PREFRONTAL LOBOTOMY FOR RELIEF OF PAIN

WITH A REPORT OF A NEW OPERATIVE TECHNIQUE

EVERETT G. GRANTHAM, M.D.

Department of Surgery, University of Louisville School of Medicine, Louisville, Kentucky

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Since Freeman and Watts reported that prefrontal lobotomy was useful as a method for relieving intractable pain, numerous reports have attested to the success of the operation in cases of intractable pain not curable by direct attack on the primary disease process. Not only is the fear of suffering abolished, but many patients no longer have pain in the usual sense of that word. The conventional (radical) prefrontal lobotomy, however, has distinct disadvantages, chief of which are changes in personality. Another disadvantage is the high incidence of epilepsy following the currently employed operations. These alterations are grave enough to limit the use of the procedure to a relatively small group of patients suffering with intractable pain.

Probably all surgeons who have performed prefrontal lobotomy for pain have envisaged that with greater experience a wide field may be opened for its usefulness. If this is to be accomplished, however, an operation resulting in less unwanted side effects must be perfected. Such a procedure should accomplish a selective or limited destruction of the frontal lobes as contrasted to the extensive destructive lesion produced by conventional methods. To develop a selective prefrontal lobotomy the fiber tracts (or cortical areas) controlling the function to be destroyed must be accurately known. It is also necessary that a method be devised to reach this limited area for destruction without damaging other important areas in the process of reaching and destroying the selected area. If, on the other hand, the results of lobotomy are in direct proportion to the quantity of tissue destroyed, then the proportion of the frontal lobes to be destroyed for a specific result must be known.

After operating on psychiatric patients by the open method of Lyerly, the writer varied the procedure to one in which an effort was made to divide only the white matter in the medial half of the frontal lobe rostral to the lateral ventricle. The results after this procedure were as gratifying as they were in the cases of more extensive incisions. The same operation also was successful in several cases performed for the relief of pain. Consideration of these facts plus a desire to produce a destructive lesion by a fractional method brought to mind the possibility of performing prefrontal lobotomy by electrocoagulation. The lesions are produced by a high frequency electrical current applied through a small needle insulated everywhere except at the tip. By this method a small lesion can be produced in any portion of
the frontal lobes and the desired area can be approached and destroyed without damage to other areas of the hemisphere. In the same manner the lesion may be increased in size if subsequent study of the patient indicates that a larger incision is needed.

TECHNIQUE

The operation may be performed under local or general anesthesia. A coronal incision 10 cm. in length is made just behind the hairline. A point approximately 6 cm. above the glabella is selected and marked on the exposed frontal bone. A burr hole is made at this level over each frontal lobe. The distance of the burr hole from the midline varies according to which portion of the white matter of the frontal lobe is to be destroyed. The center of the burr hole is 1.5-2 cm. from the midline if the lesion is to be made in the white matter of the medial half of the hemisphere, as was done on the patients included in this report. The dura is opened in a cruciate fashion. In some patients, instead of a burr-hole exposure, a 1-inch trephine has been used so that the medial surface of the hemisphere could be visualized. When the trephine opening is employed, the dura should be opened carefully to avoid damage to a vein, which is sometimes exposed, leading to the sagittal sinus. For identification of the proper plane for the electrode, a point is marked in the temple 2 cm. behind the lateral rim of the orbit. A scratch mark made on the scalp between the burr hole and the point 2 cm. behind the rim of the orbit is used in selecting the plane for the electrode. In most instances, with the burr holes at 6 cm. above the glabella, a ventricular needle, which is used to make a path for the electrode, will

Fig. 1 (left). An anteroposterior x-ray shows the correct placement of the electrodes in relation to the sagittal plane and the anterior horns of the lateral ventricle. In this instance, the electrodes are at a depth of 4.5 cm. below the surface of the cortex and lie 2 cm. from the midline.

