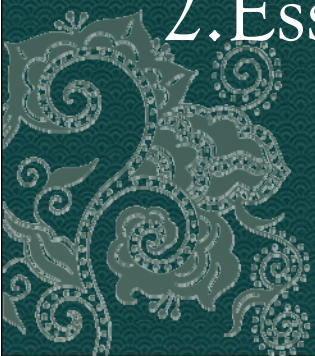


Gallium Imaging

Reference:

1. nuclear medicine in clinical diagnosis and treatment(3rd edition).
2. Essentials of nuclear medicine imaging(6th edition)





- ◆ Ga-67 imaging accumulates nonspecifically in inflammatory and infectious disease, as well as neoplastic disease.

^{67}Ga



◆ Excretion:

◆ First 24 hours: kidneys, bladder;

◆ After 24 hours: bowel → Bowel activity: bowel preparation

◆ $T_{1/2}$: 78.1 hr

◆ γ -ray 93 keV(38%), 184(24%), 296(16%), 388(4%)

mechanisms



- ◆ The process is complex, a few basic principles are known:
- ◆ 1. Bind with plasma **transferrin**, acts as carrier for ^{67}Ga to site of inflammation.
- ◆ 2. ^{67}Ga is also incorporated into leukocytes, bound by intracellular **lactoferrin**, which then migrate to inflamed area.
- ◆ 3. ^{67}Ga may be taken by pathogenic microorganisms themselves by binding to **siderophores** produced by the bacteria.



- ◇ Ga tumor survey
 - ◇ 5mCi
 - ◇ 48hr after injection
 - ◇ Lymphoma, liver tumor....
- ◇ Ga scan inflammation
 - ◇ 3mCi
 - ◇ 24hr after injection
- ◇ Osteomyelitis
 - ◇ Three phase bone scan (25mCi ^{99m}Tc -MDP) + Ga scan inflammation (3mCi ^{67}Ga)

Normal gallium scan Obtained after 48hrs.



- ◆ Lacrimal glands (upper outer aspect of the eyes)
- ◆ Bone marrow
- ◆ Nasopharynx
- ◆ Liver
- ◆ Colon
- ◆ Genital organ



Conditions leading to altered distribution of ^{67}Ga



Alteration	cause
Breast tissue uptake	Lactation Pregnancy Hormones (e.g. oral contraceptive)
Salivary gland uptake	Radiotherapy Pituitary tumors Chemotherapy Sjogren's syndrome
Salivary and lacrimal gland uptake	Sarcoidosis (panda sign)
Pulmonary hilar uptake	Idiopathic Bronchitis Chemotherapy Sarcoidosis (lambda sign)

Alteration	cause
Increased bone uptake	Recent chemotherapy AIDS Iron overload
Renal uptake	interstitial nephritis (e.g chemotherapy) Blood transfusion (iron overload) Hepatic failure Chronic anemia Pyelonephritis Glomerulonephritis
Reduced soft tissue and hepatic uptake	Chemotherapy Blood transfusion (iron overload) AIDS Cathartics Constipation Recent surgery



Alteration	cause
Absent tumor uptake	Recent chemo/radiotherapy MRI contrast administration Non-67Ga-avid tumor
Diffuse lung uptake	Chemotherapy Opportunistic infection Interstitial alveolitis Contrast lymphangiography

Abdominal inflammation & infection



- ◆ The bowel accumulations may appear as early as a few hours after injection.
- ◆ The **progress of excreted Ga through the colon over time** provides the best evidence of physiologic activity.
- ◆ This normal physiological excretion limits the usefulness of gallium in the abdomen.

Retroperitoneal inflammation & infection



- ◆ Abscesses in the retroperitoneum are frequently related to associated renal infection.
- ◆ Persisted of more than faint renal activity after 24 hrs or progressively increased activity or unilateral discrepancy → should considered abnormal.
- ◆ However, abnormally increased activity in one or two kidneys can occur in nonspecific pathologic and physiologic states and make it difficult to differential diagnosis.



- ◆ Urinary obstruction
- ◆ Nephritis
- ◆ Acute tubular necrosis
- ◆ Diffuse infiltrative neoplasm
- ◆ Vasculitis
- ◆ Parenteral iron injection
- ◆ Blood transfusion
- ◆ Perirenal inflammatory disease

