Peripheral arterial disease: Whole body MRI assessment of atheroma burden for case selection and identification of index lesions for longitudinal intervention studies

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Introduction

MR angiogram of the whole body (wbMRA) is an evolving technique. This has been possible due to the recent developments in faster imaging sequences which makes it easier to scan a larger anatomical area [1]. It allows us to perform a rapid evaluation of the patient's vascular status in a non-invasive way [2]. The diagnostic power of this technique is shown to be comparable to CT angiogram [3]. It is useful in repetitive assessment of patients with systemic vascular diseases because of lack of radiation [4].

This poster aims to discuss the basics and technique involved in wbMRA at 1.5T. It also discusses the initial results of validation analysis from our research study about the same.

Technique (1)

The examinations are performed in a 1.5 T scanner (Siemens Avanto, Erlangen). Contrast (Dotarem, Guerbet) enhanced MR angiographic sequences are obtained in 4 separate stations from vertex of the head to toes using two injections.

The stations are as follows:

-Station 1: Head and neck including the aortic arch and the great vessels
-Station 2: Abdomen down to the distal iliac vasculature
-Station 3: Upper Legs from the common femorals to the popliteals
-Station 4: Lower Legs from popliteals down to the toes

Technique (2)

Localiser sequences at four stations are obtained using TrueFISP sequence. 3D FLASH sequences are used for all image acquisition, which are acquired in the coronal plane.

Patients lie in the supine position, head first.

Coils used: Spine matrix, peripheral angiography coil, two body matrix coils, neck matrix coil and head matrix coil

Contrast injection via a pump injector. Two separate 20 ml injections at 1 ml/sec is performed, each followed by saline flush of 20ml.

Stations 1 & 4 are acquired after first injection.

Stations 2 & 3 are acquired after second injection.

Research

Two radiologists analysed these images independently. A single radiologist analysed the images twice to assess the intra-observer variability.

Analysis was performed in Siemens or Kodak Carestream workstations. The first 10 patients were included in the validation analysis. 31 vascular segments in each patient were analysed making a total of 310 segments. Each vascular segment was given a specific score based on a devised scoring system:

0 normal patent artery
1 stenosis <50%
2 stenosis 50-70%
3 stenosis >70%
4 total occlusion
5 normal patent artery and aneurysm
6 stenosis <50% + aneurysm
7 stenosis 50-70% & aneurysm
8 stenosis >70% & aneurysm
9 total occlusion & aneurysm
10 segment not interpretable
11 segment not included in scan

Results

Images were diagnostically adequate in 298 out of 310 vascular segments (96%).
Intra-observer variability – 0.72 using coefficient of variance (ANOVA).
Inter-observer variability – 0.81

Analysis

Head and neck:

	R ICA	L ICA	R VA	L VA	A Arch	Inno	R CCA	L CCA	R Subc	L Subc	Th Aort
Concordance	9	9	8	8	9	6	5	7	6	4	10
Discordance	1	1	2	2	1	4	5	3	4	6	0

Abdomen:

	Abd aorta	Coeliac	SMA	IMA	R Ren	L Ren	R Iliac	L Iliac
Concordance	9	9	8	8	9	6	5	7
Discordance	1	1	2	2	1	4	5	3

Legs – infrainguinal:

	R Fem	L Fem	R Prof	L Prof	R Pop	L Pop	R AT	R Per	R PT	L AT	L Per	L PT
Concordance	6	7	3	2	9	10	7	2	7	6	4	5
Discordance	4	3	7	8	1	0	3	8	3	4	6	5

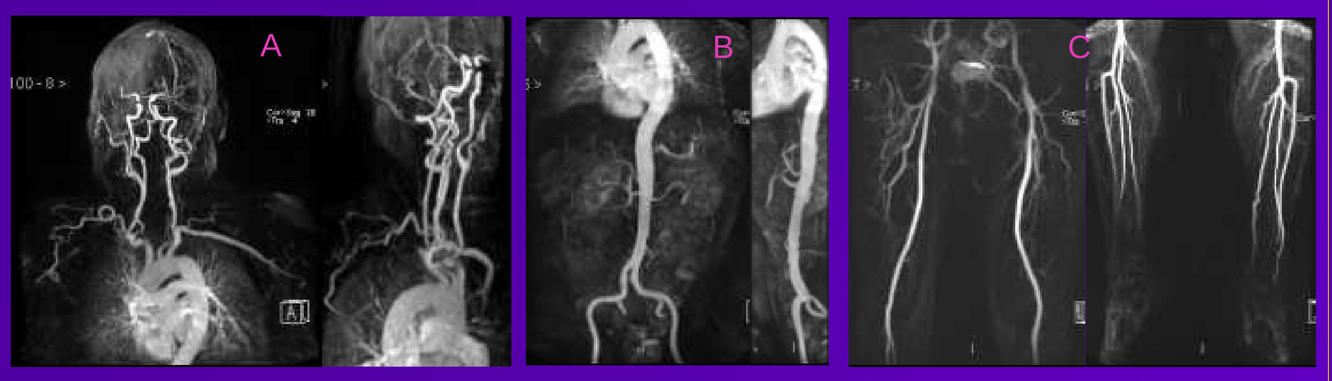
Results - Case 1

A: This coronal image shows an incidental finding of a completely occluded right common and internal carotid a (arrow) in a patient who presented with lower limb claudication

