Contents

Section 1: Coronary Artery Disease

1. Coronary Arterial and Venous Anatomy **3**

Melvin D Cheitlin, Glenn N Levine, Philip C Ursell

- Introduction and Historical Perspective *3*
- Left Main Coronary Artery *4*
- Left Anterior Descending Coronary Artery (Anterior Interventricular Artery) *4*
- Left Circumflex Coronary Artery *11*
- Right Coronary Artery *11*
- Posterior Descending Coronary Artery *15*
- Intramural Coronary Vasculature *15*
- Coronary Venous System *17*
- Coronary Sinus *18*
- Anterior Interventricular Vein *18*
- Middle Cardiac Vein *20*
- Small Cardiac Vein *20*
- Anterior Cardiac Veins *20*
- Veins Draining the Right and Left Atria *20*

2. Coronary Artery Anomalies **22**

Shakeel Ahmed Qureshi, Gareth J Morgan

- Coronary Artery Embryology *22*
- Normal Coronary Anatomy *22*
- Coronary Dominance *23*
- Classification of Coronary Anomalies *24*
- Coronary Artery Origins from the Aortic Root but taking an Abnormal Course or Origin *25*
- Abnormalities of Course and Origin *29*
- Abnormalities of Intrinsic Coronary Arterial Anatomy *31*
- Abnormalities of Coronary Termination *37*

3. Cardiac Stress Tests **45**

Jo Mahenthiran

- Stress Modalities *46*
- Stress Echocardiography *55*
- Radionuclide Myocardial Perfusion Imaging Stress *60*
- Cardiac MRI Stress *64*

4. Myocardial Viability Testing **76**

Jamieson M Bourque, Christopher M Kramer

- SPECT Nuclear Imaging *76*
- PET Viability Imaging *78*

- Dobutamine Echocardiography *78*
- Cardiac Magnetic Resonance *78*
- Cardiac Computed Tomography *83*
- Prognostic Value of Viability Testing *83*

5. Stable Ischemic Heart Disease **86**

Richard A Lange

- Pathophysiology *86*
- Risk Factors *86*
- Symptoms *87*
- Risk Assessment *87*
- Coronary CT Angiography *93*
- Therapeutic Goals *94*
- Revascularization *96*

6. Acute Coronary Syndromes: Non-ST-Elevation Acute Coronary Syndrome and STEMI **100**

Ali E Denktas, Glenn N Levine

- Terminology *100*
- Etiology of Acute Coronary Syndromes *100*
- Non-ST-Segment Elevation Acute Coronary Syndrome (NSTE-ACS) *102*
- ST-Segment-Elevation Acute Coronary Syndrome (STEMI) *106*
- Complications of STEMI *110*
- Other Causes of ACS and ACS-Like Syndromes *117*

7. Percutaneous Coronary Interventions **126**

Ali E Denktas, Hani Jneid, David Paniagua, Glenn N Levine

- Evolution of Percutaneous Coronary Intervention *126*
- Complications of Percutaneous Coronary Intervention *127*
- Indications for Percutaneous Coronary Intervention *130*
- Adjunctive Devices Used in Percutaneous Coronary Intervention *135*
- Radial Artery Percutaneous Coronary Intervention *147*

8. Coronary Artery Bypass Grafting Surgery **150**

Lorraine D Cornwell, Shuab Omer, Faisal G Bakaeen

- CABG versus Medical Therapy or PCI *153*
- Patient Selection and Evaluation For CABG *154*
- Coronary Artery Bypass Procedures *154*
- Complications of CABG *165*
- Patient Management and Follow-up *166*

