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Diagnosis of mild cognitive impairment
Diagnostyka łagodnych zaburzeń funkcji poznawczych

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Key words: mild cognitive impairment, diagnosis, neuropsychology, biomarkers, neuroimaging.
Słowa klucze: łagodne zaburzenia funkcji poznawczych, diagnostyka, neuropsychologia, biomarkery, neuroobrazowanie.

Abstract

Introduction. Mild cognitive impairment (Mild Cognitive Impairment, MCI) is usually defined as a cognitive disorder, with normal global cognition without dementia. MCI occur in 15-30% of 60 – year with age and the incidence increases chance. Recently the wider system of classification of amnestic MCI or non-amnestic ie the weakening of single or multi-domain. Amnestic subtype of MCI in clinical greatest predisposes to Alzheimer's disease (Alzheimer's disease, AD), is 10-15% per annum. Early detection of MCI, precise differentiation, strict control and monitoring of cognitive deficits is a key aspect of the diagnosis, which may affect the progression of the disease.
Purpose. Presentation and discussion of the comprehensive diagnosis of MCI used for early assessment of progression to AD.
Materials and methods. Using key words: mild cognitive impairment (mild cognitive impairment), diagnosis (diagnosis), neuropsychology (neuropsychology), biomarkers (biomarkers), neuroimaging (neuroimaging) searched Polish and foreign electronic full-text bibliographic databases: Polish Medical Bibliography, EBSCO Host Web , Wiley Online Library, Springer Link, Science Direct, and Medline.
Results. Diagnosis heterogeneous CI should be based on an interdisciplinary diagnostic assessment, ie clinical, neuropsychological, laboratory and neuroimaging. Diagnostic criteria are constantly evolving and there is no current uniform guidelines, which is a major impediment to clinical practice. Rating neuropsychological profile of patients with MCI is not conducted according to a uniform protocol, and is based on general assumptions useful in the diagnosis of disease. The study allows the identification of biomarkers of disease risk elderly people with normal cognitive function and the risk of time and the development of AD in patients with MCI. In the study of markers are used which directly or indirectly reflect the pathology of AD. Neuroimaging techniques, structural and functional brain structure enable to assess and track the activities of its individual areas and local metabolic disorders, contributing to more accurately diagnose people with MCI.
Conclusion. Comprehensive early diagnosis of patients with probable MCI
certainly affects the accuracy of the diagnosis and determines the smooth adaptation and implementation of the treatment process. The researchers recommend that intensive clinical research evaluating the effectiveness of the criteria and methods of diagnosis, which would facilitate the development of uniform diagnostic protocol in the detection of MCI.

