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THE ROLE OF METHODS FOR QUANTITATIVE ANALYSIS OF MAGNETIC RESONANCE IMAGING DATA IN THE DIAGNOSIS OF ALZHEIMER'S DISEASE AT AN EARLY STAGE

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ABSTRACT

Alzheimer's disease (AD) is the leading prevalence in the structure of neurodegenerative diseases levitation and is the most common cause of dementia in the population. Therapy is advisable to carry out in the early stages of disease, because at the terminal stage, treatment becomes ineffective. In this regard, the paramount importance acquires timely and accurate diagnosis of BA in the early stages of the disease. One of the key places in it is given neuroimaging techniques, in particular magnetic re- zone tomography (MRI). The presented systematic review searched for in electronic databases and scientific electronic libraries kah Cyberleninka, PubMed, OVID, Cochrane database cooperation. An assessment of the modern aspects of the early BA diagnosis using MRI.

Keywords: A number of Russian- Russian and foreign articles and meta-analyzes on the number of qualitative assessment of MRI data at an early stage of AD. Keywords: dementia; Alzheimer's disease; mage- thread resonance imaging; post-processor image databot; magnetic resonance morphometry; review.

INTRODUCTION

Alzheimer's disease (AD) is the leading prevalence in the structure of neurodegenerative diseases levitation and is the most common cause of dementia in the population. Therapy is advisable to carry out in the early stages of disease, because at the terminal stage, treatment becomes ineffective. In this regard, the paramount importance acquires timely and accurate diagnosis of BA in the early stages of the disease. One of the key places in it is given neuroimaging techniques, in particular magnetic re- zone tomography (MRI). The presented systematic review searched for in electronic databases and scientific electronic libraries kah Cyberleninka, PubMed, OVID, Cochrane database cooperation. An assessment of the modern aspects of the early BA diagnosis using MRI. A number of Russian- Russian and foreign articles and meta-analyzes on the number of qualitative assessment of MRI data at an early stage of AD. Keywords: dementia; Alzheimer's disease; mage- thread resonance imaging; post-processor image databot; magnetic resonance morphometry; review.

Alzheimer's disease (AD) - progressive neurodegenerative rative disease, manifesting steadily declining memory and other cognitive functions (praxis, gnosis, speech, intelligence). According to pub- jubilant data in 2013 World Health Organization (WHO), in 2010 in the mi- re, there were about 35.6 million person with dementia. According to the forecast Deputy WHO by 2030 is the number will reach 65.7 million, and by 2050 will be 115.4 million people. Approximate cumulative calculation- global costs of treatment patients with dementia in 2010 put 604 billion US dollars. AD is the most common cause dementia in the population and makes at least 35–40% of the total structure of dementias [1, 2]. Diagnosis of BA is based on anamnestic, clinical and instrumental data. Among the latter, the most important neuroimaging value have ontic methods. Neuro- visualizations include structures- other methods, which include magnetic resonance imaging fiya (MRI), computer tomography (CT), and functional - positron emission tomography (PET), single photon emission computer tomography (SPECT) and functional nasal magnetic resonance tomography (fMRI). All of them allow you to get important information formation about the nature of the current pathological process by detection of signs of cerebral vascular disease, us- localization and expression atrophic changes, detection of deposits of beta-amyloid, tau protein, reduction glucose metabolism and lower perfusion in the tissues of the brain [2, 3]. everyday clinical practice, the most common nannie acquired MRI. This is obus caught by relative easy- the conduct of the study, more lower than PET and SPECT cost, high spatio-temporal solution, non-invasiveness Toda, the absence of contraindications for examining a patient in dynamics and the possibility of next computer image data obtained [5, 6]. When evaluating MRI results are primarily excluded potentially curable causes cognitive impairment (volume-formations, normotensive hydrocephalus, etc.). Various parts of the brain are involved are involved in the pathological process to varying degrees and successor- ness. In the early stages of the disease atrophic changes more often observed predominantly in mediotemporal structures rah of the brain (entorhinal-cortex, hippocampus, amygdala, Para hippocampal gyrus). Later, atrophy is detected in the back them departments of temporal and corti- calic parts of the parietal lobes, then secondary at- rofia of the gray matter of the frontal lobe lei; primary motor and sen- weed zones are involved in patho- logical process in later stages of the disease [2, 3, 5] N.G.