Fig. 2 (right). A lateral x-ray shows the two electrodes in the same plane and at the proper distance rostral to the anterior horn of the lateral ventricle.
pass in front of the anterior horn of the lateral ventricle when directed at the point 2 cm. posterior to the lateral rim of the orbit. To be certain, however, that such is the case, the lateral horn of one or both lateral ventricles is deliberately tapped by passing the ventricular needle slightly posterior to this plane. At this time 10 cc. of ventricular fluid are removed and replaced with oxygen. The ventricular needle is then passed in a plane farther forward until it lies approximately 1 cm. anterior to the ventricle. A new line is then drawn on the scalp if the plane of the ventricular needle lies in a position different from that of the original scratch mark. The ventricular needle is then gently passed towards the floor of the skull to verify the depth of the frontal lobe at this point. In our experience the brain at this point is between 7 cm. and 8 cm. in depth. The electrode is then introduced along the path made by the ventricular needle, and the previously made scratch mark on the scalp is used to be certain that the electrode does not vary from this plane in an anterior or posterior direction. Equal care must be taken to be certain the electrode does not drift toward the midline. To make certain of this, a ribbon retractor is held by an assistant with the center of the retractor against the vertex of the skull. The operator makes certain that the advancing electrode is always at right angles to the retractor. If the lesion is to be made in the lower medial quadrant, the electrode is introduced to a depth 2 cm. short of the depth of the brain. If the frontal lobe at this point is 8 cm. in thickness, the insulated needle is passed to a point 6 cm. below the surface of the cortex. The procedure is carried out on the opposite hemisphere by introducing an electrode in an identical plane, after first providing a pathway with the ventricular needle.

At this point in the operation the position of the electrodes is checked with a portable x-ray. Before the head is draped, a loaded cassette placed beneath the head is ready to verify the relationship of the electrodes to the sagittal plane and the anterior horn of the ventricle, which has previously been filled with oxygen (Fig. 1). Another cassette dropped into a sterile pillow case is then used to make a lateral film which will record whether the electrodes are at the proper position rostral to the anterior horn of the lateral ventricle (Fig. 2). The position of the needles can be changed and rechecked with x-ray, but this will rarely be necessary if the above steps at identification are carefully followed.

The electrode is insulated except for 1 cm. of the tip, which is exposed.* The insulated portion is 2 mm. in diameter. Electrocoagulation is carried out by application of the current to the exposed connection at the free end of the needle. With the Davis-Bovie automatic-gap electrosurgical apparatus, a power setting of 20 on the coagulation device applied for 30 seconds will produce a lesion in this relatively avascular area of the brain in the form of a cylinder which will measure approximately 12 mm. in length and 8 mm. in diameter. To verify this fact, gross tests were made on excised pieces of tissue and in the intact animal brain. It is appreciated that there will be variations in the size of the lesion, depending on the vascularity of the tissue and the slight variation in the amount of current produced by the machine at different applications, but it is felt that such variation in the size of the lesion will be not over a few mm. and therefore inconsequential. A convenient method for testing the power setting of the machine at the time of surgery is to use one of the triangular flaps of dural tissue or a bit of exposed periosteum. With the tissue grasped in the tips of a fine tooth bayonet forceps, there should be charring of the tissue in 3 seconds after the current is applied to the forceps. The electrode is withdrawn 1 cm. for a second application of the current if a

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* The electrode was made by the Liebel-Flarsheim Company of Cincinnati, Ohio.
large lesion is to be produced in the lower quadrant. Withdrawal and application of the current is continued, depending on the size of the lesion that is desired.

REPORT OF CASES

The procedure was originally used on patients with advanced carcinoma who suffered intractable pain. Many of these early patients lived only a few weeks but the gratifying relief of pain and narcotic addiction and the absence of any detectable mental changes or other complications were so encouraging that the operation was then used on a few patients in whom the relief of pain of non-cancerous origin presented a difficult problem.

Since March, 1949 the operation has been performed 35 times in 22 patients. In 2 patients the operation has been performed in three stages and in 9 patients in two stages. In successive operations, the current was applied at a more dorsal depth. In most instances several weeks were allowed to elapse before a more extensive procedure was performed. In 1 patient, a tabetic, a unilateral procedure was satisfactory for 10 months, at which time severe pains recurred and the operation was then performed in the other hemisphere with relief of pain.

Thirteen patients had cancer, 1 tabetic crisis and 1 a thalamic syndrome. Seven patients had profound long-standing disability from pain considered to be of psychogenic origin. One patient with carcinoma of the throat died 22 hours following surgery without fully regaining consciousness. Autopsy was not obtained. Of the 21 patients who survived, in 19 (90 per cent) the operation has been successful to date, or for the time the patient lived following the procedure. In 2 cases the procedure was a failure in that the patients have continued to complain bitterly of pain.

To simplify an expression of the results, we have classified them into 5 grades as follows:

Grade 0—No improvement.
Grade 1—Relieved of addiction but complains spontaneously of pain.
Grade 2—Does not complain spontaneously of pain but will state that pain is present if questioned about pain.
Grade 3—Patient denies pain. Has no change in personality.
Grade 4—Relieved of pain but personality changes are present.

