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Hemimegalencephaly: A Longitudinal MR Study

Samuel M. Wolpert, Alan Cohen, and Mark H. Libenson

Summary: An infant with hemimegalencephaly was studied with MR at 5 days and again at 10 months of age. The initial scan showed an abnormally large left cerebral hemisphere. At the age of 10 months, the left cerebral hemisphere was smaller than the right—an apparent left-sided micrencephaly caused by normal growth of the right hemisphere and arrested growth of the left. The age of imaging of a patient with hemimegalencephaly can be important if the correct diagnosis is to be made.

Index terms: Megalencephaly; Brain, abnormalities and anomalies; Brain, magnetic resonance; Pediatric neuroradiology

Hemimegalencephaly, or unilateral megalencephaly, is a rare anomaly of neuronal migration and proliferation that usually presents with macrocephaly, intractable seizures, and development of later contralateral hemiparesis and mental retardation. Although usually unassociated with other conditions, it has been described in association with the linear sebaceous nevus syndrome (1), the Klippel-Trenaunay-Weber syndrome (2), neurofibromatosis (3), and the epidermal nevus syndrome (4). Somatic hemihypertrophy generally is absent in the isolated form of the disease (5–13) but may occur in some patients (14, 15). There are autopsy (6), computed tomography (CT) (8), and magnetic resonance (MR) (5) reports of the anomaly. In this paper, we report on an infant studied with MR at the age of 5 days and again at 10 months. During this period, striking changes in the appearance of the brain occurred.

Case Report

The patient was the product of an uncomplicated pregnancy and presented with prolonged seizure activity on the first day of life. He was born via spontaneous vaginal delivery at 7 pounds 4 ounces to a healthy 26-year-old mother. There was no family history of neurologic disease. Seizures first developed when the patient was 2 hours old. Seizures persisted, occurring many times daily. Two clinical seizure types were recognized: one consisted of forced eye deviation to the right associated with clonic movements of the right side, and the other consisted of blinking, facial twisting, and clonic movement of all limbs.

Initial neurologic examination showed mild dolichocephaly with a head circumference in the 50th to 75th percentile and mild axial hypotonia. MR images obtained when the patient was 5 days old demonstrated an abnormally large left cerebral hemisphere with pachygyria, thickened cortex, and periventricular cortical heterotopias (Fig 1). A diagnosis of left unilateral megalencephaly was made.

Electroencephalography demonstrated virtually continuous electrographic seizure activity referable to the left hemisphere. Seizures remained refractory to multiagent pharmacotherapy that included phenobarbital, phenytoin, valproic acid, and carbamazepine. The patient remained severely developmentally delayed. Head control was poor, and a left gaze preference and right homonymous hemianopsia were evident. A dense right hemiparesis developed with fisting of the right hand. MR images were repeated when the patient was 10 months old (Fig 2). These demonstrated apparent asymmetric growth of the brain: the previously described enlarged left cerebral hemisphere was now smaller than the right cerebral hemisphere, with evidence of central and peripheral atrophy of the left cerebral hemisphere.

A left hemispherectomy was performed when the patient was 10 months old. Intraoperative electrocorticography demonstrated continuous multifocal seizure activity occurring over the left hemisphere convexity. The left hemisphere appeared bosselated, and pathologic examination revealed polymicrogyria with gray matter heterotopias. A calcarine cortex could not be identified. The sylvian fissure was abnormally wide and the ventricle extremely large.

The patient's seizures resolved after hemispherectomy, and he demonstrated dramatic neurologic improvement. Two months after surgery a ventricular shunt was inserted to control hydrocephalus. At follow-up examination at 23 months of age, he had remained seizure-free since the

