The Contribution of the Precentral Gyrus to the Pyramidal Tract of Man

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The origin of the pyramidal tract of man is not known. For carnivores, monkeys, and man, virtually all fibers arise from the neocortex, but the exact contribution of each cortical area is known only for the cat and macaque. In man this noteworthy lack of information results from the improbability that ordinary brain lesions will be restricted to specific cortical areas. The lesions of natural disease, trauma, and, except in rare instances, congenital malformations are much too diffuse to approximate the precision of experimental cortical ablations. Since the usual clinical material is of little help in locating the areas of origin of the pyramidal tract, any case which approximates the experimental ideal gains in importance. In the case reported here, the cortical arm, trunk, and leg area of a patient was surgically removed under unique circumstances comparable to experimental conditions. The clinical features, some of which have been reported before, are important in evaluating the resulting degeneration in the pyramidal tract.

Case Report

The patient’s birth and early infancy were uneventful. At the age of 2-1/2 years, she was found to have purposeless, involuntary movements of her left arm and left leg. These movements continued and, at the time of her first hospital admission at the age of 25, were described as an arrhythmic torsion spasm occurring at a rate of about one per second in the left arm including the shoulder, elbow, and wrist. There was little evidence of spasm in the left hip or knee, but the ankle showed internal rotation and plantar flexion. There was some weakness of the left hand; the left lower abdominal reflex was not obtained, but there was no Babinski sign. At that time the left anterior column was cut at C-2 by Dr. Eric Oldberg. This was accomplished by rotating the cord and attempting to crush the anterior column with a hemostat; it resulted in temporary relief from the involuntary movements.

At the age of 27, a right frontoparietal craniotomy was performed. All parts of the exposed area were systematically stimulated with a 60-cycle sinusoidal current; only the precentral gyrus was found excitable. All of the precentral gyrus which produced movement of either the left arm or leg was excised. This included the paracentral lobule on the medial surface of the hemisphere and the anterior wall of the Rolandic fissure.

An inexitable area between the representation of the fingers and eyelids was not removed initially. At the age of 31, when involuntary movements returned in the left hand, this remaining cortex was removed.

The patient made an excellent recovery with marked diminution in the involuntary movements. She continued to show a moderately-severe left hemiparesis; the arm was worse than the leg. She could not make purposeful movements of individual fingers. She also showed loss of position sense, two-point discrimination, and perception of figure writing on the left side. She died when she was 51 years old, 7 days after a primary hemorrhage into the left cerebral hemisphere and 20 years after the last cortical extirpation.

Methods and Results

The gross extent of the two excisions is shown in Fig. 1. To determine whether structures giving rise to or conveying the pyramidal tract were damaged before the cortical excisions, we examined the brain by semi-serial section. Multiple sections were taken and stained with Luxol fast blue. The cortex anterior and posterior to the ablation did not have the cytoarchitectonic features
FIG. 1. Excision of the right precentral gyrus in man. A. Lateral view of right hemisphere. B. Semi-lateral view of right hemisphere showing medial extent of the lesion. C. Superior view of right hemisphere.