International Imaging Course
4-5 September 2004

Abstracts

4th September 2004

Imaging in cardiology - a cardiologist view point.

Dr. E.B. Wu.

In recent years, advances in cardiac and coronary imaging have been rapid and diverse and there has been a shift in focus from perfusion imaging towards anatomical imaging. While anatomical imaging is very useful in a minority of conditions like anomalous coronary arteries or Kawasaki's disease, it still has many limitations when used for the diagnosis of ischaemic heart disease. Data from Doppler flow wire studies shows that non-ischaemic lesions (those lesions which cause less pressure gradient on vasodilatation) are less likely to progress when compared to ischaemia generating coronary lesions. Therefore ischaemia as documented by perfusion defect is a better marker of significant coronary lesions when compared to anatomical imaging. To date, perfusion imaging remains a better option for diagnosis of ischaemic heart disease.

The large myocardial infarction studies of the 90s shows that about a third of myocardial infarcts occur in non obstructing coronary arteries. Thus, although a significant lesion is more likely to rupture and cause unstable angina syndrome or infarction, many nonsignificant lesions also rupture. The vulnerability to rupture in a plaque is thought to be related to the amount and distribution of cholesterol within the plaque as well as the amount of inflammation in the fibrous cap of the plaque. Some authors have proposed that anatomical imaging techniques can differentiate cholesterol mass and distribution within a plaque and thus predict the vulnerability of the plaque. If this area of imaging can be validated, plaque imaging may have a very important role in-patients with high risk of ischaemic heart disease.

Increasingly, it has become important for the cardiologists and the radiologists to differentiate between ischaemia, coronary anatomy, and plaque vulnerability which are related to perfusion, anatomical detail, and plaque anatomy and inflammation respectively. The three are different aspects of the same coronary artery disease but have different roles in different patients. Patients with symptoms who are not suitable for simple exercise tolerance test should undergo perfusion imaging. The role of anatomical imaging should be reserved for the relatively few patients who are unkeen for coronary

angiography because of its small but inherently real risks or its discomfort. The role of plaque imaging remains to be realized but may potentially be an useful tool for risk stratification of patients with non-significant coronary artery disease or high risk of coronary artery disease. The role of plaque imaging will also play an important future role in the assessment of medical therapy.

MR perfusion in ischaemic heart disease

Dr. C.H. Luk

MR perfusion imaging has emerged as a non-invasive modality for functional assessment of myocardial ischaemia. The presentation begins with the description of the ischaemic cascade. MR perfusion is compared with other existing imaging techniques. This is followed by the pathophysiology of stress, especially the vaso-dilator stress. The first-pass MR perfusion study consists of giving Gadolinium-based contrast intravenously and making dynamic acquisition of images of the heart during its transit. Analysis of the images can be qualitative, semi-quantitative or quantitative. So far, there are major studies showing promising sensitivity and specificity. Results of the recent scientific study of the Sir Run Run Heart Center at St Teresa's Hospital are also presented. The last part of the presentation focuses on some clinical cases illustrating how MR perfusion study can contribute to patient management.

NUCLEAR MEDICINE IN ASSESSMENT OF ISCHEMIC HEART DISEASE

Dr. Y.Y. Yau

Abstract:

Nuclear SPECT perfusion imaging and viability study had been well established in the assessment of ischemic heart disease. With the advent of PET, it had become the gold standard for evaluation of cardiac viability. The principle of the above imaging and their pitfalls will be discussed. Comparison with other modality will also be presented.

MDCT Coronary Angiogram – Hong Kong Sanatorium & Hospital Experience

Dr. Gladys Lo

MDCT Coronary Angiogram using 16 slice detector was first performed at Hong Kong Sanatorium & Hospital in July 2003. To date, we have performed approximately 500 CT Coronary Angiograms. A Calcium Score followed by CT Coronary Angiogram is usually performed. For patients with heart rates greater than 65 beats per minute, an oral beta- blocker is given unless contraindicated. Our protocol is as follows:

EKG gated calcium score, 10 seconds breath-hold.
20 seconds test bolus with IV contrast at 4cc per second, free breathing.
EKG gated CT Coronary Angiogram, 100cc IV contrast injected at 4cc per second followed by 50cc of saline flush, 20 seconds breath-hold.

