Index

accelerated junctional rhythm, 67–8
acetylcholine, 17
activities of daily living (ADL), 244, 245
acute myocardial infarction (AMI), 30
Ambulatory Ventricular Automatic Threshold, 289
American Heart Association, 31
amiodarone, 41
AMS see automatic mode switching (AMS)
analgiesics, 43
angiotensin-converting enzyme (ACE) inhibitor, 42–3
antegrade conduction, 17
antianginal drugs
  beta-adrenergic blockers/beta-blockers, 39, 45
calcium-channel blockers, 38
  vasodilators, 39, 45
antiarrhythmics agents/antidysrhythmics (AAAs)
amiodarone, 41
beta-blockers, 41
calcium-channel blockers, 41, 42
flecainide, 41
lidocaine, 41, 46
paradoxical, 40
plateau region, 40
potassium-channel blockers, 41, 42
quinidine, 40, 46
anticoagulants, 43–4
antihyperlipidemics, 44
antiplatelet agents, 44
arrhythmia
atrial tachyarrhythmias
  atrial fibrillation, 64–5
  atrial flutter, 64
  premature atrial contraction, 62–4
PSVT, 64
interpretative challenges, 58–9
junctional rhythms
  accelerated junctional rhythm, 67–8
  AV junctional beats sequence, 66–7
  escape beat, 66
  premature beats, 65–6
  P-waves, 65, 66
  tachycardia, 68
sinus node
  bradycardia, 60
  irregular rhythm, 60, 61
  normal sinus rhythm, 59
  sinus arrest and SA exit block, 60–62
tachycardia, 59–60
supraventricular, 58
ventricles
  AV block see atrioventricular (AV) block
  ectopic ventricular rhythms, 68–9
  idioventricular rhythm, 70
tachycardia, 69–70
ventricular standstill, 70
ATDR see atrial tachycardia detection rate (ATDR)
atrial alert period, 190
atrial arrhythmia management, 269
atrial-based timing, 240
  AA interval, 235
  advantages, 236
  modified atrial-based timing, 237–8
  PVC, 236, 237
  quirk, 236, 237
  true atrial-based timing, 237, 240
atrial fibrillation, 64–5, 175
atrial flutter, 64
atrial tachyarrhythmias, 174
  atrial fibrillation, 64–5
  atrial flutter, 64
  premature atrial contraction, 62–4
PSVT, 64
atrial tachycardia detection rate (ATDR), 227
atrial tracking, 171–2
atrioventricular (AV) block
  first-degree, 70–71
Index 321

pacing
  class I indications, 107–8
  class IIa indications, 108–9
  class IIb indications, 109
  class III indications, 109
second-degree
  Mobitz type I, 71–2
  Mobitz type II, 72
third-degree, 72–3
atrioventricular (AV) delay features
  atrial and ventricular pacing, 170–171, 173–4
  longer AV delays
    AAI/AAIR mode, 262
    AV Search Hysteresis, 262–3
    clinician considerations, 263
    DDD/DDR mode, 262
    mode switching, 262
    MVP mode, 262
  mode switching
    atrial arrhythmia management, 269
    atrial tracking, 267, 268
    DDIR pacing, 268
    MSR, 268
    non-atrial-tracking mode, 269
    prevention/suppression features, 269–70
    VVIR, 268
  neurocardiogenic syncope, 272–3
  pacemaker outputs features
    acute-to-chronic threshold transitions, 264
    automatic capture algorithms, 265
    automatic sensing, 263–4
    capture threshold, 264–5
    generous safety margin, 265
  PVARP see postventricular atrial refractory period (PVARP)
  rate response features
    rate hysteresis, 270–271
    rate smoothing, 271, 272
    sleep rates, 270
  shorter AV delays, 260–261
  atropine, 44
  automatic capture algorithms, 265
  Boston scientific see Boston scientific algorithm
  capture confirmation, 280
  features, 280
  history, 279
  Medtronic capture management, 292, 293
