

Indications for MRA (magnetic resonance angiography) whole body

- > Symptomatic lower extremity ischemia
- > Prior to digital subtraction angiography
- > Post operative and stent evaluation
- > Arteriovenous malformation
- > Post traumatic assessment
- > Chronic critical ischemia
- > Intermittent claudication
- > Chronic arterial disease
- > Acute arterial disease
- > Congenital disorders
- > Atherosclerosis

Contraindications

- > Any electrically, magnetically or mechanically activated implant (e.g. cardiac pacemaker, insulin pump biostimulator, neurostimulator, cochlear implant, and hearing aids)
- > Intracranial aneurysm clips (unless made of titanium)
- > Pregnancy (risk vs benefit ratio to be assessed)
- > Ferromagnetic surgical clips or staples
- > Metallic foreign body in the eye
- > Metal shrapnel or bullet

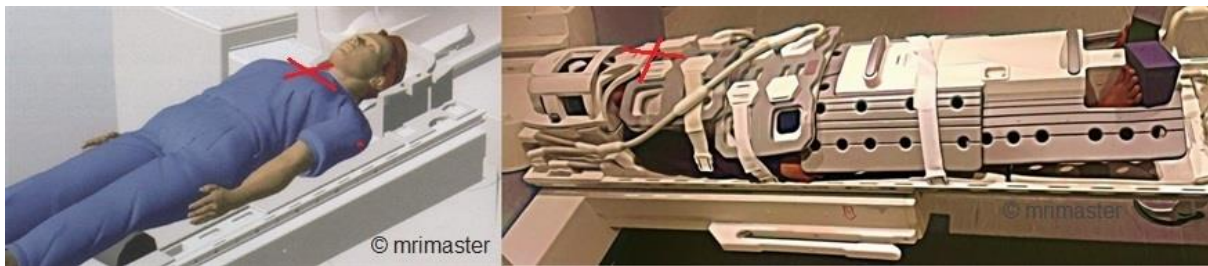
Patient preparation for MRA whole body

- > A satisfactory written consent form must be taken from the patient before entering the scan room

- > Ask the patient to remove all metal object including keys, coins, wallet, any cards with magnetic strips, jewellery, hearing aid and hairpins
- > Ask the patient to undress and change into a hospital gown
- > Instruct the patient to hold their breath for the breath hold scans (its better to coach the patient to three times before starting the scan)
- An intravenous line must be placed with extension tubing extending out of the magnetic bore
- Contrast injection risk and benefits must be explained to the patient before the scan**
- Gadolinium should only be given to the patient if GFR is > 30**
- > Claustrophobic patients may be accompanied into the scanner room e.g. by staff member or relative with proper safety screening
- > Offer headphones for communicating with the patient and ear protection
- > Explain the procedure to the patient and answer questions
- > Note down the weight of the patient

Positioning for peripheral MRA

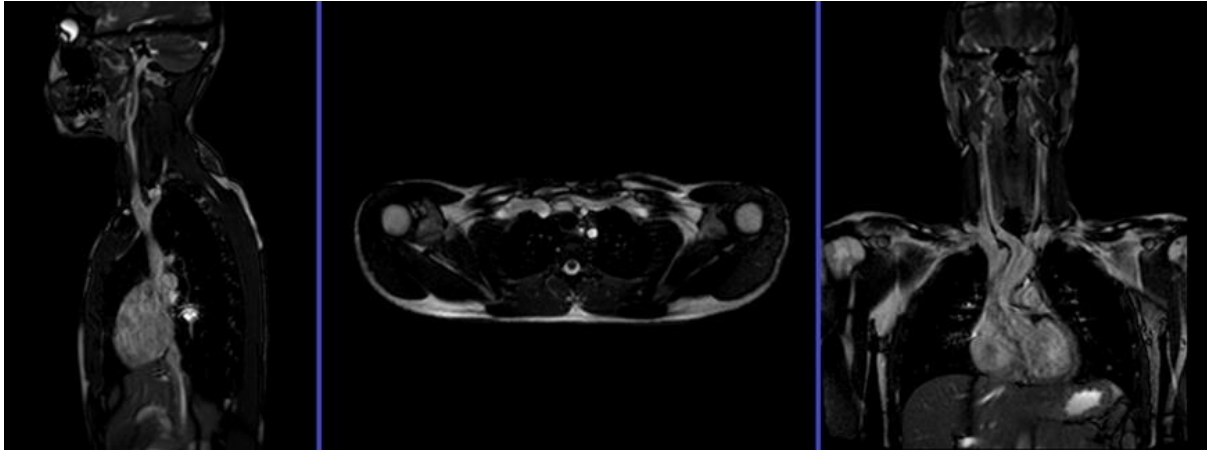
- > Position the patient in supine position with head pointing towards the magnet (head first supine)
- > Position the patient over the spine. Place the neck and head coil, then the peripheral coil over the legs, two body coils over the abdomen and chest, head and neck coil over the head and neck area
- > Centre the laser beam localiser over sternoclavicular joint



