Appendix A

ASA Difficult Airway Algorithm

Excerpted from “Standards for Basic Anesthetic Monitoring” (Approved by House of Delegates on October 21, 1986, and last amended on October 25, 2005), of the American Society of Anesthesiologists. A copy of the full text can be obtained from ASA, 520 N. Northwest Highway, Park Ridge, IL 60068-2573, USA.
Malignant Hyperthermia

Richard D. Urman

Definition
Malignant Hyperthermia (MH) is an inherited disorder of skeletal muscle, which is characterized by a hypermetabolic state and can be triggered by potent volatile anesthetics (but not nitrous oxide) and depolarizing muscle relaxants such as succinylcholine. Patients with some congenital myopathies may also be at increased risk when exposed to triggering anesthetic agents. However, all intravenous hypnotic agents are considered safe. MH is a potentially fatal disorder if it is not promptly recognized and treated, and the overall incidence during general anesthesia is about 1:50,000–1:100,000. For any patient presenting for anesthesia, a preoperative history should include questions about prior MH episodes or family history suggestive of MH.

Mechanism
In a vast majority of cases, MH-susceptible patients have a defective calcium channel (known as ryanodine receptor) that is located on the sarcoplasmic reticulum membrane. In normal cells, calcium is released into the cell during muscle contraction. In MH, there is a problem with calcium reuptake, and therefore there is a massive increase in intracellular calcium leading to sustained muscle contractions. Consequently, there is an increased demand for oxygen and ATP in the muscle cells, leading to glycolysis and lactic acidosis. If left untreated, this uncontrolled hypermetabolism results in cell hypoxia, rhabdomyolysis, organ failure, and death.
Presenting Signs and Diagnosis
The most common presenting features of MH include significant, unexplained elevation in expired CO₂, tachycardia, steady temperature rise, muscle rigidity, rhabdomyolysis, acidosis, and hyperkalemia. MH may occur at any time during anesthesia and in the postoperative period. The earliest signs are usually tachycardia and an increase in expired CO₂; a rise in temperature may follow. Diagnosis of MH can be made on the basis of these signs, although the variability in the order and time of the onset of signs often makes clinical diagnosis difficult. These signs may present during or after the administration of the anesthetic. Table B.1 outlines possible presenting signs of MH.

Diagnosis is made based on the presenting signs, and other potential conditions that might cause the same symptoms should be ruled out. Genetic testing is also available, which can be done on an outpatient basis at an MH Testing Center. If MH is suspected, treatment should be initiated as soon as possible.

Treatment
All triggering agents should be discontinued immediately, the surgical procedure should either be aborted or finished quickly, and patient cooling begun. Dantrolene, a muscle relaxant which abolishes excitation–contraction coupling in muscle cells, is the main drug of choice. Important treatment modalities for MH are outlined in Table B.2.

Over the last several decades, thanks to provider education and increased knowledge about MH, perioperative patient mortality from MH has dropped from 80% to less than 5%. An MH-susceptible patient is still a candidate for any type of anesthetic, including general, regional, or local. If general anesthetic is
required, a total intravenous anesthetic (TIVA), with or without nitrous oxide would be a safe option.

