Pre-emptive analgesia: comparison of preoperative with postoperative caudal block on postoperative pain in children

H. Holthusen, F. Eichwede, M. Stevens, U. Willnow and P. Lippert

Summary

We have compared in 25 children the effect of preoperative with postoperative caudal block on pain after circumcision in a double-blind, randomized study. After induction of anaesthesia, patients were allocated randomly to receive a caudal block either before (n = 14) or immediately after (n = 11) surgery. Postoperative pain was rated on a paediatric pain scale. If pain occurred, children received paracetamol in a dose related to body weight. Using the Mann-Whitney U test (significance < 0.05) there was no significant difference in cumulative postoperative analgesic requirements within the first 48 h and in times to first analgesic administration between the groups. Cumulative pain score, assessed every 30 min for the first 8 h after operation, was significantly lower for those patients who received caudal anaesthesia after operation. Thus we could not demonstrate any advantage in performing caudal block before compared with after surgery. (Br. J. Anaesth. 1994; 73: 440-442).

Key words


In animals, well-localized and brief noxious stimuli were found to produce long-lasting neuronal sensitization, that is repeated stimulation resulted in increased traffic in dorsal horn neurones [1-4] and in increased behavioural pain responses [5, 6]. This sensitization was prevented by pre-injury ("pre-emptive") local anaesthesia [6] or opioid pretreatment [7]. Consequently, it has been suggested that in clinical practice, pre-emptive administration of regional anaesthesia might reduce postoperative pain [8, 9] to a greater extent than postoperative administration.

However, clinical studies on local or regional anaesthesia have failed to demonstrate any advantages of pre-emptive analgesia [10-12], with one exception [13]. However, this study was criticized for the use of infiltration anaesthesia [14] and inadequate outcome measures [15], as were other studies [16, 17]. Moreover, different surgical procedures were compared in one study [17]. Failure to demonstrate pre-emptive analgesia in patients is probably related to differences between experimental stimuli, which are well-localized and brief, and surgical trauma, which provokes extensive and prolonged nociceptive input. This input usually consists of a mixture of visceral, muscular and cutaneous afferents. As the origin of this input is important for development of sensitization [18], it is desirable to select a surgical procedure in which only one of these afferents is stimulated.

In this study we have compared the effect of preoperative with postoperative caudal anaesthesia on pain in children after circumcision which involves localized, brief and painful stimulation of the skin.

Patients and methods

In a double-blind, randomized study, which was approved by the local Ethics Committee, we investigated postoperative pain after circumcision in 25 children, of ASA I (median age 4.6 (range 2.6-9.8) yr, median body weight 19.7 (range 12.6-28.5) kg). Informed consent was obtained from all parents. Operations were performed between 8:00 and 13:00. Patients received midazolam 0.5 mg kg$^{-1}$ rectally as premedication 30 min before the start of anaesthesia. General anaesthesia was induced and maintained with 0.4-2.0% halothane and 66% nitrous oxide in oxygen. Orotracheal intubation was performed after administration of atripine 0.01 mg kg$^{-1}$ and suxamethonium 1.5 mg kg$^{-1}$. No opioids, barbiturates, additional benzodiazepines or other drugs affecting central pain processing were used.

After induction, patients were allocated randomly to receive caudal block (1% lignocaine 0.5 ml kg$^{-1}$) either 30 min before or immediately after surgery. All patients were anaeasthetized by the same anaesthetist, experienced in the caudal block technique.

After operation patients were observed by one investigator who was unaware of the timing of caudal anaesthesia, and the same investigator performed postoperative pain assessment. The observer rated pain on a special paediatric pain scale [19], a modification of the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) [20]. Weep...
Pre-emptive analgesia

Table 1  Patient data (median (range))

<table>
<thead>
<tr>
<th></th>
<th>Preoperative block ( (n=14) )</th>
<th>Postoperative block ( (n=11) )</th>
<th>Mann-Whitney U test ( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>4.6 (2.6–8.5)</td>
<td>4.7 (2.7–9.8)</td>
<td>0.32</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>19.3 (12.6–25)</td>
<td>20 (14.8–28.5)</td>
<td>0.27</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>25 (15–40)</td>
<td>25 (20–35)</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Table 2  Individual requirements for paracetamol. All doses were given within the first 8 h after operation, except for four doses which were given the next day. \( n = \) Number of patients

<table>
<thead>
<tr>
<th></th>
<th>No analgesic ( (n) )</th>
<th>One dose ( (n \text{ in mg}) )</th>
<th>Repetitive doses ( (n \text{ single dose in mg}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative block</td>
<td>2</td>
<td>10 (125–500)</td>
<td>2 (2 x 250)</td>
</tr>
<tr>
<td>Postoperative block</td>
<td>3</td>
<td>7 (125–500)</td>
<td>1 (3 x 250)</td>
</tr>
</tbody>
</table>

Table 3  Influence of preoperative vs postoperative caudal block on pain-related variables (median (range)). *In two patients, no administration of paracetamol during 48 h. †In three patients, no administration of paracetamol during 48 h.

