HOW USEFUL IS THE CAT SCAN FOR INVESTIGATING EPILEPSY?

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INTRODUCTION

Prior to the advent of computerized axial tomography, patients with epilepsy in whom an anatomic diagnosis was required were often subjected to invasive procedures such as cranial arteriography or pneumoencephalography with their attendant morbidity and cost. When used, the less invasive procedure of radioisotopic brain scan was often not very informative. Routine investigations such as plain skull radiography, examination of the cerebrospinal fluid, and even scalp electroencephalography were relatively insensitive for detection of pathology.

Following its introduction and subsequent wide application in the past decade, computed tomography has been increasingly used for the clinical evaluation of epileptic patients. The advantages were obvious. The procedure is non-invasive if contrast enhancement is not employed. Consequently, there is little or no morbidity. It is less costly and inconvenient for the patient when compared to arteriography, and its images are excellent, and clearly superior to nuclear brain scans.

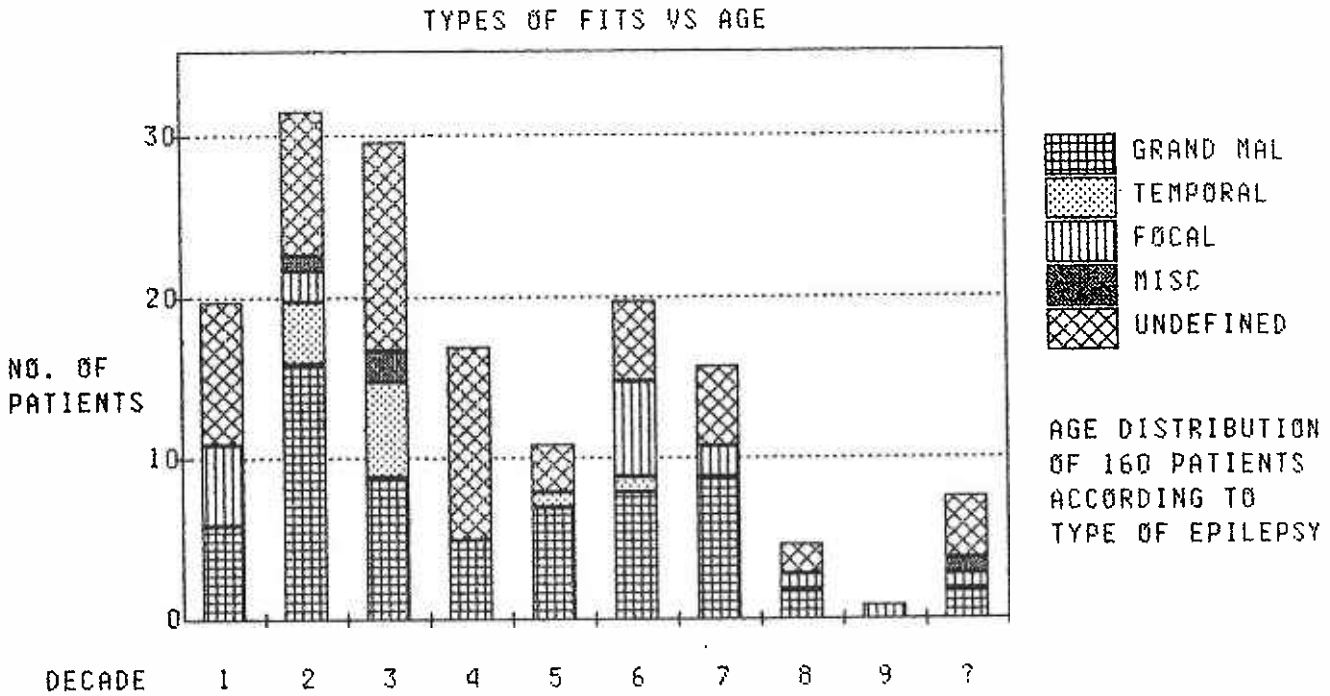
Despite its popularity, there have been relatively few studies evaluating the efficacy of computed tomographic head scanning for investigating epilepsy. To address this problem we conducted a study to analyze the sensitivity of computed tomography for detecting intracranial structural disease related to the seizures. More important, we sought to learn if the information obtained from tomography was clinically useful for influencing management. At the same time, we wanted to compare it with the more basic and established electroencephalographic examination.