Suggested protocols, parameters and planning localiser chest, neck and head

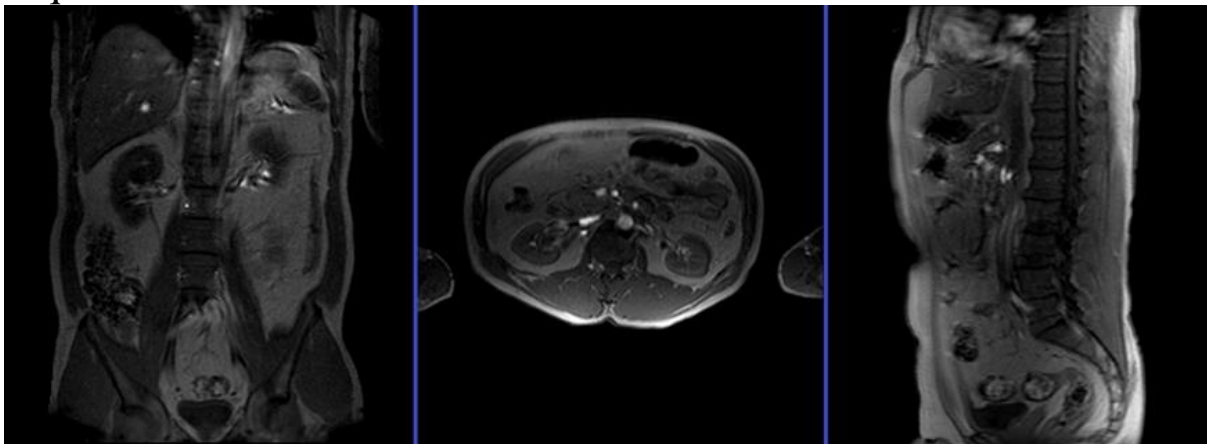
A three plane TrueFISP localiser must be taken initially to localise and plan the sequences. These are fast single shot localisers with acquisition time under 25s, which are excellent for localising vascular structures. Take at least 5-8 slices in all plane to get the best results. **Whole body MRA Protocol should be setup with an auto**

move of the table after the neck and chest localiser acquisition. Usually, in Whole body MRA Protocol an auto move of 380-420 mm is set by default, that means after the neck and chest localiser table will automatically move towards the head for the abdominal scans.



localiser MRA abdomen

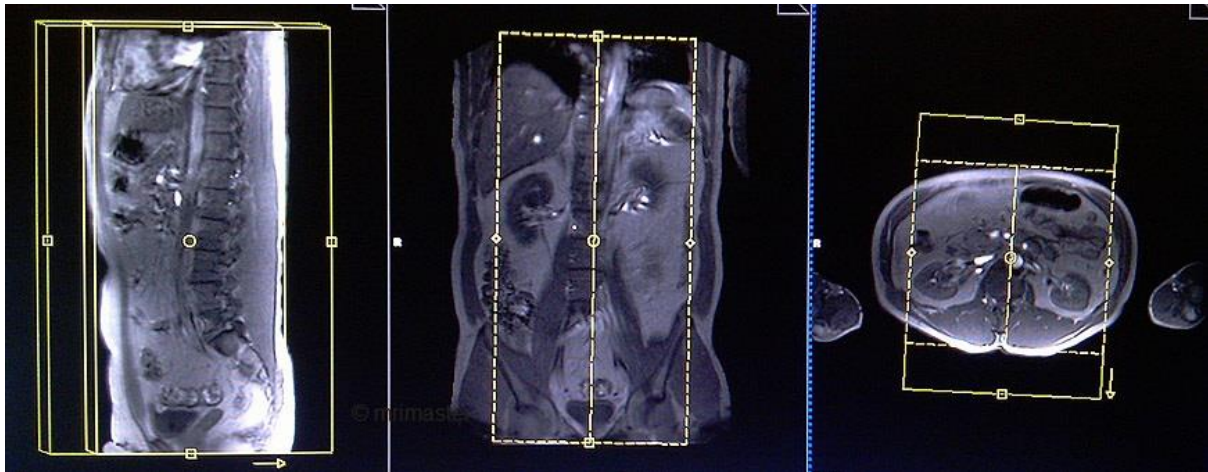
A three plane T1 or TrueFISP localiser must be taken in the abdomen to localise and plan the sequences.



