A METHOD OF IMPLANTATION OF BIPOLAR ELECTRODES FOR STIMULATION OF NERVES IN A LONG-TERM EXPERIMENT

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The method we propose here has the advantage compared with arrangements described previously [1, 2, 3] that the leads are taken out through the body by means of a special contact device. By this means not only can a reliable connection be made between the electrode and the stimulator but no infection penetrates along the wires. Furthermore the use of polythene and perspex eliminates the necessity for special varnishes and adhesives, and the electrodes may be produced in any ordinary physiological laboratory by the experimenter himself.

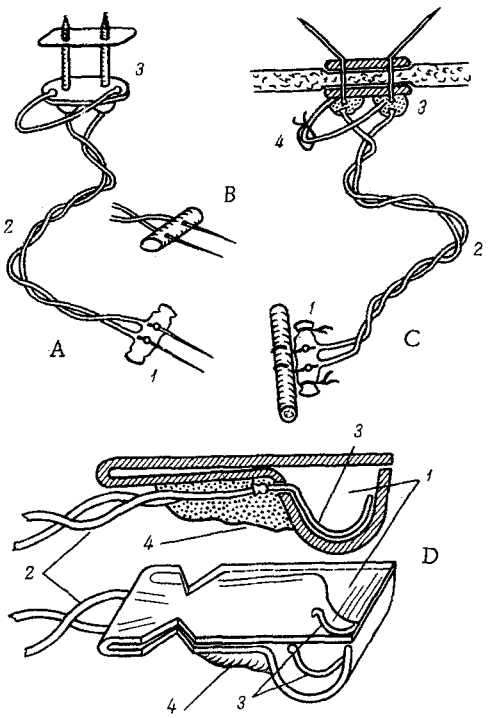

Diagram of the electrode arrangement, its preparation, and implantation. A) Electrode arrangement, as assembled; B) connection of electrodes to form a pair; C) implantation of the electrodes; D) implanted electrodes (section and sketch).

Figure A shows: 1) paired electrodes; 2) connecting leads; 3) output contacts. We prepared all these parts, and kept them sterilized in alcohol.

To make the electrodes two lengths of tantalum wire 10-15 mm in length and 0.1 mm in diameter were soldered to two flexible multiple-strand cables encased in polythene insulation. The ends of the tantalum electrodes were sharpened on a grindstone and inserted into 3 mm polythene tube as shown in Fig. B. Then the tube was compressed between two heated pieces of glass. In this way a firm connection was made between the two electrodes of the pair, and reliable insulation was ensured (see figure A1). To the other end of the leads the contact arrangement (A, 3) was fixed; it consisted of a perspex plate measuring 10 x 15 mm carrying two needles. The soldered connection and the lower part of the needles (above the plate) were covered with fused polythene.

To restrain movement of the contact device during the experiment, in order to prevent breakage of the leads running to it, a wire hoop (A, 4) was fixed onto the plate, and during the operation the contact device was fixed behind it to the underlying tissues by means of a nylon thread (see figure C4).

While aseptic precautions were observed the sharpened electrodes were fixed on the nerve so as to penetrate the latter (C, 1). The leads together with the output contacts were taken beneath the skin to the point marked for the lead-out of the contact needles. After the needles had been brought out through the skin of polythene plate also made from polythene tube was placed over the needles. The needles over the plate were bent out in opposite directions so as to fix the contact device firmly to the skin (C, 3).

Another arrangement of the electrodes is shown in figure D; the electrodes are bent so that there is no need to pierce the nerve. This arrangement enables the operation to be performed more quickly because the nerve which has been exposed for a length of 6-7 mm is placed in the electrode trough (D, 1).

We have made electrodes of this kind from strips of perspex 20 x 4 mm and 0.8 mm thick. At one end of the plate, while it was still hot, a depression was made to correspond to the thickness of the nerve while the other end was bent so as to form a roof over the groove. The tantalum electrodes brought into the groove (D, 3) were bent to conform to the shape of the latter, and were fixed outside together with the leads (D, 2) by means of melted polythene (D, 4).

Both kinds of electrodes were placed on the nerves of the external ear and on the superior cervical sympathetic ganglion, in order to stimulate them; 24 rabbits were used for this purpose.

The functional integrity of nerves with implanted electrodes was inferred from the absence of any change in threshold stimulation, which was systematically measured during the experiment; it varied for the different animals between 0.8 and 5 V. The experiments lasted from 38 to 92 days, and the value of the threshold remained constant to within 0.2-0.4 V.

The absence of functional distrubances to the superior cervical sympathetic ganglion due to implantation of the electrodes was deduced from the temperature change of the external ear, which rose on average by 3° during stimulation. The temperature was measured by a fast-acting thermometer.

SUMMARY

A simple technique is described for preparation of electrodes for implantation into nerves and a description is given of a device for connecting them with the stimulator. The arrangement prevents infection via the electrodes in the long-term experiment, and can be used as an alternative to bringing the leads straight out through the skin. The electrodes were implanted into the nerves of the outer ear and into the superior cervical sympathetic ganglion of rabbits. There was no change in the stimulus threshold or of the temperature response of the ear during a period of three months, a result which indicated the functional integrity of the nerves and the ganglion into which the electrodes were implanted.

LITERATURE CITED

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