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Current Approach to Rodents as Patients

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Abstract

Rodent species are routinely presented to veterinary hospitals for wellness checks and different illnesses. When rodents are presented to the veterinarian for diagnosis and treatment, they deserve the same thorough approach that any other domestic species receives. The purpose of this article is to provide readers a review of the current information regarding examination, diagnosis, and treatment of some of the most common conditions for which rodent patients are presented. This article will cover 5 of the most common rodent species presented to veterinarians: guinea pigs, chinchillas, rats, mice, and hamsters. Copyright 2010 Elsevier Inc. All rights reserved.

Key words: **chinchilla; guinea pig; hamster; mice; rats; rodent**

Historically, rodents have been treated as disposable pets because of their small size, low cost, and relative ease of acquisition; however, in recent years, there has been a shift away from this trend. When rodents are presented to the veterinarian for diagnosis and treatment, they deserve the same thorough approach that any other domestic species receives. This article will cover 5 of the most common rodent species presented to veterinarians: guinea pigs, chinchillas, rats, mice, and hamsters.

Husbandry and History

Guinea Pigs

Guinea pigs, *Cavia porcellus*, are lively, responsive, and gentle pets, particularly if they are handled frequently while young. When frightened, they often become immobile or make an explosive attempt to escape. There are currently 13 recognized breeds of guinea pigs.

Guinea pigs do not readily adapt to changes in type, appearance, or presentation of their food or water. Always inform clients about this characteristic of guinea pigs to prevent a self-imposed fast by an animal when offered a new food.

Guinea pigs are incapable of endogenous synthesis of vitamin C.[1] Guinea pigs require a dietary source of vitamin C (ascorbic acid) because they lack L-gluconolactone oxidase, an enzyme involved in the synthesis of ascorbic acid from glucose. Nonbreeding adult guinea pigs require 10 mg/kg daily of ascorbic acid. Higher levels should be provided for growing and pregnant animals; 30 mg/kg/daily of vitamin C is recommended for a pregnant sow.[2,3] The recommended diet for pet guinea pigs should include pellets formulated specifically for this species, grass hay (e.g., timothy, orchard grass, oat), and supplemented fresh vegetables. Alfalfa pellets are suitable for young, growing, and pregnant guinea pigs. After the guinea pig is 1 year of age and fully developed, a timothy-based pellet, which provides less calcium and more fiber, is better suited to prevent urolithiasis, obesity, and digestive and dental problems. Good-quality hay should be available at all

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times. Fruits, rolled oats, and dry cereals should only be offered as treats in very small quantities, if at all.[3] Commercially available guinea pig pellets are fortified with ascorbic acid; however, approximately half of the initial vitamin C content may be oxidized and lost 90 days after the diet has been mixed. It may be better to assume that the pellets no longer contain adequate levels of vitamin C and instead supplement this vitamin in a tablet form or as fresh greens to ensure adequate daily intake occurs. Foods that contain high levels of ascorbic acid are leafy greens (e.g., kale, parsley, beet greens, chicory, spinach), red and green peppers, broccoli, tomatoes, kiwi fruit, and oranges. Vitamin C can be added to the water at 1 g/L; however, water supplemented with added vitamin C loses more than 50% of its vitamin C content within 24 hours, and consequently the drinking water must be changed daily.[3]

It is normal for guinea pigs to eat their soft cecal feces directly from the anus.[4]

Chinchillas

Chinchillas, *Chinchilla laniger*, are a quiet, shy, agile, and relatively large rodent. Chinchillas are almost odorless and are most active at dusk and night but can be active during the day. Flight is their primary defense mechanism and these animals rarely bite. Chinchillas do not tolerate dampness and are prone to heat stroke at temperatures greater than 82°F to 86°F (28°C to 30°C).[3]

Frequent dust baths are necessary to maintain the health of their luxurious fur. Commercial chinchilla dust baths are available, but a homemade alternative using a 9:1 mixture of silver sand to Fuller's earth can be used. Beach or playground sand is not suitable to use for a chinchilla dust bath. Excessive use of dust baths can lead to conjunctivitis.[3]

When frightened, chinchillas can shed patches of fur, a condition known as "fur-slip." It can take 6 to 8 weeks for these hairless patches to regrow, and longer for the patch to become indistinguishable from the surrounding fur.[3]

Chinchillas eat and defecate mainly at night.[3] The accepted formula for chinchilla pellets is 16% to 20% protein, 2% to 5% fat, and 15% to 35% bulk fiber.[5,6] Nonbreeding animals do well on a diet of good-quality grass hay supplemented with small amounts of chinchilla or rabbit pellets, fresh vegetables, and grains.[7] One to two tablespoons of pellets per day should be sufficient for a nonbreeding adult animal. A pellets-only diet has insufficient roughage and can predispose the chinchilla to enteritis. Limit treats to not more than 1 teaspoon per day for such items as grains, dried apples, raisins, figs, hazelnuts, and sunflower seeds. Abrupt dietary changes will lead to temporary but dramatic decreases in food intake.[3] Chinchillas produce 2 types of fecal matter: nitrogen-rich cecal pellets that they consume and nitrogen-poor excreted fecal pellets, which are left uneaten.[3]

Rats

Rats are popular pets because they are affectionate and intelligent animals that quickly bond to their owners, are easy to care for, have little odor, and rarely bite. The common rat species maintained as a companion animal is *Rattus norvegicus*, with the white rat and the hooded rat being the most common variations. Rats are not as territorial as other rodent species and are very social.[8] Pine and cedar shavings are not recommended because of the volatile oils that are irritating to the respiratory tract of these and other rodent species.[9]

Rats are one of the most commonly used laboratory animals in scientific investigations; therefore, their dietary requirements have been intensely studied and commercially produced diets that provide the recommended daily nutritional requirements are available. Pet rat owners often buy seed-based diets that are lacking in the appropriate nutritional requirements needed to maintain long-term health. Commercial rodent blocks or pellets with 20% to 27% protein are the recommended dietary offering for pet rats. The commercial rodent pellets are the only food rats need to obtain their required nutrients. Seed-based diets are not recommended; significant supplementation of fruits, nuts, vegetables, cheese, or other human foods is also not recommended. For younger rats, less than 3 weeks old, softer pellets are needed because babies start eating pellets and drinking water at 2 to 3 weeks of age. A sipper bottle is recommended for the animal's drinking water. Accidental or negligent water deprivation is a common problem. The bottle should be checked for blockage or leakage, and the water should be changed daily so that accidental water deprivation is avoided.[3]

Mice

Mice are often selected as pets because of their small size and playful nature. Although playful, mice can be aggressive to cagemates and owners. Domestic mice (*Mus musculus*) and the African pygmy mouse (*Baiomys* spp.) are commonly sold as pets.[8]

