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A Cerebral Computed Tomography Study of Patients with Drug-induced Psychoses

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Summary. Twelve male patients with chronic drug consumption including cannabis (ICD = 304.3) and morphine (ICD = 304.7), who required inpatient treatment for drug-induced paranoid hallucinatory states (ICD = 292.1) were investigated using computed tomography for macroscopic structural changes in the brain. The findings were compared with those in a control group of schizophrenic patients who did not consume drugs. The brain scans were measured and not show any significant morphological differences between the two groups.

Key words: Drug-induced psychoses – Cerebral computed tomography – Chronic cannabis consumption

Introduction

Chronic drug consumption can lead to functional and structural changes in the brain. Tunving et al. (1986) found "...that the regional cerebral blood flow (rCBF) in cannabis users was significantly (11%) lower than that of age- and sex-matched healthy controls". It appears that after chronic drug consumption, non-specific macroscopic changes, such as cerebral atrophy, may follow disturbance at the cellular and molecular level.

Campbell et al. (1971) investigated by pneumoencephalography ten patients aged between 18 and 28 years, who were heavy cannabis users. Compared with an age-matched control group, all the cannabis users had cerebral atrophy in the form of dilated lateral ventricles.

Kuehnle et al. (1977), on the other hand, did not find any cerebral structural changes in their computed tomography (CT) of 19 male long-term cannabis users. Co et al. (1977), conducting a similar investigation of 12 young male cannabis users, also found no indication of cerebral atrophy. Numerous other studies, occasionally with conflicting results, were reported by Wert and Raulin (1986a, b) in an in-depth survey.

The present study investigates possible cerebral structural changes in young male patients with drug-induced paranoid hallucinatory psychoses. For the control group, we chose sex- and age-matched patients also suffering from paranoid hallucinatory psychoses, whose past histories did not, however, include drug use.

Patients and Methods

All patients admitted to our clinic during 1987 and the first half of 1988 for whom paranoid-hallucinatory symptoms were diagnosed, in accordance with the research diagnostic criteria, were included in this study. In addition, patients were selected for this study who, while also formally fulfilling these criteria, had in addition been using hashish for at least 1 month, usually daily, immediately prior to the outbreak of the schizophrenic symptoms. This latter group of patients thus satisfied the research diagnostic criteria for the diagnosis of cannabis abuse.

In order to maintain patient homogeneity and comparability and to exclude any false results due to age-related physiological changes of the brain, only male patients aged between 18 and 35 years were studied.

From the patient group thus obtained, 7 patients with histories of either alcohol abuse, cranial-cerebral trauma or neurological disease were eliminated from our study.

Twenty-two patients remained as the subjects of the study. On the basis of the "drug consumption" criterion, they were divided into two groups: (1) drug-user group ($n = 12$); (2) control group ($n = 10$). CT brain scans of these 22 patients, obtained using an EMI-Scanner CT 1010, were measured and evaluated. The evaluation was conducted without the evaluator knowing whether the patient was in the drug-user group or the control group. Special attention was paid to the following structures: the shape of the bony skull; the basal bony structures; the width of the cisternae; the width of the cerebral sulci: midline displacements; hypo- or hyperdense areas. The ventricular system of all 22 patients were also

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Paranoid hallucinatory psychosis a) endogenous b) drug-induced	1. Alcohol abuse
2. Male	2. Cranial-cerebral trauma
3. Age between 18 and 35	3. Neurological diseases

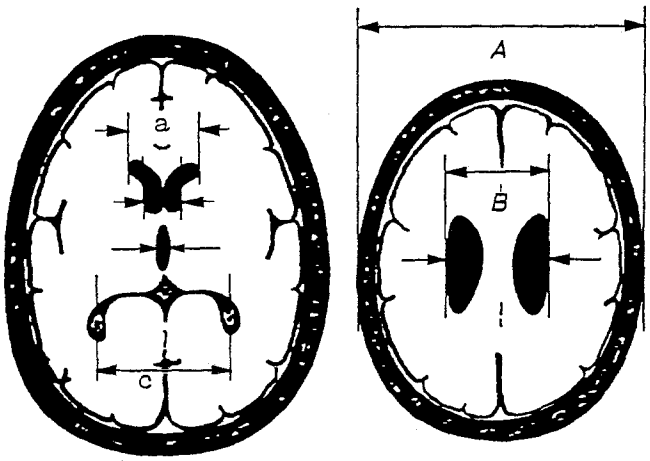

Fig. 1. c/a, Ventricle index; A/B, cella media index

measured. The following four measurements were calculated: (1) the distance between the calcified structures of the chorioid plexus; (2) the greatest distance between the anterior horns of the lateral ventricles; (3) the biparietal diameter of the skull including the external table; (4) the greatest exterior distance between the lateral ventricles at the level of the cella media.

Using the data obtained in this manner, the following indices were then calculated, which are used in radiology as measures of atrophic changes in the brain:

$$1.\ \text{Ventricle index} = \frac{\text{distance between the chorioid plexus}}{\text{greatest distance between the anterior horns}}$$

$$2.\ \text{Cella media index} = \frac{\text{biparietal diameter}}{\text{distance between the lateral ventricles at the level of the cella media}}$$

These indices of the drug-user group were compared with those of the control group. The statistical evaluation was carried out with the help of the sum of ranks test according to Wilcoxon (1945).

