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Hematologic, Serologic, and Histologic Profile of Aged Siberian Hamsters (*Phodopus sungorus*)

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Biologic samples from 18 (12 female, 6 male) Siberian hamsters (*Phodopus sungorus*) representing an aged colony (17 to 27 mo) were examined. Values for CBC and serum biochemical parameters were determined, and macroscopic and microscopic pathologic evaluations were performed. Blood urea nitrogen levels were significantly higher in male (54.2 ± 14 mg/dL) compared with female (35.3 ± 22 mg/dL) hamsters and correlated histologically with a higher incidence of chronic glomerulonephropathy in males (5 of 6 males; 0 of 12 females). All 18 hamsters had histologic evidence of follicular mite infestation. Half (6 of 12) of the female hamsters showed cystic rete ovarii. Other histologic findings included thymic or thyroid branchial cysts (3 of 18), focal enteritis (2 of 18), and single cases of hepatic hemangiosarcoma, renal adenoma, subcutaneous mast cell tumor, cutaneous sebaceous adenoma, cutaneous trichofolliculoma, squamous papilloma of the nonglandular stomach, epididymal cholesteatoma, pyometra, and pituitary craniopharyngeal cyst. This study is the first published report of hematologic and serum chemical values for any population of Siberian hamsters and the first published report showing a potential male predisposition for chronic progressive glomerulonephropathy and a potential female predisposition for cystic rete ovarii.

The Siberian hamster (*Phodopus sungorus*) is a small rodent native to the steppes of Kazakhstan, Manchuria, and Northern China. *Phodopus sungorus* originally was considered to be a single species encompassing 2 subspecies, *P. s. sungorus* and *P. s. campbelli*. However, crossbreeding, behavioral, karyotypic, and physiologic data suggest that *P. sungorus* and *P. campbelli* are 2 distinct species.[34,35] Siberian hamsters are noted for having fur along the surface of their feet and a modest, attenuated tail, leading to their nickname of 'striped hairy-footed hamster.'

Although Siberian hamsters are a popular pocket pet, they also increasingly are found in the laboratory setting due to unique physiologic properties that facilitate specific animal models of disease and behavior. Siberian hamsters have been studied with regard to circadian rhythm,[37,38] photoperiod and its effect on reproduction,[11,29] torpor,[36] sleep,[22] hair-coat growth,[27] thermogenesis,[12,16] and fat metabolism.[12,16] The general advantages of Siberian hamsters as a laboratory animal include their ease of handling, small size (which enables efficient use of housing space), and their short reproductive cycle (which is the most compressed reproductive cycle of any eutherian mammal[25]). Their average lifespan is reported as ranging from 12 to 24 mo.[15,17]

The more commonly used Syrian hamster (*Mesocricetus auratus*) has been characterized extensively biochemically and hematologically, establishing reliable normal reference ranges for both sexes at various age ranges. However, few current sources[17,23,24] of similar detailed information regarding the biochemical and hematologic parameters for *P. sungorus* are available.

Documentation of spontaneous pathologic conditions in *P. sungorus* is also scarce. Prior reports have shown a limited number of spontaneous conditions (both neoplastic and nonneoplastic) within the more broad group of 'Russian' or 'Djungarian' hamsters, demonstrating a relatively high incidence of mammary tumors[21,30] and as integumentary fibromas.[3] Although there is a paucity of information regarding spontaneous infectious disease within this particular species, experimental inoculation of *P. sungorus* with *Neospora caninum* and *Babesia microti* suggests susceptibility to these parasites.[19,39]

Our goal in the current study was to establish reference ranges for aged (17 to 27 mo) Siberian hamsters by examining serum biochemical and hematologic values of male and female animals. In addition, we wished to catalog any gross or microscopic abnormalities present in this population.

Materials and Methods

Animals. Siberian hamsters ($n = 18$; age, 17 to 27 mo; 12 female; 6 male) free from any apparent clinical disease were used. The hamsters were from a breeding colony, originally derived from stock provided by Dr Irving Zucker (University of California, Berkeley) as part of an IACUC-approved protocol. Other than for breeding, hamsters were otherwise unmanipulated. All hamsters were housed in solid-bottom static microisolation caging (9 × 7 × 6 in.; 1 to 4 per cage) on hardwood bedding (Sani-Chips, PJ Murphy, Montville, NJ) in a climate-controlled room on a 16:8-h light:dark cycle (lights on, 0200). Hamsters were provided with cotton batting for nesting material and ad libitum access to food (LabDiet 5015, Purina Mills International, St Louis, MO) and reverse-osmosis–purified water. All animals herein were treated in accordance with the *Guide for Care and Use of Laboratory Animals*[20] and the Animal Welfare Act and Animal Welfare Regulations.[1,2] Animals were monitored daily for signs of illness, none showed clinical signs of disease at the time of euthanasia (retired breeders).

Biological sampling. All sampling procedures were performed between 0900 and 1200. Each hamster was exposed to CO_2 at a flow rate of 20%/min until death was verified by cessation of movement, absence of hindpaw withdrawal reflex, and complete cessation of respiration. Hamsters were weighed, placed in dorsal recumbency, and blood collected by cardiocentesis

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Table 1. Hematology and serum chemistry reference ranges for Siberian hamsters.

