

Index

Note: Page numbers of article titles are in **boldface** type.

A

Acetaminophen, lactic acidosis due to, 265

Acidosis, lactic, **255–283**. See also *Lactic acidosis*.

Acute hemodynamic instability of unknown cause, tamponade vs. sepsis in, 376

β_2 -Adrenergic agents, lactic acidosis due to, 268

Alcohol(s)

sugar, lactic acidosis due to, 270

toxic, lactic acidosis due to, 265–266

Aliphatic nitriles, lactic acidosis due to, 271

Anemia

acute

physiologic response to, 338

tolerance to, limits of, 339

cardiac effects of, 339–340

RBCs transfusion for, 329

Anesthetics, general, lactic acidosis due to, 271

Arterial lactate, venous lactate vs., 261–262

B

Biotin, lactic acidosis due to, 269–270

Bleeding, SCVO₂ monitoring as indicator of, 329

Blood, microcirculation and, 341

C

Cancer(s), transfusion-related immunomodulation and, 344

Cardiac cycle, effects of, 298

Cardiac output

estimation of, methods of, history of, 384–385

in ICU, techniques for determination of, **355–364**

electrical bioimpedance cardiography, 363

esophageal Doppler technique, 363

FloTrac Vigileo system, 359

lithium dilution, 358

measurement in, 356–360

mixed venous oxygen saturation, 359–360

noninvasive techniques, 360–362

pulmonary artery catheter, 357–358

pulse contour waveform analysis, 359

TEB, 360

Cardiac output (*continued*)

- transgastric Doppler technique, 363
- transpulmonary thermodilution, 358
- USCOM, 363
- noninvasive monitoring of, partial CO₂ rebreathing in, **383–392**. See also *Partial CO₂ rebreathing, noninvasive monitoring cardiac output using*.
- Cardiothoracic surgery patients, NICO monitor in partial CO₂ rebreathing evaluation effects on, 387–388
- Cheyne-Stokes respiration, 356
- Children, NICO monitor in, 389
- Cocaine, lactic acidosis due to, 270
- Continuous RVEDV, 301–303
- Convective transport, delivered oxygen–oxygen consumption and, relationship between, 241–242
- “Critical” DO₂, 243–245
- CVP, 296
- Cyanide, lactic acidosis due to, 271
- Cyanogenic compounds, lactic acidosis due to, 271
- Cytopathic metabolic dysfunction, in sepsis, mechanisms of, 413–414

D

- Delivered oxygen–oxygen consumption, convective transport and, relationship between, 241–242
- Diethyl ether, lactic acidosis due to, 271
- DO₂, “critical,” 243–245
- Do₂–VO₂, dobutamine and, 247–248
- Do₂–VO₂–guided therapy, trials of, 245–247
- Dobutamine, Do₂–VO₂ and, 247–248
- Dopamine, in pharmacologic support of MAP in sepsis, 292
- Drotrecogin alfa, in resuscitation of microcirculation in sepsis, 402

E

- Early goal-directed therapy (EGRT), 248–249
- Echocardiography
 - described, 365
 - in hemodynamic assessment of septic shock, **365–382**
 - acute right ventricular failure, 374–376
 - equipment for, 366
 - focused study of, 366–369
 - fundamentals of, 366
 - hand-held and compact portable devices in, reliability of, 378–379
 - left ventricular systolic function, 374
 - strengths of, 365–366
 - training related to, for intensivists, 376–378
 - volume responsiveness in, preload/prediction of, 370–372
 - in sepsis-induced myocardial dysfunction diagnosis, 372–374
- EEO pressure. See *End-expiratory occlusion (EEO) pressure*.
- EGRT. See *Early goal-directed therapy (EGRT)*.
- Elderly, NICO monitor in, 389

Electrical bioimpedance cardiography, in determination of cardiac output in ICU, 361–362
End-expiratory occlusion (EEO) pressure, 316–317
Epinephrine, in pharmacologic support of MAP in sepsis, 291
Esophageal Doppler technique, in cardiac output determination in ICU, 363
External reference landmark, 296–297

F

Fick, Adolph, in cardiac output estimation, 384–385
FloTrac Vigileo system, in determination of cardiac output in ICU, 359
Flowmetry, in microcirculatory dysfunction measurement, 397
Fluorescence videomicroscopy, in microcirculatory dysfunction measurement, 396
5-Fluorouracil (5-FU), lactic acidosis due to, 271
Fructose, lactic acidosis due to, 270
5-FU. See *5-Fluorouracil (5-FU)*.

