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Original Article

Comparison of Two Different Doses of Hyperbaric Bupivacaine (0.75%) in Attaining the Highest Sensory Level in Supine Versus Prone Position After Spinal Anaesthesia for Percutaneous Nephrolithotomy

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Abstract

Background: To compare proportion of the patients with attainment of sensory level T4, at 5 and 10 min supine, and after 10 min prone amongst patients receiving 22.5 mg bupivacaine with those receiving 30 mg.

Methods: In this randomized clinical trial patients (n=60), undergoing percutaneous nephrolithotomy, were included. It was done to compare the achievement of sensory level T4 during PCNL after spinal anaesthesia with two doses of bupivacaine before and after positioning patients in prone position. Patients were grouped into: Group A (22.5 mg hyperbaric Bupivacaine 0.75%) versus Group B (30 mg hyperbaric Bupivacaine 0.75%) consisting 30 patients each. Spinal anaesthesia was performed while sitting. Sensory level was checked using ice-cube in mid-axillary line while patients were positioned supine and prone.

Results: Number of patients with T4 level at 5 min and 10 min supine in Group B was much higher than in Group A ($p<0.001$). In comparison of attainment of T4 level in supine and after 10 min of prone position, more number of patients achieved the level after 10 minutes of prone position in contrast to Group A and it was statistically significant ($p<0.001$).

Conclusion: Positioning in prone extends the sensory level of spinal anaesthesia to higher level (T4) when 22.5 mg of hyperbaric bupivacaine is used and hence reduced dose can be given efficiently and safely for the procedure.

Key Words: Bupivacaine, Spinal anaesthesia, Percutaneous nephrolithotomy

Introduction

Anaesthesiologists care for the surgical patients in the preoperative, intraoperative and postoperative period. Perioperative anaesthesia has made many different and difficult surgeries possible with significantly reduced morbidity and mortality. Among those, one of the procedures in the treatment of nephrolithiasis is percutaneous nephrolithotomy (PCNL). PCNL is the management of choice for large renal calculi, staghorn stones, and stones that are not amenable to lithotripsy.[1,2] Anaesthesia for PCNL can be general or regional.[3] Regional anaesthesia has many advantages over general anaesthesia in the abdomen and extremities including avoidance of anaphylaxis that may be caused by the later due to the use of multiple drugs.[4,5] Complications of general anaesthesia such as pulmonary collapse, vascular, and neurologic injuries (brachial plexus injury or spinal cord injury), or airway related complications especially during change of the position are more likely than of spinal anesthesia.[6,7]Surgery done in prone position causes anaesthetic issues.Prone position after general or regional anaesthesia brings certain hemodynamic changes due to a decrease in cardiac index[8] and control of airway may be an issue. Careful administration of anaesthesia and watchful monitoring intraoperatively avoids this problem. Operative techniques are successfully being done, while patients are prone following spinal block. This removes the need to intubate and avoids the drugs employed in general anaesthesia. An exact volume of local anaesthetic drug for spinal block to patients positioned prone has not been clearly stated.[8]

There have not been many studies conducted to find out the effectiveness of different doses of hyperbaric bupivacaine with special reference to prone positioning during PCNL. Shrestha BR,et al[8] investigated to see the level of sensory block in supine and prone position in two groups of patients undergoing PCNL in spinal anaesthesia,with two different volumes of hyperbaric bupivacaine. One group (A) received three ml while other group (B)

received four ml of hyperbaric bupivacaine in subarachnoid block. They concluded that three ml of hyperbaric bupivacaine for spinal anaesthesia is sufficient for surgery in prone position where the sensory level need not be more than T4 level and that the prone positioning extends the sensory level of subarachnoid block to higher level (T4) when three ml of drug is used.