		Male			Female		
		Mean	Range	*n*	Mean	Range	*n*
Hematology							
	WBC (×1000/µL)	2.8 ± 1.6	1.5–5.9	6	2.7 ± 2.6	0.9–10.6	12
	RBC (×10^6/µL)	8.4 ± 0.8	7.8–9.3	6	8.3 ± 0.8	7.5–9.9	12
	Hemoglobin (g/dL)	13.5 ± 1.2	11.6–14.8	6	13.5 ± 1.1	12.0–15.6	12
	Hematocrit (%)	43.1 ± 4.0	36.7–47.1	6	43.0 ± 3.9	37.5–51.2	12
	MCV (fL)	51.2 ± 1.8	48.9–52.2	6	51.6 ± 1.9	48.7–53.7	12
	MCH (pg)	16.1 ± 0.5	15.7–16.9	6	16.2 ± 0.4	15.3–16.7	12
	MCHC (g/dL)	31.2 ± 0.6	30.2–31.9	6	31.3 ± 0.4	30.4–32.1	12
	Neutrophils (×1000/µL)	0.86 ± 0.7	0.25–2.2	6	0.56 ± 0.4	0.15–1.5	12
	Lymphocytes (×1000/µL)	1.8 ± 0.9	0.89–3.6	6	1.9 ± 2.1	0.44–8.3	12
	Monocytes (×1000/µL)	0.11 ± 0.1	0.021–0.30	6	0.20 ± 0.1	0.04–0.53	12
	Eosinophils (×1000/µL)	0.048 ± 0.01	0.03–0.059	5	0.090 ± 0.09	0.023–0.32	11
	Platelets (×1000/µL)	449 ± 104	328–594	6	416 ± 127	213–578	12
Chemistry							
	Glucose (mg/dL)	130 ± 49	74–189	6	125 ± 66	47–287	12
	Blood urea nitrogen (mg/dL)*	54.2 ± 14	38–80	6	35.3 ± 22	7–58	11
	Creatinine (mg/dL)	0.57 ± 0.05	0.5–0.6	6	0.50 ± 0.1	0.3–0.6	9
	Total protein (g/dL)	5.4 ± 0.3	5.0–5.8	6	5.2 ± 0.8	2.9–5.8	12
	Albumin (g/dL)	3.3 ± 0.3	2.9–3.5	3	3.1 ± 0.2	2.9–3.4	4
	Globulins (g/dL)	2.2 ± 0.2	2.0–2.4	3	2.1 ± 0.3	1.8–2.4	4
	Calcium (mg/dL)	10.3 ± 0.2	10.1–10.4	4	9.9 ± 0.6	9.4–11.2	6
	Phosphorus (mg/dL)	7.0 ± 1.6	4.5–8.5	5	6.9 ± 0.9	5.9–8.1	9
	Sodium (mEq/L)	158 ± 1.7	156–160	6	158 ± 2.4	153–160	10
	Potassium (mEq/L)	6.9 ± 0.6	5.8–7.4	6	7.0 ± 0.9	5.8–8.4	11
	Chloride (mEq/L)*	110 ± 1.2	108–111	5	112 ± 1.6	111–113	10
	Aspartate aminotransferase (IU/L)	26.7 ± 14	11–44	6	27.3 ± 14	12–60	11
	Alanine aminotransferase (IU/L)	89.3 ± 29	47–129	6	84.8 ± 16	64–124	12
	Alkaline phosphatase (IU/L)	68.7 ± 17	57–102	6	82.8 ± 18	45–113	12
	γ-Glutamyl transferase (IU/L)	3.0 ± 2.8	0–7	6	4.2 ± 2.4	0–7	11
	Total bilirubin (mg/dL)	0.19 ± 0.1	0.02–0.28	4	0.15 ± 0.08	0.08–0.27	8
	Creatine phosphokinase (IU/L)	129 ± 92	21–247	6	143 ± 114	21–391	12
	Cholesterol (mg/dL)	160 ± 22	130–191	6	141 ± 28	99–192	11
	Triglycerides (mg/dL)	158 ± 74	102–294	6	219 ± 151	56–483	7
	HDL (mg/dL)	120 ± 18	99–140	5	108 ± 17	84–135	7
	LDL (mg/dL)	7.8 ± 3.5	6–15	6	13.6 ± 14	2–44	7
	Amylase (mg/dL)	458 ± 193	291–790	6	261 ± 49	192–321	7
	Lipase (mg/dL)	431 ± 81	349–536	6	342 ± 64	246–448	7
	Lactate dehydrogenase (IU/L)	86 ± 25	46–110	6	118 ± 151	44–457	7
	Uric acid (mg/dL)	1.2 ± 0.1	1.0–1.3	6	1.2 ± 0.3	0.8–1.8	7

[a]Significant ($P \leq 0.05$) difference between values for male and female hamsters.

with a 25-gauge needle attached to a 1-mL syringe. The needle was inserted just caudal to the xyphoid cartilage and directed cranially at a 20° to 30° angle relative to horizontal toward the heart. Once the heart was entered, percutaneous exsanguination was used to collect 0.7 to 1.0 mL blood per hamster. Gross dissection and examination then were performed. Superficial skin scrapes, pelts, perianal tape tests, cecal contents, and fecal samples were collected. All remaining tissues and organs were harvested and fixed in 10% neutral buffered formalin solution.

Laboratory testing. Immediately after cardiocentesis, blood for CBC analysis was placed in a 0.5-mL tube containing K-EDTA (Becton Dickenson, Franklin Lakes, NJ). Samples were run inhouse on an automated hematology analyzer (Cell-Dyn 3500, Abbott Laboratories, Abbot Park, IL) according to manufacturer's instructions. Blood smears were stained manually with Wright–Giemsa staining agent (Sigma–Aldrich, St Louis, MO) and underwent differential analysis.

The remainder of the blood sample was placed in a 1.5-mL collection vial devoid of anticoagulants, allowed to clot at room temperature for 30 to 60 min, and then spun at a relative centrifugal force of 1800 × *g* for 5 min. The serum was decanted and further separated into fractions for serologic pathogen screening and serum bioanalysis. Serum samples for pathogen screening were collected from dirty-bedding–exposed mouse sentinels (5-wk-old female Swiss Webster) and analyzed by ELISA inhouse (Charles River Labs, Wilmington, MA) for antibodies to mouse hepatitis virus, Sendai virus, mouse parvovirus, minute virus of mice, ectromelia virus, lymphocytic

