ORIGINAL RESEARCH

A comparative study of unilateral and conventional spinal anaesthesia by using 0.5% hyperbaric bupivacaine in lower limb orthopaedic surgery

[1]Dr. Lona Sonowal, [2]Dr. Bipul Deka, [3]Dr. Rajib Hazarika, [4]Dr. Arnav Das, [5]Dr Birinchi Kartik Das

[1]Senior Resident, Department of Anaesthesiology, State Cancer Institute, India
[2]Associate Professor, [3]Professor, [4]Assistant Professor, Department of Aanaesthesiology, Jorhat Medical College and Hospital, India
[5]Assistant Professor, Department of Physiology, Jorhat Medical College and Hospital, India

Correspondence:
Dr. Lona Sonowal
Senior Resident, Department of Anaesthesiology, State Cancer Institute, India
Email: lonasonowal4004@gmail.com

ABSTRACT

Background and Aims: Unilateral spinal anaesthesia is used for lower limb surgeries, as it offers many clinical advantages, including reducing the haemodynamic effects of spinal anaesthesia. The study was done to compare intra-operative haemodynamic responses and duration of analgesia between unilateral and conventional spinal anaesthesia.

Methods: Nighty patients of either sex, between 18 and 60 years of age, belonging to ASA grade I and II physical status scheduled for elective lower limb orthopaedic surgery were randomly allocated into two equal groups. Group A (n=45) received 7.5 mg of 0.5% hyperbaric bupivacaine for unilateral spinal anaesthesia and Group B(n=45) received 12.5 mg hyperbaric bupivacaine for conventional spinal anaesthesia. They were evaluated for haemodynamic parameters including heart rate, Mean arterial pressure (MAP) and duration of postoperative analgesia. Visual Analogue Scale (VAS) was used to assess postoperative analgesia.Incidences of complications of spinal anaesthesia were also recorded.

Results: The MAP at 5, 10, 15, 20,30 minutes were significantly lower in conventional group than in unilateral group. The duration of analgesia was 419.32 ± 9.43 min in unilateral group and 390±9.64 min in conventional group. Incidencesof hypotension, bradycardia, nausea, vomiting and postoperative headache were significantly lower in unilateral group than in conventional group.

Conclusion: The unilateral Spinal anaesthesia provides better haemodynamicstability and prolonged duration of analgesiawhen compared with conventional anaesthesia.

Keywords: unilateral spinal anaesthesia, lower limb orthopaedic surgery.

INTRODUCTION

Spinal anaesthesia provides excellent operating conditions for surgeriesof lower limbs. Spinal anaesthesia is associated with its side effects like hypotension, bradycardia, post dural puncture headache, urinary retention, nausea and vomiting and backache. Lower anaesthetic doses, direction of pencil point or cutting needles, slow injection rates anduse of hyperbaric anaesthetic solutions with 15–20minute lateral decubitus position have been suggested to induce unilateral spinal anaesthesia[1]. It is possible to create a unilateral spinal block as the

distance between the left and right nerve roots in the lumbar and thoracic regions is about 10-15 cm^2. The increase amount of local anaesthetic in one side of spinal cord improve the unilateral distribution of spinal anaesthesia. There are many benefits to this technique, including fewer haemodynamic complications, avoidance of unnecessary paralysis on the non operating side, early mobilization in the recovery period, lower incidence of urinary retention and good patient's satisfaction[3] Therefore, the study was done to compare haemodynamic changes, the duration of analgesia and side effects between unilateral and conventional spinal anaesthesia.

MATERIALS AND METHODS

Approval from the hospital ethics committee was taken before commencing the study. The study consisted of 90 patients of either sex, between 18 and 60 years of age, belonging to ASA grade I and II physical status scheduled for elective lower limb orthopaedic surgery,under the Department of Anaesthesiology, Jorhat Medical College & Hospital, Jorhat, during the period from July 2020 to June 2021. Patients with the following diseases were excluded from the study: Sensitivity to any of the drugs or its constituents under the study, fever, and respiratory, cardiovascular or neurological diseases.Patients were randomly allocated into two groups, group A and group B, each group consisting of 45 patients.

