

ORAL PRESENTATION

Open Access

Efficient 3D late gadolinium enhancement imaging using the CLAWS respiratory motion control algorithm

Jennifer Keegan^{1*}, Permi Jhooti¹, Sonya V Babu-Narayan^{1,3}, Peter Drivas¹, Sabine Ernst^{1,2}, David N Firmin^{1,3}

From 16th Annual SCMR Scientific Sessions
San Francisco, CA, USA. 31 January - 3 February 2013

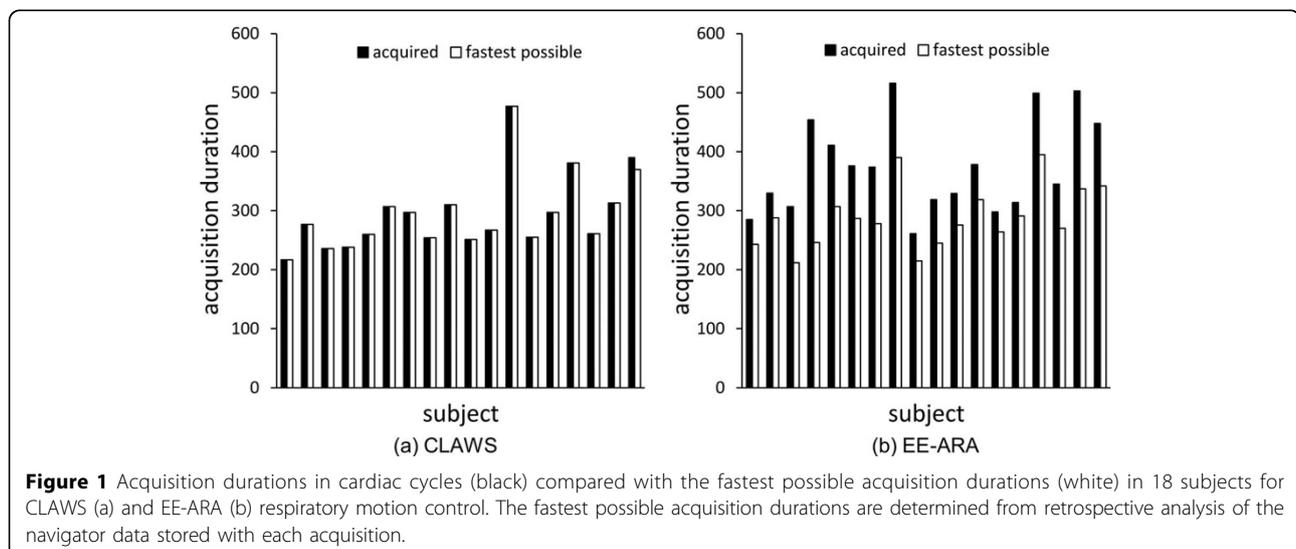
Background

Acquisition durations of navigator gated high resolution 3D late gadolinium enhancement (LGE) studies are long (1,2). While implementation of the continuously adaptive windowing strategy (CLAWS (3)) - which results in the fastest possible acquisition duration for a given breathing pattern and navigator acceptance window size - may be beneficial, the respiratory-dependent and therefore, non-smooth k-space acquisition order during gadolinium wash-out could result in increased image artifact. This study was performed to investigate if CLAWS could be

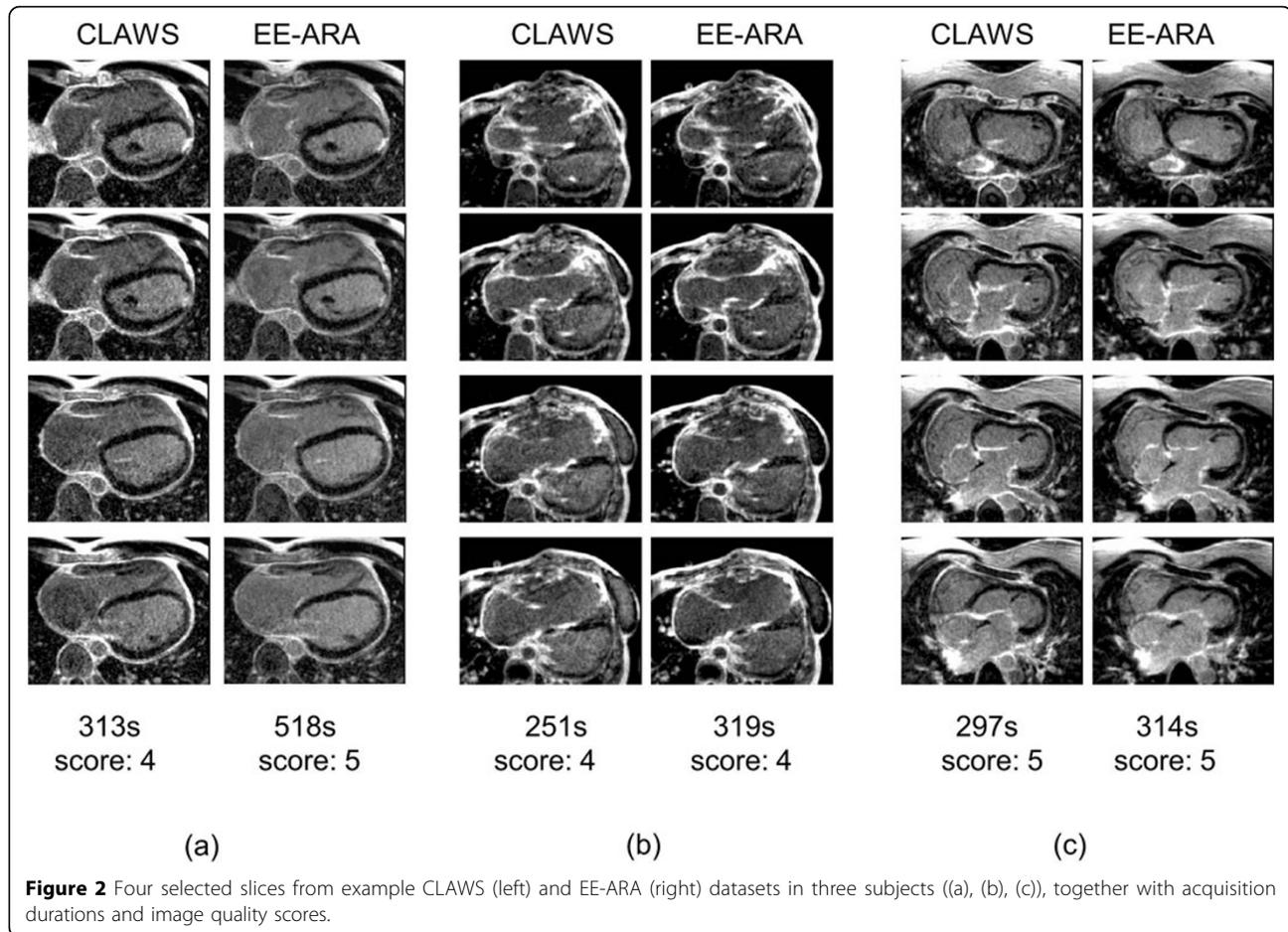
used to increase the respiratory efficiency of 3D LGE imaging without detriment to image quality.