Fever of unknown origin



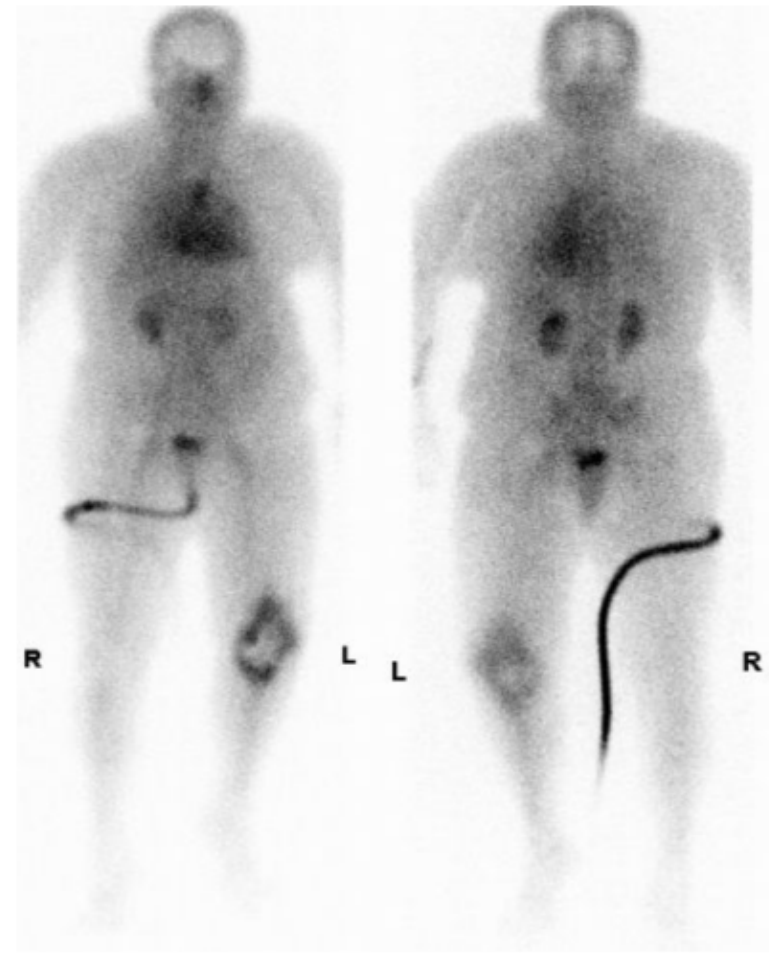
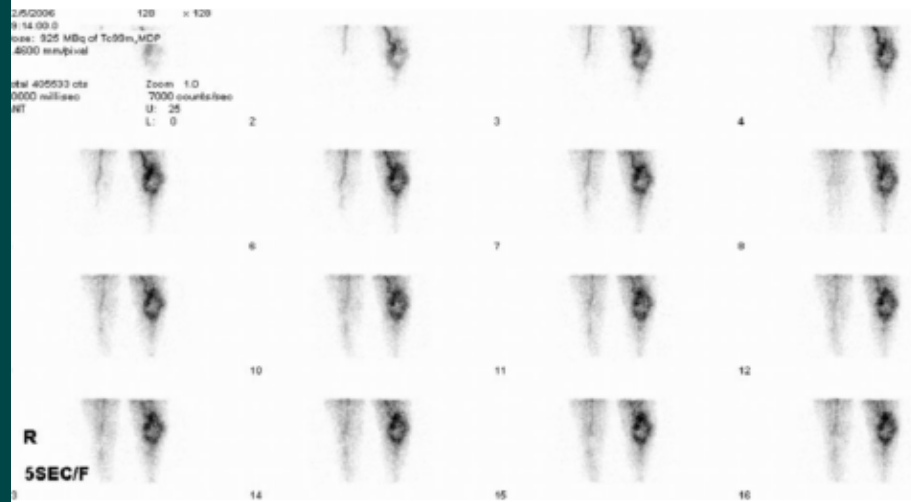
- ◆ Should begin with **labeled leukocyte** or CT scan and followed with an ^{18}F -FDG or gallium study.
- ◆ Although gallium is sensitive for localized pyogenic disease(80-90%), it's less sensitive than radiolabeled leukocytes, especially in the abdomen.

Osteomyelitis

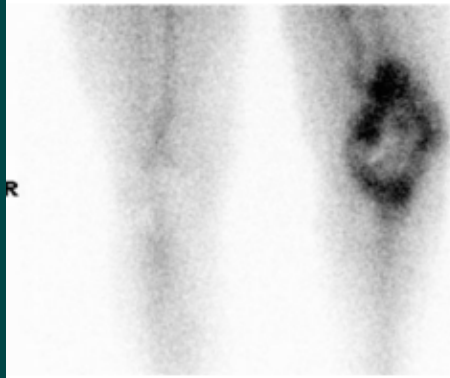


- ◆ 3 phase bone imaging + gallium imaging
- ◆ Osteomyelitis is likely if gallium activity exceeds bone scan activity in the same location (spatially congruent image) or when the spatial distribution of gallium exceeds that of bone scan location (spatially incongruent image)
- ◆ Osteomyelitis is unlikely if gallium images are normal or when gallium distribution is less than bone scan

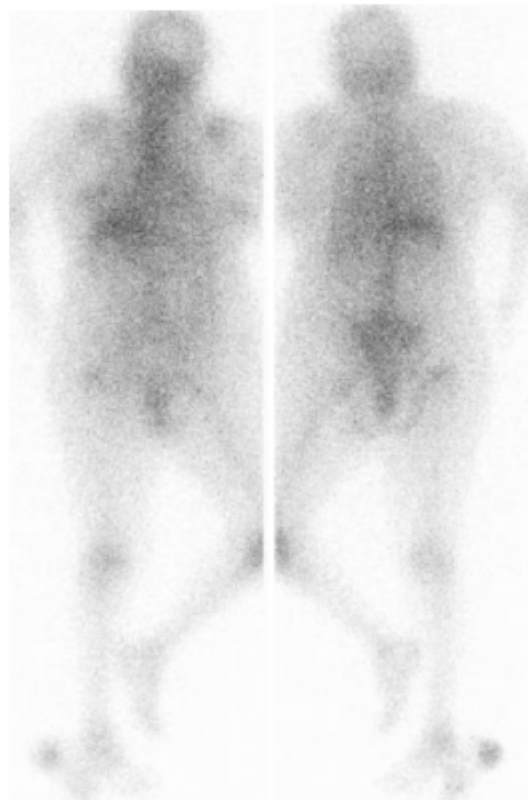
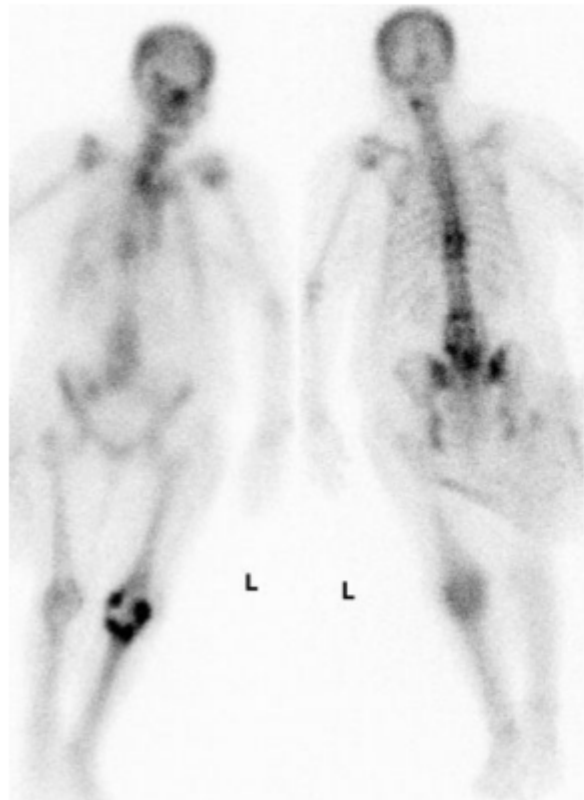
Osteomyelitis (1)