Neznanov et al. note that the use of neuroimaging markers of neuronal damage is informative to clarify the stage of the disease Alzheimer's, but their significance is through extremely variable at the beginning pain. At an early stage, atro- physical changes affect only the hippocampal form tion, then atrophy is detected also in other structures diabasal complex, including amygdala and parahippocampal gyrus [7].

An important feature of MRI is the ability to receive 3D images of the object with a high spatial solution and high contrast tyu fabrics, which allows the wire- to make an accurate analysis of even insignificant significant changes in the volume of things brain stems. For data purposes it is recommended to use MR-morphometry. a technique, allowing to obtain data about the volume of various structures brain in vivo is normal and in pathology with the help of array processing MRI data. Through the MR morphometry can be detected from- changes in the brain that rye are not determined visually when conducting a standard test following, which improves the quality and increases the potential diagnostic capabilities MRI. For Alzheimer's disease morphometry can apply- for early detection, evaluation ki severity and dynamic whom observation of severity local and general atrophy of go- brain [3, 8–11]. At present, for qualitative assessment of gray matter va in BA is most often used voxel-oriented morphometry (Voxel-based mor- phometry, VBM).

This is the ana- lysis of structural MRI images which allows you to study differences in brain structures brain using statistical an approach. This technique gives high precision capability estimate the volume of areas of interest ca (Region of interest, ROI) [11].

A significant contribution to the development botku new quantitative me- MRI data evaluation method introduced multicenter scientific research Neuroimaging Initiative imaging of Alzheimer's disease (Alzheimer's Disease Neuroimaging Initiative, ADNI). The main task cha it was to develop biomarkers for early detection niya and tracking the course of BA. ADNI specialists have developed methods of collection and quality control va MRI and PET studies on various tomographs, as a result what were formed standardized protocols that which allow direct comparison nitrate the results obtained at research centers around the world and stored in electronic throne database ADNI. On today published more than 1000 scientific papers, data using databases ADNI data. Actively developed there is a question about automation analysis of the MRI image zheniya [13, 14].

At an early stage of AD, neuro- degenerative process affecting vaet including entorhinal bark. R.S. Desikan et al. in his research was undertaken torture to determine whether auto- matizirovanny methods of measurement based on MRI with high degree of accuracy of identification categorize persons with moderate cognition active disorders [15].

About- work of an array of initial three- dimensional T1-weighted images 313 patients out of two independent groups was carried out with the use of automatic zirovanny software package Free Surfer to determine the volume ma and medium thickness 34 anatomy mic regions. To the 1st group (used for testing) niya and debugging parameters) in- there were 49 persons from the control group py and 48 individuals with moderate cognition tive disorders (MCD), while in the 2nd group (is- used directly for calculation of the thickness of the crust in op- limited regions) - 94 lives ly patient from the control groups and 57 persons with MCI. For comparison The findings in the study were also included 65 patients with a likely diagnosis of AD. To identify RCS measurement by measuring thickness of the entorhinal cortex, hippocampal volume and su- the pramarginal gyrus was 94% specificity achieved, sensitivity 74% for 1st groups of patients and specific 91% sensitivity, 90% sensitivity for the 2nd group of patients. Uka- These three MRI parameters are demonstrated a significant mutual connection with clinical and neuropsy- psychological assessments, and with indicators of biomarkers of cere- brospinal fluid. R Cuingnet et al. [16] in the system matic review evaluated the effect of the effectiveness of ten approaches: xel-based methods (including Voxel-Direct, which ry is subdivided directly directly on Direct and Direct VOI [17], STAND-score [18], Atlas-based [19], COMPARE [20]), three methods, based on thickness measurement cortex (Thickness-Direct [17], Thickness-Atlas [21], Thickness-ROI [22]) and two methods based on hippocampal volume measurements (Hippo-Volume-S [23, 24], Hippo- Shape [25]) using MR- tomograms of 509 patients from ADNI databases. For class- fictitious most approaches the method of supporting eyelids was used tori (Support Vector Machine). Three classifications were made cationic experiment: cognition tively safe faces and patients you with BA, cognitively intact individuals and patients with progressive ing RBM, which reached de- mentia for 18 months, as well as persons with stable RBM and pro- progressive UKR. All you- the collection of patients was divided into two groups. The first group (by sampling area) was used for training and optimization parameters, the second - to evaluate the effectiveness of the methods. In re- The results of the data analysis were received the following data: when comparing patients with BA and cognitively intact individuals four of the above voxels oriented class method

