

Time Resolved MRA: Clinical Applications

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Disclosures

- Research Support, Siemens Medical Solutions

Clinical applications in all vascular territories

- Head & Neck
- Thorax
- Abdomen
- Extremities

Advantages of TR-MRA

- Functional information:
 - Sequence of enhancement
- Can isolate short lived phases of vascular enhancement
- Assessment of collateralization and transit times
- Low dose of Gd contrast

Disadvantages of TR-MRA

- Additional variables and parameters:
 - Temporal resolution /temporal footprint /spatial resolution /coverage /SNR
- Hardware dependency:
 - Gradients /RF coils /RF channels /computer performance
- K-space gymnastics
- Gd contrast: how much and how fast?

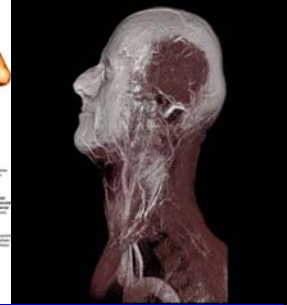
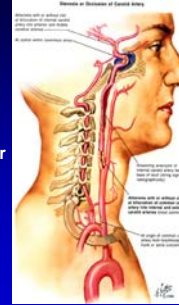
Time Resolved MRA: two broad approaches which are converging

- Anisotropic resolution with Cartesian or Cylindrical k-space sampling
- Isotropic resolution with Spherical k-space sampling

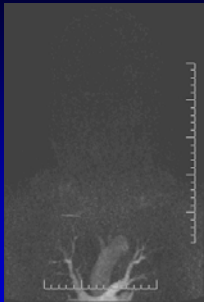
Clinical Examples

Carotid Disease: Contrast Enhanced MRA

- Bifurcations
- Origins
- Intracranial
- Vertebro-basilar



Anomalous Anatomy

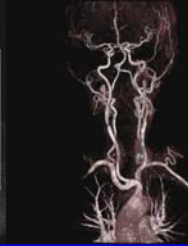
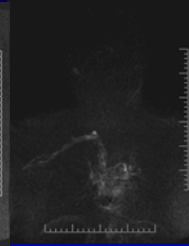
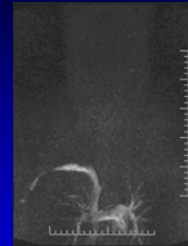


512 matrix, iPAT x 3, 1.0x 1.2 x 3 mm³
"TWIST": 1.5 sec
2mls Gd

640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³,
22 sec
8 mls Gd



Head & Neck at 3.0 Tesla – TR MRA

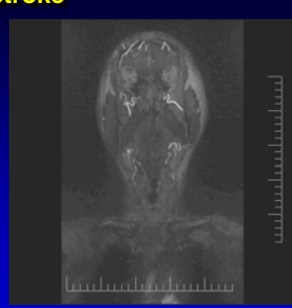


Lohan DG, Tomassian A, Saleh R, Krishnam M, Finn JP. Hypervascular Thyroid nodules on time-resolved MR angiography at 3 T. Radiologic-pathologic correlation. AJR 2008 Apr;190(4):W255-60.

Lohan DG, Tomassian A, Saleh R, Krishnam M, A. Singhal, Finn JP. Ultra-Low-Dose, Time-Resolved Contrast Enhanced MR Angiography of the Carotid Arteries at 3.0 Tesla. Invest Radiol. 2009 Apr;44(4):207-17.

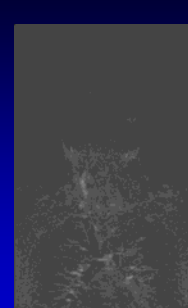


Stroke



512 matrix, iPAT x 3, 1.0x 1.2 x 3 mm³
"TWIST": 1.5 sec
2mls Gd

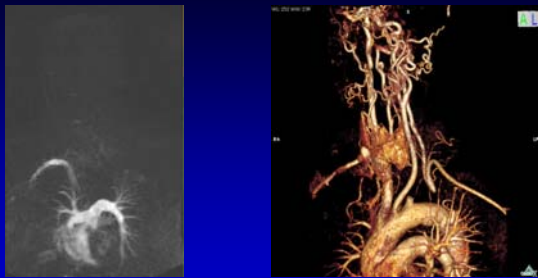
640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³, 22 sec



