

Computerized Tomography in Epilepsy

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INTRODUCTION

In 1973, the technique of computerized tomography (CT scan) was introduced by Ambrose¹⁾ into the field of clinical neuroradiology. With this as a turning point, an epoch-making improvement has been made in the ability to diagnose or prognose intracranial organic diseases, which have been affected by complications of one kind or another.

Availability of CT scan has made possible the pathoanatomical study of the central nervous system in the living body, thus giving rise to the possibility that developments in clinical epileptology will reach new dimensions. Reports on the findings of CT scan in epileptic patients have been made one after another²⁻⁴⁾ since the report of Gastaut et al.⁵⁾

It has become clear that the focus present in the so-called "silent area" of the brain can be grasped in three dimensions by an overall examination with EEG, expressions of physiological function of the central nervous system, and findings of CT scan.

We have made studies on the relationship between the findings of CT scan performed on epileptic patients and clinical pictures, the results of which are reported here.

SUBJECT

The CT scan was performed on 61 patients (38 males and 23 females) among those who were diagnosed as epileptics at our clinic over the period of a year from November, 1976. The age composition of the patients at the time the CT scans were being performed was 7 to 66 years, averaging 26.8 years. The age of onset of epilepsy was from five months after birth to 55 years, averaging 17.0 years.

According to the "Clinical and Electroencephalographical Classification of Epileptic Seizures" by the International League Against Epilepsy (ILAE), the type of seizures were broken down into "nonclassifiable epilepsy" - 7 patients, "generalized" in "classifiable epilepsy" - 14

Table 1. Classification of Epileptics (ILAE)

Classification	No. of patients
Nonclassifiable epilepsies	7
Classifiable epilepsies	54
Generalized	14
Primary	7
Secondary	7
Partial	40
Elementary symptomatology	10
Complex symptomatology	23
Secondary generalized seizures	7
Total	61

patients ("primary"; 7, "secondary"; 7), and "partial" - 40 patients (Table 1).

RESULT

Thirty two (52.5%) of the 61 patients showed abnormalities in the findings of CT scan. As abnormal findings, diffuse and/or focal atrophy of cerebral parenchyma were found in many cases. In addition to these, there were porencephaly, intracranial tumor, focal low density area, calcification and others (Table 2). Of the cases that showed two abnormalities at the same time, mention can be made of diffuse cerebral atrophy and calcification or Verga's cavity (1 case each), and cerebral hemiatrophy and calcification (1 case). Of the four cases with intracranial tumor, two cases were meningioma and the other two astrocytoma; they operated on at our medical center. These cases belonged to the late-onset epilepsy group, about which a report was already rendered (Yamada et al.⁶⁾).

The relationship between abnormal CT scan and the type of epilepsy is as follows:

Abnormal CT scan was found in 23 (57.5%) of the 40 cases of partial epilepsy and 3 (21.4%) of the 14 cases of generalized epilepsy. That is, it was found that abnormal CT scan was seen in more than half of the patients with partial epilepsy. It is also clear that abnormal CT scan was found more often in cases presenting elementary symptomatology (90.0%) compared with those showing complex symptomatology (43.5%) among cases of partial epilepsy (Table 3).

Of the cases showing good suppression of seizures following adminis-

Table 2. Results of CT scans

CT scan findings	No. of patients
Abnormal CT scans	32
Atrophy, diffuse	12*
Atrophy, focal	5
Tumor	4
Porencephaly	4
Focal low density area	3
Calcification	3*
Verga's cavity	2*
Cerebral hemiatrophy	1*
Hydrocephalus	1
Tumor suspected	1
Normal CT scans	29
Total	61

*Case showing two findings simultaneously was counted separately under the section for each finding concerned (see text)

Table 3. Frequency of abnormal CT scan by the types of seizures

Classification	No. of patients with abnormal CT scan (%)	Total
Nonclassifiable epilepsies	6 (85.7)	7
Classifiable epilepsies	26 (48.1)	54
Generalized	3 (21.4)	14
Primary	0 (0.0)	7
Secondary	3 (42.9)	7
Parietal	23 (57.5)	40
Elementary symptomatology	9 (90.0)	10
Complex symptomatology	10 (43.5)	23
Secondary generalized seizures	4 (57.1)	7
Total	32 (52.5)	61

tration of anticonvulsants, 13 (43.3%) out of 32 cases exhibited abnormalities in the CT scan, while 13 (61.9%) of the 21 cases which showed poor suppression of seizures exhibited abnormalities in the CT scan (Table 4). Worthy of note here is the fact that 10 (52.6%) of the 19 partial epileptics had seizures suppressed satisfactorily by anticonvulsants despite their showing abnormalities in CT scan.

Table 4. Degree of seizures suppressed with anticonvulsants, and CT scan findings in generalized epileptics

Degree of seizures suppressed	No. of patients with		Total
	Normal CT	Abnormal CT(%)	
Good	17	13(43.3)	40
poor	8	13(61.9)	21
Uncertain	4	6(60.0)	10
Total	29	32(52.5)	61

Table 5. Interictal neuropsychiatric symptoms and CT scan findings

Interictal symptoms	No. of patients with		Total
	Normal CT	Abnormal CT	
With and symptoms	10	24	34
Mental retardation	7	8	15*
Dementia	1	2	3*
Social maladjustment	8	16	34*
Characteristic disorders	5	16	21*
Hemiparesis	0	3	3*
Hemianopsia	0	1	1*
Disturbance of consciousness	1	5	6*
With no symptoms	19	8	27
Total	29	32	61

*Case showing two or more symptoms was counted separately under the section for each symptom concerned

