BILATERAL THALAMOTOMY AND PALLIDOTOMY AS TREATMENT FOR BILATERAL PARKINSONISM

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Clinical experience concerning the results of bilateral stereotaxic operations for parkinsonism to the present day is very limited. But meager information can be derived from the literature available. The question of bilateral thalamotomy is still open to discussion. Hassler and Riechert were the first to report postoperative states of impaired consciousness. According to their experience, these authors do not regard it justifiable to perform bilateral thalamic operations for bilateral parkinsonism, and they have advocated the combination of pallidotomy on one side and thalamotomy on the opposite. This opinion, which is stated again in their last paper, is also shared by Walker. Spiegel discussed the possibility of producing the effect of a leucotomy by cutting the thalamocortical pathway with a lesion located in the area of the nucleus ventralis anterior of the thalamus. Most of Cooper and Bravo’s patients with bilateral parkinsonism have had the pallidal operation on one side and the thalamotomy on the other. The feeling of Cooper has been that he would hesitate to sacrifice the same structure bilaterally, no matter what that structure may be.

It is the purpose of this paper to review and compare the results of bilateral operations in our own series. In this series of 263 cases of parkinsonism, bilateral operations have been performed on 51 patients. Of these 51 patients, 23 have had bilateral thalamic operations, and in 28 cases pallidotomy was performed on one side and thalamotomy on the opposite. The bilateral operation was carried out usually with an interval of 6 months or more between both interventions. Omitting the early period of our experiences, only those patients who tolerated the initial operation without complications were selected.

TECHNIQUE OF OPERATION, EXPLORATORY STIMULATION AND HIGH-FREQUENCY COAGULATION

Well-defined lesions of predetermined size are produced within the thalamus by resorting to the combined use of the Riechert stereotaxic instrument for the introduction of the coagulating electrode, the Wyss stimulator for exploratory stimulation, and the Wyss coagulator for high-frequency coagulation. A specially designed unipolar electrode is used, the tip of which is placed accurately by means of roentgen-ray checks and subsequent electrical stimulation of the target area. High-frequency coagulation is then carried out with this electrode.

The technique is based upon the following principles:

The high degree of accuracy attained in stereotaxic localization (± 0.5 mm.) demands equally high precision in electrical stimulation and methods of coagulation. The unipolar technique has proved particularly suitable for coagulation, for it ensures quantitative relation between the strength of high-frequency current applied, the active surface of the electrode used, and the volume of coagulation produced. The unipolar array has, however, also proved suitable for exploratory stimulation. The technique of selective stimulation of nervous tissue, as originally contrived by Hess, developed further by Wyss, and applied to stimulation of the motor cortex by Wyss and Obra-
Fig. 1 and 2. (Left) Wyss stimulator. (Right) Wyss coagulator.

dor, has been simplified in view of its application to general research of the brain as well as to stereotaxic neurosurgery. For the sake of convenience only one electrode is used for both stimulation and coagulation. It serves as the active electrode, the indifferent electrode, of large surface, being placed on the back of the neck of the patient.

Because of the high-current intensity necessary for coagulation and the correspondingly large area of the bared tip of the electrode, resistance to flow of current through the tissue becomes rather low and an even lower output impedance is required for both stimulator and coagulator. Thus constant-voltage device is ensured for stimulation as well as coagulation and, consequently, voltage of output does not depend on resistance of load, the stimulator's voltage of output refers directly to strength of stimulus, and measurement of the voltage of output of the coagulator can be dispensed with.

Coagulation with continuous high-frequency current has the advantage of being electrically nonstimulating. Transient excitatory effects, which may appear at sudden make or break, are avoided by slowly increasing and decreasing the intensity of the coagulating current. This also avoids stimulation by heat, i.e., by too fast a rise of local temperature. The frequency, however, should not exceed half a megacycle per second, in order to ensure sufficient accuracy in measuring the intensity of the coagulating current. Duration of flow of current depends on the size of lesion to be obtained; it varies from a few seconds for small lesions up to half a minute for large lesions.

Physical problems encountered in high-frequency coagulation of brain tissue have been studied theoretically and experimentally. Unaware of the earlier work of Hunsperger and Wyss on quantitative high-frequency coagulation of brain tissue in the cat, and of the further improvement of the technique by Wyss, Aronow recently studied the physical problem of making radio-frequency lesions in the brain. The theoretical assumptions made by this author are questionable, insofar as conduction of heat through the shaft of the electrode was not taken into account and temperature was therefore thought to be highest around the bared tip of the electrode. It was even claimed that boiling of the tissue fluid may occur at the conducting surface of the electrode, and that this would be an advantageous safety feature! From the experimental data obtained by Hunsperger and Wyss, however, it is clear that temperature can attain highest values only at a certain distance from the electrode, and that steam-bubble formation should by no means occur in a coagulation performed carefully. It also should be noted that a low output impedance of the coagulator would in cases of overheating with the effect of boiling prevent increase of voltage because of increase in resistance of tissue. Another type of increase of resistance may, however, take place at temperatures below the boiling point, probably because a thin layer of gas (CO₂, O₂, N₂) is formed over the conducting surface of the electrode. Contrary to the effect of boiling, this type of increase of resistance is perfectly reversible, and the neurosurgeon must be aware of the fact that...