FOURTH EDITION

INVASIVE CARDIOLOGY

A Manual for Cath Lab Personnel

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Brief Contents

Preface xvii
Acknowledgments xxi

PART I **Basics** 1

CHAPTER 1 **History of the Cath Lab** 3
CHAPTER 2 **Cardiovascular Anatomy and Physiology** 9
CHAPTER 3 **Electrocardiography and Rhythm Interpretation** 39
CHAPTER 4 **Radiography** 63
CHAPTER 5 **Contrast Media** 77
CHAPTER 6 **Asepsis in the Cath Lab** 85
CHAPTER 7 **Roles and Responsibilities of the Cath Lab Team** 97
CHAPTER 8 **Nursing Care of the Cardiovascular Procedure Patient** 111

PART II **Diagnostics** 123

CHAPTER 9 **Diagnostic Catheterization** 125
CHAPTER 10 **Cardiovascular Hemodynamics** 139
CHAPTER 11 **Intravascular and Intracardiac Imaging** 159
CHAPTER 12 **Functional Assessment of Coronary Artery Disease** 171

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PART III Coronary Interventions 183

CHAPTER 13 Percutaneous Coronary Interventions 185

CHAPTER 14 Coronary Atherectomy and Thrombectomy 203

CHAPTER 15 Access Site Hemostasis 213

CHAPTER 16 Emergencies in the Cath Lab 229

CHAPTER 17 Temporary Pacing and Cardioversion 239

CHAPTER 18 Temporary Cardiac Assist Devices 251

CHAPTER 19 Foreign Body Retrieval 271

PART IV Cardiac Structural Interventions 277

CHAPTER 20 Cardiac Defect Closure Devices 279

CHAPTER 21 Septal Alcohol Ablation 289

CHAPTER 22 Pericardiocentesis and Balloon Pericardiotomy 295

CHAPTER 23 Percutaneous Valve Commissurotomy, Repair, and Replacement 303

CHAPTER 24 Endomyocardial Biopsy 321

CHAPTER 25 Electrophysiology 329

CHAPTER 26 Implantable Pacemakers 347

CHAPTER 27 Implantable Cardioverter Defibrillators 377

CHAPTER 28 Pediatric Procedures 393

PART V Non-cardiac Interventions 423

CHAPTER 29 Percutaneous Carotid Interventions 425

CHAPTER 30 Percutaneous Pulmonary Embolism Treatment 437

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CHAPTER 31 Renal Artery Interventions 445

CHAPTER 32 Percutaneous Abdominal Aortic Aneurysm Repair 455

CHAPTER 33 Lower Extremity Interventions 463

PART VI Pharmacology and Research 477

CHAPTER 34 Cardiovascular Pharmacology 479

CHAPTER 35 Cardiovascular Research 497

Glossary 513

Index 549

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Contents

Preface . . . . . **xvii**
Acknowledgments . . . . . **xxi**

PART I **Basics** **1**

CHAPTER 1 History of the Cath Lab **3**
Catheters 3
Angiography 4
Coronary Intervention 5
Cath Lab Support Personnel 6
Specialty Certifications 8
Summary 8
Self-Assessment Questions 8

CHAPTER 2 Cardiovascular Anatomy and Physiology **9**
Introduction 9
The Blood 9
Hemostasis 10
The Heart 12
The Heart Wall 13
The Cardiac Valves 13
Electrical Conduction 18
Hemodynamics 19
Blood Vessels 24
Coronary Arteries 25
Peripheral Arterial System 29
Venous System 32
Congenital Cardiac Anomalies 33
Patent Foramen Ovale 33
Atrial Septal Defect 33
Ventricular Septal Defect 33
Patent Ductus Arteriosus 34
Tetralogy of Fallot 34
Transposition of the Great Vessels 35
Persistent Truncus Arteriosus 35
Tricuspid Atresia 35
Total Anomalous Pulmonary Venous Return 36
Congenital Aortic Stenosis 36
Coarctation of the Aorta 36
Summary 37
Self-Assessment Questions 37

CHAPTER 3 Electrocardiography and Rhythm Interpretation **39**
Introduction 39
Electrocardiologic Anatomy 39
ECG Analysis 40
ECG Waveforms 41
Heart Rate 42
P Wave 43
PR Interval and Segment 44
Q Wave 44
R Wave 45
QRS Complex 45
QT Interval 46
ST Segment 47
T Wave 47
U Wave 48
Identifying the Rhythm 48
Normal and Abnormal Cardiac Rhythms 48
Pacemaker Rhythm Evaluation 58
Summary 61
Self-Assessment Questions 61

CHAPTER 4 Radiography **63**
History 63
Basic Physics and Operation 64
X-Ray Tube 64
Collimation 65
Diaphragms 65
X-Ray Control 65
Image Intensifier and Camera 65
Flat Digital Plate Detector 65
C-Arm / Gantry 66

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System Settings . . . 66
Image Review and Archive . . . 67
Projections . . . 67
Naming Projections . . . 67
Radiographic Anatomy . . . 67
Hints for Image Orientation . . . 68
Radiographic Pathology . . . 68
Measuring Coronary Artery Disease . . . 68
Left Ventricular Analysis . . . 70
Regional Wall Function . . . 70
Digital Image Enhancement . . . 70
Local Contrast Enhancement . . . 71
Digital Subtraction Angiography . . . 71
Radiation . . . 71
Inverse Square Law . . . 72
Dose Measurement . . . 72
Staff Dose . . . 72
Staff Protection from Scatter Radiation . . . 72
Effects of Radiation . . . 73
Protective Clothing . . . 74
Pregnancy . . . 74
Radiation Dose Measurement . . . 74
Summary . . . 75
Self-Assessment Questions . . . 75
References . . . 75

