

Contents

Authors	IX
Abbreviations	XI
Preface	XIII

1 Birds

Introduction 1

General principles

1.1	Radiographic investigation	2
1.1.1	Equipment	2
1.1.1.1	Radiography unit	2
1.1.1.2	Screens and films	2
1.1.1.3	Radiation safety	3
1.1.2	Positioning and projections	3
1.1.2.1	Introduction	3
1.1.2.2	Positioning for imaging the body	4
1.1.2.3	Positioning for imaging the head	5
1.1.2.4	Positioning for imaging the wing	10
1.1.2.5	Positioning for imaging the hindlimb	10
1.1.3	Anatomical-physiological representation	12
1.1.3.1	Skeletal system	12
	Cranium and axial skeleton	12
	Trunk and limb skeleton	12
1.1.3.2	Cardiovascular system	20
1.1.3.3	Respiratory tract	20
1.1.3.4	Liver	22
1.1.3.5	Spleen	22
1.1.3.6	Gastrointestinal tract	24
1.1.3.7	Urinary tract	26
1.1.3.8	Genital tract	26
1.1.4	Contrast studies	28
1.1.4.1	Introduction	28
1.1.4.2	Contrast studies of the gastrointestinal tract	28
	Further reading	30
1.1.4.3	Contrast investigation of the excretory organs (urography)	32
1.1.4.4	Contrast investigation of the infraorbital sinus and diverticula (sinography, rhinosinography)	32
1.1.4.5	Contrast studies of the cardiovascular system (angiocardiology)	32
1.1.4.6	Myelography	34
	Further reading	34

1.2	Ultrasonographic examination	36
1.2.1	Technical requirements	36
1.2.2	Preparation of the patient, coupling sites	38
1.2.3	Procedure	38
1.2.4	Additional coupling sites	40
1.2.5	Biopsy	40
1.2.6	Contrast studies	42
1.2.7	Ultrasonographic imaging of normal structures	42
1.2.7.1	Skeletal system	42
1.2.7.2	Cardiovascular system	42
1.2.7.3	Respiratory tract	46
1.2.7.4	Liver	46
1.2.7.5	Spleen	48
1.2.7.6	Gastrointestinal tract and pancreas	48
1.2.7.7	Urinary tract	48
1.2.7.8	Genital tract	52
1.2.7.9	Eye	52
	Further reading	52
1.3	Computed tomography (CT)	54
1.3.1	Equipment	54
1.3.2	Preparation, positioning and planes	54
1.3.3	Assessment of the organs	54
1.3.3.1	Skeletal system	56
1.3.3.2	Respiratory tract	56
1.3.3.3	Other organs	58
	Further reading	58
1.4	Magnetic resonance imaging (MRI)	64
1.4.1	Equipment and uses	64
1.4.2	Preparation	64
1.4.3	Investigatory procedure	66
1.4.4	Imaging of the organs	66
	Further reading	66

Special diagnostics, pathological findings

1.5	Skeletal system	70
1.5.1	Cranium	71
1.5.2	Axial skeleton	71
1.5.3	Forelimbs	71
1.5.4	Hindlimbs	71
1.6	Cardiovascular system	84
1.6.1	Heart	84
1.6.2	Blood vessels	85