512 matrix, iPAT x 3, 1.0x 1.2 x 3 mm³
"TWIST": 1.5 sec
2mls Gd

640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³, 22 sec

60 Year old Male with dizziness



640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³, 22 sec

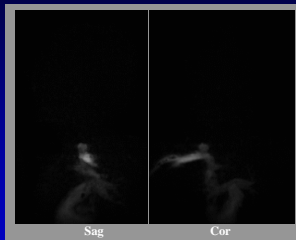
32 Year old Female with dizziness



512 matrix, iPAT x 3, 1.0x 1.2 x 3 mm³
*TWIST: 1.5 sec
2mls Gd

640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³, 22 sec

Isotropic First Pass TR MRA

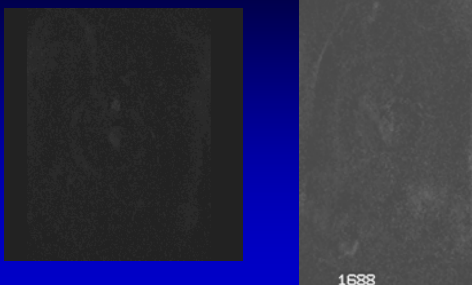


TWIST, $\Delta t = 1.7$ sec, 3cc contrast
Magnetom Avanto

New PAT
with Filter-SubTMean

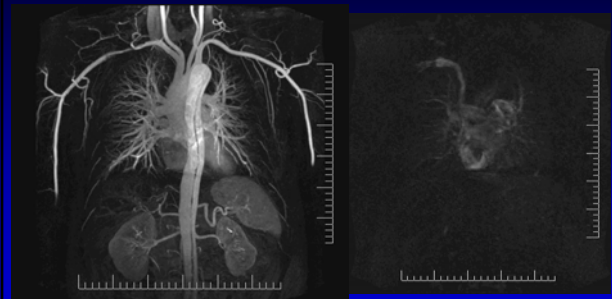
Thorax

Thorax: Aortic Aneurysm



Finn JP, Baskaran V, Carr JC, Mc Carthy BM, Perches FS, Kroczer R, Lind G. *Thorax: Low-dose, Contrast-Enhanced 3D MR Angiography with Sub-second Temporal Resolution - Initial Results.* Radiology 2002; 224:890-904.

3.0T: dissection



4ml Gd, 12 measurements each 1.7 s apart
21 s breath hold: iPAT x 3; TREAT

CEMRA at 3.0T: anterior mediastinal mass



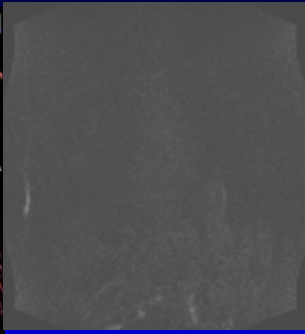
512 matrix, iPAT x 3, 1.0x 1.2 x 3 mm³
 'TWIST': 1.5 sec
 2mls Gd



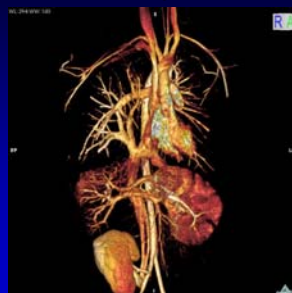
640 matrix, iPAT x 4, 0.9 x 0.8 x 0.8 mm³,
 22 sec
 12 mls Gd

