Comparison of Paravertebral Block with Conventional Spinal Anesthesia in Patients Undergoing Unilateral Inguinal Hernia Repair

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Abstract

Context: Although spinal anesthesia (also known as subarachnoid block [SAB]) is used widely for inguinal hernia repair, the paravertebral block (PVB) that produces unilateral, segmental analgesia is used with a high success rate in inguinal hernia repair. Aims: The aim of the study was to compare SAB and PVB in inguinal hernia repair, in terms of the duration of postoperative analgesia and adverse events. Settings and Design: This was a prospective, randomized, controlled double-blind study. Methods: This study was done on 60 male patients of American Society of Anesthesiology (ASA) I and II. Patients were categorized into 30 in each group, either to receive PVB block at two levels T10 and L1 using 15 mL and 5 mL of 0.5% bupivacaine and 1 µg.kg^-1 of buprenorphine or SAB with 12.5 mg of 0.5% hyperbaric bupivacaine injected intrathecally. Statistical Analysis Used: SPSS 18.0 and R version 3.2.2 were used for analyzing the data. Categorical measurements were presented in number (%) and analyzed using Chi-square/Fischer’s exact test. Continuous measurements were analyzed using Student’s t-test. Results: Age, weight, height, and ASA status were comparable in both the groups. In the PVB group, eight patients had failure of block. Hemodynamic responses, time to first analgesia and ambulation, time required to perform the block, Bromage score, satisfaction score, failure rate, and intra- and postoperative drugs used showed a statistically significant difference between the groups (P < 0.001). Conclusion: PVB is not a sole anesthetic technique due to a higher failure rate and increased intraoperative fentanyl requirement but has advantages such as prolonged analgesia, stable hemodynamics, and early ambulation.

Keywords: Analgesia, anesthesia, blood pressure, postoperative complications, subarachnoid space, urinary retention

Introduction

Herniorrhaphy is a common surgical procedure that is performed in >20 million people every year to treat inguinal hernia. The procedure can be performed under various modalities of anesthesia like general anesthesia and regional anesthesia including peripheral nerve blockade and spinal anesthesia (also known as subarachnoid block [SAB] or paravertebral block [PVB]).

PVB involves the instillation of local anesthetics into the spinal nerve roots that emerge from the intervertebral foramina of the vertebral column to produce unilateral segmental analgesia and has recently been widely used for anesthetic effect. It has the advantages of unilateral sympathetic blockade and has fewer hemodynamic variations. Although it shows good analgesic properties, it has not been used extensively due to the requirement of good skill.

Studies evaluating the efficacy of paravertebral anesthesia over spinal anesthesia in patients undergoing unilateral inguinal hernia repair are quite scare. The present study, therefore, intended to compare SAB and PVB in inguinal hernia repair, in terms of duration of postoperative analgesia and adverse events.

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**METHODS**

This study is a prospective, randomized, double-blind study conducted at a tertiary care teaching hospital in South India. After obtaining clearance from the institutional ethics and research committee and informed written consent from the participants, sixty patients aged 16–70 years were recruited for this prospective randomized study and allocated into two groups of 30 each, according to computer-generated random numbers. The sample size of 60 was calculated to determine the difference in the primary outcome variable (analgesia duration) with a 95% confidence interval and alpha (α) error 5%; the power of the study was 90%, and the minimum sample size required for this study was found to be 45. Patients aged between 16 and 70 years, belonging to the American Society of Anesthesiology (ASA) physical status Class I, II and scheduled for unilateral inguinal hernia repair were included in the study. Patients with coagulation disorders, history of drug abuse, allergy to local anesthetics, infection at the site of block, chest and spine deformity, or on anticoagulant therapy were exempted from the study. The selected patients were categorized into two groups to receive either PVB block (n = 30) or SAB block (n = 30).

After securing intravenous (i.v.) cannula, patients were shifted to the theater or induction room. The monitors for electrocardiogram, noninvasive blood pressure (NIBP), heart rate (HR), and oxygen saturation (SpO₂) measurement were connected to the patient. The baseline HR, NIBP, and SpO₂ were recorded. All patients were given injection midazolam 1 mg and oxygen was provided through facemask at 5–6 l.min⁻¹.

