

iv

Contents

Digital Contents: Quizzes, Animations and Videos List x

Contributors xii

Preface xvi

SECTION I: BASIC CONCEPTS

CHAPTER 1 CARDIAC ELECTRICAL ACTIVITY 1

Tobin H. Lim and David G. Strauss

The Book: Marriott's Practical Electrocardiography , 13th Edition 2

The Electrocardiogram 3

Anatomic Orientation of the Heart 4

The Cardiac Cycle 6

Cardiac Impulse Formation and Conduction 10

Recording Long-Axis (Base-Apex) Cardiac Electrical Activity 12

Recording Short-Axis (Left Versus Right) Cardiac Electrical Activity 17

CHAPTER 2 RECORDING THE ELECTROCARDIOGRAM 23

David G. Strauss, Tobin H. Lim, and Douglas D. Schocken

The Standard 12-Lead Electrocardiogram 24

Correct and Incorrect Electrode Placements 31

Alternative Displays of the 12 Standard Electrocardiogram Leads 34

Alternative Electrode Placement 40

Other Practical Points for Recording the Electrocardiogram 41

CHAPTER 3 INTERPRETATION OF THE NORMAL

ELECTROCARDIOGRAM 45

David G. Strauss, Tobin H. Lim, and Douglas D. Schocken

Electrocardiographic Features 46

Rate and Regularity 48

P-wave Morphology 50

The PR Interval 51

Morphology of the QRS Complex 52

Morphology of the ST Segment 59

T-wave Morphology 61

U-wave Morphology 63

QT and QTc Intervals 64 Contents v

Cardiac Rhythm 65

A Final Word 69

eChapter I: INTERPRETATION OF THE

ELECTROCARDIOGRAM IN 3D

Charles W. Olson, E. Harvey Estes Jr, Vivian P. Kamphuis,

Esben Andreas Carlsen, David G. Strauss, and Galen S. Wagner (deceased)

SECTION II: CHAMBER ENLARGEMENT AND

CONDUCTION ABNORMALITIES

CHAPTER 4 CHAMBER ENLARGEMENT 73

Douglas D. Schocken, Ljuba Bacharova, and David G. Strauss

Atrial Enlargement 75

Electrocardiogram Pattern With Atrial Enlargement 78

Ventricular Enlargement 80

Electrocardiogram QRS Changes With Ventricular Enlargement 82

Left-Ventricular Dilation 83

Left-Ventricular Hypertrophy 85

Electrocardiogram Pattern With Left-Ventricular Hypertrophy 86

Right-Ventricular Hypertrophy 90

Biventricular Hypertrophy 95

Scoring Systems for Assessing LVH and RVH 97

CHAPTER 5 INTRAVENTRICULAR CONDUCTION

ABNORMALITIES 101

David G. Strauss and Tobin H. Lim

Normal Conduction 102

Bundle-Branch and Fascicular Blocks 103

Unifascicular Blocks 107

Bifascicular Blocks 115

Systematic Approach to the Analysis of Bundle-Branch and

Fascicular Blocks 124

Clinical Perspective on Intraventricular-Conduction Disturbances 127

SECTION III: ISCHEMIA AND INFARCTION

*CHAPTER 6 INTRODUCTION TO MYOCARDIAL ISCHEMIA
AND INFARCTION 135*

David G. Strauss, Douglas D. Schocken, and Tobin H. Lim

Introduction to Ischemia and Infarction 136

Electrocardiographic Changes 140 vi Contents

*CHAPTER 7 SUBENDOCARDIAL ISCHEMIA FROM
INCREASED MYOCARDIAL DEMAND 149*

David G. Strauss and Tobin H. Lim

Changes in the ST Segment 150

*CHAPTER 8 TRANSMURAL MYOCARDIAL ISCHEMIA
FROM INSUFFICIENT BLOOD SUPPLY 163*

David G. Strauss and Tobin H. Lim

Changes in the ST Segment 164

Changes in the T Wave 175

Changes in the QRS Complex 176

***TRANSMURAL MYOCARDIAL ISCHEMIA
FROM INSUFFICIENT BLOOD SUPPLY:***

ONLINE SUPPLEMENT

David G. Strauss and Tobin H. Lim

Estimating Extent, Acuteness, and Severity of Ischemia

CHAPTER 9 MYOCARDIAL INFARCTION 181

David G. Strauss and Tobin H. Lim

Infarcting Phase 182

Chronic Phase 189

MYOCARDIAL INFARCTION:

ONLINE SUPPLEMENT

David G. Strauss and Tobin H. Lim

*Estimating Infarct Size and Infarcts in the Presence of
Conduction Abnormalities*