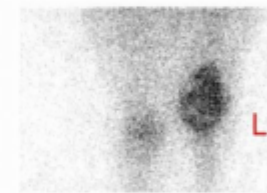
74 y/o female
left knee OA S/P TKR on 2005/05/12
Recurrent swelling over left knee
→ 2006/12/06 osteomyelitis scan F/U



Osteomyelitis (2)

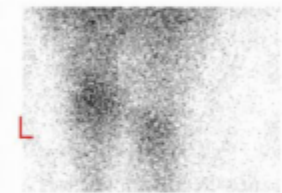


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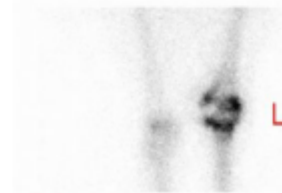


GA-67

POST

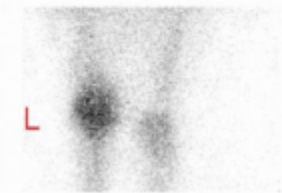


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TC-99M

POST

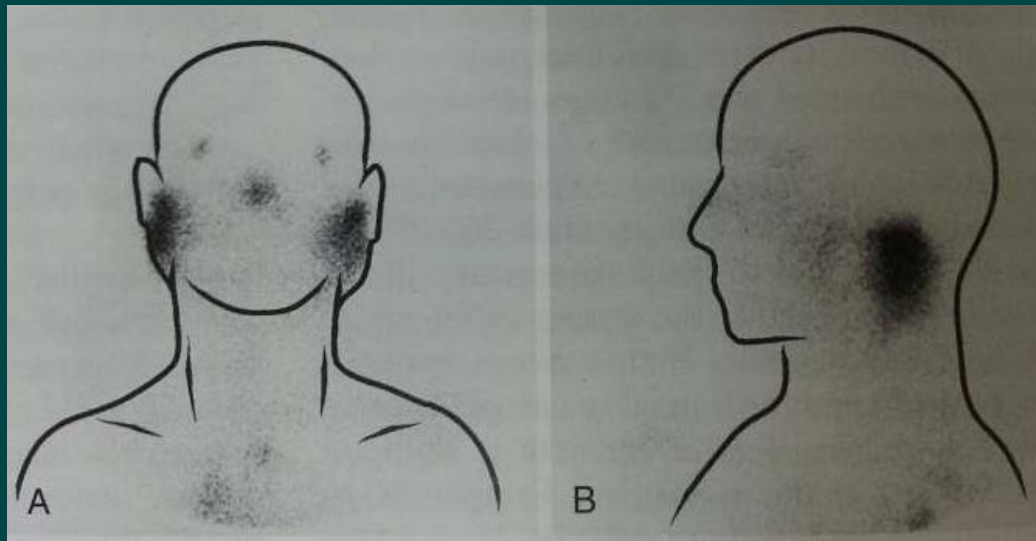


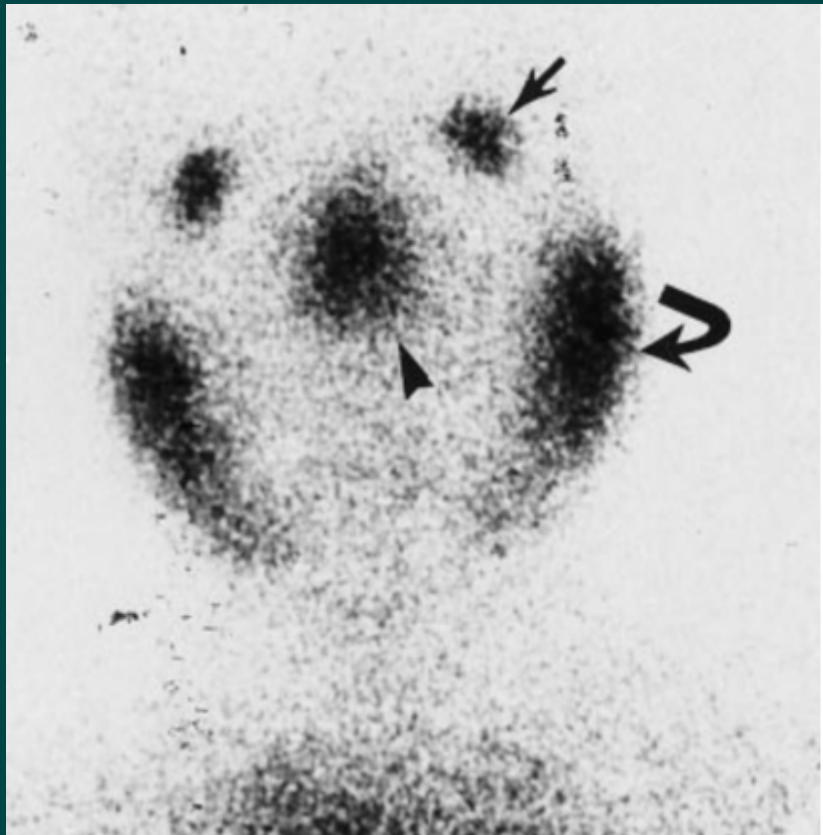
Sarcoidosis



- ◆ The lesions of sarcoidosis are quite gallium avid, especially in the chest. Both nodal and parenchymal lung involvement can be detected.
- ◆ In the early stage, gallium images are frequently positive before any radiographic abnormalities are noted.
- ◆ Intrathoracic lymph nodes (right paratracheal and hilar) in a pattern resembling λ (lambda).

