



Editorial

Special issue – Non-invasive vascular imaging



This special issue focusses on advances in non-invasive vascular imaging with some outstanding articles on cutting-edge imaging technologies and their clinical use. For many years, invasive catheter angiography with its attendant risks was the only method to obtain more detailed information on the vasculature than plain radiographs could provide, although only the outline of the lumen is visualised directly. Indeed, the risks of invasive angiography are such that they have had to be factored into risk assessment prior to embarking on imaging investigation. For example, the landmark NASCET trial of carotid endarterectomy was reported in terms of the number needed to both investigate and treat to provide benefit in the secondary prevention of stroke since the investigation itself (invasive carotid arteriography) as well as the proposed surgical intervention could both cause precisely the morbidity/mortality that the strategy was intending to avoid, i.e., stroke. As such, a shift to non-invasive carotid imaging in this scenario if equally accurate would mean a lower number to treat for the same benefit as the potential morbidity/mortality simply associated with investigation had been negated.

Fortunately, today non-invasive imaging of the cardiovascular system using ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) is now the primary diagnostic means of evaluation with invasive angiography reserved as a platform for intervention. Non-invasive imaging now not only assesses the lumen, but also the vessel wall and vascular function providing new insights into disease processes. Even the coronary arteries with their rapid motion can now be non-invasively assessed for both structure and function.

Vascular diseases affect all parts of the body from top to toe, necessitating not only evaluation of large vessels, such as the aorta and its major branches, but even the small perforating vessels of the skin, which are now of increasing importance with microsurgical techniques. Furthermore, vascular imaging often requires images to be ‘temporally resolved’ either needing to freeze motion/phases of contrast enhancement or indeed displaying movement through the cardiac cycle. The limitations of static images in conveying functional information means that cardiovascular imaging

has usually been at the forefront of advances in imaging technology taking advantage of both hardware and software innovations.

This issue reflects some of the concerns of vascular imaging, starting with Weir-McCall *et al.*¹ exploring the emerging evidence for whole-body vascular imaging and its ability to both give a characterisation of vascular health, but also “stage” both atherosclerosis and the vasculitides in a manner akin to cancer staging. On the other hand, in her paper Thimmappa *et al.*² provide a comprehensive overview of how dedicated magnetic resonance angiography (MRA) of the very small vessels of the skin now allows advanced breast reconstructive surgery. This has certainly become a large part of my own vascular imaging practise with MRA much preferred by the vascular surgeons over CT angiography for its spatial and contrast resolution in a patient population that is increasingly educated and sensitive to the issues of ionising radiation use.

Although contrast-enhanced MRA with gadolinium-based contrast agents remains the cornerstone of much guideline driven³ daily clinical work the concerns of patients and clinicians alike over the issue of gadolinium retention have recently given further impetus to the development and clinical use of both non-contrast MRA techniques and alternative contrast agents for MRA. Edelman *et al.*⁴ explain how the quiescent-interval slice-selective (QISS) technique initially developed with application in the lower-limb arterial vasculature is now evolving to be applicable in other vascular beds, including even the coronary arteries, the most challenging of all given their size, tortuosity, and movement. As an alternative to gadolinium-based contrast agents ferumoxytol is an ultra-small paramagnetic iron oxide (USPIO) with properties that make it ideally suited to vascular imaging. Lehman *et al.*⁵ review the emerging literature on the use of ferumoxytol for MRA with a beautifully illustrated article emphasising not only the high-quality arterial images obtained with this agent but the excellent venous depiction it also affords.

CT technology also continues to advance, one of the limitations of CTA has been calcium blooming, particularly

in small diseased vessels where calcified plaque can often obscure residual lumen leading to non-diagnostic results — a particular problem in the distal below knee arteries of diabetic and elderly patients. Tanaka *et al.*⁶ present work tacking this by a combination of very high spatial resolution and advanced image registration for subtraction angiography, showing compelling imaging of even very small foot arteries.

I hope you enjoy reading this vascular focus issue as much as I enjoyed bringing it together. I am grateful to Grant Baxter during his tenure as Editor for allowing me free reign in curating the content from these experts. Thanks are of course also due to the authors themselves. I am particularly grateful for their timely production of high-quality manuscripts, which has made the job of editing the issue a pleasure.

Conflict of interest

None.

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