SUPPLEMENTARY DATA

Native myocardial T1 and extracellular volume age and gender-related variations in health

Rosmini S et al.

Sequence parameters

All the scans were performed on a 1.5 T Siemens Avanto scanner (Siemens Medical Solutions, Erlangen, Germany; system software version VB17) using a 32-channel cardiac coil array. MOLLI, ShMOLLI and SASHA variant were run for the cohort of healthy volunteers.

Complete sequence details can be found on the following pages as detailed below:

a. Pages 2 & 3 – pre-contrast 5s(3s)3s MOLLI indicating 2 inversions with acquisition of images for at least 5 seconds, followed by a recovery of at least 3 seconds, and a second inversion with images acquired for at least 3 seconds.
b. Pages 4 & 5 – post-contrast 4s(1s)3s(1s)2s MOLLI indicating 3 inversions with acquisition of images for at least 4 seconds, followed by a recovery of at least 1 second, a second inversion with images acquired for at least 3 seconds, followed by a recovery of at least 1 second, and a final acquisition of 2 seconds.
c. Pages 6 & 7 - ShMOLLI.
d. Pages 8 & 9 – SASHA.

SIEMENS MAGNETOM Avanto syngo MR B17

\\USER\Kellman\cardiac\T1mapping\MOLLI 5s(3s)3s iPAT2 256r PK5

TA: 0:10 PAT: 2 Voxel size: 1.9×1.4×6.0 mm Rel. SNR: 1.00 USER: CV_map_PK5

Properties	
Prio Recon	Off
Before measurement	
After measurement	
Load to viewer	Off
Inline movie	Off
Auto store images	On
Load to stamp segments	Off
Load images to graphic segments	On
Auto open inline display	Off
Start measurement without further preparation	On
Wait for user to start	On
Start measurements	single

Routine	
Slice group 1	
Slices	1
Dist. factor	20 %
Position	Isocenter
Orientation	Transversal
Phase enc. dir.	A >> P
Rotation	0.00 deg
Auto	Off
Phase oversampling	0 %
FoV read	360 mm
FoV phase	75.0 %
Slice thickness	6.0 mm
TR	912.00 ms
TE	1.14 ms
Averages	1
Concatenations	1
Filter	Distortion Corr.(2D)
Coil elements	HE1-4

Contrast	
Magn. preparation	Non-sel. IR
TI	200 ms
Flip angle	35 deg
Fat suppr.	None
Restore magn.	On
Averaging mode	Short term
Reconstruction	Magnitude
Measurements	1
Multiple series	Off

Resolution	
Base resolution	256
Phase resolution	75 %
Phase partial Fourier	7/8
Trajectory	Cartesian
Interpolation	Off
PAT mode	GRAPPA
Accel. factor PE	2
Ref. lines PE	24
Matrix Coil Mode	Auto (Triple)
Reference scan mode	Integrated
Image Filter	Off
Distortion Corr.	On
Mode	2D
Unfiltered images	Off
Prescan Normalize	Off
Normalize	Off
B1 filter	Off
Raw filter	Off
Elliptical filter	Off
POCS	Off

Geometry	
Multi-slice mode	Sequential
Series	Interleaved
Special sat.	None

System	
Body	Off
HE2	On
HE4	On
HE1	On
HE3	On
Positioning mode	REF
Table position	H
Table position	0 mm
MSMA	S - C - T
Sagittal	R >> L
Coronal	A >> P
Transversal	F >> H
Save uncombined	Off
Coil Combine Mode	Adaptive Combine
Auto Coil Select	Default
Shim mode	Tune up
Adjust with body coil	On
Confirm freq. adjustment	Off
Assume Silicone	Off
? Ref. amplitude 1H	0.000 V
Adjustment Tolerance	Auto
Adjust volume	
Position	Isocenter
Orientation	Transversal
Rotation	0.00 deg
R >> L	350 mm
A >> P	263 mm
F >> H	350 mm

Physio	
1st Signal/Mode	ECG/Trigger
Average cycle	359 ± 53 ms
Captured cycle	359 ± 53
Acquisition window	940 ms
Trigger pulse	1
Trigger delay	0 ms
Segments	84
Phases	1
Tagging	None
Dark blood	Off
Cine	Off
Resp. control	Off

Inline	
Subtract	Off
Std-Dev-Sag	Off
Std-Dev-Cor	Off
Std-Dev-Tra	Off
Std-Dev-Time	Off
MIP-Sag	Off
MIP-Cor	Off