MATERIALS AND METHODS

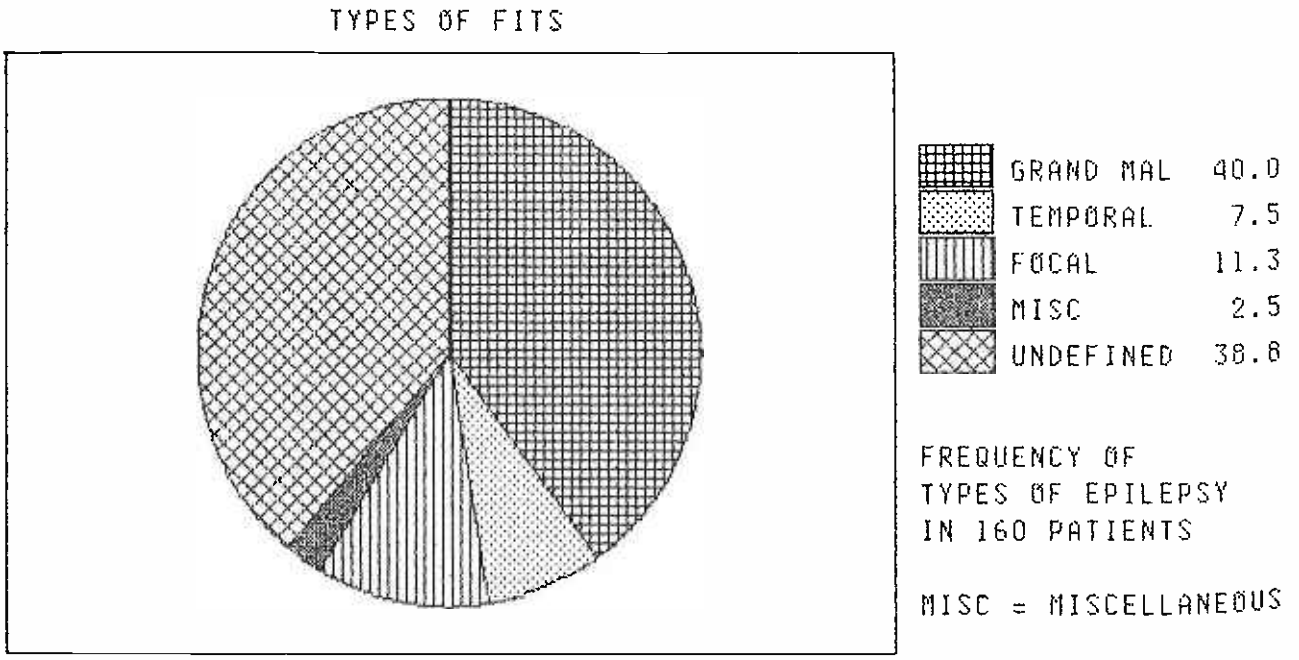
Between February and August 1983, 160 consecutive patients with epilepsy underwent computerized axial tomographic (CAT) head scanning at the Department of Radiology, Tan Tock Seng Hospital, Singapore. All scans were interpreted by trained radiologists. From the CAT scan request forms and reports, we obtained clinical, laboratory, and scan information which were then analyzed.

RESULTS

The ages of the patients ranged from 1 to 82 years. Figure 1 shows the age distribution of the patients in decade intervals. There is a bimodal distribution with peaks in the second and sixth decades. In addition, within each decade column, the patients are stacked in groups according to type of epilepsy. Grand mal and clinically undefined epilepsy each formed about two-fifths of the total. The remaining one-fifth of the patients had focal (11.3%), temporal (7.5%), and miscellaneous (2.5%) seizures. The last group included epileptics with petit mal and myoclonus.



