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The 459th International Symposium on Therapy

The 459th International Symposium on Therapy was held by the Zoom Webinar on May 18, 2023. Dr. Hirohisa Murakami, Director of the International Medical Society of Japan (IMSJ), presided over the meeting.

AI in diagnostic imaging

Introductory Message from the Chair

Tsutomu Yamazaki, MD, PhD
Director, IMSJ

【Discourse】

Soundscapes and Exhibitions - Techniques and Prospects

Hirohisa Mori Ph.D
Associate Professor
The University Museum, the University of Tokyo

Lecture I

Use of AI and radiomics in CT and MRI

Shigeru Kiryu
Chief and professor of Department of Radiology
Department of Radiology,
International University of Health and Welfare Narita Hospital

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Lecture II

The role of AI in nuclear medicine diagnosis and theraphy

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Department of Diagnostic Imaging, Graduate School of Medicine,
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I gave a talk titled "The Role of AI in Nuclear Medicine Diagnosis and Therapy." In my self-introduction at the beginning of my talk, I mentioned that I started programming when I was around 8 years old. I was fascinated by games such as Super Mario Bros. (released in 1985) and Dragon Quest (released in 1986), which were popular at the time, and started studying programming to create something that would surpass these games. At the time, there was no Internet search, and bookstores were all the learning resources I could find. I read the same books until they became dirty. This method of study is not so common today, but it seems to have been more effective than today's study methods.

After graduating from Hokkaido University School of Medicine in 2002, I immediately joined the Department of Nuclear Medicine at the same university, where I created PET viewer and analysis software using C++ and C#. Among them, Metavol, which I released in 2014, can easily used to measure SUV, MTV, and TLG of PET/CT, and can also perform texture analysis. As of July 14, 2023, 66 papers citing Metavol have been published in various diseases such as malignant lymphoma, prostate cancer, brain tumors, and cardiac sarcoidosis. I hope that Metavol has been helpful to many researchers in the preparation of their papers.

Around 2017, seeing the third AI boom coming into full swing, I started my own AI researches and gradually became capable to publish scientific papers. I started to use Python instead of C/C++. Although C/C++ is faster, Python is superior in terms of the richness of machine learning libraries. I introduced several research results: an AI that highlights pathological accumulation by extracting only physiological accumulation from maximum intensity projection (MIP) images of FDG-PET/CT images and conversely excluding it from the original images[1], an AI that diagnoses pathological accumulation in FDG-PET/CT images of breast cancer[2], a model that accurately predicts prognosis in thyroid cancer cases by measuring tumor volume by metastatic site in FDG-PET/CT before I-131 treatment and calculating "corrected tumor volume" by weighting each organ[3], an AI that applied texture analysis to the cardiac portion of FDG-PET/CT performed for the diagnosis of tumors to aid in the diagnosis of cardiac sarcoidosis[4], a paper showing that the same technique can predict the prognosis of cardiac sarcoidosis[5], and preliminary results of a study on improving image quality.

When trying to understand AI in nuclear medicine, a classification into three types of AI is helpful[6]. AI usually stands for artificial intelligence, but we introduce three backronyms (full-length words made from abbreviations in reverse): assisted interpretation, additional insights, and augmented image. Assisted interpretation is AI that uses human diagnosis as the gold standard (ground truth), with the goal of approaching human diagnosis. The goal of the AI is to approximate the human diagnosis. Specialists can use AI to make the current diagnostic process faster, more efficient, and more accurate, while non-specialists can use AI to provide a level of care similar to that of specialists. BONENAVI in bone scintigraphy would be an example. The concept of additional insights, on the other hand, places the ground truth at markers that are more rigid than human diagnosis. For example, genetic mutations or prognosis. In this way, the goal is to create an AI that can see what the human eye cannot[7]. Our paper[2] introduced above is also a study of additional insights, but the drawback is that since AI is beyond the human eye, humans cannot logically judge the results of AI output as correct or wrong. Even if AI performance deteriorates due to unnoticed dataset shifts (e.g., changes in patient background), humans cannot notice this[8]. The augmented image is an AI that returns an image when given an image, and is used to reduce radiation exposure, to correct absorption in PET/MR, and to perform shorter-time imaging. Attempts have also been made to estimate the distribution of different radiopharmaceuticals from PET images taken with one radiopharmaceutical[9].

I concluded my talk by discussing the potential use of AI in nuclear medicine therapy. Current nuclear medicine therapy does not make use of dosimetry and many cases are under-dosed and under-treated[10]. Nuclear medicine has a concept called theranostics, a term coined by combining the words therapy and diagnosis. It would also give useful information by AI to determine the absorbed dose for each organ and to determine the maximum dose within which side effects are acceptable.

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