Streszczenie

Wstęp. Łagodne zaburzenia funkcji poznawczych (Mild Cognitive Impairment, MCI) definiuje się najczęściej, jako zaburzenie poznawcze, z prawidłowym globalnym funkcjonowaniem poznawczym bez demencji. MCI występują u 15-30% osób 60 - letnich i wraz z wiekiem szansa zapadalności wzrasta. Niedawno pojawił się szerszy system klasyfikacji MCI tj. amnestyczne lub nieamnestyczne z osłabieniem jedno bądź wielodomenowym. Amnestyczny podtyp kliniczny MCI w największym stopniu predysponuje do choroby Alzheimera (Alzheimer 's disease, AD), wynosi 10-15% rocznie. Wczesne wykrycie MCI, precyzyjne różnicowanie, ścisłe kontrolowanie i monitorowanie deficytów poznawczych to kluczowy aspekt diagnostyczny, który może wpłynąć na postęp choroby.
Cel. Przedstawienie i omówienie kompleksowej diagnostyki MCI stosowanej w celu wczesnej oceny progresji do AD.
Materiał i metody. Posługując się słowami kluczowymi: *łagodne zaburzenia funkcji poznawczych (mild cognitive impairment), diagnostyka (diagnosis), neuropsychologia (neuropsychology), biomarkery (biomarkers), neuroobrazowanie (neuroimaging)* przeszukano elektroniczne polskie oraz zagraniczne pełnotekstowe bazy bibliograficzne: *Polska Bibliografia Lekarska, EBSCO host Web, Wiley Online Library, Springer Link, Science Direct oraz Medline.*
Wyniki. Diagnoza heterogennego CI powinna opierać się na interdyscyplinarnej ocenie diagnostycznej tj. klinicznej, neuropsychologicznej, laboratoryjnej oraz neuroobrazowej. Kryteria diagnostyczne stale ewoluują i brak jest aktualnie jednolitych wytycznych, co stanowi duże utrudnienie w praktyce klinicznej. Ocena profilu neuropsychologicznego pacjentów z MCI nie jest prowadzona wedle jednorodnego protokołu, natomiast odbywa się w oparciu o ogólne założenia pomocne w diagnozie choroby. Badanie biomarkerów pozwala na identyfikowanie ryzyka zachorowania starszych osób z prawidłowymi funkcjami poznawczymi oraz ryzyka i czasu rozwoju AD u osób z MCI. W badaniu wykorzystywane są markery, które bezpośrednio bądź pośrednio odzwierciedlają patologię AD. Techniki neuroobrazowe, strukturalne oraz funkcjonalne umożliwiają ocenić strukturę mózgowia oraz śledzić czynności poszczególnych jego obszarów oraz lokalnych zaburzeń metabolicznych, przyczyniając się do dokładniej diagnozy osób z MCI.

Wnioski. Kompleksowa wczesna diagnostyka pacjentów z prawdopodobnym MCI z pewnością wpływa na precyzyjność postawionej diagnozy oraz warunkuje sprawne dostosowanie i wdrążenie procesu leczniczego. Naukowcy zalecają, intensywne prowadzenie badań klinicznych, oceniających skuteczności kryteriów i metod diagnostycznych, które ułatwiłby wypracowanie jednorodnego protokołu postępowania diagnostycznego w wykrywaniu MCI.

Introduction. Mild cognitive impairment (Mild Cognitive Impairment, MCI) is characterized by memory impairment most often with normal cognitive functioning and general substantially perturbed life activity. MCI affects the deterioration of a composite activity, resulting in a reduction of quality of life. MCI is defined most commonly as cognitive impairment without dementia (Cognitive Impairment No Dementia, CIND) [1.2.]MCI occur in 15-30% of 60 - year and with the age of maturity increases the chance [3.]Much of the research indicates the relationship the prevalence of MCI with aging. Callahan et al [4] presented the prevalence of MCI in growing age groups at 18.6% of the population 60 - 70 years of age, 27.1% of the population 71-80 years of age, 29.4% of the population over 81 years. The severity of cognitive deficits in MCI is greater than in age-related weakening of memory (Age-Associated Memory Impairment, AAMI), and subjective cognitive impairment (Subjective Cognitive Impairment, SCI) [2.]The term usually MCI is considered a transitional state between the physiological process of filament to the human body and the clinical probability of progression to Alzheimer's disease (Alzheimer's disease, AD). However, more often MCI is diagnosed as a separate disease entity, which is characterized by a greater diversity than the preclinical phase of AD. Heterogeneous etiology determines the existence of a number of clinical pictures of MCI, which may be the cause of numerous pathologies of the central nervous system (CNS) [5.]Based on the assumptions described the previous various subtypes of MCI, which may take the form of a stable, reversible or develop into different types of dementia (Fig. 1). MCI subtypes were isolated following: (1) amnestic single domain (amnestic MCI, a-MCI), which runs from a single disorder of cognitive function - memory disorders predisposing to AD; (2) non-amnestic multidomain MCI (multiple not-aMCI) and amnesic (a multiple-MCI), which extend with slight cognitive impairment multiple domains, including, where appropriate with or without a memory disorders predisposing VaD (Vascular Dementia, VaD) and AD lesser extent; (3) and single-domain MCI non-amnestic (single not-a MIP), where a single domain impaired cognitive - but not memory, which predisposes to frontotemporal dementia (Frontotemporal Dementia, FTD), dementia with Lewy bodies (Dementia with Left Bodies, DLB), primary progressive aphasia, dementia in Parkinson's disease (Parkinson's Disease Dementia PDD), and to a lesser extent to the VD and AD [6, 7, 8.]

