Chapter 15

EFFECTIVE CHOICES FOR DIAGNOSTIC IMAGING IN CLINICAL PRACTICE

(Excerpts from a Report of a WHO Scientific Group on Clinical Diagnostic Imaging)

Introduction

There are so many different methods of diagnostic imaging that medical practitioners may need guidance to choose the best through the maze of options for each clinical problem. Advice may be required for more than just the first choice, because the first imaging procedure does not always give the desired answer and, depending on the results, further imaging may have to undertaken. The alternative is to submit the patient to a barrage of imaging and hope that one type, at least, provides the diagnosis. This is a quite unacceptable way to practice medicine because of the cost and the risk of radiation damage from unnecessary examinations.

If the WHO's goal of health for all by the year 2000 is to be achieved, the money available for health care must be efficiently used in every country. In an ideal world, the cost of medical care would not be a limiting factor affecting the quality or quantity of the health services provided, but unfortunately this situation does not exist in any country. Even the wealthiest nation must be aware that final support is not unlimited. As the wealth of a country grows, so do cost and complexity of medical care, often at rates which exceed other aspects of the economy. Such an imbalance can have an effect throughout the community which no society can ignore.

Cost and complexity in health care are always reflected in diagnostic imaging services that can be provided. The WHO established the principle that radiological services are of great importance at the first level of patient care, and has provided specifications for X-ray equipment and general-purpose ultrasound scanners. WHO manuals guiding radiographic and darkroom techniques and the interpretation of X-ray films are available in several different languages and are deservedly popular, and a manual on ultrasound interpretation is in preparation. In addition, several WHO published documents are concerned with the efficacy and efficiency of radiological imaging, and with the technical specifications of the equipment to be chosen. However, none of these reports has addressed the vital question of which approach is the most effective for the imaging of any specific clinical problem. What order of imaging should be followed to make the diagnosis accurately, quickly and economically? Equally important, is diagnostic imaging needed at all in some cases? It must be emphasized that imaging can never replace clinical history-taking and examination as the first steps in helping each patient.

The choice of the most effective imaging is often difficult and frequently controversial. The sequence to be followed varies with many factors: the equipment available, the skills of the practitioner, the expected quality of the results, the quality of interpretation, and conclusion which can be drawn. Local circumstances will alter need; for example, the exact diagnosis of the type of cerebral tumour is not an urgent matter if there is no neurosurgeon available. The quality of the local clinical service, and the simple question, "What can be

done with this patient after the diagnosis is made?", must also be taken into account. Priorities must therefore be established and the way in which a patient undergoes imaging will have many local variations. Unfortunately, not everyone can have the benefit of all methods of diagnostic imaging; indeed, the majority of the world's people will never even see an X-ray unit, let alone have radiographic examination. Ultrasound equipment is similar scarce. Both types of facilities are unevenly distributed and predominate in large cities. Nuclear medicine withers when departments are unable to obtain radionuclides promptly. The use of magnetic resonance imaging (MRI) is expanding at an astonishing rate in some countries, while remaining only a hope for the future in many others. Any recommendations on the use of imaging must allow for all these variants, so that in each case the best choice can be made from what is available. Despite all the difficulties, some attempt needs to be made to establish the best approach to the most common clinical problems.

Although the economic situation, which cannot easily be changed, may be the ultimate factor limiting the choice of diagnostic imaging techniques, the risk of ionizing radiation, which is controllable, must also be a consideration. At the primary care level, radiography is still the most common method of imaging, because the majority of patients can benefit from basic radiological diagnosis. This applies equally at secondary and tertiary levels of care, because throughout the world 80% of all diagnostic images are of the chest and skeleton. Ultrasonography, which is less expensive, cannot satisfy either of these needs. Computerized tomography (CT), using ionizing radiation, is not a survey tool suitable for most initial examinations. MRI is a remarkable technology, particularly for imaging the central nervous system and spine, but even its most ardent advocates have yet to recommend it as a first step when the patient has a cough or a suspected limb fracture. Scintigraphy is seldom of initial importance, except in a few cases such as osteomyelitis or suspected stress fractures. The principle that no patient should be exposed to unnecessary (meaning ineffective, clinically useless) radiation is a very good reason why the sequence of imaging must be carefully chosen by a radiologist or medical practitioner who has a clear idea of what should be done first after the clinical examination, and what subsequent imaging may be needed when the first results are available.

The growth of ultrasonography in the last decade has changed the pattern of imaging: in many clinical situations ultrasonography is now the first choice. Few clinicians would disagree that all pregnant women who need imaging should have an ultrasound scan first, and it is seldom that any other method of obstetric imaging will be contemplated throughout pregnancy. Equally, for the liver, pancreas and spleen, ultrasonography should be used first, even where CT and MRI facilities are available. CT should be deferred because it uses ionizing radiation, costs more and does not always give more information. MRI should be delayed because of even higher costs, and because ultrasonography will provide equally reliable guidance in a high proportion of cases. Similarly, ultrasound is considered the primary imaging modality for most gynaecological problems, the scrotal contents and the prostate. In some countries, ultrasonography is used as a screening procedure for detection of *echinococcal* infection, and has demonstrated a significant number of new cases. However, its predictive value is strongly influenced by the prevalence of the disease. The thyroid may be examined using scintigraphy, and for bone scanning there is no substitute for

radionuclide techniques. With the present state of knowledge mammography should be done with X-rays, despite exposure of patient to radiation, because no other method has the same accuracy, ease of access and availability.

None of the images obtained by these techniques, be they radiographic, ultrasonic or from magnetic resonance, can be interpreted without knowledge of the clinical examination of the patient, and in many cases of the results of laboratory tests also. Information should be thoroughly and carefully assessed, and the laboratory investigations as carefully chosen as the image sequence. All steps in assessing the patient are interrelated and very few images, however spectacular, are valid in the absence of all other information. There will also be circumstances where local skill and experience in one modality may override other considerations, because the images are only as good as the physician who interprets them.