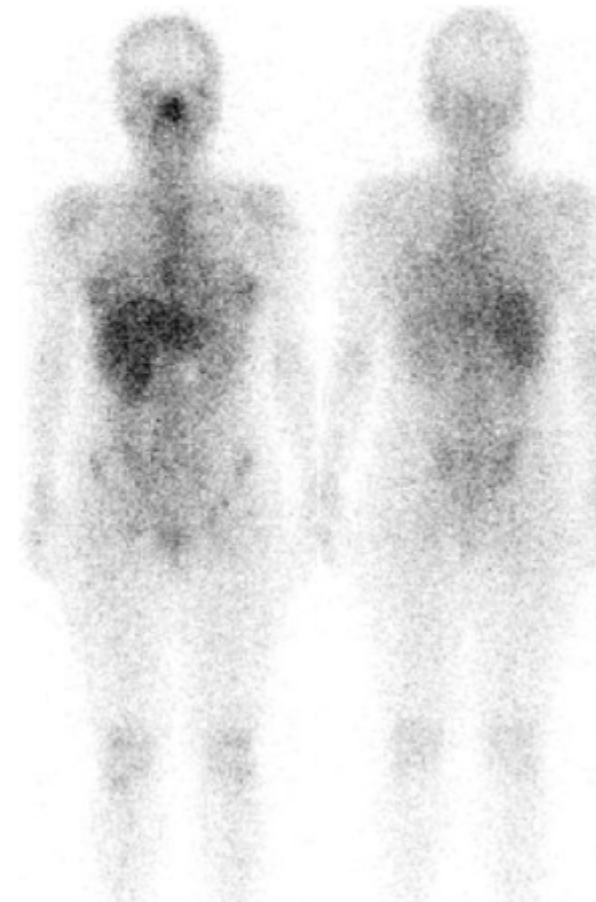
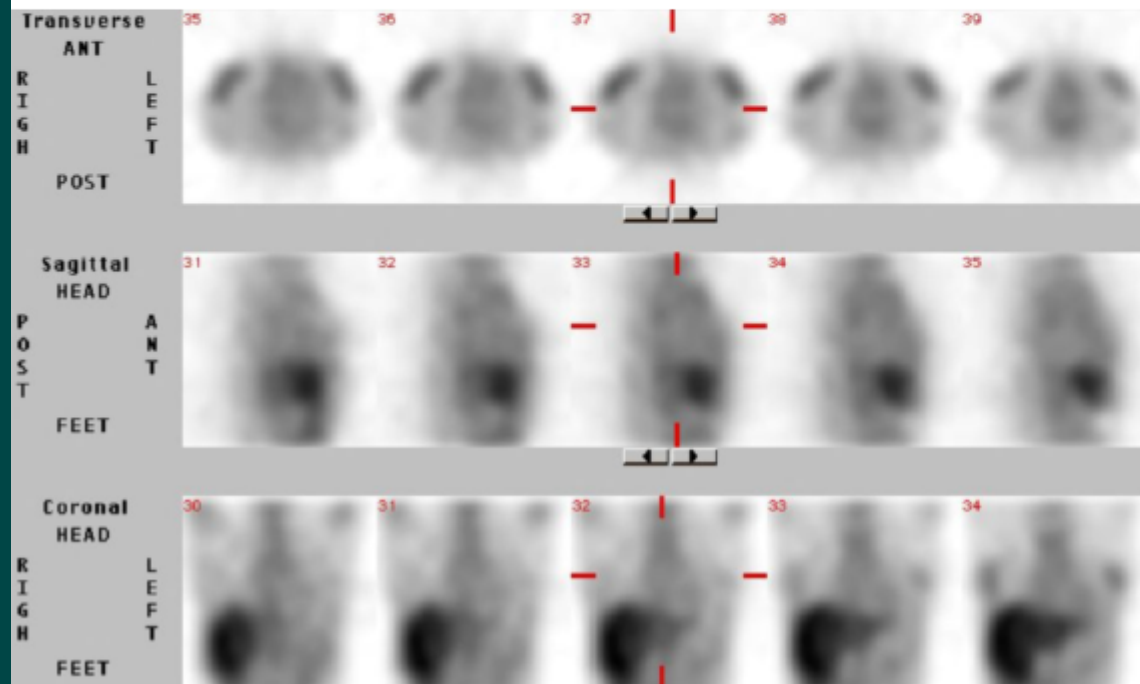
- ◇ λ sign + panda sign (symmetric increase in activity in the lacrimal, parotid and salivary glands) \rightarrow represent a highly specific pattern for sarcoidosis.



