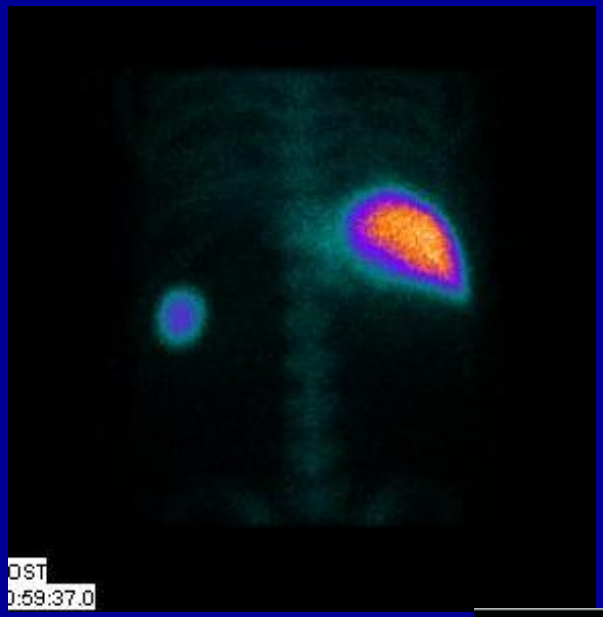
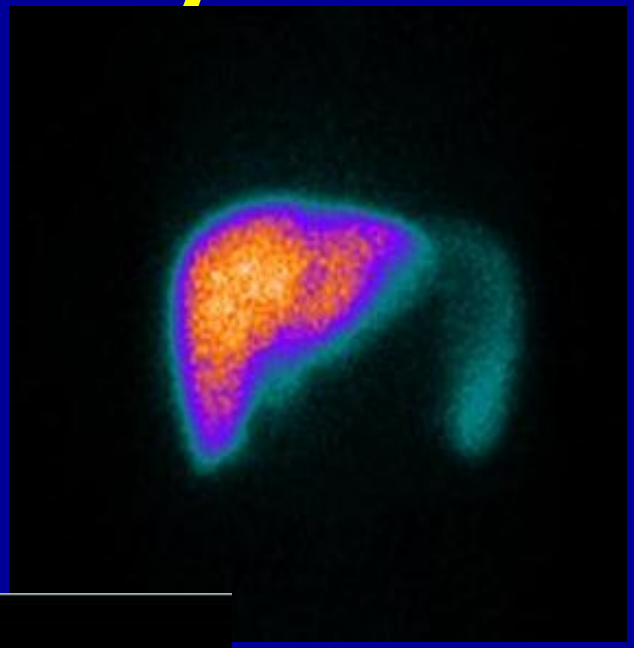
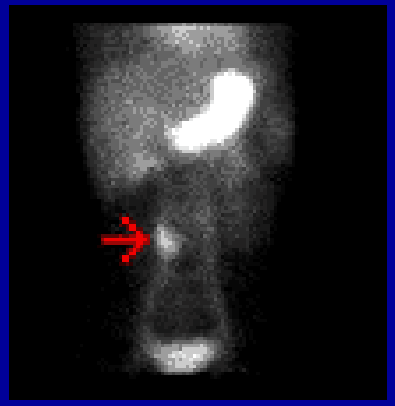
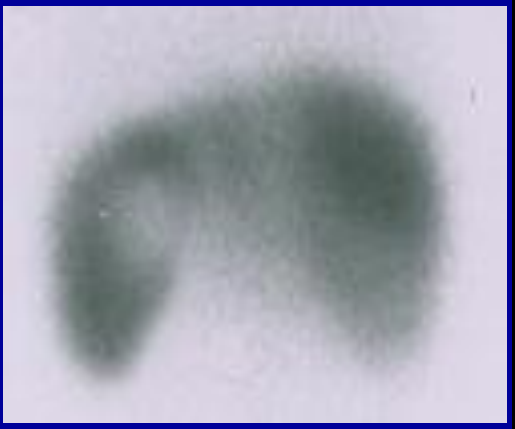
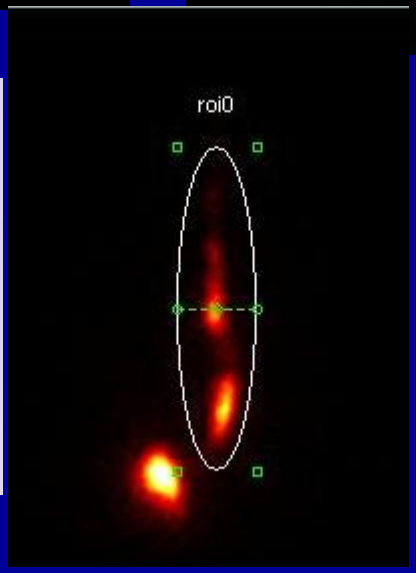
Nuclear medicine in gastrointestinal system











Assoc. prof. V. Marković, MD, PhD

Assoc. prof. A. Punda, MD, PhD

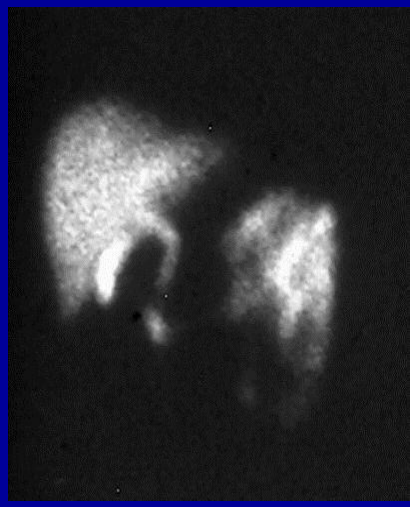
A. Barić, MD, nucl. med. spec.

Hepatobiliary imaging

- Hepatobiliary imaging is nuclear medicine diagnostic procedure for evaluation of functional and morphological state of the hepatobiliary tract, using radiotracer that follows billiary excretion pathway (blood-hepatocyte-gallbladder)

- Radiotracers:

Tc-99m labeled iminodiacetic acid analogs (IDA)
HIDA- dimethyl IDA
DISIDA- diisopropyl IDA
PIPIDA- para-isopropyl-IDA (PIPIDA)

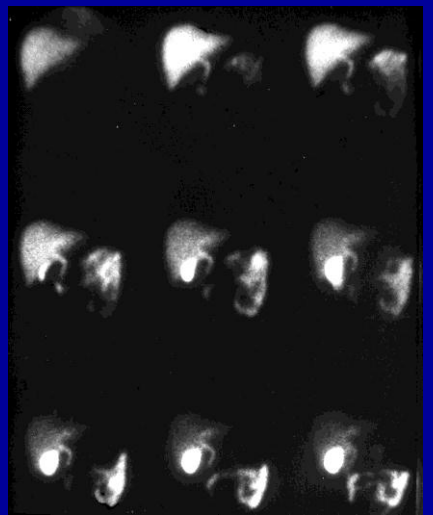


- Intravenously applayed radiotracer enters hepatocytes, following biliary excretion pathway together withh bilirubin

- 10-15% of given dose is eliminated by kidneys, even more in hyperbilirubinemia

- Dose: 111-185 MBq (3-5 mCi), sequentional images during 45 mins, each 1 min duration, afterwards delayed images untill bowel presentation of radiotracer

- Sequential images with data quantification provides an estimate of biliary function and evaluation of gallbladder functionality



- HIDA dynamics

- max. liver activity in 10-th minute

- ductus choledochus around 20-th min.

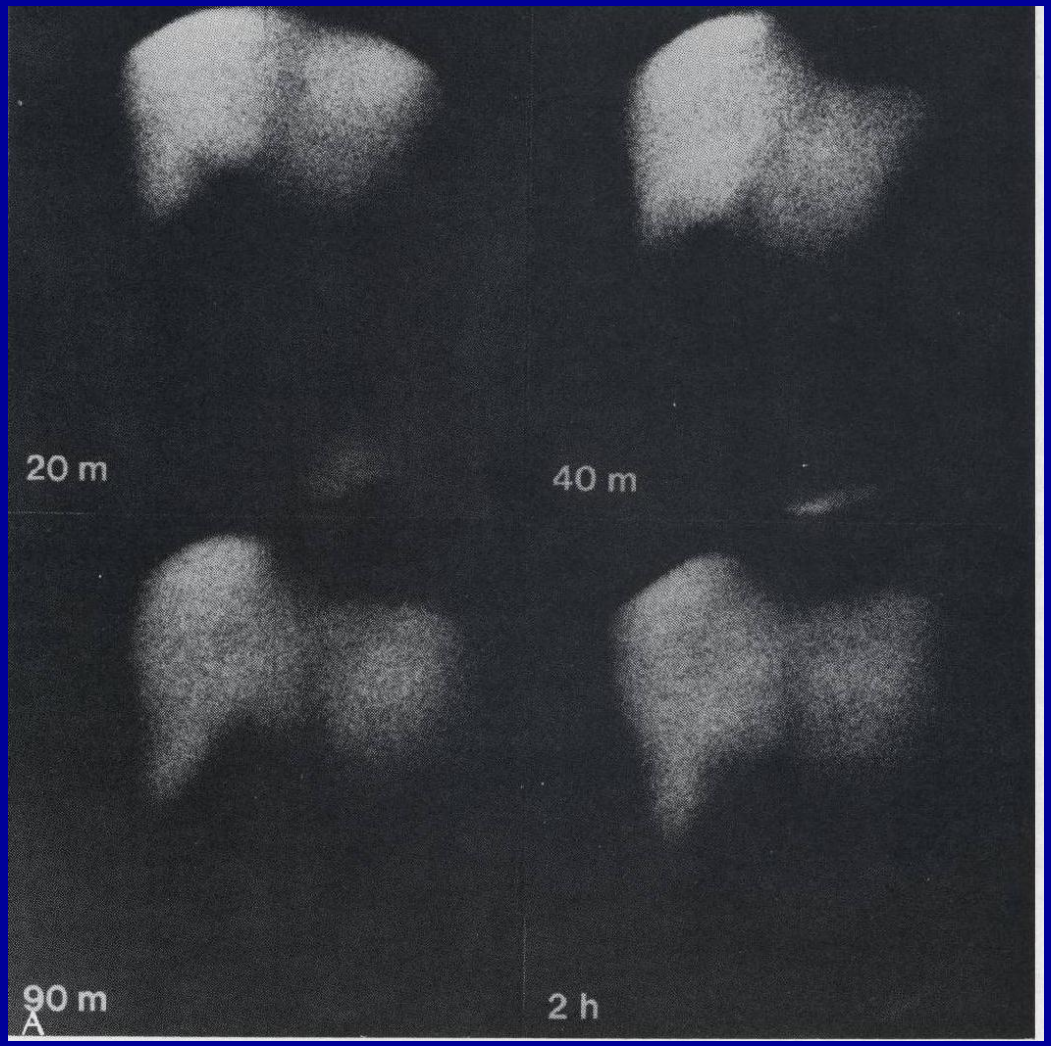
- gallbladder within first 60 min. (during wich major liver activity is eliminated)

- bowel activity within 60 min.

Indications:

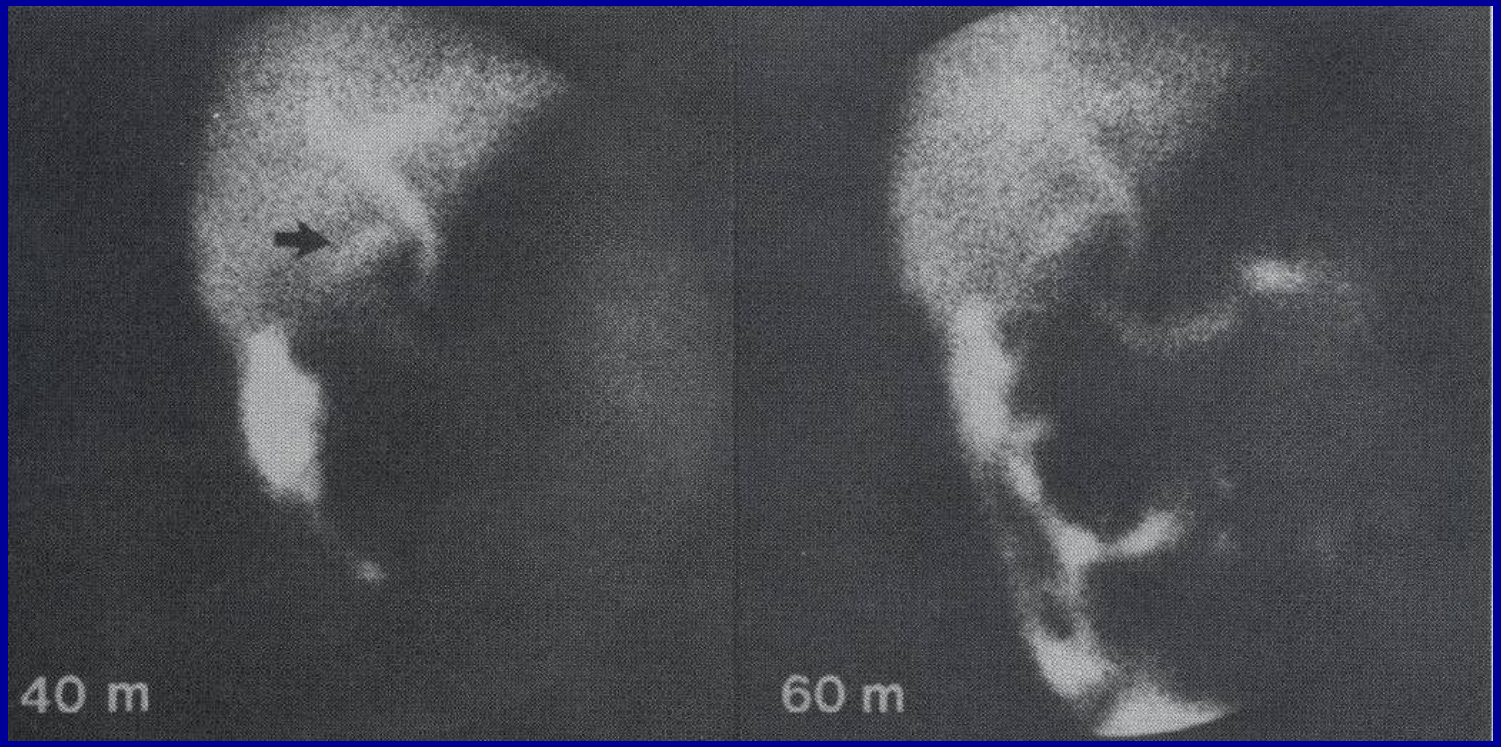
- cholecystitis (acute, chronic)
- icterus: hepatocellular vs obstructive
- congenital biliary atresia
- intrahepatic stones
- post surgical evaluation (after cholecystectomy, enterobiliary anastomosis)
- biliary fistula
- duodenogastric reflux
- liver transplatation
- biliary dyskinesia
- evaluation of focal lesions presented on liver colloid scan

Obstructive icterus



Normal liver scan. Biliary ducts not seen 2 hours post injection.

