
Observing of the asymmetry of hippocampal formation on patients with complex partial attacks

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Abstract

Lobus limbicus is anatomical basis for explaining the temporal epilepsy because it not only includes the focus of infection of temporal lobe but also the frontal lobe, and with it we can explain many of the phenomenon's of the epilepsy (hallucinations, the change of the effects, and so on.).

The goal of this assignment was to explore the asymmetry of hippocampal formation on the patients with complex partial attacks.

The results show that the least number of patients with epilepsy have a symmetric (same) size of the hippocampal formation both from the left and the right side. The number is statistically significantly lower than the number of patients with epilepsy who has asymmetric (different size) hippocampal formation both from the left and the right side. By the direction of asymmetry the difference in the number of patients with epilepsy isn't statistically significant. Coefficient. of asymmetry shows that the asymmetry on the left side is more common to men, while it is distributed evenly on sides, left and right in women. Testing of significance in age differences depends on the sim. / asim. of the hippocampal formation of both the right and the left side of coronal slice is a statistical significance. While with axial and sagittal slices, we have a statistical significance between a women and a man on the level of the course of asymmetry.

So, the use of MRI technique in examining asymmetry of the hippocampal formation, that we used on this asymmetry, we suggest it as an template of future examinations in a sense of shedding light of the anatomical functions that is located on the basis of neuropsychiatrics dysfunctions.

Keywords: limbic system, hippocampal formation, asymmetry, temporal epilepsy

Introduction

In the limbic system visceral functions are integral with emotional behaviour. That shows best a clinical picture of the complex partial attack with the vegetative, psychiatric (dysfunction of the sensible behaviour) and motored symptoms (oral automatism). The importance of hippocampus and the surrounding structures in the electrical activity is best shown with the fact that its damage causes abnormal electrical activity in the brain- epilepsy.

The results of many psychological studies on patients

with epilepsy show that the psychological deficit is much larger in the group of patients with well-known organ etiological factor. Pathology of left temporal lobe some connect with the verbal dysfunction and with learning dysfunctions, wail pathology of the right temporal lobe are conditioning disturbances timing templates and relationships.

Bilateral injury on the temporal lobe that has a great affect on an amygdaloidal complex they cause a series of behavioural changes named Kluver - Bucy syndrome. It is visible on patients as a result of trauma of temporal lobe or

After surgical operation on the temporal lobe due to epilepsy. Kluver - Bucy syndrome is characterized by the following. The patient can no longer recognize objects by site (optical agnosia); he can have a significant tactile and hearing agnosia. There is a tendency that he examines object by mouth or that he smells them. Than, the patient can have a tendency to observed cloud surroundings constant and he can also overreact on optical stimulations. Patient often doesn't show hate of fear, even when that is necessary. Patient can also over eat, even when he is not hungry, or he can eat object that are not edible. Often it is also present hipper sexuality, amnesia, dementia and aphasia; it all depends of the present of damage on the temporal lobe.

Lobus limbicus is anatomical basis for explaining the temporal epilepsy because it not only includes the focus of infection of temporal lobe but also the frontal lobe, and with it we can explain many of the phenomenon's of the epilepsy (hallucinations, the change of the effects, and so on.). Many bodily functions have their rhythm and they are done in cycles of different length. Most often 24-hourly cycles (ex. bodily temperature oscillation, urination etc). The role of "biological hourly" that regulates these rhythms is a part of the limbic system.

There fore, psychomotoric epilepsy is frequently connected with epil. focused in temporal region, witch is proven with EEG. Experience tells us that all patients with a focus in the frontal temporal region have a psychomotor type of epilepsy. For understanding the temporal epilepsy electro stimulation of the temporal cortex and medial part of temporal structures in a man is important. Electro stimulation of the lateral and upper part of temporal lobus on both sides in a mail can cause hallucinations, that is, complex visual and hearing scenes from past (as a sequence of a film), a patient are aver of the

present. The memory of past stops as the electro stimulation stops, but it recurs with the replica of electro stimulation.

Stimulation of the superior temporal gyrus can cause hearing hallucinations. Electro stimulation of upper part and lateral part of temporal cortex can cause interpretive illusions, that is, patients present time in time of stimulation wrongly interpreted.

