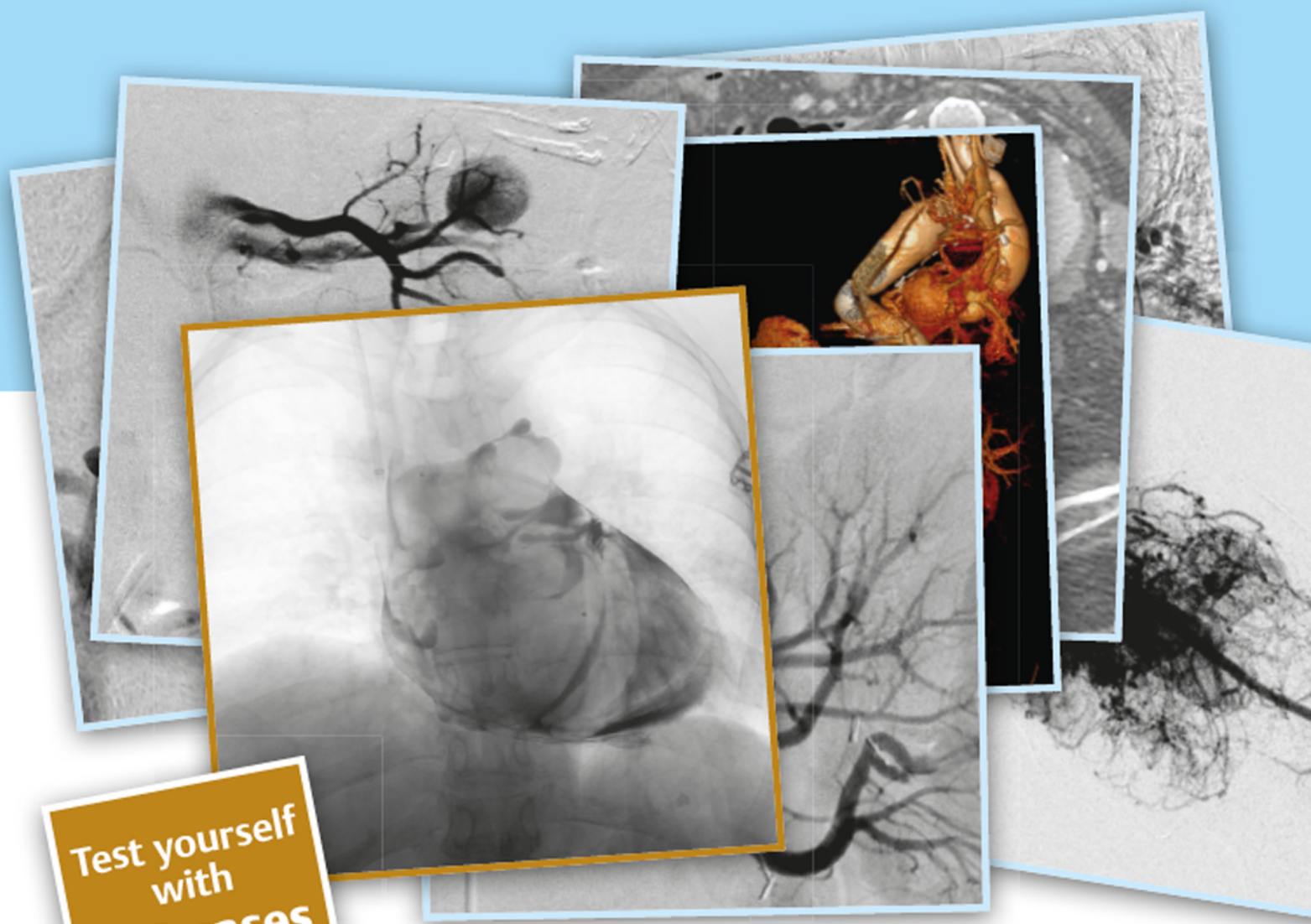


RadCases

Interventional Radiology

Hector Ferral
Jonathan M. Lorenz

Second Edition



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RadCases Interventional Radiology

Second Edition

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To Michelle, Manuel, and Emilio: Thank you for countless moments of happiness and thank you
for giving me a reason to stay alive.

– HF

To my loving wife, Cynthia, and to my kids, Matthew and Anna: Every moment is precious.

– JML

Series Preface

As enthusiastic partners in radiology education, we continue our mission to ease the exhaustion and frustration shared by residents and the families of residents engaged in radiology training! In launching the second edition of the RadCases series, our intent is to expand rather than replace this already rich study experience that has been tried, tested, and popularized by residents around the world. In each subspecialty edition, we serve up 100 new, carefully chosen cases to raise the bar in our effort to assist residents in tackling the daunting task of assimilating massive amounts of information. RadCases second edition primes and expands on concepts found in the first edition, with important variations on prior cases, updated diagnostic and management strategies, and new pathologic entities. Our continuing goal is to combine the popularity and portability of printed books with the adaptability, exceptional quality, and interactive features of an electronic case-based format. The new cases will be added to the existing electronic database to enrich the interactive environment of high-quality images that allows residents to arrange study sessions, quickly extract and master information, and prepare for theme-based radiology conferences.

