Stroke: challenges and opportunities—Perspectives on clinical research advances and future outlook in 2024

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Dear readers,

In the field of stroke research and treatment, cutting-edge technologies and studies continue to emerge, providing new perspectives and strategies for exploring the mechanisms and treatment methods of stroke.

According to the latest advancements, neuroimaging techniques play a crucial role in stroke research. MRI technology, for instance, is essential for evaluating stroke patients. The latest MRI techniques provide high-resolution brain images and, through functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI), contribute to the study of neural functional reorganization and fiber tract reconstruction after stroke. For example, fMRI can detect neural activity in stroke patients during different tasks, helping us understand brain reorganization and adaptation processes. DTI, on the other hand, provides information about white matter fiber tracts, assessing post-stroke neural network conditions. The importance of cerebrovascular imaging techniques in stroke research is also becoming increasingly evident. Cerebral hemodynamic tests allow us to evaluate vascular function and blood flow conditions in stroke patients, helping determine disease risk and hemodynamic abnormalities. These techniques include dynamic magnetic resonance angiography (MRA), assessment of cerebral autoregulation function, and laser Doppler flowmetry, among others. In the field of molecular biology, there have been significant breakthroughs in understanding the molecular mechanisms of stroke and identifying treatment targets. Researchers extensively investigate processes such as inflammation, neuronal apoptosis, and repair mechanisms. Through these studies, scientists have discovered the role of stress-regulating proteins, inflammatory cytokines, and associated signaling pathways in post-stroke processes, leading to the exploration of corresponding treatment strategies. Furthermore, emerging technologies such as neural stem cell therapy, gene editing, and RNA interference provide new avenues for stroke treatment. These approaches aim to promote brain tissue repair and regeneration, accelerating the recovery process. In conclusion, the latest advancements show that neuroimaging techniques, such as MRI, fMRI, and DTI, play a crucial role in stroke research. Cerebrovascular imaging techniques enable the assessment of vascular function and blood flow conditions. In molecular biology, researchers extensively study post-stroke inflammation, neuronal apoptosis, and repair mechanisms, while exploring the potential of emerging technologies like gene therapy and stem cell therapy.

According to the latest cutting-edge research, the prevention of stroke has become a focus of research, and people are increasingly realizing that the incidence of stroke is closely related to modifiable risk factors. Technological advancements have provided more opportunities and methods for stroke prevention. Firstly, personalized risk assessment is an important research area. By utilizing advanced genetic sequencing technology and biomarker studies, we can more accurately assess an individual’s risk of stroke. By detecting specific genetic variations or biomarkers such as lipoprotein levels, inflammatory markers, or vascular function indicators, we can better predict an individual’s risk of stroke and develop corresponding prevention strategies. Secondly, advancements in personalized drug therapy offer hope for stroke prevention. For example, antihypertensive drugs and cholesterol-lowering medications have been widely used to reduce the incidence of stroke. The latest research indicates that selecting drugs and adjusting dosages based on individual characteristics can more effectively control high blood pressure or cholesterol levels, further lowering the risk of stroke. In addition, treating diabetes is also considered an important strategy for stroke prevention. Advances in molecular biology have provided new methods for stroke prevention. Research on the molecular mechanisms of stroke has revealed a series of targets and inflammatory signaling pathways related to stroke. Based on these studies, new drugs and treatment strategies are being developed to reduce the occurrence and progression of stroke. Furthermore, intervention in platelet function, thrombosis, and apoptosis processes are also a significant focus of stroke prevention research. Additionally, lifestyle interventions are widely studied and promoted as important means of stroke prevention. Healthy eating, regular exercise, smoking cessation, and alcohol restriction have been proven to lower the risk of stroke. Technological advancements allow individuals to better monitor and manage their lifestyle, such as using smart devices and mobile applications to track dietary and exercise habits, and provide personalized advice and reminders. In conclusion, based on the latest cutting-edge research, stroke prevention has become a focus of research. Advances in personalized risk assessment, personalized drug therapy, molecular biology, and lifestyle interventions offer more effective methods for stroke prevention. These advancements offer the potential for developing individualized prevention strategies and customized intervention plans, thereby reducing the incidence of stroke and improving the quality of life for patients.

According to the latest cutting-edge research, the treatment of stroke will become more diversified and accurate, providing stroke patients with more choices and opportunities. First, the rapid development in the field of pharmacotherapy has led to the emergence of a new generation of drugs as front-line treatment for stroke. For example, thrombolytic agents and antiplatelet drugs have been widely used in the treatment of acute ischemic stroke to restore blood flow and reduce neural tissue damage. In addition, the development of new anticoagulants and antiplatelet drugs aims to provide better treatment outcomes with fewer side effects. Other drugs targeting various pathophysiological processes related to stroke, such as anti-inflammatory drugs for neuroinflammation and neuroprotection agents, are also under continuous research. Second, the rapid advancement in interventional techniques has provided new opportunities for stroke treatment. Interventional therapies, including

