A NOTE ON THE TREATMENT OF INVOLUNTARY MOVEMENTS OF THE ARM BY RESECTION OF THE BRACHIAL PLEXUS

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Paralysis agitans, chorea, hemiballism, and tremor resulting from birth palsies have been attacked surgically for more than 30 years. Various methods have been used and new ones are being devised. The many drugs introduced in recent years for control of such involuntary movements and rigidity have not, apparently, lessened the desirability for surgical treatment.

The patient whose treatment forms the basis of this report was seen many years ago before operations on the brain for athetosis and allied conditions could be performed with any degree of safety because of the lack of modern neurosurgical equipment, such as adequate suction and electro-surgery. Indeed, in these early years of neurosurgery even transcortical incisions of a relatively superficial nature were only rarely undertaken and the idea of an attack upon the basal ganglia could hardly have been entertained. We feel, therefore, that it would be of interest from the historical standpoint to present the case herein described, and it is also conceivable that even at the present time the treatment afforded this patient might in some instances be preferable to operations upon the brain.

HISTORICAL NOTE

In 1924 Hunter advocated sympathetic ganglioneectomy for the treatment of paralysis agitans, based on experimental evidence that sympathetic nerve supply to the muscle helps maintain its tonus. It is known that some surgeons attempted this, but the absence of reports in the literature attests to the negative results that must have been obtained.

In 1930 Pollock and Davis reported a case of rigidity of an arm and leg as a result of paralysis agitans, treated by rhizotomy of the 4th cervical to the 4th thoracic posterior roots. The operation relieved rigidity of the arm temporarily, but the extremity went into contracture after operation and remained in that state.

In 1934 the first intracranial procedure was attempted for the relief of paralysis agitans by Delmas-Marsalet and van Bogaert. It consisted of destruction of the dentate nucleus of the cerebellum. It was tried on only 1 patient. Rigidity was improved, but the tremor became worse and the patient died 10 days after operation.

In 1939 Bucy and Case, following Horsley’s work of 1909, reported one
case of extirpation of the precentral gyrus, an extrapyramidal suppressor area in the cerebral cortex. The "arm" area was removed. It was done in a case of right hemiparesis with coarse unilateral tremor. The operation resulted in partial paralysis. Tremor was abolished and had remained so at the time of the report, 15 months later.

This was followed by optimistic reports, including that of Klemme,14 who used this method of treating dystonia, paralysis agitans, and athetosis in 100 cases. He stated the "results were amazing," carrying an operative mortality of 10 per cent, a very high rate of rehabilitation, and no recurrence of tremors relieved by this procedure within a 3-year postoperative period. It was pointed out by Bucy on later occasions4,5 that considerable paralysis and increase in spasticity were produced by such extirpations, along with the desired loss of tremor.

A report by Bucy5 in 1948 stated that all operations for treatment of involuntary movements thus far were distinctly experimental and that all were unsatisfactory in several ways. Cortical extirpations, he said, did not affect the progress of the disease, serious contralateral hemiparesis always resulted, and their indications were sharply limited to young patients with severe, nonprogressive unilateral disease.

In 1948 Browder4 reported section of fibers of the anterior limb of the internal capsule in 15 patients with paralysis agitans, with beneficial results in 6.

Walker19 reported a case of cerebral pedunculotomy for the relief of hemiballism in 1949. In this procedure one cerebral peduncle was cut across two-thirds to three-fourths of its lateral aspect, with excellent relief of tremor and rigidity, and an eventual sequela of slight weakness of the contralateral arm. We did not find further reports of this operation.

In 1949 Ebin12 reported a new technique for relief of tremor of paralysis agitans, a combined lateral pyramidotomy with ventral pyramidal tract section on the opposite side by means of one oblique knife cut. In 1 case this was done bilaterally, with what was said to be a good result. This procedure was carried out also by Oliver16 who reported in 1950 on 79 patients treated by section of the pyramidal tracts of the spinal cord, by this and other methods. In 19 of this group, the whole lateral column on one side was sectioned in the 2nd cervical segment. This seemed to be the most satisfactory type of pyramidotomy; only 1 patient was dissatisfied as a result. It gave almost complete relief of tremor, with slight homolateral weakness, slight contralateral weakness and contralateral hemithermoe-anesthesia the only final sequelae. There was no mention of relief of rigidity.

