BRAIN CT FINDINGS IN BIPOLAR AFFECTIVE DISORDER: Preliminary report*
Bipolar affektif bozuklukta beyin komputerize tomografi bulguları: Ön bilgiler

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Abstract: *In this study, brain CT findings in 39 patients suffering from bipolar affective disorder were compared with those in 22 healthy controls. Ventricles, interhemispheric fissure and Sylvian fissures were evaluated by square and/or linear measures. The ratio of third ventricle to whole brain in the patient group (3VBR) was found to be higher than the control group with a statistical significance ($p< 0.02$). Both Sylvian fissures were larger than those in the control subjects ($p<0.001$ for the right and $p<0.01$ for the left). The enlargement was more pronounced on the right. While in the control subjects, the left Sylvian fissure was larger than the right one, this asymmetry reversed in the patient group . The enlargement of the third ventricle was correlated with the delusional symptoms. These findings are consistent with other studies which emphasize the importance of subcortical structures, particularly the right temporal lobe, in bipolar affective disorder.*

Key Words: *Bipolar disorder, Affective disorders, X ray computed tomography*

Özet: *Bu çalışmada bipolar affektif bozukluk tanısı alan 39 hastanın beyin tomografi bulguları 22 sağlıklı kontrolünkiyle karşılaştırıldı. Ventriküller, interhemisferik fissür ve Sylvian fissürlar lineer ve/veya alan ölçümleriyle değerlendirildi. Üçüncü ventrikül-beyin oranı (3VBR) hasta grubunda artmış olarak bulundu ($P<0.02$). Her iki Sylvian fissür kontrollerinkinden daha genişti (Sağ için $P<0.001$, sol için $P<0,01$). Sağdaki genişleme daha belirgindi. Kontrol grubunda sol sylvian fissür sağdakinden hafif olarak daha genişken bu asimetri hasta grubunda tersine dönmüştü. Üçüncü ventrikül genişliğinin delüzyonel belirtilerle ilişkili olduğu gözlendi. Bu bulgular, bipolar affektif bozuklukta subkortikal yapıların, özellikle sağ temporal lobun önemini vurgulayan çalışmaları destekler bulundu.*

Anahtar Kelimeler: *Bipolar bozukluk, Affektif bozukluk, Bilgisayarlı tomografi*

Rapid developments in the field of brain displaying techniques and the use of these techniques in psychiatric research have disclosed many clues about the etiology of psychiatric disorders. Mainly the schizophrenias are the most studied disorders in this domain but there are also some interesting studies and findings with bipolar affective disorder. These studies are is usually centralized on the lateral ventricle width. Some authors have reported increased ventricle-brain ratio (VBR) in bipolar patients compared to the healthy controls (1-5), but others suggested that there were no differences (6-8). This enlargement has been investigated as the cause of different clinical features, however in some studies no correlations have been found (2, 9) whereas in others correlations between ventricle

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size and delusions (1,10), negative symptoms (3,5), persistent unemployment (3,4), frequent hospitalization (4), and poorer premorbid adjustment have been demonstrated (5). There are a few studies searching third ventricle size. An increased third ventricle-brain ratio was found in one (6), and a linear enlargement was observed in the other (7). It has been shown that the third ventricle volume was increased in an MRI study (11). The CT measurements of a group of patients have been studied in this research; consequently the patients which significantly differ from the controls have been re-evaluated and their values compared to the subgroups of patients with or without delusional symptoms.

PATIENTS AND METHODS

Patients

This study included 39 patients who admitted to the department of Psychiatry of Gevher Nesibe Hospital and fulfilled DSM-III-R criteria for bipolar affective disorder. Fifteen of the patients were woman and 24 men; the mean (±SD) age was 35.02±10.47 years, mean(±SD) age of onset of the disease was 23.51±6.97 years (range 12-40 years) and the mean (±SD) duration of illness (between first and last episode) was 9.41±5.64 years (range 1-23). Twenty-two patients had delusional features. Eighteen of these had persecutive as well as any kind of delusions (12 patients had persecutive delusions only). Seven patients had mystic as well as other kind of delusions (three of these had only mystic delusions) and 5 patients had other kinds of delusions either during their manic, depressive or both episodes. All patients were remitted during the study. None of them had a history of head injury and chronic institutionalization. The healthy controls consisted of 9 women and 13 men without any physical or mental disorder and mean (±SD) age of this group was 34.54±11.32 years. Patients have been divided into two subgroubs:

1. Patients with delusional features (Mean ± SD age: 33.36 ± 12.99 years; 4 females, 15 males)
2. Patients without delusional features (Mean ± SD age: 36.43± 7.24years; 9 females, 7 males). Four patients with epileptic features were excluded from the subgroup formation process. The patients with delusional symptoms were evaluated as a whole without considering whether these symptoms were mood-congruent or mood-incongruent.

