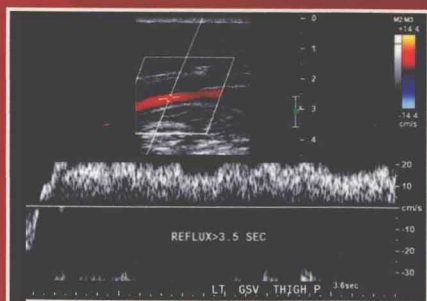
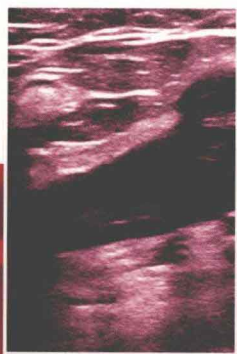
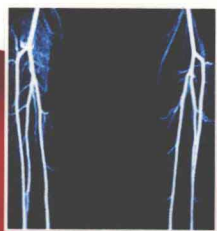


MANUAL OF VASCULAR DISEASES

SECOND EDITION

Sanjay Rajagopalan
Steven M. Dean
Emile R. Mohler
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MANUAL OF VASCULAR DISEASES

Second Edition

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I would like to dedicate this edition to my wife Kyle and my wonderful children Tejas and Shreyas. All three of them are intimately familiar with this edition as I have had to take time that I would have ordinarily spent with them to writing and editing chapters for this book. I would also like to thank my parents (Narasimhan and Shanthi Rajagopalan) and my uncle and aunt (Narasimhan and Saroja Ranganathan) who continue to inspire me and find the balance between work and play.

Sanjay Rajagopalan

To my wife and daughter, Jennifer and Annie Dean, as well as my parents, Merrell and Sherma Dean, for their unyielding support, tolerance, and love.

Steven Dean

To my family for their patience, understanding, and support throughout this writing and many other endeavors.

Emile R. Mohler

To all the outstanding faculty, fellows, residents, and students I have worked with throughout the years. I am grateful to them for sharing their insight, thoughts, and talents.

To Suchandra with love.

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A decade has passed since the first inception of an idea for a book in Vascular Medicine—an eternity in the field of medicine where changes occur nearly every week. When the original idea for this book was conceived, there were very few books in Vascular Medicine that allowed the reader to acquire a quick update on common vascular disorders from the vantage of a coat pocket. Since the last edition, there have been many other textbooks that have come and gone. Furthermore, the field has seen many changes including advances in endovascular therapy, imaging-based diagnostics, new discoveries in the genetic underpinnings of vascular disease, and even a newly consecrated board to certify practitioners of the field.

A new edition that incorporated these changes was a necessity, as many of our notions and beliefs in the field continue to evolve. Another objective, which was never planned when the first edition of the book was conceived, was the utility of the book in preparing for boards in cardiology, vascular medicine, and vascular surgery. In keeping with this function, we have provided questions following each chapter to prepare individuals who may be taking these exams.

This edition is made possible by excellent contributions from leaders in the practice of vascular medicine and my co-editors who continue to amaze me with their understanding and insights into the field I would like to acknowledge Debabrata Mukherjee for his knowledge in the field of endovascular therapy and the alacrity of his responses during the review of this book, Emile Mohler for his knowledge of peripheral arterial disease and vasospastic diseases, and finally, my good friend Steven Dean for his incredible breadth of experience in venous and lymphatic disorders. This edition would not have happened without the tireless efforts of Rebecca Abbott who kept us organized throughout the yearlong process. Finally this edition would not be possible without the efforts of Leanne McMillan who steered us towards the finish line. Thanks Leanne!

We hope that this edition continues to inspire all of you toward providing outstanding care to our patients.

Sanjay Rajagopalan, MD

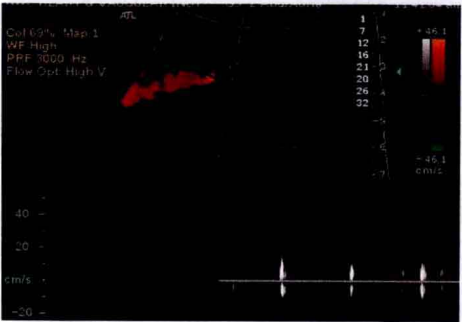
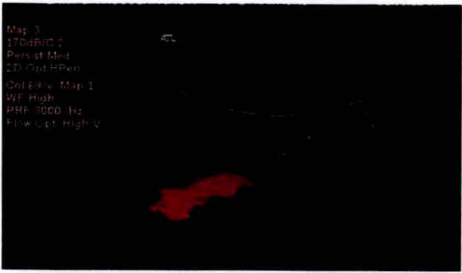


FIGURE 2-3. Duplex ultrasound of the abdominal aorta in the same patient as in Figure 2.2. **Top panel:** Color image demonstrating occluded infra-renal aorta. **Bottom panel:** Doppler analysis demonstrating preocclusive “thump” characteristic of occlusion.