Illusions of recognizing, that is, present experience is experienced as unreal and unknown. They occur as the result of stimulation of both side of temporal cortex. Illusions of emotions that are the emotions of fear, loneliness, sorrowed or discuss are accomplished by stimulating cortex in the frontal part of parties of temporal lobus.

Materials and Methods

As a material for construction of this study we used 35 MRI scan in all three projections: horizontal (axial), frontal (coronal) and sagittal patients with epilepsy (complex partial attacks). Methods of work include measuring the size of hippocampal formations in all three projections (axial, coronal and sagittal) 35 patients with epilepsy (complex partial attacks).

MRI scans are done on MAGNET IMPACT SIEMENS 1.0 TESLA in T1 relaxation (TR 500 - 600 / TE 15 / field of view 180 x 260, the fatness layer SL 5 mm) and T2 relocation (TR 4000 / TE 90 field of view 188 x 250 for axial and 173 x 230 for coronal, 210 x 240 for sagittal scans in 5 mm layer). Dual sequences are used PD and T2. In PD TR is 4000, and TE 22. We used a head - neck spiral, as well as a head spiral.

On the horizontal (axial), frontal (coronal) and sagittal MRI scans we observed the position and identified a hippocampal formation on the level of temporal lobe of the brain.

On sagittal scans we observed the relation between hippocampal formation versus insula. On some sagittal scans we can see a joined hippocampo-amigdaliod zone.

For the size measurement of hippocampal formation and their comparison from right to left we used a program of evaluation- distance on the MRI from the Institute of Radiology of Clinical Centre in Sarajevo. We tested 35 patients with epilepsy, 19 patients male and 16 female patients, approximate age 40.8 for males with standard deviation of 18.37 years and approximate age 27.1 for females with standard deviation of 11,68 years.

The size of hippocampal formation is measurement in all three projections: horizontal (axial), frontal (coronal) and

sagittal from right and left. All values of hippocampal formation are given in centimetres.

For hippocampal formation in all three projections (axial, coronal and sagittal) are met in:

1. The number of patients with epilepsy according to symmetry/asymmetry on the right and left side
2. Analysis of patients with epilepsy by the approximate size of left and right side.
Significant difference is tested with t-test
3. Distribution of patients with epilepsy towards the different between the right and left side.
The results are shown it tables and diagrams
4. The approximate age of patients with epilepsy towards symmetry / asymmetry from the right and left side.
Significant difference is tested by t-test

Methods of statistical analysis used in this assignment are:

1. Arithmetic middle
2. Standard deviation
3. Standard failure
4. Median
5. Mod
6. Chi-square test
7. t - test differences of arithmetical middle
8. t - test proportionally
9. Coefficient of asymmetry

Results

MRI analysis of patients with epilepsy

A. Hippocampal formation on the axial (horizontal) MRI scans



Picture 1 Axial MRI scans -the slice on a hippocampal formation level



Picture 2 Axial MRI scans -length of hippocampal formation from the right and the left side

Table 1 Shows patient with epilepsy towards symmetry/asymmetry hippocampal formation from right and left on the axial slice

		Male		Female		TOTAL	
		Number	in %	Number	in %	Number	in %
SYMMETRY: hippocampal formation on the right and left side of the axial slice of the same length		3	15.79	2	12.50	5	14.29
ASYMMETRY hippocampal formation on the right and the left side of the axial slice of the different lengths	Total:	16	84.21	14	87.50	30	85.71
	Out of that:						
	• The right side longer than the left side	5	26.32	7	43.75	12	34.28
	• The left side longer than the right side	11	57.89	7	43.75	18	51.43
TOTAL:		19	100.00	16	100.00	35	100.00

The difference in the number of patients with epilepsy in the relation to the length of the hippocampal formation on the left and on the right side of the horizontal slice is statistically significant. The least number of patients has the symmetrical length of hippocampal formation from the right and the left side, while the most number of patients has the hippocampal formation from the left side of the axial slice longer than the one from the right.