Methods

CT and calculations

Non-contrast CT scans were made on all subjects and controls on a third generation Toshiba 600XT scanner at 12 degrees to the orbitomeatal line with a slice thickness of 5 mm in the posterior fossa and 10 mm in the other regions. The measurements were performed on the sections taken from the same levels for every subjects, and in a window width (WW) 120 and window level (WL) 55. The evaluation of lateral ventricles, third ventricle and interhemispheric fissure of every subject were made by means of computed tomography using linear and planimetric measurement method and the evaluation of fourth ventricle and Sylvian fissures of every subject by using only linear measurement. Frontal horns and the body of lateral ventricle were evaluated as a whole and separately in the left and right hemisphere

Planimetric calculations: the calculated areas were divided by the entire brain area which is at the same level and obtained value multiplied by 100 the following values were obtained:

1. Lateral ventricle/brain ratio (LVBR)
2. Right lateral ventricle/brain ratio (RLVBR)
3. Left lateral ventricle/brain ratio (LLVBR)
4. Frontal horn/brain ratio (FHBR)
5. Right frontal horn/brain ratio (RFHBR)
6. Left frontal horn/brain ratio (LFHBR)
7. Third ventricle/brain ratio (3VBR)
8. Interhemispheric fissure/brain ratio (IFBR)

Linear calculations: The calculated width was divided by the following intracranial width and the obtained value multiplied by 100.

1. Bifrontal width: The ratio of the maximum distance between tips of the frontal horns to the

intracranial width crossing at the same level
2.Bicaudate width: The ratio of the minimum width in the convex parts of the frontal horns to the intracranial width crossing at the same level
3.Right caudate width: The ratio of the minimum width in the convex part of the right frontal horn to the intracranial width crossing at the same level
4.Left caudate width: The ratio of the minimum width in the convex part of the left frontal horn to the intracranial width crossing at the same level
5.Third ventricle width: The ratio of the maximum width of the third ventricle to the intracranial width crossing at the same level
6.Fourth ventricle width: The ratio of the maximum width of the fourth ventricle to the distance between the mastoid processes at that level
7.Interhemispheric width: The ratio of interhemispheric fissure width to the intracranial line crossing by minimal bicaudate level
8.Right and left Sylvian fissure width: This width was measured at the section passing from the supracellar level. The measurement was calculated according to the ratio of both right and left Sylvian fissure width to the length of the line crossing bicaudate width and this was decided arbitrarily.
9.Apart from these the total width of bifrontal and bicaudate widths (Huckmann's Number) were calculated.

The results have been evaluated by using Student's *t* test and one way ANOVA, post hoc Scheffé test where needed.

Table I. Comparisons of the values obtained from CT measurements of the bipolar patients and controls

	Bipolars (n: 39) Mean±SD	Controls (n: 22) Mean±SD	Comparison t*
LVBR	4.902 ± 2.300	4.455 ± 1.991	0.763
Right LVBR	2.399 ± 1.142	2.190 ± 0.911	0.736
Left LVBR	2.499 ± 1.250	2.258 ± 1.100	0.755
FHBR	1.470 ± 0.682	1.271 ± 0.427	1.233
Right FHBR	0.731 ± 0.346	0.608 ± 0.190	1.545
Left FHBR	0.732 ± 0.359	0.658 ± 0.251	0.856
3VBR	0.388 ± 0.214	0.266 ± 0.128	2.425[1]
3rd vent. width	3.293 ± 0.809	3.000 ± 0.597	1.482
IFBR	0.231 ± 0.126	0.188 ± 0.090	1.402
Int.hem.fiss.width	3.204 ± 0.810	2.949 ± 0.741	1.218
4th vent. width	11.742 ± 1.955	11.555 ± 2.302	0.335
Bicaudate width	11.382 ± 2.719	10.993 ± 1.653	0.609
Right caudate width	4.444 ± 1.697	3.950 ± 0.744	1.295
Left caudate width	4.606 ± 1.489	4.256 ± 1.105	0.961
Bifrontal width	29.352 ± 4.444	29.055 ± 4.200	0.256
Huckmann's number	50.997±11.024	50.736±9.118	0.249
Right Sylvian fiss.width	3.746 ± 0.974	2.330 ± 1.026	5.320[2]
Left Sylvian fiss.width	3.372 ± 1.065	2.518 ± 1.135	2.923[3]

