Index

**a**
abnormal rhythms, hemodynamics of 15–18
ACIST system, power injection transducer performance 151

*Hemodynamic Rounds: Interpretation of Cardiac Pathophysiology from Pressure Waveform Analysis, Fourth Edition.*
Edited by Morton J. Kern, Michael J. Lim, and James A. Goldstein.
© 2018 John Wiley & Sons Ltd. Published 2018 by John Wiley & Sons Ltd.
aortic stenosis (AS) 81–100
with aortic regurgitation 91, 112–116
artifacts 91
cardiac rhythms 89–90
disappearing gradients 88–89
disappearing, hypertrophic
obstructive cardiomyopathy 166–168
Doppler echocardiography 82–83
invasive assessment 83–85, 88–89
low‐flow, low‐gradient 90–91
paradoxically severe 87–88
transaortic valve
replacement 263–264, 269
mitral valve prostheses case 144–145
with mitral valve stenosis 148–152
nitroglycerin 60–61
percutaneous balloon valvuloplasty
257–260
screening 251–257
peripheral arterial wave
summation 91–94
post aortic root reconstruction 112–116
pressure recovery 82
prosthetic valves 94–98
transaortic valve replacement
261–273
types 81–82
zero drift methods 91–94
aortic valve area (AVA) 81, 83, 85–87, 108
aortic valve protheses 94–98
balloon mitral valvuloplasty
286–292
stenosis, with mitral prosthesis
stenosis also 152–156
AR see aortic regurgitation
arrhythmias 67–78
atrial waves 69
first-degree A–V block 78
key points 78
low output/hypotension 420
pacemakers 73–78
premature ventricular
contractions 67
QRS complexes 68–73
wide QRS 69–73
arterial pressure, heterotopic
transplantation 379–382
arterial wall abutment, tip
damping 344
atrial waveforms
anatomic–pathophysiological
assessment 414
concepts 5–6
transduser disequilibrium 32–33
AS see aortic stenosis
ASD see atrial septal defects
atrial systole
pacemakers 76
V waves 38–39
atrial waveforms
anatomic–pathophysiological
assessment 413–414
arrhythmias 69
atrial mechanical function
10–11
pacemaker activity 73–74
atrioventricular (A–V) block
first degree, left ventricular
pressure 78
right ventricular infarction 239
Austin–Flint murmurs 104
AVA see aortic valve area
A–V block see atrioventricular block
A waves
acute aortic insufficiency
109–112
concepts 4–5, 11
normal patterns 35–36
Index

malignant tumor-induced pathophysiology 213–217
pericardiocentesis 208–209
phases 205
pulsus paradoxus 202–203, 211–213
cardiopulmonary support (CPS) 389–392
carotid waveforms dyspnea 418–419
hypotension/low output 422–423
catheter fling, pressure wave artifacts 23
chest X-rays, restrictive cardiomyopathy differentiation 227
chronic aortic insufficiency 101–104
chronic pericardial compression see also cardiac tamponade; pericardial disease
chronic right ventricular failure, core concepts 14
cinefluoroscopy, mitral valve prostheses 135
clinical outcomes pulmonary balloon valvuloplasty 305
renal artery stenosis 359
CO see cardiac output coarctation of the aorta “common chamber” during diastole 9
complete support devices 385
compliance anatomic–pathophysiological assessment 413
core concepts 9–10
pericardial 197–198
preload assessment 420–422
ventricular hypertrophic obstructive cardiomyopathy 175–176 pacemakers 76–78
complications alcohol-induced septal infarction 188
left ventricular puncture 156–157 pulmonary balloon valvuloplasty 306
rheumatic mitral stenosis 148
right ventricular infarction 239–240
computed tomography (CT), restrictive cardiomyopathy differentiation 227–228
conduction abnormalities bundle branch block 46, 50–52, 297
left ventricular end-diastolic pressure 45–46
parallel ventricular pressures 50–52
genital anomalies 361–378
atrial septal defects 367–371
case studies 367–375
common forms 376–377
Ebstein’s 363–364
intracardiac shunts 364–371
preductal coarctation of aorta 371–372, 376
ventricular septal defects 372–375
genital heart disease, pulmonary balloon valvuloplasty 303–305
genital valvular aortic stenosis 81–82
see also bicuspid valvular aortic stenosis
congestive heart failure double prosthetic valve stenosis 152–156
left ventricular end-diastolic pressure 44–45
constrictive pericarditis (CP) algorithmic differentiation 232–233
non-invasive assessment 227–228
respiratory oscillations 223, 225–227
restrictive cardiomyopathy differentiation 219–234
ventricular pressures 224–225, 230–231
case studies 341–344
Doppler velocimetry 341–344
fractional flow reserve 312–328
coronary blood flow 311–348
atrial fibrillation 331
fractional flow reserve 311–313
ventricular tachycardia 331–334
coronary stenosis acute syndromes 324–325
catheter tip pressures 341–344
coronary vasodilatory flow reserve 311, 326–328
diffuse coronary disease 323
Doppler velocimetry 328–334
fractional flow reserve 312–328