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Cumulative analgesic requirement (mg; 48 h)</td>
<td>275 (0–1000)</td>
<td>250 (0–500)</td>
<td>0.14</td>
</tr>
<tr>
<td>Time to first analgesic application (min)</td>
<td>155 (140–450)*</td>
<td>150 (100–330);†</td>
<td>0.59</td>
</tr>
<tr>
<td>Administration of lignocaine ( (t=0) )</td>
<td>100 (85–395)*</td>
<td>150 (100–330);†</td>
<td>0.10</td>
</tr>
<tr>
<td>Cumulative pain score (8 h)</td>
<td>68 (57–73)</td>
<td>59 (53–75)</td>
<td>0.38</td>
</tr>
<tr>
<td>Administration of lignocaine ( (t=0) )</td>
<td>68 (57–73)</td>
<td>55 (49–71)</td>
<td>0.04</td>
</tr>
<tr>
<td>End of surgery ( (t=0) )</td>
<td>68 (57–73)</td>
<td>59 (53–75)</td>
<td>0.38</td>
</tr>
</tbody>
</table>

ing, posture of the trunk and legs, facial expression and agitation were assessed every 30 min for the first 8 h \( (0 = \) no pain, 15 = maximum pain). On evidence of pain, that is if the pain score reached a value of 7 or more, children received paracetamol suppositories in a dose related to body weight \( (125–500 \text{ mg}) \). Postoperative pain was quantified by three variables: (1) cumulative analgesic requirements within 48 h, (2) time to first analgesic administration and (3) cumulative pain score within the first 8 h.

Data are presented as medians and ranges. The Mann–Whitney U test was used for statistical analysis (patient data, cumulative analgesic requirements, cumulative pain scores, time to first administration of supplementary analgesic). \( P \leq 0.05 \) was considered statistically significant.

Results

Fourteen patients received preoperative and 11 postoperative caudal anaesthesia. Patient data (age, body weight and duration of surgery) were similar in both groups (table 1).

There was no significant difference in individual (table 2) or cumulative (table 3) analgesic requirements for paracetamol between the two groups within the first 48 h after operation. Times to first analgesic administration did not differ significantly, regardless of whether the reference point \( (t=0) \) was defined as the time of administration of lignocaine or the end of surgery (table 3). The cumulative pain score was significantly lower in the group receiving caudal anaesthesia after operation only when the reference point was defined as the end of surgery (table 3).

Discussion

We have not demonstrated any advantage of preoperative compared with postoperative conduction block on pain in children after circumcision. Thus, despite a design similar to that of experimental studies, including a brief and well-localized trauma, pre-emptive analgesia was not observed.

The experimental design corresponded with recommendations for studying pre-emptive analgesia [14, 15], that is both the preoperative and postoperative groups received an identical regional analgesic procedure. In contrast with previous studies [11, 13], regional anaesthesia, but not infiltration of the wound, was performed to avoid interference between the local anti-inflammatory action of local anaesthetics [21–23] and its suspected pre-emptive effects. Furthermore, no opioids or other analgesics which affect central pain processing [14] were given before or during surgery. Lignocaine was used for caudal anaesthesia because of its antinociceptive and anti-wind-up potential [24–26]. The concentration used was the same as that used in previous studies [11, 13], the latter study demonstrating prolonged times to first analgesic request in the pre-emptive group. Postoperative pain was rated on a pain scale which has been tested for reliability and validity in children [19].
Depending on the reference point, that is preoperative administration of lignocaine or end of surgery, there was an advantage for postoperative block and this was significant in respect of cumulative pain score. There was also a non-significant trend with respect to the time to first analgesic administration (see table 3). This advantage may be related to the duration of action of lignocaine. Therefore, the period of pain assessment was referenced either to preoperative administration of lignocaine or end of surgery (table 3), as has been done by others [12]. Nevertheless, regardless of the reference point there was no advantage for pre-emptive treatment.

Failure to demonstrate pre-emptive analgesia in our study may have been the result of several causes: first, the stimulus could have been too small or too short to evoke central sensitization. This is unlikely as the intensity and duration of stimuli in experimental studies were in a similar range and, moreover, circumcision is a painful stimulus [19]. Second, as a result of the effective analgesia, postoperative pain was low and thus differences between the groups would be difficult to evaluate. Third, ongoing inflammation and hyperalgesia at the wound may evoke neuronal sensitization after disappearance of regional analgesia in the postoperative period [11]. In recent clinical studies on pre-emptive analgesia in abdominal surgery, that is with extensive nociceptive input and thus different from stimuli in experimental studies it has not been possible to demonstrate any advantage of pre-emptive treatment [10, 12]. Thus the concept of reducing postoperative pain by preventing functional changes in central pain processing with local anaesthesia is unproven.

References


