## Brief Contents

List of Contributors  xv  
Foreword  xvii  
Acknowledgments  xix  
About the Companion Website  xxi  

### Part I  Necropsy Fundamentals  1

1  Introduction to the Necropsy  3  
2  Necropsy Basics  9  
3  The Necropsy Procedure  21  

### Part II  Organ Systems  39

4  The Integumentary System  41  
5  The Musculoskeletal System  49  
6  The Cardiovascular System  59  
7  The Respiratory System  69  
8  The Alimentary System  77  
9  The Liver and Pancreas  91  
10  The Urogenital System  101  
11  The Nervous System  107  
12  The Eye and Ear  115  
13  The Endocrine System  125  
14  The Lymphoreticular System  133  

### Part III  Special Cases  143

15  Small Mammal Necropsies  145  
16  Fetuses and Neonatal Animals  153
Part IV  Additional Testing  157

17  Cytology  159
18  Histopathology  165
19  Infectious Disease Testing  171
20  Toxicology Testing  175
21  Packaging and Shipping Samples  179

Appendix 1: Normal Organ Weights (Percentage Body Weight)  183
Appendix 2: North American Diagnostic Laboratories  187
Appendix 3: Tissue Collection Checklist  193
Appendix 4: Describing Gross Lesions  195

Index  197
Contents

List of Contributors \hspace{1em} xv
Foreword \hspace{1em} xvii
Acknowledgments \hspace{1em} xix
About the Companion Website \hspace{1em} xxi

Part I Necropsy Fundamentals 1

1 Introduction to the Necropsy 3
Sean P. McDonough and Teresa Southard
1.1 What is a Necropsy? 3
1.2 Why do a Necropsy? 3
1.3 What Information Can and Cannot Be Gained from a Necropsy 3
1.4 When to Refer a Necropsy 4

2 Necropsy Basics 9
Sean P. McDonough and Teresa Southard
2.1 Necropsy Facilities 9
2.2 Necropsy Equipment 9
2.3 Safety Considerations 13
2.3.1 Cuts and Punctures 14
2.3.2 Zoonotic Disease 14
2.3.3 Formalin 15
2.4 The Importance of a Good History 15
2.5 The Necropsy Report 15
2.5.1 Gross Description 15
2.5.2 Gross Findings 16
2.5.3 Gross Diagnosis 16
2.5.4 Comment 16
2.6 Postmortem Changes 16

3 The Necropsy Procedure 21
Sean P. McDonough and Teresa Southard
3.1 Introduction 21
3.2 Weigh the Body 21
Contents

3.3 External Examination 21
3.4 Reflect the Skin and Right Limbs 22
3.5 Open the Abdominal Cavity 26
3.6 Puncture the Diaphragm 27
3.7 Open the Thoracic Cavity 27
3.8 Open the Pericardium 28
3.9 In Situ Examination of Organs 29
3.10 Remove the Adrenal Glands 30
3.11 Remove the Pluck 30
3.12 Remove the Gastrointestinal Tract, Liver, and Spleen 32
3.13 Remove the Urogenital Organs 34
3.14 Remove the Head 35
3.15 Take Out the Eyes 35
3.16 Remove the Brain 36
3.17 Remove the Pituitary Gland 37

Bibliography 37

Part II  Organ Systems 39

4 The Integumentary System 41
Jeanine Peters-Kennedy
4.1 Anatomy Review 41
4.1.1 External Ear Canal Anatomy 42
4.2 In Situ Examination and Removal 42
4.2.1 Primary Lesions 42
4.2.2 Lesions that May Be Primary or Secondary 43
4.2.3 Secondary Skin Lesions 43
4.3 Organ Examination, Sectioning, and Fixation 44
4.3.1 Cytology 44
4.3.2 Skin Scrapes 44
4.3.3 Hair Examination (Trichogram) 44
4.3.4 Examination of the External Ear Canal 44
4.3.5 Sampling the Skin 45
4.4 Common Artifacts and Postmortem Changes 46
Bibliography 46

5 The Musculoskeletal System 49
Teresa Southard
5.1 Anatomy Review 49
5.1.1 Bones and Joints 49
5.1.2 Teeth 51
5.1.3 Skeletal Muscle 52
5.2 In Situ Evaluation, Sectioning, and Fixation 52
5.2.1 Bones 52
5.2.2 Joints, Tendons, and Ligaments 54
5.2.3 Skeletal Muscle 55
5.3 Special Techniques  55
5.3.1 Postmortem Imaging  55
5.3.2 Cleaning Bones  56
5.3.3 India Ink Evaluation of Articular Cartilage  56
5.3.4 Examining the Intervertebral Discs  56
5.3.5 Submitting Muscle for Additional Tests  56
5.4 Common Artifacts and Postmortem Changes  56
Bibliography  57

6 The Cardiovascular System  59
Kathleen M. Kelly
6.1 Anatomy Review  59
6.1.1 Right Heart  59
6.1.2 Left Heart  60
6.1.3 Vessels: Great and Small  60
6.1.4 Contextual Cardiac Embryology and Congenital Heart Malformations  62
6.2 In Situ Evaluation and Removal  63
6.3 Organ Examination, Sectioning, and Fixation  64
6.4 Common Artifacts, Non-lesions, and Postmortem Changes  66
Bibliography  68

