

ISMRM Case Based course 2009 - Dr Giles Roditi

Manifestations of Hypertension on the Cardiovascular System

Educational Objectives :

- 1 List the main effects of systemic hypertension on the cardiovascular system.
- 2 Recognize how to evaluate left ventricular mass and differentiate different forms of left ventricular hypertrophy.
- 3 Understand the requirements for comprehensive MRI evaluation of the ascending aorta with integration of cardiac MRI.
- 4 Interpret MRA and MRI examinations of aortic dissection in a standardized manner.
- 5 Understand optimized MR imaging protocols for comprehensive morphologic, angiographic and functional assessment when assessing for suspected renovascular hypertension. Appreciate current thinking on atherosclerotic renovascular disease.

Introduction - Hypertension is a systemic disorder with wide ranging and important effects on the cardiovascular system, indeed between 40 & 50 % of people dying of cardiovascular disease have underlying hypertension. Hypertension can itself be primary (so called 'essential' hypertension) or secondary due to a wide range of underlying disorders. Primary hypertension accounts for the majority of patients with raised blood pressure (and the cause remains elusive) while cases of secondary hypertension are in a definite minority. Rather than focussing on the underlying cause of raised blood pressure this talk emphasises its effects on the cardiovascular system, especially those aspects that are directly demonstrable with MRI techniques. While all atherosclerotic disease is exacerbated by hypertension including coronary disease much can not be discriminated from that seen in non-hypertensive patients, these will hence not be discussed. The major cardiovascular disorders that can be directly attributed to hypertension include cardiac disease (particularly left ventricular hypertrophy), aortic disease (especially annuloaortic ectasia, aneurysm and dissection), major arterial branch vessel arteriosclerosis (of which renal artery origin disease is a special case since this may further drive hypertension) and small vessel arteriosclerosis (which may in the renal bed result in glomerulosclerosis) though much microvascular disease is of course beyond the resolution of current in vivo MRI techniques.

Cardiac Disease - The effect of raised blood pressure on the heart is increased afterload with the consequence of left ventricular hypertrophy and the potential for myocardial ischaemia (particularly of the subendocardium), consequent systolic dysfunction and hence heart failure. However, not all left ventricular hypertrophy is the result of hypertension and MRI techniques can help to distinguish and monitor simple hypertrophy from other conditions such as hypertrophic cardiomyopathy and amyloidosis. MRI techniques for evaluation of LV muscle mass and myocardial functional evaluation will be discussed.

Aortic Disease - Annuloaortic ectasia and aneurysm of the ascending aorta lend themselves to MRI evaluation to assess the need for surgery as MRI can not only demonstrate morphology but also evaluate functional significance. The integration of these aspects is discussed for comprehensive MRI assessment including MRA and quantitative flow analysis. Aortic intramural haematoma and dissection are part of the spectrum of consequences

of damage to the vasa vasorum in the aortic wall. While acute dissection in the unwell patient is problematic for MRI it is ideal for follow-up of chronic dissection - aortic imaging techniques and important points for evaluation of dissection are presented.

Arteriosclerotic Renovascular Disease - Unlike the finding of stenotic fibromuscular hyperplasia in the renal arteries in a hypertensive patient the discovery of arteriosclerotic renal artery stenosis is more problematic as it may or may not be contributing to their elevated blood pressure and any renal dysfunction. Other factors must be taken into account over and above the angiographic appearances as to whether revascularisation is appropriate. Furthermore many secondary causes of hypertension may be identified since many are renal and comprehensive MRI imaging protocols to aid this are presented. The current status of renal artery interventions are discussed with evidence from recent large scale trials such as ASTRAL.