

Contents

Preface xx

List of Contributors xxi

About the Companion Website xxiii

1 Cardiovascular Disease 1

Jonathan M. Congdon

Introduction 1

Cardiovascular Physiology 2

Tissue Perfusion and Oxygen Delivery 2

Blood Pressure and Cardiac Output 2

Mean Arterial Pressure and Autoregulation 2

Hypotension 2

Relationship Between Mean Arterial Pressure and Cardiac Output 4

Preanesthetic Patient Assessment 6

Functional Classification of Cardiac Disease 7

Sedation Versus General Anesthesia 7

Anesthetic and Analgesic Agents 8

Premedicants 8

Induction Agents 12

Anesthetic Maintenance 13

Anesthetic Adjuncts 17

Local and Regional Anesthesia and Analgesia 17

Systemic Analgesic Infusions 18

Nonsteroidal Anti-Inflammatory Drugs 18

Sympathomimetic Drugs: Inotropes and Vasopressors 18

Dopamine 19

Dobutamine 19

Epinephrine 21

Ephedrine 21

Vasopressin 21

Norepinephrine 21

Phenylephrine 22

Patient Monitoring and Support 22

Fluid Therapy 22

Patient Preoxygenation 22

Blood Pressure (BP) 23

Electrocardiography	25
Pulse Oximetry	25
Core Body Temperature	25
Capnometry and Ventilation	26
Arterial Blood Gases	27
Central Venous Pressure (CVP)	27
Arterial Pulse Pressure Variation (PPV)	27
Anesthetic and Pharmacologic Recommendations for Specific Cardiac Diseases	28
General Preanesthetic Evaluation	28
Valvular Heart Disease	28
Congenital Cardiac Disease	34
Abnormalities of Cardiac Conduction and Cardiac Rhythm	37
Cardiac Pacemakers and Pacing	49
Anesthetic Management	49
Systemic and Pulmonary Arterial Hypertension	52
Systemic Hypertension	52
Pulmonary Arterial Hypertension (PAH)	54
Heart Failure	56
Introduction	56
Pathophysiology	56
Anesthetic Management	58
Canine and Feline Cardiomyopathies	60
Hypertrophic Cardiomyopathy	61
Dilated Cardiomyopathy	63
Arrhythmogenic Cardiomyopathy	65
Heartworm Disease	66
Incidence and Pathophysiology	66
Feline Heartworm Disease	66
Caval Syndrome	67
Anesthetic Management	67
Summary	68
References	68

2 Respiratory Disease 86

<i>Rebecca A. Johnson and David B. Brunson</i>	
Introduction	86
Ventilatory Control	86
Respiratory Volumes and Ventilation	87
Respiratory Gases	89
Carbon Dioxide (CO ₂)	89
Oxygen	91
Interactions Between CO ₂ and O ₂ Transport	93
Ventilatory Cycle Phases and Ventilatory Support	93
Ventilatory Cycle	93
Ventilatory Support with Intermittent Positive Pressure Ventilation (IPPV)	93
Oxygen Supplementation	95
Ventilation in Conscious Patients	96

Pharmacologic Effects on Ventilation	96
Opioids	96
Other Sedatives and Tranquilizers	96
Injectable and Inhalant Anesthetics	97
Anesthetic Management of Specific Disorders	98
Upper Airway Disorders or Dysfunction	98
Lower Airway and Parenchymal Diseases	102
Extrapulmonary or Thoracic Wall Disease	104
Summary	104
References	105

3 Neurologic Disease 110

Erin Wendt-Hornickle and Daniel Almeida

Introduction	110
Nervous System Physiology	110
Cerebral Blood Flow	110
Autoregulation	111
Cerebral Perfusion Pressure and Mean Arterial Pressure	112
Cerebral Metabolic Rate	112
Arterial Partial Pressure of Carbon Dioxide and Oxygen	112
Central Venous Pressure	113
Spinal Cord Blood Flow	113
Anesthesia of Patients with Neurologic Conditions	113
Preanesthetic Considerations	113
Glycemic Control	113
Other Nursing Strategies	114
Methods to Manage Increased Intracranial Pressure	114
Anesthetic Management	115
Sedatives and Analgesics	115
Injectable Anesthetics	116
Inhalant Anesthetics	117
Neurospecific Monitoring	118
Anesthetic Management of Specific Disease Processes	118
Traumatic Brain Injury	118
Intracranial Tumors	119
Seizure Disorders	120
Hydrocephalus	121
Chiari-Like Malformation and Syringomyelia	122
Intervertebral Disc Disease and Other Spinal Injuries	122
Spinal Shock	123
Other Nervous System Disorders	123
Postoperative Cognitive Dysfunction	124
References	125