We owe a debt of gratitude to our own residents and to the many radiology trainees who have helped us create, adapt, and improve the format and content of RadCases by weighing in with suggestions for new cases, functions, and formatting. Back by popular demand is the concise, point-by-point presentation of the Essential Facts of each case in an easy-to-read, bulleted format and a short, critical differential starting with the actual diagnosis. This approach is easy on exhausted eyes and encourages repeated priming of important information during quick reviews, a process we believe is critical to radiology education. New since the prior edition is the addition of a question-and-answer section for each case to reinforce key concepts.

The intent of the printed books is to encourage repeated priming in the use of critical information by providing a

portable group of exceptional core cases to master. Unlike the authors of other case-based radiology review books, we removed the guesswork by providing clear annotations and descriptions for all images. In our opinion, there is nothing worse than being unable to locate a subtle finding on a poorly reproduced image even after one knows the final diagnosis.

The electronic cases expand on the printed book and provide a comprehensive review of the entire specialty. Thousands of cases are strategically designed to increase the resident's knowledge by providing exposure to a spectrum of case examples—from basic to advanced—and by exploring “Aunt Minnies,” unusual diagnoses, and variability within a single diagnosis. The search engine allows the resident to create individualized daily study lists that are not limited by factors such as radiology subsection. For example, tailor today's study list to cases involving tuberculosis and include cases in every subspecialty and every system of the body. Or study only thoracic cases, including those with links to cardiology, nuclear medicine, and pediatrics. Or study only musculoskeletal cases. The choice is yours.

As enthusiastic partners in this project, we started small and, with the encouragement, talent, and guidance of Timothy Hiscock and William Lamsback at Thieme Publishers, we have further raised the bar in our effort to assist residents in tackling the daunting task of assimilating massive amounts of information. We are passionate about continuing this journey and will continue to expand the series, adapt cases based on direct feedback from residents, and increase the features intended for board review and self-assessment. First and foremost, we thank our medical students, residents, and fellows for allowing us the privilege to participate in their educational journey.

*Jonathan M. Lorenz, MD, FSIR
Hector Ferral, MD*

Preface

Our heartfelt appreciation goes out to the countless enthusiastic aspiring and practicing interventional radiologists (IRs) that have made *RadCases Interventional Radiology* an overwhelmingly popular educational resource for the past 5 years! The rich rewards we get from the ideas, encouragement, and successes of our trainees were the inspiration for our creation of the RadCases textbook series and our authorship of the first edition of 250 cases.

The first edition of *RadCases Interventional Radiology* provided a core source of concise, accurate, and comprehensive interventional radiology review materials. In this second edition, we have combined our continued passion for the education of IRs with your insightful feedback for the past 5 years to create 100 additional cases. The written content continues to support the knowledge base of residents facing written board exams, and the preservation of the case-presentation format supports practicing IRs and fellows, particularly those facing the oral exam for the certification of added qualifications. As with the first edition, the printed book provides a portable resource for the critical exercise of repeatedly priming core material, and all 350 interventional radiology cases are available in the electronic book to

provide concise material, high-resolution images, and sortability to tailor your daily study sessions. We are confident this second edition expansion will help you achieve your goals!

Our cutting-edge practices and leadership roles in the local and national education of IRs served as a source of content for the second edition to grow and enhance *RadCases Interventional Radiology* to accommodate changes and advancements in interventional radiology, including thermal ablation applications, prostate embolization, and advancements in the management of conditions such as portal hypertension and vascular malformations. We continue to provide the gamut of vascular and nonvascular cases emphasizing both diagnosis and interventional management. As always, many thanks to our readers and supporters for their energy and dedication to our mutual passion—interventional radiology!