7 The Respiratory System  69
Elizabeth L. Buckles and Teresa Southard
7.1 Anatomy Review  69
7.2 In Situ Evaluation and Removal  71
7.3 Organ Examination, Sectioning, and Fixation  72
7.3.1 Larynx and Trachea  72
7.3.2 Lungs  73
7.3.3 Nasal Cavity and Sinuses  74
7.4 Special Techniques  74
7.5 Common Artifacts and Postmortem Changes  75
Bibliography  75

8 The Alimentary System  77
Gerald E. Duhamel
8.1 Anatomy Review  77
8.1.1 The Oropharyngeal Cavity  77
8.1.2 The Salivary Glands  78
8.1.3 The Esophagus  78
8.1.4 The Stomach  79
8.1.5 The Small Intestine  79
8.1.6 The Large Intestine  81
8.1.7 The Intestinal Vasculature and Nervous System  82
8.2 In Situ Evaluation and Removal  82
8.2.1 The Esophagus  83
8.2.2 The Gastrointestinal Tract  83
8.3 Organ Examination, Sectioning, and Fixation  85
### Contents

8.3.1 Gastrointestinal Tract 85  
8.4 Special Techniques 87  
8.5 Common Artifacts and Postmortem Changes 88  
Bibliography 89

9 The Liver and Pancreas 91  
Sean P. McDonough

9.1 Anatomy Review 91  
9.1.1 The Liver 91  
9.1.2 The Pancreas 93  
9.2 In Situ Evaluation and Removal 94  
9.2.1 The Liver 94  
9.2.2 The Pancreas 96  
9.3 Organ Examination, Sectioning, and Fixation 96  
9.3.1 The Liver 96  
9.3.2 The Pancreas 98  
9.4 Common Artifacts and Postmortem Changes 98  
9.4.1 The Liver 98  
9.4.2 The Pancreas 99  
Bibliography 99

10 The Urogenital System 101  
Teresa Southard

10.1 Anatomy Review 101  
10.2 In Situ Evaluation and Removal 103  
10.3 Organ Examination, Sectioning, and Fixation 103  
10.3.1 Kidneys 103  
10.3.2 Ureters 104  
10.3.3 Bladder and Urethra 104  
10.3.4 Ovaries 105  
10.3.5 Oviduct/Uterus/Cervix/Vagina 105  
10.3.6 Testes/Epididymides/Ductus Deferens 105  
10.3.7 Prostate Gland 105  
10.3.8 Bulbourethral Gland (Cats Only) 106  
10.3.9 Distal Colon/Rectum/Anus 106  
10.4 Special Techniques 106  
10.5 Common Artifacts and Postmortem Changes 106  
Bibliography 106

11 The Nervous System 107  
Andrew D. Miller

11.1 Anatomy Review 107  
11.2 In Situ Evaluation and Removal 108  
11.2.1 Brain 108  
11.2.2 Spinal Cord 109  
11.2.3 Peripheral Nerves 110  
11.3 Organ Examination, Sectioning, and Fixation 110  
11.3.1 Brain 110
14.3 Organ Examination, Sectioning, and Fixation 138
14.3.1 Thymus 138
14.3.2 Lymph Nodes 138
14.3.3 Spleen 140
14.3.4 Bone Marrow 140
14.4 Incidental Findings 141

Part III Special Cases 143

15 Small Mammal Necropsies 145
Teresa Southard
15.1 Species Differences 145
15.2 Necropsy Technique 145

16 Fetuses and Neonatal Animals 153
Teresa Southard
16.1 Anatomy 153
16.1.1 Placenta 153
16.1.2 Umbilical Cord 153
16.1.3 Fetal Circulation 153
16.2 Necropsy Technique 154
16.3 Common Artifacts and Postmortem Changes 156

Part IV Additional Testing 157

17 Cytology 159
Teresa Southard
17.1 Types of Cytology Preparations 159
17.2 Making a Touch Imprint 159
17.3 Making a Bone Marrow Smear 159
17.4 Other Preparations 160
17.5 Staining 160
17.6 Atlas of Normal Tissues 161

18 Histopathology 165
Sean P. McDonough and Teresa Southard
18.1 Necropsy Samples for Histopathology 165
18.2 Fixation 165
18.3 Practical Guidelines to Optimize Fixation 168

19 Infectious Disease Testing 171
Teresa Southard
19.1 Test Types 171
19.2 Aerobic Culture 171
19.3 Anaerobic Culture 173
19.4 Fungal Culture 173
19.5 Fluorescent Antibody Tests 174
19.6 PCR 174
19.7 ELISA 174
19.8 Virus Isolation 174
19.9 Qualitative Fecal 174
19.10 Immunohistochemistry 174

20 Toxicology Testing 175
Teresa Southard

Bibliography 175

21 Packaging and Shipping Samples 179
Sean P. McDonough
21.1 Packing Samples to Send to the Lab 180

Bibliography 180

Appendix 1: Normal Organ Weights (Percentage Body Weight) 183
Appendix 2: North American Diagnostic Laboratories 187
Appendix 3: Tissue Collection Checklist 193
Appendix 4: Describing Gross Lesions 195

Index 197