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Computer Modeling On Stroke by Complex Network

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Abstract: In order to make full use of data of stroke and find the potential characters, we use computer algorithm to model the stroke so as to comply with the evolution of stroke disease. In order to visual express the complex reason of stroke, we use complex network to model the stroke so as to express the complex reason and describe the relation of stroke structure and function. Computer model and complex network model should be combined with stroke standard method and custom index, which are more direct for clinical index and practice. Hybrid methods for research of stroke are a test to model, prevention, control and serve for stroke and other clinical disease.

Keywords: Stroke; computer algorithm; Complex networks; modeling

Abbreviations: CT－Computed Tomography; EEG－Electroencephalograph; fMRI－functional Magnetic Resonance Imaging; DTI－Diffusion Tensor Imaging; DWI－Diffusion Weighted Imaging; CBF－Cerebral Blood Flow; NIHSS－National Institute of Health Stroke Scale; FIM － Function Independent Measure; MRI － Magnetic Resonance Imaging; PWI－Perfusion Weighted Imaging; ASL－Arterial Spin Labeling; MCAO－Middle Cerebral Artery Occlusion

INTRODUCTION

Algorithm is a mathematics description so as to describe the process of a detailed realization. Algorithms are accurate and complete descriptions of problem solving schemes, and are a series of clear instructions to solve problems. Algorithms represent a systematic approach to describe the strategy mechanism of solving problems. That is to say, it is possible to obtain the required output in a limited time for a certain specification input. If an algorithm is flawed or not suitable for a problem, executing the algorithm will not solve the problem. Different algorithms may use different time, space or efficiency to accomplish the same task. The advantages and disadvantages of an algorithm can be measured by space complexity and time complexity [1, 2].

Computer algorithms are ideas to solve practice question with detailed process. A computer algorithm is a step-by-step way of describing in detail how a computer converts input into the desired output, or an algorithm is a concrete description of the computational process performed on a computer. To make computers work, you have to write computer programs. To write a computer program, you have to tell the computer step by step. What exactly do you want it to do? Then, the computer executes the program mechanically according to each step to achieve the final goal. When you tell a computer what to do, you also have to choose how to do it -- that's where the computer algorithm comes from. Algorithm is the basic technology to complete the work [3, 4].

With computer algorithms, medical information achieved many potential implementations and achievements, in digital image processing [5-8], because of the large array of images, image transformation is directly processed in the spatial domain, which involves a large amount of computation. Therefore, various image transformation methods, such as Fourier transform, Walsh transform, discrete cosine transform and other indirect processing techniques, are often used to transform the spatial domain processing into transform domain processing, which not only reduces the amount of computation, but also can be used. Image coding and compression technology can reduce the amount of data describing the image (that is, the number of bits), so as to save image transmission, processing time and reduce the memory capacity occupied. The purpose of image enhancement and restoration is to improve the quality of the image, such as removing noise and improving the definition of the image. Image segmentation is one of the key technologies in digital image processing. Image segmentation is to extract the meaningful features from the image. The meaningful features include the edges and regions of the image. This is the basis for further image recognition, analysis and understanding. Image

description is a necessary prerequisite for image recognition and understanding. As the simplest binary image, its geometric characteristics can be used to describe the characteristics of the object. Generally, two-dimensional shape description is used to describe the image. It has two kinds of methods: boundary description and region description. With the further development of processing research, the study of three-dimensional object description has begun. The methods of volume description, surface description and generalized cylindrical description have been proposed. Image classification (recognition) image classification (recognition) belongs to the category of pattern recognition. Its main content is image segmentation and feature extraction after some pre-processing (enhancement, restoration, compression), so as to make decision classification [5-8].

With the development of computer technology and imaging process in radiology, stroke image meets with a chance to find new results based on imaging process. Clinical diagnosis of ischemic stroke is mainly imaging diagnosis, such as CT and MRI routine examination of cerebrovascular methods. With the development of imaging technology, imaging diagnosis is not only manifested in morphology, but also has entered into the comprehensive diagnosis of brain morphology and function. Especially in recent years, some new technologies, including CTPI, DWI, PWI, MRS, arterial spin labeling (ASL) and so on, have been applied in clinic to make ischemic stroke. The diagnosis is more accurate and fast [9].

METHODS

Computer algorithm in medical data application has gained more and more results, and many computer medical algorithms have applied to medical data process, especially in medical imaging process. Medical image processing objects are mainly X-ray images, X-ray computed tomography (CT) images, magnetic resonance imaging (MRI), ultrasound images, positron emission tomography (PET) images and single photon emission computed tomography (SPECT) images and so on , the main contents include image filtering, image restoration, edge detection, contour extraction, image coding, etc [5-8].

Mathematical modeling is to establish a mathematical model according to the actual problem, to solve the mathematical model, and then to solve the actual problem according to the results. When it is necessary to analyze and study a practical problem from a quantitative point of view, a mathematical model should be established by using mathematical symbols and language on the basis of in-depth investigation and study, understanding of object information, making simplified assumptions, and analyzing internal laws [10].

Computer modeling refers to the method of establishing mathematical model, numerical solution and quantitative study of some phenomena or processes by means of computer. In the medical field, computer modeling has become a way to solve difficult problems, such as modeling cerebrovascular disease [11], can simulate the abnormalities of hemodynamics, through the model of ischemic stroke [12], can simulate the evolution of stroke and so on.

