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Clinical and Computed Tomography Studies of Parkinson's Disease

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Abstract: ***293 patients suffering from Parkinson's disease were studied. In 230 of them a Computed Tomography (CT) scan of the brain was performed. The scan found pathological abnormalities in 95 patients (49 men and 46 women). The basic clinical symptoms were studied as well, while the patients' condition was assessed by specialized scales (UPDRS, Hoehn and Yahr, Schwab and England). Electromyography studies of tremor were conducted as well. Tremor– found in 274 patients (91,3%), hypomimia – found in 268 patients (91,4 %) and lack of motivation/initiative – found in 245 patients (83,6%) were the most frequent clinical manifestations. The modified Hoehn and Yahr scale showed that the mild to moderate bilateral pathological changes, ranging between 2, 5 and 3 stages, were most frequently found, while the Schwab and England scale revealed that 40,9 % of the patients were completely independent in their every day household activities, but they needed twice as much time to perform them. The pathological CT scan results showed a significant correlation with the severity of the clinical symptoms, assessed by the Hoehn and Yahr scale, a fact which makes the combination of these two methods particularly appropriate for clinical assessment of patients, suffering from Parkinson's diseases.***

Keywords: Parkinson's disease, Hoehn and Yahr Scale, Computed tomography

1. Introduction

Parkinson's disease, known as idiopatic or primary parkinsonism (paralysis agitans) is a degenerative disease of the central nervous system (CNS). The motor symptoms are a result of the loss of dopamine-producing cells in the substantia nigra, the cause for that cell death being unknown. It is characterized with the accumulation of specific protein in the shape of alpha synuclein inclusions in the neurons, called Lewy bodies. The earliest signs of the disease are movement disorders like tremor, rigid muscles, slowed movement, impaired posture and gait. Slowed thinking and dementia are found as well. Depression, sleep-related problems, sensory and emotional complaints appear in more advanced stages. Parkinson's disease is widespread worldwide, affecting mainly people aged between 50 and 60. A large European study of 14 636 people over the age of 65 was conducted. The overall incidence of the disease (in 100 people) was found to be 2,3 for parkinsonism and 1,6 for Parkinson's disease. Data on the prevalence of the disease in different countries showed no significant differences between them, except for the French population, where the incidence was lower. The general conclusion is that the incidence of these diseases increases with age, but there are no significant differences by gender. (De Rijk M et al., 1991). Parkinsonism is a clinical diagnosis.There are no established typical biomarkers that are characteristic of the disease, while the routine imaging techniques like CT,MRI,PET and SPECT, in most cases do not show typical changes (Hauser R, 2014). However, some of them reveal findings which can be connected with the disease.

2. Aim

Study of the correlation between the established Computed Tomography Scan findings and clinical course of the disease in patients, suffering from Parkinson's disease.

Material and Methods:

293 patients with Parkinson's disease (129 man and 164 women) aged 58-79, randomly picked for a 8-year period (2005-2012) were studied. The study used the following assessment tools:

1. Unified Parkinson's disease rating scale – UPDRS
2. Modified Hoehn and Yahr scale for assessment of clinical symptoms
3. Schwab and England Activities of Daily Living Scale
4. Computed tomography scan of the brain
5. Electromyographic studies of tremor (tremorograms) performed with EMG equipment
6. Statistical methods for processing the data received – SPSS statistics software, StatSoft 6.0 and WINEPR-SimFonia software programme.

3. Results

The Unified Parkinson's disease rating scale (UPDRS) showed that:

1. The examination of the mentation, behaviour and mood showed that the lack of motivation/initiative was most frequent - in 245 patients / 83,6%/, while thought disorder was the least common – in 79 patients/ 26,9 % /.
2. From the disorders of the daily living activities tremor was the most frequently found - in 274 patients / 93,1 % /, second came walking disorders – in 203patients/ 69,2% /,

while swallowing disorders came last – 76 patients/ 25,9% /.

3. The study of motor disorders of patients with Parkinson's disease showed that hypomimia had the highest incidence - in 268 patients / 91,4% /, followed by tremor at rest – in 261 patients / 89% /and muscle rigidity – in 240 patients /81,9%/.
4. Treatment complications showed the highest incidence of dyskinesia, found in 50 patients / 17% /

Our study showed that mild to moderate bilateral pathological changes, stages between 2,5 and 3 according to the Hoehn and Jahr scale, were most frequently observed – total of 175 patients / 59,7% /, and were equally found in male and female patients suffering from Parkinson's disease. Next came 2 -stage bilateral pathological changes with no impairment of balance - in 55 patients /33,5% /, a little more frequent in female patients.

