

Three Domains in Diagnostic Radiology

Man Chung Han, MD¹

Since the discovery of X-rays in 1895, the applications of radiation in medicine have broadened tremendously in scope. Three specialties have emerged during the last 50 years; namely, diagnostic radiology, therapeutic radiology, and nuclear medicine. Nowadays, these specialties are established worldwide in clinical practice with board certification, and in education, training, and research, although some loose interrelationships still remain in some countries.

In diagnostic radiology, subspecialization has evolved either by organ system or by technology. Even though they were met with a tremendous enthusiasm in their early stages, we have witnessed the eventual decline of 'subspecialties' for angiography and CT, and technology oriented subspecialization seems unrealistic and self limited.

Interventional radiology is a relatively young subspecialty of diagnostic radiology and the role of interventional radiologists in patient care is quite different from that of traditional image interpretation-oriented radiologists. Interventional radiology is increasingly expanding its role replacing surgery as a treatment of choice in various diseases.

Recently, with the advance of new MR technology, the clinical application of functional MR imaging, spectroscopy, diffusion and/or perfusion imaging is increasingly applied in daily practice. Furthermore, imaging of immunological process and imaging at the gene level is being explored. This means that the scope of diagnostic imaging is expanding from detection and characterization of organ or tissue level pathology, to characterization of disease at the cellular or molecular level.

Consequently, we could define three domains of diag-

nostic radiology (1, 2) as

Medical radiology
Surgical radiology
Cellular radiology

Medical radiology encompasses image interpretation oriented radiology, i.e., traditional radiology. Image generation or acquisition, interpretation, and consultation are carried out by radiologists. Although clinicians request an examination, radiologists should be integrated with the team in charge of patient care, being part of the decision making process, especially when performing invasive or costly procedures, such as angiography or MR imaging, is entertained. More often than not, image generation and interpretation, either or both, are performed by non-radiologists, and it is our responsibility to correct these improper practices.

Surgical radiology is an expanded or alternative description of intervention radiology. Although the term 'interventional radiology' is popular and widely understood, a more precise and broad definition would be surgical radiology, since we are replacing surgery or surgical procedures by using image guidance. The role of radiologists in this domain is primary and more active, similar to that of a surgeon. The decision making regarding the entire procedure is done by radiologists. In an age of minimally invasive treatment and of medical cost containment, the scope of surgical radiology will be expanded and the number of patients benefiting from these procedures will increase.

Cellular radiology is a new frontier of diagnostic radiology. Time-honored radiological imaging is based on morphological or anatomic changes of organs or tissue, and

Department of ¹Radiology, Seoul National University College of Medicine, 28, Yongon-Dong, Chongno-Gu, Seoul 110-744, Korea.

Address reprint requests to M.C. Han.

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does not provide us with information as to what kind of change, if any, is happening at the cellular or molecular level. Information regarding the functional or physiological state of an organ or tissue is not obtainable, with the exception of such primitive assessments as gastric peristalsis, gross excretory function of the kidney and gall bladder, etc. By using the sophisticated new technologies of ultrasound, CT, and MR etc., we are on the way to exploring cellular or molecular phenomena at a time before a morphologic organ abnormality is detectable. Functional MR images are easily obtained in the visual, locomotive, and language centers by applying the 'blood oxygenation level dependent' effect. MR proton spectroscopy and its imaging are not infrequently performed for the detection and differential diagnosis of malignant from benign lesions. Recently, imaging of gene delivery and gene expression has been attempted. With magnetic cell labeling techniques, tracking of stem cells or cell lines expressing transgenes is feasible using a three dimensional T1-weighted gradient-echo sequence. Research is ongoing in many centers in regard to imaging at the cellular or

molecular level using MR, nuclear medicine, and near-infrared optical imaging etc. (3). The basis of cellular radiology derives from the basic sciences, such as physiology, chemistry, immunology, and genetics etc.; its paradigm is quite different from that of medical radiology, which is morphology or gross pathology oriented.

In summary, we radiologists should be aware of the scope of these three domains of diagnostic radiology no matter what our specialty is, and the potential of cellular radiology can not be overstated.

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