AGE DISTRIBUTION OF 160 PATIENTS ACCORDING TO TYPE OF EPILEPSY

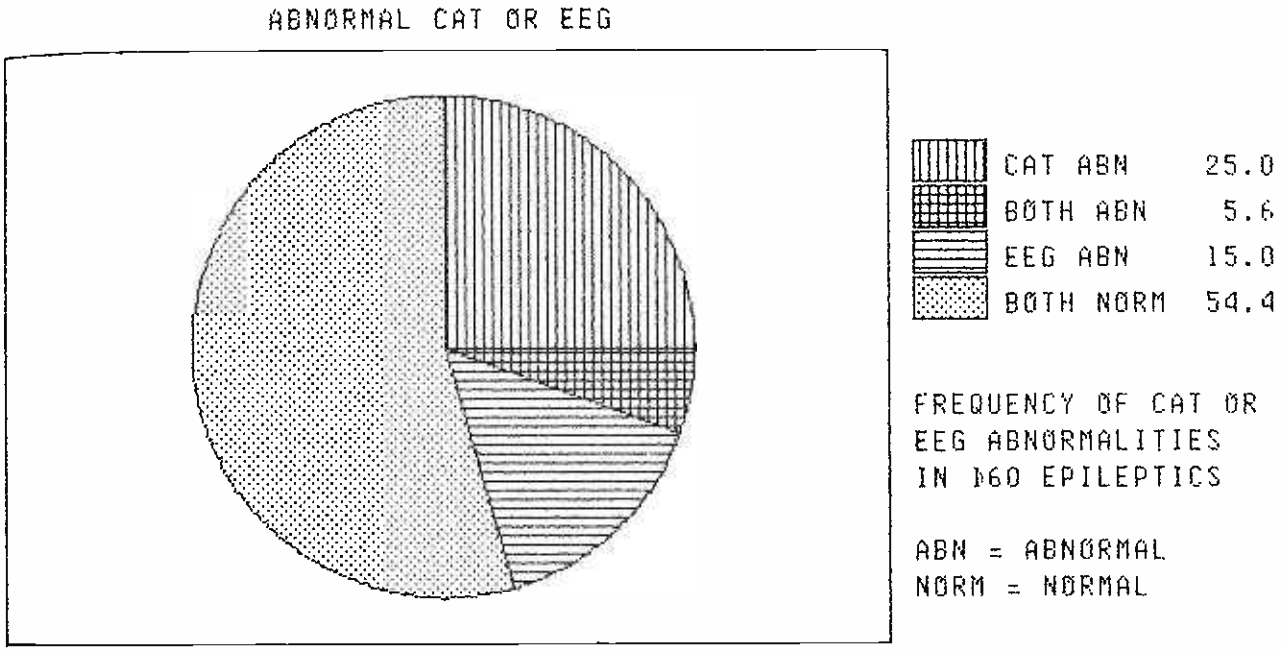


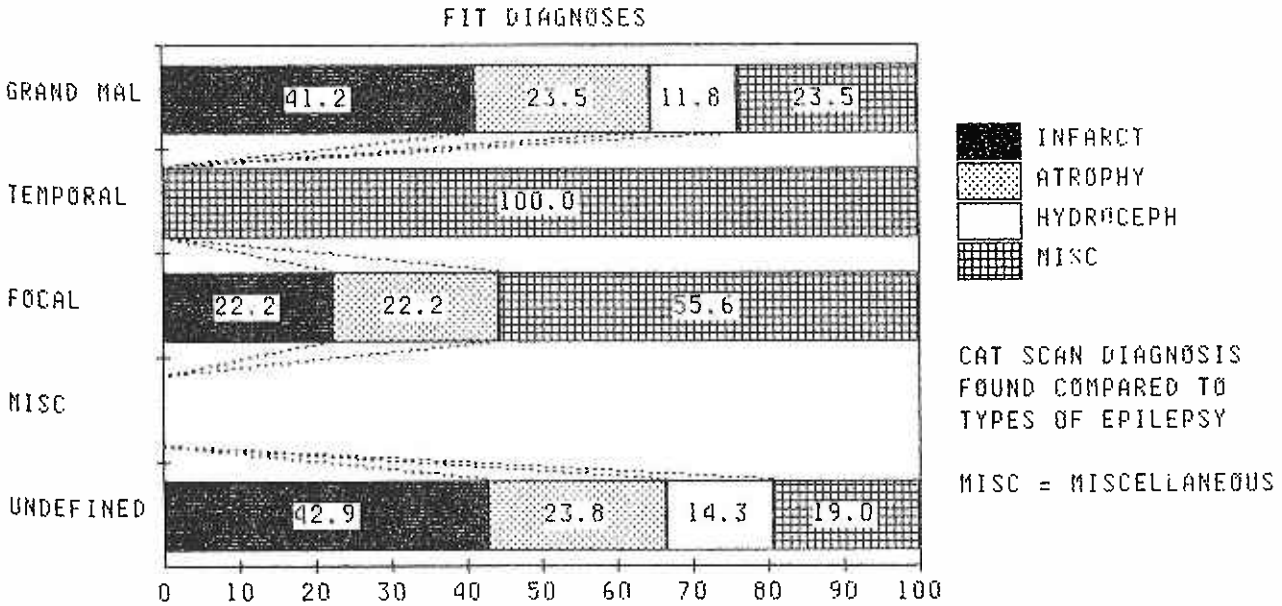
FREQUENCY OF TYPES OF EPILEPSY IN 160 PATIENTS