Results

The average age of the patients in the drug-user group was 24.4 years (range: 20–32); that of the control group was 25.3 years (range: 20–31).

For 6 of the drug-user patients and 6 of the control group patients, it was the first admission with psychotic manifestations. For the drug-user group, frequency of admissions at the time of examination averaged 2.1, with a range of 1–6. For the control group, admissions averaged 1.6 (range: 1–4).

Characteristic of the drug-user group was a history of long-term cannabis use. Eleven of the 12 patients had, for example, used cannabis for several (3–15) years. Only 1 patient (no. 5) had used it for less than 1 year, namely, for 6 months.

Five of the drug-user patients had used only cannabis. Three patients also evinced heroin addiction; 5 patients had used LSD; 3 were acquainted with cocaine; and 4 had misused medications (tranquillizers, codeine, fenetylline, barbiturates).

The evaluation of the CT scans did not result in any qualitative pathological findings.

The results obtained from the quantitative analysis, the measurement of the ventricle system, and the calculation of the indices described above are shown in Table 3.

Table 2. Drug-user group: past history of drug use

Patient/ age (years)	Cannabis use in years	Opiates	LSD	Cocaine	Medications
1/32	15	+	+	+	+
2/20	5	–	–	–	–
3/27	10	–	–	–	–
4/32	14	–	–	–	–
5/23	0.5	–	–	+	–
6/23	9	+	+	+	+
7/21	5	–	+	–	–
8/25	10	+	–	–	+
9/20	6	–	+	–	–
10/21	3	–	–	–	–
11/23	6	–	–	–	–
12/29	13	–	+	–	+

Table 3. Ventricle index

	Ventricle index	Drug-user group ($n = 12$)	Control group ($n = 10$)
Normal	>1.6	58%	60%
Slight dilatation	1.4–1.6	42%	20%
Moderate dilatation	1.0–1.3	–	20%
Pronounced dilatation	<1.0	–	–

Table 4. Cella media index

	Cella media index	Drug-user group ($n = 12$)	Control group ($n = 10$)
Normal	>4.0	83%	70%
Slight dilatation	3.6–4.0	17%	20%
Moderate dilatation	3.0–3.5	–	10%
Pronounced dilatation	<3.0	–	–

For 7 patients in the drug-user group and 6 patients in the control group, the ventricle indices were in the normal range (1.6). Five patients in the drug-user group and 2 patients in the control group showed slight dilatations, with ventricle indices between 1.4 and 1.6. Moderate dilatations (indices of 1.0–1.3) did not appear in the drug-user group; in the control group, however, they were present in 2 patients. Pronounced dilations with ventricle indices of less than 1.0 were not measured in any of the 22 patients.

Regarding the ventricle index values of the drug-user group and the control group, statistical analysis did not show any significant differences.

The cella media indices showed a similar tendency. This value lay in the norm for 10 patients in the drug-user group, and for 7 patients in the control group. Slight dilatations of the ventricle system with cella media indices of between 3.6 and 4.0 were found in 2 patients in the

drug-user group and also in 2 patients of the control group. Moderate dilatations, with cella media indices of 3.0–3.5, however, occurred in only 1 patient in the control group, and not at all in the drug-user group. Pronounced dilations with cella media indices of less than 3.0 were measured in neither the drug-user group nor in the control group.

Concerning the cella media indices of the drug-user group and the control group, statistical analysis did not reveal any significant differences.

Discussion

In contrast to the studies by Kuehnle et al. (1977) and Co et al. (1977), our investigation was not conducted with mentally healthy drug users. Instead, young males suffering from drug-induced paranoid hallucinatory psychoses were examined. They were compared with drug-free schizophrenic patients whose psychopathology nevertheless fulfilled the same research diagnostic criteria requirements.

In contrast to the work conducted by Campbell et al. (1971), patients with cranial-cerebral trauma or neurological disease such as epilepsy were excluded from the study from the very beginning.

All of the patients in the drug-user group had a long – in some cases, decades long – past history of chronic cannabis consumption. Moreover, for all of the patients in this group, psychosis appearance was immediately preceded by at least 1 month of virtually daily consumption of cannabis. Nevertheless, no cerebral structural changes that differed significantly from those of a drug-free control group could be shown by CT.

This finding is all the more remarkable as 7 patients in the drug-user group had multiple dependencies, having used heroin, LSD and cocaine, as well as cannabis. Apparently, even this type of dependency does not lead to any cerebral structural changes ascertainable by CT.

Because of the relatively small size of our sampling, we cannot at this time conclude that chronic cannabis consumption does not lead to any cerebral damage. Before such a conclusion can be reached, it will be necessary to continue investigating whether cannabis consumption can cause damage at a much later stage. Our study, in any case, has not yet been able to find a morphological substrate for this.

Endogenous and drug-induced paranoid psychoses with comparable psychopathological symptoms appear the same in the CT cross-sectional scan. We did not find any significant morphological difference between the two groups. It thus remains unclear whether the so-called drug-induced psychoses manifest their own clinical pictures, or if these are symptoms of "triggered" true schizophrenias (Taeschner 1980, 1983).

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