Aging

Central Nervous System

Processes

- Age related brain atrophy
- Non-age related brain atrophy
- Cerebrovascular disease
- Cerebral infarction
- Hypertensive hemorrhage
- Carotid artery stenosis and occlusion
Brain Atrophy

- CT brain sections
- Loss of brain parenchyma
- Enlargement of ventricles
- Widened sulci

Brain Atrophy

- MRI T2 axial image
- Cerebral atrophy
- High signal areas (white) cerebrospinal fluid in dilated sulci
Brain Atrophy

- T1 Sagittal (CSF Black)
- Shrinking of brain parenchyma with enlarged sulci

Aging Brain

- Scattered high signal lesions
  Found in people over 50
  Small ischemic lesions or edema or gliosis
- More sensitive than CT
**Acute Ischemic Infarction**

- Axial CT
- Wedge shaped area of decreased attenuation
- Mass effect on left lateral ventricle
- Left to right shift

**Acute Cerebral Infarction**

- Acute left parietal-occipital infarct
- Wedge shape
- Brain edema caused by decreased blood supply
Hypertensive Hemorrhage

- CT non-contrast
- Small rounded focus of increased attenuation posterior limb of left internal capsule
- Represents blood

Encephalomalacia

- Large area of low signal occipito-temporal
- Evidence for old infarction
CT Angiography

- Multi-planar imaging possible
- Excellent delineation of vessel lumen and plaque
- Note: atherosclerosis at the carotid bulb (arrow)

MR Angiography

- Contrast and non-contrast techniques
- Excellent evaluation of vasculature
- Limitations in presence of pacemakers
Right Internal Carotid Occlusion

- MR Angiogram
- Complete occlusion of RICA
- Left carotid is normal (arrow)

Carotid Ultrasound

- Plaque in carotid artery
Doppler Ultrasound

• Dynamic imaging study using frequency shift of returning sound
• Can detect blood flow (including very small vessels)
• Can observe abnormal blood flow such as
  – Left-to-right shunt in heart disorders
  – Turbulent flow in aneurysms and dilated post-stenotic vessels
• Can evaluate and estimate the degree of stenosis

Doppler Ultrasound

• Color Doppler – Evaluate flow direction and velocity
Carotid Stenosis

- Color Doppler US
- Severe stenosis left internal carotid (yellow arrow red vessel)
- Turbulent flow due to atherosclerosis beyond stenotic segment (green arrow blue vessel area)
- Jugular vein (blue vessel more superficial)

Aging of the Skeletal System

- Osteoporosis
- Osteoarthritis
- Other arthritis
  - Rheumatoid arthritis
  - Gout
Osteoporosis

- Lateral T-spine elderly female
- White line of cortical bone around the bodies
- Scanty and coarse trabecula
- Compression fracture (Arrow)
- In osteoporosis, quantity of bone decreased, composition normal

Dual Photon Scanning of Osteoporosis
Osteoporosis

- World Health Organization Definitions:
  - Osteoporosis = BMD $-2.5$
  - Osteopenia = BMD $-2.49$ through $-1.0$
  - Normal = BMD $>-1.0$

Normal Hand

- AP hand
- Note normal bone density and trabecula
Osteoporosis

- Thinned cortex from inside out
- Scanty trabecula

Osteoarthritis

- Wide spread or local joint involvement
- Loss of joint space due to cartilage dehydration and degeneration
- Subchondral eburnation (sclerosis) and subchondral cyst formation
- Osteophyte formation
- Hebeden’s nodes
- Location: hip, knee, spine, hand, post-trauma
Osteoarthritis

- AP hands
- Reactive sclerosis
- Sharp ridges or points (osteophytes) extending from IP joints

Osteoarthritis

- Lateral hand
- Reactive sclerosis
- Sharp ridges or points (osteophytes or Hebeden’s nodes) extending from IP joints
Osteoarthritis

- AP knee
  - Medial joint narrowing
  - Subchondral sclerosis medial femoral condyle and medial tibial plateau
  - Moderate marginal osteophyte medial tibial plateau

Osteoarthritis

- Lateral knee
  - Osteophyte both anterior and posterior distal femur
  - Spurring from articular margins of the patella
Rheumatoid Arthritis (RA)

- Systemic disturbance
- Loss of joint space by pannus destroying cartilage
- Local osteoporosis
- Diffuse soft tissue swelling
- Marginal erosions
- Location: any synovial joint, wrist, hand, foot, etc.