G

GEDV, 301–303
General anesthetics, lactic acidosis due to, 271

H

Halothane, lactic acidosis due to, 271
Heart
 anemia effects on, 339–340
 physiologic and anatomic properties of, 298–301
Hematocrit, optimal, **335–354**
 clinical trials related to, 346–347
Hemodynamic support, optimization of, in septic shock, central and mixed venous oxygen saturation in, **323–333**. See also *Septic shock, hemodynamic support in, optimization of, central and mixed venous oxygen saturation in*.
Hepatic failure, lactic acidosis and, 265
Hip surgery patients, NICO monitor in, 389
Hyperlactatemia
 aerobic, metabolic value of, 415
 drugs causing, 265–269
Hypoxia
 at cellular level, detection of, **409–421**
 described, 409–410
 tissue-specific considerations in, 415–418
 cytodynamic, hyperdynamic sepsis and, 412–413
 defined, 409
 tissue, causes of, 337

I

Immunomodulation, transfusion-related, 343–346
 cancer and, 344
 infection and, 344
 leukocytes, 344–346

Inborn errors of metabolism, lactic acidosis and, 271–272
 Infection(s), transfusion-related immunomodulation and, 344
 Inferior vena cava, respiratory variability of, 312–313
 Inotropes, in resuscitation of microcirculation in sepsis, 400–401
 Intensive care unit (ICU), cardiac output determination in, techniques for, **355–364**.
 See also *Cardiac output, in ICU, techniques for determination of*.
 Intensivists, echocardiography training for, 376–378
 Iron, lactic acidosis due to, 269–270

K

Kidney(ies), in detection of hypoxia at cellular level, 417

L

Lactate

- arterial, vs. venous lactate, 261–262
- as prognostic marker in critically ill patients, 258–259
- clearance of, 260–261
- formation of, 256
- history of, 255–256
- in sepsis, 414–415
- metabolism of, 256–258
- venous, vs. arterial lactate, 261–262

Lactated Ringer solution, 262

Lactate:pyruvate ratios, 259–260

Lactic acidosis, **255–283**

- D-, 272
- described, 255–256
- diseases underlying, 262–265
- hepatic failure and, 265
- malignancy-associated, 262–265
- SIRS and, 265
- thiamine deficiency and, 269–270
- type B, 262, 414–415
 - causes of, 264
- type B2
 - aliphatic nitriles and, 271
 - biotin and, 269–270
 - cocaine and, 270
 - cyanide and, 271
 - cyanogenic compounds and, 271
 - diethyl ether and, 271
 - drugs causing, 265–271
 - acetaminophen, 265
 - β_2 -adrenergic agents, 268
 - general anesthetics, 271
 - halothane, 271
 - linezolid, 268
 - metformin, 267
 - methamphetamine, 270–271
 - nitroprusside, 271

- NRTIs, 266–267
 - propofol, 267–268
 - salicylates, 268
 - sulfasalazine, 269
 - toxic alcohols, 265–266
 - fructose and, 270
 - 5-FU and, 271
 - iron and, 269–270
 - malaria and, 270
 - sorbitol and, 270
 - strychnine and, 270
 - sugar alcohols and, 270
 - valproic acid and, 270
 - xylitol and, 270
 - type B3, 271–272
 - types A and B, 414–415
- D-Lactic acidosis, 272
- Left ventricular systolic function, evaluation of, echocardiography in, 374
- Lesion(s), storage, 342–343
- Leukocyte(s), transfusion-related immunomodulation and, 344–346
- Linezolid, lactic acidosis due to, 268
- Lithium dilution, in cardiac output determination in ICU, 358
- Liver, in detection of hypoxia at cellular level, 416–417
- Liver failure, lactic acidosis and, 265
- Lung(s), in detection of hypoxia at cellular level, 415–416
- Lung injury(ies)
 - severe, partial CO₂ rebreathing measurements in, 388–389
 - transfusion-related, 346

M

- Malaria, lactic acidosis due to, 270
- Malignancy, lactic acidosis and, 262–265
- MAP. See *Mean arterial pressure (MAP)*.
- Mathematical coupling, 242–243
- Mean arterial pressure (MAP), **285–293**
 - defined, 286–287
 - monitoring of, 287–289
 - invasive, 288–289
 - noninvasive, 287–288
 - pharmacologic support of, in sepsis, 289–292
 - physiology of sepsis and, 289
- Metabolism, inborn errors of, lactic acidosis and, 271–272
- Metformin, lactic acidosis due to, 267
- Methamphetamine, lactic acidosis due to, 270–271
- Microcirculation
 - blood and, 341
 - in sepsis
 - disturbances in, **393–408**. See also *Sepsis, microcirculatory disturbances in*.
 - resuscitation of, 400–403
 - overview of, 394