The unilateral symptoms with axial involvement were comparatively rare – in 30 patients /10,2% /. Unilateral symptoms were the least frequent - in 11 patients/ 3,7% /, while the patients who needed a wheelchair were /0,7% /. The prevalence of patients with 2-3 stage of impairment showed that their treatment had begun relatively late. Up to that moment they had been managing comparatively well (*Table 1).* Modified Hoehn and Yahr Scale

Table 1: Distribution of the patients with Parkinson's disease according to the impairment stage

Impairment stage	men	Gender women	Total
	n %	n %	n %
0 = No signs of disease.			
1 = Unilateral symptoms	2 1,5	7 4,2	9 3
1,5 = Unilateral symptoms plus axial involvement	11 8,5	19 11,5	30 10,2
2,0 =Bilateral symptoms with no impairment of balance	21 16,2	34 20,7	55 33,5
2,5 = Mild bilateral symptoms with posture recovery during the retropulsion test	38 29,4	49 28	87 53
3 = Light to moderate bilateral symptoms;Postural instability in some patients Physically independent	47 36,4	41 25	88 30
4 = Severe disability; patients can still stand and walk unassisted	10 7,7	12 7,3	22 7,5
5 = The patients need a wheelchair or are bedridden unless unassisted	0 -	2 0,7	2 0,7

The results showed that a great part of the patients – 120 (40,9 %) were completely independent and able to do most chores, but they needed twice as much time, i.e. they showed 80% independence. From the rest of the patients included in the study, 59 /20,1%/ were completely independent. 71 of the patients had 60% independence while 20% were dependent on other people's assistance. Some of the patients could cope with only some of the daily living tasks. There were no gender-related statistically significant differences (*Table 2).*

Schwab and England Activities of Daily Living Scale

Table 2: Distribution of the patients with Parkinson's disease according to their ability to do the activities of daily living

Impairment stage / % /	men	Gender women	Total
	n %	n %	n %
100 % = Completely independent. Able to do all chores with no slowness, difficulty or impairment. They lead a normal life and are not aware of any difficulties.	- -	- -	- -
90 % = Completely independent. Able to do all chores with some slowness, difficulty or impairment. Tasks performed may take twice as long. Conscious of the diff.	19 14,7	24 14,6	43 14,6
80 % = Independent in most chores. Tasks performed take twice as long. Conscious of the difficulties and slowing.	53 41	67 40,8	120 40,9
70 % = Not completely independent. More difficulties with some chores. Three to four times as long for tasks performed. It may take large part of the day for chores.	28 21,7	31 18,9	59 20,1
60 % = Some are dependent. They can do most chores but very slow and with much effort. Errors can be made because the assessment of some patients is impossible.	6 4,6	18 10,9	24 8,1
50 % = More dependent. They need assistance with half of the chores and are very slow. They have difficulties with everyth.	10 7,7	7 4,2	17 5,8
40 % =Very dependent. They need assistance for all chores, but they can still do some of them on their own.	9 6,9	9 5,4	18 6,1
30 % =They do with effort a few chores alone, or only begin them alone. Much help needed.	3 2,3	6 3,6	9 3
20 % = They can do nothing alone. Can be assisted in doing some chores. Severe disability.	1 0,7	2 1,2	3 1
10 % = Totally dependent, helpless. Complete disability.	- -	- -	- -

0 % = Some vegetative functions, such as swallowing. Bladder and bowel not functioning.	- -	- -	- -

CT scan of the brain was performed in 230 patients (95 men and 132 women). Normal findings were observed in 135 patients (57 men and 78 women), while 95 patients (49 men and 46 women) had pathological changes. *Table 3* shows the distribution of male patients with Parkinson's disease according to the impairment stage, assessed by the modified Hoehn and Yahr scale, and on the basis of the pathological finding. 13 of 49 patients manifested symptoms of the fourth stage according to the scale. In 9 of the cases the CT scan revealed combination of cortical atrophy and multiinfarct encephalopathy, which is to show that the severity of the clinical symptoms correlates directly to the pathological changes, found with the CT scan of the brain. The same correlation was observed in 18 patients with third-stage symptoms. 8 of them also showed the severest combined pathology during the CT scan. 12 patients with 2,5- stage symptoms according to Hoehn and Yahr scale were most frequently diagnosed with total brain atrophy (in 7 patients), while only three patients had more expressed pathological findings. 6 of the patients were diagnosed with symptoms of 2,0 and 1,5 stage; in 4 of them the CT scan revealed total brain atrophy, while 1 patient had single hypodense lesion.