On arrival of patients to the operation theatre, standard monitors including NIBP, ECG, SPO2 to the patients were connected, and baseline parameters were recorded.Intravenous access was secured with 18 gauge i.v cannula, and the patients were preloaded with 500 ml ringer lactate solution. All patients were premedicated with i.v Pantoprazole (40mg).

Group A received unilateral spinal anaesthesia. Unilateral spinal anaesthesia was performed with the patients placed in lateral decubitus position with the target limb in the dependant position. Under all aseptic and antiseptic precautions, lumbar puncture was done using 25gauge Quincke needle at L3-L4 interspace and bevel end of the needle was turned towards the dependent side. After confirming for free flow of CSF, 1.5 ml of 0.5 % hyperbaric injection was injected at the speed 1ml/30sec. Then the patient was kept in the lateral position for 15 minutes and then was placed in supine position for surgery. Surgery started after confirmation of adequate sensory and motor blockade.

Group B patients received conventional spinal anaesthesia. Conventional spinal anaesthesia was performed with the patient in the sitting position. Under all aseptic and antiseptic precautions, lumbar puncture was done using 25gauge Quincke needle at L3-L4 interspace. After confirming clear and free flow of CSF, 2.5 ml of 0.5% hyperbaric bupivacaine was given through the needle. Then the patients were placed in supine position for surgery.

SBP, DBP, MAP and heart rate were recorded at before spinal anaesthesia, 0 (immediate after SA),5,10,15,20,25,30,45,60,90,120 minutes and at the end of surgery. Hypotension (if systolic blood pressure decreased by more than 25 % or systolic pressure was less than 90 mmHg) was treated immediately with inj ephedrine 5 mg intravenouslyandbradycardia (defined as heart rate less than 50 beats / min) was treated with atropine 0.5-1mg given intravenously.

The duration of analgesia was assessed by using Visual Analogue Scale (VAS). VASscore was recorded postoperatively every half an hour for two hours and one hourly for four hours till the patient demanded rescue analgesia and/or VAS score ≥4. VAS score was recorded till 6^{th} hour postoperatively. Duration of analgesia was recorded as the time from intrathecal injection to patient having VAS score ≥ 4 or in need of analgesia.Rescue analgesia was given with inj diclofenac 75 mg i.m.During the surgical procedure and postoperative period any side effects like hypotension, bradycardia, nausea and vomiting, headache, pruritis etc were recorded. Nausea and vomiting were treated with 0.1mg/kg of i.v ondansetron.

RESULTS

The two groups were comparable with regard to age, male/female ratio, weight, duration of surgery (Table 1). We found that the baseline heart rate and MAP were comparable between the two groups (Table2 &3).The intraoperative mean heart rateat 15, 20, 25 and 30 minutes in group A were significantlyhigher as compared to group B ($P<0.05$). The mean heart rate at 15 min is 79.60 ± 9.91 beats/min in group A and 69.44 ± 13.51 beats/min in group B; at 20 min 80.09 ± 9.12 beats/min in group A and 72.09 ± 15.21 beats/min in group B; at 25 min 78.69 ± 9.17 beats/min in group A and 71.27 ± 11.89 beats/min in group B; at 30 min 78.60 ± 8.52 beats/min in group A and 71.51 ± 12.31 beats/min in group B. There was significant reduction of MAP at 5,10,15,20,30 minutes in group B as compared to group B (Table 3). The intraoperative mean MAP at 5 minute was 79.40 ± 8.08mmHg in group B and 85.99 ± 6.13mmHg in group A; at 10 minute 80.67 ± 9.12mmHg in group B and 87.48 ± 5.56mmHg in group A; at 15 minutes intraoperative mean MAP was 80.99 ± 8.42mmHg in group B and 87.13 ± 6.01mmHg in group A; at 20 minutes mean MAP was 79.53 ± 11.70mmHg in group B and 86.38 ± 5.22mmHg in group A; at 25 minutes mean MAP was 80.18 ± 13.72mmHg in group B and 86.56 ± 8.17mmHg in group A; at 30 minutes mean MAP was 79.42 ± 14.80mmHg in group B and 86.87 ± 7.15mmHg in group A. At 4^{th} hour postoperatively, 71.11% of patients in Group B had VAS score ≥4 or in need of analgesia when 6.67% need analgesia in group A (Table 4). At 5^{th} hour,44.44% of patients in Group A and 100 % in group B had VAS score ≥ 4 or in need of analgesia. In our study mean duration of analgesia was 419.32 ± 9.43 min in group A whereas ingroup B it was 390±9.64 min and difference was significant(Table 5). The side effects were hypotension, bradycardia, nausea and vomiting which were significantly higher in group B (Table 6).

