Comparison of Haemodynamic Changes in Patients Undergoing Unilateral and Bilateral Spinal Anaesthesia

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ABSTRACT

Objective: To assess the haemodynamic changes in patients receiving unilateral and bilateral spinal anaesthesia with their pre-anaesthesia recordings.

Study Design: Quasi-experimental study.

Place and Duration of Study: Main Operation Theater, Liaquat National Hospital, Karachi, from May 2006 to February 2007.

Methodology: Sixty patients meeting the inclusion criteria were randomly allocated in two groups of 30 patients each. One and a half ml of 0.75% hyperbaric bupivacaine was injected with free flow of cerebrospinal fluid using a 23 gauge quincke needle. Lumbar puncture was performed in the sitting position at 3 – 4 or 4 – 5 lumbar interspace. Patients were then assigned to the supine or lateral decubitus position for 10 minutes. Heart rate, systolic, mean and diastolic blood pressures of patients were recorded with their pre-anaesthesia readings in the 1st, 5th, 15th, 30th and then at every 15th minute till the end of procedure. Recovery room readings were also taken.

Results: The systolic, mean and diastolic blood pressure changes were significant in both groups. But from 1st minute to recovery room, statistically significant difference ($p < 0.05$) was found at each time interval, the unilateral groups (group A) being more stable with respect to pre-anaesthesia readings. The decrease in heart rate was comparable in both groups.

Conclusion: Unilateral spinal anaesthesia was associated with a more stable cardiovascular profile, therefore, it is a valuable technique for high risk patients.

Key words: *Haemodynamic parameters. Unilateral spinal anaesthesia. Bilateral spinal anaesthesia.*

INTRODUCTION

Spinal anaesthesia has been shown to block the stress response of surgery,[1] decrease intraoperative blood loss,[2,3] lower the incidence of postoperative thromboembolism[4] and decrease morbidity[5] and mortality in high risk patients.[6,7] Migration of local anesthetic in the cerebrospinal fluid (CSF) depends on its specific gravity relative to CSF.[8] CSF has specific gravity of 1.003 – 1.008 at 37°C. The cardiovascular changes are related to the cephalad distance to which the local anaesthetic spreads in the sub-arachnoid space, and thus to the extent of pre-ganglionic sympathetic denervation.[10]

Unilateral spinal anaesthesia has been claimed by many as an alternative technique to restrict the undesired sympathetic block.[8] Seeking unilateral distribution of spinal anaesthesia provided more profound and longer lasting block in the operated limb, less cardiovascular effects and similar home discharge compared with bilateral spinal anaesthesia, with only a slight delay in preparation time.[9] Lateral position for spinal anaesthesia delays the onset of hypotension while requiring smaller total doses of vasoconstrictors for blood pressure maintenance.[10]

This study was undertaken to ascertain which technique is associated with minimal haemodynamic changes so that high risk patients can have the benefit of safety.

METHODOLOGY

Sixty adult patients, aged 45 years or above, scheduled for unilateral lower limb surgery, were studied. Patients with contraindication to spinal anaesthesia, known hypertensive or ischaemic heart disease patients or those who were already on antihypertensive or vasodilator agents were excluded from the study. After approval from hospital ethical committee, informed consent of patients was taken regarding this study.

Patients were randomly allocated in two groups using a simple lottery method in which the anesthetist had to pick a slip from a bowl containing equal numbers of slips for both types of anaesthesia.

Group A received unilateral spinal anaesthesia while group B received bilateral spinal anaesthesia. Venoclysis with Ringer's lactate solution was installed at operating room arrival.

After a brief history, checking CBC, PT and APTT reports and examination of spinal column, the lumbar area was prepared aseptically and draped. Lumbar puncture

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performed at 3 – 4 or 4 – 5 interspace in the sitting position with a 23 gauge quincke needle. When the intrathecal placement was confirmed, 1.5 ml of 0.75% hyperbaric bupivacaine was injected over a period of 10 – 15 seconds. Group A patients were placed immediately in the lateral position after the injection for 10 minutes while group B patients were made supine.