The recommended diet for pet mice is a commercial pelleted feed. Because mice are commonly used as laboratory animals, a significant amount of research has also been done on their daily nutritional

requirements. Seed-based diets are lacking in a number of the nutritional requirements needed to maintain long-term health. Commercial rodent blocks or pellets with more than 14% protein are recommended. Seed-based diets are not recommended, nor is significant supplementation with fruits, nuts, vegetables, cheese, or other human foods. For younger mice, those less than 3 weeks old, softened pellets are needed because babies start eating pellets and drinking water at 2 to 3 weeks of age.[8] A sipper bottle is recommended for drinking water. Accidental or negligent water deprivation is a common problem. The bottle should be checked for blockage or leakage, and the water should be changed daily so that accidental water deprivation is avoided.[3]

Hamsters

Hamsters are small, cute pets that require a relatively undersized housing environment and are inexpensive and easy to maintain. Most hamsters become tame with frequent and gentle handling, although they are notorious for their biting tendencies. The most common hamster species maintained as a pet is the golden or Syrian hamster (*Mesocricetus auratus*). Other species that the clinician may encounter include the Siberian or Djungarian hamster (*Phodopus sungorus*), the Chinese or striped hamster (*Cricetulus griseus*), the common black-bellied or European hamster (*C. cricetus*), and the gray Armenian hamster (*C. migratorius*).[10]

Hamsters are relatively asocial and are best maintained as a solitary animal. Housing groups of hamsters or introducing a new hamster into another hamster's cage is not recommended, because cagemate trauma will likely result.[11]

The recommended diet for hamsters is commercial formulated hamster pellets or blocks. Seed-based diets are lacking in a number of the nutritional requirements needed to maintain long-term health and prevent disease, especially osteoporosis. Commercial blocks or pellets with more than 16% protein and 4% to 5% fat are recommended.[3,11] Seed-based diets are not recommended, nor is significant supplementation of fruits, nuts, vegetables, cheese, or other human foods. Occasional treats should be limited to those high in protein and low in fat. A sipper bottle is recommended for drinking water. Accidental or negligent water deprivation is a common problem for small rodent species. The bottle should be checked for blockage or leakage, and the water should be changed daily so that accidental water deprivation is avoided.[3]

Capture and Restraint

Sick rodents do not tolerate clinical procedures, and the debilitated animal may go into cardiac and respiratory arrest because of stress associated with restraint and handling. Providing excellent supportive care and maintaining caloric intake in a low-stress environment, while working stepwise toward a diagnosis and therapy, may be necessary to achieve a successful outcome with the case.[3]

If the patient does not allow for adequate restraint and examination while conscious, an inhalant anesthetic may be used for sedation.[8] The animal should be placed in a small induction chamber and induced with isoflurane or sevoflurane gas. Injectable agents (Table 1) may be used as an alternative to inhalant agents to facilitate examination and diagnostic testing.

Guinea Pigs

Most guinea pigs are docile and will stay still on the examination table while being examined. Placing a towel on the table for improved traction will usually help calm the guinea pig and make it easier to restrain. Having an assistant or owner place a hand on the rump of the animal will help keep it from backing away on the table. To lift up a guinea pig, support the chest and abdomen from underneath, and cup the dorsum with the opposite hand as necessary.[3,12]

Chinchillas

Most pet chinchillas are easy to hold and do not bite, although a frightened chinchilla can and will bite. When lifting a chinchilla out of its cage, place one hand under the animal's abdomen or around the base of the head, and hold it by the base of the tail with the other hand. When carrying a chinchilla, hold the base of the tail with one hand to prevent it from jumping. Never catch a chinchilla by the tail only, or you may be left holding the skin of the tail (e.g., degloving injury) and no chinchilla.[3] Do not attempt to restrain a chinchilla by holding its limbs. The fragile limbs can fracture if the chinchilla struggles.

Rats

Most pet rats are docile and friendly and do not object to being picked up and gently manipulated. They rarely bite unless they are agitated or injured. To restrain a rat, the animal should be picked up with one hand being placed over the dorsum and rib cage, restraining the head with the thumb and fore-

Table 1. Rodent chemical restraint/anesthetic agents

Drug	Dose	Route	Species	Comments
Acepromazine	0.5-1.0 mg/kg	IM	G, C, R, M, H	preanesthetic
	0.5-2.5 mg/kg	IM, SC	R, M	preanesthetic
Buprenorphine	0.05-0.1 mg/kg	SC, IV	G, C, R, M, H	analgesic
Butorphanol	1-5 mg/kg	SC	M, H	analgesic
	2.0 mg/kg	SC, IP	R	analgesic
	0.2-2.0 mg/kg	SC, IM	C	analgesic
	0.4-2.0 mg/kg	SC	G	analgesic
Diazepam	0.5-3.0 mg/kg	IM	G	sedation
	3-5 mg/kg	IM	R, M, H	sedation
Ketamine/Diazepam	40 mg/kg + 1-2 mg/kg	IM	C, H	restraint/light sedation
	20-30 mg/kg + 1-2 mg/kg	IM	G	restraint/light sedation
	40-100 mg/kg + 3-5 mg/kg	IM	R	anesthetic
	40-150 mg/kg + 3-5 mg/kg	IM	M	anesthetic
Ketamine/Midazolam	5-10 mg/kg + 0.5-1.0 mg/kg	IM	G, C	sedation
Midazolam	1-2 mg/kg	IM	G, C, R, M, H	preanesthetic

IM, Intramuscularly; SC, subcutaneously; IV, intravenously; IP, intraperitoneally; G, guinea pig; C, chinchilla; R, rat; M, mice; H, hamster. Data from Carpenter J Exotic Animal Formulary. St Louis, MO USA, Elsevier/Saunders, 2005, pp 377-406; Tully TN, Mitchell MA: A Technician's Guide to Exotic Animal Care. Lakewood, CO USA, 2001, American Animal Hospital Association Press.

finger directly behind the rami of the jaw. The other hand should grasp the tail base and hind limbs to stabilize the body. The skin of the dorsal cervical region may also be used to pick up (e.g., scruff) the rat.[8]

Mice

Because mice are quick to jump away from a person handling them, precautions must be taken to ensure that if the animal does escape it will not injure itself and can be easily recaptured. Mice often bite when being handled, so proper restraint is necessary. To catch a mouse, the base of the tail should be grasped with the thumb and forefinger, allowing the mouse to hold onto an object with their front feet. When the mouse grabs onto the object, use the opposite hand to grab the dorsal skin (e.g., scruff) of the neck. A thin towel may be used to protect the handler and to help the mouse feel secure, but it may be more difficult to manipulate through the additional layer. Care must be taken to avoid over-restraining a mouse patient.[8]

Hamsters

Hamsters have a reputation for being biters. Some pet hamsters are very docile and pet owners of such hamsters often do not appreciate over-restraint, so assessment of the individual hamster's temperament should be determined and restraint methods adjusted accordingly. Wake the hamster gently if it is sleeping, because they are deep sleepers and will often bite if startled. A calm hamster may be receptive to being scooped up in the palm of the hand. When full restraint is required, a modification of the scruff grip is used. Hamsters have an abundance of loose skin over the back and shoulders, so a full-handed grip is required to achieve complete immobilization. Grasp the skin between the tips of all 4 fingers and the base of the thumb and lower palm of your hand.[3] A small cloth may help with restraint and reduce the risk of being bitten. Adjustment of the scruff grip may be necessary if the skin is loose and the hamster is able to turn to bite the handler. Hamsters usually do not tolerate being held for extended periods and their eyes often bulge with struggling; consequently, full restraint should be kept to a minimum.