In 1950 Cobb and associates5 reported a series of 9 cases of paralysis agitans treated by section of "U" fibers of the motor cortex, by an incision in Area 4, following Russell Meyers, who reported a good result in treating a case of hemiballism by this method. However, all 9 of Cobb's cases were failures.

Browder and associates3 in 1953 reported a "capsular operation" in 2
cases of paralysis agitans, wherein the upper one-third of the head of the caudate nucleus was removed, followed by removal of the anterior capsule just rostral to the knee of the capsule to a depth of 7 to 8 mm. Reduction of rigidity and greater amplitude of the tremor were reported.

In 1954 Spiegel and Wycis\(^8\) reported electrocoagulation of the ansa lenticularis in 6 cases of unilateral postencephalitic paralysis agitans. Tremor stopped almost completely in 2 cases. There was also some reduction of resistance to passive motion, but there were no sensory disturbances.

Cooper\(^9\) reported 2 cases of surgical occlusion of the anterior choroidal artery, principally intended for patients with total incapacitation from unilateral paralysis agitans of long standing. Both patients improved considerably, 1 enough to work again, with much relief of rigidity and improvement in ability to speak. Two more such procedures were reported by Browder and Kaplan,\(^2\) which resulted in moderate reduction of rigidity on the affected side and reduction of the rate of tremor by half.

In November 1955 Cooper and Poloukhine\(^10\) reported treatment of paralysis agitans by destruction of the globus pallidus, using absolute alcohol, a “chemopallidectomy.” Of 70 cases, they found immediate good results, consisting of abolition of contralateral tremor and rigidity without motor weakness, in 80 per cent, and lasting alleviation in 70 per cent of cases. This group is unique in that they included usage in senile and arteriosclerotic patients.

Narabayashi and associates\(^15\) early in 1956 reported 26 cases of paralysis agitans treated by procaine oil injection of the globus pallidus. They stated that the principal symptoms of tremor, rigidity, and hyperhidrosis were relieved dramatically. Tremor tended to reappear after several weeks, but it was said that relief from rigidity was sustained. Complications included death in 1 case and supranuclear palsy in another.

One might conclude from the above that surgical treatment of spastic states and involuntary movements has not resolved itself into one highly effective, accepted procedure that has stood the test of time. It also seems, on the other hand, that enough progress has been made to justify continued efforts with intracranial operations.

REPORT OF A CASE

The patient was born in Russia in 1895. He did not remember ever having been well. He believed that he had large, suppurative lymph nodes or abscesses on the right side of his neck and face at the age of 2 or 3. He had several large, poorly healed scars on the right side of his neck and face, marking where, he believed, they were excised or drained. At the age of 5, he believed, a sudden right-sided paralysis developed, although he did not remember this event. He could not walk or talk. Gradually during the next month the paralysis began to clear up, that of the leg more completely than of the arm. The arm remained spastic and involuntary movements developed which became worse as the years passed. Athetoid movements of the right hand and arm were present fairly continuously, but a great increase of these movements was always initiated by any excitement, embarrassment, or other emotional upsurge. These movements were forceful and at times almost violent, and
of the usual purposeless type. At times, the patient said, the arm had done actual damage by knocking dishes from the tables in restaurants and homes before he could curb its motion with the left hand. Because of its continual movement and uncontrollable actions the arm was not only of no use to the patient, but was actually a hindrance. He was able to do all necessary things with his left hand.

The right foot had assumed the equinus position. This was improved by a plantar tenotomy in 1904.

In 1911, before the patient came under the care of the senior author, an incision was made below the right elbow and the ulnar nerve was injected with alcohol. No improvement was noted. In 1918 a biceps tenotomy was performed. This also brought no improvement.

On examination, in 1920, the right arm showed definite hypertrophy of all the muscle groups as compared to the left arm. The arm was usually held slightly everted and abducted, with the elbow slightly flexed (Fig. 1). The wrist and hand were extended, but the fingers were clenched tightly over the flexed thumb. The patient was unable to open the right hand except by forcing the fingers open with the left hand. From time to time the arm would be thrown into violent athetoid and uncontrollable movements, as described by the patient.

