

STRUCTURAL CHANGES IN THE BRAIN IN SCHIZOPHRENIA: A COMPUTED TOMOGRAPHIC STUDY

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SUMMARY

Computed tomography of the brain was performed in thirty schizophrenic patients in the age group of 19-45 years and thirty controls matched for age and sex. The size of lateral ventricles, the width of the third ventricle and the sylvian fissure were measured in the CT scans. On group comparison, we found that the size of lateral ventricles expressed as ventricular brain ratio, and the width of the third ventricle and sylvian fissure were significantly greater in the schizophrenic patients ($P < 0.001$) as compared to the control group. No correlation was observed between the duration of illness and the cerebral findings. There was no significant difference between the group of schizophrenic patients with a history of having been treated with electro-convulsive therapy and the group without such a history.

Introduction

The literature regarding the search for structural changes in the brain in schizophrenic patients indicates that some disagreement still exists in this area of research. Most of the neuropathological and pneumoencephalographic studies claimed cerebral ventricular enlargement and cortical atrophy in schizophrenia (Weinstein 1954, David 1957, Dastur 1959, Lemke 1936, Huber 1957, Huag 1962, Nagy 1963, Asano 1967). However, there are quite a few negative reports (Peltonen 1962, Storey 1966, Ansink 1969). The findings of these studies remained inconclusive because of methodological limitations and artifacts.

Computed tomography which has eliminated the artifacts of the above two procedures to a great extent has suggested that there is enlargement of lateral ventricles in schizophrenic patients (Johnstone et al 1976, Weinberger et al 1979 a, 1979 b, Golden et al 1980, Tanaka et al 1981, Pearson

& Veroff 1981, Frangos & Athanassenas 1982, Nyback et al 1982, Nasrallah et al 1982, Andreasen et al 1982 a, 1982 b, Okasha & Madkour 1982, Rieder et al 1983, Reveley & Reveley 1983, Schulz et al 1983, Reveley & Murray 1984, Williams et al 1985). However, there are some studies, which have not found ventricular enlargement (Trimble & Kingsley 1978, Campbell et al 1979, Gluck et al 1980, Jernigan et al 1982, Benes et al 1982).

Considering the contradictory results of neuropathological and pneumoencephalographic studies and the equivocal results of computed tomographic studies, the present study was an attempt to establish the presence or absence of structural changes in the brains of schizophrenic patients.

Material and Methods

Thirty patients suffering from schizophrenia (22 males and 8 females) in the age group of 19-45 years (mean age 28.7 years)

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were randomly selected from the psychiatric services of the All India Institute of Medical Sciences, New Delhi, on the basis of definitions given in ICD-9, Code 295. These patients were continuously ill for at least two years with no remission with or without treatment. In order to maintain homogeneity, these patients also satisfied Feighner et al's research criteria (1972) for schizophrenia.

The control group was selected randomly from patients who were referred for computed tomography with complaints of heaviness of head or headache with no neurological deficits and whose plain x-rays of skull and computed tomographic scan were reported as normal. The thirty patients (22 males and 8 females), thus selected, were closely matched for age and sex. The age of the control group varied from 15 to 45 years (mean age 29.7 years).

Computed tomography of the schizophrenic patients and controls was performed with the same scanner CT-1010. A minimum of five sections (ten cuts) were taken for each patient, starting at the orbitomeatal line. The scans, thus performed, were in the form of transparent films. For each patient, the cuts of CT scan showing the body of the lateral ventricles at their largest and the third ventricle and sylvian fissures at their widest were identified and measured. Lateral ventricular size was measured by using free arm planimetry (Weinberger et al 1979). The lateral ventricular size was expressed as the ventricular brain ratio, which was calculated by dividing the ventricular area by the intracranial area and multiplying the result by 100.

For the measurement of the third ventricle and sylvian fissures, callipers were used. One reading each was taken for these parameters and the values, thus determined, were expressed to the nearest millimetres. The third ventricles in three

schizophrenic patients and two control subjects could not be delineated and measured. Similarly, the sylvian fissures in two schizophrenic patients and four control subjects could not be delineated and measured and hence were not included for the purpose of statistical analysis. All measurements were performed without knowledge of the diagnosis.

Students' 't' test was applied in group comparisons and the value of significance was calculated. The formula of Spearman's Rank correlation was used to find out the correlation between the duration of illness and the brain parameters measured.