Table 2. Histologic findings in aged Siberian hamsters

			Sex		Age (mo)	
	Histologic diagnosis	*n*	Male	Female	Range	Median
Genitourinary	Chronic glomerulonephropathy	5	5	0	18–20	19
	Cystic rete ovarii	6	0	6	17–20	19
	Pyometra	1	0	1	18	na
	Renal adenoma	1	1	0	19	na
	Epididymal cholesteatoma	1	1	0	19	na
Gastrointestinal	Focal enteritis	2	2	0	18–19	18.5
	Gastric papilloma	1	1	0	18	na
	Hepatic hemangiosarcoma	1	0	1	20	na
Integumentary	Intrafollicular mites	18	6	12	17–27	19
	Sebaceous adenoma	1	1	0	19	na
	Trichofolliculoma	1	1	0	20	na
	Subcutaneous mast cell tumor	1	1	0	18	na
Other	Branchial cyst (thymus or thyroid or both)	3	0	3	19–24	20
	Craniopharyngeal cyst	1	1	0	18	na

na, not applicable

choriomeningitis virus, mouse rotavirus, encephalomyelitis virus, and mouse adenoviruses 1 and 2. Samples for serum biochemical analysis were tested inhouse in a serum chemistry analyzer (Dimension Xpand, Siemens, Deerfield, IL) according to the manufacturer's instructions. The following 25 parameters were measured: glucose, aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, γ-glutamyl transferase, total bilirubin, cholesterol, blood urea nitrogen, creatinine, calcium, phosphorous, total protein, albumin, globulins, creatine phosphokinase, sodium, potassium, chloride, triglycerides, high density lipoproteins, low density lipoproteins, amylase, lipase, lactate dehydrogenase, and uric acid. The mean, range, and 1 SD were calculated for each biochemical marker. Differences between male and female hamsters were determined by the Student *t* test (SPSS, IBM, Somers, NY). A *P* value of less than or equal to 0.05 was considered significant for all analyses.

Superficial skin scrapes, perianal tape tests, and zinc sulfate fecal flotation preparations were examined microscopically for the presence of ecto- and endoparasites. In addition, direct pelt and cecal content examinations were performed for parasites by using a dissection microscope.

Histology. After 48 to 72 h of formalin fixation, all major soft and hard organs and tissues were trimmed and processed routinely for microscopic examination after staining with hematoxylin and eosin. Additional sections were prepared and stained otherwise for histology (Masson trichrome, Warthin–Starry method, Brown and Brenn method[28]) and immunohistochemistry (factor VIII-related antigen; Abcam, Cambridge, MA) as indicated.

Results

The mean ages of the sampled Siberian hamsters were 18.6 ± 0.9 mo for males and 20.4 ± 3.2 mo for females. Mean weights were significantly ($P = 0.04$) higher for male hamsters (36.1 ± 8.6 g) than female hamsters (24.6 ± 2.7 g). Serologic testing of sentinel mice exposed to dirty bedding was negative for all pathogens examined. In addition, all skin scrapes, pelt, cecal content, and fecal float examinations were negative for endo- and ectoparasites. Hematology and serum biochemistry values for the Siberian hamsters tested are outlined in Table 1. Various parameters were not obtained for specific animals because of limited sample volume. There were no statistically significant differences between male and female hamsters with regard to hematologic parameters.

Serum BUN values were significantly ($P = 0.05$) higher in male hamsters (54.7 ± 14 mg/dL) than female hamsters (35.3 ± 22 mg/dL). In addition, serum CO_2 values were significantly ($P = 0.001$) higher for male hamsters (38.9 ± 1.9 mEq/L) than for female hamsters (32.2 ± 5.0 mEq/L; data not shown). Conversely, serum chloride levels were significantly ($P = 0.02$) lower in male hamsters (110 ± 1.2 mEq/L, $n = 5$) than in female hamsters (112 ± 1.6 mEq/L, $n = 10$). There were no significant differences between male and female hamsters for any other serum chemistry parameter measured. None of the measured parameters showed an age correlation within the sample range.

All histologic findings are summarized in Table 2. All 18 hamsters showed follicular infestation with mites (presumed *Demodex* species) within the haired skin in all locations examined (head, neck, thorax, abdomen). The majority of hamsters did not show any host inflammatory reaction to the presence of these intrafollicular mites. However, some hamsters showed scattered follicular dilation (particularly in the eyelid), and in 2 of the 18 hamsters, evidence of follicular rupture (furunculosis) with secondary granulomatous inflammation was noted (Figure 1). Of the 6 male hamsters in this study, 5 showed evidence of mild to severe chronic progressive glomerulonephropathy (Figure 2). In addition, 6 of the 12 female hamsters in this study showed gross and histologic evidence of unilateral (5 of 6) or bilateral (1 of 6) cystic rete ovarii (Figure 3). A wide range of neoplasms were observed in these hamsters, including hepatic hemangiosarcoma (Figure 4), renal adenoma (Figure 5), subcutaneous mast cell tumor, sebaceous adenoma, trichofolliculoma (Figure 6), and gastric squamous papilloma (Figure 7).

Discussion

Our goal in this study was to establish a baseline hematologic and serum biochemical database for aged Siberian hamsters housed within our facility and to examine any differences that