CHAPTER 5 Contrast Media . . . 77

Radiographic Imaging . . . 77
Contrast Media . . . 78
Properties . . . 78
Different Contrast Media . . . 79
Contrast Media Use . . . 79
Complications . . . 79
Allergic Reactions . . . 81
Contrast-Induced Nephropathy . . . 81
High-Risk Patients . . . 82
Summary . . . 82
Self-Assessment Questions . . . 83
References . . . 83

CHAPTER 6 Asepsis in the Cath Lab . . . 85

Introduction . . . 85
Attire . . . 86
Surgical Masks . . . 87
Eyewear . . . 87
Hand Hygiene . . . 87
Surgical Hand Antisepsis . . . 88
Gowning . . . 89
Gloving . . . 89
Sterile Field . . . 90
Introducing Items to the Sterile Field . . . 90
Covering a Sterile Field . . . 91
Puncture Site Preparation . . . 91
Cath Lab Environment . . . 92
Environmental Cleaning . . . 93
Enhanced Environmental and Terminal Cleaning . . . 94
Ultraviolet Light Disinfection Systems . . . 94
Staff Education . . . 94
Summary . . . 94
Self-Assessment Questions . . . 95
References . . . 95

CHAPTER 7 Roles and Responsibilities of the Cath Lab Team . . . 97

Overview . . . 97
Monitor/Recorder . . . 98
Scrub Assistant . . . 99
Circulator . . . 100
Team . . . 101
Procedure Preparation . . . 101
Patient Preparation . . . 102
Procedure . . . 105
Blood Pressure . . . 105
ECG . . . 106
Contrast Medium . . . 106
Heparinized Saline . . . 107
The Patient . . . 107
Procedure Completion . . . 107
End of the Day . . . 108
Summary . . . 109
Self-Assessment Questions . . . 109

CHAPTER 8 Nursing Care of the Cardiovascular Procedure Patient . . . 111

Preadmission Communication . . . 111
Preprocedural Assessment and Care . . . 112
Initial Contact . . . 112
Basic Preprocedural Work-Up . . . 112
Venous Cannulation . . . 115
Blood Tests . . . 117
Postprocedure Assessment and Care . . . 117
Patient Education . . . 118
Postprocedural Observations . . . 118

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Puncture Site Assessment . . . 118
Hydration . . . 119
Blood Tests . . . 119
Pain Management . . . 119
Anxiety Management . . . 119
Airway Management . . . 119
Mobilization . . . 119
Medication and IV Management . . . 120
Diet . . . 120
Discharge Preparation . . . 120
Patient Information . . . 120
Physical Discharge . . . 121
Summary . . . 121
Self-Assessment Questions . . . 121

PART II **Diagnostics** 123

CHAPTER 9 **Diagnostic Catheterization . . . 125**

Introduction . . . 125
Indications . . . 126
Contraindications . . . 126
Absolute Contraindications . . . 126
Relative Contraindications . . . 126
Complications . . . 126
Major Complications . . . 126
Other Complications . . . 127
Invasive Cardiovascular Laboratory Staffing . . . 127
Patient Preparation . . . 127
Premedication . . . 127
Local Anesthesia . . . 128
Access Sites . . . 128
Equipment . . . 130
Needles . . . 130
Guidewires . . . 130
Sheaths . . . 130
Catheters . . . 130
Angiography . . . 132
Coronary Angiography . . . 132
Left Ventricular Angiography . . . 133
Aortography . . . 133
Other Angiographic Examinations . . . 133
Procedural Protocols . . . 134
Left Heart Catheterization . . . 134
Right Heart Catheterization . . . 134
Right and Left Catheterization . . . 136
Transseptal Catheterization . . . 136
Procedure Conclusion . . . 137
Summary . . . 137
Self-Assessment Questions . . . 137
References . . . 138

CHAPTER 10 **Cardiovascular Hemodynamics . . . 139**

Introduction . . . 139
Pressure Measurement Systems . . . 139
Sources of Error and Artifacts . . . 140
Hemodynamic Waveforms . . . 144
Central Venous Pressure/Right Atrium . . . 144
Right Ventricle . . . 145
Pulmonary Artery . . . 146
Left Atrium/Pulmonary Capillary Wedge Pressure 147
Left Ventricle . . . 148
Aorta . . . 149
Gradients . . . 150
Valve Area Calculations . . . 151
Aortic Valve . . . 151
Mitral Valve . . . 152
Cardiac Output . . . 152
Cardiac Index . . . 152
Cardiac Output Formulas . . . 152
Regurgitant Fraction . . . 154
Shunts . . . 154
Cardiogenic Shock . . . 156
Summary . . . 157
Self-Assessment Questions . . . 157
References . . . 157

CHAPTER 11 **Intravascular and Intracardiac Imaging . . . 159**

Introduction . . . 159
Intravascular Ultrasound . . . 160
IVUS and Coronary Artery Disease . . . 160
IVUS Systems . . . 160
Pullback . . . 161
IVUS Image Interpretation . . . 162
Virtual Histology Imaging . . . 163
Near-Infrared Spectroscopy . . . 164
Diagnostic Applications . . . 165
IVUS in Interventional Procedures . . . 165
IVUS and Atherectomy . . . 166
IVUS and Stenting . . . 166
Optical Coherence Tomography . . . 166
OCT System . . . 167
Image Interpretation . . . 168

