

Spinal Anesthesia in General Surgical Patients: Comparison of 0.75% and 0.5% Hyperbaric Bupivacaine

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ABSTRACT

Objective: To appraise clinical effects of 0.5% and 0.75% hyperbaric bupivacaine in general surgical patients undertaking procedure in spinal anesthesia employing crystalloid fluid preload / co-load.

Place and Duration: Islam Teaching Hospital, Islam Medical College, Sialkot and Rawal General and Dental Hospital, Rawal Institute of Health Sciences, Islamabad from 03-4-2012 to 18-9-2012 and from 19-9-2017 to 30-5-2018.

Methodology: The study consisted of one hundred and twenty-four cases which were divided by lottery into two equal components i.e group-1 and group-2 using 0.5% and 0.75% hyperbaric bupivacaine respectively for intrathecal block in general surgical patients. After spinal block hemodynamic monitoring continued at one-minute interval for fifteen minutes than at 5 minutes interval. Intravascular fluids colloids/crystalloid were given as preload and coload. After the procedure, monitoring continued in post-anesthesia care unit. Statistical analysis was done by SPSS version 19.

Results: In group-1 in two cases (3.22%) and in group-2 in thirteen cases(20.96%) required vasopressors. The mean systolic and diastolic blood pressure(mmHg) in group-1 being 135.70(with SD of 26.37) and 78.70(with SD of 32.5), similar readings in group-2 being 131.78(SD of 26.25) and 79.36(SD of 32.50) respectively. Pearson's Chi-square test, comparing two quantitative variables i.e. systolic blood pressure readings between both groups was performed p-value came out to be <0.05 and considered statistically significant.

Conclusion: There was no significant statistical hemodynamic difference between the two groups however in 0.5% hyperbaric solution, vasopressor and atropine need was significantly less with more stable hemodynamic profile in the study.

Keywords: Spinal Anesthesia, Hyperbaric Bupivacaine, Preload, Vasopressors, Coload.

Introduction

Historically the first spinal anesthesia for lower extremity surgery in six patients was demonstrated by August Karl Gustav Bier¹ on 16th August 1898 the agent used was cocaine. Nowadays spinal anesthesia is employed as sole anesthetic techniques for wide variety of surgical procedures. Various agents have been advocated for intrathecal use with varying pharmacological effects e.g. procaine and lidocaine with less than 90 minutes action

duration and agents like tetracaine, bupivacaine, and levobupivacaine with long duration of action. In general, progress of neuraxial anesthesia is related to diameter, degree of myelination and conduction velocity of affected nerve fibres and clinically, the order of loss of nerve function is first pain followed by temperature, touch, proprioception and lastly skeletal muscle tone is abolished. Among the local anesthetics commonly used agent is bupivacaine hydrochloride which is 1-Butyl-2'6'-

pipecoloxylidide monochloride, monohydrate, a white crystalline powder that is freely soluble in 95 percent ethanol, soluble in water, and slightly soluble in chloroform or acetone and related pharmacologically and chemically to aminoacyl local anesthetics group. Each ml of hyperbaric bupivacaine spinal contains 7.5 or 5 mg/ml bupivacaine hydrochloride and 82.5mg dextrose. The pH is(4.0 to 6.5). In study by Solakovic N² on sensory height level employing isobaric and hyperbaric 0.5% bupivacaine stated that amount of block with hyperbaric 0.5% bupivacaine is adequate for most operative procedures while plain isobaric 0.5% concentration is more suited for procedures requiring up to thoracic tenth sensory block level. Uppal V, Retter S³ and colleagues did a meta-analysis in non-obstetric surgical procedures stating that hyperbaric as compared to isobaric provide quick motor block but shorter duration of sensory as well as motor block although both forms provided satisfactory anesthesia with no difference in adverse effects. A study by Amjad QUA, Sharif A and Khan A⁴ on comparison of 0.5% and 0.75% concentrations of hyperbaric bupivacaine in spinal cesarean delivery pointed that 0.5% solution provided adequate level of sensory block and patient comfort although hemodynamic parameters showed no significant difference in both groups.

As stated bupivacaine is a popular anesthetic agent and there are few studies regarding dose and percent concentration variation in general surgical patients and furthermore the difference in concentration of hyperbaric bupivacaine results in variable diffusion patterns and clinical effects. We, therefore, conducted a study to foresee clinical hemodynamic effects(systolic blood pressure, pulse rate changes) of 0.5% and 0.75% hyperbaric bupivacaine concentration in general surgical patients undergoing procedures in spinal anesthesia. Secondary outcome parameters noted were a vasopressor need, atropine usage and respiratory distress. Sensory level and associated complications like nausea, vomiting, and high spinal block were also recorded.

