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Comparing the Effects of Different Volumes of 0.5% Hyperbaric Bupivacaine in Subarachnoid Blockade

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ABSTRACT

Background: Spinal subarachnoid block is a preferred alternative to general anesthesia. We aimed to evaluate the anesthetic effect of different volumes of intrathecal administration of 0.5% bupivacaine in 8% dextrose and effect on hemodynamic parameters of the patient. **Methods:** This study was performed in the Department of Anesthesiology, DY Patil School of Medicine, Navi Mumbai from January 2014 till January 2015. We divided 75 patients, of American Society of Anaesthesiologists' (ASA) grade I and II, in to three groups, and received 2ml, 3 ml and 4 ml of 0.5% heavy bupivacaine with 8% glucose in the subarachnoid space respectively. The onset of anesthesia was noted, maximum height of analgesia, onset of motor block, degree of motor block and the maximum time required to obtain motor blockade was observed every two minutes. Hemodynamic parameters like pulse and systolic blood pressure were recorded. **Results:** All three groups had onset of anesthesia between 2 to 3 minutes and the difference of onset between the three groups was insignificant. There was no difference between the three groups with regards to time to attain maximum height of anesthesia and duration of two segment regression of sensory blockage. Increasing volume of bupivacaine was associated with increasing mean duration of complete sensory regression and complete motor blockade. There was a significant fall in systolic blood pressure 15 minutes after spinal block. **Conclusion:** Total duration of analgesia and motor blockade was noted with noted with higher volumes of bupivacaine. Higher hemodynamic instability was observed with higher volumes of hyperbaric bupivacaine. Future studies are needed to support our findings.

Keywords: spinal anesthesia, bupivacaine, outcomes.

INTRODUCTION

Recently, spinal subarachnoid block has emerged as a preferred alternative to general anesthesia and is used in a variety of lower abdomen and lower limb surgeries. Studies have suggested that spinal subarachnoid block blunts the stress response to surgery and decreases intraoperative blood loss and the incidence of postoperative thromboembolic events.[1] It is also seen as a safer option in patients with concurrent respiratory disease in obese and elderly patients. Gluccal spinal analgesia were introduced in 1907.[2] Baricity of a local anesthesia is one of the major determinants of its spread into the CSF and addition of glucose makes the solution hyperbaric. Bupivacaine is one of the most widely used local anesthetics for spinal anesthesia. It provides adequate anesthesia and analgesia for intermediate-to-long-duration operating room cases and has a low incidence of transient neurological symptoms. Bupivacaine is often available as 0.75% in 8.25% dextrose. Other forms of spinal bupivacaine include 0.5% with or without dextrose and 0.75% without dextrose. Although the effects of concentration and volume of hyperbaric bupivacaine have been studied by various workers, some debate continues regarding the effects of different volumes.[3] In this study we aimed to evaluate the anesthetic effect of different volumes of intrathecal administration of 0.5% bupivacaine in 8% dextrose and effect on hemodynamic parameters of the patient.

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MATERIALS AND METHODS

Study Design and Setting

This study was performed in the Department of Anesthesiology, DY Patil School of Medicine, Navi Mumbai over a period of one year. We divided the patients in to three groups of different volume of bupivacaine. Patients of Group I received 2ml, Group II 3 ml and Group III 4 ml of 0.5% heavy bupivacaine with 8% glucose in the subarachnoid space. The study was approved by the institutional ethics committee and informed written consent was

obtained from all patients before they were included in the study.

Sample population

We included 75 patients who were American Society of Anaesthesiologists' (ASA) grade I and II between the age of 20 to 60 years who were posted for elective surgery under spinal subarachnoid block. We specifically included patients who were scheduled to undergo inguinal hernia repair and hydrocele surgery. We excluded patients with chronic conditions or organic systemic diseases, with local skin infections, bleeding or clotting disorders, neurological diseases, chronic backache or spinal deformities and those who refused consent.