Postsurgical bile leak

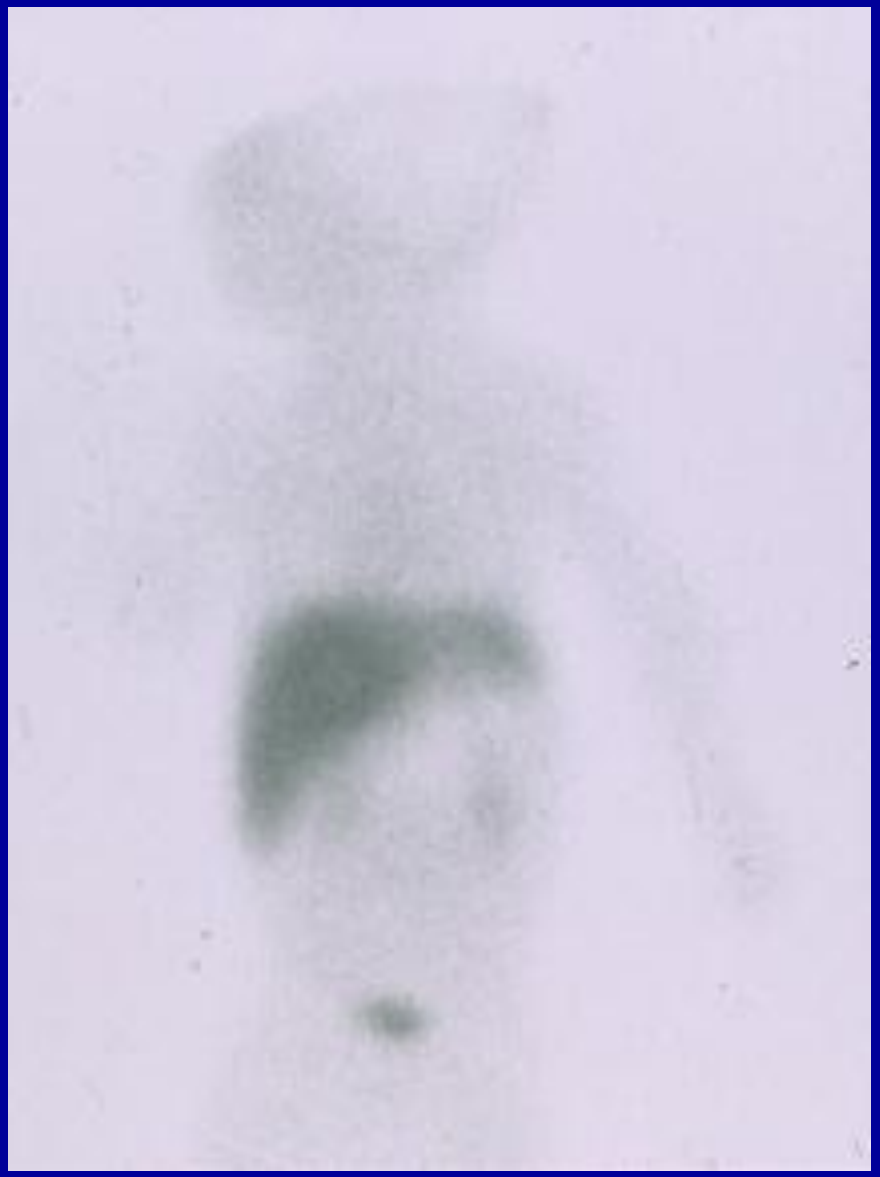


40 min. post injection radiotracer accumulation is seen along the lateral edge of the liver, descending in abdominal cavity, among intestinal loops

Biliary atresia- 24 h p.i.

Congenital biliary atresia:

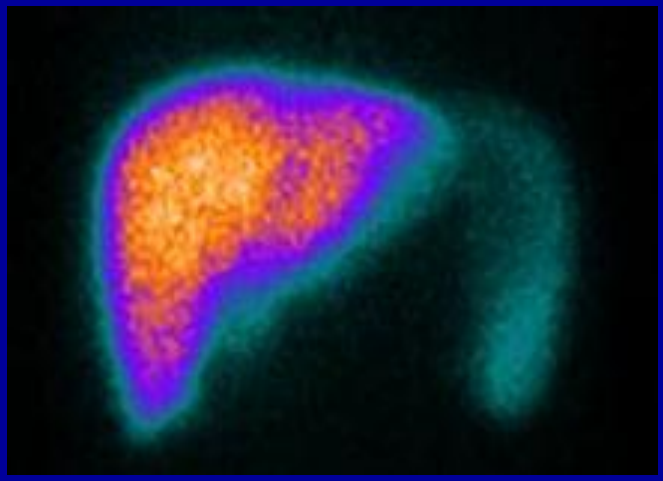
- relatively good accumulation in liver but absent bowel activity after 24 hours and renal elimination



- **HBS vs. oral/iv. cholecistography**

- HBS radiotracers aren’t toxic or allergenic
- Useful in a case of high hyperbilirubinemia during acute obstruction

Colloid liver scintigraphy



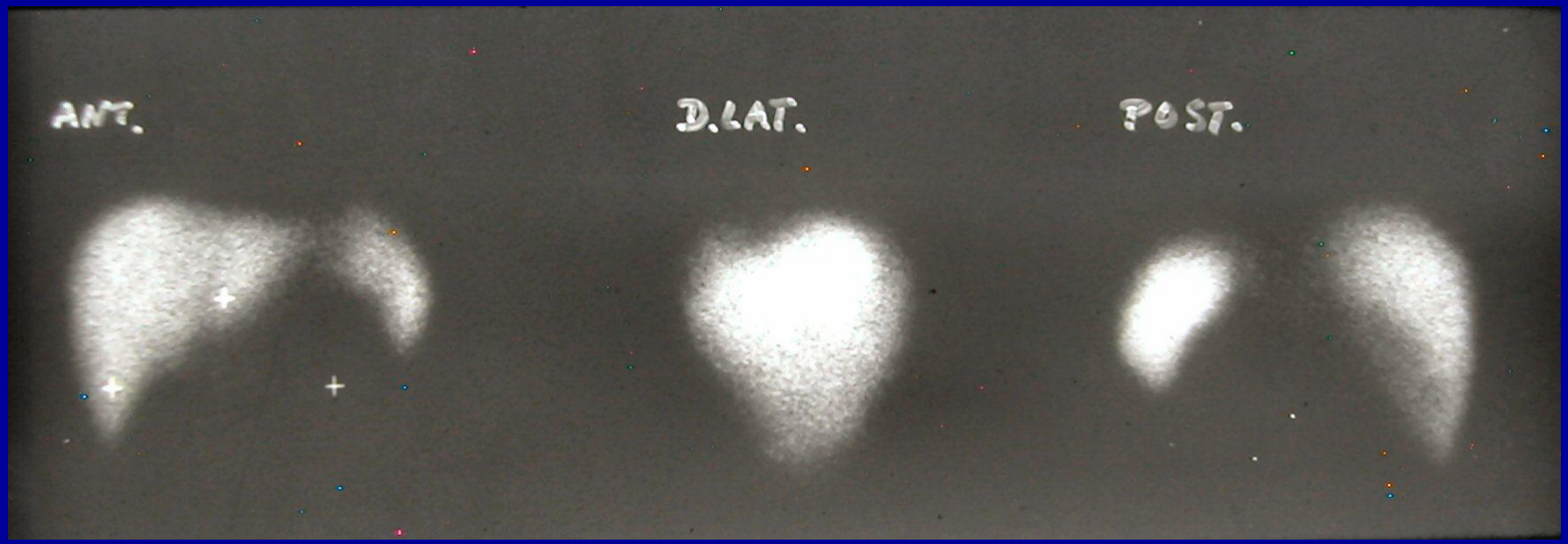
- **Colloid liver and spleen scintigraphy** is based on phagocytosis of radiolabeld colloid thus providing morphological and functional evaluation.

- **Radiotracers and biodistribution mechanisms:**

Tc-99m-tin colloid, Tc-99m-sulfur colloid

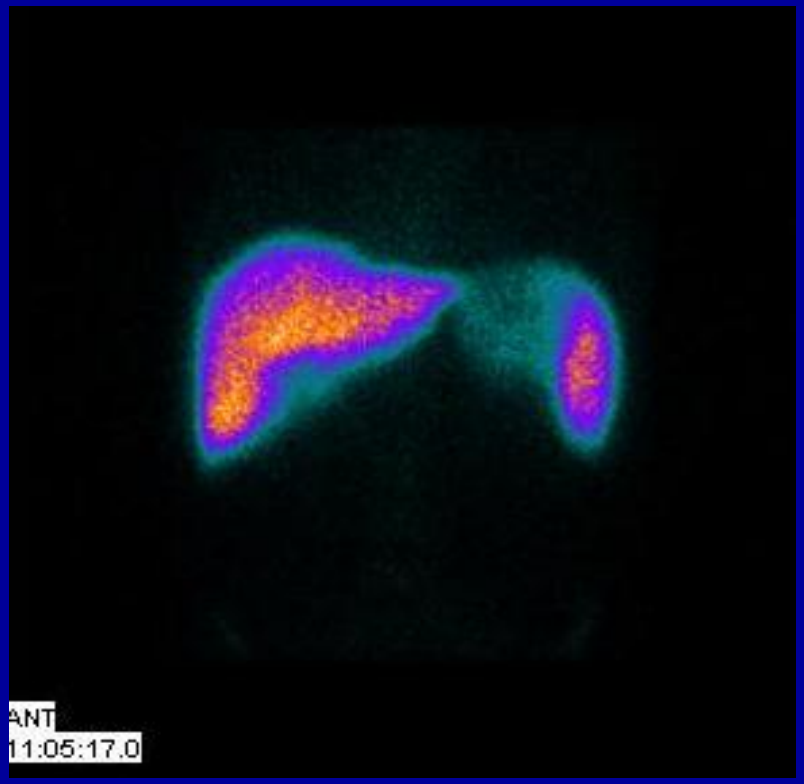
- colloid particles size of 1-5 µm
- Kupffer cells (located on the liver sinusoidal endothelial cells or beyond them) are phagocytic cells, as such are the part of the reticuloendothelial system (RES) or mononuclear phagocyte system (MPS)

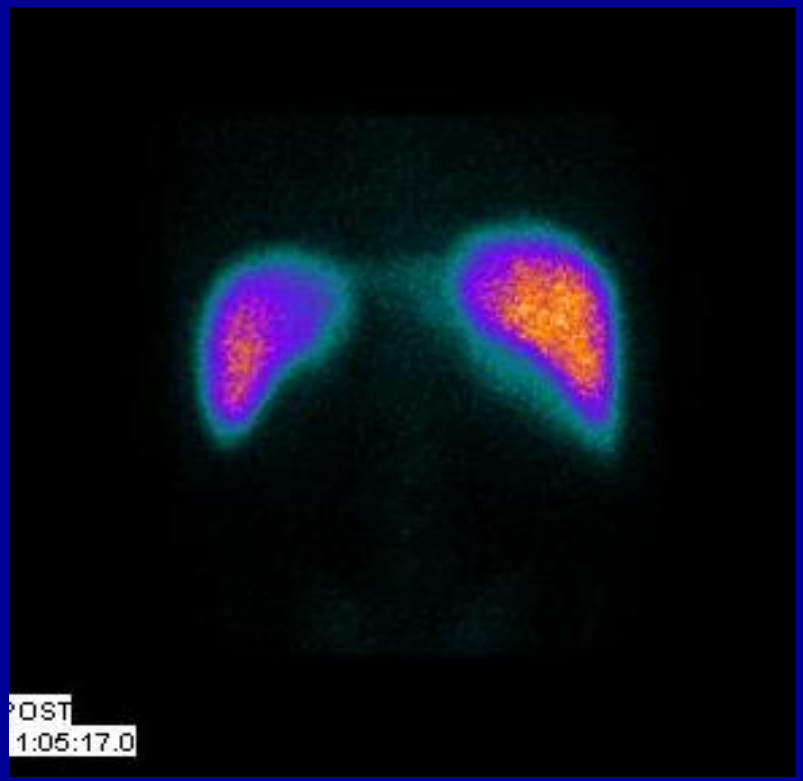
- **Dose: 111-185 MBq (3-5 mCi) iv. applied radiocolloide**
  - children: 1,85 MBq/kg (50 µCi/kg), min. 500 µCi
  - static scintigrams are obtained 10-15 min. post injection



Colloid liver and spleen scintigraphy

Colloid liver and spleen scintigraphy

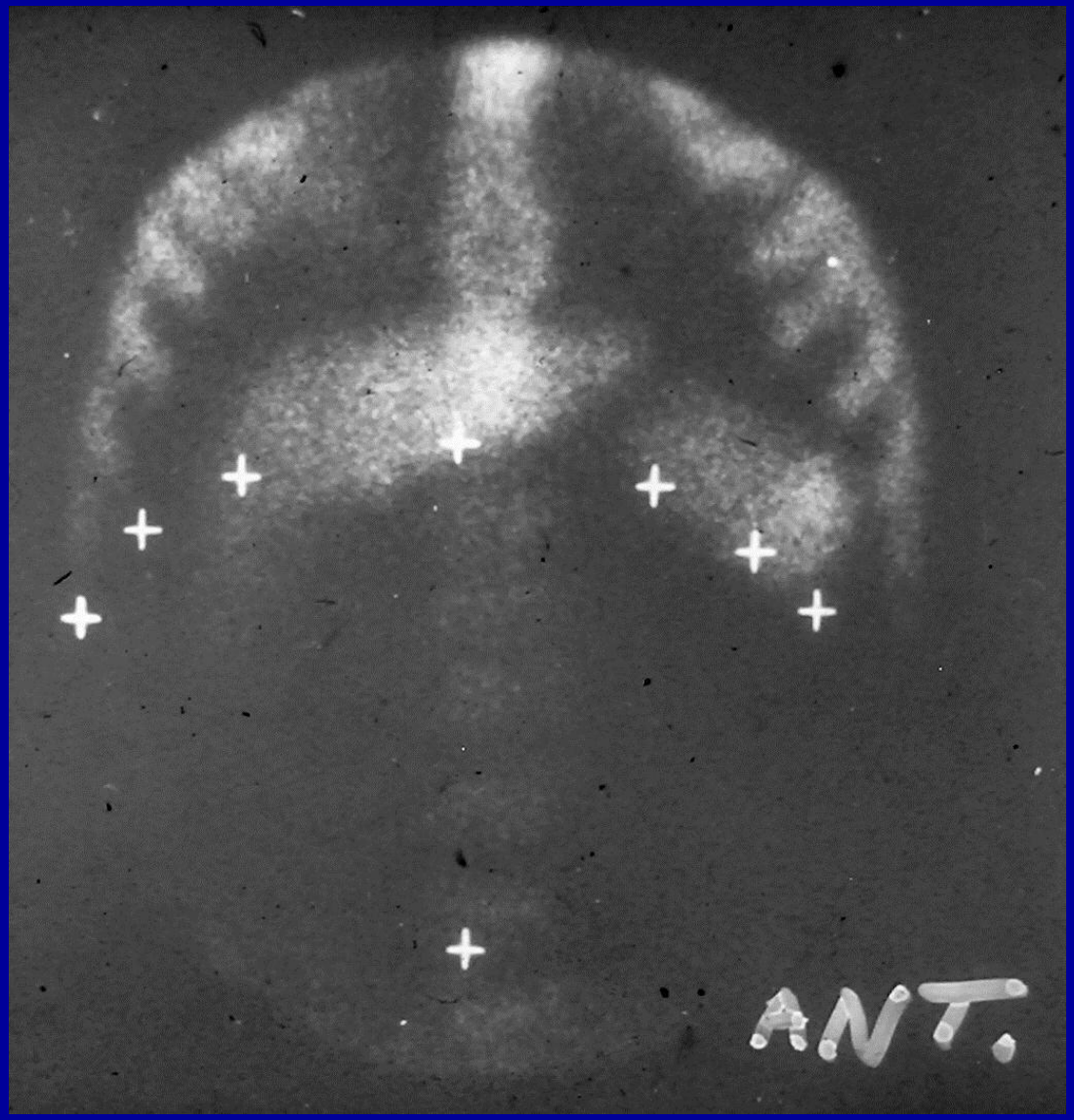




- **Phagocytosis in skeletal and bone marrow RES is increased in a case of decreased phagocytosis in liver (diffuse liver disease)**