Physical Examination

Initially observe the rodent patient in its cage or carrier. Specifically assess the animal's movement, mentation, activity, posture, and rate and rhythm of breathing. Measure the patient's weight in a tared container with a digital gram scale. Obtain a rectal temperature early during the examination process on larger individuals, before the animal becomes excited or stressed. The physical examination starts

at the head and systematically progresses toward the tail. Eyes, ears, and nares are observed for signs of discharge or inflammation. Next, examine the fur, skin, and mucous membranes. Examine the skin for hair coat quality, alopecia, external parasites, or any skin abnormalities. Especially take care to note any salivation on the chin and forelimbs, because dental disease often causes excess salivation (slobbers). Auscultation of both the thorax and abdomen is best done when the animal is least stressed. A small pediatric or neonatal stethoscope is recommended for small rodent patients, as well as other avian/exotic species. Body condition should be assessed, and abdominal palpation performed. Lymph nodes and limbs should be palpated. Check the nails and plantar surfaces of each foot and examine the rectal area for staining and impaction. Observe the genitalia and note any abnormalities. Because of the potential stress associated with inspecting the oral cavity, the author prefers to hold this to the end of the examination. Have the assistant place one hand on the animal's rump and the other hand around the shoulder and thoracic area. Use a speculum or otoscope to examine the oral cavity and cheek teeth. If the animal is too fractious for the examination, sedation is strongly advised.[3,8]

Guinea Pigs

Healthy guinea pigs should be alert and react to stimuli by moving or vocalizing. Geriatric animals may develop fecal impactions within the anus, possibly due to a loss of muscle tone or an inability to eat feces directly from the anus. The fecal impactions can be relieved by gentle manual expression, which may need to be repeated weekly.[13] Overgrowth of the nails and horny callus is common in guinea pigs. Both can be trimmed with cat nail clippers.

If the oral cavity is full of food and the teeth cannot be visualized, irrigating the mouth with warm water using a curved-tipped syringe can help facilitate a thorough examination of this area. Care must be taken to have the guinea pig's head tilted downward to avoid aspiration of the irrigating fluid.

Chinchillas

Healthy chinchillas should be alert and active. They are usually quite curious and interactive. A sick chinchilla may be depressed, have a perianal area that is stained or covered with feces, and have a dull coat. A poorly socialized chinchilla that excitedly hops around the cage may need sedation for a safe and thorough examination. Healthy chinchillas have yellow incisors.[3]

Rats

Albino rats have poor eyesight, whereas all rats rely heavily on sensory input. The Harderian gland is a lacrimal gland that is located behind the globe. This gland produces a lipid and red porphyrin-rich secretion. There is no blood in this red tear film, and the crusts will fluoresce bright red under ultraviolet light.[9] The oral cavity is difficult to examine because of the small opening of the mouth. Rat incisors have a tendency to overgrow, so it is essential to examine the incisors for normal occlusion and length. Rats normally have yellow coloration to their incisors. As rats age, their white hair coat can yellow and their tail become more dry and scaly. Aged male rats develop brown, granular sebaceous secretions at the base of their hair shafts.[3]

Mice

Mice may have presenting clinical signs of dyspnea, sneezing, coughing, chattering, and sniffling. In these patients, anesthetizing the animal to perform the physical examination is not recommended, and handling should be minimized.[8]

Hamsters

Exophthalmos, cataracts, and ocular discharge are common abnormal findings in hamsters. Urine, fecal, and vaginal staining are frequently noted in hamsters presented to veterinary hospitals. Trauma, respiratory disease, and debilitation are also common presentations. Scent glands are usually prominent on the flanks (caudal lateral body wall) of adult males. Skin abnormalities from ectoparasites, endocrinopathies, trauma, neoplasia, and abscesses are common disease diagnoses of hamster patients.[11]

Diagnostic Testing during a Routine Physical Examination

Guinea Pigs

- Fecal Gram stain: Primarily Gram-positive.[14] Anaerobic lactobacilli are the predominant bacterial species in the large intestine.[15]
- Fecal flotation and direct smear: To detect roundworms, coccidia, and cryptosporidia.
- Dermatophyte test medium (DTM): For dermatophytes (usually *Trichophyton mentagrophytes*)
- Skin scraping: For ectoparasites such as lice (*Gliricola porcelli*, *Gyropus ovalis*), and mites (*Trixacarus caviae*, *Chirodiscoides caviae*) (Fig 1).[12]

