Nuclear medicine diagnostics in the renal and gastrointestinal diseases

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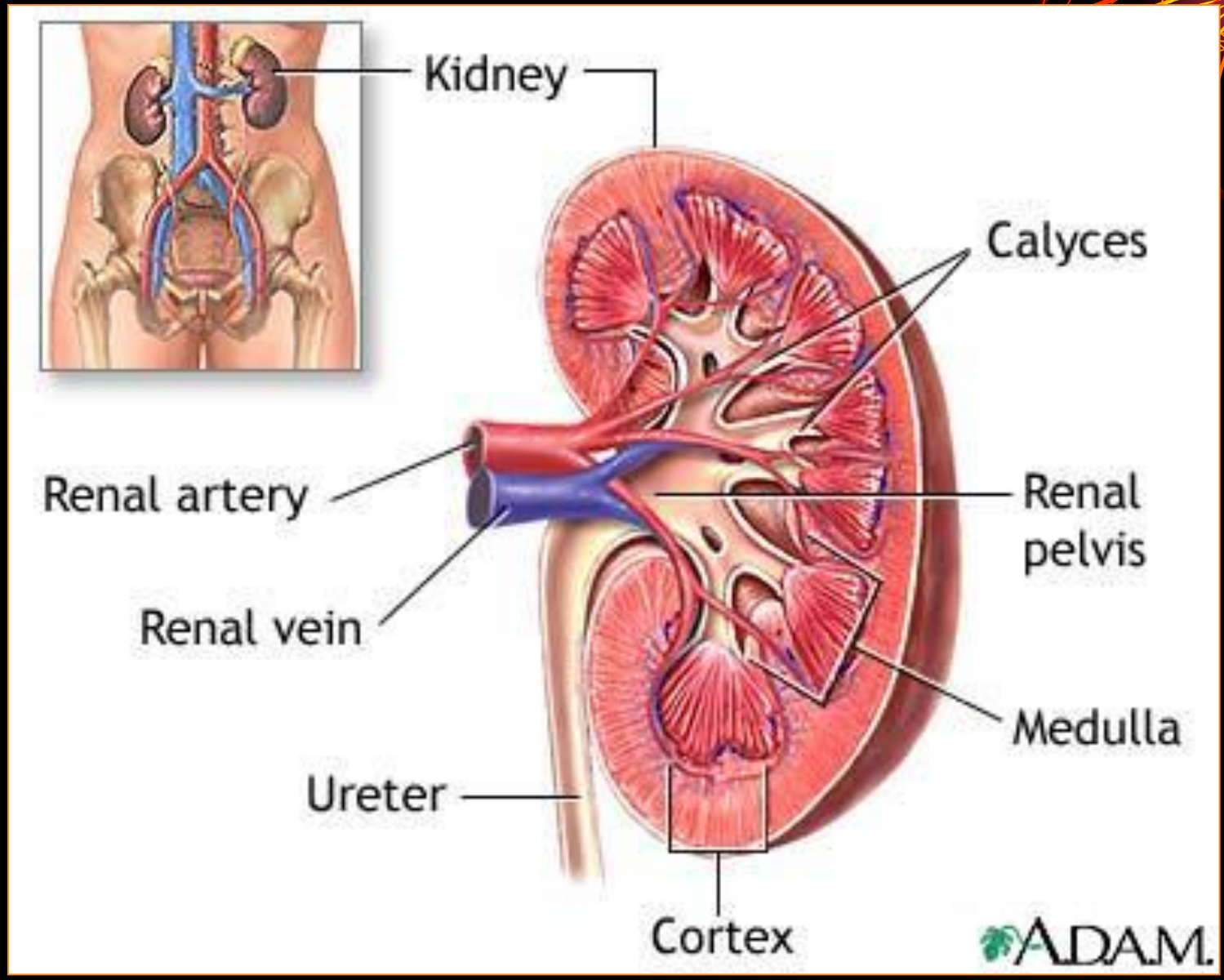
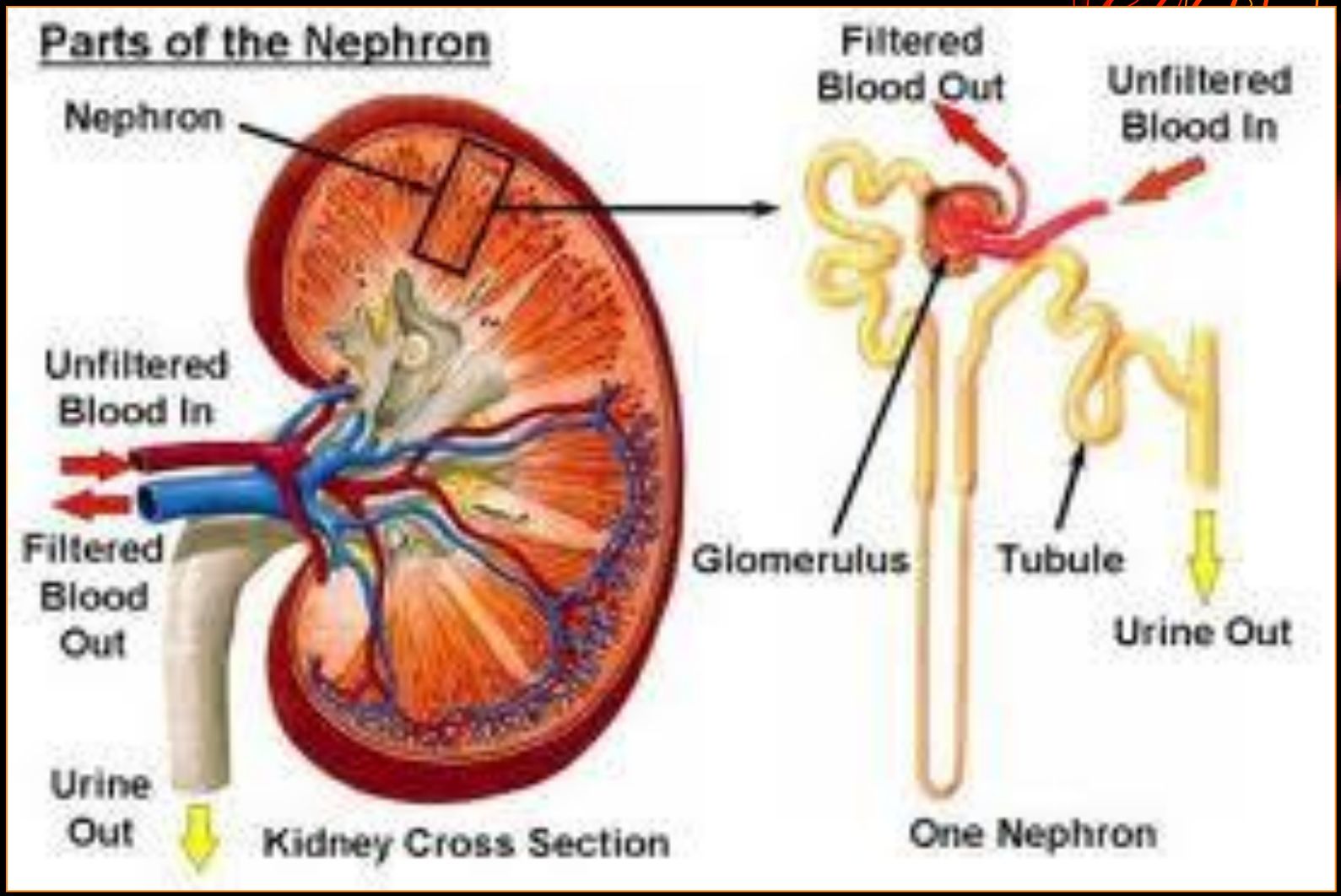
Examinations of the kidneys

Anatomy of the kidney I.



Anatomy of the kidney II.



The types of the examinations

Static examinations (scintigraphy):

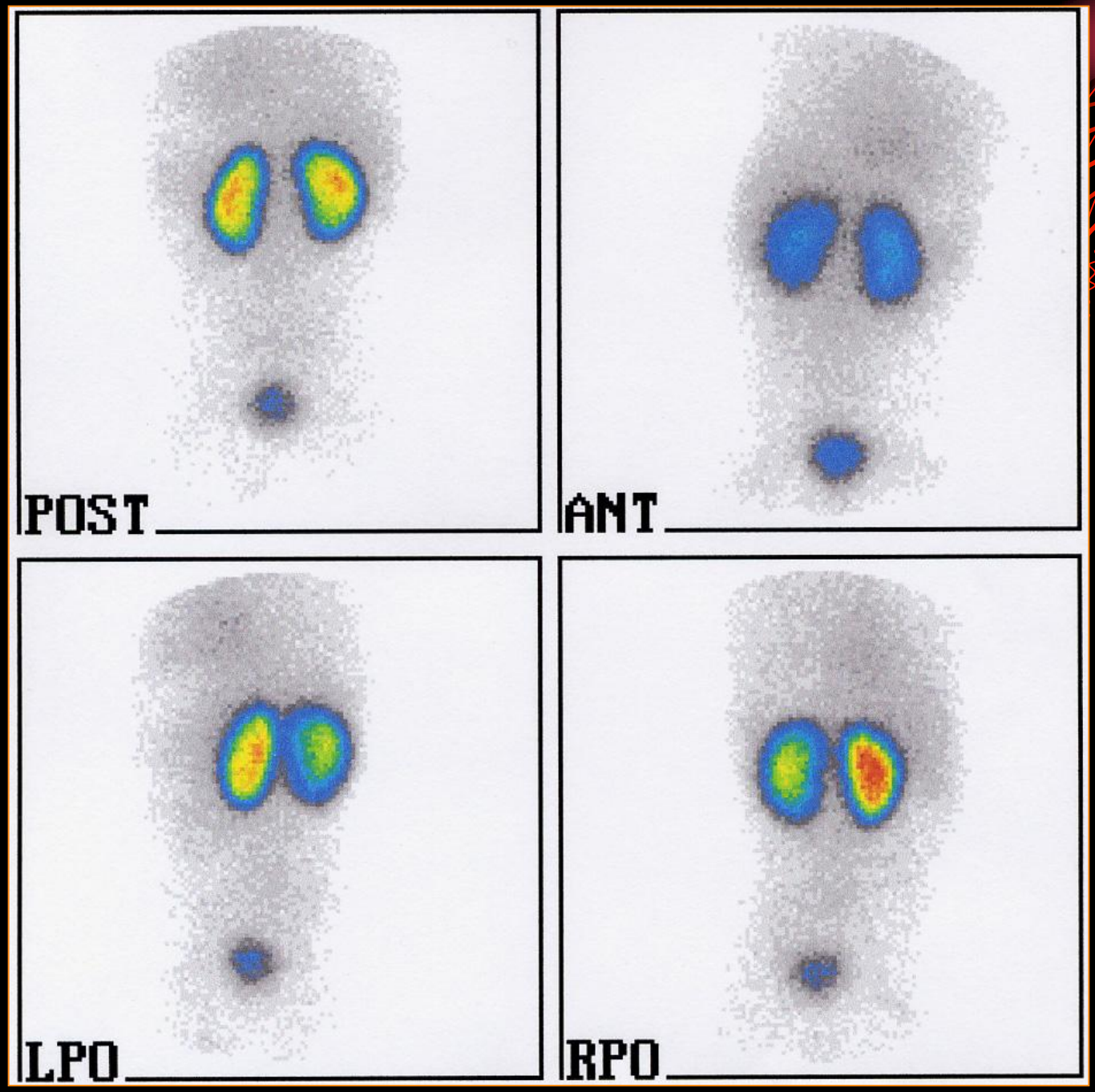
- an optimal time-period after the subject administration is delayed and imaging are made of the organ from different directions

Dynamic studies:

- a frame-serie is stored in the computer from the time of the isotope injection during an optimal time-period of the examined organ function

Renal scintigraphy I.

- **Radiofarmaceutical: 37-74 MBq 99mTc-DMSA (dimercaptosuccinic acid is enhanced in the proximal tubular cells)**
- **Acquisition time: 120 minutes after the injection**
- **Planar imaging from 4 different directions:**
  - **anterior, posterior**
  - **RPO (right posterior oblique)**
  - **LPO (left posterior oblique)**
- **Evaluation: - size, shape, pozition, homogenity**
  - **focal parenchymal defects (> 1.5 cm)**
  - **quantitative value of renal function**

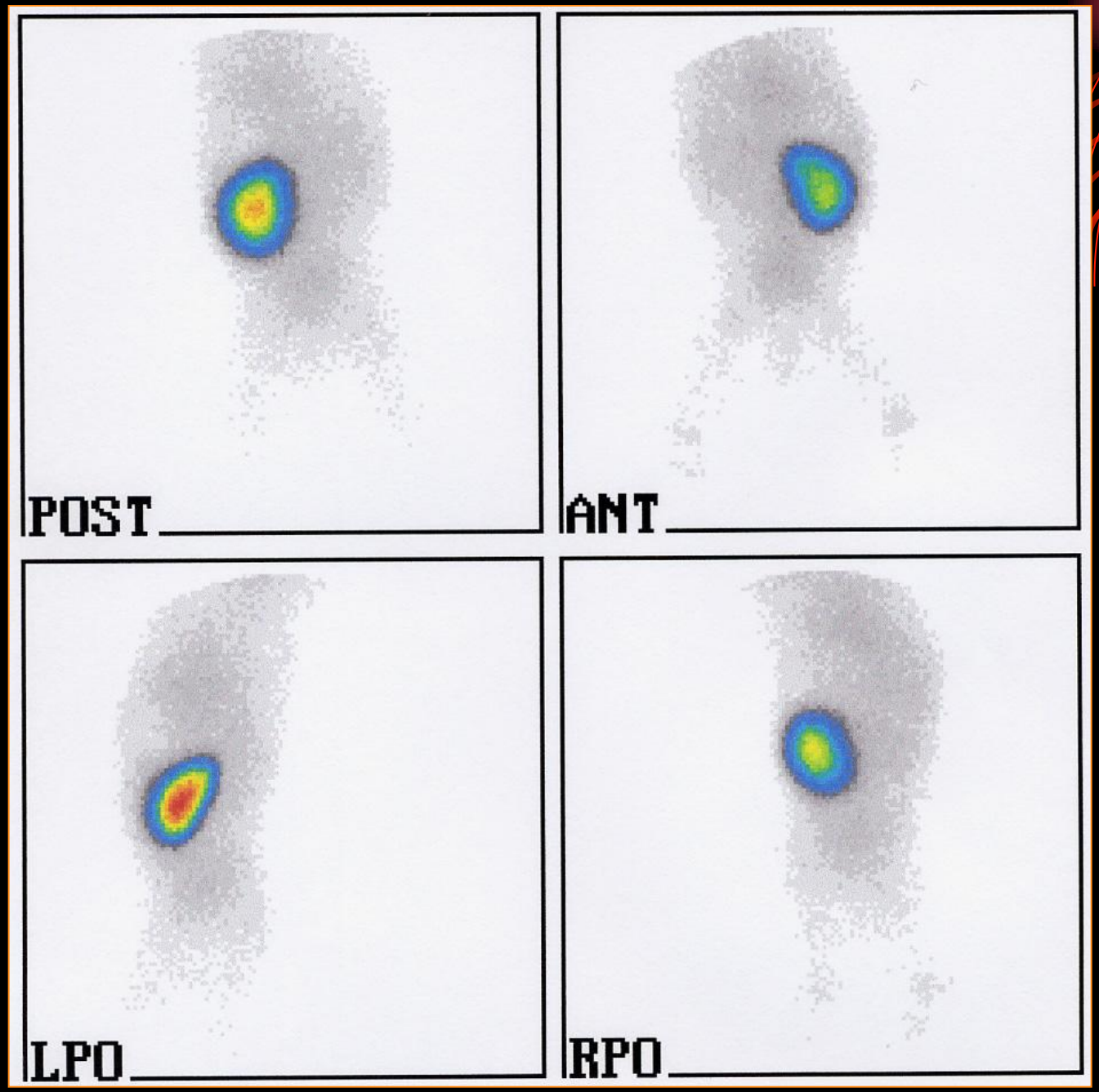


Normal renal scintigram

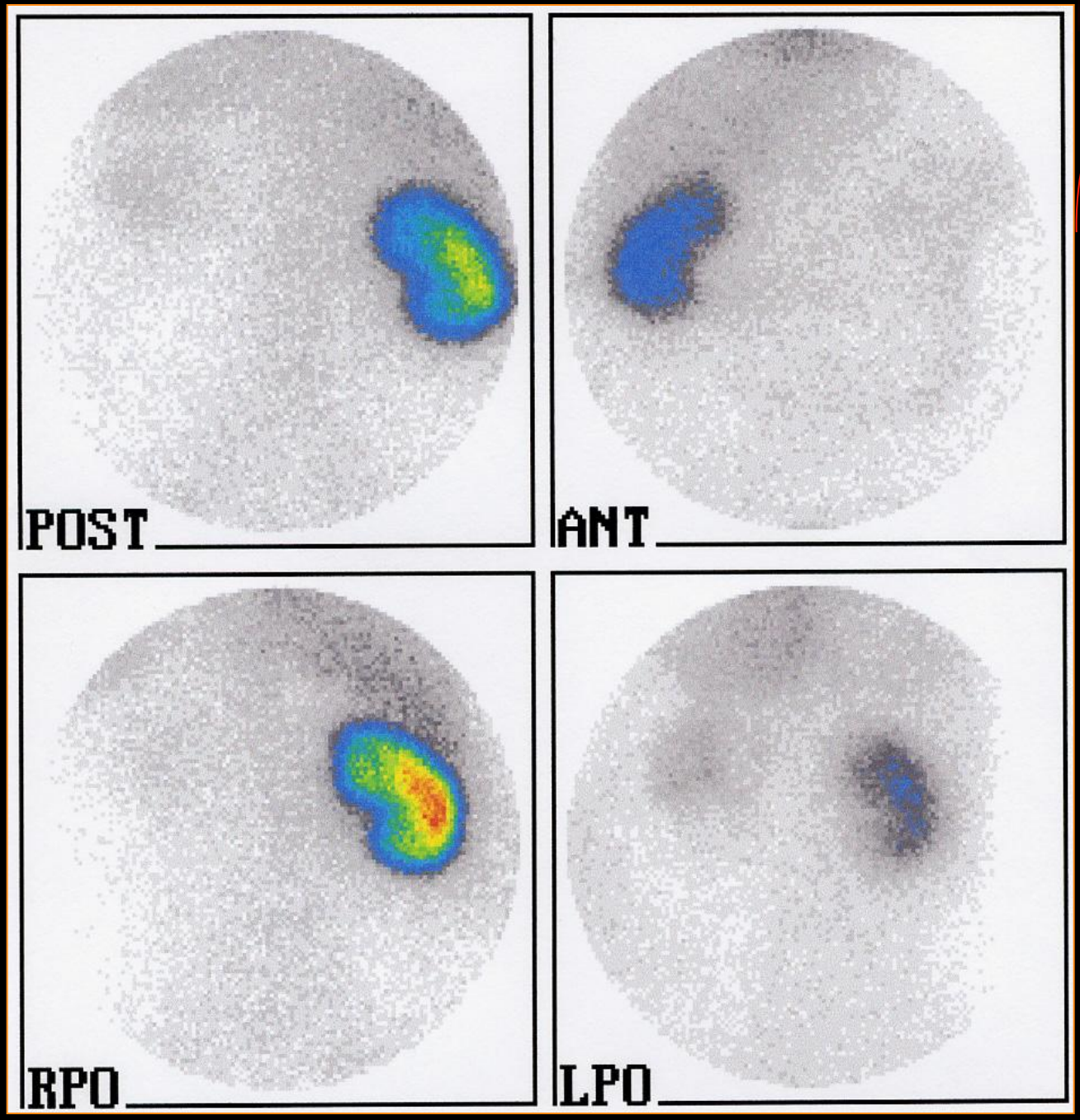
Renal scintigraphy II.

Indications:

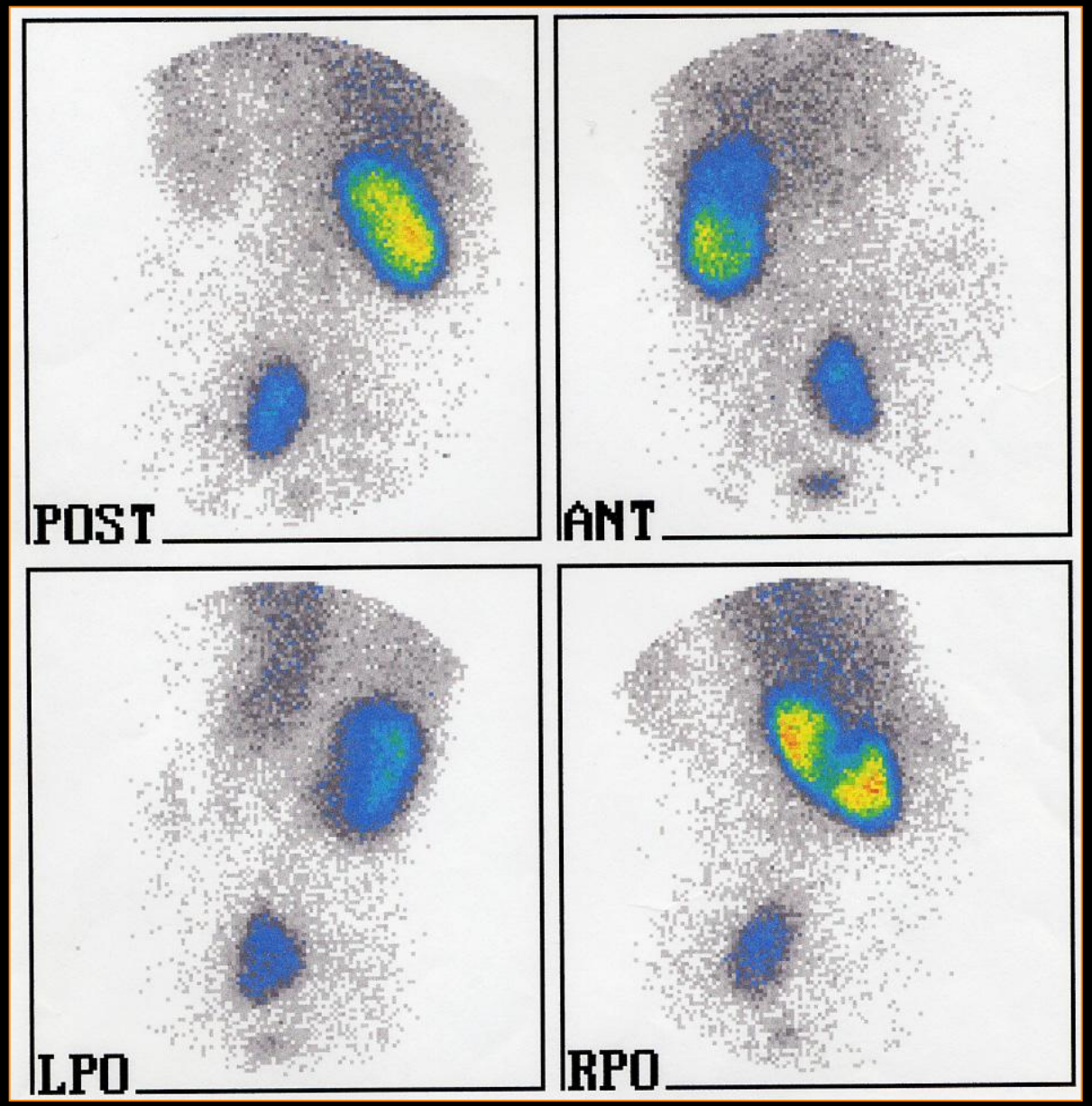
- *Determine relative (%) renal function of the left and right kidneys*
- **Pyelonephritis**
- **Renal ectopia**
- **Renal infarction**
- **Hypertension**
- **Horseshoe kidney**
- **Acute renal failure**
- **Multicystic dysplastic kidneys**
- **Renal trauma**
- **Tumors and metastases**