1.7	Respiratory tract	92	2.1.3.4	Contrast studies of the spinal cord (myelography)	156
1.7.1	Nasal passages and sinuses	92	2.2	Radioanatomy	158
1.7.2	Trachea and syrinx	92	2.2.1	Skeletal system	158
1.7.3	Lungs	93	2.2.1.1	Cranium with teeth	158
1.7.4	Air sacs	93	2.2.1.2	Spine, thorax	164
1.8	Gastrointestinal tract	104	2.2.1.3	Limbs	164
1.8.1	Esophagus and crop	104	2.2.2	Cervical soft tissues	168
1.8.2	Proventriculus	105	2.2.3	Thorax	168
1.8.3	Ventriculus	105	2.2.3.1	Esophagus	168
1.8.4	Intestines	105	2.2.3.2	Trachea	168
1.9	Liver and spleen	114	2.2.3.3	Thymus	168
1.9.1	Liver	114	2.2.3.4	Lungs	168
1.9.2	Gallbladder	115	2.2.3.5	Heart	170
1.9.3	Ascites	115		Further reading	172
1.9.4	Spleen	115	2.2.4	Abdomen	176
1.10	Urogenital tract	122	2.2.4.1	Gastrointestinal tract	176
1.10.1	Kidneys	122	2.2.4.2	Liver	180
1.10.2	Gonads	123	2.2.4.3	Pancreas	180
1.10.3	Oviduct	123	2.2.4.4	Spleen	180
	Further Reading	136	2.2.4.5	Urinary tract	180
1.11	Miscellaneous	136	2.2.4.6	Genital organs	182
	Further reading	136	2.2.4.7	Adrenals	182
			2.3	Ultrasonography	184
			2.3.1	Equipment	184
			2.3.2	Positioning and fixation	184
			2.3.3	Preparation of the patient	186
			2.3.4	Investigation protocol	186
			2.3.5	Documentation of the results	186
			2.4	Sonoanatomy	188
			2.4.1	Cervical soft tissues	188
			2.4.2	Thorax: echocardiography	188
			2.4.2.1	Equipment	188
			2.4.2.2	Preparation and positioning	190
			2.4.2.3	Standard planes	190
			2.4.2.4	Two-dimensional echocardiography	192
			2.4.2.5	One-dimensional echocardiography – M-mode	200
			2.4.2.6	Doppler echocardiography	204
			2.4.2.7	Measurements and reference values	204
			2.4.2.8	Measurements in the M-mode and two-dimensional echocardiography	210
			2.4.2.9	Measurements using PW and CW Doppler	210
			2.4.2.10	Special measurements and investigations	210
				Further reading	223
			2.4.3	Abdomen	224
			2.4.3.1	Gastrointestinal tract	224
			2.4.3.2	Liver	226
			2.4.3.3	Pancreas	226
			2.4.3.4	Spleen	226
			2.4.3.5	Urinary tract	230
			2.4.3.6	Female genital tract	232
			2.4.3.7	Male genital tract	236
			2.4.3.8	Adrenals	236
			2.4.4	Miscellaneous	238
			2.4.4.1	Eye	238

2 Small Mammals

Introduction	143
------------------------	-----

General principles

2.1	Radiography	144
2.1.1	Equipment	144
2.1.1.1	X-ray facilities	144
2.1.1.2	Film cassettes and grids	144
2.1.1.3	Film-screen combinations, imaging plate systems, and direct digital radiography	145
2.1.1.4	Exposure factors and development	146
2.1.1.5	Radiation safety	146
2.1.2	Positioning	146
2.1.2.1	General principles	146
2.1.2.2	Positioning for imaging the body	148
2.1.2.3	Positioning for imaging the head and teeth	150
2.1.2.4	Positioning for imaging the forelimbs	150
2.1.2.5	Positioning for imaging the hindlimbs	150
2.1.3	Contrast studies	152
2.1.3.1	Introduction	152
2.1.3.2	Contrast studies of the gastrointestinal tract	152
2.1.3.3	Contrast studies of the urinary tract (urography)	156

2.5	Computed tomography (CT) and magnetic resonance imaging (MRI)	242
-----	---	-----

Special diagnostics, pathological findings

2.6	Skeletal system	244
2.6.1	Cranium and teeth	244
2.6.2	Spine, thorax	246
2.6.3	Limbs	246
2.7	Cervical soft tissues	247
2.8	Thorax	256
2.8.1	Pleural cavity	256
2.8.2	Trachea	256
2.8.3	Esophagus	256
2.8.4	Lungs	256
2.8.5	Heart	257
2.8.5.1	Radiographic findings	257
2.8.5.2	Echocardiographic findings	258
	Further reading	260
2.9	Abdomen	280
2.9.1	Stomach	280
2.9.2	Small intestines	281
2.9.3	Appendix and large intestines	281
2.9.4	Liver	281
2.9.5	Pancreas	282
2.9.6	Spleen	282
2.9.7	Urinary tract	282
2.9.7.1	Kidneys	282
2.9.7.2	Ureter	283
2.9.7.3	Urinary bladder	283
2.9.8	Female genital tract	283
2.9.8.1	Vagina	283
2.9.8.2	Cervix	284
2.9.8.3	Uterus	284
2.9.8.4	Ovaries	284
2.9.9	Male genital tract	285
2.9.9.1	Testicles	285
2.9.9.2	Accessory sex glands	285
2.9.10	Adrenal glands	285
2.10	Miscellaneous	298
2.10.1	Eye	298
2.10.1.1	Cornea	298
2.10.1.2	Ciliary body	298
2.10.1.3	Lens	298
2.10.1.4	Peribulbar swelling	298
2.10.1.5	Exophthalmos	299
2.10.1.6	Trauma	299
2.10.1.7	Congenital eye anomalies	299
2.10.1.8	Neoplasia within the globe	299

