Left-Right Temporal Region Asymmetry in Infants and Children

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Thirty-two consecutive cranial computed tomographic (CT) scans in normal infants ranging from 1 day to 3 years of age were evaluated for asymmetry of the temporal lobes as evidenced by differences in the size of the sylvian fissures. The left sylvian fissure was larger than the right in 23 of the 32 cases, which was statistically significant ($p < 0.0001$). In five other cases the two sides were equal; in the four remaining cases, the right side was larger than the left. The results show that asymmetry of the temporal lobes can be demonstrated in vivo even at birth and that this asymmetry is a normal developmental difference between the two hemispheres and not secondary to an acquired abnormality.

Various functional asymmetries between the cerebral hemispheres have long been noted. Since these functional asymmetries were described, attempts have been made to find an underlying anatomic basis for their presence. In a postmortem study in 1968, Geschwind and Levitsky [1] found asymmetry between the upper surfaces of the right and left temporal lobes in adults. In a study of fetal brain development in 1977, Chi et al. [2] showed left-right asymmetries in the temporal region, including the sylvian fissure. Computed tomographic (CT) scans in normal patients have demonstrated asymmetries in the frontal and occipital lobes [3–5], but such asymmetry has not been evaluated in the temporal region. We report our experience in demonstrating temporal region asymmetry in vivo on CT as evidenced by differences in the size of the sylvian fissures.

Materials and Methods

Thirty-two consecutive cranial CT scans in infants interpreted as normal were reviewed for evidence of temporal region asymmetry. The patients ranged from 1 day to 3 years of age. All scans were performed on GE 8800 or 9800 scanners, usually with 10-mm contiguous slices.

The scans were reviewed by two observers, who noted any asymmetry of the temporal regions as evidenced by differences in the size of the sylvian fissures. The specific areas compared between the two sides were the anteroposterior distance between the frontal and temporal opercula and the anteroposterior length and width of the sylvian fissures. Actual measurements of these areas were not made for two reasons: First, our primary objective was to evaluate side-to-side asymmetry in each case regardless of the actual size of the particular areas; second, because there are wide individual variations in the size of the subarachnoid spaces of infants and children of similar ages, valid comparison between patients would be difficult if the actual dimensions were compared.

To minimize apparent side-to-side differences due to head tilting, we compared the CT slice with the largest sylvian fissure on one side to the one with the largest contralateral sylvian fissure whether or not they were the same slice.

Each case was assigned to one of three categories: (1) scans in which the left sylvian fissure was larger than the right, (2) scans in which the two sylvian fissures were equal in size, and (3) scans in which the right sylvian fissure was larger than the left. The data were

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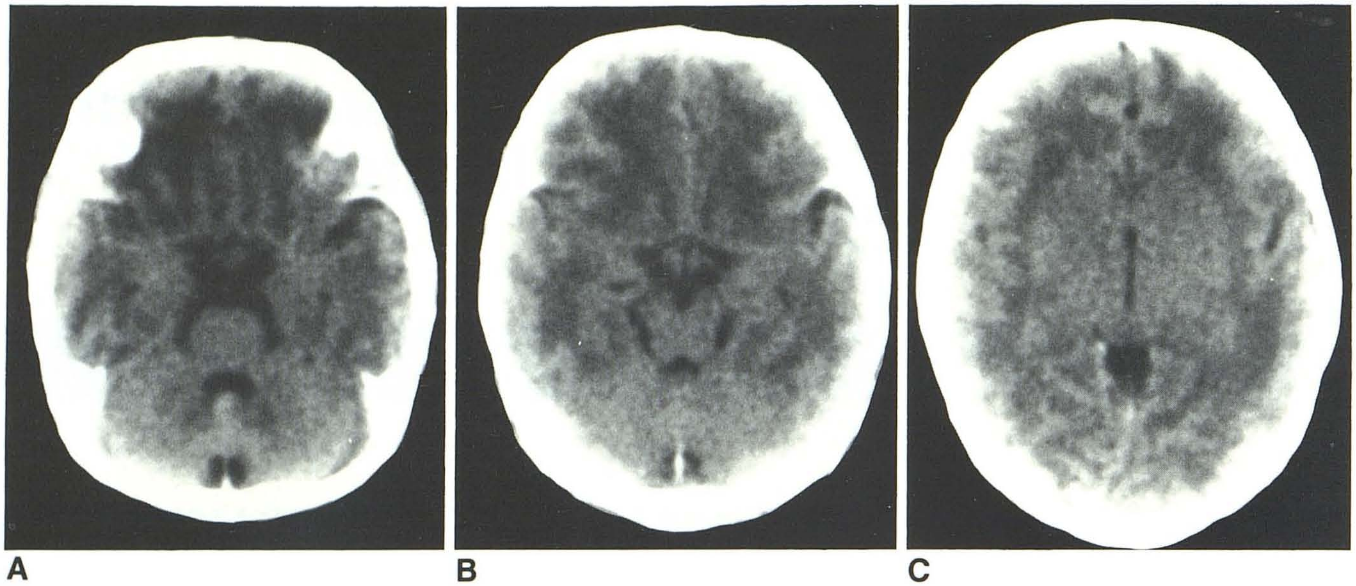

Fig. 1.—2-day-old boy. Consecutive 5-mm-thick CT scans demonstrate asymmetry of sylvian fissures with left larger than right.

