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Brain Computerized Tomographic Findings in Various Epilepic Children

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Epilepsy is, in some occassions, manifested as one of the symptoms complex of central nervous system diseases, as well as systemic diseases such as metabolic disorders. In 1976, Bachman reported that 33% of epileptic patients manifested abnormal lesions in their computerized tomographic findings.

1005 epileptic children with various types of seizures have been investigated to detect the possible causes of epilepsies. 32% of the patients had abnormal brain C-T findings, of these patients, infantile spasm was the most frequently manifested abnormal C-T finding, rating 52.9%; simple partial seizure, 37.7%; complex partial seizure, 36.1% and generalized seizure, 27.1%, in order of frequency. Curable lesions, such as tumor, granuloma and arachnoid cyst were detected by brain C-T scan, and a brain tumor was detected in 2% of the patients. The brain C-T scan is one of the most effective diagnostic tools to evaluate the underlying lesions of the central nervous system of epileptic children.

Key Words: Epilepsy, brain C-T scan

Epilepsy is known as a disease of paroxysmal discharge from the brain, but epileptic seizure often appears as one of the complex symptoms of some central nervous system disorders, as well as systemic disorders, for example, tuberous sclerosis, degenerative disorder, and space occupying lesions of the brain.

Computerized tomography of the brain in epileptic children is one of the most important diagnostic methods for evaluating the condition of the structural changes of the brain.

Gastaut (1976) reported that the brain C-T scan was the most effective diagnostic tool in epilepsy, and that 10 to 60% of various epilepsies manifested abnormal findings.

Bachman *et al.* (1976) reported that the positive detection rate was 30%, while Yang *et al.* (1979) found structural changes in 33% of their series by evaluating 256 epileptic children.

Ferry (1980) mentioned that the brain C-T scan was not an indicator in investigating epileptic patients. Pater *et al.* (1984) described in his publication that the brain C-T scan should not be involved as a routine investigation, especially in generalized epilepsy, because of the low positive detection rate of abnormal findings and the fact that most of the detected abnormalities were not curable.

This study was performed to evaluate the usefulness of brain C-T scan as a diagnostic tool for various types of epilepies in children.

MATERIALS

1005 Children who had been diagnosed as epileptics at the Neurologic Clinic. Pediatric Department of Yonsei Medical Center, Seoul, Korea from Jan 1st, 1981 to Dec 31st, 1987 were enrolled in this study, to evaluate the diagnostic usefulness of the brain C-T scan in epileptic chilren. Children who had more than two episodes of the same type of seizures were included in this study but febrile seizure and newborn with seizure were excluded from this study.

METHODS

Neurologic examinations of 1005 patients were done by a pediatric neurologist. Of these 1005 patients' medical histories were reviewed and EEG and

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brain C-T scan were performfed.

If the patient manifested subnormal mental function or delayed development we measured their IQ or developmental status by the Korean WISC test or Griffith's mental development scale. Some of the patients required aminoacid assay or hormonal assay for T3, T4, TSH and other hormonal levels as well. Chromosomal studies were done on some of the patients. If the epileptic child was suspected to have any focal or systemic disorder, an investigation was performed for clinical diagnosis in addition to their epilepsy.

These 1005 epileptics were investigated and had the brain C-T scan after we obtained permission from their parents.

RESULTS

Of the 1005 epileptics who underwent neurological investigation including brain C-T scan, 605 were males and the remaining 400 were females. Children under 1 year old, excluding children under 2 months-of-age, comprised 17.7% of all subjects. The percentage of children between the ages of one and 3 years was 25.3%; 4 to 6; 18.9%; 7 to 9; 18.1%; 10 to 12; 14.1%; and 13 to 15, 5.9% (Table 1).

322 out of 1005 patients manifested abnormal brain C-T findings (32%). Abnormal C-T findings were most frequently detected in the group under 1 year of age. In the rest of the groups, the abnormal scan detection rate ranged from 23.7% to 32.2% with minimal variation (Table 2).

