Update on Diagnostic Medical Imaging

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Introduction

In 1895, Wilhelm Conrad Roentgen, a German Nobel Prize winner in physics, first discovered X-rays. He took an X-ray photograph of his wife’s hand, and showed her bones with her wedding ring. After his groundbreaking experiments, X-ray examination spread worldwide, and has become an essential tool for the diagnosis of various diseases and traumatic injuries. In the late 20th century, advances in information technology allowed the development of computed tomography (CT scan). This modality combines a series of X-ray photographs taken from different angles and creates cross-sectional images. Although conventional CT scanners have limited spatial resolution, spiral CT scanners overcome such shortcomings, and enable studies such as coronary CT angiography.

Noninvasive ultrasound imaging was first developed in Japan. Dr. Toshio Wagai was born in Sendai, and graduated from medical school in Niigata. He started his career as a surgeon at Juntendo University. He was reunited with two dormitory mates from high school in Tokyo who were working on ultrasound in their own respective fields. Ultrasound was being used to detect fish in water at that time, and it was not known whether it could be safely used in humans. Owing to Dr. Wagai’s tremendous effort, the first prototype B-mode ultrasonograph was developed in 1953. Mechanical scanning transducers were used initially, but were soon replaced by electrical scanning transducers for improved resolution. Ultrasonography can currently provide not only anatomical images but also information on blood flow, pressure, and tissue characteristics.

The “endoscope” originated as a simple instrument for observing internal rectal hemorrhoids in ancient Greece. In 1868, a German doctor named Adolph Kussmaul succeeded in examining the stomach with a 47-cm metal tube. After years of continuous research and technological innovations, Olympus (a Japanese optical instrument manufacturer) first introduced “flexible” glass fiber endoscopes to the market. Since then, endoscope sizes have decreased in diameter, but the length remains relatively unchanged. Due to this limitation, it has been impossible to directly see the small intestine until recently. The capsule endoscope is a breakthrough technique in gastroenterology, and is expected to provide new insights in this field.

Magnetic resonance imaging (MRI) is based on a physical principle that is totally different from those of other medical imaging techniques. This technique utilizes a phenomenon called nuclear magnetic resonance (NMR) in which magnetic fields and radio waves cause atoms to emit subtle radio signals. In the 1980s, MRI scanners became available for use in medical facilities. An MRI system uses several methods to create different images. For example, diffusion-tensor imaging is used to clearly visualize the pyramidal tract.

Advances in technology continuously lead to new possibilities with regard to imaging methods. In this issue, four experts review recent advances in medical imaging in their respective fields. I am confident that these articles will provide new and different perspectives on medical imaging, and that the readers will enjoy the “eye-opening” images provided by these advances.