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Intracardiac Echocardiography 168
Complications 168
Nursing Care 169
Summary 169
Self-Assessment Questions 169
References 170

CHAPTER 12 Functional Assessment of Coronary Artery Disease 171

Introduction 171
Hyperemia 172
Hyperemic Agents 172
Intravascular Pressure Measurement 172
Fractional Flow Reserve 173
Resting (Nonhyperemic) Physiologic Indices 176
Coronary Flow Reserve (Blood Velocity) Measurement 178
Doppler 178
Coronary Flow Reserve 178
Hybrid Measurement Systems 179
Thermodilution CFR 179
Index of Microvascular Resistance 180
Summary 181
Self-Assessment Questions 181
References 181

PART III Coronary Interventions 183

CHAPTER 13 Percutaneous Coronary Interventions 185

Introduction 185
Indications 186
Material 186
Procedure Table 186
Guiding Catheters 187
Guidewires 188
Angioplasty Balloons 189
Stents 192
Embolic Protection 196
Intravascular Lithotripsy 197
Patient Preparation 197
Conscious Sedation 197
Anticoagulation Therapy 198
PCI Procedure 198
Guidewire Bias 199
Percutaneous Coronary Intervention of Saphenous Vein Bypass Grafts 199
No-Reflow Phenomenon 199
Acute Myocardial Infarction 199
Procedural Assessment 200
Postprocedural Duties 200
Postprocedure Patient Care 201
Summary 201
Self-Assessment Questions 201
References 201

CHAPTER 14 Coronary Atherectomy and Thrombectomy 203

Introduction 203
Atherectomy Devices 204
Directional Coronary Atherectomy 204
Rotational Atherectomy 204
Orbital Atherectomy 207
Laser 208
Thrombectomy Devices 209
AngioJet 209
Manual Aspiration Devices 211
Patient Care 211
Summary 211
Self-Assessment Questions 212
References 212

CHAPTER 15 Access Site Hemostasis 213

Introduction 213
Femoral Artery Access Closure 214
Manual Compression 214
Vascular Plugs and Sealers 218
Percutaneous Vascular Sutures, Staples, and Clips . . . 220
Topical Hemostasis Accelerators 221
Brachial Artery Access Closure 223
Radial and Ulnar Artery Access Closure 223
Site Care Following Hemostasis 224
Femoral Access 224
Brachial, Radial, and Ulnar Artery Access 224
Patient Care Following Sheath Removal 225
Complications 225
Vasovagal Reactions 225
Hematomas 226
Pseudoaneurysms 226
Retroperitoneal Bleeds 226
Vessel Thrombosis 226
Infection 227
Summary 227

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Self-Assessment Questions 227
References 228

CHAPTER 16 Emergencies in the Cath Lab 229

Introduction 229
Minor Complications 230
Allergic Reactions 230
Bradycardia 230
Vascular Incidents 231
Major Complications 231
Acute Coronary Syndrome 231
Life-Threatening Dysrhythmias 232
Cardiac Tamponade 235
Cerebrovascular Accident 235
Other Complications 236
Acute Pulmonary Edema 236
Endocarditis and Infection 236
Vascular Spasm 236
Pulmonary Infarct 236
Vessel Rupture 236
Summary 237
Self-Assessment Questions 237
References 237

CHAPTER 17 Temporary Pacing and Cardioversion 239

Introduction 239
Types of Temporary Pacemakers 240
Indications 240
Terminology 240
Transcutaneous Pacing 242
Components 242
Electrode Placement 242
Pulse Generator Settings 243
Complications 243
Transvenous Endocardial Pacing 244
Components 244
Electrode Placement 244
Pulse Generator Settings 245
Complications 246
Transcoronary Pacing 246
Components 246
Electrode Placement 246
Pulse Generator Settings 246
Complications 246
Transoesophageal Pacing 247
Electrode Placement 247
Pulse Generator Settings 247
Complications 247
Transthoracic Epicardial Pacing 247
Components 247
Placement Procedure 247
Pulse Generator Settings 247
Complications 248
Synchronized Cardioversion 248
Preprocedural Care 248
Medication 249
Procedure 249
Postprocedural Care 249
Summary 249
Self-Assessment Questions 250
References 250

CHAPTER 18 Temporary Cardiac Assist Devices 251

Introduction 251
Intra-Aortic Balloon Pump 252
Counterpulsation 252
Triggering 253
Timing 255
Patient Care 258
TandemHeart 260
Left Heart Device 260
Right Heart Device 261
Patient Care 263
Impella 263
Equipment 264
Impella Left Heart Devices 265
Impella RP (Right Heart Device) 266
Patient Care 266
CentriMag 266
Equipment 266
Extracorporeal Membrane Oxygenation 267
Venovenous ECMO 267
Venoarterial ECMO 267
Contraindications 268
Complications 268
Patient Care 268
Summary 269
Self-Assessment Questions 269
References 269