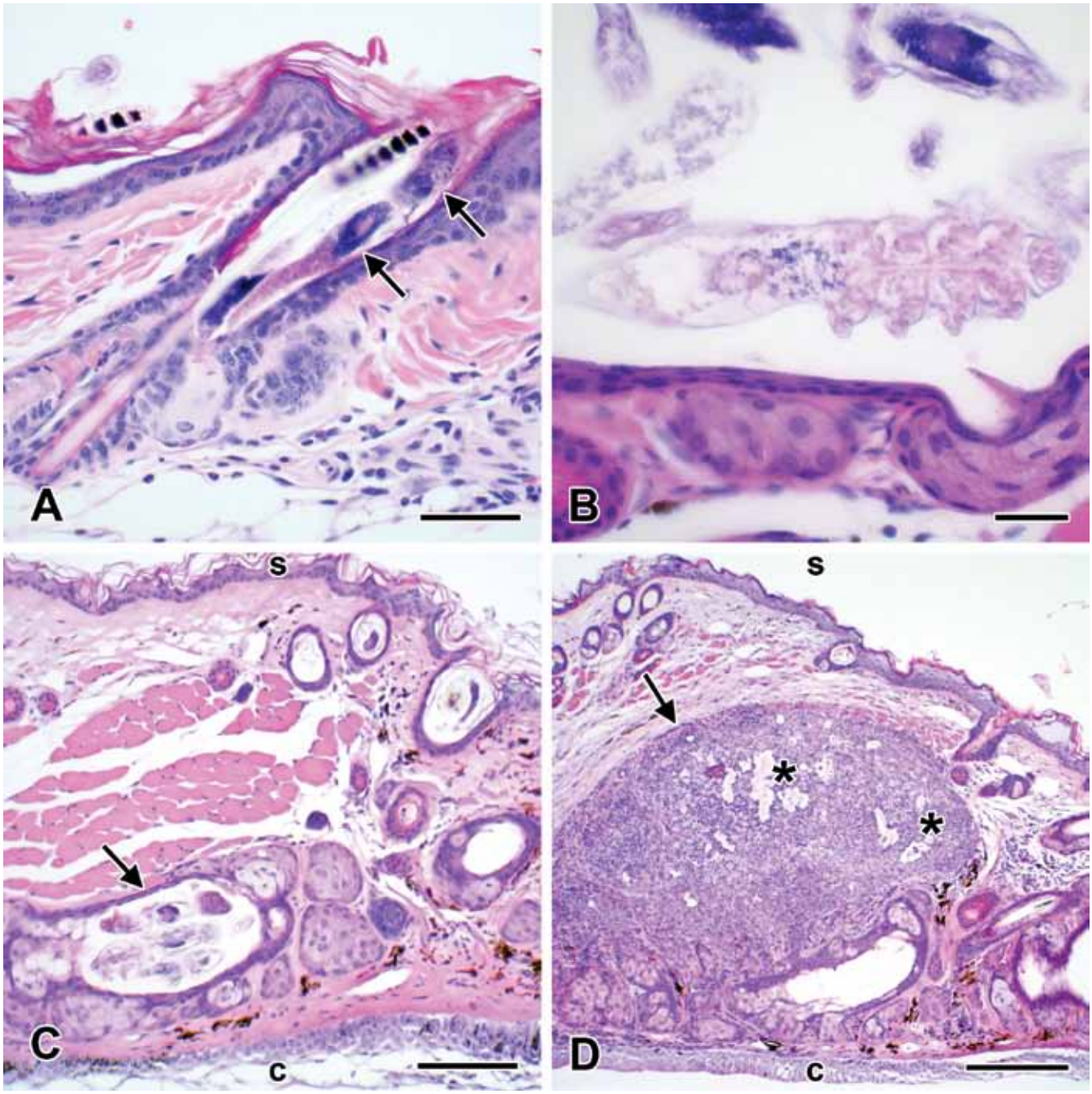


Figure 1. Haired skin. (A) Single to multiple profiles of adult mites (black arrows) were` noted within the hair follicular lumens in sections of haired skin sampled from all locations of the body. Bar, 50 µm. (B) The mites were cigar-shaped, 100 to 125 µm long, and displayed 4 pairs of legs from the thoracic segment, therefore most likely representing *Demodex* species mites. Bar, 25 µm. (C) Occasionally in the eyelids, the hair follicles were dilated (black arrow) with many intrafollicular mites. s, Eyelid skin surface; c, eyelid conjunctival mucosa. Bar, 100 µm. (D) Chronic granulomas centered around ruptured hair follicles (furunculosis; black arrow) were present in the eyelid rarely and contained degraded mite-derived body parts (asterisks). s, Eyelid skin surface; c, eyelid conjunctival mucosa. Bar, 200 µm. Hematoxylin and eosin stain.

emerged between sexes of this species. Similar to prior reports,[17] we found that male hamsters weighed significantly more than did female hamsters. Our data indicate no differences between aged male and female Siberian hamsters in any of the hematologic parameters measured. Similarly, there were no significant sex-associated differences for 22 of the 25 serum biochemistry parameters examined.

Comparing our data with prior reports in other species may highlight some key differences between *P. sungorus* and other hamster species (*M. auratus* being the best characterized example[24,32]). The most notable differences are the lower MCV and hemoglobin and higher RBC count and serum sodium levels in Siberian hamsters. The higher RBC count and lower MCV in *P. sungorus* relative to *M. auratus* are consistent with prior published data showing a similar trend in these erythrocyte parameters with decreasing body size among closely related taxonomic groups.[10] Different hematologic and biochemical profiles are similarly in reference ranges for various strains of mice.[4,14]

The observed elevation of blood urea nitrogen level for male hamsters is consistent with the relatively high occurrence of chronic glomerular disease seen histologically. These findings