Data on 283 cases performed between 23/7/02 and 22/7/03 will be presented. We also have an ongoing project with Grantham Hospital. There are 18 cases who had CT Coronary Angiogram as well conventional Coronary Angiogram. The preliminary results show a sensitivity of 88% specialvity of 89.9% positive predictive value of 73.3% and negative predictive value of 95.9%.

We conclude that MDCT Coronary Angiogram is a feasible noninvasive method to diagnose plaques and coronary artery stenosis as well as evaluation of congenital abnormalities of the coronary arteries. Our results are comparable to preliminary published data with high negative predictive value for coronary artery disease. This may well be a method of choice for evaluating patients with low to immediate risk for coronary artery disease. Further study involving larger patient population with verify the accuracy of MDCT Coronary Angiogram.

E.B.C.T. applications in Ischaemic Heart Disease

Dr. Victor GOH
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INTRODUCTION: In 1990, a new type of C.T. scanner was installed at Matilda Hospital in which an Electron Beam arrangement was utilized to generate X Rays without the need for an X Ray Head. Free from the usual constraints of gravity and friction, X Rays could be made to revolve around the study region at hitherto unachievable speeds, enabling constantly-moving structures such as the Heart to be visualized without Motion Artifacts. This talk will focus on the theory of this new C.T. Technology and discuss the possible applications with such equipment in the demanding field of Ischaemic Heart Disease.

CONTENTS: E.B.C.T. can be applied to study the Coronary Circulation and Myocardium in 5 major ways---

I)Calcium Scoring:

This involves scanning the Coronary Arteries for presence and quantitation of calcified plaques. The protocol calls for tabulating each and every spot of calcium in the whole arterial system of the heart. A Positive result is a sure sign of Atheroma, while the distribution of these plaques stratifies the patient into different categories of risk (the more proximal and /or dense the plaque(s), the more dangerous the lesion(s)). Furthermore, the score value represents the total plaque burden at the time of investigation, which can be used to follow progress of disease after treatment. Practical issues with this technology will be discussed in the talk.

II)E.B.C.T. Coronary Angiography("EBA"):

This employs an intravenous bolus of Contrast Agent to deliver the dye to the root of the Aorta, from where the contrast-enriched blood can stain the interior of the Coronary System for luminal assessment. The equipment's rapid sequence of visualization enables the entire Coronary Tree to be captured during the 1st pass of the contrast agent , thus doing away with the need for invasive placement of a catheter to deliver the dye to its destination. In addition, as the contrast mixes with blood at its point of entry, the

coronary circulation can be perfused continuously with oxygen-containing blood (rather than pure dye in the case of catheterization). Since images are taken in 3 dimensions, the lumen of any stenotic region can be analyzed with greater accuracy than with conventional coronary angiography (which is inherently a 2-dimensional technique). Obtaining an angiogram with the Electron Beam type of C.T. further enables calcific foci to be superimposed on the vessel wall, as the amount of irradiation is deliberately kept low (about 1/3 of the usual exposure compared to Spiral C.T.) This is especially advantageous as it allows heavily-calcified foci to stand out in the angiogram, to draw attention to areas where possible dissection can occur with forcible dilation in a subsequent angioplasty procedure. Comparative studies with conventional coronary angiography show the accuracy of EBA to be in the 90+ % range. Limitations of the technology will be discussed further in the talk.

III)E.B.C.T. Myocardial Perfusion:

By virtue of its unsurpassed speed of acquision, E.B.C.T. is unique among C.T. modalities in being able to perform a Time-Density Curve measurement. This involves intravenous contrast delivery to the coronary circulation, from where the dye crosses into and enhances myocardial cells if there is no vascular occlusion. After reaching the myocardium, the progressive degree of enhancement can be visualized by repeated observation of the myocardium from the start to the end of the cardiac cycle. In this way, a curve can be plotted to display the rise and fall of the enhancement---the Time-Density Curve. However, to be able to generate such a curve demands extremely rapid sequences which can only be achieved via the Electron Beam arrangement that does away with a weighty X Ray Head.

Since the entire myocardium can be so studied, many Time-Density Curves can be drawn in relation to different levels of cross-section of the heart (e.g. the Basal, Mid-Cavity and Apical cross-sections), and this in turn enables each region of the heart to be evaluated regarding the amount of blood flow reaching it. As this examination can be performed on a resting patient, it can be applied even on patients who are unsuitable to carry out any exertion as in the usual Stress Myocardial Scintigram. Furthermore, the Time-Density Curves allow a truly quantitative analysis rather than a semi-quantitative assessment in Radionuclide Imaging. Again any limitations of the technology will be discussed in the talk.