sificated patients with very high specificity (more than 89%) and high sensitivity Tew (75% - for STAND-score and more than 81% - for other me- tods). Methods based on measuring the thickness of the bark, while showed similar results – not me- less than 90% specificity and 69, 74 and 79% sensitivity for Thickness-ROI, Thickness-Direct and Thickness-Atlas, respectively. Valuation-Based Approaches hippocampus, possessed comparable my sensitivity but were less specific: 63% with volume measurement and 84% with measuring the form; when comparing cognitively intact individuals and pa- patients with cognitive impairments niyami most of the methods of fared significantly less sensitivity than before the next classification.

All methods compared to COMPARE Hippo-Volume-S and Hippo-Shape showed much better classification results. No significant difference between the results received with Direct, Direct VOI, STAND-score, Atlas- based. All these methods have achieved high specificity (more than 85%), and the sensitivity varies from 51% (COMPARE) to 73% (STAND-Score). Methods based on change rhenium of the thickness of the bark, showed similar results. Estimation of the ma hippocampus (Hippo-Volume-S) was less specific, but you- juice sensitive classification of asthma compared with cognitively intact indi- types; when comparing individuals with stable RBM and progressive ruyuschie UKR STAND-score to- stig 57% sensitivity and 78% specificity, COMPARE - 62% sensitivity and 67% special digitalis, and Thickness-Direct - 32% sensitivity and 91% specificity. Methods based on ve hippocampal volume measurements distinguished progressive RBM from stable with 62% sensitive and 69% specificity. Of great interest is no work by Hyon-Ah Yi et al., in which to which the authors set the goal of find out if a degree and ha- atrophy of the subcortical horny substance (almond-shaped body, thalamus, caudate nucleus, shells, pale ball, add- eastern nucleus and hippocampus) pre- tell progression of BA from stages of MCD to dementia [5].

The study included 773 participants, each of which ryh, a three-dimensional T1- pulse train on an MRI scanner with intense field 3 T, followed by post-processing. Of these, 181 people were referred to the control group c subject- tive symptoms of a violation the process of storing information tion and normal cognition functions, 201 people century with MCI and 391 patients at the dii dementia. During the observation (2 ± 0.9 years) in 35 patients Comrades from the group with RBM were identified slow progression to demen- tion, the condition of the other patients ents in this group remained stable. Volume measurement subcortical formations gray matter was performed using the software package FMRIB Software Library (FSL) structures, except for pale ball, were less in patients with AD than in the control group. In addition, the amygdala thalamus, putamen, adjacent nucleus and hippocampus were smaller in the group with RBM than in the control Noah. In all groups, subcortical education, with the exception of pale ball, showed positive positive correlation with cognitive ny functions measured Mental State method Examination (MMSE). Analysis proportional cox hazards taking into account age, gender, education research, neuropsychological testing Commodities CAMCOG-R (revised ny) and MMSE showed that less the largest volume of the hippocampus and adjacent growing nuclei is associated with increased risk of progression from RBM to dementia.

In addition, reduce solution in the volume of subcortical gray matter structures associated with the severity of cognitive violations. The results obtained tats testify that dressed up du with atrophy of the hippocampus and cor- atrophy of the parieto-vi- juicy localization atrophy nucleus accumbens has up to static diagnostic tool potential in the forecast of progression BA from MCI to dementia. This information is further shem can be used in the development of automated

bathroom software package for early diagnosis of AD. Jie-Qiong Li et al. analyzed roved a large amount of material la for all risk factors that rye could cause the development dementia in Alz-gamer in individuals with RBM [26].