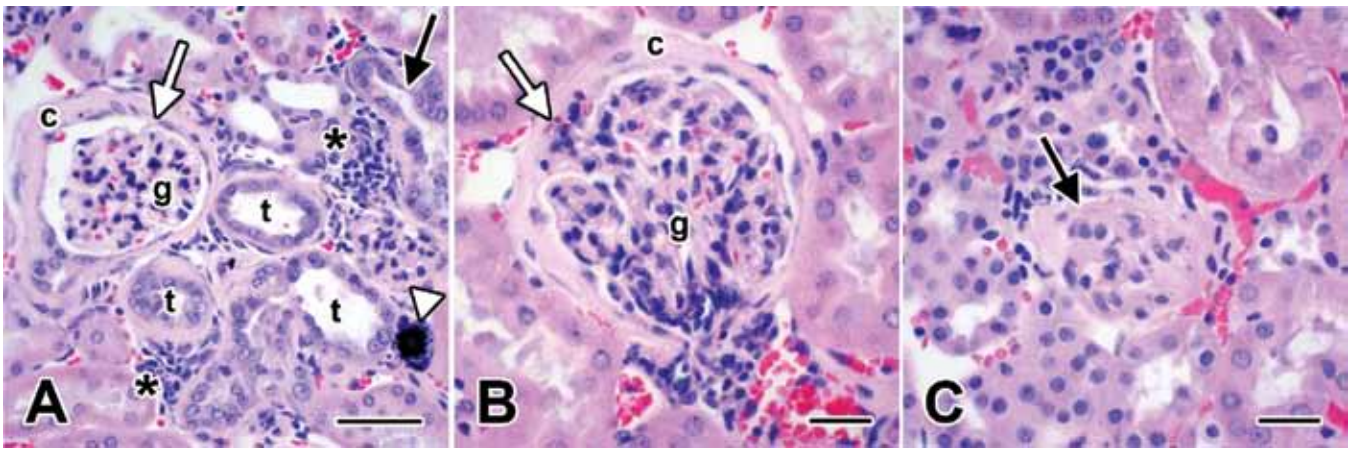
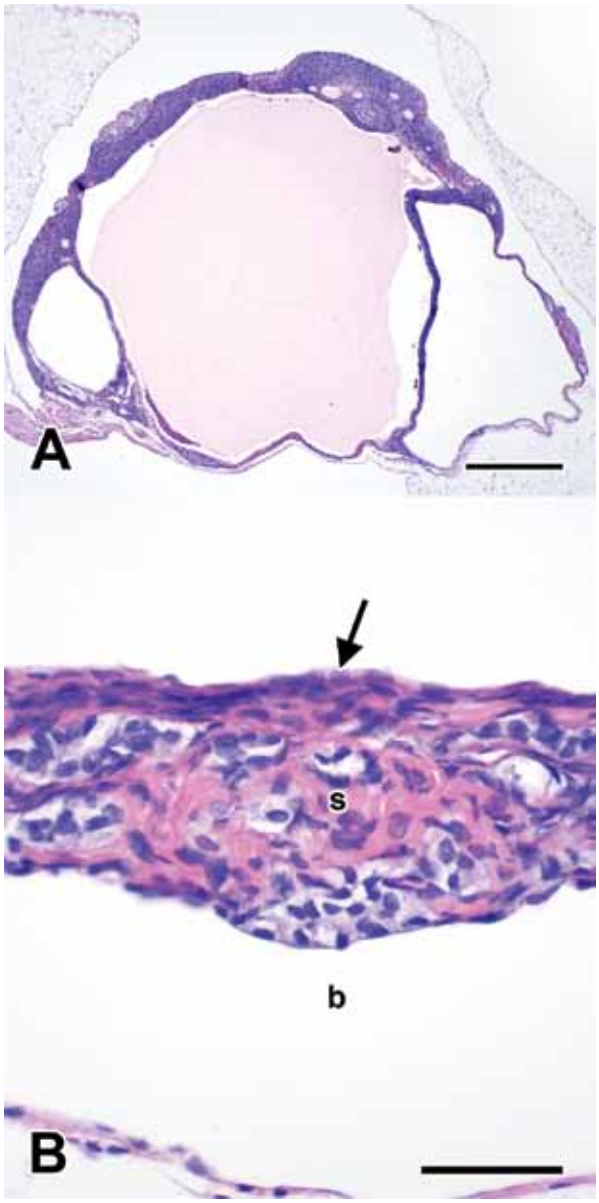


Figure 2. Kidney. (A) Glomerulonephropathy was noted, characterized by mesangial thickening in the glomerulus (g); glomerular synechia (white arrow); sclerosis of the urinary capsule (c); renal tubular epithelial attenuation and dilation with basement membrane sclerosis (t) with some tubular epithelial regeneration (black arrow); and interstitial lymphoplasmacytic infiltrates (asterisks). Intratubular mineralized deposits were also present (white arrowhead). Bar, 50 µm. (B) In other areas and cases, glomeruli were large due to mesangial thickening and podocytes proliferation (g). Note the sclerosis of the urinary capsule (c) and glomerular synechia (white arrow). Bar, 25 µm. (C) End-stage changes to glomeruli were also noted, characterized by shrinkage resulting from glomerulosclerosis (black arrow). Bar, 25 µm. Hematoxylin and eosin stain



are similar to those found in aged male Sprague–Dawley and Fischer 344 rats[28] and aged gerbils.[5] Although the risk factors for the development of this chronic glomerular disease are established clearly for rats,[28] further study is needed to determine the actual predisposing factors for renal disease in Siberian hamsters. Interestingly, another renal condition (hamster glomerulonephropathy, also known as arteriolar nephrosclerosis) commonly manifests in aged female Syrian hamsters and has been suggested to have a close association with renal amyloidosis.[28] Although other causes of increased blood urea nitrogen cannot be ruled out for our hamsters, the increase may be secondary to increase tissue catabolism as a result of old age. Despite the lack of histologic evidence, an alternative hypothesis is gastrointestinal bleeding, which has been shown unequivocally to increase blood urea nitrogen in the absence of an elevated creatinine level.[13]

The observed difference in serum chloride concentrations between male and female Siberian hamsters is not explained easily. Although such electrolyte differences are presumed to be very rare, additional samples should be taken to confirm the sex disparity of serum chloride concentration. The lack of more numerous differences between male and female hamsters is surprising, especially among some of the more classically sexually dimorphic parameters, cholesterol and triglycerides specifically. For example, serum cholesterol is increased in male compared with female Syrian hamsters.[7] In addition, similar findings in serum lipoprotein levels are common among humans.[6] One possible explanation for the lack of difference is that, as age increases, differences potentially caused by differential hormone expression tend to disappear.[23] This pattern is especially true for serum levels of cholesterol and lipase, both of which may be influenced by sex-associated differences in cortisol or testosterone.

The occurrence of follicular mites is not uncommon in laboratory hamsters. Susceptibility of Syrian hamsters to both

Figure 3. Ovary. (A) Cystic rete ovarii were noted as unilateral or bilateral ovarian lesions. Bar, 500 µm. (B) The cystic rete ovarii were lined by a single layer of flattened epithelial cells (black arrow) with little or no supporting stroma. Note the ovarian stroma (s) directly beneath the epithelial cells lining and the space of the ovarian bursa (b) around the ovary. Bar, 50 µm. Hematoxylin and eosin stain.