**Suggested Further Reading**
Malignant Hyperthermia Association of the United States: www.mhaus.org
Abdominal compartment syndrome, 335
Abdominal hernia, 116–118
Abdominal hysterectomy, 10–14
Abdominal surgeries
anesthesia considerations
intraoperative, 332–333
postoperative, 333–334
preoperative evaluation, 331–332
bowel surgery, 335
esophageal surgery, 335
hemorrhoid surgery, 335–336
hernia surgery, 337
liver and biliary tract surgery, 336
pancreatic surgery, 337
spleen surgery, 336
stomach surgery, 335
Acetylcholinesterase inhibitors, 50
Acid base analysis
anion gap (AG), 210
arterial blood gas panel, 210
blood gas analysis, 210–212
disorders, 212
primary acid–base disorders, 212
Activated factor VII (FVIIa), 215
Acute lung injury (ALI), 457
Acute respiratory distress syndrome (ARDS), 457
Acute respiratory failure (ARF)
ALI and ARDS, 457
hypercapnic respiratory failure, 455–456
hypoxemic respiratory failure, 455
management, 457
Adjunct agents
antiemetics, 76–78
antihypertensives, 78–79
case study, 80–82
dexmedetomidine, 79
NSAIDS, 79
sympathomimetics, 75–76
Adjunctive drugs, 13
AICDs. See Automatic implantable cardioverter-defibrillators
Airway evaluation and management
anatomy
glottis and epiglottis, 108
upper airway anatomy, 107
case study, 116–118
difficult airway algorithm, 115
direct laryngoscopy and tracheal intubation
Macintosh and Miller blades, 114
oral, pharyngeal, and laryngeal axes relationship, 113
fiber-optic intubation, 115
laryngeal mask airway (LMA), 111–112
Mallampati classification system, 109
optimal face mask ventilation, 109–110
physical examination features, 107–110
pulmonary aspiration, risk factors, 113–114
vs. standard induction, 114–115
video assisted endotracheal intubation, 115
Alfentanil, 42
Allowable blood loss (ABL) formula, 213
Alpha-2-agonist/tizanidine, 421
Ambulatory surgery
case study, 392–394
intraoperative management
midazolam, 385
multimodal analgesia, 385
PONV, 386
S.A.F.E. principles, 385
postoperative management, 386–387
preoperative considerations
common procedure, 383
outpatient management, 384
patient selection factors, 382
procedure-related considerations, 383
testing, 384
American Society of Anesthesiologists (ASA), 165, 473, 483–485
airway algorithm, 515
closed claims study, 484–485
monitoring standards, 134
physical status and classifications, 96, 99–100
Amides, 69
Anesthesia
consent form, 96, 99
equipment and monitors (see Equipment and monitors)
history
airway management, 21–22
autonomy, 22–23
case study, 24–26
chloroform, 18–20
CPR, 22
ether, 16–18
life outside anesthesia, 24
monitors, 20–21
prestige, 23–24
slumber of anesthesiologists, 23
induction, 11–12
machine
alarms, 126
breathing systems, 127–129
case study, 129–131
checkout, 127
cylinders, 121, 123
fail-safe system, 123
flowmeters, 124, 125
gas outlet, 125–126
high and low pressure systems, 120
humidifiers, 129
modern day, 121
oxygen flush valve, 127
pipeline inlets, 120, 122
pressure regulation, 123
two-gas machine, flow arrangement, 122
vaporizers, 124–126
waste-gas scavengers, 127
maintenance, 12–13
Anesthesiology
case study, 478–481
match, 5–6
professionalism
definition, 472
etiquette based medicine, 474–475
key elements, 474
responsibility, 473
safety and teamwork
closed loop communication, 475
communication failure, 476
team training
advantages, 477
CRM-based teamwork, 476–477
Anesthetic management
cardiopulmonary bypass (CPB)
circuit, 274–275
considerations, 273–274
induction and maintenance, 273
intraoperative myocardial ischemia management, 274
minimally invasive cardiac procedures, 276
monitoring, 273
post operative care, 276
preoperative evaluation, 272–273
wean, 275–276
elderly patients, 374–375
neurosurgical procedures, 289
preoperative examination, 374–375
urological surgery
cystoscopy/ureteroscopy/TURBT, 344
ESWL, 348
laser surgery, urology, 345
nephrectomy, 346–347
orchiectomy, 347–348
radical cystectomy, 346
renal transplantation, 347
TURP, 344–345
Anesthetic techniques
action sequence of, 164
case study, 170–172
components of, 167
drugs, 161
induction and emergence, 161–162
IV portion of, 161
machine check, 160
maintenance phase of, 162
monitored anesthesia care (MAC)/conscious sedation, 164–166
M.S.M.A.I.D.S. mnemonic, 159–160
operating room to PACU, 163
physiology of sedative-hypnotic medications, 167
total intravenous anesthesia (TIVA), 169
volatile anesthetics, 167–169
selection of, 166
special equipment, 161
stages of, 163
suction, 160
wake up and extubation, 162–163
Anion gap-acidosis, 211
Anticholinergics, 36, 51
Anticholinesterase, 36
Anticonvulsants, 421
Antiemetics, 36, 76–78
Antihypertensives, 78–79
Aortic regurgitation (AR), 271
Aortic stenosis (AS), 271
Aortic valve replacement, 271
Aorto caval compression, 304
Apgar score, 310–311
Arrhythmia management, 271–272
Arterial line placement
anatomy, 232
physiology, 233
radial artery cannulation, 232
technique, 233
Arterial puncture potential complications, 230
ASA. See American Society of Anesthesiologists
Assist-control ventilation, 458
Atroventricular (AV) node, 266
Atropine, 51
Automatic implantable cardioverter-defibrillators (AICDs), 272

