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Neurologopedic Correlates of Cognitive Ageing and Dementia

Neurologopedyczne korelaty starzenia kognitywnego i demencji

Joanna Rosińczuk, Magdalena Kazimierska-Zajac, Robert Dymarek

Department of Nervous System Diseases, Faculty of Health Science, Medical University in Wrocław, Poland

Abstract

Introduction. Aging is the subject of interest of many fields of science. Equal place of neurologopedic studies do not raise doubts today — patients followed for deterioration not only of elementary cognitive functions as memory, perception and attention, but also higher as thinking and language. Among people over 65 years old the spectrum of efficiency of cognitive functions can range from a lack of significant disorders through mild dysfunction to the processes of dementia, in which a reduction in the efficiency of intellectual makes unable the normal functioning in everyday life.

Aim. The main aim of the study was to determine the dynamics of deterioration of language and communication skills depending on a degree of dementia.

Material and Methods. The study was conducted with the use of the method of individual cases. The respondent group consisted of 59 female patients aged over 65. A self-constructed Speech Test Questionnaire was used in the study.

Results. There is a close correlation between a degree of neurodegeneration and a state of cognitive actions. The group of patients undergoing natural processes of ageing did not manifest significant cognitive disorders but only slowness of their functions which is characteristic of an advanced age. The degree of language and communication disorders is directly proportional to the size of brain damages and stages of dementia. High levels of dementia in subjects correlated with a number of cognitive deficits.

Conclusions. Post-stroke states and numerous ailments and somatic diseases the female patients suffer from may but do not have to correlate with a progressive dementia. (JNNN 2016;5(4):144–150)

Key Words: cognitive functions, dementia syndromes, communication, speech therapy, elderly patients

Streszczenie

Wstęp. Starzenie jest przedmiotem zainteresowań wielu dziedzin nauki. Równoprawne miejsce badań neurologopedycznych nie budzi dziś wątpliwości — u chorych następuje bowiem deterioracja nie tylko elementarnych funkcji poznawczych, jak pamięć, percepcja czy uwaga, lecz również wyższych, jak myślenie i język. U osób po 65. roku życia spektrum sprawności funkcji kognitywnych może wahać się od braku znaczących zaburzeń, poprzez łagodne dysfunkcje, aż do procesów otępiennych, w których obniżenie sprawności intelektualnych uniemożliwia normalne funkcjonowanie w życiu codziennym.

Cel. Głównym celem badania było ustalenie dynamiki deterioracji sprawności językowych i komunikacyjnych w zależności od stopnia otępienia.

Materiał i metody. Badanie prowadzone było metodą indywidualnych przypadków. Grupę badawczą stanowiło 59 pacjentek, powyżej 65. roku życia. W badaniu posłużono się autorskim Kwestionariuszem Badania Mowy.

Wyniki. Istnieje ścisła korelacja między stopniem neurodegeneracji, a stanem czynności poznawczych. Grupa pacjentek podlegających naturalnym procesom starzenia nie manifestowała znaczących zaburzeń kognitywnych, a jedynie właściwe dla podeszłego wieku spowolnienie ich funkcji. Stopień zaburzeń językowych i komunikacyjnych jest wprost proporcjonalny do rozmiaru uszkodzeń mózgowia i fazy choroby otępiennej. Wysoki poziom otępienia korelował u badanych z licznymi deficytami poznawczymi.

Wnioski. Stany poudarowe oraz liczne dolegliwości i schorzenia somatyczne, na które cierpią pacjentki, mogą lecz nie muszą korelować z postępującą demencją. (PNN 2016;5(4):144–150)

Słowa kluczowe: funkcje kognitywne, zespoły otępienne, komunikacja, terapia logopedyczna, pacjenci w podeszłym wieku

Introduction

Ageing is connected with physiological changes of organism. While ageing human brain decreases its mass and volume. However it does not indicate loss of nerve cells but changes in their structure caused by loss of water [1]. The biggest structural disorders can be observed in frontal and motor cortex where numerous pyramidal cells occur. Neurons built from these cells are bigger than those formed from granular cells in parietal and occipital cortex and as a result they are exposed to larger xerosis. Due to loss of water in cytoplasm, neurons shrink. Also a number of dendritic ramifications and synapses decreases [2,3].