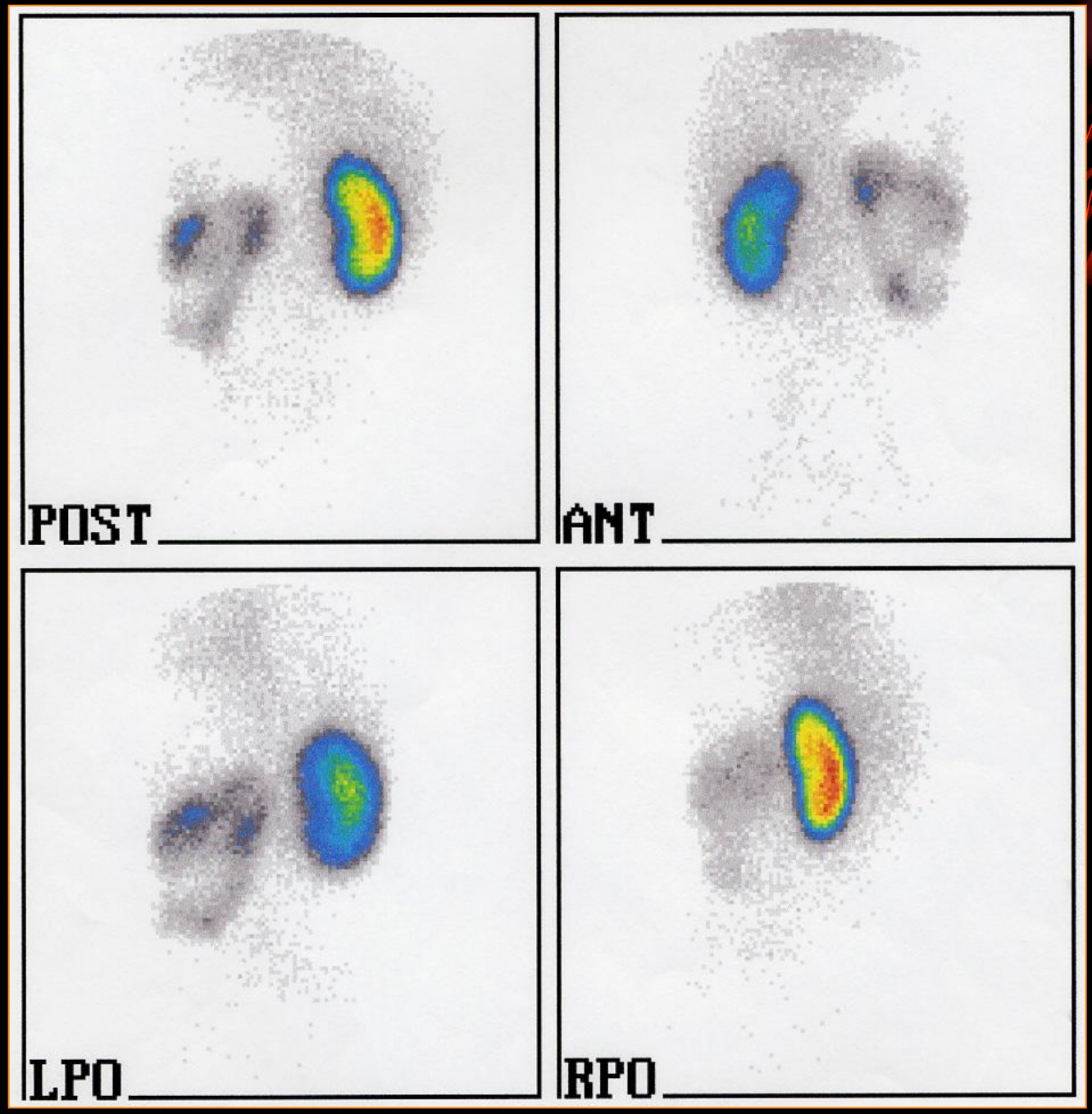
Enlarged solo kidney on the left side in a newborn (congenital)



Afunctioning kidney on the left side in adult (acquired)

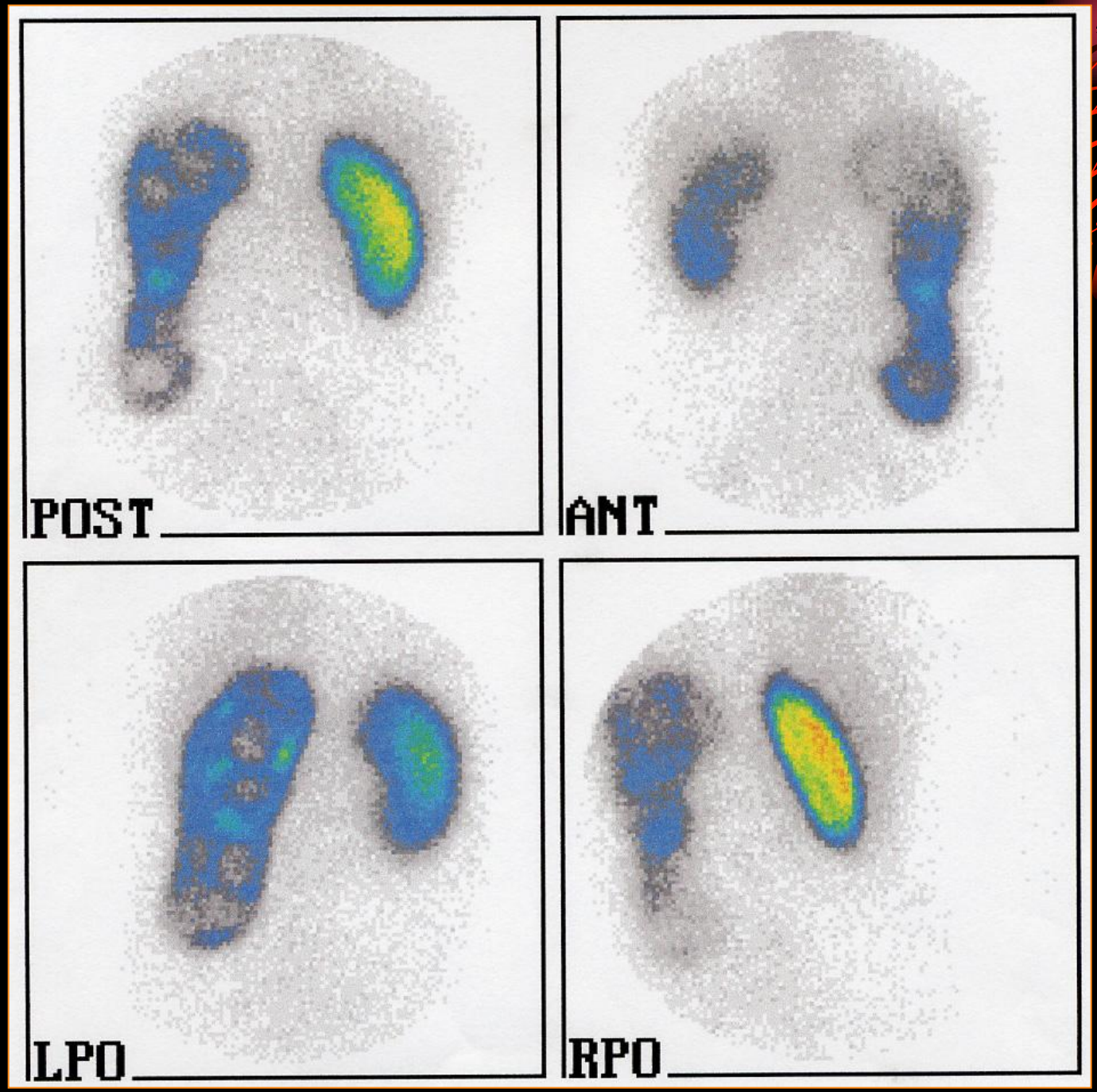


Left ptotic kidney with deteriorated function, focal parenchymal defect in the right kidney

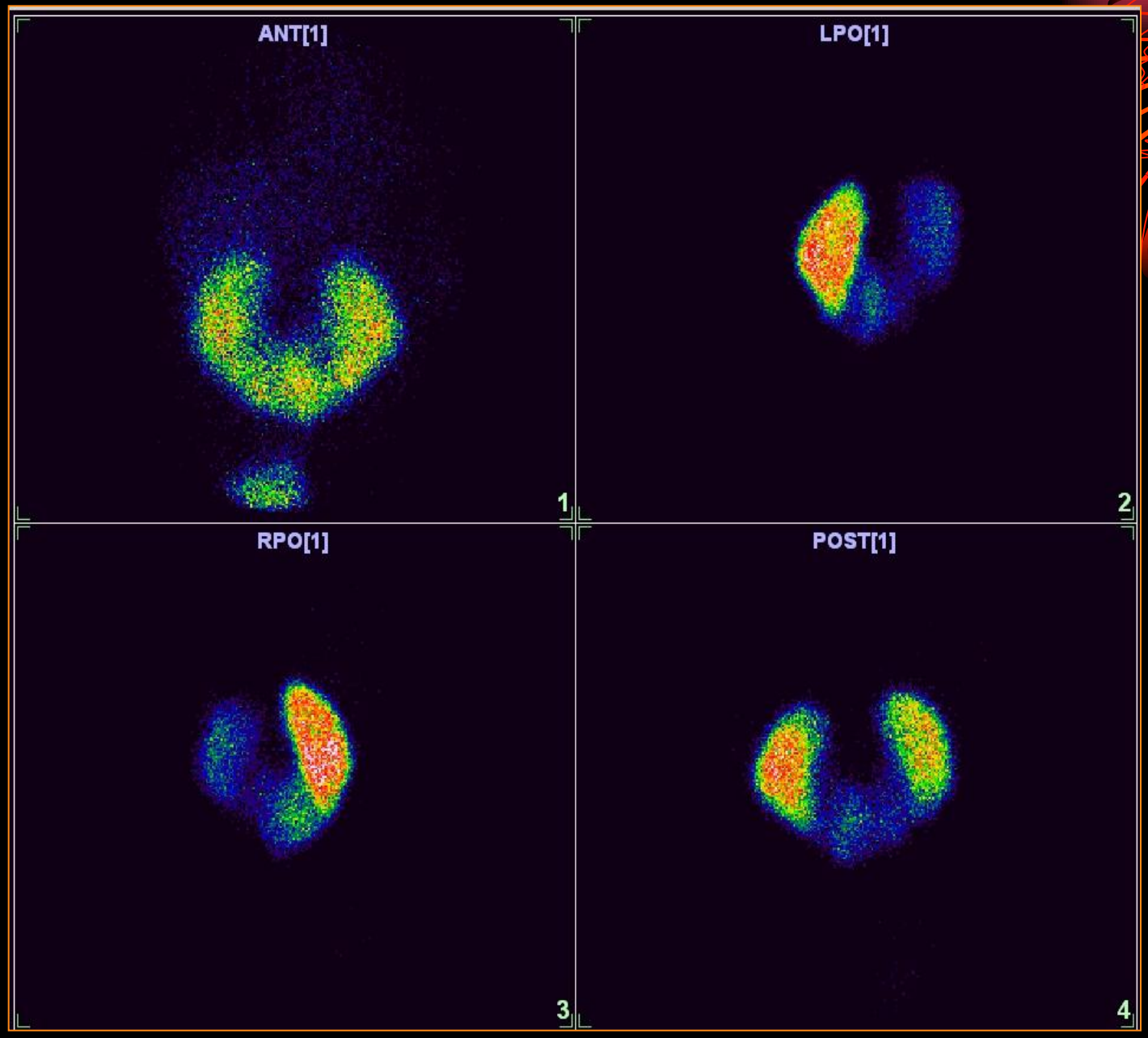


Hydro - nephrosis on the left side

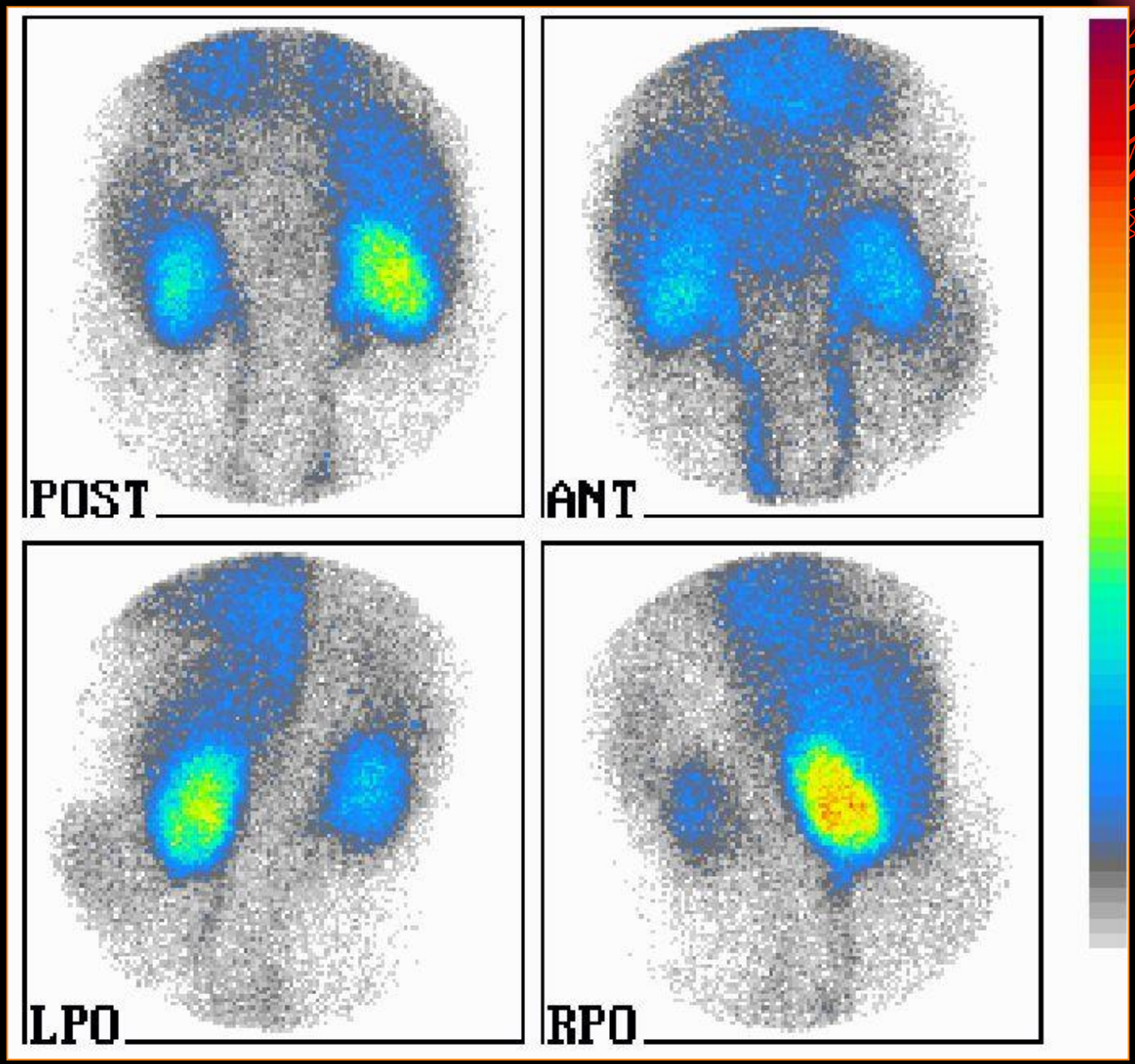
parenchymal failure



Multicystic disease in the left kidney

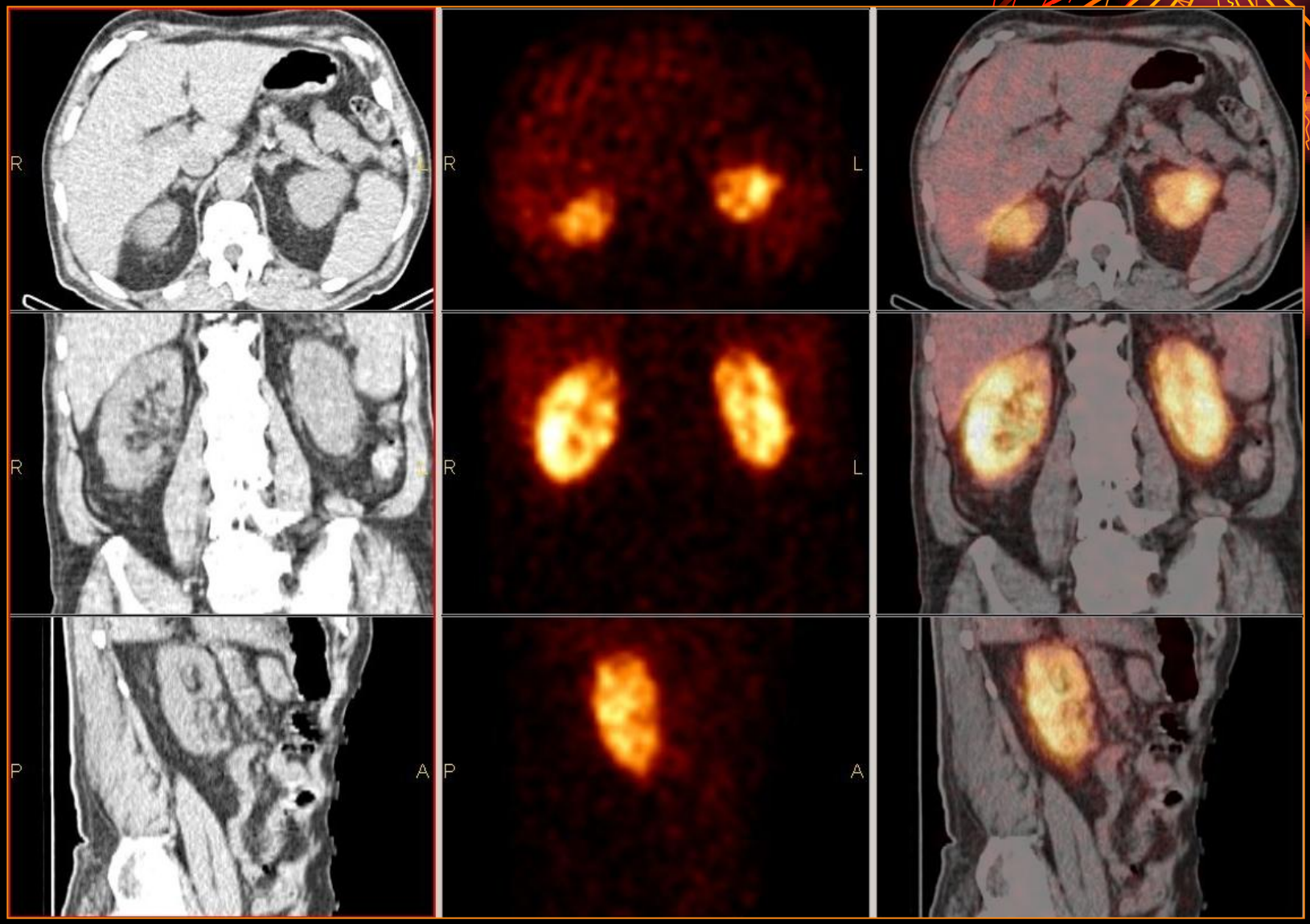


Horseshoe kidney

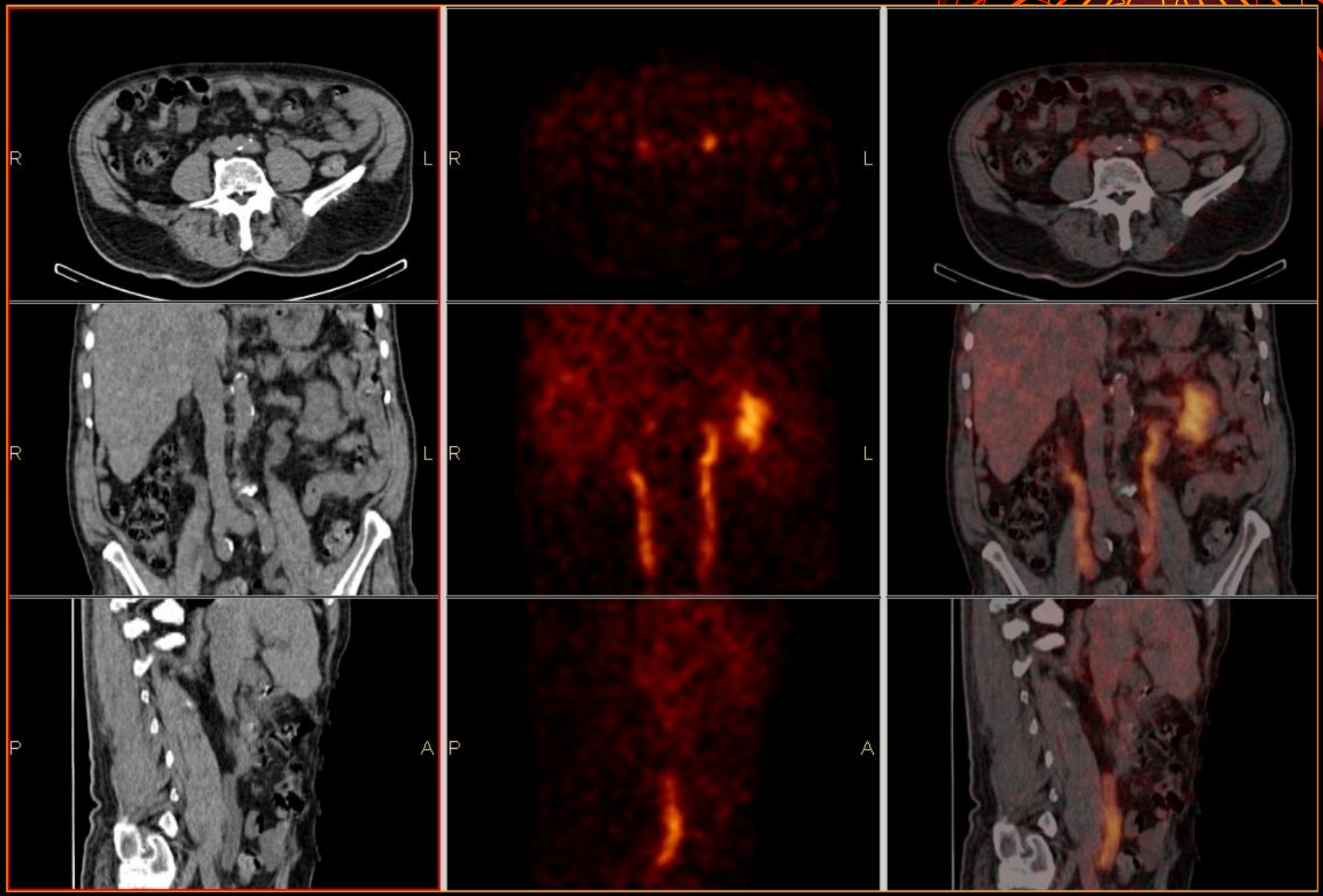


Bilateral deteriorated parenchymal function on the basis of vesicoureteral stenosis

Parenchymal focal defects by SPECT/CT



Megaureters by SPECT/CT



Renal scintigraphy III.