Barbiturate, 36
Bariatric surgery. See also Abdominal surgeries
Abdominal surgeries
bowel surgery, 335
esophageal surgery, 335
hemorrhoid surgery, 335–336
hernia surgery, 337
intraoperative considerations, 332–333
liver and biliary tract surgery, 336
pancreatic surgery, 337
postoperative considerations, 333–334
preoperative evaluation, 331–332
spleen surgery, 336
stomach surgery, 335
case study, 337–339
obesity
airway challenges, 329
anesthetic considerations, 330–331
BMI, 325–326
cardiovascular system, 326–327
diabetes mellitus, 328–329
gastrointestinal system, 327–328
neurological and psychological problems, 328–329
respiratory system, 327
surgery for, 329
types of, 325
Baseline vital signs, physical exam, 92
BBB. See Blood brain barrier
Benzodiazepines, 36, 40–41
Bier block. See Intravenous regional anesthesia
Bispectral Index (BIS) monitoring system, 143
Bleeding disorders, 91
Blood brain barrier (BBB), 286
Blood pressure monitoring
arterial line waveform, cardiac cycle, 137
equipment, 136
oscillometry, 135
Blood products transfusion
ABL formula, 213
coagulation panels, 214
EBV formula, 213–214
HCT, 213–214
practical aspects, 215
Blood volume and fluid compartments, 201–202
Body mass index (BMI), 325–326
Body temperature, 151
Bowel surgery, 335
Breathing systems, 127–129
Cancer pain, 422
Capnography and ventilation monitoring, 139–141
Cardiac anesthesia
β-adrenergic stimulation, 268
cardiac cycle
definitions and equations, 269
systole and diastole, 268
ventricular isovolumetric relaxation, 269
case study, 281–283
coronary arteries, 265–266
disease states affecting heart
arythmia management, 271–272
heart failure, 272
ischemic heart disease, 269–270
valvular disease, 270–271
heart anatomy, 266–267
Cardioplegia solution, 274
Cardiopulmonary bypass (CPB). See Anesthetic management
Cardiopulmonary exam, 92
Cardiopulmonary resuscitation (CPR), 22
Cardiovascular system
elderly patients, 370–371
local anesthetics, 71
obesity, 326–327
preoperative patient evaluation, 87–89, 100
Career options, 4–5
Cauda equina syndrome (CES), 183
Celebrex. See Celecoxib
Celecoxib, 79
Central anticholinergic syndrome, 51
Central nervous system, local anesthetics, 71
Central venous catheters, 145
Central venous line (CVL)
anatomy, 233
cannulation via anterior approach, 234–236
femoral vein, anatomy, 236
insertion site, 237
internal jugular vein, 233–234
subclavian vein, 234
Central venous pressure (CVP), 214–215, 449–451
Cerebral blood flow, 286, 287
Cerebral physiology, anesthetic agents, 287–288
Cesarean section anesthesia
epidural anesthesia, 316–317
general anesthesia, 317–318
qualities of, 315
spinal anesthesia, 316
Chloroform, 18–20
Cholinergic crisis, 50
Chronic pain management. See Perioperative acute and chronic pain management
Clinical simulation. See Simulation
Complex regional pain syndrome, 423–424
Continuous lumbar epidural analgesia, 312–313
Continuous spinal analgesia, 313
Corneal abrasions, 259
Coronary artery supply, 265–266
Coronary perfusion maintain, 252
CPR. See Cardiopulmonary resuscitation
Craniotomy
intraoperative considerations, 290
neurovascular surgery, 290–291
preoperative considerations, 289–290
Crew resource management (CRM), 476–477
Crisis resource management, 506
Critical care
acute respiratory failure (ARF)
ALI and ARDS, 457
hypercapnic respiratory failure, 455–456
hypoxemic respiratory failure, 455
management, 457
case study, 465–467
hemodynamic monitoring
cardiac output, 447–449
central venous pressure, 449–451
goals, 446
invasive arterial blood pressure, 446–447
pulmonary artery catheter, 451
initial assessment, 443
mechanical ventilation
assist-control ventilation, 458
autoPEEP, 460
inspiratory pressures, 459–460
intermittent mandatory ventilation, 458
NIPPV, 460–461
PEEP, 459
pressure support ventilation, 458–459
VAP, 461
oxygen balance and tissue perfusion, 445–446
oxygen transport, 444–445
shock
classification, 451–452
hemodynamic disturbances, 452
management, 452–453
septic shock, 453–454
vasoactive agents, 453
supportive care, ICU
ethical decisions and end-of-life, 464
glucose management, 462
nosocomial infections, preventive measures, 462
nutrition, 464
sedation management, 462
stress ulcer prophylaxis, 463
thromboprophylaxis, 462–463
Cryoprecipitate, 215
C-Trach, 115
Cushing’s response, 286
CVL. See Central venous line
CVP and PA catheters, volume assessment, 214–215
Deceleration patterns principal, 308–310
Delirium, 373
Depolarizing neuromuscular blocking agent, 36
Desflurane, 63
Dexamethasone, 77
Dexmedetomidine, 79
Diabetes mellitus, 91, 101–102
Diameter-index safety system (DISS), 120, 122
Dilutional anemia, 305
Discogenic pain, 423
Dopamine, 76
Double lumen tubes (DLT), 279–281
Droperidol, 78
Dysfunctional pain, 417
Dysrhythmias, 255–257
nonhemolytic febrile transfusion reactions, 254
severe transfusion reaction management, 258
E-cylinders, 123
Edrophonium, 50
Elderly patients
age and organ function relationship, 370
anesthetic management, 374–375
care of, 369
case study, 377–379
intraoperative management
general vs. regional anesthesia, 376
induction agents, 376
monitoring, 375
premedications, 375
thermoregulation, 376
physiological changes
cardiovascular system, 370–371
nervous system, 373
pharmacokinetic and pharmacodynamic changes, 374
postoperative cognitive dysfunction and delirium, 373–374
pulmonary changes, 371–372
renal changes, 372
postoperative period, 376–377
Electrocardiographic monitoring, 136–137
Electrolyte and non-electrolyte solute composition, 201
Electrolytes and fluid compartments
abnormal fluid shifts, intracellular to extracellular, 199
of body and composition, 199–200
Endocardium, 265
Endocrine, preoperative patient evaluation, 91
Endoscopic sinus surgery, 296
Ephedrine, 75
Epidural catheter placement level, 334
Epiglottis, 108
Epinephrine, 69
Equipment and monitors
ASA monitoring standards, 134
blood pressure monitoring, 134–137
capnography and ventilation monitoring, 139–141
case study, 151–154
central venous pressure, 145
depth of anesthesia, 143–144
electrocardiographic monitoring, 136–138
muscle relaxation, 141–143
pulmonary artery pressure, 146–147, 150
pulse oximetry, 137–139
standards for
body temperature, 151
circulation, 150–151
oxygenation, 149
ventilation, 149–150
temperature, 144
visual and auditory surveillance, 133–134
Esophageal surgery, 335
Esters, 69
Estimated blood volume (EBV) formula, 213–214
Ether, 16–18
Ethical and legal issues
advanced directives, 498–499
case study, 499–501
do not resuscitate (DNR)/do not intubate (DNI), 499
informed consent, 497–498
malpractice, 498
Etiquette based medicine, 474–475
Etomidate, 46
Extensive rectal hemorrhoids, 281–283
Extracellular–intravascular space, 201–202
Extracorporeal shock wave lithotripsy (ESWL), 348
Face mask ventilation, airway evaluation, 109–110
Facet arthropathy, 423
Factor IX concentrate, 215
Fentanyl, 42
FFP. See Fresh-frozen plasma
Fiber size and type, local anesthetics, 68
Fibreoptic intubation (FOI), 330
Fluid management, patient evaluation
euvoletic, 204
hypervolemic and hypovolemic, 204
intravascular, clinical indicators of, 202–203
Fluid replacement options
advantages, disadvantages, 208–209
case study, 224–226
colloids, 204, 206–207
crystalloids, 204, 207
Fluid requirements calculation, 204–206
Flumazenil, 41
Frank–Starling curve, 446, 448
Fresh-frozen plasma (FFP), 215
Gamma-aminobutyric acid (GABA) enhancement, 58
Gastric tube placement techniques. See also
Arterial line placement; Central venous line (CVL)
nasogastric tube technique, 238–239
orogastric tube technique, 238
Gastrointestinal exam, 92
Glidescope, 115
Glottis and epiglottis, 108
Glycopyrrolate, 36, 51
Heart anatomy, 266–267
HELLP syndrome, 306
Hematocrit (HCT), 213–214
Hemodynamic monitoring, critical care
 myocardial output, 447–449
 central venous pressure monitoring, 449–451
goals, 446
 invasive arterial blood pressure monitoring, 446–447
 pulmonary artery catheter, 451
Hemoglobin–oxygen dissociation curve, 247
Hemorrhoid surgery, 335–336
Hepatic and gastrointestinal disease, 90–91
Hernia surgery, 337
High-fidelity simulation, 505–506
Humidifiers, 129
Hydromorphone, 42
Hypercarbia, 251
Hyperchloremic acidosis, 211
Hypersensitivity/allergy, local anesthetics, 72
Hypocarbia, 251
Hypoventilation, 431
ICP. See Intracranial pressure
Induction agents, 44–47
Inflammatory pain, 417
Inhalational anesthetics, 36
case study, 63–66
concentration effect, 61
minimum alveolar concentration (MAC), 58–59
nitrous oxide, 59–61
second gas effect, 61–62
theories of, 58
uptake, distribution and elimination pharmacokinetics
emergence, 55–56
fresh gas flow rate, 57
induction, 55
INDEX • 527