The value of Chi-square test is: $\text{ChiSq} = 7.225$, The level of assurance is $p < 0.05$.

Graph 1 Distribution of patients with epilepsy towards difference between the lengths of hippocampal formation from the right and the left side

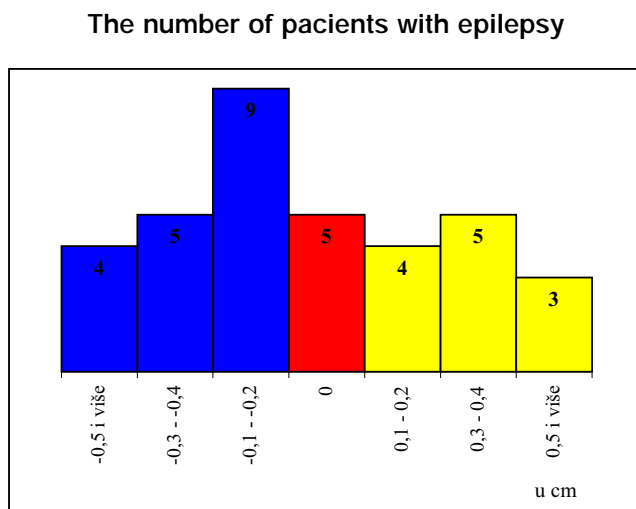


Table 2 The patients with epilepsy towards the approximate length of hippocampal formation from the right and the left

		Male		Female	
		Right side	Left side	Right side	Left side
Arithmetic middle		3.42 cm	3.57 cm	3.23 cm	3.18 cm
Standard deviation	S.D. \bar{x}	0.40 cm	0.55 cm	0.38 cm	0.41 cm
Standard failure	S \bar{x}	0.092	0.13	0.095	0.102
Median	Me	3.49 cm	3.575 cm	3.3 cm	3.1 cm
Coefficient of asymmetry	α	-0.504	-0.027	-0.592	+0.598

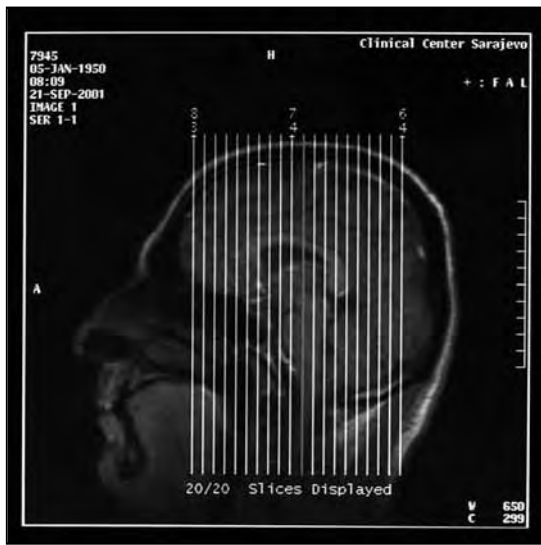
The coefficient shows it is a slight asymmetry to the left, except for women where the asymmetry on the left side is shown the asymmetry of the right side

Table 3 Average age of patients with epilepsy according to symmetry / asymmetry of hippocampal formation at the right and left side of the axial slice

		Male		Female		TOTAL	
		In a year	S.D. \bar{x}	In a year	S.D. \bar{x}	In a year	S.D. \bar{x}
TOTAL		40.8	18.37	27.1	11.68	34.6	17.09
SYMMETRY: hippocampal formation on the right side and on the left side of axial slice of the same length		39.0	9.64	32.0	14.14	36.2	9.43
ASYMM-ETRY: hippocampal formation on the axial slice of the different length	Total:	39.12	18.36	26.2	11.91	33.1	16.96
	Out of that:						
	• The right side longer than the left side	29.2	12.67	29.3	15.69	29.3	13.29
• The left side longer than the right side	43.6	20.09	23.1	7.93	35.7	18.57	

The statistical of significant difference between the man and the woman in a group of patients in which the length of hippocampal formation from the left side axial slice larger on the right. The value of t- test is: $t = 3.305$, the level of assurance is $p < 0.01$.

