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| <p>Although three-dimensional contrast-enhanced (3-D CE) MR angiography reliably produces images of outstanding quality, there are a number of common pitfalls and artifacts to avoid. In addition, the widespread application of 3-D CE MR angiography has led to the generation of enormous amounts of data. Efficient reconstruction, display, and interpretation of MR angiography data are important, especially as the number of source images becomes increasingly unwieldy. This article examines the variety of reconstruction techniques available, discusses their strengths and weaknesses, and describes common pitfalls and artifacts in 3-D CE MR angiography.</p> |           |
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| <p>MR angiography has evolved rapidly into a robust diagnostic tool with ever-increasing flexibility for tailored applications for illustration of the abdominal aorta and its</p>  |           |

branches. The abdominal indications for MR angiography continue to expand as technical advances overcome old barriers, such as motion and the time required for a high-quality diagnostic study. Three-dimensional contrast-enhanced MR angiography is now standard practice in the noninvasive evaluation of a wide range of clinical situations and is particularly well suited for imaging patients who are not able to tolerate invasive procedures or iodinated contrast material.

**MR Angiography of the Peripheral Arteries** 91

James F.M. Meaney and Niall Sheehy

This article discusses the use of MR angiography in the evaluation of patients with peripheral vascular disease. A carefully tailored three-station moving table study performed on a scanner equipped with fast gradient technology in association with parallel imaging at the first two (and preferably all three) locations with bolus detection, optimized k-space filling strategies, and thigh compression to delay the onset of venous enhancement will deliver high spatial resolution images free from venous contamination in virtually all patients.

**MR Venography** 113

Florian M. Vogt, Christoph U. Herborn, and Mathias Goyen

This article describes existing MR techniques for the assessment of the venous system and summarizes the clinical experience. It also discusses new applications that are likely to increase the use of MR venography in clinical practice.

**MR Angiography in Patients with Renal Disease** 131

Henrik J. Michaely, Stefan O. Schoenberg, Johannes R. Rieger, and Maximilian F. Reiser

This article discusses the advantages and applications of MR angiography in patients with renal disease.

**Role of MR Angiography in Vascular Interventional Planning** 153

Scott A. Koss and E. Kent Yucel

Peripheral vascular disease is a common problem in the United States. MR angiography is a high-quality noninvasive imaging tool for planning vascular intervention. This technique has supplanted conventional angiography as the tool of choice for planning surgery and percutaneous intervention. The evolution from two-dimensional time-of-flight MR angiography to three-dimensional contrast-enhanced MR angiography has provided improved imaging quality and reduced examination times. Further advancements in the field will continue to improve this technique.

**Contrast-Enhanced MR Angiography in Infants and Children** 161

Taylor Chung and Rajesh Krishnamurthy

There are challenges to performing contrast-enhanced MR angiography in infants and children because of the more rapid circulation times, higher respiratory rates, and the inability to suspend respiration. With the advances in MR techniques and stronger gradients, however, diagnostic-quality MR angiographic studies can be obtained. One

approach is to incorporate parallel-imaging techniques to achieve a time-resolved method to perform the MR angiography without the need for bolus timing. This article describes one implementation of time-resolved MR angiography with sensitivity encoding and provides clinical examples.

## **Atherosclerosis Imaging Using MR Imaging: Current and Emerging Applications**

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Milind Y. Desai and David A. Bluemke

Because of its high resolution, 3-D capabilities, noninvasive nature, and capacity for soft tissue characterization, MR imaging has emerged as a powerful modality to assess the process of atherosclerosis comprehensively in different arterial beds, including the coronary arteries. It holds great promise in studies involving longitudinal follow-up of plaque progression and for detection of therapeutic intervention-related changes. With the development of newer, target-specific contrast agents and molecular imaging applications, an exponential growth in its current applications is anticipated. This article reviews the technical principles and current status of *in vivo* MR imaging of atherosclerosis in various arterial beds and briefly discusses ongoing research in this field.

## **Emerging Functional MR Angiographic Techniques**

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Honglei Zhang, Julianna M. Czum, and Martin R. Prince

As the accuracy of MR angiography approaches that of conventional digital subtraction angiography, further refinements will focus on providing functional information about the normal and pathologic vasculature. In particular, PC flow measurement, time-resolved contrast-enhanced MR angiography, and detection of turbulent flow jets help to establish the functional significance of stenoses. This article discusses these emerging functional MR angiographic techniques.

## **Contrast Agents: Innovations and Potential Applications for Body MR Angiography**

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Maureen N. Hood and Vincent B. Ho

This article reviews some promising contrast agents and potential benefits for vascular imaging. The future of contrast-enhanced (CE) MR angiography is full of a wide variety of imaging options, from time-resolved CE MR angiography, to steady-state high-resolution imaging, to tissue-specific imaging. The growth in the complexity of contrast agent formulation for CE MR angiography and improvements in pulse sequence design are providing countless opportunities for improved applications of MR and MR angiography for the evaluation of cardiovascular disease.

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