Purpose. Presentation and discussion of the comprehensive diagnosis of MCI used for early assessment of progression to AD.

Materials and methods. Using key words: *mild cognitive impairment (mild cognitive impairment), diagnosis (diagnosis), neuropsychology (neuropsychology), biomarkers (biomarkers), neuroimaging (neuroimaging)* searched Polish and foreign electronic full-text bibliographic databases: *Polish Medical Bibliography, EBSCO Host Web , Wiley Online Library, Springer Link, Science Direct, and Medline.*

Results and Discussion. The diagnostic procedure performed in order to identify and differentiate neurodegenerative disease is a complex process. Diagnosis of a heterogeneous disease which is the MCI should be based on an interdisciplinary diagnostic assessment, ie clinical, neuropsychological, laboratory and neuroimaging. Early detection is a key aspect of MCI Diagnostic since the deterioration of cognitive deficits in patients in this group is growing much faster than in healthy in the same age group [5.] According Dawe et al [9] has identified the risk of MCI to AD conversion, a 1 - 25% per year. Black [10] stated that after 3 years from the identification of MCI will develop dementia in 30% of patients. However, in the study, Flickr

et al [11] after 5-7 years u50-80% of people with MCI diagnosed dementia. Kawas et al [12] determined the average time conversion of MCI to AD at 4.4 years. Aa. Studies have shown that the incidence of a-MCI among people aged 60 years and above ranges from 9.9 to 40.6/1000 per year. It is believed that patients MCI's chance of increasing the incidence of AD 10 - 15 [13.14%] per annum. Because of the increased risk of progression to AD, the American Academy of Neurology recommends that patients with MCI were diagnosed as soon as possible, closely controlled and monitored [15.]

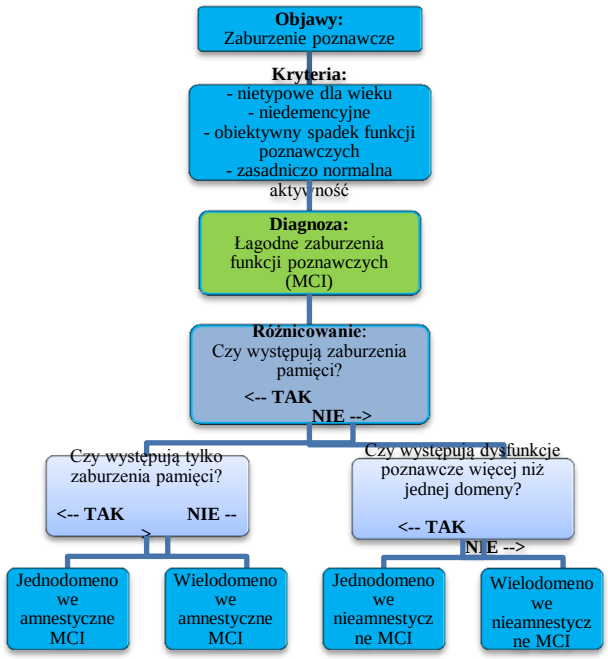

Figure. 1. The ordered power exceeds the available capacity of the WTTP. This makes it necessary to limit the area under consideration and to supply a part of it from the EDF west main. The process of classification of mild cognitive impairment.

Source: Winblad B, Palmer K, M, et al Kipivelto (2004). Mild cognitive impairment - beyond Controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. J Intern Med 256, 240-246.

Clinical Diagnostics

The basis of clinical diagnosis of MCI are the diagnostic criteria. For initial diagnosis, clinicians may wykorzystaćICD-10 (International Statistical Classification Classification of Diseases and Related Health Problems 10 [th] Revision), which discussed the disease is defined as mild cognitive impairment (Mild Cognitive Disorder MCD) characterized by memory impairment secondary concepts and learning skills, and the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders 5 [th] Edition.) in which the assigned term mild neurocognitive processes (Mild Neurocognitive Disorder, MNCD) [16-19.]

