Biology and Pathology

Cardiovascular Disease

Molecular Imaging of Myocardial Ischemia and Remodeling

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Learning Objectives:

- Become familiar with the principal molecular processes relevant to myocardial ischemia and remodeling
- Become familiar with the advantages and disadvantages of the various molecular imaging platforms with specific reference to myocardial imaging
- Review the work that has been done to date on the molecular imaging of myocardial ischemia and remodeling

Numerous molecular processes are involved in myocardial ischemia and remodeling and are amenable to molecular imaging.(1, 2) Myocardial ischemia is characterized by cell death. This can be due to apoptosis, necrosis or autophagy. Molecular MRI approaches have been developed to image apoptosis and necrosis in vivo.(3, 4) These processes can also be imaged with SPECT and PET.(5, 6) More recently, a fluorescence based approach was developed to image autophagy in vivo.(7) Cell death in ischemia is followed by inflammation. This can be imaged with iron oxide nanoparticles,(8) Gd loaded liposomes,(9) and fluorine loaded liposomes.(10) The proteolytic enzymes released by these infiltrating macrophages have been imaged with activatable MR and optical imaging agents.(11, 12) Inflammation is followed by myocardial healing during which scar formation and angiogenesis are the principal processes. Radiolabeled RGD has been used to image angiogenesis during the remodeling process.(13, 14) Gd chelates targeted to type-1 collagen and elastin and radiolabeled probes to MMP allow scar formation to be assessed noninvasively.(15-17) The remodeled heart is characterized apoptosis, fibrosis, overactivity of the renin-angiotensin system and an imbalance in cardiac sympathetic activity. Approaches have been developed to image sympathetic activity and angiotensin-II receptors in the heart.(18, 19)

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