FIGURE 2-5. Duplex ultrasound demonstrating color power angiography technique of the distal anastomosis of a synthetic external iliac artery to peroneal artery bypass graft.

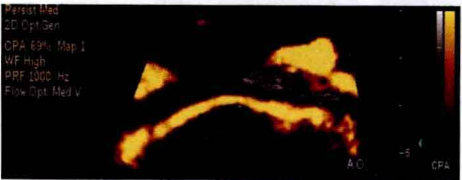


FIGURE 2-7. Color power angiography technique demonstrating the right renal artery from the aorta (AO) to the hilum of the kidney.

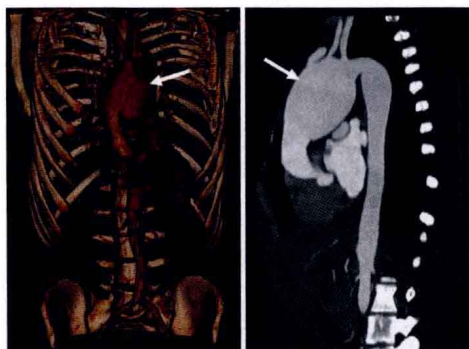


FIGURE 5-4. Volume rendered (right) and MIP (left) display of a large ascending thoracic aortic aneurysm.



FIGURE 5-7. An aortic dissection with extension into the abdomen. **A:** Three-dimensional volume reconstruction (upper left). **B:** A maximum intensity projection with a 60-mm thickness (slab-MIP) demonstrates calcium in the abdominal aorta and reveals segments of the celiac, superior mesenteric, and lumbar arteries in relation to the hepatic parenchyma (bottom left).

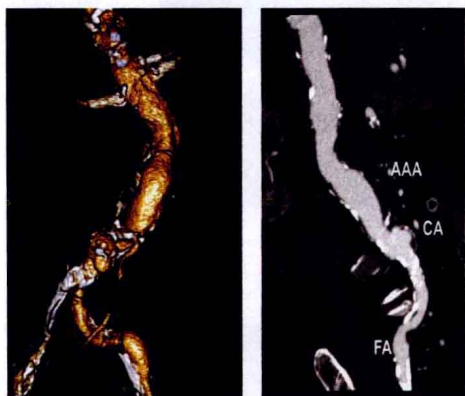


FIGURE 5-8. The volume-rendered image (left) of this aorta does not adequately reveal diffuse aneurysmal involvement. A curved multiplanar reconstruction (right) of this tortuous area enables electronic linearization of the aorta perpendicular to the flow of blood and provides a more reliable assessment of abdominal aneurysm length. (Reprinted from Goldman C, Sanz J. CT Angiography of the abdominal aorta and its branches with protocols. In: Mukerjee D, Rajagopalan S, eds. *CT and MRI angiography of the peripheral circulation: practical approach with clinical protocols*. London, UK: Informa Health Care, 2007:117, with permission.)

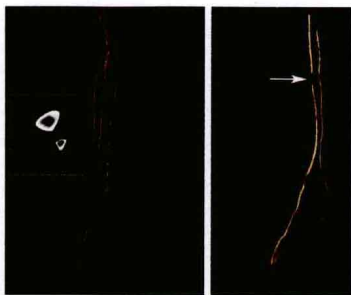


FIGURE 5-10. A volume-rendered display of lower extremity atherosclerotic disease (left). Axial CTA image (inset) illustrates calcification within the walls of the anterior tibial, posterior tibial, and peroneal arteries with poor luminal visualization. Occlusive disease (right). Three-dimensional CTA volume-rendered image (left anterior oblique view) shows a segmental occlusions of the anterior tibial artery (arrow) with small bridging collateral arteries. (Reprinted from Cohen E, Doshi A, Lookstein, R. CT angiography of the lower extremity circulation with protocols. In: Mukerjee D, Rajagopalan S, eds. *CT and MRI angiography of the peripheral circulation: practical approach with clinical protocols*. London, UK: Informa Health Care, 2007:139, with permission.)