Moreover, the level of neurotransmitters decreases in an ageing brain. The biggest changes are observed in the following systems: serotonergic, cholinergic and dopaminergic. Reduction of number of serotonergic receptors is one of hypotheses indicating depression in old people. In case of cholinergic system a significant loss of muscarine receptors in caudate nucleus, putamen, hippocampus and frontal cortex is observed. Changes of neurotransmission in these two systems are considered a factor responsible for deficits of cognitive functions. Deterioration of dopaminergic transmission results from loss of D2 receptors in caudate nucleus and putamen as well as reduction of number of dopaminergic neurons in black substance. Those changes result in worsening of motor activity among old people [4,5].

With age, blood flow through cerebral structures and rate of metabolism decrease, while the biggest changes were observed in frontal lobes. Moreover, conduction speed of electrical stimulus along nerve fibres decreases and amplitude with latency of induced potentials increase [6]. Also more symmetrical stimulus of cerebral hemispheres is observed especially in prefrontal cortex. Decrease of brain functional asymmetry while ageing can be a compensatory function: activation of the other, unspecific for a given task, hemisphere is an attempt of reducing cognitive deficits caused by an advanced age [7].

The process of ageing is influenced by a number of factors which can accelerate, slow down or modify its course in a different way. Among them we can mention: sex, health state, education and socioeconomic status, activity and intellectual stimulation, lifestyle and cognitive style, physical activity and also personality features [8,9].

Neurologopedic examinations are also very important in the research on ageing — since among patients deterioration of not only elementary cognitive functions such as memory, perception or attention occurs but also of higher ones like thinking and language [10]. In people over 65 spectrum of efficiency of cognitive functions may fluctuate from lack of significant disorders (physiological ageing — PA), through mild dysfunctions

(mild cognitive impairment — MCI), to dementia processes in which decrease of intellectual skills hinders normal functioning in everyday life. Disorder of cognitive processes, including language, in dementia diseases has a long-standing, progressive and irreversible character.

The main aim of the study was to determine the dynamics of deterioration of language and communication skills depending on a degree of dementia.

Material and Methods

The study was conducted with the use of the method of individual cases. The group consisted of 59 patients over 65 year of life (the youngest — 65, the oldest — 101) staying in Nursing and Treatment Institution of Shepherd Sisters of Divine Providence in Święta Katarzyna, Poland. The study protocol was approved by the Bioethics Committee of Medical University in Wrocław, Poland (no. KB-115/2012).

Due to large age differential an additional division into age groups was introduced: 65–70 years old (n=3,5%), 71–80 (n=16, 27%), 81–90 (n=34, 58%), 91–101 (n=6, 10%).

In the study the following women did not participate: those with documented mental impairment, down syndrome and mental diseases such as schizophrenia, bipolar affective disorder as well as delusions and delirium of persecution, which did not result from demented processes. Patients were also divided into groups according to a degree of disorder of cognitive functions. For that purpose medical and psychological documentation as well as logopedic diagnoses were used. Six groups of patients were selected, namely: control group — CG (n=10); physiological ageing — PA (n=11); mild cognitive impairment — MCI (n=6); mild dementia — MiD (n=4); moderate dementia — MoD (n=18); and profound dementia — PrD (n=20).

In case of patients with profound dementia, 13 patients did not make any contact with the surroundings and 7 had drastically disturbed understanding and production of speech but remained in the gesture-mime contact and in a very limited verbal contact.

A self-constructed Speech Test Questionnaire was used in the research.

Results

Observations of 59 women concerned the condition of language and memory functions both among patients not afflicted by neurodegenerative processes (natural ageing processes) and in pathology.

In the group of patients without cognitive disorders (CG — control group) patients have arterial hypertension (n=10), atheromatosis (n=9) and type 2 diabetes (n=3). Co-occurrence of these ailments along with an advanced age are not sufficient factors for appearance of disorders of cognitive functions though. Also Parkinson's disease, which 2 patients from that group suffer from, can proceed without cognitive deterioration.