Table 1: Demographic Characteristics

Variables	Group A	Group B	P value
Age(year)	41.00±75.56	41.53± 11.68	0.829
Male/female	75.56%	73.33%	0.809
Weight(kg)	48.16± 6.13	50.87± 7.18	0.057
Duration of op(min)	129.16±4.8	125.82± 14.96	0.158

Table 2: Heart Rate

HEART RATE (Beats/min)	Group A		Group B		p value
	Mean	± S.D.	Mean	± S.D.	
Before S.A. *(Baseline)*	77.89	11.05	79.84	15.05	0.370
Immediately after S.A. *(0 min)*	79.00	9.62	75.53	9.12	0.083
At 5 minutes	79.40	10.34	75.18	11.20	0.067
At 10 minutes	77.91	9.39	74.47	9.20	0.082
At 15 minutes	79.60	9.91	69.44	13.51	0.000
At 20 minutes	80.09	9.12	72.09	15.21	0.003
At 25 minutes	78.69	9.17	71.27	11.89	0.001
At 30 minutes	78.60	8.52	71.51	12.31	0.002
At 45 minutes	77.84	9.08	80.47	18.49	0.395
At 60 minutes	77.31	9.21	79.84	16.89	0.380
At 90 minutes	72.84	6.10	74.64	5.71	0.152
At 120 minutes	71.62	6.17	73.18	9.72	0.367

At the End of Surgery	78.53	8.76	77.91	14.45	0.805

Table 3: Mean Arterial Pressure

Mean Arterial Pressure (mmHg)	Group A		Group B		p value
	Mean	± S.D.	Mean	± S.D.	
Before S.A. *(Baseline)*	89.26	9.86	87.53	6.66	0.333
Immediately after S.A. *(0 min)*	86.41	6.90	86.84	7.67	0.781
At 5 minutes	85.99	6.13	79.40	8.08	0.000
At 10 minutes	87.48	5.56	80.67	9.12	0.000
At 15 minutes	87.13	6.01	80.99	8.42	0.000
At 20 minutes	86.38	5.22	79.53	11.70	0.001
At 25 minutes	86.56	8.17	80.18	13.72	0.009
At 30 minutes	86.87	7.15	79.42	14.80	0.003
At 45 minutes	87.81	5.50	85.07	7.94	0.060
At 60 minutes	86.60	6.38	88.19	6.41	0.241
At 90 minutes	84.33	3.99	85.22	6.62	0.443
At 120 minutes	84.84	3.92	85.46	5.48	0.537
At the End of Surgery	88.07	6.43	88.27	7.27	0.894

Table 4: Comparison of VAS score ≥ 4 at different interval

VAS score ≥ 4	Group A		Group B		p value
	N	%	N	%	
At ½ hour	0	0.00	0	0.00	–
At 1 hour	0	0.00	0	0.00	–
At 1.5 hour	0	0.00	0	0.00	–
At 2 hour	0	0.00	0	0.00	–
At 3 hour	0	0.00	2	4.44	0.153
At 4 hour	3	6.67	32	71.11	<0.001
At 5 hour	20	44.44	45	100.00	<0.001
At 6 hour	45	100.00	45	100.00	1

Table 5: Duration Of Analgesia (Minutes)

GROUP	Duration of analgesia		p value
	Mean	± S.D.	
Group A	390.48	9.64	0.001
Group B	419.32	9.43	