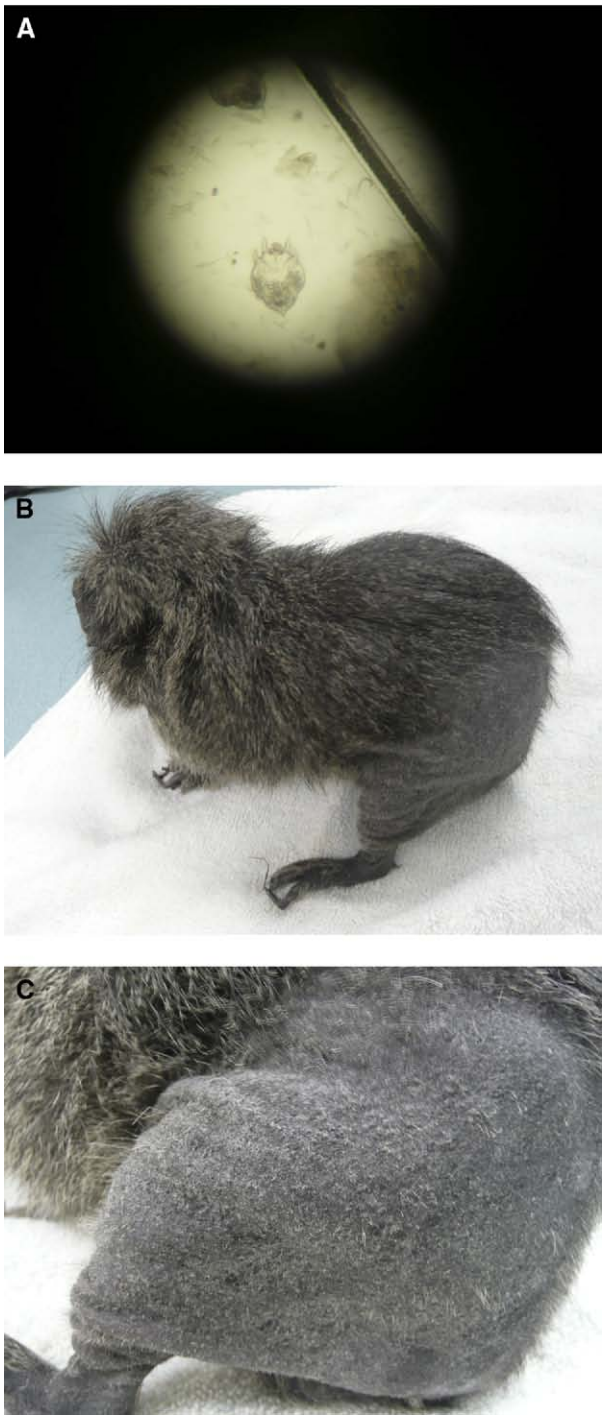

Figure 1. Guinea pig scabies. (A) *Trixacarus caviae* adult (400× magnification) from a skin scraping. (B) Guinea pig with alopecia and dermatitis due to *T. caviae*. (C) Close-up of same guinea pig.

Chinchillas

- Fecal direct and flotation: *Giardia* spp. *Cryptosporidium* spp.
- Fecal Gram stain: Predominantly Gram-positive normal flora.
- DTM: *Trichophyton mentagrophytes* is most common; however, *Microsporum canis* and *M. gypseum* have also been reported.[16]

Rats

- Skin scraping/pelage tape test: To identify *Radfordia* spp. (rat fur mite), *Ornithonyssus bacoti* (tropical rat mite), *Demodex nanus*, *Polyplax spinulosa* (spined rat louse) (Fig 2).
- Fecal direct and flotation, anal tape test: Tapeworm (*Hymenolepis nana*), pinworms (*Syphacia muris*), nematodes (*Trichosomoides crassicauda*), and *Giardia muris*.[17]

Mice

- Skin scraping/pelage tape test: To identify *Radfordia affinis*, *Psorergates simplex*, *Polyplax serrata*, *Myobia* spp., and *Myocoptes* spp.
- Fecal direct and flotation, anal tape test: Tapeworm (*Hymenolepis nana*, *Cysticercus fasciolaris*), pinworms (*Syphacia obvelata*), and *Giardia muris*.[17]

Hamsters

- Skin scraping/pelage tape test: To identify *Demodex aurati* and *D. criceti*. *Notoedres notoedres* and *N. cati* can cause intense pruritis. The tropical rat mite, *Ornithonyssus bascoti*, or the northern fowl mite, *O. sylvarium*, can cause a transient infestation.
- Fecal direct and flotation, anal tape test: Tapeworm (*Hymenolepis nana*, *H. diminuta*, *Cysticercus*

Figure 2. Rat louse, *Polyplax spinulosa* (spined rat louse) adult (100× magnification) collected from a superficial skin scraping.

fasciolaris, Taenia taeniaeformis), pinworms (*Syphacia obvelata, S. muris,* and *S. mesocriceti*), and *Giardia muris.*[17]

Diagnostic Testing for a More Detailed Investigation

Blood Sample Collection

Venipuncture can be technically difficult in all pet rodent species because of their small size and the stress associated with the procedure. If a small quantity of blood is adequate for the test being submitted, the lateral saphenous and cephalic veins are the most accessible venipuncture sites. Insulin syringes may be used for collection. Venipuncture of multiple veins may be necessary to collect an adequate volume of blood for the test(s) being requested. Use an insulin or tuberculin syringe and a small needle (25-gauge needle for a guinea pig, 25- to 29-gauge needle for a chinchilla and rat) to prevent collapse of the vein.[3]

When a larger blood sample is required, the jugular vein, cranial vena cava, or femoral vein can be used. These sites are best accessed with the animal under anesthesia to reduce patient stress and movement. The benefits of obtaining diagnostic samples must be weighted against the risk of anesthesia for each individual patient.[16]

Because of the small patient size and difficulty obtaining a sample, routine hematology is seldom performed in pet mice and hamsters. Approximately 0.5 to 0.7 mL/100 g body weight can be safely removed from a nonanemic healthy rat, mouse, or hamster. In addition to the above-mentioned sites, the ventral tail vein may be used in rats and mice. Warming the tail for 15 minutes before sample collection will aid in vessel visualization.[3,8,11]

In mice and hamsters, venipuncture must be performed with the animal under anesthesia. A warmed ventral tail vein or artery and the anterior vena cava may be used for blood collection in mice. The sites used for blood collection in hamsters include the jugular vein, anterior vena cava, saphenous vein, cephalic vein, and/or tail vein. From the peripheral veins, open collection or small-gauge preheparinized needle placement with open collection from the hub may be used after sterile lancet puncture.[8,11]

Urinalysis

Urinalysis may be necessary in animals with clinical signs of urinary tract disease, renal disease, or diabetes. Samples may be obtained by free catch, floor catch, or cystocentesis. Standard rodent cages can be used without substrate to collect urine from the cage bottom. Rodents will often urinate during restraint, so disinfecting the examination table before capture and restraint will prepare the surface for collection should the patient void while being restrained.[3,8] Cystocentesis may be performed as in other species, but care must be taken because guinea pigs and chinchillas can have a very large cecum that can interfere with the procedure. Unless the bladder is distinctly palpable, ultrasound-guided cystocentesis or collecting a voided sample is recommended for patients that may have a large cecum.

Pigments in the urine can sometimes be mistaken for hematuria and must be ruled out by the absence or presence of blood cells on a direct smear. The pH of guinea pig and chinchilla urine should be alkaline (pH 8.0-9.0). The normal pH range for hamster urine is 5.1 to 8.4; the urine is typically milky and turbid because of the normal crystal concentration of the urine. Urinary protein levels of most rodent species maintained as pets are normally high.[3]

Radiography

In pet rodents, whole body radiographs often help in the diagnosis of conditions such as urolithiasis, cardiac disease, pneumonia, gastrointestinal (GI) stasis, and neoplasia. Skull radiographs can be used to assess dental health, including the degree of dental malocclusion and potential osteomyelitis. Clinical presentations suited to diagnostic radiographic imaging of hamsters include impaction of the cheek pouches, bloat, and abdominal masses.[18]