Data Collection and Data Analysis

After inclusion in the study, patients were randomly assigned a group, so that each group comprised of 25 patients. Detailed medical and surgical history was obtained along with their physical characteristics like height and body weight. Routine and specific investigations were done as and when required in certain cases. No premedication was given till the patients were tested for maximum sensory block. Hemodynamic parameters like pulse and systolic blood pressure were recorded for the patients, before and during the surgery. Lumbar puncture was performed with 22 gauge lumbar needle in L3-L4 vertebral space in all patients. The onset of anesthesia was noted as the loss of sensation to pin prick on dorsum of foot. Similarly, the maximum height of analgesia was also noted as loss to pin prick on the corresponding dermatome in the anterior axillar line and the time required to achieve the same after spinal injection was also noted as time required to achieve maximum height of analgesia. Furthermore, onset of motor block, degree of motor block and the maximum time required to obtain motor blockade was observed every two minutes. The degree of motor blockade was graded according to modified Bromage scale. Regression of motor block was observed simultaneously till complete recovery. Duration of complete motor blockade was recorded from the time of complete motor blockade to the time at which patient was able to flex the ankle joint and first toe. Hemodynamic parameters like pulse and systolic blood pressure were recorded preoperatively and after spinal block every five minutes for the first 30 minutes and then every 10 minutes till one hour and then every half hour till the end of the surgery.

Time for two segment regression of analgesia was noted when the sensation to pin prick was determined two segment below the maximal level of dermatome which was achieved after spinal block. The time interval between the time of maximum height of analgesia which was attained and this regression time was taken as the time for two segment regression of analgesia. Time at which the sensation to pin prick at S2 segment i.e. posterior aspect of leg was determined and time interval of intrathecal injection of the drug was taken as the time for complete sensory regression of analgesia upto S2 segment. Patients were observed for 24 hours for any complications.

The data were codified and analysed in SPSS version 23 for windows. Quantitative data were presented as means and standard deviations and qualitative data were presented as frequency distribution tables. Analysis of variance was used to compare two or more groups. Paired t test was used to compare pre and post operative measures. P value less than 0.05 was considered as statistically significant.

RESULTS

Table 1: Physical characteristics of patients included in the study

Total patients	**75**
Variable	**N (%)**
Age distribution	
20-30 years	16 (21%)
31-40 years	19 (25%)
41-50 years	26 (35%)
51-60 years	14 (19%)
Height of patients (in cms)	
140-150	3 (4%)
151-160	9 (12)
161-170	48 (64%)
171-175	15 (20%)
Weight of the patients (in kgs)	
40-50	12 (16%)
51-60	40 (53%)
61-70	21 (28%)
71-80	2 (3%)
Type of surgery	
Inguinal hernia	40 (53%)
Hydrocele	33 (44%)
Inguinal hernia and hydrocele	2 (3%)

In the present study 75 male patients were included. 41 to 50 years was the most common age group involved in the study [Table 1]. Height of the patients ranged from 140 to 175 cms and weight ranged from 40 to 80 kgs. Inguinal hernia repair was the most commonly performed surgery on the study patients (53%). 44% underwent hydrocele surgery and 3% both hernia and hydrocele surgery. Mean age in all three groups was comparable ($p = 0.89$). Similarly, height and weight of the patients comparable among the groups [Table 2]. There was no statistical difference in the duration of surgery in the patients in the three groups. All three groups had onset of anesthesia between 2 to 3 minutes and the difference of onset between the three groups was insignificant ($p = 0.61$). Time required to attain maximum height of anesthesia ranged between 6 to 20 minutes and there was no significant difference between the groups ($p = 0.29$). Furthermore, we found that the mean duration of two segment regression of sensory blockade was similar in the

three groups (p = 0.53). Mean duration of complete sensory regression (upto S2) was 130.12 ± 13.43, 200.8 ± 21.14 and 230.6 ± 24.55 minutes in Group I, II and III respectively. This increase in the mean duration with increase in dosage was statistically significant (p <0.001). Similarly, mean duration of complete motor blockade in group I was 10.54 ± 2.6 minutes. In group II, 22 patients had complete motor blockade, and the mean duration was 8.6 ± 2.7 minutes. In group III all 25 patients had complete motor blockade with a mean of 6.24 ± 2.08 minutes. This decrease in the mean duration with increasing dosage of anesthesia was statistically significant (p <0.001).

