Effect of the addition of alfentanil to lignocaine during axillary brachial plexus anaesthesia

W. P. GORMLEY, J. M. MURRAY, J. P. H. FEE AND S. BOWER

Summary
Peripheral administration of opioids has been suggested as a means of improving regional block. We studied 60 patients receiving axillary brachial plexus anaesthesia, allocated randomly to receive either normal saline 10 ml or normal saline 10 ml with alfentanil 10 µg/kg body weight through an axillary cannula. All patients received 1.5 % lignocaine at a dose of 7 mg/kg body weight with adrenaline 1 in 200 000. The incidence of satisfactory block was similar in both groups. Although the percentage of patients with complete anaesthesia in the median nerve distribution was greater in the alfentanil group, there was no significant difference in any other distribution. The time to return of sensation and motor function was prolonged significantly in the alfentanil group (P < 0.05). After return of normal sensation, there was no significant difference between groups in postoperative analgesia. In a second part of the study, there was no significant increase in plasma concentrations of alfentanil in 10 patients given lignocaine and alfentanil, as outlined above. These observations suggest that alfentanil may have a peripheral local anaesthetic action. (Br. J. Anaesth. 1996; 76: 802–805).

Key words
Anaesthetic techniques, regional, brachial plexus. Anaesthetics local, lignocaine. Analgesics opioids, alfentanil.

Traditionally, antinociception has been associated with occupation of opioid receptors exclusively within the spinal cord [1]. Recently, opioid receptors have been discovered on immune cells, sympathetic nerve fibres and peripheral neurones [2, 3]. Animal behavioural studies have demonstrated antinociception after peripheral administration of opioids [4]. Peripheral effects of opioids may improve regional anaesthesia without centrally mediated side effects. This would clearly be of benefit during brachial plexus anaesthesia, a commonly used anaesthetic technique for upper limb surgery. However, clinical studies have shown results ranging from improved quality of anaesthesia and postoperative analgesia [5–7] to no effect [8, 9].

Ineffective opioid activity during brachial plexus anaesthesia may be because of the inability of the opioid to penetrate axonal myelin and the nerve membrane [4]. In this study, alfentanil was chosen as it is highly un-ionized (89 %) at pH 7.4 [10]. Lignocaine is a commonly used short-acting local anaesthetic which may benefit from improvement in duration of action or postoperative analgesia.

Patients and methods
After obtaining local Ethics Committee approval and written, informed consent, we studied 60 patients, ASA I and II, aged 18–70 yr, weighing 50–100 kg. All were unpremedicated and undergoing elective upper limb surgery.

An 18-gauge i.v. cannula was inserted into the contralateral arm. Routine monitoring was used throughout the study. After sterile preparation, axillary brachial plexus block was carried out using a 20-gauge cannula, as described by Hill and Campbell [11]. Loss of resistance to saline was used to locate the axillary sheath. Having found the sheath, the needle was removed, the cannula advanced and secured in place. A length of primed plastic tubing was attached to the cannula and to a syringe. The patients were then allocated randomly to one of two groups using a sealed envelope technique. Group A received alfentanil 10 µg/kg body weight made up to 10 ml with 0.9 % saline. Group S received 0.9 % saline 10 ml. These solutions were prepared before use by a colleague who took no further part in the study. All patients received commercially prepared 1.5 % lignocaine with adrenaline 1 in 200 000 to a total dose of 7 mg/kg body weight. The pH of the mixed solutions in each group was measured later using a pH meter.

Sensory and motor observations were performed every 10 min for 30 min after injection by an observer who was unaware of the solution used. Anaesthesia was assessed using response to pinprick on a three-point scale: normal, impaired or absent sensation. The extent of motor block was assessed...
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using hand grip with a modified Bromage scale: normal, impaired or absent motor function [12]. The block was judged overall to be satisfactory if anaesthesia involved at least two peripheral nerve distributions, including one of the following: median, ulnar, radial or musculocutaneous. The use of rescue adjuvants such as nerve blocks, infiltration or sedation was recorded. The return of sensory and motor function and the time to first request for analgesia were noted. A visual analogue pain score was obtained at hourly intervals for 6 h and at 12 and 24 h. Sedation, ventilatory frequency and peripheral oxygen saturation were also noted at these times. Systemic effects such as nausea, vomiting or pruritus were recorded.

In the second part of the study, 10 patients received axillary brachial plexus anaesthesia as described for group A. In addition, 10-ml samples of venous blood were obtained at 30 min, 1, 2, 3 and 4 h after injection. The samples were centrifuged and frozen to −40°C. Plasma concentrations of alfentanil were measured later by a radioimmunoassay technique of sensitivity 2 pg ml\(^{-1}\) and coefficient of variation 7 % [13].

