

POSTER PRESENTATION

Open Access

Operator-guided Navigator Gating for Real-Time Interactive Coronary Cardiovascular Magnetic Resonance

Keigo Kawaji^{1*}, Mita Patel¹, Jouke Smink², Hui Wang³, Roberto Lang¹, Amit R Patel¹

From 19th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 27-30 January 2016

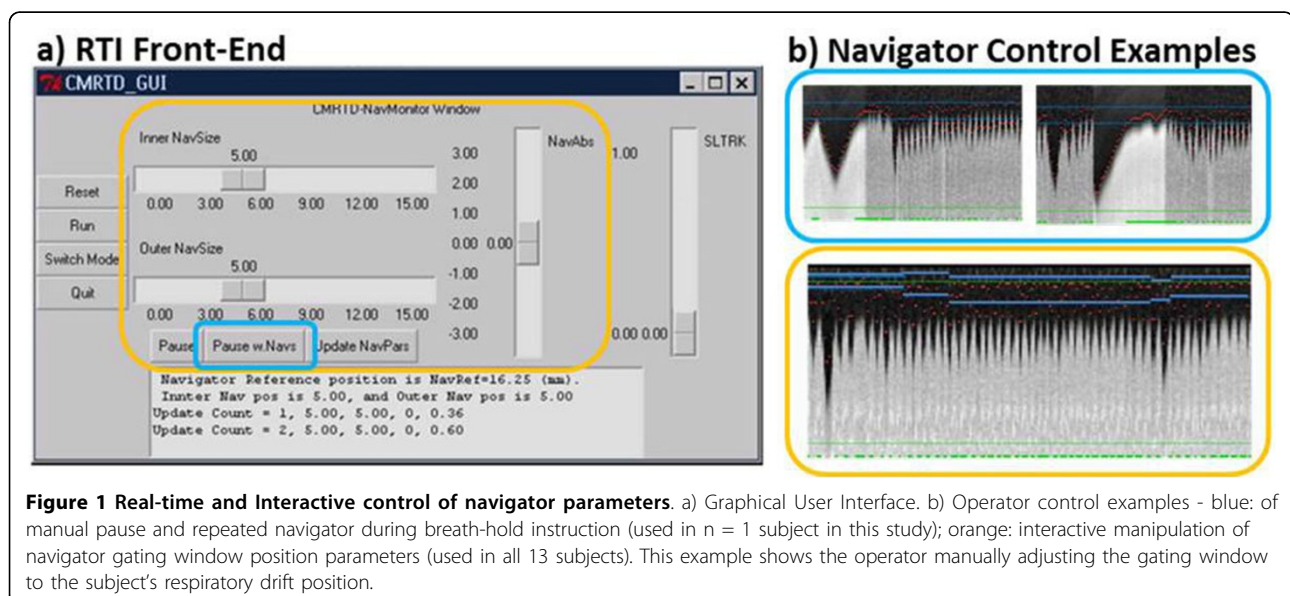
Background

Real-time interactive (RTI) MRI parameter manipulation during the scan [1] may potentially address challenges imposed by respiratory motion during a free-breathing cardiovascular magnetic resonance (CMR) acquisition. In this study, we propose an operator-guided processing that allows manipulation of navigator gating parameters in real-time. This approach was evaluated in healthy volunteers, where coronary CMR (CCMR) with and without RTI manipulation was examined to assess acquisition failure rates, scan time reduction, and vessel sharpness.

Methods

The proposed RTI framework employs a custom communication protocol between the scanner host and the waveform generation hardware that allows non-time-critical operator tasks (ie. made changes are reflected in the next collected heart beat without overtasking the scan runtime). The custom front-end (Figure 1a) shows the operator-interactive navigator control that allows manipulation of the diaphragm navigator gating window in real-time (Figure 1b).

This RTI approach was incorporated into a CCMR sequence with view/profile order compatible with



¹Medicine, Section of Cardiology, The University of Chicago, Chicago, IL, USA
Full list of author information is available at the end of the article