FIGURE 5-11. Volume-rendered image illustrating occlusion of bilateral common iliac arteries and the proximal portion of the right external iliac artery secondary to giant cell arteritis. (Reprinted from Cohen E, Doshi A, Lookstein R. CT angiography of the lower extremity circulation with protocols. In: Mukerjee D, Rajagopalan S, eds. *CT and MRI angiography of the peripheral circulation: practical approach with clinical protocols*. London, UK: Informa Health Care, 2007:141, with permission.)

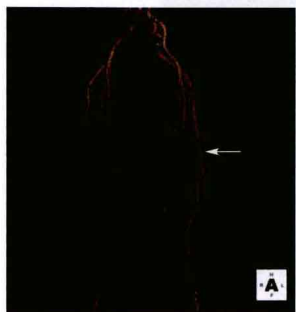


FIGURE 5-12. Persistent sciatic artery. Three-dimensional CTA volume-rendered image (anteroposterior view) shows occlusion of the distal left superficial femoral artery. The left popliteal artery is supplied by a persistent left sciatic artery fed by the internal iliac artery (arrow). (Reprinted from Cohen E, Doshi A, Lookstein R. CT angiography of the lower extremity circulation with protocols. In: Mukerjee D, Rajagopalan S, eds. *CT and MRI angiography of the peripheral circulation: practical approach with clinical protocols*. London, UK: Informa Health Care, 2007:143, with permission.)

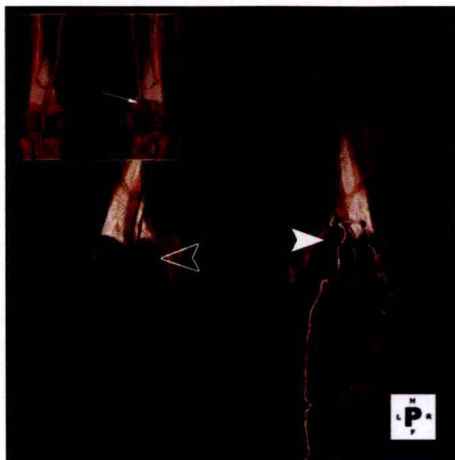


FIGURE 5-13. Popliteal artery entrapment. Three-dimensional CTA volume-rendered image (*posteroanterior view*) of a young patient with right calf pain on exertion. The medial head of the right gastrocnemius muscle demonstrates an abnormal origin lateral to the popliteal artery (*closed arrowhead*). *Inset* image shows complete occlusion of the right popliteal artery (*arrow*) with multiple superficial collateral arteries originating just proximal to this level. The normal origin of the medial head of the left gastrocnemius medial to the popliteal artery (*open arrowhead*) is shown for comparison. (Reprinted from Cohen E, Doshi A, Lookstein R. CT angiography of the lower extremity circulation with protocols. In: Mukerjee D, Rajagopalan S, eds. *CT and MRI angiography of the peripheral circulation: practical approach with clinical protocols*. London, UK: Informa Health Care, 2007:143, with permission.)

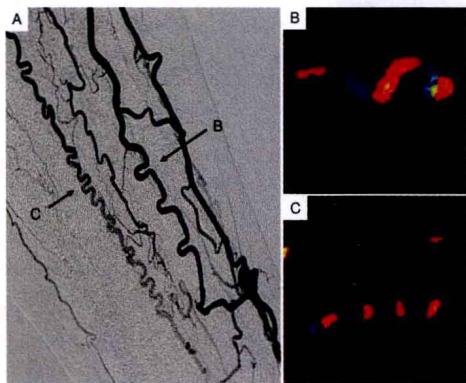


FIGURE 9-1. **A:** Digital subtraction angiography shows corkscrew collaterals around the area of occlusions in the right lower leg. Continuous-wave Doppler ultrasound shows corkscrew collaterals as color Doppler flows of a snake sign [**A** (*arrow B*), and **B**] and a dot sign [**A** (*arrow C*) and **C**]. (From Fujii Y, Nishioka K, Yoshizumi M, et al. Corkscrew collaterals in thromboangiitis obliterans (Buerger disease). *Circulation* 2007;116:e539–e540, with permission.)