Advice regarding statistical analysis was obtained from the Department of Statistics at the Queen’s University of Belfast. Patient data and characteristics were compared using unpaired Student’s \(t\) test and Mann–Whitney \(U\) test as appropriate. Onset times in the peripheral nerve distributions were categorized as 0–10, 10–20, 20–30 and greater than 30 min. The number of patients in each category was calculated for all peripheral nerve distributions and for motor function. They were compared using the chi-square test. The fact that complete anaesthesia failed to develop in certain peripheral nerve distributions precluded the use of analysis of variance. \(P < 0.05\) was considered statistically significant.

Results

There were 32 patients in group S and 28 patients in group A. The type of surgery included correction of Dupuytren’s contracture (57 %), carpal tunnel median nerve decompression (26 %) and others (17 %). There was no significant difference between groups in age, weight, sex or duration of surgery (table 1). There was a greater percentage of patients with complete anaesthesia in the median nerve distribution in group A at 30 min after injection \((P < 0.05)\). There was no significant difference between groups in any other peripheral nerve distribution or in motor function (fig. 1).

The overall incidence of satisfactory block was 91.7 % and was not significantly different between groups. The use of rescue adjuvants was similar for both groups. The times to return of sensation \((P = 0.013)\) and motor function \((P = 0.001)\) were prolonged significantly in group A compared with group S (table 2). The time to first request for analgesia was similar in both groups.

There was a significant reduction in visual analogue pain scores (VAS) at 3 h in group A \((P = 0.019)\) but not at any other time (fig. 2). There were no significant differences between groups in sedation, peripheral oxygen saturation or ventilatory

Table 1 Patient data (mean (SD or range) or number)

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yr)</th>
<th>Weight (kg)</th>
<th>Sex (M/F)</th>
<th>Duration of surgery (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saline</td>
<td>50.4 (18–69)</td>
<td>72.4 (11.2)</td>
<td>24/8</td>
<td>65.2 (18.7)</td>
</tr>
<tr>
<td>Alfentanil</td>
<td>44.1 (20–62)</td>
<td>75.5 (11.8)</td>
<td>20/8</td>
<td>74.6 (33.3)</td>
</tr>
</tbody>
</table>

Figure 1 Percentage of patients with complete anaesthesia or motor block 30 min after injection of saline (☐) or alfentanil (●). The peripheral distributions shown are the lateral cutaneous nerve of the arm (LCA), median cutaneous nerve of the arm (MCA), lateral cutaneous nerve of the forearm (LCFA), median cutaneous nerve of the forearm (MCFA), ulnar nerve (ULN), median nerve (MED) and radial nerve (RAD). Motor block (MOT) is also shown. *\(P < 0.05\).

Table 2 Time to return of sensation and motor function, and time to first request for analgesia (mean (SD) minutes). *\(P < 0.05\)

<table>
<thead>
<tr>
<th>Group</th>
<th>Return of sensation (min)</th>
<th>Return of motor function (min)</th>
<th>Time to first analgesia (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saline</td>
<td>189.7 (58)</td>
<td>191.6 (43)</td>
<td>335.8 (171)</td>
</tr>
<tr>
<td>Alfentanil</td>
<td>231.7 (64.8)*</td>
<td>240.6 (61.9)*</td>
<td>320 (92)</td>
</tr>
</tbody>
</table>

Figure 2 Postoperative visual analogue scores (VAS) in the saline (☐) and alfentanil (●) groups (median, interquartile range). *\(P < 0.05\).
of anaesthesia in one peripheral nerve distribution. It is known that the peripheral effects of opioids are enhanced after inflammation [22]. This may be because of infiltration of immune cells which would produce a delayed analgesic response. There is evidence for the existence of endogenous opioids in a variety of immune cells infiltrating inflamed subcutaneous tissue [23]. An alternative suggestion is that both axonal transport and proliferation or activation of opioid receptors may be enhanced by inflammatory mechanisms [24, 25]. This inflammatory requirement may limit the usefulness of peripheral opioids in acute pain. Furthermore, axonal opioid receptors may be functionally less efficient than those located at peripheral nerve terminals [4].

In summary, this study has demonstrated prolongation of sensory and motor block suggestive of a local anaesthetic effect. However, the degree of improvement in anaesthesia is unlikely to render this technique clinically useful. In particular, we did not demonstrate a significant improvement in the quality of postoperative analgesia. The absence of a significant clinical effect is in keeping with the theoretical limitations of peripheral axonal administration of opioids in acute pain.
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References