* *Student's t test*
[1] *Statistically significant ($p<0.02$)*
[2] *Statistically significant ($p<0.001$)*
[3] *Statistically significant ($p<0.01$)*

Table II. Comparisons of the values of 3VBR and Sylvian fissures width of the patients with and without delusions and controls

	Patients with delusional features n: 19 Mean±SD	Patients without delusional features n: 16 Mean±SD	Controls n: 22 Mean±SD	F*	p
3 VBR	0.451 ± 0.203[a]	0.329 ± 0.231	0.266 ± 0.128	5.02	<0.05
Right Sylvian fissure width	3.959 ± 1.095[a]	3.471 ± 0.888 [a]	2.330 ± 1.026	13.30	<0.05
Left Sylvian fissure width	3.314 ± 1.217	3.303 ± 0.844	2.518 ± 1.135	3.52	>0.05

**ANOVA (Post-hoc Scheffé)*
[a]Significantly different than those of the controls

RESULTS

The results obtained from all measurement have been shown in table I. There were significant differences between the control and the patient groups in the third ventricle size and Sylvian fissure width. The third ventricle-brain ratio (3VBR) was found to be increased ($p < 0.02$) in the patients. There was an increase in the third ventricle width in the linear measurement as well, but this increase was not statistically significant. Both Sylvian fissures were larger than those in the control subjects ($p < 0.001$ for the right and $p<0.01$ for the left). The enlargement was more pronounced on the right. While in the control subjects, the left Sylvian fissure was larger than the right one, this asymmetry reversed in the patient group.

When the patient group was divided into those with or without delusional features, the third ventricle enlargement was found to be significantly increased in the subgroup with delusional features (F: 5.02 $p< 0.05$); however this enlargement was not significant in the latter (Table II).

In both subgroups, the Sylvian fissures were found to be enlarged compared to the controls and this was statistically significant; this difference was pronounced on the right (F: 13.30 $p<0.05$). Furthermore the values of the right and the left lateral ventricles, frontal horns, caudate width and Sylvian fissures were compared within all groups in order to investigate interhemispheric asymmetry. There was a significant difference only between the right and the left Sylvian fissures in the total patient group ($t=2.222$ $p<0.05$) and in the subgroup of patients with delusional features ($t=2.510$ $p<0.05$) when compared with each group.

DISCUSSION

Our significant findings are:
1) The enlargement of third ventricle in the patient group, and the fact that this result was related to the delusional symptoms.
2) The fact that the width of both Sylvian fissures were increased in the right hemisphere compared to the controls. Thus, interhemispheric asymmetry reversed in the patient groups.

The first finding was similarly reported in a previous study (6). In an other study, this finding was reported in the linear measurement only, but in that study patients were not homogenous and when

only the bipolar patients had been taken as a subgroup, no difference was found (7). In the first study there was no relationship between 3VBR and clinical features. In the second one the width of the third ventricle was found to be increased in the psychotic group compared to the normals contrary to the non-psychotics. Again in this study lateral ventricle-brain ratio was significantly increased in the psychotic group compared to the non-psychotics. The relationship between delusional symptoms and enlargement of lateral ventricles in affective disorders were noted before (1, 10). The meaning of third ventricle enlargement found in schizophrenics (12,13) has been discussed in the literature. The enlargement of the third ventricle in the schizophrenics has been attributed to periventricular diencephalic gliosis (14).

For the moment, one can not make such assumptions about bipolar disorder, since there were no neuropathological studies on this subject (6,7). While in patients with affective disorders the ventricular enlargement was related to the delusional symptoms, this was related to the negative symptoms in schizophrenics (15). There are some studies pointing out the same relationship in bipolar disorder as well (3,5). Our findings constitute further evidence of the hypothesis that the diansefalo-limbic area is important in the pathogenesis of psychotic syndromes (6).

The enlargement of Sylvian fissures, one of our findings, has not been reported previously. The evaluation of this finding might be speculative and needs further investigation . In our patient group, the Sylvian fissure enlargements were found on both sides, but this enlargement was more pronounced on the right. The MRI studies in the bipolar patients have not shown any reliable results by now (16-19). If one assumes that the Sylvian Fissure enlargement found in bipolar patients might induce a pathological condition occurring in temporal lobes, this finding is consistent with the other MRI studies reporting a decrease in the volume of both temporal lobes (16).

The fact that this enlargement was more pronounced on the right would be consistent with the thought that the temporal lobe pathology is more conspicuous on the right.

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