COMPARISON OF THE EFFECT OF EMLA CREAM, SUBCUTANEOUS RING ANAESTHESIA AND A DOUBLE CUFF TECHNIQUE IN THE PREVENTION OF Tourniquet Pain

Y.-C. TSAI, Y.-Y. LAI AND C.-L. CHANG

SUMMARY
We have examined the effect of EMLA on tourniquet pain and compared it with those of subcutaneous ring anaesthesia (SRA), a double cuff technique and a single cuff (control) during i.v. regional anaesthesia. The durations of analgesia (mean 57.3 (SD 16.6) min) and tolerance (72.3 (13.9) min) to tourniquet inflation in the EMLA group were comparable to those in the SRA group (54.1(16.2) min and 68.3(19.0) min), but significantly (P < 0.05) greater than those in the control group (30.0 (10.7) min and 45.6 (14.0) min). The double cuff technique was the most effective method, with 91.5 (14.9) min duration of analgesia.

We conclude that EMLA provided a significant analgesic effect on tourniquet pain compared with the control group, but a relatively limited analgesic effect compared with a double cuff technique.

KEY WORDS

I.v. regional anaesthesia (IVRA) is a useful and safe block for analgesia of the extremities. Nevertheless, analgesia at the site of the tourniquet is not achieved as easily as that at the operative site and various methods have been described to relieve tourniquet pain [1-5]. EMLA (Astra), a 5% eutectic mixture of two local anaesthetics, lignocaine and prilocaine, has been shown to be effective in producing local anaesthesia of intact skin in infants, children and adults [6—11]. The purpose of this study was to evaluate the effect of EMLA in the prevention of tourniquet pain, and compare it with subcutaneous ring anaesthesia (SRA), a double cuff technique and a standard technique (control).

PATIENTS AND METHODS
This study was performed in a randomized, single-blind, controlled manner and was approved by the local Ethics Committee. Informed consent was obtained from each patient. Forty adult patients (ASA physical status I or II) undergoing elective forearm or hand surgery were allocated randomly to four groups of 10. No premedication was given. With the patient supine, an i.v. cannula was placed in a vein on the dorsum of the hand or distal forearm of the limb to be blocked. The tourniquet, 6.5 cm in width, was applied midway between axilla and elbow over a cushioning layer of orthopaedic padding. Before IVRA, patients in group 1 received topically applied 5% EMLA cream 30–35 g circumferentially over the site of the tourniquet, then an occlusive plastic dressing was positioned for 1 h. Patients in group 2 received SRA with 1% lignocaine 20 ml, using a 22-gauge, 70-mm long needle at the site of tourniquet just before the single pneumatic tourniquet cuff was applied; the total dose of lignocaine combined with that used in IVRA was 400 mg. Double tourniquet cuffs (6 cm wide) were used in group 3 patients, without EMLA or SRA. The proximal cuff was inflated to 250 mm Hg after the arm was exsanguinated with an Esmarch bandage. The distal cuff was inflated and the proximal cuff released 30 min after i.v. injection of lignocaine. Patients in group 4 (control group) received placebo cream (a cream base containing no local anaesthetic) over the site of tourniquet, using the same procedure as in group 1. For each patient, the arm was exsanguinated by applying an Esmarch bandage from the finger tips to the tourniquet site. The cuff was inflated to 250 mm Hg. When satisfactory ischaemic conditions were obtained, the solution of 0.5% lignocaine 40 ml was injected.

The duration of tourniquet analgesia was defined as the time between application of tourniquet pressure and complaint of tolerable pain or soreness over the tourniquet site. The duration of tourniquet tolerance was defined as the time between application of tourniquet pressure and complaint of intolerable pain or discomfort that required additional analgesia.

Data were analysed by Kruskal-Wallis test with Dunn procedure. P less than 0.05 was considered statistically significant.

RESULTS
Patient characteristics are shown in table 1. The duration of analgesia to tourniquet inflation was regarded as the same as the duration of operation (which lasted longer than 90 min) if the patient still...
EMLA and Tourniquet Pain

Table I. Patient data (mean (range or SD))

<table>
<thead>
<tr>
<th></th>
<th>EMLA (n = 10)</th>
<th>SRA (n = 10)</th>
<th>Double Cuff (n = 10)</th>
<th>Control (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>32.6 (17-63)</td>
<td>36.8 (22-60)</td>
<td>35.6 (22-61)</td>
<td>37.7 (26-65)</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>6/4</td>
<td>4/6</td>
<td>5/5</td>
<td>5/5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>61.6 (11.5)</td>
<td>59.3 (7.8)</td>
<td>61.1 (10.0)</td>
<td>56.9 (9.6)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.6 (7.7)</td>
<td>163.9 (8.2)</td>
<td>164.3 (5.4)</td>
<td>161.3 (10.5)</td>
</tr>
</tbody>
</table>

Table II. Mean (SD) durations of analgesia and tolerance to tourniquet inflation in each group. P < 0.05: * compared with other three groups; † compared with control group. CI = confidence interval