3 Reptiles

Introduction	309
------------------------	-----

General principles

3.1	Radiographic investigation	310
3.1.1	Equipment	310
3.1.2	Positioning and projections	310
3.1.2.1	Radiography of lizards	311
3.1.2.2	Radiography of snakes	312
3.1.2.3	Radiography of chelonians	314
3.1.3	Contrast studies	316
3.1.4	Assessment of radiographs in reptiles	316
3.1.4.1	Radiograph quality (exposure, contrast, positioning)	316
3.1.4.2	Assessment of the skeleton and musculoskeletal system	318
3.1.4.3	General assessment of the internal organs	318
3.1.4.4	Evaluation of the individual organ systems	318
3.1.4.5	Standard radioanatomy	320
3.2	Ultrasonography	334
3.2.1	Equipment	334
3.2.2	Coupling sites	334
3.2.3	Approaches	336
3.2.3.1	Approaches in lizards	336
3.2.3.2	Approaches in snakes	336
3.2.3.3	Approaches in chelonians	338
3.2.4	Ultrasonographically controlled aspiration and biopsying	340
3.2.4.1	Biopsy of the liver in snakes	340
3.2.5	Assessment of the organs	342
3.2.5.1	Liver	342
3.2.5.2	Cardiovascular system	342
3.2.5.3	Urinary tract	348
3.2.5.4	Genital tract	348
3.2.5.5	Gastrointestinal tract	354
3.2.5.6	Fat bodies	354
3.2.5.7	Fluid	354
3.2.5.8	Tumors	354
3.2.5.9	Eye	354
3.3	Computed tomography (CT)	358
3.3.1	Equipment	358
3.3.2	Preparation, positioning, and scanning planes	358
3.3.3	Assessment of the organs	358
3.3.3.1	Skeletal system	358
3.3.3.2	Respiratory tract	360
3.3.3.3	Gastrointestinal tract and the liver	360
3.3.3.4	Urogenital tract	366
3.3.3.5	Other organs	366
	Further reading	366

3.4	Magnetic resonance imaging (MRI)	368	3.7	Gastrointestinal tract	398
3.4.1	Equipment	368	3.7.1	Excessive emptying of the gastrointestinal tract	398
3.4.2	Preparation, positioning, and scanning planes .	368	3.7.2	Foreign bodies	398
3.4.3	Assessment of the organs	368	3.7.3	Disturbances in emptying	398
3.4.3.1	Fat bodies and musculature	370	3.7.4	Infections	399
3.4.3.2	Respiratory tract	370	3.8	Liver	408
3.4.3.3	Liver	370	3.9	Urinary tract	414
3.4.3.4	Gastrointestinal tract	370	3.9.1	Kidneys	414
3.4.3.5	Urinary tract	370	3.9.2	Allantois	414
3.4.3.6	Genital tract	372	3.10	Genital tract	420
3.4.3.7	Other Organs	372	3.10.1	Ovary	420
	Further reading	372	3.10.2	Oviduct and eggs.....	420
Special diagnostics, pathological findings					
3.5	Skeletal system	378	3.11	Other organ systems, space-occupying lesions .	430
3.5.1	Fractures	378	3.11.1	Heart.....	430
3.5.2	Metabolic bone disease	379	3.11.2	Eye	430
3.5.3	Skeletal deformities and fusion	379	3.11.3	Space-occupying lesions	431
3.5.4	Luxations	379	Photograph credits		440
3.5.5	Bone and joint infections	379	Subject Index		441
3.5.6	Gout	380			
3.5.7	Neoplasia	380			
	Further reading	394			
3.6	Respiratory Tract	394			