

Skull Roentgenography of Infants and Children With Convulsive Disorders

In the experience of most pediatric radiologists, skull roentgenography in children rarely yields significant diagnostic information. Two million roentgenographic examinations of the skull were performed in patients less than 15 years old in 1970, and there is a steady increase in the number of visits and procedures annually; the increase in the number of these examinations far exceeds that expected from the population growth alone.¹ Each roentgenographic examination of the skull in a young person delivers an average of 0.3 to 1.1 rads to the skin.² An enormous amount of money and radiation probably is wasted for the acquisition of little meaningful information.

Recent reports confirm that routine skull roentgenography in infants and children is generally inefficient and contributes nothing to patient care.³⁻⁷ Therefore, criteria should be set for the selection of patients for whom the procedure is indicated. Although textbooks and articles have recommended routine roentgenographic examination of the skull for seizure disorders in infancy and childhood, there is little documentation for the necessity of these examinations; recent studies have not shown any real value for them.⁵⁻⁷

Convulsions are among the most frequently observed neurologic disorders in children. The most common form of seizure is the febrile convulsion, which occurs in association with fever and acute systemic infections in approximately 3% to 4% of all children. The incidence of febrile seizures peaks at 23 to 30 months of age. Recurrent seizures, unassociated with fever or systemic infection, occur in about 0.5% of children.⁸ According to Van den Berg and Yerushalmy,⁹ the risk of a convulsive disorder by 5 years of age is 2% for febrile and 1% for nonfebrile seizures.

FEBRILE CONVULSIONS

Febrile convulsions are epileptic events that occur in the context of a fever caused by an infection anywhere other than the CNS, regardless of the type of seizure, duration, or previously

recognized nervous system abnormalities.¹⁰ Simple febrile convulsions occur in previously normal children 6 months to 6 years old. They are often brief (less than 15 minutes), are generalized, and have, as a rule, a benign prognosis. These patients have a normal EEG if it is performed after a seven-day, afebrile period. Epileptic seizures may also be precipitated by fever, and they can occur in either an otherwise normal or a previously abnormal child. These seizures can occur at any age. They may be prolonged and/or focal, and they are usually associated with specific EEG abnormalities.^{10,11}

Nealis et al.³ studied 753 children between the ages of 6 months and 6 years who had had a brief, generalized seizure after an elevation of body temperature and who had no evidence of meningitis or encephalitis. Children with any history of neurologic abnormality or an abnormal EEG were excluded. Skull roentgenograms were obtained in 489 children. Not one child showed any roentgenographic abnormality. The total cost of the examinations was \$24,000. The group of children studied was gathered from the Boston City Hospital; Babies Hospital, New York; Variety Children's Hospital, Miami; and Grace-New Haven (Conn.) Hospital. The authors concluded that when a detailed history and a complete physical examination suggest that a previously normal child had had a strictly defined, simple febrile convulsion, skull roentgenograms need not be part of the workup.

NONFEBRILE EPILEPTIC SEIZURES

On thorough investigation, a large number of patients with nonfebrile epileptic seizures fail to demonstrate any cause for the seizures and are considered to have idiopathic, cryptogenic, or primary epilepsy.⁸ Skull roentgenography usually does not yield any useful information about these patients. Of the patients with nonfebrile seizures, 26.5% have severe congenital anomalies of the CNS.⁹ These patients may have roentgenographic

manifestations of a small brain, with microcephaly, cerebral hemiatrophy with cranial asymmetry, and, occasionally, an abnormal shape of the calvarium. Intracranial calcifications may be present in some congenital proliferative diseases of the brain (e.g., tuberous sclerosis) and in intrauterine infections (e.g., toxoplasmosis and cytomegalic inclusion disease). Acute infections of the CNS, postinfectious states, and metabolic and toxic disorders (including hypocalcemia and hypoglycemia) are usually suspected from clinical and/or laboratory evidence. Cerebral neoplasms are not a common cause of seizures in the young,^{8,12} and skull roentgenography for their detection has been disappointing.¹³ Abnormal roentgenograms in slightly more than half the children with brain tumors showed mainly signs of increased intracranial pressure.¹³ In these patients there is almost always clinical evidence suggestive of intracranial hypertension and other neurologic signs. Cerebrovascular disease may be associated, although uncommonly, with plain film roentgenographic findings such as intracranial calcifications. Therefore, skull roentgenograms may be used to aid in the differential diagnosis of the cause of a nonfebrile seizure, even though they are frequently normal. Occasionally, there may be intracranial calcifications, signs of increased intracranial pressure, or bone changes such as osteomyelitis, sinusitis, and mastoiditis.

