REGIONAL ANALGESIA WITH BUPIVACAINE IN DENTAL ANAESTHESIA

I. H. WILSON, M. N. RICHMOND AND P. W. STRIKE

Cardiac arrhythmias are common during dental anaesthesia (Kaufman, 1966; Rollason and Dundas, 1968; Tuohy, 1968; Alexander, 1971; Ryder, 1971) and the majority occur during the surgical procedure. Stimulation of the trigeminal nerve during dental extraction under general anaesthesia may trigger such arrhythmias: afferent impulses from the trigeminal nerve (Alexander, 1971) may stimulate the sympathetic nerve centre in the medulla, with the result that impulses reach the cardiac plexus from the spinal cord. This increase in adrenergic activity, which predisposes to the development of cardiac arrhythmias, is exacerbated by the presence of volatile agents such as halothane and any increase in $P_{aCO_2}$.

In a pilot study we found that the incidence of arrhythmia accompanying the extraction of third molar teeth under general anaesthesia could be reduced significantly by using a technique of bilateral blockade of the afferent nerves with 0.25% bupivacaine. As pain may be severe after the extraction of third molar teeth, we have studied also the effects of local blockade on the pain after surgery.

PATIENTS AND METHODS

Ethical approval to study the effects of bilateral inferior alveolar and posterior superior alveolar nerve blockade on the incidence of arrhythmia during the extraction of four third molar teeth was obtained.

As local anaesthesia using lignocaine and

prilocaine (Plowman, Thomas and Thurlow, 1974) have both been reported to be effective in reducing the frequency of arrhythmia in this clinical situation, we elected to test the null hypothesis of "no reduction in arrhythmia frequency" under the following constraints on our trial conclusions:

(1) Significance level of test statistics ($\alpha$) = 0.05; that is, we were prepared to accept a 5% chance (or less) of failing to reject the null hypothesis in error.

(2) Power of test statistic ($1 - \beta$) = 0.90; that is, we were prepared to accept a 10% chance (or less) of failing to reject the null hypothesis in error.

(3) The minimum reduction in arrhythmia frequency to be detected, if it in fact existed, was set at 10%.

The number of subjects required was estimated to be 30 in each of the control and treatment groups (Schwartz, Flamont and Wellouch, 1980). The treatment allocation was randomized using a computer-based random allocation routine (Wang 2200 MVP randomize function). The allocations were coded such that the subjects, and the anaesthetists responsible for assessing the response variables, were unaware of the treatment status at the time the final assessments were made; that is, we used a controlled, randomized, double-blind experimental design.
Sixty subjects (ASA I) between the ages of 16 and 60 yr, who had given their informed consent were studied. All subjects had extraction of all four third molar teeth.

The study was explained fully and a personal pain analogue score sheet was shown to each patient. It was explained that we would visit between 4 and 6 h after the procedure, and the following day, and would ask the subjects to quantify their pain at these times. They were requested to communicate any unpleasant effects from the anaesthetic or operation.

The patients were premedicated with hyoscine 0.6 mg by mouth and temazepam (20 mg under 70 kg body weight, and 30 mg over 70 kg body weight) approximately 90 min before surgery.

Anaesthesia was induced with thiopentone 3–5 mg kg⁻¹ and intubation of the trachea was facilitated by suxamethonium 1 mg kg⁻¹. A gauze pack was positioned in the oropharynx.

The patient breathed spontaneously through a Bain coaxial breathing system with a fresh gas flow at least 150 ml/kg body weight. Anaesthesia was maintained with nitrous oxide and halothane in oxygen.

Arterial pressure (Dinamap) and ECG (RAF patient monitoring system, CM5) were monitored from the moment of arrival in the operating theatre. The anaesthetist was able to observe the ECG continuously and store abnormal segments by "freezing" the screen display, thus allowing time for analysis. One patient was withdrawn from the trial as he did not have sinus rhythm at the beginning of surgery.

Only the surgeon knew which test treatment the patient received. He carried out the local anaesthetic injection in the bupivacaine group out of the anaesthetist's field of view. An injection was simulated in the control group. Three minutes was allowed to elapse before surgery commenced. The anaesthetist was unaware if bupivacaine had been given.