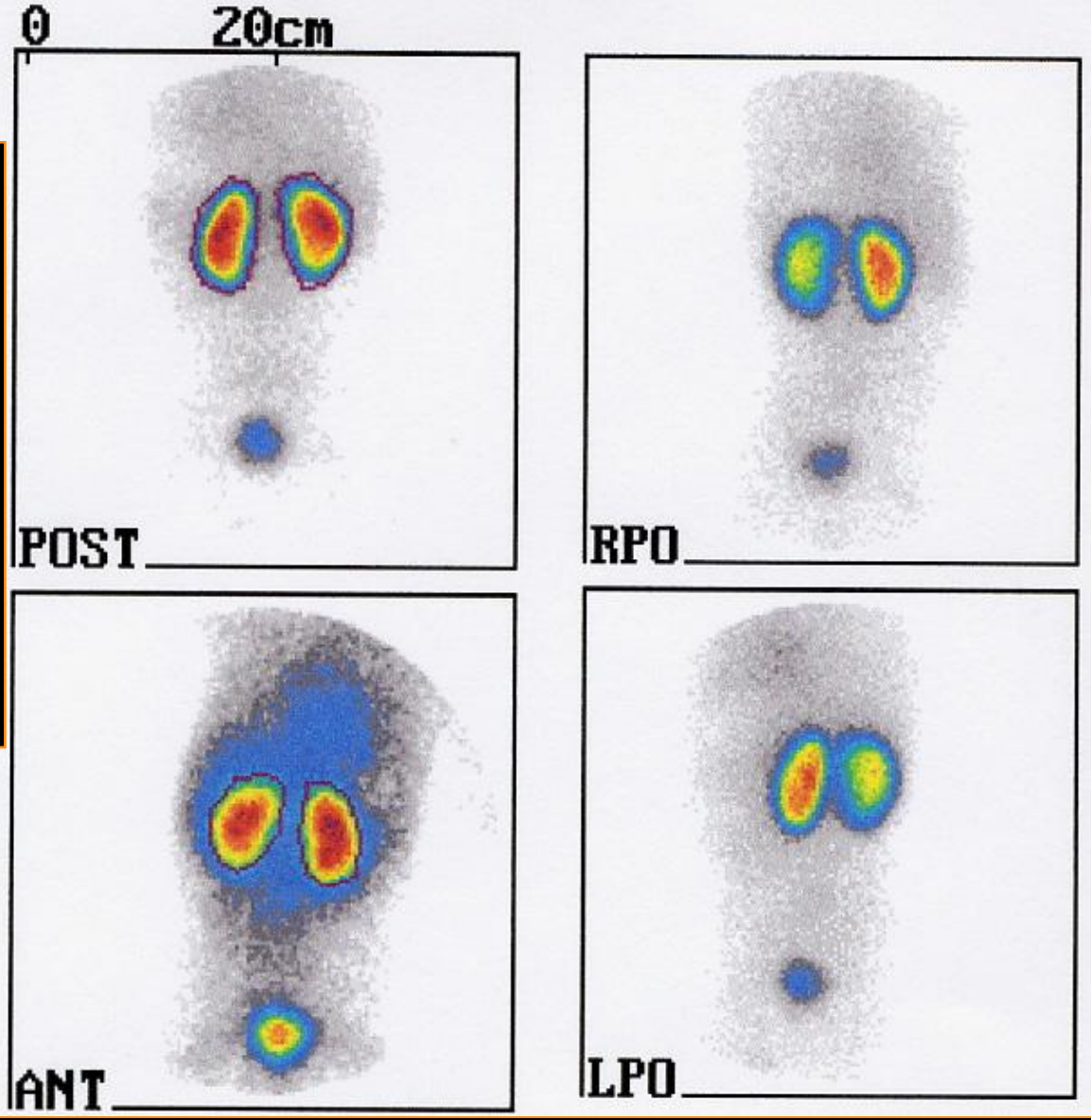
Determine relative renal function in the left and right kidney from the DMSA imaging:

- **Posterior view: ROI of the left and the right kidney**
- **Anterior view: ROI of the left and the right kidney again**
- **Calculating of the parameters by computer**
- **It is very important in children with congenital kidney failures**

Normal ratio

Relative ratio of the renal function:

Posterior view:
left kidney: 48.4%
right kidney: 51.6%
Anterior view:
left kidney: 50.7%
right kidney: 49.3%
Average:
left kidney: 49.5%
right kidney: 50.5%

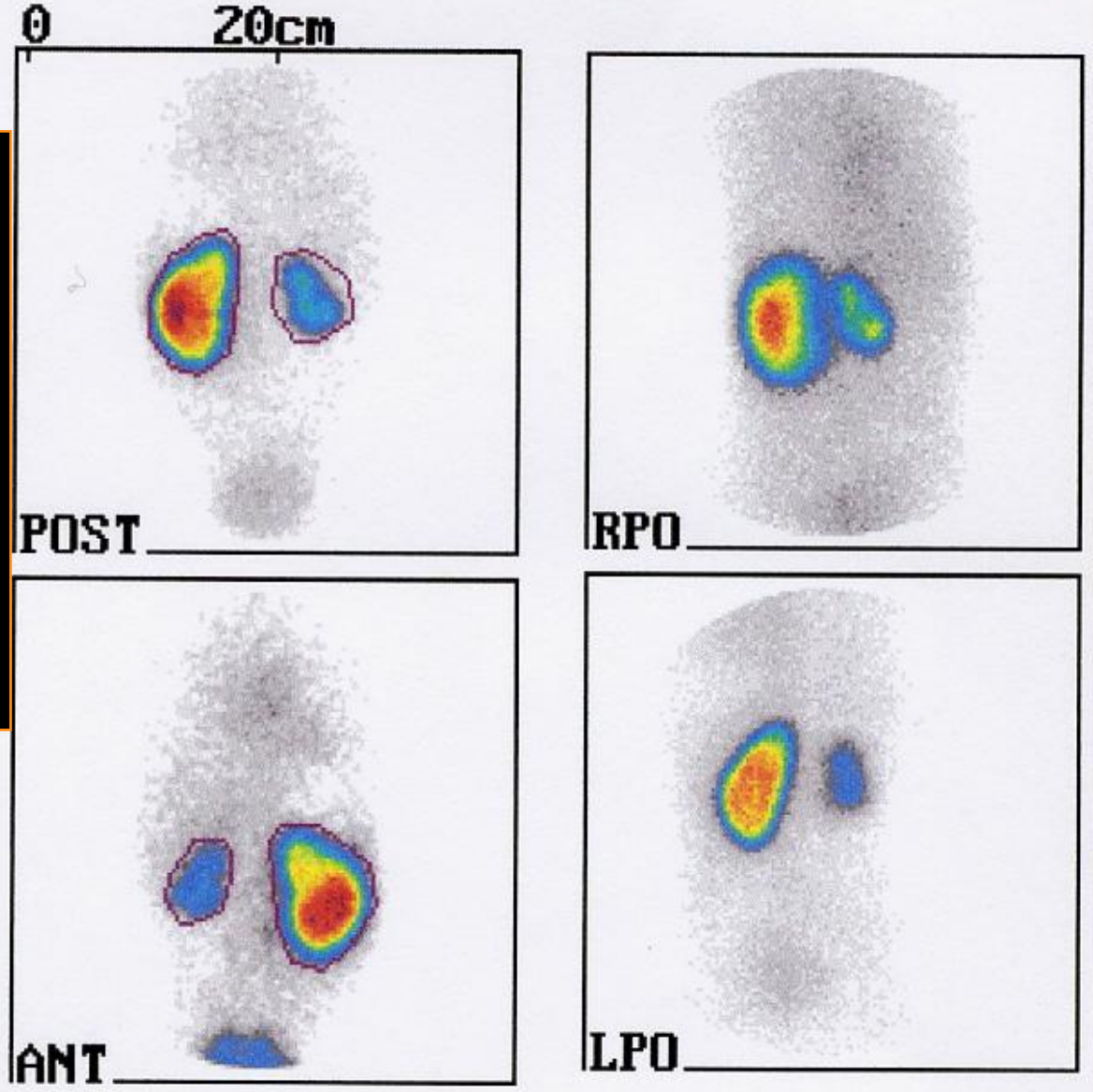


Ratio of reduced kidney function on the right side

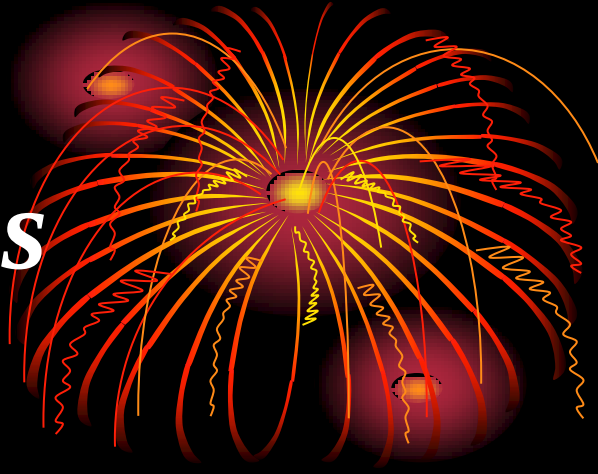
Relative ratio of the renal function:

Posterior view:
left kidney: 83.8%
right kidney: 16.2%
Anterior view:
left kidney: 88.5%
right kidney: 11.5%
Average:
left kidney: 86.3%
right kidney: 13.7%

Operation is absolutly indicated under 10%!



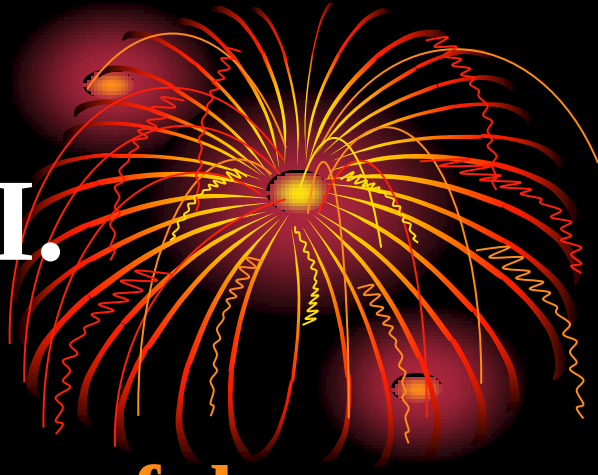
Dynamic studies



- **Follow up the physiological or patho-physiological function of an organ or an organ system by radioactive subjects**

- **Gamma-camera-computer system**
- **ROI (region of interest) technique**
- **Time-activity curves, T maximum, T 1/2**

Camera-renography I.

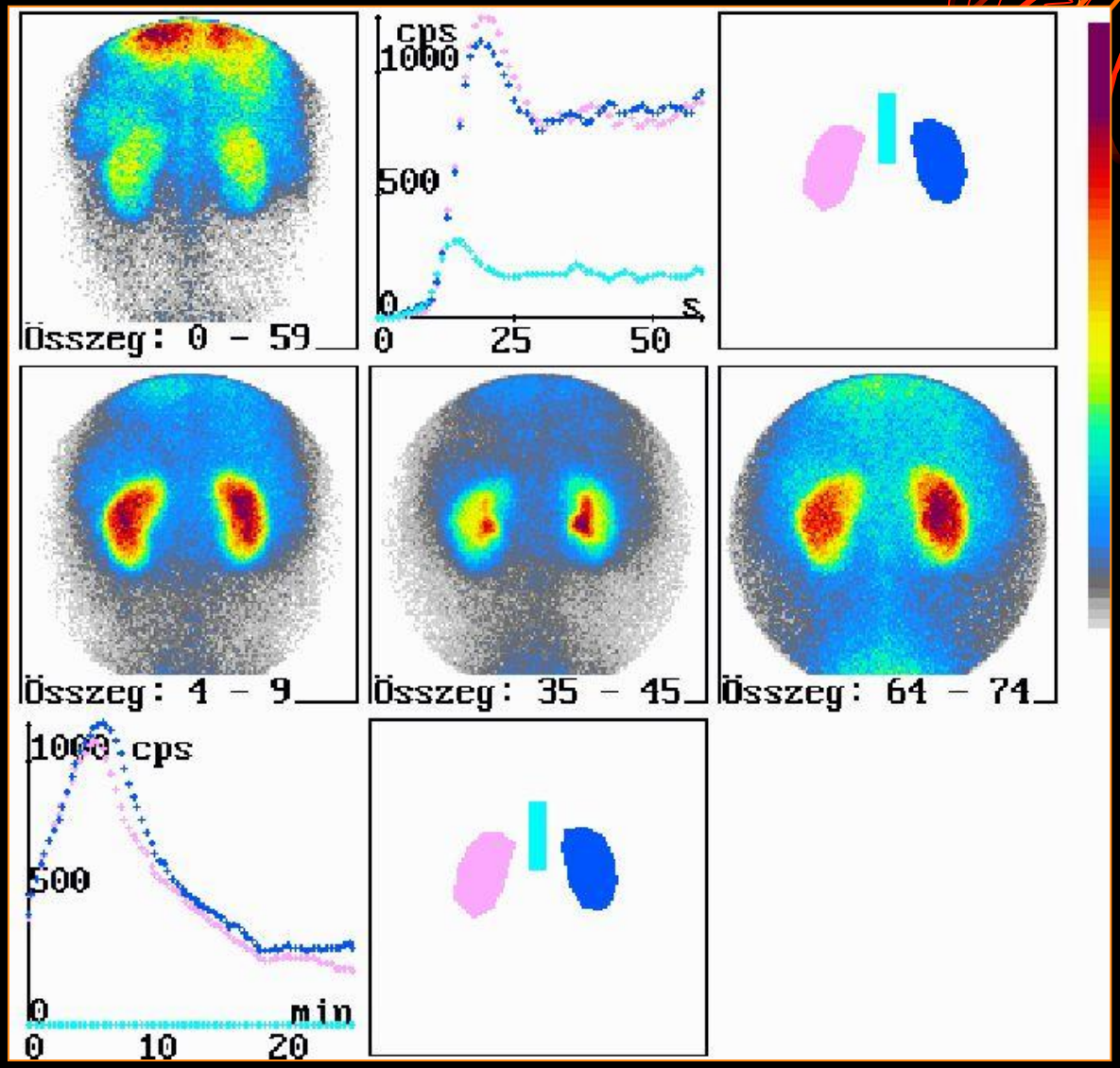


- Glomerular or tubular function of the kidneys are investigated (370 MBq 99mTc-DTPA, 99mTc-EC, 99mTc-MAG3)
- Time-activity curve = renogram
  - Phase I. = perfusion
  - Phase II. = filtration or secretion function
  - Phase III. = excretion function

Normal renal function

Perfusion

Renography



Camera-renography II.

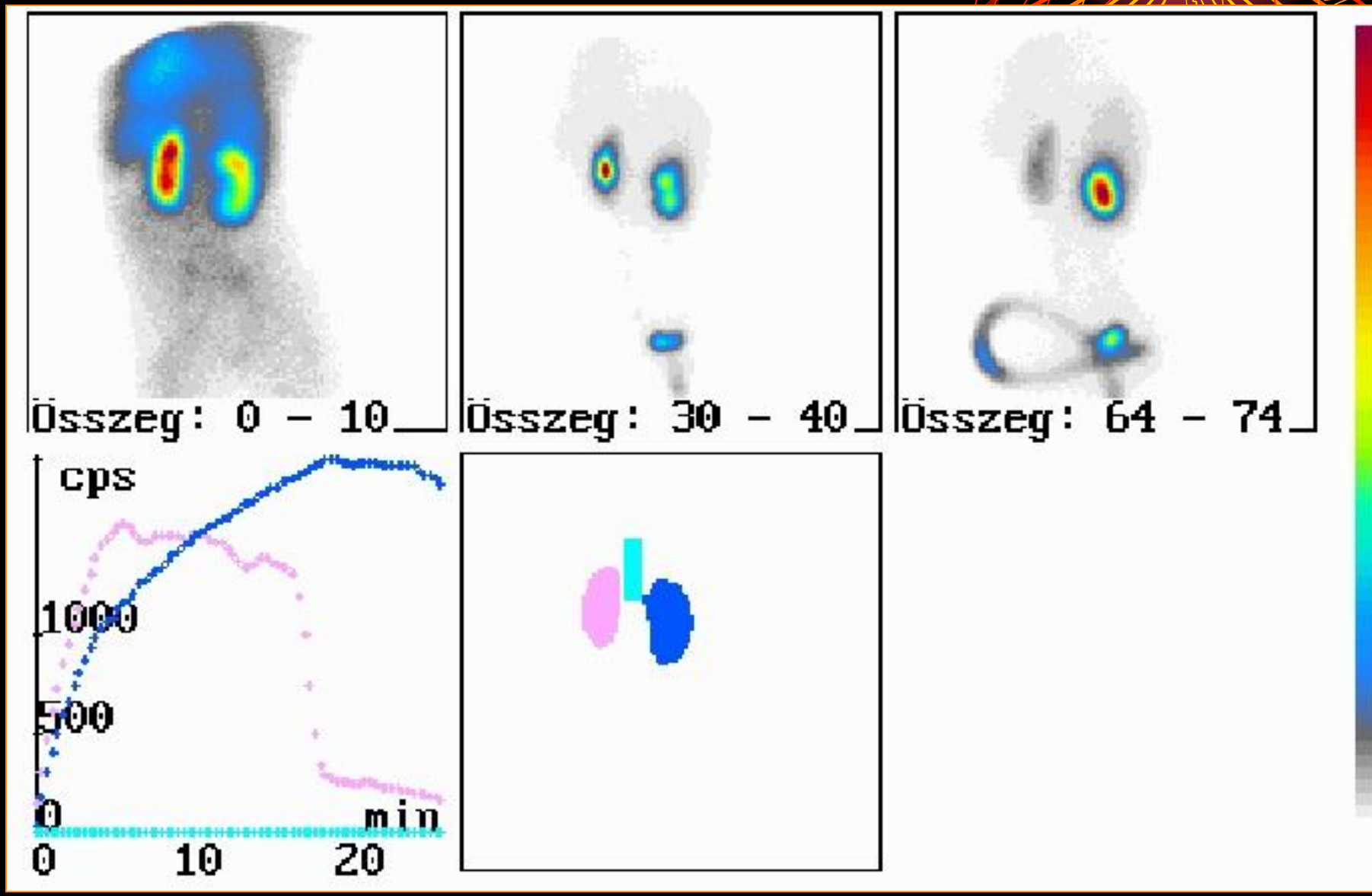
Indications:

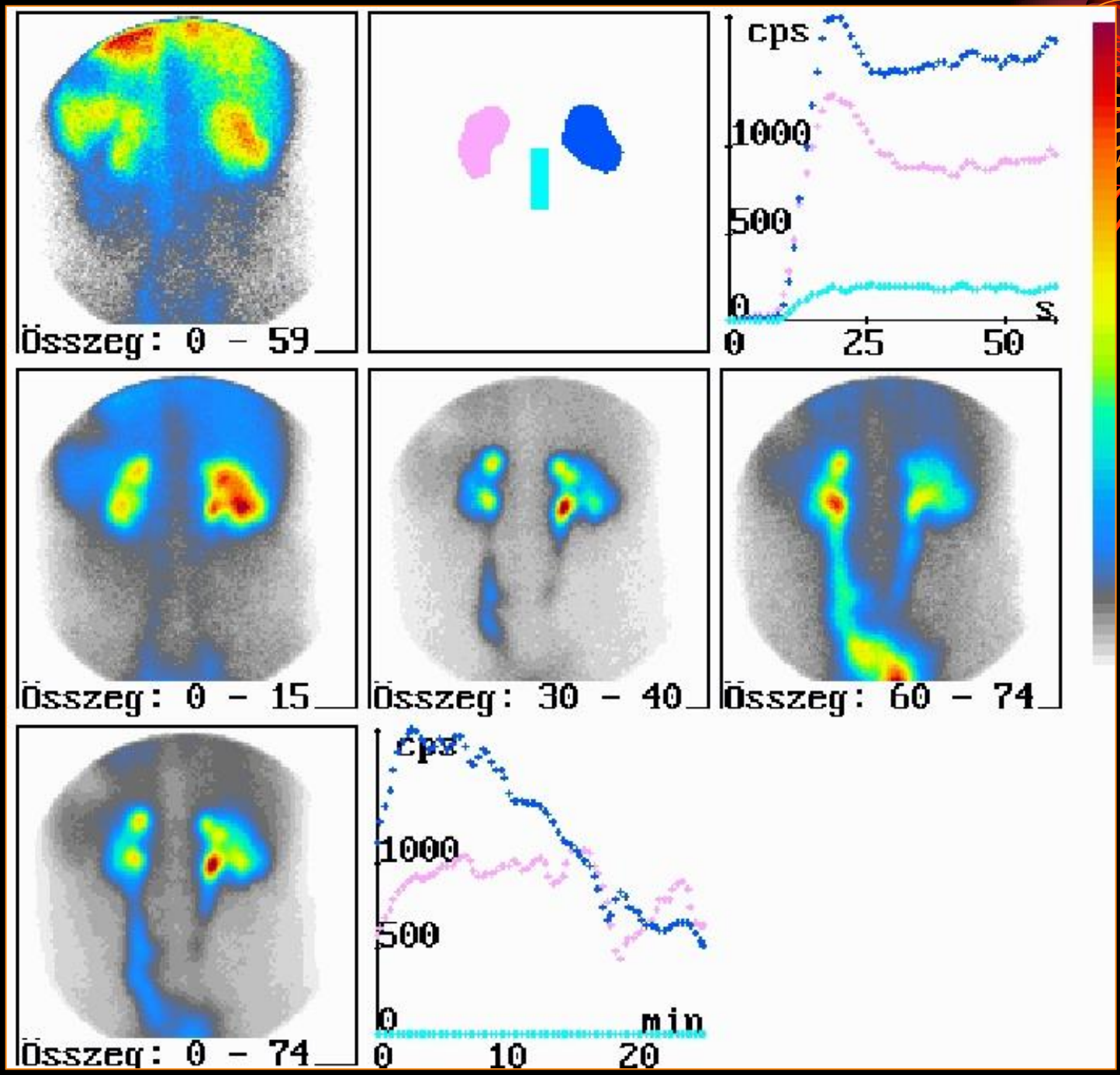
- *Functional or organic obstructions*
- *Hypertension – renal perfusion*
- **One-side kidney diseases (nephrolithiasis, pyelonephritis)**
- **Clearence-studies (GFR)**
- **Vesico-ureteral reflux**
- **Kidney transplantation**

Camera-renography III.