B: Some luminal irregularity is noted in the abdominal aorta. There are tight stenoses in both SFA. The tibio-peroneals are unremarkable

C: MIP image combining all 4 stations showing whole body vasculature

Results - Case 2

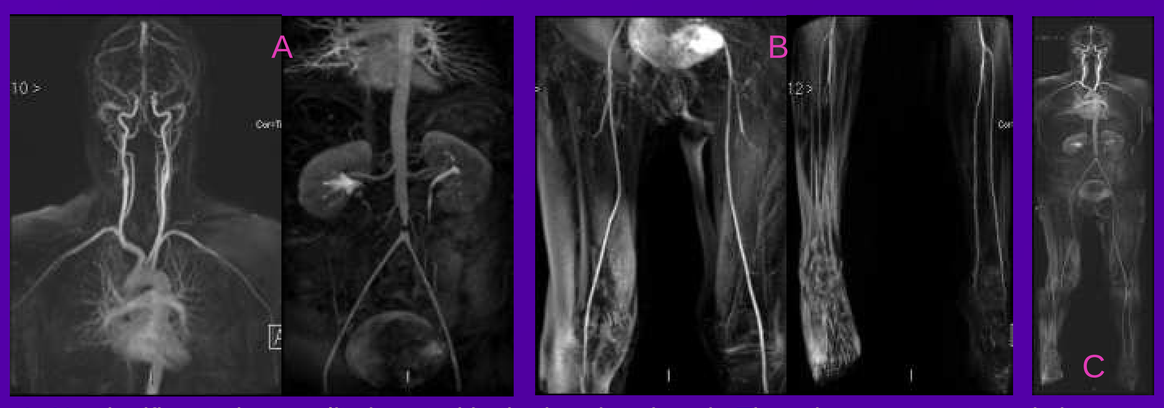


A: There is a complete occlusion of the right subclavian artery associated with collaterals. Sagittal view is very useful in the analysis of the carotid bifurcation.

B: Coronal view demonstrates the normal renal and iliac vessels. Sagittal view is useful for analysis of the coeliac, SMA and IMA origins.

C: The lower limb vessels are unremarkable.

Results - Case 3

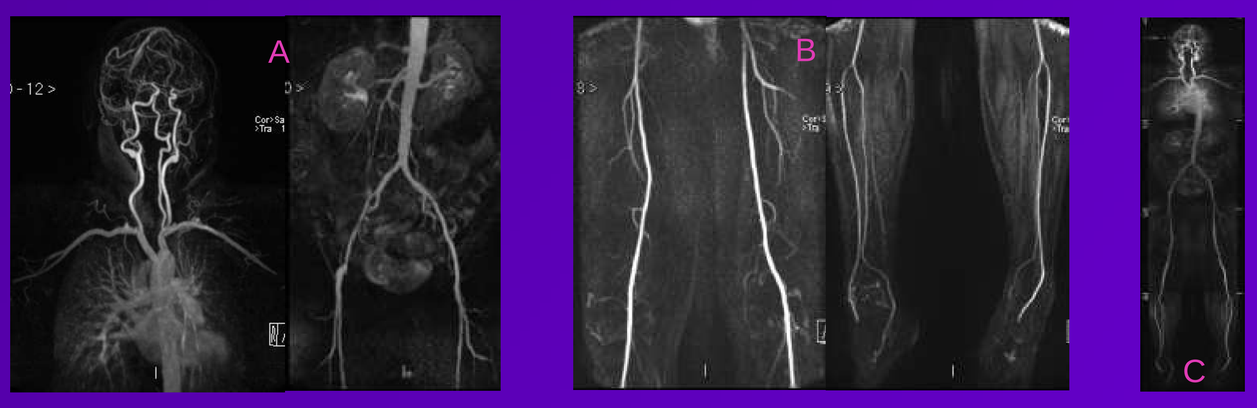


A: No significant abnormality is noted in the head and neck. There is a severe stenosis in the distal abdominal aorta. There are slender iliac a but no stenosis

B: Slender femoral vessels noted. No stenosis. The right tibio-peroneals are not visualised well due to technical difficulties

C: MIP image of the whole body

Results - Case 4



A: No significant stenosis in station 1. There is a tight stenosis in the right common iliac a.

B: The femorals are unremarkable. The right peroneal a. is diseased and the left posterior tibial artery is completely unremarkable

C: MIP image combining all 4 stations showing whole body vasculature

Conclusion

The wbMRA technique appears to be a good way of analysing the patients' vascular status in a non-invasive manner. It is well tolerated by the patients. Although the validation results of our study is shown to be good, further refinement of the assessment technique is needed to confirm this. In this poster, we have described the basics and technique of wbMRA and have shown several interesting imaging examples.

Lay summary

wbMRA is an evolving technique which enables rapid evaluation of a patient's entire arterial system in a non-invasive way. In this exhibit, we have shown the technique employed, presented good validation results from our study and highlighted case examples. wbMRA shows promise as a means of assessing atheroma burden, which will facilitate case selection and identification of index lesions for longitudinal interventional studies.

References:

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