Paravertebral block can be an alternative to unilateral spinal anaesthesia for inguinal hernia repair

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ABSTRACT

Background: Inguinal hernia repair can be performed under satisfactory anaesthetic conditions using general, regional and peripheral nerve block anaesthesia. Unilateral spinal anaesthesia provides optimal anaesthesia, with stable haemodynamics and minimal adverse events. The paravertebral block, being segmental in nature, can be expected to produce some advantages regarding haemodynamic stability and early ambulation and may be a viable alternative. **Methods:** Fifty-four consenting male patients posted for inguinal hernia repair were randomized into two groups, to receive either the two-segment paravertebral block (group-P, n=26) at T10 and L1 or unilateral spinal anaesthesia (group-S, n=28), respectively. The time to ambulation (primary outcome), time to the first analgesic, total rescue analgesic consumption in the first 24-hour period and adverse events were noted. **Results:** Block performance time and time to reach surgical anaesthesia were significantly higher in the patients of group-P (P<0.001). Time to ambulation was significantly shorter in group-P compared to group-S (P<0.001), while postoperative sensory block was prolonged in patients of group-S; P<0.001. A significantly higher number of patients could bypass the recovery room in group-P compared to group-S, (45% versus 0%, respectively, P<0.001). No statistically significant difference in adverse outcomes was recorded. **Conclusion:** Both the paravertebral block and unilateral spinal anaesthesia are effective anaesthetic techniques for uncomplicated inguinal hernia repair. However, the paravertebral block can be an attractive alternative as it provides early ambulation and prolonged postoperative analgesia with minimal adverse events.

Key words: Anaesthetic technique, early ambulation, inguinal hernia repair, paravertebral block, postoperative analgesia, unilateral spinal anaesthesia

INTRODUCTION

Unilateral spinal anaesthesia (unilateral SA) is widely used nowadays for unilateral inguinal hernia repair, providing intense sensory and motor blockade.[1] Limiting the block to the operative side by using small doses of hyperbaric solutions injected slowly through a directional needle and maintaining a lateral decubitus position for a certain duration have been proposed, to produce high quality, long-duration analgesia, with minimal haemodynamic adverse events.[1]

The paravertebral block (PVB) has been used with success, both as anaesthetic and analgesic techniques, for inguinal herniorrhaphy.[2,3] PVB provides an analgesia equivalent to extensive peripheral nerve block for inguinal herniorrhaphy, offering an alternative method of postoperative pain management with fewer adverse events. PVB has been found to be more advantageous than conventional spinal anaesthesia for inguinal hernia repair, in terms of early ambulation and better postoperative pain scores.[4] We designed this study as a modification of our previous study,[4] to evaluate whether two-segment PVB can sustain as a viable alternative to unilateral SA as well. This was judged by comparing the time to ambulation (primary outcome), duration of postoperative analgesia and incidence of adverse events.

METHODS

After obtaining the Institutional Ethics Committee's approval, 54 consenting males, of American Society of Anaesthesiologists (ASA) physical status I and II, aged 18–65 years, were scheduled for a unilateral inguinal hernia repair procedure and enrolled in this randomized clinical study. The exclusion criteria were: Patients' refusal, morbid obesity, coagulopathy and significant cardiovascular, respiratory, renal, hepatic or metabolic disease. Patients with a history of substance abuse, mental dysfunction, active gastrointestinal reflux, chronic analgesic use and allergy to local anaesthetics were also excluded.

Patients were randomized, following a sealed envelope method, to receive either a paravertebral block (group-P) or unilateral spinal anaesthesia (group-S). Intra- and postoperative data were recorded by residents not participating in the study.

Patients of both the groups were cannulated in the procedure room with a wide-bore intravenous (IV) catheter and infusion with lactated Ringer's solution (RL) was started. A multichannel monitor was attached for monitoring the peripheral arterial haemoglobin oxygen saturation (SpO_2), electrocardiogram (ECG) and noninvasive blood pressure (NIBP) during the procedure and surgery. Prior to both the procedures, all the necessary equipment for general anaesthesia and resuscitation were kept ready in case of a block failure or any complication. All patients received IV midazolam before block placement to decrease anxiety and discomfort during the procedure, while maintaining a meaningful patient contact. A senior trainee under the direction of a consulting anaesthesiologist performed the blocks.