General diagnostic criteria were developed by an international team of experts in 2004 years based on recommended clinical criteria Peterson's research into the diagnosis of MCI. The clinical picture is visible abnormal cognitive status, without dementia who were excluded on the basis of the diagnostic criteria of DSM-IV and ICD-10 dementia. There is also deterioration of cognitive performance reported in person and / or by a third party confirmed by objective neuropsychological tests and a slight deterioration in the complex, instrumental activity with normal simple physical activity [5,8.]

Another commonly used criteria proposed team of experts Mayo Clinic Group in 2004, they refer to the guidelines outlined by Peterson in 2001 and the guidelines established at the International Interdisciplinary Conference in Stockholm in 2003. Then the authors for inclusion criteria adopted: (1) the complaint on the memory impairment reported by the informant, ie the patient, his family or his doctor (medical history), (2) normal activities of daily living (simple daily activity of life preserved, while the complex activity disturbed - to a lesser or greater extent), (3) correct global cognitive performance; (4) objectively ascertained memory impairment or cognitive impairment confirmed another area of standard deviations of 1.5 - 2.0 (SD) below the age, (5) the outcome of the Clinical Dementia Rating Scale (Clinical Dementia Rating, CDR) equal to or greater than 0.5; (6) absence of dementia. Prior to establishing the diagnosis of the Mayo Clinic Group recommends exclusion of mental illness, which can contribute to observable deficits; use of drugs acting on the central nervous system slowed down; and disorders of consciousness [8, 20, 21.]

In 2007, the existing criteria have been operationalized by a team of specialists from the Memory Clinic in Basel. The guidelines for the diagnosis of MCI also introduced a requirement for a patient ≤ 24/30 test points in the Mini-Mental State Examination (MMSE), and in tests assessing basic and complex activities of daily living, ie Nurses' Observation Scale for Geriatric Patients (NOSGER), Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and CDR patient should acquire a sufficient (> 10), (<4.0), (≤ 0.5). In two studies, separated from each other by at least 6 months, the difference between these results should be "Z-score ≥ 1".The study neuropsychological should see a mild decrease in score in one or more of the following cognitive domains: attention, memory, language, praxis, gnosis, executive functions [22.]

After the first times the diagnostic criteria for a-MCI were published by Peterson et al [7] in 1999, is included in them: (1) the complaint on memory impairment usually confirmed by an informant, (2) objectively ascertained memory impairment, (3) essentially preserved global cognitive functioning, (4) no significant adverse activities of daily living; (5) absence of dementia. The proposed recommendations are not currently recognized by professionals as a credible and reliable diagnostic criteria are treated rather as a set of guidelines recommended in the follow-up of elderly patients with dementia discrete.

Last revision of the criteria for a-MCI was carried out by the National Institute on Aging and the Alzheimer's Association. In 2011 it published a proposal for a diagnostic for the preclinical phase of AD called Alzheimer MCI. Proposed two sets of criteria. The first describes the basic clinical criteria, which are very similar to the recommendations of Peterson. This diagnosis method can be used by OWA grounds care, which has limited access to advanced diagnostic techniques (Table 1).The second set of criteria is a test that can be used in clinical research. In addition to basic diagnostic criteria further comprises a measurement of biomarkers based on neuroimaging studies and studies of cerebrospinal fluid (CSF) [7, 23.]

Table 1. Clinical and cognitive diagnostic criteria for Alzheimer's, MCI by National Institute on Aging and the Alzheimer's **Association.**

Determination of clinical and cognitive criteria
Concern related to changes in cognitive performance reported by the patient, informant or clinician (evidence of the progressive nature of the changes). Objective evidence of deterioration of one or more areas of cognition, including memory ships. Retained independent daily functioning ability. None of dementia.
Research etiology of MCI consistent with Alzheimer physiological process
Exclusion of vascular, traumatic medical causes of cognitive impairment - if it is possible. Establishing evidence of longitudinal cognitive deterioration - if it is feasible.

