SURGERY IN LENNOX-GASTAULT SYNDROME

Corpus Callosum Division for Children

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Atonic or “drop” attacks—often seen in Lennox-Gastaut syndrome—are some of the most feared childhood seizures, since they may lead to head injuries. Corpus callosum division will often control atonic seizures, and other types of generalized seizure.

INTRODUCTION

Corpus callosotomy was first performed by Van Wagenem and Herren in 1939 in Rochester, New York as a treatment for severe epilepsy in humans. The authors stated, “As a rule, consciousness is not lost when the spread of the epileptic wave is not great, or when it is limited to one cerebral cortex.” As the procedure has evolved in the subsequent half century, its indications, surgical techniques, results and consequences, especially as relates to children, are still the object of continuous clinical and investigational research. This chapter reviews the more prominent contributions to the fields of basic and clinical research relating to corpus callosotomy as a treatment for medically refractory epilepsy.

BACKGROUND: ANATOMY AND PHYSIOLOGY OF THE CORPUS CALLOSUM

There is considerable variation in the anatomy of the corpus callosum as one ascends the evolutionary scale. In mammals, for example, the corpus callosum develops in proportion to neocortical volume, and, therefore, reaches its maximum expression
in adult humans, where it measures approximately 10 cm. in length from the anterior commissure to the posterior commissure. Figure 1 demonstrates the different anatomical components of the corpus callosum and their relationship to the other interhemispheric fiber tracts. It is estimated that the human corpus callosum contains 180 million axons.

A fundamental concept in the physiology of the callosum is that the cerebral hemispheres may be connected either homotopically or heterotopically, as elaborated by Pandya in the Rhesus monkey. In the Rhesus, for example, the primary auditory cortex sends projections mainly to the opposite auditory cortex, whereas the primary somatosensory cortex sends connections not only to the opposite somatosensory cortex, but also to secondary and supplementary sensory cortex. Consequently, auditory cortex may be considered more homotopic in Rhesus, and somatosensory cortex more heterotopic, as a consequence of these connections.

It is now known that different sets of neurons may project ipsilaterally as well. The connections between the cerebral hemispheres are organized in a rostral-caudal manner, with the frontal lobes occupying the rostral portion of the callosum and the other lobes following the anterior posterior anatomy. Grafstein in 1959 concluded that the homotopic connections, the callosal axons, terminated at roughly the same depth and relationship to the cerebral cortex as they arose in the opposite hemisphere. The nature of these connections appears to be both stimulatory and inhibitory, but the data do fully support the anatomical/physiological hypothesis that the corpus callosum plays the principle role in the propagation of electrical discharges from one hemisphere to the other.

Innocenti in 1986 introduced the concept of “exuberance” in relationship to the corpus callosum. It was meant to describe the widespread distribution of callosal projection neurons in the visual cortex of the neonatal cat. The widespread (heterotopic) distributions of such callosal neurons are not only seen in different mammalians, but are also subjected to substantial changes in the mature brain of the primate. Kass, studying a different species of new world monkey, the prosimian galagos, and the old world macaque, demonstrated a significant reduction of density and distribution of callosal...