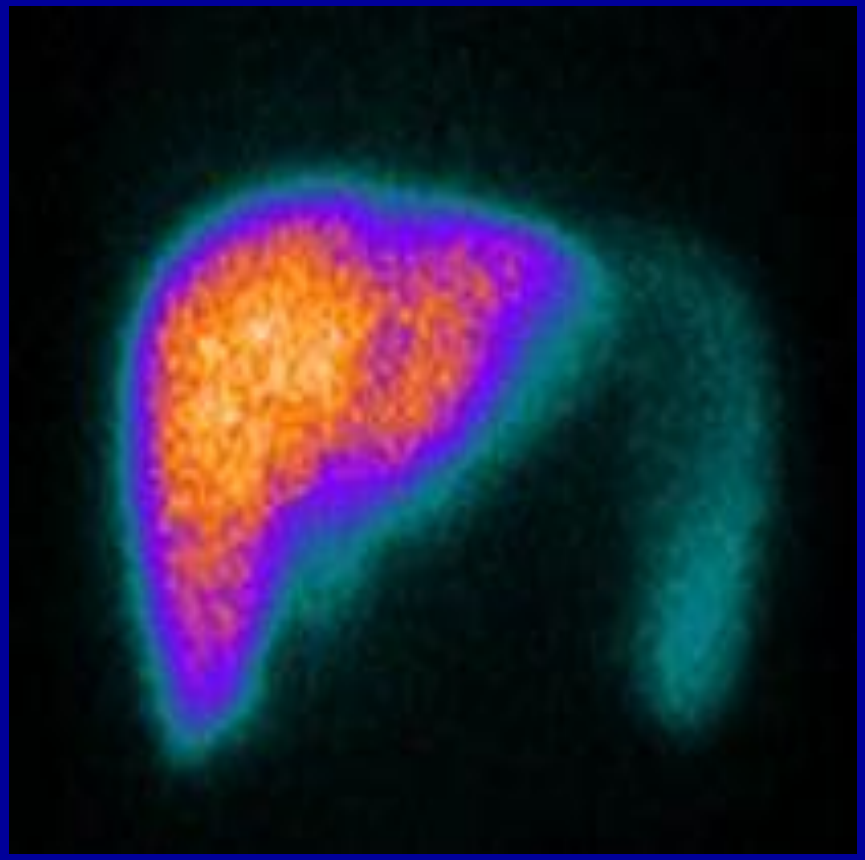
Indications:

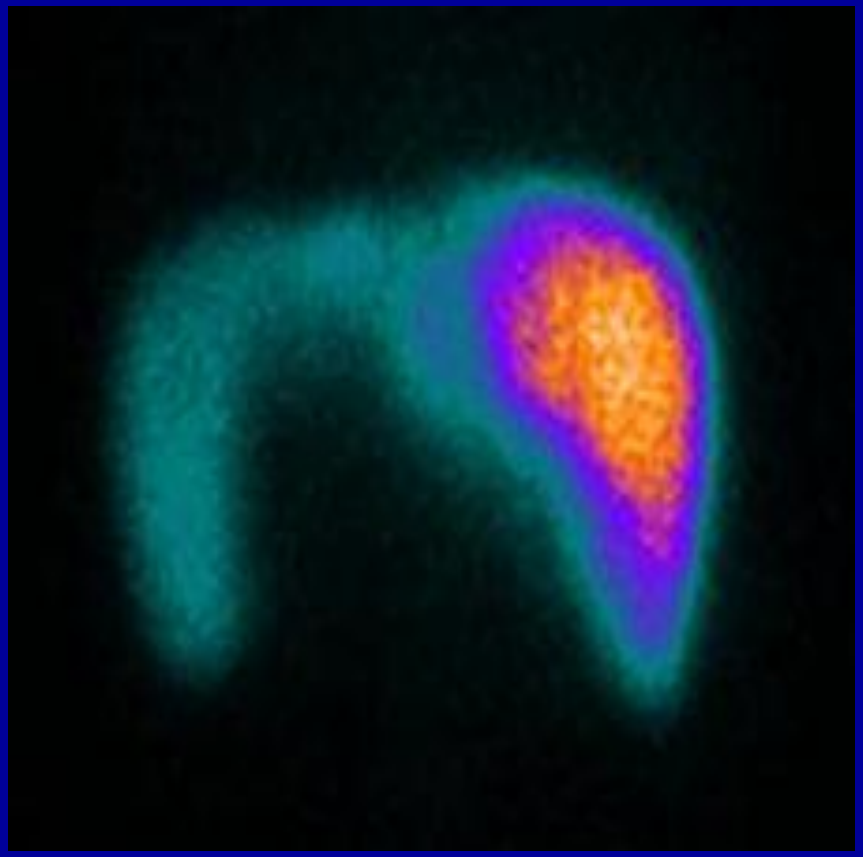
1. **Diffuse liver and spleen lesions:** enlarged, atypically shaped, hypotrophic left lobe, palid liver parenchyma with inhomogeneous accumulation and increased extrahepatal uptake in spleen, spine and ribs

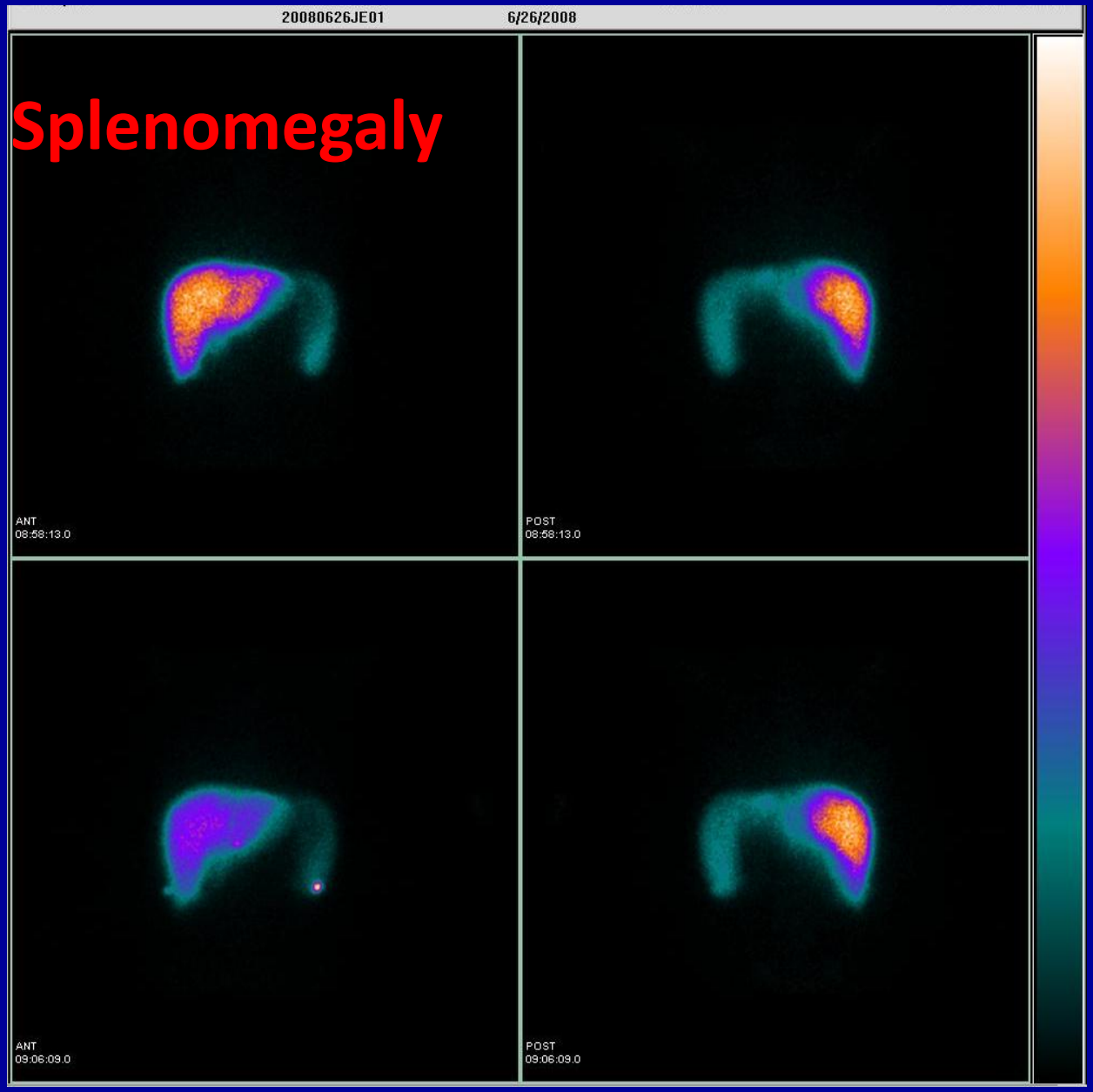


Liver cirrhosis- atrophic liver

Splenomegaly



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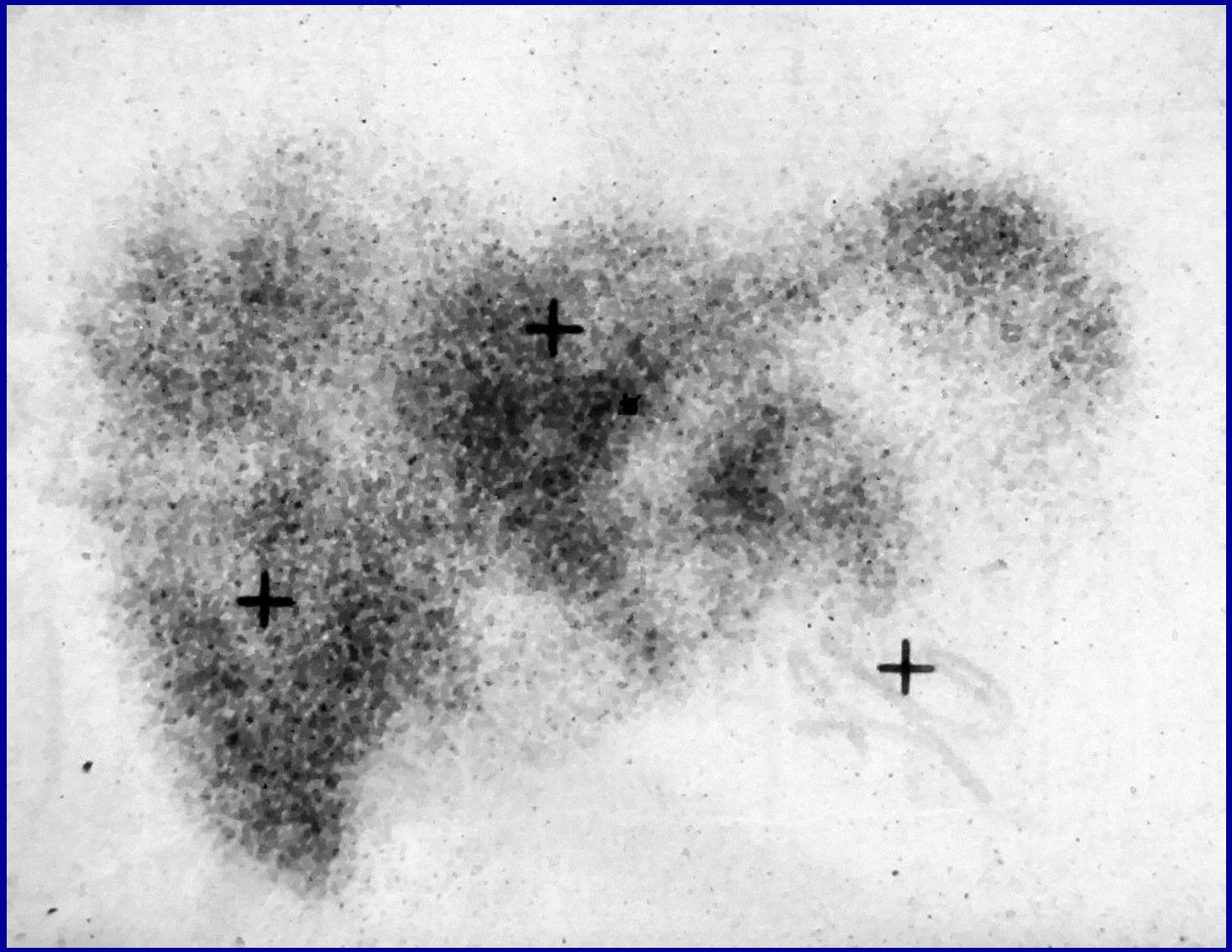
2. Focal lessions

Scintigraphic **cold lessions-** area of decreased or absent uptake

- **benign**: adenoma, hemangioma, cyst, echinococus cyst, abscess
- **malignant**: primary liver tumor (hepatoma), metastasis

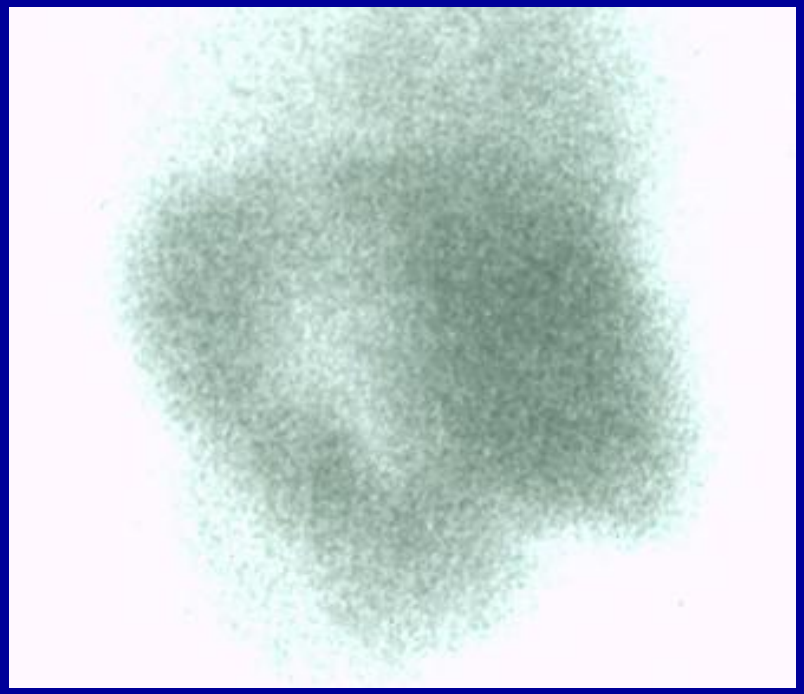
Scintigraphic cold lesions in the liver- metastases