IV) E.B.C.T. Stent-Patency Assessment:

By applying the same sequence of scanning and placing the region of interest proximal and distal to a stented arterial segment, 2 Time-Density Curves can be engendered, representing the blood flow to and beyond a stented portion of a vessel. Where there is

in-stent restenosis, the flow past the stent would be drastically reduced, producing a post-stent curve that shows markedly delayed passage of dye. In this way, patency of stents can be non-invasively evaluated when patients present with suggestive features of chest pain after stent surgery. Limitations with this technique will be discussed in the talk.

V) E.B.C.T. Wall Motion Assessment:

By programming the scanner to capture a target at different phases of the cardiac cycle, the movement of the target during the cycle can be displayed. The programme also allows several cross-sections of the heart to be so examined, resulting in generating the motion pattern of the (L) Ventricle from Base to Apex throughout the Cardiac Cycle. By studying the degree of contractility of each segment of a cross-section, Wall Motion abnormalities can be detected. Summation of the motion effect of all the sections gives the overall Ejection Fraction. Ischaemic Motility disorders can thus be evaluated. Practical issues with this technique will be discussed in the talk.

CONCLUSIONS: Thus this technology can play a useful role in detecting I.H.D. as well as managing it (with serial scanning to compare findings). Early Diagnosis is promoted by the attributes of this technique, viz.

-Noninvasiveness,

-Safety (requiring less X Ray exposure),

-Broad applicability (able to study multiple aspects of the Ischaemic Process at the same sitting).

In addition, improvements in future generations of this scanner will produce even better Spatial and Temporal Image Resolution.

MRI coronary arteries

Prof. Wynnie Lam

Coronary artery angiogram is currently the gold standard for the assessment of coronary artery disease. With advances in technology, the role of non invasive imaging such as computed tomography angiography and magnetic resonance imaging has been revised. Magnetic resonance angiography of coronary arteries is theoretically the ideal imaging of choice as no radiation nor iodinated contrast is involved. It is potentially suitable for serial examinations and long term follow up.

Magnetic resonance coronary artery angiography can be used to document the anatomical relationship. This is therefore useful in the detection of anomalous origin of coronary artery. There is also a role in the assessment of morphology including stenosis and aneurysm of the coronary artery by MR angiography.

In general, imaging of coronary arteries can be divided into bright blood and black blood technique. Paramagnetic contrast could be given in the bright blood technique.

Whichever technique is adopted, cardiac motion and respiratory motion are the major obstacles to overcome in coronary artery imaging. Cardiac gating is therefore required to minimize the motion artifact related to cardiac motion. To reduce the breathing motion, either free breathing technique or the breath holding technique is adopted. There are also different ways to perform breath hold techniques and free breathing techniques. Sustained end expiratory breath hold technique and the navigatory sequence in free breathing are the two most popular techniques adopted.

There are advantages and disadvantages of different techniques. In general, the total examination time will be much shorter for breath-hold sequence. For sub-optimal positioning or motion artifact, the scans could be repeated without any patient hazard. The spatial resolution of the images will depend on the maximum duration that the patient can sustain his breath. On the other hand, the imaging time of the navigatory sequence will be much longer. Data could be acquired over a longer period of time and the signal to noise ratio and spatial resolution could be increased.

Recent advances in coronary artery imaging include the application of intravascular contrast and use of parallel imaging. Imaging of the coronary artery wall for characterization for the plaque is also a very challenging area for further exploration.

Advances in MSCT – Technology drive clinical outcome

Dr. Tobias Seyfarth

The new advantages in MSCT have a huge impact especially in the field on preventive care. Routinely performed cardiac CT for example becomes clinical feasible, not limited to dedicated centers anymore.
Special focus hereby is the technology change in X-Ray tube design and detector technology, where a major breakthrough was achieved in the latest generation of SIEMENS SOMATOM SENSATION CT Scanners. The revolutionary SIEMENS proprietary technology in tube design is strongly supporting the clinical outcome, especially in cardiac imaging. Presentation will give an introduction in the technical background and challenges.

