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Poster presentation

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Time-resolved spin-labeled balanced SSFP cineangiography of the heart: a novel approach for visualizing intracardiac shunt

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Introduction

Present methods for intracardiac shunt evaluation have important technical limitations. For example, phase contrast imaging (PC) is sensitive to velocity encoding setting and angle of imaging plane. PC can also be difficult to interpret due to complex flow patterns and separation of morphologic from velocity images. Cine GRE sequences that involve saturation of inflowing blood have poor SNR. Methods requiring gadolinium have limited use within a single exam and in patients with renal insufficiency. A method that circumvents these technical limitations in shunt visualization is desirable.

Purpose

We sought to develop a time-resolved spin-labeled technique (TRSL) to image tagged blood within the heart for visualization of intracardiac shunt.

Methods

Background signal was suppressed with a non-selective inversion radiofrequency pulse. Slice-selective inversion slabs were applied immediately thereafter to remagnetize the labeled blood pool. Remagnetized blood within the heart was visualized using an ECG gated, segmented, bSSFP readout at sequential inversion times. General parameters were FOV 340, matrix 128 × 100, slice thickness 6-8 mm, TR 46 ms, TE 1.3 ms, 30-40 phases reconstructed, breathhold time 12-14 seconds. The sequence was implemented on a 1.5 T Siemens Avanto scanner.

Six subjects with known atrial septal defects (ASD) were evaluated. Inversion slabs were prescribed in the pulmonary veins to tag left atrial blood and in the inferior/superior vena cava to tag right atrial blood.

Results

Tagged inflowing blood was depicted with high signal intensity (SI) while non-tagged blood was suppressed. In ASD patients, tagged blood with high SI in the left atrium (LA) was visualized crossing the atrial septum demonstrating left-to-right flow (white arrows, panel A). Non-tagged blood with low SI is seen simultaneously in the right atrium (RA), right ventricle (RV), and left ventricle (LV). Mean CNR of shunt to RA blood was 19.4 (range 8.6-34.6). Flow was visualized both inplane (long/short axis) and throughplane (en face). Panel B shows the cross-sectional (en face) view of a large ASD with white cross-hairs defining its size and shape. Flow was visualized while maintaining good morphological assessment of

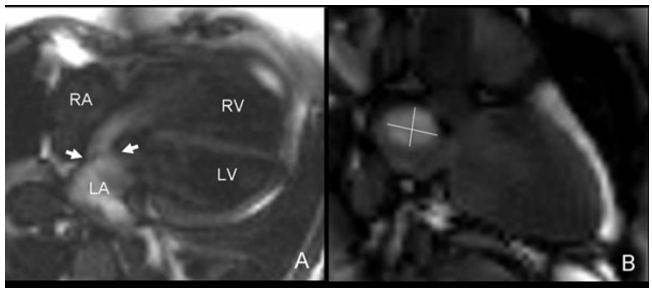

Figure 1

surrounding cardiac structures. In 2 patients right-to-left flow was detected Figure 1.

Conclusion

1. TRSL is a non-contrast, non-velocity dependent, non-subtractive method for visualizing RF-tagged blood flowing through cardiac chambers.

2. The method successfully demonstrated left-to-right and right-to-left intracardiac shunting.

3. TRSL has potential use in the detection and pre-procedural assessment of intracardiac shunt.

4. Application in small shunts, valvular disease, and perfusion has yet to be evaluated.