

PATHOLOGY OF GUINEA PIGS, HAMSTERS and GERBILS

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PURPOSE

The purpose of this 1.5-hour block of instruction is to gain knowledge and experience in the gross diagnosis of diseases of these three rodent species which are actually very rarely used in research today. In most cases, among pathologists, interest in these species generally stems from board preparation.

There is extensive overlap in diseases affecting these species (especially infectious disease) and other rodents such as rats and mice, although each species does have one or two unique spontaneous diseases to call their own. When confronted with disease presentation in this species, the observer is well-cautioned to consider the presentation in light of their experience with other rodents and lagomorphs.

I have included a brief morphologic diagnosis for each entity. The formulation of concise, accurate morphologic diagnoses is a major pursuit of every good pathologist, especially those who seek certification in this specialty. The formulation of a good morphologic diagnosis is a learned skill; for those seeking additional experience in this endeavor, I would suggest attendance at the annual AFIP Descriptive Pathology Course in Washington, DC.

Slide No.	Organ	Condition	Morphologic Diagnosis	Notes
1	TITLE SLIDE			
2	PHOTOGRAPH CREDITS			
3	GUINEA PIGS			
4	Skin, pinna	Acromelanism		"Albino" GP are actually acromelanic, with melanin on pinna and feet.
5	Plantar aspect of feet			
6	Teats	Normal		GPs have two paired conical inguinal nipples
7	Vesicular glands	Normal		Male GPs have extremely large vesicular glands.
8	Penis	Normal		The end of the penis has two horny "styles" on either side of the urethra.
9	Vulva	Vaginal closure membrane		Like other hystricomorphs, females have a vaginal closure membrane which is perforated only at estrus and parturition.
10	Lung	Pulmonary arterial hyperplasia	Smooth muscle hyperplasia of pulmonary arteries	This is a normal finding in guinea pigs and should not be construed as evidence of pulmonary hypertension.
11	Lung:	Perivascular lymphoid nodules		These are common findings in guinea pigs and do not necessarily
12	Presentation	Pregnancy		Sows can more than double their weight during pregnancy – infants are large and precocious.
13	Peripheral blood	Kurloff body		Kurloff cells contain a single PAS-positive secretory granule, are more prevalent in females, and may serve anti-cancer or immune-modulating functions. They are seen in increased numbers in the
14	Spleen	Kurloff cells		

				placenta and spleen, and estrogen administration causes a rise in numbers.
15	Lung	<i>Bordetella bronchiseptica</i>	Multifocal to coalescing suppurative bronchopneumonia	<i>B. bronchiseptica</i> is one of the most important GP pathogens. Due to its predilection for ciliated epithelium, it causes classic bronchopneumonia and may be also recovered from the tympanic bulla and uterus. Rabbits may serve as a source of infection.
16	Lung, heart	Streptococcus pneumonia	Diffuse severe fibrinosuppurative pleuropneumonia and fibrinous pericarditis	Not as commonly seen today, pneumococcal infections often are triggered by environmental changes. Suppurative lesions in multiple organs and fibrinosuppurative exudates in body cavities are characteristic. High mortality may be seen in outbreaks.
17	Lungs	Adenoviral pneumonia	Bilaterally symmetrical necrotizing bronchitis and bronchiolitis	Adenoviral pneumonia, characterized by necrosis of airway epithelium and prominent intranuclear inclusions, may have up to 100% in outbreaks. Outbreaks usually occur following experimental manipulation.
18	Heart	Rhabdomyoma	Focally extensive Cardiac muscle glycogenesis	This is a common incidental finding seen in increased prevalence with age. The condition is currently thought to be a glycogen metabolism disorder
19	Aorta	Aortic mineralization	Focally extensive aortic mineralization	Metastatic calcification is a common finding in older guinea pigs, and maybe worsened by diets with low magnesium, high calcium, and high phosphorus diets.
20	Heart	Metastatic calcification		
21	Cheek teeth	Malocclusion	Malocclusion of cheek teeth with lingual	Normal growth of cheek teeth in guinea pigs results in lingual spur