4 Hepatobiliary Disease 134

Carrie A. Schroeder

Introduction	134
--------------	-----

Anatomy and Physiology	134
Markers of Hepatic Dysfunction	136
Perioperative Effects on Hepatic Function	137
General Anesthetic Effects	137
Surgical Effects	138
Hepatic Dysfunction and Pharmacological Agents	138
Sedative Agents	138
Opioids	140
Nonsteroidal Anti-Inflammatory Agents	140
Induction Agents	141
Inhalational Agents	142
Anesthetic Management of Patients with Hepatic Dysfunction	142
General Considerations	143
Liver Biopsy	144
Portosystemic Shunts	144
Hepatic Neoplasia Resection	146
Cholecystectomy	147
Summary	148
References	148

5 Gastrointestinal Disease 155

<i>Juliana Peboni Figueiredo</i>	
Gastrointestinal (GI) Tract Function	155
Oropharyngeal Diseases	155
Clinical Signs	155
Laboratory Data	157
Anesthetic Management	157
Esophageal Diseases	164
Esophageal Anatomy	164
Esophageal Obstruction	165
Megaesophagus	166
Clinical Signs	166
Laboratory Data	167
Anesthetic Management	167
Gastric and Small Intestinal Disease	174
Clinical Signs	175
Laboratory Data	176
Anesthetic Management	176
Gastric Dilatation–Volvulus	180
Colonic, Rectal, Anal, and Perineal Surgery	187
Clinical Signs	188
Laboratory Data	190
Anesthetic Considerations	190
Secondary Septic Peritonitis	191
Anesthetic Considerations	191
Summary	192
References	192

6 Renal Disease 202*Carrie A. Schroeder*

Introduction 202

Anatomy and Physiology 202

Pathophysiology 203

Renal Disease and Surgery 206

Renal Disease and Pharmacologic Agents 207

Pre-anesthetic Agents 207

Induction Agents 210

Inhalational Agents 211

Adjunctive Drugs 212

Anesthetic Management of Patients with Renal Disease 213

Pre-anesthetic Stabilization 213

Intraoperative Management 216

Summary 217

References 217

7 Urogenital Concerns 225*Carrie A. Davis*

Introduction 225

Urogenital Emergencies 225

Urethral Obstruction 225

Clinical Signs and Physical Examination 226

Initial Database and Clinicopathology 226

Preanesthetic Management and Initial Stabilization 228

Sedation and Anesthesia 235

Adjunctive Anesthetic Techniques 238

Urethrotomy/Urethrostomy 239

Recovery and Postoperative Care 240

Upper Urinary Tract Obstruction 240

Clinical Signs and Physical Exam 240

Initial Database and Stabilization 240

Sedation and Anesthesia 242

Recovery and Postoperative Care 243

Uroabdomen 244

Clinical Signs and Physical Exam 244

Initial Database and Clinicopathology 245

Preanesthetic Management and Initial Stabilization 246

Urinary Diversion 247

Sedation and Anesthesia 248

Recovery and Postoperative Care 249

Pyometra 250

Clinical Signs and Physical Exam 250

Initial Database and Clinicopathology 250

Preanesthetic Management and Initial Stabilization 251

Anesthesia and Monitoring 252

Recovery and Postoperative Care 254

Nonurgent Urogenital Procedures	254
Laparoscopic Urogenital Procedures	254
Cystourethroscopy	254
Renal Biopsy	255
Urinary Tract Diagnostic Imaging	255
Excretory Urography	256
Cystography/Urethrography	256
References	257

