

## Saturation-Band Cine MRI Improves Detection of Intracardiac Shunt

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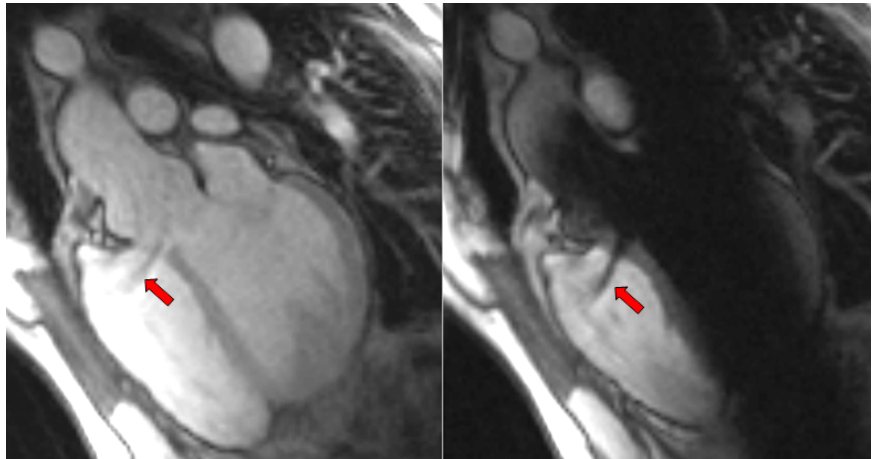
**Background:** Saturation-bands interleaved with gradient echo cine MRI provides “tagged” blood, but its use in the assessment of congenital intracardiac shunt has been limited. In a recent review of the literature, there was very little evidence to support the use of the saturation pulses in the assessment of intracardiac shunt with one study reporting the use of saturation bands to identify partial anomalous pulmonary vein anatomy.

**Objective:** The purpose of this study was to demonstrate the utility of adding a saturation pulse to gradient recalled echo (GRE) cine MRI to assist in the identification of intracardiac shunt.

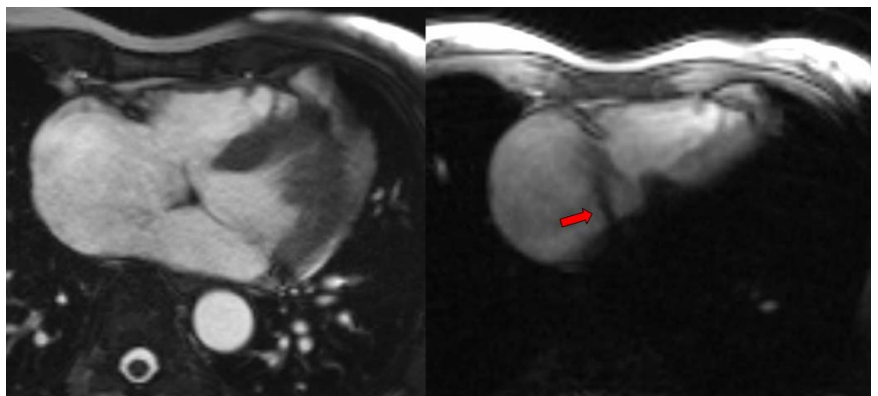
**Methods:** Twenty-nine patients were referred specifically for CMR assessment of either known or suspected intracardiac shunt. All CMR studies were performed on a 1.5 T scanner using a 12-element surface coil array. All patients underwent cine CMR of the heart with steady state free precession techniques. Select views were obtained using the saturation pulse applied to a GRE sequence in which the saturation pulse was prescribed over inflowing blood leading to areas of possible intracardiac shunt (e.g., for an atrial septal defect, the saturation bands were prescribed over the pulmonary veins). Pulmonary (Qp) and systemic (Qs) flows and the ratio Qp:Qs were measured with velocity encoded phase contrast cine MRI (Qp:Qs > 1.2 was considered a hemodynamically significant intracardiac shunt). A blinded, experienced observer reviewed each study and recorded the presence or absence of intracardiac shunt and the location based upon the cine images and then the saturation pulse images.

**Results:** Sixteen of the 29 patients had a hemodynamically significant shunt (mean Qp:Qs 1.7±0.6) while 13 did not (mean Qp:Qs 1.1±0.1). In 5 of 16 patients with a significant shunt, saturation-band cine MRI aided detection of intracardiac shunts. In 5 of 13 patients without a shunt, saturation-band cine MRI improved confidence in excluding specific intracardiac shunts (5 of 13 patients had conventional cine images that could not exclude presence of a shunt). Even in retrospect, 1 of the 16 shunts was not visualized on conventional cine images and was only detected by the saturation-band images.

**Figure 1.** There is a subtle flow abnormality across a membranous ventricular septal defect on cine MRI (left). The panel on the right is a GRE image in which saturation bands have been laid across the left heart, and the left-to-right flow is much more apparent.



**Figure 2.** The interatrial septum is not easily visualized in the panel on the left; however, the saturation-band cine MRI image on the right clearly illustrates a secundum atrial septal defect with left-to-right shunting.



**Conclusion:** Standard steady state free precession cine imaging is an excellent technique for visualizing intracardiac shunts. Imaging with the addition of a saturation pulse can aid in the anatomic delineation of an intracardiac shunt. The technique is easily implemented and can be added to a standard congenital imaging protocol. Compared with echocardiographic bubble studies that detect a small amount of reverse flow through an atrial septal defect, saturation band cine MRI allows detection of the primary direction of flow through an atrial septal defect.

References: Kimura K. *Angiology*. 2001 May;52(5):331-5.