inspired concentration, 56–57
minute ventilation, 57–58
tissue and blood solubility, 56
volatile anesthetics, 62–63
Inner ear surgery, 296
Internal jugular (IJ) vein, 233–234
Interventional pain procedures, 419
Intracranial pressure (ICP), 299–301
Intraoperative management. See also Elderly patients
general vs. regional anesthesia, 376
induction agents, 376
monitoring, 375
premedications, 375
thermoregulation, 376
Intraoperative problems
anaphylactic/anaphylactoid reactions, 252
awareness, 252–253
case study, 260–262
delayed emergence, 252
and differential diagnoses, 244–246
dysrhythmias, 255–257
nonhemolytic febrile transfusion reactions, 254
severe transfusion reaction management, 258
foley (bladder) catheters, 257
gastric acid aspiration, 254
general concepts, 243–247
hypercarbia, 251
hypocarbia, 251
hypotension, 248–249
hypoxemia corrective actions, 248
hemoglobin-oxygen dissociation curve, 247
myocardial ischemia, 251–252
nasogastric (NG)/orogastric (OG) tube related problems, 257, 259
patient movement/waking up during surgery, 253
postoperative complications, 259
regional anesthesia failed, 253
venous air embolism, 253–254
ventilation failure, 250
Intrapartum fetal evaluation, 308–310
Intravenous anesthetic agents
acetylcholinesterase inhibitors, 50
anticholinergics, 51
balanced anesthesia, 39–40
benzodiazepines, 40–41
induction agents cardiovascular effects of, 47
etomidate, 46–47
ketamine, 47
propofol, 45–46
recommended dosages for, 45
thiopental, 46
neuromuscular blockers (NMBs)
depolarizing NMBs, 48–49
nondepolarizing NMBs, 49–50
opioids adverse side effects, 44
context-sensitive half time, 43
dose, peak effect and duration for, 42
fentanyl, 42
meperidine, 43
morphine, 42
receptor subtypes and effects, 41
remifentanil, 43
sufentanil and alfentanil, 42
Intravenous (IV) lines
anatomy, 229–230
case study, 239–241
complications, 231
infiltration, 259
peripheral cannulation technique, 230–231
veins physiology, 230
Intravenous regional anesthesia, 193
Invasive arterial blood pressure, 446–447
Ischemic cardiac disease, 269–270
Isoflurane, 37–38, 63
Ketamine, 47
Ketorolac, 79
Labor analgesia, 320–322
Laparoscopic surgery, 332–333
Laparotomy/open surgery, 332–333
Laryngeal mask airway (LMA), 111–112
Laryngoscopy and tracheal intubation
Macintosh and Miller blades, 114
oral, pharyngeal, and laryngeal axes relationship, 113
Laryngospasm, 430–431
Laser surgery, 345
Left ventricular assist devices (LVAD), 272
Lithotomy position, 342, 343
Liver and biliary tract surgery, 336
Local anesthetics
  case study, 72–74
  factors
    epinephrine, 69
    fiber size and type, 68
    pH, 68–69
    use-dependent blockade, 69
  history of, 67
  mechanism of action, 67–68
  metabolism
    properties of, 70
    structure, 69–70
  side effects and toxicity
    cardiovascular effects, 71
    central nervous system, 71
    hypersensitivity/allergy, 72
    methemoglobinemia, 72
    neurotoxicity, 71–72
  treatment of, 72
  uses of, 71
Lung volumes depiction, 277–278