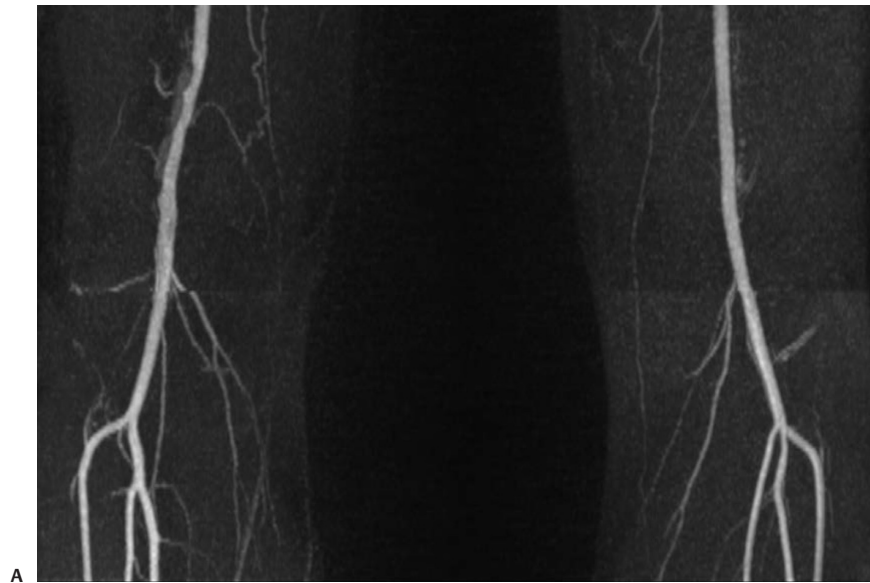
Case Authorship

Cases 1 to 50 were authored by Hector Ferral and cases 51 to 100 were authored by Jonathan M. Lorenz.

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We would like to thank William Lamsback and Timothy Hiscock at Thieme Publishers for their guidance, encouragement, and expertise throughout the creation and preparation of RadCases, and we thank Owen Zurhellen for his expert technical assistance. We also thank Kenneth Schubach and Torsten Scheihagen for their fine work on the book manuscript.

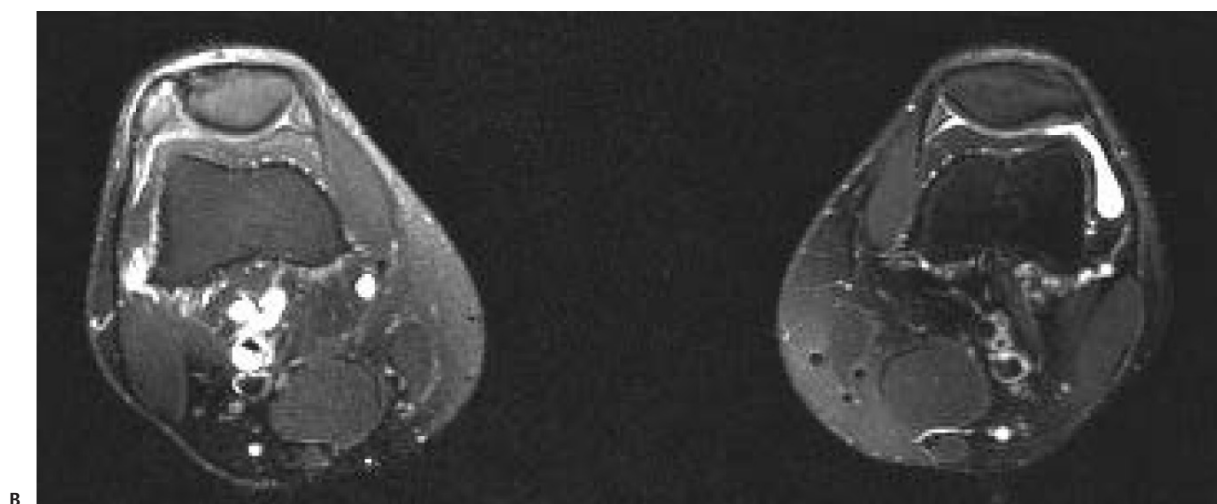
Case 1



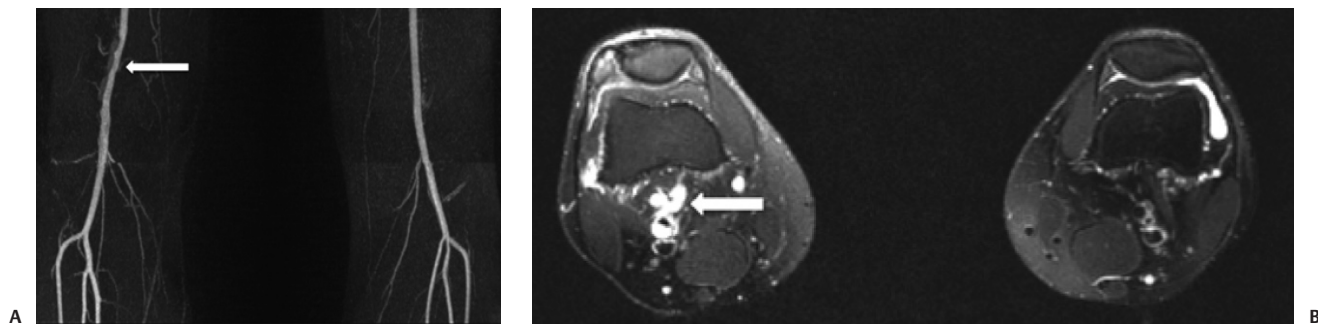
■ Clinical Presentation

A 42-year-old man, a marathon runner, presents with sudden onset of claudication.