CHAPTER 19 Foreign Body Retrieval 271

Introduction 271
Prevention 272
Techniques 272

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Small Balloon Catheter Technique 272
Two-Wire Technique 273
Hairpin Trap Technique 273
Instruments 273
Amplatz Goose Neck Snare 273
EN Snare Endovascular Snare System 274
The Micro Elite Snare 274
CloverSnare 4-Loop Vascular Retriever 274
Vascular Retrieval Forceps 274
Dormia No-Tip 274
Forceps 275
Summary 275
Self-Assessment Questions 276
References 276

PART IV Cardiac Structural Interventions 277

CHAPTER 20 Cardiac Defect Closure Devices 279
Introduction 279
Patent Foramen Ovale 279
Devices 281
Procedure 281
Patient Care 282
Atrial Septal Defect 282
Devices 282
Procedure 282
Patient Care 283
Ventricular Septal Defect 283
Devices 283
Procedure 284
Patient Care 284
Patent Ductus Arteriosus 284
Devices 284
Procedure 284
Patient Care 285
Left Atrial Appendage 285
Devices 286
Procedure 286
Patient Care 286
Summary 287
Self-Assessment Questions 287
References 288

CHAPTER 21 Septal Alcohol Ablation 289
Hypertrophic Obstructive Cardiomyopathy . . 289
Procedure 291
Patient Care 292
Patient Preparation 292
During the Procedure 292
Postprocedural Care 292
Summary 292
Self-Assessment Questions 293
References 293

CHAPTER 22 Pericardiocentesis and Balloon Pericardiotomy 295
Cardiac Tamponade 295
Diagnosis 296
Pericardiocentesis 297
Procedure 297
Balloon Pericardiotomy 299
Procedure 299
Complications 300
Patient Care 300
Summary 301
Self-Assessment Questions 301
References 301

CHAPTER 23 Percutaneous Valve Commissurotomy, Repair, and Replacement 303
Introduction 303
Mitral Valve 304
Mitral Stenosis 304
Mitral Regurgitation 307
Aortic Valve 310
Aortic Stenosis 311
Pulmonic Valve 316
Pulmonic Stenosis 316
Tricuspid Valve 318
Tricuspid Stenosis 318
Summary 319
Self-Assessment Questions 319
References 319

CHAPTER 24 Endomyocardial Biopsy 321
Introduction 321
Indications 321
Equipment 322
Procedure 322
Patient Preparation 323

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Biopsy Sample Extraction . . . 323
Biopsy Sample Preparation . . . 323
Complications . . . 324
Patient Care . . . 325
Postprocedure . . . 326
Summary . . . 326
Self-Assessment Questions . . . 326
References . . . 327

CHAPTER 25 Electrophysiology . . . 329

Introduction . . . 329
History . . . 329
Equipment . . . 330
Personnel . . . 331
Procedure . . . 331
Catheter Placement . . . 331
Interval Measurements . . . 334
Programmed Electrical Stimulation Protocols . . . 337
Arrhythmias . . . 340
Catheter Ablation Therapy . . . 340
Atrioventricular Nodal Reentrant Tachycardia . . . 342
Atrial Flutter . . . 342
Ventricular Tachycardia . . . 342
Atrial Fibrillation . . . 342
Nursing Care . . . 343
Prior to the Procedure . . . 343
During the Procedure . . . 344
After the Procedure . . . 344
Complications . . . 344
Pediatric Electrophysiology . . . 344
Summary . . . 345
Self-Assessment Questions . . . 345
References . . . 345

CHAPTER 26 Implantable Pacemakers . . . 347

Introduction . . . 347
Normal Cardiac Conduction . . . 347
NBG Codes . . . 348
Indications . . . 349
Temporary Pacing . . . 349
Permanent Pacing . . . 349
Pacemaker Components . . . 350
Temporary External Pulse Generators . . . 350
Permanent Pulse Generators . . . 350
Rate Adaptation . . . 352
Motion (Activity) Sensor . . . 352
Respiration Sensor . . . 353
QT Interval Sensor . . . 353
Right Ventricular Pressure . . . 354
Lead Design . . . 354
Implantation Procedure . . . 356
Preparation . . . 356
Staffing . . . 357
Procedure . . . 357
Other Methods of Pacing . . . 366
Biventricular Pacing . . . 366
Complications . . . 367
Postoperative Care . . . 367
Patient Evaluation . . . 367
Patient Care . . . 368
Postprocedure Education . . . 368
Follow-Up . . . 370
ICD Patients . . . 374
Summary . . . 374
Self-Assessment Questions . . . 375
References . . . 375

CHAPTER 27 Implantable Cardioverter Defibrillators . . . 377

Sudden Cardiac Death . . . 377
Implantable Cardioverter Defibrillators . . . 378
Indications . . . 378
System Components . . . 378
Defibrillator Codes . . . 379
Basic Device Operation . . . 380
Detection . . . 380
Therapy . . . 381
Data Storage . . . 383
Implantation Procedure . . . 383
Patient Preparation . . . 383
Room Preparation . . . 384
Staffing . . . 384
Implantation Technique . . . 385
Complications . . . 386
Postoperative Evaluation and Care . . . 386
Ward Care . . . 386
Emergency Care . . . 386
Device Monitoring . . . 386
Prior to Discharge . . . 387
Noninvasive Electrophysiology Study . . . 387
Patient Education . . . 387
Follow-Up . . . 389
Psychosocial Functioning . . . 389
Summary . . . 390
Self-Assessment Questions . . . 390
References . . . 391

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CHAPTER 28 Pediatric Procedures 393