Phase contrast (PC) vessel localiser abdomen

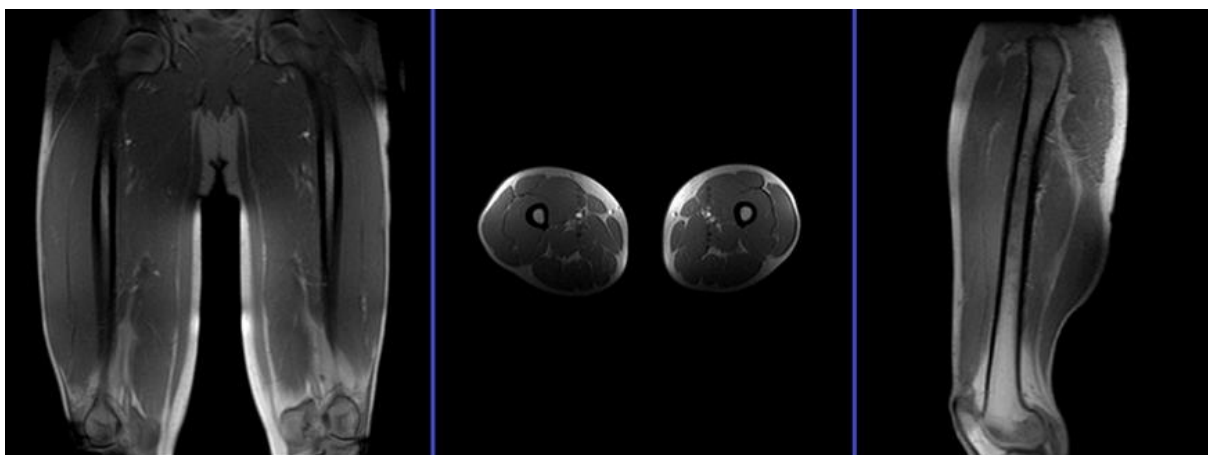
A sagittal Phase Contrast vessel localiser must be taken in the abdomen for further localisation and planning of the coronal 3D flash sequence. Phase contrast localisers are fast scans with less than 1 minute acquisition time, which are excellent for localizing vascular

structures. Whole body MRA Protocol should be setup with an auto move of the table after the abdomen localiser acquisition. Usually, in Whole body MRA Protocol an auto move of 380-420 mm is set by default, that means after the abdomen localiser table will automatically move towards the head for the upper leg scans.



localiser MRA upper leg

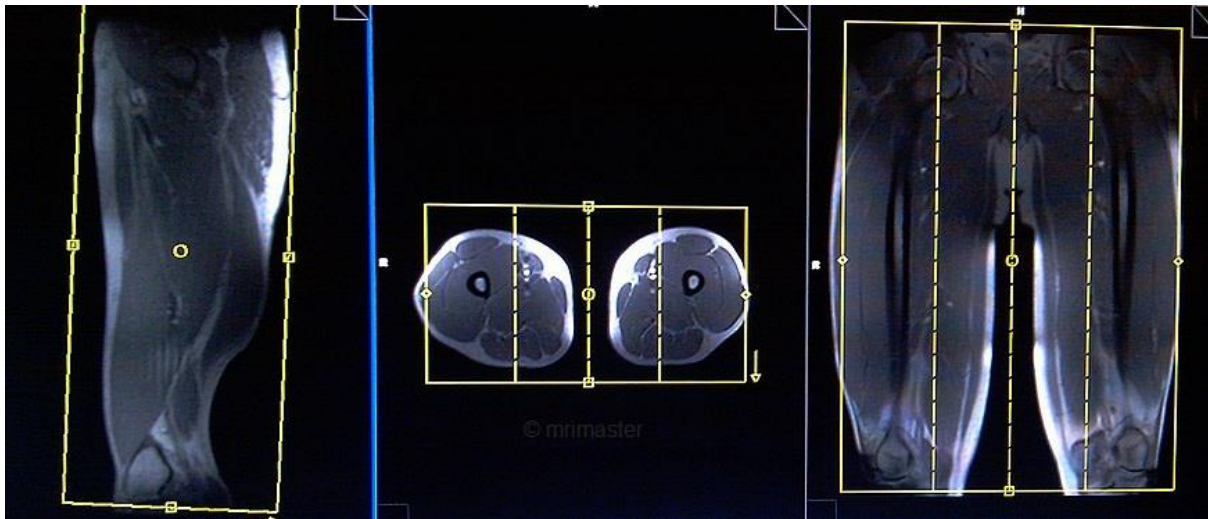
A three plane T1 localizer must be taken in the upper leg to localise and plan the sequences.