Table 6: Side Effects

Side Effects	Group A		Group B		P Value
	N	%	N	%	
Hypotension	0	0.00	10	22.22	<0.001
Bradycardia	0	0.00	6	13.33	0.011
Nausea & Vomiting	0	0.00	6	13.33	0.011
Headache	2	4.44	7	15.56	0.079

DISCUSSION

The difference of mean heart rate in two groups at 0, 5, 10, 45, 60, 90,120 minutes and at the end of surgery were statistically insignificant. The intraoperative heart rates at 10, 15, 20, 25 and 30 minutes in group A were significantly higher as compared to heart ratesin group B ($p<0.05$).Rahman *et al*[4] did a prospective study to assess haemodynamic effects and complications between unilateral and standard spinal anaesthesia in 60 elderly patients with low ejection fraction who were scheduled for lower limb surgery. In their study they found that the heart rate was significantly lower in conventional spinal anaesthesia at 15 and 30 min after the block as compared to unilateral spinal anaesthesia. They concluded that when unilateral spinal anaesthesia was performed with low dose and slow injection technique, provides better haemodynamic stability with adequate motor and sensory block. Casati*et al*[5] carried out a prospective, randomised, parallel group study to evaluate cardiac performance during unilateral spinal anaesthesia when compared with standard bilateral spinal anaesthesia among 30 patients undergoing elective lower limb orthopaedic surgery. They observed that the mean heart rate was significantly lower at 5, 30, 45 minutes in standard bilateral group when compared to unilateral group. Their findings were similar to our study.Srikanth *et al*[6] did a study to compare classical subarachnoid blockandunilateral subarachnoid block for lower limb surgeries. They found that incidence of bradycardia in classical subarachnoid block was 30% higher as compared to unilateral subarachnoid block.

In our study we found that there was significant decrease in intraoperative mean MAP at 5,10,15,20,25,30 minutes in group B as compared to group A. Similar to our study, Rahman *et al*[4] did a study and they found that there was significant decrease in MAP at 5, 10 and 15 minutes after the block in conventional group when compared with unilateral group. The differences were statistically significant. Tekye*et al*[7] conducted a study to compare the effects and complications of unilateral spinal anaesthesia with bilateral anaesthesia in 72 patients who were to undergo lower limb orthopaedic surgery. In their study, none of the patients in the unilateral group developed hypotension, whereas 6 patients experienced hypotension in bilateral group. Five patients in bilateral group had bradycardia, but there was no bradycardia in unilateral group ($p=0.04$). Their findings are similar to our study. Ijaz *et al*[8] did a study to compare haemodynamic effects between unilateral and bilateral spinal anaesthesia. They conducted the study on 60 patients who were scheduled for elective inguinal herniorraphy by using 0.75% hyperbaric bupivacaine. They found that there was significant fall in mean MAP in bilateral group at 15, 20, 25 and 30 minutes when compared to unilateral group. In the study conducted by Rahman *et al*[4] there was no bradycardia in unilateral group and 5 patients had bradycardia in bilateral group. They observered that none of the patients developed hypotension in unilateral group, but 6 patients in the bilateral group developed hypotension and were treated with inj ephedrine. In our study, we found that none of the patient in group A developed hypotension, but 10 patients in group B developed hypotension which was

statistically significant (p<0.001). In our study, no bradycardia in group A, but in group B 6 patients had bradycardia and difference was statistically significant (p<0.05). Akhter *et al*[9] did a study to compare haemodynamic changes between unilateral and conventional spinal anaesthesia in patients who were to undergo unilateral lower limb surgery by using 0.75% hyperbaric bupivacaine. Their findings are similar to our study.