5th September 2004

MR imaging of intracranial hemorrhage

Prof. Scott Atlas

FUNCTIONAL NEUROANATOMY

Prof. CHAN Yu Leung

The basics of of neuro-anatomy will be revisited with illustration of lobar and fiber tract anatomy with CT and MR imaging. A sectional as well as topographical approach will be used. The objective is to provide a platform for further acquaintance of important structures of the brain. Functional correlation of different brain substrates will then be emphasized. This second objective is to provide an understanding of the function of different parts of the brain. For this end, correlation of morphological lesion on imaging with neurological deficit and correlation of brain activation on BOLD fMRI with different tasks will be employed.

MRI of brain tumour: The fundamentals

Prof. Scott Atlas

Imaging of stroke: Current status

Prof. Scott Atlas

Advances in MRI of the brain

Prof. Scott Atlas

VASCULAR DISEASE - PERSPECTIVE FROM A NEUROSURGEON.

Dr. M.K. Lam
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Abstract.
Neurovascular investigations are now an integrated part of patient management pathway. The simple sequence of clinical assessment, radiological investigation, confirm diagnosis then decide on treatment may not apply in most situation. There are more interaction between neurosurgeon and radiologists in order to provide the best and seamless patient management. A few examples will be used for illustration.

For patients with transient ischaemic attack or minor stroke, Duplex ultrasound is often the first screening investigation for carotid artery stenosis. However, for patient management, determining the degree of stenosis is not enough, neurosurgeon will also want to know any coexisting intracranial artery stenosis, whether the stenosis is central or eccentric, the location of the carotid bifurcation as compared to standard anatomical structure e.g. angle of jaw or C-spine level. Moreover, the accuracy of Duplex ultrasound measurement for individual sonographer needs to be calibrated. Hence, MRA or CTA are required before definitive treatment. The information required for clinical management need to be addressed in the MRA and CTA reports.

For management of patients with subarachnoid haemorrhage (SAH), a common practice is to have diagnostic CT scan, then diagnostic angiogram and then decide on treatment. However, this is not a very efficient patient management pathway and that important information needed for treatment may not be reviewed during the investigations. Once patient is diagnosed of SAH on CT scan, one may proceed directly to CT angiogram while patient is still in CT suite. The important information to get from CT angiogram include: (1) whether there is cerebral aneurysm, (2) the location of the aneurysm, (3) whether the shape and configuration of the aneurysm are suitable for embolisation or surgical clipping, (4) what is the status of the collateral circulations. MR angiogram is an alternative with also good sensitivity and specificity. The involvement of neurosurgeon and intervention radiologist at this stage is very important. If it is decided for clipping, then preoperative digital subtraction angiogram (DSA) may not be needed. Intraoperative or postoperative DSA will be used to confirm adequate treatment. If it is decided for

endovascular embolisation, the information from CT angiogram or MR angiogram will enhance the planning of the procedure. During DSA supplementary information may be obtained with 3D DSA and/or balloon occlusion test. After treatment of aneurysm, other investigations will be useful for detection and management of hydrocephalus and vasospasm. Some investigations assess the anatomically vasospasm of the cerebral vessels and some on the cerebral haemodynamic. Endovascular angioplasty becomes part of the management of cerebral vasospasm.

Management of arteriovenous malformation (AVM) has become more complex. The treatment options including a combination of surgical excision, endovascular embolisation and stereotactic radiosurgery. The decision on the treatment depends on the detailed radiological assessment of the location of AVM, any associated AV fistula or aneurysm, nidus configuration (compact or diffuse), and location of functional area around the AVM. During each investigation especial for invasive procedures, the treatment team should be involved to get the most useful information from each study.

Neuroimaging of cerebrovascular DiseaseStroke

Prof. K.S. Wong

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Cerebrovascular disease is the predominant vascular disease among Chinese with stroke outnumbers myocardial infarct at a ratio of about 5 to 1. For decades, strategies to prevent stroke aim primarily to modify traditional vascular risk factors such as hypertension and diabetes. Recent advances in stroke prevention, however, underscore the importance of targeting underlying stroke mechanisms such as atrial fibrillation and carotid stenosis. The mechanisms of cerebrovascular disease among Chinese are somewhat different from the West. Intracerebral haemorrhage and intracranial large artery occlusive disease are more commonly found in Chinese stroke patients.