Section 2: Heart Failure and Cardiomyopathy

9. Cardiac Anatomy and Function **171**

Jin T Kim, Pradeep Vaideeswar, Glenn N Levine

- The Cardiac Chambers *174*
- Assessment of Cardiac Function *179*

10. Systolic Heart Failure and Dilated Cardiomyopathies 193
Allison M Pritchett, Ravi S Hira, Biykem Bozkurt
- Definition and Etiology *193*
- Physiology of Heart Failure *197*
- Clinical Evaluation of Heart Failure *198*
- Echocardiography *204*
- Cardiovascular Magnetic Resonance *206*
- Endomyocardial Biopsy *207*
- Medical Therapy *207*
- Coronary Revascularization *209*
- Device Therapy *210*

11. Heart Failure with Preserved Ejection Fraction ("Diastolic Heart Failure") 211
A Afşin Oktay, Sanjiv J Shah
- Pathogenesis and Phenotypes of HFpEF *212*
- Diagnosis of HFpEF *215*
- Treatment of HFpEF *226*

12. Hypertrophic Cardiomyopathy 229
Christian Prinz, Lothar Faber
- Clinically Important Pathophysiological Principles *229*
- Imaging and Hemodynamics *233*
- Invasive Diagnostic Testing *237*
- Hypertrophy and Myocardial Fibrosis *240*
- Clinical Observations and Symptoms *245*
- Therapeutic Algorithms *246*
- Risk Stratification *246*
- Asymptomatic Patients *247*
- Symptomatic Hypertrophic Non-Obstructive Cardiomyopathy Patients *247*
- Symptomatic Hypertrophic Obstructive Cardiomyopathy (HOCM) Patients *247*

13. Infiltrative Heart Disease and Restrictive Cardiomyopathy 251
Steven D Zangwill, Salil Ginde
- Etiology *251*
- Pathophysiology *256*
- Clinical Presentation *259*
- Diagnostic Studies *259*
- Management *262*

14. Arrhythmogenic Right Ventricular Cardiomyopathy 266
Darra T Murphy, Marc W Deyell
- Genetics and Pathophysiology of ARVC *269*
- Diagnosis of ARVC *270*
- Prognosis and Management of ARVC Patients *278*

15. Left Ventricular Assist Devices **281**
Kory J Lavine, Susan M Joseph
- Introduction, Technology, and Outcomes *281*
- Complications *288*

16. Cardiac Transplantation **297**
Ajay V Srivastava, Ahmad Y Sheikh, Kiran K Khush
- Surgical Techniques for Orthotopic Heart Transplantation *299*
- Heterotopic Heart Transplantation *299*
- Management of Post-Transplant Patients *303*

Section 3: Valvular Heart Disease

17. Normal Valve Anatomy and Function **313**
Alvin S Blaustein, Anita Deswal, Glenn N Levine
- Mitral Valve *314*
- Aortic Valve *317*
- Tricuspid Valve *319*
- Pulmonic Valve *323*
- Valve Imaging and Evaluation *323*

18. Aortic Stenosis **326**
Blase A Carabello
- Etiology of Aortic Stenosis *326*
- Pathophysiology of Aortic Stenosis and its Relationship to Symptoms *328*
- Physical Examination *333*
- Diagnosis *335*
- Management of Aortic Stenosis *337*

19. Aortic Regurgitation **345**
Kanu Chatterjee, James D Rossen, Phillip A Horwitz
- Acute Aortic Regurgitation *345*
- Evaluation of the Patient with Acute Aortic Regurgitation *347*
- Causes of Chronic Aortic Regurgitation *350*
- Physiology of Chronic Aortic Regurgitation *352*
- Evaluation of the Patient with Chronic Aortic Regurgitation *353*
- Management of Chronic Aortic Regurgitation *355*

20. Mitral Stenosis and Percutaneous Mitral Valvotomy **361**
Sivadasanpillai Harikrishnan, Sanjay Ganapathi
- Pathology of Rheumatic Mitral Stenosis *361*
- Hemodynamics of Mitral Stenosis *362*
- Natural History of Rheumatic Mitral Stenosis *362*
- Clinical Evaluation of Patients with Rheumatic Mitral Stenosis *363*
- Management of Mitral Stenosis *367*

