Infection

Bone and joint structures can be contaminated by three primary routes:

- Hematogeneous spread
- Contiguous source (adjacent soft tissue into bone)
- Penetrating injury/following surgery

Infection → early alterations → rapid osteoblastic accumulation in vascularity response bone seeking agents

Scintigraphic changes: more rapid than RX changes

Three phase bone scan and delayed images are of interest in differential diagnosis between cellulitis (diffuse hyperaemic phase in cellulitis with decreasing activity in delayed phase/non focal accumulation, relative increase with time of bone activity in osteomyelitis: interest of 24 hours late images: fourth phase)

Rising pressure leading to ischemic injury can induce cold areas
Imaging infection/inflammation


**Inflammation:** reaction of body to any kind of injury (trauma, ischaemia, neoplasm, invasion of microorganisms)

**Infection:** contamination with microorganisms

Components of inflammatory response:

- increased blood supply
- increased vascular permeability
- enhanced transudation of plasma proteins
- enhanced influx of leukocytes

**Mediators**

Involved <-> generated at focus of inflammation/infection <-> amplify local response: recruitment of cells

(vasoactive) plasma components

(chemotactic)

**Leukocytes migrate**

From circulation to inflammatory tissue -> adhere to vascular endothelium (enhanced expression of adhesion molecules)

Pass through (diapedese)

Migrate into inflammation focus (chemotaxis)

**Labelling:** 111In oxine
- 99mTc HMPAO (lipophilic/penetrates C membrane -> hydrophilic: trapped)
- Monoclonal antibodies

111In oxine (labelling in plasma not possible: binding to transferring)
99mTc HMPAO (labelling in plasma)
99mTc Monoclonal Ab (BW 250/183 IgG:antigranulocyte, anti CD 66: Fab: leukoscan, antiCD 15, IgM: leuco-tech)

**Advantages-Disadvantages**

- 111In oxine, 99mTc HMPAO: direct labelling, ex vivo, high sensitivity (up to 95%), late images (111In)

Disadvantages: blood manipulation (HCV, HIV, Staph...), preparation time

- Monoclonal Ab: in vivo, easy

Disadvantages: blood clearance: slow (background activity) (late images 24h), 10 to 20% associated with granulocytes, high kidney clearance and high liver uptake, antimouse Ab.

"It is now accepted that radiolabelled antigranulocytes Ab localize infectious foci mainly by non specific extravasation: enhanced vascular permeability". sensitivity ( >80% to 90%)
Three phase bone scan and 24 hours delayed images (fourth phase)

In case of osteomyelitis and advanced vascular disease, since there can be a relative reduction of delivery of the agent, late images at 24 hours (fourth phase) can help, since there is an improvement of lesion to background ratio with time.
Increasing activity with time in a case of left elbow osteomyelitis (fourth phase bone scan) (improvement of lesion to background ratio with time)
Neuropathic foot

In this situation, there is a frequent combination of arthropathic, ulcerative and soft tissue infection due to diabetic angiopathy, neuropathy and leucocyte dysfunction.

Most frequently, diabetic osteomyelitis is the consequence of a spread of infection from contiguous ulceration. Involved sites include metatarsal heads, phalanges, calcaneus.

SPECT and when available SPECT/CT are helpful.

Comparison of labelled leucocyte scan and bone scan is useful to determine the presence of bone infection added to soft tissue infection.
Neuropathic foot: patient with longstanding diabetes mellitus and neuroarthropathy of the feet. Chronic ulceration beneath first and second metatarsal heads of right foot
Bone scan: Intense uptake in the region of first and second MTP joints of right foot
Patient with left foot scab, bone scan indicates a hyperactivity (important osteoblastic reaction) of calcaneus suggestive of osteitis
Leucocytes scan, however shows activity mostly in soft tissues with however a contact point with the inferior wall of calcaneus (contiguous infection source: adjacent soft tissues into bone)
Hematogeneous osteomyelitis

Relatively uncommon in the adult

When present: localizes generally in the vertebral column (spondylodiscitis)
Spondylodiscitis of L5
Note photopenic effect (leucocytes): b
Increased activity at bone scan and 67 Ga scan (a and c)

Adult hematogenous osteomyelitis is relatively uncommon but, when present, it localizes generally in vertebral column
Septic arthritis

Infection occurs via the vasculature of synovial membrane or by direct extension from adjacent bone or soft tissue infection

Consequences: edema of synovial membrane, cartilage damage, rapid joint destruction

Knee: most frequent site of infection (followed by hip, ankle, Elbow, shoulder)
Septic arthritis of the right knee
a) planar views
b) SPECT and SPECT/CT indicating involvement of the joint
Chronic osteoarthritis of the left knee. Leucocytes scan: a planar view, b coronal tomoscintigraphic view, c transverse plane, d sagittal plane. Note increased activity of patella (also well demonstrated on SPECT/CT fusion images), indicating osteitis + arthritis of the joint.
Chronic infection can be a complication of insertion of prosthetic joint.

Consequence of surgery

Chronic sepsis in immunosuppressed patients (Tuberculosis cold abscess in HIV patients)
Chronic osteitis of right femoral prosthesis implantation site: left: bone scan, right: leucocytes scan
Faint uptake of leucocytes can be due to the fact that patient receives antibiotics
Patient operated on of a left knee prosthesis in 2001
Pain and swelling in 09 04
Bone scan shows abnormal increased uptake of femoral and tibial sites of the prosthesis
Same patient: leucocytes
Diffuse increased uptake indicates a septic process of prosthetic implantation site (note incongruence of bone scan and leucocytes scan)