TR MRA in Congenital Heart Disease

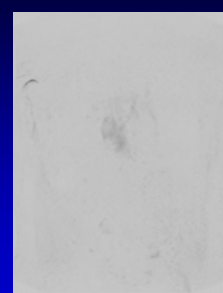
D-Transposition of the Great Arteries



Male; 38 years old. History of hypertension

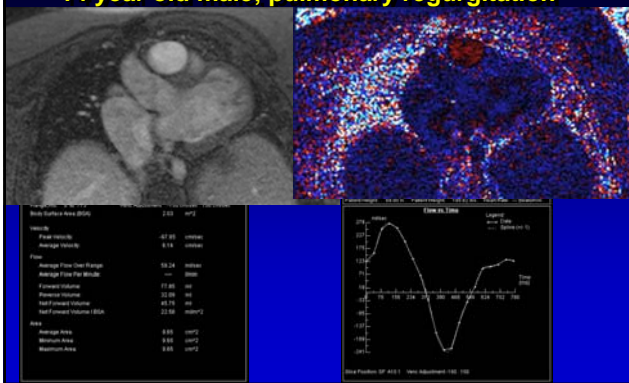


3D CEMRA
 Venous phase



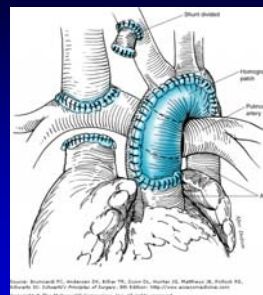
Time resolved CEMRA:
 one frame per second