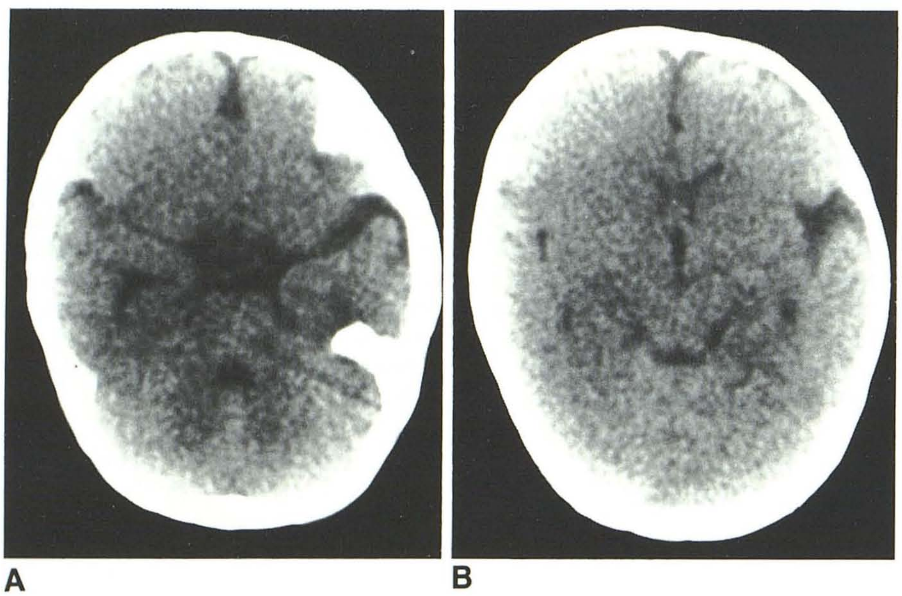

Fig. 2.—2-month-old girl. Consecutive 10-mm-thick CT scans demonstrate asymmetry of sylvian fissures with left larger than right.

analyzed by means of the binomial distribution, assuming 0.5 as the expected frequency of the left sylvian fissure being larger than the right; and by the Wilcoxon rank sum test.

Results

In 23 of the 32 cases the left sylvian fissure was larger than the right (figs. 1 and 2), in five they were equal, and in four the right was larger than the left. Statistical analysis by both the binomial distribution and Wilcoxon rank sum test showed that the asymmetry of the sylvian fissures was statistically significant ($p < 0.0001$).

Discussion

Our results agree with the postmortem studies of Geschwind and Levitsky [1] in adults and Chi et al. [2] in fetuses, and give direct in vivo evidence of asymmetry of the temporal regions as demonstrated by differences in the size of the sylvian fissures.

A potential limitation of the current study is the fact that our patient population was not "normal" in that they were referred for a variety of possible neurologic disorders. However, only cases that were interpreted as normal and that also were normal in retrospect were used; this is probably as close to a true normal population as possible because it would be unethical to expose children to the theoretical risk of radiation without a clinical indication. In the future magnetic resonance may offer a method for performing this type of study without the risk of radiation.

The significance of left-right asymmetry in the infant and child's brain is apparent on two levels From the theoretical standpoint, it is of interest to note that anatomic differences between the two hemispheres in a region with known functional asymmetries are present even at birth. This lends support to the concept that functional asymmetries have an underlying anatomic basis that is genetically determined [6, 7]. It has been suggested that the reason for the asymmetric enlargement of the left sylvian fissure is probably to provide more space for the planum temporale, which is part of the temporal speech cortex [1]. This has not been proven, but it is an attractive theory. If such is the case, sulci in other areas such as the motor cortex might be expected to be asymmetric at some point in their development, depending on the ultimate handedness of the individual; we have undertaken an investigation to determine whether this can be demonstrated.

On a practical level, it is essential that asymmetry of the sylvian fissures be recognized as a normal variant so that it is not misinterpreted as focal atrophy, evidence of previous infarction, or other disorder causing loss of brain substance with secondary enlargement of the cerebral sulci and adjacent subarachnoid space. The asymmetry is most prominent in infants and children under 2 years of age because they have relatively larger subarachnoid spaces in general [8]. After this age the asymmetry is less pronounced because of the relatively smaller subarachnoid spaces.

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