MIP-Tra	Off
MIP-Time	Off
Save original images	On

Sequence

Introduction	Off
Dimension	2D
Reordering	Linear
Asymmetric echo	Weak
Contrasts	1
Bandwidth	977 Hz/Px
Optimization	Min. TE
Allowed delay	0 s
Echo spacing	2.7 ms
Sequence type	Trufi
Define	Shots
Shots per slice	1
Trufi delta freq.	0 Hz
RF pulse type	Fast
Gradient mode	Fast
Excitation	Slice-sel.
Flip angle mode	Constant
Parameter Map Type	T1 Map
No. of Inversions	2
MOLLI TI start	120 ms
MOLLI TI increment	80 ms
MOLLI Trigger delay	80 ms
Motion Correction	On
MoCo Images Only?	Off
Acq HB Inv 1	5
Acq HB Inv 2	3
Recov HB Inv 1	3
Recov HB Inv 2	0

SIEMENS MAGNETOM Avanto syngo MR B17

\\USER\Heart\The Heart hospital\Modified Veteran\MOLLI 4s(1s)3s(1s)2s iPAT2

TA: 0:13 PAT: 2 Voxel size: 2.3×1.8×6.0 mm Rel. SNR: 1.00 USER: CV_map_PK5

Properties

Prio Recon	Off
Before measurement	1
After measurement	Breath normally
Load to viewer	Off
Inline movie	Off
Auto store images	On
Load to stamp segments	Off
Load images to graphic segments	On
Auto open inline display	Off
Start measurement without further preparation	On
Wait for user to start	On
Start measurements	single

Routine

Slice group 1	
Slices	1
Dist. factor	20 %
Position	L41.5 A33.7 H14.5
Orientation	C > T34.1 > S-3.1
Phase enc. dir.	R >> L
Rotation	1.22 deg
Auto	Off
Phase oversampling	0 %
FoV read	450 mm
FoV phase	75.0 %
Slice thickness	6.0 mm
TR	955.20 ms
TE	1.05 ms
Averages	1
Concatenations	1
Filter	Distortion Corr.(2D)
Coil elements	BA1-4;BP1-4

Contrast

Magn. preparation	Non-sel. IR
TI	273 ms
Flip angle	35 deg
Fat suppr.	None
Restore magn.	On
Averaging mode	Short term
Reconstruction	Magnitude
Measurements	1
Multiple series	Off

Resolution

Base resolution	256
Phase resolution	75 %
Phase partial Fourier	7/8
Trajectory	Cartesian
Interpolation	Off
PAT mode	GRAPPA
Accel. factor PE	2
Ref. lines PE	24
Matrix Coil Mode	Auto (Triple)
Reference scan mode	Integrated
Image Filter	Off
Distortion Corr.	On
Mode	2D
Unfiltered images	Off
Prescan Normalize	Off
Normalize	Off
B1 filter	Off
Raw filter	Off
Elliptical filter	Off
POCS	Off

Geometry

Multi-slice mode	Sequential
Series	Interleaved
Special sat.	None

System

Body	Off
BA1	On
BA2	On
BA3	On
BA4	On
BO1	Off
BO2	Off
BO1	Off
BO2	Off
BP1	On
BP2	On
BP3	On
BP4	On
Positioning mode	FIX
Table position	H
Table position	0 mm
MSMA	S - C - T
Sagittal	R >> L
Coronal	A >> P
Transversal	F >> H
Save uncombined	Off
Coil Combine Mode	Adaptive Combine
Auto Coil Select	Default
Shim mode	Tune up
Adjust with body coil	On
Confirm freq. adjustment	Off
Assume Silicone	Off
? Ref. amplitude 1H	0.000 V
Adjustment Tolerance	Auto
Adjust volume	
Position	Isocenter
Orientation	Transversal
Rotation	0.00 deg
R >> L	350 mm
A >> P	263 mm
F >> H	350 mm

Physio

1st Signal/Mode	ECG/Trigger
Average cycle	579 ± 5 ms
Captured cycle	579 ± 5
Acquisition window	994 ms
Trigger pulse	1
Trigger delay	0 ms
Segments	84
Phases	1
Tagging	None
Dark blood	Off
Cine	Off
Resp. control	Off

1/+

Inline

Subtract	Off
Std-Dev-Sag	Off
Std-Dev-Cor	Off
Std-Dev-Tra	Off
Std-Dev-Time	Off
MIP-Sag	Off
MIP-Cor	Off
MIP-Tra	Off
MIP-Time	Off
Save original images	On

Sequence

Introduction	Off
Dimension	2D
Reordering	Linear
Asymmetric echo	Weak
Contrasts	1
Bandwidth	977 Hz/Px
Optimization	Min. TE
Allowed delay	0 s
Echo spacing	2.5 ms
Sequence type	Trufi
Define	Shots
Shots per slice	1
Trufi delta freq.	0 Hz
RF pulse type	Fast
Gradient mode	Fast
Excitation	Slice-sel.
Flip angle mode	Constant
Parameter Map Type	T1 Map
No. of Inversions	3
MOLLI TI start	113 ms
MOLLI TI increment	80 ms
MOLLI Trigger delay	160 ms
Motion Correction	On
MoCo Images Only?	Off
Acq HB Inv 1	4
Acq HB Inv 2	3
Acq HB Inv 3	2
Recov HB Inv 1	1
Recov HB Inv 2	1
Recov HB Inv 3	0