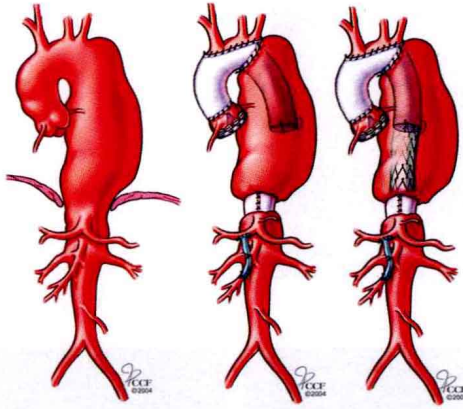


FIGURE 14-4. Elephant trunk procedure. **Left:** Preoperative disease. **Middle:** Stage I with replacement of the ascending aorta and arch with a Dacron graft with the distal graft sutured circumferentially to the aorta distal to the left subclavian artery and the free end of the graft (“elephant trunk”) within the descending aneurysm. **Right:** Completion of the procedure using an endovascular stent graft attached proximally to the “elephant trunk” and the distal end secured to a Dacron graft cuff. (Adapted from 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease. *Circulation* 2010;121;1544–1579.)

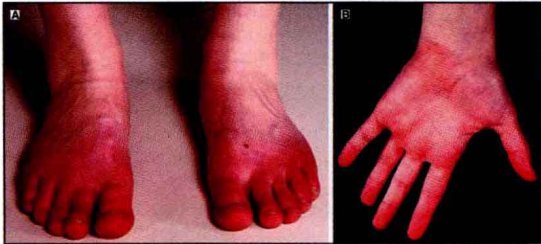


FIGURE 18-3. Erythralgia affecting the feet and the hand. (Reprinted from Sandroni P, et al. *Arch Dermatol* 2006;142:283–286, with permission.)



FIGURE 18-4. Livedo reticularis. Note the symmetric, regular, “unbroken” rings.



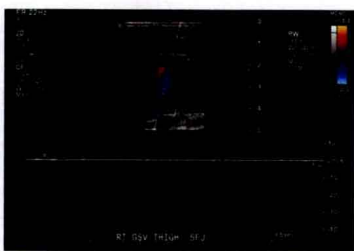
FIGURE 18-5. Livedo racemosa. Note the asymmetric and irregular appearance of the cones.



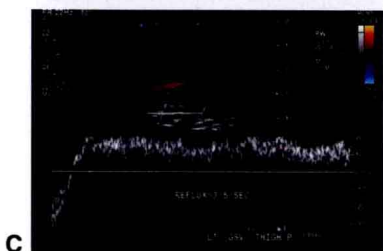
FIGURE 18-6. Pyoderma gangrenosum.



A



B



C

FIGURE 19-4. Demonstration of competency of the SFJ by duplex ultrasound. During quiet respiration (A, B), blood flows cephalad in the greater saphenous and the common femoral veins as indicated by the arrows. With performance of the Valsalva, there is complete cessation of flow (B) with a competent SFJ. In contrast, in (C), there is blood flow in the opposite direction with the Valsalva suggesting reflux of the SFJ. From Zwiebel WJ. *Introduction to vascular ultrasonography*, 4th ed. Philadelphia: W. B. Saunders, 2000:356–357.



FIGURE 26-4. Hyperkeratotic, papillomatous skin along the dorsum of the second toe prohibits the ability to pinch or “tent” the affected area, thus fulfilling the definition of a *positive Stemmer’s sign*.



A



B

FIGURE 26-5. Chronic venous insufficiency is an increasingly recognized secondary cause of lymphedema. Note the constellation of marked venous stasis hyperpigmentation and profound lymphedematous dorsal foot swelling.



FIGURE 26-6. Classic lipedema of the lower extremities. Observe the symmetric calf involvement and “ankle cutoff sign” with sparing of the feet and toes. These clinical features delineate lipedema from lymphedema.



FIGURE 26-7. Lipolymphedema. Rarely, long-standing lipedema can eventuate in secondary lymphedema. Although this female patient experienced a 40-year history of familial symmetric thigh and calf swelling without foot involvement, for the last several years, dorsal pedal edema evolved.



FIGURE 30-1.



FIGURE 30-2A.



FIGURE 30-2B.



FIGURE 30-2C.



FIGURE 30-2D.



FIGURE 30-3.