Both ventrodorsal and lateral views should be obtained. Unless the animal is extremely debilitated and does not fight restraint, sedation may be necessary in guinea pigs and chinchillas and is usually required for the smaller rodent species to obtain diagnostic radiographic images and reduce stress on the patient. Care should be taken to extend the limbs when positioning the patient to minimize rotation and the superimposition of the limbs over the abdomen or thorax; masking tape can be used to hold the legs in extension. A high-speed, 300-mA machine with fine or detail-intensifying screens is usually adequate to get diagnostic images. Dental radiography units that can focus at short distances may be helpful for isolating focal anatomy. In these small patients, individual organs may be poorly defined in the radiographic images.[8,11,16,19]

Ultrasonography

Ultrasound is useful in the diagnosis of intraabdominal pathology, especially when investigating cysts, abdominal effusion, neoplasia, and urinary tract cal-

culi. Sedation or anesthesia is often necessary to obtain a quick diagnostic ultrasound examination, but may be performed without anesthesia if the pet is properly restrained. To prevent hypothermia, the gel must be warmed, and the fur should remain intact. For best results, a B-mode 10-MHz transducer is recommended.[20]

Guinea pigs often have a large amount of gas accumulation in the GI tract, thereby limiting the diagnostic value of an abdominal ultrasound in this species.[12] Chinchillas have a large cecum; if it contains a large amount of gas, the value of an abdominal ultrasound will also be reduced.[16]

Microbiology

Standard collection techniques used for other animals are appropriate. The primary pathogens isolated from chinchillas include Gram-negative bacilli (e.g., *Bordetella* spp., *Escherichia coli*, *Klebsiella* spp., *Salmonella* spp., *Pseudomonas* spp.) and Gram-positive cocci (*Staphylococcus aureus*, *Streptococcus* spp.). Many of these organisms are isolated from healthy animals and may be considered opportunists if no disease signs are evident.[16] The difficulty with culturing mice and hamsters is acquiring a representative sample of the suspect area that will provide diagnostic information.[8,11]

Serology

There are serologic diagnostic tests available through Sound Diagnostics, Inc. (Woodinville, WA USA) that require only 50 μL of undiluted serum to run one test or a rat infectious panel. Rat infectious diseases for which serologic tests are available include Kilham's rat virus, pneumonia virus of mice, rat parvovirus, rat coronavirus, *Mycoplasma pulmonis*, Toolan's H-1 virus, Sendai virus, Theiler's murine encephalomyelitis virus, cilia-associated respiratory bacillus, mouse adenovirus, and reovirus 3.[8]

Mouse infectious diseases for which serologic tests are available include ectromelia virus, mouse hepatitis virus, mouse parvovirus, mouse minute virus, rotavirus, pneumonia virus of mice, *Mycoplasma pulmonis*, lymphocytic choriomeningitis virus, Sendai virus, Theiler's murine encephalomyelitis virus, cilia-associated respiratory bacillus, mouse adenovirus, and reovirus 3.[8]

Diagnostic tests using blood, serum, and polymerase chain reaction technology are available for a number of viruses to which the hamster is susceptible, including lymphocytic choriomeningitis virus, Sendai virus, mouse pneumonia virus, hamster polyomavirus, and hamster parvovirus.[11]

Basic Emergency Care

Oxygen Therapy

Rodent patients often present with dyspnea as their primary clinical disease sign. Such patients cannot tolerate the stress of handling and should be placed in an oxygen cage after their weight is measured and before any other treatment or evaluation is attempted.

Fluid Therapy

Supplemental fluids are commonly administered subcutaneously in the dorsal cervical and thoracic region in all rodent species described in this article. Many guinea pigs react to the discomfort caused by subcutaneous fluid administration and become stressed, but chinchillas usually tolerate this treatment without difficulty. When grasping the skin to introduce the needle, care should be taken to avoid causing fur slip in chinchillas. A 22- to 25-gauge butterfly catheter is recommended for delivering fluids, because it allows the patient to move around while the fluids are being delivered and it does not have to be pulled out and reinserted.[3] Fluids are usually administered at 100 mL/kg body weight per day divided every 8 to 12 hours (25-35 mL per site) in guinea pigs and chinchillas.[21]

Fluids administered through the intraperitoneal route are presumed to be absorbed via the serosal surfaces of the viscera and the peritoneal membrane. This route is suitable for moderately to severely dehydrated animals and for animals with collapsed peripheral veins. Larger boluses of fluids can be provided intraperitoneally, but care should be taken to avoid inducing ascites; direct visualization or ultrasonography can be used to assess whether fluid accumulation is occurring. The patient should be placed in dorsal recumbency during the procedure, because the organs will fall away from the injection site by gravity. The needle should be inserted at a 20° to 30° angle off the abdominal wall to minimize the likelihood of inserting the needle into the viscera. Aspirate the syringe before delivering the fluids to ensure that the fluids are not going to be delivered into an organ. The fluids should always be prepared at body temperature.[3,16]

Indwelling peripheral intravenous catheters can be used, but are often difficult to place because of the small size of the patients. Better success may be achieved with intraosseous catheters. Use a local anesthetic when placing an intraosseous catheter to help reduce stress and movement of the patient. The proximal femur and tibia are the preferred sites to insert intraosseus catheters. For a catheter being

placed into the proximal femur, the space between the neck of the femur and the greater trochanter should be used as the insertion landmark. For catheters being placed into the proximal tibia, the tibial crest is the insertion landmark. A spinal needle with a stylet should be used to prevent obstruction of the needle with a bone and/or tissue core. The catheters can be secured by placing tape in a butterfly pattern over the end of the catheter and suturing it to the skin.[16]

Intravenous catheters can be placed in the cephalic vein, lateral and medial saphenous veins, and jugular veins. Sedation will facilitate catheter placement. An Elizabethan collar constructed out of radiographic film may be used to prevent the patient from chewing the catheter setup.[16]

Fluid therapy can be provided to rats and mice through subcutaneous, intraperitoneal, and intravenous routes. Up to 10 mL of fluid may be given via a 25-gauge needle in rats, 1 to 3 mL in mice. Although the lateral tail vein is often mentioned as a location in which intravenous fluids may be administered, it is technically difficult to access. Warming the tail of rats and mice 15 minutes before venipuncture with warm water allows for better visualization of the lateral tail vein. Intraosseous catheters are much easier to place in mice than intravenous catheters. The tibial plateau and the greater trochanter are the anatomic sites of choice for intraosseous catheter placement.[17]

A combination of crystalloid (10-15 mL/kg at rapid infusion) and colloid (5 mL/kg Hetastarch over 5-10 minutes) fluid therapy via an intraosseous catheter is recommended for rehydration in hamster patients. Crystalloid fluids alone can be administered by subcutaneous or intraperitoneal routes if vascular access is not possible. The shock fluid dose for hamsters is 65 to 80 mL/kg.[22]