- **Accumulation curve = increased activity of the kidney is found during the examination time period**
- **Obstruction of the renal cavity:**
  - **organic - no excretion after Furosemid**
  - **functional - excretion is found after Furosemid**

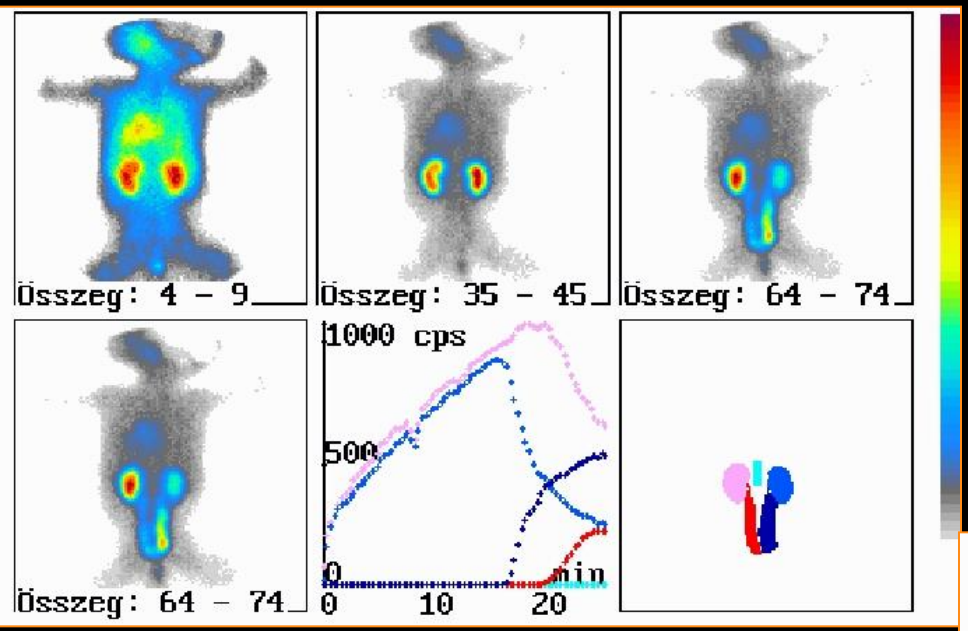
Pyeloureteral stenosis: functional one on the left side, organic one on the right side



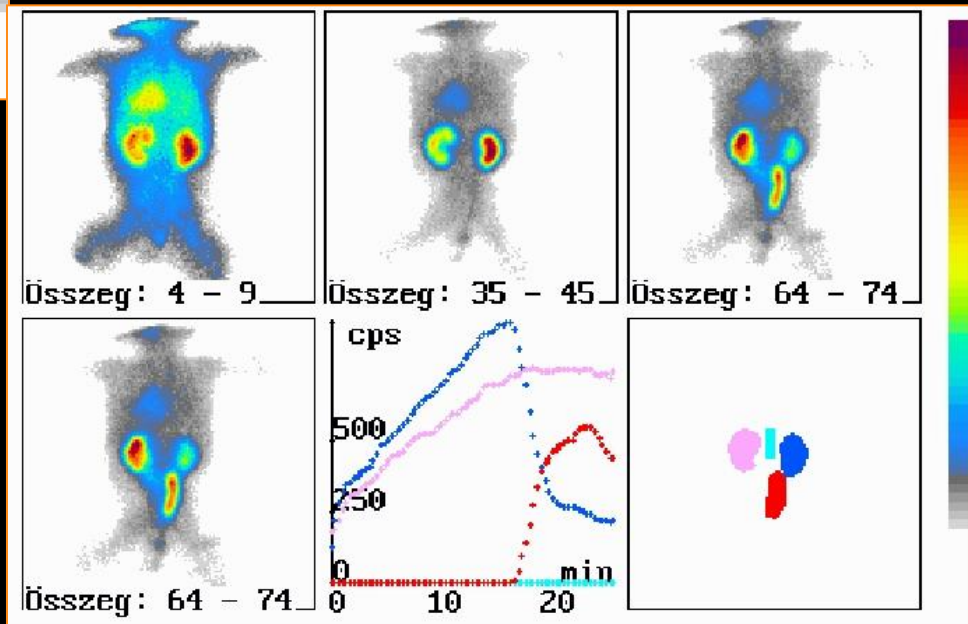


Bilateral vesico-ureteral stenosis

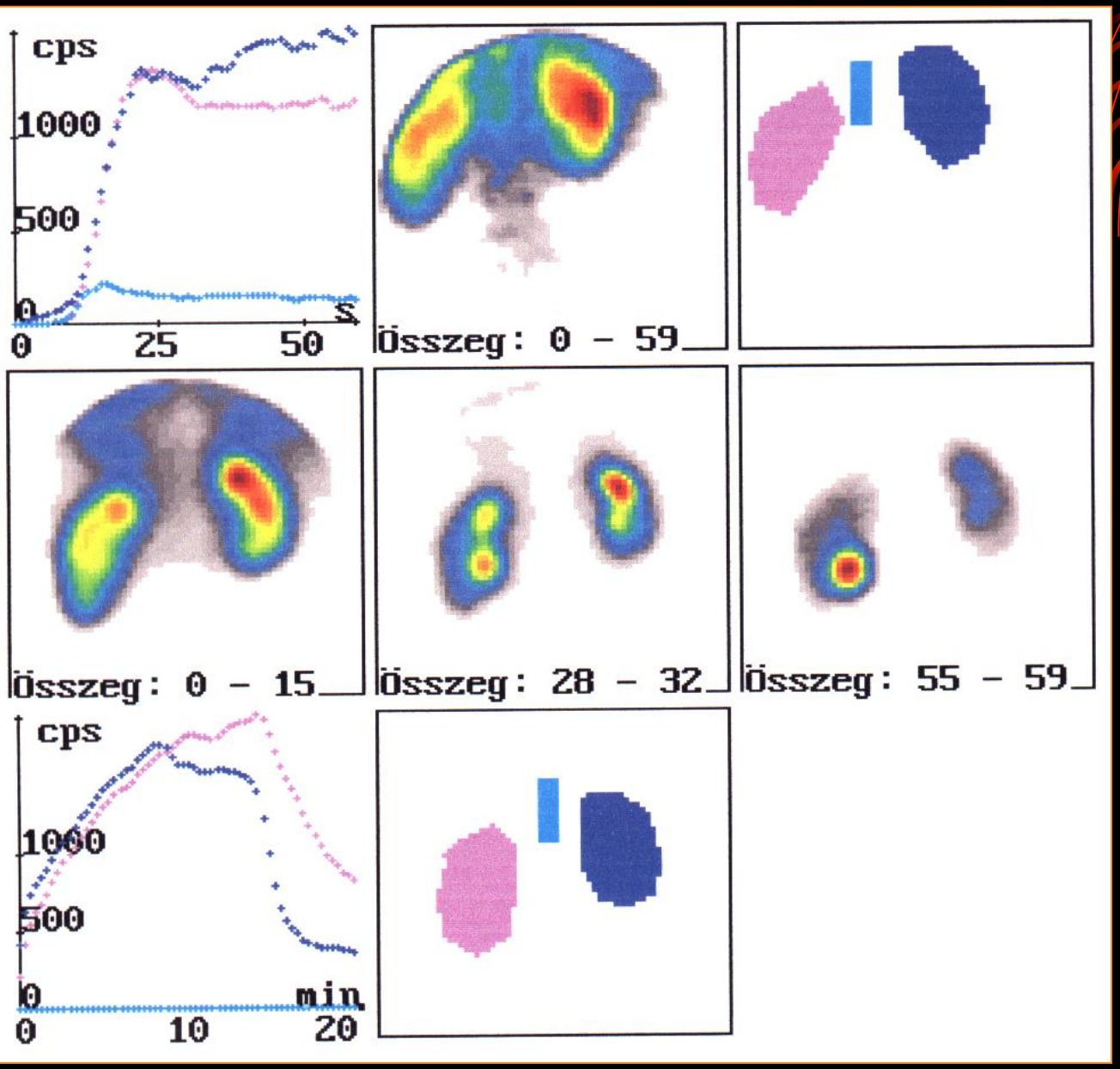
Congenital stenosis in twins



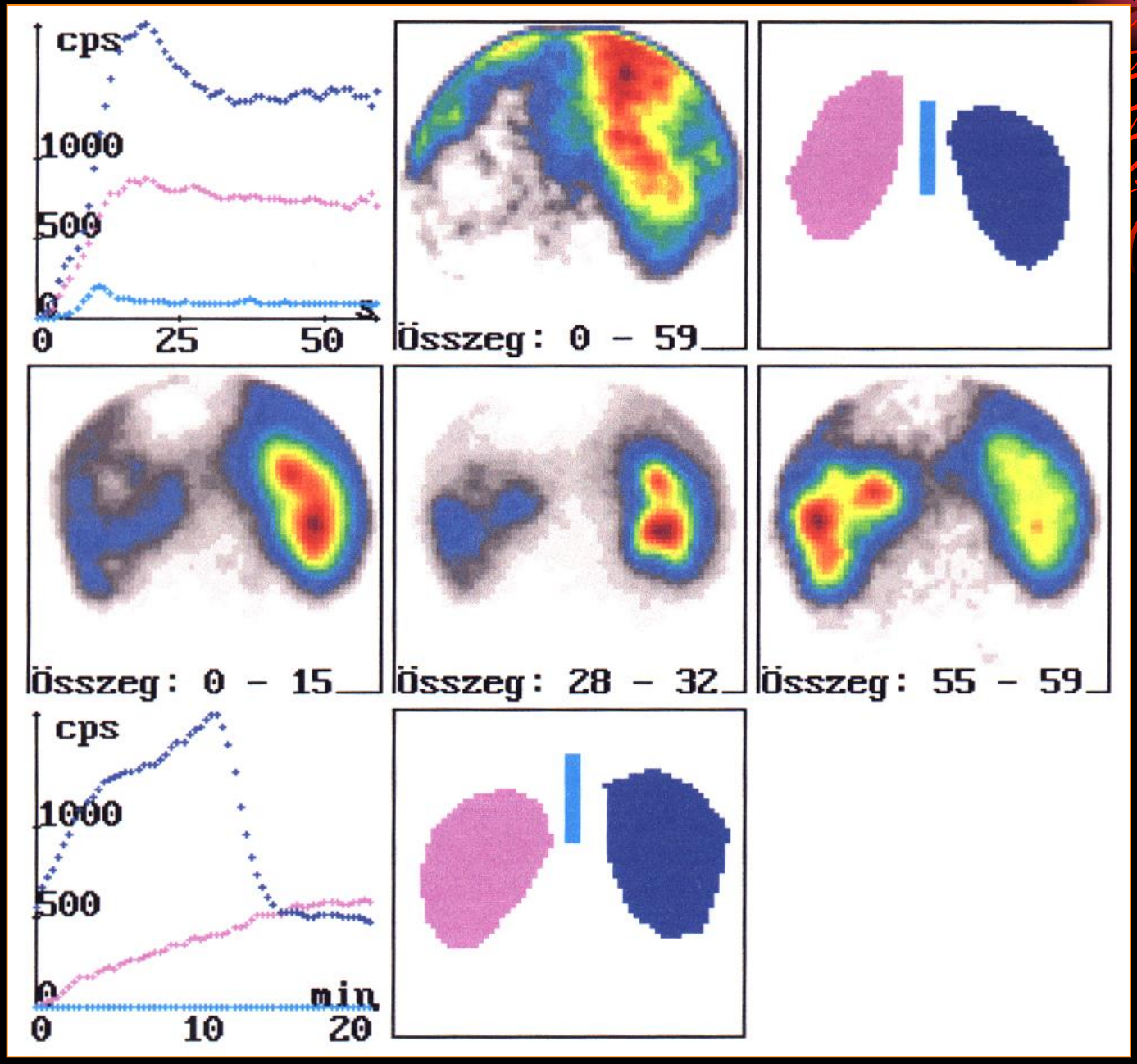
Organic pyeloueretal one on the left side, functional pyeloueretal and organic vesicoureteral ones on the right side.



Bilateral functional pyeloureteral and organic vesicoureteral ones.



Deteriorated function, excretion only after Furosemid

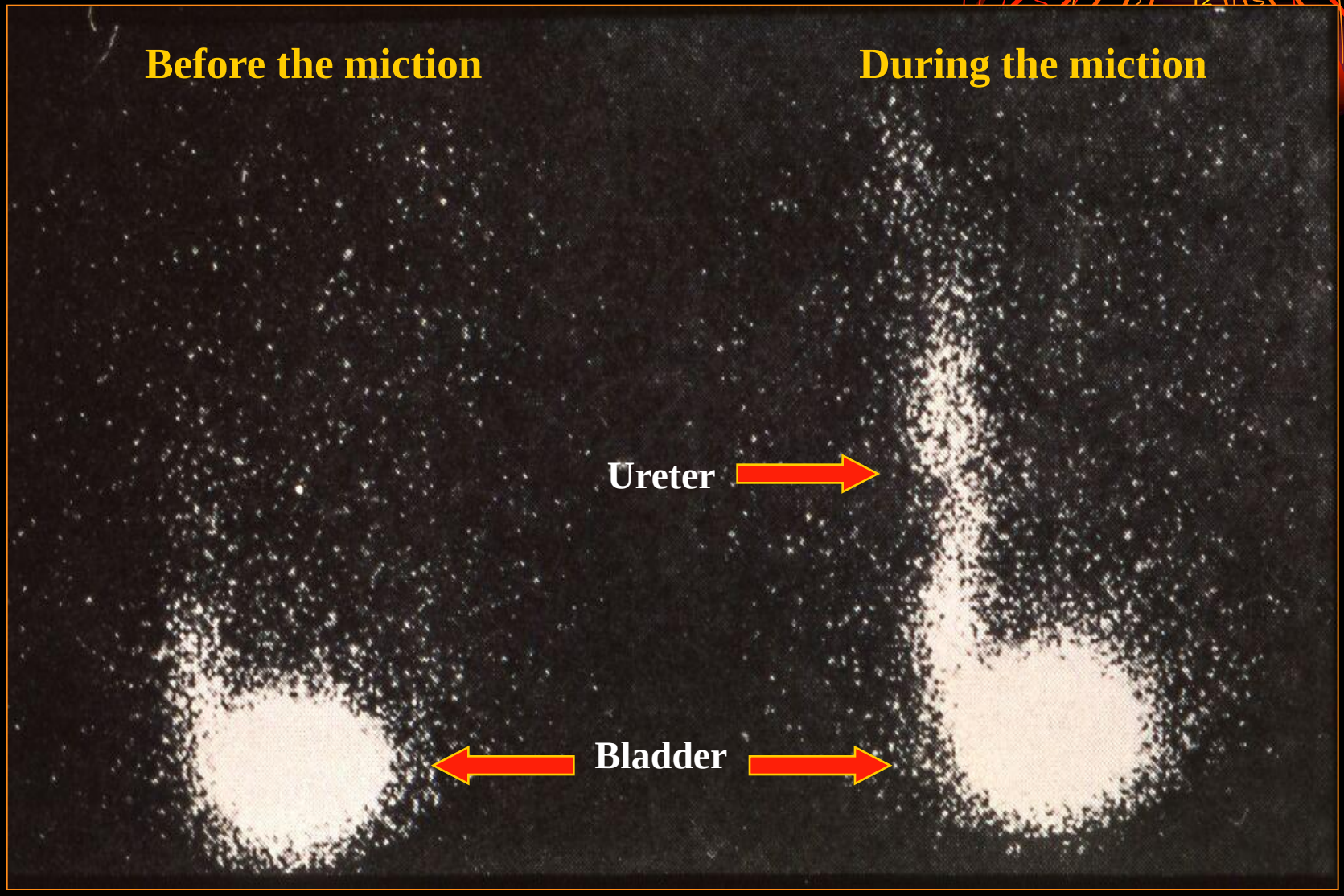


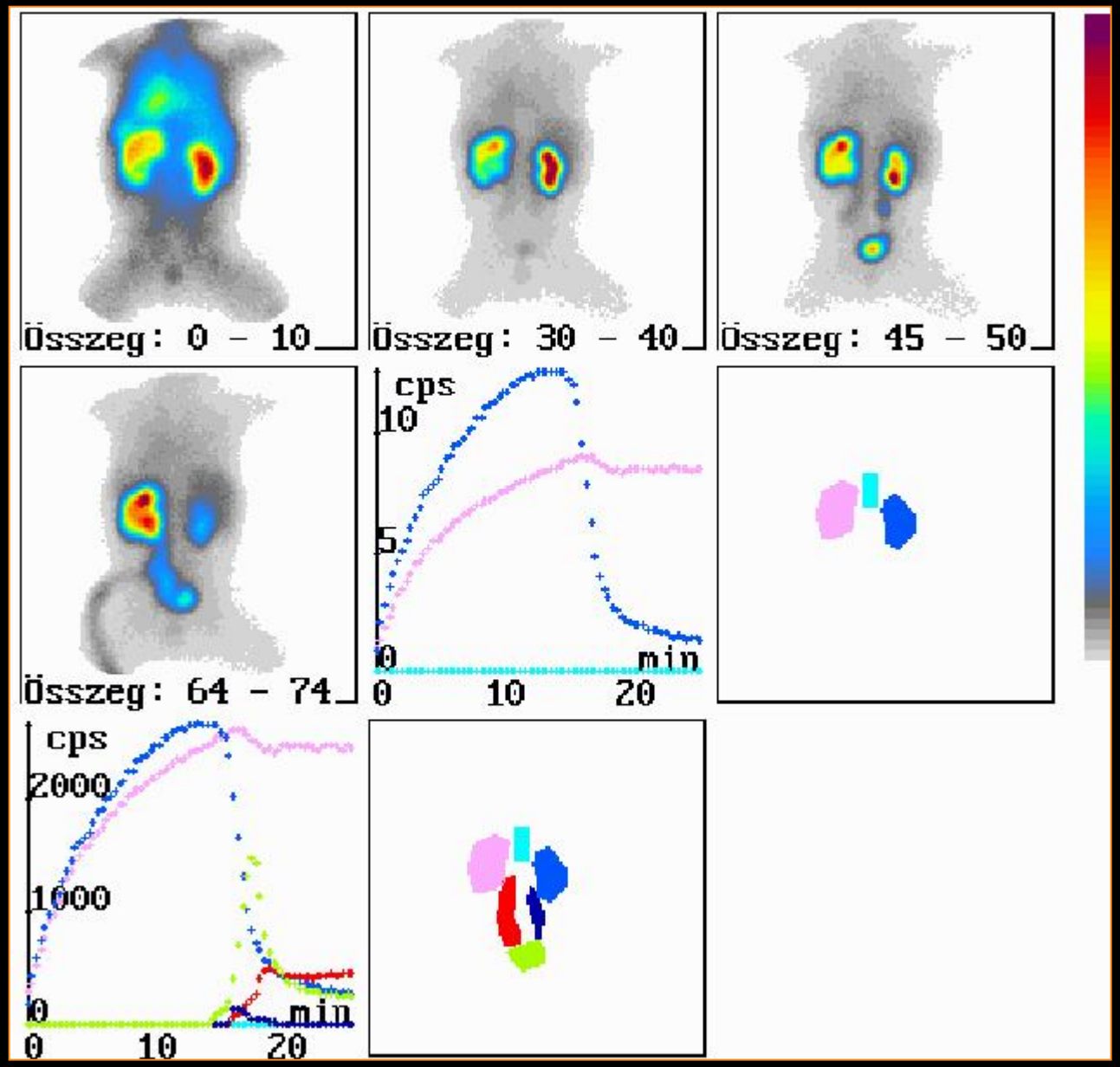
Distroyed function, no excretion on the left side

Camera-renography IV.

- **Vesico-ureteral reflux:**
  - **the urine goes back to the ureters or the pyelon during the miction**
  - **the patient has to micturate in front of the gamma camera**
  - **examination by computer: activity rising in in the ROI of the ureter**

Vesicoureteral reflux in the left ureter





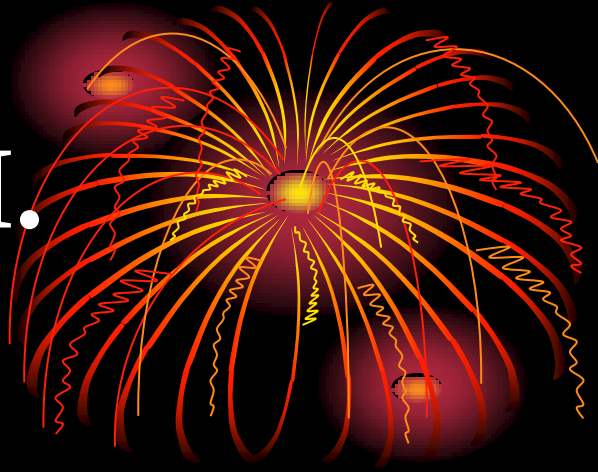
Examination of the vesico-ureteral reflux by computer

Camera-renography V.

Measurement of glomerular filtration (GFR)

- **Radiofarmaceutical: 99mTc-DTPA**
- **Method: camera-renography+cupping in two time (60. min, 120. min)**
- **Calculation: GFR(ml/min)=k*V**
  - **k=(logM1-logM2)*(T2-T1)**
  - **V=250*(S1+S2+S3+S4)/A0**
  - **A0=M1*exp(k*T1)**

Camera-renography VI.

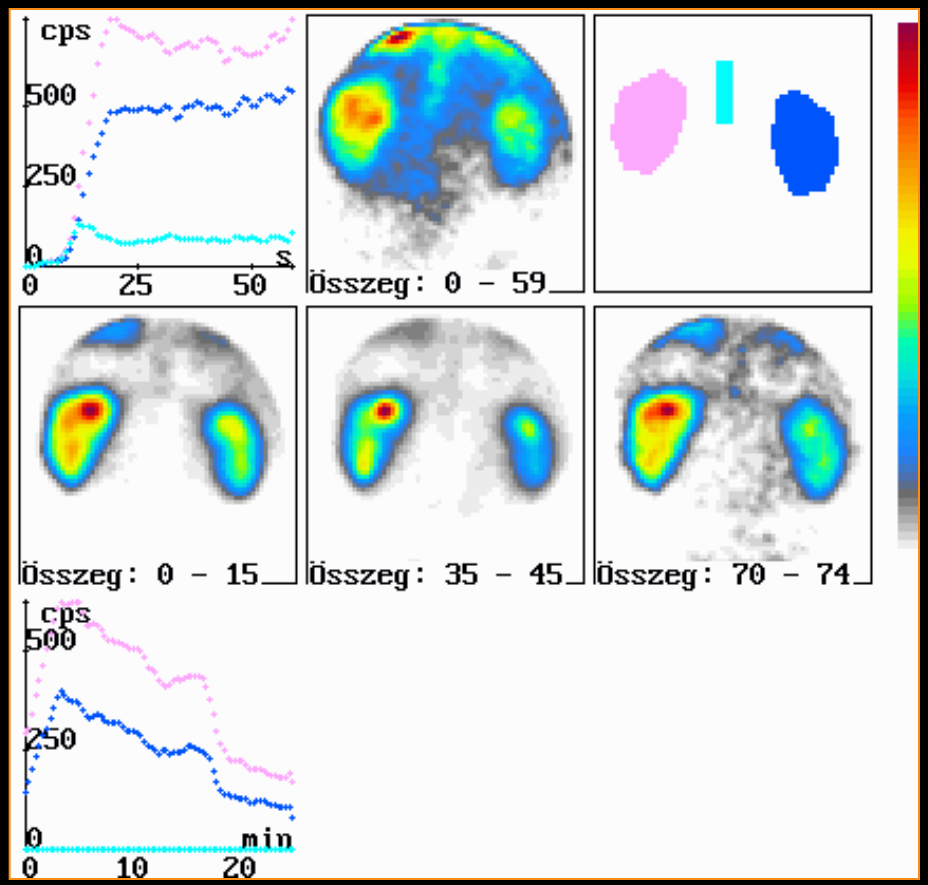


Renovascular hypertony:

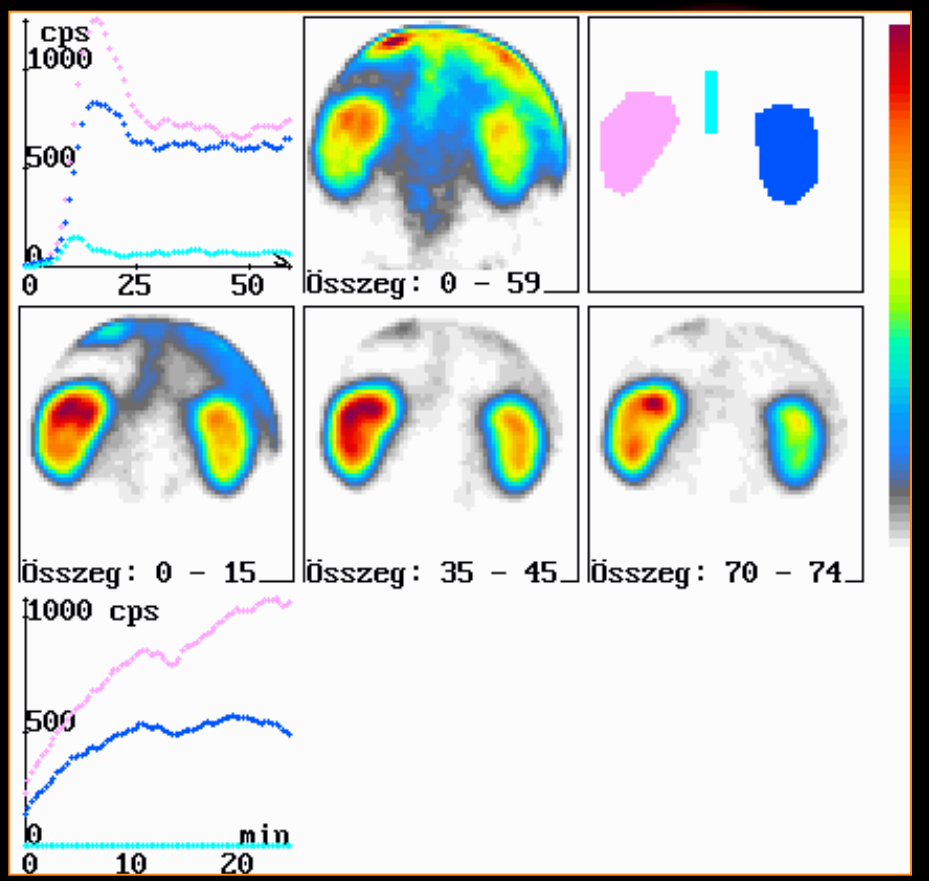
- **Stenosis of renal artery → increased renin secretion → increased angiotensin I to II conversion is moderate by *ACE* (angiotensin convertase enzym)**
- **Angiotensin II narrows only the vas efferens of the glomerulus → the intraglomerular pressure does not decrease**
- **Effect of *ACE inhibitor:* decreased angiotensin II secretion → decreased intraglomerular pressure → decreased intraglomerular filtration**
- ***Failure* of the kidney function on the renogram**

Examination of renovascular hypertony

Baseline study

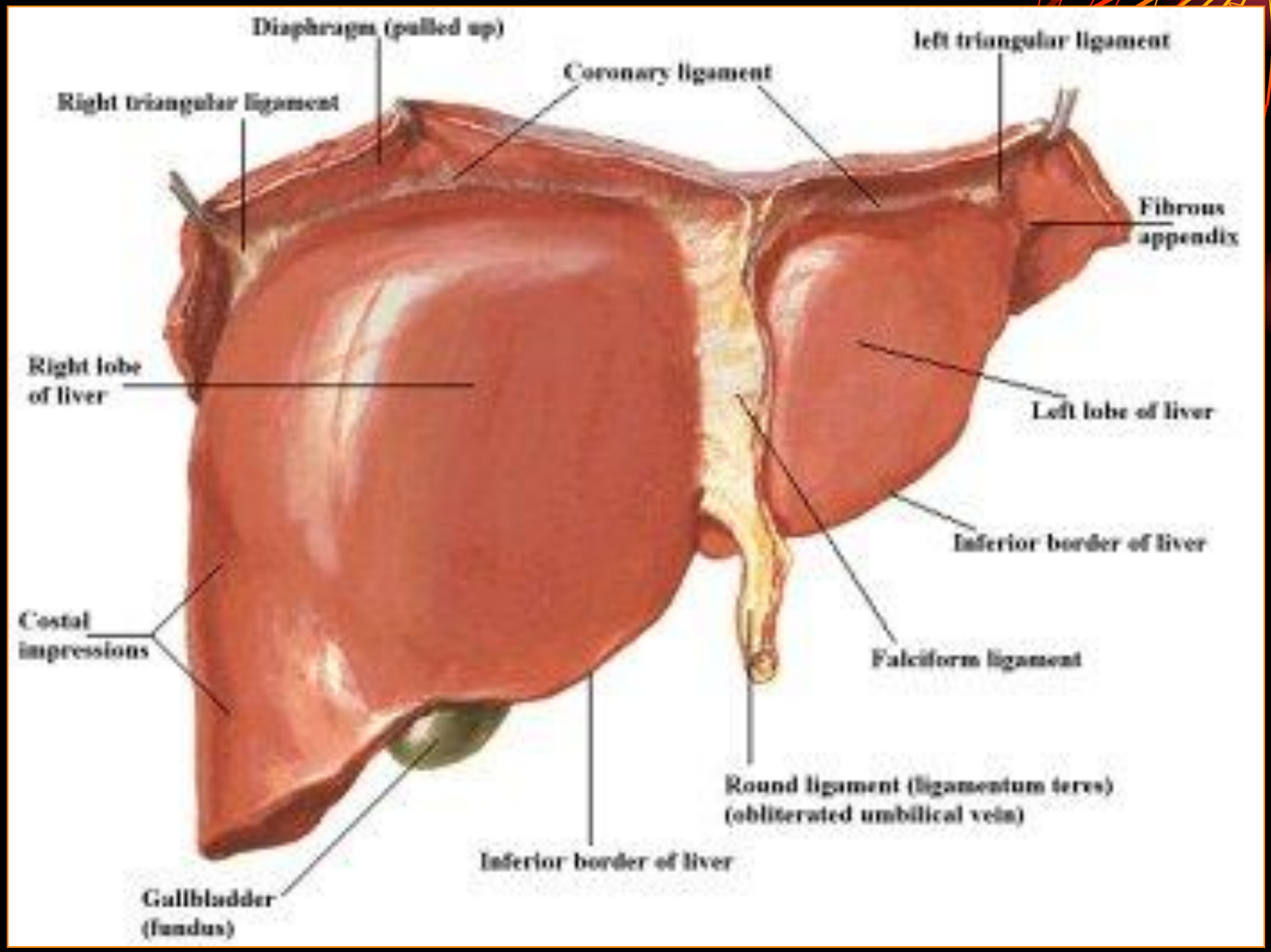


In influence of ACE-inhibitor

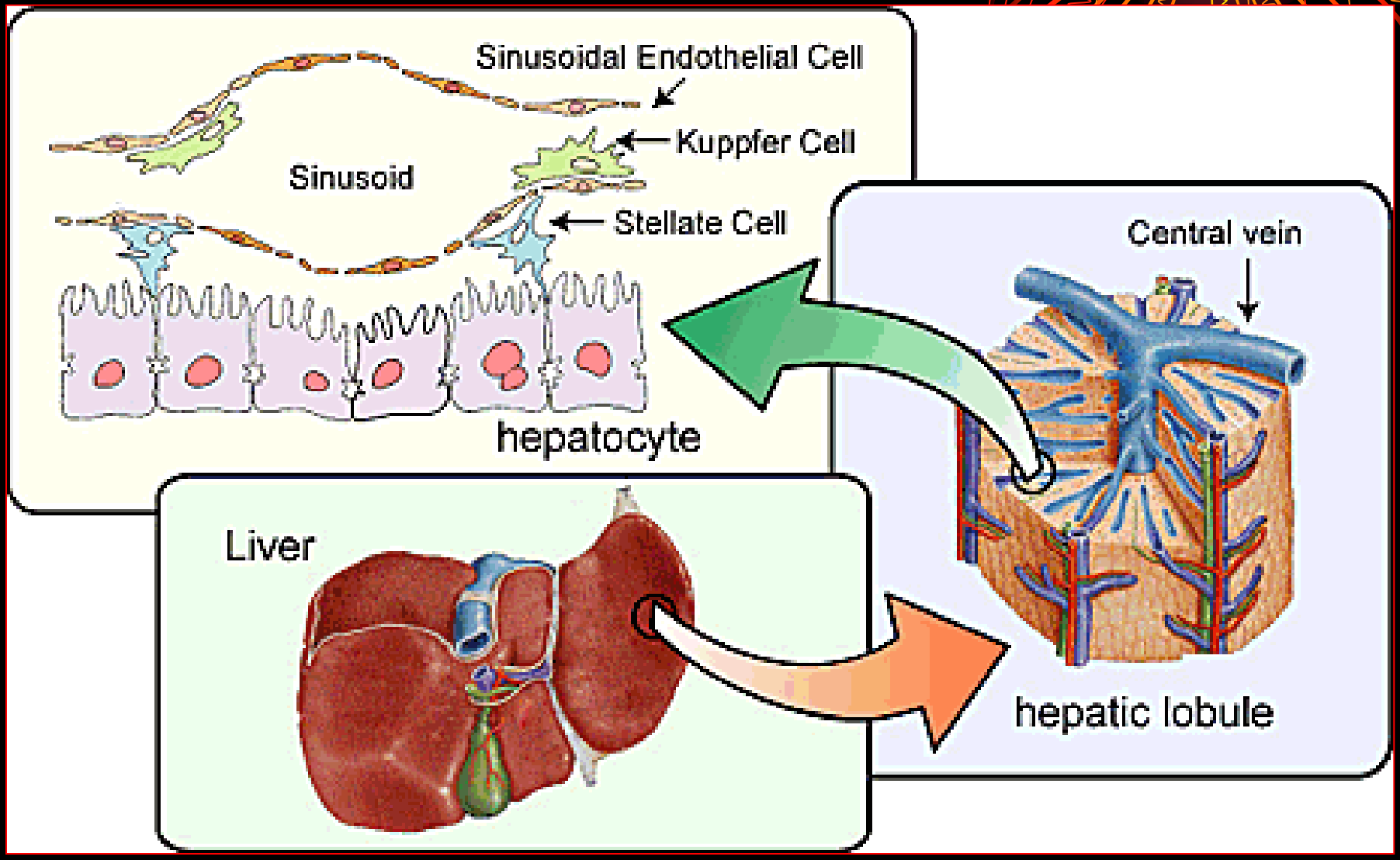


Examinations of the liver

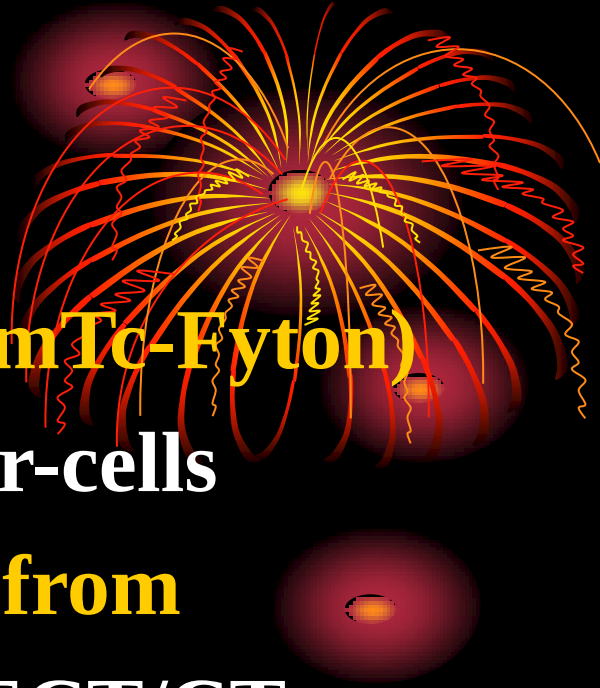
Anatomy of the liver I.



Anatomy of the liver II.



Liver scintigraphy



The labelled colloid (200 MBq 99mTc-Fyton) is phagocyted by the Kuppfer-cells

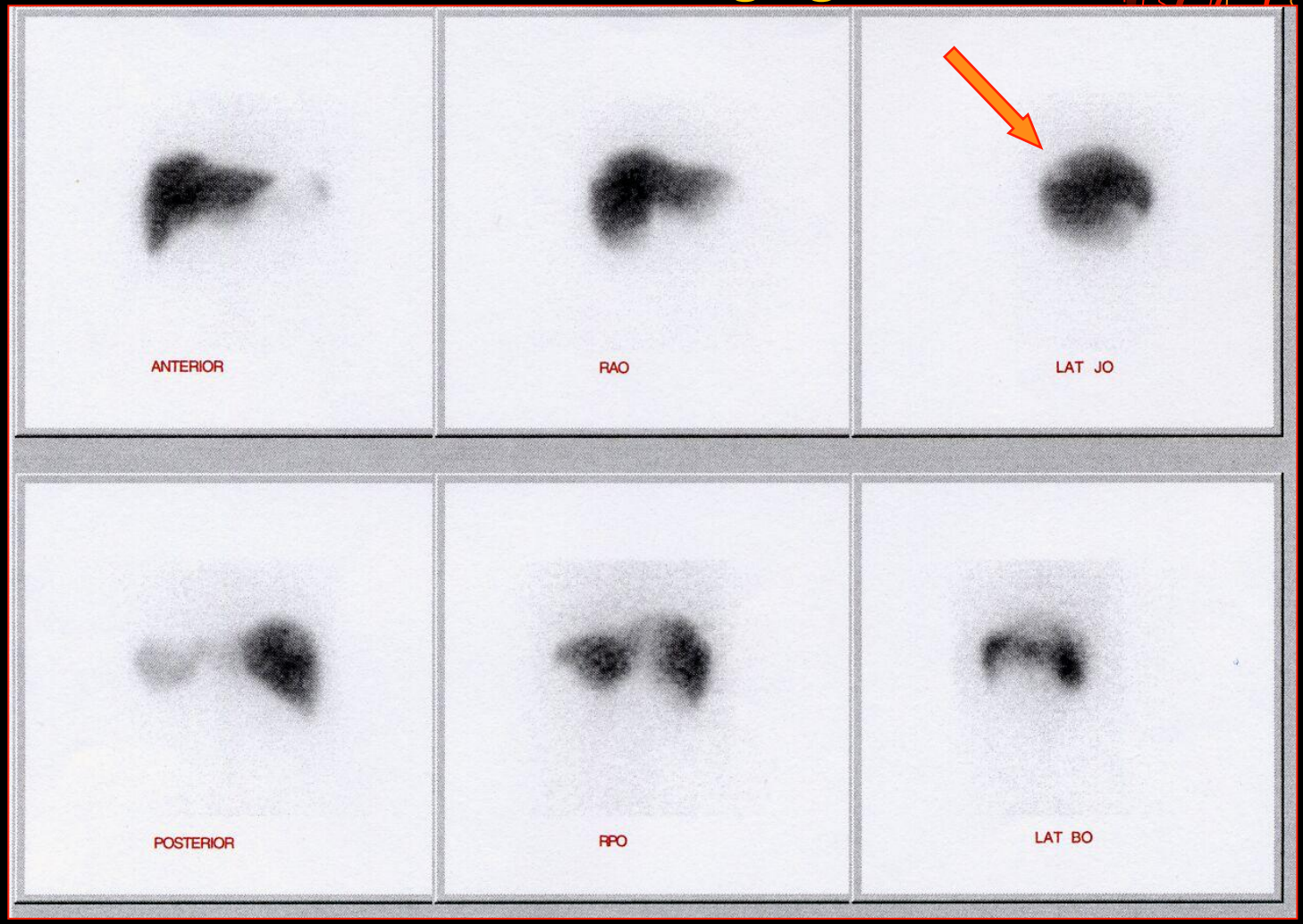
Static imaging (after 20 minutes) from 6 directions + SPECT or SPECT/CT examination is very useful