■ Further Work-up



■ Imaging Findings



(A) A selected image from an MR angiogram (MRA) of the lower extremities. There is moderate irregularity of the lateral wall of the proximal popliteal artery (arrow). (B) An axial image from the MRA showing intense, irregular, cystic structures surrounding the right popliteal artery consistent with peri-arterial cysts (arrow).

■ Differential Diagnosis

- **Cystic adventitial disease:** An MR angiogram (MRA) shows peri-adventitial cysts, which confirm the diagnosis.
- **Popliteal aneurysm:** The findings in the present MRI scan do not correspond to aneurysm. Arteries have a normal wall and are not dilated.
- **Popliteal entrapment:** This is usually bilateral and is seen as a linear extrinsic compression of the popliteal artery or medial displacement of the popliteal artery. Provocative maneuvers (dorsiflexion/plantarflexion) may be necessary to demonstrate these changes.

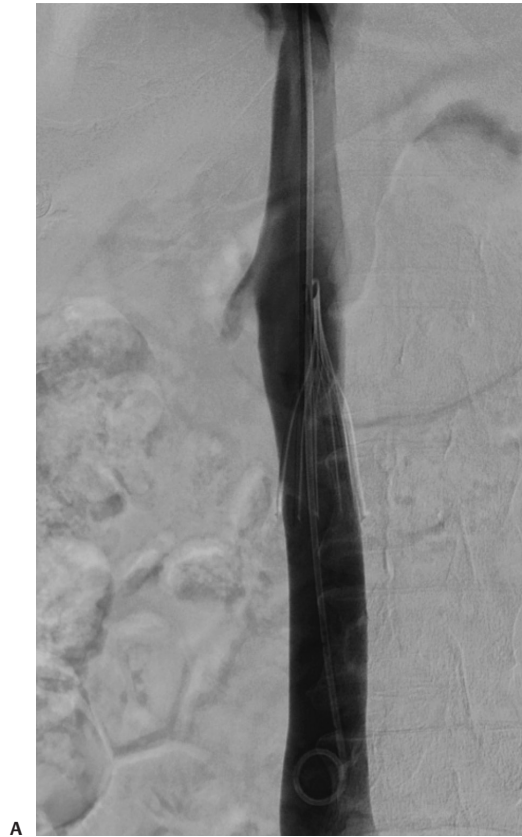
✓ Pearls and ✗ Pitfalls

- ✓ Always look for the above-mentioned possibilities in any young patient with sudden onset of claudication.
- ✓ The most important aspect is clinical suspicion.
- ✓ MRI will be diagnostic.
- ✓ Surgery is the treatment of choice.
- ✓ Always evaluate distal arterial patency. This condition may also be associated with arterial thrombosis.
- ✗ Cyst aspiration may work but is usually associated with recurrence. It is better to avoid aspiration.

■ Essential Facts

- Cystic adventitial disease may be difficult to diagnose.
- The cysts can be identified with ultrasound or MRI. The best diagnostic study is MRI.
- Patients are typically young and active and have no reason to have vascular disease.

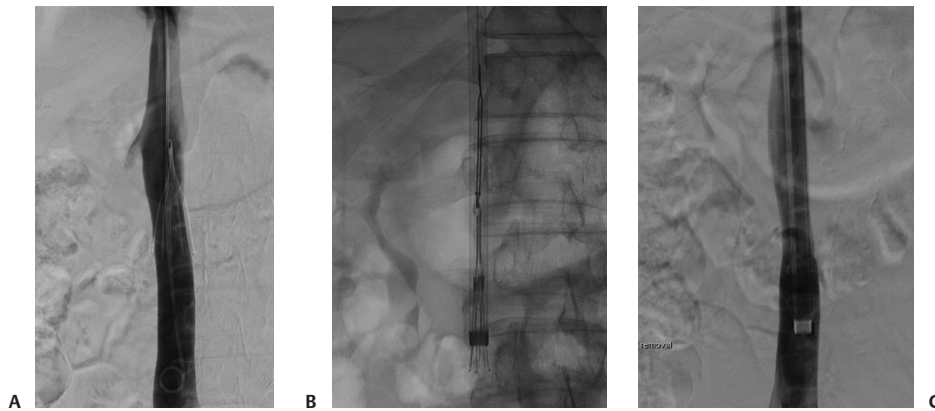
Case 2



■ Clinical Presentation

A patient who had elective knee surgery presents for inferior vena cava (IVC) filter removal. You are asked to evaluate the diagnostic cavagram.