hyperemic evaluation 336–340
instantaneous wave-free pressure ratios 314–316
intermediately severe 317–319
“jailed” side branches 323–324
microvascular disease 340
morphology 312–313
multivessel disease 319–321
nonhyperemic indices of severity 314–316
pressure loss 311–312
serial lesions 322–323
thermodilution technique 336
vasodilatory flow reserve 311, 326–328, 334–340
coronary vasodilatory flow reserve (CFR) 334–340
damping 342–344
definition 311
heart rate 336
hyperemic evaluation 336–340
microvascular disease 340
myocardial perfusion imaging 316–317
normal variation 335–336
post-myocardial infarction 326–328
thermodilution technique 336
ventricularization 341–344
Corrigan’s pulse 104, 109
counter-pulsation, heterotopic transplantation 382–383
CPS see cardiopulmonary support
Cui mean mitral valve gradient calculation 131–132
C waves, core concepts 17

coronary artery, fractional flow reserve 313–314
coronary flow 311–348
correction factor (CF) 311–313
temperature 336
ECG 311
EDX 336
ephaptic coupling 336
damping, coronary blood flow measurement 342–344
data collection
aortic regurgitation 107–108
aortic stenosis 82–85, 88–89, 91–94, 251–260
artifacts 29–33
Doppler velocimetry 329
methodology 27–29
parallel ventricular pressures 49
prosthetic aortic valve assessment 94–98
transducer disequilibrium 32–33
DDD pacing see dual‐chamber pacing
decrescendo diastolic murmur, aortic insufficiency 104
degenerative aortic stenosis 81
see also calcific aortic stenosis
deMusset’s sign 104, 109
depressed cardiac output, anatomic–pathophysiological assessment 421–423
depressed carotid waveforms, dyspnea 418
diastolic dysfunction, definition 9–10
diastolic function
anatomic–pathophysiological assessment 413
“common chamber” 9
concepts 4, 5
core concepts 9–10
Frank–Starling relationship 9–10
hypertrophic obstructive cardiomyopathy 175–176
parallel ventricular interactions 14
pericardial pressure 198–199
phases 9
transaortic valve replacement 264–266, 270, 272
diastolic murmur, pulmonary stenosis 163–164, 298–299
diastolic pressure, generation 9–10
diastolic suction, left ventricle 8
differential diagnosis
anatomic–pathophysiological approach 411–426
left ventricular end-diastolic pressure 43–46
pulmonary hypertension 425–426
restrictive cardiomyopathies 219–234
right ventricular infarction 244
differentiation
preload and filling pressures 10
pressure wave artifacts 29–33
diffuse coronary disease, fractional flow reserve 323
“dip and plateau” patterns, restrictive cardiomyopathies 220–222
dipyridamole, coronary vasodialatory flow reserve 337–338
disappearing aortic stenosis, hypertrophic obstructive cardiomyopathy 166–168
disappearing gradients, aortic stenosis investigations 88–89
disequilibrium, transducers 32–33
distensibility, peripheral arterial tree 5, 7
dobutamine balloon mitral valvuloplasty 284–286
coronary vasodialatory flow reserve 338
dopamine, renal artery flow 349, 352
Doppler echocardiography aortic stenosis 82–83
heart tamponade 203–204
mitral valve area 127
prosthetic aortic valves 97
pulmonary stenosis and insufficiency 297–298
restrictive cardiomyopathy differentiation 227, 233
transaortic valve replacement 261–273
Doppler velocimetry
atrial fibrillation 331
coronary blood flow 328–334
flow reserve 335–336
principles 328–329
respiratory oscillations 330–331
signal components 329–330
ventricular tachycardia 331–334
double prosthetic valve stenosis, left ventricular puncture assessment 152–156
dual‐chamber pacing (DDD pacing), hypertrophic obstructive cardiomyopathy 177–181, 186–187
Duroziez’s sign 104, 109
dynamic left ventricular outflow tract gradients, causes of 171–175
dyspnea evaluation 416–420
dyssynchrony, pacemakers 74–76
effective arterial resistance (Ea), principles 7
effective orifice area (EOA), aortic stenosis 81
effusion
malignant tumors 213–217
pericardial disease 206–208, 213–217
see also cardiac tamponade
effusive-constrictive pericarditis 206–207
electrocardiograms (ECGs)
anatomic–pathophysiological assessment 413–414
arrhythmias 68–69
pulmonary stenosis 160–162, 295–297
Wiggers diagrams 4–5
see also A waves; P waves; QRS complexes; S waves; T waves; V waves
E max see left ventricular contractility
end-diastolic pressure (EDP)
constrictive pericarditis vs. restrictive cardiomyopathies 224
core concepts 9
end-systolic pressure–volume (ESPV) point 7
end-systolic pressure–volume relationship (ESPVR) 7
EOA see effective orifice area
epicardial coronary arteries 311
episodic aortic insufficiency 29
ESPV see end-systolic pressure–volume point
ESPVR see end-systolic pressure–volume relationship
excessive catheter fling 23
exercise
