

# Zoom Imaging for Cardiovascular Risk Assessment

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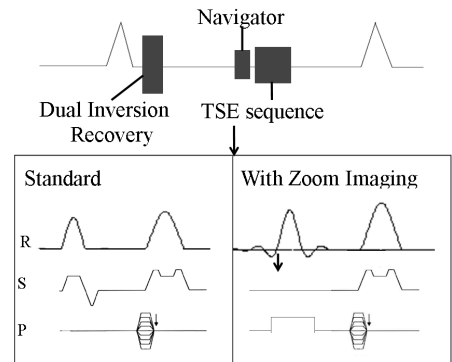
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## Background

A free-breathing ECG triggered, turbo-spin-echo (TSE) black-blood sequence has been described to detect subclinical aortic atherosclerosis (Fayad et al, Circulation 1998) and the value of this sequence to stratify cardiovascular risk has been demonstrated in more than 2500 patients recruited from the Framingham population (Jaffer et al 2002 & Oyama et al 2008). Routine use of this sequence for aortic plaque screening is challenging due to the relatively long imaging time. This study seeks to demonstrate the use of the 'reduced FOV' or more recently renamed 'zoom imaging', technique for accelerating aortic vessel wall imaging.

## Methods

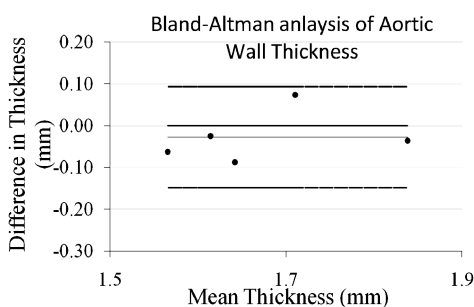
Five healthy volunteers underwent cardiovascular magnetic resonance imaging (CMR) of the thoracic aorta using a 1.5T Achieva clinical MR scanner (Philips Healthcare, Best, NL). Aortic vessel wall images were obtained using a five element cardiac phased-array receiver coil. Forty transverse slices encompassing the aortic arch and entire thoracic aorta down to the diaphragm were obtained using a free-breathing navigator gated and ECG-triggered, black-blood 2D TSE sequence. A 5mm slice-thickness was used with a 1mm overlap and partial Fourier imaging (factor = 0.75) was used to further shorten scan time. Other imaging parameters included: repetition time of two heart beats, one signal average, shortest trigger delay, echo time of 5.0 ms and 60ms acquisition window. Imaging was performed both with zoom imaging (FOV = 220mm x 67mm) and without zoom imaging (FOV = 220mm x 220mm). Zoom imaging is implemented by changing the orientation of the refocusing pulse so that it is at an orthogonal plane to the excitation pulse. Scan times, signal-to-noise ratios (SNR, mean signal intensity of the aortic wall divided by the s.d. of the signal anterior to the chest) and contrast-to-noise ratios (CNR, difference in mean signal intensity between paraspinal muscle and aortic wall divided by the s.d. of the signal anterior to the chest) were then compared between sequences. Additionally, aortic vessel wall sharpness and thickness was compared between the two sequences using 'SoapBubble' software analysis tool (Etienne et al 2002).



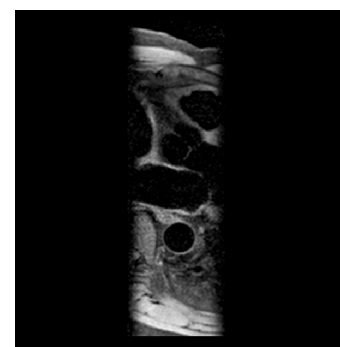
In the Zoom TSE sequence, the excitation and refocusing pulses are in orthogonal planes, allowing a small FOV without wraparound artefact. (RF = Radiofrequency pulse; S = Slice Selection; P = Phase Encoding)

## Results

5 healthy volunteers (4 male) were recruited for this study with a mean age of 33 years (range 25 to 43 years) and a mean heart rate of 65bpm (range 60 to 72). Excellent diagnostic quality imaging of the aortic vessel wall (Grade 4, McConnell et al 1997) was achieved in all cases with an in-plane spatial resolution of 0.98 x 1.06mm (0.31 x 0.30mm reconstructed). Mean navigator efficiency was 56%. Zoom imaging significantly reduced imaging time from a mean of 35 ±12 minutes to a mean of 11 ±2 minutes (p<0.01). There was a trend of higher SNR without zoom imaging (38 ±34 vs. 24 ±15; p=0.18). However, CNR was comparable at a mean of 10.3 ±6 with zoom imaging and 10.8 ±10 without (p=0.84). More importantly, aortic vessel wall sharpness was also comparable at a mean of 39 ±2% with zoom imaging and 36 ±3% at full FOV (p=0.16). Furthermore there was no difference in aortic vessel wall thickness (mean with zoom 1.66 ±0.11 mm and 1.68 ±0.10mm at full FOV; p=0.4). Aortic wall thickness measures had excellent agreement (Bland-Altman analysis (below) indicating that the 95% limits of agreement between the two methods ranged from -0.15 to 0.09mm).



Full field of view Image



Equivalent with Zoom imaging

## Discussion

Previous studies have demonstrated how zoom imaging can be used for rapid small field of view imaging during percutaneous interventions (e.g. Buecker et al 1998 and van Vaals et al 1994). This study demonstrates for the first time the use of zoom imaging to reduce imaging time for diagnostic cardiovascular aortic vessel wall imaging. We were able to use zoom imaging to reduce imaging time by 68% without loss of contrast-to-noise ratio or vessel sharpness. There was a trend to lower SNR without relevance to image quality or image analysis. We propose that use of this sequence will allow rapid and more time efficient imaging of the thoracic aorta for cardiovascular risk prediction. By reducing imaging time, the sequence becomes more applicable for future studies of risk stratification and monitoring of treatment effects in those individuals.