A COMPARATIVE STUDY OF UNILATERAL PARAVERTEREBRAL BLOCK VERSUS CAUDAL BLOCK IN CHILDREN UNDERGOING INGUINAL HERNIA SURGERY UNDER GENERAL ANAESTHESIA
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ABSTRACT

BACKGROUND

Inguinal hernia repair in children is the commonest day-care surgical procedure done in the paediatric age group. Regional anaesthesia and nerve blocks are now widely used in children, mostly in conjunction with general anaesthesia. Caudal analgesia is the most common regional block performed in children due to ease of performance and reliability. Paravertebral blockade has recently been shown to produce long lasting postoperative analgesia when used in combination with general anaesthesia in paediatric herniorrhaphy. The objectives of this study were- 1) to compare the efficacy of caudal and paravertebral blocks in children. 2) to compare intraoperative hemodynamic parameters and analgesic requirements. 3) to compare postoperative pain relief in both the groups.

MATERIALS AND METHODS

80 paediatric patients with unilateral inguinal hernia between 2-7 years were allocated into 2 groups of 40 each. Group A received paravertebral block using nerve stimulator at T12-L1 interface, while group B received caudal block using the loss of resistance technique. Statistical analysis- for qualitative data chi square fischer test was used. For quantitative data unpaired t test was used. All analysis was done by SPS statistical method version 16.0.

RESULTS

Haemodynamic parameters, pain score, incidence of nausea and vomiting were comparable in both the groups. However, duration of postoperative analgesia and urinary retention were found to be significantly different. In Group A mean time for rescue analgesia administration was 11.39 hrs. while for Group B it was 5.32 hrs. (p=0.001). The mean time of voiding urine in group A was 5.32 hours while in group B it was 9.24 hours (p=0.003).

CONCLUSION

Both the techniques are safe and provide good quality postoperative pain relief. However, the postoperative analgesia was better and the time to void urine was earlier with paravertebral block than with caudal block.

KEYWORDS

Regional Anaesthesia, Caudal Anaesthesia, Paravertebral Anaesthesia, Nerve-stimulator, Inguinal Hernia, Pediatric Anaesthesia.


BACKGROUND

Inguinal hernia repair is the commonest day-care surgery performed in paediatric age group. Caudal block is commonly performed in children due to ease of performance and reliability. It is usually combined with general anaesthesia, however, single shot caudal blockade requires supplementary analgesia in the immediate postoperative period. Paravertebral blockade (PVB) produces prolonged postoperative analgesia with general anaesthesia in paediatric herniorrhaphy and carries no risk of lower limb weakness, paralysis, urinary retention or profound hypotension.

We conducted a prospective randomized study comparing single injection lumbar paravertebral block versus caudal block using plain bupivacaine with general anaesthesia in children undergoing unilateral inguinal hernia surgery.

MATERIALS AND METHODS

This study was conducted in 80 ASA grade I-II patients in the age group of 2-7 years scheduled for unilateral inguinal hernia surgery after approval from the institutional ethical committee (CTRI No. CTRI/2018/05/013933). The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional) and with the Helsinki Declaration of 1975, as revised in 2000. All patients had undergone a detailed pre-anaesthetic check-up. Patients
received syrup midazolam 0.5 mg/kg, 1 hour prior to surgery as premedication. Baseline heart rate, blood pressure, and oxygen saturation was recorded using standard non-invasive monitors. Children underwent either intravenous induction with propofol or inhalational induction with halothane or sevoflurane, and nitrous oxide. Injection fentanyl 2 micrograms/kg was given, and airway was secured by a Proseal laryngeal mask airway of appropriate size. All patients were allowed to breathe spontaneously and maintained using a mixture of oxygen and nitrous oxide with inhalational agent. The patients were then allocated to one of the two groups through a computer-generated random number chart using a sealed envelope technique. Group A patients received paravertebral block while group B patients received caudal block.

The patients in group A were placed in lateral position and paravertebral block was performed at T12-L1 intervertebral space. Site to be blocked was cleaned and draped following aseptic precautions. A fine 25-gauge needle was inserted perpendicularly lateral to the spinous process to locate the transverse process. The lateral distance from the midline was calculated as per the Lonnqvist formula (0.12 X body weight + 10.2) in mm. The depth of the paravertebral space was also decided by the Lonnqvist formula (0.53 X body weight + 21.2) in mm. A 21 G insulated needle, already attached to Plexygon nerve stimulator (Vygon, Paris, France), was then introduced perpendicular to the skin and contact with the transverse process of L1 was made. For confirmation of needle in the thoracic paravertebral space contraction of abdominal muscles was observed, by initially setting the current strength at 2 mA. Once the contractions were noted, current strength was reduced gradually in steps of 0.5 mA. Presence of the needle in paravertebral space was confirmed once the contractions persisted at the current strength of 0.5 mA. After that, negative aspiration of air, blood and CSF was noted, and 0.5 ml/kg of 0.25% bupivacaine was injected superior to the transverse process. Then the needle was withdrawn and walked off inferior to the transverse process and the drug was injected again. After performing the block, the patient was turned supine and hemodynamic parameters were recorded.