Patients were monitored for heart rate, blood pressure, ECG and pulse oximetry during the procedure. Haemodynamic changes were recorded with the pre-anaesthesia readings in the 1st, 5th, 15th, 30th and then at every 15th minute till the end of the procedure with recovery room readings on a proforma. Clinically relevant hypotension was a decrease in systolic arterial blood pressure by 30% or more from baseline value. It was initially treated with 200 ml Ringer's lactate solution. If this proved ineffective, 5 mg ephedrine were given. Clinically relevant bradycardia was defined as a heart rate decrease to < 45 beats/minutes and was treated with 0.5 mg atropine intravenously.

The data was entered and analyzed into Statistical Packages for Social Sciences (SPSS) version 10.0. Frequency and percentage were computed for categorical variable like gender, ASA classification for group A (unilateral spinal anaesthesia) and group B (bilateral spinal anaesthesia). Mean and standard deviation were computed for quantitative variables like age, duration of surgery, systolic blood pressure, diastolic blood pressure, mean blood pressure and pulse for both groups.

Student’s t-test was applied to compare mean significant difference between groups for age and duration of surgery. Student’s t-test was applied to compare mean significant difference between groups for systolic blood pressure, diastolic blood pressure, mean blood pressure and pulse. Haemodynamic mean difference were checked at pre-anaesthesia, 1st minutes, 5th minutes, 15th minutes, 30th minutes and then every 15 minutes to the recovery room. Repeated measure ANOVA was used to compare mean difference for systolic blood pressure, diastolic blood pressure, mean blood pressure and pulse within subject effect for both groups. $P \leq 0.05$ was considered level of significance.

RESULTS

The average age of patients was 52.4 ± 6.38 years. Out of 60 patients, 47 (78.33%) were male and 13 (21.67%) female in this study with 3.6:1 male to female ratio. Regarding ASA classification, 33 patients (55%) were in ASA-I and 27 (45%) were in ASA-II.

In group A, the average age of the patients was found 50.70 ± 6.29 years while in group B, the average age was found 53.23 ± 7.35 years, the mean difference was not statistically significant between the groups at $p = 0.15$.

In both groups (within effect) there was statistically significant difference in the haemodynamic changes (systolic blood pressure, mean blood pressure, diastolic blood pressure and pulse) from pre-anaesthesia readings. (Repeated measure ANOVA; within subject effect $p < 0.01$). Mean comparison between groups for haemodynamic changes were not statistically significant at pre-anaesthesia then after from 1st minute to recovery

Table I: Comparison of mean systolic blood pressure between groups with respect to time.

Systolic blood pressure (mmHg)	Bilateral n = 30		Unilateral n = 30		p-values
	n	Mean ± SD	n	Mean ± SD	
Pre-anaesthesia	30	140.27 ± 7.36	30	139.33 ± 6.97	0.616
1st minutes	30	129.93 ± 9.23	30	136.57 ± 6.58	0.002*
5th minutes	30	117.63 ± 11.17	30	132.83 ± 7.28	0.0001*
15th minutes	30	110.33 ± 7.50	30	124.37 ± 8.29	0.0001*
30th minutes	30	103.27 ± 5.41	28	117.54 ± 9.88	0.0001*
45th minutes	22	103.32 ± 3.63	18	110.94 ± 9.89	0.002*
60th minutes	14	101.57 ± 3.25	15	109.27 ± 7.17	0.001*
75th minutes	10	99.70 ± 3.74	8	106.00 ± 6.63	0.021*
Recovery room	30	101.17 ± 3.37	30	110.13 ± 7.77	0.0001*

1. Independent sample t-test was used to compare mean difference between groups.
2. Repeated measure ANOVA was used to compare mean difference within subject (p < 0.01).
** Statistical Significant.*

Table II: Comparison of mean blood pressure between groups with respect to time.

