|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **information** | **Measurement** | **Method** |
| Myocardial perfusion | Coronary circulation  Tissue perfusion | inflow of contrast agent  non-contrast agent based | Angiography  US - microbubbles  SPECT – 99Te  MRI – first pass MRI  – Arterial spin labelling |
| **Morphology** | **Chamber dilation**  **Hypertrophy** | **End diastolic dimension/volume**  **End systolic dimension/ volume**  **LV mass**  **Wall thickness** | **US - M-mode & 2D**  **CineMRI**  **CT** |
| *Global systolic function* | *Myocardial contraction* | *Fractional shortening*  *ejection fraction, cardiac output,* | *US - M-mode & 2D*  *CineMRI* |
| **Regional systolic function** | **Regional contraction** | **wall thickening**  **tissue stress/strain/torsion** | **US - speckle tracking**  **MRI - tissue tagging./ Velocity encoding** |
| *Diastolic function* | *Myocardial relaxation* | *Myocardial compliance* | *US – Doppler* |
| **Myocardial viability** | **Dead or alive?** | **Glucose metabolism**  **Uptake of contrast agent** | **PET - 18F FDG**  **MRI - Late enhancement** |
| *Metabolism* | *Energy production/ utilisation* | *Glucose metabolism*  *Fatty acid metabolism*  *ATP/PCr levels* | *PET - 18F FDG*  *SPECT – 123I BMIPP*  *MRI - spectroscopy* |
| **Ultrastructure** | **Fibre orientation** | **Water diffusion in direction of fibres** | **MRI – diffusion tensor imaging** |
| *Edema* | *Area at risk after infarction* | *Change in tissue’s magnetic transverse relaxation rate* | *MRI – T2 weighting* |
| **Collagen content** | **Interstitial fibrosis** | *Change in tissue’s magnetic longitudinal relaxation rate* | *MRI – T1 mapping* |
| *Molecular and cellular targets* | *Inflammation, apoptosis, fibrosis, cell grafting* | *Detection of a smart contrast agent that associates with the target. Measurement of extracellular volume* | *Antibody based smart contrast agents for PET/SPECT (radionuclides), MRI (iron oxide particles)and US (microbubbles). Dynamic equilibrium MRI* |
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|  |  |  |  |

**Learning objectives**

To gain an understanding of

What can be assessed using cardiovascular imaging.

How to measure cardiovascular function in experimental models

The strengths and weaknesses of imaging modalities

The technical challenges of experimental imaging

Examples of experimental applications

|  |  |  |
| --- | --- | --- |
| ***1D M-mode echo*** |  | ***mouse*** |
| End diastolic dimension EDD | Cavity diameter at diastole | 3.5 mm |
| End systolic dimension ESD | Cavity diameter at systole | 2 mm |
| Fractional shortening | (EDD-ESD)/EDD | 40 % |
| Wall thickness |  | 1 mm |
| ***2D B-mode echo & cine-MRI*** |  |  |
| End diastolic volume EDV | Cavity volume at diastole | 70 µl |
| End systolic volume ESV | Cavity volume at systole | 30 µl |
| Stroke volume SV | EDV-ESV | 40 µl |
| Ejection fraction EF | (EDV-ESV)/EDV | 60 % |
| Cardiac output CO | SV x heart rate | 24 ml/min |
| Wall volume (LV mass) |  | 100 mg |