left ventricular assist devices 385–389
mitral valve stenosis 136
normal cardiac function 12
“extra” hearts 379–399
cardiopulmonary bypass 389–392
heterotopic transplantation 379–385
left ventricular assist devices 385–398
mechanical circulatory support devices 392–398

Index

f
FA see femoral arterial pressure
Fallot’s tetralogy 377
FAME study 320
FAME II study 320–321
felodipine, renal artery stenosis 349–350
femoral arterial (FA) pressure, aortic regurgitation 104–105, 108–109
fenoldopam, renal artery flow 352
“fern” patterns 37
FFR see fractional flow reserve
filling pressure, preload 10
first-degree atrioventricular block, left ventricular pressure 78
forward failure, core concepts 12–14
fractional flow reserve (FFR) 312–328
clinical applications 316–324
coronary artery 313–314
diffuse coronary disease 323
guidewire pressure measurement 312–314
intermediately severe angiographic stenosis 317–319
intracoronary pressure 312–316
intravascular imaging 317
“jailed” side branches 323–324
left main coronary artery disease 321–322
multivessel disease 319–321
myocardial perfusion imaging 316–317
ostial lesions 323–324
renal artery stenosis 350, 353, 355–356
safety 319
serial lesions 322–323
STEMI patients 324–325
Frank–Starling relationship 5, 9–10
functional preload, definition 9
general cardiovascular examination 415–416
glomerular circulation, renal artery stenosis 349–350
Gorlin equation 85–87, 124
gradient augmentation, hypertrophic obstructive cardiomyopathy 168–170
grading, aortic regurgitation 107
guidewire pressure measurement, fractional flow reserve 312–314

h
heart failure backward 14
diastolic function 10
ejection fractions and diastolic function 10
forward 12–14
heart rate
coronary vasodilatory flow reserve 336
mitral stenosis 291–292
mitral valve area determination 127
heterotopic transplantation 379–385
arterial pressure 379–382
atrial pressure 384–385
co-pulsation/counter-pulsation 382–383
Hill’s sign 104
HOCM see hypertrophic obstructive cardiomyopathy
HSPG see hyperemic systolic pressure gradients
hyperemia
coronary vasodilatory flow reserve 336–340
microvascular disease 340
renal artery stenosis 349–353
hyperemic systolic pressure gradients (HSPG), renal artery stenosis 349, 352, 354–359
hypertension, parallel ventricular pressures 49–50
hypertrophic obstructive cardiomyopathy (HOCM) 165–193
alcohol-induced septal infarction 181–191
diastolic function 175–176

i
IABP see intra-aortic balloon pumps
iFR see instantaneous wave-free pressure ratios
Impella hemodynamic support system 392–394, 396, 405–406
IMR see index of microvascular resistance
index of microvascular resistance (IMR) 340
indocyanine green dye dilution 364–367
Inoue balloon technique, mitral valvuloplasty 278–279
instantaneous wave-free pressure ratios (iFR) 314–316
intermediately severe angiographic stenosis 317–319
intra-aortic balloon pumps (IABP) 392–394, 396
intracardiac shunts 364–377
atrial septal defects 367–371
post-operative ventricular tachycardia 372–375
preductal coarctation of aorta 371–372
intracavitary pressure difference initiation 168–170
intracoronary pressure, fractional flow reserve 312–316
intramyocardial pressure, intraventricular pressure gradients 175
intrapericardial pressure (IPP)
atrial waveforms 11
respiratory oscillation 12
disappearing aortic stenosis 166–168
dual-chamber pacing 177–181, 186–187
dynamic gradients, causes of 171–175
intracavitary pressure difference initiation 168–170
Valsalva maneuver 170–171
hypertrophy, left ventricular end-diastolic pressure 43–44, 46
hypotension
anatomic–pathophysiological assessment 412, 420
bedside evaluation 420
intrapulmonary hypertension, core concepts 13
intrathoracic pressure (ITP) anatomic–pathophysiological assessment 413
constrictive pericarditis vs. restrictive cardiomyopathies 223, 225–227
respiratory oscillations 11–12
intravascular imaging fractional flow reserve 317
renal artery stenosis 352–353, 355–359
intravascular ultrasound (IVUS), renal artery stenosis 352–353, 355–359
intraventricular gradients, hypertrophic obstructive cardiomyopathy 170–171
intraventricular pressure gradients, intramyocardial pressure 175
invasive assessment aortic regurgitation 107–108
aortic stenosis 83–85
balloon mitral valvuloplasty 275–277
dyspnea 419–420
intracardiac shunts 364–367
mitral regurgitation 136–138
percutaneous balloon aortic valvuloplasty 251–260
prosthetic aortic valves 97
pulmonary stenosis 295–296
renal artery stenosis 349–359
right‐heart failure 421, 426
shock 401–407
transaortic valve replacement 261–273
IPP see intrapericardial pressure ischemia, nitroglycerin 59–60