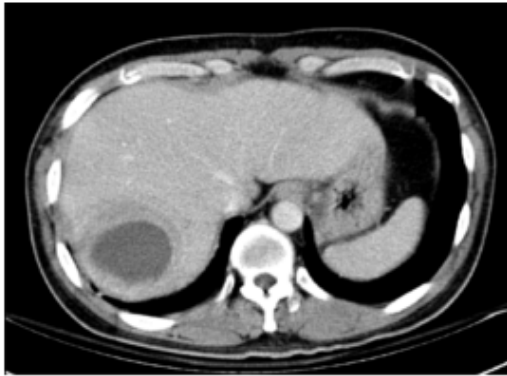


Myocarditis

2005.10.7.22



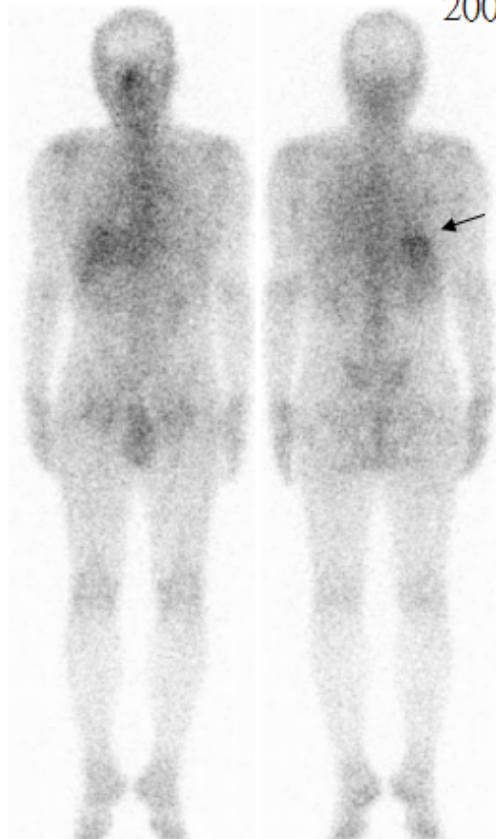
Liver abscess



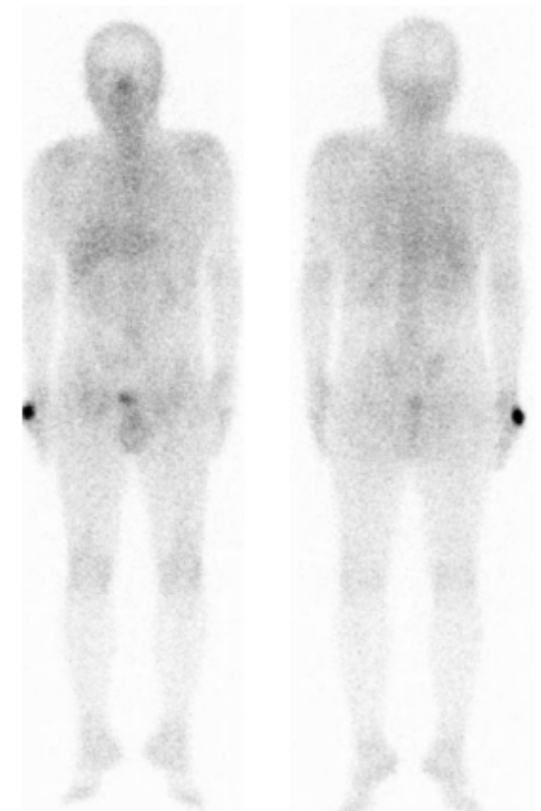
48 y/o male

Prolonged fever → liver abscess

2006-5-23 active inflammation



2006-8-29 complete remission



Abx Tx & drainage

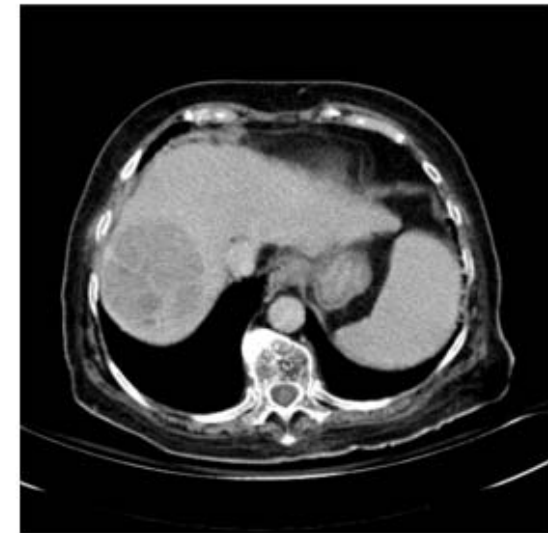
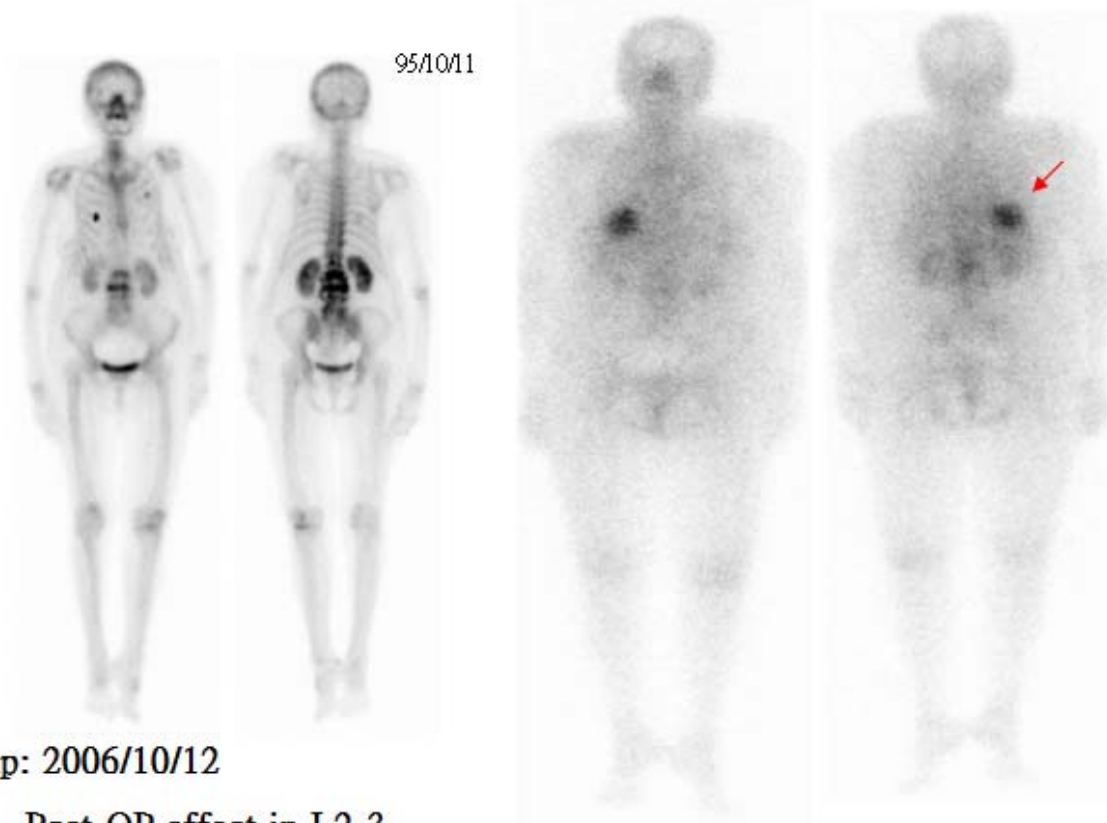