  noncapture, 279–80
  optimal safety margin, 280
  St. Jude Medical see St. Jude Medical AutoCapture algorithm
  automaticity, 17, 18
  automatic mode switching (AMS)
  AF, 228, 230
  ATDR, 227
  CHADS score, 228, 230–231
  definition, 227
  FARI, 227
  programmed parameters, 227
  VRR, 227–8
  automatic sensing, 263–4
  autonomic nervous system
    cardiac conduction, 17
    neurocardiogenic syncope, 110
    parasympathetic nervous systems, 24
    sinoatrial (SA) node, 59
    sympathetic nervous system, 24
  Bachmann’s bundle, 15
  backup pacemakers, 16
  beta-blockers, 39, 45
  bipolar pacing system, 80
  Boston scientific algorithm
    backup safety pulse, 289, 290
    beat-by-beat capture algorithm, 291
    capture threshold trend graph, 291
    characteristics, 293
    C-LOC, 289–90, 292
    inadequate evoked response signal, 290
    pulse amplitude setting, 289, 290
    System Summary screen, 291
  bradycardia, 60
  British Pacing and Electrophysiology Group (BPEG), 140–141
  CAD see coronary artery disease (CAD)
calcium-channel blockers, 38, 39
calcium chloride, 44
  capacitors, 80
cardiac conduction system
  antegrade conduction, 17
  atrioventricular (AV) node, 15
  autonomic nervous system, 17
  Bachmann’s bundle, 15
depolarization, 15–16
  electrical stimulus, 17
  refractoriness, 17, 18
  repolarization, 16
  sinoatrial node see sinoatrial (SA) node
cardiac cycle
  atrial systole and ventricular diastole, 21
  autonomic nervous system, 24–5
  cardiovascular anatomy, 25–7
  contractility, 23
  definition, 21
  heart rate, 22–3
  hemodynamics
Index

cardiac cycle (cont’d)
atrial systole, 21
atrioventricular synchrony, 21
cardiac devices, 21
LVEF, 22
stroke volume, 22
systole and diastole, 21, 22
LVEDP, 23
SVR, 23
systolic and diastolic pressures, 23–4
cardiac glycosides, 38
cardiac medication see medication
cardiac resynchronization therapy (CRT), 3, 11, 12, 136, 141
cardiac tamponade, 2
cardiomyopathy, 33
cardiomyopathy index card (cont’d)
atrial systole, 21
atrioventricular synchrony, 21
cardiac devices, 21
LVEF, 22
stroke volume, 22
systole and diastole, 21, 22
LVEDP, 23
SVR, 23
systolic and diastolic pressures, 23–4
cardiac glycosides, 38
cardiac medication see medication
cardiac resynchronization therapy (CRT), 3, 11, 12, 136, 141
cardiac tamponade, 2
cardiomyopathy, 33
cardiovascular anatomy and physiology
blood flow
corresponding items, 3
deoxygenated blood, 2–3
left and right ventricles pump blood, 3, 4
LVOT, 5–7
pulmonary valve, 3
RVOT, 5, 6
trabeculae, 3, 4
tricuspid valve, 5
CAD, 11
CRT, 11, 12
healthy heart, 1–2
LCA, 10
RAA, 8, 9
RCA, 10, 11
trabeculae, 8
tricuspid valve, 7
veins, 9, 10
volume and pressure, 7–8
catecholamines, 45
Centers for Disease Control and Prevention in Atlanta, 30
Centers for Medicare and Medicaid Services (CMS), 300, 301
CHADS score, 228, 230–231
chronic obstructive pulmonary disease (COPD), 33
chronotropic drugs, 37, 45
chronotropic incompetence (CI)
causes, 243–4
definition, 242
disorder, 244
heart rate, 244
metabolic equivalents, 245
MHR, 243
patient diagnosis
counters, 247
histograms, 247
trends, 247–8
prevalence, 244
rate response, 248
stages, 243
symptoms, 242–3
closed-loop stimulation (CLS) system, 252–3
complementary metal oxide semiconductors (CMOS), 301
complete pacemaker follow up, 302
congenital heart disease, 33–4