ischemic right‐heart dysfunction 235–248
atrial compensation 238–239
ventricular 235–238
see also right ventricular infarction
isovolumetric force, principles 5
isovolumetric relaxation period, concepts 4
isovolumic relaxation, concepts 9
ITP see intrathoracic pressure
IVUS see intravascular ultrasound

j
“jailed” side branches, fractional flow reserve 323–324
jugular pulse, diagnostic features 19
jugular venous pressure (JVP) 423–426
JVP see jugular venous pressure

k
Kussmaul’s sign 22–23

l
large A waves, acute aortic insufficiency 109–112
latency, ACIST system power injection transducers 151
late‐rising central aortic pressures, differentiation 29–32
Law of Laplace 5
left anterior descending (LAD) artery, post‐operative shock 401–403
left atria 35–42
A waves, normal 35–36
dyspnea evaluation 417
mitral regurgitation 38
PCWP/LVEDP correspondence 36–37
V waves
alternans 40
mitral regurgitation 38
morphology 39–40
normal 35–36
size of 37–38
systole 38–39
left atrial pressure, mitral stenosis 130–131, 136
left bundle branch block
left ventricular end‐diastolic pressure 46
parallel ventricular pressures 50
left heart inflow obstruction 421–422
left main coronary artery disease, fractional flow reserve 321–322
left ventricle (LV), rotational mechanics 8–9
left ventricular afterload, low output 422
left ventricular assist devices (LVAD) 385–389, 392–394, 396, 405–406
left ventricular contractility (Emax) 7, 422
left ventricular diastolic dysfunction dyspnea evaluation 418
relaxation impairment 175–177
left ventricular end‐diastolic pressure (LVEDP) 43–47
acute myocardial infarction 7
aortic regurgitation 102, 105–107
in comparison to RVEDP 44–46
concepts 4
CP vs. RCM 224
differential diagnosis 43–46, 224
factors influencing 46
mean left ventricular pressure calculation 131
PCWP correspondence 36–37
pericardial pressure 198–199
transaortic valve replacement 262–263, 268
ventricular filling 10
left ventricular end‐diastolic volume (LVEDV), aortic regurgitation 102
left ventricular failure preload assessment 421–422
shock 404–405
left ventricular hypertrophy, left ventricular end‐diastolic pressure 43–44, 46
left ventricular outflow tract (LVOT) obstruction
alcohol‐induced septal infarction 181–191
augmentation 168–170
dual‐chamber pacing 177–181, 186–187
dynamic 171–175
hypertrophic obstructive cardiomyopathy 165–193
mechanical treatments 165, 186–188
prosthetic aortic valves 94–98
repaired ventricular septal defects 373–375
septal myectomy 187
left ventricular pressure
atrial systole, pacemakers 76
constrictive pericarditis vs. restrictive cardiomyopathies 224–225
first‐degree A–V block 78
pericardial pressure 198–199
right ventricular pressure interactions 49–65
see also parallel ventricular interactions
see also left ventricular end-diastolic pressure
left ventricular puncture complications of 156–157
double prosthetic stenosis assessment 152–156
left ventricular systolic dysfunction, right ventricular infarction 240–242
low-flow, low-gradient aortic stenosis 90–91
paradoxically severe 87–88
transaortic valve replacement 263–264, 269
low output anatomic–pathophysiological assessment 412, 420
bedside evaluation 420
low-pressure cardiac tamponade 206
lusitropic function see isovolumic relaxation
LV see left ventricle
LVAD see left ventricular assist devices
LVEDP see left ventricular end-diastolic pressure
LVEDV see left ventricular end-diastolic volume
LVOT see left ventricular outflow tract
m magnetic resonance imaging (MRI)
renal artery stenosis 354
restrictive cardiomyopathy differentiation 227–228
malignant tumors, cardiac tamponade 213–217
MAP see mean arterial pressure
MCS see mechanical circulatory support devices
mean arterial pressure (MAP), pulse amplification 6–7
mean mitral valve gradient (MVG) simple calculation of 131–132
see also mitral valve area
mechanical aortic valves, balloon mitral valvuloplasty 286–292
mechanical circulatory support devices (MCS) 392–398
mechanical mitral valves construction 134
dysfunctions 135–138
mechanical support, right ventricular infarction 242–244
mechanical treatments, LVOT obstruction 165, 186–188
methodologies aortic regurgitation 107–108
aortic stenosis measurement 82–85, 88–89, 91–94
Doppler velocimetry 329
intracardiac shunt diagnosis 364–367
parallel ventricular pressures 49
percutaneous balloon mitral valvuloplasty 275–279
prosthetic aortic valve assessment 97
transluminal alcohol septal ablation for HOCM 181–183
MIBI‐SPECT multivessel disease 319–321
STEMI patients 324–325
microcirculatory resistance 311, 340
mitral regurgitation with aortic regurgitation 148
balloon mitral valvuloplasty 280–281, 283
