MR Angiography using TRICKS with ASSET

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Introduction

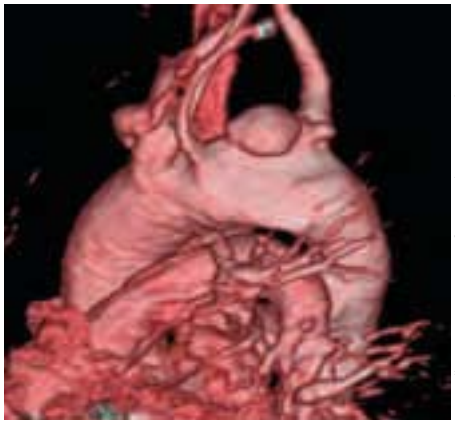
Magnetic Resonance Angiography (MRA) studies have been very challenging because they depend on several subtle techniques, that have direct influence on the failure or success of the exam. Basic requirements of hardware configurations such as high field strength, powerful gradients, and phased array coils are not enough to guarantee a high quality MRA exam. Suboptimal and low quality exams are often the result of inappropriate timing (ideally, image acquisition is performed when the contrast is at its maximum arterial peak concentration in the anatomy of interest) or patient inability to hold breath.

Objective

To examine whether the use of the Array Spatial Sensitivity Encoding Technique (ASSET), and Time Resolved Imaging of Contrast KineticS (TRICKS) techniques improve the quality of thoracoabdominal aorta MRA.

Material and method

A prospective study was performed during December 2005 to May 2006 in 17 patients aged 52 to 82 years (average 67 years; seven were female and 10 male). All studies were performed on a Signa® HD 1.5T MR (GE Healthcare, Milwaukee, WI), 33 mT gradient, and 120 T/m/s slew rate, using the 8 channel body coil. Medrad Spectris® Solaris (Pittsburg, PA) injector was used. The dose of Gadolinium (Magnevistan, Bayer-Schering) was 0.2 ml/kg injected at a rate of 1.5 ml/s, followed by a 20 ml flush of normal saline. The sequence used was a 3D TRICKS with ASSET, with a slice thickness of 3.0 mm to 4.0 mm, a 288x160 matrix, 40 to 48 cm FOV, 62.4 kHz variable bandwidth, and 1 NEX. Image assessment was accomplished by consensus of two radiologists experienced in MRA.



All Images Courtesy of Hospital Centro Medico Campinas

Figure 1. Reconstruction in "Volume Rendering" VR (Anterior view) of the aorta arch demonstrating aneurysm at the emergence of the aberrant right subclavian artery.

Footnote

1. Medical Radiologists at the Hospital Vera Cruz;
2. Resident Doctors of Radiology at the Hospital Vera Cruz at the time of the study.
3. Advanced Application Engineer of GE Healthcare in Brazil
4. Chief of the Department of Radiology of the Hospital Vera Cruz.

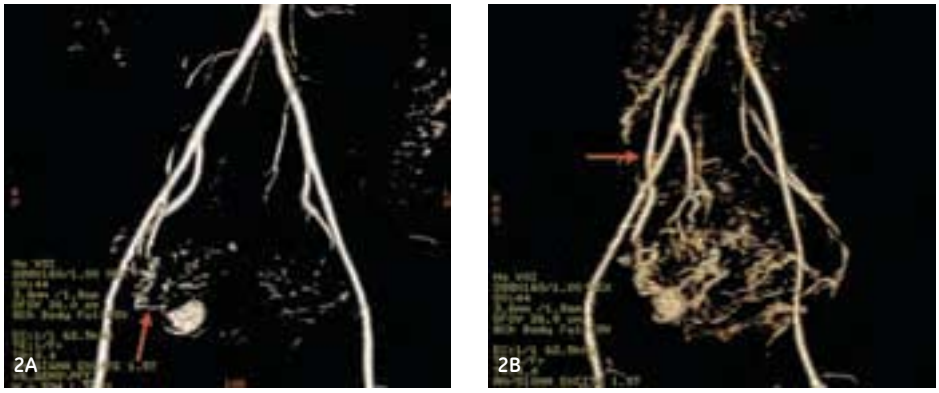


Figure 2. TRICKS MRA with ASSET. Reconstruction in VR (anterior view) in a patient with uterine arteriovenous fistula. Note the dominant nutritive artery in the arterial phase (2A-arrow). In the venous phase, drainage is done by the right ovarian vein (2B-arrow).

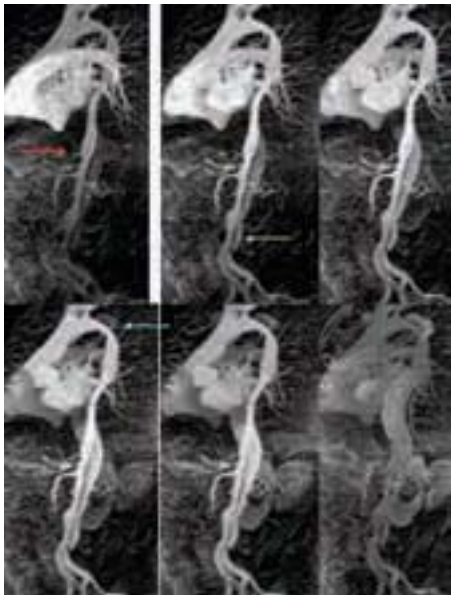


Figure 3. TRICKS MRA with ASSET with multiple phases of 2 s each in a patient with Stanford type B aortic dissection of the thoracoabdominal aorta. Note the premature filling of the real lumen (red arrow). The false lumen shows retrograde filling from the distal aorta (green arrow). There is also delayed anterograde filling of the initial portion of the dissection (blue arrow).

