Guideline for Justification of Diagnostic Radiology

Yoshihiro HIRAMATSU* and Sukehiko KOGA**

* Department of Radiology, Toho University School of Medicine
** Department of Radiology, Fujita Health University

Abstract: Availability of medical imaging equipment in our country is the highest in the world and far beyond the world average, but at the same time, the radiation exposure of the population is unfortunately far beyond the international standard. A guideline for diagnosis with minimal radiation to the patients and with minimal examination cost and in minimal time interval was needed. Because of the differences of imaging equipments and differences of personal experiences among the institutions, it is not possible to make a guideline to satisfy every one involved in the imaging diagnosis, but it is possible to make a proper diagnosis in reasonable time reducing the radiation dose to the patients after reviewing each diagnostic modality and their combination. The most fundamental point for the diagnostician is to reconsider the efficacy of the examination in the viewpoint of the patients.

Key words: Diagnostic imaging; Efficient combination; Guideline

Introduction

Fortunately, availability of medical imaging equipment in Japan is the highest in the world and far beyond the world average, but at the same time, the radiation exposure of the population is unfortunately far beyond the international standard. We have to admit that a large portion of the exposure is abuse and could be cut down. Now is the time to create a practical guideline for diagnostic radiology, not only in the view of radiation reduction, but also in the view of the new medical insurance system, similar to the Diagnosis Related Group (DRG) system in the United States of America, which already started partially in Japan.

In the medically advanced countries such as European countries and the United States of America, guidelines for imaging diagnosis using medical radiation have been made many years ago and clinically applied, but in Japan such a guideline for the efficient usage of imaging examinations associated with radiation has not been made.

The guideline should not be fixed permanently and should be modified according to the swift changes of the medical system. Steps to perform various imaging modalities for diagnosis
are directly influenced by changes of imaging equipments. They are also influenced by other factors of the institutions such as number of staff and social status surrounding the institution.

As a part of the research group of the Ministry of Health and Welfare: A study of optimization of the usage of medical radiation and protection, Report of the study for optimization and clinical judgment of radiation medicine was finalized in 1998. This paper is a part of the summary of the report.

Characteristics of the Imaging Modalities

1. Plain radiography

Plain Radiograph can be obtained in any medical institution and is the most un-expensive imaging test. The International Commission on Radiological Protection (ICRP) had analyzed radiation from plain radiography, and it has been concluded that no serious dose would be emitted unless extremely overused. Information obtained from plain radiography is very valuable and especially for the chest, abdomen, and extremities, it is performed as the initial modality for screening of various diseases.

In diagnosis of diseases of the head, information obtained by plain radiography is limited and it is rarely considered as the modality of first choice, but it is obtained frequently in many institutions.

2. Contrast radiography

Contrast studies have been performed to compensate the weak points of plain film studies. Especially, angiography is still performed as the gold standard in many diseases. In recent years, interventional radiology (IVR) has been prevailed as the modality for treatment using the technique of angiography (Seldinger’s technique). However, in performing IVR, it sometimes takes hours in fluoroscopic and radiographic procedure. Recently there are many reports of cutaneous ulcers which could never been imagined to happen in this modern age of radiology.

Contrast studies of the gastrointestinal tract have been widely replaced by endoscopy but they are still frequently performed as screening. Intravenous urography has been performed as the basic study for screening of urinary tract diseases. Although it could be replaced by ultrasonography or computed tomography but IVU is still performed as the routine examination in urology.

3. Computed tomography (CT)

Nearly 30 years have passed since the CT was introduced into the field of clinical examination and became one of the most important clinical tools. Especially due to the recent development of the helical system, hemodynamic information and three-dimensional demonstration of the organs and diseases can be obtained. Virtual endoscopy using helical system is now clinically used after years of experimental application. Detection of small ureteral stone by CT is now drawing attention as the CT urography in clinical practice.

The most recently developed CT unit with multiple detectors (multidetector or multi-slice CT) would be the main modality for imaging diagnosis in the future. It has a capability of examining the whole body in a single study and it is called “one stop shopping”, eliminating need for the rest of the studies. However, when the economical situations such as the health insurance system is taken into consideration, the ideal diagnostic strategy (decision tree) cannot be fully practical.

Radiation dose to the patients by the modern powerful CT is also becoming a new problem.

4. Ultrasonography (US)

As there is no radiation associated, the ultrasonography has become one of the most important imaging modality. It has been established as a diagnostic tool replacing the classical stethoscope, and moreover it can replace the manual palpation skill of physicians. It is clear that this simple tool can help the physician at the clinical
practice.