invasive assessment 136–138
left ventricular end-diastolic pressure 44–45
with mitral stenosis 124, 148
percutaneous balloon aortic valvuloplasty 259–265
repaired ventricular septal defects 372–375
tansaortic valve replacement 263, 266, 269, 273
V waves 38
mitral stenosis 119–141
2D echocardiographic planimetry 127
anatomic–pathophysiological assessment 417–418
with aortic stenosis 148–152
balloon valvuloplasty 275–294
balloon dilation 277–279
case studies 281–283
dobutamine stress testing 284–286
mechanical aortic valve patient study 286–292
pulmonary capillary wedge pressure 283–285
screening 275–277
Doppler echocardiography 127
dyspnea evaluation 417–418
heart rate 291–292
left atrial pressure vs PCWP 130–131, 136
parallel ventricular pressures 53–54
pathophysiology 124
pressure half-time methods 126–127
prostheses 132–138, 143–148
pulsus alternans 127–130
with regurgitation 124, 148
simplified gradient method 131–132
valve area calculation 123–127
V waves 119–122
mitral valve area balloon mitral valvuloplasty 275–279, 284–286, 292
calculation 123–127, 131–132
Doppler echocardiography 127
echocardiographic planimetry 127
heart rate 127
pressure half-time methods 126–127
simplified gradient method 131–132
mitral valve prostheses 132–138, 143–148, 152–156
dysfunction assessment 135–138, 145–148
failure mechanisms 135
post-operative multiple heart murmurs 143–148
stenosis, with aortic prosthetic stenosis also 152–156
types 134
mixed venous oximetry 365
moniker pulsus paradox 12
morphology, coronary stenosis 312–313
“M” patterns, restrictive cardiomyopathies 222
MRI see magnetic resonance imaging
Muller’s sign 104, 109
multivalvular regurgitant lesions 143–158
double prosthetic valve stenosis 152–156
left ventricular puncture assessment 152–156
mitral valve prostheses 143–148
native aortic and mitral stenosis 148–152
surgical outcomes 148
multivessel disease, fractional flow reserve 319–321
muscular septal defects, intracardiac shunts 365
MVG see mean mitral valve gradient
myocardial ischemia
anatomic–pathophysiological assessment 415
left ventricular assist devices 385–389
nitroglycerin 59–60
myocardial perfusion imaging, fractional flow reserve 316–317
n
nitroglycerin 56–63
aortic pressure waveforms 61–62
aortic stenosis 60–61
coronary blood flow 59–60
coronary vasodilatory flow reserve 338
effects of 56–59
hypertrophic obstructive cardiomyopathy 170–171
non-hemodynamic investigations 415–416, 420
non-invasive assessment
aortic stenosis 82–83
mitral regurgitation 136–137
prosthetic aortic valve assessment 97
renal artery stenosis 354
restrictive cardiomyopathies 227–228, 233
transaortic valve replacement 261–273
see also individual methods...
normal carotid waveforms, dyspnea 419
ostial lesions, fractional flow reserve 323–324
ostium primum/secundum 376
overdamped waveforms 26–27
oximetry, intracardiac shunt diagnosis 364–365
p
pacemakers
arrhythmias 73–78
atrial systole 76
atrial waveforms 73–74
dysynchrony 74–76
hypertrophic obstructive cardiomyopathy 177–181, 186–187
parallel ventricular pressures 52–53
ventricular compliance 76–78
papaverine
coronary vasodilatory flow reserve 340
renal artery flow 352
paradoxically severe aortic stenosis 87–88
paradoxical pulse 12
parallel ventricular pressures 49–65
bundle branch block 50–52
conduction abnormalities 50–52
hypertension 49–50
interactions 14–15
key points 63
measurement methodology 49
mitral stenosis 53–54
nitroglycerin 56–63
pacemaker pressure responses 52–53
pericardial pressure 198–199
pulsus alternans 54–56
paravalvular aortic regurgitation, transaortic valve replacement 264–265, 271
paracardial compliance 197–198
paracardium, anatomy 197–199
partial support devices 385
PASP see pulmonary artery systolic pressure
patent ductus arteriosus (PDA) 376
pathophysiology
acute aortic insufficiency 105–107
cardiac tamponade 199–200
chronic aortic insufficiency 101–104
mitral stenosis 124
restrictive cardiomyopathies 220–223
PBAV see percutaneous balloon aortic valvuloplasty
PB MV see percutaneous balloon mitral valvuloplasty
PBV see pulmonary balloon valvuloplasty
PCI see percutaneous coronary intervention
PCWP see pulmonary capillary wedge pressure
PDA see patent ductus arteriosus
percutaneous balloon aortic valvuloplasty (PBAV) 251–274
case studies 257–260
key points 273
mitral regurgitation reduction 259–265
principles 251
screening 251–257
very elderly patient case study 257–259
percutaneous balloon mitral valvuloplasty (PM BV) 275–294
balloon dilation 277–279
case studies 280–292
dobutamine stress testing 284–286
Inoue technique 278–279
key points 292
mechanical aortic valve patient study 286–292