HCC

84 y/o female

L3 compression fracture S/P OP on 2006/09/13, positive B/C (2006/9/22) with intermittent fever

→ R/O osteomyelitis → 2006/10/11 osteomyelitis scan



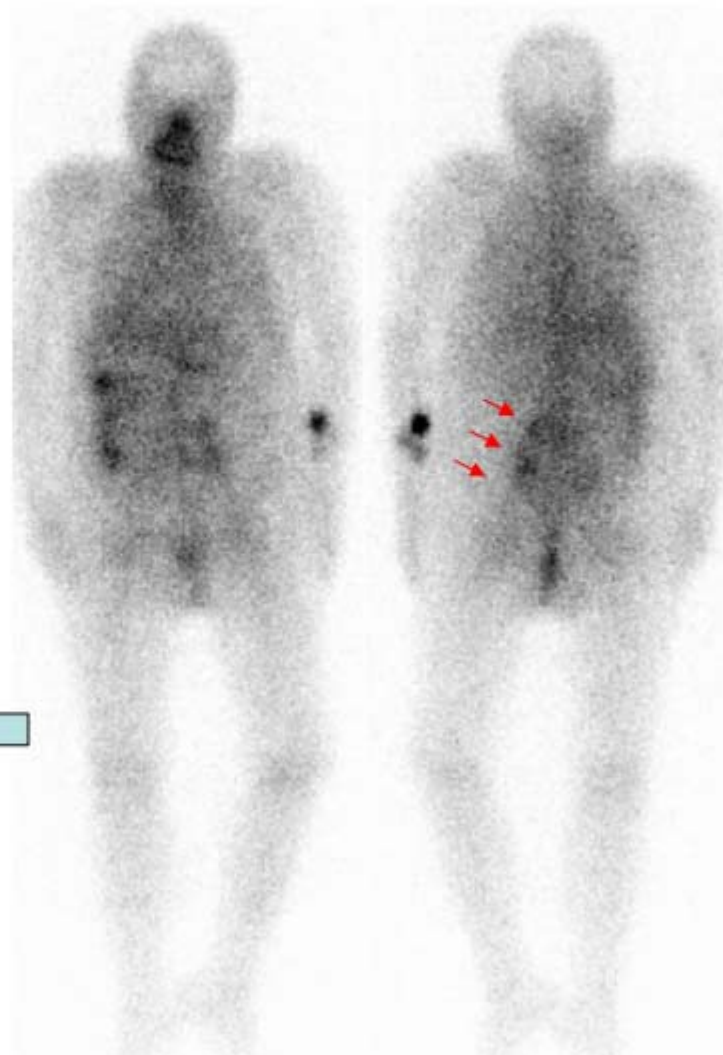
2006/10/13 Abdominal CT: HCC in right lobe of liver with portal vein invasion

Imp: 2006/10/12

1. Post-OP effect in L2-3.
2. Certain lesion in right lobe of liver → DDx: abscess or HCC, suggest abdominal sonography.

Psoas muscle abscess

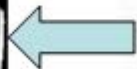
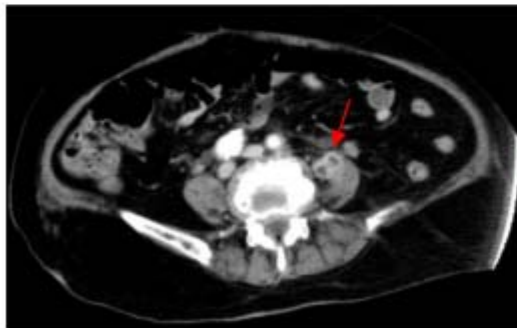
- 80 y/o female
- Fever, low back pain with bacteremia (Salmonella)
- 2007-07-09 osteomyelitis scan



POST



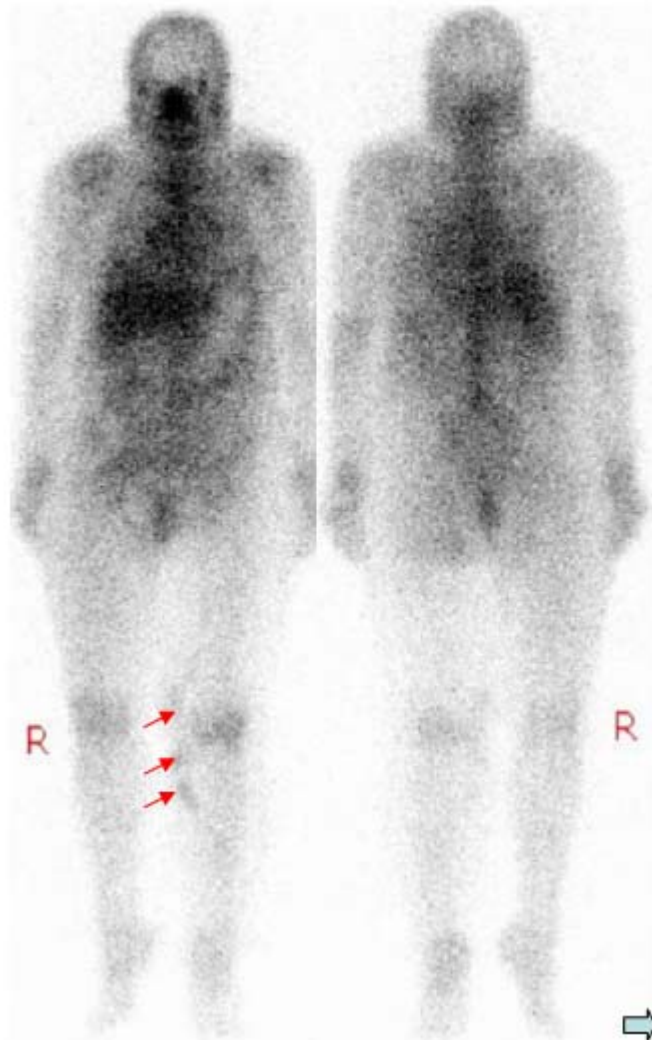
POST



2007-7-12 Abd CT:

LT psoas muscle abscess.