Gathering intelligence associated with AD genetic factors - where relevant.

Source: Albert MS, DeKosky ST, Dickson D, et al.(2011): The diagnosis of mild cognitive impairment due Alzheimer's disease: Recommendation from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimer'sDement 7: 270-279.

Patel et al [24] recommend caution when making a diagnosis, as it still is a lack of conclusive evidence for the objectivity of diagnostic criteria. Reduction of cognitive and / or subjective complaints of cognitive disorder presents many diagnostic difficulties arising from the distinction between physiological cognitive decline associated with aging, since the early changes that are a manifestation of the pathological process in the CNS [25.]The diagnosis of AD at a preclinical stage, is still a challenge in modern medicine, mainly because of clinically silent period of the disease is long lasting. Early diagnosis of AD increase the chances of treatment, and therefore constantly conducts research to improve diagnostic methods and increase their sensitivity in the detection of MCI.

Neuropsychological Diagnostics

Neuropsychological allow an objective assessment of cognitive performance, facilitate the differential diagnosis of persons meeting the criteria for MCI and based on a profile of a dysfunctional allow for verification of the progression of deficits. Neuropsychological assessment of patients with suspected MCI involves assessment of all higher cortical following functions. Full diagnostics should determine the level of decrease in efficiency compared with the period before the onset of disorders and identify etiological factors disorders [25.]For diagnostic analysis uses a variety of standardized tests and psychometric clinical trials. The techniques used are designed to accurately assess: (1) verbal functions, ie the ability of naming, verbal fluency, attention span and memory direct, learning and recall saved content and abstract-conceptual thinking; (2) visual-spatial functions including perception and visual attention, praxis design, figural fluency, processes of memorizing and reproducing visual-spatial material; (3) executive functions, that is, the ability to plan and control the activities of mental [26.]The final result highly depends on the clinical experience of the person leading the research. Numerous scientific reports indicate that MCI is characterized by mostly declarative memory reduction mainly episodic weakness of discrete verbal fluency, ability to generate and activate concepts [27-29.]It is recognized that in addition to the clinical picture can be observed disorders of attention, executive function, and visuospatial abilities [30.]Armiz et al [31] also indicated a decrease in the efficiency of semantic memory in patients with MCI.

Currently there is no uniform test protocol neuropsychological profile of patients with MCI. There are only general guidelines to help you select diagnostic test for the diagnosis of MCI. Clinicians recommend that in the current situation to the diagnosis was based on an assessment of the widest possible range of cognitive functions including the cognitive domains considered essential in the diagnosis of MCI. It is proposed whereby the use of numerous and diverse neuropsychological research tools that exhibit excellent sensitivity at acceptable specificity [32.]Due to the continuous growth of neuropsychological tests, in accordance with the tenets Evidence-based medicine (EBM), it is suggested that a decision on the choice of methods based on a preliminary analysis of their functionality and reliability. For the best way to compare two diagnostic strategies, it is considered a randomized trial in which patients were randomly allocated to groups and evaluate meaningful endpoints for the patient. These studies, however, are rare in the literature, so clinicians should decide on the usefulness of the tests on the basis of their diagnostic accuracy, focusing on the sensitivity, specificity, positive predictive value (Positive Predictive Value, PPV), negative predictive value (Negative Predictive Value , PNV) and repeatability (test-retest, inter-rater) [25,32-35.]

