PRESS RELEASE

FOR IMMEDIATE RELEASE

NUS Medicine Researchers Develop Breakthrough Nanoparticle Technology for Targeted Diagnosis and Treatment of Atherosclerosis

Singapore, 18 September 2024 – Atherosclerosis is the build-up of plaque in the arteries which causes their narrowing. It is a primary cause of ischemic heart disease (IHD) and ischemic stroke (IS), both of which are major contributors to the 17.9 million deaths caused by cardiovascular diseases each year globally. The incidence of atherosclerosis-related conditions has been rising steadily over the past three decades, and particularly in younger populations. The increase is driven by lifestyle factors such as unhealthy diets, lack of exercise, smoking, and alcohol consumption. In Singapore, cardiovascular diseases (CVDs) are a leading cause of mortality, accounting for 31% of deaths in 2022, and a projected three times increase in obesity-related heart attacks by 2050.

Commonly used methods for imaging atherosclerotic plaques include techniques like intravascular ultrasound, coronary angiography, computed tomography angiography and magnetic resonance imaging (MRI). However, these methods have limitations in resolution, invasiveness, and most importantly, the ability to deliver targeted therapies.

1. Intravascular ultrasound, utilises an ultrasound probe on a catheter inside the blood vessel to visualise the walls of the arteries for a detailed assessment of the extent and nature of the plaques. However, this method is invasive and applies only to larger blood vessels with limited spatial resolution
2. Coronary angiography, uses X-ray imaging and an injection of a dye that provides contrast for visualising arteries and detecting blockages caused by plaque.
3. Similar to X-ray coronary angiography, computed tomography angiography, which uses ionizing radiation and an injection of a dye to obtain more detailed images of blood vessels.
4. MRI provides the highest-resolution images of blood vessel and plaque morphology among all the four imaging techniques.

There are currently no medications or treatments that can specifically target atherosclerotic plaques, to significantly reduce plaque burden or reverse atherosclerosis. Patients with high CVD risk are generally prescribed medications that can stabilise plaques including statins that lower cholesterol levels, anti-platelet agents such as aspirin to reduce risk of clots forming at the site of plaques, while ace inhibitors and beta-blockers are used to manage high blood pressure.

A team at **NUS Yong Loo Lin School of Medicine (NUS Medicine)** has developed a groundbreaking nanoparticle technology that offers an effective solution to diagnose and treat atherosclerosis, in a non-invasive manner. This innovative theranostic approach, published in the journal Small, represents a significant advancement in the field of cardiovascular medicine as it offers a promising alternative to current medical practices for the management of atherosclerosis.

Led by **Assistant Professor Wang Jiong-Wei from the Department of Surgery, Nanomedicine Translational Research Program at NUS Medicine, and Cardiovascular Research Institute (CVRI),** this multidisciplinary study was conducted in collaboration with Associate Professor James Kah from the Department of Biomedical Engineering and Professor Liu Bin from the Department of Chemical and Biomolecular Engineering under the College of Design and Engineering at NUS, and Prof Liu Xiaogang from the Department of Chemistry at the NUS Faculty of Science.

The team developed a nanoparticle that addresses prevailing challenges; the newly developed nanoparticle can diagnose atherosclerosis, target atherosclerotic plaques, and deliver therapeutic agents directly to inhibit the progression of atherosclerosis in the preclinical models. Composed of nanoscale coordination polymers (NCP) and a pH-responsive linker, the nanoparticles work by breaking down specifically in the acidic environment of atherosclerotic plaques, releasing gadolinium — a contrast agent for MRI — for real-time imaging of plaque severity while simultaneously delivering Simvastatin, a water-insoluble drug with anti-inflammatory properties and anti-ROS (reactive oxygen species) properties that contribute to plaque stabilisation and treatment, reducing the risk of cardiovascular events. Compared to the systemic delivery of similar doses of Simvastatin, the nanoparticles can deliver 1000 times more of the drug to the plaques, thereby enhancing the therapeutic efficacy while minimising systemic side effects.

“Overall, our nanoparticles offer a promising novel approach to non-invasive diagnosis, monitoring and targeted treatment of atherosclerosis, a significant advancement that could pave the way for a new era of cardiovascular care,” said Asst Prof Wang, Principal Investigator, Nanomedicine Translational Research Programme, NUS Medicine.

This proof-of-concept study demonstrates significant potential for the innovative approach and the team is looking to further validate their research before they move forward to clinical trials.

For media enquiries, please contact:

Xuan LEE
Manager, Communications
Yong Loo Lin School of Medicine
National University of Singapore
DID: +65 8288 1237
Email: lxuan@nus.edu.sg

About National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research and entrepreneurship, with a focus on Asian perspectives and expertise. We have 16 colleges, faculties and schools across three campuses in Singapore, with more than 40,000 students from 100 countries enriching our vibrant and diverse campus community. We have also established more than 20 NUS Overseas Colleges entrepreneurial hubs around the world.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, research centres of excellence, corporate labs and more than 30 university-level research institutes focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research and cybersecurity.

For more information on NUS, please visit http://www.nus.edu.sg/

About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

The NUS Yong Loo Lin School of Medicine is Singapore's first and largest medical school. Our enduring mission centres on nurturing highly competent, values-driven and inspired healthcare professionals to transform the practice of medicine and improve health around the world.

Through a dynamic and future-oriented five-year curriculum that is inter-disciplinary and inter-professional in nature, our students undergo a holistic learning experience that exposes them to multiple facets of healthcare and prepares them to become visionary leaders and compassionate doctors and nurses of tomorrow. Since the School's founding in 1905, more than 12,000 graduates have passed through our doors.

In our pursuit of health for all, our strategic research programmes focus on innovative, cutting-edge biomedical research with collaborators around the world to deliver high impact solutions to benefit human lives.

The School is the oldest institution of higher learning in the National University of Singapore and a founding institutional member of the National University Health System. It is one of the leading medical schools in Asia and ranks among the best in the world (Times Higher Education World University Rankings 2024 by subject and the Quacquarelli Symonds (QS) World University Rankings by subject 2024).

For more information about NUS Medicine, please visit https://medicine.nus.edu.sg/