Results

The result of the present study brought out the following observations:

- (1) The size of lateral ventricles expressed as ventricular brain ratio was significantly greater in the schizophrenic patients than the control group ($p < 0.001$). Table 1 illustrates the distribution of the size of lateral ventricles for the schizophrenic patients and the control group.
- (2) The present study indicated that the width of the third ventricle was significantly broader in the schizophrenic patients in comparison to the control group ($p < 0.001$) Table 1.
- (3) With regard to the sylvian fissure, there was a highly significant difference between the schizophrenic patients and the control group ($p < 0.001$) Table 1.
- (4) The present study also indicated that the brain parameters measured did not correlate significantly with the duration of illness.
- (5) It was observed that there was no significant difference on the brain parameters measured in the group of schizophrenic patients with a history of

Table 1
Structural changes in the brain in schizophrenic patients and control subjects

Parameters	Schizophrenic patients			Control subjects			t/p
	No.	Range	Mean \pm SD	No.	Range	Mean \pm SD	
Lateral ventricular size (VBR)	30	2.39 - 17.60	10.09 \pm 4.04	30	2.11 - 11.43	6.39 \pm 2.46	t = 4.28 p < 0.001
Width of third ventricle (in mm)	27	0.75 - 3.00	1.53 \pm 0.57	28	0.50 - 2.00	1.05 \pm 0.31	t = 3.90 p < 0.001
Width of sylvian fissure (in mm)	28	0.75 - 3.50	1.91 \pm 0.75	26	0.50 - 2.00	1.17 \pm 0.40	t = 4.47 p < 0.001
Age (in years)	30	19 - 45	28.73 \pm 6.81	30	16 - 45	28.70 \pm 7.28	

of having been treated with electro-convulsive therapy (ECT) as compared to the group without such a history.

Discussion

The results of the present study indicate that there is significant enlargement of lateral ventricles and widening of the third ventricle and sylvian fissures in a group of thirty schizophrenic patients as compared to an equal number of control subjects matched for age and sex, who were patients complaining of headache without any neurological deficits. These findings are in keeping with a number of pneumoencephalographic and computed tomographic studies (Lemke 1936, Huber 1957, Huang 1962, Weinberger et al 1979a, Johnstone et al 1976, Weinberger et al 1979b, Golden et al 1980, Tanaka et al 1981, Frangos & Athanassenas 1982, Nyback et al 1982, Nasrallah et al 1982, Andreasen et al 1982 a 1982 b, Okasha & Madkowitz 1982, Rieder et al 1983, Reveley and Reveley 1983, Schulz et al 1983, Reveley & Murray 1984, Williams 1985). In the absence of obstruction to cerebrospinal fluid circulation, enlargement of ventricular systems probably indicates cerebral atrophy (Weinberger et al 1979a).

There was no correlation between

structural findings in the brain and the duration of illness. This probably indicates that the duration of illness is not responsible for producing these changes in the brain as they would have been more apparent in patients who had been ill for a longer period of time.

Because of the retrospective nature of this study, the possibility must be considered that the findings described may be related to the treatment given to the patients in the past, especially electro-convulsive therapy (ECT). There was no significant difference between the group of schizophrenics with a history of having received electro-convulsive therapy (ECT) and the group without such a history. Results of other similar studies also support this conclusion (Weinberger et al 1979a, Weinberger et al 1979 b; Tanaka et al 1981). The present study definitely favours the speculation of previous authors in this area of research that the duration of illness and the experience of electro-convulsive therapy (ECT) are not the primary cause of structural changes found in the brain of schizophrenic patients (Weinberger et al 1979a, Weinberger et al 1979 b).

The enlargement of the lateral ventricles and the widening of the third ventricle and sylvian fissures are commonly seen in normal senescence, dementia and

other degenerative neurological disorders (Barron et al 1976). Therefore, structural changes seen in the brain of the schizophrenic patients might be nonspecific findings. Although these CT findings may be non-specific in the broader sense, they are likely to be of significance when seen in the younger age group of the patients with a schizophrenic psychosis. The pathogenesis of these cortical findings is not clearly understood at this stage and a more dynamic study by Positron Emission Tomography (PET) or some new modalities may throw some light on the pathophysiology involved in producing these structural changes in the brain of schizophrenic patients.

The present study as well as the various reported positive studies definitely favour the speculation that structural changes in the brain are associated with schizophrenia in the majority of patients. These changes are independent of the duration of illness and the effect of electro-convulsive therapy (ECT).

Although it is difficult to comment about the relevance of these findings as a cause or concomitant of schizophrenia, the present study indicates that cortical changes in the brain of schizophrenia may be the result rather than the cause of disease process.

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