Nutritional Support

Nutritional support should be provided for any anorexic rodent patient or animal that is eating but continuing to lose weight and body condition. Anorexic chinchillas and guinea pigs can experience a significant change in their gastrointestinal microflora within 8 to 12 hours from the time they stop eating.[12,16] This change in the microflora can lead to ileus, colic, overgrowth of pathogenic bacteria (dysbiosis), and enterotoxemia. To minimize the likelihood of the gastrointestinal tract from slowing or stopping, it is important to provide caloric intake for these animals. Oxbow Critical Care for herbivores (Oxbow Hay Company, Murdock, NE USA), Emeraid Herbivore (Lafeber Company, Cornell, IL USA), or a soaked guinea pig/chinchilla pellet slurry are examples of nutritional offerings that can be fed to the anorexic rodent (e.g., guinea pig, chinchilla) patient. These animals will often eat the nutritional diets listed above directly from a dish, but they can be syringe fed if needed.[16] In guinea pigs, a nasogastric tube (e.g., 3.5-French Argyle tube) may be placed to facilitate feeding anorexic patients.[23]

For rats, mice, and hamsters, pureed baby food mixed with a slurry of moistened rabbit or rodent pellets and yogurt containing active cultures may be used.[11]

Medication Administration

Most drug formulations are too concentrated for use in smaller rodent patients. To administer an accurate dose and to avoid causing tissue damage, drugs must be suitably diluted for parenteral use and a tuberculin or insulin syringe used to ensure delivery of accurate volumes. Ideally, the diluent selected should be the same one in which the drug is currently formulated. Otherwise, an isotonic solution, such as sterile physiologic saline solution, should be used.[3]

Oral treatment with a dropper or tuberculin syringe is technically the easiest and least stressful for the patient, especially when used for the very small species. Both oral medication and nutritional supplementation can be administered through a bulbed stainless-steel feeding needle or flexible red rubber feeding tube. The length of the tube should be premeasured, externally from the nares to the last rib, and marked. A water-based lubricant should be applied to the feeding tube before it is inserted through the intradental space toward the back of the oral cavity. The animal can be restrained for the procedure by scruffing the dorsal neck skin fold and holding the body with the remaining free fingers. The tube should advance without difficulty until the premeasured mark is reached.[8] Oral medication via gastric gavage or oral syringe is preferred over food or water medication, because ill rodents are unlikely to ingest food and water in appropriate amounts.

Routes used to administer parenteral medication are generally limited to subcutaneous, intramuscular, intraperitoneal, or intraosseous routes. Subcutaneous injections in the dorsal cervical or thoracic areas are preferred because they are easy to give, pose the least risk to the animal, and allow delivery of relatively large volumes of medication. Five to 10 mL of fluid or medication can be administered per site in a rat. Two to 3 mL of fluid or medications can be administered per site in mice.[3]

Intramuscular injections may be given in the semitendinosus, triceps, and/or epaxial muscles in mice. The intramuscular route of administration is restricted in some hamsters because of their small size and muscle mass.

For intraperitoneal access, hold the animal in dorsal recumbency with the head below the abdomen and the hindlimb in extension. Inject into the caudal abdomen on the side of the extended leg.

Antibiotic-associated enteritis is common in guinea pigs, chinchillas, and hamsters. The normal microbial flora of these rodents is predominantly *Lactobacillus* spp. and *Bacteroides* spp. Dysbiosis occurs as normal bacteria are killed by antibiotics, thus leading to overgrowth of opportunistic organisms, particularly *Escherichia coli* and *Clostridium* spp. Examples of antibiotic agents associated with dysbiosis are: cephalosporins, lincomycin, penicillins, clindamycin, erythromycin, vancomycin, bacitracin, oral gentamicin, and tylosin. Administration of streptomycin, dihydrostreptomycin, and procaine in hamsters causes death because of the neuromuscular blocking action of these drugs.[24]

Thermal Support

Debilitated animals are often hypothermic, and thermal support is often an integral part of rodent emergency care. Care must be taken to not overheat the patient in an attempt to increase the body temperature.

Basic Treatment Recommendations for Select Common Disease Presentations

Guinea Pigs

Dermatophytosis/Ringworm

Features. The dermatophyte most frequently isolated from guinea pigs is *Trichophyton mentagrophytes*, although *Microsporum canis* is occasionally identified. Young animals tend to be more susceptible to infection. Animals may be subclinical carriers, with the disease usually manifesting secondary to overcrowding, poor husbandry, and other stressors.

Diagnosis. Physical examination: Affected animals are usually pruritic. Lesions typically consist of focal areas of alopecia with crusts, which are often white. The lesions are often first observed on the face, forehead, and ears, and later spread over the dorsum and down the limbs (Fig 3).[25]

DTM: Because the disease has zoonotic potential, initiation of treatment is recommended while results are pending.

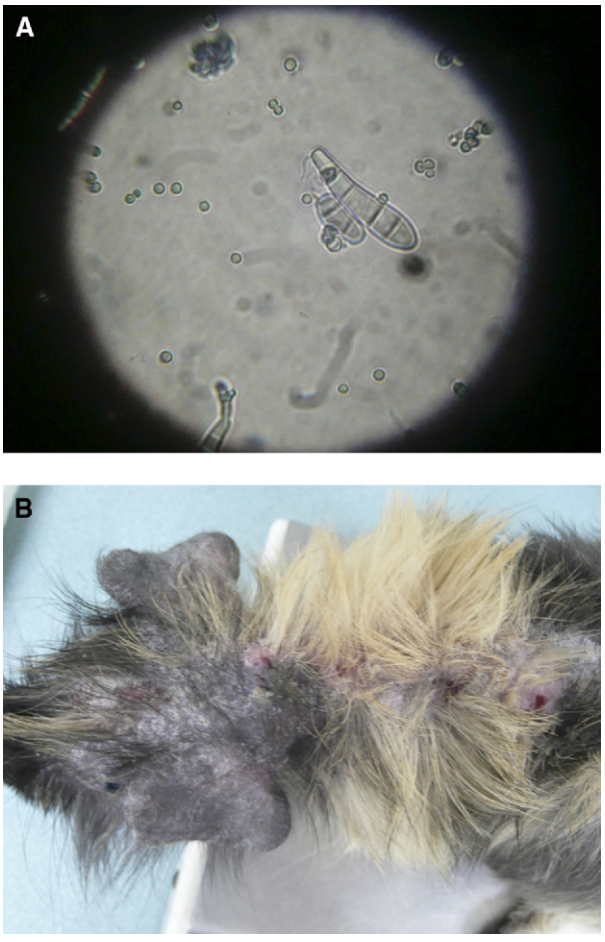

Figure 3. *Trichophyton mentagrophytes* (A) from a DTM culture grown from hairs of a guinea pig (400× magnification). (B) Dermatophytosis in a guinea pig.