contractility, 23, 27
coronary artery disease (CAD), 11
AMI, 30
antianginal drugs, 38
arrhythmias, 29
blockage, 30
cholesterol, 31
diabetes mellitus types I and II, 31–2
diabetics, 32
family history, 31
hypertension/high blood pressure, 32
ischemic heart disease, 29
myocardial infarction, 30
plaques, 29–30
smoking, 32
statin therapy, 31
coronary sinus (CS), 3
coumadin, 44
DDDR pacemaker patient, 148, 255
defibrillator, 78
diaphragmatic muscle, 25
digoxin, 38, 45
dilated cardiomyopathy, 33
diuretics, 43
dobutamine, 44
dopamine, 44
dromotropic drugs, 37, 45
dual-chamber pacemaker
atrial and ventricular pacing
annotated strip, 171–2
AS/VP pacing states, 172–3
atrial tracking, 171–2
AV delay, 170–171, 173–4
base rate, 170
interval measurements, 171
rhythm strip, 172–3
total inhibition, 174
ventricular depolarization, 173–4
ventricular output pulse, 171–3
atrial tracking, 220
AV delay
DAVID study, 181–2
healthy heart, 180
intrinsic atrial event, 181
latency, 181
mechanical dyssynchrony, 182
mitral valve regurgitation, 180
PR interval, 182
properly timed and programmed, 180–181
right ventricular pacing, 182
1:1 AV synchrony, 170
fixed-ratio block, 221
four states, 169–70
arrhythmia diagnosis, 174
atrial fibrillation, 175
atrial tachyarrhythmia, 174
intact AV conduction, 175
no/minimal pacing, 174
pacemaker program, 174
patient's condition and arrhythmia changes, 174
sinus node dysfunction, 174–5
intrinsic atrial rate, 175–6
magnet mode, 145
MTR, 220–221
nontracking modes, 147–8
pacemaker timing, 175
pacemaker Wenckebach, 221, 229, 230
postventricular atrial refractory period
atrial channel refractory, 183
benefit, 184
PMT prevention see pacemaker-mediated tachycardia (PMT)
programmable atrial blanking period, 183
programmed base rate, 175
programming strategies
atrial tachyarrhythmias, 225
AV delay parameter, 226–7
high MTR values, 225
mode switching see automatic mode switching (AMS)
pacemaker parameters, 226
PMT prevention, 226
PVARP, 222, 229
refractory and alert periods, 179–80
tracking
AV interval clock, 146
DDD pacemaker, 145–8
goal, 147
internal clock, 145–6
magnet mode, 145
maximum/max tracking rate, 147
upper-rate behavior
atrial continuum, 223
Pseudo-Wenckebach behavior, 223
TARP, 222
two-to-one block, 223–4
Wenckebach window, 224–5
ventricular channel see ventricular channel
ventricular paced rate, 176
ventricular rate, 175
dual-chamber timing
atrial-based timing
AA interval, 235
advantages, 236
modified atrial-based timing, 237–8
PVC, 236, 237
quirk, 236, 237
true atrial-based timing, 237
base-rate/LRL, 233–4
pacemaker malfunctions, 238–9
ventricular-based timing
PAV delay, 234–5
quirks, 235
VA interval, 234–5
dynamic AV delay, 226–7
ectopic ventricular rhythms, 68–9
Einthoven's triangle, 48–9
electric management
amplitude, 81
artificial cardiac pacemaker, 78
bipolar pacing system, 80
defibrillator, 78
electricity
conductors, 78
definition, 78
depolarization, 78
pacing leads, 79
electromagnetic interference, 81
impedance and resistance, 81
Ohm's law
current, 80–81
resistance, 81
troubleshoot lead problems, 81
voltage, 80
pacemaker battery, 80
pulse duration, 81
unipolar pacing system, 79–80
electrocardiogram (ECG)
Einthoven's triangle, 48–9
and electrograms (EGM) analysis
atrial capture, 211
atrial channel, 206
atrial pacing spikes, 206–7
base rate, 208