The clinical diagnoses of these patients with scan abnormalities were mental retardation, cerebral palsy, developmental disorders and hyperactivity, microcephaly, brain tumors, tuberous sclerosis, and congenital heart disease associated with central nervous system disorders mainly cerebral infarction, Partial agenesis of corpus callosum, cysticercosis of the brain, craniosynostosis, Sturge-Weber syndrome, Dandy-Walker malformation and arachnoid cyst (Table 3).

The relation between abnormal scan findings and types of seizures showed that infantile spasm manifested the highest detection rate of 52.9%; with subtle seizure, 46.7%; partial seizure, 35.2%; and generalized seizure, 27.1%.

In partial epilepies, simple partial seizure showed

Table 1. Age and sex distribution of children with epileptic seizure

Age (years)	Sex		Total (%)
	Male	Female	
< 1	116	62	178 (17.7)
1– 3	152	102	254 (25.3)
4– 6	100	90	190 (18.9)
7– 9	119	63	182 (18.1)
10–12	87	55	142 (14.1)
13–15	31	28	59 (5.9)
Total	605	400	1005 (100.0)

Table 2. Relation between brain C-T finding and age of the patient

Age (years)	Total No. of Cases	No. of Abnormal C-T Findings	%
< 1	178	88	49.4
1– 3	254	71	28.0
4– 6	190	45	23.7
7– 9	182	54	29.7
10–12	142	45	31.7
13–15	59	19	32.2
Total	1005	322	32.0

Table 3. Relation between clinical diagnosis associted with epilepsy and brain C-T findings

Clinical Diagnosis	No. of Normal C-T Findings	No. of Abnormal C-T Findings	Total
Mental retardation	94	76	170
Cerebral palsy	30	56	86
Hyperactivity & development disorder	68	14	82
Microcephaly	12	15	27
Tumor	–	22	22
Tuberous sclerosis	–	18	18
Arachnoid cyst	–	16	16
Porencephaly	–	9	9
CHD* associated	–	9	9
Partial agenesis of corpus callosum	–	7	7
Craniosynostosis	–	3	3
Cysticercosis of central nervous system	–	2	2
Struge-Weber syndrome	–	1	1
Dandy-Walker cyst	–	1	1

*CHD: Congenital heart disease

abnormal scan in 37.7% of cases, complex partial seizure, 36.1%; and secondary generalized epilepsy, 33.5%. In generalized epilepises, 7 petit mal children had normal scans, while 15% with atypical absence manifested abnormal scans; in patients with myoclonic seizure, abnormal scans were detected in 36.9%, and in atonic-akinetic seizure, 20.5%. Patients with generalized tonic clonic seizures showed abnormal scan in 26.1% of cases; generalized tonic seizure, showed in 23.6%; and generalized clonic seizure, 37.5%. Unclassified epilepsy showed abnormal scans in 26.3% (Table 4).

The most common abnormal scan findings in these patients were cortical atrophy, hydrocephalus, granulomas, ischemia, subdural hygroma, cerebromalacia, calcification, brain tumors, arachnoid cyst, porencephaly, partial agenesis of corpus callosum, intracranial hemorrhage, and Dandy-Walker malformation, in order of frequency (Table 5).

The relation between neurologic signs and positive scan findings showed that children with focal neurological abnormalities commonly showed posi-

Table 4. Relation between number of positive C-T finding and types of epilepsy

Seizure Type	Total No. of Cases	No. of Abnormal C-T Findings (%)	%
Partial seizure	420	148	35.2
Simple	122	46 (37.7)	
Complex	83	30 (36.1)	
Secondary generalized	215	72 (33.5)	
Generalized seizure	439	119	27.1
Tonic-Clonic	207	54 (26.1)	
Tonic	55	13 (23.6)	
Clonic	8	3 (37.5)	
Myoclonic	103	38 (36.9)	
Atonic-Akinetic	39	8 (20.5)	
Atypical absence	20	3 (15.0)	
Typical absence	7	0 (0.0)	
Unclassified seizure	80	21	26.3
Infantile spasm	51	27	52.9
Subtle seizure	15	7	46.7
Total	1005	322	32.0

