

## **Pathology of Exotic Animals**

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In exotic animal medicine, the postmortem examination is a valuable part of the diagnostic work-up. The known disease conditions are not as well described as those of our domestic animals, so antemortem tests may only hint at the true disease pathology. In some situations, the findings in one animal will help others in a collection. The purpose of this overview is to describe a few of the more common disease presentations found on gross pathologic examination and to briefly review some highlights of the postmortem examination by species. The information presented here is by no means a complete description of all possible findings.

Before you agree to perform a postmortem examination, ask yourself if the owners have expressed any dissatisfaction with your treatment of this animal. If so, STOP! For your peace of mind and legal protection, you should consider sending the body to a pathologist for the examination. If the animal's owner has lost confidence in your veterinary abilities, it is unlikely they will accept your postmortem findings without question. In these cases, utilize a pathologist who has training, experience, or an interest in exotic species.

If you decide to perform the postmortem examination yourself, get your books and camera out! A quick refresher on the basic anatomy of the exotic species you are about to examine is useful. It is also helpful to develop a routine and use a check list to ensure you examine everything. Regardless of the system you utilize, it is important to describe all of your findings in the medical record. Don't be afraid to describe what you are seeing, even if it turns out to be normal. A helpful tip is to collect samples of EVERYTHING. For those tissues you may submit for histopathologic examination, cut two sections; one to retain and one to send in. If you collect a small or friable piece, place it in a another container separate from the larger sections or wrap it in gauze for protection and ease of later recovery. This will help to prevent these pieces from being overlooked in the submitted samples and protects the friable pieces from becoming the unexamined amorphous debris at the bottom of the container.

A cytologic study is an excellent way to augment your postmortem examinations. Make impression smears of any lesions and of all major organs. For example, impressions of the lung and spleen are useful in screening for atoxoplasmosis in canaries. The impression smear will also quickly differentiate tumor-like masses from mycobacterial granulomas. Another rarely utilized diagnostic tool for postmortem examinations, is the radiograph. A radiographic evaluation can alert you to bony lesions, fractures, and metallic densities.

Cultures are usually collected soon after opening the body cavity in order to reduce contamination. This is also the time to evaluate the endocrine system. Due to the small size of many of the endocrine glands, these glands need to be examined before they are obscured by the blood that will eventually fill the body cavity.

### **Selected Findings in the Gross Anatomy of Reptiles (1,2,3)**

The first incisions into a chelonian may require the use of a bone saw. Cut through the marginal bridge to remove the plastron from the carapace. Snakes are placed in dorsal recumbency and the incision is made from the inter-mandibular space to the cloaca at the junction of dorsal and ventral scales. Reflect the skin and dissect it away from ribs to give adequate exposure. Lizards are handled in the same manner as a mammals.

In snakes and chelonians the thyroid is a single structure immediately dorsal to heart. Lizards may have paired or bilobed thyroids. The parathyroids can be found in one or two pairs. In snakes and chelonians one pair is usually within or near the thymus. The parathyroids are difficult to identify, even in large animals. The thymus may be found anywhere from the base of the heart to the neck. Adrenal glands are elongated, paired, and are located caudomedial to the gonads in snakes. In chelonians the adrenal glands are located on the ventral surface of the kidneys. In lizards the adrenal is incorporated within the mesorchium or the mesovarium. The fat bodies of a reptile in good flesh will obscure most viscera.

As with most organs within the snake, the stomach is spindle shaped. Reptiles are the first vertebrate group with a colic cecum. The liver is the largest organ within the coelomic cavity. A gall bladder is present in all reptiles. The splenopancreas is usually in contact with the proximal duodenum.

The lungs appear as sac-like structures. In most snakes there is complete right lung and a vestigial left lung (exception: pythons, boas). In snakes the cranial lung is the area of gas exchange and the caudal lung is an air sac. The kidneys of most lizards and chelonians are found within the pelvic canal.

### **Selected Findings in the Gross Anatomy of Amphibians (4,5)**

It is important to complete a postmortem examination on a freshly dead or euthanized animal, as amphibians autolyze rapidly.

