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Computerized Tomography Studies on Schizophrenic Diseases

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Summary. Earlier clinical pneumoencephalographic studies showed a subgroup of schizophrenics that have small and dysplastic cerebral ventricles as well as a subgroup with a "pure defect", i. e., a slight internal brain atrophy. In echoencephalograms of pure and mixed residual schizophrenic syndrome patients, a significantly higher average transverse diameter of the third ventricle was demonstrated compared to that in patients with complete remissions. Correlations cannot be expected between certain groups of disease, e.g., epilepsy, multiple sclerosis, or schizophrenia on the whole, and pneumoencephalographic (PEG) and CT findings. Only schizophrenics with distinct signs of pure defect that had persisted for at least 3 years revealed deviations from normal by CT and PEG, but those with irreversible fixed deformations of personality structure ("Strukturverformungen" [9, 10]) did not. In patients who were 50 years of age or less with psychic reactive and psychopathic personality disorders, CT showed an average third ventricle diameter of 4.2 mm (range 2–6 mm). Of 117 schizophrenics (average age 35.5 years), only 28% revealed pathological CT changes. However, of 36 schizophrenics with pure residual syndromes 69% showed pathological CT findings that always concerned the third ventricle, rarely the lateral ventricles, and in no case the cortex. The average transverse diameter of the third ventricle in this subgroup with pure defect was 7.6 mm, as compared to 4.6 mm in the subgroup of schizophrenics with complete remission. There was no increase in size with increasing years until the 50th year in schizophrenics, as well as in the control group of variations of psychic being (neuroses and psychopathic personality disorders).

Key words: Computertomographic findings in schizophrenics – Neuroradiological findings in schizophrenics – Brain atrophy in schizophrenics – Pure defect – Correlations between psychopathological and CT findings

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Zusammenfassung. Frühere klinisch-pneumencephalographische Untersuchungen zeigten, daß Schizophrene teilweise konstitutionell kleine und dysplastische Hirnventrikel und eine Untergruppe mit „reinem Defekt" eine geringgradige innere Hirnatrophie aufweisen („neuroradiologisches Basalgangliensyndrom"). Bei Schizophrenen mit reinen oder gemischten Residualsyndromen konnte im Echoencephalogramm ein signifikant höherer Mittelwert des Transversaldurchmessers des 3. Ventrikels gefunden werden als bei vollremittierten schizophrenen Kranken. Zwischen bestimmten Krankheitsgruppen, z. B. Epilepsie, multiple Sklerose oder Schizophrenie im ganzen, und PEG- und CT-Befunden können keine Korrelationen erwartet werden. Nur bei Schizophrenen mit zumindest seit 3 Jahren persistierenden deutlichen Zeichen der „reinen Defizienz" ergeben sich Abweichungen von der Norm im CT (und PEG), nicht aber bei Schizophrenen mit irreversiblen Strukturverformungen. Bei einer Kontrollgruppe mit erlebnisreaktiven Entwicklungen und psychopathischen Persönlichkeitsstörungen fand sich bis zum 50. Lebensjahr im CT ein durchschnittlicher Mittelwert des Transversaldurchmessers des 3. Ventrikels von 4,2 mm mit einer Streuung von 2 bis 6 mm. Von 117 schizophrenen Kranken mit einem durchschnittlichen Lebensalter von 35,5 Jahren boten nur 28% pathologische CT-Veränderungen. Von 36 Schizophrenen, deren Psychose vollständig, ohne Hinterlassung eines Residuums remittierte, boten 3%, dagegen von 36 Schizophrenen mit reinen Residualzuständen 69% pathologische CT-Veränderungen, die ausnahmslos den 3. Ventrikel, selten die Seitenventrikel und in keinem Fall die Hirnrinde betrafen. Der durchschnittliche Mittelwert des 3. Ventrikels betrug in der Untergruppe mit leichten reinen Residuen 7,6 mm gegenüber 4,6 mm in der Gruppe mit vollständiger Remission. Eine Altersabhängigkeit dieses Wertes (Ansteigen mit zunehmendem Lebensalter) läßt sich bis zum 50. Lebensjahr in unserem Beobachtungsgut von Schizophrenen und Variationen seelischen Wesens nicht nachweisen.

Schlüsselwörter: Computertomographische Befunde bei schizophrenen Erkrankungen - Neuroradiologische Befunde bei schizophrenen Erkrankungen - Hirnatrophie bei schizophrenen Erkrankungen - Reiner Defekt - Korrelationen von psychopathologischen und CT-Befunden.