MISC = MISCELLANEOUS

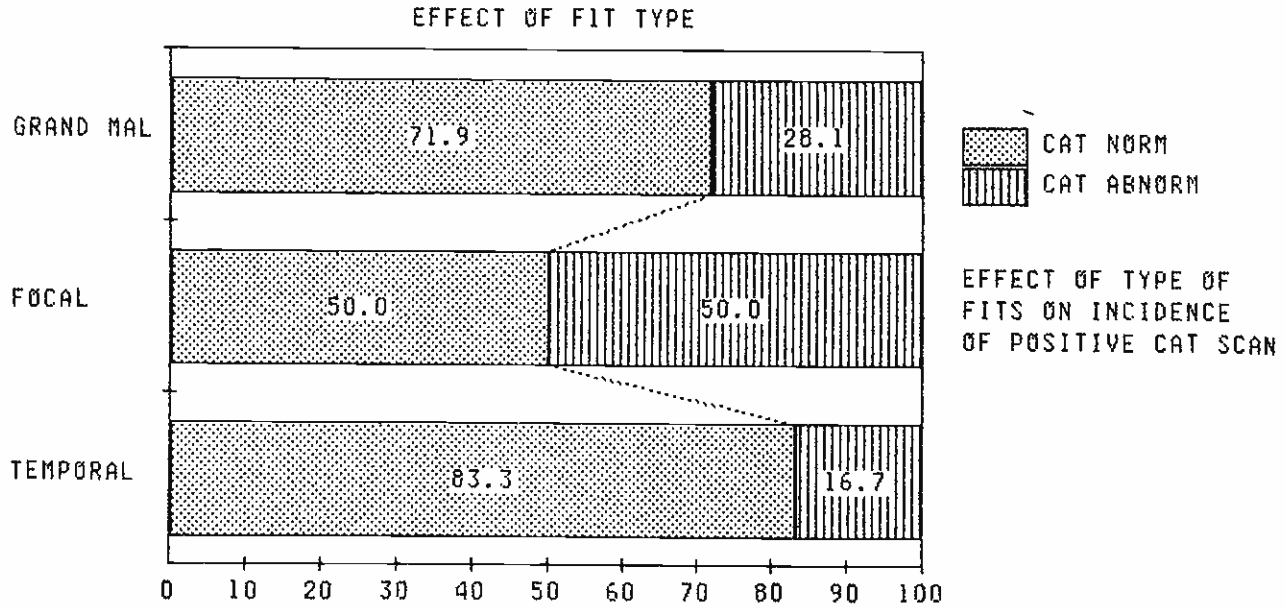
Figure 3 illustrates the frequency of abnormal CAT scans, abnormal scalp electroencephalograms (EEG), or both, in the study population. 25% had only CAT scan abnormalities while 15% had only EEG abnormalities. Combined CAT scan and EEG abnormalities were present in a further 5.6% (9 patients). However, only 3 of the 9 patients in this group showed anatomic correlation between CAT scan and EEG localization. Both CAT scan and EEG were normal in 54.4% of the patients.

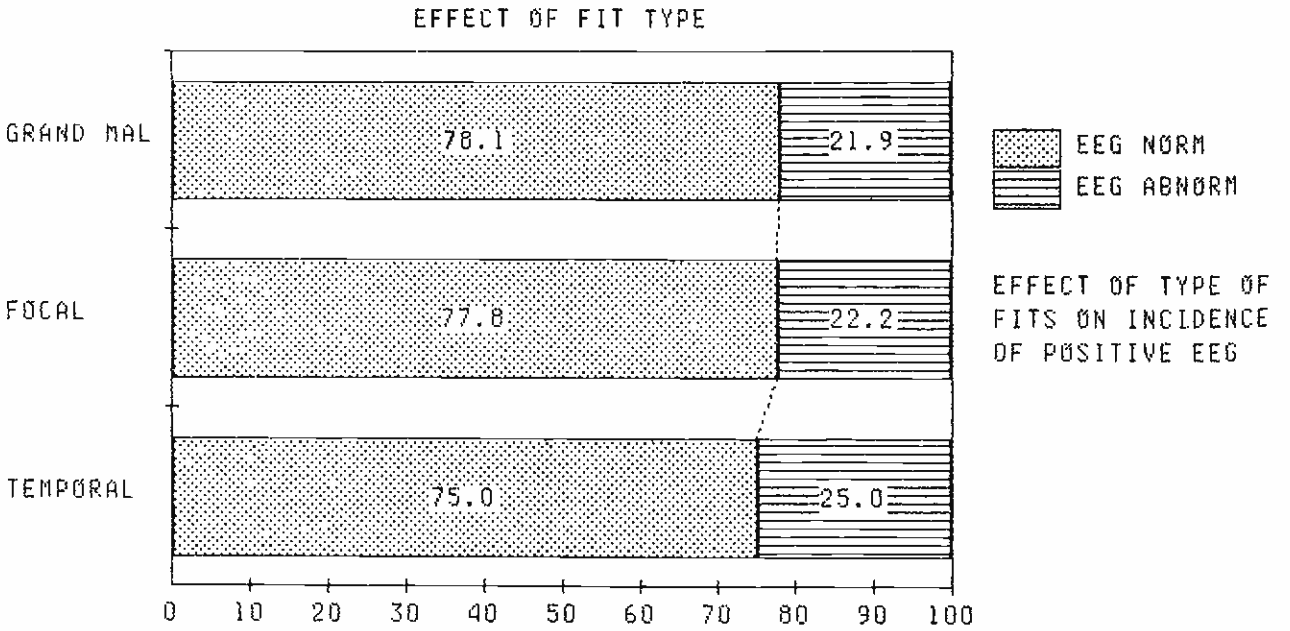
For the 49 patients with CAT scan abnormalities, Figure 4 depicts the incidence of various CAT scan diagnoses in the different groups of epilepsy. Infarction (18 patients), atrophy (11 patients), and hydrocephalus (5 patients) were the commonest diagnoses. Other abnormalities grouped as "miscellaneous" included neoplasms, sequelae of trauma and surgery, and marked calcification. The pattern of abnormalities in grand mal and undefined epilepsy appear similar suggesting that the group with undefined seizuers were largely patients with undiagnosed grand mal. Although miscellaneous abnormalities appear to constitute a large proportion of those with temporal and focal epilepsy, the absolute numbers are too small for meaningful analysis.