Microscopy, in microcirculatory dysfunction measurement, 396
 Microvascular flow, measuring of, prognostic value of, 398–400
 Mixed venous oxygen saturation, in cardiac output determination in ICU, 359–360
 Myocardial dysfunction, sepsis-induced, diagnosis of, echocardiography in, 372–374

N

NICO (Noninvasive Cardiac Output) monitor, in partial CO₂ rebreathing evaluation, 385–388
 described, 385–386
 in cardiothoracic surgery patients, 387–388
 in children, 389
 in hip surgery patients, 389
 in the elderly, 389
 limitations of, 386–387
 pulmonary disease effects on, 387
 validation of, 386–387
 Nitric oxide, inhibition of mitochondrial respiration by, cytopathic metabolic dysfunction in sepsis related to, 413
 Nitriles, aliphatic, lactic acidosis due to, 271
 Nitroprusside, lactic acidosis due to, 271
 Noninvasive Cardiac Output (NICO) monitor, 385–388. See also *NICO (Noninvasive Cardiac Output) monitor*.
 Norepinephrine, in pharmacologic support of MAP in sepsis, 290–291
 NRTIs. See *Nucleoside/tide reverse transcriptase inhibitors (NRTIs)*.
 Nucleoside/tide reverse transcriptase inhibitors (NRTIs), lactic acidosis due to, 266–267

O

OPS imaging. See *Orthogonal polarization spectral (OPS) imaging*.
 Orthogonal polarization spectral (OPS) imaging, in microcirculatory dysfunction measurement, 396–397
 Oxidative phosphorylation, uncoupling of, cytopathic metabolic dysfunction in sepsis related to, 413
 Oxygen consumption, macrocirculatory perspective of, **237–253**
 Oxygen delivery, macrocirculatory perspective of, **237–253**
 Oxygen transport, principles of, 336–337
 Oxygenation, tissue
 effective, 410–411
 ineffective, 411
 measurement of, 337–338
 Oxyge–oxygen consumption, delivered, convective transport and, relationship between, 241–242

P

Partial CO₂ rebreathing, noninvasive monitoring cardiac output using, **383–392**
 in severe lung injury, 388–389
 NICO monitor in, 385–388. See also *NICO (Noninvasive Cardiac Output) monitor, in partial CO₂ rebreathing evaluation*.
 Passive leg raising (PLR), 314–315
 Peroxynitrite, inhibition of mitochondrial respiration by, cytopathic metabolic dysfunction in sepsis related to, 413

- Phenylephrine, in pharmacologic support of MAP in sepsis, 291–292
- Plethmysography, 311–312
- PLR. See *Passive leg raising (PLR)*.
- Poly-(ADP-ribose) polymerase, activation of, cytopathic metabolic dysfunction in sepsis related to, 414
- P_{pao} , 296
- PPV. See *Pulse pressure variation (PPV)*.
- Preload
- assessment of, static measures of, **295–305**
 - pressure measurements, 296–301
 - volumetric measurements, 301–303
 - dynamic indices of, **307–321**
 - Cavallaro group A and B indices, cautions regarding, 313–314
 - EEO pressure, 316–317
 - physiologic rationale of, 308–309
 - plethmysography, 311–312
 - PLR, 314–315
 - PPV, 310–313
 - RSVT, 315–316
 - SPV, 310
 - SVV, 309–310
 - Valsalva maneuver, 317–318
- Pressure, EEO, 316–317
- Pressure measurements, 296–301
- CVP, 296
 - effects of cardiac cycle, 298
 - effects of respiratory cycle, 297–298
 - external reference landmark, 296–297
 - physiologic and anatomic properties of heart, 298–301
 - P_{pao} , 296
- Propofol, lactic acidosis due to, 267–268
- Pulmonary artery catheter, in cardiac output determination in ICU, 357–358
- Pulmonary disease, NICO monitor in partial CO_2 rebreathing evaluation affected by, 387
- Pulse contour waveform analysis, in cardiac output determination in ICU, 359
- Pulse pressure variation (PPV), 310–313
- Pyruvate dehydrogenase, inactivation of, cytopathic metabolic dysfunction in sepsis related to, 413

R

- RBCs. See *Red blood cells (RBCs)*.
- Rebreathing, partial CO_2 , noninvasive monitoring cardiac output using, **383–392**. See also *Partial CO_2 rebreathing, noninvasive monitoring cardiac output using*.
- Red blood cells (RBCs)
- physiology of, 340–341
 - transfusion of, 329
- Respiration, Cheyne-Stokes, 356
- Respiratory cycle, effects of, 297–298
- Respiratory systolic variation test (RSVT), 315–316
- Right ventricular failure, acute, echocardiographic identification of, 374–376
- RSVT. See *Respiratory systolic variation test (RSVT)*.
- RVEDV, continuous, 301–303

S

Salicylates, lactic acidosis due to, 268

SCVO₂

measurement of, 325–326

SVO₂ measurement and, relationship between, 326–327

monitoring of, bleeding indicated by, 329

SDF imaging. See *Sidestream dark-field (SDF) imaging*.