			entrapment	formation in the mandible, and buccal spurs in the maxilla.
22	Facial skin	“Slobbers”	Moist facial dermatitis	“Slobbers” is a result of malocclusion in rodents and lagomorphs.
23	Salivary gland, lung	Cytomegalovirus	Multiple intranuclear inclusions in salivary ductular epithelium	Cytomegalovirus is a latent infection in many gp colonies which infects salivary gland, kidney, and liver. Rare cases of systemic CMV have been reported in weanlings, and occasional cases of lymphoproliferative disease may be seen.
24	Stomach	Bloat	Diffuse gastric dilatation	Gastric dilatation and volvulus are occasionally seen as a sporadic finding; predisposing factors have not been identified.
25	Intestine	Intussusception	Focal jejunal intussusception	
26	Cecum	Coccidiosis	Diffuse chronic necrotizing typhlitis.	<i>E. caviae</i> may cause increased severity of a number of other enteric diseases, or weight loss and debilitation in weanlings.
27	Intestine	Cryptosporidium wrairi	Diffuse catarrhal and hyperplastic enteritis	Young guinea pigs less than 6 months manifest disease with ill thrift, weight loss, and diarrheic feces.
28	Anus	Fecal impaction		Seen in geriatrics due to loss of muscle tone or impaired cecotrophy.
29	Liver	Salmonellosis	Multifocal to coalescing necrotizing and granulomatous hepatitis	Now uncommon in lab animal colonies, the “paratyphoid nodules” of <i>Salmonella typhimurium</i> are a rare finding. Outbreaks claim 50% mortality, with weanlings and pregnant sows hardest hit. Zoonotic potential (and potential for human sources)
30	Spleen		Multifocal to coalescing necrotizing and granulomatous	

			splenitis	must be considered.
31	Liver	Idiopathic hepatic necrosis	Multifocal to coalescing hepatic coagulative necrosis	An occasional finding in guinea pigs, terminal blood flow changes in the liver are postulated to be the cause.
32	Liver	Pregnancy toxemia	Diffuse hepatic lipidosis	Two forms, the metabolic and circulatory forms are identified in gps. The metabolic form is seen in obese sows during last 2-3 weeks of pregnancy is the result of caloric deprivation due to changes in diet or environment. The circulatory form results in uteroplacental ischemia due to compression of the aorta caudal to the renal vessels by the gravid uterus, and is also associated with uterine and placental hemorrhage and necrosis.
33	Cervical lymph node	Cervical lymphadenitis	Focally extensive suppurative cervical lymphadenitis	Cervical lymph nodes are a characteristic location for abscesses due to <i>S. zooepidemicus</i> (Lancefield Group C). Inoculation is usually the result of oral abrasions with contamination. Most guinea pigs harbor the organism in the nasopharynx.
34	Cervical lymph nodes	Cavian leukemia	Cervical node lymphoma	Cavian leukemia is a leukemic form of lymphoma (as the name suggests) with massive numbers of lymphoblasts within circulating blood and infiltrating numerous organs. Both type C retrovirus particles have been seen in the disease, and it has been transmitted by transplanted cells and cell-free extracts.
35	Liver		Hepatic lymphoma	
36	Liver			
37	Stifles	Hypovitaminosis C	Bilateral periarticular	Vitamin C is a cofactor for lysyl and

		(scurvy)	hemorrhage	proline hydroxylases, a requirement of the proper cross-linking of Type I and IV collagen. Deficiency results in mineralized abnormal cartilage that cannot be remodeled and converted to bone. Deficient type IV collagen results in increased capillary fragility. Other lesions include odontoblastic defects, decreased cholesterol metabolism, decreased resistance to bacterial infections, and aberrations in amino acids.
38	Costochondral junction		Diffuse costochondral osteodystrophy	
39	Hind feet	Ulcerative pododermatitis	Bilateral chronic suppurative pododermatitis	Ulcerative pododermatitis (also known as “bumblefoot”, is a common problem in guinea pigs associated with wire cages, poor sanitation, and obesity. The infection is often due to coagulase-positive <i>S. aureus</i> and severe cases may be associated with systemic amyloidosis.
40	Face	Sarcoptic mange	Focally extensive ulcerative and eosinophilic dermatitis	<i>Trixacarus caviae</i> , the sarcoptid mite of the guinea pig causes intense pruritus and crusting excoriations over the body. Hematologic signs may be seen, and severe pruritus may result in seizures. Affected animals may lose body condition and die.
41	Hair	Pediculosis	Diffuse pelagic peiculosis	<i>Gliricola porcelli</i> and <i>G. ovalis</i> are large common lice that are often seen in guinea pigs.
42	Face	Dermatophytosis	Focally extensive proliferative and hyperkeratotic dermatitis	Usually due to <i>T. mentagrophytes</i> , dermatophytosis is common in guinea pig colonies (although most animals are asymptomatic. Environmental condition may predispose to outbreaks.