■ Imaging Findings



(A) The diagnostic cavagram immediately before removal attempt. The cavagram in the present case is normal, showing an intact inferior vena cava (IVC) filter with no tilting. (B) A sequence during removal. The filter cone has been captured with a snare, and then a 9-Fr sheath has been advanced to collapse the legs of the IVC filter. (C) A cavagram after filter retrieval. The image shows an intact IVC.

■ Differential Diagnosis

- **Normal cavagram; straightforward removal of an inferior vena cava filter:** The case shows a straightforward IVC filter removal. The cavagram is normal. The filter is not tilted and there is no thrombus within the cava.
- **IVC thrombosis:** No signs of thrombosis are identified.
- **IVC filter complication:** The image shows an intact IVC filter with no tilting and no fractures.

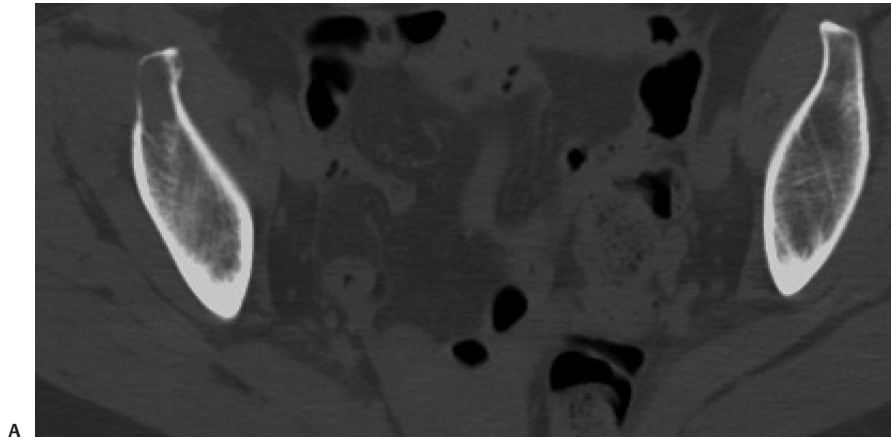
■ Essential Facts

- IVC retrieval has gained importance in clinical practice.
- When released, retrievable IVC filters were considered to be suitable for long-term insertion as permanent devices.
- Clinical practice has demonstrated that retrievable filters are associated with unexpected complications—mainly, fractures and leg penetration beyond the IVC wall.
- The U.S. Food and Drug Administration released a letter in 2010 indicating that retrievable filters should be removed as soon as they are no longer required.

✓ Pearls and ✗ Pitfalls

- ✓ Try to identify the type of filter before attempting removal. Each IVC filter has different optimal removal times.
- ✓ A frontal KUB is the best imaging study to identify the filter and to evaluate for fractures.
- ✗ CT and MRI are suboptimal studies to identify the type of filter or the presence of filter fractures.
- ✗ If the diagnostic venogram shows thrombus within the filter cone, and if it occupies more than 25% of cone surface, consider avoiding removal.

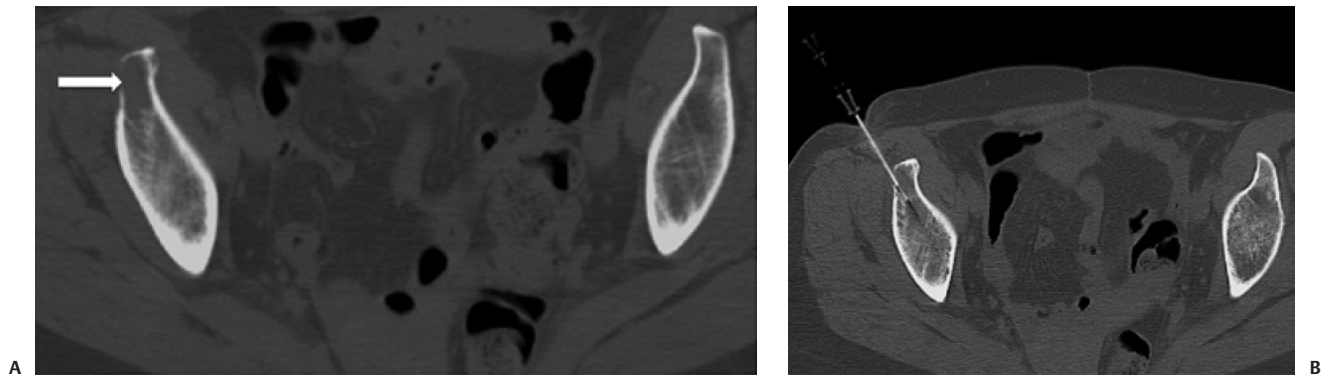
Case 3



■ Clinical Presentation

A 58-year-old woman with a history of breast cancer presents, and a surveillance CT scan is performed.