Graft infection

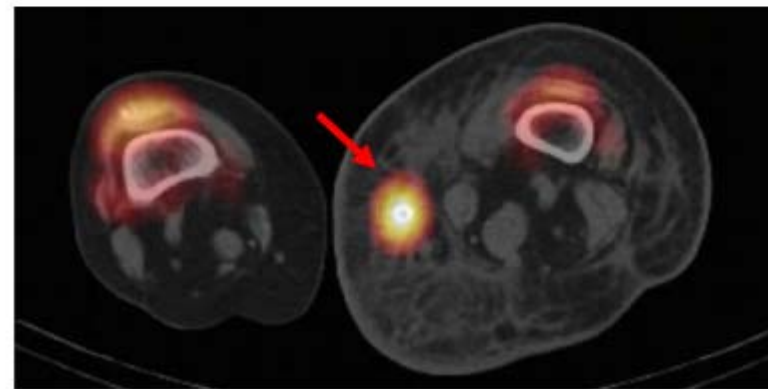


74 y/o female

➤ endometrial carcinoma S/P OP, complicated with lymphedema and recurrent cellulitis over left leg S/P s/p vessel reconstruction in 2007-08

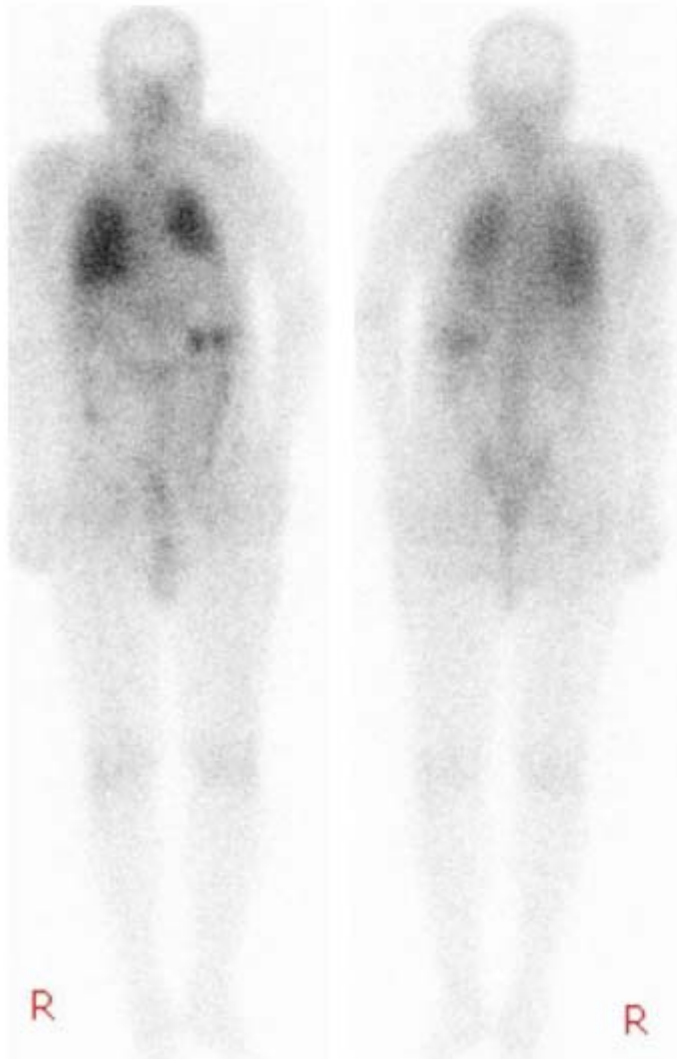
➤ Erythematous change over left lymphatic graft location area