8 Perioperative Fluid, Electrolyte, and Acid–Base Disturbances 262

<i>Carolyn L. Kerr</i>	
Introduction	262
Body Fluids	263
Dehydration and Intravascular Volume Deficits	265
Electrolytes	270
Sodium	270
Chloride	275
Potassium	277
Calcium	282
Acid–Base Homeostasis and Disturbances	286
Respiratory Acidosis	286
Respiratory Alkalosis	289
Nonrespiratory Acidosis	290
Nonrespiratory Alkalosis	291
Stepwise Approach to Acid–Base Status Assessment	292
Stepwise Approach to the Anesthetic Management of the Patient with an Acid–Base Disorder	292
References	293

9 Endocrine Disease 299

<i>Berit L. Fischer</i>	
Introduction	299
Thyroid Disease	299
Thyroid Gland Anatomy and Physiology	299
Thyroid Hormone Effects	299
Hypothyroidism	299
Hyperthyroidism	304
Adrenal Disease	309
Adrenal Gland Anatomy and Physiology	309
Hyperadrenocorticism (HAC; Cushing's Disease)	309
Hypoadrenocorticism (Addison's Disease)	314
Pheochromocytoma	317
Pathophysiology	317
Diabetes Mellitus	324
Canine Diabetes Mellitus	324
Feline Diabetes Mellitus	324
Clinical Signs and Symptoms	324

	Clinicopathologic Changes	324
	Diagnosis	325
	Treatment	325
	Anesthetic Management	325
	Diabetic Ketoacidosis (DKA)	326
	Summary	329
	References	329
10	Nutritional Disease	336
	<i>Lindsey B. C. Snyder</i>	
	Introduction	336
	Pathophysiology	336
	Anesthetic Management of the Obese Patient	338
	Induction	338
	Maintenance	339
	Postoperative Care	341
	Additional Concerns	341
	Additional Nutritional Concerns	341
	Boutique Diets (Grain-Free Diets, Novel Protein Diets, All-Meat Diet)	341
	Ideal Body Weight	342
	Cachexia	343
	References	343
11	Genetic Disease	345
	<i>Tania Perez Jimenez</i>	
	Introduction	345
	Pharmacogenetics	345
	Genetically Related Diseases	346
	Breed-Related Differences	346
	Drug Metabolism and Disposition	346
	Transporters	347
	Malignant Hyperthermia	348
	Opioid Receptors	351
	Anticholinergic Response	351
	Brachycephalic Airway Obstruction Syndrome (BAOS)	351
	von Willebrand Disease (VWD)	353
	Summary	355
	References	355
12	Anesthesia for Ophthalmic Patients	359
	<i>Philip Lerche</i>	
	Introduction	359
	Intraocular Pressure	359
	Tear Production	360
	Patient Positioning	361
	Oculocardiac Reflex (Aschner Reflex)	361
	Ophthalmic Drugs	362

Drugs Used to Treat Glaucoma	362
Topical Corticosteroids	363
Drugs Used to Dilate the Pupil	363
The Presence of Coexisting Disease	363
Neuromuscular Blockade and Ventilation	363
Pain Management	366
Local Anesthetics	366
Opioids	367
Nonsteroidal Anti-Inflammatory Drugs	368
Anesthetic Management	368
Anesthetic Recovery	369
Postoperative Care	370
References	370

13 Oral and Maxillofacial Disorders 373

Christopher J. Snyder and Jason W. Soukup

Introduction	373
Locoregional Anesthetic/Analgesic Agents	374
Locoregional Agent Administration	375
Maxillofacial Locoregional Techniques	376
Specific Regional and Local Blocks	377
Complications and Contraindications	385
Inflammation and Local Anesthetic Efficacy	386
Pathology Chronicity and Analgesic Needs	387
Anesthetic Management of Other Oral and Maxillofacial Conditions	387
Oral and Maxillofacial Trauma	387
Oral and Maxillofacial Surgery	387
Long-Acting Local Anesthetics—Bupivacaine	388
Buprenorphine Combined with Local Anesthetics	388
Local Anesthetic Redosing	388
Intraoperative and Postoperative Continuous Rate Infusions	388
Circumstances Requiring Unique Anesthetic Management Approaches	388
Airway Management	388
Occlusion Assessment	389
Maxillomandibular Fixation	391
Other Oral and Maxillofacial Surgery Techniques	391
Trismus	391
References	392