43	Abdomen	Telogen effluvium	Diffuse alopecia	Telogen effluvium can occur in a number of conditions, especially pregnancy, weaning, or other stressful conditions.
44	Haired skin	Trichofolliculoma		Trichofolliculoma is the most common skin neoplasm of gps, is invariable benign, and differentiates toward all three segments of the hair follicle.
45	Perineum	Urine scald	Focally extensive perineal exfoliative dermatitis	Urine scald in any pet rodents or lagomorphs suggests poor husbandry/sanitation.
46	Eye	Guinea pig inclusion conjunctivitis	Focally extensive suppurative conjunctivitis	Usually seen in gps from 4-8 weeks, GPIC (due to <i>C. psittaci</i>) is usually a self-limiting disease. Other syndromes, such as pneumonia or abortions have been reported.
47	Eye	"Pea eye"	Unilateral prolapse of the third eyelid	The third eyelid is prolapsed as a result of swelling of the lachrymal gland and/or local fatty tissue.
48	Presentation	Lethal white	Multiple defects	25% of the offspring of roan or Dalmatian guinea pigs are homozygous for the roan allele, resulting in a constellation of birth defects including white coloration, microphthalmia, deafness, malocclusion, malabsorption, and a poor immune system.
49	Uterus	<i>Bordetella bronchiseptica</i>	Diffuse chronic and suppurative endometritis	<i>B. bronchiseptica</i> is occasionally isolated from the uterine tract, and during outbreak, pregnant sows may abort or deliver stillborn.
50	Ovaries	Cystic rete ovarii	Bilateral ovarian cysts	Cystic rete ovarii are associated with decreased reproductive performance in sows aged 1.5 years or older.

52	Uterus	Mucometra	Mucometra	Mucometra, hydrometra, and cystic endometrial hyperplasia have all been reported in association with cystic rete ovarii.
53	Kidney, adrenal gland	Segmental nephrosclerosis	Multifocal to coalescing fibrosing interstitial nephritis	GPs have a characteristic pattern of segmental fibrosis which parallels chronic progressive renal disease in other species. Note the very large size of the adrenal gland in the GP.
54	Kidney	Segmental nephrosclerosis		In segmental nephrosclerosis, the glomeruli are largely spared.
55	Kidney	Polycystic kidney	Multiple renal cortical cysts	It happens in guinea pigs just like in other species.
56	Urinary bladder	Urolithiasis	Multiple cystic calculi	Cystic calculi are seen in older sows, and chronic bacterial UTIs are considered a major predisposing cause.
57	Fetus, presentation	Anasarca		Dystocia is a common problem in gps due to the large size at births.
58	HANSTERS			
59	Presentation	Syrian or Golden Hamster		Most Golden Hamsters today originated from the same litter captured in Syria in 1930, resulting in a low number of MHC genes due to extensive inbreeding.
60	Presentation	Chinese or gray hamster		
61	Cheek pouches	Normal		Cheek pouches are highly distensible and an anatomically privileged site.
62	Hip glands	Normal		Sebaceous glands used for scent marking.
63	Presentation	Diarrhea		“Wet tail” is a commonly abused term for a variety of bacterial causes of enteritis in this species.

64	Ileum	<i>Lawsonia intracellulare</i>	Diffuse proliferative ileitis	The classic cause of “wet-tail” in this species, <i>L. intracellulare</i> results is epizootics in younger animals, primarily weanlings, with resistance occurring about 10-12 weeks. Environmental changes can result in disease in older animals. In outbreaks, morbidity of 60% and mortality of 90% is expected.
65	Small intestine	<i>Helicobacter pylori</i>	Diffuse proliferative ileitis	A range of <i>Helicobacter</i> species have been identified in hamsters, and they can also be infected with <i>H. pylori</i> . Gastritis and intestinal metaplasia have been identified in hamsters infected with <i>H. aurati</i> .
66	Cecum	<i>Giardia muris</i>	Chronic lymphoplasmacytic typhlocolitis	Giardiasis in hamsters are usually asymptomatic, but some animals develop marked distention, both acute and gaseous and chronic with marked mural thickening. Infections may be associated with wasting and hepatic amyloidosis in this species.
67	Intestine	<i>Clostridium difficile</i>	Focally extensive transmural necrotizing enteritis	Clostridial infections in this species are associated with antibiotic administration. The most common bacteria in the hamster enteron are <i>Lactobacillus</i> and <i>Bacteroides</i> . Administration of –mycins and –cillins will precipitate overgrowth with <i>C. difficile</i> , toxin production, and death. Even non-treated animals in the same room may result in fatal typhlocolitis.
68	Liver	<i>Clostridium piliforme</i>	Multifocal to coalescing necrotizing hepatitis	Epizootics of Tyzzer’ disease, primarily in weanlings, may occur following environmental changes. Clostridial spores persist for up to 2 years in the environment.