Phase contrast (PC) vessel localiser upper leg

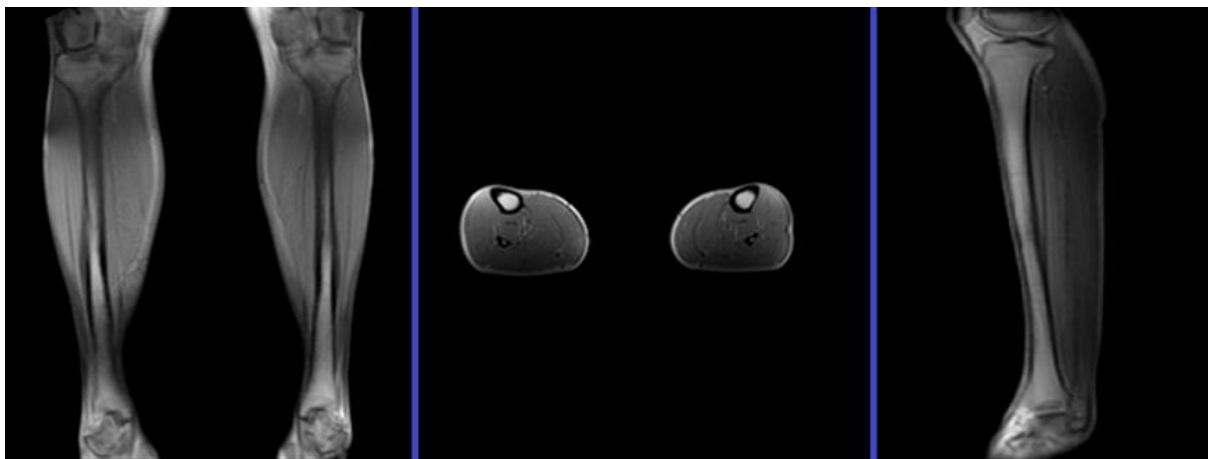
A sagittal Phase Contrast vessel localiser must be taken in the upper leg for further localisation and planning of the coronal 3D flash sequence. Phase contrast localisers are fast scans with less than

1 minute acquisition time which are excellent for localising vascular structures. Protocol should be setup with an auto move of the table after the upper leg localiser acquisition. Usually, in MRA leg protocols an auto move of 380-420 mm is set by default, which means after the lower leg localiser table will automatically move towards the head for the lower leg scans.



localiser MRA lower leg

A three plane T1 localiser must be taken in the lower leg to localize and plan the sequences.



T1 flash 3D coronal 0.9mm -1.1mm pre-contrast chest and neck

Plan the coronal slices on the sagittal plane; angle the position block parallel to the carotid arteries and veins (alternatively make it parallel to the cervical spine). Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to the right and left shoulder joints). Slices must be sufficient to cover the vessel from the anterior chest wall to the spinous process of vertebrae. The FOV must be big enough to cover both shoulder joints. Phase oversampling and slice oversample, must be used to avoid wrap-around artifacts. Instruct the patient to hold their breath during image acquisition. (In our department we instruct the patients to breathe in and out twice before the 'breath in and hold' instruction) .It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 16 seconds to get the best results)



Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
2- 3	1- 2	20	1	1 MM	384x32 0	400 - 450	R>L	50%	OFF

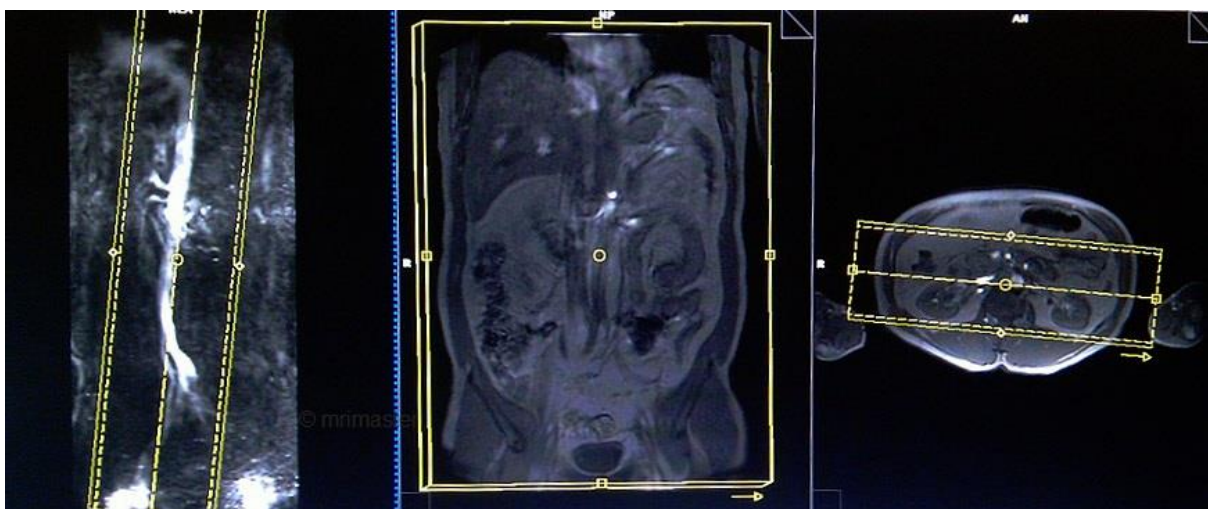
Parallel Acquisition Technique (IPAT)

