SKIN RESISTANCE CHANGES IN THE LOWER LIMB AFTER LUMBAR GANGLIONECTOMY

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THE estimation of sweat gland thermo-regulatory activity has, in the past 20 years, been increasingly utilised, as an objective method of localising and interpreting lesions in the central, peripheral and sympathetic nervous systems. In many cases, such as those of lesions interrupting and limited to the sympathetic pathways, the detailed plotting of anhidrotic skin is the only clinical method available that can accurately outline the cutaneous area affected by the neural section. The revelation of such anhidrotic areas may therefore be used, diagnostically in those rare selective types of trauma, the sympathetic chain stretch injuries described by Guttmann, or more commonly, as a means of evaluating the effectiveness and extent of surgical sympathectomies. It is with the disturbances of the thermo-regulatory sweat gland activity in the first 10 days after lumbar ganglionectomy that this paper deals. A new technique for measuring skin resistance changes is also described.

For the measurement of thermo-regulatory sweating in both clinical and physiological practice, two entirely different methods have been developed, the “chemical” and the “electrical.”

The former depend on the colour changes resulting from the interaction of the skin surface moisture and a colorimetric substance which has previously been applied to the skin. The original substance used was starch and iodine. This has largely been replaced as a colour indicator by the red-brown dye quinizarin (2-6-di-sulphonic acid). The chemical methods unfortunately have many disadvantages. They all necessitate the heating of the patient sometimes to an uncomfortable degree, in order to exaggerate the contrast between the sweating and non-sweating areas, and in the constitutionally hypohidrotic person, syncope may result before an adequate pattern can be demonstrated. It is not possible therefore to examine patients satisfactorily by this technique within a few days of a major operation. The heating is most suitably done in a special and rather cumbersome sweat cabinet, as reflex thermo-regulatory sweating by immersion of the limbs in hot water will often not reveal the finer details. Heating by ordinary electric lamp cradles is unsatisfactory and may result in burns, especially over anaesthetic areas. The quinizarin powder may be difficult to apply evenly on shiny skin and is always unpleasantly dirty to the patient especially around the head and neck regions, where sneezing or lacrimation from powder irritation may also invalidate the findings. Finally, the interpretation of the resulting sweat patterns requires meticulous attention to detail and considerable experience.
in the method. Absolute measurements of sweat gland activity cannot of course be made by the chemical techniques.

The electrical methods are based on the finding that the electrical resistance between two skin electrodes varies with the amount of sweat gland activity occurring in the skin under the electrodes. The actual distance between the skin electrodes is of little account.

The electrical circuit between the electrodes A and B in contact with the skin may be represented in simplified form by the resistance network shown in Fig. 1. Here $R_1$ and $R_4$ represent the contact resistance between the electrodes and the tissue, $R_2$ represents the resistance between the electrodes at the surface of the skin, and $R_3$ represents the resistance through the tissues and appears in parallel with $R_2$. $R_3$ is small compared with the other resistances and virtually short-circuits $R_2$. Thus the reading obtained depends on $R_1 + R_4$, that is, the contact resistance between the electrodes and the skin. This can be demonstrated by a simple experiment.

A subject was chosen whose skin was rather more moist than the average. A disc-electrode $\frac{1}{2}$ inch in diameter was strapped on the forearm just below the elbow, electrical contact being made to the skin through electrode cream. Direct contact with the skin was made at points 1, 2, 3, 4 and 5 inches away from the first electrode through a $\frac{1}{2}$ inch diameter spring-loaded electrode. The resistance between the electrodes was measured by means of a battery and micro-ammeter.

The values obtained in each case lay between 270,000 and 280,000 ohms, which may be regarded as constant within the limits of experimental error, or, in other words, the resistance is not dependent on the distance between the electrodes. Because the thermo-regulatory activity of the sweat glands is dependent on the integrity of their "sympathetic" sudomotor fibres, it follows that "sympathectomised" skin shows a higher electrical skin resistance than normally innervated skin. At a room temperature at $18^\circ$C, the difference between the resistance of normal and sympathectomised skin of the average patient is small, the resistance of the sympathectomised being of the order of 10 per cent higher than that of the contiguous normal areas. In the method developed by Richter, and later modified by Jasper, and Whelan and Richter, the skin resistance is measured by putting the patient in series with a low voltage (4$\frac{1}{2}$–9 volts) battery and a micro-ammeter with a full-scale deflection of 20 microamperes. The indifferent electrode was originally clipped to the lobe of an ear, electrical contact being made with an electrolytic cream; later a simple zinc surface electrode was used. The exploratory electrode consisted of a small plated phosphor-bronze disc attached to a wooden handle. As the resistance over the normal skin was too high to give a meter deflection of enough magnitude, the patient was first heated in a hot-air cabinet until the resistance was lowered sufficiently by...