Journal of Cardiovascular Magnetic Resonance

Meeting abstract

401 New dynamic gradient echo cine for detection of intracardiac shunts

Philip J Grimaldi*, Richard Shulman and Heather Hurlburt

Address: Cardiovascular Associates of Rhode Island, Providence, RI, USA
* Corresponding author

from 11th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 1–3 February 2008

Published: 22 October 2008

Journal of Cardiovascular Magnetic Resonance 2008, **10**(Suppl 1):A115 doi:10.1186/1532-429X-10-S1-A115

This abstract is available from: http://jcmr-online.com/content/10/S1/A115

Introduction

CMR is a useful diagnostic tool in the evaluation of patients with intracardiac shunting. Balanced gradient echo sequences provide excellent temporal and spatial resolution. Fast gradient echo techniques are more sensitive to flow artifacts and with the use of saturation bands are therefore useful in the evaluation of nulled and turbulent blood flow associated with intracardiac shunts. Standard cine acquisition necessitates adequate breath holding for improved spatial and temporal resolution. Patient selection would be broadened by eliminating the need for breath holding and sensitivity for detecting small interatrial shunts would be increased by focusing on that portion of the cardiac cycle in diastole when shunt flow is maximal. By using an unusual combination of EKG triggered sequencing with cine acquisition and respiratory navigation, it is possible to produce a "cine" of sequential, repetitive views limited to mid-diastole that improves sensitivity for the detection of small inter-atrial shunts even in patients who have difficulty with breath holding.

Purpose

To improve detection of intracardiac shunting, a new technique is described which uses a free breathing, EKG triggered, fast gradient-echo "cine" acquisition of a narrow cardiac phase in mid-diastole.

Methods

Ten patients with a known atrial septal defect (ASD) by standard 2D echocardiography with color flow Doppler imaging were referred for CMR. A standard four chamber view was obtained using saturation bands that were placed adjacent to the interatrial septum in the left atrium and outside the left atrium to overlay areas of pulmonary venous inflow. Attention was given to exclude the IVC and SVC structures from the territory of the saturation band so that blood flow from these venous structures was not erroneously nulled. Images were obtained using both previously described gradient echo cine techniques with breath holding and the new EKG triggered gradient echo cine acquisition during free breathing. For the proposed method, the time delay from the R wave was optimized to include early-mid diastolic filling which approximated 400–500 ms. A "cine" image was created comprised of repeated images with the use of respiratory navigation which allowed for synchronization of both respiratory and cardiac phases during acquisition. The result was a "cine" of multiple views of the same cardiac mid diastolic phase synchronized for end expiration.

Results

All ten patients referred for CMR had detectable interatrial shunting as identified by a jet of nulled blood flow which was visualized in the right atrium by both techniques. Interatrial shunting was best appreciated at a phase which began acquisition approximately 400 ms after the R wave with both techniques. The free breathing method using the respiratory navigator had reduced motion artifact compared to the breath hold standard cine sequence. In addition, repeated frames looking at the same mid diastolic phase of the cardiac cycle had the effect of amplifying the signal drop out due to small left to right ASD shunts. (Figure 1.)

