## Contents

### 1. Evolution of Coronary Angioplasty

*David Cumberland, Raveen Kandan*

- Acute Coronary Syndrome 8
- Intracoronary Thrombus 8
- Chronic Total Occlusions 8
- Multivessel and Left Main Disease 8
- Bifurcations 8

### 2. An Overview of the History and Fundamentals of Coronary Stent Design

*Keith D Dawkins, Paul F Chouinard*

- Timeline Overview 11
- Stent Technologies 11
- Performance Requirements 17
- Design Optimization 21

### 3. Percutaneous Coronary Intervention

*Dev Pahlajani, Akshay K Mehta*

- Indications 27
- Contraindications 27
- Guidelines 27
- PCI Based on Anatomic Lesion 28
- Special Patient Classes 29
- PCI in Specific Clinical Situations 29

### 4. Coronary Angioplasty for the Beginners

*Jagdish S Hiremath*

- Initial Musings 32
- Setting the Tone 32
- Take Back and Apply 32
- Decisions Galore 33
- Beyond Hand Skills 33
- Welcome to a Fascinating World 33

### 5. Periprocedural Use of Drugs for Routine Percutaneous Coronary Intervention

*Shekhar Shriram Ambardekar, Amit V Sharma*

- Armamentarium for the Interventionist: Are We Battle Savvy Enough? 34
- Antiplatelets 34
Antithrombotics 37
Adjuvant Treatment in the Laboratory 38

6. Hardware for Coronary Angioplasty 42
Susheel K Malani, DS Chadha
Guide Catheters 42
Commonly Used Guiding Catheters 43
Guide Catheter Selection for Radial Intervention 45
Guide Catheter for Saphenous Vein Grafts and Left Internal Mammary Artery Interventions 46
Coronary Guidewire 46
Characteristics and Classification of Guidewires 46
Balloon Angioplasty Catheter Platforms and Balloon Angioplasty Procedure 49
Specific Balloon Angioplasty Devices 51
Coronary Stents 52
Ancillary Hardware 53

7. Fractional Flow Reserve 55
Y Chandrashekhar, Todd Drexel
Basic Coronary Physiology and Intravascular Measurements 55
Limitations of Angiography as the Gatekeeper for Interventions 57
Clinical Methods to Study Coronary Physiology 58
Clinical Superiority of Fractional Flow Reserve in Revascularization Decisions 60
FFR in Selected Clinical Populations 62
Limitations of Fractional Flow Reserve 64

8. Use of IVUS and OCT in Cath Lab 68
Imad Sheiban, Filippo Figini
Background 68
Basic Differences between IVUS and OCT 68
Baseline Vessel and Lesion Evaluation 68

9. Difficult Situations of Angioplasty: Ectasia/Aneurysm and Thrombus 82
Anish Chandarana
Definition and Prevalence 82
Pathogenesis 82
Clinical Course and Natural History 83
Clinical Presentations and Diagnosis 83
Medical Management 84
Percutaneous Intervention in Coronary Artery Ectasia 85
Imaging to Help Coronary Angiography 85
Interventional Pharmacology 87
Dealing with the Thrombus  90
Stent? Not to Stent? Deferred Stenting?  92
Primary Percutaneous Coronary Intervention in Coronary Artery Ectasia  93
Which Stent?  94
Surgical Treatment of Coronary Artery Ectasia  95

10. Multivessel Percutaneous Coronary Intervention: Interventional Cardiologist’s Perspective  103
   *K Sarat Chandra, S Nagendra Boopathy*
   Multivessel Disease  103
   Syntax  103
   Best Study  104
   Recommendations  105

11. Multivessel Coronary Angioplasty: Cardiac Surgeons’ Viewpoint  107
   *Kaushal Pandey*
   Percutaneous Coronary Intervention versus Coronary Artery Bypass Graft in Low-risk Multivessel Coronary Artery Disease  108
   Results of Arterial Revascularization Therapies Study II Trial  110
   Percutaneous Coronary Intervention versus Coronary Artery Bypass Graft in High-risk Multivessel Coronary Artery Disease  110
   Quality of Life after Percutaneous Coronary Intervention versus Coronary Artery Bypass Graft  113
   Cost Effectiveness of Percutaneous Coronary Intervention versus Coronary Artery Bypass Graft  117