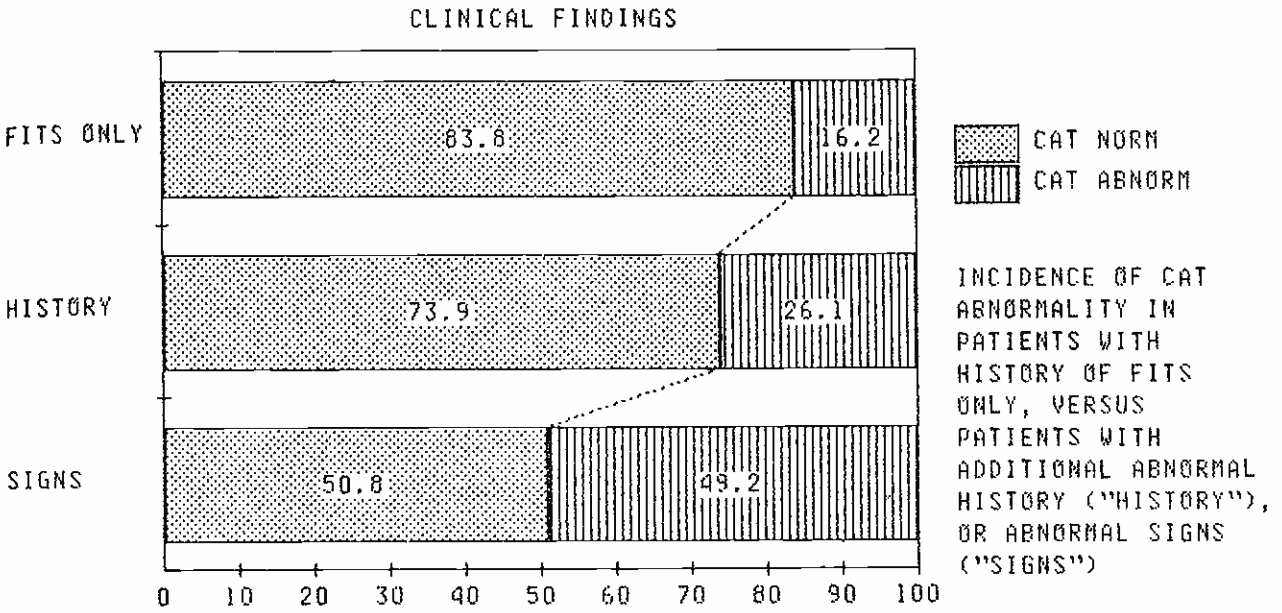


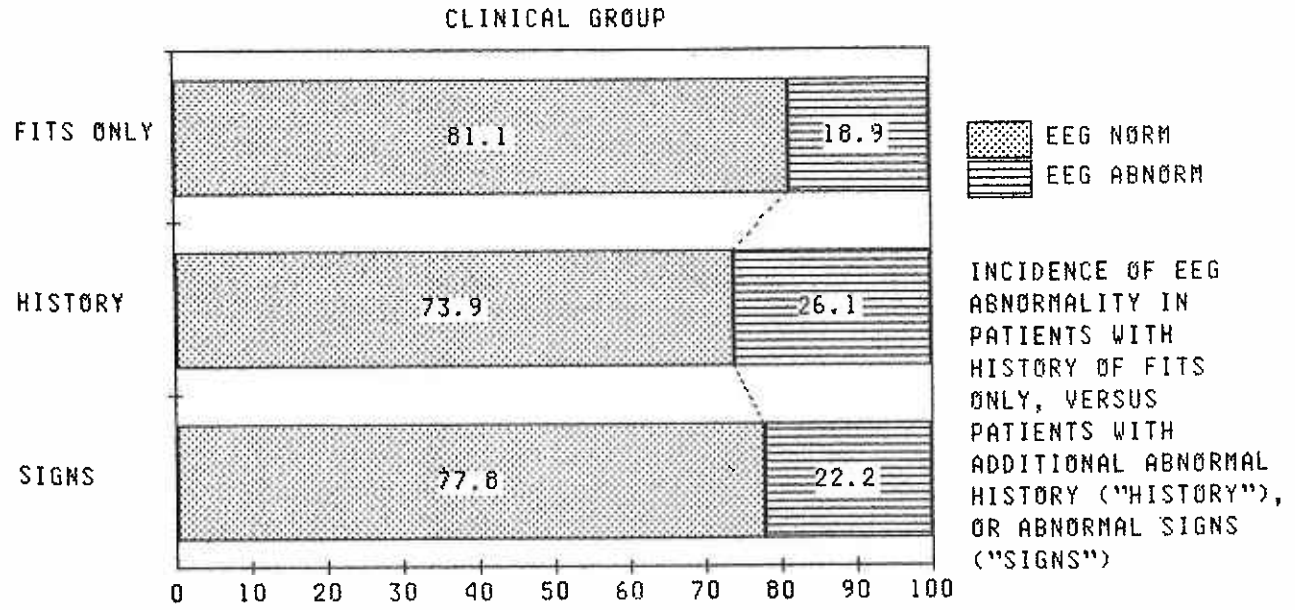
The pickup rates of abnormal CAT scans and EEGs in the different groups of epilepsy are shown in Figures 5A and 5B respectively. Although a trend towards a higher pickup rate of abnormal CAT scans in focal epilepsy compared to grand mal is apparent in Figure 5A, the difference is not statistically significant (p between 0.05 and 0.10). The number of patients with temporal epilepsy and abnormal CAT scans is too small for statistical comparison. It is clear from Figure 5B that there are no significant differences in the EEG pickup rate.





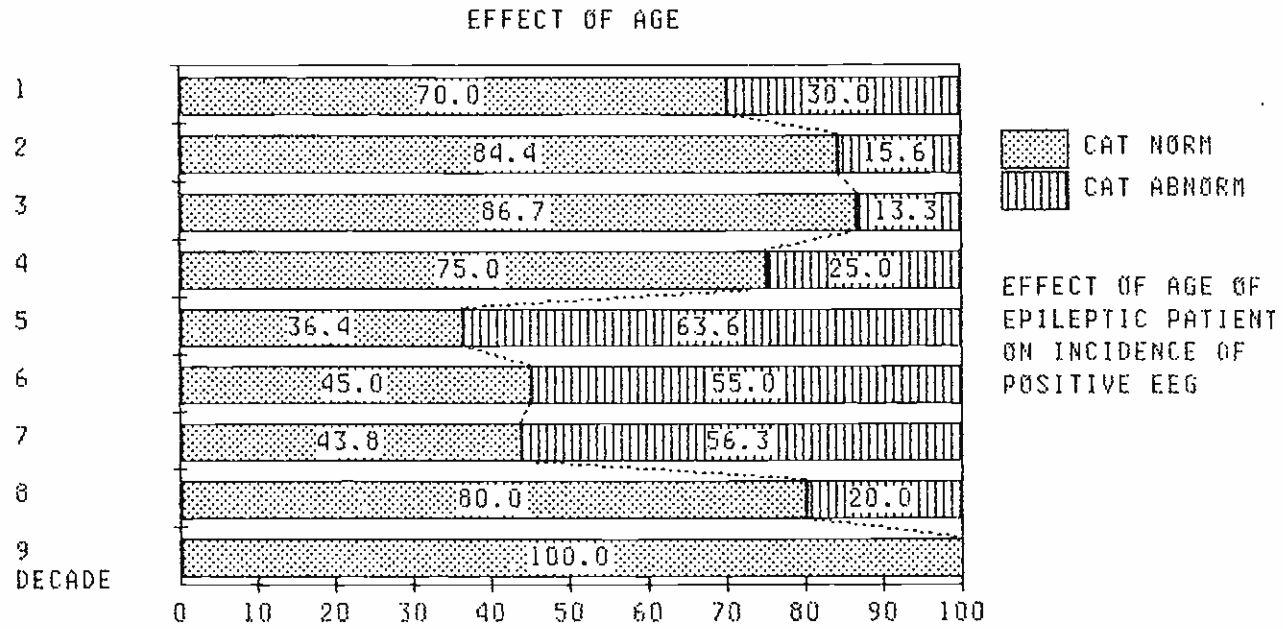
In Figure 6A and 6B, the pickup rates of abnormal CAT scans and EEGs are compared between patients divided into 3 clinical groups: those with only a history of fits; those with additional abnormal history such as paresthesia, mental retardation, and behaviour change; and those with abnormal clinical signs such as hemiparalysis, papilledema, and hyperreflexia. The pickup rate of abnormal CAT scans (Figure 6A) is significantly higher in those with abnormal signs compared to those with fits only (p less than 0.001), and those with additional abnormal history (p less than 0.05). The difference between those with additional abnormal history and those with fits alone is not statistically significant. There are no significant differences in the EEG pickup rate (Figure 6B).

