Caudal Analgesia In Paediatric Patients: Comparision Between Bupivacaine And Ropivacaine

S Ahmad, K Mohammad, M Ahmad, I Nazir, M Ommid, V Nabi

Abstract

Introduction: Caudal block since its first description in 1933 for paediatric urological interventions has evolved to become the most popular regional anesthetic technique for use in children. It provides excellent analgesia during surgery as well as during postoperative period in subumblical surgeries in children. This randomised prospective controlled study was undertaken to find and compare quality and duration of analgesia, motor and sensory block after a single shot caudal block with either Bupivacaine or Ropivacaine.

Method: 60 ASA I-II patients in the age range -12 years scheduled for Elective subluminal procedures were enrolled. Standard anaesthetic induction was conducted in all patients. After induction caudal block was performed in the lateral position. Perioperative haemodynamic parameters were recorded. Patients were randomly allocated to one of the two groups of 30 patients each. Group A received 1ml/kg of 0.25% bupivacaine. Group B received 1ml/kg of 0.2% ropivacaine.

Results: Post operative pain score was comparable in two groups in the first 4 hours but it was significantly less in ropivacaine group after 4 hour. The mean duration of analgesia in group A was 7.4±1.0 hours while in group B mean duration of analgesia was 7.6±1.3 hours. 19 patients (63.3%) in group A received rescue analgesic as compared to 10 (33.3%) patients in group B during 12 hour study period.

Conclusion: Caudal ropivacaine provides effective post-operative analgesia and possessing less motor blockade makes it a suitable agent for day care surgery with increased margin of safety particularly in younger children.

INTRODUCTION

The provision of adequate analgesia is necessary after any surgery and it is all the more important in children (1). There is a well defined pathway for the sensation of pain in the new-born infant. Nociception is associated with signs of distress even in new-born infants (2). The density of nociceptive nerve endings in the skin of new-born infants is similar to or greater than that in adults (3, 4).

Under-treatment of postoperative pain even in the children and new-borns may trigger biochemical and physiologic stress response and cause impairments in pulmonary, cardiovascular, neuron-endocrine, gastrointestinal, immunological, and metabolic functions (1).

Pain after surgery is inevitable. Relieving pain has been the focus of continuing human effort. However, it has been recognized for some time that the management of acute pain, especially postoperative pain, has been consistently and systematically inadequate. If anything, the situation in children has been even worse, who have long been under-medicated for acute pain (3).

Caudal block since its first description in 1933 for paediatric urological interventions has evolved to become the most popular regional anesthetic technique for use in children (5). It provides excellent analgesia during surgery as well as during postoperative period in subumblical surgeries in children (6).

Ropivacaine hydrochloride is a member of the amide class of local anaesthetics and is supplied as the S(-)-enantiomer. In vitro testing indicates that ropivacaine is comparable to (or slightly more potent than) bupivacaine in blocking sensory fibres and less active in blocking motor fibres. Studies in both animals and man indicate that ropivacaine is less toxic than bupivacaine with respect to the CNS and cardiovascular systems.

This randomised prospective controlled study was undertaken to find and compare quality and duration of analgesia, motor and sensory block after a single shot caudal block with either Bupivacaine or Ropivacaine.

METHODS

This prospective double blind randomised controlled study
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was conducted in the Department of Anaesthesiology and Critical Care from 2009 to 2011.

After taking the institute’s ethics committee approval, 60 patients of American Society of Anaesthesiologist (ASA) physical status I and II of either sex in the age range of 1 to 12 years scheduled for elective sub-umbilical surgical procedures were selected for this study. Exclusion criteria included: Infection at site of injection, deformity of spine at the site of injection, systemic infection, patients with history of bleeding diathesis ASA grade III or IV, pre-existing neurological, hepatic or renal disease and any known allergic diathesis.

During the preoperative visit, all patients were evaluated and assessed. The study protocol was explained to the parents and written informed consent was taken from them. No premedication was given to any patient. In the operation theatre after connecting the patient to the monitors, an intravenous line was established. Patients were induced with standard doses of thiopental (4 to 6mg/kg) + Atracurium (0.5mg/kg) to facilitate intubation and maintained on N₂O in O₂ plus 0.5% halothane as inhalational agent administered via LMA or ET tube. No intravenous or pre-rectal analgesic drugs were given to any patient intraoperatively.

Patients were randomly allocated to one of the two groups of 30 patients each.

Group A received 1ml/kg of 0.25% bupivacaine.

Group B received 1ml/kg of 0.2% ropivacaine

After induction of anaesthesia patients were placed in the lateral position and a caudal injection was performed using an aseptic technique with 22 gauge needle. Immediately after the caudal injection the patients were turned to supine position for performance of surgical procedure. Skin incision was allowed after 15 minutes of caudal block.