Treatment. Guinea pig dermatophytosis can be managed topically with miconazole every 24 hours for 2 to 4 weeks.[3] Butenafine has also been used effectively as a topical agent: 1% cream applied topically every 24 hours for 10 to 20 days.[26] Fluconazole can be administered at 16 mg/kg orally (PO) every 24 hours for 14 days in more severe cases.[27] Griseofulvin is commonly given at 25 mg/kg PO every 24 hours for 14 to 28 days. Because griseofulvin is a teratogenic agent, this medication should not be administered to pregnant animals.[28]

Respiratory Disease

Features. Guinea pigs are very susceptible to respiratory disease caused by *Bordetella bronchiseptica* and *Streptococcus pneumoniae.* Both organisms are commonly found in many species, including humans, who may act as subclinical carriers.[3,29] Stress increases susceptibility to disease with young guinea pigs being more susceptible. Concurrent hypovita-

minosis C increases susceptibility to bacterial infections because of a disruption in the protective epithelial layer of the respiratory tract.[30]

Diagnosis. History and physical examination: Clinical signs include anorexia, nasal and ocular discharge, and dyspnea.

Radiographs: Consolidation of the lung lobes and exudates in the tympanic bullae may be noted in advanced cases. With concurrent hypovitaminosis C, long bone epiphyses and costochondral junctions of the ribs may be enlarged and pathologic fractures may be present.

Microbiology: Culture and sensitivity, or enzyme-linked immunosorbent assay, of the respiratory exudates to confirm a diagnosis.[31,32]

Treatment. Antibiotics: Chloramphenicol palmitate (30-50 mg/kg PO every 12 hours for 7-21 days), trimethoprim-sulfa (30-50 mg/kg PO every 12 hours for 7 days), and enrofloxacin (5-10 mg/kg PO every 12 hours) are recommended for treating guinea pigs diagnosed with respiratory infections. A combination therapy using enrofloxacin and doxycycline (2.5 mg/kg PO every 12 hours) for 7 to 21 days has also been found to be effective. Long-term treatment with any of these antimicrobial agents may be necessary, but the patient's stool, attitude, and appetite should be monitored and the antibiotic therapy reassessed if abnormal changes occur regarding any or all of the clinical criteria listed. Concurrent supportive care measures (e.g., oxygen therapy, fluid therapy, vitamin C supplementation) should be administered as warranted.[3]

Malocclusion/Dental Disease

Features. All guinea pig teeth are open-rooted and grow throughout life. Any damage to the teeth or changes to the growth of the teeth can result in malocclusion. In animals with dental malocclusion, the maxillary cheek teeth tend to overgrow laterally into the buccal gingiva and the mandibular cheek teeth tend to overgrow in a medial direction, entrapping the tongue.[3,12] The incisors are normally white in guinea pigs. The occlusal plane in guinea pigs is angled, which will result in tongue entrapment when the already narrow rostral cheek teeth overgrow. There is a genetic predisposition to malocclusion in guinea pigs, but diet, trauma, or infection may also contribute to this commonly diagnosed disease process.[3]

Diagnosis. History: Clinical signs associated with dental disease include decreased appetite or dysphagia, weight loss despite apparent interest in food, ptyalism, halitosis, decreased fecal output, and declining coat quality. Vitamin C–deficient diets and inadequate roughage in the diet are predisposing factors to malocclusion problems in guinea pigs.

Physical examination/gross visualization: Overgrown incisors are readily visible. Oral examination to assess the premolars and molars usually requires sedation. Use of an otoscope, vaginal speculum, or an endoscope enables direct visualization of the cheek teeth through the narrow oral cavity. Dental specula and pouch dilators are invaluable in obtaining an adequate view of the molars and premolars. The oral cavity may need to be rinsed out with warm water via a curved-tipped syringe if food material is hindering visualization. Abnormal oral examination findings may include an uneven occlusal surface or angle of the incisors and/or cheek teeth, formation of sharp points with or without associated ulceration of the oral mucosa, food impaction, and abnormal spaces between teeth. Abscessation of the molar and the premolar apices can also occur with the overgrowth of these teeth. Careful palpation of the ventral mandible and maxilla may reveal bony protruberances that correspond to overgrowth of the apical surfaces of the cheek teeth. The apical surfaces of maxillary teeth can overgrow and impinge on the nasolacrimal duct, causing ocular discharge. The apices can also overgrow into the nasal cavity, which may result in the seeding of the sinuses with bacteria from the oral cavity, causing nasal discharge.[3,16]

Skull radiographs: Radiographs help evaluate the extent and magnitude of the disease process. Lateral, left and right (45°) obliques, dorsoventral or ventrodorsal, and apical (rostrocaudal) views are recommended. One or more intraoral dental views may also be useful.[33] Even if the oral examination is fairly normal, significant disease can be present in the tooth anatomy found below the gingival surface (e.g., apical abscesses, osteomyelitis, root elongation, crown elongation).

Treatment. Dental malocclusion is a disease to be managed for life and is rarely cured. Owners should be made aware of the long-term expenses and prognosis for their pet once a diagnosis has been made and before any further treatment on the patient. Typically, affected animals require repeated trimmings every 4 to 6 weeks for the remainder of the animal's life.

Treatment centers on restoring a normal occlusal plane to the teeth.[12] This is a procedure that must be performed with the animal under general anesthesia to allow adequate visualization of the oral cavity, to minimize stress to the patient, and for the safety of the patient. Compromised patients should be provided supportive care before undergoing an anesthetic procedure.

Use of a rabbit/rodent dental stand greatly facilitates positioning for guinea pig patients. The teeth can be trimmed with a high-speed dental drill fitted with an elongated bur designed for rabbits and rodents. Restore the normal occlusal plane of the affected teeth and reduce any sharp points that have formed because of improper wear. With any dental instrument, care should be observed to minimize trauma to the soft tissue in the oral cavity. Bur guards and dental specula should be used to prevent such trauma in the narrow space. The use of rongeurs and handheld trimmers, such as canine/feline nail trimmers, are no longer recommended because of their tendency to fracture and splinter the teeth, resulting in tooth pulp exposure.[34]

In cases in which masticatory muscles have been stretched because of severe crown elongation, the animal may not be able to normally masticate. To alleviate this, syringe feeding and pain management should be administered until the animal is able to recover and eat on its own.