In mild cognitive impairment (MCI) group atheromatosis (n=4), and hypertension (n=3) were diagnosed; however post apoplectic states (n=2) and depressive disorders (n=3) occurred in this group as well.

In the four-person group of patients with mild dementia (MiD) atheromatosis (n=3) and arterial hypertension (n=3) are common. Whereas medical documentation does not record depressive disorders and only one patient additionally reveals type 2 diabetes and psychoorganic disorders.

The group of patients with symptoms of moderate dementia (MoD) is numerous (18 patients) and diverse. It includes patients with dementia: Alzheimer's (n=2), angiogenic (n=9), dementia in Parkinson's disease (n=2) and mixed dementia (n=2). In other 3 patients a progressive dementia syndrome was diagnosed without indication of etiology. In this group there are patients with atheromatosis (n=7), with arterial hypertension (n=10), with ischemic diseases (n=6), with type 2 diabetes (n=3), with post apoplectic states (n=4), and with arthrosis (n=6). Also, psychoorganic disorders (n=3); and depressive syndromes (n=4) in the form of psychomotor sluggishness were observed. Two patients from this group have had suicide attempts.

In the 20-patient group with profound dementia (PrD) there are people with Alzheimer's disease (n=9), angiogenic dementia (n=4), Parkinson's disease (n=1), mixed dementia (n=2) and dementia of unknown etiology (n=8). Also the atheromatosis was found (n=8), as well as arterial hypertension (n=5), type 2 diabetes (n=4), and depressive disorders at earlier stages of dementia (n=4). Moreover contractures and arthrosis were recorded in this group.

Results of oral praxis examination, in which patients were asked to perform five exercises of articulation organs, show that in groups of patients ageing physiologically, with mild cognitive impairment and mild dementia both correct and imprecise performance of exercises was observed. One should look for reasons for those difficulties in motor activity disorders — they resulted from improper muscle tone of tongue and orbicular muscle of lips. In patients with Parkinson's disease symptoms of hypertonic and hypokinetic dysarthria were visible such as increased muscular tone, motor sluggishness, muscular rigidity, hypokinesis of lips and tongue.

In the group of patients with moderate and profound dementia, despite the above mentioned dysfunctions, also

difficulties resulting from post apoplectic states and associated with them nerve paralyses were observed as well as dysesthesia of position patterns of speech organs and motor sequences. Similar to occurring in Brocka's aphasia disorders of brain programmes responsible for acquired, precise motor patterns necessary for uttering a series of phonemes, partial or total disorganization of movements of muscles of articulation organs were observed. In case of aphasia this defect is connected with the damage of brain in a lower part of the left premotor area which may also be reached by neurodegenerative processes.

Another difficulty was understanding an order, which can be only partially explained by deficits in auditory perception. Not only demonstration of exercises but also mechanical placement of articulation organs in the respondents was helpful. Exercises requiring lifting tongue up and a task impossible to observe precisely and as a result — to reconstruct by imitation caused the biggest difficulties to the respondents. The respondents were also asked to repeat vowels, opposing syllables, expressions, sentences, automated sequences and sequences of words and numbers. All staying in touch patients could repeat vowels presented to them.

Most patients correctly repeated pairs of opposing syllables as well. Recorded rare and incorrect realizations resulted from a significant hypoacusia or disorders of phonemic hearing and occurred in all groups with disorders of cognitive functions. Disorder of phonemic hearing could suggest damage in a back region of the left association auditory cortex (back part of the first temporal gyrus, field 22) and in neighbouring areas as it happens in Wernicke's aphasia.

Automated sequences (counting from 1 to 10 and days of the week) did not cause problems to patients without cognitive disorders, with mild cognitive impairment and mild dementia — they performed them on their own. In the group of moderate dementia automated sequences were articulated without aid or with a speech therapist. Even in the group of profound dementia staying in touch patients were able to reconstruct — though imprecisely — automated sequences together.