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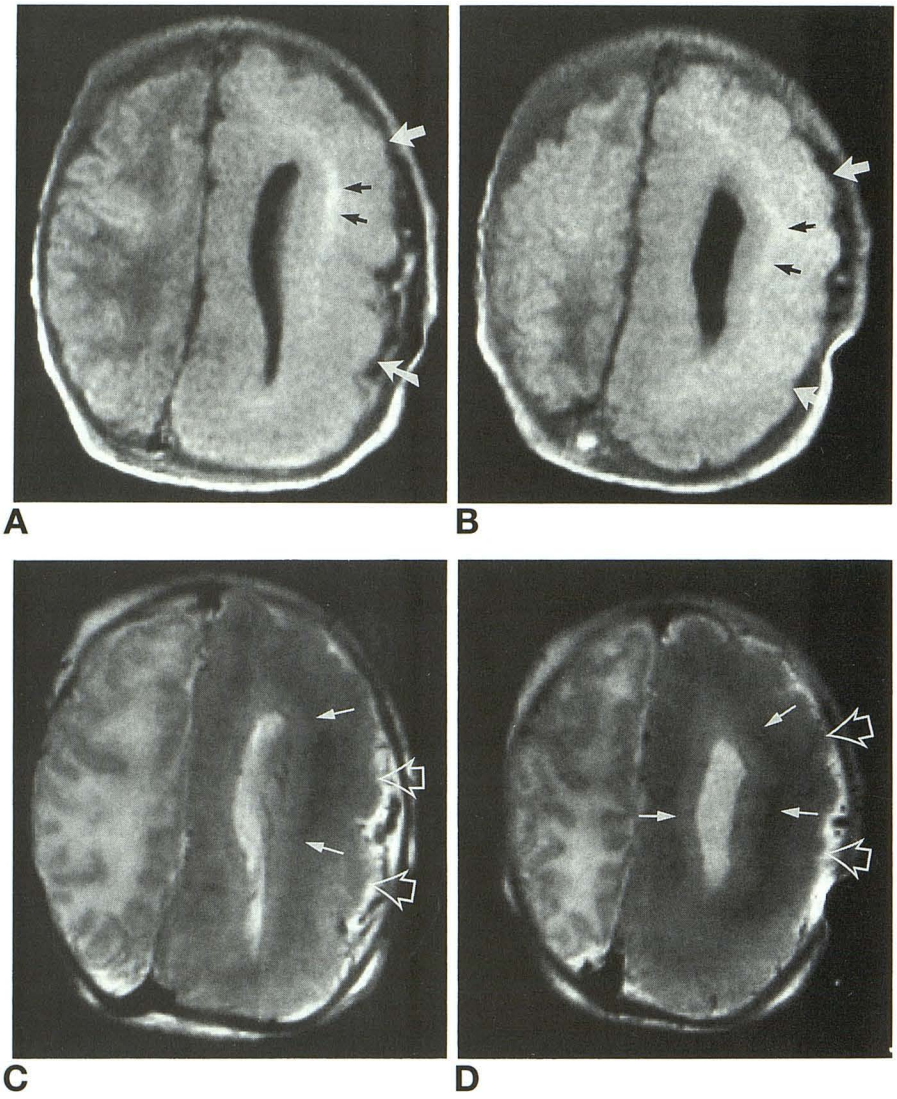


Fig 1. *A* and *B*, 5 days of age. Axial T1-weighted MR image, 650/20/1 (repetition time/echo time/excitations) through central white matter demonstrates enlarged abnormal left hemisphere with thick gray matter and pachygyria (*white arrows*) and hyperintense white matter (*black arrows*). B is 8 mm, higher than A. Note also enlarged left lateral ventricle. (Right lateral ventricle, not shown here, was seen on lower sections.)

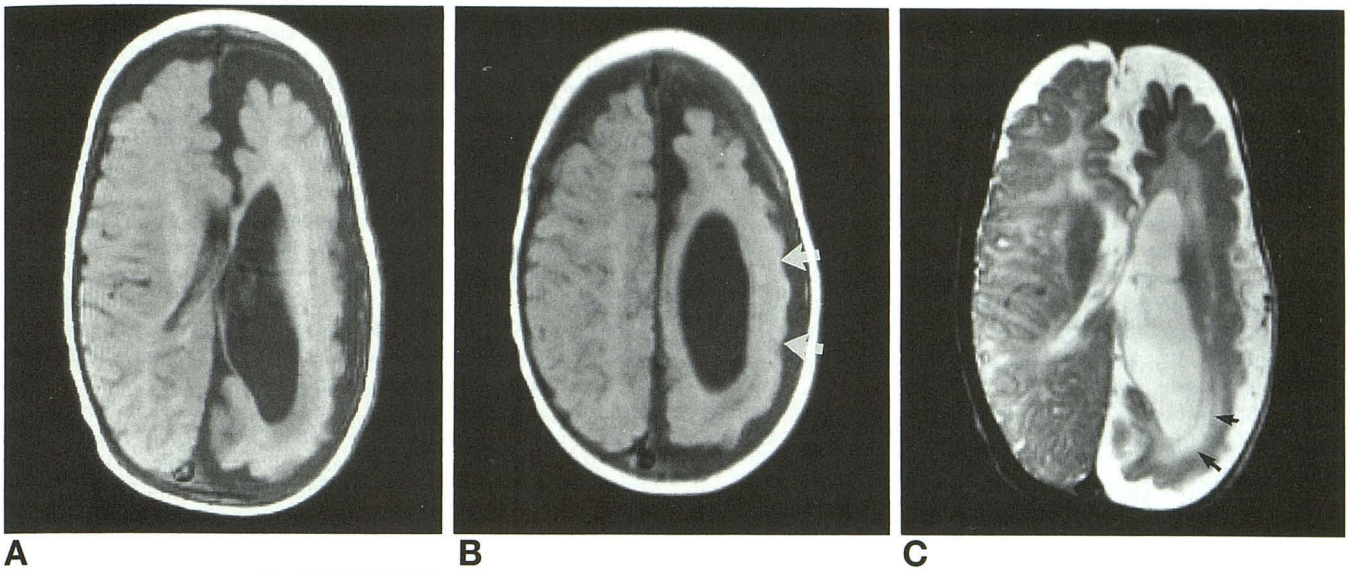
C and *D*, Axial T2-weighted images, 3000/140/1, at same levels as A and B demonstrates thick pachygyric gray matter (*open arrows*), enlarged left lateral ventricle, and minimal hyperintensity of surrounding white matter (*arrows*) caused presumably by gliosis.