Introduction

Cranial computerized tomography (CT) has become the most important method in neuropsychiatric diagnosis of atrophic syndromes of the brain. Previous clinical pneumoencephalographic studies have shown that schizophrenics, or a subgroup of schizophrenics, have constitutionally small and dysplastic cerebral ventricles and that another subgroup with certain defect syndromes [7], i.e., a reduction of psychic energetic potential (i.e., "pure defect" [7]), has a slight internal brain atrophy [4–6].

Significant positive correlations were found between irreversible psychosyndromes of well-known brain diseases and brain atrophy by pneumoencephalogram (PEG). Furthermore, certain types of atrophic brain syndromes could be correlated to certain types of irreversible

psychosyndromes [6]. More generalized and cortically accentuated atrophy seems to correspond to organic dementia processes, whereas internal cerebral atrophy in the area of the ventricular system is correlated to more isolated (not associated with severe organic dementia) organically derived personality alterations ("organische Persönlichkeitsveränderung") and irreversible pseudoneurasthenic syndromes. PEG findings in schizophrenics with severe and typical schizophrenic defect psychoses [4, 5, 9] were confirmed by other investigators [6]. Finally, increased pathological changes in PEG in relation to degree of the schizophrenic defect [4, 5] was shown, as well as a significant difference in the average transverse diameter of the third ventricle in schizophrenics compared with normal persons [14].

Echoencephalographic findings in "pure" and "mixed" schizophrenic residual syndromes revealed a significantly higher average transverse diameter of the third ventricle and a significantly higher rate of pathology in this are a than in schizophrenics with complete remissions [13]. However, no clear pathological findings could be found in the half (48%) of those residual syndrome patients. On the basis of PEG and echoencephalographic investigations, we concluded that in neuroradiological clinical studies no correlations could be expected between certain groups of diseases, e.g., epilepsy, multiple sclerosis, or schizophrenia as a whole, and PEG or echoencephalographic findings.

Correlations also exist in definable organic psychoses, as well as in endogenous schizophrenic, and affective psychoses, when irreversible psychosyndromes of a organic character are present [3, 8]. However, no brain atrophy, which is detectable by neuroradiological methods, could be found in patients with psychic reactive personality disorders if these disorders and changes were not reversible (e.g., "erlebnisreaktiver Persönlichkeitswandel" of concentration-camp syndrome). The same is valid for the above-mentioned chronic irreversible fixed schizophrenic psychoses; that is, deformation of personality structure ("Strukturverformungen mit Psychose" [9]) as a psychological consequence of the psychosis at the base of a predisposing constitution and primary personality, e.g., as in schizoid personality disorder [9, 10, 13].

The differences in results of PEG investigations can be partly explained by the lack of psychiatric-psychopathological differentiation of the investigated probands. We repeat: only those schizophrenics and cyclothymic patients with pronounced signs of "pure defect" show deviations in PEG or CT, but not those patients who remit without signs of pure potential reduction or those patients with irreversible fixed "structural deformation" [9, 10]. Regarding these questions it is also important that the problem of the normal PEG was clarified to a great extent by echoencephalographic investigations of an average population, eliminating the uncertainty regarding the evaluation scale [13].

The Problem of Normal Data

Up to now the problem of normal data in CT has not yet been solved. Especially regarding the cortex, the risk of faulty judgement, i.e., false-positive findings, is considerable [3, 8]. In probands who were not older than 50 years and without neurological or psychiatric diseases, we found an average third ventricle diameter of 4.2 mm: there was no age-correlated increase in size (Table 1).

In this group of variations in psychic reactions and personality in the sense of K. Schneider (psychic-reactive disturbances and psychopathic personality disorders), there were no significant differences with regard to average diameter of the third ventricle in third to fifth decades: the size in each of these three subgroups was 4.3 mm. Only after the age of 50 years was there an increase to 5.9 mm; in one proband, older than 60 years of age, we found a size of 7 mm. There was also no significant difference up to the 50th year of age between the two groups of schizophrenics with complete recovery and with pure residual syndromes (Table 1).

According to Götze et al. [2], the normal width of the third ventricle shows deviations between 2.0 and 5.5 mm. In our material of 34 cases with variations of psychic being, these

sizes varied between 2.0 and 6.0 mm. Therefore, up to the 50th year of age we considered a transverse diameter of the third ventricle of 7 mm and more as pathological. On the lateral ventricles more markedly change form in the frontal segments, in cella media, and on the surface of the brain (cortex), a 3 mm width of the sulci or more was deemed pathological. For judging the brain cortex, more basically situated sulci in various slices had to be taken into consideration, whereas the sulci of the three highest slices near the vertex (just as the cysterns, the interhemispheric fissura, and pacchionian granulations) were not considered [3, 8, 11].