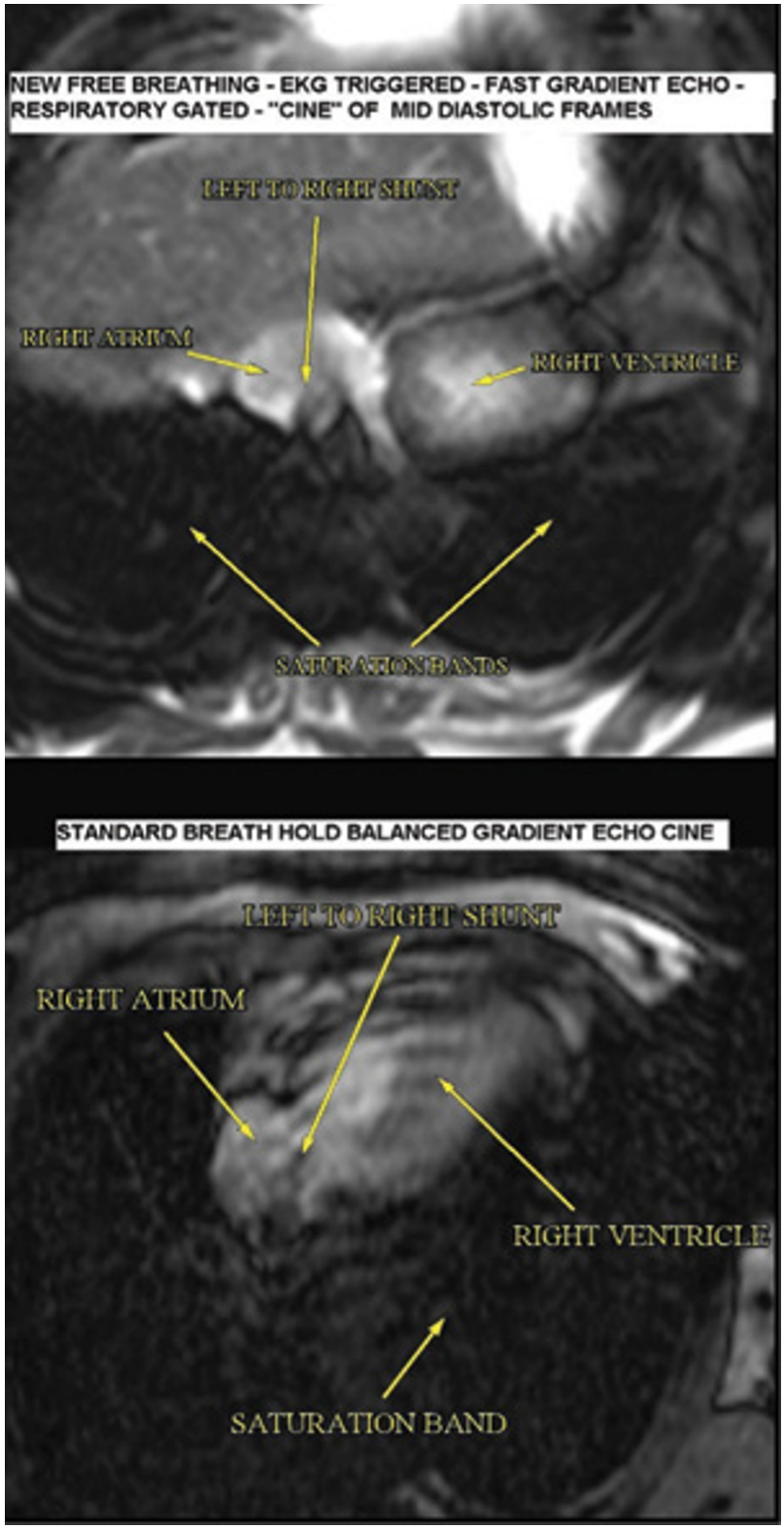

Figure 1
A new technique for improved sensitivity and reduced motion artifact in the evaluation of intracardiac shunts is described using a combination of EKG trigerring and dynamic gradient echo free breathing "cine" acquisition with respiratory tracking.

Conclusion

Free breathing, EKG triggered mid diastolic dynamic gradient echo "cine" acquisition with respiratory navigation can be used to enhance image quality and thereby the detection of intracardiac shunting. While this technique does not use standard cine phase acquisition to depict cardiac motion, it provides enhanced image quality due to focused phase acquisition when shunt flow is maximized and significantly reduces motion artifact with its capability for respiratory navigation. CMR has become an excellent tool for the evaluation of cardiac structure, function, and viability in a single test. This technique would broaden patient selection by permitting free breathing and enhance the diagnostic capability of CMR as it applies to the evaluation of patients with suspected intracardiac shunting.