Introduction 393
Patient Preparation 393
- Teaching 394
- Anesthesia, Sedation, and Analgesia 394
- Patient Positioning 394
- Safety 395
- Emergency Equipment 395

Diagnostic Procedures 395
- Equipment 395
- Procedure 396
- Complications 397
- Postprocedural Care 397

Interventional Procedures 398
- Balloon Angioplasty 398
- Stent Implantation 399
- Balloon Atrial Septostomy 401
- Pulmonary Atresia with an Intact Ventricle Septum 403
- Pulmonary Valve Stenosis 404
- Aortic Valve Stenosis 405
- Peripheral Pulmonary Artery Stenosis 407
- Coarctation of the Aorta 408
- Patent Ductus Arteriosus Closure 410
- Vascular Occlusion 413
- Atrial Septal Defect Closure 415
- Pulmonary Valve Replacement in Repaired Tetralogy of Fallot 417
- Electrophysiology and Catheter Ablation 421

Summary 422
Self-Assessment Questions 422
References 422

PART V Non-cardiac Interventions 423

CHAPTER 29 Percutaneous Carotid Interventions 425

Introduction 425
Cerebrovascular Anatomy 426
Stroke 426
- Diagnosis 427
- Treatment 428

Patient Preparation 428
Diagnostic Procedure 428
Interventional Procedure 429
- Material 429
- Procedure 431
- Complications 432
- Patient Care 432

Transcarotid Artery Revascularization 433
Summary 434
Self-Assessment Questions 435
References 435

CHAPTER 30 Percutaneous Pulmonary Embolism Treatment . . 437

Pulmonary Embolism 437
Catheter-Directed Thrombolysis 438
- Equipment 438
- Procedure 438

Ultrasound-Assisted Thrombolysis 439
- Equipment 439
- Procedure 439

Mechanical Thrombus Disruption and Removal 439
- Manual Thrombus Disruption 439
- AngioJet 440
- Aspirex 440
- AngioVac 440
- Indigo Aspiration System 441
- QuickClear 441
- FlowTriever 441
- Patient Care 442

Summary 442
Self-Assessment Questions 442
References 443

CHAPTER 31 Renal Artery Interventions 445

Renal Artery Anatomy 445
Renal Artery Stenosis 446
- Fibromuscular Dysplasia 446
- Atherosclerotic Renal Artery Stenosis 446
- Clinical Manifestations 447
- Diagnostic Assessment 447
- Treatment Options 448

Equipment 449
- Guiding Catheters 449
- Guidewires 449
- Balloons 449
- Stents 449

Procedure 449
- Angiography 450
- Hemodynamic Assessment 450
- Angioplasty 450
- Postintervention Assessment 451
- Complications 451

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Patient Care . . . 451
Preprocedural Care . . . 452
Postprocedural Care . . . 452
Summary . . . 452
Self-Assessment Questions . . . 453
References . . . 453

CHAPTER 32 Percutaneous Abdominal Aortic Aneurysm Repair . . . 455

Abdominal Aortic Aneurysm . . . 455
Diagnosis . . . 456
Treatment . . . 456
Surgical Repair . . . 456
Endovascular Repair . . . 457
Contraindications . . . 457
Complications . . . 457
Material . . . 458
Patient Preparation . . . 458
Procedure . . . 458
Postprocedural Care . . . 460
Follow-up . . . 460
Summary . . . 461
Self-Assessment Questions . . . 461
References . . . 461

CHAPTER 33 Lower Extremity Interventions . . . 463

Peripheral Vascular Anatomy . . . 463
Peripheral Artery Disease . . . 463
Diagnosis . . . 464
Treatment . . . 465
Material . . . 466
ILIAC Artery Disease . . . 470
Treatment . . . 470
Superficial Femoral Artery Disease . . . 472
Treatment . . . 472
Infrapopliteal Artery Disease . . . 473
Treatment . . . 474
Complications . . . 474
Patient Care . . . 474
Preparation . . . 474
Post procedure . . . 474
Staffing . . . 475
Summary . . . 475
Self-Assessment Questions . . . 475
References . . . 475

PART VI Pharmacology and Research 477

CHAPTER 34 Cardiovascular Pharmacology . . . 479

Introduction . . . 479
Local Anesthetics . . . 479
Analgesics and Sedatives . . . 480
Opioids . . . 480
Benzodiazepines . . . 481
Vasodilators . . . 482
Nitroglycerin . . . 482
Sodium Nitroprusside . . . 482
Beta Receptor Blockers . . . 483
Metoprolol . . . 483
Propranolol . . . 484
Esmolol . . . 484
Labetalol . . . 484
Calcium Channel Blockers . . . 484
Diltiazem . . . 484
Verapamil . . . 484
Nicardipine . . . 485
Vasopressor and Inotropic Agents . . . 485
Anticoagulation and Thrombolytic Agents . . . 485
Platelet Aggregation Inhibitors . . . 486
Adenosine Diphosphate Inhibitors . . . 487
Glycoprotein IIb/IIIa Inhibitors . . . 489
Antithrombin Agents . . . 490
Direct Thrombin Inhibitors . . . 492
Thrombolytics . . . 493
Summary . . . 495
Self-Assessment Questions . . . 495
References . . . 495