Examine the skin and collect scrapings of the body mucus especially in areas of hyperkeratosis, excessive mucus, or ulceration. A small section of the external gills is collected for a squash preparation. Immediate microscopic examination is necessary to identify most external protozoans, since the identification is made by seeing their movement and their living structures.

Evaluate the subcuticular lymph sacs over the dorsum, and in anurans (without tails, frogs and toads) the lymph spaces of the hindlimbs. The lymph fluid should be collected for cultures, and a tissue section, including the lymph sacs and overlying skin, collected for histopathology. Open the mouth to evaluate the oral cavity. Amphibians have a fleshy tongue, paired vocal sac openings in the male, internal nares, and a glottis. Make a ventral incision from the mandible to the cloaca. Take care to avoid the thin-walled bladder. The pectoral girdle and the sternum need to be incised. In females the ovaries are paired, black to grey grape-like masses. They will fill the coelomic cavity. The lungs are sac-like structures and extend the length of the coelomic cavity. Some salamanders (family Plethodontidae) utilize cutaneous respiration and have no lungs. The liver is usually black in color because of melanin pigment. The adjacent tissues may also be stained black in all but the freshest specimens. In anurans the liver is bilobed, and in salamanders it is elongated. A gall bladder is present in most amphibians. The stomach has a large fundic portion that opens into short, simple intestines. The kidneys are elongate, reddish brown, and lie in the mid-abdomen. Normal fat bodies are yellow, finger-shaped, and arise adjacent to the kidneys. In a malnourished animal they will be difficult to identify. The adrenals glands are also elongate, yellow, and lie on the ventromedial surface of the kidneys. The testes are paired, elongate, creamy white, and are located at the cranial pole of the kidneys.

### **Selected Findings in the Gross Anatomy of Laboratory Animals (6,7,8)**

In the mouse, brown fat is present as a subcutaneous fat pad over the shoulders. The stomach is divided into squamous nonglandular and glandular portions. The liver has a variable number of lobes. Male mice have spleens that are 50% larger than the females.

The rat also has a divided stomach with a glandular and squamous non-glandular portions. Also notable are the diffuse pancreas and large cecum. The liver has four lobes and no gall bladder.

The hamster stomach is divided into squamous and glandular parts with a distinct constriction between the parts. The cecum is divided into apical and basal sections by a semilunar valve. Hamster livers are four-lobed and contain a gallbladder.

The guinea pig has a very long colon that is 60% the length of the small intestine as compared to 16% in the rat. The large, thin-walled cecum has multiple pouches and it fills the left side of the abdomen. The liver has six lobes. The adrenal glands are large in this species.

In the rabbit, there is a glandular and non-glandular stomach. The cecum comprises 40% of digestive tract and has a high luminal water content. A unique feature is the sacculus rotundus located at the ileocecal junction. This structure contains many lymphoid follicles. There is a lymphoid appendix at the free end of the cecum. In the rabbit, 50% of the lymphoid tissue is gut-associated. The liver has four lobes and a gallbladder. The thoracic cavity is small compared to the abdominal cavity and contains a comparatively small heart.

<b>Gross Lesion</b>	<b>Animal/System</b>	<b>Differential Diagnosis</b>
<b>Amphibian</b>	<b>Musculoskeletal</b>	
Toe or foot Swollen	Bullfrog	Articular or periarticular gout 9
Submandibular edema	Newt	Renal disease 10
<b>Kidney</b>		
Swollen with multiple white, tan or yellow foci	Frog	Renal mineralization 10
<b>Skin</b>		
Dermatitis Ulcerative and Erosive	Amphibian sp.	Bacteria 4 Fungus 4 Capillaria 4 Trauma 4 Chemical toxins 4
Skin nodules	Amphibian sp.	Fungus 4 Parasitic granulomas 4 Capillaria 4 Mycobacteria 4 Trematode cercariae 4
Dermal hyperemia	Frog	Aeromonas hydrophila 9
Dermatitis Ulcerative and Erosive	Frog	Cutaneous mycosis (Chromomycosis) 10 11 Aeromonas hydrophila 12 Mycobacterium sp 12
Dermal mass Proliferative	Frog	Papilloma 12 Epithelioma 12
Mass Subcutaneous	Toad	Mycobacteria 12 Pseudocapillaroides (nematode) infestation 12 Parotid glands 12
<b>Special Senses</b>		
Eye Corneal opacity	Frog	Corneal ulceration 12 Lipid keratopathy 12