69	Small intestine	<i>Rodentolepis nana</i>	Segmental catarrhal enteritis	<i>R. nana</i> infections are common but asymptomatic, and the life cycle is a direct one. There is zoonotic potential for a related tapeworm, <i>Hymenolepis diminuta</i> , in man.
70	Rectum	Rectal prolapse	Focally extensive rectal prolapsed and exenteration	This sequel to the multiple forms of “wet-tail” in this species is not uncommon. Pick one.
71	Liver	Hepatocellular inclusions		Non-specific inclusions are common in the liver of the hamster. IC may be lysosomes and represent liver injury, IN may represent nuclear membrane invaginations.
72	Liver, accessory sex glands	Polycystic disease	Multiple hepatic, intestinal, and peritesticular cysts	Considered to be of congenital origin, liver cysts (generally of biliary origin) are often accompanied by cysts in the gonads, accessory sex glands, and pancreas. They are considered incidental findings at necropsy..
73	Liver	Amyloidosis	Diffuse hepatic amyloidosis	Amyloidosis is a common cause of renal insufficiency and mortality in older hamsters, but may be seen as early as 5 mos. Affected livers have a prominent lobular pattern, and in the kidney, deposition being in the glomerulus.
74	Kidney		Diffuse renal amyloidosis	
75 76	Left atrium	Atrial thrombosis	Focally extensive atrial thrombosis	Atrial thrombosis is often associated with amyloidosis, although cardiac insufficiency may also play a role. Changes also occur in coag and fibrinolytic parameters in affected animals. May be seen in up to 33% in some colonies.
77	Pancreas	Diabetes mellitus	Focally extensive pancreatic islet degeneration and	Diabetes mellitus is autosomal recessive in some lines of Chinese hamsters. Unlike traditional diabetes, islet cells involute and

			necrosis	become necrotic, rather than accumulate glycogen.
78	Kidneys	Nephrosclerosis	Diffuse bilateral chronic progressive nephropathy.	Very similar to that seen in rats, it is a common cause of disease in mortality in older hamsters, and may confound chronic renal research protocols in this species.
79	Ovary	Paraovarian cysts		This finding is occasionally seen in hamsters.
80	Meninges, choroid	Lymphocytic choriomeningitis	Diffuse lymphoplasmacytic meningitis and choroiditis	This arenavirus has zoonotic potential, especially for immunosuppressed owners. Most hamsters are asymptomatic, and the virus is spread through saliva or urine. Serology is the recognized method for diagnosis.
71	Brain	Spontaneous hemorrhagic necrosis of the CNS	Focally extensive liquefactive cerebral necrosis	This condition has been seen in third trimester fetuses and newborn hamsters and is reproduced by feeding dams a vitamin E-deficient diet. Most affected pups are cannibalized.
82	Liver, mesenteric lymph nodes	Hamster papovavirus-associated lymphoma	Hepatic lymphoma	Hamster papovavirus is the agent of transmissible lymphoma, which primarily causes epizootics within naïve colonies. Tumors do not have detectable virus. It is spread in the urine. Enzootic infections of colonies require slaughter to rid the colony of the virus.
83	Haired skin	Hamster papovavirus-associated trichoepithelioma	Cutaneous trichoepitheliomas	Caused by the same virus as transmissible lymphoma, this form is more commonly seen in infected adults, and tumors do contain infectious virus (although it is likely not necessary for transmission.) These tumors are only seen in association with virus.