■ Imaging Findings



(A) A selected axial image from a noncontrast CT scan of the pelvis that shows a lytic lesion of the right iliac bone. There is discontinuity of the cortex (arrow). There is no soft tissue swelling or stranding, and no fluid surrounding the bony structure. (B) A selected axial image obtained during bone biopsy. A 19-gauge guiding needle has been advanced into the right iliac bone, and a fine needle aspirate was obtained using a 22-gauge Franseen needle. The guiding needle was advanced through the area of cortex discontinuity.

■ Differential Diagnosis

- **Metastatic breast carcinoma to the right iliac bone:** The images show a lytic lesion with no soft tissue abnormalities. In a patient with history of breast cancer, this is the most likely diagnosis.
- **Osteomyelitis:** Osteomyelitis of this site is unusual in the absence of the history of trauma or penetrating injury.
- **Osteoporosis:** Very unlikely. The contralateral iliac bone is of normal density for the patient's age. Focal osteoporosis is unlikely.
- **Multiple myeloma:** Other bones should be evaluated. Multiple myeloma usually affects multiple bones.

■ Essential Facts

- Bone biopsy is important in the work-up of metastatic disease.
- The procedure may be quite painful if the cortex is intact.
- Bone biopsies can be frustrating. If cortex is intact, expect lower diagnostic yield (70-80%).
- If cortex is affected and soft tissue mass is present, the yield approaches 100%.

✓ Pearls and ✗ Pitfalls

- ✓ Always evaluate the lesion to be biopsied. The key to planning the procedure is the status of the cortex. If the cortex is intact, you will need a bone biopsy system and most probably the patient will need to be sedated.
- ✓ If the cortex is involved, then bone biopsies are relatively straightforward. In these cases, a small guiding needle and a fine needle aspirate will be diagnostic.
- ✗ Bone biopsies may be associated with fracture of the biopsied bone. The site of biopsy needs to be carefully evaluated before proceeding.

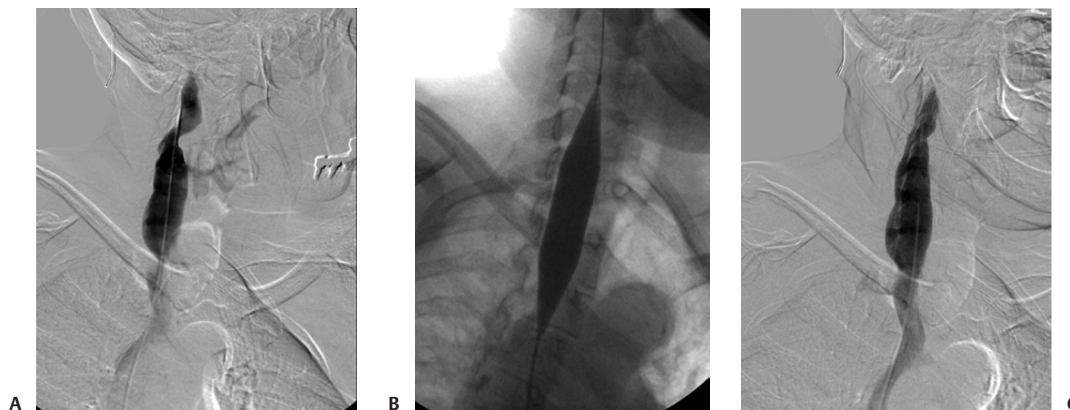
Case 4



■ Clinical Presentation

A 40-year-old woman presents with dizziness and gait abnormality.

■ Imaging Findings



(A) A selected image from a right internal jugular vein digital venogram. The image shows a $> 90\%$ stenosis at the base of the right internal jugular vein. (B) A spot film obtained during balloon angioplasty of the right jugular vein. The balloon is fully inflated. (C) A selected image from the right internal jugular vein obtained immediately after angioplasty. The stenosis has been treated successfully.

■ Differential Diagnosis

- **Right internal jugular vein stenosis:** The patient presented here had multiple sclerosis. Her dizziness improved after angioplasty. The clinical entity affecting these patients has been termed “chronic cerebrospinal venous insufficiency” (CCSVI). This patient had no history of previous jugular vein catheterization.
- **Catheter-induced venous stenosis:** This patient had no history of previous catheter insertions.
- **Extrinsic compression:** This patient had no adenopathy and no history of malignancy.

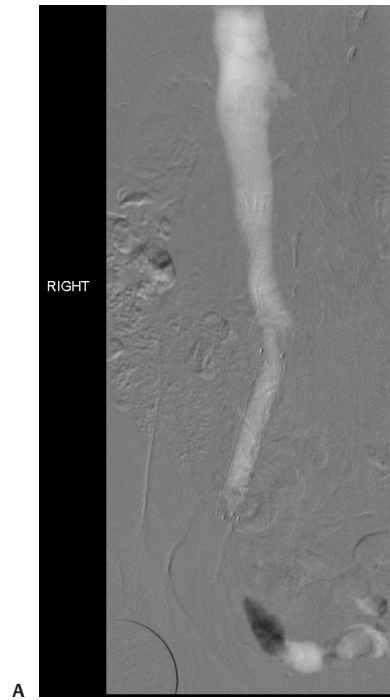
■ Essential Facts

- CCSVI is a topic of great controversy. It has its supporters but it has many more detractors. To date, the existence of CCSVI has not been proved, but there is a large number of patients who have shown significant improvement in their symptomatology after balloon angioplasty of the jugular veins.
- In its original description, CCSVI was thought to be strongly associated with multiple sclerosis.