On May 28, 1920, at the suggestion of the late Dr. Harvey Cushing, the brachial plexus region was exposed and injected with 0.5 per cent procaine. This resulted in temporary anesthesia and loss of movement in the arm. This was done in order to paralyze the arm temporarily so that the patient could decide whether he would rather have a paralyzed arm or a strong but useless one with athetoid movements. Sensation reappeared within a few days, and with its return there was a throbbing, pumping pain down the right arm. He was advised to wait until this pain quieted down before resection of the plexus was attempted, but the pain continued. The patient decided that he wanted the brachial plexus resected.

On July 23, 1920, the patient entered Peter Bent Brigham Hospital. He complained of persistent pain in the right shoulder posteriorly. He had athetoid movements of the right upper extremity, accentuated by voluntary movements. He had hypertrophy of both right extremities. There was little voluntary movement of the right upper extremity and it was held in internal rotation.

On July 24, 1920, division and resection of the outer, inner and posterior cords of the right brachial plexus was carried out by one of us (G.H.) under local anesthesia, using 0.5 per cent procaine with epinephrine. Gaps of about 1½ inches were left between the ends of the resected cords.

Following this operation a flexion contracture of the hand occurred, and some residue of athetosis of the fingers persisted, despite further exploration of the plexus region for aberrant nerves (Fig. 2).

On Aug. 6, 1920, division and resection of the median and ulnar nerves in the upper arms were performed, under procaine anesthesia. A 5-cm. segment of each of these nerves was removed in the region of the middle third of the biceps muscle. This obliterated the athetoid movements in the fingers.

On the first postoperative day it was found that the patient had complete paralysis of the right upper extremity except for small muscles of the thumb supplied by the radial nerve, the extensor and adductor pollicis. There was still some sensation in the thumb region. On discharge from the hospital on Aug. 14, 1920, the patient was "90 per cent satisfied." He could at that time extend the forearm a little if the arm was flexed at the elbow.

On Dec. 3, 1920, the patient returned on an outpatient basis because of athetoid
Fig. 1. Usual position of right arm. From this position it would make involuntary, purposeless, violent, uncontrollable movements. Hypertrophy of the upper arm is evident.

Fig. 2. After brachial plexus resection. The arm is paralyzed but the wrist is sharply flexed and has some athetoid movement.

Fig. 3. After resection of nerves in upper arm. The wrist is no longer flexed. There is now only slight athetoid movement in the thumb.

movements in the right thumb. The radial nerve was sectioned in the midforearm region. After this procedure, paralysis of the hand was complete (Fig. 3).

In December 1921, the patient's only complaint was a pulling sensation in the right shoulder. In September 1922, he noted some “shock-like” feelings through the right hand and heavy feelings in the fingers. He had a few blisters on the right hand from burns that resulted from lack of sensation. He reiterated that he was completely satisfied with the result of his operations.

In 1934 the patient had a subtotal thyroidectomy because of hyperthyroidism which had developed gradually during the preceding years. The last operation left him in a hypothyroid state and he has been taking thyroid extract daily ever since.

When seen in May 1956 the patient was still well satisfied with the condition of the right upper extremity, which was markedly atrophied and completely flaccid. Occasional fibrillary motions of the fingers occurred when at rest, but they did not bother him. His right lower extremity was very weak and the foot dragged during walking. There was a flexion contracture of the lateral four toes, and during the past several years painful, slow contractions of the plantar flexors of the right foot have been occurring several times a day with increasing frequency.

SUMMARY AND CONCLUSIONS

A review of surgical procedures used for the relief of involuntary movements and spasticity during the past 30 years is presented. Many proce-
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dures attempted in the past have been discarded as useless or as producing too great a motor deficit, and of those employed most recently the follow-up period has not as yet been long enough to ascertain the end results.

A case is presented of unilateral severe athetosis of obscure origin, undoubtedly still progressive at its central lesion. In this patient the cords of the brachial plexus and peripheral nerves of the upper extremity were resected 36 years ago, leaving a flaccidly paralyzed extremity in exchange for a useless one dominated by very troublesome athetoid movements.

In the case presented, the patient remains well satisfied with the result of the paralysis of his arm in exchange for the uncontrollable, violent movement.

REFERENCES


