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10. Effects of percutaneous electrical stimulation on spinal nociceptive responses

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Peripheral percutaneous and transcutaneous electrical stimulation has been shown to be effective for relief of both acute and chronic pain in man (Meyerson 1983), and acute experimental pain in rats (Woolf *et al.* 1980).

Cell firing was recorded by using multibarrel micropipettes in 16 rats anaesthetized with pentobarbitone or Halothane–nitrous oxide. The cells recorded were in laminae IV to VI of the dorsal horn. Pinch stimuli were applied regularly, usually to a toe. In some experiments, iontophoretic L-glutamate and non-noxious peripheral stimuli such as tap or hair movement were also used and alternated with pinch.

Two needles were placed through the skin in the plantar metatarsal region at least 1 cm proximal to the pinch forceps. The percutaneous stimulation consisted of 1 ms pulses which were applied across these needles as 70 ms trains of stimuli at 100 Hz repeated at 2 Hz (Eriksson *et al.* 1979).

Neither the intensity used (3–30 times the threshold to produce a potential in dorsal horn or dorsal root) nor the duration of stimulation (5–30 min) was critical in determining the effect on responses to pinch. However, when tests at different intensities were carried out on individual cells, on all but one occasion the effect on pinch increased as the intensity increased. In 59 tests (26 cells) on pinch, the mean effect was to reduce responses to 33% of control (± 5 s.e.m.) with a mean time to maximum recovery of 5 min (± 1 s.e.m.) with a range of 2 to 22 min. Complete abolition of responses to pinch has been seen at an intensity of 5× threshold.

In 15 tests on glutamate the mean effect was to reduce responses to 59% of control (± 10 s.e.m.) with a mean time to maximum recovery of 4 min (± 1 s.e.m.). If a cell was spontaneously active, this too was reduced, usually abolished, with a mean time to maximum recovery of 7 min (± 1 s.e.m.).

The mean effect of percutaneous electrical stimulation on responses to innocuous inputs was to reduce them to 72% of control (± 7 s.e.m.) with a mean time to maximum recovery of 2 min (± 1 s.e.m.).

Compound action potentials recorded in the tibial nerve were unaffected by percutaneous stimulation of equal or greater intensity and duration than those needed to abolish responses of dorsal horn cells to pinch.

Thus percutaneous electrical stimulation can inhibit dorsal horn cell responses to noxious mechanical stimuli but has less effect on responses to innocuous stimuli. This inhibition seems to be a central rather than peripheral phenomenon and to be at least partly due to a reduction of cell excitability in laminae IV to VI of the dorsal horn.

References

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