As a modeling tool and method, complex networks have penetrated many interdisciplinary research fields such as biomedicine, cybernetics and engineering [13, 14]. The main research focuses on: (1) discovering: revealing the statistical properties of network system structure, and appropriate methods to measure these properties; (2) modeling: establishing appropriate methods; Network model to help people understand the significance and mechanism of these statistical properties; (3) Analysis: Based on the characteristics of a single node and the structure of the whole network, analysis and prediction of network functions and behavior; (4) Control: proposed effective methods to improve the performance of existing networks and design new networks, especially stability, synchronization and data circulation.

RESULTS AND DISCUSSION

At present, there is no unified standard model or index for the evaluation and prediction of stroke. The commonly used methods are blood flow index, scale score and image data. Blood flow indices generally include blood flow, blood flow velocity, vascular diameter, etc. [15], in which the changes of CBF can directly reflect the degree of stroke injury, by measuring CBF before and after stroke to assess and predict blood flow perfusion, and then to evaluate the degree of injury and treatment improvement of stroke, predict the functional changes that may be caused. Convert [15-17]. Common scales are NIHSS scale [18], FIM scale [19], DRAGON scale [20], iScore scale [21], Albert CT score [22].

In recent years, the combination of brain imaging data (MRI, PWI, DWI, ASL, etc.) [23-26] for stroke evaluation and prediction is also a hot research topic, especially ASL through bloo to assess cerebral blood flow [23] and collateral circulation [26] and predict the brain. Functional changes [24], but ASL requires a high level of experimental hardware environment, cerebral hemodynamics information is relatively small. The above studies show that the evaluation and prediction of cerebral blood flow perfusion support the diagnosis, treatment and prediction of stroke, and can be used as an important reference for clinical treatment, efficacy judgment and prognosis. At present, there are few reports on modeling, evaluating and predicting the complex network of blood perfusion at home and abroad.

Using the advantages of evaluation and prediction of complex networks [14], traffic congestion, fault analysis, route optimization, road connectivity, robustness, security and survivability are discussed in the field of traffic networks; changes of networks after nodes or links are destroyed are predicted in the field of ecological networks, and protective and preventive measures are proposed. In the field of biological networks, it is found that the infectious behavior and process of diseases are related to the dynamic characteristics of networks, and the strategies for preventing and controlling the spread of diseases are formulated.

In particular, in the field of brain science, a large number of brain network models have been established by combining CT, EEG, fMRI and DTI imaging data. At the same time, the mechanisms of cognition, development, aging, functional evaluation and prediction of the brain, as well as Alzheimer's disease, depression, epilepsy, obsessive-compulsive disorder, schizophrenia, brain tumors and other studies have also been taken. Much research has been done, [27, 28]. At the same time, empirical studies in various fields show that the network model is advantageous in evaluation and prediction.

In recent years, scholars at home and abroad have begun to introduce complex networks into the study of stroke, using image data to establish complex networks of stroke [29, 30], to explore the dynamic changes of functional networks of stroke and their relationship with clinical function and performance; Beijing Normal University Institute of Brain and Cognitive Sciences [31], Shanghai Jiaotong University Med [32] experts and scholars also used fMRI data to establish a functional network assessment model for stroke [33], and established a complex network of stroke data to predict cognitive function recovery [34].

Stroke data processing needs to cover a wider range, not only in the hospital sector, but also in pre-hospital disease prevention such as screening and intervention for high-risk groups, continuous management of chronic diseases after hospital, including treatment continuity and lifestyle interventions. Of course, there are also some problems in the actual stroke data processing, such as the structured content of the medical record and the template of each specialty, the structured examination report, the integrity of the physical sign record, the standardized execution of the medical record and report writing, the connection of the community and primary medical system, the regulation of telephone and home follow-up records et al. These problems need to be solved later [35].

The above complex network for stroke research, mostly using brain imaging data to complete, stroke is essentially a vascular disease, that is, hemodynamic disorders, brain imaging data reflects the structure and metabolism of the brain, choose blood perfusion research stroke can visually express the degree of injury and pathology of stroke Physiological changes and other complex situations and the meaning they represent are more targeted and specific. The above studies show that it is feasible to use complex network to model stroke and study the evaluation and prediction of stroke by using the dynamic characteristics of network. The results also show that it has a good application prospect in the prevention and treatment of stroke.

CONCLUSION

Nowadays, the development of science and technology is very rapid, and our medical field should keep up with the pace of the times, the use of computers in the medical field. With the development of the times is also constantly changing, so we must closely combine medicine and computer science and technology, to make contributions to the development of human medicine.

This paper makes a bold discussion on cerebrovascular diseases, especially cerebral apoplexy [36, 37] and complex network modeling and application [38]. In the study of cerebral apoplexy, various methods of making animal models of ischemic stroke, detecting indexes and processing and analyzing data are used; in the study of complex network, small world and scale-free are used. Two typical complex network models, together with research results and applications in brain memory function network and public transport network.

On the basis of the previous design, this paper adopts the general idea of complex network modeling, and takes the MCAO model rats as the experimental object. From the point of view of complex network, this paper puts forward the establishment of ischemic stroke blood flow perfusion network model, and establishes the evaluation and prediction methods of blood flow perfusion. The design of this paper will promote the study of stroke evaluation and prediction mechanism. The results and conclusions provide a solid theoretical basis for related clinical research and clinical treatment, and provide a new method and breakthrough for the scientific and theoretical research and clinical prevention and treatment of stroke.

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