21. Mitral Regurgitation **379**
Alvin S Blaustein, Glenn N Levine
- Evaluation of Mitral Regurgitation *381*
- Management of Patients with Mitral Regurgitation *383*

22. Mitral Valve Prolapse **399**
Pravin V Patil, Mohammad A Kashem, T Sloane Guy
- Pathophysiology *400*
- Clinical Presentation *404*
- Diagnostic Testing *404*
- Management *406*
- Surgical Treatment *409*

23. Right-Sided Valvular Heart Disease **414**
Ivan Anderson, Jason H Rogers
- Tricuspid Regurgitation *414*
- Pulmonic Regurgitation *424*
- Tricuspid Stenosis *426*
- Pulmonic Stenosis *426*
- Assessment of Right Ventricular Function in Patients with Right-Sided Valve Disease *433*

24. Endocarditis **439**
Tina Shah
- Risk Factors of Infective Endocarditis *442*
- Pathogenesis of Infective Endocarditis *442*
- Diagnosis of Infective Endocarditis *444*
- Noninfective Endocarditis *448*
- Complications of Infective Endocarditis *452*
- Treatment of Infective Endocarditis *452*
- Endocarditis Prophylaxis *453*

25. Transcatheter Aortic Valve Replacement **457**
Michael J Mack, Ambarish Gopal
- Patient and Procedural Considerations for TAVR *460*
- Route of Delivery Considerations in TAVR *464*
- Complications *467*
- Post-Procedure Considerations *471*

26. Valve Surgery and Prosthetic Heart Valves **477**
Sebastian A Iturra, Arul D Furtado, Vinod H Thourani
- Surgical Approach *477*
- Aortic Valve Surgery *479*
- Mitral Valve Surgery *480*
- Bioprosthetic Aortic Valves *481*
- Mechanical Aortic Valves *484*

- Bioprosthetic versus Mechanical Valve Decisions *486*
- Postoperative Management *488*
- Surgical Complications *488*
- Clinical Follow-up *488*
- Antithrombotic Therapy *491*

Section 4: Pericardial Disease

27. Pericarditis **497**

Trevor L Jenkins, Brian D Hoit

- Pericardial Anatomy and Function *497*
- Pericardial Heart Disease *497*
- Evaluation of Patients with Suspected Pericarditis *498*
- Treatment of Pericarditis *504*

28. Pericardial Effusion **509**

Faisal F Syed, Nandan S Anavekar, William D Edwards, Jae K Oh

- Hemodynamic Sequelae *510*
- Approach to Diagnosis *515*
- Pericardiocentesis *517*
- Other Considerations in Patients with Cardiac Tamponade *528*

29. Constrictive Pericarditis **530**

Min Pu, Hiroyuki Iwano, William C Little

- Normal Pericardium *530*
- Clinical Presentation *530*
- Diagnosis *532*
- Effusive-Constrictive Pericarditis *542*
- Management of Constrictive Pericarditis *542*

Section 5: Congenital Heart Disease

30. Patent Foramen Ovale **549**

Luc M Beauchesne, John P Veinot

- Embryology *549*
- Diagnosis of PFO *550*
- Paradoxical Emboli *552*
- PFO Closure Devices *553*

31. Atrial Septal Defects **558**

Luc M Beauchesne, Carole J Dennie

- Secundum ASDs *558*
- Sinus Venosus ASDs *563*
- Primum ASDs *566*
- Coronary Sinus ASDs *566*
- Complications of ASDs *568*
- Management of ASDs *568*

32. Ventricular Septal Defect **571**
Elijah H Bolin, Daniel J Penny
- Types of VSD *572*
- Pathophysiology and Clinical Manifestations of VSD *573*
- Diagnostic Evaluation *574*
- Management of Patients with VSD *581*

33. Patent Ductus Arteriosus **584**
David A Parra, Ann Kavanaugh-McHugh
- Embryology and Function of the Ductus Arteriosus *584*
- Ductal Closure and Persistence *586*
- Evaluation of Patent Ductus Arteriosus *592*
- Management of Patent Ductus Arteriosus *594*