Group B patients received caudal block in lateral position and the caudal space was identified by the loss of resistance technique to the sacrococcygeal ligament and after negative aspiration of air, blood and CSF, 0.5 ml/kg of 0.25% of bupivacaine was given. Patients received supplemental injection of fentanyl whenever there was an increase in heart rate or blood pressure of >20% compared to the baseline.

All patients received inj. ondansetron 0.1 mg/kg i.v. approximately 30 minutes before the end of the surgery. Intraoperative fentanyl requirement in each group was recorded. Post-operative saturation was monitored for two hours. Postop pain intensity using CHEOPS was recorded as soon as the patient was awake, 30 mins., 1 hour, 2 hours, 6 hours, 18 hours and 24 hours at rest. Rescue analgesia was given in the form of 10-15 mg/kg paracetamol by I.M. route if CHEOPS was greater than nine.

Side effects like nausea, vomiting and urinary retention were recorded. Postoperatively CHEOPS pain score, time of rescue analgesia, nausea and vomiting and urinary retention data were collected. SPSS software, version 16.0 was used for statistical analysis. P-value ≤0.05 was set as criteria for level of statistical significance. Chi-square Fischer test was used for qualitative analysis while unpaired t-test was used for quantitative evaluation. Mann-Whitney test was used for data which did not follow the normal distribution. Considering the mean pain score between both the groups as the significant outcome parameter and the difference of 40% between both the groups, alpha = 0.05, and power of 80%, minimum of 40 patients are required in each group.

RESULTS
The two groups were comparable in terms of demography, haemodynamic (Table 1, 2) and incidence of nausea and vomiting (Figure 1). Two patients from each group were excluded as during the intra-operative period, they had to be paralysed due to increase in heart rates and blood pressures.

<table>
<thead>
<tr>
<th>HR /MIN</th>
<th>PVB (HR/min)</th>
<th>CB (HR/min)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR 0</td>
<td>111.375 ± 16.170</td>
<td>108 ±17.751</td>
<td>0.377</td>
</tr>
<tr>
<td>HR 5</td>
<td>100.025 ±16.435</td>
<td>96.75 ± 20.371</td>
<td>0.855</td>
</tr>
<tr>
<td>HR 10</td>
<td>100.675 ± 18.959</td>
<td>100.475 ±18.502</td>
<td>0.307</td>
</tr>
<tr>
<td>HR 15</td>
<td>101.325 ±19.158</td>
<td>98.103 ±17.941</td>
<td>0.945</td>
</tr>
<tr>
<td>HR 20</td>
<td>101.447 ±18.453</td>
<td>100.158 ± 18.189</td>
<td>0.654</td>
</tr>
<tr>
<td>HR 25</td>
<td>98.026 ± 15.796</td>
<td>98.395 ±18.941</td>
<td>0.329</td>
</tr>
</tbody>
</table>

J. Evid. Based Med. Healthc., pISSN- 2349-2562, eISSN- 2349-2570/ Vol. 6/Issue 11/March 18, 2019
Table 1. Comparison of Heart Rates of Patients Per Minute in Paravertebral Block Group (PVB) and Caudal Block Group (CB). Both the Groups are Comparable as p-Value is Above 0.05 During All Times

<table>
<thead>
<tr>
<th>HR</th>
<th>PVB (HR/min)</th>
<th>CB (HR/min)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>96.8 ± 16.417</td>
<td>95 ± 15.066</td>
<td>0.744</td>
</tr>
<tr>
<td>35</td>
<td>96.846 ± 14.666</td>
<td>93.4 ± 16.922</td>
<td>0.384</td>
</tr>
<tr>
<td>40</td>
<td>89.364 ± 16.883</td>
<td>88.563 ± 17.761</td>
<td>0.204</td>
</tr>
<tr>
<td>45</td>
<td>94.778 ± 25.093</td>
<td>80.545 ± 8.238</td>
<td>0.852</td>
</tr>
<tr>
<td>50</td>
<td>92.62 ± 22.296</td>
<td>90 ± 11.060</td>
<td>0.630</td>
</tr>
<tr>
<td>55</td>
<td>105.5 ± 6.364</td>
<td>101 ± 34.621</td>
<td>0.718</td>
</tr>
</tbody>
</table>

Table 2. Comparison of Systolic Blood Pressures (SBP) of Patients in Paravertebral Block Group (PVB) and Caudal Block Group (CB). Both the Groups are Comparable as p-Value is Above 0.05 During All Observed Intervals