immediate postoperative period, was able to sit if placed, used three words specifically, and demonstrated a mild right hemiparesis and a left gaze preference. The electroencephalogram showed a normal posterior rhythm on the right and voltage depression on the left; there was no residual epileptiform activity.

Discussion

Unilateral megalencephaly is considerably less common than the generalized form, which has been divided into anatomic megalencephaly (including the neurocutaneous syndromes and a variety of genetic syndromes) and metabolic megalencephaly (16). In this latter group of disorders, which includes Tay-Sachs disease and other gangliosidoses, Canavan disease, Alexander disease, and some of the mucopolysaccharidoses, white matter swelling is usually present (17). In unilateral megalencephaly (hemimegalencephaly), the white matter is usually excessive, and the nerve cells are larger and less densely packed than on the normal half of the brain (6), and polymicrogyria, neuronal heterotopias (11), and lissencephaly occur. Unilateral megalencephaly is probably related to an interference in normal neuronal migration along radially oriented glial fibers (18, 19). Gliosis and/or heterotopic gray matter may occur in the white matter (5).

Brain growth after birth is largely determined by glial rather than by neuronal growth (20). In an infant with hemimegalencephaly, it is expected that through childhood the normal hemisphere should undergo normal growth, maturation, and myelination. The MR appearances in this case report are consistent with normal neu-



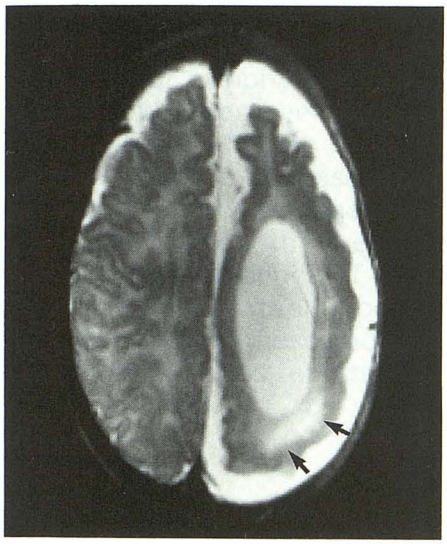


Fig 2. *A* and *B*, 10 months of age. Axial T1-weighted MR image 650/20/1 at approximately the same levels as Figure 1A and B demonstrate a smaller left than right hemisphere. Again left-sided pachygyria is seen (*arrows*). The subarachnoid spaces surrounding the hemisphere are wider on the left than on the right side. Note that the left hemicranium remains larger than the right despite the atrophic underlying hemisphere.

C and *D*, Axial T2-weighted images, 3000/140/1 at the same levels as A and B demonstrate again a smaller left than right hemisphere. Again left-sided pachygyria is noted. There are hyperintense areas (*arrows*) surrounding the left occipital horn because of gliosis.

ronal and glial proliferation in the "normal" hemisphere. It is not clear what later effect the in utero event that lead to the subsequent maldevelopment and abnormal prenatal enlargement of the left hemisphere (likely occurring in the second trimester of pregnancy) should have on later brain growth. It would not be unexpected that such a severely disorganized region of cerebrum would have limited future growth potential. A review of the literature, either through longitudinal studies or in studies of patients diagnosed in the first years of life, however, fails to demonstrate this consequence of differential brain growth in patients with hemimegalencephaly. We cannot account for the lack of similar descriptions in the literature of differential growth of the cerebral hemispheres in patients with hemimegalencephaly. The child did not experience any clinical event during his course that would account for the failure of the affected hemisphere to grow. One could speculate that the patient's poorly controlled seizures were responsible for some portion of the growth arrest of the involved hemisphere, but the extent of the growth differential makes seizures as the sole explanation for the discrepancy implausible.

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