

Cardiovascular MR Imaging: Exploring the Boundaries
Tues: Cardiovascular Molecular Imaging
Contrast Agents & Platforms

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Molecular MR imaging of the cardiovascular system is an expanding field. Cardiovascular diseases such as coronary artery disease represent the leading causes of death and morbidity worldwide. Diagnosis, prognosis, and monitoring therapy response are all significant needs being addressed by molecular MRI. Many treatment options involve surgical intervention or aggressive drug therapy and imaging can play a role in selecting patients for appropriate treatment.

The cardiovascular system is well suited to molecular imaging because imaging probes are administered intravenously. Vascular targets, then, are readily accessed. The high metabolic demand of the heart means that delivery of probes to the cardiac extracellular matrix and into myocytes is also quite feasible. This is in contrast to the brain where the blood brain barrier must be traversed. As a result there are numerous examples of targeted probes that recognize important biomarkers of atherosclerosis, apoptosis, necrosis, angiogenesis, thrombosis and inflammation.

This overview will focus on the different platforms that have been used to generate MR contrast. These include T2 agents like iron oxide nanoparticles that make the target dark, T1 agents like gadolinium-based probes that make the target appear bright, chemical exchange saturation transfer (CEST) based agents whose contrast is pulse sequence selective, and chemical shift and heteronuclear probes based on fluorine-19 or hyperpolarized C-13. In addition, the utility of probes that combine more than one imaging reporter (e.g. MR-PET) will be discussed, as well compounds that comprise a therapeutic and an imaging reporter.

Imaging probes can also be classified in terms of their physical properties. There are small molecules that can rapidly extravasate from the vascular system into the extravascular, extracellular space, and in some cases into cells. There are probes based on nanoparticles that deliver a large payload imaging reporter, but which have different pharmacokinetics and biodistributions compared to small molecules. There are also small molecule probes that undergo some sort of signal amplification process in situ, for instance in the presence of an enzyme.

Using recent examples from the literature, the different platforms and contrast agents will be compared and contrasted.

For additional information on this topic, a fairly recent review on this topic may also be consulted: Uppal and Caravan, "Targeted Probes for Cardiovascular MR Imaging", *Future Med Chem*, 2010; 2:451-70.