<b>Avian</b>	<b>Gastrointestinal</b>	
Oral cavity Yellow to brown caseous debris	Avian sp.	Hypovitaminosis A with 2° infection 12 Capillaria 12 Candida 12 Trichomonas 12 Bacterial abscess 12
Dilated crop, proventriculus, ventriculus, or intestines	Psittacine	Proventricular dilatation Disease 13
<b>Kidney</b>		
Swollen and pale	Avian sp.	Visceral gout 14
<b>Liver</b>		
Swollen and yellow	Avian sp.	Hepatic lipidosis 14 Normal in chicks 14 Adenovirus 15 Reovirus 15
Multiple white, tan, or yellow foci	Avian sp.	Mycobacteria 14 Hepatic necrosis secondary to chlamydia, bacterial, or viral infection 13
Pale, ± enlarged	Avian sp.	Lymphosarcoma 14 Amyloidosis 14
Swollen and mottled	Avian sp.	Mycobacteria 14 Bacteria 15 Chlamydia 15 HerpesVirus 15 Polyomavirus
Swollen and reddish-brown	Mynahs, toucans	Iron storage disease 14
Swollen and black	Raptor	Malaria 14
<b>Musculoskeletal</b>		
Foot Focal to diffuse swelling	Avian sp.	Pododermatitis 14 Articular gout 14
Hemorrhage within the calvarium	Avian sp.	Hypostatic intraosseous vascular congestion incidental 12 Brain hemorrhage 12 Encephalitis 12
Long bone exostosis	Avian sp.	Osteitis from respiratory fungal infections 12 Osteitis from Mycobacteria 12 Mesothelioma 12
Wing Mass lesion, thickening	Avian sp.	Osteoarthritis 12 Xanthoma 12
Serosal surfaces Thickening and Opacification	Avian sp.	Visceral gout 14 Infectious serositis 14
<b>Respiratory</b>		
Lung Reddened, heavy	Canary and finch	Lung mites (Sternostoma) 12
Lung Dark red and wet	Psittacine	Sarcocystosis 13 Teflon toxin 13 Necrotizing bacterial infection 13 Noxious gas inhalation 13

<b>Skin</b>		
Dermal nodules	Canary	Feather cyst 12
Subcutaneous swelling	Psittacine	Ruptured airsacs or subcutaneous emphysema 12
<b>Spleen</b>		
Splenomegaly	Canary	Systemic Pox 14 Atoxoplasma 16
Splenomegaly	Finch	Systemic Pox 14
Splenomegaly Black	Raptor	Malaria 14
<b>Special Senses</b>		
Eye Lens opacity	Raptor	Cataracts 12 Normal ocular opacity of young owls 12

<b>Reptile</b>	<b>Cardiovascular</b>	
Aorta Pale and thickened	Common green iguana	Aortic mineralization due to dietary imbalances 12
<b>Gastrointestinal</b>		
Stomach Thickened walls	Snake	Cryptosporidiosis 9,17 Adenocarcinoma 18
Oral Cavity Yellow to brown caseous debris Mucus membranes, Hyperemic to pale, mottled	Snake	Bacterial stomatitis 10 Visceral gout 9
Enteritis Fibrinonecrotic	Tortoise	Salmonella 10
<b>Liver</b>		
Swollen and yellow	Reptiles	Hepatic lipidosis 12
Multiple white, tan, or yellow foci	Snake	Visceral gout 12
<b>Kidney</b>		
Swollen and pale	Common green iguana	Interstitial nephritis 9
Swollen and pale ± Multiple white, tan, or yellow foci	Snake	Renal mycetoma 9 Visceral gout 9
Pale, Mottled, and enlarged	Snake, Tortoise	Renal gout 10 Renal tubular adenoma-snake 10
<b>Musculoskeletal</b>		
Coelomic cavity Numerous red raised lesions	Reptile	Serous atrophy of the fat bodies 9
Mandible Firm swelling	Common green iguana	Nutritional osteodystrophy 12 Abscess 12 Ossifying fibroma 9
Limb Firm swelling	Common green iguana	Abscess 9 Osteomyelitis 9 Metabolic bone disease 9 Subcuticular parasitism 9
Cardiac and/or Skeletal Muscles White to grayish streaks	Common green iguana	White muscle disease (Vitamin E and Selenium deficiency) 9 Soft tissue mineralization
Spinal Column Proliferative or lytic lesions	Snake	Trauma 19 Osteomyelitis 19 Osteitis deformans 19 Chondrosarcoma 19
<b>Skin</b>		
Proliferative, raised lesions	Lizard	Epidermal papillomata 9
Raised, reddened lesions	Snake	Abscess 12 Fibrosarcoma 12 Blister Disease 12 Foreign Body dermatitis 12 Squamous Cell Carcinoma 9
Firm subcutaneous mass	Snake	Malignant chromatophoroma 9 Dermatomycosis 9 Encysted subcuticular parasites (Spirometra, Pentastomid) 9
Hyperemic to ulcerative	Tortoise	Hypervitaminosis A 9