Methodology

After hospital ethical committee consent the study was completed at Islam Teaching Hospital, Islam Medical College on Pasroor Road, Sialkot and at Rawal General

and Dental Hospital (Rawal Institute of Health Sciences, Islamabad) from 03-4-2012 to 18-9-2012 and from 19-9-2017 to 30-5-2018 respectively. The patients had pre-operative anesthesia evaluation and assessment including review done by associated medical and cardiology departments as needed along with an examination of patients back for any anatomic deformity. The study consisted of one hundred and twenty four cases which were divided by lottery method into two equal components i.e. group-1 and group-2 using 0.5% and 0.75% hyperbaric bupivacaine respectively and cases belonged to American Society of Anesthesiologist grades⁵(ASA) I,II,III and medically optimized class IV patients. Informed written consent was obtained. Exclusion criteria included patients with general contraindications for spinal anesthesia, e.g., hypovolemia, fixed cardiac output states, coagulopathy and local infection. Patients were received in the pre-operative area by nursing staff. In operation room anesthesia machine was checked and recording of baseline blood pressure, pulse oximetry saturation and heart rate was done. Two large bore intravenous lines were secured. Patients were placed in sitting position and were given intra-thecal block with 25g quincke spinal needle after standard pyodine scrubbing and wiping off clean. Plain 1% lidocaine 3ml local infiltration was done. Hyperbaric bupivacaine (0.5 or 0.75%) was given after ascertaining aspiration of cerebrospinal fluid, confirming entry into sub-arachnoid space. After block patients were placed supine and monitoring of heart rate and non-invasive blood pressure continued at one-minute interval for fifteen minutes than at 5 minutes interval along with monitoring pulse oximeter saturation throughout the case. Supplemental facemask oxygen given for saturation level < 95% on ambient air. The sensory level was assessed with alcohol swabs and motor block by modified bromage scale by Breen TW, Shapiro T⁶and colleagues at two-minute interval for 15 minutes. Intravascular fluids colloids/crystalloid were given as preload⁷ and coload⁸. After procedure care of spinal anesthesia and monitoring continued in post-anesthesia care unit. Statistical analysis was done by SPSS version 19. Comparison between two quantitative variables i.e. systolic blood pressure readings between both groups was performed with Pearson's Chi-square test. P-value <0.05 was considered to be statistically

significant. Mean \pm S.D, frequencies and percentages were presented for variables e.g. age, gender and sensory levels, vasopressor needs, and associated complications in the study.

Results

The study demographics are depicted in table I. In table II operative surgical procedures data of both groups is shown. The intravenous fluid administered in the study in group-1 were crystalloid in 60cases i.e., in 96.77% and colloid fluids along with crystalloids were used in 2cases i.e, in 3.22%. Similar fluid data in group-2 being 52 cases(83.87%) and 10 cases (16.12%) was noted. The crystalloid fluid was given as coload and preload in 55cases (88.70%) and 7 cases (11.29%) in group-2, similar readings in group-1 being 60 cases (96.8%) and two cases(3.22%) respectively. Colloid fluids were needed as coload in 9 cases (14.5%) in group-2 and in group-1 in one case(1.6%) only.

		Group-1	Group- 2
		(number / percent)	
Age in years	Mean / SD	48.98/17.87	48.43/16.15
	Minimum	25	25
	Maximum	90	75
Hemoglobin.g m/dl	Mean / SD	12.85/2.27	13.10/2.47
	Minimum	9.60	8.30
	Maximum	17.70	19.50
American Society of Anesthesiologist physical status	Class – 1	43/69.4	52/83.9
	Class – 2	9/14.5	5/8.1
	Class – 3	7/11.3	5/8.1
	Class – 4	3/4.8	0/0
Gender	Males	11/17.74	16/25.80
	Females	51/82.25	46/74.19
Co-morbids	Diabetes Mellitus	7/11.3	5/8.1
	Hypertension	9/14.5	9/14.5
	Diabetes/Hypertension	1/1.6	1/1.6
	IHD	1/1.6	-/-
	Rheumatoid Arthritis	1/1.6	-/-
	Malignant neoplasm	1/1.6	-/-
	Hyperthyroid	1/1.6	-/-

The mean dose(mg)of hyperbaric bupivacaine in group-1 being 14.17(SD of 3.62) and in group-2 being 14.66(SD of 3.5) respectively. The sensory level of block in the study are depicted in table III.