The injection of 0.25% bupivacaine plain was carried out bilaterally in the manner described by Erikson (1969), with the following doses: 3 ml to the inferior alveolar nerves; 1 ml buccal nerve infiltration; 1 ml posterior superior alveolar nerve. No palatal injections were given, nor was any attempt made to block the lingual nerve, although it is frequently blocked during an inferior alveolar nerve block.

We predicted that these blocks would produce anaesthesia of both lower third molar teeth and of the buccal aspect of the upper third molar teeth. If the lingual nerve were blocked inadvertently, loss of sensation (trigeminal) and taste (chorda tympani fibres in lingual nerve trunk) in the anterior two-thirds of the tongue would occur. Full proprioception of the tongue would be retained, as it is thought that afferent proprioceptive fibres may travel in the hypoglossal nerve (Adatia and Gehring, 1972). No motor loss would occur.

During the operation all arrhythmias were noted and classified as (a) junctional arrhythmia where normal sinus rhythm was replaced by normal width QRS complexes but absent P waves; and (b) arrhythmias with premature, widened QRS complexes and absent P waves which we described as "wide complex extrasystoles." At the end of the operation the trachea was extubated under deep halothane anaesthesia and the patient remained in the recovery ward until awake and in full control of all faculties.

Analgesia after surgery was given at the ward sister's discretion and consisted of papaveretum 0.2 mg kg⁻¹ i.m. or Distalgesic 2 tabs orally. The patients were reviewed 4–6 h after surgery and again the following morning and asked to document the severity of their pain on an analogue scale and note any untoward effects of the anaesthetic or operation. Patients were questioned directly to ascertain whether any paraesthesia was present.

Statistical methods

Qualitative response variables—frequency of arrhythmia and requirement for analgesia—were assessed using a $\chi^2$ statistic for $2 \times 2$ contingency tables. Where expected frequencies were inappropriate for the $\chi^2$ test (less than 5 in any one cell), Fisher's exact probability test was used. All probabilities were calculated exactly under a one-sided alternative hypothesis. Our use of a one-sided test procedure may be criticized as unduly restrictive in terms of the possible trial outcome, but we note that the conclusions we drew subsequently from our trial data would not have been altered substantially under a two-sided test procedure.

The quantitative response variable (pain score) was examined initially for evidence of significant deviations from normal distribution expectations using a formal test of the observed coefficients of skewness and kurtosis. In light of the clearly established non-normality of our pain scores data,
we have used the median and range for summary purposes and the Mann–Witney U statistic to test for evidence of significant differences between the control and treatment group pain scores. The U statistic was evaluated using standard tables (Neave, 1978).

RESULTS

The number of patients who showed wide complex extrasystoles was significantly reduced in the treatment group (table I). The incidence of Junctional rhythm was similar in both groups (table I). Two patients received treatment for wide complex extrasystoles in the control group.

As judged by analogue pain scores, the patients had significantly (P < 0.05) less pain at 4 and 6 h in the bupivacaine group as compared with those in the control group (fig. 1). The pain scores were similar the following morning. Unfortunately, two patients (one in each group) were lost to the study during this phase as they were discharged early.

Paraesthesia, especially in the lingual distribution, is a known complication following third molar extraction. No difference between the two groups was found.

<table>
<thead>
<tr>
<th>Table I. Frequency of arrhythmias</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Bupivacaine group</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Wide complex extrasystoles</td>
</tr>
<tr>
<td>Junctional arrhythmia</td>
</tr>
</tbody>
</table>

Analgesic requirements were estimated in the two groups by the consumption of drugs (table II). There was no statistically significant difference in analgesia requirements. This finding has been noted before (Hellden et al., 1974). To determine whether any significant difference does exist would require a larger sample size.

DISCUSSION

Arrhythmias in dental anaesthesia are common—estimates of frequency range from 0 to 80% (Pelkofski, 1974). Their clinical significance is debatable in the majority of patients, but occasionally they may lead to serious or even life-threatening episodes, especially in patients with compromised cardiovascular function (Alexander, Beckheit and Fletcher, 1972; Plowman, Thomas and Thurlow, 1974; Tomlin, 1974). Patients receiving concurrent medication, such as tricyclic antidepressants, may be at increased risk (Plowman and Thomas, 1974).