Systolic blood pressure (mmHg)	Bilateral n = 30		Unilateral n = 30		p-values
	n	Mean ± SD	n	Mean ± SD	
Pre-anaesthesia	30	102.70 ± 7.06	30	99.73 ± 7.04	0.109
1st minutes	30	93.60 ± 7.80	30	97.07 ± 6.71	0.020*
5th minutes	30	83.40 ± 8.42	30	93.80 ± 6.37	0.0001*
15th minutes	30	77.87 ± 5.98	30	87.10 ± 6.49	0.0001*
30th minutes	30	73.10 ± 6.41	28	82.43 ± 7.34	0.0001*
45th minutes	22	73.45 ± 3.58	18	78.39 ± 7.11	0.007*
60th minutes	14	71.86 ± 3.28	15	77.27 ± 4.99	0.002*
75th minutes	9	70.56 ± 4.22	8	74.75 ± 5.18	0.05*
Recovery room	30	70.00 ± 4.66	30	77.10 ± 5.34	0.0001*

1. Independent sample t-test was used to compare mean difference between groups.
2. Repeated measure ANOVA was used to compare mean difference within subject (p < 0.01).
** Statistical Significant.*

Table III: Comparison of mean diastolic blood pressure between groups with respect to time.

Diastolic blood pressure (mmHg)	Bilateral n = 30		Unilateral n = 30		p-values
	n	Mean ± SD	n	Mean ± SD	
Pre-anaesthesia	30	83.87 ± 7.98	30	80.43 ± 8.13	0.104
1st minutes	30	75.37 ± 8.16	30	77.90 ± 7.79	0.022*
5th minutes	30	66.73 ± 7.78	30	74.73 ± 6.98	< 0.001*
15th minutes	30	62.10 ± 5.89	30	68.97 ± 6.45	< 0.001*
30th minutes	30	58.43 ± 6.63	28	65.32 ± 6.98	< 0.001*
45th minutes	22	59.14 ± 4.18	18	62.56 ± 6.37	0.048*
60th minutes	14	57.79 ± 3.47	15	61.80 ± 5.13	0.021*
75th minutes	10	56.20 ± 4.57	8	59.63 ± 4.98	0.014*
Recovery room	30	55.67 ± 4.53	30	61.07 ± 4.78	< 0.001*

1. Independent sample t-test was used to compare mean difference between groups.
2. Repeated measure ANOVA was used to compare mean difference within subject (p < 0.01).
** Statistical Significant.*

Table IV: Comparison of mean pulse between groups with respect to time.

Pulse beats/minute	Bilateral n = 30		Unilateral n = 30		p-values
	n	Mean ± SD	n	Mean ± SD	
Pre-anaesthesia	30	86.20 ± 6.85	30	84.93 ± 9.00	0.542
1st minutes	30	90.03 ± 7.83	30	85.87 ± 9.21	0.064
5th minutes	30	87.40 ± 9.84	30	83.07 ± 8.37	0.071
15th minutes	30	81.57 ± 8.58	30	78.07 ± 9.30	0.135
30th minutes	30	76.63 ± 9.08	28	74.93 ± 8.24	0.458
45th minutes	22	72.36 ± 18.14	18	72.89 ± 5.16	0.906
60th minutes	14	76.43 ± 12.40	15	71.40 ± 4.64	0.154
75th minutes	10	73.90 ± 12.68	8	68.75 ± 4.03	0.288
Recovery room	30	71.60 ± 8.63	30	70.10 ± 7.58	0.477

1. Independent sample t-test was used to compare mean difference between groups.
2. Repeated measure ANOVA was used to compare mean difference within subject ($p < 0.01$).

room, statistically significant difference was found at each time interval between groups. Systolic blood pressure, mean blood pressure and diastolic blood pressure in group A were more established than group B while pulse reading in groups B were more established then group A. The break-up of each parameter reading is shown in Tables I – IV.

Mean comparison between groups for duration of surgery, no significant difference ($t = 0.158$, $DF = 58$, $p = 0.87$) was observed.