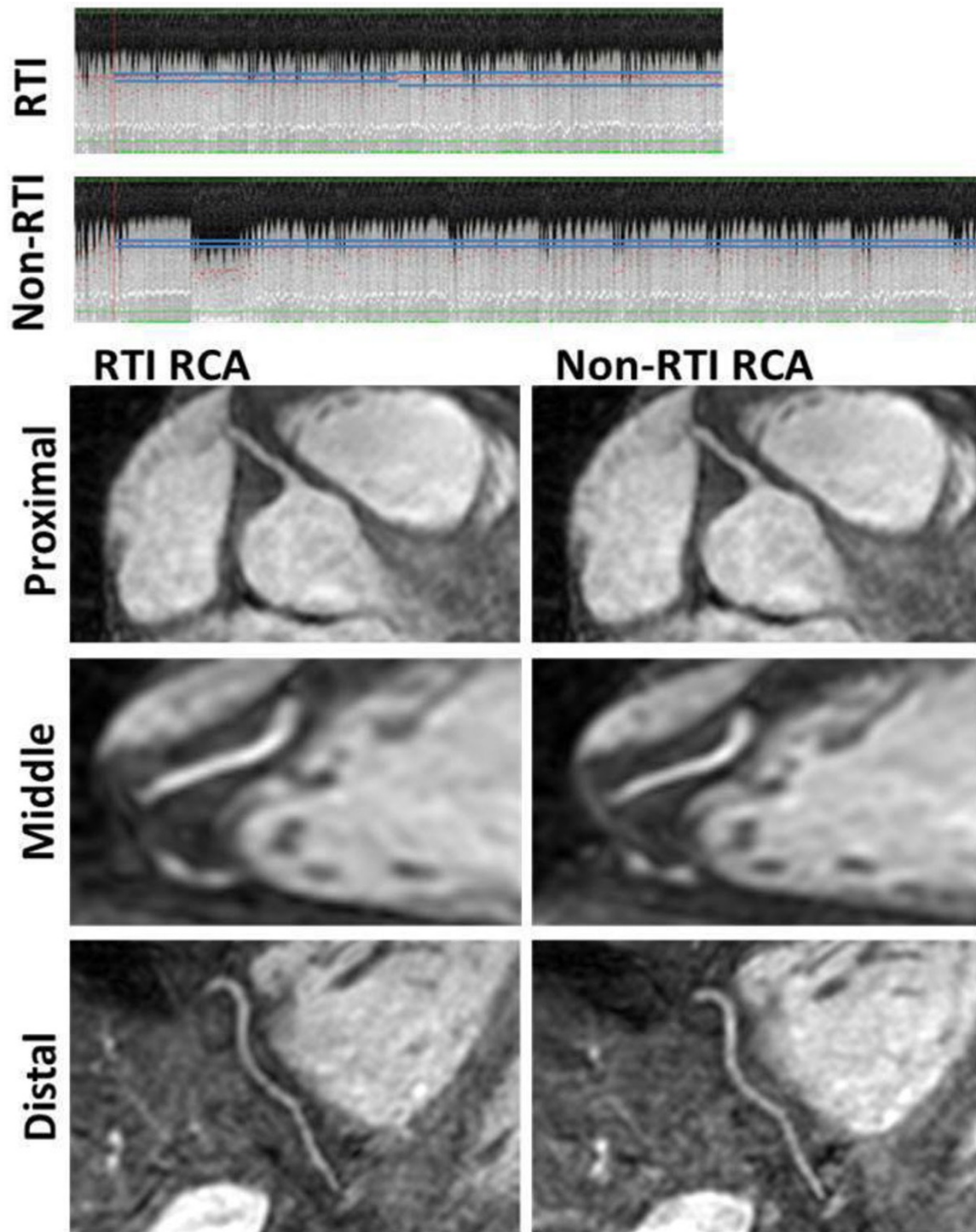


Figure 2 Example of RTI adjusted CCMR compared against a non-RTI approach reference. Top: RTI and non-RTI NAV profiles. RTI: 324 HBs; NavEff = 62% vs non-RTI: 438 HBs and 46%. Operator interaction involved expanding the navigator gating window size from 5 mm to 7.5 mm midway (136th out of 324 HBs) during the scan. This increased the navigator efficiency from 56% (first 136 HBs) to 66% (Remaining 188 HBs). Bottom: Acquired RCAs. Sharpness scores were (RTI: 0.52) vs (non-RTI: 0.48).

weighted navigator gating. 13 healthy volunteers were imaged on a 1.5T system (Philips Achieva) using a 5 channel cardiac array. Scan parameters were: TR = 4.4 ms; TE = 1.9 ms; FA = 90; $300 \times 300 \times 100\text{-}130 \text{ mm}^3$ at 1.3 mm^3 , interpolated to $0.65 \times 0.65 \times 1.3 \text{ mm}$ resolution; Sensitive Encoding (R = 2) was used. The default gating window was 5 mm set by a 20-heart-beat (HB) calibration. Slice tracking was not used. Two volumes were acquired; one employing RTI, and another without using this tool. RTI and non-RTI CCMR acquisitions were randomized. Total number of HBs (calibration HBs not included), navigator efficiency (NavEff), and vessel sharpness in the RCA, LAD, and LCX were measured. Student's t-test was used for statistical analysis.

Results

The proposed RTI tool allowed successful completion of 3D coronary acquisition in all 13 subjects (375 ± 67 HBs, NavEff = $56 \pm 9\%$). Figure 2 shows a representative example. The non-RTI scans resulted in the operator restarting the scan in seven subjects ($n = 8$ total restarts; stopped @ 82 ± 51 HBs w. NavEff = $26 \pm 12\%$; restart rate = 40% [8/20 scans]). Of these, non-RTI data was not collected in $n = 1$ due to significant respiratory drifting. The total HBs for $n = 12$ non-RTI scans were 443 ± 76 ($p < 0.001$ vs RTI), with NavEff = $48 \pm 6\%$ ($p < 0.005$ vs RTI). Sharpness scores (RTI vs non-RTI) were as follows: RCA (0.48 ± 0.04 vs 0.46 ± 0.05 ; $p < 0.05$), LAD (0.41 ± 0.06 vs 0.42 ± 0.04 ; $p = \text{NS}$), and LCX (0.40 ± 0.05 vs 0.41 ± 0.04 ; $p = \text{NS}$).

Conclusions

The feasibility of RTI manipulation between waveform generator and host console during MRI data acquisition was successfully demonstrated without need for additional dedicated research hardware. RTI operator-guided manipulation of the navigator gating window eliminated repeated acquisitions of 3D CCMR sequences in all 13 subjects, while achieving ~70 fewer HBs, ~8% NavEff increase, and improved/comparable sharpness compared to conventional non-RTI CCMRs.

Authors' details

¹Medicine, Section of Cardiology, The University of Chicago, Chicago, IL, USA. ²Philips Healthcare, Best, Netherlands. ³Philips Healthcare, Cleveland, OH, USA.

Published: 27 January 2016

Reference

1. Kawaji, et al: *MRM* 2014.

doi:10.1186/1532-429X-18-S1-P321

Cite this article as: Kawaji et al.: Operator-guided Navigator Gating for Real-Time Interactive Coronary Cardiovascular Magnetic Resonance. *Journal of Cardiovascular Magnetic Resonance* 2016 **18**(Suppl 1):P321.

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