Table 3: Distribution of male patients with Parkinson's disease according to the stage of impairment and the pathological CT scan finding

Stage according to Hoehn and Jahr		Pathological CT scan Finding			
	Number	Cortical atrophy	Total brain atropy	Hypodense lesions	Cortical atrophy and multiinfarct encephalopathy
4	13	2	3	-	9
3	18	2	6	2	8
2,5	12	1	7	1	3
2	4	-	4	-	-
1,5	2	-	-	1	-
Total	49	5	20	4	20

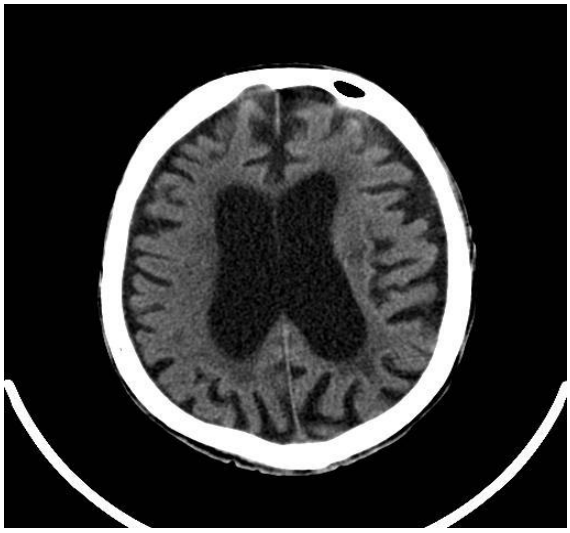

Figure 1: CT scan of Male patient with Parkinson's disease. Total brain atrophy.

Table 4 shows the distribution of female patients with Parkinson's disease according to the impairment stage, assessed by the modified Hoehn and Yahr scale, and on the basis of the pathological CT scan finding. 6 of the patients manifested symptoms of fourth stage according to the Hoehn and Yahr scale. Half of them had a combination of cortical atrophy and multiinfarct encephalopathy. Clinical symptoms of third stage were more frequently observed (in12 patients). 4 of them had a combination of cortical atrophy and multiinfarct encephalopathy, while 2 of the patients showed cortical atrophy, total brain atrophy and single hypodense lesions respectively. Most frequent were the cases of patients with symptoms of 2,5 stage (14 patients). The most frequent finding in them was total brain atrophy (7 patients), followed by cortical atrophy and single hypodense lesions – three patents for each. The female patients studied, just like the male ones, showed that patients with symptoms in the 2,0 ; 1,5 and 1,0 stage according to the Hoehn and Yahr scale, had more rare and less expressed CT scan pathological findings.

Table 4: Distribution of female patients with Parkinson's disease according to the stage of impairment and the pathological CT scan finding

Stage according to Hoehn and Jahr		Pathological CT scan Finding			
	Number	Cortical atrophy	Total brain atrophy	Hypodense lesions	Cortical atrophy and multiinfarct encephalopathy
4	6	3	1	3	3
3	12	2	2	2	4
2,5	14	3	7	3	1
2,0	8	2	3	1	1
1,5	5	3	-	-	1
1,0	1	-	-	1	-
Total	46	13	13	10	10

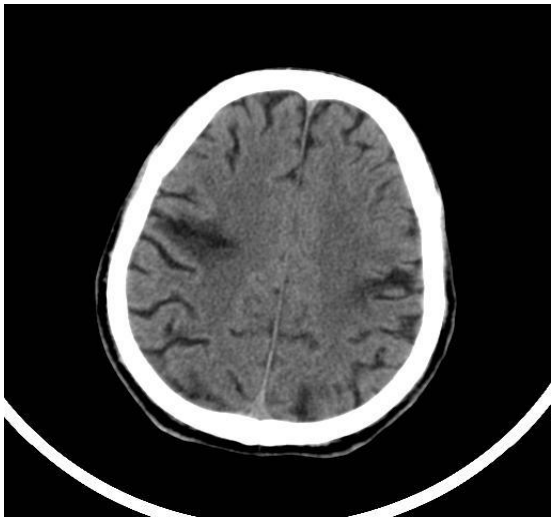

Figure 2: CT scan of Female patient with Parkinson's disease. Multiinfarct encephalopathy