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Research the provide function of and reality technology, the Group virtual for as studying restoration the better collaborate patients. and much patients will stroke techniques, optical of the rehabilitation need stroke. The latest research indicates that the treatment of stroke will become more diversified and accurate. New generations of drugs and interventional techniques are being developed. In addition, in stroke treatment, research on neural stem cells has shown great potential. Neural stem cells have the ability to self-renew and differentiate into various types of brain cells, such as neurons and glial cells. The latest research suggests that transplanting neural stem cells can promote brain tissue repair and regeneration, thereby improving post-stroke neurological function. Although this field is still at the research stage, neurodegenerative therapy includes stem cell transplanta n, neural protection, and the application of trophic factors. The latest research indicates that stem cell transplantatio n can facilitate brain tissue regeneration and repair, providing new opportunities for functional recovery after stroke. Additionally, the application of neural protection and trophic factors has shown potential in improving post-stroke neurological function and reducing damage. The advancements in optical imaging technology provide better opportunities for studying cerebral reperfusion and regeneration. Optical imaging techniques, such as near-infrared spectroscopy and optical coherence tomography imaging, can provide non-invasive monitoring and imaging of cerebral blood flow, aiding in the assessment of cerebral reperfusion and tissue repair. These technologies also serve as powerful tools for studying the reconstruction of the neurovascular network and functional improvement following stroke. In conclusion, the forefront of the latest research indicates that the treatment of stroke will become more diversified and accurate. The development of new generations of drugs, interventional techniques, neural stem cell therapy, and optical imaging technology provides stroke patients with more choices and opportunities for the restoration of neural function and improvement in quality of life. However, these areas are still in a phase of continuous research and exploration, requiring further clinical trials and validation to ensure safety and efficacy.

According to the latest cutting-edge research, the development of personalized rehabilitation strategies is also an important trend in the treatment of stroke. The rehabilitation needs of each stroke patient are unique, so customized rehabilitation strategies are crucial. The latest research shows that using big data and artificial intelligence algorithms, we can better analyze and predict the rehabilitation potential of stroke patients, as well as the effectiveness of different rehabilitation treatments. This will help doctors and rehabilitation therapists develop individualized rehabilitation plans to maximize the rehabilitation outcomes and quality of life for stroke patients. The innovation of virtual reality technology and intelligent rehabilitation assistive devices has brought new progress to the rehabilitation treatment of stroke patients. Virtual reality technology can help patients restore their daily life functions by providing personalized rehabilitation environments and simulating situations. Intelligent rehabilitation assistive devices and mobile applications can monitor the patients’ physical condition and motor abilities in real-time and provide personalized rehabilitation training guidance. In addition, the application of artificial intelligence algorithms can help analyze and process a large amount of rehabilitation data and provide effective rehabilitation strategies. By combining medical image analysis, motion monitoring, and speech recognition technologies, artificial intelligence can help identify patients’ rehabilitation progress and risks, thus supporting the adjustment and optimization of rehabilitation plans. In conclusion, the development of personalized rehabilitation strategies is an important trend in the treatment of stroke. With the innovation of big data, artificial intelligence algorithms, virtual reality technology, and intelligent rehabilitation assistive devices, we can better meet the specific rehabilitation needs of stroke patients and provide effective rehabilitation training and guidance to help them regain function and improve their quality of life. However, these technologies and strategies are still under constant research and development, requiring further empirical research and clinical validation to ensure their safety and effectiveness.

In summary, stroke research and treatment are at the forefront of technological advancements and innovation. With the progress of neuroimaging technology, we can better understand the mechanisms of stroke and accurately locate and assess the damaged areas of the brain. At the same time, discoveries in molecular biology have revealed the molecular basis of stroke, providing a basis for the development of new drugs and treatment targets. The application of virtual reality technology and smart devices brings new opportunities for stroke rehabilitation. By providing personalized rehabilitation environments and simulated scenarios, virtual reality technology can help patients better regain their daily functioning. Smart devices and mobile applications can monitor and record patients’ rehabilitation progress in real-time, as well as provide personalized rehabilitation training guidance to improve the rehabilitation outcome. However, despite significant progress, stroke is still a complex disease, and treatment still faces many challenges. Therefore, further research and innovation are needed to improve the prevention, treatment, and rehabilitation of stroke. This includes in-depth studies on the pathogenesis of stroke, the search for new treatment targets and innovative drugs, and the development of personalized rehabilitation strategies.

Overall, technological advancements and innovation in the field of stroke provide hope for unraveling the mysteries of stroke, improving treatment outcomes, and enhancing patient recovery. However, there is still much work to be done. We need to continue our efforts and closely collaborate with scientists, doctors, and technology experts to innovate and improve stroke research and treatment.

We look forward to discovering more about the latest developments and breakthroughs in stroke research and treatment in the upcoming issue of Clinical Research Communications.

Best regards,
Chao-Liang Tang

Competing interests
The author declares no conflicts of interest.

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