The unilateral PVB was performed in a sitting position. With aseptic precautions, a point, 3 cm lateral to the cephalad aspect of spinous processes of T10 and L1 vertebrae was marked. This point corresponded to the transverse process of the vertebra below in case of T10 and the caudad edge of the homologous transverse processes of L1. Local infiltration with lignocaine (1%) was given at this point. A Tuohy needle (18G) was inserted perpendicular to the skin in all planes to contact the respective transverse processes (usually at a depth of about 2 – 4 cm in the thoracic region and 5 – 8 cm in the lumbar region). The needle was then withdrawn a bit and walked off the transverse process by redirecting the needle to the cephalad in case of thoracic PVB and caudad in case of lumbar PVB. The needle was angled slightly medially. At a depth of 1 to 2 cm from the transverse process, a 'loss of resistance' to normal saline was felt. After negative aspiration of blood and cerebrospinal fluid (CSF), 15 ml of bupivacaine (0.5%) at T10 and 5 ml of bupivacaine (0.5%) at L1 was injected slowly. After the block, the patients were repositioned to a supine position.

The patients in group S were preloaded with 10 ml/kg of RL. With aseptic precautions, unilateral SA was performed using the midline approach with a 27-G Whitacre needle at the L3-4 or L2-3 intervertebral space in the lateral decubitus position, with the operation side dependant. The subarachnoid injection contained 8 mg of hyperbaric bupivacaine (5 mg/ml). The patients were then maintained in the same position for 15 minutes. At the end of the procedure, the patients of both groups received similar dressings extending from T9 to L4. The observer had access to the patients only after the dressings were applied at the end of the block procedure.

In both the groups, we assessed the onset of unilateral pinprick discrimination at five minutes and every five minutes, thereafter, up to 30 minutes. Absence of onset of pinprick discrimination within 15 minutes was taken as a 'block failure'. We considered PVB as the 'successful' one if the following criteria were met: (i) Onset of loss of pinprick discrimination started within 15 minutes, (ii) Sensory block (T10-L2) was achieved within a maximum time of 30 minutes. Successful unilateral spinal anaesthesia was defined as surgical anaesthesia (loss of pinprick sensation at L1 and complete motor block) on the dependant side only, while the nondependent side maintained somatic sensibility to the pinprick test at L1 and motor block lesser than the first degree. A peak level of sensory block was noted. The motor block was evaluated using the modified Bromage scale,[5] measured at the peak of sensory block.

In case of 'block failure' in any group, the patient received general anaesthesia (GA) and was excluded from the study. Any episode of hypotension [mean arterial pressure (MAP) <70 mmHg] was managed with aliquots of IV fluids and ephedrine. Any episode of significant bradycardia (HR <50 bpm) was managed with IV atropine (0.6 mg). During surgery, patients of both groups received an IV infusion of propofol titrated to light sleep with easy arousability. Time required to perform the procedures, time to surgical anaesthesia,

duration of surgery and total duration in the operating room (OR) was recorded. The total duration in the OR was defined as the time elapsed between the arrival to the OR and departure after the surgery. The total dose of propofol and the total volume of IV fluids were calculated.

After surgery, the patients were transferred either to the recovery room or directly to the ward under strict monitoring. The senior anaesthesiologist supervising all cases made this decision of triaging the patients. The eligibility criterion to bypass the recovery room was a modified Aldrete score[6] of ≥9. Postoperatively, the data were collected at 2, 4, 6, 12 and 24 hours by recovery room residents, not involved in the study. They were blinded to the anaesthetic technique due to the presence of identical dressings and a formal request of not-to-ask any question regarding patient's experience about the block. The outcome measures of this study were time to ambulation, time to first analgesic (duration of postoperative analgesia), total rescue analgesic consumption in the first 24-hour period and incidence of adverse events. The patients were observed for the return of perianal sensation, the ability to dorsiflex the foot and regaining of proprioception of the great toe. When the observer was satisfied with these findings, he encouraged the patient to ambulate under supervision, provided they had clear mental status, stable haemodynamics, adequate pain relief and no residual motor block. When the patient succeeded in ambulation, the time was noted (the time to ambulation). Postoperative pain was assessed with the visual analog scale (VAS) score of 0 – 10 (0 = no pain and 10 = worst imaginable pain). VAS scores of 4 or more were treated with rescue analgesic tramadol in boluses of 50 mg IV, repeated as necessary. Before surgery, all the patients were instructed in the use of the VAS score. Ondansetron (4 mg) IV was used as the rescue antiemetic. The patients were asked to note the time of the first passage of urine. Those who were unable to pass urine despite bladder fullness, within six postoperative hours, or complained of urinary retention were catheterized with a simple rubber catheter, maintaining strict asepsis. Other postoperative adverse events were recorded.

