

## Spinal anaesthesia inhibits central temporal summation

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### Summary

In a previous investigation we found that extradural anaesthesia did not adequately inhibit temporal summation of repeated electrical stimuli: pain to repeated stimuli was blocked in only one of 10 patients, and pain thresholds to repeated stimuli were significantly lower than pain thresholds to a single stimulus. In this study we have investigated in 10 patients the effect of spinal anaesthesia on temporal summation, assessed by repeated electrical stimulation of the sural nerve. Plain 0.5% bupivacaine 18 mg was injected at L2–3. The pain threshold to a single electrical stimulus, summation threshold (increase in perception during repeated electrical stimuli with five impulses of the same intensity at 2 Hz), pinprick and cold sensation were assessed. After spinal anaesthesia, pain to both single and repeated stimulation, and pinprick and cold sensation, disappeared in all patients. We conclude that spinal anaesthesia inhibits temporal summation elicited by repeated electrical stimulation. (*Br. J. Anaesth.* 1997; 78: 88–89)

### Key words

Anaesthetic techniques, subarachnoid. Pain, experimental. Pain, threshold.

Repetition of a peripheral stimulus can cause increased pain perception (temporal summation). Increased and prolonged firing of dorsal horn neurones after repeated stimulation<sup>1</sup> (central sensitization) is probably the mechanism explaining temporal summation.

Repeated cutaneous stimulation can be used to investigate temporal summation in humans.<sup>2</sup> Nociceptive reflex and subjective pain thresholds after repeated stimulation have been found to be increased slightly by isoflurane concentrations used for surgical analgesia,<sup>3</sup> ketamine<sup>4</sup> and alfentanil,<sup>5</sup> although none of these drugs adequately blocked temporal summation. In a previous investigation,<sup>6</sup> we found that even extradural anaesthesia did not completely block temporal summation of repeated electrical stimuli: pain to repeated stimuli was blocked in only one of 10 patients, and pain thresholds to repeated stimuli were significantly lower than pain thresholds to a single stimulus.

The aim of this study was to assess the effect of

spinal anaesthesia on temporal summation, assessed by repeated electrical stimulation.

### Methods and results

We studied 10 ASA I–II patients (five male), median age 43 (range 18–54) yr, median body weight 71 (54–85) kg and median height 170 (157–182) cm, undergoing spinal anaesthesia for elective surgery. Exclusion criteria were: age less than 18 or more than 65 yr, heart disease, pregnancy, opioid intake during the last 2 weeks, intake of other analgesics during the last 24 h, alcohol abuse and use of psychotropic drugs. The study was approved by the local Ethics Committee and informed consent was obtained from all patients.

Patients were not premedicated. Spinal anaesthesia was performed in the sitting position, at L2–3, with a 27-gauge Quincke needle, by the midline approach. Plain 0.5% bupivacaine 18 mg was injected over 40–45 s, with the bevel of the needle pointing cranially. Cerebrospinal fluid (0.2 ml) was aspirated and re-injected after administering half and the whole dose, to assure intrathecal placement of the needle. After injection patients were placed in the supine horizontal position.

Bipolar surface silver–silver chloride electrodes were placed behind the lateral malleolus for stimulation of the sural nerve. A 25-ms, train-of-five, 1-ms, square-wave impulse (perceived as a single stimulus) was delivered from a computer-controlled constant current stimulator (University of Aalborg, Denmark). To determine the single stimulus pain threshold, current intensity was increased from 2 mA in steps of 1–5 mA until pain was evoked, or a maximum current of 60 mA was reached. In the last case, the threshold was defined as 60 mA. The mean of two threshold measurements was calculated. To determine the threshold for temporal summation, the single stimulus was repeated five times at 2 Hz.<sup>2</sup> Current intensity was increased as described above until summation (increase in perception during the five stimuli) was observed, or a maximum current of 60 mA was reached. In the last case, the threshold

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Table 1 Median values (ranges) of thresholds to single (pain threshold) and repeated (increasing perception during five stimulations at 2 Hz) electrical stimulation of the sural nerve. Number of patients displaying slight or normal perception of pinprick and cold at the site of electrical stimulation

	Basal	10 min	20 min	30 min	40 min
Single stimulus threshold (mA)	7 (2–12)	60 (19–60)	60 (39–60)	60 (60–60)	60 (60–60)
Repeated stimuli threshold (mA)	4 (1–7)	53 (10–60)	60 (35–60)	60 (40–60)	60 (60–60)
Pinprick sensation (No. patients)	10	1	0	0	0
Cold (No. patients)	10	0	0	0	0

was defined as 60 mA. The mean of two threshold measurements was calculated.

Sensitivity to pinprick and cold were tested 2 cm anterior to the site of electrical stimulation (dermatome S1) and on the forehead to allow comparison with a non-anaesthetized area. Pinprick was performed with a 21-gauge sharp-bevelled needle, and cold test with gel bags (Physiopack, Fisch Laboratories) kept in a freezer, applied to 4 cm<sup>2</sup> of 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.

Before spinal puncture a test series (single and repeated stimulations of the sural nerve, pinprick and cold) was performed for training, followed by baseline recordings. The test series was then repeated 10, 20, 30 and 40 min after spinal injection. The upper and lower levels of sensory block were determined 40 min after injection by absence of pinprick sensation. At the end of the experiment patients were transported to the operating room for surgery.

The median upper level of sensory block, as assessed by pinprick, was T9 (range T3–L4). Block of S5 was achieved in every patient.

Each test series lasted 2–4 min. After anaesthesia all patients had single stimulus and summation thresholds more than 60 mA (table 1). Pain to repeated stimulation disappeared in all patients. All patients lost both pinprick and cold sensation.

## Comment

We have shown that spinal anaesthesia effectively blocked pain elicited by single and repeated electrical stimulations of the sural nerve. Pain could not be evoked in any of the 10 patients by repeated stimulation with a maximum current intensity of 60 mA.

This contrasts our previous study,<sup>6</sup> where extradural anaesthesia blocked pain to repeated stimulations in only one of 10 patients.

Pinprick and cold sensation disappeared very rapidly after spinal anaesthesia, when pain could still be evoked by electrical stimulation (table 1). This confirms that pinprick and cold tests inadequately assess the efficacy of regional block.<sup>6</sup>

We conclude that spinal anaesthesia inhibits temporal summation of nociceptive stimuli elicited by repeated stimulation of the sural nerve. This indicates that spinal anaesthesia can prevent sensitization of dorsal horn neurones during nociceptive stimulation and could be useful for the prevention of hyperalgesic states.

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