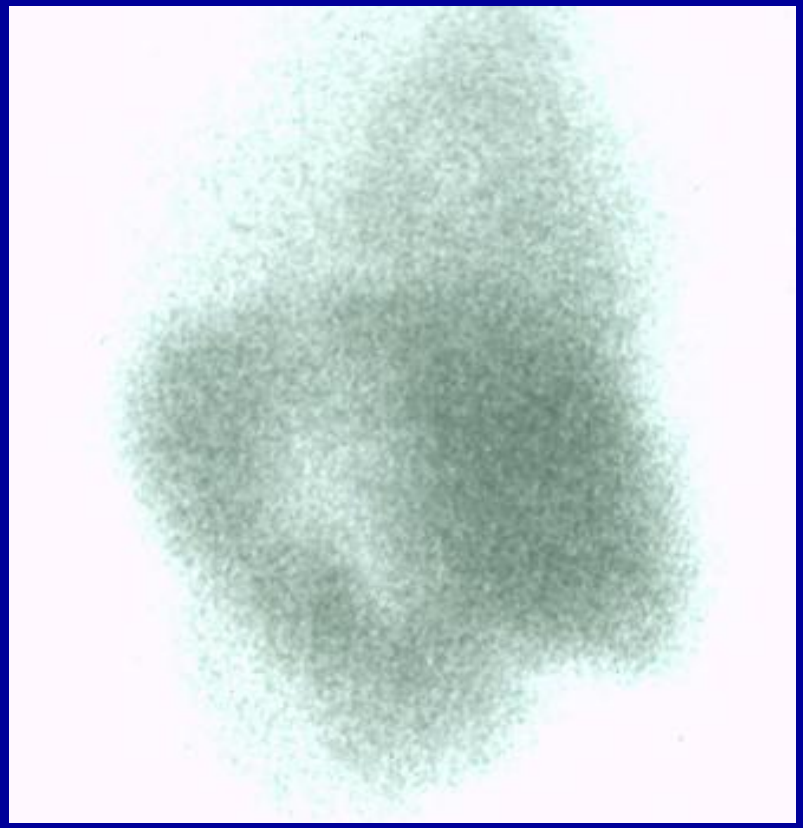
Enlarged liver with multiple metastasis

3. Traumatic liver and spleen lesions

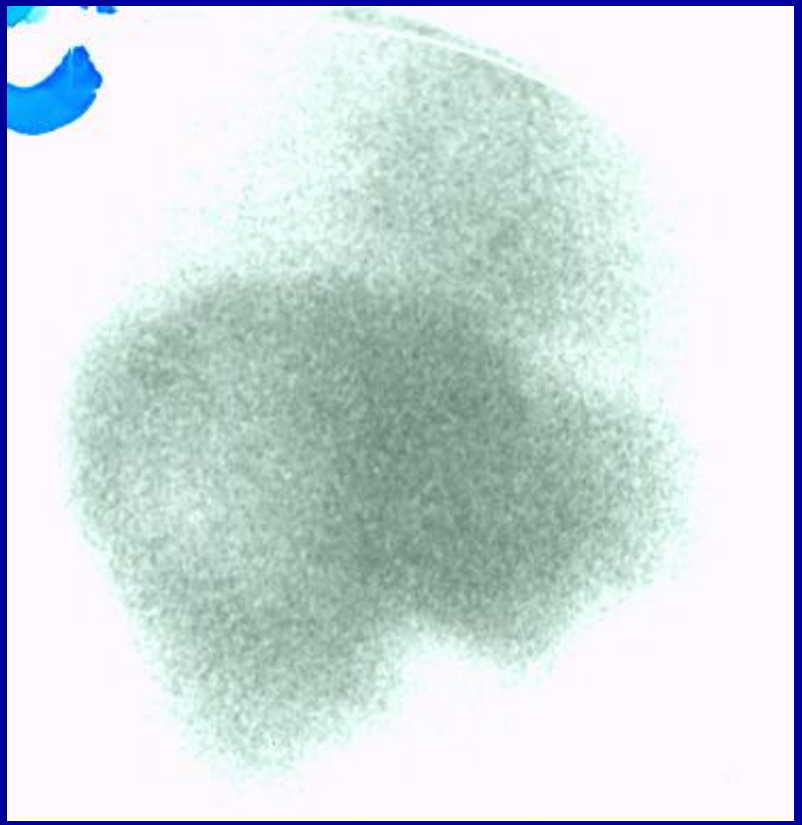
Laceration, rupture, subcapsular hematoma, posttraumatic or postoperative splenosis



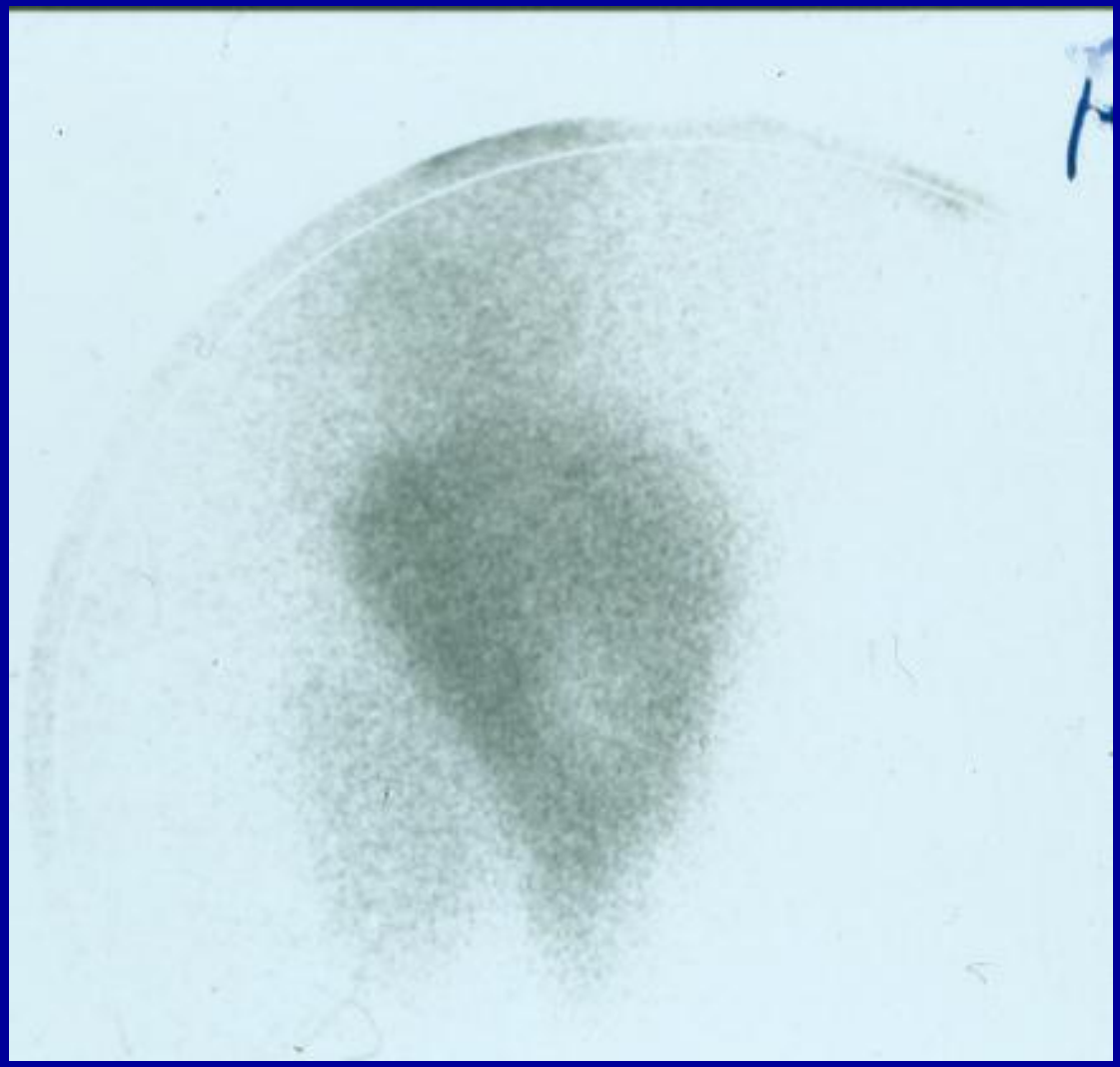
Liver rupture- RL



Liver rupture- RAO 25



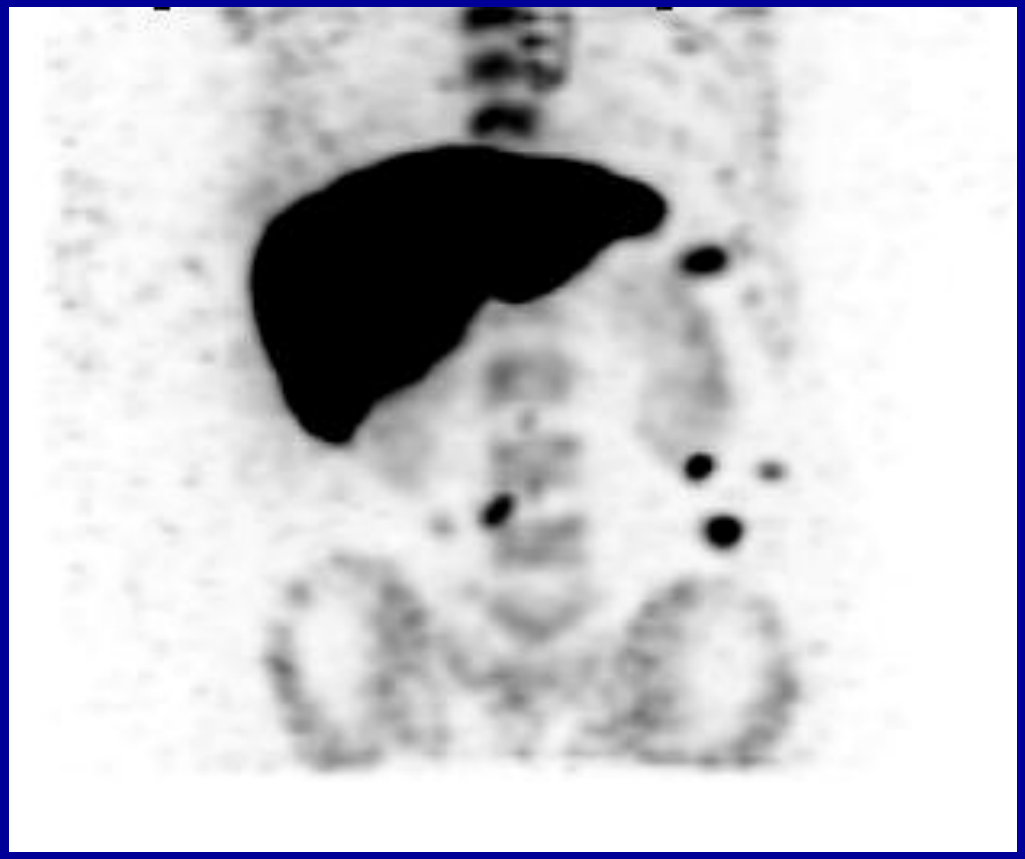
Liver rupture- RPO 30



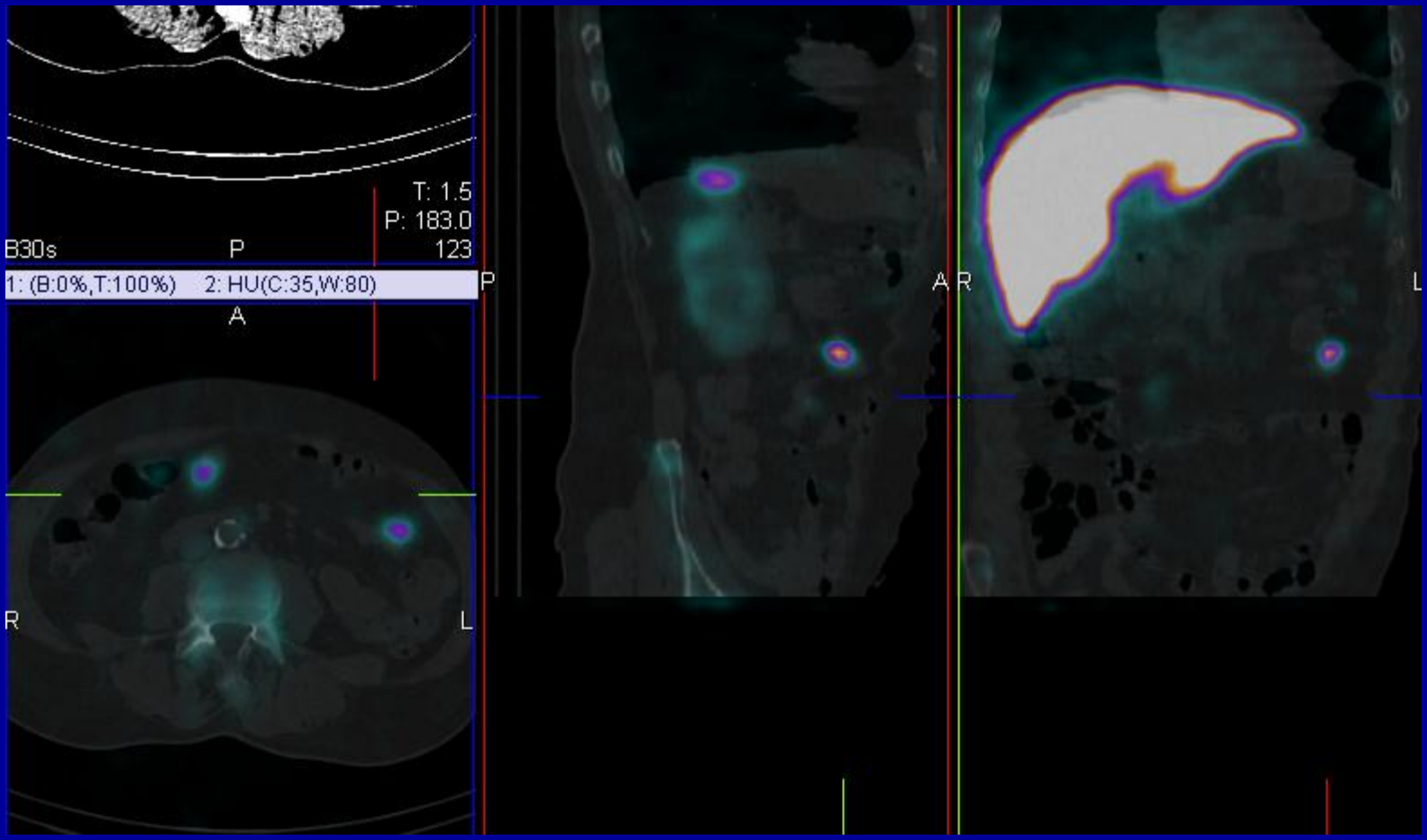
Liver trauma- rupture (digital scintigrams)