<table>
<thead>
<tr>
<th></th>
<th>EMLA (n = 10)</th>
<th>SRA (n = 10)</th>
<th>Double Cuff (n = 10)</th>
<th>Control (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of analgesia (min)</td>
<td>57.3 (16.6)†</td>
<td>54.1 (16.2)</td>
<td>91.5 (14.9)*</td>
<td>30.0 (10.7)</td>
</tr>
<tr>
<td>95% CI</td>
<td>(45.4-69.2)</td>
<td>(42.5-65.7)</td>
<td>(80.8-102.2)</td>
<td>(22.3-37.7)</td>
</tr>
<tr>
<td>Duration of tolerance (min)</td>
<td>72.3 (13.9)†</td>
<td>68.3 (19.0)</td>
<td>—</td>
<td>45.6 (14.0)</td>
</tr>
<tr>
<td>95% CI</td>
<td>(62.4-82.2)</td>
<td>(54.7-81.9)</td>
<td>—</td>
<td>(35.6-55.6)</td>
</tr>
</tbody>
</table>

had no complaint about the tourniquet site. The mean duration of analgesia to tourniquet inflation in the double cuff group was 91.5 (SD 14.9) min, which was significantly longer than that in the SRA, EMLA or control groups (P < 0.05) (table II). The mean duration of analgesia to tourniquet inflation in the EMLA group was 57.3 (16.6) min, comparable to that in the SRA group (54.1(16.2) min) (P < 0.05 compared with the control group (30.0 (10.7) min). The duration of tolerance to tourniquet inflation in the double cuff group could not be evaluated for lack of data in eight of 10 patients because surgery ended before occurrence of intolerable symptoms. The mean duration of tolerance to tourniquet inflation in the EMLA group (72.3 (13.9) min) was not significantly different from that in the SRA group (68.3 (19.0) min), but was significantly longer (P < 0.05) compared with the control group (45.6 (14.0) min).

DISCUSSION

To avoid subjectively reminding patients about their tourniquet pain, we did not evaluate pain scores at fixed intervals, but for practical purposes, we selected two points to evaluate pain, the duration of tourniquet analgesia and the duration of tourniquet tolerance. These two points were equivalent to each end of a visual analogue scale (perceptible and intolerable). Our study indicated that the duration of tourniquet analgesia and duration of tourniquet tolerance in the EMLA group were significantly longer compared with the control group. Lowrie, Jones and Eastley [12], studying 10 healthy male volunteers, found a significantly longer duration and smaller pain scores in an EMLA group. However, the duration of tourniquet analgesia or tolerance in the EMLA group is of little clinical significance, because the technique is time-consuming, variably effective and expensive. We found that the most reliable method was the double cuff technique.

Although the double cuff is not favoured by some users because of the increased incidence of tourniquet failure in IVRA [13, 14], this technique is both effective and safe in the prevention of tourniquet pain if used correctly and carefully. Brown, McGriff and Malinowski reviewed 1906 cases receiving IVRA with a double tourniquet and concluded that the major cause of adverse effects was technical error [15]. It is essential that all equipment be checked before use. However, it is held by many clinicians that the double cuff method is less safe than a single cuff technique. Using EMLA cream or SRA to prevent tourniquet pain with a single cuff technique may be an alternative, but not ideal, method in clinical practice.

Subcutaneous ring anaesthesia was reported by Rousso and colleagues to be an excellent analgesic technique for tourniquets [2]. However, in our study, SRA only provided similar analgesia as EMLA. Lack of a control group and the duration of observation in Rousso’s study may explain the difference in observations. Although there were no toxic signs in the SRA group patients who received lignocaine 400 mg (half in SRA and half in IVRA), the total dose was significantly in excess of the maximal recommended doses. However, the recommendation of a single maximum dose without regard to the site of injection is of little significance [16]. The plasma concentration of local anaesthetic drugs varies considerably as a function of the site of injection [17]. To achieve a plasma toxic concentration of lignocaine administered by subcutaneous infiltration requires a much greater dose than administration via the intercostal, extradural or brachial plexus routes [18]. Nevertheless, we did not measure serum concentrations of lignocaine in the SRA group.

The mechanism of tourniquet pain has been the subject of much debate [1, 12, 19-21]. Many factors are thought to be implicated. Cole [19] suggested that tourniquet pain had both a superficial and a deep component. Rousso and colleagues [2] and Lowrie, Jones and Eastley [12] proposed that tourniquet pain has a significant cutaneous component. In our study, EMLA and SRA provided predominantly superficial analgesia, and both provided only limited analgesia, suggesting that skin compression is one component of tourniquet pain.
The double cuff technique prevents tourniquet pain by the same mechanism as that of IVRA. The site of action of IVRA is controversial, but is explained best by multiple and complementary mechanisms [22-24]. With 0.5% lignocaine 40 ml in IVRA, the double cuff tourniquet can provide more reliable anaesthesia at the tourniquet site.

ACKNOWLEDGEMENT
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REFERENCES