device clinicians, 206
dual-chamber pacemaker, 206, 209–12
eyeball, 214, 215
fast and accurate, 205
force capture, 212–13
functional noncapture, 209
interpretation, 205
paced AV interval, 208
pacemaker refractory periods, 212
electrocardiogram (ECG) (cont’d)
patient history, 206
patient’s diagnosis, 208
patient system, 213–14
P-waves, 206, 207–8
QRS complexes, 206
rhythm strips, 205, 214
R-waves, 207–8
VA interval, 208
ventricular pacing spikes, 207
VVI pacemaker, 210
lead configurations
lead I, 49, 50
lead II, 49, 50
lead III, 49–50
refractory periods, 55
systematic rhythm strip analysis
calculate rate, 51–4
PR interval determination, 54
P-wave assessment, 54
QRS duration determination, 54
regularity, 54
waveform landmarks
P-wave, 50–51
Q-, R-, and S-waves, 50, 52
T-wave, 50, 51
U-wave, 51
electromagnetic interference (EMI), 81
electronic medical records (EMR), 300
epinephrine/adrenaline, 17
eyeballing rhythm strip, 214
far-field R-wave oversensing, 196
filtered atrial rate interval (FARI), 227
flecainide, 41
fusion, 160–162
heart disease
CAD see coronary artery disease (CAD)
congenital, 33–4
nonischemic, 33
Heart Rhythm Society (HRS), 141
heart’s natural pacemaker see sinoatrial (SA) node
high-density lipoprotein (HDL), 31
high-impedance leads, 285
hypercholesterolemia, 31
hypertrophic myopathy, 33
hypertrophic obstructive cardiomyopathy (HOCM), 7, 33
IEAP see industry-employed allied professionals (IEAP)
implantable cardioverter defibrillator (ICD), 141
implantable pulse generator (IPG)
casing, 90
crystal oscillator, 91
headers, 94
hybrid system, 90–91
leads see leads, implantable pulse generator (IPG)
left side implant, 89–90
lithium-iodide battery, 92
mercury–zinc batteries, 91
nickel–cadmium battery, 92
nuclear pacemaker, 91
pacemaker battery life, 92–3
rechargeable pacemaker, 91–2
reed switch, 91
right side implant, 90
sealing rings, 94
setscrews, 94
standardization, 93–4
industry-employed allied professionals (IEAP), 303, 306–7
inotropic drugs, 37, 45
International Standard-1 (IS-1), 131–2
Inter-Society Commission for Heart Disease (ICHD), 140
isuprel, 44
junctonal rhythms
accelerated junctonal rhythm, 67–8
AV junctonal beats sequence, 66–7
escape beat, 66
premature beats, 65–6
P-waves, 65, 66
tachycardia, 68
leads
implantable pulse generator (IPG)
connection problem, 134
connector block, 132
dual-chamber pacemaker, 133
extraction, 136–7
ideal characteristics, 135
IS-1, 131–3
low-profile, 132
pacing
active-fixation mechanisms, 96
conductor coil, 98–9
electrodes, 99
impedance, 99–100
insulation, 97–8
myocardial/epicardial, 97
passive-fixation mechanisms, 96
polarity, 94–6
steroid-eluting, 97
thresholds, 100
sealing rings, 132
single-pass lead (VDD), 134–6
standardized connector, 131
torque wrench, 133–5
left coronary artery (LCA), 10
left ventricular end-diastolic pressure (LVEDP), 23
left ventricular outflow tract (LVOT), 5–7
lidocaine, 41, 46
low-density lipoprotein (LDL), 31
lower-rate limit (LRL), 233–4
magnet mode, 154–5, 311
maximum heart rate (MHR), 243
maximum sensor rate (MSR), 148, 220
maximum tracking rate (MTR), 201, 255
atrial tracking
drawback, 220
dual-chamber pacemaker, 220
handy formula, 221
PMTs, 220
sinus acceleration, 220
timing cycle, 221
1:1 AV synchrony, 219, 220, 229
definition, 219
speed limit, 219–20
medication
ACE, 42–3
analgesics, 43