Macintosh and Miller blades, 114
Malignant hyperthermia (MH)
  definition, 517
  mechanism, 517
  presenting signs, 518
  treatment, 518–519
Maternal fetal exchange, 307
Mechanical ventilation, critical care
  assist-control ventilation, 458
  autoPEEP, 460
  inspiratory pressures, 459–460
  intermittent mandatory ventilation, 458
  NIPPV, 460–461
  PEEP, 459
  pressure support ventilation, 458–459
  VAP, 461
Medical simulation. See Simulation
Medical student rotations, 3–4
Meperidine, 43
Metabolic alkalosis, 211
Methemoglobinemia, local anesthetics, 72
Meyer–Overton rule, inhalational anesthetics, 58
MG. See Myasthenia gravis
Minimum alveolar concentration (MAC), 58–60, 305
Mitral stenosis (MS), 270–271
Monitored anesthesia care (MAC)/conscious sedation, 164–166
Monitors, 20–21. See also Equipment and monitors
Morphine, 42
Muscle relaxation monitoring, 141–143
Musculoskeletal exam, 92
Myasthenia gravis (MG), 292–293
Myofascial pain, 424
Nasogastric tube technique, 238–239
Needle-directed breast biopsy, 80–82
Neonatal circulation, 356–357
Neostigmine, 50
Nephrectomy, 346–347
Nerve injury, 230
Neuraxial analgesia, 314–315
Neuraxial anatomy. See also Regional anesthetic technique
  anterior spinal artery syndrome, 174
dermatome, 175, 176
  epidural anesthesia
    pharmacology, 179
    technique, 178–179
  spinal anesthesia
    factors effecting level and local anesthesia duration, 181–182
    iliac crest, 175, 180
    technique, 180–181
    subarachnoid space, 174
    surface anatomy, 174–175
    vertebral anatomy, 173–174
Neuroanesthesia
  BBB, 286–287
case study, 299–301
cerebral blood flow, 286, 287
craniotomy
  intraoperative considerations, 290
  neurovascular surgery, 290–291
  preoperative considerations, 289–290
  intracranial pressure (ICP), 285–286
  MG, 292–293
  neuromonitoring, 287–288
  neurophysiology, anesthetic effects, 288–289
  neurosurgical procedures, anesthetic management, 289
Neurologic exam, 92
Neuromuscular blockers (NMBs), 47–50
Neuropathic pain, 417
Neurotoxicity, local anesthetics, 71–72
Nociceptive pain, 417
Nondepolarizing neuromuscular blocking drug, 36
Noninvasive positive-pressure ventilation (NIPPV), 460–461
Nonsteroidal anti-inflammatory drugs (NSAIDS), 79
Norepinephrine, 76

Obesity
airway challenges, 329
anesthetic considerations
intraoperative considerations, 330–331
postoperative considerations, 331
preoperative evaluation, 330
BMI, 325–326
physiologic changes
cardiovascular system, 326–327
diabetic and metabolic system, 328
gastrointestinal system, 327–328
neurological and psychological problems, 328–329
respiratory system, 327
surgery for, 329