mitral regurgitation 280–281, 283
mitral stenosis case studies 281–283
pulmonary capillary wedge pressure 283–285
screening 275–277
percutaneous coronary intervention (PCI), multivessel disease 319–321
pericardial disease 197–218
allograft rejection 209–211
anatomic–pathophysiological assessment 415
assessment of 207–208
atypical compression syndromes 206–207
case studies 209–217
Doppler echocardiography 203–204
malignant tumors 213–217
pericardiocentesis 208–209
pulsus paradoxus 202–203, 211–213
see also cardiac tamponade
pericardial pressure, ventricular
diastole 198–199
pericardiocentesis 208–209
peripheral amplification, concepts 6–7
peripheral arterial tree, distensibility 5, 7
peripheral arterial wave summation, aortic stenosis 91–94
peripheral arterial wave summation, aortic stenosis 91–94
peripheral pressure amplification, aortic regurgitation 109
peripheral pulse amplification, aortic regurgitation 104
persistent arterial ducts, coarctation of aorta 371–372
porcine mitral valves 132–134, 143–148
portable cardiopulmonary bypass 389–392
post-capillary pulmonary hypertension, core concepts 14
post-myocardial infarction, flow reserve measurements 326–328
post-operative assessment
aortic root reconstruction 112–116
aortic valve prostheses 94–98
power injection transducers, ACIST system performance 151
precapillary pulmonary hypertension 13, 311
preductal coarctation of aorta 371–372
preload
compliance properties 420–422
diastolic function 9–10
filling pressures 10
hypertrophic obstructive cardiomyopathy 170–171
nitroglycerin 58–59
premature ventricular contractions (PVCs), arrhythmias 67
pressure damping, coronary blood flow 342–344
pressure gradients, renal artery stenosis 349–352
pressure half-time methods, mitral valve area 126–127
pressure loss, coronary stenosis 311–312
pressure recovery
aortic stenosis 82
transaortic valve replacement 263, 268
pressure ventricularization, coronary blood flow 341–344
pressure–volume (PV) loops 7–8
pressure–volume (P–V) relationships, V waves 37–38
pressure wave artifacts
 calibration 23–25
core concepts 25–27
differentiation 29–33
intramyocardial pressure 175
right-heart hemodynamics 21–25
prostheses–patient mismatch, aortic valves 98
prosthetics
aortic root reconstruction 112–116
aortic valves
balloon mitral valvuloplasty 286–292
left ventricular outflow tract gradients 94–98
patient mismatches 98
stenosis, with mitral prosthesis stenosis also 152–156
double stenosis, left ventricular puncture assessment 152–156
mitral valves 132–138
dysfunction assessment 135–138, 145–148
porcine 132–134, 143–148
stenosis, with mitral prosthesis stenosis also 152–156
pulmonary artery systolic pressure (PASP), restrictive cardiomyopathies 230–231
pulmonary balloon valvuloplasty (PBV) 299–306
case studies 300–305
clinical outcomes 305
complications and outcomes of PBV 305–306
congenital 377
diastolic murmur and RVEDP 163–164, 298–299
ECG abnormalities 160–162, 296–297
key points 306
post-operative gradients 305–306
presentations of 159–160, 295–297
with pulmonary insufficiency 162–163, 297–298
pulmonary valves 159–164
see also pulmonary stenosis
pulmonary capillary wedge pressure (PCWP)
aortic regurgitation 102, 106
balloon mitral valvuloplasty 283–285
concepts 10
dyspnea evaluation 416–417, 419–420
intracardiac shunts 365
LVEDP correspondence 36–37
main utility 35
mitral stenosis 130–131, 136
post-capillary pulmonary hypertension 14
transaortic valve replacement 261, 267
pulmonary hypertension differential diagnosis 425–426
forms of 13
pulmonary insufficiency, with pulmonary stenosis 162–163, 297–298
pulmonary stenosis 159–164, 295–306
balloon valvuloplasty 299–306
case studies 300–305
complications and outcomes of PBV 305–306
congenital 377
diastolic murmur and RVEDP 163–164, 298–299
ECG abnormalities 160–162, 296–297
key points 306
post-operative gradients 305–306
presentations of 159–160, 295–297
with pulmonary insufficiency 162–163, 297–298
pulmonary valves 159–164
pulmonary valve regurgitation 102, 106
pulsus alternans mechanisms of 55–56
mitral stenosis 127–130
parallel ventricular pressures 54–56
pulsus paradoxus 202–203, 211–213
P–V see pressure–volume relationships
PVCs see premature ventricular contractions
PV loops see pressure–volume loops
P waves, concepts 4
QRS complexes
arrhythmias 68–73
concepts 4
heterotopic transplantation 382–383
wide patterns 69–73
Quincke’s sign 104, 109
RAS see renal artery stenosis
RCA see right coronary artery
regadenoson, coronary vasodilatory flow reserve 340
relaxation impairment, left ventricular diastolic waveform abnormalities 175–177