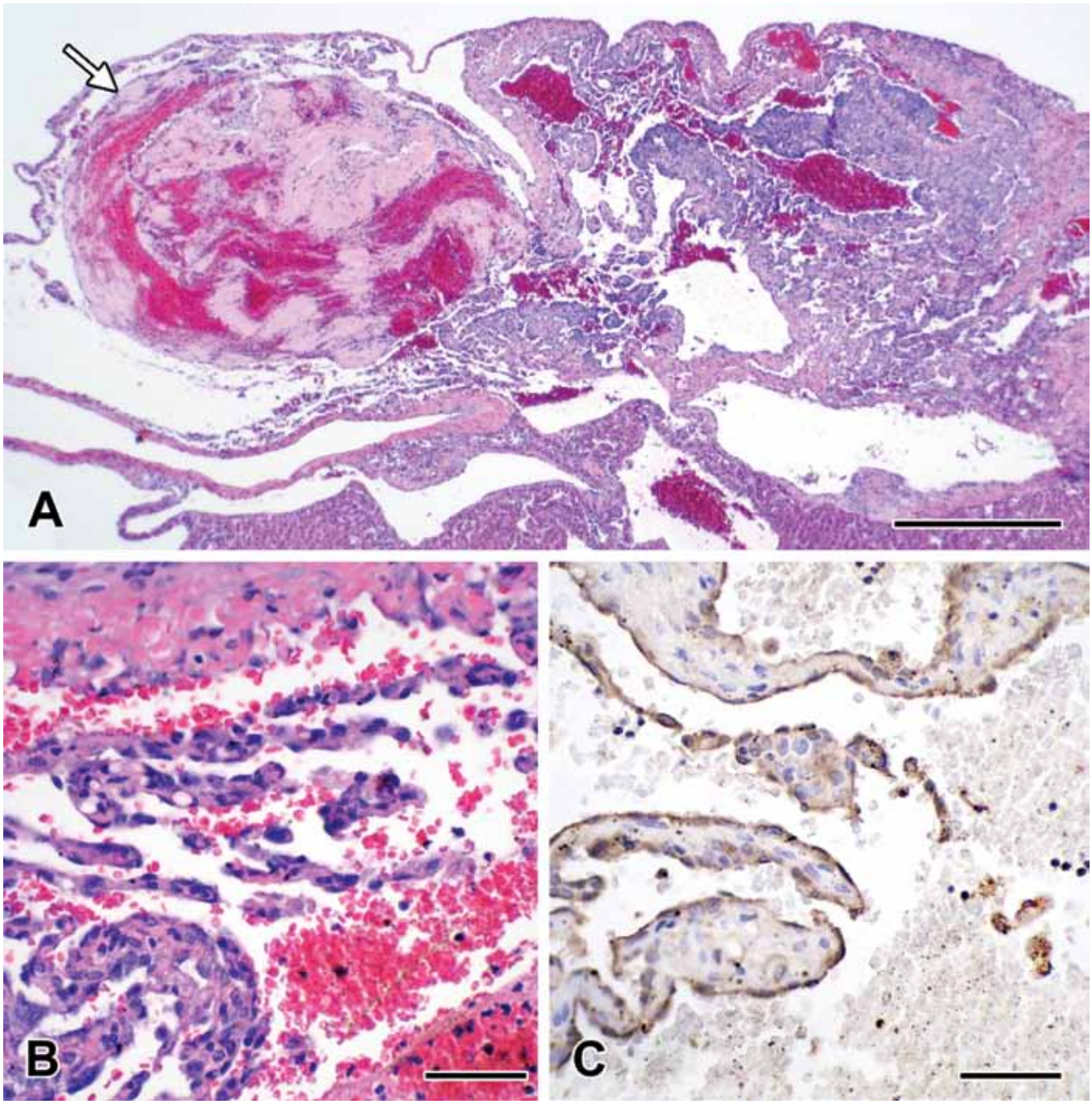


Figure 4. Liver. (A) An invasive, poorly-circumscribed hemangiosarcoma was noted in the left lateral lobe of the liver in a single hamster. Note the relatively extensive thrombus within the hemangiosarcoma (white arrow). Bar, 500 µm. (B) The hemangiosarcoma was characterized by irregular nonpatent vascular channels lined by neoplastic endothelial cells. Bar, 50 µm. (C) The neoplastic endothelial cells were immunoreactive to the antibody directed against factor-VIII–related antigen. Bar, 50 µm. Hematoxylin and eosin stain.

Demodex aurati and *D. criceti* has been well established.[33] More recently, reports of newly recognized species of *Demodex* have been characterized, infesting the Armenian (*D. cricetuli*[18]), Chinese (*D. sinocricetuli*[9]), and Siberian (*D. phodopi* n. sp. and *D. sungori* n. sp.[8]) hamsters. The lack of associated clinical signs and pathology (that is, pruritis, alopecia, inflammation) in 16 of our 18 hamsters indicates that these mites, although widespread within the colony, do not manifest in clinical disease. The lack of corroborative clinical pathologic findings (negative skin scrapes) likely is due to the deep follicular environment preferred by these mites. Further characterization of the mites within the colony in the current study is necessary to establish whether the *Demodex* follicular mites are of the same species as those of the previous report.[8]

Cystic rete ovarii are common in aged female laboratory guinea pigs and gerbils.[26,31] Given the small nucleus from which the colony of Siberian hamsters was derived, genetic predisposition is likely. With the high incidence we report here, further investigation is warranted examining both potential causes as well as the potential relationship between the presence of cystic rete ovarii and decreased reproductive performance. Moreover, the remaining lesions may lend themselves to further investigations. For example, although the observed hemangiosarcoma is consistent with a prior findings,[21] multiple branchial cysts