The aim was to record the blood pressure and heart rate just before and after surgical incision and then every ten minutes till the end of surgery. If a child responded to the incision with an increase in blood pressure (>10mmHg) or heart rate (>10beats/min), was considered as failure of caudal block. These patients were excluded from the study and rescue intraoperative analgesia was provided to them.

After completion of surgery, neuromuscular blockade was reversed with appropriate doses of neostigmine and atropine and patients send to recovery room and then to postoperative ward where patients were observed again. In the recovery room patients were monitored for 2 hours and following parameters were recorded.

Quality of pain relief by using Hanallah pain scale

Motor power and level of sensory block (pin prick test) were evaluated every 30 minutes.

Postoperatively severity of pain was assessed by an observer not aware of patient’s group as shown in Table 1.

### Figure 1

Table – 1: Hanallah Pain Scale

<table>
<thead>
<tr>
<th>No.</th>
<th>Observation</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Arterial pressure</td>
<td>&lt;10% preoperative</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;20% preoperative</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;30% preoperative</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Crying</td>
<td>Crying responding to tender consents</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crying not responding to TLC</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Movement</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Agitation</td>
<td>Arispinal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miot</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hysterical</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Posture</td>
<td>No special posture</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexing legs and thighs</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Holding gait</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Complaint of pain</td>
<td>Asleep/ignoring pain</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cannot localize</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can localize</td>
<td>2</td>
</tr>
</tbody>
</table>

Interpretation

Minimum score 0

Maximum score 12

Maximum score if too young to complain of pain 10

The higher the score the greater the degree of pain

### Figure 2

Table – 2: Motor Power Scale

<table>
<thead>
<tr>
<th>Muscle Function</th>
<th>Flexion</th>
<th>Hypotonia</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle power</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ankle</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Knee</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Thigh</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ability to stand</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

After discharge from recovery room, patients were
monitored every 2 hours until the administration of first rescue analgesic, the maximum time being 12 hours. The time in minutes from the caudal block to the time when rescue analgesia was first administered was considered duration of analgesia. Rescue analgesia was given in the form of rectal paracetamol (20mg/kg) or inj. Diclofenac (1mg/kg) of pain score was >4. The number of doses required for analgesia in first 12 hours in both the groups was recorded.

After completion of the study, the data was analysed statistically. Data was described as mean ± SD and percentages. The intergroup comparisons for the metric data was done by Student’s ‘t’ test, whereas non-metric data was analysed by Mann-Whitney ‘U’ test. The intergroup difference was measured at 95% confidence interval. Statistical Package for Social Sciences (SPSS) and MS Excel software was used for data analysis.

RESULTS

Sixty patients selected for this study were randomly divided into two groups of 30 patients each. The two groups were matched with regard to their age, gender, body weight. (Table 3).

In the study, hemodynamic effects with regards to pulse rate and systolic blood pressure showed a benign profile and no clinically relevant change was observed in these variables at various stages (Table 4 & 5).

The mean pain scores were higher in Group A as compared to Group B at all stages postoperatively till 12 hours . Postoperative pain score was significantly less in Group B as compared to Group A after 4 hours (p <0.05) (Figure 1).

It was observed from the study that less number of patients...
in group B required rescue analgesia and the difference was
found to be statistically significant when compared with
group A (p <0.05), however the duration of analgesia
between the two groups was not found statistically
significant (p >0.05) (Table 7).

Table 7: Rescue Analgesia administered in the Studied
patients

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Number of Rescue</td>
<td>0</td>
<td>11</td>
<td>63.7</td>
</tr>
<tr>
<td>Analgesia Doses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of Analgesia (mean ± SD) in hour</td>
<td>7.4 ± 3.0</td>
<td>7.6 ± 1.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 (8)</td>
<td>6 (10)</td>
<td>0.594 (NS)</td>
</tr>
</tbody>
</table>

NS= Not significant, Sig= Significant

Complete sensory recovery was achieved in 85±26.8 min in
group A and 81.3±21.3 min in group B and when the
sensory recovery time was compared between the two
groups it showed statistically insignificant difference (Figure 2).

All patients showed some amount of motor weakness in both
groups, immediately after surgery. But after two hours
almost normal motor power was recorded in group B as
compared to group A (Figure 3)

DISCUSSION

Pain after surgery is inevitable and the relief of acute pain,
especially postoperative pain, has been consistently and
systematically inadequate. If anything, the situation in
children has been even worse, who have long been under
medicated for acute pain (3).

Caudal block is one of the common regional anesthetic
technique used in paediatric age group undergoing infra
umbilical surgery. It is generally considered a simple & safe
procedure. It provides excellent analgesia during surgery as
well as during postoperative period in subumbilical surgeries
in children (7)

Ropivacaine (R) the N-propyl homologue of bupivacaine is
a long acting amide local anesthetic. Compared with
bupivacaine (B) which is a racemic mixture, R is the pure S
–enantiomer (8). Ropivacaine has several properties which
may be useful in paediatric practise, namely the potential to
produce differential neural blockade with less motor block,
and reduced cardiovascular and neurological toxicity.