antianginal drugs
beta-adrenergic blockers/beta-blockers, 39, 45
calcium-channel blockers, 38
vasodilators, 39, 45
antiarrhythmics agents see antiarrhythmics agents/
antidysrhythmics (AAAs)
anticoagulants, 43–4
antihyperlipidemias, 44
antiplatelet agents, 44
atropine, 44
calcium chloride, 44
cardiac glycosides, 38
catecholamines, 45
chronotropic drugs, 37, 45
diuretics, 43
dobutamine, 44
dopamine, 44
dromotropic drugs, 37, 45
drug–device interactions, 38
drug–drug interactions, 37
inotropic drugs, 37, 45
isuprel, 44
levophed, 45
nipride, 44
thrombolytics, 44
Medtronic (Activitrax), 249
Medtronic algorithm, 292, 293
metabolic equivalents (MET), 245, 246
minute ventilation (MV), 245–6
MSR see maximum sensor rate (MSR)
MTR see maximum tracking rate (MTR)
muscle noise, 95
NBG code, 141–2
neurocardiogenic syncope, 272–3
advanced hysteresis, 112
cardioinhibitory forms, 112
class IIa indications, 112
class IIb indications, 112
class III indications, 112–13
class I indications, 112
closed-loop stimulation, 112
fainting disorders, 110
fight-or-flight reflex, 110
geriatric patients, 110–111
mixed NCS, 111
postural changes, 110
rate drop response, 112
sudden brady response, 112
treatment options, 111–12
younger patients, 110
nipride, 44
nitroglycerin, 43
nonischemic heart disease, 33
North American Society for Pacing and Electrophysiology (NASPE), 140–141
Ohm’s law, 80–81
PAC see premature atrial contraction (PAC)
paced AV (PAV) delay, 233, 234
pacemaker codes
dual-chamber pacing see dual-chamber pacemaker
ICHD, 140
NBG code
atrial and ventricular pacing, 141
BPEG code, 140
DDD and VVI pacemaker, 141
ICD, 141
magnet mode, 142
manufacturers’ designation, 142
NASPE, 140
O code, 142
patient’s heart beats, 141
rate response/adaptation, 142
senses intrinsic signals, 141
triggered response, 142
single-chamber see single-chamber pacemaker
pacemaker follow up
benefits, 299–300
communication, 300
frequency
complete pacemaker follow-up, 302
guidelines, 300–301
pacemaker follow up (cont’d)
  interrogation evaluation, 302
  lost to follow-up, 301–2
  patient-initiated RM, 302–3
  periprocedural evaluation, 302
IEAP, 303, 306–7
PUBL-STOP method
  battery status, 304, 305
  lead impedance, 304, 305
  observations, 304, 305
  presenting rhythm, 304, 305
  programming, 304, 306
  sensing, 304
  threshold, 304
  underlying rhythm, 304
types
  in-clinic visit, 298
  RM, 298–9
  TTM, 297–8
pacemaker-mediated tachycardia (PMT), 220, 229, 266
antegrade P-waves, 184
atrial tracking, 184
AV synchrony, 185
identification, 187
magnet application, 187
normal conduction, 185
prevention
  algorithms, 188–9
  long PVARP value, 187–8
  patient’s trigger, 188
PVARP
  prevention algorithms, 266
  termination algorithms, 266–7
retrograde P-waves, 184, 186–7
retrograde VA conduction, 185, 186
stop tracking episode, 187
termination algorithms, 189–90, 266–7
unidirectional heart block, 185
pacing
AV block
  class Ia indications, 108–9
  class IIb indications, 109
  class III indications, 109
  class I indications, 107–8
capture threshold
  energy equation, 87
  lead maturation, 88
  pacemaker output pulse, 85, 86
  patient’s medications, 88
  pulse settings, 86
  safety margin, 87–8
  strength–duration curve, 86–7
cardiac signal sensing
  oversensing, 89
  sensitivity, 88–9
  undersensing, 89
classes of evidence, 104–5
