IMPROVEMENT OF MODERN DIAGNOSTIC AND TREATMENT METHODS OF MULTIFOCAL ATHEROSCLEROSIS AND ATHEROTROMBOTIC ISCHEMIC STROKE

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Abstract

In the World Health Sector, high morbidity of the population with vascular patalogy of the nervous system is the number one problem that leads to disability and is completed with significant death. This requires current attention to the issues of developing various aspects of this problem, especially modern diagnostic and therapeutic methods, preventing or slowing the development of Vascular Pathology of the brain and multifocal atherosclerosis. The basis of atherosclerosis is due to thickening of the inner floor of the arteries, damage to the endothelium. As a result, the elasticity of the vessel wall decreases significantly. This leads to a decrease in blood flow in it. Due to a violation of the Rheology of the blood and hemostasis system, the appearance of blood clots in atherosclerotic plaques, which subsequently leads to the development of atherothrombotic strokes due to the final blockage of the artery or the displacement of the resulting plaques and clogging of the thrombus into the blood vessels. Unlike classical atherosclerosis, complications of multifocal atherosclerosis are most pronounced, since it affects several vessels at the same time. Its development leads to coronary heart disease, leg angiopathy leading to amputation, intestinal ischemia, nephropathy and vision disorders. Rapid and accurate diagnosis of stroke remains a major call in the medical field. For this reason, the use of computerized methods, especially signal analysis and artificial intelligence, is being recognized as an effective solution in assessing stroke.

Keywords: Ishemik insult, multifokal ateroskleroz, aterotrombotik insult, EEG, EMG, EKG

Introduction

Stroke occurs as a result of decreased blood flow or bleeding through the cerebral blood vessels. Physical and neurological examination of the patient and medical history are important in diagnosing stroke. And to determine the type of stroke, it is necessary to carry out ultrasound examinations of CT, MRI, ECG, Exocg, carotid vessels. Stroke is a common disease that worries medical professionals around the

world. For this reason, assessment of the severity of stroke is important for the attending physicians to choose the right treatment and for physiotherapists to prescribe appropriate rehabilitation exercises for patients. One of the most commonly used methods for assessing stroke severity is the National Institutes of Health Stroke Scale (NIHSS). This method is aimed at objectively assessing the condition of the patient's brain and muscle. However, the NIHSS method also has its drawbacks: it depends on the assessment carried out by a person, which can lead to incorrect results. For this reason, one considers a computerized method for assessing stroke status using electromyogram (EMG), electroencephalogram (EEG), and electrocardiogram (ECG) signals. This new approach minimizes human error and increases the accuracy of the results. (17) the degree of theft of stroke patients is determined by a combination of electromyogram (EMG), electroencephalogram (EEG), and electrocardiogram (ECG) measurements. A diagnostic method sensitive to cerebral ischemia is electroencephalography. With this method, an early diagnosis of acute stroke, TIA and major vascular occlusion can be made. (1) EEG is now a studied, promising, multicenter, diagnostic research method, and patients in pre-hospital settings can be carried out with the onset of the symptom if they have suspected a stroke, and this is done by ambulance personnel. There are significant differences between patients with (2) ischemic stroke compared to control groups delta/Alpha ratio (DAN), (delta+Theta)/(Alpha+beta) ratio (DTABN), and paired brain symmetry index (JMSI). (3) the exact relationship between the volume of blood flow in the affected vessel measured Angiographically and the average frequency of rhythmic activity in this area is of particular diagnostic importance. This allows us, based on EEG data, to approximate the state of blood flow and the possibility of treatment and rehabilitation of ischemic disorders of the cerebral circulation.(4). On the same basis, EEG carotid is used to monitor brain functions during endarterectomy operations. (5).

This article focuses on conducting a meta-analysis of computerized methods for assessing stroke, in particular, EEG (electroencephalogram), EMG (electromyogram), ECG (electrocardiogram) signal analysis and machine learning techniques, as well as published research on the use of these technologies in the clinic.

Purpose from learning. This article explores and summarizes published research on EEG, an important diagnostic method for early detection of ischemic stroke, a computerized method for assessing stroke status, and other diagnostic methods.

Material and Methods

A literature review based on scientific work from the last 10 years has been conducted using the Elibrery search engine and the CyberLeninka scientific Electronic Library

and other resources using the above keywords. For this meta-analysis, articles were used that included evidence, experimental and clinical evidence on the most pressing issues related to the diagnosis and treatment of patients with ischemic stroke.