Table 6. Positive brain C-T finding according to neurologic signs

Neurologic signs C-T	Normal	Diffusely abnormal	Locally abnormal	Total
Normal	461	23	21	505
Diffusely abnorma	112	71	32	215
Locally abnormal	110	35	140	285
Total	683	129	193	1005

Table 5. Brain lesion detected by brain C-T scan in different types of epilepsy

Brain Lesion	Subtle seizure	Infantile spasm	Partial			Generalized							Unclassified	Total
			Simple	Complex	2nd G.*	Tonic Clonic	Tonic	Clonic	Myoclonic	Typical absence	Atypical absence	Atonic Akinetic		
Cortical atrophy	2	18	7	4	12	17	6	2	17	–	1	1	5	92
Hydrocephalus	2	4	5	12	9	10	4	1	9	–	1	–	4	61
Granuloma	–	–	18	9	20	1	–	–	1	–	–	–	5	54
Ischemia	3	1	6	5	7	9	1	–	5	–	–	–	3	41
Subdural hygroma	–	6	3	2	4	5	5	–	3	–	1	–	–	29
Cerebromalacia	3	1	4	5	–	4	2	–	1	–	–	2	2	24
Calcification	–	2	3	1	1	4	1	–	7	–	1	1	3	24
Tumor	–	–	–	1	15	6	–	–	–	–	–	–	–	22
Arachnoid cyst	–	1	4	–	2	5	–	–	–	–	1	1	1	16
Porencephaly	–	–	1	1	2	2	–	–	–	–	1	2	–	9
Partial ACC**	–	1	–	–	3	1	–	–	–	–	–	1	1	7
Hemorrhage	–	–	1	1	1	1	1	–	–	–	–	–	–	5
Dandy-Walker cyst	–	–	–	–	1	–	–	–	–	–	–	–	–	1

* 2nd G.: secondary generalized

** ACC: Agenesis corpus callosum

Table 7. Positive brain C-T finding according to EEG

EEG \ C-T	Normal	Diffusely abnormal	Locally abnormal	Total
Normal	49	6	9	64
Diffusely abnormal	192	60	36	288
Locally abnormal	442	63	148	653
Total	683	129	193	1005

tive scan findings (Table 6).

The relation between EEG findings and positive scans showed that focal abnormal EEG findings manifested a high frequency of positive scan detection rates (Table 7).

The curable lesions in these patients were 22 cases which were brain tumor, some cases of granulomatous lesions, and a few cases of arachnoid cysts.

DISCUSSION

Brain C-T scan is known as a superior investigative method for evaluating the cause of epilepsy (Holmes, Gastaut, Bachman, Zimmerman) as it clearly shows the pathologic conditin of the brain. There is considerable debate in literature as to whether all patients with epilepsy requires C-T scan, even though it has been reported that quite a large number of epileptic patients had pathologic lesions in their brain.

Gastaut and Gastaut (1976) reported in 1976 that 50% of epileptics had abnormal scans. Bogdanoff *et al.* (1975) reported 35.3%; Baucer *et al.* (1980), 54%; Bachman *et al.* (1976), 30%; McGohn *et al.* (1979), 40%; Yang *et al.* (1979), 33% and Patel *et al.* 24%. This investigation also revealed a positive scan rate in 32% which is quite similar to the results of many previous reports.

Correlation between clinical types of seizure and abnormal scans reveals that simple partial epilepsy is known to be the most common type of epilepsy. In Yang's series (1979) 50% of patients with simple partial epilepsy and 30% with generalized epilepsy revealed abnormal scan findings. Bachman *et al.* . (1976) reported abnormal scan findings in 43% with simple partial epilepsy, 27% with psychomotor epilepsy, and 32% with generalized epilepsy.

