IMAGING OF HEART, LUNGS AND VESSELS

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Radionuclide ventriculography

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Radionuclide angiography (RNA)

- Analysis of ventricular wall motion during the cardiac cycle provides information of global ejection fraction (EF) of both right and left ventricle as well as of regional wall motion changes

- First-pass RNA:
  - Tc-99m pertechnetat, iv. bolus injection, 440-740 MBq (12-20 mCi)

- Equilibrium RNA:
  - 1. Tc-99m- red blood cells (labeled in vivo or in vitro)
  - 2. Tc-99m-albumin
• Equilibrium radionuclide angiography (E-RNA)

  – Tc-99m – labeled autologous red blood cells
  – ANT
  – LAO 45º (best septal)
  – LL 70º
• Method
  - gamma camera
  - computer synchronised with EKG
  - stress imaging
  - multistage treadmill exercise
  - defibrilator
- ED = end diastolic volume (hill)
- ES = end systolic volume (valley)

- Global ejection fraction (GEF) represents relation between stroke volume and diastolic volume of the chamber
- It can be calculated from the formula GEF=1-(ES/ED)
- Global ejection fraction (GEF) for the left and right ventricle
  
  \[
  \text{GEF} = \frac{\text{SV}}{\text{EDV}}
  \]
  
  GEF of the left ventricle ≥ 65%
  
  GEF of the right ventricle > 55%

- Regional ejection fraction:
  - Reduced or absent in the area of myocardial infarction
  - Aneurysm of the ventricle demonstrates paradoxical motion
• Indications
  - Coronary disease
  - Cardiomyopathy
  - Cardiac surgery
Equilibrium radionuclide ventriculography: ED – image of the heart in telediastole, ES image - of the heart in telesystole
Slika 3-16. Ekvilibrijska radionuklidna ventrikulografija. Volumna krivulja lijeve klijetke: maksimalna brzina pražnjenja klijetke tijekom sistole, tzv. PER (prema engl. peak ejection rate), maksimalna brzina punjenja klijetke tijekom dijastole srca tzv. PFR (engl. peak filling rate), vrijeme postizanja maksimalne brzine pražnjenja, tzv. TPER (engl. time to peak emptying rate) i vrijeme postizanja maksimalne brzine punjenja, tzv. TPFR (engl. time to peak filling rate).
* IVC  Ejection  **IVR  Rapid filling  Diastasis  Atrial kick

Systole

Diastole

* Isovolumic contraction
** Isovolumic relaxation
First pass radionuclide angiography. Sumation image of the left ventricle showing: left ventricle (A), aortic valve (B) and aorta ascendens (C)
GATED SPECT

- "gated" scintigraphy
- Synchronised with EKG
- Functional imaging
- Total and regional motion
GATED SPECT

LV Volume Curve

Frame Number

LV Volume (ml)

EF = 73%
EDV = 104 ml
ESV = 28 ml
SV = 76 ml
Mass = 123 gm
Nuclear medicine imaging of acute myocardial infarction

- Tc-99m- pyrophosphate; 15-20 mCi; imaging after 90 min

- In-111 labeled monoclonal miozin antibodies; 2-3 mCi; imaging after 24 do 48 h.

- Accumulation can be seen both in the active fase of myocarditis and during rejection of the transplanted heart
Antimyosin- Antibody imaging

Imaging of myocarditis with antimyosin antibodies in anterior and left anterolateral projection. There is diffuse pathological accumulation of antibodies in myocard and physiological accumulation in the liver and kidneys.
Myocardium inervation imaging

- **MIBG** (metajodobenzilgvanidin) – labeled with the I-131 or I-123

- Dosage:
  - I-131 MIBG - 18,50 MBq (0,5 mCi) i.v.
  - I-123 MIBG - 185 MBq (5mCi) i.v.

- Imaging begins 15 min after injection, and lasts up to 4 hours
Indications: reduction of myocardial accumulation of MIBG

- after heart transplantation

- diabetic neuropathy combined with ischemic congestive and hypertrophic cardiomyopathy, heart failure, postinfarction myocardial scar, ventricular arrhythmia
Examples of planar cardiac 123I-mIBG images. The example on the left shows normal cardiac 123I-mIBG uptake with a H/M ratio of 2.24 and a normal tracer washout (WO) from initial to delayed images of 10.64%. The example on the right shows an abnormal H/M ratio of 1.29 in images with an abnormal tracer washout of 23.35%.
Periferal angioscintigraphy

- Patency of large pelvic arteries, arteries of upper and lower limbs
  - 444-740 MBq (12-20 mCi) Tc-99m pertechnetate
  - Tc- 99m DTPA
  - Tc- 99m – labeled red blood cells

- Indications
  - Acute thromboembolisam
  - Patency of arteries after therapy
  - Foot perfusion (obliteration disease)
  - Hand perfusion (Syndroma Raynaud)
Morbus Bürger: (A) Blood pool imaging of distal part of cruris and foot is showing faint accumulation of labeled erytrocytes on the right cruris and on the right foot – arteriographicly and clinicly varrified oclusion of the big cruric and foot artery arteries on the right (B) Faint circulation of the right foot.
Thromb scintigraphy

- I-123 or Tc-99m labeled fibrinogen: for the detection of venous thromb
- In-111 labeled thrombocytes: for the detection of arterial thromb
Indications

- Deep vein thrombosis
- Follow up and assessment of surgical and conservative therapy of deep vein thrombosis of limb or pelvic vessels
- Pulmonary embolism caused by thrombus of unknown origin
- Assessment of venous filters patency (cava-filter)
- Unavailable radiophlebography
- Differential diagnosis of leg edema
- Differential diagnosis of muscle rupture and phlebothrombosis
Phleboscintigraphy
Phlebothrombosis of left iliac vein

The end!