<b>Small Exotic Mammal</b>	<b>Cardiovascular</b>	
Pleuritis and Pericarditis Fibrinopurulent	Guinea Pig	Streptococcus pneumoniae 20
Pigmented meninges, parathyroid glands, heart valves	Mouse	Melanosis 6
Cardiac Muscles White to grayish streaks	Mouse	Spontaneous myocardial mineralization 6 Auricular thrombosis 6
Aorta Pale and thickened	Rabbit	Kidney failure and uremia with aortic mineralization 10 Nutritional mineralization 10
Pleuritis and Pericarditis Fibrinopurulent	Rat	Streptococcus pneumoniae 20
<b>Gastrointestinal</b>		
Intestine Pale and thickened	Ferret	Campylobacter-like (Proliferative colitis) 10
Gastric ulcers	Ferret	Helicobacter mustelidae
Cecum and Large intestine Congested and Distended	Guinea Pig	Antibiotic-associated enteropathy 20 Coccidiosis 6
Ileum Thickened and enlarged	Hamster	Proliferative enteropathy 20
Intestines Flaccid and distended	Mouse	Epizootic diarrhea of infant mice 6
Intestines Thickened	Mouse	Normal physiological mucosal hyperplasia of lactation 6 Citrobacter freundii (Transmissible murine colonic hyperplasia) 6
Gastric ulcers	Rabbit	Enterotoxemia 21
Ileum Flaccid, dilated	Rat	Tyzzers' disease 6
<b>Kidney</b>		
Enlarged and pale	Hamster	Amyloidosis 20 Degenerative renal disease 6
Enlarged and pale	Mouse	Amyloidosis 6
Pale	Rabbit	Encephalitozoon cuniculi 21a
Fluid-filled cysts	Rat	Hydronephrosis 6 Pyelonephritis 6 Polycystic kidneys 6 Renal papillary necrosis 6
Enlarged, pale ± cortical pitting	Rat	Chronic progressive nephropathy 6,20
<b>Liver</b>		
Enlarged with Multiple white, tan, or yellow foci	Gerbil	Tyzzers' disease 6,20,22
Enlarged with Multiple white, tan, or yellow foci	Guinea Pig	Tyzzers' disease 6,20
Enlarged and pale	Guinea Pig	Cavian lymphocytic leukemia 6
Enlarged with Multiple white, tan, or yellow foci	Hamster	Tyzzers' disease 6,20,22
Enlarged with Multiple white, tan, or yellow foci	Mouse	Mouse hepatitis virus 6 Streptobacillus moniliformis 20 Tyzzers' disease 20 Mousepox 6

