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Dr. Kwan Seob Park and Dr. Tae Joong Eom of APRI: "We can observe blood flowing deep in the brain in real-time"

□ GIST (President Seung Hyeon Moon) – Dr. Kwan Seob Park (first author) and Dr. Tae Joong Eom (corresponding author) of the Advanced Photonics Research Institute have developed an angiographic tomographic imaging technique to capture hippocampal structures and blood flow in real-time high-resolution without injecting additional fluorescent material.

◦ To investigate the causes and developmental processes of Alzheimer's dementia and brain metastasis, which are typical diseases related to the brain, experimental animal models are used to study not only the efficacy and mechanism of drugs but also the function of the hippocampus * by observing the distribution of vessels and changes in blood flow.

* The hippocampus belongs to the limbic system and plays important roles in the consolidation of information from short-term memory to long-term memory, and in spatial memory that enables navigation. The hippocampus is located under the cerebral cortex.

◦ Magnetic resonance imaging (MRI), a representative technique for observing brain functions, is mainly used with humans and large

animals. However, MRI cannot be used with small animals in developing new drugs or in observing brain function because of resolution and size restrictions. It is a difficult situation. In particular, to study memory-related diseases in the brain, blood flow should be observed in real time with the response to external stimuli or behavioral patterns, which were difficult to observe in a short period of time. Therefore, there has been a need to develop a new type of cerebral blood flow imaging technology that can overcome the technical limitations of conventional MRI or optical microscopy technology that can be used to identify brain diseases and develop therapeutic agents.

□ In this study, to overcome the limitations that light cannot deeply penetrate biological tissue, the researchers used characteristics of brain tissue that scatters light differently depending on the wavelength used. Generally, using a laser with a long wavelength can penetrate deeper into the brain, so an optical imaging technique using light can increase the depth. However, the relatively large absorption of biological tissue made the results difficult to understand.

◦ Light with 1.7 micrometer wavelength used in the study has less characteristic of scattering in biological tissues than light with 1.3 micrometer wavelength, which was commonly used in the past and has large absorption characteristics. Despite the unfavorable absorption characteristics of the 1.7-micrometer wavelength band, the researchers demonstrated that vascular tissue deep in the brain was clearly visible compared to conventional imaging equipment due to its low scattering characteristics, which was demonstrated by imaging micro-vessels in the hippocampus.

◦ The research team also analyzed the major components that make up the brain and found a new laser wavelength band that best represents the vascular tissue inside the brain. The laser was developed with the help of a Japanese company that specializes in optical instruments. The laser technology, developed for the use of industrial inspection technology, has been used in the field of brain imaging research.

□ Since the laser shows the structure of the brain and the flow of blood, the single-layer imaging technology can be miniaturized, which allows it to record brain function images and simple blood flow without the need for dyeing or marking.

□ Dr. Tae Joong Eom said, "For the first time in the academic community, this research was successful in visualizing the microscopic blood flow of hippocampus tissue located deep in the brain and shown in real-time images, thereby revealing the cause of brain diseases and suggesting a new optical imaging technique necessary for the development of therapeutic drugs."

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