Rheumatoid Arthritis

- AP hands
- Early rheumatoid changes
- Juxta-articular
- Narrowing of the joints
Rheumatoid Arthritis

- Osteoporosis most prominent at the metacarpal-carpal joints and IP joints
- Marginal erosions several joints (arrow)

Rheumatoid Arthritis

- Magnified view
- Bony erosions of distal metacarpals
  Caused by synovial inflammation and synovial proliferation
- Initially at the margin of the articular cartilage
Rheumatoid Arthritis

- Late changes
- Juxta-articular osteoporosis
- Ulnar dislocation

Gout

- Metabolic disorder
- Bone destruction secondary to urate deposits
- Loss of joint space
- Lumpy soft tissue swelling
- Primary location: first metatarsal-phalangeal joint
Gout

- AP view
- Erosion medial head of 1st metatarsal away from joint
- Soft tissue swelling in adjacent soft tissues

Cardiovascular System

- Coronary artery disease (Ischemic heart disease)
  - Cardiac Catheterization
  - Radionuclide study
  - PET Scanning
  - MRI
- Congestive heart failure
- Future Modalities
Ischemic Heart Disease

- PA chest
- Normal findings on chest x-ray

Coronary Arteriogram

- Normal left coronary
- Right Anterior Oblique projection
Coronary Arteriogram

- Normal right coronary
- Right Anterior Oblique projection

Coronary Stenosis

- Left coronary
- RAO projection
- Severe stenosis proximal circumflex (yellow arrow)
- LCX = L Circumflex, LMCA = left main coronary, LAD = left anterior descending
Coronary CTA

CT Cardiac Scoring

- Non-invasively evaluate coronary calcification loading
- May be proportional to the amount of ‘soft’ plaque that is present in vessels
- Future developments: CT coronary angiograms
Thallium and Sestamibi Cardiac Scanning
• Radionuclide agents for scanning to identify cardiac perfusion
• Thallium functions as a Potassium analogue and demonstrates perfusion at the time of injection and shortly thereafter
• Sestamibi provides a snapshot of cardiac perfusion at the time of injection that persists
• Compare Stress and Rest images

Stress – Rest Thallium
• Normal study
• Homogeneous uptake
• Short axis, vertical long axis, horizontal long axis
• Stress and rest
Stress Rest Thallium Scan

- Reversible defect septum = ischemia
- Persistent defect apex = infarction

Cardiac PET

- PET requirement for cyclotron access to radioactive N-13
- PET less widely available than SPECT
Cardiac PET at MSU

Cardiac MRI

- Evaluation of morphology and function is possible
- Evaluation may be possible without using contrast
Congestive Heart Failure

- PA chest
- Interstitial pulmonary edema
- Cardiomegaly
- Redistribution of pulmonary blood to upper lungs

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Congestive Heart Failure

- Indistinct hilar margins and blurring of pulmonary vessels
- Kerley B lines at costophrenic angles
- Increased central interstitial markings
Kerley B Lines

- Magnified view
- Short, horizontal lines
- Close to lateral chest wall
  represent thickened interlobular septa
- Thickening due to fluid

Congestive Heart Failure

- Interstitial and alveolar pulmonary edema
- Large upper lobe vessels
- Hilar blurring
- Prominent interstitial markings
- Peri-hilar fluffy infiltrates