The PVB was performed with a 10 cm nerve stimulator needle at two levels, T10 and L1 interspace, with the patient in a sitting position. The paravertebral space was identified using nerve stimulator after visualizing rectus abdominis muscle. Twitches with 1.5 mA current and drug was injected if the twitch persisted even with a stimulating current of 0.5 mA solution containing 20 mL of 0.5% bupivacaine with 1 µg.kg⁻¹ buprenorphine was prepared and 15 mL of plain bupivacaine 0.5% was injected in T10 and 5 mL of 0.5% plain bupivacaine was injected in L1 interspace. Midline fibers were covered with local infiltration. The presence of pinprick sensation for more than 15 min was considered as block failure and the patient was given general anesthesia and omitted from the study. This procedure was done in the induction room at least 30 min prior to the proposed surgical procedure under strict monitoring.

SAB was performed using the midline/paramedian approach using 25 G Quincke’s needle at the L2–L3 interspace or L3–L4 interspace and injecting 12.5 mg of 0.5% of hyperbaric bupivacaine with buprenorphine at a dose of 1 µg.kg⁻¹. Sensory block was assessed by pinprick sensation in either group every 5 min. Surgery was commenced once the level of a blockade of T10-L1.

The pulse rate, systolic, diastolic and mean arterial pressure (MAP) were recorded at 5 min, 10 min, 15 min, 30 min, 1 h and 2 h (min = minutes, h = hour). MAP < 60 mmHg was considered hypotension and treated with i.v. mephentermine boluses of 6 mg. HR <50 bpm (beat per minute) was treated with i.v. atropine boluses of 0.6 mg. The primary outcome was the time to first analgesic requirement. Total analgesic required in the intraoperative and postoperative periods were also assessed. Intraoperatively, patients were given fentanyl boluses of 1 µg.kg⁻¹ i. v. if the visual analog scale (VAS) was more than 4. Postoperatively, patient’s VAS score was assessed second hourly and injection tramadol of 50 mg was given in 100 mL NS if the VAS was more than 4. The time required to perform the block was recorded. After 30 min of performing the block, the Bromage scores were recorded using modified Bromage scale[12] (0–3) to assess motor block. Postoperatively, when the patients were able to flex the knee, they were made to ambulate under supervision. Patient satisfaction was assessed 24 h postoperatively by a numerical scale of 1–5, 1 for minimum (least satisfied) and 5 for maximum (most satisfied) score. The occurrence of any adverse events in the first 24 h such as vomiting and urinary retention was watched for, noted, and treated appropriately.

**Statistical analysis**

SPSS 18.0 and R version 3.2.2 was used for analyzing the data. Continuous measurements were presented as mean ± standard deviation (minimum–maximum) and analyzed using Student’s t-test. Categorical measurements were presented in number (%) and analyzed using Chi-square/Fischer’s exact test. Significance was assessed at 5% level of significance.

**RESULTS**

Of the total 60 patients, most (36.7%) of them belonged to the age group of 41–50 years. However, eight patients from the PVB group experienced a failed block and had to be given general anesthesia and were excluded from the study. The mean age, ASA status, height, and weight were similar in both the groups [Table 1].

The baseline pulse rate, systolic blood pressure, diastolic blood pressure, and MAP were comparable between both the groups. While throughout the subsequent minutes after anesthesia, the difference was statistically significant (P < 0.001) [Table 2].

Time to first analgesic requirement and time required to perform the block were significantly prolonged in the PVB group compared to the SAB group (P < 0.001). Patients from group PVB ambulated faster than those from SAB group (P < 0.001). Patients of SAB group were more satisfied in comparison with the PVB group (P < 0.001). None of the patients in the PVB group attained complete motor blockade, whereas all patients of SAB group significantly attained complete motor blockade [P < 0.001; Table 3].

None from the PVB group required mephentermine, while 12 patients from the SAB group received mephentermine (P < 0.001). All patients from the PVB group required fentanyl (P < 0.001). Postoperative tramadol...
The fall in hemodynamic responses was substantially lesser in the PVB group when compared to the SAB group, and our findings were consistent with previous studies.\(^6,^{15,16}\) This might have also resulted in the administration of mephentermine in the SAB group to maintain BP during hypotensive state, also consistent with the previous studies.\(^{17}\) Although the sympathetic chain is a part of the paravertebral space, not much hemodynamic variation is noticed in PVB since it is a unilateral anesthetic technique. This feature has made PVB favorable for elderly patients and certain conditions where hypotension is undesirable.