Preliminary neuropsychological assessment of patients with MCI uses clinimetric screening scales, with the task to establish a general profile of cognitive functioning. The most common test used in clinical practice is the MMSE. Milne et al [36] analyzed that 51% of primary care using the MMSE to detect cognitive deficits. A more recent study Iracleous et al [37] confirmed the above thesis. Overview systematic verify the accuracy of the MMSE in detecting MCI, shows that the sensitivity and specificity is 18-85% sequentially, and 77-100% [34.]The results indicate a low reliability of the test for the disease entity discussed. The test of less commonly used but more reliable is the Six-Item Cognitive Impairment Test (6-CIT).On the basis of clinical trials evaluating the usefulness in the diagnosis of MCI is known that 6-CIT has a 78% sensitivity and 100% specificity [38.]Highly sensitive (89-96%) and specific m (87-95%) test in detecting MCI is also a Montreal Cognitive Assessment (MoCA) [39.40.]According to reports, only 5-6% of clinicians use both methods in practice [36,37.]The next notable methods to facilitate detection of MCI include The Test Your Memory (THIS TEST) and The 7-Minute Screen (7 - MS).The first of these studies showed a 86% sensitivity and 93% specificity [41.] Identical sensitivity test showed 7-MS using slightly higher specificity of 96% [42.]When the result of the screening test conducted clinimetric suggests the presence of cognitive impairment, then in order to obtain a more precise cognitive profile, apply advanced neuropsychological tests assessing the cognitive domain specifically (Table 2) [43.]

Table 2. Examples of neuropsychological tests assessing different cognitive domains.

Cognitive Domain	Neuropsychological test
Memory	WMS-R/III Logical Memory II WMS-R/III Visual Reproduction II California Verbal Learning Test II Rey Complex Figure Test
Remarks	WAIS-III Digit Span WAIS-III Digit Symbol Trail Making Test, Part A
Language	Boston Naming Test Category Fluency-Animals
Visual-spatial functions	WAIS-III Block Design Rey Complex Figure Test-Copy
Executive Functions	Trail Making Test, part B Stroop Interference Test COWAT-FAS

WMS-R/III (Wechsler Memory Scale); WAIS-III (Wechsler Adult Intelligence Scale); COWAT (Controlled Oral Word Association Test).

Source: Teng E, Tingus KD, Lu PH, et al. (2009): Persistence of Neuropsychological Testing Deficits in Mild Cognitive Impairment.DementGeriatrCognDisord.28 (2): 168-178.

Diagnostics Laboratory

The clinical value of MCI is associated with skills predictive of progression to dementia. Pathological changes in AD occur 10-20 years before symptoms of cognitive impairment and a significant loss of neurons. Accordingly, the focus of researchers, there are a number of biomarkers that identify the

risk of elderly people with normal cognitive function, and risk of developing AD and time of patients with MCI [44,45.]

Biological markers can be divided into several classes each. Certain markers may directly reflect the AD pathology and provided evidence for the presence of key proteins deposited in the brain of Alzheimer's disease such as beta-amyloid protein (A. beta) and tau [46.]Other biomarkers provide less direct evidence AD or non-specific monitoring various indicators neuronal damage in the brain. These markers may have a certain specificity for AD by regional patterns disorders. Still other biomarkers may be useful to exclude AD [7, 23.]

National Institute on Aging and the Alzheimer's Association in 2011 presented writhed and advice on Alzheimer's, MCI, which has made the distribution of biomarkers into three groups. The first group are biological markers of deposition of amyloid-beta (A. beta) reduction in CSF concentrations of Aβ42 and febrile deposits A. beta PET molecular imaging. The second contains biomarkers of neuronal damage, ie the increase of tau / phosphorylated-tau in the CSF; reduction in hippocampal volume or atrophy of the medial temporal lobes; rate of brain atrophy; reduction of glucose metabolism in-FDG PET and perfusion SPECT. In the third biochemical biomarkers: inflammatory (cytokines); oxidative stress (isoprostanes); or other markers of synaptic damage or death of the cell [7, 23.]