The focal defect is indicated by the decreased and/or the lack of the activity

Indications: *haemangioma, FNH,* primary tumors, metastases, cysts

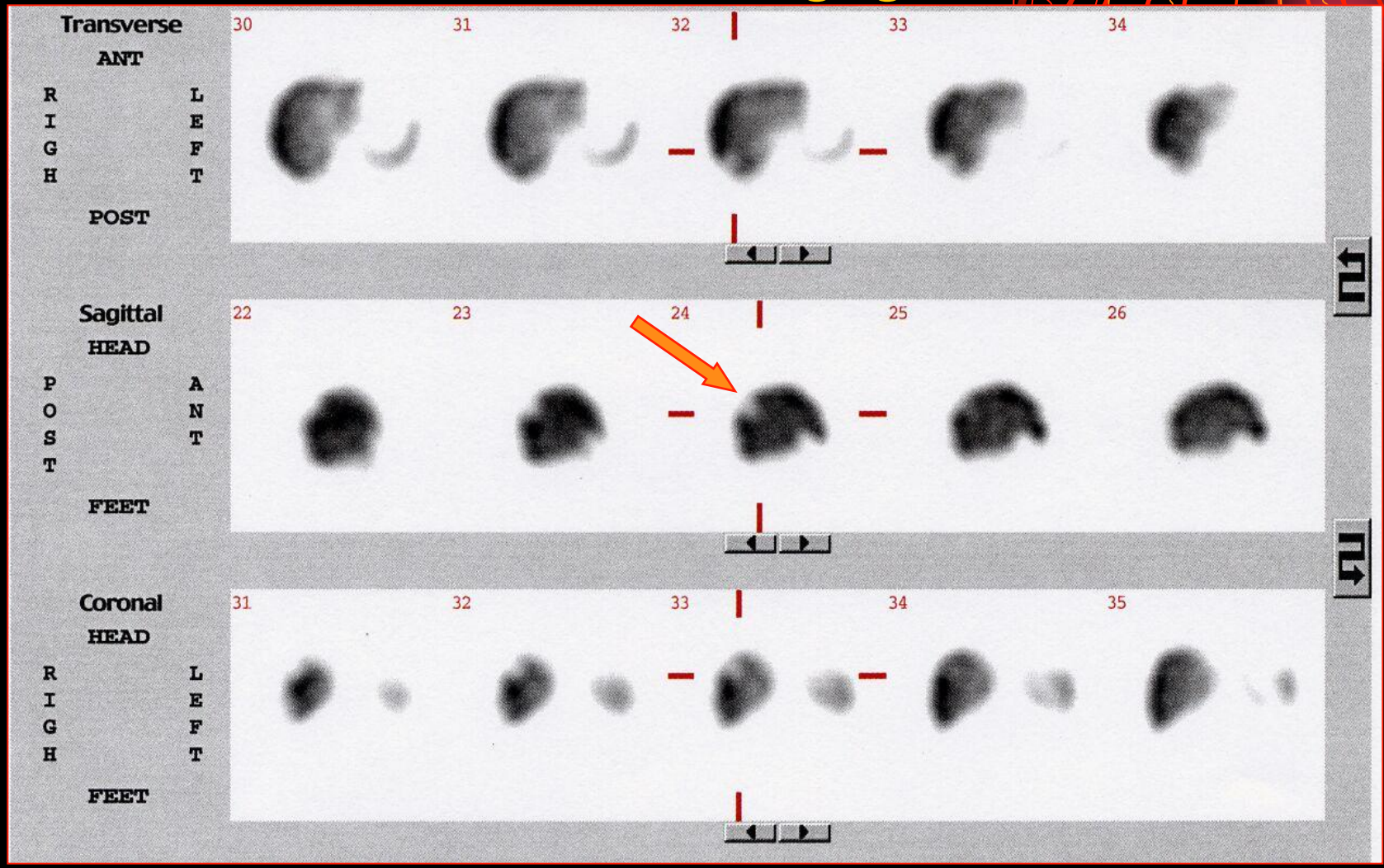
Focal parenchymal defect

Static imaging

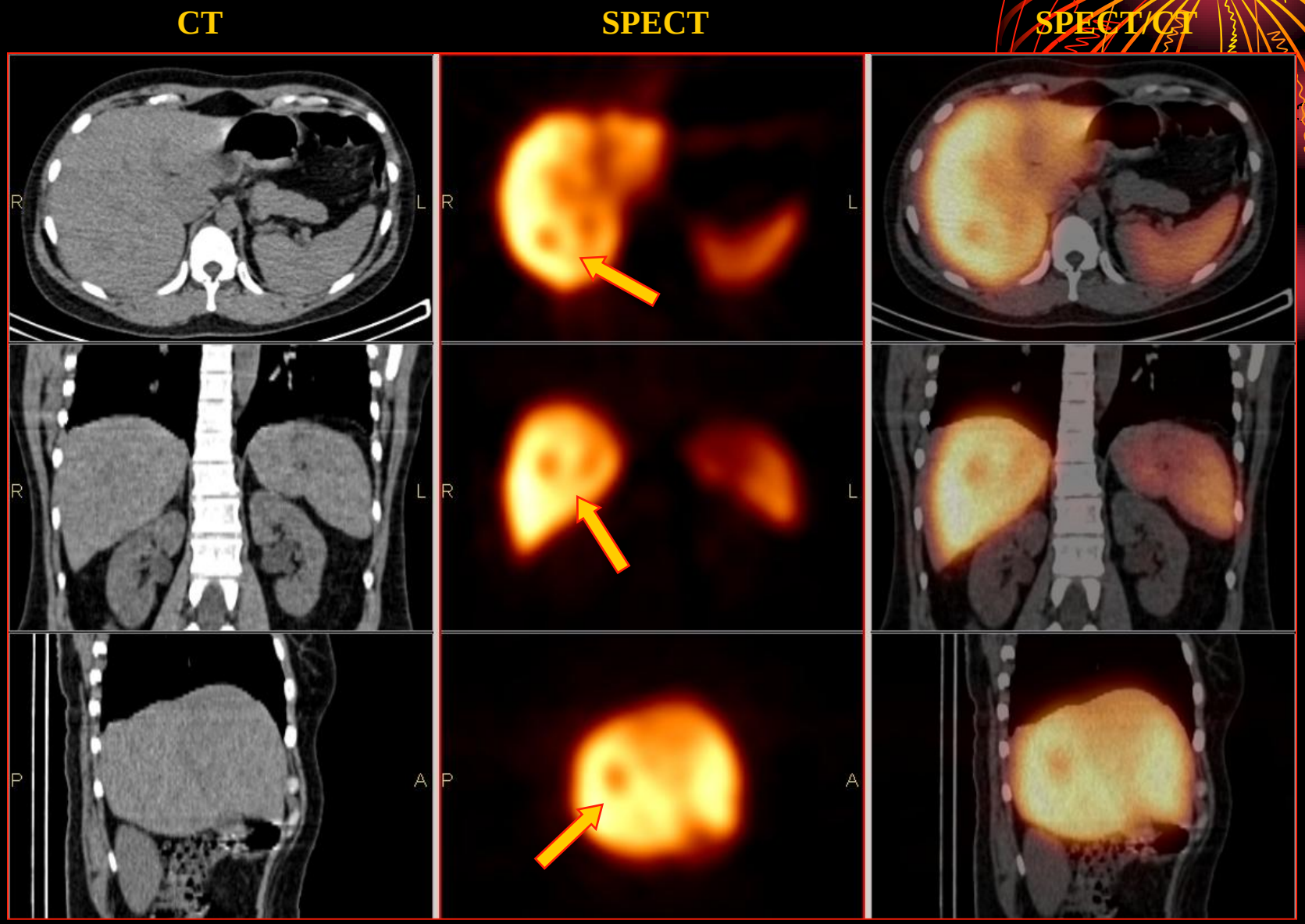


Focal parenchymal defect

SPECT imaging



Liver SPECT/CT fused imaging



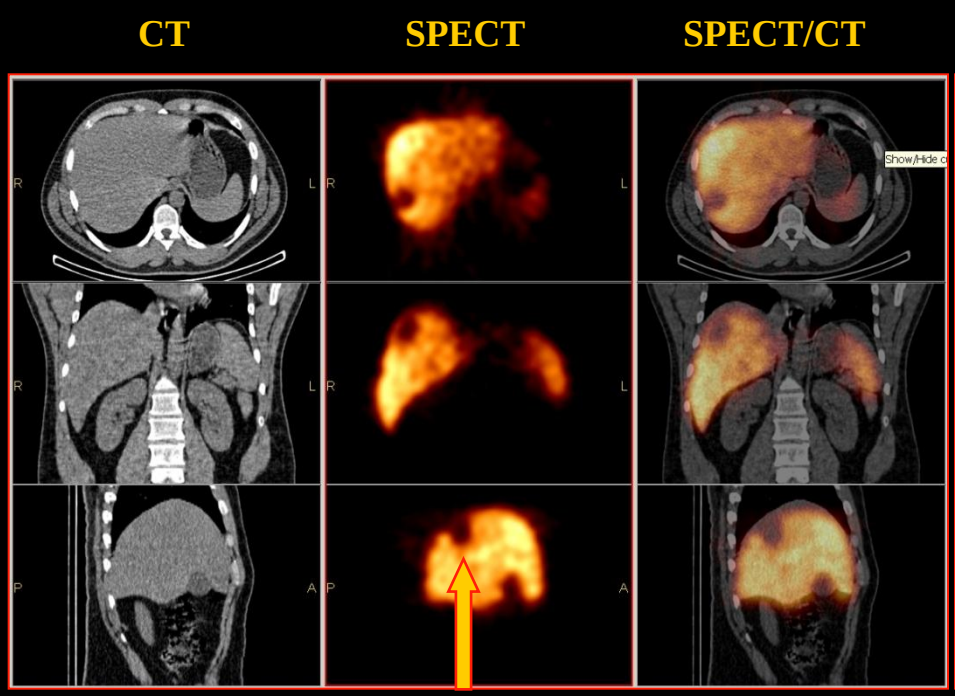
Liver blood-pool scintigraphy

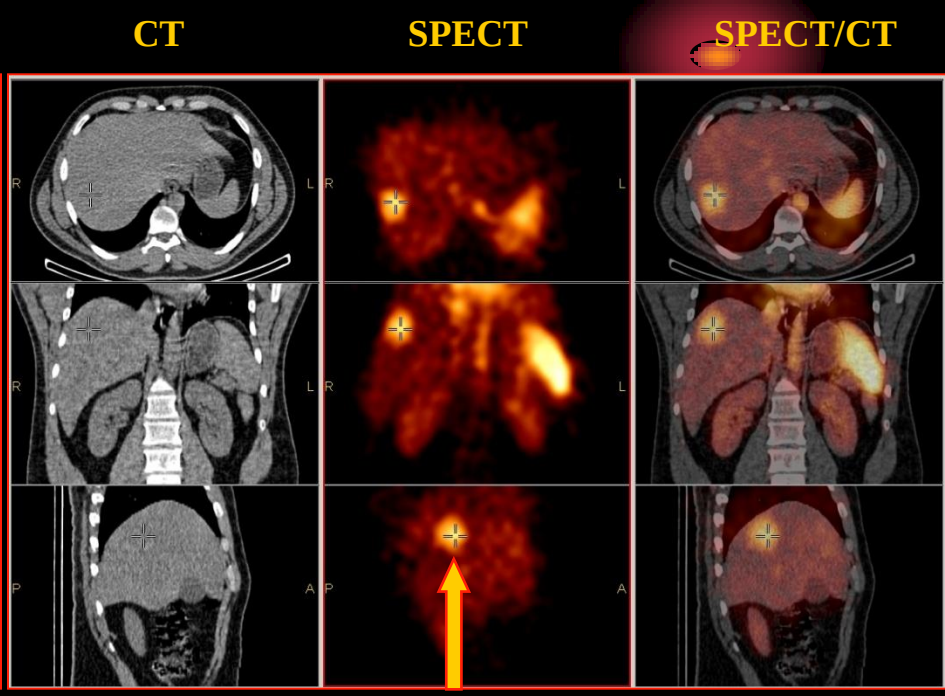
- The blood-pool of the liver is labelled by 99mTc-pyrophosphate-red blood cells:
- Inactive pyrophosphate is injected i.v. at first
- 20 minutes later 500 MBq 99mTc-pertechnetate is injected i.v., too
- Imaging is performed in equilibrium from 6 directions (similar to colloid scan) + SPECT or SPECT/CT
- Haemangioma is indicated by increased activity

Liver colloid and blood-pool SPECT/CT fused imaging in haemangioma

Colloidal scintigraphy

Blood-pool scintigraphy





Focal parechymal defect

Increased blood pool

Hepatobiliary scintigraphy I.

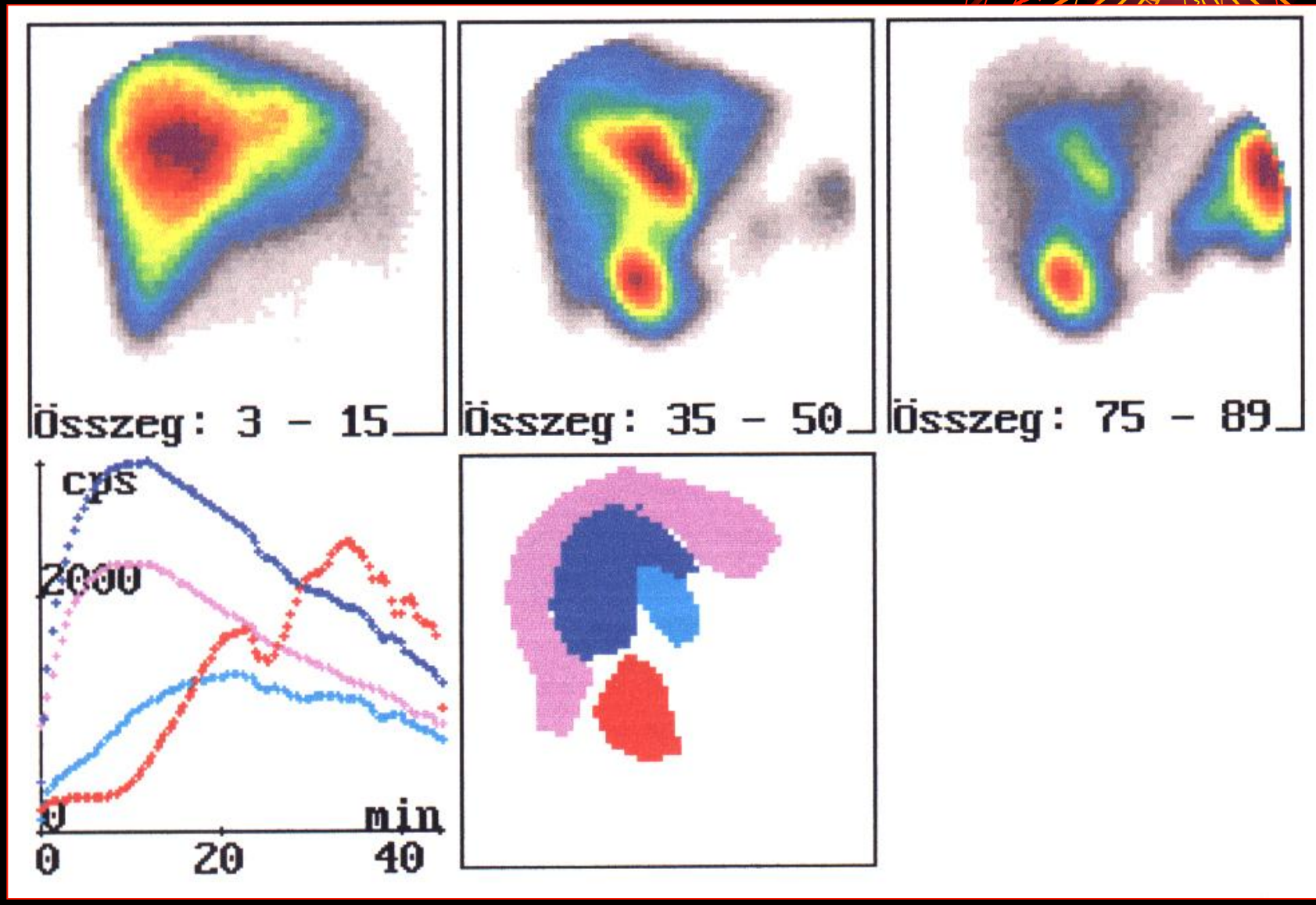
The goal of the examination:

- **secretion function of the liver from the blood**
- **excretion function of the bile through the hepatocytes**
- **function of the gall bladder (contraction by Sorbitol, ejection fraction)**

The way of the radioactive agent - 99mTc-HIDA - from the blood to the bowels:

- **parenchymal part of the liver**
- **ductus hepaticus**
- **ductus choledochus**
- **cholecysta**
- **bowels**

Normal hepatobiliary dynamics

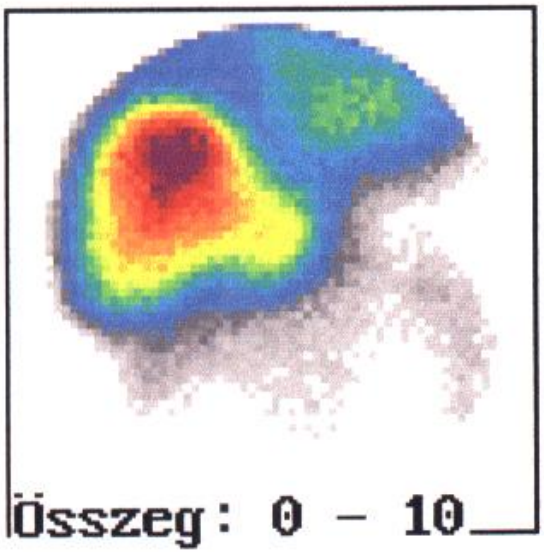


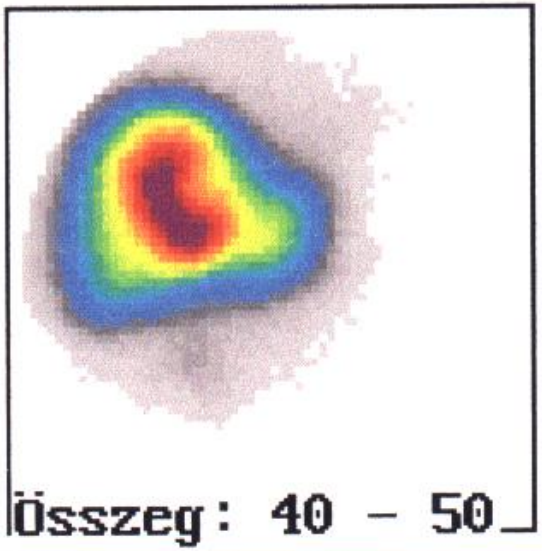
Hepatobiliary scintigraphy II.

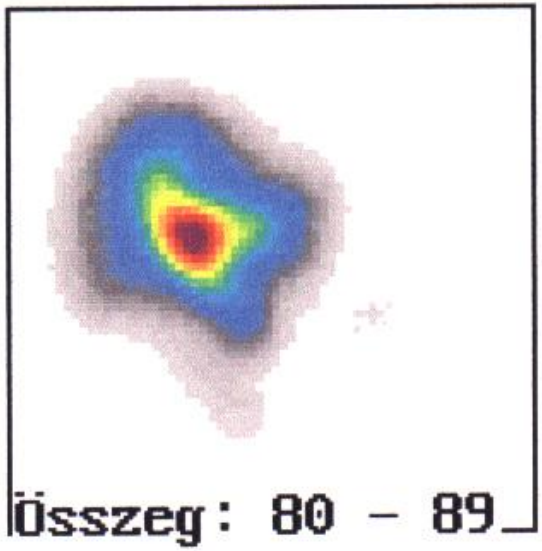
Indications:

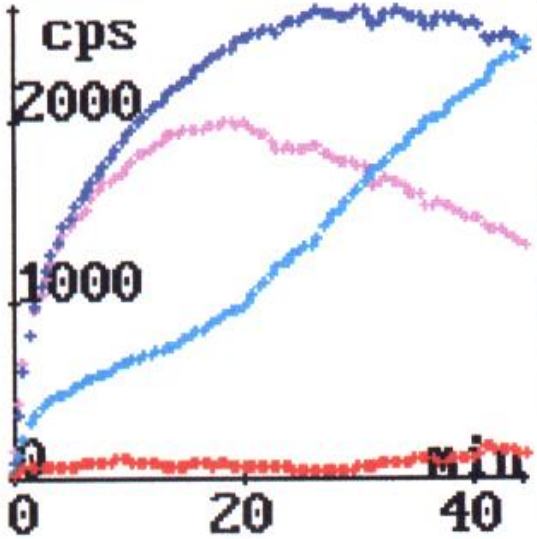
- *Post - cholecystectomical syndrome*
- **Bile excretion disorders**
- **Acut or chronic cholecystitis**
- *Cholecysta dyskinesis*
- *Focal nodular hyperplasia*
- **Flow of the bile to the abdomen cavity**
- **Atresia of the ductus hepaticus or choledochus**
- **Transplantation of the liver**

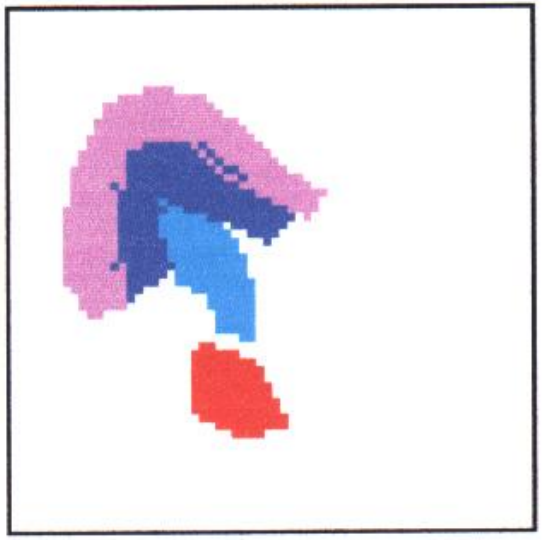
Obstruction of the papilla Vateri



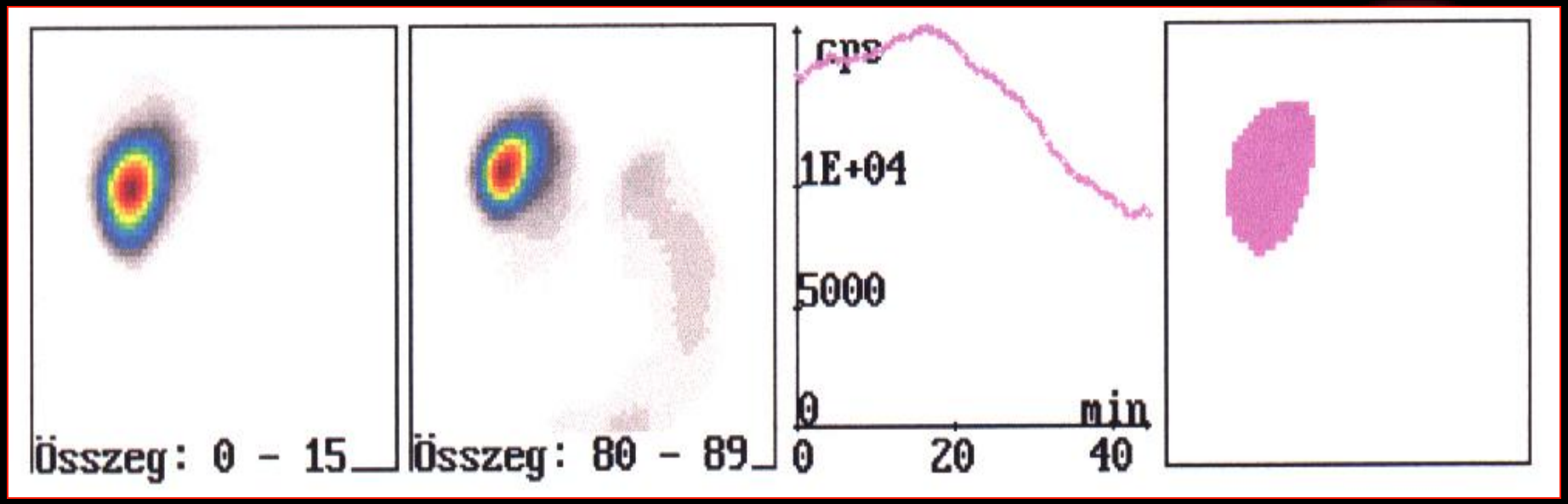




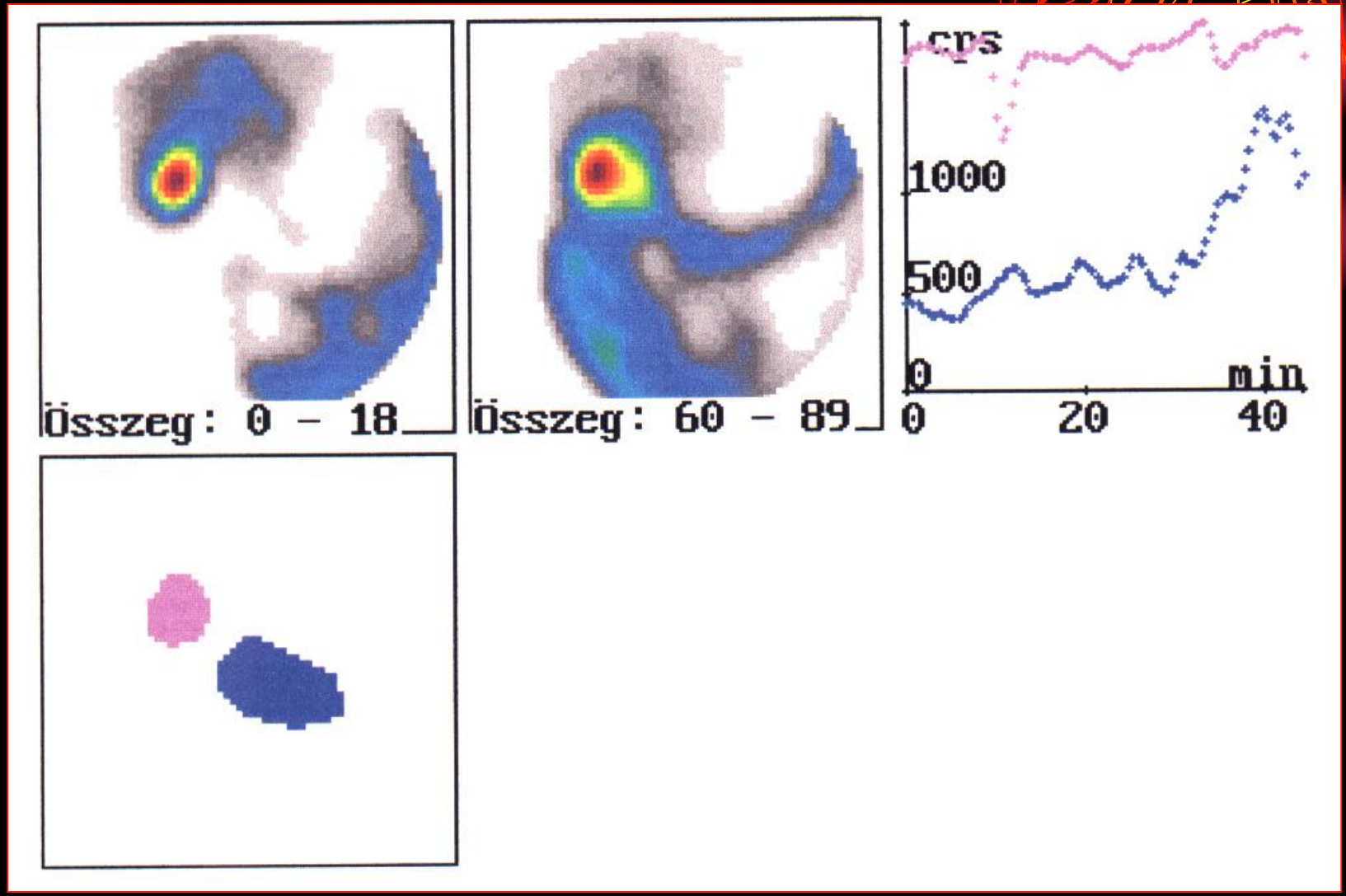


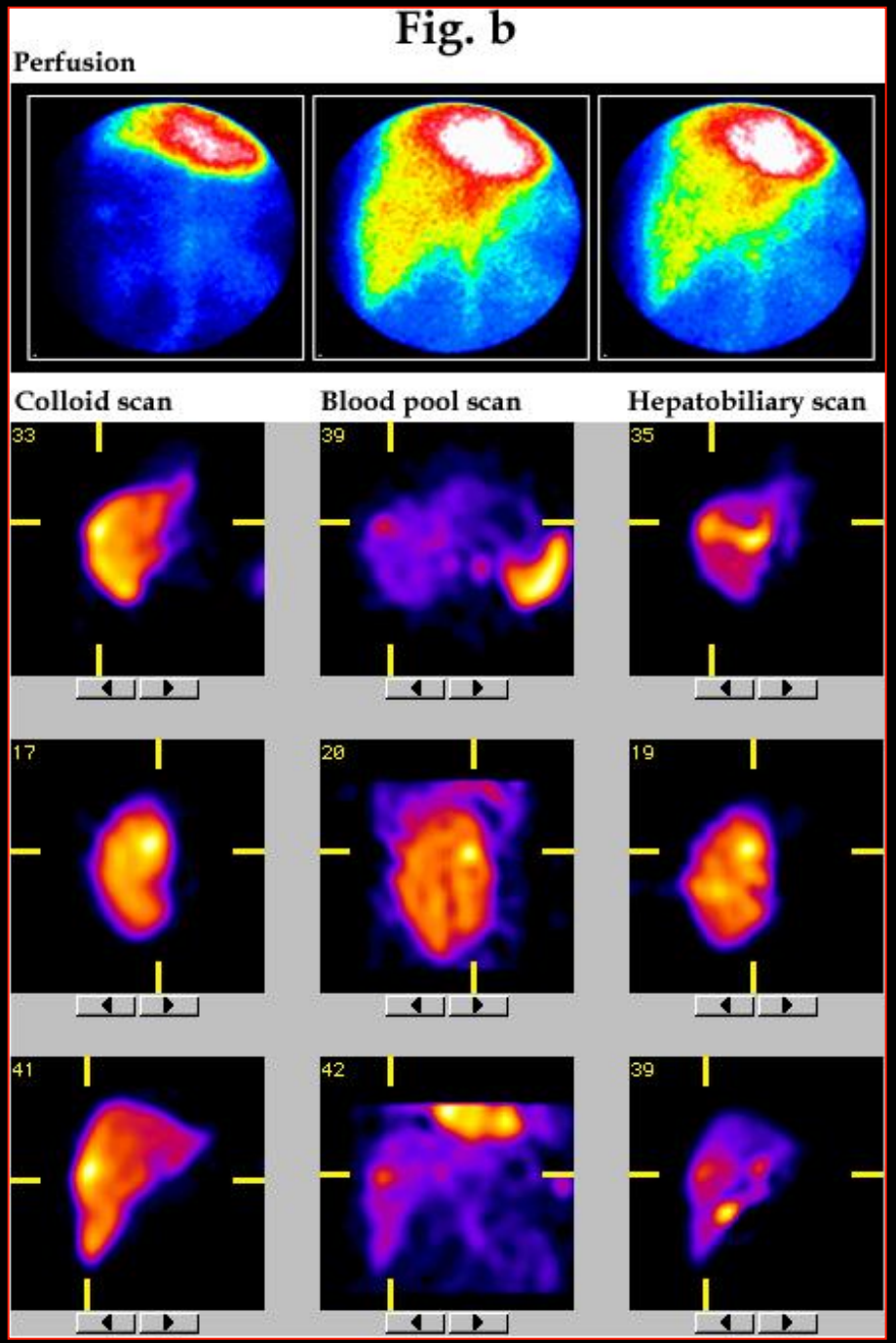


Normal ejection fraction of the gall bladder: >1%/min



Damaged contraction of the gall bladder





Focal nodular hyperplasia:

- higher perfusion
- normal or higher colloid activity
- higher blood-pool activity
- higher hepatobiliary activity

Somatostatin receptor scintigraphy

Injected subject: 111-Indium-pentetreotide

(somatostatine analog peptid are binding to the receptors overexpressed on the surface of tumor cells)