SIEMENS MAGNETOM Avanto syngo MR B17

\\USER\Heart\The Heart hospital\32 Channel coil\Oxford_ShMOLLI

TA: 0:12 PAT: 2 Voxel size: 1.8×1.8×8.0 mm Rel. SNR: 1.00 USER: CV_molli_561

Properties	
Prio Recon	Off
Before measurement	1
After measurement	Breath normally
Load to viewer	On
Inline movie	On
Auto store images	On
Load to stamp segments	On
Load images to graphic segments	On
Auto open inline display	Off
Start measurement without further preparation	On
Wait for user to start	On
Start measurements	single

Routine	
Slice group 1	
Slices	1
Dist. factor	20 %
Position	L4.2 A63.1 F5.8
Orientation	T > C19.5 > S1.8
Phase enc. dir.	A >> P
Rotation	-0.63 deg
Auto	Off
Phase oversampling	0 %
FoV read	340 mm
FoV phase	75.0 %
Slice thickness	8.0 mm
TR	210.71 ms
TE	1.05 ms
Averages	1
Concatenations	1
Filter	Distortion Corr.(2D)
Coil elements	BA1-4;BP1-4

Contrast	
Magn. preparation	Non-sel. IR
TI	110 ms
Flip angle	35 deg
Fat suppr.	None
Restore magn.	On
Averaging mode	Short term
Reconstruction	Magn./Phase
Measurements	1
Multiple series	Off

Resolution	
Base resolution	192
Phase resolution	100 %
Phase partial Fourier	6/8
Trajectory	Cartesian
Interpolation	On
PAT mode	GRAPPA
Accel. factor PE	2
Ref. lines PE	20
Matrix Coil Mode	Auto (Triple)
Reference scan mode	Integrated
Image Filter	Off
Distortion Corr.	On
Mode	2D
Unfiltered images	Off
Prescan Normalize	Off
Normalize	Off
B1 filter	Off
Raw filter	Off
Elliptical filter	Off
POCS	Read & Phase

Geometry	
Multi-slice mode	Sequential
Series	Interleaved
Special sat.	None

System	
Body	Off
BA1	On
BA2	On
BA3	On
BA4	On
BP1	On
BP2	On
BP3	On
BP4	On
Positioning mode	FIX
Table position	H
Table position	0 mm
MSMA	S - C - T
Sagittal	R >> L
Coronal	A >> P
Transversal	F >> H
Save uncombined	Off
Coil Combine Mode	Adaptive Combine
Auto Coil Select	Default
Shim mode	Tune up
Adjust with body coil	Off
Confirm freq. adjustment	Off
Assume Silicone	Off
? Ref. amplitude 1H	0.000 V
Adjustment Tolerance	Auto
Adjust volume	
Position	Isocenter
Orientation	Transversal
Rotation	0.00 deg
R >> L	350 mm
A >> P	263 mm
F >> H	350 mm

Physio	
1st Signal/Mode	ECG/Trigger
Average cycle	579 ± 5 ms
Captured cycle	-not set-
Acquisition window	700 ms
Trigger pulse	1
Trigger delay	340 ms
Segments	82
Phases	1
Tagging	None
Dark blood	Off
Cine	Off

Inline	
Subtract	Off
Std-Dev-Sag	Off
Std-Dev-Cor	Off
Std-Dev-Tra	Off
Std-Dev-Time	Off

MIP-Sag	Off
MIP-Cor	Off
MIP-Tra	Off
MIP-Time	Off
Save original images	On

Sequence

Introduction	Off
Dimension	2D
Reordering	Linear
Asymmetric echo	Allowed
Bandwidth	1002 Hz/Px
Optimization	Min. TE TR
Echo spacing	2.5 ms
Sequence type	Trufi
Define	Shots
Shots per slice	1
Trufi delta freq.	0 Hz
RF pulse type	Fast
Gradient mode	Fast
Excitation	Slice-sel.
Flip angle mode	Constant
Mode	MOLLI
Inversions	3
Acquisition 1st Inv	5 HBs
Acquisition 2nd Inv	1 HBs
Acquisition 3rd Inv	1 HBs
Recovery 1st Inv	1 HBs
Recovery 2nd Inv	1 HBs
Recovery 3rd Inv	1 HBs
TI	110.0 ms
TI increment	80 ms
MOLLI Trigger delay	500 ms

