

Scientists propose a new reliable method for predicting the outcome in patients with acute ischemic stroke

A team of Krasnoyarsk scientists developed a simple reliable and minimally invasive method for dynamically assessing the clinical course of acute ischemic stroke and predicting early results and recovery prospects for patients.



After studying the concentration of brain-derived neurotrophic factor (BDNF) and vascular endothelial cell growth factor (VEGF) in blood plasma, the researchers came to the conclusion that not single but serial dynamic measurements of plasma BDNF concentration in the acute period of ischemic stroke are of prognostic value. Moreover, excessively high concentrations of VEGF during the first week from the onset of the disease indicate a less favourable prognosis of patient rehabilitation. Their key research findings [are published](#) in Bioinformatics and Biomedical Engineering.

Stroke is an acute malfunctioning of the central nervous system and one of the main causes of death and disability globally. In Russia, about 450 thousand people suffer a stroke annually, the mortality rate from this disease in our country is 4 times higher than in the United States and Canada. Among all types of strokes, 80 per cent are the ischemic strokes. About a third of the patients who have suffered a stroke need outside help and care, some of the patients lose their ability to be ambulant. Only about 20 per cent of stroke sufferers can return to their previous lifestyle and work. That is why it is extremely important to conduct timely diagnostics that help to predict a short-term and long-term course of the disease.

“The human immune system perceives its own brain like an alien body and attacks it. In cases of cerebral circulation disorder, the brain begins to experience a colossal deficiency of nutrients. In order to recover the condition of the patient whose brain underwent such an attack and make it get close to the pre-stroke, first of all, it is necessary to restore the blood supply system. And to do so we need to grow new blood vessels to replace the affected ones.

The so-called growth factors circulate in the blood plasma, those are VEGF and BDNF — the biochemical compounds responsible for the development of small peripheral blood vessels. The hypothesis of my co-authors was that measuring the level of these factors in the blood plasma of patients on days 1, 7 and 21 of their hospital stay will help to predict what their rehabilitation will be in each individual case,” told **Mikhail Sadovsky**, professor at the Department of Biophysics and a senior researcher of Siberian Federal University.



The researcher noted that the initial hypothesis was only partially confirmed — observation of the patients and the use of simple statistical methods did not confirm a direct relationship between fluctuations in VEGF and BDNF levels and people's state on the long run. The bioinformatics method of elastic maps, however, gave more complete and reliable information that allows considering a blood test for growth factors as an effective tool.

“Using the elastic map method, we managed to distribute 56 patients participating in the experiment into three clusters. The results of this grouping were quite unexpected for the physicians: the second group, where the VEGF and BDNF indices increased by leaps by the 7th day of the disease, revealed the highest

mortality rate. This is paradoxical since growth factors themselves are considered useful for recovery of the circulatory system. Apparently, the secret here is precisely in the sharp increase in the amount of these substances, and in this case, more does not mean better at all," Mikhail Sadovsky explained.

Having built the elastic maps and analysed the revealed patterns, the scientists proved that the first results obtained and the method as a whole are stable — even a patient generated artificially or accidentally lost in the sample could not throw the system out of gear.

"For me, as a bioinformation scientist, it is the use of the elastic map method for the purpose of forecasting in this work that is interesting. These maps help visualise and analyse multidimensional data. The method is universal and, as it turned out, quite effective for application in medicine — anyway, we processed the empirical data, which my partners had been collected for over two years, in such a way that we got another tool for predicting the long-term effects of ischemic stroke," the scientist concluded.

According to the key conclusions of the researchers, in the case of acute stroke, the specific numerical values of BDNF in the blood plasma are not so important as observing the dynamics i.e. the increase and decrease in the level of this substance on the 1st, 7th and 21st day. In addition, a VEGF concentration of more than 260 pg/ml on days 1 and 7 from the onset of ischemic stroke is highly likely to indicate a more severe course of the disease. Perhaps, this is due to the ability of the substance not only to grow new blood vessels but also to increase their permeability, as well as provoke cerebral oedema.

The study involved staff and students of V.F. Voyno-Yasenetsky Krasnoyarsk State Medical University, Krasnoyarsk Interdistrict Clinical Hospital No. 20 and the Institute of Computational Modelling of the Siberian Branch of the RAS (Krasnoyarsk).

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