Hays and Shopfner⁴ reviewed 234 skull roentgenograms of patients referred to the radiology department of the Children's Mercy Hospital, Kansas City, Missouri, for seizures. Ten patients were ultimately shown to have doubtful seizure activity, and 16 were proved to have no seizures. These patients are especially interesting because they indicate the trend to quick referral before confirmation of the need for an examination. Thirty roentgenograms (12.8%) were abnormal. The most common abnormality found in 23 patients was microcephaly, a condition that may be determined clinically. Other findings included cerebral hemiatrophy (in a patient subsequently shown not to have seizures), premature craniosynostosis, and increased intracranial pressure—all conditions that are suspected on clinical evidence. In one patient with intracranial hypertension, a major finding was ataxia. The remaining roentgenographic changes were of no clinical significance (e.g., positional moulding and calcification of the falx). Berman and Johnson⁵ studied 130 consecutive patients who had routine skull roentgenograms as part of their seizure workup during a 12-month period at the Johns Hopkins Epilepsy Clinic, Baltimore. Those with simple

febrile convulsions, breath holding, and hysterical and fainting spells were excluded. There were nine abnormal roentgenograms (6.9%); microcephaly was indicated in three, calvarial thickening in two, and intracranial calcifications, coronal synostosis, coronal diastasis, and traumatic defect of the skull in one each. Calvarial thickening was attributed to diphenylhydantoin therapy.¹⁴ Coronal diastasis in a severely retarded child—presumably caused by chronic, repetitive trauma secondary to persistent seizure activity—was not unsuspected, but the roentgenographic finding was probably of value for management. The traumatic defect followed a depressed skull fracture, the coronal synostosis with oxycephaly was suspected clinically, and the intracranial calcification was present in a patient with clinical evidence of tuberous sclerosis.

These studies indicate a low yield of diagnostic information from skull roentgenography in young patients with epilepsy and suggest that, in most instances, abnormal findings may be anticipated on clinical grounds. Instead of routine roentgenography, selection of patients is recommended based on clinical suspicion of a specific abnormality or abnormalities. Proper selection would have resulted in roentgenographic examination of about one in 8 patients in the series of Hays and Shopfner,⁴ and one in 14 patients in the study by Berman and Johnson.⁵ A selective approach is cost-efficient, reduces radiation exposure, and will not increase professional liability if treatment results are not satisfactory.

CONCLUSION

Routine skull roentgenograms are not necessary in patients with well-documented, simple, febrile convulsions. In patients with recurrent, nonfebrile seizures, the need for roentgenographic examination should be determined after a detailed history and neurologic examination, pertinent laboratory evaluation, and electroencephalography. With the exception of perhaps unusual circumstances (e.g., posttraumatic seizures, a course suggesting a progressive neurologic syndrome, and increased intracranial pressure), skull roentgenograms are not an emergency procedure in childhood epilepsy and may be obtained whenever indicated in the course of a diagnostic workup. Focal seizures, abnormal findings on neurologic examination, persistent seizures despite anticonvulsant therapy, psychomotor epilepsy, infantile spasms, a history suggesting a deteriorating clinical condition, and suspicion of intracranial hypertension are situations in which skull roentgenography may be

informative. Children with these conditions should be given consideration on an individual basis.

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ABSTRACT

Genetic Aspects of Temperamental Differences in Infants: A Study of Same-Sexed Twins, by Anne Marie Torgersen, Ph.D, and Einer Kringlen, M.D.

A sample of 53 same-sexed twin pairs has been studied at 2 and 9 months with regard to the temperamental attributes of activity level, rhythmicity, approach/withdrawal, adaptability, intensity, threshold, mood, distractibility, and attention span/persistence. By comparing the MZ and DZ groups, we found that genetic factors play an important role in the development of temperamental characteristics. In all the temperamental variables measured, MZ twins were more similar than DZ twins, statistically significant with regard to three temperamental categories at 2 months, and significant for all temperamental variables at 9 months. *J Am Acad Child Psychiatry* 17:433, 1978.

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