Subjects and Method

Our investigation was based on 451 inpatients (275 males, 175 females) of the Nervenklinik of the University of Bonn who were admitted during 1978–1980 with various psychiatric diagnoses. Of the whole sample of 451 patients, 117 patients were schizophrenics (73 males, 44 females), with an average age of 35.5 years. Diagnoses were made according to the criteria of K. Schneider, which is described in detail elsewhere [9].

The CT investigations were made with a Philips tomoscan 200. The distance between the slices was 10 mm, except for the area of the third ventricle (5 mm). The scans were evaluated without knowledge of diagnosis or other clinical and anamnestic data, apart from age and sex.

The endogenous and particularly schizophrenic psychoses were divided into subgroups according to our typology of schizophrenic residual syndromes, as described in 1961 [5], 1966 [7], and 1979 [9], that are beside the subgroup with complete remission and with the postpsychotic asthenic "basic stages" slight pure residual syndromes, mixed residues, typical schizophrenic defect psychoses, chronic pure psychoses, and psychotic structural deformities. The postpsychotic asthenic basic stages appear immediately after the remission of the productive psychotic schizophrenic manifestation and cannot be differentiated by psychopathological and psychological methods from irreversible pure residual syndromes [9]. Only when such more-or-less noncharacteristic states with cognitive and dynamic deficiencies persist continuously for more than 3 years do we speak of irreversible pure defect syndromes (pure residual syndromes).

The concept of pure defect corresponds partly, but not completely, with the type II schizophrenia syndrome of Crow et al. [1]. Possibly, type II is equivalent to the more marked degrees of pure residual syndromes. Negative (defective) symptoms, i.e., cognitive and dynamic deficiencies, obviously characterize both syndromes. Cognitive impairment also could be proved by psychological tests in pure defect by Huber et al. [9] as well as in type II syndromes by Johnstone et al. [11].

In the above-described sample of 117 schizophrenics were 36 patients with complete remissions, 36 with slight pure residual syndromes, 32 with reversible asthenic basic stages, and 13 patients with chronic pure psychoses (eight cases) or structural deformities (five cases).

Results

In the group with definable brain diseases and brain damage (251 cases), we found pathological CT findings (brain atrophy) in 13% of the subgroup without

Table 1. Average diameter of the third ventricle in CT in pure residual syndrome and complete remission patients with schizophrenic diseases and in "variations" (psychic-reactive and psychopathic personality disorders)

Age at CT	"Pure" residual syndromes			Complete remissions			"Variations"		
	$n=36$	∅ width		$n=36$	∅ width		$n=40$	∅ width	
16–19	1	8.0		4	4.7		3	3.8	
20–29	8	7.0	25	16	4.5	34	11	4.3	34
30–39	7	7.1	7.1	9	5.0	4.6	8	4.3	4.2
40–49	9	7.2		5	4.2		12	4.3	
50–59	7	7.7	11	1	5.0	2	5	5.9	6
>60	4	10.6	8.8	1	6.0	5.5	1	7.0	6.1

irreversible psychopathological changes (75 cases), and, in the subgroup with irreversible organic psychosyndromes (176 cases), in 81%. There was a significant correlation between brain atrophy, which is demonstrable in CT, and irreversible organic psychosyndromes [3, 6].

The group of schizophrenics as a whole showed only 28% with pathological CT changes. Thirty-six schizophrenics with complete remission showed pathological CT changes in only 3%, but in 36 schizophrenics with (slight) pure residual syndromes, 69% (25 cases) showed pathological CT findings. In all cases of the subgroup with pure residual syndromes, pathological findings concerned the third ventricle. Only 4 of 36 patients (11%) with slight pure residual syndromes revealed additional pathological changes of lateral ventricles. Cortical pathological findings were absent. The average transverse diameter of the third ventricle in the subgroup with complete recovery was 4.6 mm, and, in the subgroup with pure residual syndromes, 7.6 mm.

Considering only the pure residual syndrome cases 50 years of age or less, no age-correlation was found (Table 1). The average transverse diameter of the third ventricle in the three subgroups (third, fourth, and fifth decades) is nearly the same (7.0, 7.1, and 7.2 mm, respectively). In patients with complete recovery the third-, fourth-, and fifth-decade subgroups showed a third ventricle diameter of 4.5, 5.0, and 4.2 mm, respectively. Referring exclusively to patients not more than 50 years of age, average diameter is 7.1 mm in the subgroup of pure residual syndrome cases (25 cases) and 4.6 mm in the subgroup with complete remission (34 cases). This difference was statistically significant (Wilcoxon test). In comparison with the results of other investigators it must be emphasized that until the 50th year of age there was no significant increase of the width of the third ventricle with increasing age in any of our groups.

None of our schizophrenics showed cortical pathological measurements. As previously mentioned, false-positive cortical findings are still frequent. However, we do not completely reject cortical evaluations, as was done by Johnstone et al. [3, 11].