✓ Pearls and ✗ Pitfalls

- ✓ The best way to evaluate these patients is with a multimodal approach. No single imaging study has high sensitivity or specificity for the diagnosis of CCSVI.
- ✓ If noninvasive studies are positive, then it is worthwhile to study the patient with an invasive venogram.
- ✗ The existence of CCSVI has not been proved. All work on this topic is considered to be investigational and experimental at this point.

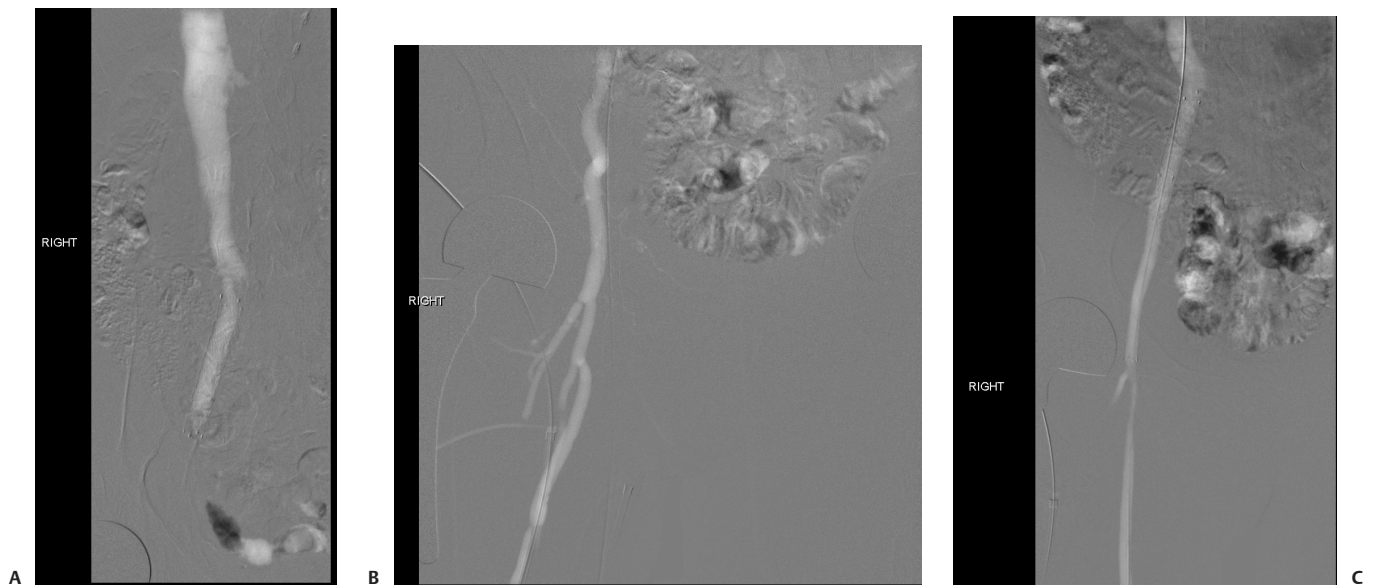
Case 5



■ Clinical Presentation

A 65-year-old woman with end-stage renal disease presents with an occluded arteriovenous graft. She has a severe allergy to iodinated contrast media.

■ Imaging Findings



(A) A selected digital subtraction image obtained during a dec clotting procedure with the use of carbon dioxide as a contrast agent. The outflow vein is shown. There is a patent, self-expandable metallic stent. (B) A selected digital subtraction image obtained during the same dec clotting procedure, clearly showing the inflow anastomosis and inflow artery. The inflow artery is patent, as well as the inflow anastomosis. (C) A selected digital subtraction image obtained at procedure completion. Carbon dioxide digital subtraction image shows a widely patent outflow vein and outflow anastomosis.

■ Differential Diagnosis

- **Graft dec clotting using carbon dioxide:** The current case illustrates the use of CO₂ in a patient with history of severe iodinated contrast allergy. The procedure was completed without the use of non-ionic contrast.
- **Graft dec clotting using iodinated contrast:** The image definition of the iodinated contrast is different from that generated with the use of carbon dioxide. The image is sharper when iodinated contrast is used. Iodinated contrast dissolves in blood; carbon dioxide displaces blood. The mechanism of image acquisition is different.