<table>
<thead>
<tr>
<th>SBP (mmHg)</th>
<th>PVB (mmHg)</th>
<th>CB (mmHg)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP 0</td>
<td>94.211 ± 10.473</td>
<td>95.474 ± 11.154</td>
<td>0.612</td>
</tr>
<tr>
<td>SBP 5</td>
<td>84.605 ± 6.474</td>
<td>85.763 ± 7.506</td>
<td>0.965</td>
</tr>
<tr>
<td>SBP 10</td>
<td>86.132 ± 7.993</td>
<td>84.947 ± 5.034</td>
<td>0.364</td>
</tr>
<tr>
<td>SBP 15</td>
<td>89.474 ± 6.454</td>
<td>88.421 ± 8.701</td>
<td>0.397</td>
</tr>
<tr>
<td>SBP 20</td>
<td>92.974 ± 9.269</td>
<td>92.053 ± 7.562</td>
<td>0.397</td>
</tr>
<tr>
<td>SBP 25</td>
<td>94.395 ± 8.400</td>
<td>93.474 ± 8.333</td>
<td>0.550</td>
</tr>
<tr>
<td>SBP 30</td>
<td>93.829 ± 8.371</td>
<td>92.357 ± 7.893</td>
<td>0.446</td>
</tr>
<tr>
<td>SBP 35</td>
<td>92.923 ± 7.386</td>
<td>90.75 ± 7.792</td>
<td>0.799</td>
</tr>
<tr>
<td>SBP 40</td>
<td>95.818 ± 5.896</td>
<td>92.25 ± 8.962</td>
<td>0.266</td>
</tr>
<tr>
<td>SBP 45</td>
<td>92.556 ± 8.748</td>
<td>93 ± 6.985</td>
<td>0.621</td>
</tr>
<tr>
<td>SBP 50</td>
<td>95.625 ± 8.450</td>
<td>94 ± 11.150</td>
<td>0.971</td>
</tr>
<tr>
<td>SBP 55</td>
<td>109 ± 12.727</td>
<td>102.25 ± 21.469</td>
<td>0.620</td>
</tr>
</tbody>
</table>

Table 3. Comparison of CHEOPS Pain Scores of Patients in Paravertebral Block Group (PVB) and Caudal Block Group (CB)

<table>
<thead>
<tr>
<th>CHEOPS Pain Score</th>
<th>PVB (0-10)</th>
<th>CB (0-10)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min.</td>
<td>7.368 ± 1.17</td>
<td>7.7 ± 1.65</td>
<td>0.303</td>
</tr>
<tr>
<td>30 min.</td>
<td>7.053 ± 1.27</td>
<td>7.368 ± 1.36</td>
<td>0.803</td>
</tr>
<tr>
<td>1 hr.</td>
<td>6.857 ± 0.9</td>
<td>6.848 ± 1.0932</td>
<td>0.311</td>
</tr>
<tr>
<td>2 hr.</td>
<td>6.853 ± 0.85</td>
<td>7.419 ± 1.204</td>
<td>0.018</td>
</tr>
<tr>
<td>6 hr.</td>
<td>7.129 ± 1.20</td>
<td>8 ± 1.3784</td>
<td>0.122</td>
</tr>
<tr>
<td>12 hr.</td>
<td>7.583 ± 0.92</td>
<td>8.5 ± 1.2693</td>
<td>0.436</td>
</tr>
<tr>
<td>18 hr.</td>
<td>7.75 ± 0.960</td>
<td>8.167 ± 1.169</td>
<td>0.974</td>
</tr>
<tr>
<td>24 hr.</td>
<td>7.07 ± 1.25</td>
<td>6</td>
<td>0.895</td>
</tr>
</tbody>
</table>

Figure 1. Bar Diagrams Representing the Incidence of Nausea and Vomiting in Either Study Group

Figure 2. Comparison of Mean Duration of Analgesia in Caudal Group and Paravertebral Group (in Hours)
DISCUSSION

Lumbar plexus block, also known as psoas compartment block, comprises an injection of local anaesthetic in the fascial plane within the posterior aspect of the psoas major muscle. Because the roots of the lumbar plexus are located in this plane, an injection of a sufficient volume of local anaesthetic in the postero-medial compartment of the psoas muscle results in block of the majority of the plexus (femoral nerve, lateral femoral cutaneous nerve, and the obturator nerve). The anterior boundary of the fascial plane that contains the lumbar plexus is formed by the fascia between the anterior two thirds of the compartment of the psoas muscle that originates from the anterolateral aspect of the vertebral body and the posterior one third of the muscle that originates from the anterior aspect of the transverse processes. This arrangement explains why the transverse processes are closely related to the plexus and therefore are used as the main landmark during LPB.\(^\text{12}\)

