EFFECT OF CERVICAL CORD SECTION OF HEMIBALLISMUS

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Hemiballismus is a violent, uncontrollable movement of the arm and leg that is almost invariably unilateral. The origin of the term is somewhat obscure and was originally credited to Kussmaul by Oppenheim. However, Moersch and Kernohan were unable in their studies to verify this origin, and credit Jakob with this term suggesting the motion of tossing a ball by one side of the body.

Martin and Alcock, as well as Moersch and others, have verified the usual pathology to be a lesion of the contralateral subthalamic nucleus (corpus Luysii). Most observers are now agreed that the illness, if truly ballistic in nature and not hemichorea, is usually fatal because of exhaustion with terminal cardiac failure or pneumonia within a period that varies from 1 to 6 weeks in most cases. The etiology has been vascular, usually hemorrhage or thrombosis, in the great majority of instances; however, occasional reports have appeared of subthalamic involvement by a neoplastic or granulomatous process. Meyers, Sweeney and Schwidde believed that apparently bona fide cases of hemiballismus occur from involvement of the afferent or efferent pathways connecting to the corpus Luysii and possibly from pathology involving the corpus striatum and ventral neothalamus as well. The present evidence, however, is definitely clouded in attributing ballistic movement to locations in the basal ganglia and midbrain other than the subthalamic nucleus and its immediate projection pathways; certainly it appears that some case reports have confounded severe hemichorea with the pure ballistic movement. Meyers felt that there is some indication of somatotopic localization in the corpus Luysii with lesions rostrally causing movement of the head and neck, lesions of the middle portion affect-

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ing the upper extremity, and of the caudal portion involving the lower extremity. Mettler and Carpenter⁵ have been able to produce complex involuntary movements by stereotaxic lesions of the subthalamic nucleus in Macacus rhesus; subsequently they modified or eliminated these movements by fulguration of various extrapyramidal projections, including the lenticular fasciculus, the medial segment of the pallidum, and large lesions in the lateral thalamic nucleus.

Recent surgical efforts to ameliorate or abolish hemiballismus have all uniformly implicated partial or complete interruption of the pyramidal pathways. At the cortical level Bucy⁶ extirpated areas 4 and 6, with a subsequent enduring left paralysis and apraxia. Meyers⁷ has noted relief by linear subpial section between areas 4S and 6 anteriorly and 4, 3, 1, 2 posteriorly. Other interruptions, by Talairach, Paillas and David⁸ at the capsular level and Walker⁹ by cerebral pedunculotomy, have likewise shown considerable pyramidal deficit. We have been unable to find in the literature any cases of pure extrapyramidal interruption similar to that carried out by Putnam⁷ in cases of chorea and athetosis until the present opportunity arose.

CASE REPORT

A 73-year-old white male was referred on March 3, 1953, for treatment of a violent hemiballismus of 5 days' duration. He was a known hypertensive of 12 years' standing and 6 years prior to admission he had had a minor cerebrovascular accident involving the right arm

![Fig. 1. Recent fresh hemorrhage is noted in the right subthalamic nucleus. The old cystic lesion in the left basal ganglia with slight dilatation of the left lateral ventricle is apparent.](image)

and leg, which completely cleared. Five days before admission he fell in his home, striking the occipital area; he was stunned and dazed but did not actually lose consciousness. The ballistic movements began immediately thereafter in the left arm, leg, and side of the neck. His family was not able to ascertain whether his stroke preceded the fall, or whether the reverse was the case. Within 24 hours the movements, at first gentle, became so violent that on several occasions he was thrown from his bed. They ceased completely with the sleep of exhaustion, but immediately returned with consciousness. For a few seconds at a time he was able to voluntarily control the movements, which then resumed with undiminished intensity.

Examination. The patient was conscious, cooperative, and somewhat restless. B.P. was 200/120, and pulse 86. The optic fundi showed grade II retinal sclerosis without hemorrhages, exudates, or choked disc. There was a severe hemiballistic movement involving the entire left side of the body, with very slight hypotonia and generalized reduction of reflex activity.
Hoffmann and Babinski signs were obtained in the right hand and foot respectively. Spinal fluid studies showed an initial pressure of 140 mm., 1 WBC, 3 RBC, positive Pandy test, total protein 78 mg. per cent, negative Kolmer, and colloidal gold curve 0285555320. Blood serology was negative. X-rays of the skull and chest were normal on admission.