SIEMENS MAGNETOM Avanto syngo MR B17

\\USER\Heart\The Heart hospital\32 Channel coil\SASHA CV_map_448C

TA: 0:13 PAT: 2 Voxel size: 2.2×1.7×8.0 mm Rel. SNR: 1.00 USER: CV_map_448C

Properties	
Prio Recon	Off
Before measurement	1
After measurement	Breath normally
Load to viewer	On
Inline movie	Off
Auto store images	On
Load to stamp segments	Off
Load images to graphic segments	On
Auto open inline display	Off
Start measurement without further preparation	On
Wait for user to start	On
Start measurements	single

Routine	
Slice group 1	
Slices	1
Dist. factor	20 %
Position	L26.6 A33.5 F14.3
Orientation	C > T44.9 > S1.3
Phase enc. dir.	R >> L
Rotation	1.22 deg
Auto	Off
Phase oversampling	0 %
FoV read	440 mm
FoV phase	75.0 %
Slice thickness	8.0 mm
TR	852.80 ms
TE	1.36 ms
Averages	1
Concatenations	1
Filter	Distortion Corr.(2D)
Coil elements	BA1-4;BP1-4

Contrast	
Magn. preparation	Non-sel. SR
TI	715 ms
Flip angle	70 deg
Fat suppr.	None
Restore magn.	On
Averaging mode	Short term
Reconstruction	Magnitude
Measurements	1
Multiple series	Off

Resolution	
Base resolution	256
Phase resolution	78 %
Phase partial Fourier	7/8
Trajectory	Cartesian
Interpolation	On
PAT mode	GRAPPA
Accel. factor PE	2
Ref. lines PE	36
Matrix Coil Mode	Auto (Triple)
Reference scan mode	Integrated
Image Filter	Off
Distortion Corr.	On
Mode	2D
Unfiltered images	Off
Prescan Normalize	Off
Normalize	Off
B1 filter	Off
Raw filter	Off
Elliptical filter	Off
POCS	Off

Geometry	
Multi-slice mode	Sequential
Series	Interleaved
Special sat.	None

System	
Body	Off
BA1	On
BA2	On
BA3	On
BA4	On
BO1	Off
BO2	Off
BO1	Off
BO2	Off
BP1	On
BP2	On
BP3	On
BP4	On
Positioning mode	ISO
Table position	F
Table position	14 mm
MSMA	S - C - T
Sagittal	R >> L
Coronal	A >> P
Transversal	F >> H
Save uncombined	Off
Coil Combine Mode	Adaptive Combine
Auto Coil Select	Default
Shim mode	Standard
Adjust with body coil	Off
Confirm freq. adjustment	Off
Assume Silicone	Off
? Ref. amplitude 1H	0.000 V
Adjustment Tolerance	Auto
Adjust volume	
! Position	L26.6 A41.3 H36.2
! Orientation	C > T8.4 > S1.3
! Rotation	2.35 deg
! F >> H	174 mm
! R >> L	164 mm
! A >> P	103 mm

Physio	
1st Signal/Mode	ECG/Trigger
Average cycle	587 ± 0 ms
Captured cycle	-not set-
Acquisition window	866 ms
Trigger pulse	1
Trigger delay	0 ms
Segments	93
Phases	1
Tagging	None
Dark blood	Off
Cine	Off
Resp. control	Off

Inline	
Subtract	Off
Std-Dev-Sag	Off
Std-Dev-Cor	Off
Std-Dev-Tra	Off
Std-Dev-Time	Off
MIP-Sag	Off
MIP-Cor	Off
MIP-Tra	Off
MIP-Time	Off
Save original images	On

Sequence	
Introduction	Off
Dimension	2D
Reordering	Linear
Asymmetric echo	Off
Bandwidth	1028 Hz/Px
Optimization	Min. TE
Allowed delay	0 s
Echo spacing	2.7 ms
Sequence type	Trufi
Define	Shots
Shots per slice	1
Trufi delta freq.	0 Hz
RF pulse type	Fast
Gradient mode	Fast
Excitation	Slice-sel.
Flip angle mode	Variable
Parameter Map Type	T1 Map
VFL Window	82 pulses
No. of preps	10
TI start	121 ms
TI increment	66 ms
Motion correction	On
Goodness of fit map	Off
Synth MagIR and PSIR	Off
Acq heartbeats 1	1
Acq heartbeats 2	1
Acq heartbeats 3	1
Acq heartbeats 4	1
Acq heartbeats 5	1
Acq heartbeats 6	1
Acq heartbeats 7	1
Acq heartbeats 8	1
Acq heartbeats 9	1
Acq heartbeats 10	1
Recov heartbeats 1	0
Recov heartbeats 2	0
Recov heartbeats 3	0
Recov heartbeats 4	0
Recov heartbeats 5	0
Recov heartbeats 6	0
Recov heartbeats 7	0
Recov heartbeats 8	0
Recov heartbeats 9	0
Recov heartbeats 10	0