✓ Pearls and ✗ Pitfalls

- ✓ Carbon dioxide is nonallergenic and non-nephrotoxic.
- ✓ It has very low viscosity, which allows injection via very small catheters.
- ✗ Careful injection technique is essential for the safe use of CO₂ in angiography.
- ✗ At the present time, CO₂ is contraindicated for arterial use above the diaphragm because of the risk of cerebral CO₂ embolism.

■ Essential Facts

- Carbon dioxide has been used as a contrast agent for more than a century. CO₂ was initially used in the abdomen and retroperitoneum. Beginning in the 1960s, CO₂ was administered intravenously to identify pericardial effusions.
- Dr. Hawkins published the first report of the use of carbon dioxide for angiography in 1982. The use of CO₂ as an arterial and venous contrast agent has expanded in recent years.

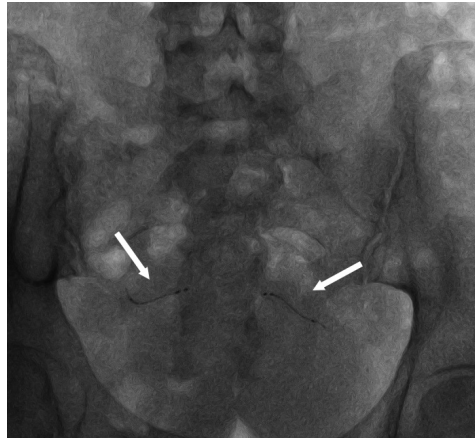
Case 6



■ Clinical Presentation

A 40-year-old woman who refuses a pregnancy test.

■ Imaging Findings



A spot film obtained before an angiographic procedure in this woman. The image shows an Essure intratubal sterilization device (arrows).

■ Differential Diagnosis

- **Essure intratubal sterilization device:** The current case shows an Essure intratubal sterilization device (Bayer, Whippany, NJ).
- **Malpositioned intrauterine device:** This is a possibility; however, the location and appearance of the Essure device is quite characteristic. No other intrauterine device has this same appearance.
- **Postsurgical foreign body:** This is also a possibility; however, as mentioned previously, the Essure device has a characteristic appearance.

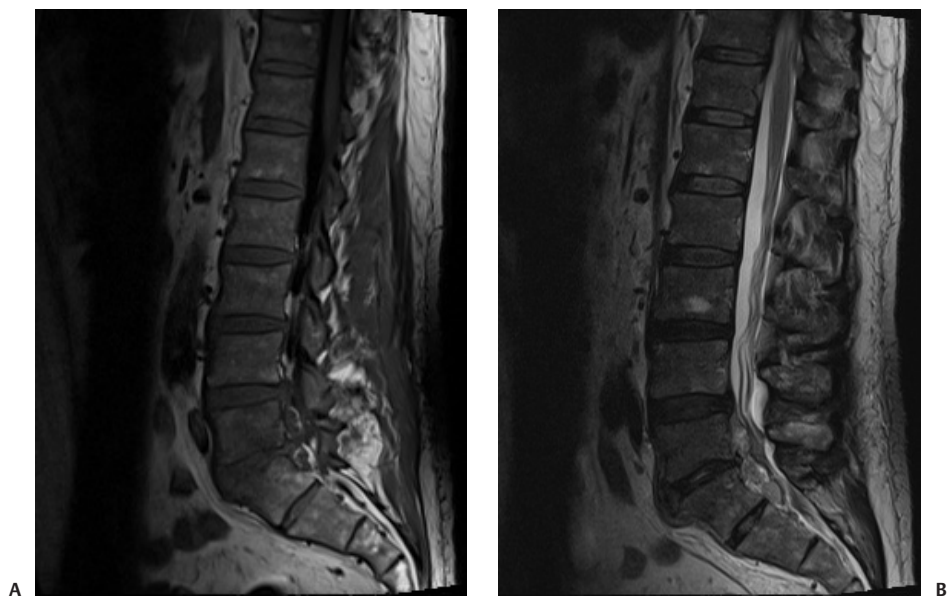
✓ Pearls and ✗ Pitfalls

- ✓ The Essure system is designed to induce fibrosis and tubal occlusion.
- ✓ Effective and complete tubal occlusion by this device needs to be confirmed by hysterosalpingogram 3 months after insertion.
- ✗ Several complications have been described after Essure insertion, including incomplete tubal occlusion, tubal perforation, intractable pain, bleeding, and unintended pregnancies.

■ Essential Facts

- The Essure system was approved by the U.S. Food and Drug Administration for permanent sterilization in 2002.
- It is a nitinol coil that is implanted in the office, under hysteroscopy. The procedure is an outpatient procedure. The Essure device has a characteristic appearance on plain films.

Case 7



■ Clinical Presentation

A 59-year-old diabetic man presents with lower back pain and fever.