). On average, the time to the onset of anaesthesia and immobility was faster in the bilateral as compared to the unilateral spinal anaesthesia group ($p = 0.028$ and 0.018 respectively). The sensory and motor block lasted for less time in the unilateral as compared to the bilateral group. Unilateral spinal anaesthesia is therefore suitable for out-patient surgery.

Valanne used 4 or 6 mg of bupivacaine to induce unilateral spinal anaesthesia in 106 patients scheduled to undergo knee arthroscopy. While both doses were sufficient for sensory and motor block, 4 mg of bupivacaine achieves a more rapid regression of motor function.[21]

Headache after spinal anaesthesia was reported in three and eight patients in the unilateral and bilateral groups respectively. In contrast, Smaoglue used 1.5 ml and 3 ml of hyperbaric bupivacaine 0.5% for unilateral and bilateral anesthesia, respectively: six and nine patients, respectively, experienced headache. This discrepancy may be related to the type of needle used (Quincke).[22]

In our investigation, the average time to voiding after spinal anaesthesia was 7.3 and 8.65 hour in the unilateral and bilateral groups, respectively. This difference was not significant(p=0.18). Atef et al. reported no urinary retention after unilateral spinal anaesthesia with 5 mg of hyperbaric 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, as well.[23]

In the available literature reports, the unilateral anaesthesia, like in our study, is shorter than conventional anaesthesia. In operations such as knee arthroscopy, inguinal herniorrhaphy, and other operations, this is rather an advantage which means less need of postoperative observation and earlier discharge of patients, as seen in our study.[24]

Reduction of local anaesthetic dose is crucial for unilaterality of block. However, too small dose can increase failure rate of spinal and shorten the duration of block. We used intermediate dose of 1.75ml of 0.5% heavybupivacaine with adjuvants Fentanyl 25 µgwhich allowed surgery without need of supplementary analgesia and also reduce risk of failed block.[25]

Conclusion:

Unilateral spinal anaesthesia with a low dose, limited volume and low-flow injection technique induces sufficient sensory and motor block with an appropriate level of analgesia. This technique achieves stable hemodynamics, also results in rapid recovery and greater satisfaction among patients, in addition to preventing unnecessary nerve block in the contra lateral side.

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