14 Hematologic Disorders 395

Molly Shepard and Benjamin Brainard

Introduction	395
Oxygen Content Monitoring in the Anesthetized Patient	396
Red Blood Cell Transfusions	401
Anesthetic Considerations for Patients with Anemia	403
Red Blood Cell Disorders and Blood Viscosity	405
Disorders of Hemostasis	406

Hypocoagulable Disorders	406
Primary Hemostasis	406
Evaluation of Primary Hemostasis	406
Disorders of Primary Hemostasis	407
Treatments in Preparation for Anesthesia	408
Thrombocytopathias	409
Secondary Hemostasis	412
Evaluation of Secondary Hemostasis	412
Disorders of Secondary Hemostasis	412
Viscoelastic Coagulation Monitoring	415
Disseminated Intravascular Coagulopathy	416
Hypercoagulable States	418
Disorders of Fibrinolysis	419
References	419

15 Skin and Musculoskeletal Diseases 426

Paulo V. M. Steagall

Introduction	426
Burns	426
Metabolic Derangements and Systemic Effects	427
Treatment and Anesthetic Management	428
Chronic Pain Syndrome after Feline Onychectomy	431
Anesthesia and Perioperative Analgesia	432
Chronic Pain Syndrome Treatment	434
Auricular Disease	435
Diagnosis	435
Treatment	436
Anesthetic Management	436
Laryngeal Paralysis	438
Clinical Signs	438
Diagnosis	438
Treatment	439
Anesthetic Management	439
Malignant Hyperthermia	442
Clinical Signs	443
Diagnosis	443
Treatment and Anesthetic Management	443
Myasthenia Gravis	446
Clinical Signs	446
Diagnosis	448
Treatment	448
Anesthetic and Analgesic Management	448
Myopathies	450
Noninfectious Inflammatory Joint Diseases	450
Osteoarthritis	451
Systemic Lupus Erythematosus	452
Rheumatoid Arthritis	453

Reactive Polyarthrititis	454
Skin (Intradermal) Testing	454
Summary	455
References	456

16 Infectious Disease 463

Bradley T. Simon and Jusmeen Sarkar

Introduction	463
Contamination and Cleaning of Anesthetic Equipment	463
Breathing Circuits	463
Endotracheal Tubes	464
Anesthetic Equipment and Monitors	464
Multidrug-Resistant Organisms and Surgical Site Infection	464
Multidrug-Resistant Organisms	464
Surgical Site Infections	466
Respiratory Infections	468
Aspiration, Bacterial, and Viral Pneumonia	468
Canine Influenza A Virus	471
Feline Respiratory Disease Complex	474
Gastrointestinal Infections	475
Infectious Gastroenteritis	475
Bloodstream Infections	477
Catheter- and Drug-Related Infections	477
Clinical Signs	478
Diagnosis	479
Anesthetic Management	480
Sepsis	481
Clinical Signs	482
Diagnosis	482
Anesthetic Management	482
Cutaneous Infections	485
Necrotizing Fasciitis	485
Additional Common Infectious Diseases	487
Lyme Disease	487
Ehrlichiosis	488
Leptospirosis	490
Feline Immunodeficiency Virus and Feline Leukemia Virus	492
References	493

17 Neoplastic Disease 502

Verónica Salazar

Introduction	502
Pathophysiologic Considerations	502
Paraneoplastic Syndromes	503
Treatment	511
Cancer Pain	514
Pain Pathophysiology	514

Pain Evaluation	514
Specific Pain Characteristics	515
Cancer Pain Management	521
Nursing Care of Hospitalized Patients	530
Considerations for General Anesthesia	530
Effects of Perioperative Management on Postoperative Oncologic Outcomes	532
Surgery	532
Anesthetic Drugs	533
Analgesic Agents and Analgesic Techniques	534
Palliative Care	539
Hospice Care Programs	539
Acupuncture for the Oncologic Patient	541
Alternative Analgesic Options in Palliative Care	541
Nonopiate IV Infusions	541
Epidural Injection	541
Subcutaneous Opioid Infusion and Other Opioid Delivery Routes	542
Joint Injections for Osteoarthritis	542
Myofascial Injections	542
Toxins	542
Neurolysis	543
Spinal Cord Stimulation	543
References	543