The lumbar plexus is formed by the anterior rami of the first four lumbar nerves; it frequently includes a branch from T12 and occasionally from L5. The plexus lies between the psoas major and quadratus lumborum muscles in the so-called psoas compartment. The lower compartment of the plexus, L2, L3 and L4, primarily innervate the anterior and medial aspects of the thigh. The anterior divisions of L2, L3, and L4 form the obturator nerve, the posterior divisions of the same component form the femoral nerve and the lateral femoral cutaneous nerve is formed from posterior divisions of L2 and L3. The main anatomic difference between children and adults pertains to the smaller size of nerve trunks and extensive spread to local anaesthetic along fascial planes and perineural sheaths.\(^\text{13}\)

In our study we compared the two groups with respect to demographic data, intraoperative haemodynamic parameters, nausea and vomiting, postoperative pain scores, postoperative analgesic requirement and time of voiding urine postoperatively.

Our results were comparable and quite consistent to the only study available in the literature which compared caudal block with paravertebral block in paediatric inguinal hernia in seventy children in age group 3-7 years by another author in 2008 in Turkey.\(^\text{4}\) In group PVB, a single shot of 0.2 ml/kg levobupivacaine was administered via the lumbar paravertebral route at L2 level by loss of resistance to saline technique and in group CB, patients were given 1ml/kg levobupivacaine caudally. They evaluated sevoflurane concentration after induction and recorded it during incision, sac traction and closure. Face, legs, activity, cry and consolability (FLACC) scores, heart rate, blood pressure and SpO\(_2\) were evaluated postoperatively.\(^\text{4}\)

In a study conducted by another author,\(^\text{14}\) nerve stimulator guided paravertebral block and ilioinguinal nerve block for inguinal herniorrhaphy in children aged 5-12 years were compared. They showed that haemodynamic stability was maintained significantly better in paravertebral group than in ilioinguinal nerve block.\(^\text{14}\)

Another study concluded that the mean duration of analgesia after paravertebral block using levobupivacaine was 1300 minutes with a range of 120-1440 minutes,\(^\text{4}\) the mean duration of analgesia was 699 minutes in our study. The difference in our results could be due to the difference in the level of block, i.e., at L1 in our study compared to at L2 as done by the other authors,\(^\text{4}\) or due to the use of levobupivacaine (0.2 ml/kg) in their study, and the use of FLACC as the pain score instead of CHEOPS as used in our study.

Another study concluded that the mean duration of analgesia by single shot caudal block with bupivacaine (0.25%) as reported in different studies is variable and largely ranging from 2-6 hours to 24 hours.\(^\text{16-20}\)

Our results were consistent with a retrospective study conducted in 2011 in 2088 paediatric patients which observed that mean postoperative analgesia duration in caudal block with bupivacaine was 314 minutes.\(^\text{3}\)

In paediatric patients, urinary retention has been less well studied. Although neuraxial (caudal) anaesthesia was previously thought not to affect the ability to void in infants and children, a recent report, described two children who developed urinary retention after caudal anaesthesia with 0.25% plain bupivacaine.\(^\text{21}\)

The mean time of voiding urine in group A (PVB) was 5.316 ± 5.84 hours while for group B (CB) Was 9.24 ± 7.28 hours. The difference between the two was statistically significant with p value=0.003. However, none of the patients in both the groups had to be catheterized.

The main benefit of PVB over CB was significant improvement in the duration of postoperative analgesia after inguinal hernia surgery in children treated with paravertebral nerve blockade compared to those undergoing caudal block. Another important observation was that the time to void urine was less in group A (PVB) patients compared to group B (CB) patients.

There are a number of other benefits of PVB use in children as reported by other authors. For instance, in a
study, they demonstrated significantly higher overall parental satisfaction with PVB use, as well as a higher proportion of same-day discharge in the SPVB group relative to general anaesthesia combined with systemic analgesia. Various authors have studied prospectively the failure rate and complications in 367 paediatric and adult patients who received a thoracic or a lumbar paravertebral block. The overall failure rate was 10.1%; adults 10.7%; children 6.2%. The frequency of complications were: hypotension 4.6%, vascular puncture 3.8%, pleural puncture 1.1% and pneumothorax 0.5%. Since these results are similar to those found with alternative methods, e.g. epidural, intrapleural and intercostal blocks, paravertebral block can be recommended as an effective, safe technique for unilateral analgesia in both adults and children. A study found that 8.3% of children in a study suffered from vascular punctures. No such complications were noted in our study. Therefore, while precautions must clearly be taken to reduce potential complications of the technique, it is generally safe and beneficial in the paediatric population.

CONCLUSION
Both the techniques are safe and provide good quality postoperative pain relief, however the postoperative analgesia was better with paravertebral block and also the time to void urine was earlier in patients who were given paravertebral block than with caudal block.

REFERENCES