The desired result is either a Grade 2 or Grade 3. In the 21 patients who have lived, 14 patients (66.7 per cent) have been classed in Grade 2 or Grade 3 and the result has been considered near perfect. Two patients (9.5 per cent) have had a Grade 4 result, but the changes in personality were not significant enough to detract from the good results. In both of the patients who had personality changes, 3 operations were done before pain was relieved satisfactorily and autopsy revealed that the lesion involved virtually all the white matter of the medial half of the hemispheres. Three patients (14.3 per cent) have been relieved of their severe pain but still complain spontaneously—Grade 1. Two patients (9.5 per cent) had no benefit and a second procedure was not permitted.

In all of the cases, except the patient who died, there has been a prompt
recovery of consciousness following anesthesia. Slight mental confusion was noted in 2 patients for 24 hours. In 3 patients operated on with local anesthesia there was no confusion but mild drowsiness for a few hours. The temperature usually rises to 101° or 102° F within the first 24 hours and is thereafter normal. No other abnormal changes have been noted in physiologic processes. Several patients have had extensive psychometric evaluation before and after surgery and no changes have been detected.

**DISCUSSION**

The original plan in performing the operation by the coagulation technique was to make lesions that were confined to the fibers in the medial half of the hemisphere. The intention was to produce lesions in the lower medial quadrant at the original operation, and in the event the results were not entirely satisfactory then at a second operation a lesion would be made in the upper medial quadrant. This is the method that has been used in all of the cases included in this report. If one visualizes the coronal section of the frontal lobe as consisting of four quadrants, it is obvious that a variety of combinations can be investigated in the search for minimal-size lesions that would produce the desired effects. The present feeling from the study of the cases done so far is that the lesion placed in the lower medial quadrants may be effective, but it is also felt that the larger lesions which have extended into the upper quadrant have been most successful in relieving pain. In future operations it is planned to make lesions in other quadrants for comparison with the cases presented here. It is of interest that the 2 patients who had distinct personality changes following operation had a larger lesion in the lower medial quadrant than the other patients who have come to autopsy.

Radiographic verification of the position of the electrodes in their relation to the anterior horns of the lateral ventricles affords precise information as to the location of the lesion. Variation in the position and size of the anterior horns alone emphasizes the necessity of the radiographic identification in addition to the other precautions taken for localization.

Autopsy studies on several patients who died within 6 weeks of their original cancerous pathology showed an area of malacia in the white matter of the frontal lobe corresponding to the size that was planned at surgery. In 1 patient who lived 10 weeks following the operation, only a small area of softening persisted. It is anticipated from these cases that by 12 to 16 weeks all signs of the lesion produced by electrocoagulation in the frontal lobe white matter will have disappeared. The complete absence of any scarring 4 months after the application of heat destruction to the cortex of the monkey’s brain was shown by Dusser de Barenne and Zimmerman1 in 1935. In this interesting article they suggested the use of this method to neurosurgeons.

There are several features in the technique that may be improved in the future. The use of a special localizing device has been entertained but has not been considered necessary. It is felt that it would still be necessary
to verify the location of the electrode in its relation to the anterior horn of the lateral ventricle. It is possible that a more precise method can be evolved for the application of the heat to give even greater uniformity to the size of the lesion.

One advantage of the electrocoagulation method is its simplicity and ease in performance. Another advantage is the protection of the cortex from injury, thereby minimizing the possibility of postoperative epilepsy. Pool has reported an incidence of 16 per cent in his cases of topectomy. Freeman reports an incidence of 7 per cent of seizures in his patients who have been operated upon one time. This percentage increased to 20 per cent in those upon whom a second operation has been performed. To date we have had no incidence of an epileptic seizure in any of the patients operated upon by the coagulation technique. Seven patients have been followed for 15 months and an additional 3 patients have been followed for more than 9 months. The remaining patients died of their carcinoma between 3 and 16 weeks following surgery.

The last, and perhaps the greatest, advantage is the ability to produce a lesion in any portion of the frontal lobe with radiographic verification of the site of this lesion and the further ability to increase the lesion in a systematic manner in subsequent operations if these become necessary.

**SUMMARY**

1. A new technique to perform a selective prefrontal lobotomy is described.
2. Preliminary study of the results in 22 patients treated by this technique for the relief of pain is presented.

**REFERENCES**