renal artery stenosis (RAS) 349–360
case studies 354–359
clinical outcomes 359
glomerular circulation 349–350
key points 359
practical tips 352–354
pressure gradients 349–352
renin 349
repaired congenital heart disease, pulmonary balloon valvuloplasty 303–305
reperfusion, right ventricular infarction 239
residual gradients, pulmonary balloon valvuloplasty 305–306
resistance
coronary blood flow 311–313
low output/hypotension 420
respiratory oscillations
anatomic–pathophysiological assessment 413–414
coronary blood flow 330–331
restrictive cardiomyopathies 223, 225–227, 230–231
venous circulations 11–12
resting systolic pressure gradients (RSPG), renal artery stenosis 353–359
restrictive cardiomyopathies (RCM)
algorithmic differentiation 232–233
amyloidosis 222–223, 232
criteria limitations 228–229
differentiation 219–234
from systemic illness 231–232
noninvasive imaging 227–228, 233
pathophysiology 220–223
respiratory oscillations 223, 225–227, 230–231
ventricular pressures 224–225
rheumatic mitral stenosis 148
RHF see right-heart failure
rhythm disorders, right ventricular infarction 239
right atria
right ventricular ischemia 238–239, 244–245
systolic regurgitation 20
right atrial–right ventricular gradients, tricuspid valve dysfunction 21
right bundle branch block
parallel ventricular pressures 51–52
pulmonary stenosis 297
right coronary artery (RCA), right ventricular ischemia 235–248
right-heart failure (RHF)
abnormal rhythms 15–18
fundamentals of 15–25
invasive assessment 421, 426
jugular venous pressure 423–426
preload assessment 421
pressure wave artifacts 21–25
shock 405–406
tricuspid regurgitation 18–21
right ventricles
acute failure, core concepts 13–14
chronic failure, core concepts 14
right ventricular end-diastolic pressure (RVEDP)
in comparison to LVEDP 44–46
constrictive pericarditis vs. restrictive cardiomyopathies 224–225
pericardial pressure 198–199
pulmonary stenosis 163–164, 298–299
right ventricular free wall (RVFW) dysfunction
acute myocardial infarction 235–238
core concepts 14–15
right ventricular hypertrophy, pulmonary stenosis 297
right ventricular infarction
core concepts 13–14
mechanical support 242–244
right ventricular infarction (RVI) 235–248
acute ventricular dysfunction 236–238
atrial compensation and ischemia 238–239, 244–245
case studies 244–245
differential diagnosis 244
hemodynamic manifestations 245–247
left ventricular systolic dysfunction 240–242
mechanical complications 239–240
mechanical support 242–244
pulmonary stenosis 297
reperfusion 239
rhythm disorders 239
shock 405–406
right ventricular pressure
constrictive pericarditis vs.
restrictive cardiomyopathies 224–225
left ventricular pressure interactions 49–65
see also parallel ventricular interactions
pericardial pressure 198–199
preload assessment 421
rigid constriction, pericardial disease 207
“ringing” artifacts 23–25
rotational mechanics, left ventricle 8–9
RSPG see resting systolic pressure gradients
RVFW see right ventricular free wall
RVI see right ventricular infarction
safety, intracoronary lesion assessment 319
screening
aortic stenosis, PBAV 251–257
mitral stenosis, PBVM 275–277
septal-mediated ventricular interactions, core concepts 14–15
septal myectomy, hypertrophic obstructive cardiomyopathy 187
serial lesions, fractional flow reserve 322–323
severe left ventricular systolic dysfunction 240–242
severe right ventricular infarction 244
Index

shock
acute left ventricular failure 404–405
acute right-heart failure 405–406
invasive assessment 401–407
shunts 364–377
atrial septal defects 367–371
post-operative ventricular tachycardia 372–375
preductal coarctation of aorta 371–372
signal components, Doppler velocimetry 329–330
simultaneous right/left data collection 28–29
single pacing modes
dyssynchrony 74–76
ventricular compliance 76–78
single-photon emission computed tomography (SPECT) multivessel disease 319–321
STEMI patients 324–325
sinus venosus 376
sodium nitroprusside 338–339
SPECT see single-photon emission computed tomography
“square root” patterns, restrictive cardiomyopathies 220–222
STEMI see ST-segment elevated myocardial infarctions
stenosis see aortic stenosis; coronary stenosis; mitral valve stenosis; renal artery stenosis; tricuspid valve stenosis
stenotic bioprosthetic mitral valves, evaluation of 132–138
stress, normal cardiac function 12
stroke volume (SV)
acute myocardial infarction 7
core concepts 4
low output/hypotension 420
ST-segment elevated myocardial infarctions (STEMI) fractional flow reserve 324–325
right ventricular 240–242
subacute pericardial compression 207
see also cardiac tamponade; pericardial disease