Spleen trauma- hematoma -LPO

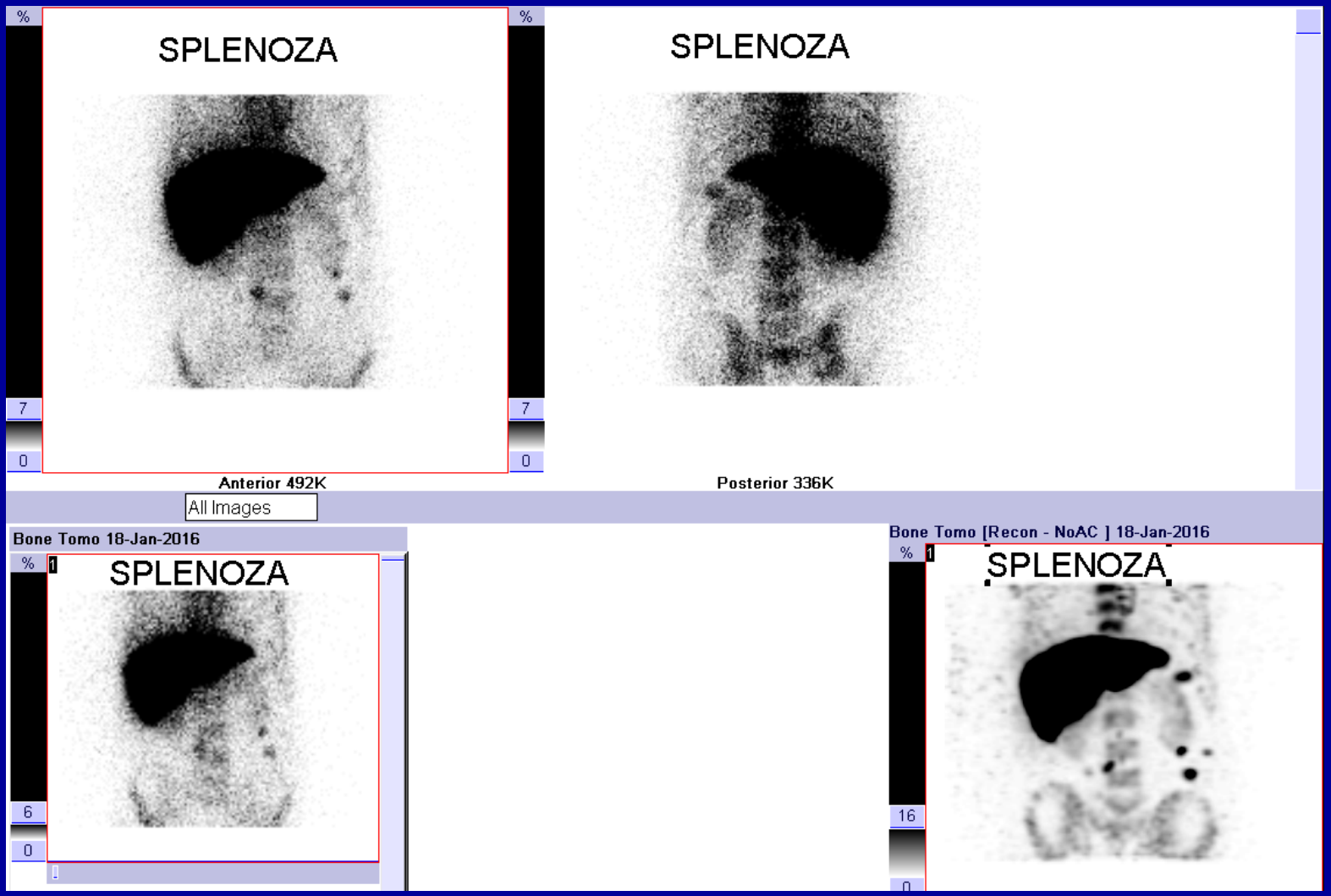
Splenosis



Splenosis

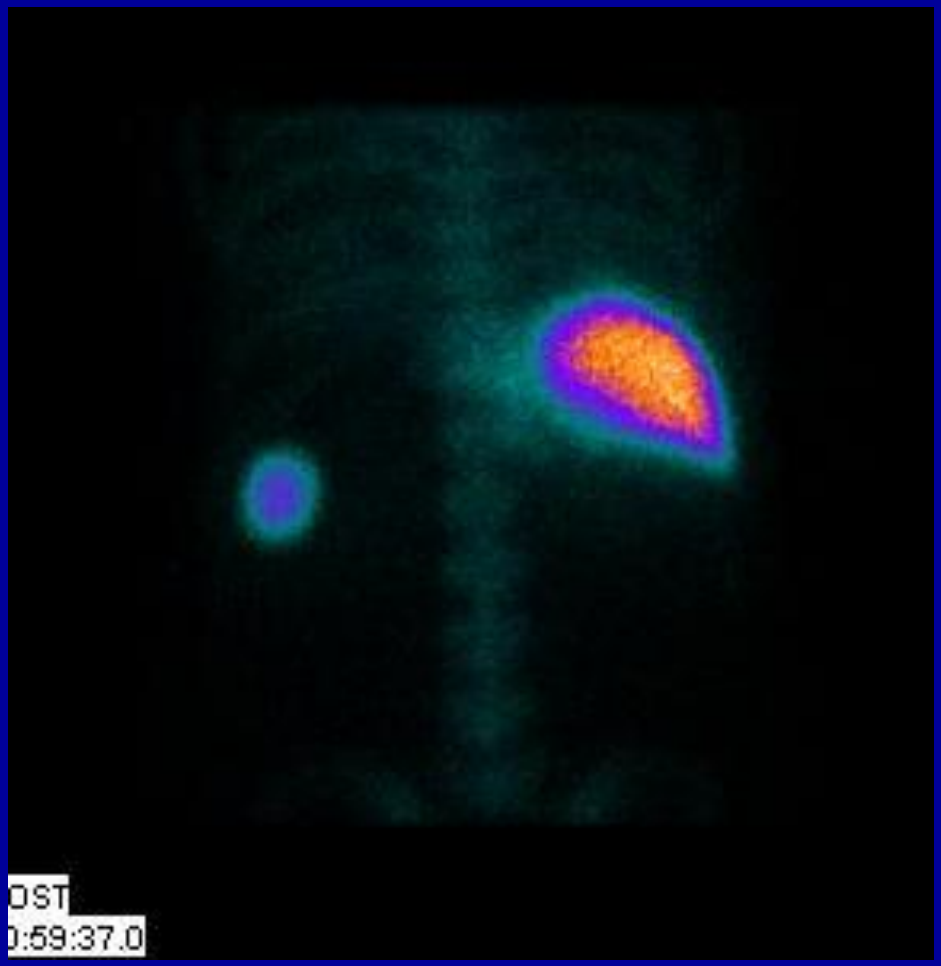


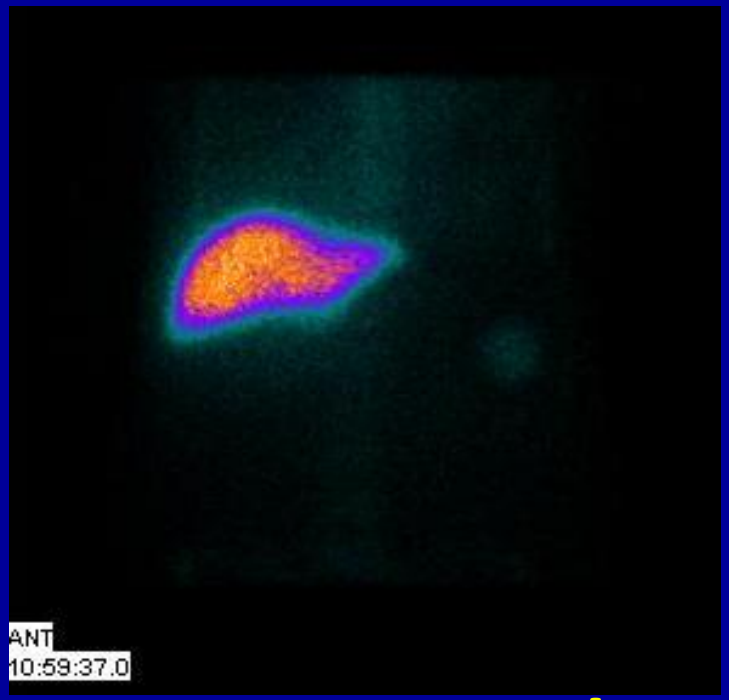
Splenosis

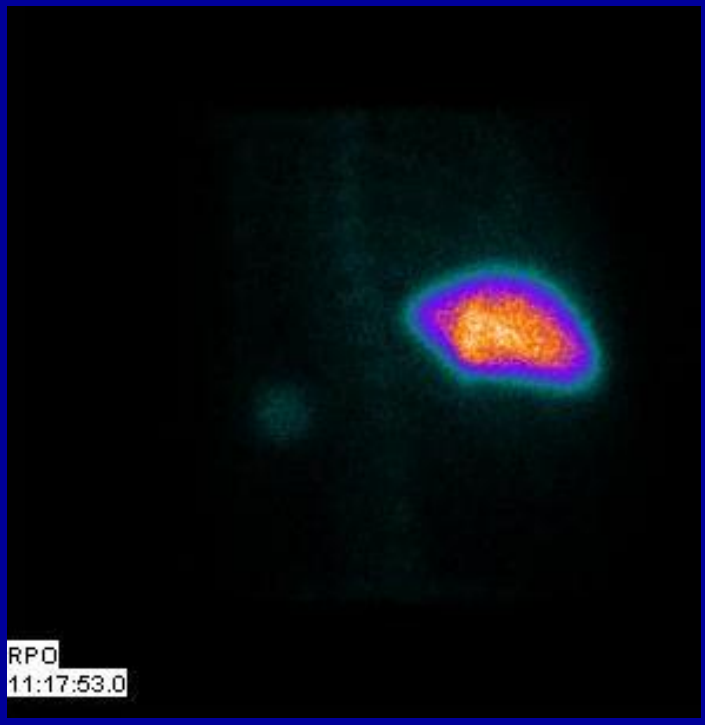

SPLENOZA
SPLENOZA
Anterior 492K
Posterior 336K
All Images
Bone Tomo 18-Jan-2016
SPLENOZA
Bone Tomo [Recon - NoAC] 18-Jan-2016
SPLENOZA

4. Congenital anomalies

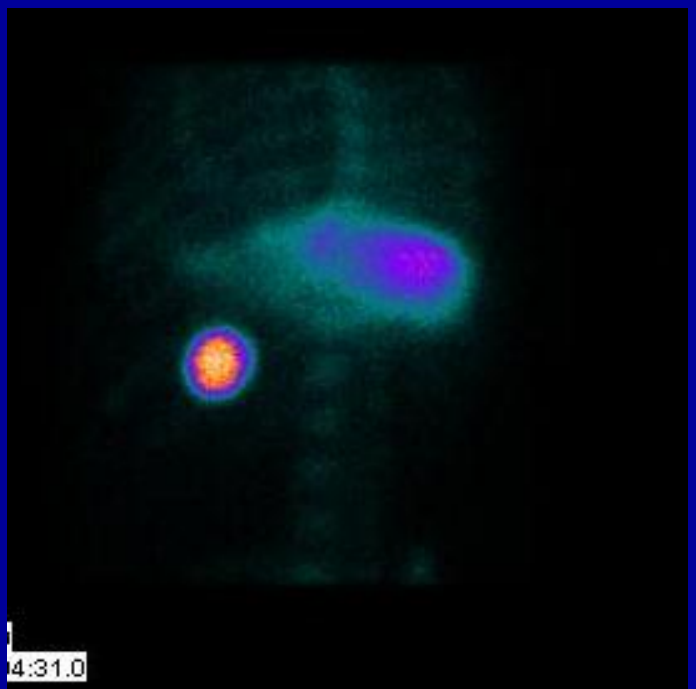
Accessory spleen, polysplenia, situs viscerum inversus.



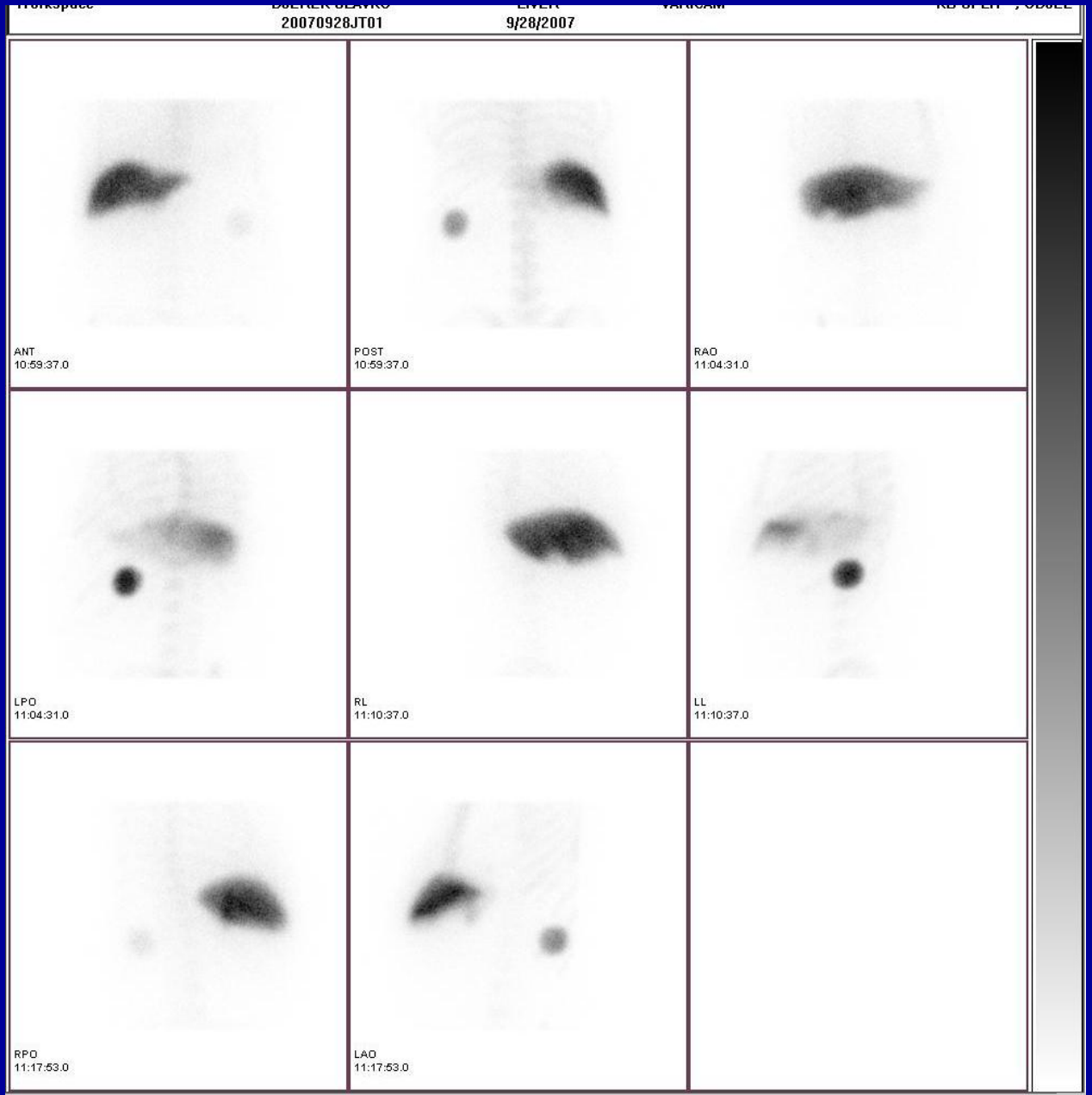




Accessory spleen



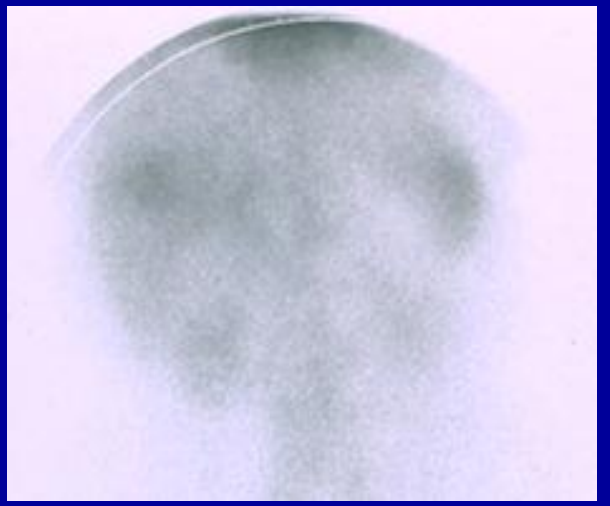
Accessory spleen



Spleen scintigraphy

- **Spleen scintigraphy-** may be done using heat-damaged (49-50^0 C) erythrocytes labeled with Tc-99m and reinjected to the patient (37 MBq), because the spleen captures damaged erythrocytes. Images are obtained 3 h post injection.

