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Original research article

Articulation disorders and duration, severity and L-dopa dosage in idiopathic Parkinson's disease

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ABSTRACT

Background: Parkinson's disease (PD) is one of the most common diseases of the central nervous system (CNS). It is frequently heralded by speech disturbances, which are one of its first symptoms.

Aim: The aim of this paper is to share our own experience concerning the correlation between the severity of speech disorders and the PD duration, its severity and the intake of L-dopa.

Material and methods: The research included 93 patients with idiopathic PD, aged 26–86 years (mean age 65.1 years). Participants were examined neurologically according to the Unified Parkinson's Disease Rating Scale (UPDRS) and the Hoehn and Yahr Scale. They were also assessed by Frenchay Dysarthria Assessment.

Results: Considerable and severe disorders were concurrent with impairments in the mobility of the tongue, lips, the jaw as well as the pitch and loudness of the voice. The strongest correlation but at a moderate level was found to exist between the severity of labial impairment, voice loudness and the length of the disease. There was also a positive correlation between lip movement while the motions were being diversified, lip arrangement while speaking and the intake of L-dopa.

Conclusions: As PD progresses a significant decline in vocal articulation can be observed, which is due to reduced mobility within the lips and the jaw. Exacerbation of articulation disorders resulting from progression of the disease does not materially influence the UPDRSS scores. L-dopa has been found to positively affect the mobility of the lips while the patient is speaking and their arrangement at rest.

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Parkinson's disease (PD) is one of the most common diseases of the central nervous system (CNS). It is frequently heralded by speech disturbances, which are one of its first symptoms [1,2] present in up to 89% of parkinsonian patients [3]. Most of them do not perceive their communication problems [1,4]. Impaired speech results from the patients' articulation, phonation and breathing dysfunction, which consequently leads to reduced loudness, lack of rhythm and pace of speech, numerous pauses, reduction of stress as well as improper consonant articulation [5,6].

Studies show imprecise articulation of consonants /p/, /b/, /s/, /f/, as well as /ʃ/ and /ʒ/ [7,8].

The quality of articulation is influenced by the pace of speech, which, apart from the disease itself, is also affected by patients' age. There are few studies into the relation between the exacerbation of the movement disorder within the speech organs and duration of the disease, its severity and L-dopa dosage. The findings are inconsistent. Some of those studies show that relation does exist [9–14]. On the other hand, research carried out with the application of the measurement of energy concentration in an acoustic spectrum of an acoustic image of vowels of the lower formants F1 and F2 shows lack of connection between duration of the diseases, its severity and motor symptoms [15]. It needs to be noted though that the subjects were patients with mild speech impairment. Although various studies attempted to show the relation between the dosage of L-dopa and the quality of speech in PD patients, the results are still inconclusive [16–19].

Diverse research into speech disorders in PD patients has been conducted and although many techniques of acoustic analysis [18], videoscopic examination [20] and positron emission tomography [21,22] have been applied, the mechanism responsible for the onset of speech disorders in PD has not been identified yet.

The aim of this paper is to share our experience concerning the correlation between the severity of speech disorders and the PD duration, its severity and the intake of L-dopa.

Material and method

The study involved 93 patients diagnosed with PD, 33 (35.5% women; aged between 26 and 86 – average 65.1 years. PD was diagnosed by means of neurological examinations, biochemical tests and MRI and CT scanning in accordance with the United Kingdom Parkinson's Disease Society Brain Bank (UKPDSBB) criteria [23]. Duration of the illness, measured from the occurrence of the first symptoms of PD, varied from 1 month to 27 years (average 7.5 years). Daily intake of L-dopa ranged from 150 to 2000 mg, on average 570.9 mg.

The Unified Parkinson's Disease Rating Scale (UPDRS) [23] and the 5-stage Hoehn and Yahr Scale [24] were used for the assessment of the severity of the disease.

A speech and language test involved the assessment of the mobility of the speech organs as well as the reflexes inside the oral cavity. *Frenchay Dysarthria Assessment – FDA* [25], an objective test for the assessment of the vocal organs and the severity of speech disorders, was applied. The test enables monitoring both the effect of the therapy and the severity of speech disturbances. A 5-point rating scale (a–e) is used for the assessment, where letter 'a' represents norm, 'b' mild severity, 'c' moderate, 'd' considerable severity, 'e' very high severity. The test evaluates the following functions: swallowing, breathing, performance of the tongue, lips, the soft palate and the jaw as well as the pitch and loudness of the voice.

Patients with considerable deviation from the norm were referred for laryngological consultations so that possible other conditions within the speech organs could be ruled out.

The study was approved by the Pomeranian Medical University Commission of Ethics – Resolution no KB-0012/07/10 of 21 January 2010.

Statistical analysis

The analysis of the results was carried out by means of STATISTICA – a statistics and analytics software package for Windows 10. Distributions of the answers to the survey questions were analyzed through the application of tables of descriptive statistics and multiplicity charts. In case of variables measured on quantitative scales, the Shapiro–Wilk test [26] was used to determine whether the obtained distributions were in conformity with hypothetically standard normal distribution or significantly different. The Mann–Whitney *U* [27] test was applied in order to analyze the differences between the quantitative scales distributions and grouping qualitative variables. The statistical dependence between the variables on the quantitative scales was analyzed by means of an estimated Spearman's rank correlation coefficient. Level $p < 0.05$ was adopted as significant and $p < 0.01$ highly significant [28,29].

Results

Table 1 shows the relationship between articulation disorders and their severity on the FDA scale. Considerable and severe disorders were concurrent with impairments in the mobility of the tongue, lips, the jaw as well as the pitch and loudness of the voice.

Table 2 illustrates the correlation between articulation disorders evaluated by means of the objective FDA test and the duration of the disease. The strongest correlation at a moderate level was found to exist between the severity of labial impairment, voice loudness and the length of the disease. There was also a positive correlation between arrangement of the lips, jaw movement during speaking, the pitch and the duration of the disease. No correlation was found between articulation disorders and severity of PD measured on UPDRS scale. A hardly material tendency was found in the relation between the arrangement of the lips during speaking and the severity of the disease (R Spearman 0.2881, $p = 0.0610$). No correlation was found between articulation disorders and a stage of the disease measured according to the Hoehn and Yahr scale.

According to Table 3 there was a positive correlation between lip movement while the motions were being diversified, lip arrangement while speaking and the intake of L-dopa.