DISCUSSION

This study results show that within subject effect there was a statistically significant difference in both groups regarding haemodynamics (systolic blood pressure, mean blood pressure, diastolic blood pressure and pulse) from the pre-anaesthetic values (repeated measure ANOVA; within subject effect $p < 0.01$). Pre-anaesthetic values of haemodynamic variables were comparable in both groups.

Study was done in ASA I and II patients keeping in mind that studies are routinely done in fit patients to assess the baseline efficacy and then applied in high risk patient. In this study, it was found that unilateral spinal anaesthesia is associated with stable cardiovascular profile and, therefore, is a valuable technique in high risk patients.

From 1st minute to recovery room readings, statistically significant difference was found at each time interval between groups with each of systolic blood pressure, mean blood pressure and diastolic blood pressure. The unilateral group being more stable with respect to pre-anaesthetic values.

The pulse rate decreased significantly from the pre-anaesthesia reading to the recovery in each group, but the mean pulse decrease at each time interval when comparison between the groups was not significant.

Frequency of hypotension was also studied by an Italian group and found that the incidence of hypotension was higher in the conventional than unilateral group.[11] They also recorded a greater decrease in systolic blood pressure and heart rate from the baseline values in the bilateral group. The greater decrease in heart rate may be attributed to the barbotage through a cranially directed needle orifice before the patients were turned to supine.

Spinal hypobaric bupivacaine seems to be superior to isobaric in that it prolongs the sensory block on the operative side and delays the use of analgesics after surgery without further compromising haemodynamic stability.[12] Even a complete sympathectomy only leads to a 20% decrease of systemic arterial resistance because of the basic tone of arteries and arterioles[13] but causes massive dilatation of thin walled veins. There is fast onset of profound block under spinal anaesthesia as compared to epidural, that explains higher incidence of severe circulatory complications as patients can reach the limits of their cardiac functional capacity.[14] This a regimen which minimizes sympathetic block.

A study on 40 ASA-III and IV patients all receiving unilateral spinal anaesthesia with hyperbaric bupivacaine and kept in the lateral decubitus position for 10 minutes showed minimal haemodynamic changes following the technique.[9] The results of the present study were similar.

In an another study in which all patients received unilateral spinal anaesthesia with 5 mg of 0.5% hyperbaric bupivacaine at the rate of 1 ml/minute had observed no hypotension. These patients were kept in lateral decubitus position for 20 minutes resulted in block on dependent site with minimal haemodynamic changes.[15]

Similar results were observed in another study in which the patients positioned immediately supine showed a greater decrease in arterial blood pressure and heart rate than the patients who were kept in the lateral decubitus position for 20 minutes after the induction of spinal anaesthesia.[16]

A study by Sen and Aydin concluded that elderly patients with low ejection fractions were more likely to predispose to higher sensorial block level. Hypotension was more common during spinal anaesthesia with supine position compared to lateral decubitus position.[17]

The observations recorded in this study supports the view that unilateral spinal anaesthesia is associated with a more stable cardiovascular profile than the conventional spinal anaesthesia.[18] A similar study conducted by Khan and colleagues found haemodynamic stability slightly more in unilateral spinal group but results were statistically insignificant.[19] Rao concluded that unilateral block could be a more useful concept in older age group and autonomically compromised patients. As in younger age group, patients haemodynamic changes were negligible most probably due to active sympathetic system at the unblocked area.[20] Unilateral sensory and motor block, a faster recovery profile, and a stable haemodynamic state can be achieved with doses of 5 mg and 7.5 mg of hyperbaric bupivacaine 0.5% injected slowly through pencil-point directional needles in patients who are maintained in the lateral decubitus position for 20 minutes.[21] Unilateral spinal anaesthesia ensures higher intraoperative haemodynamic stability.[22]

CONCLUSION

From the observed findings, it can be concluded that unilateral spinal anaesthesia is a valuable technique, especially for high risk patients where major concern is haemodynamic stability.

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