CHAPTER 35 Cardiovascular Research . . . 497

Introduction . . . 497
Clinical Trials in the ICVL . . . 498
Good Clinical Practice . . . 498
GCP Implementation within the ICVL . . . 498
Food and Drug Administration . . . 499
FDA and European Conformity Mark Approval . . . 499
Device Versus Pharmaceutical Trials . . . 500
Stages of a Clinical Trial . . . 500
Preclinical . . . 500
Phase I . . . 500
Phase II . . . 500
Phase III . . . 501

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Phase IV 501
Regulatory Components Unique to Devices . . 501
Premarket Approval 501
Premarket Notification 502
Humanitarian Device Exemption 502
Institutional Review Board/Ethics Committee 502
Protocol 503
Trial Design 503
Prospective and Retrospective Trials 503
Randomized Trials 504
Registries 504
Single-Center Versus Multicenter Trials 504
Primary and Surrogate Endpoints 505
Blinding 505
Postmarketing Surveillance and Postapproval Studies 505
Compassionate Use 505
Clinicaltrials.gov 506
Written Informed Consent 506
Live Case or Taped Case Presentation of Investigational Procedures 507
Statistical Analysis 507
Sample Size and Power 507
p-Value 508
Institutional Responsibility 508
Data and Safety Monitoring Committee 508
Clinical Events Committee 508
Drug/Device Accountability 509
Financial Implications 509
Summary 510
Self-Assessment Questions 510
References 510

Glossary 513
Index 549

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Preface

The invasive cardiovascular laboratory (ICVL) is a fast-paced, continually evolving medical area. Seemingly routine procedures can rapidly become emergency situations, and an institution's scheduling can push its staff to their limits more often than they find comfortable. New devices and treatments are always being developed, research projects are carried out, and new staff and new operators need to be taught how to work efficiently in the system. An ICVL is rarely boring.

For a novice it can be overwhelming. Cath lab personnel are expected to be knowledgeable and proficient in hundreds of different procedures, from routine diagnostics to lifesaving interventional therapies. Most of the equipment used in the ICVL is not encountered anywhere else in the hospital, so the novice has to learn what each device is used for, how it works with other devices, how to prepare it, and how to use and dispose of it correctly. There is a lot of knowledge to assimilate and many new skills to develop. Although it may take a few months to learn the basics of the most common procedures, it often takes years for a cath lab novice to feel comfortable and be competent with all aspects of working in an ICVL.

Many textbooks on cardiovascular catheterization are available, but the vast majority are written by physicians for physicians; very few have been written to address the training needs of nonphysician members of the ICVL team. Although there is a large overlap in the knowledge and skills required of physicians and ICVL staff, the perspectives are different. What the nonphysician staff does in the lab is not the same as what the physicians do. This text was written by cath lab nurses, technicians, and educators for cath lab nurses, technicians, and educators. It has been designed not only to be a helping hand to those just starting out in the specialty, but also to serve as a reference for those who have been working in our field for years.

The nonphysician staffing mix of an ICVL varies among institutions but can include registered nurses (RNs), cardiovascular technologists/technicians (CVTs), radiologic technologists (RT [Rs]), emergency medical technicians/paramedics (EMTs), respiratory therapists (RRTs), nurse practitioners (NPs), physician assistants (PAs), and nurse anesthetists (CRNAs). It is for these people that this book has been written. This multidisciplinary team shares a field of knowledge and range of skills that are unique, and the body of information they use every day is larger than any one book can cover. In this book, we have brought together the basics: the what, why, and how we do things in the lab, as well as where to go for more information when needed.

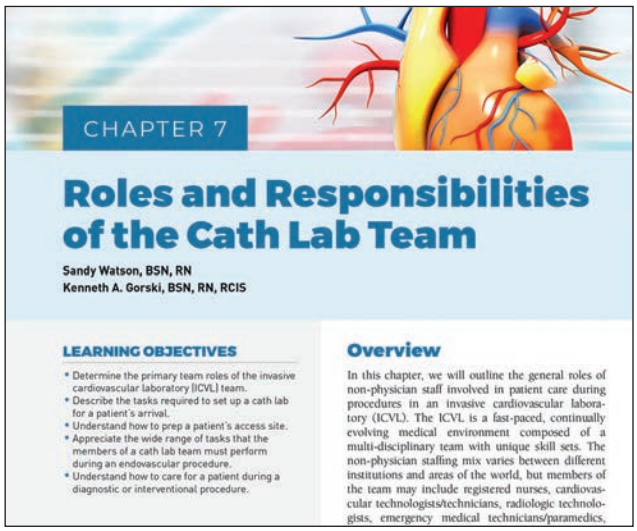
Regardless of academic or professional background, patient care is the central pillar of all work carried out by cath lab personnel. Treat every patient as you would like to be treated yourself.

New to This Edition

Endovascular cardiovascular therapy continues to grow and evolve. Procedures that were experimental when our last edition was published may be commonplace today, whereas others have fallen out of clinical practice and might never be seen again. In such a rapidly changing field, textbooks need to be updated regularly. The decade since we published the third edition has seen many changes to the work carried out in the ICVL, and these are reflected in changes we have made to the text.

This edition includes the following updates from the previous edition:

- **Learning objectives** have been developed for each chapter to clearly explain what readers will learn from the chapter. They set out the chapter's


CHAPTER 7

Roles and Responsibilities of the Cath Lab Team

Sandy Watson, BSN, RN
Kenneth A. Gorski, BSN, RN, RCIS

LEARNING OBJECTIVES

- Determine the primary team roles of the invasive cardiovascular laboratory (ICVL) team.
- Describe the tasks required to set up a cath lab for a patient's arrival.
- Understand how to prep a patient's access site.
- Appreciate the wide range of tasks that the members of a cath lab team must perform during an endovascular procedure.
- Understand how to care for a patient during a diagnostic or interventional procedure.