In our study, PVB group received more intraoperative supplemental analgesics; therefore, the time for the first postoperative analgesic requirement was prolonged in the PVB group. Bhattacharya \(^{et\,al.}\)\(^{[2]}\) in their study also stated that the time for the first postoperative analgesic was significantly more in the PVB group (342 ± 73 min) as compared to the group which received SAB (222 ± 22 min). Moreover, a total postoperative analgesic requirement in the first 24 h was also less as compared to the SAB group due to the administration of tramadol boluses for 24 h after assessing the VAS score of the patient. In the study done by Bhattacharya \(^{et\,al.}\)\(^{[2]}\) where two-level PVB was given, the requirement of intraoperative propofol, used as an infusion, was found to be more in the PVB group when compared to the SAB group. Similarly, Mandal \(^{et\,al.}\)\(^{[14]}\) compared unilateral spinal anesthesia against two-level PVB and reported propofol consumption to be more in the PVB group. In our study, we used supplemental fentanyl boluses.

The time required to ambulate in the PVB group in this study was less as compared to the SAB group. This might be due to the segmental nature of the sensory block which, in turn, provides prolonged pain relief after amputation. Whereas due to the nonsegmental nature of the sensory block, patients in the SAB group experienced pain relief only for a brief period. Low Bromage score, i.e., minimum motor blockade, also perhaps contributed to the early amputation of patients in the PVB group in our study, as compared to a high Bromage score in SAB group, which corroborated with other studies.\(^{[6,10]}\)

Although not significantly different, SAB group experienced more adverse effects than in the PVB group, similar to the
Table 3: Comparison of block characteristics in the two groups

| Parameters                        | SAB (n=30) | PVB (n=30) | P  |
|-----------------------------------|------------|------------|----|
| Time to 1st analgesic (min)*      | 249.8±27.05| 328.86±20.00| <0.001† |
| Time to perform the block (min)* | 4.83±0.50  | 15.86±0.89 | <0.001† |
| Time to first ambulation (min)*   | 317.10±57.54| 212.27±20.04| <0.001† |
| Satisfaction score*               | 3.85±0.33  | 3.11±0.31  | <0.001† |
| Bromage score (0/1/2/3)           | 0/0/0/30   | 0/14/0/8   | <0.001† |

*Data presented as mean±SD. †Highly significant. SAB=Subarachnoid block, PVB=Paravertebral block, SD=Standard deviation

Table 4: Comparison of drugs administered, outcome, and adverse effects in both the groups

| Drugs                  | Group SAB (n=30) | Group PVB (n=30) | P  |
|------------------------|------------------|------------------|----|
| Mephentermine*         | 12 (40)          | 0 (0)            | <0.001 |
| Intraoperative fentanyl* | 0 (0)       | 22 (100)         | <0.001 |
| Postoperative tramadol* | 30 (100)         | 22 (100)         | <0.001 |
| Failure rate*          | 0 (0)            | 8 (36.4)         | <0.001 |
| Adverse events, n (%)  | 2 (6.7)          | 0 (0)            | 0.24 |
| Urinary retention*     | 1 (3.3)          | 0 (0)            |     |

*Data presented as n (%). SAB=Subarachnoid block, PVB=Paravertebral block

Previous findings\[15\] urinary retention and vomiting were the two complications observed in the SAB group. The blockade of parasympathetic fibers that innervate the autonomic bladder control might be probable reasons behind the adverse effects in the SAB group. The complications might have also impeded early ambulation of patients in the SAB group compared to the PVB group.

Patient satisfaction scores were lower in the PVB group, perhaps attributable to the multiple injections and increased intraoperative fentanyl requirement, even though the postoperative analgesia was prolonged. In contrast, other studies\[6,14\] reported patients to be more satisfied with PVB.

The small sample size in our study restricted us to draw certain conclusions regarding failure rate of block; therefore, further studies need to be performed, on a larger sample population. Another limitation was that the paravertebral space for PVB was identified using a nerve stimulator rather than an ultrasound due to lack of facilities.

**Conclusion**

We found that paravertebral anaesthesia given at two levels was not a sole anesthetic technique because of the associated higher failure rate and increased intraoperative fentanyl requirement. However, PVB has several advantages postoperatively, such as prolonged duration of postoperative analgesia, stable intraoperative hemodynamics, and early ambulation. Hence, we suggest that multiple-level PVBS may be preferable in terms of better intraoperative analgesia. Longer time duration and skilled expertise are required to perform a successful PVB.

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**Conflicts of interest**

There are no conflicts of interest.

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