34. Ebstein Anomaly **599**
Christine H Attenhofer Jost, Patrick W O'Leary, Joseph A Dearani, Heidi M Connolly
- Diagnosis of Ebstein Anomaly *601*
- Management of Patients with Ebstein Anomaly *606*

35. Tetralogy of Fallot **612**
Gruschen R Veldtman, Ryan Allen Moore, Peace C Madueme, Gary D Webb
- Epidemiology, and Genetics of Tetralogy of Fallot *612*
- Functional and Surgical Anatomy of TOF *612*
- Associated Lesions with TOF *618*
- Surgical Intervention for TOF *620*
- Late Complications in Patient with TOF *622*
- Late Intervention on the Right Ventricular Outflow Tract *625*

36. Transposition of the Great Arteries **629**
Paula Martins
- Introduction, Terminology, and Anatomy *629*
- Prenatal Diagnosis of d-TGA *630*
- Postnatal Diagnosis of d-TGA *634*
- Management of Patients with d-TGA *634*
- Management of Patients with cc-TGA *636*

37. Supravalvular and Subvalvular Aortic Stenosis **644**
Glenn N Levine, Luc M Beauchesne
- Supravalvular Aortic Stenosis *645*
- Subvalvular Aortic Stenosis *647*

38. Aortic Coarctation **653**
Unnati H Doshi, P Syamasundar Rao
- Clinical Features *656*
- Laboratory Studies *656*
- Management of Aortic Coarctation *659*
- Summary of Management *667*

Section 6: Cardiac Arrhythmias

39. Cardiac Depolarization and Impulse Conduction **679**
Irakli Giorgberidze, Hamid Afshar, Glenn N Levine
- Cardiac Action Potentials and Action of Antiarrhythmic Drugs *679*
- Anatomy and Function of the Conduction System *683*
- Physiological Benefits of the Evolved Conduction System *686*
- ECG Correlates of Depolarization *688*

40. Bradyarrhythmias, Conduction Abnormalities, and Heart Block **691**
Philippe R Akhrass, Adam S Budzikowski
- Sinoatrial (SA) Node-Related Bradycardia *692*
- Atrioventricular (AV) Node Related Bradycardia and Heart Block *694*
- Bundle-Branch Block, Fascicular Blocks, and Paced Rhythms *697*
- Device-Related Bradycardia *703*

41. Atrial Fibrillation **704**
Michael E Field
- Definition and Diagnosis of Atrial Fibrillation *704*
- General Management of Atrial Fibrillation *704*
- Prevention of Thromboembolism *706*
- Rate Control *709*
- Rhythm Control *710*
- Tachy-Brady Syndrome *722*

42. Atrial Flutter **724**
Gregory K Feld, Thomas J McGarry
- Atrial Flutter Terminology, Mechanisms, and Electrocardiographic Patterns *725*
- Pharmacological Therapy of Atrial Flutter *729*
- Cardioversion of Atrial Flutter *730*
- Mapping and Ablation of Atrial Flutter *731*
- Atypical Forms of Isthmus Dependent Atrial Flutter *737*
- Atypical Left AFL *738*

43. AV Reentrant Tachycardia (AVRT) and Wolff-Parkinson-White (WPW) Syndrome **740**
Christopher R Ellis, Arvindh N Kanagasundram
- Introduction and Definition *740*
- Terminology *742*
- Clinical Presentation *742*
- Anatomy *742*
- Pathophysiology *744*
- Diagnosis *744*
- Invasive Electrophysiology Testing *745*
- Management *747*

44. Atrioventricular Nodal Reentrant Tachycardia **754**
George D Katritsis, Demosthenes G Katritsis
- Mechanism of AVNRT *754*
- Differentiating AVNRT from Other Arrhythmias *760*
- Treatment of AVNRT *762*

