HEMIBALLISMUS RELIEVED BY VENTRAL QUADRANT SECTION OF THE CERVICAL SPINAL CORD WITHOUT PARALYSIS*

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Hemiballismus, as you know, is a rare disorder in which violent, uncontrollable movements of one arm and leg occur. The term "hemiballismus," credited to Kussmaul by Oppenheim, is reserved for those cases in which the movements are massive, violent, flinging movements of one extremity or one half of the body. Walker17 stated that hemiballismus probably should be considered a variety of choreo-athetosis. These involuntary actions may begin at times with little more than flinging of an article from the hand, but soon reach such dramatic violence that the patient may be thrown from the bed by them. The flingings and hurlings of the extremities usually persist through every waking moment. Although the movements disappear with sleep, sleep is usually impossible even with heavy sedation. The patient becomes distraught and eventually exhausted9 by the violent constant movements and usually dies of pneumonia or cardiac failure in a few days to 5 weeks.

Greiff10 in 1888 was the first to localize the lesion to the contralateral corpus subthalamicum. This was forgotten until Bonhoeffer11 in 1897, Jakob in 1923 and Martin12 in 1927 reviewed the pathology to be in the contralateral subthalamic nucleus of Luys.

Moersch and Kernohan13 in 1939 reported a case. Whittier14 in 1947 was able to find 30 cases with adequate pathological studies of the subthalamic nucleus. In 6 of these the subthalamic nucleus was intact, but it was presumed that its connections were interrupted. In 4 cases no change was noted in the nucleus or its connections. Meyers et al.15 believed that the lesion may arise in different areas of a neural circuit rather than be confined to the nucleus of Luys. In the majority of instances, the lesion is vascular, either hemorrhage or thrombosis, although occasional cases of neoplastic involvement have been reported.

Hampel16 stated that the blood supply of the subthalamic nucleus is derived from three arteries—a branch of posterior cerebral, a choroidal artery and a branch of the posterior communicating. Carpenter4 felt that the primary blood supply is from branches of the posterior cerebral artery.

The Vogts had expressed the belief that a topical relationship existed in the thalamic nucleus. In the cases reviewed by Whittier14 the oral pole was destroyed in 17, with the face being involved. Meyers et al.15 have felt that there is a somatotopic localization in the nucleus with rostral lesions causing movement of the head and neck, lesions of the middle portion affecting the upper extremity and the caudal portion involving the lower extremity.

Herz and Meyers7 proposed a theory for the pathogenesis of hemiballismus in which impulses of the kinetic circuit flow from the periphery to the thalamus and are passed on to the postcentral areas 1, 2, 3—then by U-fibers to the motor area 4 and 4Y and premotor area 6 (Fig. 1).

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Kinetic impulses leave the motor cortex and pass by parapyramidal fibers through subcortical nucleus, probably including the reticular substance to the lower motor neurone—presumably some over extrapyramidal cord tracts. The kinetic circuit, when unopposed by a suppressor circuit, produces ballistic movements of the opposite half of the body.

The suppressor circuit S, which phasically complements and suppresses irregular showers of kinetic impulses, starts with impulses from the periphery via the thalamus going to the cortical suppressor strip 4S; from suppressor strip 4S impulses go via the caudate, putamen, globus pallidus through the subthalamic nucleus to the reticular substance and finally the lower motor neurone. While these circuits are still highly theoretical, they appear to be compatible with known facts of hemiballismus.

Nearly all recent writers have emphasized that hemiballismus should be treated surgically by early operation if these patients are to survive.11

Clinically the majority of patients are elderly—the average age in Whittier's series was 64, although Bonhoeffer had a patient 7 years old.

As a rule the onset is sudden. Hypertension and arteriosclerosis are usually present, and the hypertension is usually of a formidable degree. Such individuals are not good surgical risks and yet procrastination in the hope that the violent movements will stop nearly always leads to the death of the patient.

The number of reported cases in which surgery was performed appears to be

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**Fig. 5.** A reverberating circuit theory of the pathogenesis of hemiballismus.9 Solid black line, kinetic circuit (K); black line with white dots, suppressor circuit (S). K circuit, acting unopposed, produces ballistic movements of the opposite half of the body; S circuit phasically complements and suppresses the irregular showers of kinetic impulses. Under normal circumstances, the latter are dissipated in such a way as to contribute to normal muscle tonus.

*Fig. 1. Diagram reproduced from Baker's Clinical Neurology with the kind permission of E. Herz and R. Meyers' and P. B. Hoeber, Inc.*