Main Part

Stroke has become the main cause of disability all over the world. Early diagnosis and treatment of stroke, its rehabilitation contributes to the faster recovery of survivors after stroke. Currently, doctors rely on CT and MRI examination methods to diagnose stroke. These diagnostic methods are expensive, time-consuming, and cause discomfort for patients. A faster, portable and automated diagnostic system is needed when assessing post-stroke status in order to take the right measures in time. The use of medical cues to assess stroke allows the study of changes in brain, muscle, and heart function. EEG, EMG, and ECG signaling can be key tools in detecting changes in the human body. Processing and evaluating these signals using computerized analysis can help determine the type, extent, and affected area of a stroke.(20) to meet this need, EEG is useful because of its portability. (6). Electroencephalography is a monitoring technique used to record electrical activity in the brain. This is done using a number of electrodes. They are small electrically conductive contacts, set to a standard position above the scalp, and detect electrical signals generated by neuronal activity. The basic principle of EEG is based on detecting small changes in electrical voltage caused by neurons sending signals to the brain. These fluctuations are measured in Microvolts, measurements are taken hundreds of times per second using the EEG apparatus. The data collected can then be shown as a time series, where the voltage is plotted with respect to time. These frequency, amplitude and waveform abnormalities can be studied and analyzed manually. These EEG series can be divided into different frequency bands such as delta, Theta, Alpha, beta, and gamma. Each of them is associated with different states of brain activity and cognitive functions. For example, while alpha waves are noticeable during relaxed wakefulness, beta waves are associated with active thinking and alertness. Advances in EEG technology such as high-density electrode arrays and complex signal processing algorithms have increased the accuracy in its diagnostics and expanded the range of applications.(7) when damage to brain vessels does not lead to gross fatal changes in brain tissue and severe, clinically manifested cerebral ischemia, changes in the electroencephalogram are usually absent or normal at the border. In EEG, irregular a-rhythm, multiple fast waves, sometimes triple and slow vibrations are recorded, but their number and amplitude remain in the normal range. Vertebrobases with no prolapse symptoms are circular disturbances in the basin, while phenomena of EEG desynchronization and

flattening can be observed. (8) changes in EEG with thrombosis and stenosis with clinical manifestations in the form of Paresis, hemianopsia and aphasia are manifested by slow waves of the Theta and delta ranges. The exact relationship between the volume of blood flow in the affected vessel and the average frequency of rhythmic activity in this area, measured by the angiographic method, is of particular diagnostic importance. This allows us, based on EEG data, to approximate the state of blood flow and the possibility of treatment and rehabilitation of ischemic disorders of the cerebral circulation. With the help of computerized analysis, it is possible to determine the changes in the EEG signal. For example, spectral analysis of brain waves using wavelet Transform and Fourier Transform is used to identify different stages of stroke (e.g. ischemic or hemorrhagic stroke). Fractal measurements of EEG signals, or some kind of wave (delta, Alpha, beta waves), are analyzed using computer programs to show how stroke has affected brain activity. (19) electroencephalographic data in ischemic cerebrovascular diseases can serve to some extent differential diagnostic purposes. Thus, pathological EEG with carotid stenosis occurs in less than 50% of patients, with sleep artery thrombosis - 70% and with tuberculosis artery thrombosis - in 95% of patients. A relatively low percentage of pathological EEGs in sleep artery stenosis is apparently explained by the possibility of collateral circulation through the arterial circle (Villisius ring) system of the brain.(9) additional diagnostic data can be obtained using sleep artery compression tests. With complete thrombosis of the sleeping artery, compression on the affected side does not affect the EEG, compression on the healthy side leads to the formation of bilateral slow waves. with sleep artery stenosis or tuberculosis artery thrombosis, an increase in the visibility or number and amplitude of slow waves can be observed when the sleep artery is compressed from the affected side. Regardless of the, the occurrence of EEG slow waves when the sleeping artery is compressed is usually observed in elderly people with global cerebral vascular insufficiency.(10,11) it should be noted that the evaluation of tests with sleep artery compression should be carried out taking into account the entire complex of electroencephalographic and clinical data. In particular, EEG changes when the sleeping artery is compressed may be caused by reflector sinocarotid effects. In distinguishing between reflector and organic hemodynamic effects, pulsation of the intracranial and extracranial arteries of the brain may be aided by the acquisition of polygraphic EEG by a rheographic or photometric method. (12) in the acute stage of ischemic stroke, changes in local Theta and delta waveforms are observed in the ischemic zone in the EEG, respectively. Vertebrobasis are observed with ischemic changes in the vessels, with general bilateral synchronous slow waves, or sometimes desynchronization events with diffuse beta

