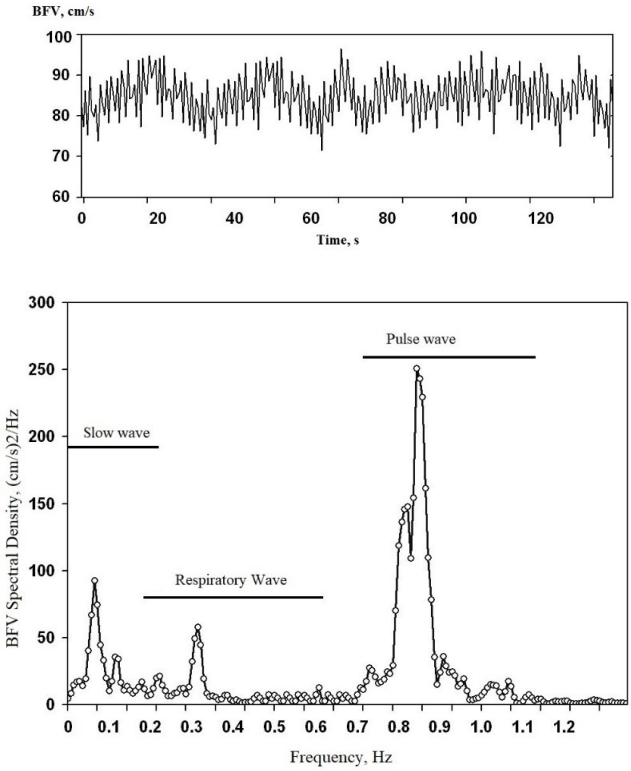

Fig. 2. Curves for monitoring blood flow velocity (BFV) in the middle cerebral artery (*a*) and spectral density (SD) of spontaneous fluctuations in the Slow-Wave Activity, Respiratory-Wave Activity and Pulse-Wave Activity ranges, calculated by fast Fourier transforms (*b*)

hemodynamic shock associated with the changes in vascular tone (an increase in CBF velocity can lead to narrowing of the lumen in blood vessels);

metabolic factors, such as oxygen supply to tissues, neuronal metabolism, and the autonomic nervous system, which is involved in regulating vascular reactions [1].

Study of AR mechanisms is an important and urgent problemc currently tackled by numerous research groups. As new methods of mathematical analysis and signal processing are developed and widely introduced in practice, this greatly expands the opportunities for comprehensive study of cerebral blood flow regulation.

This paper is dedicated to comparative analysis of modern methods for studying the regulation of cerebral circulation, which can be regarded as the interaction of the input signal (AP) and the resulting response (CBF) via a regulation system with feedback.

Methods for signal processing

Data processing is used to analyze, modify and synthesize the signals received, for example, sound, images and the results of biological monitoring. Signal processing methods are used to improve transmission and storage efficiency, as well as to isolate or locate the components for further analysis in a measured signal. For example, the Fourier transform allows to extract the fundamental harmonics from a signal that at first glance appears to be noise (Fig. 2).

Types of signal conversion. Because the signals have a different nature, different methods are used for processing them.

Continuous-time processing. This group of methods is applied to signals for which the time interval can be regarded as a continuum, including both time and frequency domains. The Fourier transform of the time series allows to obtain the frequency response of the process.

Discrete-time processing. It is used to analyze signals such as samples whose elements are defined only at a finite number of points in time.

Digital processing. It consists in processing of digitized sampled signals with discrete time. Examples of algorithms for this type of processing are Fast Fourier Transform, finite impulse response filter, infinite impulse response filter, and adaptive filters such as Wiener and Kalman filters.