For single injection caudal epidural block, comparisons
between equal masses of ropivacaine and bupivacaine have
shown virtually identical profiles in terms of onset time,
efficacy, duration of analgesia and incidence of motor
blockade (9, 11). The more concentrated solutions of
ropivacaine do produce motor block but the frequency,
intensity and duration is shorter than an equal mass of
bupivacaine (9)

Both the groups were homogenous with reference to age,
sex, weight and duration of anesthesia and surgery. Mean
age of patients in group A was 5.4±3.1 years whereas in
group B mean age was 4.4±2.6 years. Although male
dominated in group A with no female in group B, yet the
difference in male female ratio between the groups was
statistically insignificant (p> 0.05). Mean weight of patients
in group A was 20.1±8.1kg while mean weight of patients in group B was 17.7±5.8kg.

All the caudal blocks were regarded as clinically successful because none of the children required additional analgesic doses during surgery. No significant difference with respect to mean heart rate & systolic arterial pressure were noted during perioperative period between the groups. No patient required drug therapy to treat hypotension or bradycardia.

No significant difference with respect to mean heart rate & systolic arterial pressure were noted during perioperative period between the groups. No patient required drug therapy to treat hypotension or bradycardia.

Our study correlate with the study of Da Conceicao MJ, Coelho et al 1999(9) who found no difference between heart and arterial pressure between the groups, ropivacaine 0.25% compared with bupivacaine 0.25% by caudal route.

In our study, the quality of analgesia post-operatively was assessed by using Hannallah Pain Scale at 1 hour intervals while in the recovery room and thereafter 2 hourly for 12 hours. Post operative pain score was comparable in two groups in the first 4 hours but it was significantly less in ropivacaine group after 4 hour (p <0.05).

The mean duration of analgesia in group A was 7.4±1.0 hours while in group B mean duration of analgesia was 7.6±1.3 hours but the difference was not statistically significant (p >0.05).

19 patients (63.3%) in group A received rescue analgesic as compared to 10 (33.3%) patients in group B during 12 hour study period. The difference on comparison was statistically significant between the two groups (p <0.05).

Manjushree Raj et al 2000(10) observed less post operative pain score in ropivacaine group after 5 hour in their study between the two groups to receive either 0.25% bupivacaine or 0.25% ropivacaine via caudal block. These results correlate well with our findings.

P.A Lonnquist et al 2000(12) also observed in their study that caudal block with ropivacaine 2 mg/kg in children aged 1-8 year results in plasma concentration of unbound ropivacaine well below toxic concentration in adults. The dose studied was associated with adequate post-operative analgesia. Breschann, C; Krumpholz, R et al 2000(13) observed in their study that only one child in ropivacaine group had sign of pain 2 hour after surgery in children undergoing inguinal hernia repair via caudal block either 0.25% bupivacaine or 0.2% ropivacaine.

The difference in duration of analgesia in our study was not statistically significant, although rescue analgesia requirement was significantly lower in group B. One of the reasons for this could be small sample size. Alternatively the differing evaluating tools for pain assessment & statistical analysis may also account for this variability.

Sensory block resolved completely by 85±26.8min in group A and by 81.3±21.3 min in the group B with statistically not significant variation.

All the patients showed some amount of motor weakness in both groups, immediately after surgery. But after two hours almost normal motor power was recorded in group B as compared to group A. The difference was statistically significant (p <0.05).

Similar studies correlate with our findings. Omar Elsafty et al 2002(14) reported ropivacaine group showed a shorter duration of motor block than bupivacaine group, but no difference in duration of analgesia. Da-Conceicaco and his colleague’s study 1998(9) confirmed that ropivacaine administered to children by the caudal route is an effective long acting local anesthetic, producing less duration of motor block than bupivacaine group. B. Locatelli et al 2005(15) reported in their study that bupivacaine produced a higher incidence of residual motor blockade than ropivacaine or levo-bupivacaine. Ivani, Giorgia M.D; et al 2002(16) reported in their study that the use of ropivacaine but not levobupivacaine was found to be associated with less motor block during the first post-operative hour compared with racemic bupivacaine.

Our study is contradictory to that of J.S Tan et al 2000(17) which showed that there was no significant difference in pain intensity & degree of motor blockade between Ropivacaine and Bupivacaine on comparison in paediatric caudal block.

CONCLUSION

We conclude that caudal ropivacaine provides effective post-operative analgesia and possessing less motor blockade makes it a suitable agent for day care surgery. The lower intrinsic toxicity of ropivacaine and lower mass of drug gives an increased margin of safety which may be important, particularly in younger children.
References

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