This report, then, is concerned with the many different indications which will guide the physician in the diagnostic imaging of each patient. There are, today, so many different choices and such wealth of information that it is often too much for any individual to master, and consultation with colleagues has become essential for good care of patients. While this report may provide useful guidance, it will not displace, wherever available, personal discussions between patient's physician and the specialist in diagnostic imaging. Such consultations should precede and guide the choice of imaging, rather than being merely a review of images after they are taken. Early consultation will improve the results, and the twin goals of high quality of patient care and cost restriction may be reached. If, at the same time, ionizing radiation is used more sparingly, the process will be further justified.

The Scientific Group was guided by three previous WHO reports, which outline the criteria for diagnostic imaging. The first considers the indications for and the limitations of the most common diagnostic X-ray investigations, and provides recommendations for limiting their use when unlikely to provide any clinically significant information. The second considers the use of ultrasonography and CT in developing countries, as well as the specifications of equipment required, and outlines the major clinical indication for these imaging methods. The third considers the rational use of diagnostic imaging in paediatrics, and provides recommendations for improving the use of the various imaging techniques which are valid for children up to the age of 14- years. It includes criteria, not only for those who have to decide which imaging technique is best for their patients, but also for those who are performing examinations, in the hope of limiting the use of diagnostic imaging to cases where it will really benefit the individual.

The Scientific Group was well aware of the wide variety of imaging techniques available, and yet at the same time, the many parts of the world where the choices are very limited. The report attempts to reflect this practical situation and gives as many alternatives as possible. Throughout it has also been made clear when imaging is not really helpful, or when there are significant limitations on the benefits that will result.

The report is arranged on an anatomical basis, and within anatomical section the clinical indications for imaging are discussed. While anatomy and illness are much the same

everywhere, available equipment is not so uniform. The Group has therefore described the sequences to be followed, envisaging three different levels of imaging equipment, while being aware that there is to be overlap and discrepancy. It is hoped that within the useful life of this report most facilities will approach the levels of imaging described. Unfortunately, Level I represents the most likely situation for most of the world and the Scientific Group was unanimous in recommending that this represented the minimum which should be accepted for good patient care.

 # Level I

Standard radiography, as with the WHO Basic Radiological System;

General-purpose ultrasonography;
Where possible within the health care facility or available within a reasonable distance:

- conventional linear tomography
- fluoroscopy with image intensification.

 # Level II

All Level I techniques and:
Sophisticated radiography
Sophisticated ultrasonography, including Doppler
Mammography
Angiography
Digital subtraction angiography
Computerized tomography
Radionuclide scintigraphy, including SPECT
Thermography (of limited use).

 # Level III

All Level I and Level II techniques and:
Magnetic resonance imaging (MRI)
Positron emission tomography
Advanced radionuclide scanning: labelling by means of monoclonal antibodies (immunoscintigraphy).

It is assumed that any Level II department will have all the imaging facilities that are available at Level I, and similarly for Level III, which must be fully equipped to perform any type of imaging. This does not imply, however, that diagnostic tests performed at Level I, for example, necessarily have to be applied at Levels II to III; the choice of imaging procedures will strongly depend on the particular clinical situation.

More important than the equipment is the availability of skills. An error in diagnosis because of inadequate education and experience is as dangerous as being without the equipment, and the success of any interventional procedure (e,g. angiography) is very dependent on the skill and the experience of the responsible physician. Qualified radiologists are not available in many parts of the world, and it should never be suggested that an adequate standard can be reached in any type of imaging on the basis of self learning and reading. In particular, the effective use of an ultrasound scanner, although less expensive than other imaging equipment, is very dependent on the physician. The minimum required training for ultrasonography and CT, which should be completed in a large centre, has been described elsewhere. The recommendations made by this Scientific Group are based on the assumption that at least an equivalent level of expertise will be available to interpret the images obtained in every facility. If a choice of imaging can be made, the decision should always be in favour of that for which there is the most local experience. Thus, many of the Group's recommendations can only be, at best, broad guidelines to be adapted according to local conditions and disease patterns.

Yet, the principles remain the same, and the message is very clear. An orderly and logical approach to the diagnostic imaging of patients will result in more accurate diagnosis, less harmful radiation and less expense. All three are goals well worth achieving in any country.

SUGGESTED READING

[1] WORLD HEALTH ORGANIZATION, Efficacy and efficiency of the diagnostic applications of Radiation and radionuclides. (Report of a WHO meeting, Neuherberg, FRG, December 1979), WHO, Geneva (1980) (unpublished document RAD 80.4; available on request from Radiation Medicine, World Health Organization, Geneva, Switzerland.

[2] WORLD HEALTH ORGANIZATION, The efficacy and efficiency of the diagnostic applications of radiation and radionuclides. (Report of a WHO meeting, Brussels, November 1977), WHO, Geneva, (1978) (unpublished document RAD/78.2; available on request from Radiation Medicine, World Health Organization, Geneva, Switzerland).

[3] WORLD HEALTH ORGANIZATION, Rational approach to radiodiagnostic investigations: report of a WHO Scientific Group on Indications for and Limitations of Major X-Ray Diagnostic Investigations, WHO Technical Report Series, No. 689 (1983).

[4] WORLD HEALTH ORGANIZATION, Future use of new imaging technologies in developing countries: report of a WHO Scientific Group, WHO Technical Report Series, No. 723, (1985).

[5] WORLD HEALTH ORGANIZATION, Rational use of diagnostic imaging in paediatrics. report of a WHO Study Group, WHO Technical Report Series, No. 757, (1987).