Scintigraphic evaluation of hepatic hemangioma



- **Cavernous hemangioma** is the most common primary liver tumor; and the most common of all benign tumors, usually asymptomatic.

- Usually are discovered as incidental finding on CT or US examination, but further evaluation must be provided to distinguish them from all the other liver tumors, especially metastasis.

- Cavernous hemangioma is formed of dilatated cavernous vascular spaces, filled with blood and poorly connective tissue. Despite abundant vascularity they have low perfusion, so it takes about 1/2-2 hours for radiotracer to intermix with retained blood in caverns.

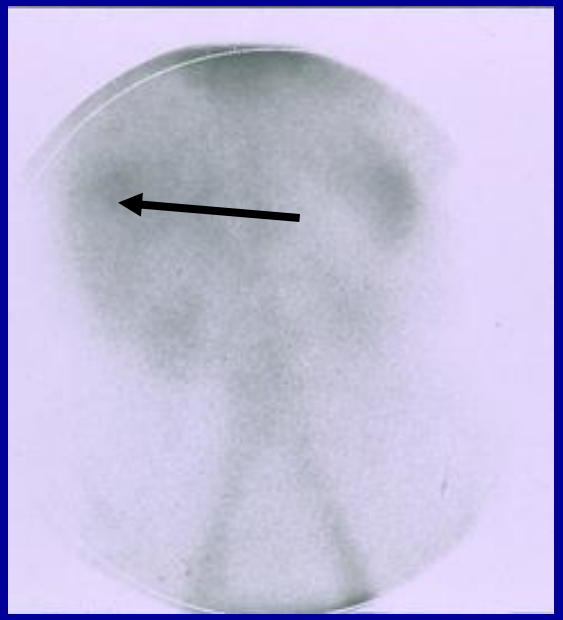
- **Radiotracers and biodistribution:**
  - **Tc-99m-HSA**
  - **Tc-99m labeled autologous erythrocytes in dose of 740 MBq (20 mCi)**
  - **three phase study and SPECT, if possible.**

- **Findings:**
  - **perfusion: decreased perfusion, NOT increased!**
  - **early static: cold lesion in a case of larger tumors (eventualy normal accumulation)**
  - **delayed static: increased uptake**

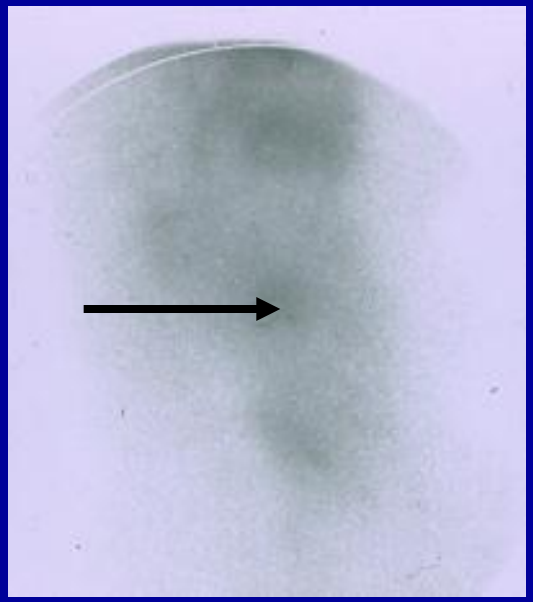
- **Liver hemangioma scintigraphy is precise method with high accuracy and sensitivity. False positive findings are extremely rare.**

Tc-99m-colloid liver scintigram- cold lesion- cyst? tumor? hemangioma?

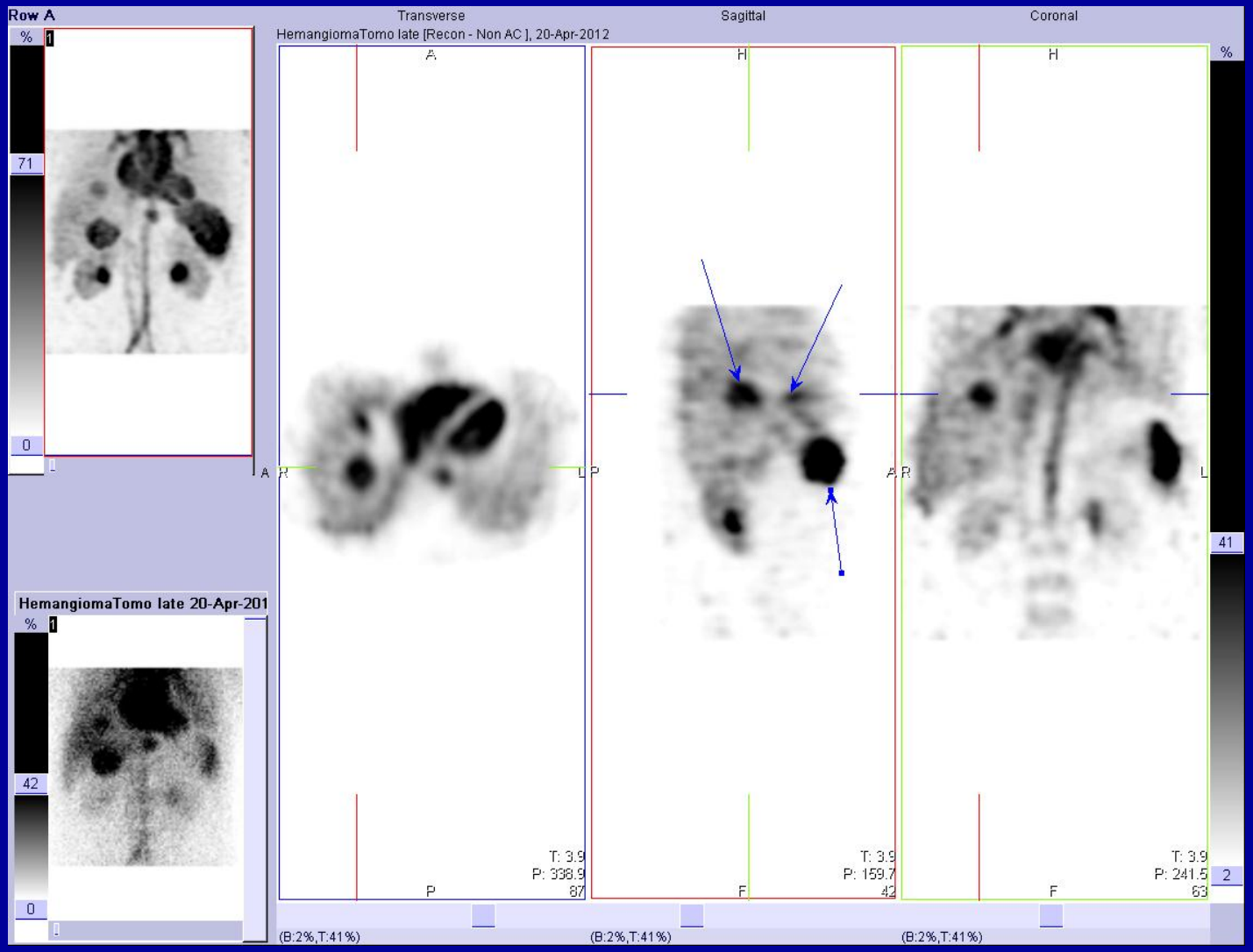
Liver scintigraphy with labelled erytrocytes- liver hemangioma Increased uptake (scintigraphic warm lesion) on the site of previously seen cold lesion on the colloid liver scan



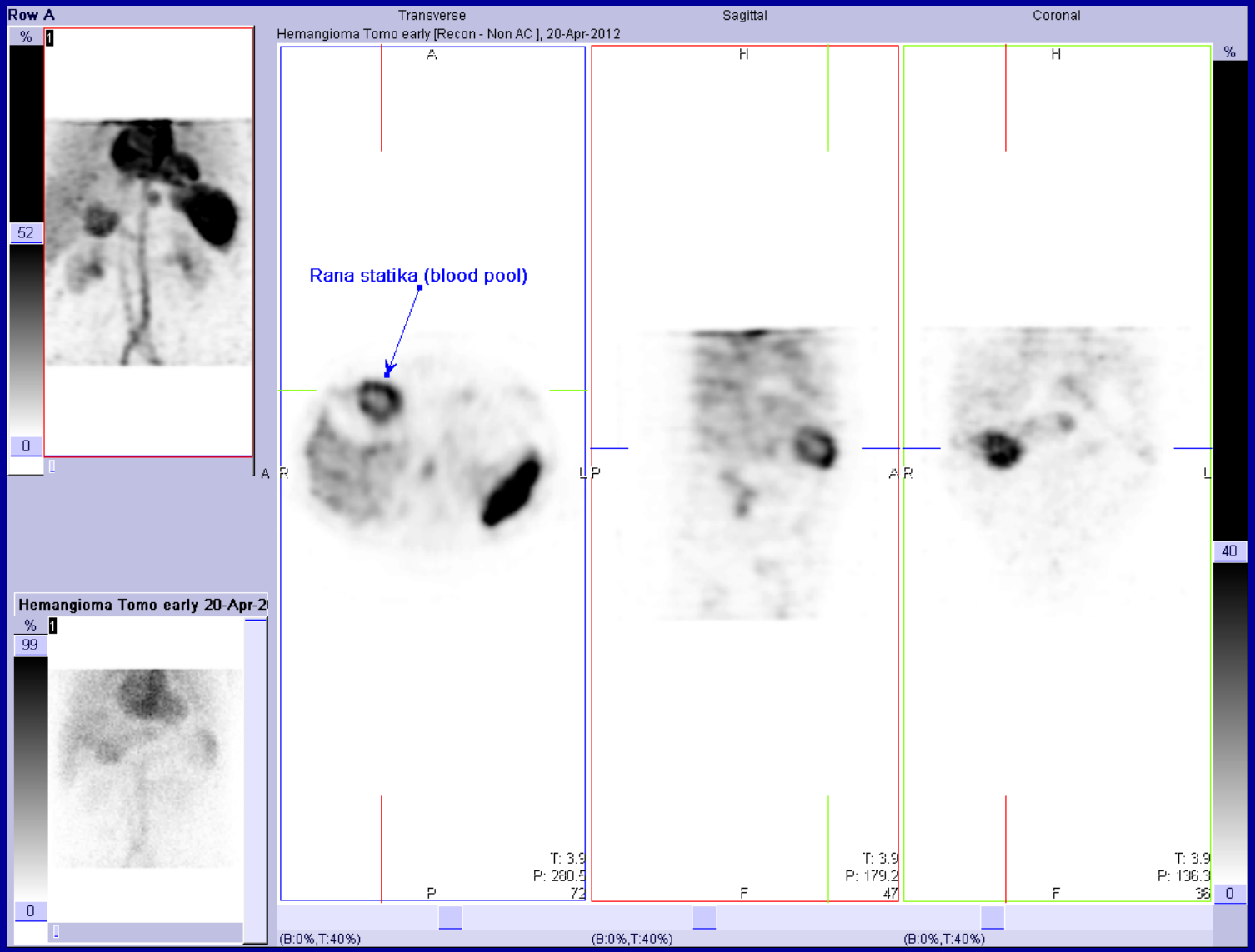
Tc-99m-colloid liver scintigram- cold lesion