4. Discussion

A study of 122 patients (50 women and 72 men of an average age of 62) with idiopatic Parkinson's disease was conducted. The patients were examined with FP – CIT SPECT, while the severity of the disease was assessed according to the Hoehn and Yahr scale. The analysis of the results showed a significant difference in the FP – CIT SPECT uptake in the subgroup of tremor-dominated patients as compared to those with akinetic-rigid type of Parkinson's disease. (Eggers C et al., 2011). The magnetic resonance changes in the brain of 30 patients of an average age 64,5 were studied together with a control group of 30 healthy volunteers. The severity of the disease was assessed by the Hoehn and Yahr Scale and the Rating Scale. As compared to the control group the patients had significantly more severe impairment in the putamen and substantia (Wang J et al.2011).

The relationship between the white matter alteration (leukoaraiosis) and Parkinson's disease is not completely explained. There are quite a lot of studies of that problem. The ARIC study was conducted in 141 patients with PD, who were grouped in two phenotypes – tremor dominated patients and patients with postural instability and gait difficulties (PIGD). The clinical estimation was done with the UPDRS and Hoehn and Yahr scales. Multivariate logistic regression analysis showed, that leukoaraiosis was independently associated with the PIGD motor phenotype of Parkinson's disease (Lee S et al. 2008). Other studies showed that leukoaraiosis was usually associated with cerebral small vessels disease (Young V 2008, Longstreth W 2009, Smith E 2010), with subtle gait and balance disorders (De Laat K 2011), with rigidity and slowed movements (Acharya H, 2007, Slawek J 2010, Bohnen N 2011) and with cognitive impairment (Gunning – Dixon F 2000, Kuo H 2004). The important question is whether concomitant leukoaraiosis in Parkinson's disease reflects the effect of normal aging, the effect of specific diseases or is due to other pathological processes (Levy G 2007). The lesions in the white matter structure can cause various clinical symptoms, which depend on their anatomical location. In contrast to the more acute lesions in brain stroke and multiple sclerosis, which can result in sudden sensorimotor deficit, slow white matter aging causes gradual and subtle changes, resulting mainly in cognitive impairment .Such cognitive symptoms have been explained by strategically located white matter lesions in the deep forebrain that may disrupt the cholinergic projection fibers. Imaging studies conducted prove that white matter periventricular lesions are associated with the cortical cholinergic deafferentation in elderly people with leukoaraiosis (Bohnen N, Albin R, 2011). F-fluorodopa Positron Emission Tomography scan showed correlation between the number of dead nigral cells and the clinical symptoms of Parkinson's disease like bradykinesia, muscle rigidity and postular instability (Vingerhoets F et al,1997). To clarify the importance of brain atrophy in relation to the symptoms of Parkinson's disease 173 patients were examined by computed tomography. In 51,4 % of the CT findings pathological brain atrophy was observed. Statistically significant differences of gender and age were found with regard to the extent and localization of brain atrophy. Cortical atrophy also showed a significant dependence on duration of disease. It can be assumed that brain atrophy in Parkinson's patients is more prevalent than in healthy people of the same age (Bacher H , 1979). CT scan examinations of the brain in Parkinson's patients were conducted, where the patients were divided in two groups– patients with dementia and others without dementia. The demented patients were older and more frequently had findings for brain atrophy and leukoaraiosis as compared to the nondemented ones (Levin R, 1994). Systemic studies showed that concomitant vascular pathology can significantly contribute to the clinical manifestations of neurodegenerative dementias. (Schneider J, Benneth D, 2010, Brown W 2009).

There are other studies which, like ours, show that patients with loss of functions for independent life usually complain for the first time during the second and third stages of the disease according to the Hoehn and Jahr scale (Schulman L 2008). Our results show that the CT scan of the brain, though not in the same extent as compared to Nuclear Magnetic Resonance and other highly specialized neuroimaging techniques, can provide sufficient information about the pathological changes in brain parenchyma. These data show a significant degree of correlation with the severity of clinical symptoms, assessed by the modified Hoehn and Jahr scale. That makes the combination of the two methods particularly appropriate for assessment of Parkinson's patients in daily work as the said methods are easily accessible and comparatively less expensive.

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