Methods

Whole-heart 3D (32-36 slices, 1.5 x 1.5 x 4 mm, reconstructed to 64-72 slices, 0.7 x 0.7x.2 mm) inversion-prepared segmented gradient echo imaging was performed in 18 consecutive patients on a Siemens 1.5 Tesla Avanto scanner. Two acquisitions were performed in random order, one with CLAWS respiratory motion control and one with an end-expiratory tracking accept/reject



¹Cardiovascular Biomedical Research Unit, Royal Brompton and Harefield NHS Trust, London, UK
Full list of author information is available at the end of the article



algorithm (EE-ARA). Imaging started 15 minutes post-gadolinium administration with inversion-time scouting both before and after each acquisition. Paired t-testing was used to compare the acquisition durations against the best possible scan times that could have been achieved for the patient-specific respiratory patterns which were determined from retrospective analysis of the navigator data stored with each acquisition. CLAWS and EE-ARA qualitative image quality scores (ranging from 1 = non-diagnostic to 5 = excellent) were compared using paired-Wilcoxon analysis.

Results

Retrospective analysis of the navigator data stored with the acquisitions shows that CLAWS results in scan times which are very close to (within 1%) or equal to the fastest achievable scan times (293.8 ± 65.0 cardiac cycles vs 292.7 ± 63.4 cardiac cycles, $p = ns$) while EE-ARA significantly extends the scan duration (374.8 ± 81.4 cardiac cycles vs 289.2 ± 51.4 cardiac cycles, $p < .0001$) (see Figure 1). EE-ARA acquisitions are 26% longer than CLAWS acquisitions (378 ± 104 s vs 301 ± 85 s, $p = .002$). Image quality scores are slightly but not significantly reduced for CLAWS scans (4.1 ± 0.6 vs 4.3 ± 0.6 , $p = ns$). Example

data is shown in Figure 2. Detailed numerical phantom simulations confirm that for noise levels consistent with in vivo acquisitions, the non-uniform k-space ordering introduced by the CLAWS algorithm does not result in changes in blood signal-to-noise ratio (21.4 ± 4.0 vs 22.9 ± 4.8 , $p = ns$) or in blood-myocardium contrast to noise ratio (19.3 ± 3.9 vs 19.9 ± 4.5 , $p = ns$).

Conclusions

We conclude that the CLAWS algorithm allows efficient acquisition of free-breathing 3D LGE without detriment to the image quality.

Funding

Wellcome Trust: WT093953MA; NIHR (National Institute for Health Research); British Heart Foundation Intermediate Clinical Research Fellowship.

Author details

¹Cardiovascular Biomedical Research Unit, Royal Brompton and Harefield NHS Trust, London, UK. ²Cardiology, Royal Brompton and Harefield NHS Trust, London, UK. ³Imperial College of Science Technology and Medicine, London, UK.

Published: 30 January 2013

References

1. Peters, *et al.*. *Radiology* 2007.
2. McGann, *et al.*. *JACC* 2008.
3. Jhooti, *et al.*. *Magn Reson Med* 2010.

doi:10.1186/1532-429X-15-S1-O63

Cite this article as: Keegan *et al.*: Efficient 3D late gadolinium enhancement imaging using the CLAWS respiratory motion control algorithm. *Journal of Cardiovascular Magnetic Resonance* 2013 15(Suppl 1):O63.

**Submit your next manuscript to BioMed Central
and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