Obstetrics
case study, 320–322
cesarean section anesthesia
epidural anesthesia, 316–317
general anesthesia, 317–318
qualities of, 315
spinal anesthesia, 316
hemorrhagic emergencies
antepartum/intrapartum hemorrhage, 318–319
post-partum hemorrhage, 319
intrapartum fetal evaluation
deceleration patterns principal, 308–309
fetal heart rate (FHR), 308
maternal fetal exchange, 307
neonatal evaluation, apgar score, 310–311
non-obstetric surgery anesthesia, 319–320
physiologic changes
cardiovascular, 303–304
central nervous system, 305
gastrointestinal, 306
hematologic changes, 305–306
musculoskeletal, 306–307
renal, 306
respiratory, 304–305
uteroplacental blood flow, 307
vaginal delivery anesthesia
combined spinal-epidural analgesia, 314
epidural analgesia, 312–313
nerve block analgesia, 314–315
non-pharmacologic options, labor pain, 312
pain pathways, 311
regional anesthesia, 312, 313
spinal analgesia, 313–314
stages, 311
systemic medications, labor pain, 312

Oculo-cardiac reflex, 298
 Omphalocele and gastroschisis, 366
 Oncotic vs. osmotic pressures, 201
 One-lung ventilation (OLV), 279
 Opioid pharmacodynamics and dose, 420–421
 Opioids, 36, 41–44
 Orchietomy, 347–348
 Orogastic tube technique, 238
 Orthopedic surgery
blood loss, 407
case study, 408–410
choice of anesthetic, 404–405
fat embolism syndrome, 407
methylmethacrylate cement, 406–407
positioning injuries, 406
postoperative pain management, 405–406
tourniquet issues, 406
Oscillometry, 134
 Otolaryngology (ENT), anesthetic approach
airway surgery, 297
case study, 299–301
endoscopic sinus surgery, 296
inner ear surgery, 296
intraoperative issues, 295
neck dissection, 295–296
ophthalmology
intraocular pressure (IOP), 297
retrobulbar and peribulbar blocks, 297–298
preoperative planning, 294–295
specialized equipment, 293
Out-of-OR (OOR) procedures
- case study, 392–394
- electrophysiology lab (EP), 389–390
- gastrointestinal (GI) endoscopy, 388–389
- neuroradiology, 391–392
- radiology, 390–391
- unique aspects, 387

Oxygenation, 149

Oxygen flush valve, 127

Oxyhemoglobin dissociation curve, 307

PA. See Pulmonary artery

Pain assessment, 422

Pain pathways, gross anatomy of, 414–415

Pancreatic surgery, 337

Paralytics. See Neuromuscular blockers (NMBs)

Patient and provider safety
- ASA closed claims study, 484–485
- basic anesthetic monitoring, 485–486
- case study, 491–494
- challenges, anesthesia provider, 487
- CMS, 491
- high quality anesthesia care, 487–488
- history, 483
- pay-for-performance concept, 490
- perioperative complications
  - dental trauma, 488
  - eye injury, 488–489
  - intraoperative recall, 489–490
  - peripheral nerve injuries, 489
- quality assurance (QA), 484

Patient preparation, 10–11

Pay-for-performance concept, 490

Pediatric surgery
- anatomy
  - trachea, 355
  - upper airway, 353, 354
- case study, 366–368
- OR equipment and setup
  - intravenous fluid, 362–363
  - radiant heat loss, 361–362
- pharmacology, 359
- physiology
  - blood, 359
  - cardiac, 358
  - gastrointestinal, 358–359
  - hepatic, 358
  - neonatal circulation, 356–357

neurologic, 359
renal, 358
respiratory, 358
temperature regulation, 359

preoperative evaluation
- physiological assessment, 360–361
- psychological assessment, 360

techniques
- HCT and EBV, 365
- maintenance, 363–364
- omphalocele and gastroschisis, 366
- oximetry, 364
- pyloric stenosis, 365
- venous access, 355–356

Pelviscopy, 51–53

Perioperative acute and chronic pain management
- acute vs. chronic pain
- somatic pain, 416
- types of, 417
- visceral pain, 417
- case study, 425–427

pain sensation
- modulation, 414
- pain pathways, gross anatomy, 414–415
- perception, 416
- transduction, 413–414
- transmission, 414

palliative care, 425

physical and psychological therapy, 425

syndromes, 422–424
- complex regional pain syndrome, 423–424
- discogenic pain, 423
- facet arthropathy, 423
- myofascial pain, 424
- postherpetic neuralgia, 424
- radicular pain, 423
- sacroiliac joint dysfunction, 424
- spinal stenosis, 422

treatment of
- acute pain, 418
- chronic pain, 419–421
- types and definitions, 416