Results

Optimal image quality was obtained in 100% of the studies (17 patients). The following changes were detected in these 17 tests: two tests were normal; one showed an aneurysm at the emergence of the aberrant right subclavian artery; two stenoses at the emergence of the renal artery; four thoracoabdominal aneurysms; and, eight thoracoabdominal dissections (two Stanford type A and six type B). The most demonstrative cases are shown in Figures 1 to 6.

Discussion

New techniques, such as parallel imaging with ASSET, provides a 50% scan time reduction (with a trade off of 40% signal loss), and TRICKS MRA, which achieves a high temporal resolution through k space segment sharing, have led to a considerable quality improvement of these exams.

The main advantage of this new technique is the ability to acquire exams with high temporal resolution in two seconds for each 3D volume to accurately demonstrate the dynamics of blood flow. Thus, a good characterization of the real lumen and the false lumen are achieved in an aortic dissection study. The re-entry orifice and the relation of the thoracoabdominal aorta main branches with the true and false lumens are also accurately detected. This capability has significant implications in therapy planning.

The study of aortic aneurysms without a dissection also benefits from this technique. The turbulence and generally reduced flow speed within the aneurysm can lead to weak contrast signal during the arterial phase in tests with low temporal resolution. TRICKS MRA with ASSET allows clinicians to perform studies in patients unable to maintain apnea. Due to its high temporal resolution, respiratory movements do not interfere with image quality.

Figure 4. TRICKS MRA with ASSET with 15 phases of 2 s each. Reconstruction in VR (anterior view) demonstrating the retroaortic left renal vein.

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Dr. Alexandre Peroni Borges

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About the facility

Hospital Vera Cruz was founded by a group of physicians in 1943 and is considered one of the best private hospitals in the region of Campinas, São Paulo, Brazil. The hospital continues to grow rapidly by performing procedures in all medical specialties. The hospital's department of radiology, Centro Radiológico Campinas, performs around 10,000 radiological studies per month, including interventional radiological techniques.

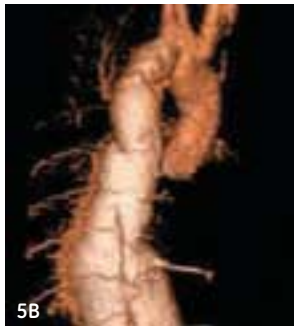


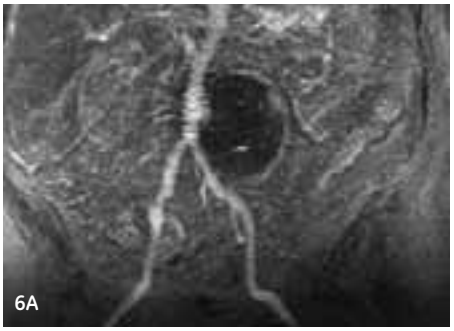
Figure 5. Reconstruction in VR (anterior view) demonstrates stenosis of the distal anastomosis of the prosthesis on the aortic arch, dissection of the descending thoracic aorta. A focal dissection can also be noted affecting the celiac trunk and the left renal artery, which has a pseudo-aneurysm at the emergence (5A). Posterior view demonstrates the emergence of the intercostal arteries from the real lumen (5B).

The disadvantages are associated with lower spatial resolution, compared to the 3D spoiled gradient echo (3DSPGR) MRA technique with ASSET. We should point out, however, that the latter technique has an acquisition time of approximately 20 s per phase, which characterizes low temporal resolution and makes it susceptible to breathing artifacts.

Conclusion

3D contrast MRA TRICKS and ASSET technique allows high temporal resolution image acquisition. This factor provides a good alternative for imaging pathologies such as aneurysms and dissections of the aorta and is indicated for patients who are unable to maintain apnea.

With the arrival of new body coils offering a greater number of channels and more powerful image reconstruction engines, this MRA method promises to revolutionize vascular studies, allowing high temporal and spatial resolution studies. ■



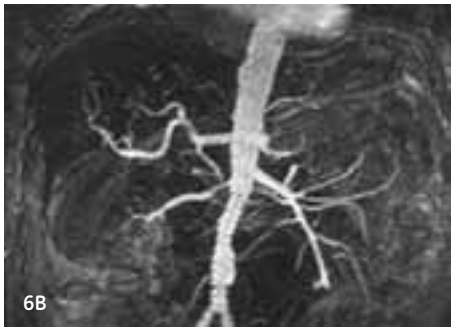


Figure 6. 3D SPGR MRA with ASSET: 1 phase of 20 s smudging of the walls of the major vessels and fading of the smaller caliber vessels are due to the breathing artifact (6A). This same patient had a TRICKS MRA with ASSET at 15 phases of 2 s each, contrast peak in the arterial phase, showing optimal characterization of the abdominal aorta and its branches (6B).