Ropivacaine and bupivacaine for long-term epidural infusion in a small child

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Ropivacaine is assumed to be less toxic than bupivacaine but there are no reports concerning its long-term use in paediatric anaesthesia. We report the use of ropivacaine for long-term epidural anaesthesia in a 21-month-old girl. In two consecutive periods of 3 days each, 0.5% bupivacaine and 0.5% or 0.75% ropivacaine were administered to facilitate painful vaginal brachytherapy. The mean dose of bupivacaine increased from 1.05 to 1.32 mg kg–1 h–1 and that of ropivacaine increased from 1.40 to 3.86 mg kg–1 h–1. No toxic side effects were observed. We conclude that both epidural ropivacaine and bupivacaine were effective and safe during long-term epidural anaesthesia in this particular case. However, the doses were potentially toxic and should therefore be used with extreme caution.

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Epidural catheter techniques are currently used in paediatric regional anaesthesia.1–4 However, during continuous epidural anaesthesia, increasing plasma concentrations of local anaesthetics may induce toxic adverse effects.5 6 The new long-acting local anaesthetic ropivacaine is assumed to be less toxic than bupivacaine in adults.7 Recently, the efficacy and safety of ropivacaine in paediatric single-shot caudal anaesthesia were demonstrated.8 9

There are few details in the literature on the use of ropivacaine for long-term regional anaesthesia in children.10 Therefore, we report the case of a 21-month-old girl who received 3-day continuous epidural infusions of ropivacaine or bupivacaine on two separate occasions.

Case report

A 21-month-old girl, weighing 11 kg, underwent two periods of brachytherapy for a vaginal rhabdomyosarcoma, each lasting 3 days, separated by an interval of 1 week. Radiation was applied via an applicator filling the whole vaginal cavity, causing a certain degree of pain. Preventing displacement of the applicator by occasional movements of the lower body is important to ensure successful therapy. To achieve both analgesia and motor block for immobilization, continuous epidural anaesthesia was performed.

After obtaining parental written informed consent, an epidural 23-gauge open-end catheter (Portex, Hythe, UK) was placed at the third or fourth lumbar interspace. After a test dose and a titrated loading dose to reach a sensory level of T10, a continuous epidural infusion was started using a patient-controlled analgesia pump (SIMS Deltec, St Paul, USA). This allowed an optional bolus (lockout time 30 min). An additional bolus was administered at defined times (i.e. sensory blockade ≤T12, low motor block (Bromage ≤1), restlessness or abdominal discomfort).

Bupivacaine 0.25% did not provide sufficient motor block during a pretreatment period, 1 day before brachytherapy. Therefore, bupivacaine was administered at a concentration of 0.5% during the first application period at a rate of 2.2 ml h–1 (1 mg kg–1 h–1) with an optional bolus of 2.3 ml (1.05 mg kg–1).

The second application period was initiated with epidural infusion of 0.5% ropivacaine at a rate of 2.5 ml h–1 (1.14 mg kg–1 h–1) with a 3-ml (1.36 mg kg–1) bolus option. Ropivacaine 0.5% was replaced by 0.75% ropivacaine after 51.5 h. According to our routine practice, small doses of pentobarbital 2.5–5 mg kg–1 or the tricyclic neuroleptic chlorprothixen 0.5 mg kg–1 were given when required.

Heart rate and peripheral oxygen saturation were monitored and the child was kept under continuous observation. Sensory and motor block were assessed regularly. Plasma concentrations of bupivacaine and ropivacaine were meas-
Table 1 Plasma concentrations of local anaesthetics during long-term epidural anaesthesia

<table>
<thead>
<tr>
<th></th>
<th>22 h</th>
<th>28 h</th>
<th>70 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bupivacaine (µg ml⁻¹)</td>
<td>–</td>
<td>0.92</td>
<td>0.97</td>
</tr>
<tr>
<td>Ropivacaine (µg ml⁻¹)</td>
<td>1.83</td>
<td>–</td>
<td>1.54</td>
</tr>
</tbody>
</table>

Table 2 Mean dose of local anaesthetic during long-term epidural anaesthesia

<table>
<thead>
<tr>
<th></th>
<th>1–24 h</th>
<th>25–48 h</th>
<th>49–72 h</th>
<th>73–72 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bupivacaine (mg kg⁻¹ h⁻¹)</td>
<td>1.05</td>
<td>1.06</td>
<td>1.32</td>
<td>—</td>
</tr>
<tr>
<td>Ropivacaine (mg kg⁻¹ h⁻¹)</td>
<td>1.40</td>
<td>1.59</td>
<td>3.00</td>
<td>3.86</td>
</tr>
</tbody>
</table>

ured after the first and third days (Table 1), revealing bupivacaine concentrations below those associated with toxicity in children (3.7 µg ml⁻¹)⁶ and adults (2.1 µg ml⁻¹)¹¹ and ropivacaine in adults (2.2 µg ml⁻¹)¹¹.

During the treatment periods there were no respiratory or cardiovascular complications, or toxic side effects. Sensory block never exceeded T8. Short periods of reduced tolerance to the applicator responded rapidly to additional bolus doses and the child remained calm and showed no signs of discomfort. Adequate sleep was observed at night, although sometimes aided by moderate doses of pentobarbital or chlorprothixen.

Discussion

In this patient, long-term epidural anaesthesia was performed using a combination of continuous infusion and optional bolus doses. With this approach, the particular requirements of brachytherapy, both pain control and motor block, were achieved successfully for several days. However, a marked increase in the requirement for additional boluses was observed during the last day of each treatment period (Table 2) because of decreasing duration of motor block.

Currently, bupivacaine is the most widely used drug for epidural anaesthesia. The risk of toxic side effects increases at a rate of 1.25 mg kg⁻¹ h⁻¹.⁵⁻⁶ As this rate was exceeded in the first treatment period (Table 2), we decided to use ropivacaine for the second period as it is associated with less systemic toxicity in adults compared with bupivacaine.¹¹

Under almost identical conditions, epidural ropivacaine produced a similar degree of anaesthesia but less motor block compared with bupivacaine, leading to the need for a higher dose of ropivacaine. This is in agreement with the results of a previous study showing less motor block with 0.5% ropivacaine compared with 0.5% bupivacaine.¹²

In a recent study in adults, Scott and colleagues reported a progressive increase in total plasma ropivacaine concentrations during epidural infusion of 0.2% ropivacaine over 63–72 h.¹³ In our patient, we did not observe such an increase (Table 1). This could be a result of increased metabolism resulting from preceding chemotherapy and enzyme induction in our patient, although we have no data to support this view. However, the safety of our dosage regimen in this patient was proved by measurement of plasma concentrations which were considerably below the toxic range reported for bupivacaine in children and adults and for ropivacaine in adults.⁵⁻⁶¹¹ As yet, toxic concentrations of ropivacaine have not been identified for children.

In summary, this is the first case report of long-term epidural infusion of ropivacaine in a small child. It proved to be effective and safe over a 3-day period. However, in this particular patient, potentially toxic doses were administered and the safety of this technique is not proved. Before general recommendations can be made, further controlled studies are needed to evaluate the use of ropivacaine for long-term epidural anaesthesia in children.

Acknowledgement

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References

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