B. Hippocampal formation on the coronal (frontal) MRI slices



Picture 3 Coronal MRI scans -a slice on the level of the frontal part of hippocampal formation



Picture 4 Coronal MRI scans -the width of the hippocampal formation on the left and the right side

Table 4 Shows patients with epilepsy towards symmetry/asymmetry hippocampal formation from right and left on the coronal slice

	Male		Female		TOTAL		
	Number	In %	Number	in %	Number	In %	
SYMMETRY: hippocampal formation on the right side and on the left side of the coronal slice of the same width	7	36.84	2	12.50	9	25.71	
ASYMMETRY: hippocampal formation on the right side and on the left side of the coronal slice of the different width	Total:	12	63.16	14	87.50	26	74.29
	Out of that:						
	• The right side wider than the left side	6	31.58	11	68.75	17	48.58
• The left side wider than the right side	6	31.58	3	18.75	9	25.71	
TOTAL:	19	100.00	16	100.00	35	100.00	

Number of epilepsy patients with symmetric (same width) of hippocampal formation at the left and right side on the coronal slice significantly is smaller than the epilepsy patient with asymmetrical (different width) of hippocampal formation from the left and right side

The value of Chi-square test is: ChiSq =8.257; the level of assurance is $p < 0.01$.

Graph 2 Distribution of patients with epilepsy towards difference of hippocampal formation from the right and the left side on the coronal slice

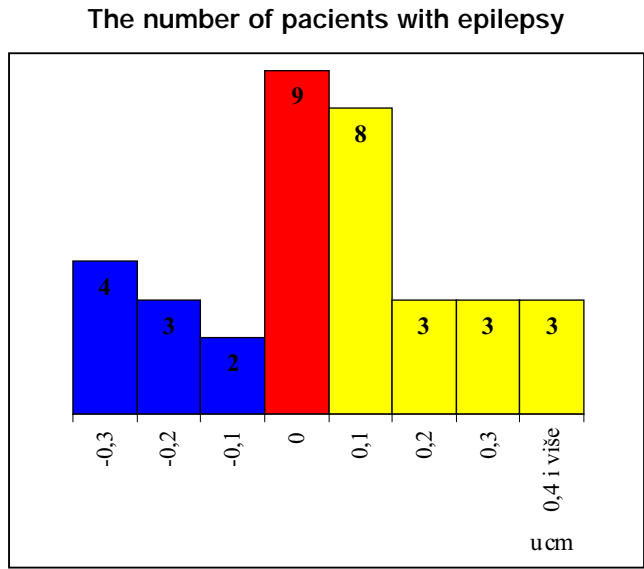


Table 5 The patients with epilepsy towards the approximate width of hippocampal formation from the right and the left

		Male		Female	
		Right side	Left side	Right side	Left side
Arithmetic middle		1.974 cm	1.958 cm	2.056 cm	1.975 cm
Standard deviation	S.D. \bar{x}	0.338 cm	0.258 cm	0.179 cm	0.216 cm
Standard failure	S \bar{x}	0.078	0.0592	0.045	0.0541
Median	Me	2.11 cm	2.11 cm	2.15 cm	2.05 cm
Coefficient of asymmetry	α	-1.208	-1.768	-1.570	-1.039

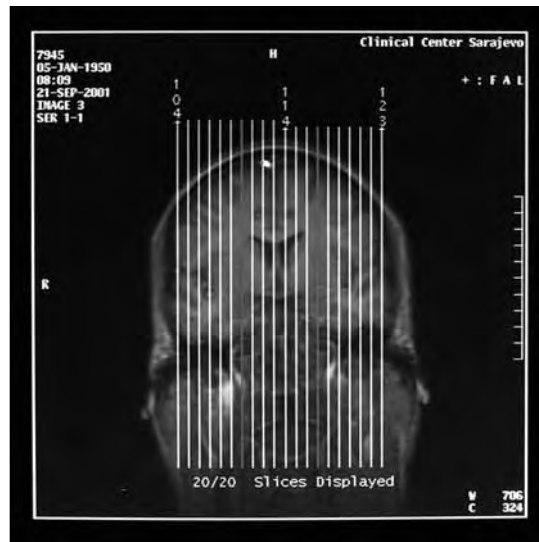
Coefficient of asymmetry shows asymmetry on the left side, for both sides (left and right) and for both sex.