Recently, Patel *et al.* (1984) reported that an abnormal scan showed in 24.3% of the cases in his study of childhood partial epilepsy. Gastaut and Gastaut (1976) reported abnormal scan findings in 63% of patients with partial epilepsy 61% with secondary generalized epilepsy, and 10% with primary generalized epilepsy. In their study, simple partial epilepsy was the most common type of epilepsy, showing abnormal scans in 70% of cases and in 22% of complex partial epilepsy cases. From the above reports, it is well known that simple partial epilepsy manifests abnormal scans most often and primary generalized epilepsy shows the least abnormal scans. The abnormal scan related to EEG, the focal slow wave yields the most common abnormal scan. Baucer *et al.* (1980) mentioned that epilepsy, having persistent slow waves in EEG, showed abnormal scans in 52% of his seizure patients. Scollo-Lavizzari (1977) demonstrated that continuous delta waves were more frequently accompanied by abnormal scans than theta or focal spike waves. In our series, infantile spasm most frequently showed a positive scan in 52.9% of cases, and second was subtle seizure with 46.7%. Simple partial seizure showed scan in 37.7% as the third; generalized clonic seizure, 37.5%; and myoclonic seizure, 36.5%, in order of frequency. Even in generalized epilepsy, a positive scan was detected in 27.1% of the cases.

Abnormal neurologic examinatins, especially focal neurologic signs, yield abnormal scans more often (Brucer *et al.* 1980). Yang *et al.* (1979) reported in their study which analyzed 256 patients that children with focal neurologic abnormalities in physical examination more often revealed focal changes in their scan, representing 64%. Yang *et al.* (1979) mentioned in their paper that the conditions corelated with abnormal scan were partial epilepsy, especially simple partial epilepsy, abnormal neurologic finding, focal slowing in EEG and epilepsy starting from the neonatal period. Analysis of the relationship between a positive scan and EEG and focal neurologic abnormalities yielded positive scan rates more frequently.

Ferry (1980) mentioned in his paper in 1980, that focal slowing in a brain C-T scan should not be recommended for use in the screening of children with epilepsy.

Patel *et al.* (1984) suggested that a brain C-T scan should not be a routine study in children with generalized epilepsy. This is because abnormal scans are detected in less than 10% of patients, and even if an abnormal scan is noted, most of the lesions are not curable.

The curable lesions commonly detected in epileptic children are brain tumors, some arachnoid cysts, and arteriovenous malformation.

Gastaut and Gastaut (1976) reported brain tumors in 8% of the patients in his study, and Von Gall as well as Mosely reported 10%. McGohn *et al.* (1979) reported 6 cases of brain tumors in 150 cases and Bachman *et al.* (1976) detected 2 cases in 98 cases of child epilepsy. Curable lesions such as brain tumors were detected in 2.18% of the patients in our study. Some cases of arachnoid cyst were also surgically curable.

This study shows that brain C-T scan is one of the important tools for diagnosis and should be done in some forms of epilepsy such as infantile spasm, subtle seizure and partial epilepsy as well as generalized epilepsy. If the epilepsy has manifested focal neurologic signs, mental retardation or delayed development, a positive scan may be detected more frequently.

SUMMARY

1. Brain C-T scan was performed in 1005 epileptic children as one of the diagnostic methods, and 32% showed abnormal findings.
2. Infantile spasm showed the most frequent abnormal scan at 52.9%, subtle seizure 46.7%, simple partial epilepsy 37.7%, and myoclonic epilepsy 37.5%, in order of frequency.
3. In partial epilepsy, the positive scan detection rate was 35.2%, simple partial epilepsy, 37.7%; complex partial epilepsy, 36.1%; and secondary generalized epilepsy, 33.5%; which is higher than that of generalized epilepsy.
4. In generalized epilepsy, abnormal scans were observed in 27.1% in generalized tonic, 23.6%; in generalized clonic, 37.5%; in myoclonic, 37.5%; in atonic-akinetic, 20.5%; in atypical absence, 15%; and no abnormal scans were observed in typical absence.
5. Brain tumor was detected in 2.18% of patients.
6. Positive scans are commonly detected in seizures starting at a young age group, in epileptic patients with focal neurologic sings, as well as focal EEG abnormality.
7. The curable lesions detected were brain tumors, some granulomas, and arachnoid cysts.
8. Brain C-T scan is one of the most effective diagnostic methods used in epileptic children to identify structural abnormalities of the brain and to ensure that the abnormality does not progress, but it would be better to perform a C-T scan in case by case basis rather than as a routine diagnostic procedure.

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