Perioperative complications
- dental trauma, 488
- eye injury, 488–489
- intraoperative recall, 489–490
- peripheral nerve injuries, 489
Peripheral nerve blocks (PNB)
cervical plexus blockade, 186–187
target nerve identification, 185–186
Peripheral nerves classification, 414
Pharmacodynamics
  competitive vs. noncompetitive antagonism, 35
drug dose response relationship, 34
receptor systems, 34
tolerance and physiological dependence, 35
Pharmacokinetics
  absorption, 30
distribution
  free fraction and protein binding, 30
  redistribution, 31
  storage, 31
  volume of distribution (Vd), 31
metabolism and excretion
  clearance, 32
  context-sensitive half-time, 33
  mechanisms of, 31
  zero vs. first order kinetics, 32, 33
Pharmacology
inhalational anesthetics
  case study, 63–66
  concentration effect, 61
  minimum alveolar concentration (MAC), 58–60
  nitrous oxide, 59–61
  second gas effect, 61–62
  theories of, 58
  uptake, distribution and elimination, 55–58
volatile anesthetics, 62–63
intravenous anesthetic agents
  acetylcholinesterase inhibitors, 50
  anticholinergics, 51
  benzodiazepines, 40–41
  induction agents, 44–47
  neuromuscular blockers (NMBs), 47–50
opioids, 41–44
local anesthetics
  case study, 72–74
  factors, 68–69
  history of, 67
  mechanism of action, 67–68
  metabolism, 69–70
  side effects and toxicity, 71–72
treatment of, 72
uses of, 71
principles
  case study, 35–38
  pharmacodynamics, 34–35
  pharmacokinetics, 30–33
Phenergan. See Promethazine
Phenylephrine, 76
pH, local anesthetics, 68–69
Pin index safety system (PISS), 125
Platelets, 215
PNB. See Peripheral nerve blocks
Pneumoperitoneum, 332
Positive end-expiratory pressure (PEEP), 459
Postanesthesia care unit (PACU), 9–10, 14
Postdural puncture headache (PDPH), 183–184
Postherpetic neuralgia, 424
Postoperative care unit
  case study, 440–442
  discharge criteria, 438–439
  hemodynamic complications, 431–434
  hypothermia and shivering, 438
  neurologic complications, 434–436
  pain control, 437–438
  postoperative nausea and vomiting (PONV), 436–437
  respiratory complications, 429–431
  sample PACU sign-out, 429, 430
Postoperative nausea and vomiting (PONV), 386, 393, 436–437
Pregnancy, normal physiologic changes
  cardiovascular, 303–304
  central nervous system, 305
  gastrointestinal, 306
  hematologic changes, 305–306
  musculoskeletal, 306–307
  renal, 306
  respiratory, 304–305
Preoperative patient evaluation
anesthesia consent form, 96, 99
  case study
    ASA physical status, 99–100
    cardiovascular complications, 100
    diabetes, 101–102
    pulmonary complications, 100–101
  goals of, 85
  history
    airway, 86–87
bleeding disorders, 91
cardiovascular, 87–89
dermatome, 175, 176
dermatome, 175, 176
endocrine, 91
hepatic and gastrointestinal disease, 90–91
musculoskeletal, 92
neurologic, 92
renal, 91–92
indications for, 94–95
interview, 85–86
laboratory data, 93–95
medical records/family history, 93
medications/allergies, 92–93
physical exam, 92
plan
ASA physical status classifications, 96
formulation, patient history, 97–98
Pressure support ventilation, 458–459
Primary acid–base disorders, 212
Professionalism. See also Anesthesiology
definition, 472
etiquette based medicine, 474–475
key elements, 474
responsibility, 473
Promethazine, 77
Propofol, 45–46
Pulmonary artery (PA), 214–215, 451
Pulmonary artery catheters
data, 146–147
hemodynamic parameters, 150
Pulmonary aspiration, 305
Pulmonary complications, preoperative
patient evaluation, 100–101
Pulse oximetry, 137–139
Purkinje fibers, 266
Quality assurance (QA), 484. See also Patient and provider safety
Radial artery cannulation, 232
Radical cystectomy, 346
Radicular pain, 423
Rapid sequence induction (RSI)
pulmonary aspiration, risk factors, 113–114
vs. standard induction, 114–115
Red blood cells (RBCs), 215
Regional anesthetic technique
brachial plexus and upper extremity
blocks, 192
axillary block, 190–191
infraclavicular block, 189–191
interscalene block, 187–190
supraclavicular block, 189
case study, 195–197
caudal anesthesia, 182
combined spinal–epidural, 182
complications and side effects
cardiovascular changes, 183
CES, 183
epidural abscess, 185
high/total spinal anesthesia, 184
intravascular injection, 184
post-dural puncture headache (PDPH), 183–184
spinal/epidural hematoma, 184–185
transient neurologic symptoms, 183
urinary retention, 184
epidural anesthesia
pharmacology, 179
technique, 178–179
indications and contraindications, 175, 177
intravenous regional anesthesia
(Bier block), 193
lower extremity peripheral nerve block, 194
ankle block, 193
femoral nerve block, 191–192
sciatic nerve block, 192–193
mechanism of action, 176–177
neuraxial anatomy
anterior spinal artery syndrome, 174
dermatome, 175, 176
subarachnoid space, 174
surface anatomy, 174–175
vertebral anatomy, 173–174
PNB
cervical plexus blockade, 186–187
target nerve identification, 185–186
potential risks, 175, 177
spinal anesthesia
factors effecting level and local
anesthesia duration, 181–182
iliac crest, 175, 180
technique, 180–181
surface anatomy, 174–175
ultrasonography, 194–195
vertebral anatomy, 173–174
Remifentanil, 43
Renal transplantation, 347
Respiratory alkalosis, 304
Retrobulbar and peribulbar blocks approach, 297–298
Rheumatic heart disease, 281–283
RSI. See Rapid sequence induction
Ryanodine receptor, 517
Sacroiliac joint dysfunction, 424
Safety and team training. See also
Anesthesiology advantages, 477
closed loop communication, 475
communication failure, 476
CRM-based teamwork, 476–477
Scopolamine, 78
Sedative-hypnotic medications, 167
Sensation of pain
modulation, 414
pain pathways, gross anatomy, 414–415
perception, 416
transduction, 413–414
transmission, 414
Serotonin antagonists, 36, 77
Serotonin-norepinephrine reuptake inhibitors (SNRI), 421
Sevoflurane, 63
Shock
classification, 451–452
hemodynamic disturbances, 452
management, 452–453
septic shock, 453–454
vasoactive agents, 453
Short-acting, fast-emergence anesthetic (S.A.F.E.) principles, 385
Simulation
case study, 511–514
categories, 504, 505
crisis resource management, 506
definition, 503
evidence, 505
expectations, 510–511
formal assessment, 509–510
high-fidelity simulation, 505–506
history, 504–505
laboratory
benefits, 508–509
mannquin, 507
physical layout, 506–507
mannquin, 509
Sinoatrial (SA) node, 266
SNRI. See Serotonin-norepinephrine reuptake inhibitors
Spinal– Epidural anesthesia, combined advantages, 182
complications and side effects
cardiovascular changes, 184
CES, 183
epidural abscess, 185
high/total spinal anesthesia, 184
intravascular injection, 184
post-dural puncture headache (PDPH), 183–184
spinal/epidural hematoma, 184–185
transient neurologic symptoms, 183
urinary retention, 184
Spinal stenosis, 422
Spleen surgery, 336
Stomach surgery, 335
Succinylcholine, 48–49
Sufentanil, 42
Swan-Ganz catheter, 146
Sympathomimetics, 75–76
Systole and diastole, cardiac cycle, 268
Team training. See Anesthesiology
Temperature monitoring, 144
Thiopental, 46
Thoracic anesthesia
anatomy, 276–277
anesthetic management, 278–279
case study, 281–283
double lumen endotracheal tube, 279–281
invasive cardiac procedures, 281
one-lung ventilation, 279
preoperative evaluation, 276–278
Thromboprophylaxis, 462–463
Toradol. See Ketorolac
Total intravenous anesthesia (TIVA), 169, 295
Total knee replacement (TKR), 195–197
Tracheae and bronchi, 276–277
Transfusion hazards
- blood products, 220–221
- blood type compatibility matrix, 216, 222
- hyperkalemia, 223
- hypocalcemia, 223
- infectious risks, 216–217
- transfusion reactions, 216, 218–219
- transfusion-related acute lung injury (TRALI), 222