12. Left Main Stenting  120
   *Shirish (MS) Hiremath, Omkar Thopte*
   Assessment of LMCA Lesion  121
   Angiographic Evaluation of LMCA  121
   Fractional Flow Reserve in LMCA Stenosis  121
   IVUS to Guide LMCA Interventions  122
   Periprocedural IVUS  122
   Lesion Preparation (Rotational Atherectomy)  124
   Intra-aortic Balloon Pump  124
   Aorto-ostial Unprotected Left Main PCI  124
   Mid-shaft Left Main PCI  127
   Left Main Bifurcation PCI  127

13. Coronary Chronic Total Occlusion Intervention Technique  133
   *Masaki Tanabe*
   Histopathological Considerations  133
   Clinical Consideration and Preprocedural Preparation  134
   Antegradde Approach  136
14. Primary Angioplasty in Myocardial Infarction 164

Ajit S Mulasari

Strategies in Acute STEMI 164
Advantage of Primary PCI over Thrombolytic Therapy 164
Interventions during PAMI 165
Prevention of Distal Embolization in PAMI 165
Covered Stents 167
Embolic Protection Devices 167
Glycoprotein IIB/IIIA Inhibitors 167
Timing of GPI Administration 168
Intracoronary versus Intravenous GPI Administration 169
Intracoronary Pharmacotherapy in PAMI 169
Bare-metal Stents versus Drug-eluting Stents 171
Newer Generation DES 171
Primary PCI in Special Situations: Nonculprit Artery PCI in STEMI 172
Left Main Coronary Angioplasty in PPCI 172
PPCI in the Elderly Patient 172
PPCI in Cardiogenic Shock 172
PPCI in Cardiac Arrest Survivors/Unconscious Patient 172
PPCI at Hospitals without Onsite Cardiac Surgery 173
Current Status of Primary PCI in India and Challenges for STEMI System of Care in India 173
OCT-based Characterization of Plaque Morphology in Management of STEMI 173

15. Complications in Coronary Angioplasty 179

Vilas P Magarkar

Procedural Complication Categories 179
Important Tips before Going for Percutaneous Transluminal Coronary Angioplasty 179
Vascular Complications 180
Complications Related to Coronary Blood Flow 182
Thrombus Formation 184
Air Embolism 184
Minimizing the Risk of Acute Kidney Injury 188

16. Non-left-main Bifurcation Angioplasty 192

Rajiv G Bhagwat, Ronak V Ruparelia, Jaideep Rajebahadur

Pathophysiology 192
Classification of Bifurcation Lesions 193
Various Techniques of Bifurcation Stenting 194
Main Branch Stenting Only 195
17. Saphenous Vein Graft Intervention

Anil Dhall, Salil Garg, Ajay Joshi, Anup Banerji

Natural History of SVG Disease  
Thrombosis  
Intimal Hyperplasia  
Atherosclerosis  
Indications for Intervention  
Difficulties and Methods  
Access Site and Guiding Catheter Choice  
Embolic Protection  
Choice of Stent  
Plaque Sealing in SVG

18. Interventions from the Upper Limb: Transradial Approach

Cherukupalli Raghu

Challenges in Transradial Interventions  
Radial Artery Access  
Transradial Procedures: Traversing Loops and Tortuosities  
Complications and Management  
Learning Curve in Transradial Procedures

19. Radial and Groin Care after Percutaneous Coronary Intervention

Kaushik Sheth

Site-related Complications  
Vascular Closure Devices

20. Bioresorbable Vascular Scaffold

Maciej Lesiak, Aleksander Araszkiewicz

IGAKI-TAMAI Scaffold  
Absorb Bioresorbale Vascular Scaffold  
DESoive, Novolimus-eluting Coronary Scaffold  
Fantom, Sirolimus-eluting Bioresorbable Scaffold  
Ideal Biostent  
Magnesium Metallic Stents  
Bioresorbable Vascular Scaffold Rationale and Clinical Indications  
Absorb Bioresorbable Vascular Scoffold Clinical Studies  
Absorb Bioresorbable Vascular Scaffold Implantation Technique
Special Lesion Subsets 239
Dual Antiplatelet Therapy after Bioresorbable Vascular Scaffold Implantation 240
Device Limitations 241
Future Directions 241

