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# CT of Cerebral Hemiatrophy

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**Computed tomography (CT) findings in 10 cases of cerebral hemiatrophy are described. The CT appearance is typical and reflects the pathologic changes of unilateral loss of brain substance and calvarial thickening. In four patients with a mild form of the disease, a correct analysis of the plain skull radiographs was made only in retrospect. CT was found superior to plain skull films in the demonstration of subtle calvarial thickening and changes affecting the base of the skull.**

Cerebral hemiatrophy is due to a variety of disease processes that result in atrophy of one cerebral hemisphere [1]. Clinically, it is characterized by hemiplegia and seizures. Mental retardation may or may not be present. Radiologically, the hemicranium is small with unilateral thickening of the calvarium, overdevelopment of the paranasal sinuses, and elevation of the petrous ridge. We describe the computed tomographic (CT) findings in 10 patients with cerebral hemiatrophy.

## Materials and Methods

Of 5,000 CT studies of the head over a 2-year period, 10 patients were found to have clinical, radiologic, and CT evidence of cerebral hemiatrophy (tables 1 and 2). The scans were performed on a GE scanner CT/T 7800 (320 × 320 matrix). The scan time was 4.8 sec, one slice per scan, with 10 mm collimator. All 10 patients had plain skull films; none underwent pneumoencephalography.

## Representative Case Reports

*Case 3*

An 18-year-old woman developed psychomotor seizures, left hemiparesis, and mental retardation after varicella encephalitis at age 1 year. She had recently experienced an increased frequency of seizures. Physical examination revealed a mild left spastic hemiparesis, increased reflexes on the left, and mild mental retardation. Plain skull radiographs showed right calvarial thickening and enlarged right frontal and ethmoid sinuses. CT showed small right anterior and middle cranial fossae, right calvarial thickening, enlarged right paranasal sinuses, mild dilatation of the right lateral ventricle, midline shift to the right, and mild widening of the subarachnoid sulci on the right (fig. 1).

*Comment.* This case is an example of cerebral hemiatrophy secondary to encephalitis. CT findings were typical, including diminution of the anterior and middle cranial fossa on the affected side.

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TABLE 1: **Findings in Cerebral Hemiatrophy**

| Case No. | Age (yr) Gender | Findings ($n$ = 10) | | Etioloy |
|---|---|---|---|---|
| | | Clinical | Radiography | |
| 1 | 40,F | Left hemiparesis since birth; seizures at 18 months; mental retardation | Right calvarial thickening | Congenital |
| 2 | 12,F | Left hemiparesis since birth; seizures at 6 years; left hemiatrophy; normal mental status | Right calvarial thickening; elevation of Right petrous ridge | Congenital |
| 3 | 18,F | Left hemiparesis and seizures after encephalitis at 1 year; mental retardation | Right calvarial thickening; right enlarged paranasal sinuses | Varicella encephalitis at age 1 year |
| 4 | 30,M | Right Hemiparesis, seizures, and Right choreathetosis after encephalitis at 18 months; right hemiatrophy; normal mental status | Left calvarial thickening; left enlarged paranasal sinuses | Encephalitis at age 18 months |
| 5 | 65,M | Right hemiparesis and seizures after poliomyelitis at 9 months; right hemiatrophy; normal mental status | Left calvarial thickening; left enlarged paranasal sinuses | Poliomyelitis at age 9 months |
| 6 | 1,M | Left hemiparesis at 4 months; no seizures; normal mental status | Right calvarial thickening | Perinatal trauma |
| 7 | 5,M | Right hemiparesis and seizures at 5 months; mental retardation | Left calvarial thickening | Perinatal trauma |
| 8 | 13,M | Seizures at 6 years; right hemiparesis at 13 years; normal mental status | Left calvarial thickening | Perinatal trauma |
| 9 | 41,F | Left hemiparesis and seizures since infancy; left hemiatrophy; mental retardation | Right calvarial thickening; right enlarged paranasal sinuses; elevation of right petrous ridge | Unknown |
| 10 | 20,F | Right hemiparesis since infancy; seizures after recent car accident; normal mental status | Left calvarial thickening | Unknown |