Parallel Imaging is a newly developed technique used to reduce scan time without affecting the scan resolution. Using parallel acquisition MRI techniques, it is possible to reconstruct full-FOV images from an

under sampled k-space data by using the uncorrelated information from RF array coil elements. The main disadvantage of parallel acquisition techniques is that the signal-to-noise ratio (SNR) is degraded due to the reduced data samples and the spatially correlated nature of multiple RF receivers.

T1 flash 3D coronal 0.9mm -1.1mm pre-contrast abdomen

Plan the coronal slices on the sagittal Phase contrast vessel localiser; angle the position block parallel to the aorta. Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to the long axis of both kidneys). Slices must be sufficient to cover the aorta and iliac arteries. The FOV must be big enough to cover the vessels from the heart to the femoral arteries. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. Instruct the patient to hold their breath during image acquisition. (In our department we instruct the patients to breathe in and out twice before the 'breath in and hold' instruction). It is important to overlap the chest and abdominal blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 20 seconds to get the best results). Protocol should be setup with an auto move of the table after the abdominal 3D flash acquisition.

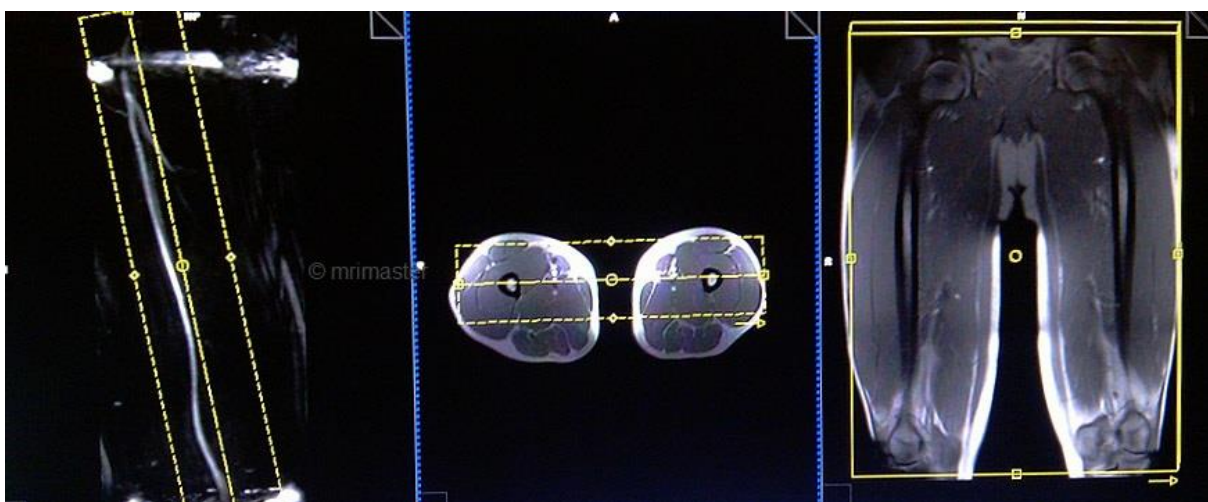


Parameters

TR	TE	FLIP	NEX	SLICE	MATRIX	FOV	PHASE	OVERSAMPLE	IPAT
4-5	2-3	10	1	1 MM	384x384	430-470	R>L	50%	ON

T1 flash 3D coronal 0.9mm -1.1mm pre-contrast upper legs

Plan the coronal slices on the sagittal Phase Contrast vessel localiser; angle the position block parallel to the femoral arteries. Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to both femurs). Slices must be sufficient to cover the femoral arteries. The FOV must be big enough to cover the vessels from iliac arteries down to popliteal arteries. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. It is important to overlap the abdominal and femoral blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 15 seconds to get the best results). Protocol should be setup with an auto move of the table after the upper leg 3D flash acquisition.



Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
4- 5	2- 3	10	1	1 MM	384x38 4	430 - 470	R>L	50%	ON

T1 flash 3D coronal 1mm -1.3mm pre-contrast lower legs

Plan the coronal slices on the sagittal localiser; angle the position block parallel to both tibiae. Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to the right and left tibia). Slices must be sufficient to cover the whole lower legs. The FOV must be big enough to cover the vessels from knee joints to ankle joints. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. It is important to overlap the upper leg and lower leg blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 15 seconds to get the best results).



Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
4- 5	2- 3	10	1	1 MM	384x38 4	430 - 470	R>L	50%	ON

Contrast administration and timing of scans

Guess timing technique: -

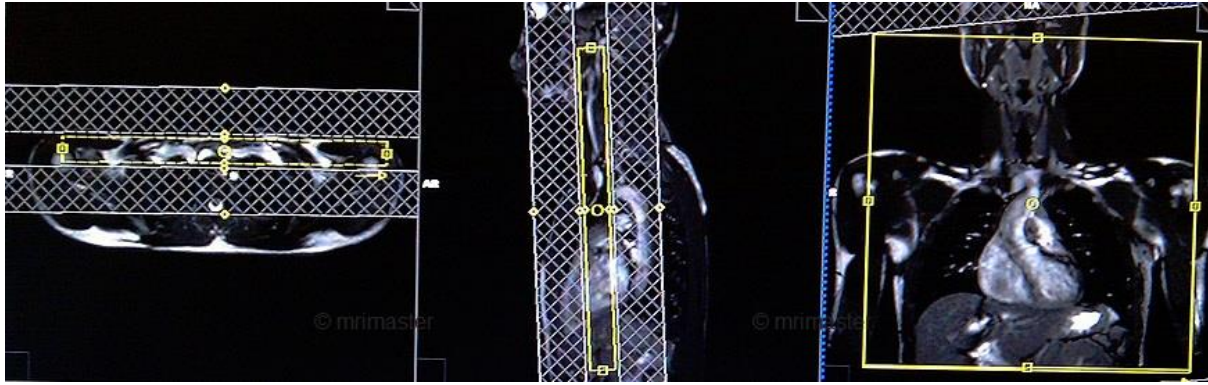
This is one of the simplest methods. It works by estimating the time of contrast traveling from the site of injection to the vascular structure of the chest. This technique is highly dependent upon the site of contrast injection, age of the patient, cardiac output and vascular anatomy. Generally, the contrast takes about 15-20 seconds to travel from antecubital vein to the arch of aorta. Therefore, the post contrast T1 acquisition should start within 15seconds of contrast administration.

Care bolus technique: -

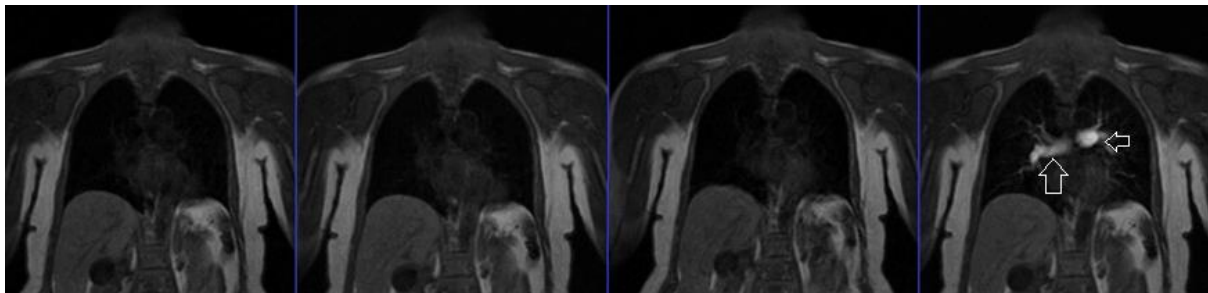
Care bolus is the most commonly used bolus detection technique. This technique uses a coronal fast gradient refocused sequence. Real-time images are obtained every second through the vascular structure of interest (usually placed over the heart). The operator can then watch the contrast bolus arriving in the heart and then switch to the centric 3D sequence.

Planning care bolus

Plan the coronal care bolus slice on the sagittal plane; angle the slice parallel to the ascending aorta. Check the positioning block in the other two planes.



Care bolus scans must start one second prior to the contrast administration. The operator can then watch the scans live and wait for the contrast bolus to arrive in the heart. When the contrast reaches the heart, the care bolus must be stopped immediately and the patient should be instructed to hold their breath before starting the centric 3D dynamic sequence.