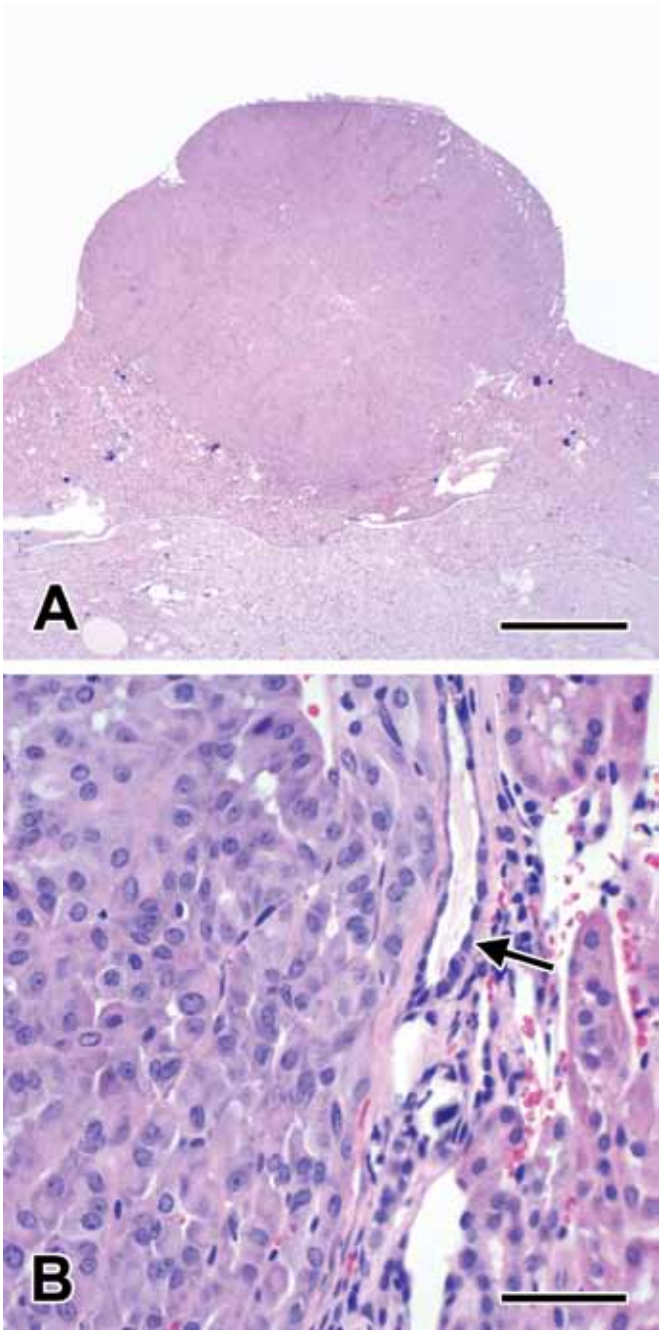


Figure 5. Kidney. (A) A well-circumscribed, expansile, unencapsulated, nodular renal adenoma was noted in a single hamster. Bar, 1000 µm. (B) The neoplastic renal tubular epithelium was organized in solid sheets of cells. Note the compression of adjacent normal renal tubular epithelium (black arrow) at the margins of the neoplasm. Bar, 50 µm. Hematoxylin and eosin stain.

have not been reported previously and may be a feature of our specific colony.

To our knowledge, this report is the first published study of hematologic and serum biochemistry reference ranges for any population of Siberian hamsters. Differences in hematologic and serum biochemistry values between sexes, although extant, are minor. In addition, this is the first published report showing a potential male predisposition for chronic progressive glomerulonephropathy and potential female predisposition for cystic rete ovarii. More data collected from both aged and nonaged adult populations will enable better characterization of scientific models of disease offered by this species.

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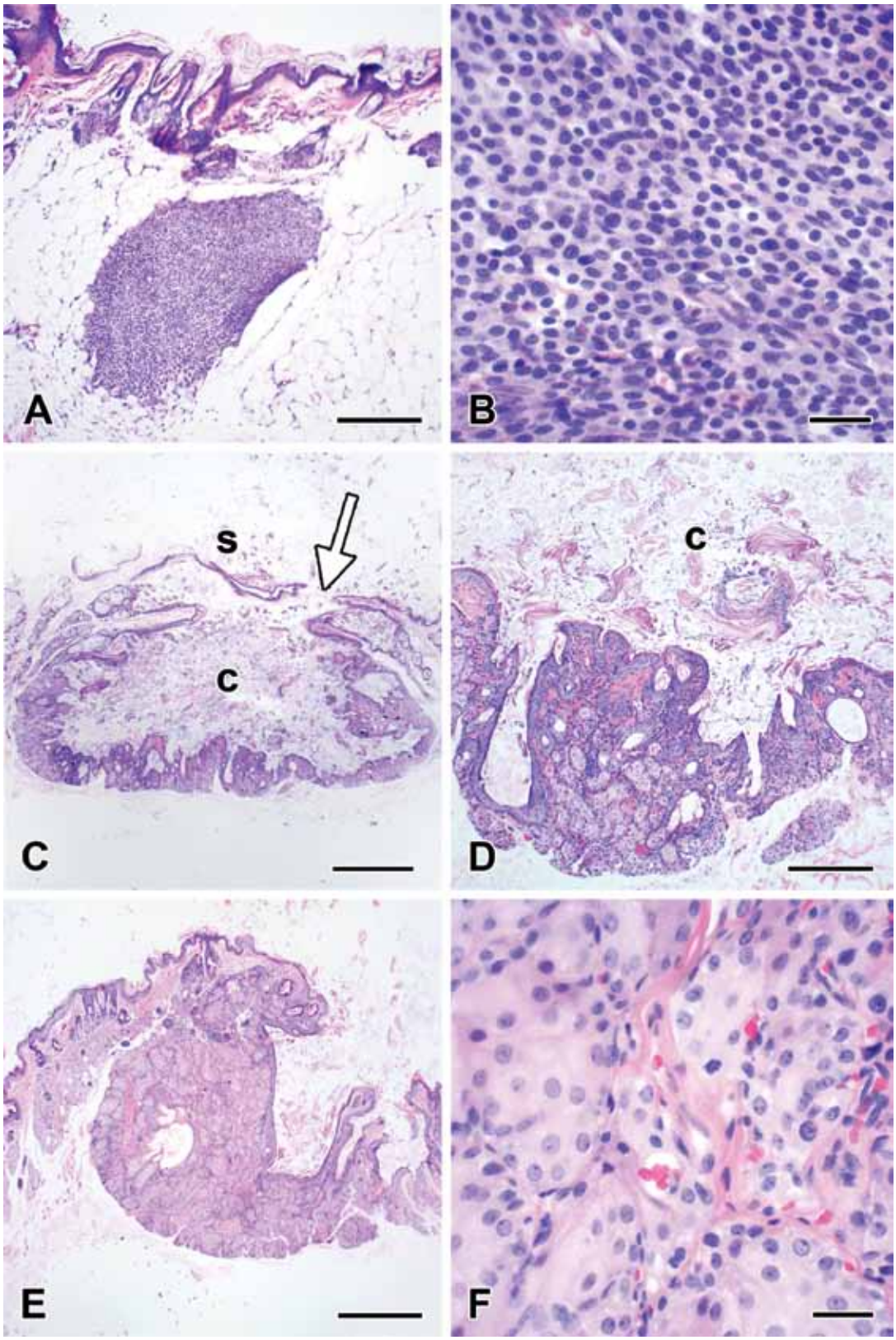