14 year old male; pulmonary regurgitation

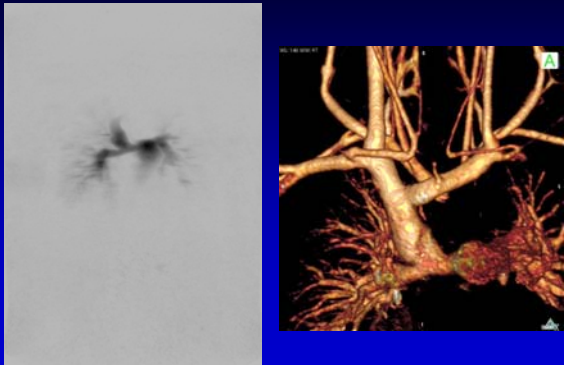


05/15/97

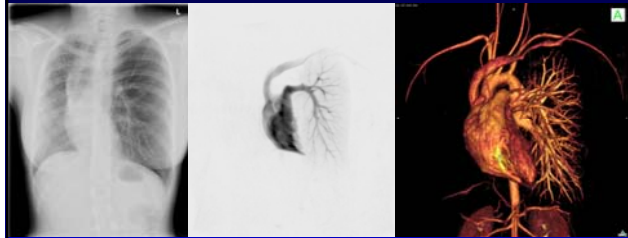
Glenn Shunt



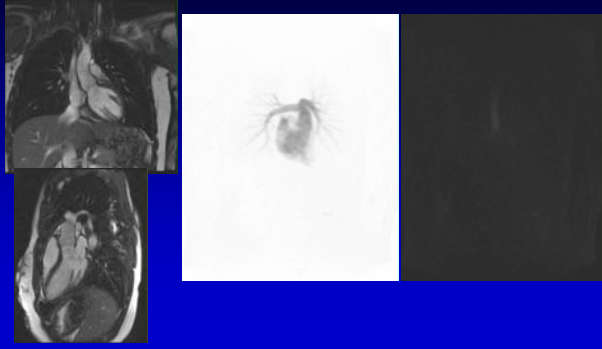
14 year old male; history of surgery



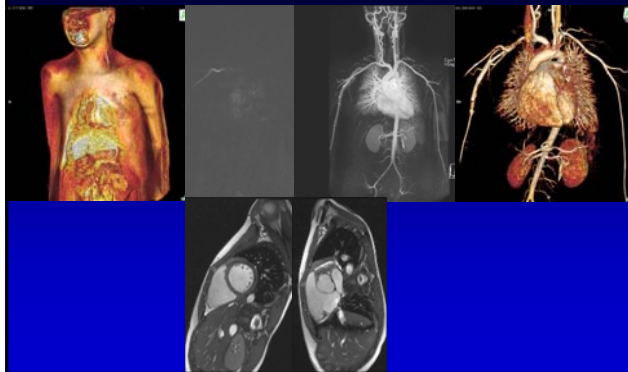
25 y.o. female: abnormal CXR



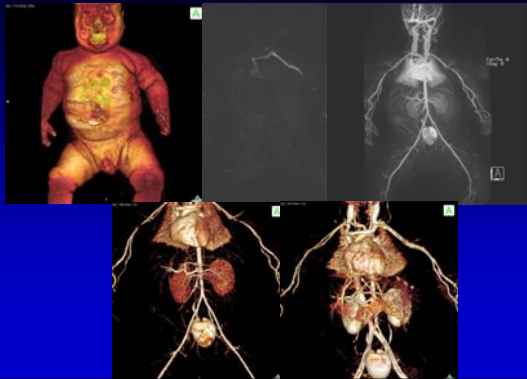
15 year old: query Marfan's?



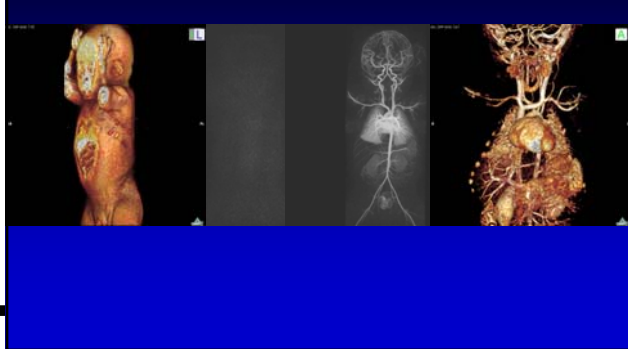
5 year old: query Marfan's?



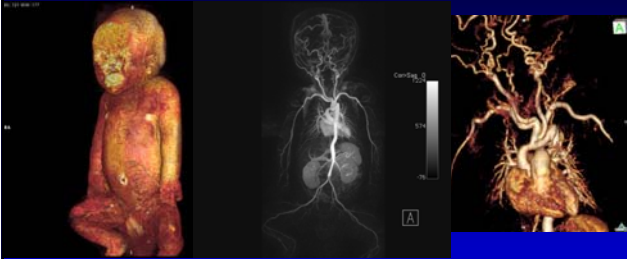
3.0T: 14 month old. Pre-Tx workup



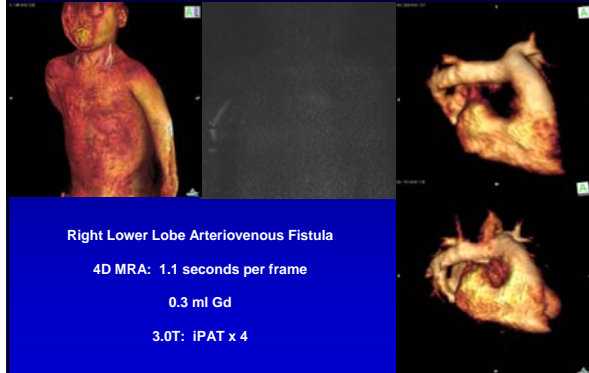
3.0T: Pediatric 8 months



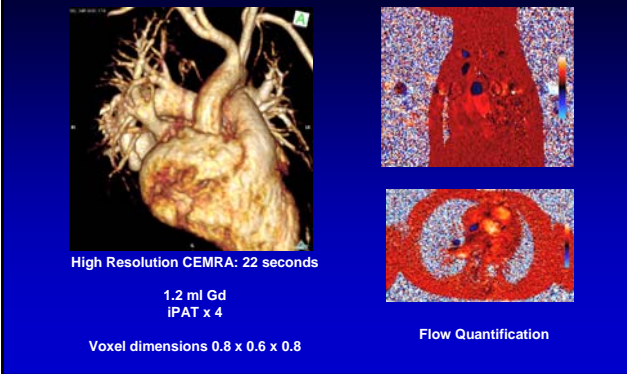
3.0T: 3kg baby



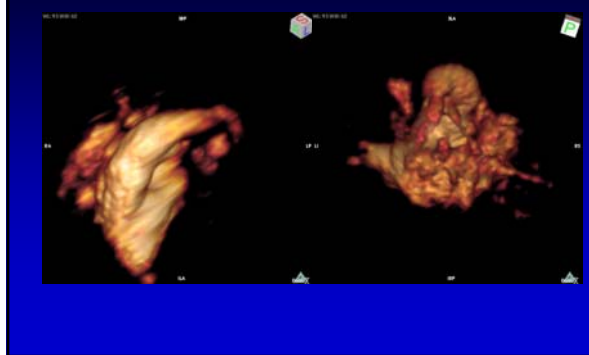
3.0T: 3kg baby – unexplained oxygen desaturation