TABLE 2: **CT Findings in Cerebral Hemiatrophy**

| Case No. | Findings | | | |
|---|---|---|---|---|
| | Small Anterior Cranial Fossa | Small Middle Cranial Fossa | Enlarged Paranasal Sinuses | Dilated Sulci |
| 1 | − | + | − | − |
| 2 | − | + | − | − |
| 3 | + | + | + | + |
| 4 | + | + | + | + |
| 5 | + | + | + | − |
| 6 | − | + | − | − |
| 7 | ... | ... | − | + |
| 8 | − | − | − | − |
| 9 | − | + | + | + |
| 10 | ... | ... | − | − |
| Total | 3 | 7 | 4 | 4 |

Note.—+ = positive; − = negative. All cases had calvarial thickening and midline shift. All except case 4 had dilated ipsilateral ventricles; case 4 had a dilated contralateral ventricle. Case 6 only had a middle cerebral artery infarct.

*Case 6*

A 1-year-old boy was evaluated for a left hemiparesis. He was born at full term by breech presentation and forceps traction. A right-sided cephalhematoma was present at birth. Left hemiparesis was noted at age 4 months. There was no history of seizure disorder. Mental status was normal. Plain skull radiographs were initially interpreted as normal. A retrospective analysis revealed a slightly smaller right hemicranium (fig. 2A). CT showed right calvarial thickening, small right middle cranial fossa, dilatation of the right lateral ventricle, midline shift to the right, and an old infarct in the distribution of the right middle cerebral artery (figs. 2B–2D).

*Comment.* In this case, a birth injury apparently resulted in vascular damage and infarct in the distribution of the middle cerebral artery. Correct analysis of the skull films was made in retrospect.

*Case 8*

A 13-year-old boy was evaluated for recurrent seizures. He was born at 44 weeks gestation by vaginal delivery with some perinatal distress and Rh incompatibility requiring two exchange transfusions. Generalized seizures were noted for the first time at age 6 years, and he was treated with anticonvulsant medication until recent recurrence of grand mal seizures. Physical examination revealed mild right spastic hemiparesis and slightly increased reflexes on the right. There was no Babinski sign and mental status was normal. Plain skull radiographs were initially interpreted as normal. Retrospective evaluation revealed mild left calvarial thickening (fig. 3A). CT showed left calvarial thickening, mild dilatation of the left lateral ventricle, and mild shift of the midline to the left (figs. 3B and 3C).

*Comment.* This case is an example of perinatal trauma resulting in a mild form of cerebral hemiatrophy. A correct interpretation of the skull films was made after CT findings became available.

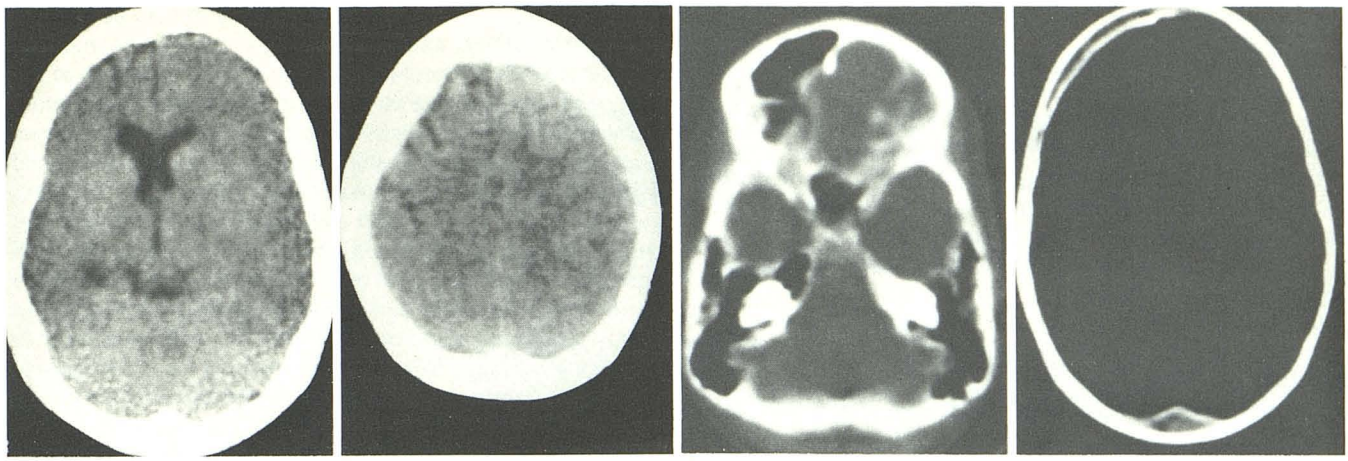


Fig. 1.—Case 3. **A**, Small right hemicranium. Mild dilatation of right lateral ventricle and midline shift to right. **B**, Sulci mildly widened on right. **C** and **D**, Bone window setting. **C**, Small right anterior and middle cranial fossa and enlargement of right paranasal sinuses. **D**, Calvarial thickening involves particularly diploic space and inner table.