Figure 6. Haired skin (multiple lesions). (A) A discrete, well-circumscribed, expansile, unencapsulated mast cell tumor was present in the subcutaneous tissues of haired skin in one hamster. Bar, 200 µm. (B) The mast cell tumor was comprised of sheets of round cells which contained characteristic fine basophilic intracytoplasmic granules that were metachromatic with Toluidine blue staining (not shown). Bar, 25 µm. (C) A well-circumscribed, expansile, unencapsulated, endophytic, flask-shaped trichofolliculoma was noted in the haired skin of a single hamster. The central cystic cavity (c) communicated with the skin surface (s) through a pore (white arrow). Bar, 1000 µm. (D) The wall of the trichofolliculoma was composed of many folliculosebaceous units that surrounded the central cystic cavity (c), which was filled with abundant keratin- and hair-shaft-derived debris. Bar, 200 µm. (E) A discrete, well-circumscribed, expansile, unencapsulated, endophytic, nodular sebaceous adenoma was noted in the haired skin of a single hamster. Bar, 1000 µm. (F) The sebaceous adenoma was composed of lobules of well-differentiated neoplastic sebaceous gland cells. Bar, 25 µm. Hematoxylin and eosin stain.

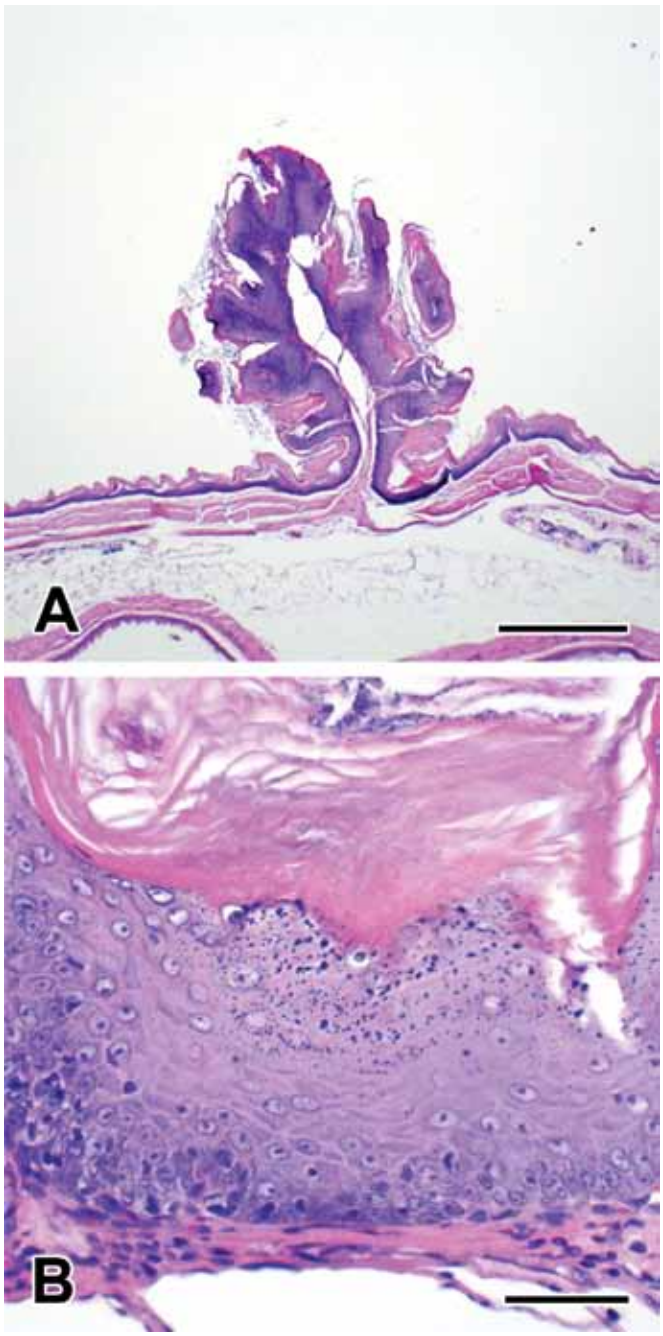

Figure 7. Nonglandular stomach. (A) A discrete, exophytic squamous papilloma was noted arising from the stratified squamous epithelium of the nonglandular stomach in one hamster. Bar, 500 µm. (B) The squamous papilloma was composed of papillary projections of thickened keratinized stratified squamous epithelium that otherwise displayed normal organization. Marked orthokeratotic hyperkeratosis, hypergranulosis, acanthosis, and hypertrophy–hyperplasia of the stratum basale accounted for the epithelial thickening. Viral cytopathic effect (including presence of giant keratohyaline granules, koilocyte morphology, and basophilic intranuclear inclusion bodies) was not a feature of this squamous papilloma, suggesting that papillomavirus infection was not associated with the development of this neoplasm. Bar, 50 µm. Hematoxylin and eosin stain.

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