Various methods of preventing such arrhythmias have been described. Lignocaine i.v. (Clayton and Alt-Graham, 1983) or by infiltration (Plowman, Thomas and Thurlow, 1974) has been found to decrease the incidence of arrhythmias, as has infiltration of prilocaine and octapressin (Alexander, 1971). However, some authors consider infiltration to be effective only in operations on the upper jaw (Kaufman, 1966). Beta-adrenoreceptor blockers (Ryder, Charlton and Gorman, 1971; Rollason and Russel, 1980; Whitehead, Whitmarsh and Horton, 1980), either as pretreatment or as treatment during anaesthesia, and induction with Althesin (Alexander, 1974) have all been shown to reduce the frequency of arrhythmias. Controlled ventilation of the lungs (Thomas, Thomas and Thurlow, 1976), or maintenance of anaesthesia with enflurane (Wright, 1980) instead of halothane, have reduced the frequency of arrhythmia.

Bupivacaine has been used in dental treatment (Laskin, 1977; Babstand Gilling, 1978; Ganganroa, 1981; Moore and Dusky, 1983) and as a result of
its long duration of action it has proved useful in the prevention of pain after surgery (Atkinson, Rushman and Lee, 1982; Moore and Dunsley, 1983).

Bilateral inferior alveolar, buccal and posterior superior alveolar nerve blocks were carried out. No palatal blocks were performed as it was considered unwise to produce total anaesthesia to the posterior sphincter of the mouth. Bilateral inferior alveolar nerve block has been controversial in the past (Plowman, Thomas and Thurlow, 1974), but it has been shown clearly that the patient maintains full proprioceptive sensation and motor function of the tongue and has no difficulty maintaining a clear airway (Adatia and Gehring, 1972). At no time during our experience of more than 100 patients using this technique were there any problems with the patient's airway.

During anaesthesia, in patients who had received a local nerve block, the frequency of wide complex extrasystoles was reduced markedly. These extrasystoles with absent P waves are not classified easily into ventricular, junctional or supraventricular extrasystoles with aberrant conduction without the facility of direct intracardiac monitoring (Wellens, Bär and Lie, 1978) or oesophageal electrocardiography (Alexander, Beckheit and Fletcher, 1972). There was little difference in the frequency of junctional rhythm between the two groups. This lack of difference can probably be attributed to the fact that the patients were sometimes anaesthetized more deeply with halothane than they required. When bupivacaine was used in a pilot study, only 0.5% halothane was required usually for maintenance, and this resulted in a lower incidence of junctional rhythm (around 8%). In the double-blind trial the inspired halothane concentration tended to be reduced slowly to the value required for maintenance and probably resulted in deeper anaesthesia for a time in these particular patients.

Following dental surgery patients may experience marked pain (Seymour, Blair and Wyatt, 1983), especially in the first 12 h. Bupivacaine reduced pain at 4–6 h after surgery, but to assess the full extent of this improvement a larger trial would be required. The lack of difference in the analgesic requirements between the two groups may be attributable to insufficient data, added to which the effect of bupivacaine would tend to diminish after 4–6 h.

Altered sensation in the lingual nerve distribution after surgery was similar in both groups and in no case did it persist. Any altered sensation is caused probably by trauma to the lingual nerve during surgical extraction, rather than by the nerve blocks per se. The paraesthesia produced by the bupivacaine did not upset patients, few admitting to any numbness at 4–6 h except on direct questioning.

CONCLUSIONS

Bupivacaine infiltration and nerve blockade significantly reduce wide complex extrasystoles and postoperative pain. In the majority of patients the advantages are probably marginal, but in patients scheduled for general anaesthesia who are unsuitable for local anaesthesia alone, and in whom it is desirable that cardiac arrhythmias and instability are to be avoided, it may be a useful technique.

A further refinement of the technique would be to use the new intraligamentary injection (Miller, 1983) of local anaesthetic which would produce specific analgesia of the teeth involved, thus avoiding formal nerve blocks.

ACKNOWLEDGEMENTS

The authors are grateful to Group Captain Chapman-Andrews, Consultant in Oral Surgery, for permission to study patients under his care; Director General Medical Services (RAF) for permission to publish the paper; and Mrs Carol Wilson for secretarial services.

REFERENCES


