CELL STATIONS IN THE UPPER SYMPATHETIC CHAIN

EVIDENCE THAT FUNCTIONAL REGENERATION OF SYMPATHETIC NERVES IN MAN OCCURS ONLY IN POSTGANGLIONIC NEURONES

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The inferences and conclusions that are presented in this paper are derived from studies on patients after various types of sympathectomy and apply only to the sympathetic neurones that innervate sweat glands. In a previous communication, we presented evidence to show that the pilocarpine (or mecholyl) sweating test might serve as a method of differentiating pre- and postganglionic sympathectomy. We feel that if sufficient time is allowed for degeneration of postganglionic neurones, the sweat glands that they had innervated will not respond to pilocarpine (gr. ½) or mecholyl (gm. 0.025) when injected hypodermically. Two to 3 weeks may be sufficient time for degeneration in some patients, but unless the sympathectomized zone is completely anhidrotic to mecholyl, one should not draw final conclusions until 2 months have elapsed. It appears that the cholinergic drug does not act directly on the gland in the doses used but acts at the neuroglandular junction (end plate), and in some cases evidently more than 2 weeks are required for the end plate to become pharmacologically inactive. If the postganglionic neurone remains intact as after preganglionic sympathectomy, the sweat glands will respond to the cholinergic drugs indefinitely. Such glands do not atrophy from disuse at least up to 2 years (proven by biopsy in 2 cases). After preganglionic sympathectomy sweat glands will often respond more copiously to the cholinergic drugs than they did before sympathectomy. This also holds true for a short time after postganglionic sympathectomy.

We feel that this so-called increased sensitivity of the gland is due to the fact that central connections have been severed and hence, the gland is uninhibited and completely free to respond to the drug. Drug sweating after postganglionic sympathectomy ultimately decreases so that from 2 weeks to 2 months postoperatively it ceases to occur.

Patients vary greatly in their response to pilocarpine and mecholyl, and if studies are to be made, a normal sweating test should be done before sympathectomy and a photograph taken so that accurate comparisons may be made with the results after sympathectomy. Many patients react so weakly to the drugs normally that they are not suitable for study. The lower extremities, unless normally hyperhidrotic, usually respond too weakly to pilocarpine to provide conclusive information.

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A heat sweating test should be done within a few days of the corresponding drug test so that the two may be accurately compared. In making our studies concerning cell stations we have conformed to the above principles.

METHOD

The sweating tests were carried out by using the Minor\(^6\) starch-iodine preparation as an indicator.

The thermoregulatory or heat test was carried out by placing the subject in a Burdick heat cabinet where he was exposed for 20–30 minutes to a dry heat of 110 to 120°F. The response which occurred only in skin that was not in contact with anything was considered valid.\(^5\)

The drug test was performed at room temperature. Either \(\frac{1}{3}\) gr. of pilocarpine hydrochloride or 0.025 gm. of mecholyl (acetyl-beta methylcholine chloride) was injected intramuscularly. Although the subjective response to mecholyl is more severe, the drug acts more quickly and apparently causes a greater sweating response than pilocarpine. Either drug should otherwise give the same result.

CELL STATIONS OF POSTGANGLIONIC NEURONES TO SWEAT GLANDS OF THE FACE

In a previous report,\(^4\) we presented 5 patients who were studied after cervicodorsal ganglionectomy (removal of inferior cervical and 1st and 2nd dorsal ganglia). The anhidrotic zone after pilocarpine was identical with the anhidrotic zone after a heat sweating test. Since the face was anhidrotic after pilocarpine, we concluded that in these patients a removal of the inferior cervical ganglion constituted a postganglionic sympathectomy to the face. Hence, it was also concluded that the postganglionic cells governing sweat glands of the face were in the inferior cervical ganglion or below and that none resided in the superior cervical ganglion. We repeated the heat, pilocarpine and mecholyl test on M. B., reported previously.\(^4\) The patient had had a bilateral cervicodorsal ganglionectomy. The repeat tests were made 2 years after those shown in Fig. 3 of the previous report. The sweat patterns in the repeat tests were identical in every respect to those shown in the photographs of 2 years before, indicating no regeneration. Both the heat and drug tests showed complete anhidrosis of the face and upper extremities.

Since that paper was published we have encountered the following 3 patients who maintained drug sweating on the face after removal of the inferior cervical ganglion.


Mar. 20, 1939. The inferior cervical and 1st dorsal ganglia (stellate ganglion) were removed on the left.

Jan. 11, 1941. A heat sweating test (22 months following operation) revealed an anhidrosis of the left face and shoulder. A pilocarpine test showed free sweating that seemed equal on both sides of the face. The heat test proved that there had been no regeneration.

Case 2. E. V. (40-6956). White female, aged 45.

Aug. 19, 1940. On the right the sympathetic chain was cut below D3. All rami to and from D2 and D3 were cut, but no others. The free end of the chain was sutured to the nearest muscle.

On the left the inferior cervical and upper 2 dorsal ganglia were removed.