Table 6 Average age of patients with epilepsy according to symmetry / asymmetry of hippocampal formation at the right and left side of the coronal slice

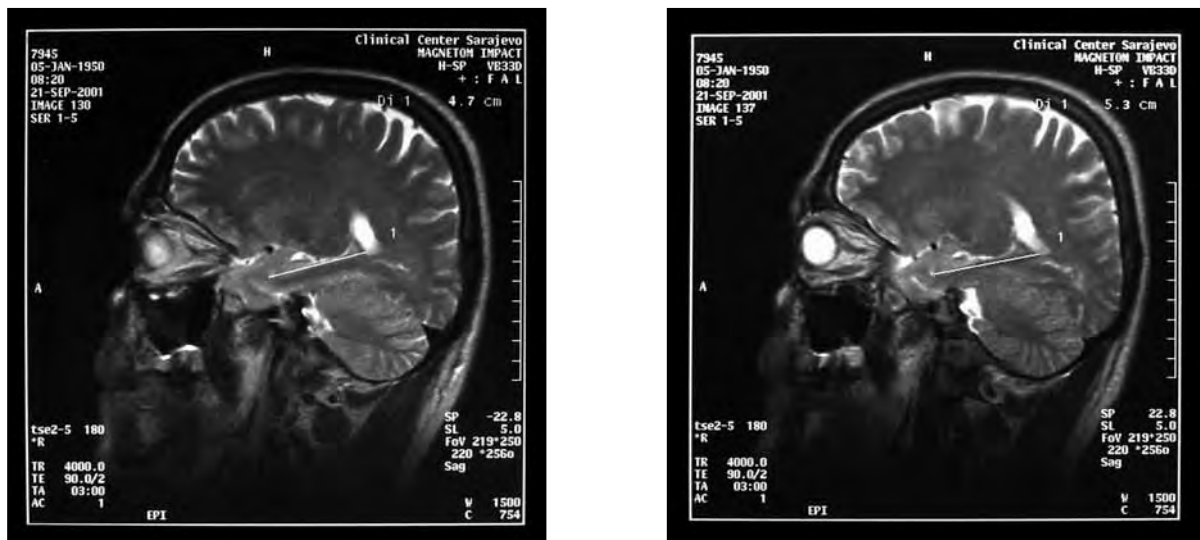
		Male		Female		TOTAL	
		In a year	S.D. \bar{x}	In a year	S.D. \bar{x}	In a year	S.D. \bar{x}
TOTAL		40.8	18.37	27.1	11.68	34.6	17.09
SYMMETRY: hippocampal formation on the right and on the left side of the coronal slice of the same width		47.71	19.04	23.0	2.82	42.22	18.66
ASYMMETRY: hippocampal formation on the right and on the left side of the coronal slice of the different width	Total:	34.08	14.68	27.71	12.36	30.65	13.83
	Out of that:						
	• The right side wider than the left side	34.0	17.49	28.36	13.35	30.35	14.27
• The left side wider than the right side	34.16	14.52	25.33	12.34	31.22	12.97	

Difference in age average between patient with symmetric value of width of hippocampal formation at the right and left side of coronal slice and patients with asymmetric values, is statistically significant on the level of assurance $p < 0.10$. The value of t-test is : $t=1.703$.

C. Hippocampal formation on the sagittal MRI slices



Picture 5 Sagittal MRI scans -slice on the level of the parahippocampal gyrus and the hippocampal formation



Picture 6 Sagittal MRI scans -the measurements for the hippocampal formations on the right and the left side

Table 7 Shows patients with epilepsy towards symmetry/asymmetry hippocampal formation from right and left on the sagittal slice