Authors conducted a systematic literature random search for cohort studies advice on this issue in PubMed databases, OVID, EMBASE, Cochrane database cooperation, Library ke Congress, published between January 1966 and March 2015 (total 3565 articles in English) lyi language). As a result rigorous selection in the meta-analysis Are 60 cohort studies included? data covering 14,821 participant from 16 countries, of which for detection of neuroimaging markers of AD development analyzed the data of 19 studies statements, including the following structural signs: atrophy hippocampus, medial atrophy ny departments of the temporal lobe, atro- fia entorhinal cortex, hyper- intense signal from white substances and subcortical infarctions You. When analyzing the obtained re- the strongest results risk factors responsible mi for progression from stage MCI to dementia in AD, proved to be hippocampal atrophy, ento- rinal cortex and other media- al parts of the temporal lobe. It was also found positive positive correlation between fig-com of the development of the disease and hyperintense white substances. The analysis showed that MRI is a significant tool BA diagnosis at the stage UKR. medial temporal lobe, including hippocampus and para- hippocampal gyrus (by the latter includes the entorhinal bark), is affected most early. A larger atro- hippocampal phia, predominantly but the CA1 area and the base of the hypokampa (subiculume), as well as entorhinal cortex, especially in the anteroinferior pole from two sides. Moreover, in patients with RBM, an increase in the volume of stomach daughters and total volume change brain matter per year, as well as age-related changes in logo substance in the basal gangesliah increased the risk of progression sirovaniya to BA. Higher the value of the measured coefficient hippocampal diffusion cell in individuals with progressive RBM at the initial stage of association are at higher risk progression to dementia in future. M.V. Krotenkova et al.* developed a method for differentiating diagnostics of vascular morbidity thogo and degenerative genesis. The authors carried out a voxel- oriented morphometry structural analysis of MR- brain images. By regions of interest (almond- prominent body, hippocampus, etc.) a number of masks were created and the even the ratio of the volume of gray values of each mask in voxels to the total volume of gray matter brain in voxels.

Then ROC-analysis was carried out volumes of regions of interest in voxels to the total volume of gray th substance in each of the groups, including control, in vox- lyakh. With the ratio of ma- juice to the total volume of gray matter of the brain of the left hypnotic pokamp less than 0.006609, right hippocampus less than 0.00654, left parahippocampal gyrus less than 0.005484, left almond- prominent body less than 0.001743, right vogo amygdala less 0.001399 and left lower temporal gyrus less than 0.019112 to the total volume of gray matter brain and the absence of at-rophia of the amygdala and ta- Lamus is diagnosed as degenerative active genesis of RBM. With regard to nii volume of the left orbital cha- sti of the inferior frontal gyrus less than 0.008642, right orbital part of the inferior frontal gyrus lines less than 0.008546, right ta- lamus less than 0.004742, left ta- lamus less than 0.004872 to the total head gray matter volume brain and absence of atrophy hippocampus and almond bodies diagnose vascular the genesis of UCR. According to the authors, the method provides you with juicy differential accuracy diagnostics of RCC vascular of that and degenerative genesis. Given the small sample size (58 pa- patients), it is expedient to further the highest estimate of the method on a larger group of patients. Thus, the given data show an important role MRI for the diagnosis of AD and pro- predicting the development of dementia in

the early stages of cognitive ny disorders. One of the promising directions in dia-gnostic of this disease is a post-processor image analysis of MRI results using schew special software provision (MR-morphometry). This technique allows keep accurate numbers assessment of the volumes of various structures tour and areas of the brain, and evaluate their change in dynamics, which makes it possible not only improve the quality of dia- Gnostics BA, but also to judge the degree nor the progression of atrophic whom process. At present, I'm spreading more and more in clinical practice yut automated methods quantitative analysis volume- MR image characteristics zhenii, which simplify and generalize activate the evaluation of structures brain through minimizing human involvement in this process.

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