*Myocardial Infarction and Scar in the Presence of
Conduction Abnormalities*

SECTION IV: DRUGS, ELECTROLYTES, AND

MISCELLANEOUS CONDITIONS

CHAPTER 10 ELECTROLYTES AND DRUGS 203

Robbert Zusterzeel, Jose Vicente Ruiz, and David G. Strauss

Cardiac Action Potential 204

Electrolyte Abnormalities 206

Drug Effects 212

CHAPTER 11 MISCELLANEOUS CONDITIONS 223

Douglas D. Schocken, Tobin H. Lim, and David G. Strauss

Introduction 224

Cardiomyopathies 224 Contents vii

Pericardial Abnormalities 228

Pulmonary Abnormalities 232

Intracranial Hemorrhage 237

Endocrine and Metabolic Abnormalities 238

CHAPTER 12 CONGENITAL HEART DISEASE 245

Sarah A. Goldstein and Richard A. Krasuski

Atrial Septal Defects 246

Ventricular Septal Defect 251

Patent Ductus Arteriosus 253

Pulmonary Stenosis 253

Aortic Stenosis 253

Coarctation of the Aorta 253

Tetralogy of Fallot 254

Ebstein Anomaly 255

Congenitally Corrected Transposition of the Great Arteries 256

Complete Transposition of the Great Arteries 257

Fontan Circulation 258

SECTION V: ABNORMAL RHYTHMS

CHAPTER 13 INTRODUCTION TO ARRHYTHMIAS 263

*Zak Loring, David G. Strauss, Douglas D. Schocken,
and James P. Daubert*

<i>Introduction to Arrhythmia Diagnosis</i>	264
<i>Problems of Automaticity</i>	265
<i>Problems of Impulse Conduction: Reentry</i>	268
<i>Approach to Arrhythmia Diagnosis</i>	272
<i>Clinical Methods for Detecting Arrhythmias</i>	280
<i>Ambulatory Electrocardiogram Monitoring</i>	281
<i>Invasive Methods of Recording the Electrocardiogram</i>	286
CHAPTER 14 PREMATURE BEATS	293
<i>James P. Daubert, Aimée Elise Hiltbold, and Fredrik Holmqvist</i>	
<i>Premature Beat Terminology</i>	294
<i>Differential Diagnosis of Wide Premature Beats</i>	297
<i>Mechanisms of Production of Premature Beats</i>	298
<i>Atrial Premature Beats</i>	299
<i>Junctional Premature Beats</i>	304
<i>Ventricular Premature Beats</i>	307
<i>Right-Ventricular Versus Left-Ventricular Premature Beats</i>	312
<i>Multiform Ventricular Premature Beats</i>	315
<i>Groups of Ventricular Premature Beats</i>	316
<i>Vulnerable Period and R-on-T Phenomenon</i>	317
<i>Prognostic Implications of Ventricular Premature Beats</i>	317viii
CHAPTER 15 SUPRAVENTRICULAR TACHYARRHYTHMIAS	321
<i>Kevin P. Jackson and James P. Daubert</i>	
<i>Introduction</i>	322
<i>Differential Diagnosis of Supraventricular Tachycardia</i>	324
<i>Sinus Tachycardia</i>	329
<i>Atrial Tachycardia</i>	331
<i>Junctional Tachycardia</i>	334
<i>Atrioventricular Nodal Reentrant Tachycardia</i>	335
<i>Accessory Pathway Mediated Tachycardia</i>	338
CHAPTER 16 ATRIAL FIBRILLATION AND FLUTTER	345
<i>Jonathan P. Piccini, James P. Daubert, and Tristram D. Bahnson</i>	
<i>Pathophysiology of Atrial Fibrillation and Atrial Flutter</i>	346

Twelve-Lead Electrocardiographic Characteristics of Atrial Fibrillation 350

Atrial Flutter 355

Twelve-Lead Electrocardiographic Characteristics of

Atypical Atrial Flutter 358

Clinical Considerations of Atrial Fibrillation and Atrial Flutter 364

CHAPTER 17 VENTRICULAR ARRHYTHMIAS 369

Albert Y. Sun and Jason Koontz

Definitions of Ventricular Arrhythmias 370

Etiologies and Mechanisms 370

Diagnosis 371

CHAPTER 18 BRADYARRHYTHMIAS 391

*Larry R. Jackson II, Camille Genise Frazier-Mills, Francis E. Ugowe,
and James P. Daubert*

Mechanisms of Bradyarrhythmias: Decreased Automaticity 393

Atrioventricular Conduction Disease 400

Severity of Atrioventricular Block 400

Location of Atrioventricular Block 410

Atrioventricular Nodal Block 411

Infranodal (Purkinje) Block 414

CHAPTER 19 VENTRICULAR PREEXCITATION 421

Donald D. Hegland, Stephen Gaeta, and James P. Daubert

Clinical Perspective 423

Pathophysiology 426

Electrocardiographic Diagnosis of Ventricular Preexcitation 430

*Ventricular Preexcitation as a “Great Mimic” of Other
Cardiac Problems 434*

*Electrocardiographic Localization of the Pathway of
Ventricular Preexcitation 435*

Ablation of Accessory Pathways 438 Contents ix

CHAPTER 20 INHERITED ARRHYTHMIA DISORDERS 445

John Symons and Albert Y. Sun

The Long QT Syndrome (LQTS) 446

LQTS Electrocardiographic Characteristics 446

Electrocardiogram as Used in Diagnosis for LQTS 448

The Short QT Syndrome (SQTS) 449

SQTS Electrocardiographic Characteristics 449

Electrocardiogram as Used in Diagnosis for SQTS 451

The Brugada Syndrome 452

Arrhythmogenic Right-Ventricular Cardiomyopathy/Dysplasia 454

J-wave Syndrome 458

Catecholaminergic Polymorphic Ventricular Tachycardia 460

CHAPTER 21 IMPLANTABLE CARDIAC PACEMAKERS 465

Brett D. Atwater and Daniel J. Friedman

Basic Concepts of the Implantable Cardiac Pacemaker 466

Pacemaker Modes and Dual-Chamber Pacing 472

Pacemaker Evaluation 478

Myocardial Location of the Pacing Electrodes 482

Special Algorithms to Avoid Right-Ventricular Pacing 484

Cardiac Resynchronization Therapy 485

Index 493