A bigger differentiation applied to performance of other structures. Patients were asked to repeat two-syllable words (water), three-syllable (matura), four-syllable (rectangular), tongue-twisters (encephalography), sequence of names of things from 2 to 7 elements (belt, water; pear, carpet, tram; wardrobe, banana, sea, cow; window, tree, shoes, bucket, butterfly; leaf, radio, beer mug, liver, celery, beer; earphone, teeth, bed, ladybird, village-mayor, carrot, frog), sequence of numbers (3, 6; 9, 2, 5; 6, 3, 1, 8; 2, 6, 1, 7, 5; 5, 9, 8, 6, 8, 3; 7, 3, 2, 5, 4, 8, 1), simple (I like tomato soup. In my bag I have keys, purse, pen, lipstick and comb) and compound

sentences (I like reading but today I'd rather go for a walk).

As it is shown in Table 1 crucial disorders in repeating can be observed in case of compound lexical structures. Even patients with moderate dementia correctly repeated 2-, 3- and 4-syllable words.

Intensifying, along with a degree of disorder of cognitive functions, difficulties in repeating multi-element structures — tongue-twisters, sequences of words and numbers as well as simple and compound sentences — should be associated with impairment of sensory and short-term memory, which is an initial stage of coding of information coming in, but not with repetition disorders typical of aphasia.

It was also observed that the respondent patients memorize and repeat sequences of numbers better than words — an amount of reconstructed numbers is most often bigger and sometimes equal to an amount of reconstructed words (Figure 1 and 2).

Table 1. Repetition of words, sequences of words and numbers as well as simple and compound sentences

Repetition	2, 3, 4-syllable words and tongue-twisters	Sequence of words	Sequence of numbers	Simple sentences 1 and 2	Compound sentence
CG (n=10)	All	M=7 min=7 max=7	M=7 min=7 max=7	1 Yes 2 Yes	Yes
PA (n=11)	All	M=4.5 min=4 max=6	M=6.25 min=6 max=7	1 Yes 2 Yes	Yes
MCI (n=6)	Without tongue-twister	M=3.5 min=3 max=4	M=4 min=3 max=5	1 Yes 2 Yes	Yes
MiD (n=4)	Without tongue-twister	M=3.5 min=3 max=4	M=4.5 min=3 max=6	1 Yes 2 No	Yes
MoD (n=18)	Without tongue-twister	M=2.6 min=0 max=4	M=3.4 min=2 max=6	1 Yes 2 No	No
PrD (n=20)	0	M=0	M=0	0	0

Abbreviations: n — number of respondents in a particular subgroup, M — statistical mean, min — the lowest result, max — the highest result, CG — control group, PA — physiological ageing, MCI — mild cognitive disorders, MiD — mild dementia, MoD — moderate dementia, PrD — profound dementia