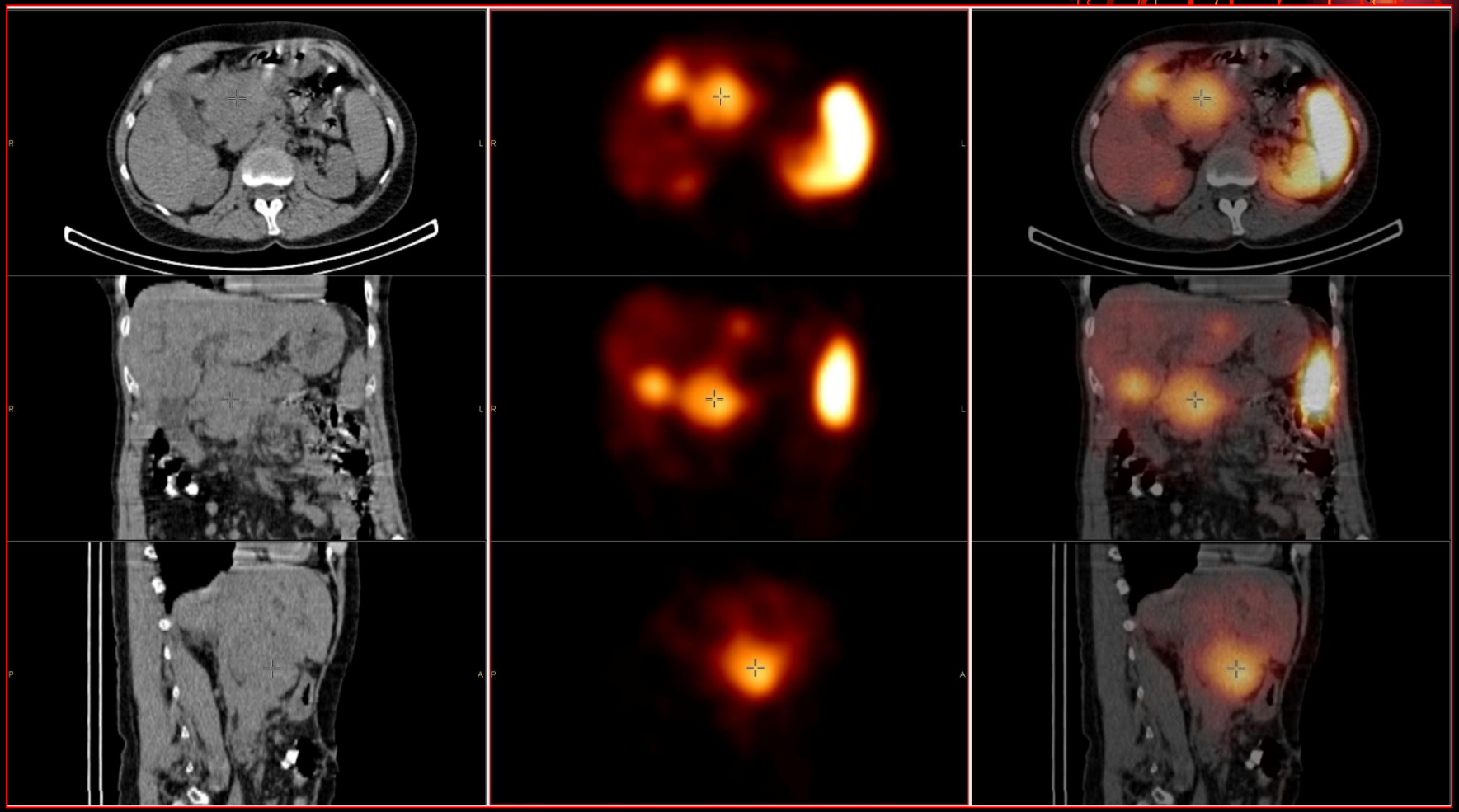
Imaging time: 24 and 48 hours after the intravenous injection, SPECT/CT at the delayed time

Indications: - carcinoid

- GEP tumors

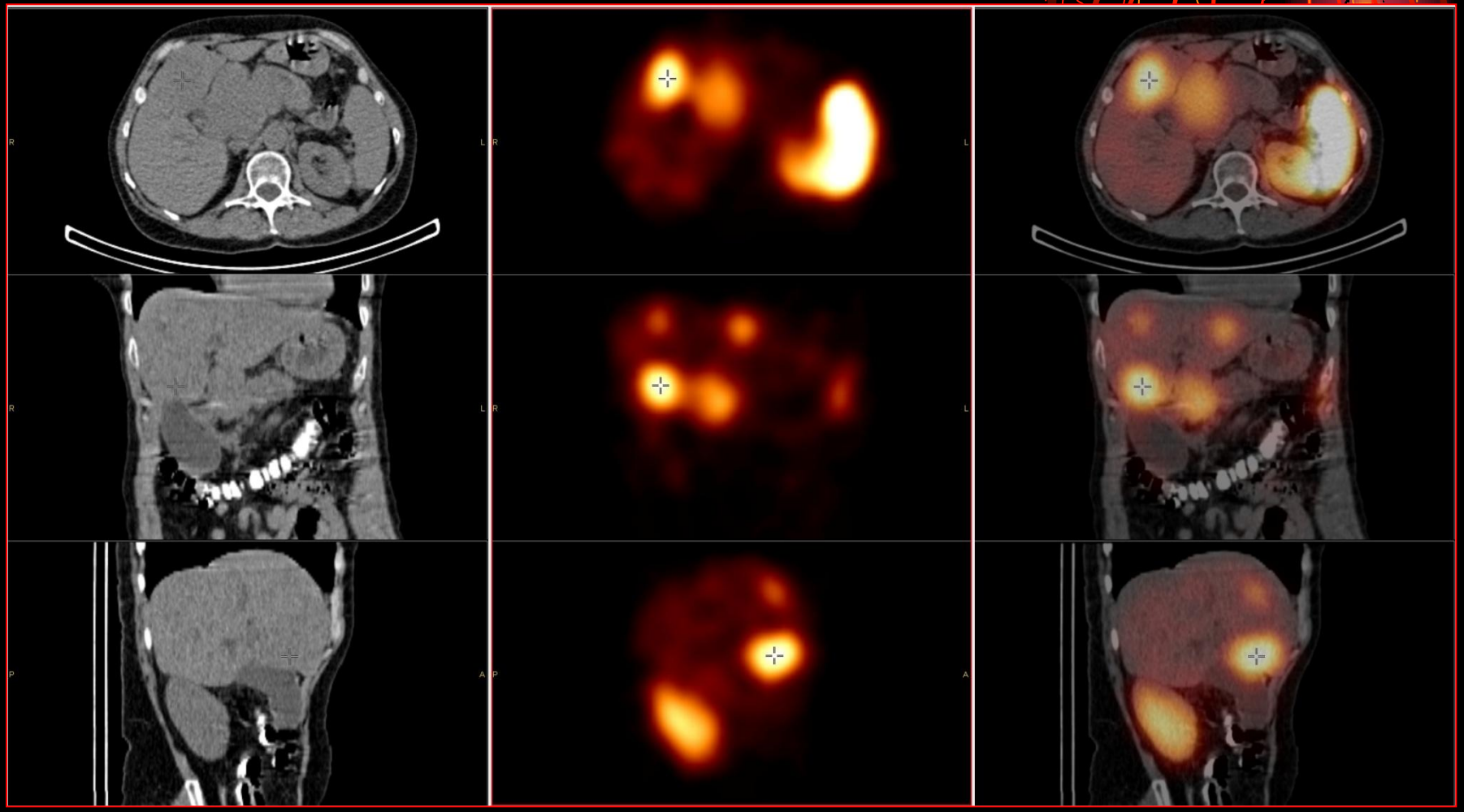
Carcinoid in the pancreas head

by 111-In-pentetreotide



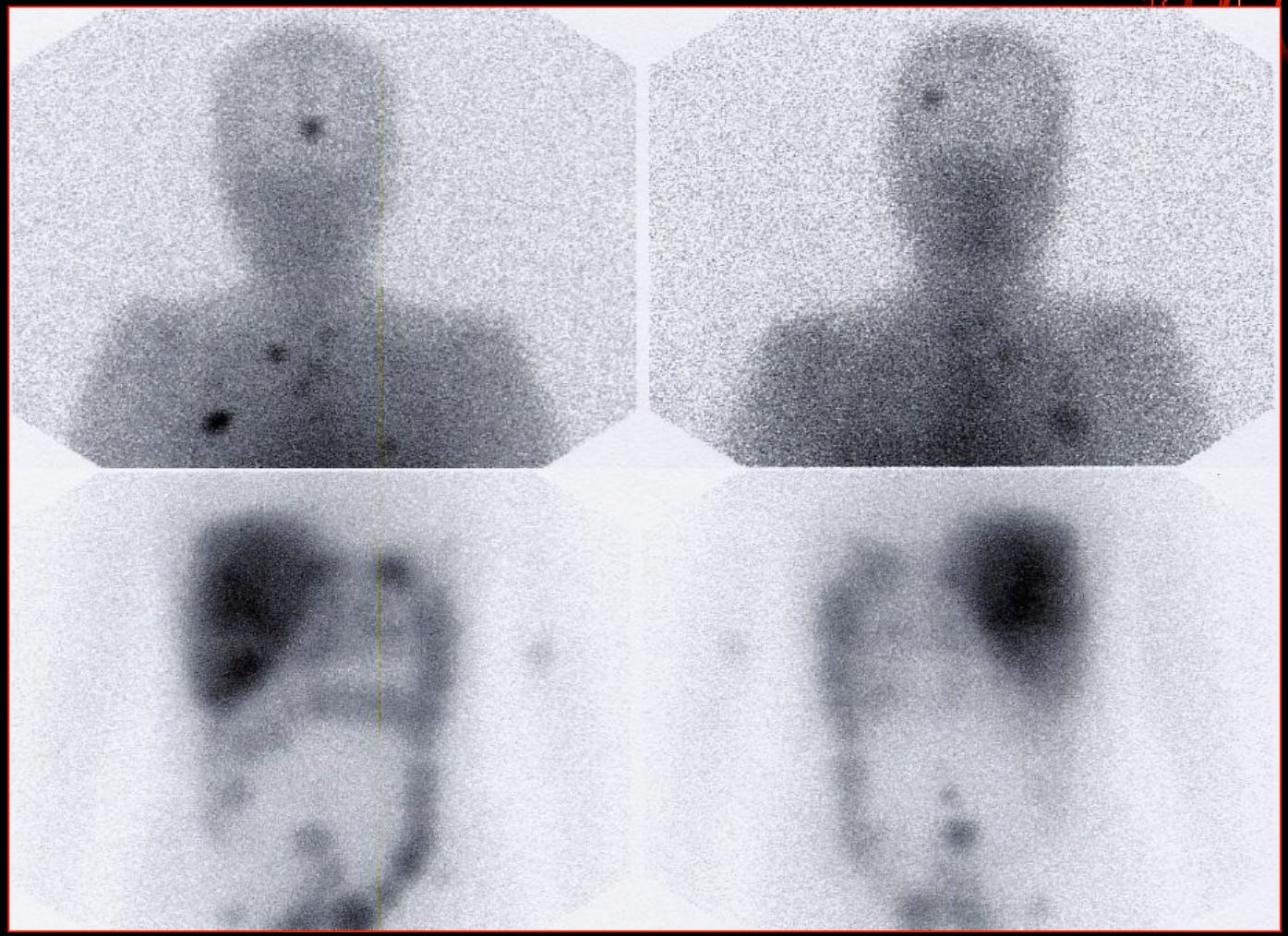
Carcinoid metastases in the liver

by 111-In-pentetreotide

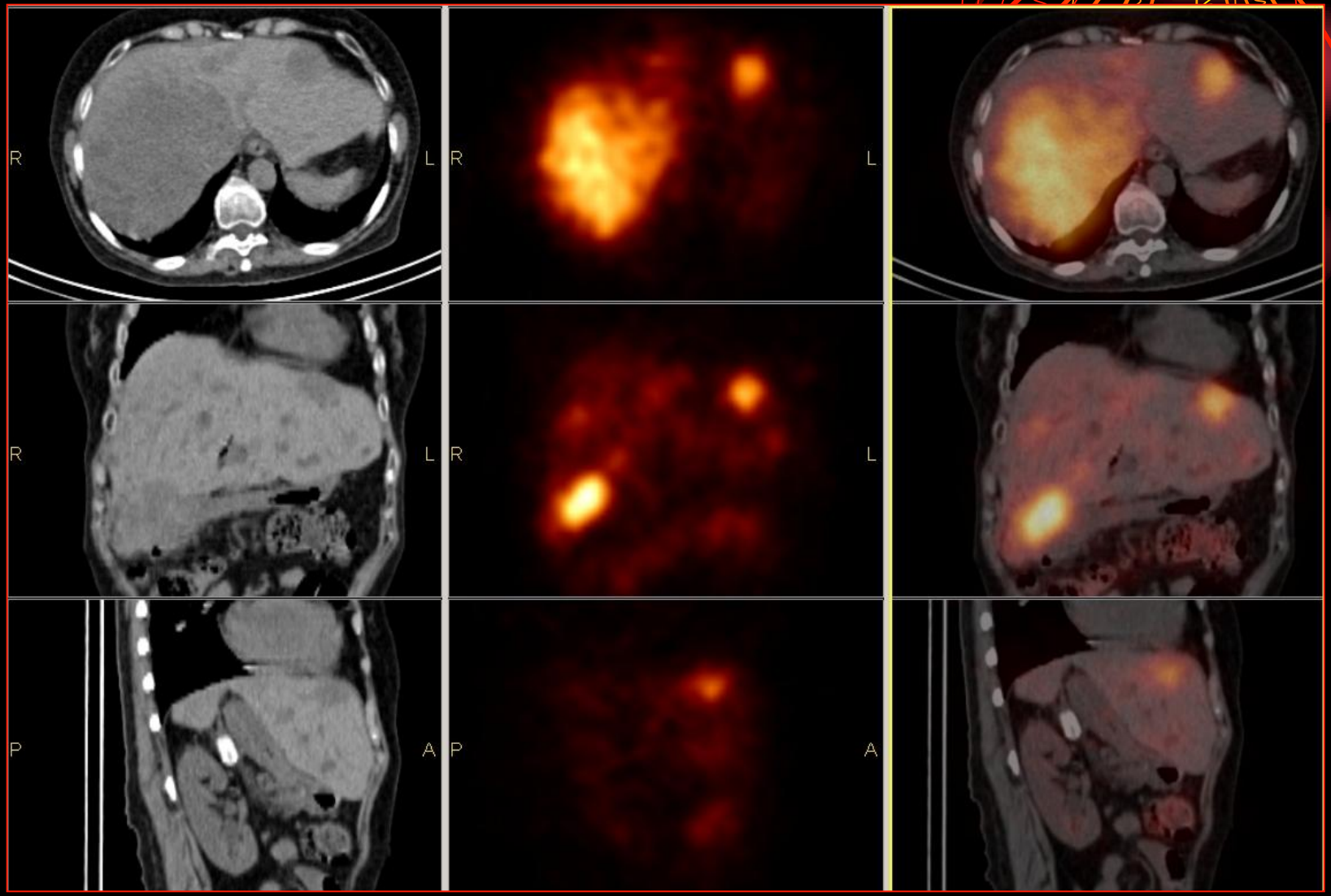


Carcinoid in pancreas head, st. p. surgery, metastases?

Static imaging by 111-In-pentetreotide

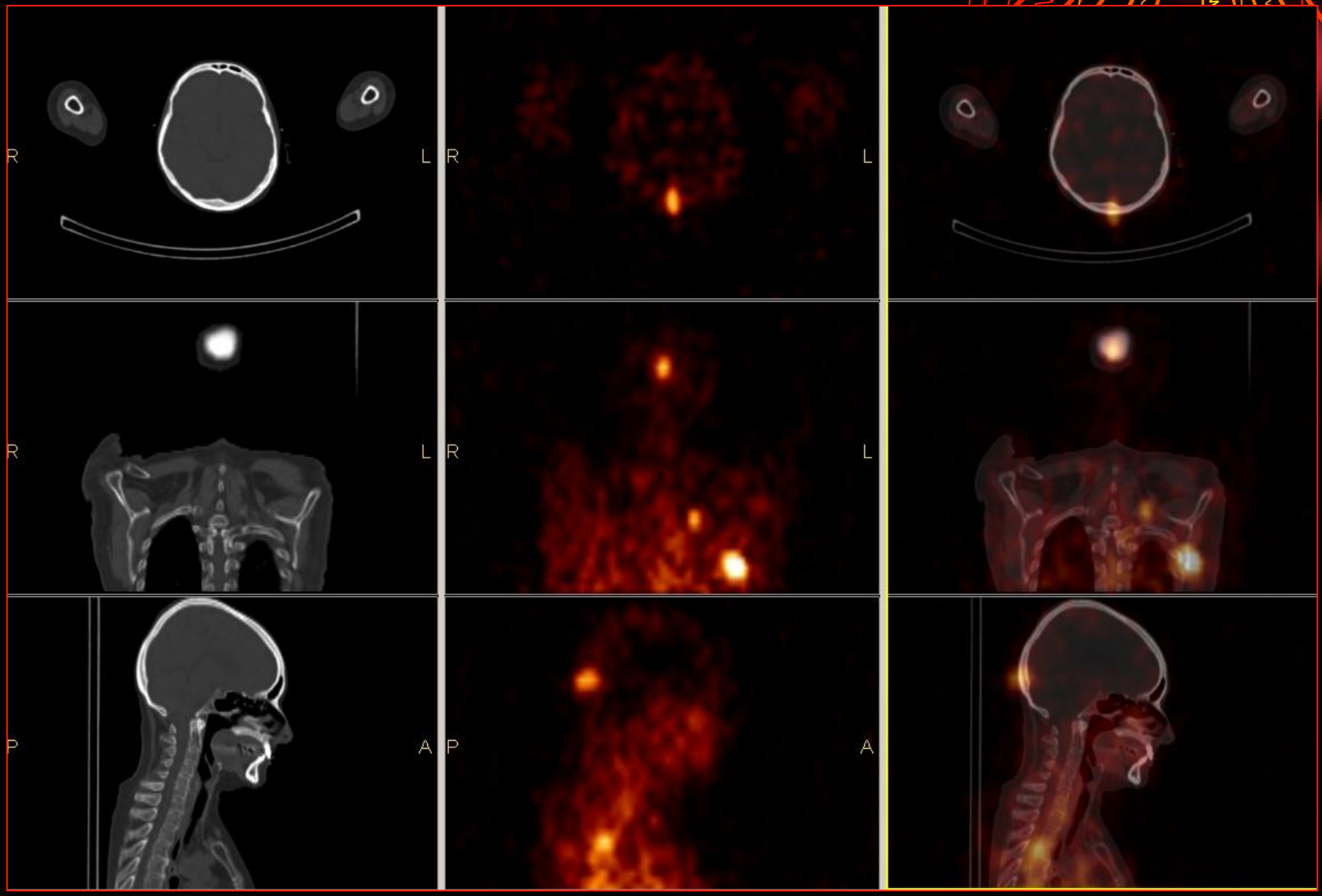


Multiplex carcinoid metastases in the liver
by 111-In-pentetreotide



Multiplex carcinoid metastases in the bones by 111-In-pentetreotide

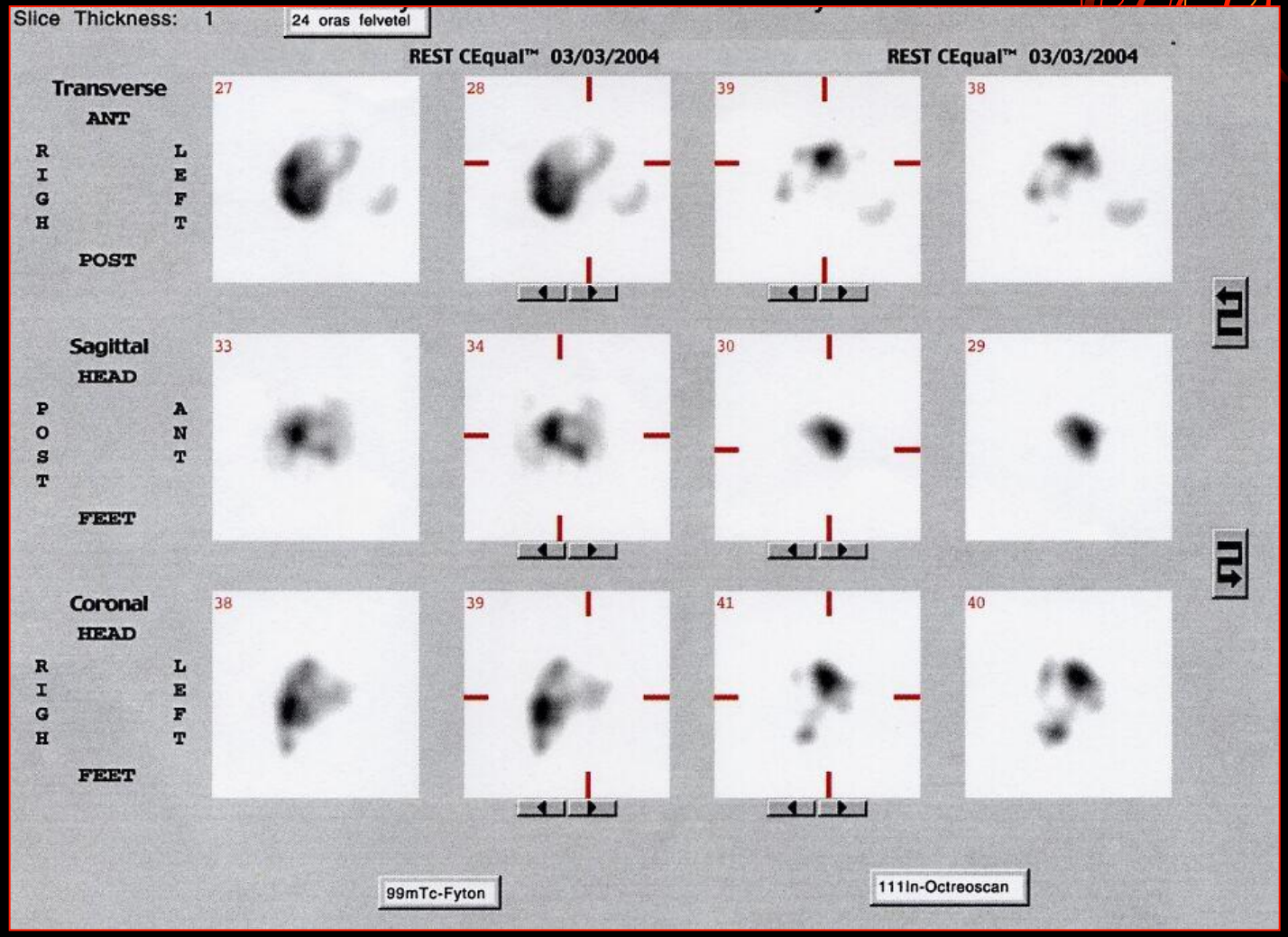
CT SPECT SPECT/CT



Carcinoid metastasis in the liver

by 99mTc-colloide and 111-In-pentetreotide

SPECT imaging



Adrenerg receptor scintigraphy

Injected subject: 123-iodine or 131-iodine-MIBG (metaiodobenzyl-guanidine) is binding to adrenerg receptors

Imaging time: 6 and 24 or 24 and 48 hours after the intravenous injection, SPECT/CT at the delayed time

