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Temporal summation during extradural anaesthesia

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Summary

We have investigated in 10 patients the effect of extradural anaesthesia on temporal summation by comparing pain thresholds to single and repeated (five impulses at 2 Hz) electrical stimuli and compared these tests with pinprick and cold stimulation. Bupivacaine 0.5 % (20 ml) was injected at L2–3. After extradural anaesthesia the threshold to repeated stimuli was significantly lower than the threshold to single stimuli ($P = 0.0007$). Nine patients lost cold sensation and 10 patients pinprick sensation. Pain to single electrical stimulation disappeared in six patients and pain to repeated electrical stimulation in one. Pain may be evoked by temporal summation of repeated electrical stimuli even when pinprick sensation, cold sensation and pain to single electrical stimuli are inhibited. Thus temporal summation should be taken into consideration when extradural analgesia is assessed. (*Br. J. Anaesth*. 1995; **75**: 634–635)

Key words

Anaesthetic techniques, extradural. Pain. Pain, threshold.

Weak stimuli may evoke pain if they are repeated or their duration prolonged (temporal summation). Inhibition of temporal summation is a major goal in pain prevention and treatment. Indeed, repetitive nociceptive input produces an increase in the excitability of neurones in the spinal cord (central sensitization), which probably plays an important role in the pathophysiology of acute and chronic pain syndromes [1]. Temporal summation is not evoked by pinprick and cold, which are conventionally used to assess extradural analgesia, and inadequate analgesia may be observed in the presence of loss of discrimination to pinprick [2].

Brief localized stimuli are blocked more frequently by extradural anaesthesia than prolonged stimuli [3]. This suggests that temporal summation may be blocked inadequately by extradural anaesthesia, and evoking temporal summation may be important for assessing extradural block. The aims of the present study were to investigate the effect of extradural anaesthesia on pain elicited by repeated electrical stimulation of the sural nerve which, unlike the methodology used in the aforementioned study [3], investigates temporal summation specifically [4]. A further aim was to compare this test with single electrical stimulation, pinprick and cold for assessment of extradural analgesia.

Methods and results

We studied 10 ASA I–II patients, 26–57 yr old, undergoing extradural anaesthesia for elective surgery. The study was approved by the local Ethics Committee and informed consent was obtained from all patients. The same anaesthetist performed the extradural blocks and tests in all patients.

Bipolar surface Ag–AgCl electrodes were placed behind the lateral malleolus for stimulation of the sural nerve, which was performed with a constant current stimulator (Digitimer Ltd, England). Subjective pain detection thresholds were recorded as follows. A 25-ms train-of-five 1-ms square-wave impulse was used as a single stimulus. The current intensity was increased from 2 mA in steps of 1–5 mA until pain was evoked or a maximal current of 60 mA was reached. In the last case, the threshold was defined as 60 mA. The mean of three threshold determinations was calculated. To determine the threshold for temporal summation, the single stimulus was repeated five times at 2 Hz [4]. Current intensity was increased as described above until summation (perception of the last one or two stimuli as painful) was observed.

Sensitivity to pinprick and cold were tested 2 cm anterior to the site of electrical stimulation and on the forehead to allow comparison with a non-anaesthetized area. Pinprick was performed with a 21-gauge sharp-bevelled needle and the cold test with gel bags (Physiopack, Fisch Laboratories) kept in a freezer, applied to 4 cm^2 skin surface for 2 s. Tests were considered positive when patients reported normal or light perception of puncture or cold, compared with sensation at the forehead.

Patients were not premedicated. A catheter was inserted at L2–3, 4 cm cephalad in the extradural space, and the patient turned to the supine position. Before administration of the anaesthetic solution a test series was performed for training, followed by a baseline test series. Plain bupivacaine 0.5 % (4 ml) was injected through the catheter as a.test dose. After 4 min, 4-ml boluses of the same solution were administered every 1 min to a total dose of 20 ml.

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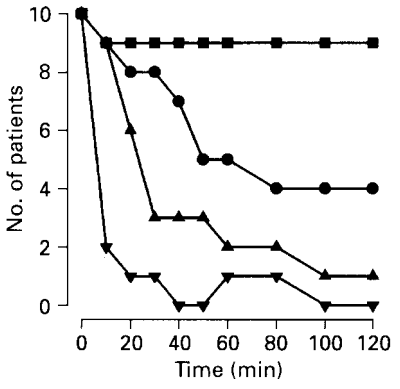

Figure 1 Number of patients displaying a positive test, that is temporal summation (■) and single stimulus (●)pain threshold lower than 60 mA, and slight or normal perception of cold (▲) and pinprick (▼). Time 0 before injection of the anaesthetic solution.

Single and repeated stimulations of the sural nerve, pinprick and cold tests, were performed 10, 20, 30, 40, 50, 60, 80, 100 and 120 min after the last bolus of anaesthetic solution. At the end of the experiment patients were transported to the operating room for surgery.

Friedman repeated measures ANOVA on ranks was performed on the difference between single and repeated thresholds at each time of the experiment (software SigmaStat, version 1.0). $P < 0.05$ was considered significant.

Each test series lasted 2–6 min. All patients displayed normal perception of pinprick and cold at the forehead. It was difficult to define the single stimulus pain threshold, whereas the summation pain threshold was easy to detect and very reproducible. The median values of single/summation threshold (mA) were, respectively: 9/6 (baseline), 16/8 (10 min), 25/12 (20 min), 33/16 (30 min), 47/18 (40 min), 55/24 (50 min), 59/23 (60 min), 60/26 (80 min), 60/26 (100 min) and 60/27 (120 min). Single stimulus thresholds were significantly higher than summation thresholds ($P = 0.0007$). Figure 1 shows data comparing temporal summation, single stimulus, cold sensation and pinprick sensation over a period of 1200 min after administration of bupivacaine.

Comment

Analgesia to brief stimuli did not imply analgesia to repeated stimuli in our study. Moreover, our data suggest that extradural anaesthesia does not necessarily prevent central sensitization.

The segment S1 is difficult to block by extradural anaesthesia [5]. This is supported by the high incidence of pain to repeated stimulation found in the present study, in spite of loss of discrimination to pinprick and cold (fig. 1). Dyhre, Renck and Andersson found that single electrical stimulation is superior to pinprick and cold for assessing extradural analgesia [6]. Our results confirm these findings, but show also that false negatives may be expected with single electrical stimulation, as this test does not evoke temporal summation (fig. 1). We suggest therefore that temporal summation should be elicited when the efficacy of extradural analgesia is assessed.

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