Research Center for Medical Sciences Division of Ultrasound Device Development and Application (DOUDA)

Norio Nakata, *Associate Professor and Director*　　Zuojun Wang, *Assistant Professor*

Research Activities

Education/Research outline

1. Development of a decision-supporting system for breast ultrasonography using deep learning

The purpose of this study is to develop a decision-supporting system for breast ultrasonography using deep learning, which is machine learning technique. The goal of this system is a classification tool between benign and malignant breast mass lesions. Required by this study are at least 1,000 cases of supervised data sets, including breast ultrasonographic images and pathologic diagnosis results. This study has already been approved by The Jikei University Ethics Committee. We are preparing to install the deep learning program and to experiment on artificial intelligence (AI) tests. With this study we are expecting to improve the diagnostic efficiency of breast ultrasonography for diagnostic radiologists.

2. Improvement of computer hardware and software environment for AI development

In Japan Agency for Medical Research and Development, 2017: "Clinical research etc. ICT infrastructure building · AI implementation research project" Adoption of secondary public offering (medical productivity revolution realization project), utilization of AI (research representative: Masatoshi Kudo, president of the Japan Society of Ultrasonic Medicine),

As a research contributor, Norio Nakata has developed ultrasonographic image processing and prototype diagnosis support. In this first year, to study the AI transfer learning effect with images of other areas, we developed an AI algorithm for judging diseases of the chest with chest X-ray images (more than 100,000) published at the NIH to prepare computer hardware and software for AI development.

3. Education and awareness activities to promote AI utilization in diagnostic radiology

In the Japan Society of Ultrasonic Medicine and the Japan Radiological Society, we conducted educational and awareness activities to explain to academic members (ultrasonic specialists and radiologists) the principle and the near future use of AI for imaging support. Norio Nakata wrote and published its contents in the journal of the Japanese Society of Nephrology and the Journal of Medical Image Information Society.

4. In vitro study of a method of quickly reopening acutely occluded vessels with ultrasound and microbubbles

Early reopening of occluded blood vessels is the most effective treatment for acute cerebral infarction. Transcranial ultrasound, alone or in combination with microbubbles, has been shown to promote the thrombolytic efficiency of recombinant tissue plasminogen

activator (rt-PA). However, thrombolytic therapy has frequently failed for completely occluded cerebral arteries, likely because rt-PA has difficulty reaching the thrombus site. We theoretically examined and demonstrated that the combined use of ultrasound and microbubbles has the effect of transporting rt-PA over a long distance, in addition to locally promoting the thrombolytic effects of rt-PA. In this study, we are conducting research on the existence and amplitude of this transportation effect and its relationship with various parameters of ultrasound through in-vitro experiments.

5. Study of method of preventing vascular re-occlusion with ultrasound

After thrombolytic therapy with intravenous rt-PA, blood vessels are frequently re-occluded. Because anticoagulation therapy is prohibited within 24 hours after rt-PA treatment, vascular re-occlusion is a fatal problem. Together with Lecturer Sawaguchi (Faculty of Biomedical Engineering, Toin University of Yokohama), we have conducted research on the thrombus growth control effect of noninvasive ultrasound with an in-vitro clot growth model. This study showed that noninvasive ultrasound irradiation can control thrombus growth. Safe and simple ultrasonic irradiation can be used to prevent re-occlusion after rt-PA treatment for acute cerebral infarction. Additional advanced basic research studies are being conducted to allow clinical application.

Publications

Inoue M, Ohta T, Shioya H, Sato S, Takahashi H, Nakata N, Taniguchi C, Hirano M, Nishioka M, Yamakawa H. Inflammatory myofibroblastic tumors of the breast with simultaneous intracranial, lung, and pancreas involvement: ultrasonographic findings and a review of the literature. *J Med Ultrason.* 2018; **45:** 331-5.

Nakata N. Recent technical development of artificial intelligence for diagnostic medical imaging. *Jpn J Radiol.* 2019; **37:** 103-8.