



HAL
open science

Quantitative assessment of myocardial motion from displacement measurements derived from velocity encoded MRI

Anja Lutz, Jan Paul, Patrick Etyngier, Axel Bornstedt, G Ulrich Nienhaus, Peter Bernhardt, Wolfgang Rottbauer, Volker Rasche

► **To cite this version:**

Anja Lutz, Jan Paul, Patrick Etyngier, Axel Bornstedt, G Ulrich Nienhaus, et al.. Quantitative assessment of myocardial motion from displacement measurements derived from velocity encoded MRI. 15th Annual Scientific Sessions of the Society for Cardiovascular Magnetic Resonance, Feb 2012, Orlando, FL, United States. pp.W20, 10.1186/1532-429X-14-S1-W20 . hal-00764814

HAL Id: hal-00764814

<https://hal.science/hal-00764814>

Submitted on 13 Dec 2012

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

WORKSHOP PRESENTATION

Open Access

Quantitative assessment of myocardial motion from displacement measurements derived from velocity encoded MRI

Anja Lutz¹, Jan Paul¹, Patrick Etyngier³, Axel Bornstedt¹, Gerd Ulrich Nienhaus², Peter Bernhardt¹, Wolfgang Rottbauer¹, Volker Rasche^{1*}

From 15th Annual SCMR Scientific Sessions
Orlando, FL, USA. 2-5 February 2012

Summary

It is objective of this study to investigate the potential of velocity encoded MRI (TPM) to derive quantitative parameters based on local displacement information for the automatic assessment of mechanical asynchrony in CRT patients.

Background

About 30% of patients treated with cardiac resynchronization therapy (CRT) do not benefit. Several MRI derived parameters have been published for quantification of mechanical asynchrony. Most parameters are based on tagging techniques. Evaluation of the tagging information is often cumbersome due to fading of the tag pattern (SPAMM) or low SNR (CSPAMM) especially during diastole.

Methods

12 volunteers (30±8 years) and 3 patients (41±11 years) were investigated at a 3T whole body MR scanner (Achieva, Philips) with a 32 channel coil. The patients suffer from DCM, asynchrony and/or LBBB. A velocity encoded navigated segmented gradient echo sequence was applied in the apical, equatorial and basal slice. Acquisition parameters: FOV=340²mm², in-plane res.=2.5²mm², slice thickness =8mm, TR/TE=6.3ms/4.6ms, α=15°, 3 k-lines per segment, VENC=30cm/s, scan duration =5.51 min., black blood imaging with alternating presaturation pulses[1], SENSE=2 and 32 cardiac phases for 60 bpm.

Displacement and strain were calculated from the TPM data. Quantitative parameters derived included: circumferential and radial temporal uniformity of strain (TUS)[2-5], regional variance of strain (RVS) and regional variance of principle strain(RVVPS)[2], standard deviation of onset and peak time (SD(T_{onset}),SD(T_{peak}))[6], coefficient of variance (CV) and difference between septal and lateral peak circumferential strain (DiffSL-peakCS)[6,7], the absolute values of the OS and PS delay vector between septal-lateral (SL), inferior-anterior (IA) and apical-basal (AB) wall[8,9] and the base apex rotation coefficient (BARC)[10].

Results

Table 1 summarizes the quantified parameters for the volunteer and patient group. TUS_c, SD(T_{onset}), the coefficient of variation, all OS delay values and the SL and IA PS delay values and BARC are not within the standard deviation of the respected volunteer data. Figure 1 shows the displacement of apical and basal slices exemplarily for one volunteer and one patient with proven asynchrony, with a clear loss of twisting motion.