Considering the time to ambulation as the primary outcome and taking the confidence interval as 95% (α = 0.05) and the power of test (1-β) as 80%, 24 patients were required in each group. Considering the possibility of dropouts, 10% extra patients were taken. Thus, we recruited 54 patients for randomization. Discrete categorical data were presented as *n* (%); continuous data were given as mean±SD. Differences in demographic, surgical, anaesthetic and postoperative data were tested by independent Student's *t*-test (continuous data), the Pearson Chi-square test, or the Fisher's exact test, as appropriate (categorical data). A 'P' value <0.05 was considered to be statistically significant. All analyses were conducted using SPSS for Windows (version12.0; SPSS Inc., Chicago, IL).

RESULTS

The study spanned from January 2009 to November 2009. A total of 100 patients were taken from the pre-anaesthetic clinic, among them 54 met our inclusion criteria. Four patients in each group were lost to follow up due to different reasons. Finally, data from 22 patients in group-P and 24 patients in group-S were available for analysis [Figure 1].

The patients were statistically comparable in demographic characteristics (age, weight, height, ASA class) and preoperative vital parameters. Intraoperative vitals were comparable in both groups (HR, MAP, SpO_2). Intravenous fluid requirement, episodes of bradycardia, hypotension and ephedrine requirement were not significantly different. Intraoperative propofol consumption was higher (*P*<0.001) in group-P than group-S, 133±31 mg versus 99±17 mg, respectively [Table 1].

There was no significant difference in the duration of surgery (*P*=0.98) and duration in the OR (*P*=0.325). Time to perform block (*P*<0.001) and time to surgical anaesthesia (*P*<0.05) was significantly greater in group-P as compared to group-S. Bromage scores
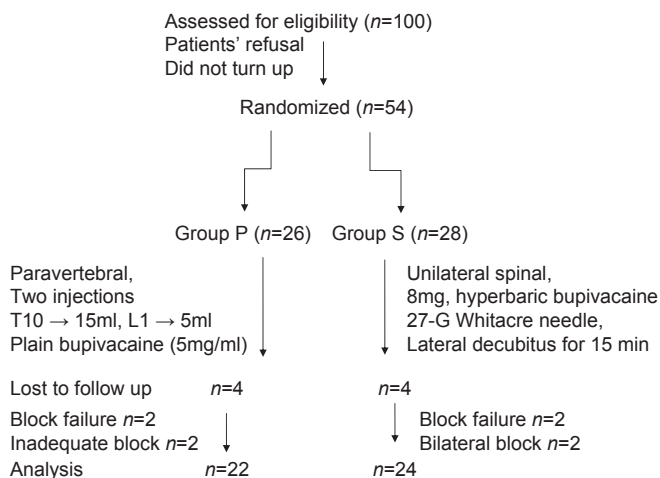

Figure 1: Flow diagram showing patient selection, randomization and lost to follow-up

(measured at peak sensory block) were significantly lower in group-P (*P*<0.001) than in group-S [Table 2].

The time to ambulation in unilateral SA with 8 mg hyperbaric bupivacaine (310±38 minutes) was significantly more prolonged (*P*<0.001) than PVB (225±98 minutes). The time to the first analgesic in group-P (334±70 minutes) was significantly longer (*P*<0.001) than in group-S (215±19 minutes). Sensory block was also found to be greater (*P*<0.001) with PVB (487±96 minutes) than with unilateral SA (254±22 minutes). The total analgesic requirement was significantly lower in group-P (*P*<0.05) than in group-S in the first 24 hours postoperatively. There was significant difference in VAS scores between the two groups. It was the lowest at two hours in both groups. The VAS scores were highest at six hours in group-P and at four hours in group-S. Total rescue analgesic (IV tramadol) consumption in the first 24 hours was significantly lower (*P*<0.05) in group-P in comparison to group-S; 126±54 mg versus 172±35 mg, respectively [Table 3].