45. Ventricular Arrhythmias **765**
Ramil Goel, Komandoor Srivathsan, Farouk Mookadam
- Premature Ventricular Complex *765*
- Ventricular Tachycardia *766*
- Ventricular Flutter *780*
- Ventricular Fibrillation *781*

46. Pacemakers **785**
Khaled Albouaini
- Pacing Mode Selection *786*
- Implantation Procedure *788*
- Device Follow-up *792*
- Complications *793*
- Cardiac Resynchronization Therapy (CRT) *800*
- Special Cases *805*

47. Implantable Cardioverter Defibrillators **808**
Kevin C Floyd, Lawrence S Rosenthal
- Evolution of the ICD *808*
- ICD for Primary and Secondary Prevention *811*
- ICD Function *812*
- Complications *812*
- Management of Patients Treated with ICDs *812*

Section 7: Peripheral Vascular Disease

48. Peripheral Arterial Disease **823**
Carlos F Bechara, George T Pisimisis
- Aortoiliac Occlusive Disease (AIOD) *824*
- Femoropopliteal Occlusive Disease *829*
- Tibial Occlusive Disease *838*
- Upper Extremity Peripheral Arterial Disease *838*
- Non-Atherosclerotic Peripheral Artery Disease *839*

49. Carotid Artery Disease **845**
Gerd Brunner, George T Pisimisis,Vijay Nambi
- Carotid Artery Anatomy *845*
- Carotid Artery Disease *845*
- Imaging of Carotid Artery Disease *845*
- Management of Atherosclerotic and Nonatherosclerotic Carotid Artery Disease *853*
- Nonatherosclerotic Carotid Artery Disease *859*

50. Aortic Aneurysm **864**
David M Dudzinski, Brian B Ghoshhajra, Eric M Isselbacher
- Pathogenesis of Aortic Aneurysm Formation *864*
- Early Detection and Symptomatology *867*
- Aortic Aneurysm Imaging *867*
- Natural History of Aortic Aneurysms *871*
- Medical Therapy for Patients with Aortic Aneurysms *871*
- Surgical and Percutaneous Treatment of Aortic Aneurysms *874*

51. Aortic Dissection **881**
Alan C Braverman
- Acute Aortic Syndromes *881*
- Diagnosis of Aortic Dissection *887*
- Complications of Aortic Dissection *888*
- Management of Patients with Aortic Dissection *889*

52. Renovascular Disease **898**
Ido Weinberg, Michael R Jaff
- Diagnostic Modalities *900*
- Indications for a Procedure *900*
- Renal Denervation *904*

53. Peripheral Venous Insufficiency **908**
Lorena Gonzalez, Carlos F Bechara, George T Pisimisis
- Venous Anatomy and Physiology *908*
- Varicose Veins *910*
- Chronic Venous Insufficiency *914*

Section 8: Miscellaneous Cardiovascular Disease

54. Cardiac Tumors **923**
Eun Young Kim, Yeon Hyeon Choe
- Benign Tumors *923*
- Primary Malignancies *937*
- Metastases *940*

55. Hyperlipidemia **942**
Yashashwi Pokharel, Salim S Virani
- Treatment of Hyperlipidemia *943*
- Familial Hypercholesterolemia *947*

56. Stroke **952**
Sharyl R Martini, Aaron W Grossman, Thomas A Kent
- Ischemic Stroke *956*
- Ischemic Stroke—Large Vessel Subtype Due to Atherosclerosis *958*
- Ischemic Stroke—Lacunar Subtype Due to Small Vessel Arteriopathy *963*

- Ischemic Stroke—Cardioembolic Subtype *963*
- Hemorrhagic Stroke *967*
- Cerebral Venous Sinus Thrombosis *969*

57. Venous Thromboembolism **973**
Luis H Eraso, Taki Galanis, Geno J Merli
- Diagnosis of Venous Thromboembolic Disease *977*
- Treatment of Venothromboembolic Disease *983*

58. Physical Findings in Cardiovascular Disease **992**
Glenn N Levine

Index *1009*