		Male		Female		TOTAL	
		In a year	S.D. \bar{x}	In a year	S.D. \bar{x}	In a year	S.D. \bar{x}
TOTAL		40.8	18.37	27.1	11.68	34.6	17.09
SYMMETRY: hippocampal formation on the right and on the left side of the coronal slice of the same width		47.71	19.04	23.0	2.82	42.22	18.66
ASYMMETRY: hippocampal formation on the right and on the left side of the coronal slice of the different width	Total:	34.08	14.68	27.71	12.36	30.65	13.83
	Out of that:						
	• The right side wider than the left side	34.0	17.49	28.36	13.35	30.35	14.27
	• The left side wider than the right side	34.16	14.52	25.33	12.34	31.22	12.97

Number of patient with epilepsy with symmetric (same length) of hippocampal formation at the right and left side of sagittal slice is significantly smaller by statistics from number of patient with epilepsy with different length of hippocampal formation at the right and left side. The value of Chi-square test is: $\text{ChiSq} = 24.028$ while level of assurance is $p < 0.001$

Graph 3 Distribution of patients with epilepsy towards difference between the length of hippocampal formation from the right and the left side

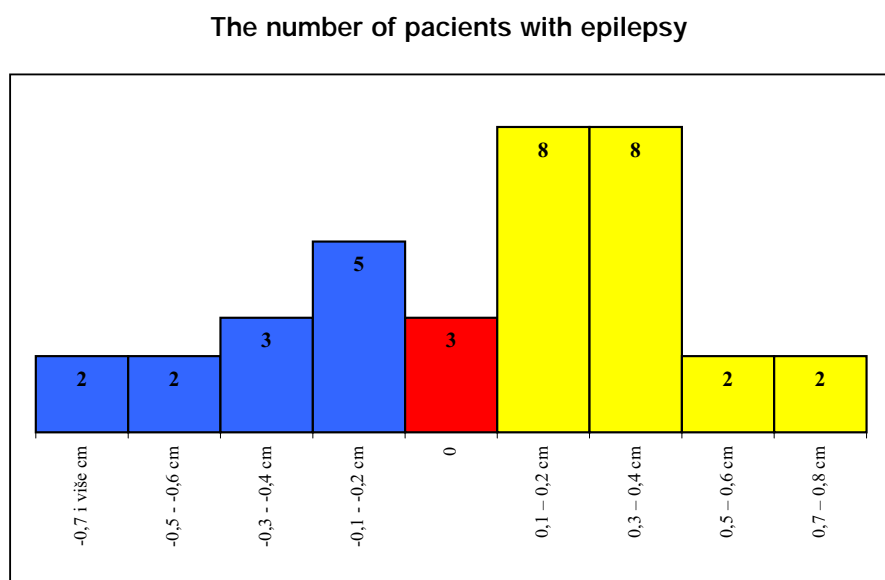


Table 8 The patients with epilepsy towards the approximate length of hippocampal formation from the right and the left

		Male		Female	
		Right side	Left side	Right side	Left side
Arithmetic middle		4.16 cm	4.11 cm	4.20 cm	4.14 cm
Standard deviation	S.D. \bar{x}	0.43 cm	0.42cm	0.37 cm	0.53 cm
Standard failure	$\overline{S\bar{x}}$	0.099 cm	0.096	0.093	0.118
Median	Me	4.15 cm	4.12 cm	4.15 cm	4.1 cm
Coefficient of asymmetry	α	+0.090	-0.044	+0.408	+0.214

Coefficient of asymmetry shows asymmetry on the right side. Excuse is asymmetry for the mails left side - which asymmetry is on left side

Table 9 Average age of patients with epilepsy according to symmetry / asymmetry of hippocampal formation at the right and left side of the sagittal slice

		Male		Female		TOTAL	
		In a year	S.D. \bar{x}	In a year	S.D. \bar{x}	In a year	S.D. \bar{x}
SYMMETRY: hippocampal formation on the right and on the left side of the sagittal slice of the same length		19.5	3.5	30.0	0	23	5.72
ASYMMETRY: hippocampal formation on the right and on the left side of the sagittal slice of the different length	Total:	41.41	16.62	26.93	12.0	34.62	16.34
	Out of that:						
	• The right side longer than the left side	41.36	18.94	29.56	13.5	36.05	17.73
• The left side longer than the right side	41.5	11.18	23.0	7.85	32.37	13.37	

The difference in average age between mail and female in group of patient which hippocampal formation is longer from the left side in compare to the right side is statistically significant. The value of t test is: $t = 3.317$; the level of assurance is $p < 0.05$.