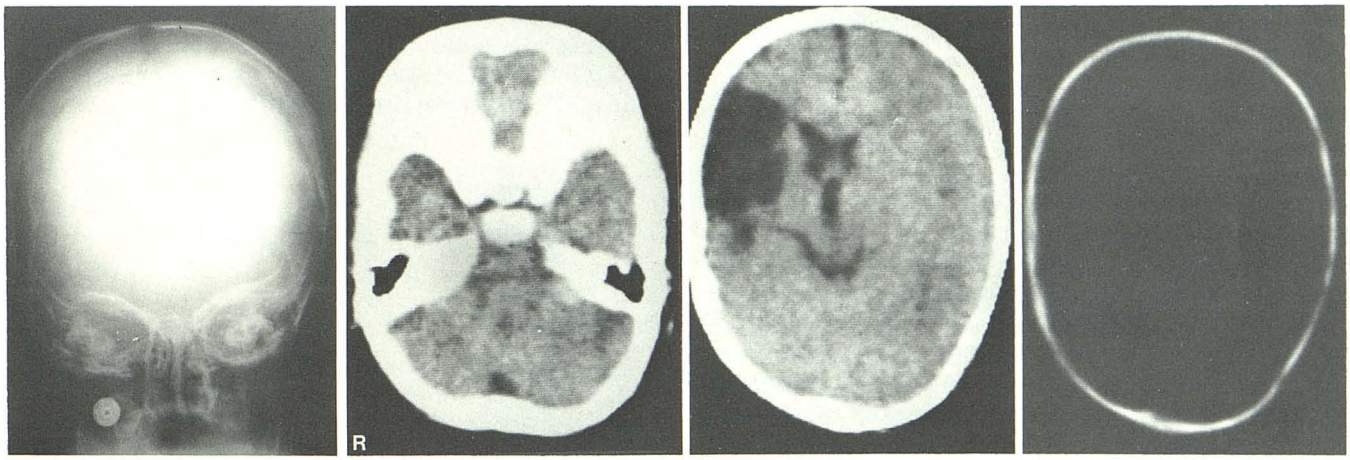


Fig. 2.—Case 6. **A**, Posteroanterior view. Slightly small right hemicranium. **B**, Small right middle cranial fossa. **C**, Dilatation of right lateral ventricle, midline shift to right, and large low density area on right compatible with old middle cerebral artery infarct. **D**, Bone window setting. Mild right calvarial thickening.

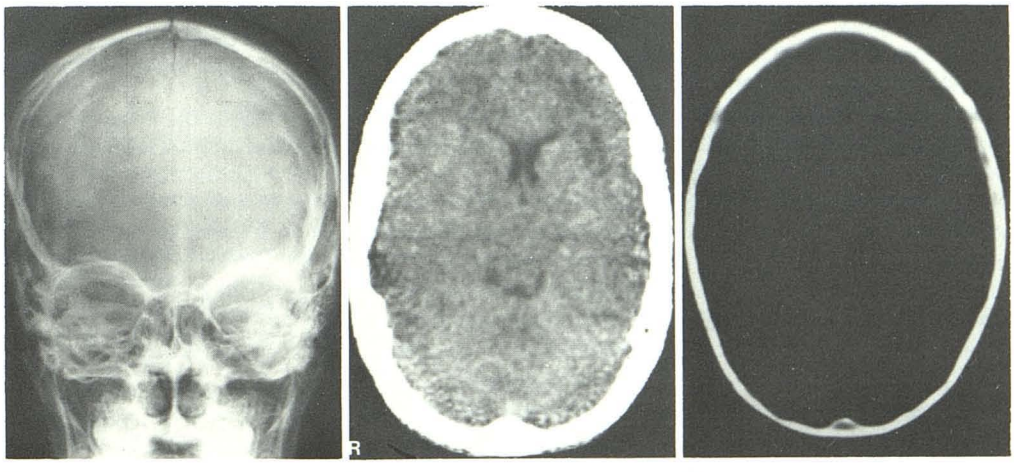


Fig. 3.—Case 8. **A**, Posteroanterior view. Mild calvarial thickening on left. **B**, Mild dilatation of left lateral ventricle and mild midline shift to left. **C**, Bone window setting. Mild left calvarial thickening involves particularly diploic space and inner table.