In the small subgroup (13 cases) of patients with persistent deformities of personality structure ("Strukturverformungen") and of chronic pure psychoses

("chronische reine Psychosen"), there were only two patients (15%) with pathological CT findings: the average transverse diameter of the third ventricle was here 4.7, which was nearly the same as in the subgroup of schizophrenics with complete remission (4.6 mm). According to our hypothesis and that of Janzarik [9, 10], the second component of irreversibility in schizophrenic diseases, i.e., the "structural deformity", is presumably not of organic character [3, 4, 8].

In accordance with K. Jaspers and others, a psychological process ("psychischer Prozess") is proposed, especially in relation to schizoid premorbid personality disorders and to signs of an abnormal dysplastic constitution [4].

Patients with cyclothymia, i.e., with mono- and bipolar-affective psychoses, show the same pathological findings in the area of the third ventricle insofar as they develop pure residual syndromes after remission of a depressive or manic manifestation. The percentage of pathological CT findings in our material (60%) was approximately the same as in the patients with pure residual schizophrenic syndromes [3], and the CT changes also concerned the third ventricle. On the other hand, affective psychosis patients with full remission showed no brain atrophy by CT.

Discussion

Because pure residual syndromes at first sight seem pseudoneurasthenic-organic psychopathic, or pseudoneurotic, the diagnosis of schizophrenia is impossible without knowledge of case history. The psychopathological picture is determined by dynamic and cognitive deficiencies which are experienced and communicated by the patients themselves. Since 1966, we have described the phenomenological aspects of "pure defect" as substrate-related basic disorders ("substratnahe Basisstörungen") [7, 9]. The most frequent symptoms are cognitive disturbances described by the patients as disorders of concentration, thinking, and memory; exhaustibility, and lack of general well-being; lack of energy, resilience, vitality, persistence, and patience; cenesthetic pains and bodily sensations [4, 9] and increased impressionability, a category which corresponds to the decrease of tolerance threshold to nonspecific stress. Patients perceive their losses and suffer from them; they are able to describe the deficiencies and to develop mechanisms of defense and compensation ("coping behaviour").

Several interpretations of the CT findings in schizophrenics are possible: (1) The postulated biochemical disorders of a schizophrenic disease can potentially lead to a slight atrophy in the area of limbic system [4, 5, 13]; (2) the findings are the consequence of a premature, locally marked age-related involution, i.e., of a "asynchronic aging of brain" [5–7, 10, 13]; (3) the findings are the consequence of brain damage in the early infancy, perhaps in Janzarik's sense of a "preceding defect" ("vorauslaufender Defekt") [9, 10]; (4) the findings are a consequence of an etiologically different, nonspecific diencephalopathy, i.e., organic damage in the area of the limbic system, independent of schizophrenia.

We showed that only schizophrenic patients with distinct signs of pure defect, i.e., marked reduction of psychic-energetic potential [7] persisting for 3 years, reveal deviations from normal by PEG, echoencephalography, and CT. On the other hand, pathological findings cannot be expected in schizophrenics with irreversible fixed "deformations of personality structure". Residual syndromes in schizophrenic, as well as in cyclothymic diseases that are characterized by

dynamic and cognitive deficiencies are correlated in about two-thirds with slight brain atrophy mainly concerning the third ventricle. Phenomena similar to or identical to reversible asthenic basic stages must be excluded by observation for at least 3 years.

We found pathological changes of lateral ventricles in only 11% of our pure residual syndrome patients. Weinberger and Wyatt [15] described a significant enlargement of the ventricular system in chronic schizophrenics compared to healthy controls. An explanation of this difference could be that these authors investigated "chronic schizophrenics", while we mainly examined patients with slight pure residual syndromes, and our sample included no chronic schizophrenics in the sense of typical schizophrenic defect psychoses. This type of chronic schizophrenia in earlier PEG investigations also showed pathological changes in lateral ventricles [4–6]. Nybäck et al. [12] found that the lateral ventricles and the third ventricle were significantly wider in relatively young patients with schizophrenia.

The fact that no definite pathological CT changes were found in about one-third of schizophrenics with the "pure defect" component (see above) can be declared first with it that these schizophrenics have small and dysplastic ventricles. On the other hand, it is well imaginable that the postulated genetically conditioned pathological neurochemical processes do not lead to morphological cerebral alterations that can be demonstrated by neuroradiological methods, such as CT or PEG. Independent of their interpretation (e.g., brain damage in early childhood), the CT findings concerning the ventricles, i.e. slight internal brain atrophy, can be correlated with the "pure defect" as the sole morbogenic-organic component of irreversibility in schizophrenic diseases.

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