84	Haired skin	Demodicosis	Diffuse hyperkeratotic and proliferative dermatitis	<i>D. auratus</i> and <i>D. criceti</i> occur naturally in the Syrian hamsters. Infection is common, and lesions are rarely seen except in older animals.
85	Presentation			<i>D aurati</i> is a long, slender parasite that lives in hair follicles, while <i>D. criceti</i> are stubbier mites which live in epidermal “pits”.
86	Presentation		Diffuse hyperkeratotic and proliferative dermatitis	An alternate location for <i>D. aurati</i> is within the ostia of sebaceous glands.
87	Haired skin	T-cell epitheliotropic lymphoma	Cutaneous lymphoma	T-cell epitheliotropic lymphoma, also referred to as <i>mycosis fungoides</i> is a spontaneous lymphoma of older hamsters.
GERBILS				
88	Presentation	Mongolian gerbil		Mongolian gerbils are the most common type of gerbil used in research today. Additional types include jirds, sand rats, and antelope rats. Gerbils are diurnal and won't bite you like hamsters.
89	Presentation	Gerbils		All sorts of pretty colors. The agouti pattern is the standard color.
90	Presentation	Fat sand rat		<i>Psammomys obesus</i> , the fat sand rat is gaining in popularity due to a predilection to develop diabetes mellitus on normal rodent chows, and its extremely efficient kidney function.
91	Ventral abdomen	Ventral marking gland		The ventral marking gland of male gerbils is a modified sebaceous gland, and a site for cutaneous neoplasia.

92	Adrenal glands			Gerbils have extremely large adrenal glands (up to 4x that of other species.)
93	Presentation	Gerbil pups		Pups are not precocious, and eyes do not open until around 3 weeks – at which time they may be weaned. Distressed mothers will cannibalize young..
94	Nasal planum	“Sorenose”	Focally extensive ulcerative nasal dermatitis	Sorenose is a common problem in gerbils. When not groomed, porphyrin pigments from the nasolacrimal duct accumulate and irritate the nasal skin. This area is commonly infected by <i>S. aureus</i> as a sequel.
95	Tail	“Tail slip”		Gerbils should not be picked up by the tail. Tail slip is a degloving injury which is used to escape predators.
96	Presentation	Epilepsy		Epileptiform seizures are common among Mongolian gerbils under stress. Up to 40% are afflicted with the condition, and lines with high incidence are sought after for research purposes. No histologic lesions have been reported.
97	Cerebrum	Incomplete circle of Willis		Gerbils have an incomplete circle of Willis. Ligation of the common carotid artery results in cerebral ischemia, which makes them a good model for stroke research.
98	Middle ear	Aural cholesteatoma	Aural cholesterol granuloma	Up to 50% of gerbils over 2 years of age have aural cholesteatomas. These are masses of keratinizing epithelium which arise from the external surface of the eardrum and external auditory canal. Compression can result in destruction of the temporal bone

				and inner ear structures.
99	Presentation			Head tilt is a common presenting sign of aural cholesteatoma.
100	Liver	<i>Clostridium piliforme</i>	Multifocal to coalescing necrotizing hepatitis	Mongolian gerbils are very susceptible to the disease, and are often used as a sentinel to detect the presence of <i>C. piliforme</i> in the research facility.
101	Liver	<i>Salmonella enteritidis</i>	Multifocal to coalescing pyogranulomatous hepatitis	Fatal salmonellosis may be seen as epizootic in weanlings with evidence of paratyphoid nodules, enteritis, and septicemia.
102	Intestine	<i>Rodentolepis nana</i>		Very similar situation to that seen in hamsters. <i>R. nana</i> may be cause debilitation in severely affected gerbils.
103	Colon	<i>Dentostomella translucida</i>		The flattened eggs are unusual, but pinworms don't really cause any problems in this species. <i>Syphacia obvelata</i> has been reported in gerbils.
105	Kidney	Chronic progressive nephropathy	Diffuse chronic interstitial nephritis	This common lesion of aging gerbils results in thickening of glomerular and tubular basements membranes and abundant protein tubular casts.
106	Mite	<i>Demodex meriones</i>		It is unknown whether this actually may be one of the hamster mites. These are usually not a problem in healthy gerbils
107	Haired skin	Ventral marking gland carcinoma	Ventral marking gland carcinoma	These neoplasms are consistent with squamous cell carcinomas.
108	Ovary	Granulosa cell tumor	Ovarian granulose cell tumor	This is one of the most common neoplasms in gerbils
109	Adrenal gland	Adrenocortical adenoma	Adrenocortical adenoma	Another commonly recognized neoplasm in gerbils.

110	Heart	Focal Myocardial degeneration	Multifocal to coalescing myocardial fibrosis with myocyte loss	This is a common finding in older gerbils with up to 50% of male breeders affected. It is considered an incidental finding in the majority of cases. A linkage to hyperadrenocorticism has been proposed.
111	Eye	Cataracts		Yeah, they get them.