Adverse events were lesser, but not significant in group-P than in group-S. Three patients (12.5%) in group-S and two patients (9.1%) in the group-P experienced episodes of postoperative nausea and vomiting (PONV) and were treated with IV ondansetron (4 mg). Recovery room bypass was achieved in ten patients (45.5%) in group-P (*P*<0.001) compared to none in the group-S [Tables 2 and 3]. In group-P no patient required urinary catheterization, whereas, two patients (8.3%) in the group-S required it.

DISCUSSION

In our study two-segment PVB for inguinal hernia repair was found to be a viable alternative to unilateral SA in achieving shorter time to ambulation and longer postoperative analgesia, with minimal adverse events. The time to ambulation was shorter in group-P as compared to that in group-S (*P*<0.001). Early ambulation was possible in group-P in spite of the persisting sensory block as it was segmental in nature. This persisting block provided prolonged pain relief even when patient had started ambulating. In group-S, due to the non-segmental nature of block, the patient enjoyed pain relief only for a brief period after starting ambulation.

Poor recovery room bypass was found in group-S, probably due to a higher grade of motor block (*P*<0.001).

Table 1: Demographic profile, baseline and intraoperative vital parameters

Parameters	Group P (*n*=22)	Group S (*n*=24)	P value
Age (year)	52.8±6.0	50.7±10.2	NS
Weight (kg)	62.6±5.4	62.0±5.2	NS
Height (cm)	163.3±8.1	162.3±6.7	NS
ASA I/II (%)	15/7 (68/32)	13/11 (54/46)	NS
Preoperative pulse (bpm)	75.9±7.4	78.3±7.7	NS
Preoperative MAP (mmHg)	93.6±7.0	90.4±7.2	NS
Preoperative SpO$_2$ (%)	99±1	99±1	NS
Intraoperative pulse (bpm)	74±6	73±7	NS
Intraoperative MAP (mmHg)	90.5±5.1	88.7±3.9	NS
Intraoperative SpO$_2$ (%)	99±0.9	99±0.6	NS
I.v. fluids (ml)	914±142	946±138	NS
Ephedrine requirement (boluses of 6 mg)$	0	2	NS
Propofol (mg)	133±31	99±17	<0.001*

Significant (*P*<0.05), $, Pearson Chi-square test used, results are presented as number of patients. For others, Student's independent sample t-test used, results are presented as mean±SD. Group P, paravertebral group; group S, unilateral spinal group

Table 2: Block characteristics and OR duration

Parameters	Group P (*n*=22)	Group S (*n*=24)	P value
Time to perform block (min)	10.7±2.3	6.9±1.9	<0.001*
Time to surgical anaesthesia (min)	20±5	10±2	<0.001*
Duration of surgery (min)	64±13	64±12	NS
Duration in OR (min)	91±15	87±12	NS
Bromage scores (3/2/1/0)$	0/12/8/2	24/0/0/0	<0.001*

Significant (*P*<0.05), $, Pearson Chi-square test used, results are presented as number of patients. For others, Student's independent sample t-test used, results are presented as mean±SD. Group P, paravertebral group; group S, unilateral spinal group; OR, operating room

Table 3: Recovery times and adverse events

Parameters	Group P (*n*=22)	Group S (*n*=24)	P value
Time to ambulation (min)	225±98	310±39	<0.001*
Time to first analgesic (min)	334±71	216±20	<0.001*
Time to complete sensory regression (min)	487±96	254±22	<0.001*
Total rescue analgesics (tramadol in mg)	126±54	172±35	<0.05*
Patients experiencing PONV	2 (9.1)	3 (12.5)	NS
Total antiemetics (ondansetron in mg)	2 (9.1)	3 (12.5)	NS
Urinary catheterization	0	2(8.3)	NS
Recovery room bypass	10 (45.5)	0	<0.001*