Legal and ethical issues
- economic issues, 224
- professional issues, 220–224
- religious/philosophical issues, 223

Transurethral resection of prostate/bladder tumor (TURP/TURBT), 344–345

Trauma injury
- advanced trauma life support (ATLS), 398
  - bleeding
  - coagulopathy, 403
  - hypothermia, 402
  - hypovolemia and acidosis, 402–403
  - massive transfusion protocol, 404
- case study, 408–410
- clearing C-Spine, 401–402
- epidemiology, 397–398
- Glasgow coma scale (GCS), 398, 399
- head trauma, 402
- mechanisms of, 398
- trauma airway, 400–401
- trauma arrest, 400
- Tricyclic antidepressants, 421
- Twitch monitoring, 142

Typical general anesthesia case
- emergence, 9
- induction and intubation, 8
- maintenance, 8–9
- monitoring, 7

PACU management, 9–10
- phases of, 7
- preoperative evaluation, 6–7
- sedation, 7

Upper airway anatomy, 107, 353, 354

Urological surgery
- anatomy, 341–342
- anesthetic management
  - cystoscopy/ureteroscopy/TURBT, 344
  - ESWL, 348
  - laser surgery, urology, 345
  - nephrectomy, 346–347
  - orchietomy, 347–348
  - radical cystectomy, 346
  - renal transplantation, 347
  - TURP, 344–345
- case study, 350–352
- complications of
  - autonomic hyperreflexia, 348
  - bacteremia, 350
  - bladder perforation, 348
  - hypothermia, 350
  - irrigating solutions, 349
  - TURP syndrome, 349
  - lithotomy position, 342, 343
  - preoperative assessment, 343–344
- Uterine atony and retained placenta, 319
- Uteroplacental blood flow, 307

Vaginal delivery anesthesia. See Obstetrics

Vaporizers, 124–126

Vasopressors. See Sympathomimetics

Ventilation, 149–150

Ventilator-associated pneumonia (VAP), 461

Volatile anesthetics, 62–63, 167–169

Waste-gas scavengers, 127

Weight loss procedures, 329