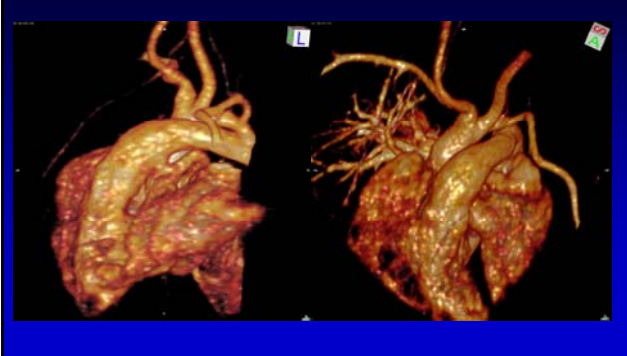
3.0T: 3kg baby – unexplained oxygen desaturation



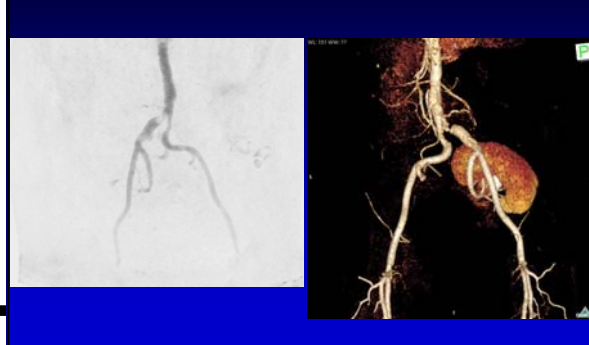
Ductus:



Ductus:



Renal Tx: abnormal velocity spectrum on Doppler US



Renal A-V Fistula

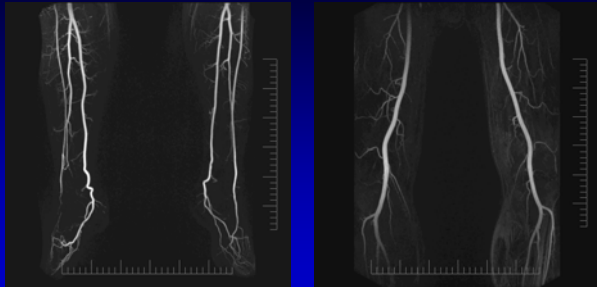
LEMRA at 3.0T

Contrast-enhanced MRA is very successful at 3T

Higher SNR

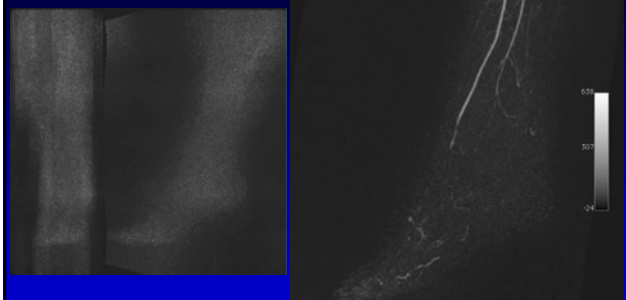
Lower contrast doses

Dedicated 3.0T pMRA coil



640 matrix, GRAPPA x 4, 0.9 x 0.8 x 1.1 mm³, 20 sec
Interpolated to 1024

Lower Extremities



Summary

- Time resolved MRA is a powerful complement to conventional MRA and may provide unique functional insight
- Higher SNR at 3.0T supports improved performance relative to 1.5T
- Dense coil arrays and multiple RF channels further support improved speed and resolution
- Very low contrast doses are effective



Acknowledgements

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