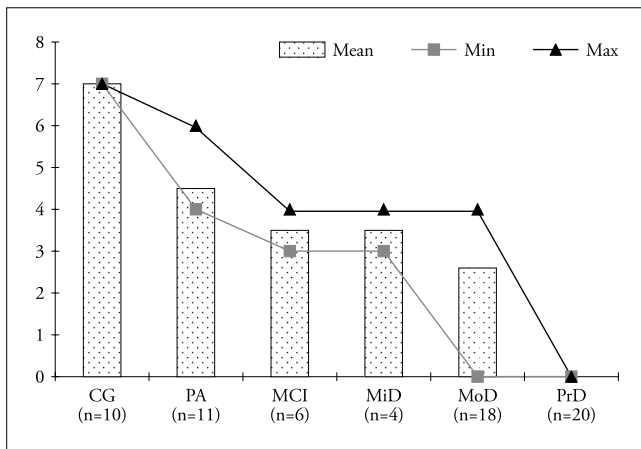


Figure 1. Repetition of sequence of words

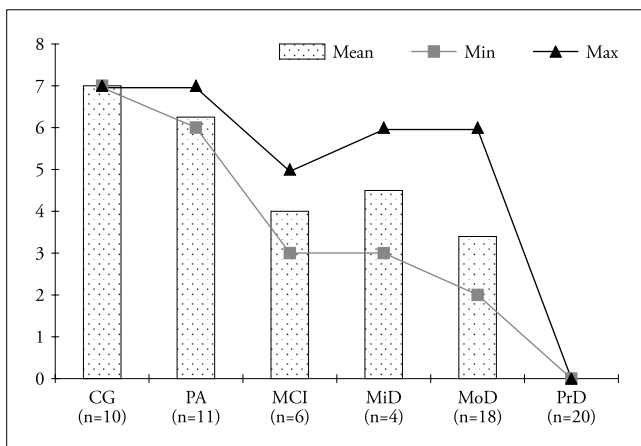


Figure 2. Repetition of sequence of numbers

During test for recognizing, naming and memorizing objects 10 photographs were presented to the respondents. Patients were to recognize, name objects and remember as many of them as possible (Table 2 about here). Patients ageing physiologically (PA) and those with mild cognitive impairment (MCI) did not demonstrate difficulties in recognizing and naming the presented objects. Some problems were observed on the level of mild dementia (MiD) — in this group results are diverse; both 100% and 50% response correctness was recorded as well as results placing between those limit values. The group of patients with moderate dementia (MoD) is most differentiated as regards recognizing and naming objects — from 2 to 10 recognized and named objects. Heterogeneity of the research group is implied by diversity of mechanisms leading to problems with recognizing and naming objects. Disorders of visual perception had a little effect on difficulties in recognizing — they applied only to 3 sand-blind patients. In most cases the cause of difficulties in object identification was visual agnosia (problems with recognizing familiar objects as a result of damage of the lower temporal lobe, in places responsible for integration of single sensations, more often after damage of the right hemisphere) or nominal disorders associated with impairment of long-term memory which hinders searching in cognitive resources for appropriate representations.

Easier to recognize were objects presented in a simple way; the more colours and extra elements, the more

Table 2. Number of recognized, named and remembered objects presented in photographs

Recognizing, naming and remembering objects	Number of recognized and named objects	Number of remembered objects
CG (n=10)	M=10 min=10 max=10	M=9.5 min=9 max=10
PA (n=11)	M=10 min=10 max=10	M=5.8 min=4 max=7
MCI (n=6)	M=9.5 min=9 max=10	M=2.5 min=2 max=3
MiD (n=4)	M=6.6 min=5 max=9	M=1.5 min=0 max=3
MoD (n=18)	M=5.7 min=2 max=10	M=0.3 min=0 max=3
PrD (n=20)	M=0	M=0

Abbreviations: n — number of respondents in a particular subgroup, M — statistical mean, min — the lowest result, max — the highest result, CG — control group, PA — physiological ageing, MCI — mild cognitive disorders, MiD — mild dementia, MoD — moderate dementia, PrD — profound dementia

difficult was identification. Also objects which are used by patients everyday were more recognizable than rare or exotic ones. The exception here were bananas, which are the constant element of patients' diet; however recognizing them and in case of succeeding — naming them caused a lot of difficulties. It is assumed that this term has poor traces in long-term memory since this fruit had remained exotic and hard to reach for a relatively long time in patients' lives. Paradoxically, quite fancily shown ladies shoes were recognized almost immediately and they belong, along with mug — also called little pot and comb, to most frequently identified objects. Explanation of this phenomenon is ventured by the fact that the research group consisted of women for whom elements of ladies' clothes may have strong emotional associations which is in favour of long-term memorizing.

Next observation seems important. Patients with Alzheimer's dementia and mixed dementia had the biggest difficulties in recognizing objects. In angiogenic dementia recognizing was maintained but nominal difficulties revealed. Patients did not recall names of objects (but I know what it is..., My God, I know how it is called, don't I...), replaced them with semantic categories (bird instead of parrot, animal instead of horse, vegetable instead of carrot) or used definitions and descriptions of objects (to drink instead of mug, on a sandwich instead of tomato, to comb, for hair instead of comb).

A task consisting in remembering the presented objects shows correlation of disorders of short-term memory not only from the perspective of the degree of dementia but also of age. Even in the group of patients ageing non-pathologically the memorizing results differed from control group just to reach much lower values in next research subgroups. This part of the research, due to explicit results, confirms the view that the most typical dementia symptom is impairment of the memory function. Damages of cerebral cortex and subcortical structures cause multiple forms of amnesic disorders. Defects of recognizing and naming should be associated with damages of long-term, declaratory and semantic memory. Whereas memorizing dysfunctions indicate impairment of short-term and operative memory. However it should be noticed that deterioration of functioning of operative memory also concerns older people without dementia symptoms.