Overview

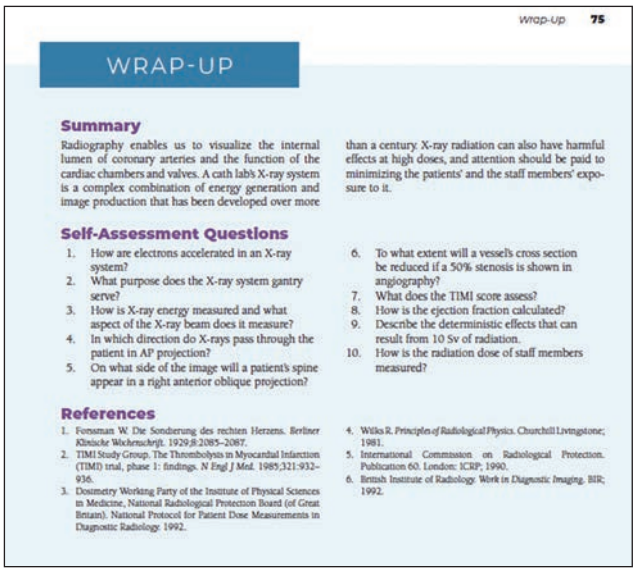
In this chapter, we will outline the general roles of non-physician staff involved in patient care during procedures in an invasive cardiovascular laboratory (ICVL). The ICVL is a fast-paced, continually evolving medical environment composed of a multi-disciplinary team with unique skill sets. The non-physician staffing mix varies between different institutions and areas of the world, but members of the team may include registered nurses, cardiovascular technologists/technicians, radiologic technologists, emergency medical technicians/paramedics,

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desired outcomes and provide a basis on which learning can be gauged.

- Each chapter ends with a **summary** that recaps the chapter content.
- **Self-assesment questions** have been added to the end of each chapter. An **answer key** is available to instructors.
- All **references** throughout the book have been updated.



Wrap-Up 75

WRAP-UP

Summary

Radiography enables us to visualize the internal lumen of coronary arteries and the function of the cardiac chambers and valves. A cath lab's X-ray system is a complex combination of energy generation and image production that has been developed over more than a century. X-ray radiation can also have harmful effects at high doses, and attention should be paid to minimizing the patients' and the staff members' exposure to it.

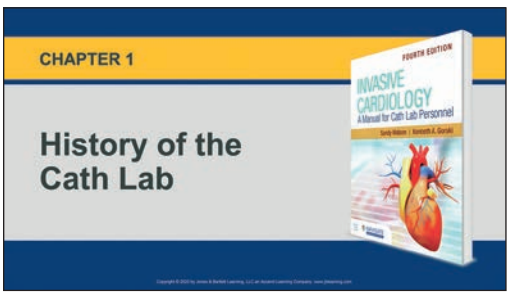
Self-Assessment Questions

1. How are electrons accelerated in an X-ray system?
2. What purpose does the X-ray system gantry serve?
3. How is X-ray energy measured and what aspect of the X-ray beam does it measure?
4. In which direction do X-rays pass through the patient in AP projection?
5. On what side of the image will a patient's spine appear in a right anterior oblique projection?
6. To what extent will a vessel's cross section be reduced if a 50% stenosis is shown in angiography?
7. What does the TIMI score assess?
8. How is the ejection fraction calculated?
9. Describe the deterministic effects that can result from 10 Sv of radiation.
10. How is the radiation dose of staff members measured?

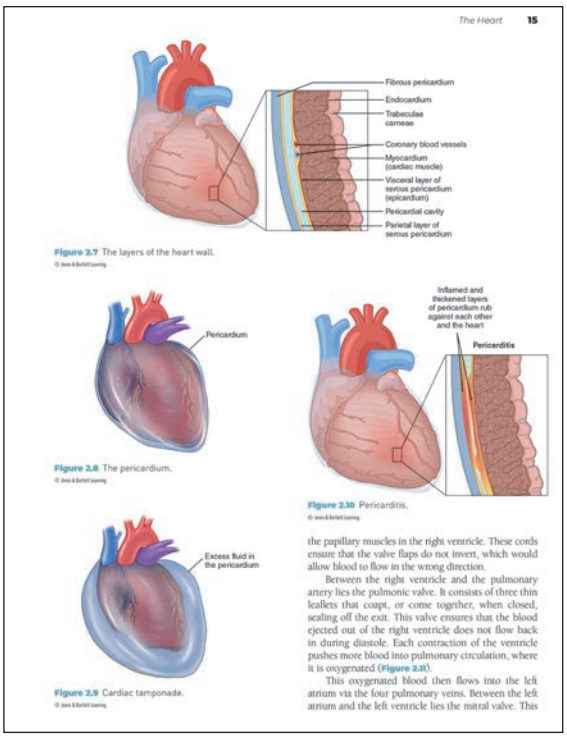
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- **Slides in PowerPoint format** provide a summary of each chapter's content. These slides can be used to accompany lessons in a classroom and by students who need to compress the relevant information prior to assessment.