Large artery stenosis and/or occlusion are found in about half of patients with ischaemic stroke. Most of these lesions located intracranially (35%) or both intra- and extracranially (10%) while pure extracranial carotid stenosis account for <5% of ischaemic stroke. Moreover, prognosis of stroke patients depends on the presence and the extent of occlusive vascular lesions. The pathogenesis of cerebral infarcts for patients with intracranial occlusive remains unclear. Recently, with transcranial Doppler microemboli detection and diffusion-weighted magnetic resonance imaging, it is now possible to visualise asymptomatic emboli in vivo. Our data have confirmed that haemodynamic compromise, artery-to-artery embolisation and a combination of both are important factors in causing cerebral infarcts. The risk of cerebral infarcts is associated with the degree of arterial stenosis and the length of stenotic segment. In future, we may be able to identify asymptomatic patients with intracranial large artery occlusive disease and to start treatment before the lesion become symptomatic.

Primary intracerebral hemorrhage accounts for 20-40% of stroke in Chinese. Surgical management has not been shown to be of benefits in large clinical trial and thus prevention remains the most important strategy to alleviate the burden of this disease. Advances in MRI allow the visualization of “microbleeds” on gradient-recall echo sequences. Microbleeds are showed to be of clinical importance in predicting future risk of ICH among patients with ischemic and hemorrhagic stroke.

In summary, advances in neuroimaging help clinician to stratify the risk of individual patients and direct the use of different medications accordingly.

THE CERVICAL SPINE IN CHILDREN – NORMAL VERSUS ABNORMAL

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Not only is the pediatric cervical spine subject to numerous congenital anomalies, but it is also prone to physiologic movement which is greater than in adults and in doing so produces findings mimicking those seen with pathology. This dissertation deals with both of these problems. Emphasis will be on how to differentiate normal variation from a pathologic state. Mechanisms of trauma are discussed where applicable and in depth reviews of normal variations and congenital abnormalities are presented. Entities discussed include normal physiologic pseudo subluxations, normal upper vertebral body wedging, normal movement on both extension and flexion, and both normal and abnormal lateral mass movement. Isolated findings mimicking fractures also will be discussed and an in depth discussion of the os odontoideum, hypoplastic dens anomaly is presented. In addition other congenital defects, especially of C1 and C2 are covered in depth and differentiated from fractures.

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ABDOMINAL IMAGING IN CHILDREN: NEW DEVELOPMENTS

Prof. Winnie Chu

With the introduction of new sequences in magnetic resonance (MR) imaging and multi-slice scanning in CT, there has been new development in pediatric imaging.

MR imaging does not use ionizing radiation, which is an advantage for paediatric imaging. The property of multi-planar scanning in MR imaging is also good for depiction of anatomical structures.

Multi-slice (Multi-detector) CT enables a short scanning duration and a decreased need for sedation in children. Better spatial and temporal resolution leads to the visualization of small structures and the possibility to produce high-quality scans of vessels. Isotropic voxels enable excellent multi-planar reconstruction and 3D rendering.

MR Cholangiopancreatography (MRC) is a good technique for visualization of the biliary system without invasive procedure such as percutaneous cholangiography. With the use of heavily T2-weighted sequence and fat suppression, static fluid or slow moving fluid can be visualized using multiple-intensity projection (MIP) reconstruction. MRC is useful in cases of biliary atresia, choledochal cyst including Caroli's disease, cholelithiasis and choledocholithiasis including bile plug syndrome and post transplant biliary strictures.

MR Urography (MRU), using the same principal, is good for visualization of urinary system. It is useful in precise assessment of complications associated with duplex renal system, in particular, ectopic extra-vesical ureteric insertion and suspected occult upper pole. The introduction of gadonilium enhanced dynamic MR urography can reliably evaluate urinary excretion, allow accurate determination of single-kidney function and high quality depiction of urinary tract in infants and children. It is also shown to be a useful noninvasive imaging method in distinguishing obstructive from non-obstructive dilated renal systems.

Arterial and venous vasculature can be depicted clearly by either MR or CT angiography, thus obviating conventional angiography. The latter is associated with higher radiation doses and longer sedation times.

Besides anatomical delineation, tissue characterization is made possible by new MR techniques.

Fatty changes in the liver can be quantified by applying phase contrast MR study. MR images processed from in-phase (+water, +fat) or out-of-phase (+water, -fat) signals can be used to derive fat fraction from the difference of image's pixel intensity values.