Patients and Methods

This prospective randomized comparative study was conducted by the Department of Anaesthesia at Benazir Bhutto Hospital, Rawalpindi, from August 2016 to January 2017. All the patients (n=60), undergoing percutaneous nephrolithotomy, were included The inclusion criteria was, age from 30-50 years, ASA I and II, body weight of 45-80 kg and minimum height of 150 cm. Exclusion criteria was ASA III or more, patients with history of coagulopathy, ingestion of antiplatelet drugs and infection on their back at the site of lumbar puncture,patients with deformed spine and ineffective or partial spinal block not reaching the desired sensory level of T5-6 and needing general anesthesia afterwards. Randomization was done through random number list already generated using SPSS software version 22 equally but randomly allocating 60 patients either group A for bupivacaine dose 22.5 mg or group B for Bupivacaine 30 mg. Thirty patients in group A received 22.5 mg of hyperbaric bupivacaine (0.75%) for spinal anaesthesia by a consultant anaesthesiologist while 30 patients of group B received 30 mg of the same drug. Spinal anaesthesia was given in sitting position with full aseptic precautions using 25 G Whitacre spinal needle at L3-4 intervertebral space. Patients were kept in supine position for some time. Hemodynamic parameters were recorded at different time intervals of 1, 5 and 10 minute following spinal block while they were supine and first 10 minute of prone positioning. Attainment of sensory level T4 was checked along the mid-axillary line on both sides using ice-cube at the time interval of 5 and 10 minute while patients remained in supine position. For each patient, position was changed from supine to prone position and at 10 minute following change of position to prone, Attainment of sensory level at T4 was rechecked.To facilitate venous drainage and have abdomen free, two bolster rolls were kept at two different sites- one at the xiphisternum and other one at iliac crest level. The highest sensory levels achieved in supine position and at 10 minutes of prone positioning were recorded. Heart rate less than 50/minute and mean arterial pressure (MAP) drop more than 30% of the baseline value were managed with anticholinergics and crystalloid/vasopressor (phenylephrine) respectively. The end point of this study was the 10th minute after turning patients to prone position and the sensory level of T4 achieved at this point of time was regarded as the highest level of sensory block in this study. Any adverse events if occurred during the procedure were noted and managed accordingly.

Results

A total of 60 patients were included in the study with 30 in each group. There were 42 male patients in the study while 18 patients were female. Gender distribution is given below.Mean age in group A was 37.93±5.27. In group B mean age was 40.46±6.22 (Table 1).

Table 1: Age Distribution

	Mean±SD				
Parameter	Group A	Group B	Mean difference	p-value	Significance
Age(Years)	37.9±5.27	40.4±6.2	2.53	.095	Not Significant

The number of patients attaining the T4 sensory level at 5 minute in Group B was significantly higher than in Group A ($p<0.001$). After 10 minutes of spinal block total of 27 out of 30 patients in Group B reached the T4 sensory level while being in supine which was higher than in Group A (8 patients) and the difference was statistically significant ($p<0.001$) (Table 2).

Comparing attainment of T4 level in supine and after 10 minutes of prone position, more patients attained the level after 10 minutes of prone position as compared to supine position in Group A and the difference was statistically significant ($p<0.001$). This relation did not hold consistent in Group B and the difference was not significant statistically (Table 2). After keeping the patients in prone position in 10 minutes, the number of patients reaching T4 level was found to be 30 from 8 in Group A whereas it was 30 in Group B which was not significant statistically ($p=0.08$) (Tables 3). This shows that 22.5 mg of hyperbaric bupivacaine in spinal anaesthesia is similar in effect to produce the same level of anaesthesia as does 30 mg of the drug once kept in prone position. More of anticholinergics were used to correct the heart rate in group B. The blood pressure decreased more in Group B at 10 minutes which further decreased following prone positioning in group B. More of vasopressors were used to increase the blood pressure in group B (Table 4&5).