Table 2: Baseline description of patients in the three groups

	Group I*	Group II*	Group III*	p value
Age (years)	42 ± 11.82	42.68 ± 10.70	43.4 ± 9.12	0.89
Height (cms)	166.52 ± 5.8	165.48 ± 6.6	166.4 ± 5.14	0.79
Weight (kg)	59.04 ± 6.24	56.72 ± 7.2	58.28 ± 6.0	0.44
Duration of surgery (minutes)	53.32 ± 16.24	53.40 ± 13.82	51 ± 10.50	0.784
Time for onset of analgesia (minutes)	2.46 ± 0.43	2.4 ± 0.43	2.34 ± 0.42	0.616
Time to attain maximum height of anesthesia (minutes)	13.4 ± 3.6	12.76 ± 3.0	11.88 ± 3.5	0.293
Duration of two segment regression of sensory blockage (minutes)	83 ± 8.33	85.4 ± 13.83	86.72 ± 12.5	0.53
Mean duration of complete sensory regression (upto S2) (minutes)	130.12 ± 13.43	200.8 ± 21.14	230.6 ± 24.55	<0.001
Mean duration of complete motor blockade (minutes)	10.54 ± 2.6	8.6 ± 2.7	6.24 ± 2.08	<0.001

*all values are mean ± standard deviation

Table 3: Intraoperative changes in systolic blood pressure

	Group I N (%)	Group II N (%)	Group III N (%)
No change	6 (24%)	3 (12%)	0 (0%)
Less than 20% of basal	17 (68%)	15 (60%)	7 (28%)
More than 20% but less than 30%	2 (8%)	7 (28%)	13 (52%)
More than 30% of basal	0 (0%)	1 (4%)	5 (20%)

Table 4: Mean systolic blood pressure in the three groups

	Group I	Group II	Group III	p value
Before spinal block (mm of Hg)	120.4 ± 9.34	125.44 ± 9.99	124.8 ± 11.94	0.187
15 mins after spinal block (mm of Hg)	108.56 ± 12.45	105.44 ± 8.35	94.4 ± 10.10	<0.0001

In the study, we found that the 68% of the patients of Group I and 60% of the patients of Group II had less than 20% change in systolic blood pressure intra-operatively. However, 52% of the patients of Group III had more between 20 to 30% change in the intra-operative systolic blood pressure [Table 3]. Moreover, there was a significant fall in systolic blood pressure after spinal block. Greater fall was observed in the patients of Group III [Table 4]. No patient had hypotension or bradycardia in the post-operative period. One patient in Group II had post-spinal headache which was treated with analgesic and proper hydration.

DISCUSSION

This study was conducted to evaluate the anesthetic effects of 2ml, 3ml and 4ml of 0.5% hyperbaric bupivacaine in 75 patients scheduled to undergo hernia repair and hydrocele surgery. Veering et al reported that ageing results in slightly higher level of analgesia, increased time for maximum cephalad spread and faster onset of motor blockade with 0.5% hyperbaric bupivacaine.[4] In our study, we found that different volumes of hyperbaric bupivacaine had no effect on the speed of onset of analgesia, which has also been reported by previous authors.[5] The present study also did not find any significant difference in the time duration for maximum cephalad spread of analgesia with different volumes and the range was between 6 to 20 minutes in all patients. Previous studies have reported similar spread times.[6] Additionally, Bigler et al noted a mean time of spread of 21 minutes with both 0.5% isobaric and hyperbaric bupivacaine.[7] The choice between isobaric and hyperbaric is one of the numerous technical factors that determine the clinical effects of subarachnoid block. However, previously studies have shown that factors such as barbotage and the level of injection may not make a difference to the clinical outcome in terms of success or failure, and cardiovascular effects in the patients.[8]

Findings of our study found an increase in the maximum height of analgesia with increasing volume of drug used. Chambers et al in heir comparative study with 3ml of 0.5% bupivacaine without glucose and with 5% and 8% dextrose observed that the maximal spread of analgesia was upto T9-T10 in isobaric group, T7 in 5% dextrose group and T5 in 8% dextrose group.[9] However, their study did not find any significant change in the level of analgesia with increasing volume of drug. The position of the patient while administering the block also determines the level achieved as shown previously. Furthermore, we studied the sympathetic block by clinical observations lie monitoring of blood pressure in intra-operative and post-operative period. Patients in our study had an increased incidence of hypotension with increasing volumes,

though patients responded well with vasopressors, oxygen therapy and perioperative intravenous fluids. There are a few limitations of our study. Small sample size of our study limits the generalizability of the results of this study. Secondly, other factors which might have affected duration of spinal anesthesia like nutritional status of the patient, electrolyte, and anatomical deformity were studied in this research.

CONCLUSION

Higher hemodynamic instability was observed with higher volumes of hyperbaric bupivacaine. Total duration of analgesia and motor blockade was noted with noted with higher volumes of bupivacaine. Future studies are needed to support our findings.

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