STEREOTAXIC SURGERY FOR PARKINSONISM

A METHOD OF EVALUATION AND CLINICAL RESULTS*

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In the past decade there has been a resurgence of interest in the dyskinesias stimulated, apparently, by the availability of new technics of radical therapy. Destruction or inactivation of selected portions of the basal ganglia has been shown to relax the muscular rigidity and reduce the tremor of parkinsonism. Cooper4 has demonstrated how this can be accomplished with such effectiveness and ease by the application of alcohol to the target tissue that his method has been adopted widely. Already a very considerable body of experience has been accumulated and reported.5

Development of practical and reliable stereotaxic devices by Spiegel and Wycis,6 Leksell,7 and others has made possible greater precision in directing an effective instrument to a subcortical target and has enabled a wider choice of targets in any given case. Adaptation of electronic technics to the method1,2,6 has added factors of relative exactness, control, and safety.

The effort to achieve standardization that would permit the better application of scientific method has emphasized the universally appreciated difficulty of converting to useful data phenomena that are to any extent determined subjectively. This com-

munication depicts our attempt to overcome the difficulty. Having essayed a careful quantitative evaluation of certain characteristics of an abnormal state of muscles, we have then sought by statistical technics to test the validity of our artificial quanta and to examine the results of our study and treatment of some patients with parkinsonism.

Leksell's instrument and method have been modified6 to enable adherence to the principle, arbitrarily adopted, of restricting the therapeutic lesions to minimal effective size. Normally the inner frame of the apparatus is affixed to the head and there supported by the shafts of three twist drills, locked firmly in sleeves after penetration of the outer cranial table. Exact and repeated replacement of the frame is permitted by replacing each drill shaft by a solid rod which mates in a male-female arrangement with a small stainless-steel plug which has been inserted firmly into each drill hole. The plugs remain indefinitely. Each rod has a locator, indicating length, and the three rods used for each case are labeled as to location on the frame and also with the patient's name.

Under general anesthesia the frame is thus affixed, and pneumoencephalography, using sufficient gas to disclose the anterior and posterior commissures, and trephination are done. Calculations and corrections necessary to set the apparatus for the target are simplified by the use of a device that insures a constant and invariable spatial relationship among the roentgen-ray tube, stereotaxic frame, and film cassette (Fig. 1). The frame is held in this assembly by means of
three magnets so that more sudden or vigorous movements of the head will dislodge it safely.

The therapeutic procedure, under local anesthesia, follows a 5- to 10-day convalescence. The monopolar operating electrode (Fig. 2) is constructed of 19-gauge stainless-steel tubing, insulated except for the tip of selected length, which contains a thermistor bead. This bead, by way of a bridge circuit, enables direct readings of temperature. After insertion of the electrode to the target, the tissue at the tip is stimulated by square-wave pulses of gradually increased amperage. Intended as a safety measure to warn of proximity to the internal capsule or other misdirection, stimulation has been found to evoke tremor, muscular movements, or even subjective phenomena. Targets have included points within the ventrolateral nucleus of the thalamus and the globus pallidus.

High-frequency current is then used to raise the temperature at the tip of the probe to 62°C for 2 to 4 minutes. Electrode-tip exposure of 1 cm. used in the globus pallidus probably determines a lesion roughly ellipsoidal in shape with average diameters of 11.5 and 6.5 mm. after 2 minutes. An exposed tip of 5 mm. length used in the thalamus is thought to yield a more nearly spherical lesion 6.5 mm. in average diameter.

To augment such a therapeutic inactivation of tissue by later returning the patient to surgery for creation of subsequent proximate or remote lesions has proven neither inconvenient nor dangerous. Advantage has been taken of this facility to observe the effects of incremental inactivation in an effort to achieve an effective lesion of minimum dimension.

We have not been able to set satisfactorily rigid criteria for subsequent procedures for extending the bulk of inactivated tissue. Generally, it has been prompted by significant failure to relieve symptoms or by recurrence of signs within 10 days. The ordinary contraindications to surgery or to general anesthesia have been observed. Good physi-

![Fig. 1. Patient in position for anteroposterior roentgenogram, showing assembly which insures fixed spatial relationship among the roentgen-ray tube, stereotaxic frame, and film cassette.](image)

![Fig. 2. Therapy electrode, with and without Teflon sheath. One thermistor lead passes up center of hypodermic tubing. Tubing serves as common lead for thermistor and high-frequency therapy current, which is filtered from bridge circuit. Entire electrode with sheath is autoclavable.](image)