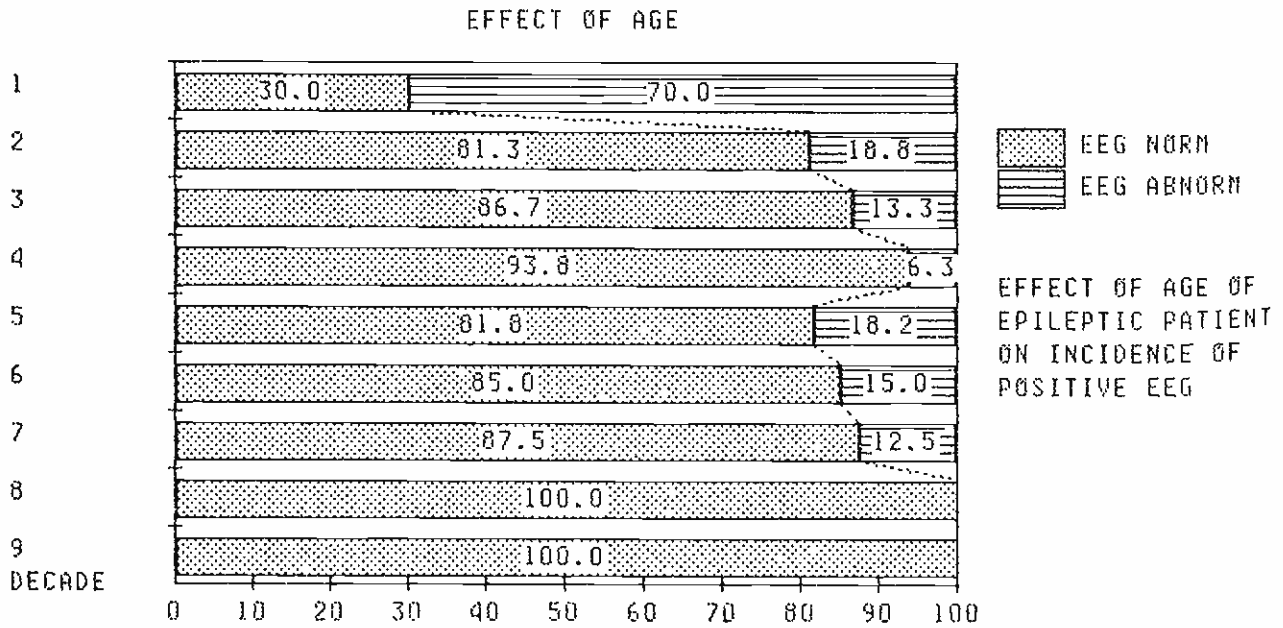




Figures 7A and 7B correlate abnormal CAT scan and EEG pickup rates respectively to the age of the patients classified in decades. In Figure 7A, it is evident that the CAT pickup rate increases noticeably after the fourth decade. There were very few patients in the eighth and ninth decades with resultant distortion of the trend. Comparing the pickup rate for patients below 40 years old (19.4%) with those aged 40 years or more (52.8%), the difference is highly significant (p less than 0.001). By contrast, the pickup rate for abnormal EEG is higher in the young being 70.0% in the first decade, and 15.9% for those older. This difference is also highly significant (p less than 0.001).

Finally, contrast enhancement was utilized in 31 of the 160 CAT scan studies whenever the presence of abnormality was suspected. In 25 of these, an abnormality was excluded; in the others, an abnormal finding was confirmed.





DISCUSSION

In an early study of the subject, Bogdanoff et al in 1975 reported abnormal CAT findings in 35.5% of 50 consecutive non-hospitalized patients referred because of focal seizures diagnosed clinically, if the fits showed focal characteristics, or with EEG , if a focal abnormality was demonstrated. (1) All their patients had at least one abnormal EEG. In the following year, Bachman and his colleagues reported that structural abnormalities on CAT scanning were identified in 28.6% of 98 children with chronic seizure disorders. (2) More recently, Gilsanz et al found CAT abnormalities in 37.8% of 169 children with seizures and a history of abnormal neurological findings. (3) In contrast, only 6 (3.6%) of another 169 children with seizures but normal general andneurological examinations had abnormal CAT scans. Our study of 160 children and adults shows a similar sensitivity of CAT scans for detecting intracranial structural disease. 30.6% of our patients had abnormal CAT scans. Despite the heterogeneity of the study populations, it is remarkable that the prior studies and ours obtained a fairly consistent pickup rate of abnormal CAT findings in approximately one-third of epileptics investigated.