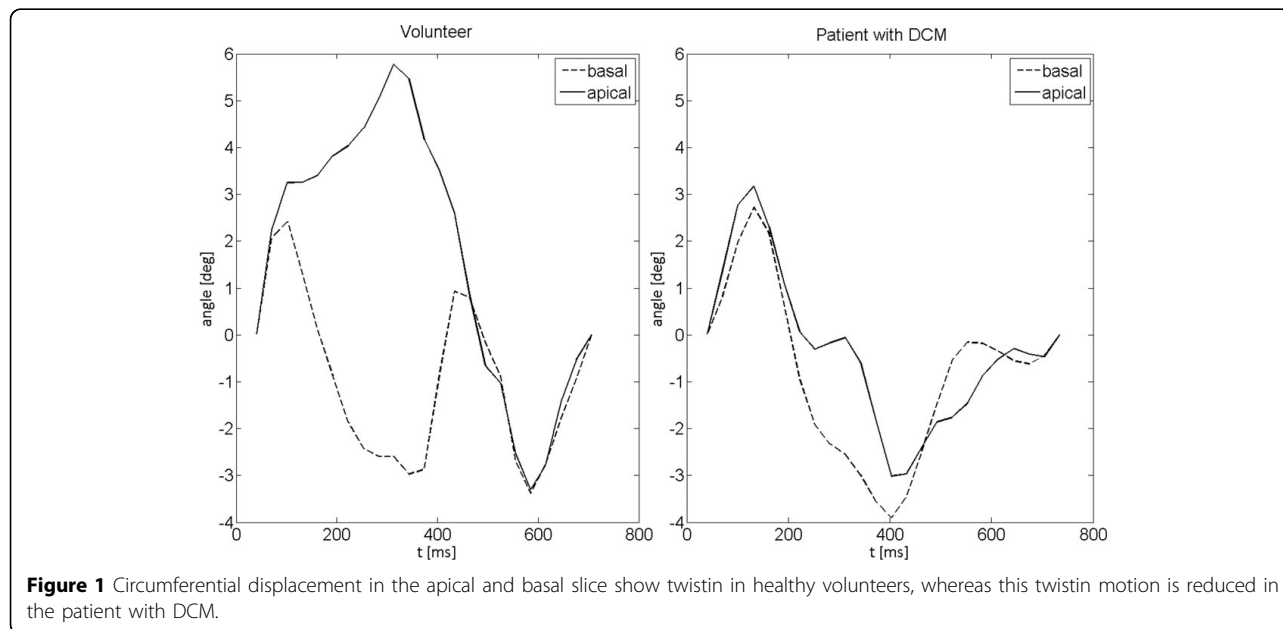
Conclusions

All parameters for asynchrony quantification based on tagging published earlier can also be derived from TPM data and similar differences between volunteers and patients as known from tagging are observed. Since TPM data provide higher spatial resolution and the evaluation appears less error prone than the tagging analysis, TPM may become a helpful adjunct for automatic assessment of mechanical asynchrony.

¹University Hospital of Ulm, Ulm, Germany
Full list of author information is available at the end of the article

Table 1 Displacement and strain derived motion quantification parameters calculated from tissue phase mapped MRI data are displayed as mean \pm standard deviation in volunteers and for all three investigated patients.

parameter	volunteers		patients	
	mean	σ	mean	σ
TUS _c	0.89	0.03	0.74	0.03
TUS _r	0.86	0.04	0.76	0.07
RVS _{max} [% ²]	62.22	30.68	114.49	57.90
RWPS _{max} [%]	88.45	28.33	145.34	57.29
SD(T _{onset})[ms]	15.18	4.28	34.42	14.12
SD(T _{peak})[ms]	39.53	8.52	60.32	21.34
CV [%]	27.89	10.77	47.15	21.13
DiffSLpeakCS [%]	0.14	2.76	1.80	0.97
OS delay SL [ms]	0.77	1.88	52.11	1.88
OS delay IA [ms]	2.10	6.04	19.86	6.04
OS delay AB [ms]	3.63	12.58	41.63	12.58
PS delay SL [ms]	28.53	21.06	195.77	21.06
PS delay IA [ms]	9.68	9.46	158.01	9.46
PS delay AB [ms]	58.30	34.30	86.32	34.30
BARC	-0.02	0.32	0.66	0.16



Funding

AL and VR have a research agreement with Philips Medical, PE is employed by Philips Healthcare.

Author details

¹University Hospital of Ulm, Ulm, Germany. ²Institute of Applied Physics and Center for Functional Nanonstructures, Karlsruhe Institute of Technology, Karlsruhe, Germany. ³Medisys Research Lab, Philips Healthcare, Suresnes, France.

References

1. Lutz : *MAGMA*. 2011, **24**:127-35.
2. Helm : *CIRCULATION*. 2005, **111**:2760-2767.
3. Byrne : *J AM COLL CARDIOL*. 2007, **50**:1484-1490.
4. Bertola : *J AM SOC ECHOCARDIOG*. 2009, **22**:665-671.
5. Bilchick : *JACC Cardiovasc Imaging*. 2008, **1**:561-568.
6. Nelson : *Circulation*. 2000, **101**:2703-2709.
7. Rüssel : *JMRI*. 2007, **26**:1452-1460.
8. Zwanenburg : *Am J Physiol Heart Circ Physiol*. 2004, **286**:H1872-1880.
9. Zwanenburg : *J AM COLL CARDIOL*. 2005, **46**:2215-2222.
10. Rüssel : *J CARD FAIL*. 2009, **15**:717-725.

doi:10.1186/1532-429X-14-S1-W20

Cite this article as: Lutz et al.: Quantitative assessment of myocardial motion from displacement measurements derived from velocity encoded MRI. *Journal of Cardiovascular Magnetic Resonance* 2012 **14**(Suppl 1):W20.

**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