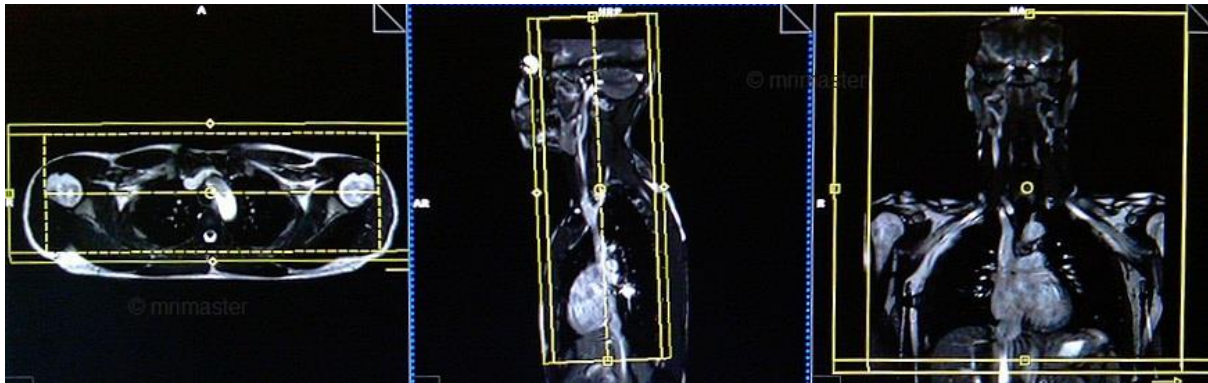


Parameters of Pre and post contrast T1 scans should be exactly same except from the sequence preparation time(preparation time should be nil in the post-contrast scans)

T1 flash 3D coronal 0.9mm -1.1mm post-contrast chest and neck

Plan the coronal slices on the sagittal plane; angle the position block parallel to the carotid arteries and veins (alternatively make it parallel to the cervical spine). Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to both shoulder joints). Slices must be sufficient to cover the vessels from the anterior chest wall to the spinous process of vertebrae. The FOV must be big enough to cover both shoulder joints. Enough phase oversampling and slice oversampling must be used to avoid wrap-around

artifacts. Instruct the patient to hold their breath during the image acquisition. (In our department we instruct the patients to breathe in and out twice before the 'breath in and hold' instruction). It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 16 seconds to get the best results).



Parameters

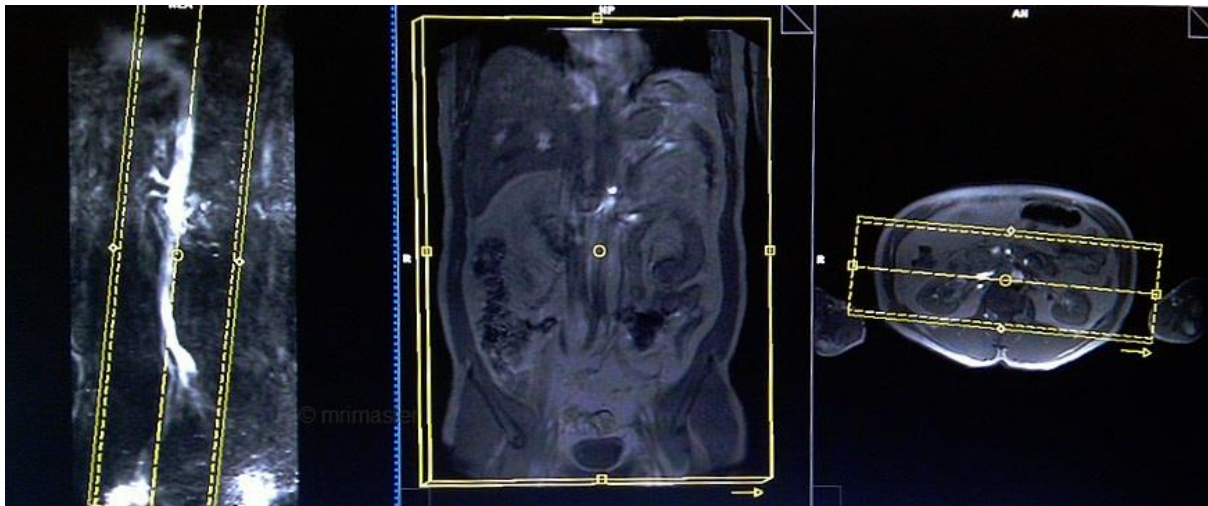
T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
2- 3	1- 2	20	1	1 MM	384x32 0	400 - 450	R>L	50%	OFF