Significant improvement in the quality of the images has been made. Hemodynamic information of the lesion is now easily obtained with the Doppler system. Improvement in the computer technology brought the three dimensional images of ultrasonography. The ultrasonography can be performed by the physician, nurse, clinical radiology technician, and by clinical laboratory technician. The imaging quality, however, depends on the clinical skill and the experience of the examiner significantly. The use of US is limited in some anatomical sites because of the presence of gas and bones, which reflect the ultrasonic wave.

5. Magnetic resonance imaging (MRI)

As with US, there is no radiation to the patient with MRI. The scanning technique is improving very rapidly and scanning time is remarkably shortening, some of which being as short as the conventional X-ray exposure for film. Voluntary slice level can be selected and different information is obtained using a variety of imaging factors. Fine detailed angiography (MR angiography) is also obtained and conventional angiography can be avoided in many cases. Using NMR spector, MR spectroscopy (MRS) is obtained and the tissue characteristics is estimated for more precise imaging diagnosis. Differentiation between malignancy and inflammation could be made in some instances.

Common Items for Consideration to Reduce Radiation Exposure

1. Strict indications for examination
   1) Alternative examination
      Prior to performing the imaging examination with radiation to the patients, it is necessary to consider whether the alternative examinations without radiation such as US or MRI can be done.
   2) Comparison films
      When previous examinations are available for comparison, unnecessary study can be avoided in some cases. Previous examinations performed at other institutions should also be obtained for review. Due to advancement and prevailing of the computer, the new picture archive and communicating system (PACS) is available to convey the images to the remote institution.

2. High performance X-ray units

When taking radiographs, it is preferable to use the machine of higher performance, so that shorter exposure time could be selected, which is advantageous especially for pediatric patients to reduce the artifact on the radiographs due to body movement.

Accurate collimation is also possible with the high performance machine.

3. Fast film/screen combination

Faster film/screen combination is preferable. Radiation dose is significantly reduced by the use of rare earth screen.

4. Digital system

Digital imaging system is now used widely instead of film/screen system. Not only reduction of the radiation to the patient, application of the PACS system become possible by the digital system.

5. Cautions to be marked on the fluoroscopy

1) Full use of fluoroscopic collimation is important to keep the gonads out of the direct radiation field.
2) Dead man type on-off switch is ideal to reduce the un-necessary radiation dose to the patient.
3) Recording system such as Video significantly cut down the fluoroscopy type.
4) Only personnel needed to perform the examination should be arrowed to stay within the examination room.
5) When the personnel must stay within the examination room during the fluoroscopy, he or she should ware a lead apron or should be behind the lead protective screen.
6. Storage of images

Images should be filed properly to be utilized effectively. Digitalized images can be more easily filed. It is a necessity for the medical institution that all images could be readily reviewed whenever needed, whether the images are digitalized or not. This rule is, however, not kept at many institution in Japan.

Decision Tree for Effective Diagnosis

Plain film is still the modality of first choice in diagnosis of diseases in many organs because of its simplicity and low radiation dose to the patients. It is important to decide which examination to combine with plain film, US, CT, MRI or nuclear medicine. The combination is different in various organs and also among the institutions and among the physicians of different experiences. Supposing the institution is equipped with the newest diagnostic tools, the ideal decision tree can be established.

To reduce the expanding medical expenses, unnecessary examination should be spared. In medically advanced countries such as the United States of America or United Kingdom, study has been done to establish the ideal diagnostic decision tree. Excessive simplification should not, however, disturb the process of making diagnosis.

Now, ideal guideline for diagnosis suited for Japanese medical situation especially for the medical insurance system is needed. The human body was divided according to the anatomical regions, the head, neck, chest, gastrointestinal system, hepatobiliary and pancreatic system, genitourinary system, extremities, spine, breast, and cardiovascular system and interventional radiology was added. In each of these regions and categories, a guideline was made with the example of representative cases or representative symptoms.

Conclusion

A guideline for diagnosis with minimal radiation to the patients and with minimal examination cost and in minimal time interval was needed. Because of the differences of imaging equipments and differences of personal experiences among the institutions, it is not possible to make a guideline to satisfy every one involved in the imaging diagnosis, but it is possible to make a proper diagnosis in reasonable time reducing the radiation dose to the patients after reviewing each diagnostic modality and their combination.

The most fundamental point for the diagnostician is to reconsider the efficacy of the examination in the viewpoint of the patients.

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