Discussion

The research results confirm common in literature description of a progressive character of cognitive disorders in patients with dementia [11–13]. Division of the research group according to the efficiency degree of cognitive functions allowed to observe a proceeding degradation, from insignificant disturbances to profound dementia. Increasing dysfunctions are clearly manifested on both language and communication plane. Linguistic barriers, amnesic problems, limited social activity and psychomotor sluggishness impair patients' interactivity. The research reveals an increasing deterioration of oral praxis, understanding, repeating, recognizing, naming, remembering and verbal fluency [14].

Observation of the dynamics of increase of symptoms and correlating of disturbed functions with their cerebral representation can be an element supplementing the primary diagnostic hypothesis. The collected data can be particularly important for that specific group examined due to limited diagnostic instruments — in most cases it was impossible to obtain data from family history about language and communication skills within the period before occurrence of the disease and data from neuroimaging studies which had never been conducted. Therefore neurologopedic assessment seems to be a valuable piece of information which enriches neuropsychological evaluation within the scope of cognitive functioning (processes of memory, thinking, attention, sense of direction and time as well as perceptive functions), neurological assessment and nervous system functioning as well as psychiatric evaluation concerning mental disorders and behaviour disturbances. Diagnostic difficulties can be indicated by the fact that in case of 15 patients with dementia syndromes medical

documentation does not mention their etiology at all. Clear deterioration of cognitive functions afflicts only a part of population of older people, which is usually a result of pathologic processes leading to development of neurodegenerative diseases and connected with them dementia syndromes [15]. During physiological ageing cognitive functions do not change radically and just at a very late age we can observe significant worsening of memory, attention, perception, thinking and language [16,17]. Significant changes mainly concern short-term memory and are mild towards long-term memory.

The least controversial is a clinical image of patients with profound dementia in whom, due to profound memory disorders, skills of naming, verbalizing thoughts and constructing simplest logical statements are abolished. Communication disorders on the non-verbal level mean increasing difficulties with understanding and expressing one's thoughts with the use of body language, gestures, mime and eye contact.

Conclusions

The obtained research results have allowed to formulate main conclusions concerning correlation between quality and quantity speech disorders and the degree of neurodegeneration in people aged over 65.

1. There is a close correlation between the state of cognitive activities and the degree of neurodegeneration. The group of patients undergoing natural processes of ageing did not manifest significant cognitive disorders but only sluggishness of their function which is typical of an advanced age. So dementia is not a natural symptom of ageing — it consists of overlapping with physiological processes decrease of efficiency of cognitive functions caused by neurodegeneration. The degree of language and communication disorders is directly proportional to the stage of dementia disease. A high level of dementia in patients correlated with numerous cognitive deficits in the form of disorders of sensory and operative memory, worse results in verbal fluency and also disorders of hearing and visual memory.
2. Post-stroke states and numerous ailments and somatic chronic diseases patients suffer from may but do not have to correlate with a progressive dementia — since they are characteristic of all the examined subgroups.
3. Although age is a serious risk factor in the development of dementia diseases, it is not a sufficient reason for their occurrence.
4. Due to the progressive and irreversible character of dementia diseases, communication barriers grow along with the passing time.

Implications for Nursing Practice

1. Dementia is not a natural symptom of ageing, nevertheless it consists of overlapping with decrease of efficiency of cognitive functions caused by neurodegeneration.
2. The fact is that the age is a serious risk factor in the development of dementia, however it is not a sufficient reason for their occurrence.
3. Dementia in advanced level correlates with numerous cognitive deficits in the form of disorders of sensory, memory, verbal, hearing and visual memory.

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Corresponding Author:

Joanna Rosińczuk
Department of Nervous System Diseases
The Faculty of Health Sciences
Wroclaw Medical University
Bartla Street 5, 51-618 Wroclaw, Poland
e-mail: joanna.rosinczuk@umed.wroc.pl

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