activity, corresponding to damage to the nospecific reticular systems of the brain. The persistence and severity of pathological changes in EEG largely depends on the possibilities of collateral circulation and, naturally, on the severity of brain damage. After the acute period, in the absence of repeated strokes, there is a decrease in the severity of pathological changes in the electroencephalogram, which often parallels clinical improvement. In some cases, during a much longer period of stroke, EEG is completely normalized, even if significant clinical functional deficits remain. (13) electroencephalography is of particular importance in the differential diagnosis of vascular stroke. In hemorrhagic strokes, EEG changes are much more severe and persistent, accompanied by significant changes in the brain, which corresponds to a more severe clinical picture. (14) this study was conducted at the National University of Malaysia Canselor Tuanku Muhriz hospital from April 2021 to December 2022 with the approval of the local ethics and Research Council (FF-2021-135). Patients who were diagnosed with acute ischemic stroke were involved. Patients with debilitating neurological disease, severe excitability that interferes with proper writing of EEG, stroke imitations (e.g. patients with major seizures, epilepsy, hyperglycemia, metabolic, infection, and venous sinus thrombosis), traumatic brain injury, tumors were excluded from the study. Patients were diagnosed with acute ischemic stroke following Anamnesis, clinical examination, and brain imaging studies. Data on clinical history, stroke type, demographic data, stroke risk factors, and National Health Stroke Scale (NIHSS) indicators are tabulated in admissions. The weight of the blood vessels is divided according to the NIHSS indicator into light (1-4), medium (5-15), medium heavy (16-20) and heavy (21-42). The Oxfordshire public stroke project (OCSP) has been used to classify the types of stroke syndromes divided into four subspecies: cranial general anterior circulatory infarction (UOQAI), partial anterior circulatory infarction (QOQAI), lacunar infarcts (LI), and posterior circulatory infarcts (OQAI) (15). EEG was conducted as a inpatient for all admitted stroke patients and was recorded in Nicolet one Extension (v32 Amplifier) using 24 reusable gold electrodes glued to the scalp according to the international system 10-20. Abbreviations in EEG are: Fp - frontopolar, C - Central, f - frontal, T-temporal, P-parietal, O-occipital. Bipolar and intermediate reference mounts were used for evaluation. The duration of each recording was half an hour. The EEG filter configuration was: 50 Hz filter; low frequency filter: 0.5 Hz; high frequency filter: 70 Hz. The EEG was evaluated by two trained neurologists who were unaware of clinical and Radiological indications. Each gave an individual report on the EEG based on the results obtained. Then any inconsistencies in the reports were discussed and the EEG was revised and the final joint report was submitted for classification. Abnormal EEG

has been identified as general deceleration (US), focal deceleration (FS), or the presence of epileptiform patterns (spikes, sharp waves, rhythmic and periodic pattern). US is defined as the dominant rhythm in the Theta (4-8 Hz) or delta (<4 Hz) frequency bands that occur in all regions of the head. Focal deceleration (FS) has been identified as slow activity (theta or delta) occurring in a restricted area of the head. The data was studied and analyzed using version 21.0 of the SPSS program.

1. Supervised Learning

Using controlled training techniques (e.g. Support Vector Machines (SVM), Random Forests, k-Nearest Neighbors (k-NN)), one can analyze the properties of EEG, EMG, and EKG signals to detect stroke. This method uses previously classified data (training data) to classify signals. By training the Model itself, classification with new (test) data is carried out.

2. Unsupervised Learning

Uncontrolled teaching techniques (e.g., K-means clustering, Principal Component Analysis (PCA)) assist in detecting signal similarities and clustering stroke-like uncertainties. These techniques are useful for automatically detecting certain inaccuracies and developing new analysis methods.

3. Deep Learning

Deeper training (Deep Learning) techniques for high-resolution classification, such as Convolutional Neural Networks (CNN) or Recurrent Neural Networks (RNN), can be used to analyze EEG, EMG and EKG signals. These techniques study signals at a high level, allowing them to detect hidden features. Deep learning algorithms often achieve very high efficiency in classification, but they need large amounts of data. This new approach minimizes human error and increases the accuracy of the results. The severity of stroke patients is determined by a combination of electromyogram (EMG), electroencephalogram (EEG), and electrocardiogram (ECG) measurements. EMG, EEG and EKG signals are processed to eliminate unnecessary features in the signal. The power Spectra and frequency of each biosignal are calculated. These results are included in the Matrix equation used to calculate the stroke Vector (s) to determine the patient's weight level. The stroke vector is used to direct the patient to appropriate virtual rehabilitation exercises. This virtual rehabilitation program helps to restore the motor activity of the hands and fingers of stroke patients. The study involved 40 stroke patients. Of these, 30 were recruited for biosignal testing and 10 for testing the developed system. The results showed that the developed system could effectively

redirect patients to appropriate virtual rehabilitation exercises by calculating the stroke vector. The stroke severity detection system also achieved a 96.67% accuracy. (17) the computerized stroke assessment method provides a more accurate execution of this process. Computerized methods, especially EEG, EMG, and ECG signal analysis, are frequently used in the clinic. They are useful in the following areas:

Early diagnostics: a quick computer-aided EEG and other signal analysis can help you detect a stroke before it starts.

Determination of the type of stroke: using computer analysis, it can be determined whether the stroke is ischemic or hemorrhagic.

Rehabilitation monitoring: after a stroke, computerized systems are useful in monitoring motor functions and brain recovery.

Medical classification and decision making: computer systems help doctors choose the type of stroke, its degree and effective treatments. (18)

Conclusion

A computerized method for assessing stroke status using EEG, EMG, and EKG signals has high accuracy in assessing stroke severity, determining the use of the right treatments for patients, determining the effectiveness of the treatment process, and properly directing rehabilitation exercises. At the same time, the development of artificial intelligence and computer analysis opens up new opportunities for the detection and treatment of stroke in the future.

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