## Discussion

The etiology of cerebral hemiatrophy may be divided into congenital and acquired [2]. In the congenital or primary type, there is usually no apparent etiologic factor and the symptoms are present at birth or shortly thereafter. In this category, the cerebral damage most likely occurs during intrauterine life. A well documented example is that of Parker and Gaede [3] who described unilateral vascular anomalies in a 40-year-old woman with a congenital type of cerebral hemiatrophy.

In the acquired or secondary type, the symptoms are related to central nervous system damage that occurs in the perinatal period or later. Among the etiologic factors are trauma, infection, vascular abnormality, and ischemic and hemorrhagic conditions [1, 2, 4–7]. Another possible etiology is subependymal germinal matrix and intraventricular hemorrhage in premature infants [8]. With the increasing use of CT in newborns, such a finding is becoming increasingly recognized [9]. Typical skull changes develop when insult to the brain occurs during the first 18 months to 2 years of life. Of our 10 cases with cerebral hemiatrophy, two were congenital, three were related to perinatal trauma, three were due to infection, and two were of unknown origin.

Clinically, the syndrome is characterized by seizures, hemiparesis, and mental retardation [1]. Seizures may not be present initially and may appear many months or years after the onset of hemiparesis. In case 6, a 1-year-old child, there were no seizures. In case 10, seizures developed after a minor car accident and nearly 20 years after the initial onset of hemiparesis. Likewise, hemiparesis may not be present initially and may appear some time after the onset of seizures. This was noted in case 8. Mental retardation was present in four cases and normal mental status in six.

Before the advent of CT, traditional radiologic evaluation of cerebral hemiatrophy included plain skull radiography and pneumoencephalography. The skull changes are unilateral and consist of calvarial thickening with loss of convolutional markings of the inner table of the skull [1]. There may be overdevelopment of the frontal and ethmoid sinuses and of the mastoid air cells. Elevation of the petrous ridge may also be present. These changes reflect adaptation to unilateral decrease of brain substance. All our patients had plain skull films. Calvarial thickening was present in all 10 cases, enlarged paranasal sinuses in four, and elevation of the petrous ridge in two (table 1). In four cases, the skull films were initially interpreted as normal, and correct analysis was made in retrospect, after the CT findings became known.

Pneumoencephalography is the second traditional radiographic method of investigating patients with cerebral hemiatrophy. This study may show varying degrees of dilatation of one lateral ventricle and displacement of the midline structures toward the atrophic side [1]. The subarachnoid sulci may be widened on the affected side or may not fill. None of our patients had pneumoencephalography.

CT findings are characteristic and include those of plain skull radiography and pneumoencephalography (table 2) [10, 11]. Unilateral thickening of the calvarium was present in all 10 cases, affecting particularly the diploic space and inner table of the skull. The degree did not necessarily parallel that of ventricular enlargement. Enlargement of the paranasal sinuses was identified in four cases. The middle cranial fossa was diminished in seven cases, normal in one, and not included in the study in two. The anterior cranial fossa was diminished in three cases, normal in five, and not included in the study in two. Dilatation of a lateral ventricle was present in all the cases, on the same side as the skull changes in nine cases and on the opposite side in one (case 4). The subarachnoid sulci were widened on the affected side in four cases and not demonstrated in six. Midline shift toward the atrophic side was present in all cases. In case 6, there was an old infarct located in the distribution of the middle cerebral artery.

Analysis of our series suggests that a slight unilateral calvarial thickening may be difficult to assess on plain skull radiographs and can be easily missed, particularly if a proper clinical history is not available. On CT, using a variable window setting, a comparison of the calvarium on both sides can be made and any slight discrepancy in bone thickening is readily apparent. CT is also superior to plain skull films in the evaluation of the cranial fossae, particularly the anterior fossa. Recent reports have emphasized the value of CT in cerebral hemiatrophy [10, 11].

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