Sepsis

cytopathic metabolic dysfunction in, mechanisms of, 413–414

defined, 393

hyperdynamic, cytopathic hypoxia and, 412–413

hypodynamic, management of, 411–412

incidence of, 393–394

lactate in, 414–415

microcirculation in, resuscitation of, 400–403

drotrecogin alfa in, 402

inotropes in, 400–401

vasodilators in, 401–402

vasopressors in, 400–401

microcirculatory disturbances in, **393–408**

correction of, 400–403

measurement of, 395–398

flowmetry in, 397

fluorescence videomicroscopy in, 396

indirect techniques in, 397–398

microscopy/videomicroscopy in, 396

OPS imaging in, 396–397

prognostic value of, 398–400

SDF imaging in, 397

technical limitations in, 398

mechanisms of, 394–395

myocardial dysfunction related to, diagnosis of, echocardiography in, 372–374

pharmacologic support of MAP in, 289–292

physiology of, MAP and, 289

tamponade vs., in acute hemodynamic instability of unknown cause, 376

Septic shock

hemodynamic assessment of, echocardiography in, **365–382**. See also

Echocardiography, in hemodynamic assessment of septic shock.

hemodynamic support in, optimization of, central and mixed venous oxygen

saturation in, **323–333**

bleeding, 329

clinical uses of, 327

monitoring of, 327–329

SVO₂ and SCVO₂ measurements, 325–327

venous-to-arterial CO₂ difference, 329–330

Shock, septic. See *Septic shock*.

Sidestream dark-field (SDF) imaging, in microcirculatory dysfunction measurement, 397

SIRS. See *Systemic inflammatory response syndrome (SIRS)*.

Sorbitol, lactic acidosis due to, 270

SPV. See *Systolic pressure variation (SPV)*.

Storage lesion, 342–343
Storage medium, 343
Stroke volume variation (SVV), 309–310
Strychnine, lactic acidosis due to, 270
Sulfasalazine, lactic acidosis due to, 269
Superior vena cava, respiratory variability of, 312–313
Surviving Sepsis Campaign guidelines, 249–250
SVO₂ measurement, 325–326
 SCVO₂ measurement and, relationship between, 326–327
SVV. See *Stroke volume variation (SVV)*.
Systemic inflammatory response syndrome (SIRS), lactic acidosis and, 265
Systolic pressure variation (SPV), 310

T

Tamponade, sepsis vs., in acute hemodynamic instability of unknown cause, 376
TEB. See *Thoracic bioimpedance (TEB)*.
Thiamine deficiency, lactic acidosis due to, 269–270
Thoracic bioimpedance (TEB), in cardiac output determination in ICU, 360
Tissue hypoxia, causes of, 337
Tissue oxygenation
 effective, 410–411
 ineffective, 411
 measurement of, 337–338
Transfusion(s), immunomodulation related to, 343–346. See also
 Immunomodulation, transfusion-related.
Transgastric Doppler technique, in cardiac output determination in ICU, 363
Transpulmonary thermodilution, in cardiac output determination in ICU, 358

U

USCOM, in cardiac output determination in ICU, 363

V

Valproic acid, lactic acidosis due to, 270
Valsalva maneuver, 317–318
Vasodilators, in resuscitation of microcirculation in sepsis, 401–402
Vasopressin, in pharmacologic support of MAP in sepsis, 291
Vasopressors, in resuscitation of microcirculation in sepsis, 400–401
Vena cava
 inferior, respiratory variability of, 312–313
 superior, respiratory variability of, 312–313
Venous lactate, arterial lactate vs., 261–262
Venous oxygen saturation
 central, in optimizing hemodynamic support in septic shock, **323–333**. See also *Septic shock, hemodynamic support in*.
 mixed
 determinants of, 325

Venous oxygen (*continued*)

in optimizing hemodynamic support in septic shock, **323–333**. See also *Septic shock, hemodynamic support in*.
physiology of, 324–326

Venous-to-arterial CO₂ difference, 329–330

Videomicroscopy

fluorescence, in microcirculatory dysfunction measurement, 396

in microcirculatory dysfunction measurement, 396

Volume responsiveness, in hemodynamic assessment of septic shock, preload/prediction of, 370–372

Volumetric measurements, 301–303

X

Xylitol, lactic acidosis due to, 270