If the patients can hold there breath for 35 seconds (most of them will do) do the chest and abdomen in a single breath hold (15 seconds for each scans and 5 seconds for automatic table move)

T1 flash 3D coronal 0 .9mm -1.1mm post-contrast abdomen

Plan the coronal slices on the sagittal Phase Contrast vessel localiser; angle the position block parallel to the aorta. Check the positioning block in the other two planes. An appropriate angle must be used in

the axial plane (parallel to the long axis of both kidneys). Slices must be sufficient to cover the aorta and iliac arteries. The FOV must be big enough to cover the vessels from the heart to femoral arteries. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. Instruct the patient to hold their breath during the image acquisition. (In our department we instruct the patients to breathe in and out twice before the 'breath in and hold' instruction.). It's important to overlap the chest and abdominal blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 20 seconds to get the best results). Protocol should be setup with an auto move of the table after the abdominal 3D flash acquisition.

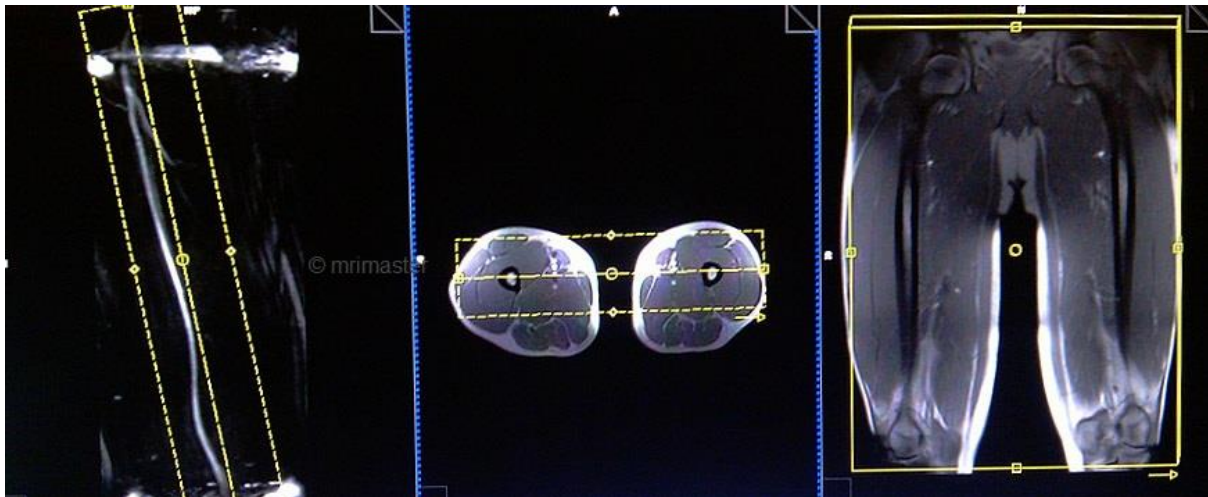


Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
4- 5	2- 3	10	1	1 MM	384x38 4	430 - 470	R>L	50%	ON

T1 flash 3D coronal 0.9mm -1.1mm post-contrast upper leg

Plan the coronal slices on the sagittal Phase Contrast vessel localiser; angle the position block parallel to the femoral artery. Check the positioning block in the other two planes. An appropriate angle must be used in the axial plane (parallel to the right and left femur). Slices must be sufficient to cover the femoral arteries. The FOV must be big enough to cover the vessels from iliac arteries to popliteal arteries. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. It is important to overlap the abdominal and femoral blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 15 seconds to get the best results). Protocol should be setup with an auto move of the table after the upper leg 3D flash acquisition.



Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
4- 5	2- 3	10	1	1 MM	384x38 4	430 - 470	R>L	50%	ON

T1 flash 3D coronal 1mm -1.3mm post-contrast lower leg

Plan the coronal slices on the sagittal localiser; angle the position block parallel to the tibia. Check the positioning block in the other two planes. An appropriate angle must be given in the axial plane (parallel to both tibiae). Slices must be sufficient to cover the whole lower leg. The FOV must be big enough to cover the vessels from knee joints to ankle joints. Enough phase oversampling and slice oversample must be used to avoid wrap-around artifacts. It is important to overlap the upper leg and lower leg blocks by 1 to 2 centimetres to avoid any misregistration. It is highly advisable to use the parallel acquisition technique to reduce scan time (scan time should be less than 15 seconds to get the best results).



Parameters

T R	T E	FLI P	NE X	SLIC E	MATRI X	FO V	PHAS E	OVERSAMP LE	IPA T
4- 5	2- 3	10	1	1 MM	384x38 4	430 - 470	R>L	50%	ON