Final criteria are divided into four levels of assurance. (1) Direct the probability of conversion of MCI to AD is observed in the case of a positive finding in the study A. beta and neuronal injury. In addition, people with this type of profile depth marker are more likely to have a faster progression of cognitive deficits and progress of dementia due to AD. (2) Obtaining a positive A. beta under conditions of neuronal damage biomarkers are not or can not be detected or vice versa is attributed to the likelihood of developing intermediate MCI to AD. People in this situation have a significant aspect of the pathological process of AD, but without full proof of deposition of A. beta or further damage to neurons. Please note that this category does not include people who have both types of biomarkers provide conflicting information. Category but includes a situation in which one group of biomarkers can not be tested due to limited access to technology or funds.(3) The next level takes into account the final results that are contradictory, ie positive and negative A. beta neuronal damage or vice versa, or biomarker studies have not been conducted. (4) Last least a certain level of confidence of conversion of MCI to AD occurs when markers of neuronal damage A. beta and not detected. In such a situation it is contemplated tested markers that reflect alternative pathological processes which may point to different subtypes of MCI indicating the different types of dementia [23.]

Diagnostic neuroimaging

Use a variety of imaging techniques allows the nervous system to find appropriate neural structures responsible for the formation of specific cognitive disorders and to track changes by monitoring the dynamics of regional hemodynamic and metabolic parameters. The diagnosis of MCI uses structural methods such as computed tomography (Computed Tomography, CT) and magnetic resonance imaging (Magnetic Resonance Imaging, MRI), which allow for the exclusion of other substrate of dementia (vascular changes, tumors, hydroceles, hydrocephalus), and allow an assessment of the location and the degree of brain atrophy progression potential. Development of advanced imaging methods such as computed tomographic single photon emission (Single-Photon Emission Computed Tomography, SPECT), magnetic resonance spectroscopy (Magnetic Resonance Spectroscopy, MRS), functional magnetic resonance imaging (functional Magnetic Resonance Imaging fMRI), positron emission tomography (Positron Emission Tomography, PET) allows in addition to the assessment of brain structures, tracking the activities of the individual local areas of disturbances and metabolic [5, 47.]

Neuroimaging techniques are considered as an important element in the diagnosis of MCI. Play a special role in differentiating the causes of cognitive disorders, predicting the likelihood of developing AD and in the assessment of disease progression [8].

CT and MRI allow the assessment of cerebral atrophy, visible in the image is to reduce the volume of brain structures and secondary extension of adjacent intracranial fluid spaces. Patients with MCI imaging study observed lapses left middle temporal lobe [48] and the lower volume with the exception of the right hippocampus turns [49].According to many researchers use of quantitative measurement of CT or MRI in patients with MCI reveals atrophy of the hippocampus and entorhinal cortex. The probability of the AD conversion is dependent on the size of the hippocampus, the smaller, the higher the risk. Atrophy in the hippocampus are not present in patients with AAMI, so this formation and can be used to differentiate MCI [50-52].

SPECT allows the assessment of cerebral blood flow in different regions of the brain. The MCI concludes pressure-temporal hypoperfusion and asymmetry (left / right) pressure-temporal [53].Decreased perfusion in patients with MCI is larger than normal, but lower than in AD. The MCI is only observed significant reductions in cerebral blood flow in the temporo-parietal without fading, while the AD states atrophy and reduced blood flow in areas of the mid-temporal and parietal-temporal [54].

MRS allows measurement of metabolites such as regional myo-inositol (ml), choline (Cho), N-acetyl-aspartate (NAA) and creatine (Cr) in the various structures of the brain [55].Published numerous reports on the occurrence of regional metabolic abnormalities within the limbic system in people with AD [56-59].In contrast, relatively little research conducted on MRS patients with MCI. Kantarci et al [60.61] may be measured within the posterior cingulate, in subjects with MCI and AD, yielding metabolic disorders in this region. The obtained parameters of MCI were arranged between AD and a group of healthy people. MRS may also be useful in the differentiation of subtypes of MCI. Namely, patients with MCI and-smaller size characterized by elevated index of hippocampal ml / Crw compared to patients with MCI non-amnestic [62].