*Significant (*P*<0.05), $, Pearson Chi-square test used. For others, Student's independent sample t-test used. Results are presented as mean±SD, number of patients (%), total amount (mg). Group P, paravertebral group; group S, unilateral spinal group; Figures in parenthesis are in percentage; PONV – postoperative nausea and vomiting

The sensory block persisted longer (*P*<0.001) with PVB (487±96 minutes) than with unilateral SA (254±22 minutes). This reduced the rescue analgesic consumption in patients of group-P. This corroborates with the finding of Ozkan D and others.[7] They found the duration of sensory block to be 11±1 hours with

two-segment PVB (T10 and L1). Prolonged duration of analgesia could be explained by the comparatively less vascularity of the paravertebral space and greater volume of LA. Intraoperative propofol consumption was higher in group-P. The slower onset of block and less magnitude of deafferentiation (segmental block) might be the cause.

Both single and multiple PVB injections were used for open inguinal hernia repair. Saito T and colleagues,[8] cited their experience, where the local anaesthetic injected in the ventral area of the lower thoracic paravertebral space, at the T11 level, resulted in an extended unilateral block, not just confined to the intercostal nerves, but also involved the lumbar dermatomes. They favoured the single-injection, multi-segmental, paravertebral block, as an acceptable one, instead of multiple insertions of a needle. Although multiple-segment PVB injections provided very good anaesthetic condition in a short time, they were not comfortable for patients and also increased the chances of pleural puncture and pneumothorax.[7,9,10] Lonnqvist and Hildingson[11] reported that the psoas muscle interrupted the paravertebral space at the level of T12. With this idea, in the present study, we used two-segment PVB at the T10 and L1 levels, to increase the patient's comfort, success rate and to decrease the adverse events. This also reduced the time to perform the block.

To our knowledge, only one study[12] has compared PVB with unilateral SA, drawing an impression that both techniques are useful, with minimal adverse effects. The study has also observed a shorter home readiness time, longlasting postoperative analgesia and improved quality of recovery, indicating that PVB can be a safe alternative to unilateral SA. However, they have used five-segment injections (from T9 to L1) to accomplish the PVB.

Limitations of PVB are that the technique is time-consuming, rarely practiced, chances of pneumothorax and inadvertent intravascular injection of LA, which increases with the number of injections.[9,13] In our previous study,[4] the block performance time and time to surgical anaesthesia was found to be significantly greater in PVB compared to conventional SA. In our present study, we tried to maintain a slight medial direction of the block needle, to avert the pleural puncture. The additional time to achieve unilateral SA by maintaining the lateral decubitus for 15 minutes had delayed the start of

surgery. However, performing the PVB in the procedure room helped in reducing the time spent in the OR. Thus, the time spent in the OR was comparable in both the groups (*P*=0.325).

Better haemodynamic control in the unilateral SA had reduced the incidence of PONV, comparable with PVB. No incidence of PDPH was recorded in group-S. The credit should possibly go to the small bore pencil-point needle. The block failure rates were 15.4% in group P and 14.3% in group-S, which was comparable. Although this failure rate in group-P was higher than the recent reports,[7] it could be comparable with the initial failure rates of the earlier studies.[2,14] A possible explanation of such a finding could be relative inexperience with the paravertebral technique and the inconsistent nature of the block, especially without any nerve stimulation or ultrasonic guidance. In case of the spinal technique, higher failure rates could be attributed to the use of a finer (27-G) pencil-point needle and strict criteria for successful unilateral SA in the present study. The small study population limited us to draw a conclusion about failure rate and complications precisely. Moreover, we were in the initial phase of practicing the PVB procedure. Despite achieving satisfactory time to ambulation, we could not perform inguinal hernia repair on an ambulatory basis, as it largely depended on infrastructural support.

CONCLUSION

To conclude, this study reports that two-segment PVB provides an optimal anaesthetic condition, with acceptable adverse events for unilateral inguinal hernia repair. PVB is advantageous in providing segmental anaesthesia, early ambulation, and prolonged pain relief. In the hands of experts, PVB can be a safe alternative to unilateral SA for unilateral inguinal hernia repair. An anaesthesiologist who is well-conversant with the paramedian epidural block can easily learn PBV.

PVB should be practiced under the supervision of experts, so that this technique can be revived well for ambulatory surgery.

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