21. Hybrid Coronary Revascularization 245
   Piroze M Davierwala, Omür Akhavuz
   Procedure Strategy: Timing and Staging 245
   Indications and Contraindications for the Hybrid Coronary Revascularization Procedure 246
   Surgical Techniques 248

22. Difficult Situations in Coronary Angioplasty 256
   Lalita Nemani
   Anomalous Coronary Origin 256
      Classification 256
      Epidemiology 257
      Diagnosis 257
      Angiographic Profiling of Anomalous Coronaries 258
      Percutaneous Intervention in AOCA: Technical Challenges 260
      Guide Catheter Selection 261
      Ancillary Hardware and Techniques 264
   Calcific Coronaries 271
      Background 271
      Definition of CAC 271
      Epidemiology 271
      Pathophysiology and Risk Factors 271
      Detection of Coronary Calcification 272
      Percutaneous Intervention in Calcified Arteries 272
      Cutting Balloon Angioplasty 273
      Plain Balloon Angioplasty 275
      Directional Atherectomy 276
      Rotational Atherectomy 276
      Excimer Laser Coronary Atherectomy 277
      Orbital Atherectomy System 280
      Successful Rota 286
      Failed Rota 289

23. Contrast-induced Nephropathy 291
   Aditya Kapoor, Pritika Gaur
   Diagnostic Criteria 291
   Clinical Features, Management and Prognosis 291
Incidence and Predisposing Factors 292
Development of Clinical Scores for Risk Stratification 293
Pathophysiology of Contrast-induced Nephropathy 293
Prevention Strategies 293
Withholding Various Drugs 297

24. Rehabilitation after Percutaneous Transluminal Coronary Angioplasty 301
   Rajendra G Bahaley
   Cardiac Rehabilitation Definition 301
   Evidence Base 301
   Education and Counseling 302
   Objectives 303
   Exercise Training 305
   Exercise Prescription 305
   Intensity of Exercise Training 305
   Alcohol Consumption 306
   Sexual Counseling 306
   Management of Psychosocial and Professional Issues/Stress 307

25. Outcomes of Coronary Angioplasty 310
   Chandrashekhar V Patil
   Stable Coronary Artery Disease PCI versus Medical Treatment 310
   Stable Coronary Artery Disease PCI versus CABG 311
   Non-ST Elevation Acute Coronary Syndrome 312
   ST Elevation Myocardial Infarction 313
   Post-CABG Patients 314
   Special Situations: Stent Thrombosis and Restenosis 315
   Bioreorbable Stents 315
   Drug-coated Balloons 316

26. Future of Angioplasty 322
   Tiny Nair, K Krishnakumar
   Luminogram to Plaque Character 322
   Integrated Imaging 322
   Miniaturization 323
   Hybrid Procedures 323
   Robotics and Navigation 323
   Hardware 324
Printable Hardware 324
Closure Device 325
Economics and Cost 325
Locating Hardware in the Lab 325
Radiation Safety 325
Myocardial Viability 326
Data Network 326

27. Rotablation in Coronary Artery Disease 327
Chandrashekhar Makhale, Varun Nivargi

Need for Rotablation 327
Indications 329
Other Frequent Uses 329
Contraindications 329
Rotablator Products and System Components 330
First-generation Guidewires 331
Second-generation Wires: Floppy and Extra Support 331
Wire Clip Torquer Features 331
Procedure 331
IVUS in Rotablation 337
OCT in Rotablation 338

28. Hardware for Chronic Total Occlusion 340
Jaskaran Singh Dugal, Ajit Mehta

Sheaths 340
Guide Catheters 340
Microcatheters 341
Guidewires 343
Dissection/Reentry Equipment 344
Snares 344
Uncrossable and Undilatable Lesion Equipment 344
Intravascular Ultrasound 348
Complication Management Equipment 348
Radiation Protection 349

Index 351