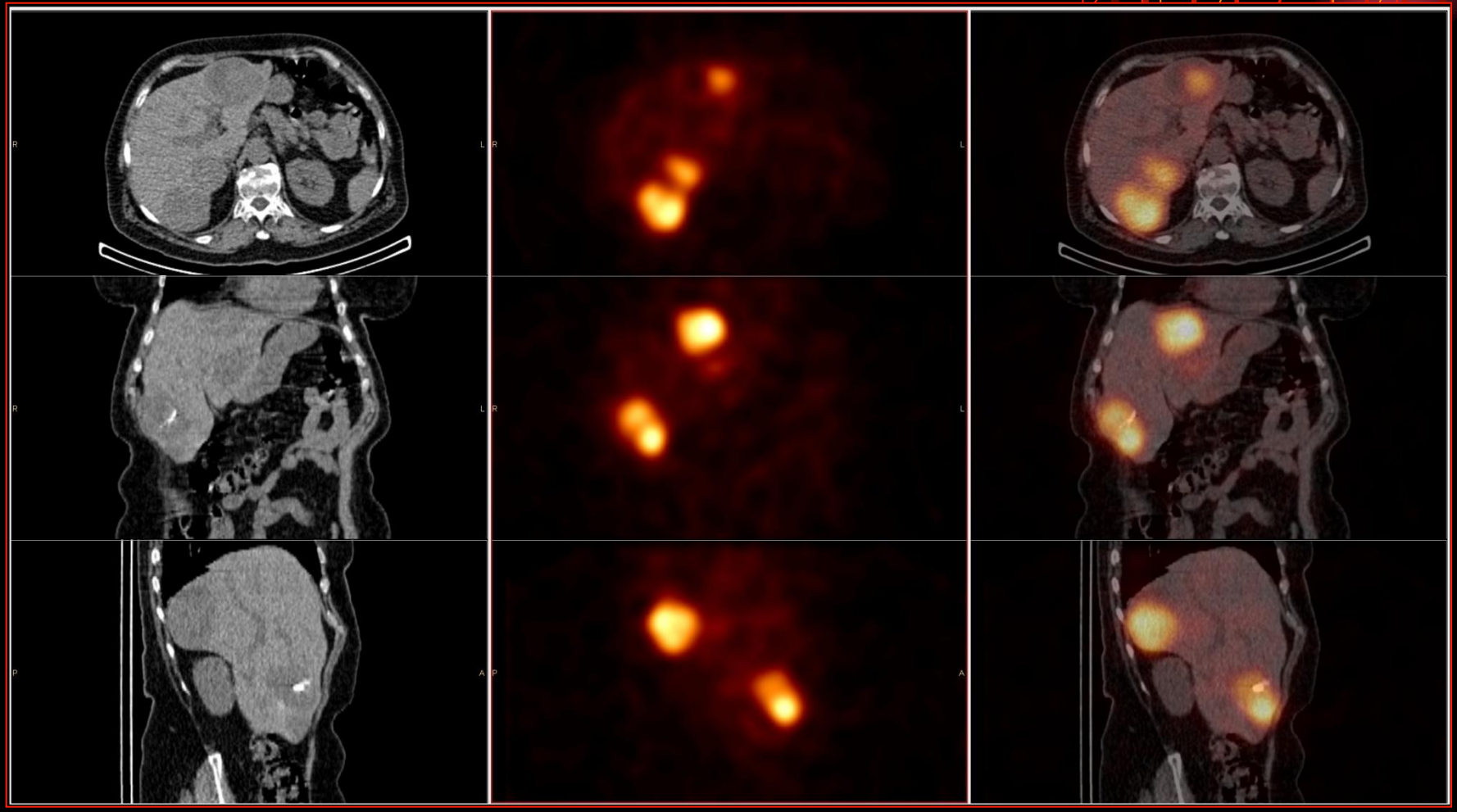
Indications: - neuroendocrin tumors
- pheochromocytoma
- neuroblastoma

Liver metastases of GEP tumor

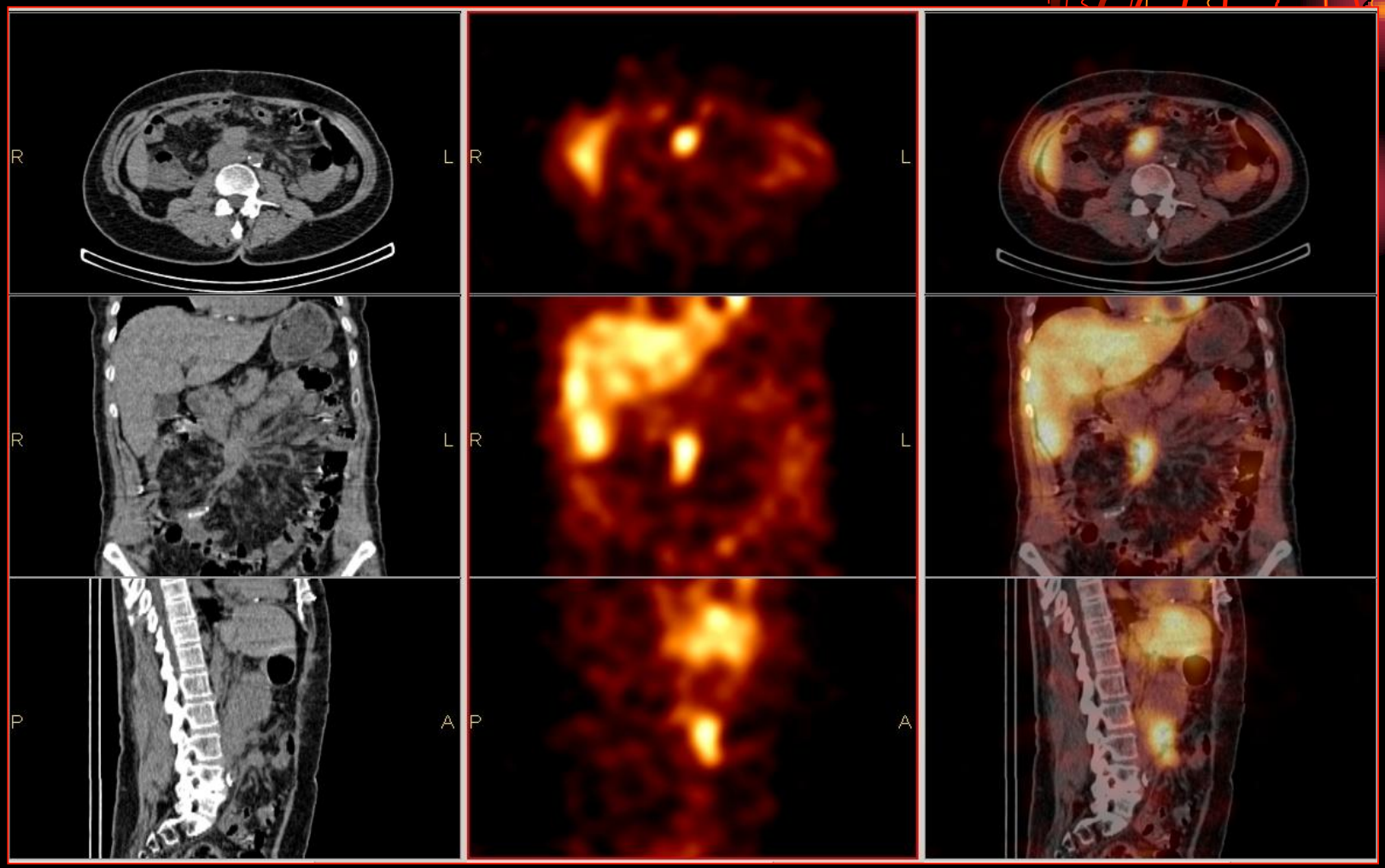
by 123-I-MIBG

(examination before 131-I-MIBG therapy)

CT SPECT SPECT/CT



Paraaortic lypmh node metastasis after operation of NET of small intestine by 123-I-MIBG



Oesophagus scintigraphy and gastric emptying study

Radiopharmaceutical: the patient drink water for oesophagus study and/or eat a meal in which a solid component of the meal (for example, scrambled egg), a liquid component of the meal (for example, water), or both for gastric emptying study, are mixed with a small amount of radioactive material 40-80 MBq **99mTc-DTPA**

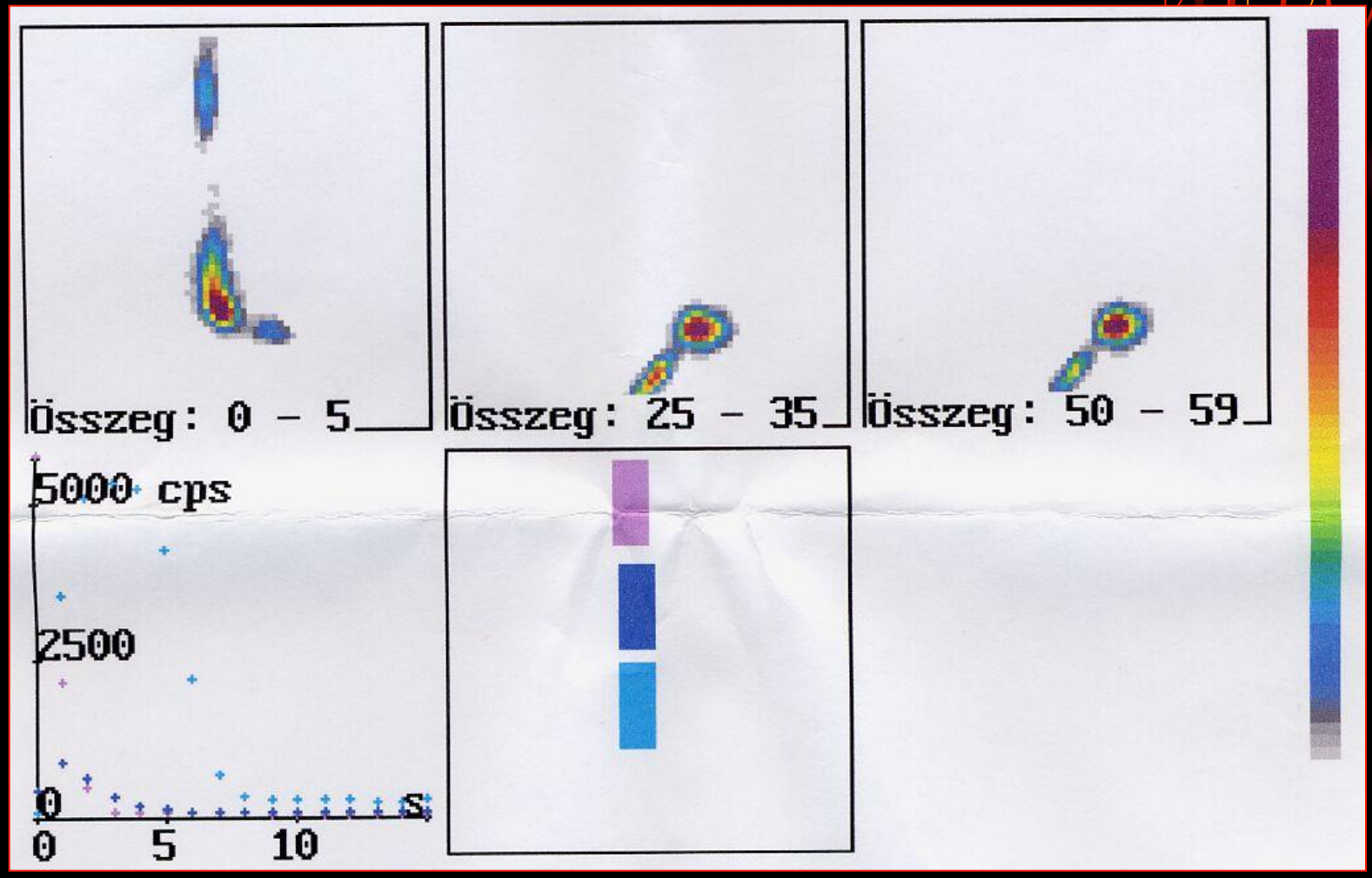
Dynamic examination is started immadiately

Generation of time-activity curves by software program

Calculation of parameters: half time, emptying speed of the radioactive meal through to the stomach and bowels

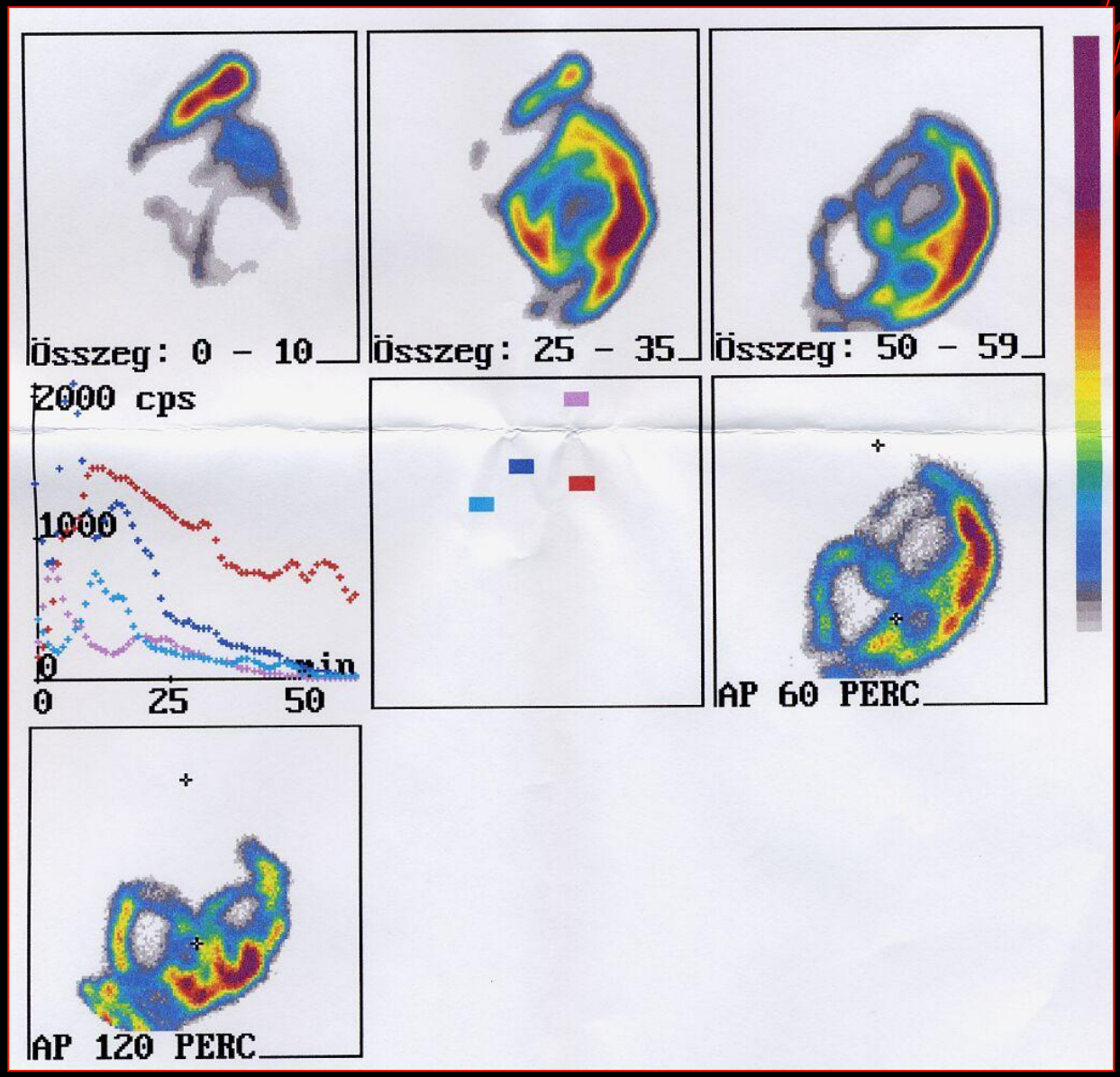
Indications: motility failures of eosophagus and/or stomach, cardiac and pyloric stenosis, tumors

Cardiac stenosis



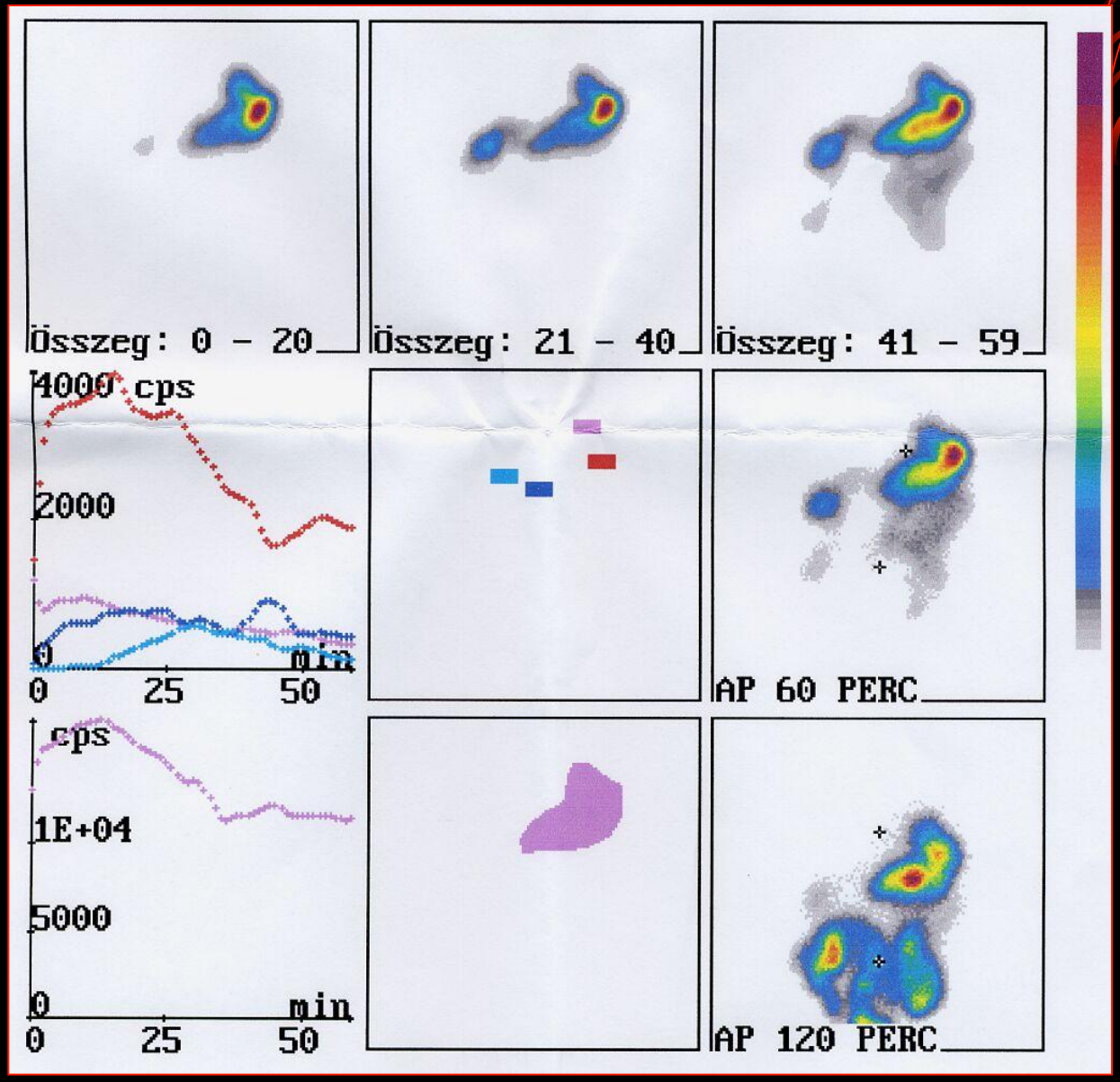
Slower passage through the oesophagus

Gastric emptying study



Normal examination

Pyloric stenosis



Definition of Meckel's diverticulum

An outpouching from the small intestine, due to failure of obliteration of the yolk stalk (which normally disappears during embryonic life).

About 2% of people have a Meckel's diverticulum. It is usually located about 2 feet (60 cm) above the junction of the small intestine with the colon (the large intestine).

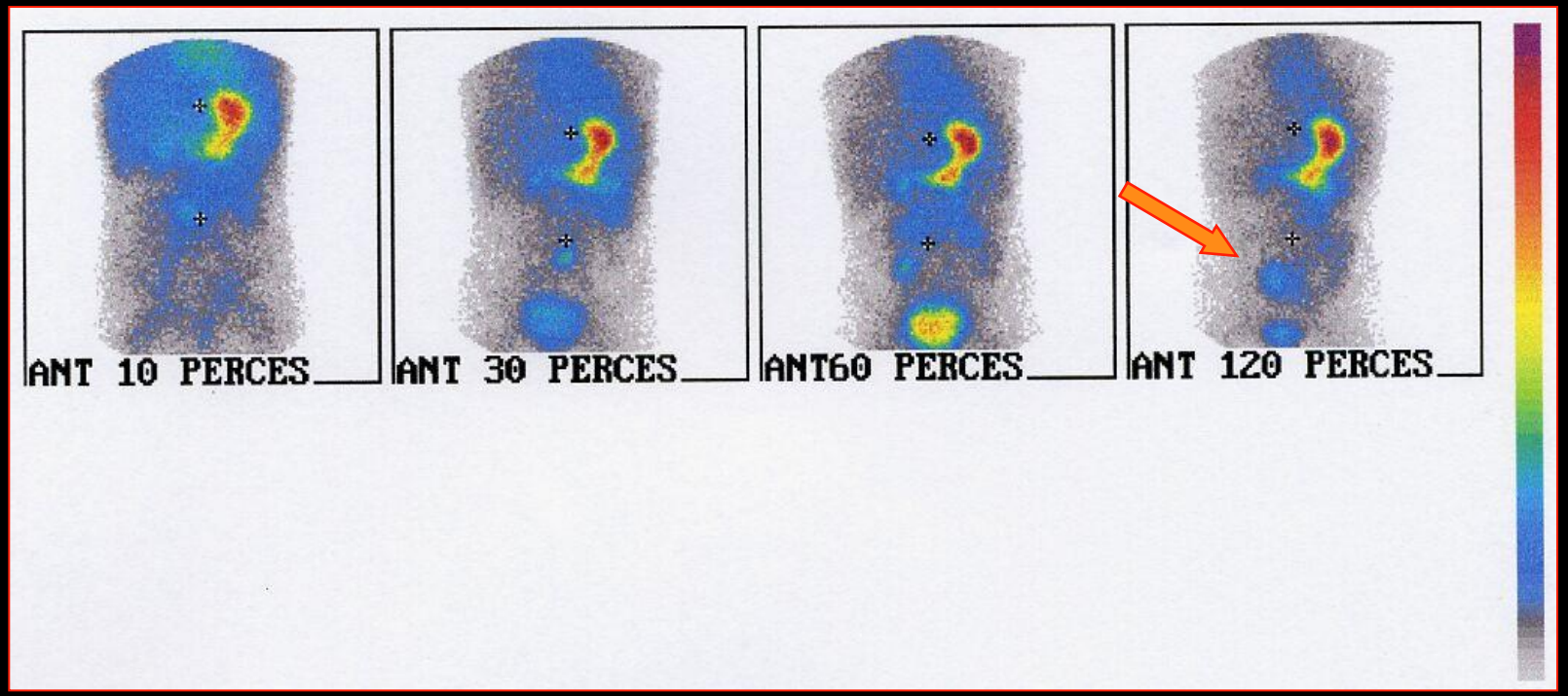
A Meckel's diverticulum can become inflammed, ulcerate, bleed, perforate or cause obstruction of the small bowels. If it is inflammed or perforated, it is usually removed by surgery.

Examination of Meckel's diverticulum

Radiopharmaceutical: 99mTc-pertechnetate i.v.

Anterior static imaging 10, 30, 60, 120 minutes after the injection

Pathological increased activity in the region of bowels




Thank you for your attention!