*Course.* For several days the patient was treated by sedation, including large amounts of demerol, scopolamine, and barbbiturates. The movements were controlled only when sedative drugs were sufficient in dosage to cause alteration of consciousness. Supportive therapy, including blood transfusions, oxygen, and parenteral fluids, was administered.

1st *Operation.* On the 5th hospital day, under pentothal supplemented by local anesthesia, two postparietal trephine openings were made, revealing no evidence of subdural hematoma on either side as an aftermath of his head injury. Ventriculography was carried out, which was negative for any space-occupying lesion. The left lateral ventricle was very slightly larger than the right; this was ascribed to mild cerebral atrophy secondary to his cerebral thrombosis 6 years previously.

*Course.* By March 14, 1953, the patient’s condition had deteriorated further and it was obvious that the prognosis was hopeless without control of the involuntary movements.

2nd *Operation.* Under general anesthesia, a low suboccipital craniectomy and bilateral upper cervical laminectomy were performed with the patient in the upright position. When the dura mater was reflected the dentate ligaments were sectioned at the 2nd cervical level and the cord was rotated to the right. Incision for left ventrolateral tractotomy was made, beginning exactly at the point of attachment of the dentate ligament, extending 4.5 mm. in depth in a transverse direction, and emerging 2.0 mm. ventral to the left 2nd cervical motor root. The patient’s blood pressure and respiration did not appear to change following the ventral quadrant section. He was returned to his room in fair condition.

*Postoperative Course.* The left arm and leg showed no evidence of any impairment of voluntary movement. The deep reflexes appeared to be slightly less active than prior to surgery, but were symmetrical on the two sides. There were no pathological reflexes elicited. There was a right hemi-anesthesia for pain and temperature below the level of the clavicle. No evidence of the previous ballistic movement could be observed, except for an occasional mild twitch of the head on the neck towards the left. Clinically this appeared to arise from the posterior rotator group of suboccipital muscles. During the subsequent week the patient remained slightly confused and gave evidence of increasing respiratory distress, despite vigorous chemotherapy, oxygen, and thorough bronchial aspirations. He expired on March 21, 1953, with clinical evidence of an extensive bilateral bronchopneumonia.

*Necropsy.* The calvarium was pierced by two recent postparietal trephine openings. The cortical surface of the brain showed prominent accentuation of the sulci with some bilateral involution present beneath the dura mater on both sides and slightly increased amounts of subdural fluid, but no evidence of subdural hemorrhage.

The brain was fixed and sectioned coronally. At the level of the mammillary bodies a circumscribed area of hemorrhage was noted in the right subthalamic nucleus, measuring 1.0 cm. in its anteroposterior dimension and up to 0.8 cm. in diameter (Fig. 1). A small old cystic
lesion, measuring 0.6 cm. in diameter, was observed in the left caudate nucleus. The vessels at the base of the brain showed diffuse prominent atheromatous plaque formations, but there was no evidence of old or recent occlusion (Fig. 2).

The spinal cord was grossly not remarkable, apart from a clean recent surgical laceration embracing the left ventral quadrant at the 2nd cervical level.

The pertinent visceral findings included multiple small pulmonary infarcts with an extensive confluent bronchopneumonia bilaterally and moderate pleural effusion on the left. There was advanced suppurative sinusitis with mucocele formation in the sphenoid and ethmoid, which presumably contributed to the pulmonary complications. The heart revealed a grade II coronary sclerosis with dilatation of the right auricle and ventricle, and there was chronic passive congestion of the liver, kidneys and spleen.

**DISCUSSION**

It is apparent that procrastination with medical measures and the faint hope of spontaneous disappearance of the movements is an unwise course in hemiballismus. A good deal of hesitation to embark on surgical intervention of the descending extrapyramidal projection pathways was because of the patient’s age, poor general condition, and lack of any precedence in the neurosurgical literature for relief of the movements by the procedure carried out in this case. The long period of exhaustion and intermittent narcosis prior to surgical intervention diminished this patient’s resistance to the point where he was finally unable to resist hypostatic pulmonary infection. Although hemiballismus is a rare disorder, it would appear that prompt diagnosis and operation will salvage some of these unfortunate patients in the future. In the future it would appear advisable to combine ipsilateral section of the upper 3 cervical motor roots with ventral quadrant section in order to control hemiballistic movements above the level of the surgical section.

**CONCLUSIONS**

1. A fatal case of hemiballismus has been described in which cessation of the movements was produced by ventral quadrant section of the upper cervical cord. 
2. The importance of prompt diagnosis and surgical treatment in this uncommon but almost uniformly fatal disorder is emphasized.

**REFERENCES**