

## Recent Innovations in Cardiac MR: MR Angiography - Best of Both Worlds

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### Highlights:

- Clinical cases highlighting CE-MRA and non-contrast MRA
- Perspective on why/when to choose contrast vs. non-contrast MRA
- Understanding the limitations of contrast vs. non-contrast MRA

**Title:** Best of Both Worlds

**Target audience:** – Clinicians practicing or planning to practice MRA. Physicists interested in the clinical application of MRA.

**Outcome/Objectives:** – Participants will gain a clinical perspective on how and when to use contrast-enhanced vs. non-contrast MRA techniques, learn about the strengths and limitations of each in the clinical realm, and see several clinical cases highlighting both techniques.

**Purpose:** – Become familiar with contrast and non-contrast techniques as they are used clinically. Realize it is not a competition between the two techniques, but rather understanding and being able to utilize multiple types of MRA to achieve the desired diagnostic result with the least patient risk.

**Methods:** – Primarily a case-based presentation, examining how to approach a clinical vascular case in terms of deciding: what is the desired outcome, what are the patient-specific challenges, what MR resources are available to draw from. Based on this, an MRA strategy can be tailored to the clinical situation.

**Results:** – It is important to develop and know how to use a complete MRA “toolbox” of techniques that are compatible with your institution’s MR scanning capabilities. This requires some investment in learning time on both the physician and technologist’s part to know the capabilities of both contrast and non-contrast MRA sequences on their unique MR platform, and how and when to apply each.

**Discussion:** - Gadolinium-enhanced techniques remain the backbone of MR angiography for several reasons: simplicity, familiarity, high success rate, versatility, and time-efficiency. CE-MRA works for arteries from intracranial to pedal, digital to spinal. It can be used for veins/portal structures, is amenable to “time-resolved” acquisition, and can even be used to measure tissue perfusion and renal GFR. Despite this success, CE-MRA is not without problems: added expense, improper bolus-timing, not all patients can safely receive contrast, and some patients cannot or will not breath-hold or lay still. Modern non-contrast MRA techniques can address these problems, being divided into flow-dependent and flow-independent variants, used alone or in conjunction with various arterial spin labeling (ASL) techniques. These techniques often require ECG-gating or subtraction (e.g. diastolic minus systolic, tagged minus untagged). Readout strategies range from balanced steady state free precession (bSSFP) to half-Fourier fast spin echo (FSE). Inflow techniques used to suppress background and/or venous can be “flow-in” where the region of interest is saturated and fresh “bright” blood flows in, “flow-out” where selective and non-selective saturation pulses similarly suppress background and bright blood flows in, and “tag on/off” where interleaved sequences are performed +/- a saturation tag band and subtracted, leaving only signal where the tagged blood has flowed. As can be imagined, this smorgasbord of techniques requires considerable skill to set such parameters as inversion delays, ECG timing parameters, saturation band placement etc. that are all crucial to success - again adding to the complexity. But, once a non-contrast MRA technique is “dialed in”, meaning the technique is adopted to a particular vascular region on a particular scanner, the technique can be invaluable under the proper circumstances.

**Conclusion:** – Understand how and when to apply contrast vs. non-contrast MRA techniques.