Operative procedures	Group-1		Group-2	
	Number	Percent	Number	Percent
Paraumbilical hernia	-	-	2	3.22
Vaginal hysterectomy	1	1.61	2	3.22
Hemorrhoids/ anal fissure	5	8.06	8	12.90
Brodie abscess tibia	1	1.61	-	-
Perianal fistula/fissure in ano	3	4.83	5	8.06
Inguinal hernia	7	11.29	20	32.25
Arthroscopy	4	6.45	2	3.22
Hydrocoele	-	-	1	1.61
Urethroplasty	3	4.83	-	-
Cystoscopy / urethral stricture	8	12.90	-	-
Post turp bleeding	1	1.61	-	-
External fixator tibia	1	1.61	-	-
Pilonidal sinus	1	1.61	1	1.61
Vericose veins	1	1.61	2	3.22
Talonavicular fracture	1	1.61	-	-
Total abdominal hysterectomy	-	-	2	3.22
Leg amputation diabetic below knee	-	-	3	4.83
Swelling gluteal region	1	1.61	-	-
Wound debridement	1	1.61	-	-
Bilateral testicular biopsy	2	3.22	-	-
Benign prostatic hypertrophy transurethral	3	4.83	2	3.22
Vericocoele	2	3.22	4	6.45
Hypospadias repair	1	1.61	-	-
Hip replacement	1	1.61	-	-
Fracture neck of	4	6.45	2	3.22

femur				
Testicular biopsy infertility	1	1.61	-	-
Missed abortion	-	-	1	1.61
Foreign body foot	-	-	1	1.61
Fracture calcaneous	1	1.61	-	-
Fracture tibia/fibula	2	3.22	2	3.22
Missed abortion			-	-
Ca bladder bilateral orchidectomy	1	1.61	-	-
Rectal prolapse	-	-	2	3.22
Uterovaginal prolapse	-	-	-	-
Fracture femur	3	4.83	-	-
Carcinoma bladder	2	3.22	-	-

Table III: Sensory block level data.

Thoracic Sensory Block Level	Group -1		Group -2	
	Frequency	Percent	Frequency	Percent
T6 Sensory	22	35.5	13	21
T8 Sensory	35	56.5	45	72.6
T10 Sensory	5	8.1	4	6.5

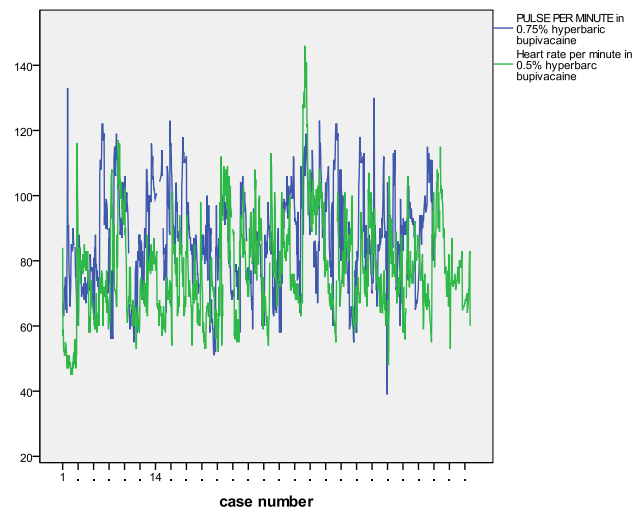
In group-1 in two cases (3.22%) and in group-2 in thirteen cases(20.96%) vasopressors were required to counter sympathetic block associated hypotension. Whereas atropine was given in group-1 in eight cases (12.9%) and in group-2 in thirty three cases (53.22%) respectively. There was no complain of nausea and vomiting associated with intra-thecal block in both groups in the study. In group-1 in thirty-three cases (53.2%) supplemental facemask oxygen was given while in group-2 in twenty-nine cases (46.8%), it was used. Respiratory distress managed by tight face mask assisted ventilation. It was used in one (1.6%) case in group-2 for a minute period. The mean systolic and diastolic blood pressure(mmHg) in the group -1 being 135.70(with SD of 26.37) and 78.70(with SD of 32.5), whereas the respective median and mode readings being 134 and 135

systolic and 76 and 70 diastolic readings in mmHg. In group-2 mean systolic and diastolic blood pressure(mmHg) being 131.78(SD of 26.25) and 79.36(SD of 32.50) respectively with median and mode systolic readings noted being 128 and 126 mmHg the diastolic similar readings being 79 and 61 mmHg. Pearson's Chi-square test is shown in table IV. The P-value came out to be 0.01 and of significance. Heart rate variations are depicted in graph-1.