In our study, there were 18 patients with focal seizures diagnosed clinically or on EEG. This subset, similar to Bogdanoff's study group, yielded abnormal CAT findings in half (9/18). The increase in positive results for this subset (50.0%) compared to the general group (30.6%) approaches statistical significance. Bogdanoff also analyzed a further subset within his patients with focal seizures who had, in addition, predominantly focal slowing in the EEG and found an even higher detection rate of 66.7%. Observing the trend, we may speculate that CAT scans are more likely to be abnormal in focal seizures, especially when accompanied by predominantly focal slowing in the EEG.

In Bogdanoff's study which also included children and adults, the incidence of abnormal CAT scans rises as the age of the seizure onset increases. This early observation is confirmed by our larger study which shows that more than half (52.8%) of epileptics aged 40 years or more have abnormal CAT scans. This compares with a much lower pickup rate of 1 in 5 in those younger than 40. In addition, we found the converse to be true for EEG examination where younger patients, particularly those in the first decade, were more likely to manifest abnormalities. Clearly, the CAT scan and EEG appear to be complementary investigations with older patients having more structural (CAT scan) disease and younger patients having more functional (EEG) or structurally undetectable ones.

In an observation similar to Gilsanz's, we noted that epileptics with abnormal physical signs in addition to their history of seizures were more likely (49.2%) to have abnormal CAT scans than epileptics with only a history of seizures (16.2%). In the latter group, sometimes termed cryptogenic or idiopathic epilepsy, CAT scanning is therefore less likely to be informative.

BULLETIN OF INFECTIOUS DISEASES 26/84
REPUBLIC OF SINGAPORE

S/N.	DISEASES	26TH WEEK Ending 30.6.84	26TH WEEK Ending 2.7.83	MEDIAN 1979-1983	CUMULATIVE, FIRST 26 WEEKS 1984	1983	MEDIAN 1979-1983
1	CHOLERA	0	1	0	0	11	5
2	PLAGUE	0	0	0	0	11	0
3	SMALLPOX	0	0	0	0	0	0
4	YELLOW FEVER	0	0	0	0	0	0
5	CHICKENPOX	43	33	10	1573	551	551
6	DENGUE FEVER/DHF	2	3	42	45	69	
7	DIPHTHERIA	0	0	0	0	1	0
8	ENTERIC FEVERS	0	3	3	51	62	194
9	LEPROSY	0	2	0	15	40	31
10	MALARIA	7	5	8	77	70	73
11	POLIOMYELITIS	0	0	0	0	0	1
12	VIRAL HEPATITIS	8	14	11	299	276	219
13	VIRAL ENCEPHALITIS	0	0	0	9	4	14
14	TUBERCULOSIS	27	38	—	1153	996	—
15	MEASLS	118	3	—	2026	379	—

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Apart from an increased detection rate in the very young, we could not correlate the EEG with clinical examination or type of seizure. Further, there were too few patients (9) with both EEG and CAT abnormalities to allow significant correlations. Nevertheless, within this small group, it is noteworthy that only 3 patients showed anatomic agreement between EEG and CAT localization. In a different study, Oakley and coworkers demonstrated an association between CAT and clinical lateralization of an epileptic focus when the EEG was non-lateralizing. (4)

The predominant CAT diagnoses of infarction, atrophy, and hydrocephalus detected in our patients were seldom of therapeutic significance. For example, of the 5 patients with hydrocephalus, 4 had chronic mental retardation or cerebral palsy. In the group with miscellaneous CAT diagnoses, there were 5 patients with neoplasms; 3 had metastases, 1 had a pituitary tumor, and 1 had a suspected meningioma. Signs of cranial trauma on CAT scan were clinically obvious in 2 out of 3 patients.

Despite its modest therapeutic utility in evaluating epileptic patients, the CAT scan, when it provides a definitive diagnosis, reduces the need for more expensive, hazardous, or uncomfortable procedures. On the other hand, normal scans are useful for prognostication. Rarely, presumed idiopathic epilepsy may have a demonstrable structural cause.

SUMMARY

The sensitivity of CAT scan for detecting intracranial structural disease in epileptics is approximately 30-40%. It is higher in older patients and those with abnormal clinical signs (50-60%). There is probably an increased sensitivity in focal seizures. For cost-containment, it would seem pragmatic to concentrate the use of CAT scan in these high yield subgroups. The CAT scan is complementary to the EEG which is more likely to be abnormal in the young. Although the therapeutic significance of CAT scan findings in epileptics is modest, it is useful in patient management because it may provide a definitive diagnosis and facilitate prognostication. Compared to alternative investigations such as cranial arteriography, it is safe, virtually non-invasive, and relatively inexpensive.

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