Discussion

The locating of the precise location of the incorrect anatomical function that is in the basis of the neurological and psychiatric dysfunctions just recently became the subject of intensive research in this field. In that sense it is important to apply structural and functional techniques of MRI, for future pinpointing of the problems in working with epilepsy. There for, MRI offers the most sensitive volumetric measurements of hippocampal formation. R. C. Peterson et al. - 2000 (22) proves that MRI - hippocampal formation precisely shows structural-functional relationship between the deficit of memory and hippocampal damage with the sector of normal ageing of dementia. Authors underline, that the hippocampal sizes can be precisely sensitive as the diagnostically techniques in early uncovering of the degenerative diseases as it is in AD. In the work of N. Bernasconi et al. - 2001 (3) it is shown that the hippocampal sclerosis is most often pathology that can be found in the basis of epilepsy of temporal lobe (ETR) that doesn't react to pharmaceuticals. Authors show that the usual MRI medical findings on patients with epilepsy with ETR hippocampal atrophy. Also, they emphasize the cause / effect relationship between the formation of hippocampal sclerosis, and its vivo relationship with hippocampal atrophy with the existence of temperature convulsions in the picture ETR. Tuuli Salmenpera et al. - 2000 (29) proves that the status epilepticus doesn't always lead to progressive lessening of the size of the structure in the medial temporal lobe on matured patients that have been treated without hospitalization, with already known protocol for quick relief from the attacks. There for the authors emphasize that the serial showing of the magnetic resonance (MRI) offers a tool for following the temporal progression of the cerebral damage that follows the status of epileptics thru the life. Authors also emphasize the presence of the progressive hippocampal damage on MRI after the prolonged status epilepticus and the resistant one to the drugs. And finally, an emphasize on doing the aetiology, that is the acute or chronically of the process.

On the basis of the analysis of our results connected with the size of the **hippocampal formation** in all three projections (axial, coronal and sagittal), in the group of patients with epilepsy we can conclude in the following way:

1. In all three slices the least number of patients with epilepsy have a symmetric (same) size of the hippocampal formations from the left and the right side. That number is statistically significantly lower than the number of patients with epilepsy with asymmetric (different size) hippocampal formations from both sides. By the way of asymmetry the difference in the number of patients with epilepsy isn't statistical significant, except with axial slice, were we have the largest number of patients with

hippocampal formation on the left side longer than on the right (51.43 %).

2. With all three slices in the approximate size of the hippocampal formation from the right and left sides isn't statistically significant in men nor in women, except in axial slice were we have the difference between the approximate size of hippocampal formation on the left side between the men and a women is statistical significant, that is the same in the text before.

3. When it comes to the coefficient of asymmetry it shows that the asymmetry on the left side is more often in men, while women have the same distribution on both sides.

4. The testing of the significance differences in approximate ageing of patients depends on the sim./ asim. hippocampal formation from the right and the left sides of coronal slice is stat. sign. While in axial and sagittal slice, we have a statistically significant between the women and a man on the level of asymmetry:

- a) With the axial slice in the group of patients that have the longer hippocampal formation on the left side - males are older than women.
- b) With the sagittal slice in the group of patients with the longer hippocampal formation on the left side - males are older than women.

Conclusions

On basis of our analysis we can conclude:

1. Every one of analyzed asymmetry shows the same characteristics in the group, in which we emphasize variations.

2. We also emphasize the importance of presence of conciseness in individual characteristics of every one of the parameters in the shading light on asymmetry of hippocampal formation.

3. We have to be careful about what projection we are refusing to as being watched hippocampal formation because the results will depend on that. We can suggest the prospective studies in more projections because of the value of the statistically significant conclusions.

4. MRI - volumetric measurement have their value.

5. Usage of MRI techniques in examining the asymmetry of hippocampal formation, that we used, we suggest as the studies in the future research in the sense of the shading light on the anatomical functions that are on the basis of neuropsychiatry dysfunctions.

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