Table IV: Chi – square test.

	Value	Df	Asymp.Sig.(2-sided)
Pearson Chi – square	11896.174 ^a	11312	.000
Likelihood Ratio	2801.67	11312	1.000
Linear – Linear Association	11.414	1	.001

^a11526 cells (100.0%) have expected count less than 5. The minimum expected count is .00

**Figure 1. Heart rate variations.**

Discussion

Spinal anesthesia avoids general anesthesia associated issues such as airway instrumentation, pulmonary aspiration, polypharmacy along with attenuation of stress response and providing skeletal muscle relaxation and analgesia, thus Spinal block has become an important armamentarium of an anesthesiologist with the development of vigilance to anticipate and adequately respond to its sequelae. Runza M, Albani A⁹ and colleagues did a comparison of 0.75% and 1% bupivacaine and

observed that 0.75% concentration provide better anesthetic effects and few post-operative problems as compared to 1% concentration. A study done by Vernhiet J, Cheruy D¹⁰ and colleagues stated that isobaric bupivacaine was associated with lower incidence of hypotension in comparison to hyperbaric, while few other studies^{11,12} also noted a higher incidence of hypotension with use of hyperbaric agent in intra-theatal block. In comparison, few studies¹³ pointed similar incidence of hypotension between isobaric and hypobaric agents. A single case of vasovagal shock after the spinal block was seen in each group, which was immediately managed by simultaneous leg raising to increase venous return, supplemental facemask oxygen administration and intravenous atropine 0.5 to 1mg. In group-1 in one case (1.6%) premature ventricular contractions were noted after spinal. In group-2 in single case complained of itching, epigastric discomfort and missed beat with long interval which were managed accordingly. There were no neurological complication or deficit noted in the post-operative follow up of the cases in study.

In study by Nair GS, Abrishami A¹⁴ and colleagues reviewing literature regarding clinical course and recovery profile employing bupivacaine for knee arthroscopy stated that lower dose of hyperbaric bupivacaine employed as a unilateral spinal technique is effective and larger dose of 10 to 15 mg was associated with delayed recovery profile and failure rate was also increased with supine positioning after spinal block. Vanno O, Chumsang L and Thongmee S¹⁵ in their study of the spinal block for urological procedures comparing 2.5ml 0.5% isobaric and hyperbaric bupivacaine concluded that they both agents have equal potency as regards onset and duration of sensory block time. The median effective dose of bupivacaine for effective motor block after spinal anesthesia in patients undergoing lower extremity surgery employing varying bupivacaine concentration i.e. 0.375% and 0.75% was noted to be 8.89mg and 9.99mg respectively in study conducted by Chen MQ, Chen C, and Ke QB.¹⁶ In another study by Chambers WA, Little wood DG¹⁷ and colleagues on effect of 0.5 and 0.75% hyperbaric concentration hyperbaric bupivacaine and volume administered intrathecally, they noted that increasing volume of 0.75% solution resulted in greater cephalad spread and higher sensory level achieved with

no such effect in 0.5% concentration. They stated that increasing volume of both resulted in longer duration of action while use of 0.75% concentration had no clinically significant effect compared to 0.5% solution.

The circulatory etiology of asystole seen after spinal anesthesia in some way or other is interrelated with sympathetic blockade¹⁸. The heart sympathetic outflow come out from C5 to Th5 level with ventricular main supply from Th1 to Th4. During ongoing decrease in venous return, there may be a sudden fall in blood pressure, heart rate and peripheral vascular resistance. A study done by Mirt K, Vesna K¹⁹ concluded that cardiac output decrease after spinal block countered by pushing crystalloid solution i.e coload, the technique used in our study. After spinal block when bradycardia is the first presenting sign of atropine usage may lower incidence of cardiac arrest associated with spinal anesthesia.²⁰ This strategy was employed in our study.

Limitations: The study was not on a large national scale to address hemodynamic stability of 0.5% concentration compared to 0.75% hyperbaric solution.

Conclusion

There was no significant statistical hemodynamic difference between the two groups however in 0.5% hyperbaric solution vasopressor and atropine need was significantly less with more stable hemodynamic profile in the study. There is a strong need to continue vigilant monitoring of pulse, blood pressure, conscious level and ventilatory status after spinal block to avoid untoward events with availability of emergency trolley..

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