- Each chapter has a corresponding a document that provides the reader with a range of vetted, relevant **Additional Educational Resources**. These resources provide background information and supporting material for trainers and students.
- **Every chapter has been updated** with input from experts in our field who come from a wide range of backgrounds. All are experienced professionals who have worked for many years in ICVLs, and many are active in cardiovascular education.
- This is the first edition printed in **color**, enabling us to create a more visually appealing learning experience for the reader. Many new images have been added to improve the learner's understanding of the procedures and technology presented.



The Heart 15

Fibrous pericardium
Endocardium
Trabeculae carneae
Coronary blood vessels
Myocardium (cardiac muscle)
Visceral layer of serous pericardium (epicardium)
Pericardial cavity
Parietal layer of serous pericardium

Figure 2.7 The layers of the heart wall.

Pericardium

Figure 2.8 The pericardium.

Inflamed and thickened layers of pericardium rub against each other and the heart
Pericarditis

Figure 2.10 Pericarditis.

Excess fluid in the pericardium

Figure 2.9 Cardiac tamponade.

the papillary muscles in the right ventricle. These cords ensure that the valve flaps do not invert, which would allow blood to flow in the wrong direction.

Between the right ventricle and the pulmonary artery lies the pulmonic valve. It consists of three thin leaflets that coapt, or come together, when closed, sealing off the exit. This valve ensures that the blood ejected out of the right ventricle does not flow back in during diastole. Each contraction of the ventricle pushes more blood into pulmonary circulation, where it is oxygenated (Figure 2.11).

This oxygenated blood then flows into the left atrium via the four pulmonary veins. Between the left atrium and the left ventricle lies the mitral valve. This

- More than **470 figures are included in this edition**. They have been developed to help students and veterans connect the written descriptions and explanations with visual examples.

Changes have also been made to the book's **structure**. Some of the important content changes include the following:

- A new chapter covering the endovascular treatment of pulmonary embolism has been added to the book.
- Structural heart procedure chapters have been updated and expanded.
- Defibrillation, which had its own chapter in the third edition, has been added to the *Emergencies in the Cath Lab* chapter, and cardioversions were moved to the *Temporary Pacing and Cardioversion* chapter.
- Distal embolic protection and stents, which had their own chapters in the third edition, have been added to the *Percutaneous Carotid Interventions* chapter in this edition.
- The intravascular ultrasound chapter has been renamed *Intravascular and Intracardiac Imaging* to include optical coherence tomography.

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- Several chapters that were less specific to invasive cardiovascular procedures have been removed.

To make it easier to navigate within the book, the chapters have been rearranged into six parts or sections.

- **Part I: Basics**. Covers the basic information that everyone who works in an ICVL must have a good grasp of, such as cardiovascular anatomy and physiology, radiology, asepsis, patient care, etc.
- **Part II: Diagnostics**. Includes diagnostic cardiac procedures, hemodynamic measurements, IVUS, and the functional assessment of coronary lesions.
- **Part III: Coronary Interventions**. Covers percutaneous coronary interventions as well as emergencies, cardiac assist devices, and object-retrieval procedures.
- **Part IV: Cardiac Structural Interventions**. Includes pacemaker and defibrillator implantation, valve repair and replacement, electrophysiology, and pediatric procedures.
- **Part V: Non-cardiac Interventions**. Groups together peripheral procedures from top to bottom: carotid artery interventions, pulmonary embolism treatment, renal artery interventions, abdominal aortic aneurysm repair, and subaortic interventions.
- **Part VI: Pharmacology and Research**. Includes a chapter on cardiovascular pharmacology and one on cardiovascular research.

Dedication

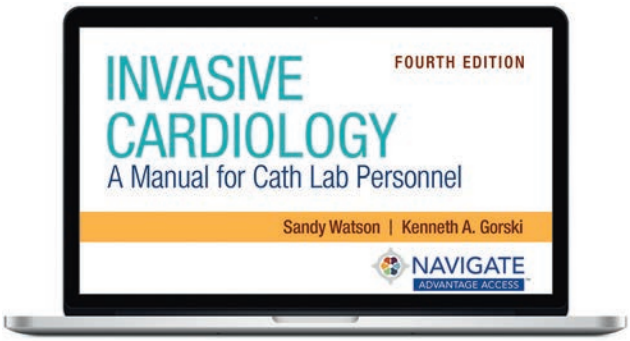
When we set out to update this book in February 2020, coping with a deadly pandemic was not something we had a risk management plan for. The fourth edition of *Invasive Cardiology: A Manual for Cath Lab Personnel* is dedicated to our colleagues who have struggled with COVID-19, either directly or indirectly. Long shifts, changed schedules, losing team members to the virus or emotional and physical burnout, and changing regulations covering work and private life have all made these last couple of years more difficult than most. But we are resilient, and we are flexible—colleagues who do what has to be done to maintain the health of their patients, themselves, and their communities.

A special thanks goes out to those colleagues who, despite the challenges this virus has added to their work, still found time to contribute to this book. Your personal time spent writing, revising, and reviewing materials made this book fantastic.

Thank you.

Sandy Watson
Ken Gorski

Resources



Student Resources

The following student resources come with the purchase of this text (and are available for separate purchase):

- eBook
- Step-by-step procedures
- Terminology flashcards
- Additional Educational Resources

Instructor Resources

Instructor resources are available to qualified instructors:

- Slides in PowerPoint format
- Lecture Outlines
- Image bank

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