subaortic stenosis, repaired ventricular septal defects 372–375
subvalvular aortic stenosis 81
supravalvular aortic stenosis 81
surgical myomectomy, LVOT obstruction 165, 188
SV see stroke volume
S waves, tricuspid regurgitation 19
systemic illness, restrictive cardiomyopathies 231–232
system resonance, pressure wave artifacts 26–27
systolic function
anatomic–pathophysiological assessment 413
atrial, V waves 38–39
concepts 5
parallel ventricular interactions 14
systolic regurgitation, right atria 20
systolic twist, left ventricle 8
T
tachycardia, coronary vasodilatory flow reserve 336
Tandem Heart extracorporeal bypass system 392, 394–398
TASH see transluminal alcohol septal ablation for HOCM
TAVR see transaortic valve replacement
TEE see transesophageal echocardiography
tetralogy of Fallot 377
thermodilution technique, coronary vasodilatory flow reserve 336
Torricelli’s law 86
total blood volume, preload assessment 421
transaortic valve replacement (TAVR) 261–273
aortic regurgitation 264–266, 271–272
diastolic function 264–266, 270, 272
key points 274
low flow, low gradient aortic stenosis 263–264, 269
mitral regurgitation 263, 266, 269, 273
paravalvular aortic regurgitation 264–265, 271
pressure recovery 263, 268
transcatheter waveforms, transaortic valve replacement 261–273
transducer disequilibration 32–33
transesophageal echocardiography (TEE)
mitral valve prostheses 135
transaortic valve replacement 262, 268
transiently wide pulse pressures, differentiation 29
transluminal alcohol septal ablation for HOCM (TASH) 181–191
case study 188–191
comparative efficacy 186–188
complications 188
methodologies 181–183
Valsalva maneuver 183–186
transplantation, allograft rejection 209–211
Traube’s sign 104, 109
tricuspid regurgitation
mitral valve prostheses 144
pulsatile venous waves 21
right atrial–right ventricular gradients 21
vena caval pressure 18–19
tricuspid valves, normal function 19–20
T waves, concepts 4
two-dimensional echocardiographic planimetry, mitral valve 127
U
underdamped waveforms 26–27
V
Valsalva maneuver
hypertrophic obstructive cardiomyopathy 177–181
intracardiac shunts 367
transluminal alcohol septal ablation for HOCM 183–186
valves
anatomic–pathophysiological assessment 415
aortic
area calculation 81, 85–87
prosthesis 94–98
basic functioning 5
see also aortic... bicuspid...
multivalvular regurgitant lesions; mitral...; pulmonary...; transaortic valve replacement; tricuspid...
valvular aortic stenosis 81
vascular resistance, low output/hypotension 420
vasodilation  
nitroglycerin  56–63  
renal artery flow  349, 352  
velocimetry, Doppler, coronary blood flow  328–334  
vena caval pressure, tricuspid regurgitation  18–19  
venous circulations  
anatomic–pathophysiological assessment  413–414  
cardiac mechanical function  11–12  
pulsatile waves  21  
respiratory oscillations  11–12  
ventricles  
interactions  12–15  
pacemakers  76–78  
parallel interactions  14–15  
restrictive cardiomyopathies  220, 230–231  
see also left ventricles; right ventricles  
ventricular compliance  
hypertrophic obstructive cardiomyopathy  175–176  
pacemakers  76–78  
ventricular diastolic dysfunction, with atrial septal defect  367–371  
ventricular electrograms, atrial pressure  361–364  
ventricular ischemia  
atrial compensation and ischemia  238–239, 244–245  
reperfusion  239  
right-sided  235–248  
see also right ventricular infarction  
ventricularization, coronary blood flow measurement  341–344  
ventricular septal defects (VSD)  372–376  
ventricular tachycardia  
coronary blood flow  331–334  
repaired ventricular septal defects  372–375  
ventricular unloading, nitroglycerin  56–63  
ventricular waveforms  
anatomic–pathophysiological assessment  414  
concepts  5  
very elderly patients, percutaneous balloon aortic valvuloplasty  257–259  
VSD see ventricular septal defects  
VVI pacemakers  
dyssynchrony  74–76  
ventricular compliance  76–78  
V waves  
alternans  40  
atrial systole  38–39  
concepts  4–5  
factors influencing size  37–38  
mitral regurgitation  38  
mitral stenosis  119–122  
morphology  39–40  
normal patterns  35–36  
tricuspid regurgitation  19  
w  
water-hammer pulses  104  
waveforms, concepts  4–5  
Wiggers diagrams, core principles  4–5  

x  
X descent  9  
atrial waveforms  11  
restrictive cardiomyopathies  222  
X-rays, restrictive cardiomyopathy differentiation  227  
X troughs, atrial pressure  20  
y  
Y descent  
atrial waveforms  11  
restrictive cardiomyopathies  222  
Y troughs, atrial pressure  20  
z  
zero drift, aortic stenosis  91–94  
Z point, left ventricular end-diastolic pressure  46