18 Cesarean Section and Pregnancy 566

Turi K. Aarnes and Melissa A. Murdock

Introduction	566
Maternal Physiology	566
Cardiorespiratory System	566
Gastrointestinal System	568
Central Nervous System (CNS)	568
Placental Drug Transfer	568
Opioid and Nonsteroidal Anti-Inflammatory Drug Effects on Maternal and Fetal Physiology	570
Opioids	570
Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)	571
Patient Management for Cesarean Section	571
Preoperative Considerations	571
Anesthetic Induction and Intraoperative Management	573
Postoperative Pain Management	576
Neonatal Resuscitation	577
Fetal Physiology	579
Pregnant Patient Management for Noncesarean-Section Surgery	580
References	581

19 Neonatal and Pediatric Concerns 585

Anderson Fávoro da Cunha

Introduction	585
--------------	-----

Physiological Alterations	585
Respiratory System	585
Cardiovascular System	586
Hepatic System	587
Central Nervous System	588
Renal System	588
Pharmacokinetic and Pharmacodynamic Considerations	588
Anesthetic Management of Neonatal and Pediatric Patients	589
Preanesthetic Evaluation	589
Sedation	589
Anesthetic Induction and Maintenance	590
Analgesic Techniques	591
Anesthetic Recovery	592
Conclusion	592
References	592

20 Senior and Geriatric Concerns 595

Anderson Fávoro da Cunha

Introduction	595
Physiological Alterations	595
Respiratory System	595
Cardiovascular System	596
Hepatic System	597
Central Nervous System (CNS)	597
Renal System	598
Gastrointestinal (GI) System	598
Endocrine System	599
Pharmacokinetic and Pharmacodynamic Considerations	599
Anesthetic Management of Senior and Geriatric Patients	599
Preanesthetic Evaluation	600
Sedation	600
Anesthetic Induction and Maintenance	601
Analgesic Techniques	601
Anesthetic Recovery	603
Summary	603
References	603

21 Disorders Related to Trauma 606

Andre Shih

Introduction	606
Initial Patient Evaluation	607
Anesthesia in Severe Trauma Patients	608
Head Trauma	610
Thoracic and Abdominal Trauma	613
Orthopedic Trauma	614
Analgesia in Severe Trauma Patients	615
Pain Effects in Polytrauma Patients	616
Summary	619
References	619

22 Nociceptive Disorders 624*Andrew Claude*

Introduction 624

Definitions 624

The Nociceptive Process 625

Transduction 625

Transmission 626

Primary Modulation 626

Projection 627

Supraspinal Modulation (Perception) 627

Nociception and Pain Disorders 627

Peripheral Sensitization (Wind-Up) 627

Central Sensitization (Wind-Up) 627

Chronic or Maladaptive Pain 628

Neuropathic Pain 629

Preventive and Multimodal Analgesia 629

Practical Anesthetic and Analgesic Considerations 630

Common Analgesic Categories Used in Small-Animal Veterinary Medicine 630

Preemptive Phase 633

Intraoperative Phase 635

Postoperative Phase 635

Immediate Postoperative Care 635

Long-Term Postoperative Care 637

References 637

23 Cardiopulmonary Resuscitation and Postcardiac Arrest Care 641*Thomas K. Day*

Introduction 641

CPR Preparedness and Prevention 641

Basic Life Support 645

Advanced Life Support 647

Monitoring During CPR 649

Postcardiac Arrest Care 650

Clinical Application of the RECOVER Guidelines for Veterinary CPR 652

Conclusion 657

References 657

CPR Recommendations in a Cat Sedated with Preanesthetic Medication Before an

Elective Laceration Repair 659

Signalment and History 659

CPR Efforts 660

CPR Recommendations for a Dog During Anesthesia for an Elective Ovariohysterectomy 660

Signalment and History 660

CPR Efforts 660

CPR Recommendations During an Abdominal Exploratory of a Dog with a

Hemoperitoneum Secondary to a Ruptured Splenic Mass 661

History and Signalment 661

CPR Efforts 661