FMRI imaging reveals a lot of new information about the brain areas active during the execution of specific tasks, and the degree and order of activation of individual centers in patients with cognitive impairment. MCI is a condition in which fMRI is of particular importance, thanks to a comprehensive assessment of structural and functional changes of the brain. The fMRI study the local effect is used increase the blood flow in the active regions of the cortex, and changing the magnetic properties of hemoglobin depend on the degree of oxygenation [47].Wagner et al [63] in a study of fMRI in patients with mild AD when performing tasks involving memory observed in all areas of brain activation compared to healthy subjects. Similar correlations have been demonstrated in carriers of the Apo E gene, which increased risk for developing AD, and in [64] patients with a [65-MCI].It is suggested that the results described investigations reflect the need to compensate for memory deficits by engaging all areas of the cortex [47].Researchers have also reported a reduced activation of the cortex in AD patients compared to the control group, while performing tasks oriented visual storing new information. These disorders have shown correlations with the degree of atrophy of the temporal lobe areas [66].By using fMRI, there is the possibility of early separation of patients with MCI group of people that predispose to dementia. Consider that that changes in the functioning of the brain can be observed before the onset of clinical symptoms of AD (Table 3) [47,67,68].Shown in the table of the different areas with increased and decreased activity due to the emerging specific domains of cognitive deficits, indicating the crucial role of the interaction between the various disorders centers than their function impairment [47].

In a study using PET uses radioactive isotopes to visualize, measure the severity of many metabolic processes and functional studies of particular regions of the brain. Enable ± on an assessment of neurotransmitter receptor systems of the central nervous system (CNS).The process of aging is a reduction

in blood flow and oxygen consumption in the brain, whereas the metabolic ratio of oxygen and glucose consumption increases slightly. In patients with AD with a significant reduction in glucose metabolism in the parietal-temporal area and a rear cingulate cortex, with a slight reduction in the oxygen consumption in these areas [69.]Scientifically confirmed the usefulness of PET in predicting the conversion of MCI to dementia and in estimating the risk of AD in people with a genetically increased likelihood for the development of the disease [47.]According Chetelat et al [70] have significantly lower levels of glucose in the rear of the temporal and parietal lobes in PET in patients with MCI may predispose to the development of AD. Arnáiz et al [71] in patients with MCI who converted to AD quickly located the significantly lower glucose uptake in the left temporo-parietal area, above the level of the basal ganglia. In contrast, no change was reported well above patients whose degree of cognitive deficits remained stable. In addition, de Leon et al [72] demonstrated the effectiveness of PET in the prediction of MCI in the elderly, having no cognitive impairment at the time of the study.

Table 3. The areas of the cerebral cortex of AD patients, a reduced and increased activity as compared to healthy subjects. based on fMRI.

Performed	**↓ Activation**	**↑ Activation**
Associating faces with the name	• Medial part of the temporal lobes	• Medial part of the parietal lobe • The rear part of the cingulate • The upper front corners (BA 9)
Storing images	• Medial part of the temporal lobes	
Analysis of visual-spatial	• Parietal lobules top	• Occipito-temporal cortex (ventral visual pathway)
Count	• Left lower frontal gyrus • The upper front corners (BA 9/6) • Lower parietal cortex (BA 40) • Cerebellum	• Medial part of the parietal lobe

Source: Walecki J, Pavlovsk-Detko A, Adamczyk M (2007): The role of modern imaging techniques in the diagnosis and monitoring of dementia. The Polish Neurologiczny3 (2); 69-89.

The scientific reports confirm described by Braak et al [73] distinctive, repeatable topographic distribution of neuropathological changes in various stages of AD, emphasizing the early classes limbic structures, including the hippocampus and entorhinal cortex [74,75.]Thus, it seems likely that the existence of prior pathology in some individuals with a-MCI in these regions. These data suggest that a-MCI and AD like my anatomical substrate. In addition, it can be concluded that the differentiation of MCI from early AD should be based on a comprehensive neuroimaging assessment of the severity of functional and structural disorders [47.]

Conclusions. Comprehensive early diagnosis of patients with probable MCI will affect the accuracy of the diagnosis and determines the smooth adaptation and implementation of the treatment process. The researchers recommend that intensive clinical research evaluating the efficacy of diagnostic criteria and methods that would facilitate the development of uniform diagnostic protocol in the detection of MCI.

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