Table 2- Frequency of Patients with sensory level T4 in two groups

Group	Patients with sensory level T4 after 5 min in supine position	Patients with sensory level T4 after 10 min in supine position	Patients with sensory level T4 after 10 min in prone position	
A(n=30)	3/30	8/30	30/30	P<0.001
B(n=30)	19/30	27/30	30/30	p=0.08
p-value	P<0.001	P<0.001		

Table 3 – Heart rate per minute in two groups

Group	Baseline value	At 5 min supine	At 10 min supine	At 10 min prone
A	87±5.69	79±9.22	76±9.53	73±9.40
B	85±5.73	75±5.44	67±4.37	62±9.41
p-value	0.236	0.051	<0.001	<0.001

Table 4: Systolic blood pressure in two groups

Group	Baseline value	At 5 min supine	At 10 min supine	At 10 min prone
A	132±7.36	118±9.38	110±9.35	98±6.35
B	133±6.75	109±8.75	97±7.26	88±5.50
p-value	0.549	<0.001	<0.001	<0.001

Table 5: Diastolic blood pressure in two groups

Group	Baseline value	At 5 min supine	At 10 min supine	At 10 min prone
A	85±4.10	77±6.13	70±5.88	63±4.68
B	85±4.06	71±4.28	64±3.97	56±4.31
p-value	0.777	<0.001	<0.001	<0.001

Discussion

This study shows that patients receiving 22.5 mg local anaesthetic in spinal anaesthesia exhibited superior spread of level up to T4 after positioning them prone for 10 minutes while those receiving 30 mg of the drug demonstrated sensory distribution up to the same level even when supine. As stated otherwise 22.5 mg of hyperbaric bupivacaine was shown to be as effective as 30 mg of the drug in spinal block to achieve the sensory level, T4. In two groups, median age was not statistically different. Age difference may cause local anaesthetic distribution according to Cameron AE et al who showed that the greater the age the more rostral the spread of the block. [9] Gender of a patient has no direct impact on spread of local anaesthetic solution in the cerebrospinal fluid (CSF).[10]The procedural technique of spinal anesthesia were kept uniform for all patients. These factors could impact on the local anaesthetic spread in the CSF.[11]The local anaesthetic injected in the CSF gets fixed to the receptors in 10 to 25 minutes after giving the highest sensory height before regression of the block begins.[12]

The more rostral spread of sensory anaesthesia while prone that we observed in this study could be due to swinging motion of CSF during positioning of patients from supine to prone with change of spinal curvature and obstruction to venous outflow from abdominal compartment causing venous engorgement in epidural space and relative upward flow of CSF.[8] This phenomenon was seen in group A, more than in Group B, as with higher dosage of local anaesthetic the receptors might have been preoccupied in supine position.

To perform PCNL the level attained with 22.5 mg of hyperbaric bupivacaine was more than enough for the patients going to be in prone position after 10 min being supine with relatively stable haemodynamics than with 30 mg of the same agent for spinal anaesthesia which could produce higher sensory and autonomic blockade leading to significant bradycardia and hypotension. The major haemodynamic changes are further exaggerated by the decreased cardiac index of prone position.[13] It is suggested that the physiologic impact of prone position on cardiorespiratory system is minor so long as the abdomen is not compressed.[14]

In our study there was more need of crystalloids, vasopressors and anticholinergics in patients of group B to correct the resulting decreased heart rate and blood pressure. This is in accordance with the study done by Shrestha BR et al.[8] Spinal anaesthesia is relatively easy to perform, has many advantages over general anaesthesia and allows the surgery to take place in the best possible conditions. [15-17] There are some risks of spinal anaesthesia for prone position surgery like potential for higher blocks, limited airway access, uncomfortable surgical positions, need of repositioning if critical incidents occur and cumbersome if spinal anaesthesia fails. Questions arise what in case of cardiac arrest. The patient can be positioned supine. Literature says that chest compressions in the prone position are possible and may generate greater systolic pressure and improve ventilation. [18,19] Patients can be defibrillated in prone position.[20]

Nevertheless spinal anaesthesia allows early ambulation and enhanced recovery after surgery with adequate postoperative pain relief.[21,22,23] Studies are being conducted to explore other modalities of regional anaesthesia like combined spinal-epidural anaesthesia or epidural anaesthesia alone in PCNL.[24,25] Efficient and safe local anaesthetic doses in all these modalities need further studies.

Conclusion

As sensory level extended in the group receiving lesser dose of bupivacaine when the patient was turned prone, it is concluded that prone positioning extends the sensory level of subarachnoid block to higher level (T4) when 22.5 mg of hyperbaric bupivacaine is used and hence reduced dose can be given efficiently and safely for the procedure.

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