hypersensitive carotid sinus syndrome, 110
implantable pulse generator
  casing, 90
  crystal oscillator, 91
  headers, 94
  hybrid system, 90–91
  left side implant, 89–90
  lithium-iodide battery, 92
  mercury–zinc batteries, 91
  nickel–cadmium battery, 92
  nuclear pacemaker, 91
  pacemaker battery life, 92–3
  rechargeable pacemaker, 91–2
  reed switch, 91
  right side implant, 90
  sealing rings, 94
  setscrews, 94
  standardization, 93–4
leads
  active-fixation mechanisms, 96
  conductor coil, 98–99
  electrodes, 99
  impedance, 99–100
  insulation, 97–8
  myocardial/epicardial, 97
  passive-fixation mechanisms, 96
  polarity, 94–6
  steroid-eluting, 97
  thresholds, 100
levels of evidence, 104, 105
neurocardiogenic syncope
  advanced hysteresis, 112
  cardioinhibitory forms, 112
  class Ia indications, 112
  class IIb indications, 112
  class III indications, 112–13
  class I indications, 112
  closed-loop stimulation, 112
  fainting disorders, 110
  fight-or-flight reflex, 110
  geriatric patients, 110–111
  mixed NCS, 111
  postural changes, 110
  rate drop response, 112
  sudden brady response, 112
  treatment options, 111–12
  younger patients, 110
programmer, 89
sinus node dysfunction
Index

class IIa indication, 106
class IIb indication, 106
class III indication, 106–7
class I indication, 105–6
sinus bradycardia documentation, 107
threshold
definition, 84
demand pacing, 85
intrinsic signal, 85
sensing circuit, 85
parasympathetic system, 17
paroxysmal supraventricular tachycardia (PSVT), 64
PASSIVE rate response, 254
patent foramen ovale (PFO), 33
pericardial sac, 2
PMTs see pacemaker-mediated tachycardia (PMT)
point of maximal impulse (PMI), 1–2
polyurethane leads, 98
postventricular atrial refractory period (PVARP), 222, 226, 229
dual-chamber pacemaker
atrial channel refractory, 183
benefit, 184
PMT prevention see pacemaker-mediated tachycardia (PMT)
programmable atrial blanking period, 183
PMT prevention algorithms, 266
termination algorithms, 266–7
WARAD feature, 265
potassium-channel blockers, 41, 42
premature atrial contraction (PAC)
atrial irritability, 62–3
less-than-compensatory pause, 63
nonconducted PAC, 63
occasionally irregular patterns, 62
pulmonary disorders, 63
supraventricular arrhythmia, 63–4
premature junctional contraction (PJC), 66
premature ventricular contraction (PVC), 68–9, 236, 237
programming sensitivity, 156
pseudofusion, 161, 162
PUBL-STOP method
battery status, 304, 305
lead impedance, 304, 305
observations, 304, 305
presenting rhythm, 304, 305
programming, 304, 306
sensing, 304
threshold, 304
underlying rhythm, 304
Purkinje fibers, 17
PVARP see postventricular atrial refractory period (PVARP)
quindidine, 40, 46
rate-adaptive AV delay, 226
rate-responsive pacing
CI see chronotropic incompetence (CI)
exercise physiology, 244–5
healthy chronotropic response, 246–7
minute ventilation (MV), 245–6
programming rate response
automatic/AUTO feature, 256
Medtronic-style rate response, 253
optimizing rate response, 255, 256
turning rate response, 254
sensors
accelerometer, 250, 251, 253
activity sensor, 249–51, 253
blended, 252, 253
blood sensing system, 249
CLS, 252–3
ideal sensor, 249
kind of, 249
MV sensor, 251
perfect sensor, 249
QT plus activity sensor, 253
sensor-indicated rate, 248
refractoriness, 17, 18
relative bradycardia, 60