Multiple white, tan, or yellow foci	Rabbit	Hepatic coccidiosis 8 Migrating Tapeworm larvae 8 Colibacillosis 8 Tularemia 8 Listeriosis 8 Salmonellosis 8 Toxoplasmosis 8,23 Tyzzer's Disease 20
Enlarged and pale	Rat	Leukemia 6
Enlarged with Multiple white, tan, or yellow foci	Rat	Tyzzer's disease 6
<b>Musculoskeletal</b>		
Mass in cervical region	Guinea Pig	Cervical Lymphadenitis 20 Thyroid Papillary Adenoma 24
Widespread hemorrhages esp. around enlarged joints	Guinea Pig	Hypovitaminosis C 20
Mandibular region Firm swelling	Rabbit	Abscess 12
Skeletal Muscles White to greyish streaks	Rabbit	Ionophore toxicity 25 Vitamin E/Selenium Deficiency 25
Mandibular region Swelling	Rat	Sialodacryoadenitis virus 6 Streptobacillus moniliformis 20
<b>Reproductive</b>		
Ovary cystic	Guinea Pig	Cystic rete ovarii 6
Testis Swollen	Ferret	Hydrocoele 12
Uterus Thickened walls, ± Discrete swellings	Rabbit	Pyometra 26 Adenoma 12 Adenocarcinoma 12 Endometrial Venous Aneurysms 27
Ovary cystic	Rabbit	Ovarian abscesses 26
<b>Respiratory</b>		
Lung Mottled with patchy consolidation	Guinea Pig	Bordetella bronchiseptica 20 Streptococcus pneumoniae 20 Streptococcus zooepidemicus 20
Lung Heavy, red, and wet	Guinea Pig	Heat Stress 20
Lung Mottled with patchy consolidation	Mouse	Mycoplasma 6,20 Sendai virus 20
Lung Heavy, red, and wet	Mouse	Heat exhaustion 20
Nasal Passages Mucopurulent exudate, ± extending into major airways	Mouse	Mycoplasma 6,20
Lung Mottled with patchy consolidation	Rabbit	Pasteurella bronchopneumonia 12
Lung Heavy, wet, red	Rat	Pseudomonas aeruginosa septicemia 6 Heat exhaustion 20
Lung Mottled with patchy consolidation	Rat	Mycoplasma 6,20 CAR-cilia-associated respiratory bacillus 6 Streptococcus pneumoniae 20

Lung Multiple nodules in pulmonic parenchyma	Rat	Chronic mycoplasma with abscess formation 6,20 Corynebacterium kutscheri abscesses 6 Chronic CAR infection 6 Histiocytic sarcoma 6
Nasal Passages Mucopurulent exudate, ± extending into major airways	Rat	Mycoplasma 6,20
<b>Skin</b>		
Alopecia	Ferret	Adrenal cortical disease 10 Seasonal molting 12 Sarcoptic mange 12 Dermatophytes 12
Alopecia	Guinea Pig	Endocrine/metabolic disorders 6 Pregnancy alopecia 6 Sarcoptic mange (Trixacarus caviae) 12 Dermatophytes 12 Pediculosis (Glirocola porcelli) 6
Subcutaneous mass	Guinea pig	Trichofolliculoma 6
Alopecia	Hamster	Demodectic mange (Demodex criceti and D. aurati) 28,20 Cutaneous Lymphoma 29 Endocrine disorders 6
Alopecia	Mouse	Barbering 12 Dermatophytes 12 Mites (Myobia musculi) 12
Dermatitis Multifocal ±ulcerative	Mouse	Bacterial 6 Mites (Myobia musculi) 6 Acariasis hypersensitivity 6 Mousepox 6
Subcutaneous mass	Mouse	Mammary gland tumor, benign and malignant 12 Abscess 12
Alopecia	Rabbit	Barbering 8 Cheyletiella infestation 8 Demodex 8 Sarcoptic mange 8 Dermatophytes 8
Dermatitis Multifocal ±ulcerative	Rabbit	Cutaneous myiasis (Cuterebra sp.) 10
Alopecia	Rat	Dermatomycosis 6 Radfordia ensifera mite 6
Dermatitis Multifocal ±ulcerative	Rat	Staphylococcus aureus 6 Dermatomycosis 6
Subcutaneous mass	Rat	Mammary gland tumor, benign and malignant 12 Abscess 12
<b>Special Senses</b>		
Eye Exophthalmia	Rabbit	Retrobulbar abscess 8 Heritable buphthalmos 8

<b>Spleen</b>		
Splenomegaly	Ferret	Lymphosarcoma 10 Idiopathic hypersplenism 30
Splenomegaly	Mouse	Streptobacillus moniliformis 20 B cell lymphoma 6
Splenomegaly	Rat	Pseudomonas aeruginosa septicemia 6 Salmonella 6 Leukemia 6

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