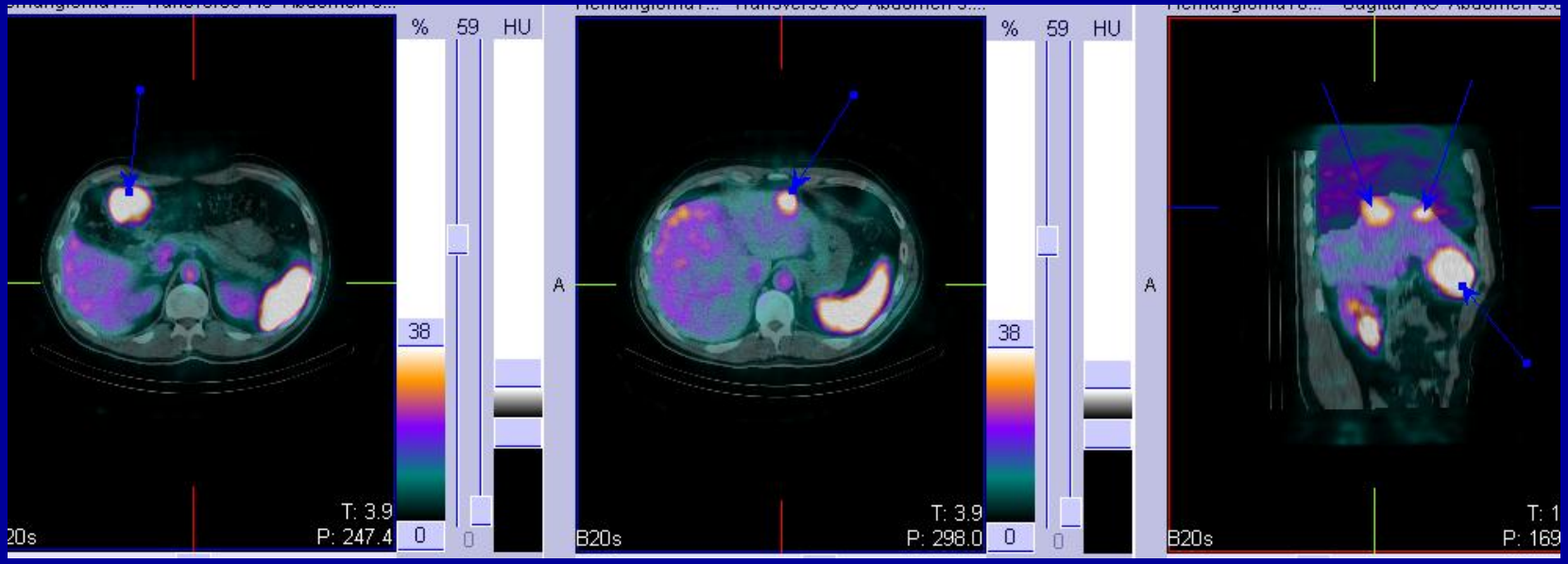
Multiple liver hemangiomas



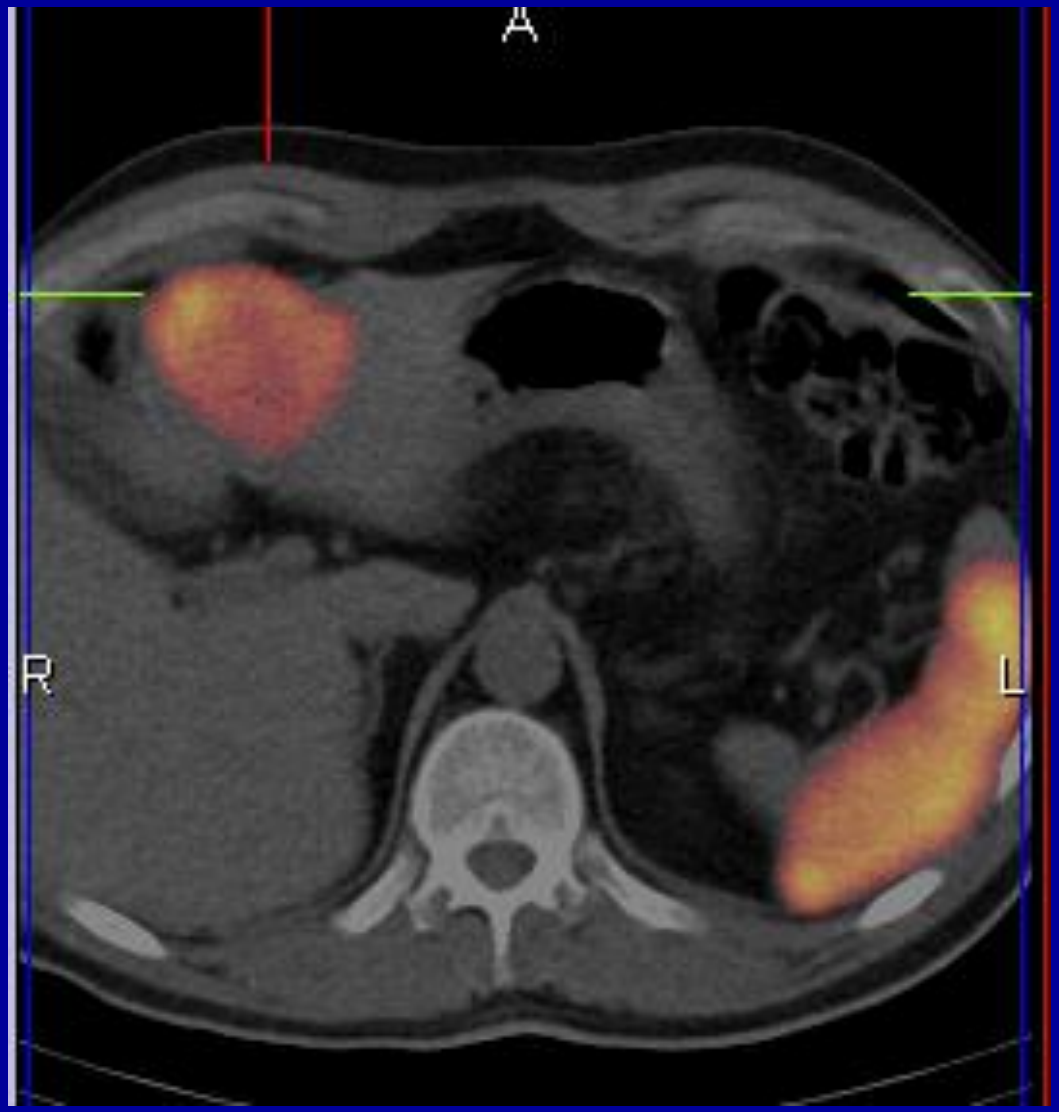
Multiple liver hemangiomas



Multiple liver hemangiomas



Multiple liver hemangiomas



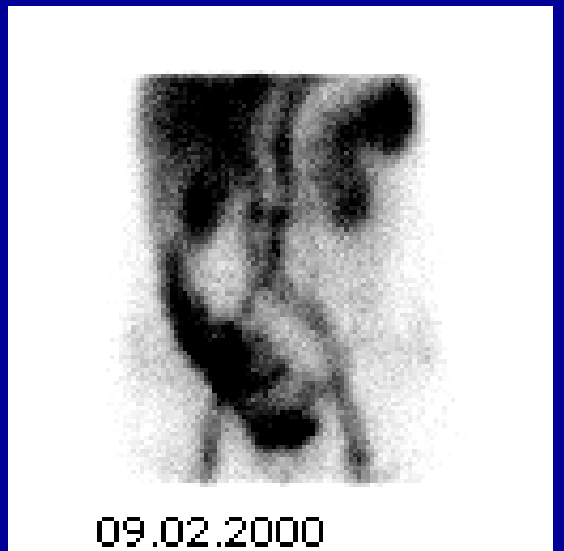
Gastrointestinal bleeding studies

- Scintigraphic methods are successful in detection of GI hemorrhage (angiodysplasia, diverticular disease, intestinal polyp, varices)

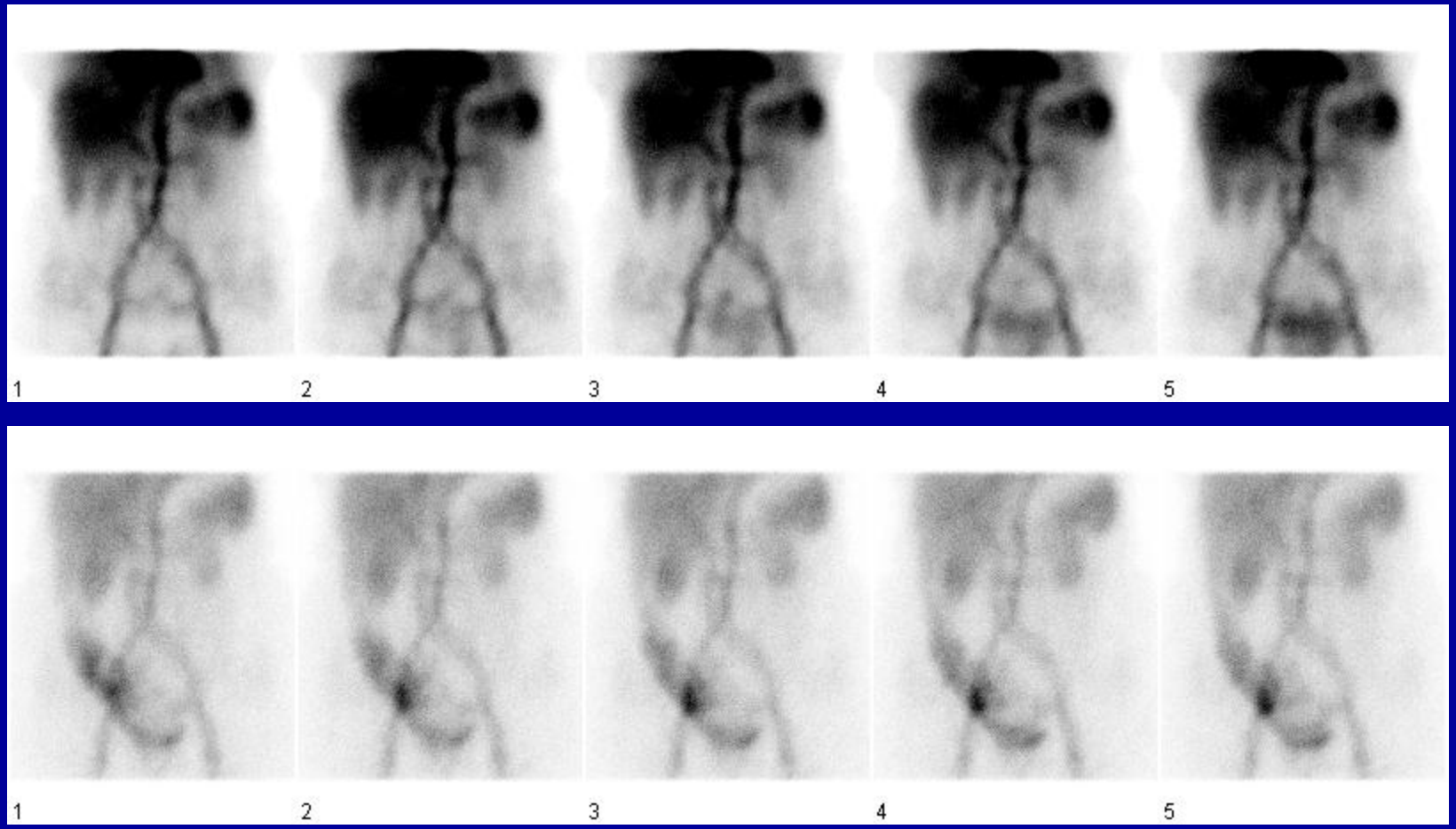
- Radiotracers:

  a) Tc-99m labeled colloids

  b) Tc-99m labeled erytrocytes



Labeled RBC – angioscintigram and dynamics



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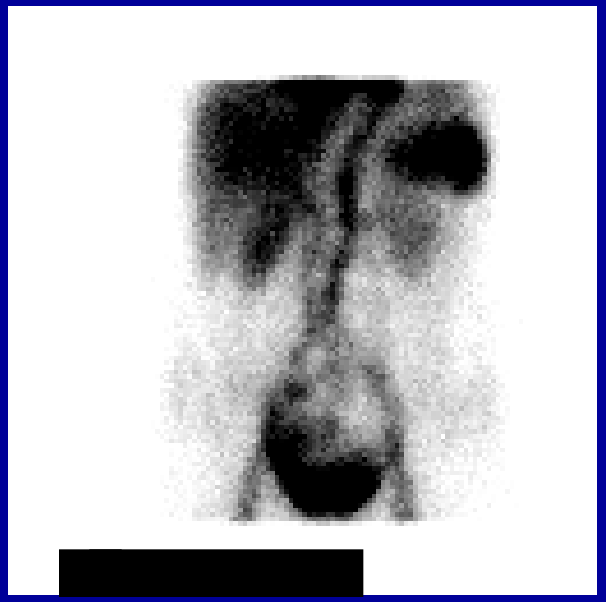
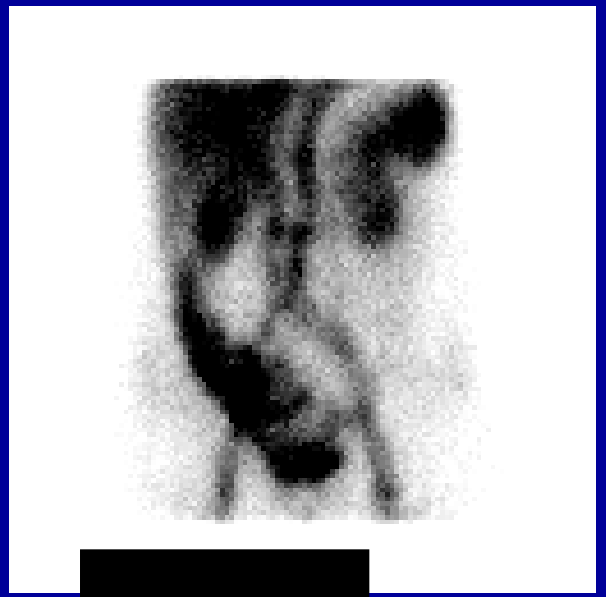
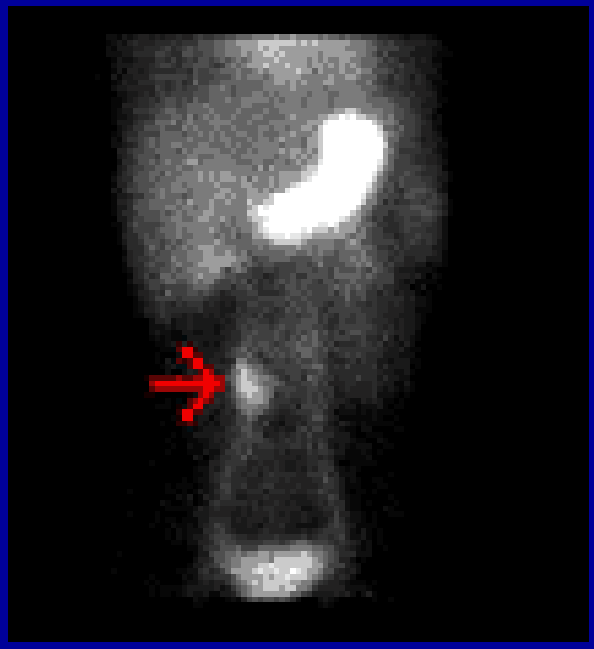


16:00



18:00

Meckel diverticulum scintigraphy



- **Meckel diverticulum-** occurs in about 2% of the population, predominantley in male patients, mostly asymptomatic except in a case of ulceration and hemorrhagia (usually during first 3 yr.)

- Meckel diverticulum contains gastric mucose so it can be visualised after iv aplied T-99m (parietal cells)

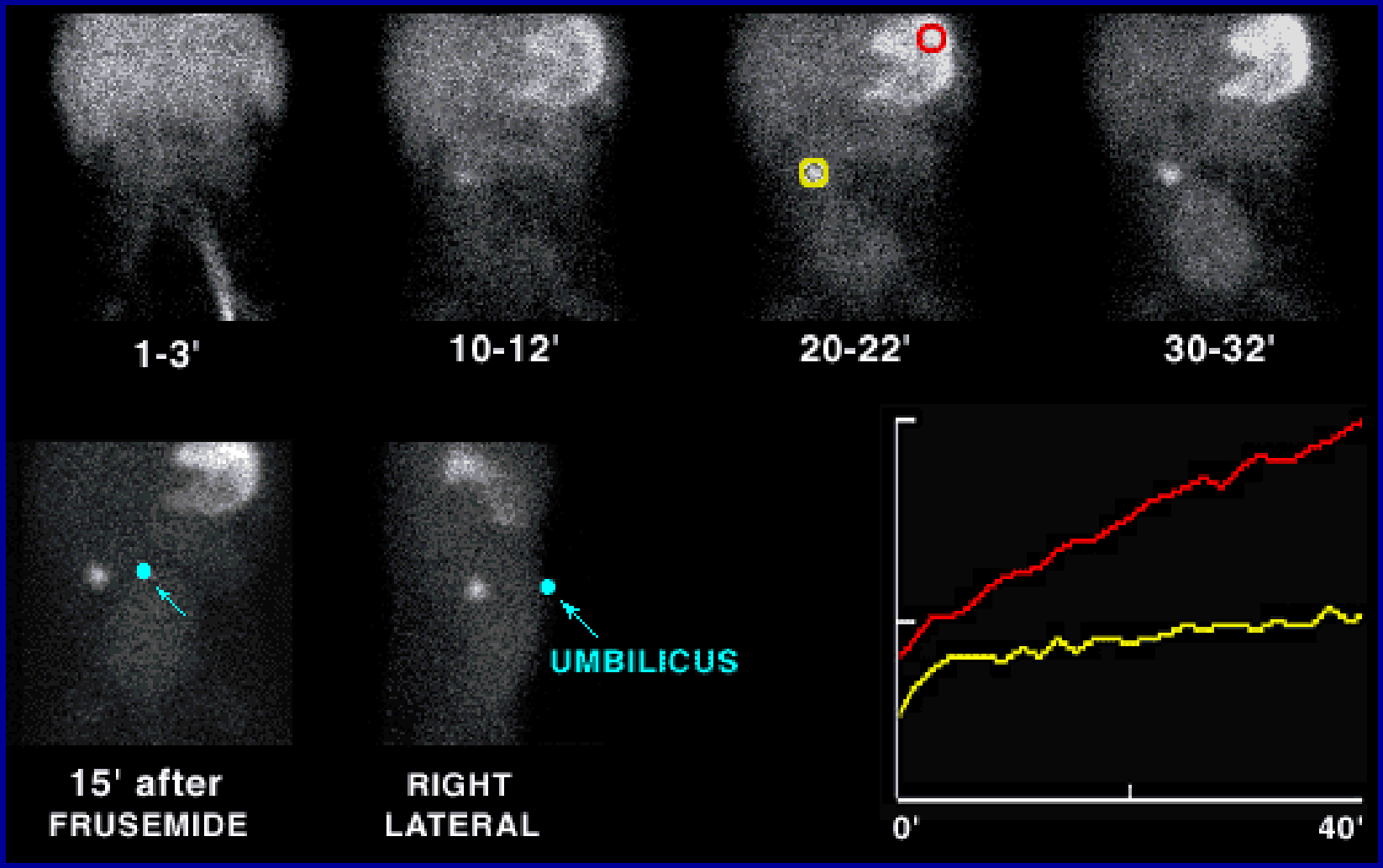
- Sensitivity of radiologic methods, including selective angiography, is very low.

