Scientists at Masaryk University have developed a new, more effective enzyme for dissolving blood clots. They named it after Brno

New study suggests that the Brnoteplase enzyme could be more effective than current blood clot treatments while simultaneously leading to a lower rate of severe bleeding. It was developed by scientists from Masaryk University in cooperation with other experts from the STROKE Brno consortium.



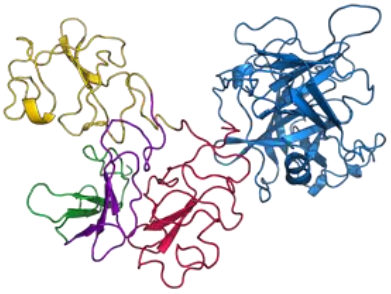
A blood clot blocks a blood vessel in the brain, triggering an ischemic stroke, or cerebral infarction. Strokes are among the leading causes of death and permanent disability worldwide. However, current treatments remain limited by insufficient efficacy, side effects, and bleeding. Alteplase, which has been the only approved drug for dissolving clots in strokes for nearly three decades, clears blocked blood vessels in less than half of patients. The second drug, tenecteplase, was approved in the USA only in March 2025.

Scientists in Brno therefore focused on developing a thrombolytic enzyme with improved properties, such as efficacy, safety, and the ability to penetrate the clot and dissolve it effectively from the inside. The result is Brnoteplase, which holds the potential to aid in the treatment of blood clots in the future. In animal models, it dissolved clots faster than currently used drugs, and the blood vessel was reopened in 87% of treated animals, compared to 56% with alteplase.

Brnoteplase outperformed alteplase in three key parameters simultaneously. It has 80 times higher selectivity for fibrin, the main structural protein of a blood clot. This high selectivity means that the enzyme is “activated” practically only where it encounters a clot and remains inactive elsewhere in the bloodstream, which reduces the risk of bleeding. At the same time, Brnoteplase has four times higher resistance to the natural inhibitor PAI-1, which rapidly deactivates thrombolytic enzymes in the blood, thereby significantly prolonging their circulation time, and has four times the ability to penetrate deep into the clot.

The biggest difference lies in the potential method of administration. Thanks to the last two improved properties, Brnoteplase could be administered as a single rapid injection, whereas Alteplase must be administered via a one-hour infusion. At the end of the experiments, researchers found up to 37 times more active enzyme in the rats' plasma than with alteplase. In the case of a stroke, where every minute counts, this could be a crucial practical advantage. However, there is still a long road ahead before it reaches clinical practice.

This combination of properties was achieved by combining several approaches to protein engineering; out of more than 10,000 simulated variants, only one passed through a series of tests and proceeded to animal testing.



"Traditional protein engineering methods often improve only a single property. In our study, we optimized multiple of these properties simultaneously. This allowed us not only to identify combinations that complement each other well and avoid undesirable opposing effects, but also to explore countless potential variants much more efficiently. Instead of searching for the best single ingredient, we searched for the best recipe as a whole," explains the first author of the study, postdoctoral researcher Martin Toul, laureate of Česká hlava award.

Although so far only in animal models, Brnoteplaza has demonstrated better clot dissolution and faster restoration of blood flow. Severe intracerebral hemorrhage occurred in 15% of animals treated with Brnoteplaza, compared to 35% with tenecteplase and 21% with alteplase.

"The human body is extremely complex, and successful treatment must simultaneously meet many different requirements. We therefore looked at the problem from multiple different angles, which enabled us to develop a promising new thrombolytic enzyme, Brnoteplase, and evaluate it in a way that is much closer to real medical practice than many traditional laboratory studies," describes the corresponding author of the study, Zbyněk Prokop from Loschmidt laboratories at RECETOX, Faculty of Science, Masaryk University.

A multidisciplinary approach also contributed to this success. During the development process of the new treatment, from the initial idea to testing in living organisms, the study's authors utilized a combination of expertise in computer modeling, laboratory biology and biophysics, medicine, and animal testing. Researchers from the STROKE Brno group collaborated on the research—a consortium of interdisciplinary experts associated within the TACR National Competence Center focused on the application of modern technologies in medicine, RETEMED.

DOI: https://doi.org/10.1021/acscatal.6c02903

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