Table 6. Clinical history and CT findings

Past history	No. of Patients with		Total
	Normal CT	Abnormal CT (%)	
Relevant antecedent history	9	12(57.1)	21
Perinatal trauma or anoxia	3	6(66.7)	9
Infection of CNS	2	3(60.0)	5
Head injury	4	3(42.9)	7
No history	20	20(50.0)	40
Total	29	32(52.2)	61

Abnormal findings of CT scan were often found in cases in which the disease developed before three years of age and in cases where the onset of disease occurred after 21 years of age (so-called late-onset epilepsy). Three cases in which the onset of epilepsy occurred before three years of age and which showed abnormal CT findings were all secondary generalized epileptics. In all of the four cases in which intracranial tumor was discovered, the disease developed after 21 years of age, that is, sometime between 28 years and 36 years of age. Of them two cases had partial epilepsy and presented elementary symptomatology, one case had partial epilepsy that was secondary generalized and one case had unclassifiable epilepsy. In cases which showed neuropsychiatric symptoms in the interictal period, abnormal findings in CT scan were found in 24 (70.6%) of the 34 cases, while in the group which showed no symptoms in the interictal period, abnormal findings in CT scan were found in 8 (29.4%) of the 27 cases (Table 5).

Concerning the contribution of past history to epilepsy, mention can be made of perinatal trauma or anoxia, encephalitis, head injury and others. Twelve (57.1%) of the 21 cases with such a history showed corresponding findings in the CT scan. Meanwhile, 20 (50.0%) of the 40 cases with no clear past history showed findings in the CT scan (Table 6).

Results of the examination on the agreement between those who showed the "focus" finding on EEG and findings of CT scan were as follows. Abnormal findings were found in CT scan in the areas consistent with EEG findings in 14 (31.8%) of the 44 cases which showed "focus" on EEG. Conversely, "focus" on EEG consistent with the findings in CT scan were found in 14 (58.3%) of the 24 cases which clearly showed local abnormal findings in CT scan.

DISCUSSION

When CT scan is performed on epileptic patients, the number of abnormal findings found, though varying more or less with the reports, is said to be 34%²⁾ to 51%⁵⁾. According to our results, it was 52.5%, a little higher than the values hitherto reported.

The incidence of brain tumor in epileptic patients is reported to be 8-11%^{3-5,7)}. According to our results, brain tumor was found in 4 (6.6%) of the 61 cases. In weighting this figure, however, it should be taken into consideration that many patients with a relatively long history of epilepsy were included in the cases subjected to CT scan (Yamada et al.⁸⁾). According to Mosely et al.⁷⁾, the longer the history of epilepsy is,

the less the incidence of brain tumor. Furthermore, they pointed out that tumor is found often in the age group of 30-60 years.

As for the result that abnormal findings in CT scan were frequent in patients with partial epilepsy, and less frequent in generalized epileptics, this was consistent with the assertion by Gastaut et al.⁵⁾. Also, abnormal findings were often found in the patients with partial epilepsy showing elementary symptomatology; this is in agreement with the report of Scollo-Lavizzari et al.⁹⁾. Abnormal findings of CT scan were of a higher incidence in the group in which suppression of attacks by antiepileptics was unsuccessful than in the group in which attacks were controlled satisfactorily. However, it should be pointed out that abnormal findings were found in many of the patients in whom attacks were controlled satisfactorily, so far as partial epilepsy was concerned. Abnormal findings in CT scan were often found in cases where the onset of disease was before three years of age and in cases where the disease developed after 20 years of age (late-onset epilepsy).

Many of those showing abnormality in CT scan are among those who show neuropsychiatric symptoms in one form or another during the interictal period. This naturally points to the possibility that more extensive organic impairment exists in the central nervous system, and these cases can indicate a need for further study by CT scan⁹⁾.

The correlation of past diseases as a possible cause of epilepsy with the abnormal findings in CT scan was not too convincing. The correlation between findings in EEG and findings in CT scan was not convincingly high. There are a few findings which can easily be interpreted as a change in the tissue density, depending on the site and size or properties of the lesions in the brain. Naturally, there may be a limit to the performance of CT scan, and the question of technique in CT scan plays a part in this. Refining the technique will contribute to the improvement in accuracy of detecting findings.

Examinations by a combination of EEG and CT scans is useful in making more accurate diagnoses of epilepsy. Clarification of morphological changes in the brain by CT scan can help to make more precise judgements on the prognosis, which could be reflected in the therapeutic planning. It should be stressed that CT scan will prove to be indispensable in the future because of the small danger it presents to the living body. Pathoanatomical studies of the brain by CT scan and studies of the central nervous system by EEG will go a long way toward the progress of clinical epileptology.

SUMMARY

EEG examination and cranial CT scan were performed almost at the same time on 61 epileptics age 7 to 66 years. In CT scan, abnormal findings in one form or another were found in 32 out of the 61 patients. In three cases, two or more findings such as cerebral atrophy and calcification were shown at the same time. Intracranial tumor was discovered in four cases with late-onset epilepsy. The rate of abnormal findings in CT scan being found was high in partial epileptics, particularly in cases exhibiting elementary seizures. Abnormal CT findings were found very frequently even in the group in which seizures were suppressed by anticonvulsants. Cases showing abnormal CT scan findings were numerous among patients with late-onset epilepsy, thus attesting to the usefulness of CT scan for this group. Correlation between abnormality in EEG and abnormal findings in CT scan was not too high, but the technique in performing the CT scan and the performance of the scanner should be taken into consideration with this result. It was stressed that examination of epileptics by a combination of EEG and CT scan is very useful.

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