- Tc-99m-pertechnetate in a dose of 3,7 MBq/kg TT, intravenously

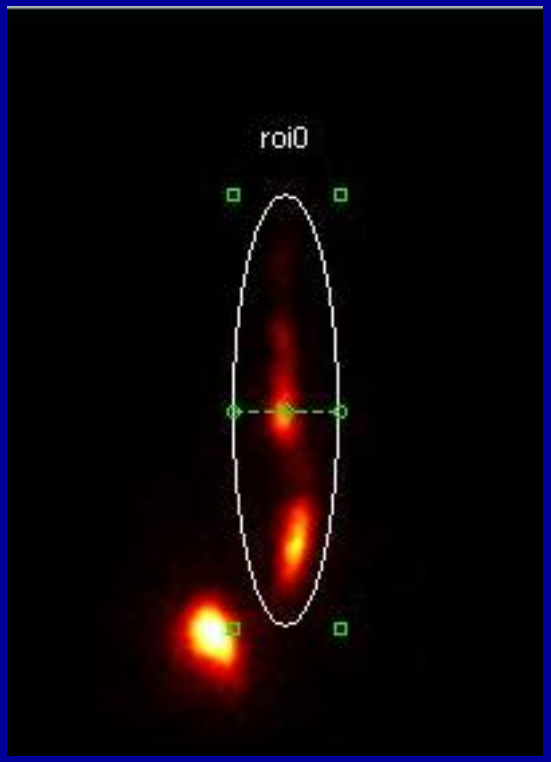
- Abdominal scintigraphy during 45 min.

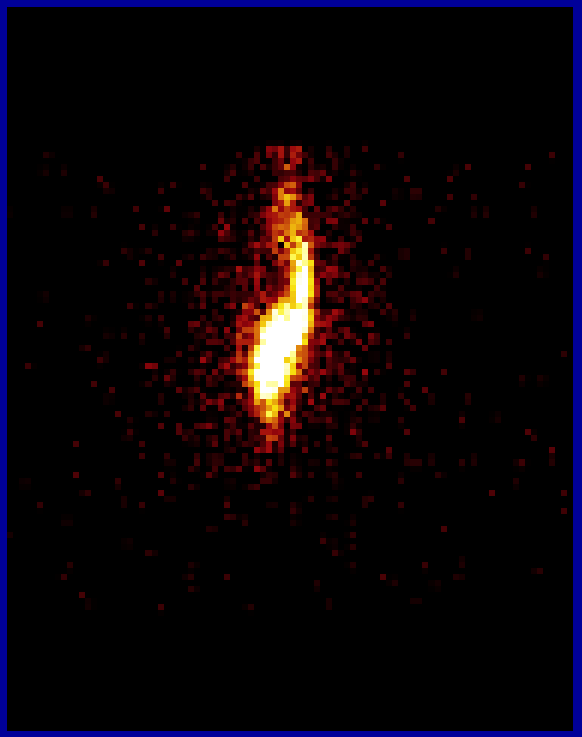
- Focal increasd activity on the right paraumbilical area wich has same scanning dynamic s as stomach indicates Meckel's diverticle

Meckel diverticulum



Oesophageal scintigraphy





Radionuclides (radiolocoides) are used to monitor dynamic of activity passage from oesophagus to the stomach, in order to estimate oesophageal function and morphology, most commonly for detection of gastroesophageal reflux.

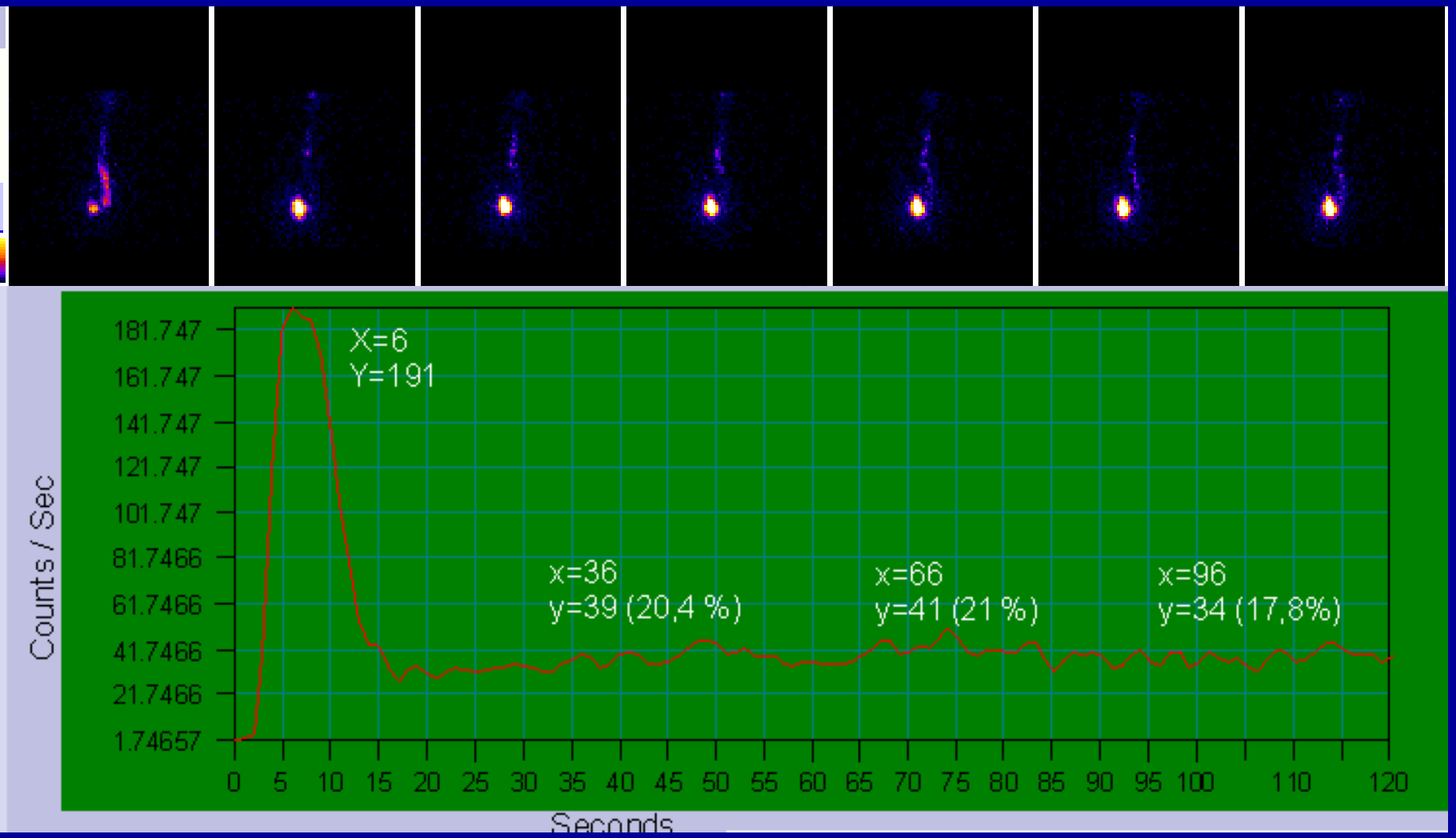


Figure 1. Oesophageal scintigraphy in a volunteer.

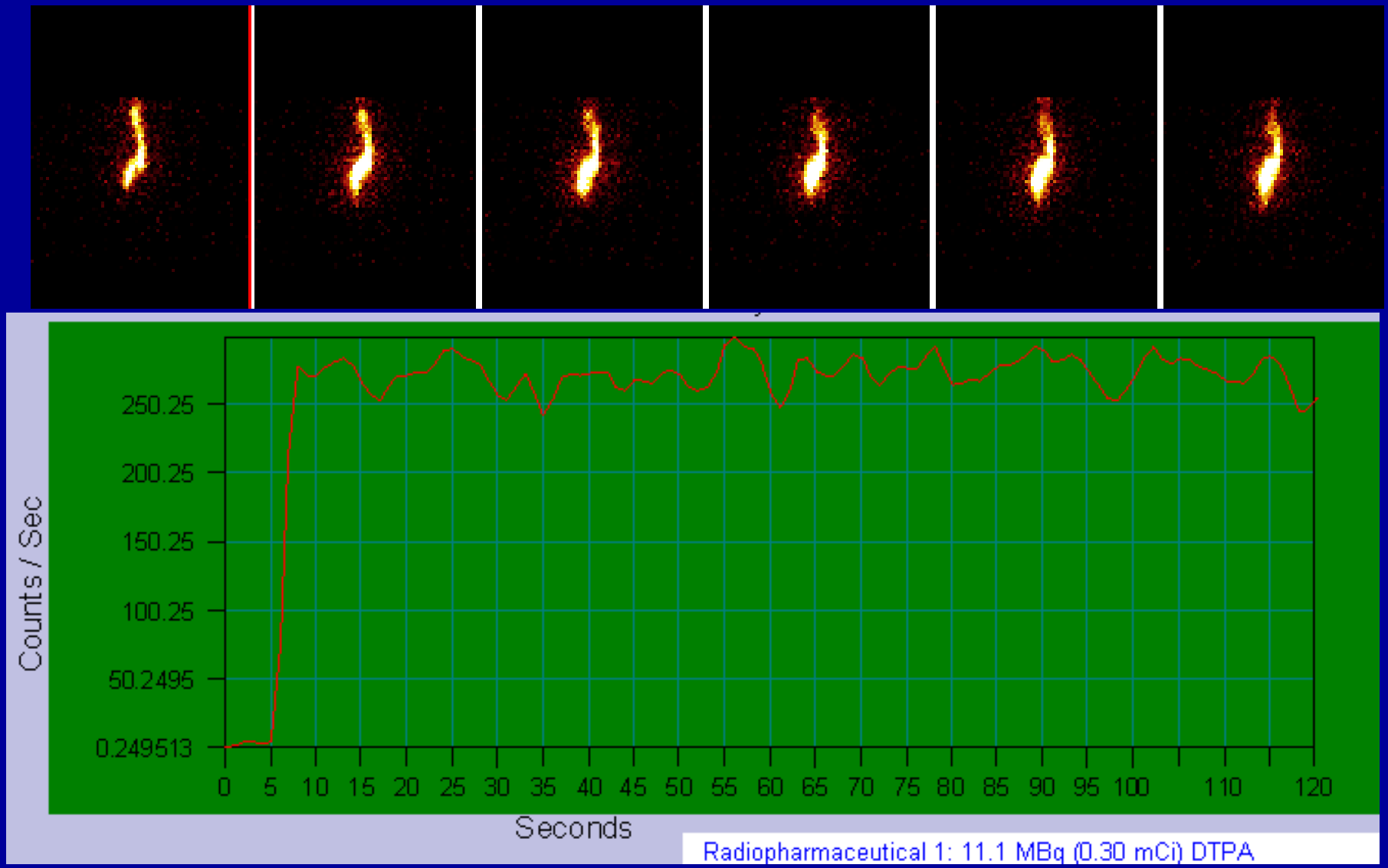


Figure 2. Complete retention of radioactive bolus in a patient with scleroderma.

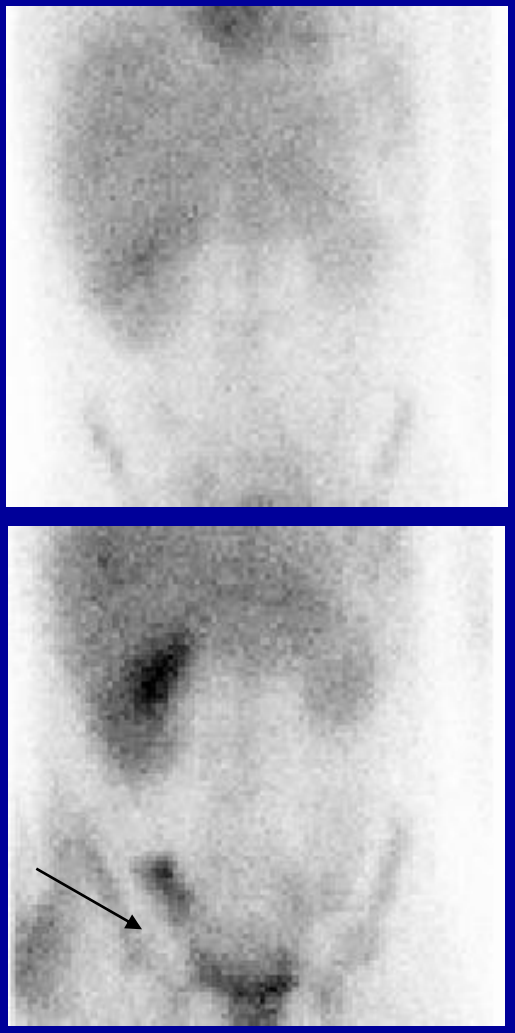
- **Gastric emptying rate:** scintigraphic tracking of Tc-99m labeled meal passing (liquid or solid) during 60 min, to evaluate the gastric motor function

- **Protein loss through the gastrointestinal tract** is seen in intestinal disorders with or without ulcerations (inlflammation, tumors…)

1. Cr-51 chloride aplied intravenosuly binds on blood proteins, so the percentage of the activity in the excreted feces (collected during 4-5 days) is counted
2. Tc-99m-HSA with sequential abdominal scintigraphy

Protein-losing enteropathy

- Accumulation of Tc-99m-albumin in intestine, 24 h post injection (i.v.)



THE END