Phosphorus MR spectroscopy is useful to determine phospholipid membrane metabolism and energy status of the liver. The phospholipid ratios reflect the degree of hepatic disease severity while the adenosine triphosphate (ATP) level reflects the hepatic bioenergetics. MR spectroscopy may provide a way to eliminate biopsy and follow up the post treatment evolution of liver disease in a non-invasive way. Wilson's disease and post liver transplant complications are two clinical examples.

MR is good for imaging spinal canal pathology. It is particularly useful in the assessment of intraspinal extension of abdominal disease, such as abdominal tumours and TB associated paravertebral abscesses.

Besides, static imaging for anatomical depiction, functional imaging is also made feasible and in a non-invasive way by ultrafast MR imaging technique. One of the potential applications is the visualization of pelvic floor descent and contraction of the external anal sphincter in investigating children with constipation.

SUBTLE FRACTURES:
HOW NOT TO MISS THEM

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Subtle fractures in infants and young children are common. They occur throughout the appendicular skeleton and many are extremely subtle. The broad categories of epiphyseal-metaphyseal injuries, buckle (torus), plastic bending, and hairline, and impaction fractures are discussed. There will be emphasis on the use of comparative views and the overall theme will be "know what to look for and know what it looks like". An indication as to which fractures are most common at the various joints will be part of the presentation and the audience should leave with a better understanding of the mechanisms of these injuries and with a more sensitive eye for their detection.

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IMAGING OF PEDIATRIC EMERGENCIES: NONTRAUMATIC CHEST PROBLEMS AND OTHER CASE SCENARIOS IN THE EMERGENCY ROOM

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Non-trauma induced chest problems presenting to the Emergency Room include acute pulmonary infections, foreign bodies, delayed diaphragmatic hernia, delayed congenital lobar emphysema, asthma and its complications, and allergic lung problems. The presentation will be in the form of case presentations with differential diagnoses developed where appropriate. Helpful points which can assist one in making the correct diagnosis are stressed throughout the presentation. As time allows other, non-chest problems will be presented primarily dealing with special trauma cases and subtle, low-grade skeletal infections.

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Neonatal diagnostic imaging in the era of fetal MRI: focus on surgical diseases of chest and abdomen

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Abstract:
This presentation discusses the present status of neonatal diagnostic imaging for surgical diseases of chest and abdomen in the era of fetal MRI.

There are a variety of surgical diseases of chest and abdomen encountered during neonatal period. Among them, there are abnormalities of thoracic cavity, abdominal wall, gastrointestinal tract, hepatobiliary system, genitourinary tract and others. The majority of these conditions are developmental in etiology. For these conditions, prompt preoperative diagnosis is essential for appropriate treatment. Preoperative diagnostic imaging tests include a variable combination of plain radiography, ultrasound (US), fluoroscopy, computed tomography, magnetic resonance imaging (MRI) and nuclear medicine. Compared with other patients in the paediatric age group, neonates are prone to develop unexpected negative effects just from diagnostic tests. Therefore, any diagnostic imaging test for neonates should be the least invasive, most reliable, easiest to perform and the least time consuming possible.

Recently, however, a variety of diseases can be accurately diagnosed prenatal by using US and/or MRI. Fetal MRI is usually indicated when fetal abnormalities are found on US. The fetuses are usually imaged with MRI at 18 weeks of gestation or later to allow completion of organogenesis. As is well known, major advantages of US are its real time nature and non-invasiveness, whereas major disadvantages of US are operator dependency and small field of view (FOV). Major advantages of MRI are less operator dependency, increased objectivity, higher soft tissue contrast and large FOV. In the past, the usefulness of MRI for the diagnosis of fetal abnormalities was limited by fetal motion secondary to the long acquisition times of the conventional spin-echo technique. The recent development of ultra fast MRI techniques, namely SSTSE (Single Shot Turbo Spin Echo) and Balanced FFE (Fast Field Echo), by Philips has allowed fetal MRI to become a definitive diagnostic adjunct for both prenatal and postnatal management.

In the situation of extensive use of ultra fast fetal MRI, initial postnatal diagnostic

imaging findings especially of plain radiography could be modified by immediate postnatal therapeutic interventions. Therefore, the radiologist needs to be familiar with these effects when interpreting plain radiography and discussing indications of further diagnostic imaging tests.