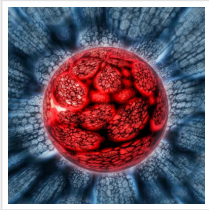
Dynamics of Nanoparticles Using a New Isolated Lymphatic Vessel Lumen Perfusion System



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Researchers have developed a new isolated lymphatic vessel lumen perfusion system that can move carbon nanotubes and other nanoparticles into surgically removed lymphatic vessels to visually evaluate their properties.

Nanoparticles used in drug delivery systems, bioimaging, and regenerative medicine migrate from tissues to lymphatic vessels after entering the body, so it is necessary to clarify the interaction between nanoparticles and lymphatic vessels. Although technology to observe the flow of nanoparticles through lymphatic vessels in vivo has been developed, there has been no method to evaluate the flow of nanoparticles in a more detailed and quantitative manner ex vivo.

Thus, research was conducted to develop an ex vivo lymphatic vessel lumen perfusion system to determine how nanoparticles move in lymphatic vessels and how they affect the physiological movement of lymphatic vessels.

Nanoparticles introduced into the body enter the lymphatic vessels, which spontaneously contract and dilate to transport lymph fluid throughout the organism. A research group led by Professor Naoto Saito, Director of the Institute for Biomedical Sciences, and Chika Kuroda, a third-year student at Yamaguchi University Faculty of Medicine and Health Sciences and graduate of the Master's Program at Shinshu University Graduate School of Medicine, have developed a new isolated lymphatic vessel lumen perfusion system that can move carbon nanotubes and other nanoparticles into surgically removed lymphatic vessels to visually evaluate their properties.

The group succeeded in developing a novel experimental system to evaluate how nanoparticles move in lymphatic vessels and how they affect the physiological movement of lymphatic vessels. The experimental system developed in this study has made it possible to

visually and quantitatively elucidate the interaction between nanoparticles and lymphatic vessels and to evaluate the biological safety of nanoparticles.

This is the first time that an ex vivo perfusion system has been created to assess the effects and kinetics of nanoparticles in lymphatic vessels during spontaneous vessel contraction and expansion. Compared with in vivo examinations, the perfusion system permits higher-resolution and more detailed observation of nanomaterial movements along with associated lymphatic vessel reactions.

Furthermore, the new system enables both quantitative and histological assessments of a single lymphatic vessel's physiological reaction to nanomaterials. By using this experimental system to evaluate specific nanoparticles, the physiological and histological effects of the nanoparticles on the lymphatic vessels can be clarified, and the clinical application of nanoparticles can be achieved more safely by evaluating their biological safety in combination with cell and animal experiments.

Nanoparticles are considered to be useful options for drug delivery and cancer imaging. After entering the body, they are known to enter lymphatic vessels and accumulate in lymph nodes, although the precise interactions between nanoparticles and lymphatic vessels remain unclear. The new perfusion system enables detailed examinations, safety, and the elucidation of pharmacokinetics for future clinical nanoparticle applications.

In the future, the group plans to examine the effects of various nanoparticles on lymphatic vessels depending on their concentration and time with the aim of applying nanoparticles to medicine. In addition, the research group plans to verify the safety of nanoparticles for clinical applications by combining them with cell and animal experiments. Ultimately, they would like to use this system to clinically apply particles whose safety has been confirmed in a wide range of fields such as DDS and imaging, and to elucidate the effects of nanoparticles on the lymphatic system.