WorldCare Clinical
A PreScan Imaging Company

The WCC Note™

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A Weekly Guide To Harmonizing Clinical Trial Imaging

Volume 2, Number 3 – February 5, 2008

RADIOLOGY MODALITIES: A QUICK OVERVIEW (Part 1)

X-RAY

CONVENTIONAL X-RAY RADIOGRAPHY

Main principle: X-rays (high-energy photons) are shot from an x-ray tube through the patient to a film plate on the other side. Dense substances don't allow the x-rays to penetrate, while less dense substances do.

What the image looks like: An x-ray image is dependent on the density of the tissues in the body. Very dense tissues (bone, metal) appear white. Medium-density tissues (muscles, soft-tissue organs, blood vessels) appear grey and are difficult to distinguish from one another. Low-density tissues (air, fat) appear black. X-ray images have very fine resolution.

Amount of harmful radiation: Usually a relatively small amount for a single x-ray. For example, a chest x-ray (0.05 mSv) is less than 2% of the annual normal background radiation dose of 3.6 mSv.

Cost and speed: Inexpensive, fast, and readily available.

Some common uses: Evaluation of bones for fracture, lungs for pneumonia or large mass, abdomen for bowel obstruction.

Contrast: Not used for conventional radiography, but often used for fluoroscopy and angiography.

Pros: Sensitive to detecting calcium, cortical bone, air, gas, and metal.

Cons: Insensitive to soft-tissue abnormalities involving muscle, masses, blood, water, solid tumors, and so on.

Other important points: Although the radiation dose is relatively small, radiation causes cumulative damage.

ULTRA-SOUND

ULTRASOUND

Main principle: The transducer emits high-frequency sound waves and detects which waves bounce back to the transducer. This can be done in "real time."

What the image looks like: The ultrasound appearance of a tissue depends on its ability to transmit sound. Tissues that transmit sound well (water) appear black, while those that cause sound waves to bounce back (bone, air, metal, fat) appear white. Intermediate structures (soft-tissue organs, muscle) appear grey. Ultrasound images have poor spatial resolution.

Amount of harmful radiation: None.

Cost and speed: Relatively inexpensive and fast. However, a good exam requires an experienced ultrasonographer..

Some common uses: Evaluation of enlarged thyroid gland, flow mechanics of blood vessels, heart motion (echocardiography), breast masses, uterus, ovaries, fetuses, gallbladder, prostate, testicles, lymph nodes. Also commonly used to guide biopsies.

Contrast: Not commonly used.

Pros:

• "Real-time" imaging.

• No radiation (as a result, often used in children).

• Can distinguish simple cysts from solid masses reliably.

Cons:

• Anatomic detail is poor because of low resolution.

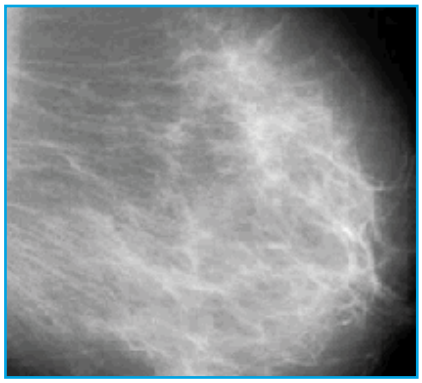
• Cannot evaluate bone, lungs, or bowel.

• Images are poor in obese patients or when air is present.

• Quality of images depends on expertise of operator.

MAMMO-GRAPHY

MAMMOGRAPHY



Main principle: A mammogram is simply an x-ray image taken of each breast. The breasts are compressed while the x-ray is taken, to increase the radiologist's ability to see abnormal masses.

What the image looks like: The x-rays used to create mammograms are essentially the same as the ones to make an x-ray of the chest or hand; dense structures appear as white, intermediate structures appear as grey, and less dense structures appear as black. Low-energy x-rays are used to create mammograms, so that soft tissues (such as masses) are whiter and thus easier to see. Calcifications are a bright white, soft tissues (breast glands and masses) are a softer white, and breast fat is black.

Amount of harmful radiation: Mammograms expose the breasts to a relatively small amount of radiation, typically less than 20% of average yearly background radiation.

Cost and speed: Inexpensive and fast.

Some common uses: Mammograms are used for screening (to look for an unknown breast cancer) or for diagnostic purposes (to get a closer look at a breast mass).

Contrast: Not used.

Pros:

- Quick and easy.
- Relatively small amount of radiation.

Cons:

- Often misses cancers, especially if they are small or in women with large and/or dense breasts.
- Can be difficult to distinguish benign masses from cancers.

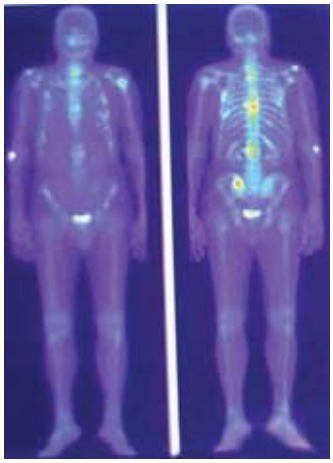
Other important points:

- Breast ultrasound can be used to get a better look at a mass that is seen on a mammogram or is felt.
- Breast MRI, although expensive and time-consuming, is increasingly used for screening

high-risk women, clarifying questionable mammogram findings, evaluating women with newly diagnosed breast cancer, and assessing the response of breast cancer to treatment.

NUC MED

NUCLEAR MEDICINE



Main principle: In a nuclear medicine examination, first a "radio-pharmaceutical" is prepared. This is a radioactive substance, with known chemical properties, that can be injected directly into the patient. After it is injected, the substance localizes to a specific area in the body, depending on its chemical properties.

What the image looks like: After giving enough time for the radio-pharmaceutical to settle into the appropriate places, the patient is placed in a "gamma camera." This is a device that can detect the radiation coming from the patient's body (a "hot spot"), and localize where it is coming from. This machine then makes a map of where the radiation is within the patient's body. These images have poor resolution.

Amount of harmful radiation: Ranges from about 1-11 mSv -- about 1/3 to three times the amount of normal annual background radiation.

Cost and speed: Moderate cost, time-consuming, and mildly invasive (usually requires radio-pharmaceutical to be administered into a vein).

Some common uses: Bone scans are used to look for metastases, fractures, and infection. PET scans are used to look for tumors. Thyroid scans can assess the function of the thyroid gland and characterize masses in the gland. Biliary scans look for acute cholecystitis. Ventilation/perfusion scans assess for pulmonary embolism. Heart scans look for areas of poor blood flow in the heart.

Pros:

- Able to give information about the function and physiology of many organs.

Cons:

- Poor resolution and anatomic detail.
- Time-intensive and invasive.
- Moderate radiation dose.

NEXT ISSUE: RADIOLOGY MODALITIES: A QUICK OVERVIEW (Part 2)

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