→ 2008/09/04 gallium inflammation scan



⇒ Active inflammation over left lymphatic graft location area of left leg

Lung infection



78 y/o male

FUO

→ 2008-8-21 gallium inflammation scan

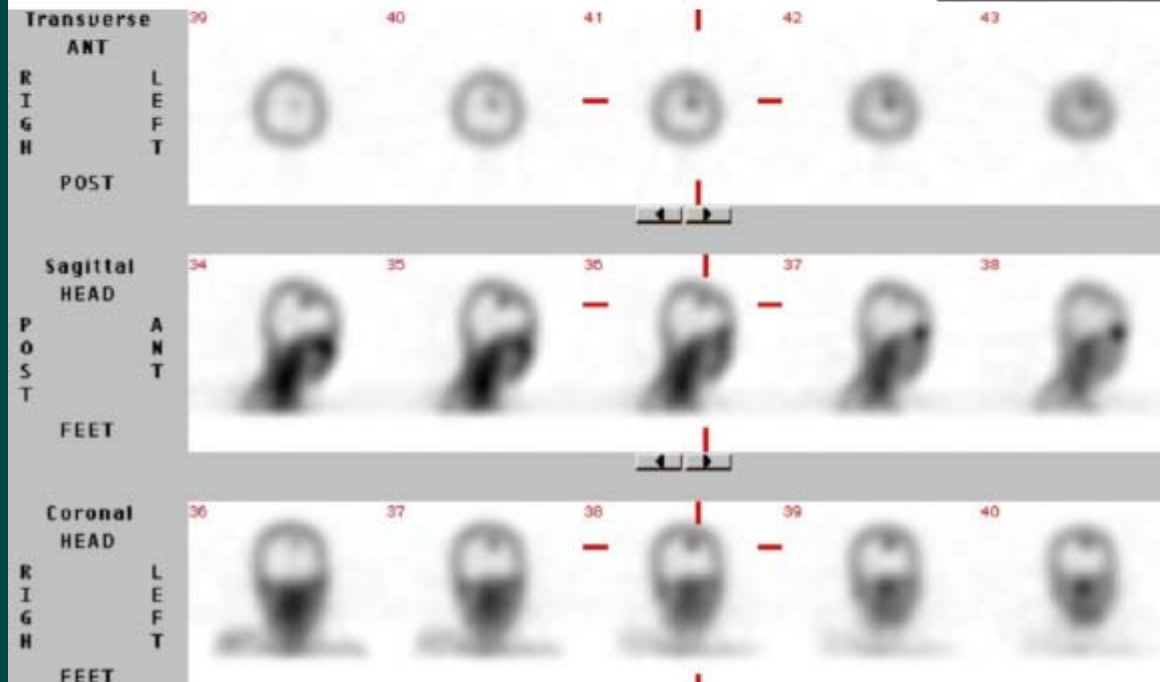
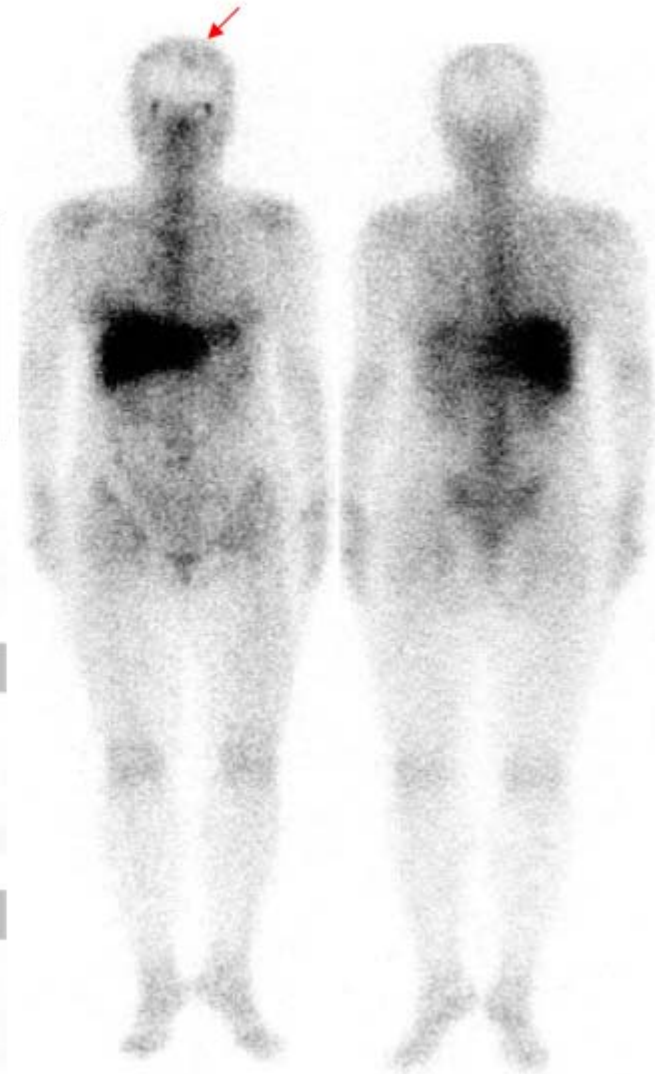
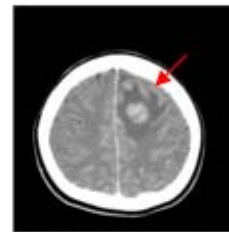
→ Sputum culture: K.P.

Brain tumor

48 y/o female

- right breast cyst s/p aspiration and ovarian tumor s/p op 6 years ago
- Left frontal tumor, R/O metastasis
- 2006/06/15 gallium tumor scan

➡ CNS lymphoma



Box 10-1 Radiopharmaceutical Affinity for Various Tumors

Gallium-67 Citrate

Hodgkin disease
Non-Hodgkin lymphoma (especially high-grade)
Hepatoma
Bronchogenic carcinoma
Melanoma
Seminoma
Rhabdomyosarcoma

Thallium-201 Chloride

Gliomas (high-grade)
Thyroid carcinoma
Benign tumors (usually fade over 2 hr)
Osteosarcoma
Lymphoma (especially low-grade)
Kaposi sarcoma (gallium-negative)

Technetium-99m Sestamibi

Cancer metastases
Breast cancer
Parathyroid adenoma
Gliomas
Lymphoma
Thyroid

Indium-111 Pentetreotide

APUD cell tumors
Pancreatic islet cell
Pituitary adenoma
Pheochromocytoma

Neuroblastoma
Paraganglioma
Carcinoid
Gastrinoma
VIPoma
Medullary carcinoma of thyroid
Small-cell lung cancer
Meningioma

Fluorine-18 Fluorodeoxyglucose

Most tumors (see Chapter 11)
Head and neck cancer
Esophageal cancer
Non-small-cell lung cancer
Melanoma
Lymphoma
Colorectal cancer
Breast cancer
Poorly differentiated neuroendocrine tumors

Iodine-123 or 131 Sodium Iodide

Thyroid cancer

Iodine-123 or 131

Metaiodobenzylguanidine

Pheochromocytoma
Neuroblastoma
Paraganglioma

Monoclonal Antibodies

Lymphoma



Gallium-67 Citrate

Hodgkin disease

Non-Hodgkin lymphoma (especially
high-grade)

Hepatoma

Bronchogenic carcinoma

Melanoma

Seminoma

Rhabdomyosarcoma