remote monitoring (RM), 298–9
restrictive cardiomyopathy, 33
right atrial appendage (RAA), 8, 9
Right coronary artery (RCA), 10, 11
right ventricular outflow tract (RVOT), 5, 6, 144
single-chamber pacemaker
atrial pacing
AAI device, 143–4
AOO pacing, 143
RVOT, 144
rate response, 148–9
ventricular pacing, 145
single-chamber timing cycles
AAI pacemaker, 153, 154
alert period, 162–3
automatic interval, 163
escape interval, 163
hysteresis rate, 163–4
inhibition, 158, 159
magnet mode, 154–5
pacemaker dependent, 155
pacing
capture threshold, 159
fusion, 160–162
pacing interval, 158–9
Index

single-chamber timing cycles (cont’d)
  patient’s intrinsic pacing rate, 158–9
  pseudofusion, 161, 162
  refractory period, 161–2
  rhythm strips, 157–8
  search hysteresis, 164
  sensing, 156–7
  VVI pacemaker, 153, 154
 sinoatrial (SA) node
  automaticity, 17
  backup pacemakers, 16–17
  internodal tracts, 15
  Purkinje fibers, 16
  sinus arrest, 60–62
  Sinus node dysfunction, 174–5
  sinus pause, 60–62
  Starling’s Law, 23
  statin therapy, 31
  St. Jude Medical AutoCapture algorithm
    ACap™ Confirm, 287–8
    advantage, 282
    AutoCapture pacing systems, 288–9
    backup safety pulse, 280–284
    capture thresholds, 282
    capture verification
      E/R sensitivity test, 285
      evoked response, 284–5
      low-polarization, 285–6
      not-recommended verdict, 286–7
      polarization/afterpotential, 284, 285
      programmer, 286
      characteristics, 293
      evoked response test, 280, 284
      features, 287–8
      goal, 279, 287
      long-term threshold record, 287
      loss of capture recovery, 282
      threshold search, 282, 283
  superior vena cava (SVC), 3
  sympathetic nervous system, 17
    brain chemical acetylcholine, 25
    contractility, 24
    fight-or-flight response, 24
    systemic vascular resistance (SVR), 23
  tachy–brady syndrome, 144
  tachycardia
  junctional rhythms, 68
  sinus node, 59–60
  ventricles, 69–70
  TARP see total atrial refractory period (TARP)
  thrombolytics, 44
  total atrial refractory period (TARP), 189–90, 222, 226, 229
  total inhibition, 174
  trabeculae, 3, 4, 8
  transtelephonic monitoring (TTM), 297–8
  tricuspid valve, 5
  troubleshooting
    cause determination, 311–12
    corrective action, 311–12
    issue identification, 310–311
  unipolar pacing system, 79–80
  vasodilators, 39, 45
  ventricular alert period, 199
  ventricular-based timing, 239
    AV delay, 234–5
    quirks, 235
    VA interval, 234–5
  ventricular blanking period (VBP)
    atrial output pulse, 196
    far-field R-wave oversensing, 196
    paced atrial event, 196–7
    right atrial and ventricular lead, 196
    ventricular safety pacing, 196
  ventricular channel
    VBP, crosstalk inhibition
      atrial output pulse, 196
      far-field R-wave oversensing, 196
      paced atrial event, 196–7
      right atrial and ventricular lead, 196
      ventricular safety pacing, 196
    ventricular safety pacing
      crosstalk sensing window, 197–8
      VA interval, 199–201
    ventricular alert period, 199
    ventricular refractory period, 198–9
    ventricular rate regulation (VRR), 227–8
    ventricular refractory period, 198–9
    VVIR pacemaker, 149–50
  Wenckebach rhythm, 144
  Wenckebach window, 224–5, 230

Wenckebach rhythm, 144
Wenckebach window, 224–5, 230