We found that mean value of postoperative visual analogue scale at 1.5hr, 2ndhr, 3rdhr, 4thhr and 5thhr in the unilateral group were significantly lower than those in conventional group. In our study, 71.11% of patients needed rescue analgesia at 4th hour postoperatively in group B and only 6.67% in group A. The mean duration of analgesia was found to be 419.32 ± 9.43 min in group A and 390±9.64 in group B. This explains that unilateral block provides better and prolonged duration of analgesia than conventional spinal anaesthesia. Dawer*et al*[10]found that first rescue analgesia required at 9 hours after unilateral subarachnoid block and at 7 hours after standard bilateral anaesthesia. In their study mean duration of effective analgesia was 526.4±27.38 min in unilateral group and 401±34.71 min in bilateral group.Kirdemir*et al*[11]found that recovery and first analgesic demand were longer in unilateral group (479±2.52 min) than the bilateral group (468±1.69 min). Incidence of postoperative headache was found to be higher in conventional spinal anaesthesiacompared to unilateral spinal anaesthesia(7 in group B vs 2 in group A). None of the patients in group A experienced nausea and vomiting and 6 patients developed nausea(p<0.05). In the study conducted by Tekye et al[7], none of the patients in the unilateral group developed nausea and vomiting, but in bilateral group 8 patients developed nausea and one of them experienced vomiting (p=0.02).

CONCLUSION

The unilateral Spinal anaesthesia provides better haemodynamic stability and prolonged duration of analgesia with fewer side effects when compared with conventional anaesthesia.

FUNDING

None

CONFLICT OF INTEREST

None

ETHICAL APPROVAL

Taken from Jorhat Medical College and Hospital.

REFERENCES

1. Imbelloni L. The State of the Art of Unilateral Spinal Block. Rev Bras Anestesiol. 2007;57(6):589–91.
2. Imbelloni L. Spinal hemianesthesia: Unilateral and posterior. Anesth Essays Res. 2014;8(3):270–6.
3. Venkateshwarlu G, Adam A, Fathima. Compare the Efficacy of Classical Subarachnoid Block Using and Unilateral Spinal Anaesthesia. Indian J Anaesth Analg. 2017;4(2):246–53.
4. Rahman MM, Munir MMH, Raihanuddin, Shaheen SA, Khan MAS, Sardar K, et al. Haemodynamic Effects and Complications of Unilateral Spinal versus Standard Spinal Anesthesia in Elderly with Low Ejection Fraction Undergone Lower-Limb Surgery. Delta Med Coll J. 2017;5(1):20–4. 32.
5. Casati A, Fanelli G, Becarria P, Alde G, Berti M, Senatore R, et al. Block distribution and cardiovascular effects of unilateral spinal anaesthesia by 0.5% hyperbaric bupivacaine. A clinical comparison with bilateral spinal block. Minerva Anestesiol. 1998;64:307–12.

6. Srikanth A, Indurkar PS, Nagrale MH. Comparative Evaluation of Classical Subarachnoid Block,Unilateral Subrachnoid Block and Low Dose Subarachnoid Block with Fentanyl in ASA III and IV Patients Undergoing Lower Limb Surgeries. J Med Sci Clin Res. 2015;03(09):7697–705.
7. Tekye SMM, Alipour M. Comparison of the effects and complications of unilateral spinal anesthesia versus standard spinal anesthesia in lower-limb orthopedic surgery. Brazilian J Anesthesiol. 2014;64(3):173–6.
8. Ijaz N, Ali K, Afzal F, Ahmad S. Comparison of Haemodynamic Effects of Unilateral Versus Bilateral Spinal Anaesthesia in Adult Patients Undergoing Inguinal Hernia Repair. Biomedica. 2013;29:244–50.
9. Akhtar NM, Tariq S, Abbas N, Murtaza G, Nadeem Naqvi SM. Comparison of haemodynamic changes in patients undergoing unilateral and bilateral spinal anaesthesia. J Coll Physicians Surg Pakistan. 2012;22(12):747–50.
10. Dawer S, Dawer RA, Meda R, Tilkar Y. Comparison of the Effects and Complications of Unilateral Spinal Anesthesia Versus Standard Spinal Anesthesia in Lower-Limb Orthopedic Surgery. Int J Heal Clin Res. 2021;4(12):288–92.
11. Kirdemir P, Marsan A, Kirdemir V. Comparison of hemodynamic and postoperative analgesic effects and recovery of unilateral and bilateral spinal anesthesia. Neurosciences. 2006;11(1):37–40.