Dental disease appears to have a heritable component; therefore, animals with dental disease should not be bred. A dietary component is also considered a likely variable in the development of guinea pig dental disease. Owners of guinea pigs and chinchillas with dental disease should be advised to increase the amount of roughage in the diet to enhance the grinding motion of the teeth and increase wear.[12]

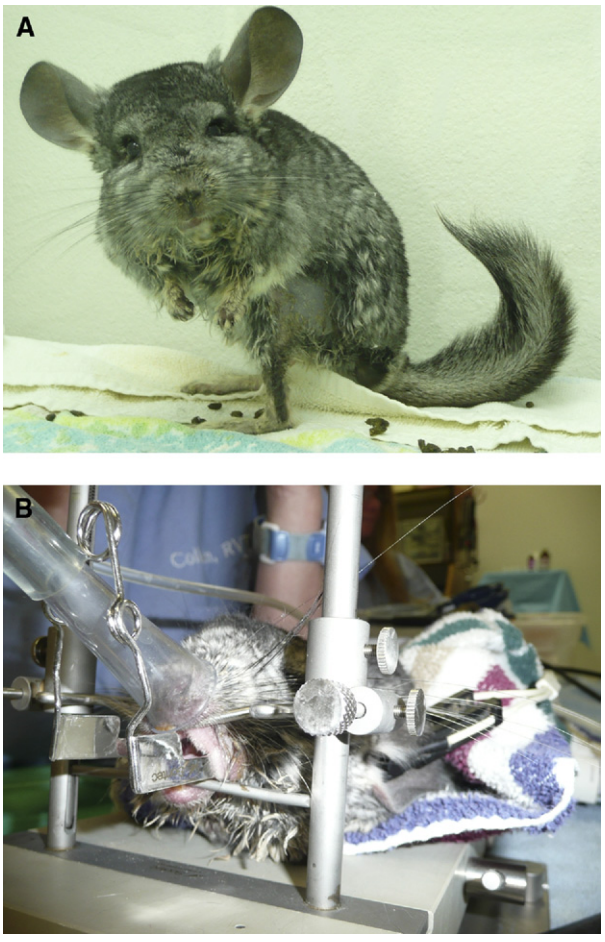

Figure 4. (A) Chinchilla with ptyalism from malocclusion. (B) Chinchilla on a rabbit/rodent dental stand.

Chinchillas

Malocclusion. Malocclusion is a common condition diagnosed in chinchilla patients, and the management of these cases should follow the previous examples given for guinea pigs. The incisors are normally yellow in adult chinchillas, and the occlusal plane of their cheek teeth is near horizontal.[3] Because of their extra fine and delicate hairs, chinchillas often present with "slobbers" from the excessive salivation that occurs with malocculsion (Fig 4).

Gastrointestinal Stasis

Features. Ileus is often overlooked because owners do not always monitor their pet's normal droppings.[3] Chinchillas with constipation strain to defecate, and the few pellets they pass are thin, short, hard, and occasionally blood-stained. Rectal prolapse may occur from excessive straining. With ileus, there may not be any straining or attempts to defecate. Chinchillas are highly dependent on the function of their GI tract to provide essential calories in the form of volatile fatty acids. When chinchillas become dehydrated, the shift of the fluid balance to maintain the function of the brain and heart often comes at the expense of the GI tract. As the shift in the fluid balance occurs, GI motility diminishes, microflora changes occur, and the animals reduce their dietary intake and production of calories. If left untreated, these patients die.[16]

The usual cause of GI stasis in the chinchilla patient is associated with feeding too much of a concentrated diet, which is high in energy and protein, without supplying sufficient roughage or fiber.[35] Dental disease, insufficient water intake, intestinal atony in older animals, or lack of exercise may be contributing factors to the GI stasis condition. Other causes of constipation include obesity, intestinal obstruction, and intestinal compression secondary to large fetuses.[3,36]

Diagnosis. Diagnosis of GI stasis in chinchillas is determined by evaluation of the husbandry and dietary history of the patient, assessment of fecal material, or lack thereof, and physical examination. Radiographic evaluation of the abdomen and skull is important for diagnosis and therapeutic considerations.

Treatment. For animals that are active, eating, and drinking, changing the diet by increasing the fiber content may be sufficient to correct mild cases of GI stasis. Carefully adding small amounts of fresh foods, such as apples, carrots, and/or lettuce, and omitting treats, such as grains or raisins, can also help correct GI stasis. Provide nutritional support to anorexic chinchillas by syringe-feeding Oxbow Critical Care Formula, vegetable baby foods, and/or soaked or ground chinchilla pellets. Syringe feed approximately 2.5% of the animal's body weight (e.g., 10-15 mL) of the supplemental formula 3 times daily. The feedings should be gradually reduced until fecal production and appetite return to normal.[37] Rehydration of the GI tract is required for it to regain its normal function. In cases of severe dehydration, the intravenous and intraosseous routes are preferred, although oral, subcutaneous, and intraperitoneal fluids are acceptable in less severe cases.

The use of oil- and petroleum-based laxatives for cats are no longer recommended to treat GI stasis in chinchillas. If there is no intestinal blockage, metoclopramide (0.5 mg/kg PO, subcutaneously [SC], intramuscularly [IM] every 12 hours) or cisapride (0.5 mg/kg PO every 8 hours) for 3 to 5 days may be used to enhance intestinal motility. Analgesia should be provided, because GI stasis can be a painful condition. Meloxicam (0.1 mg/kg PO, SC every 12 hours) or buprenorphine (0.02-0.05 mg/kg SC, IM, intravenously every 8-12 hours) can be used.[37]

If a rectal prolapse is present, the prolapse needs to be reduced. If diagnosed and treated early, the prolapse may be replaced and retained by a purse-string suture. If the tissue is edematous, soaking in a dextrose solution may reduce the swelling. Care must be taken to leave an opening sufficient to allow passage of feces.[3]

Diarrhea

Features. The most common cause for diarrhea in pet chinchillas is inappropriate feeding. This includes overfeeding fresh greens and offering damp hay that may be moldy or too young. Stress and sudden changes in the diet also seem to predispose chinchillas to diarrhea. The owner may first notice that feces are smeared on the resting boards in the cage and that the fur around the anus is matted with feces.[3]

Bacterial and parasitic infections can also cause diarrhea, but usually the owner describes signs of diarrhea that have been present for a few days. These chinchillas are often lethargic and have dry, dull fur. Because an animal may camouflage diarrhea by cleaning itself, fecal staining of the fur is not always apparent. Enteric disease from *Yersinia pseudotuberculosis*, *Y. enterocolitica*, *Listeria monocytogenes*, *Salmonella* spp., and *Klebsiella* spp. have been recorded in chinchillas.[3] Enterotoxemia cases associated with *Clostridium* species have also been noted.[3] The indigenous microflora of chinchillas are predominantly Gram-positive, and certain antibiotics can cause severe antibiotic-induced dysbiosis. Enteral administration of penicillins (e.g., amoxicillin, ampicillin), macrolides (e.g., erythromycin, lincomycin), and first-generation cephalosporins are most commonly associated with these pathologic changes in a chinchilla's GI flora.[38] Antibiotics that are generally considered safe to use for chinchillas diagnosed with diarrhea include chloramphenicol, ciprofloxacin, enrofloxacin, and trimethoprim-sulfa.[16]

Chinchillas can carry *Giardia* spp. in low numbers and show no clinical disease signs. Stress and poor husbandry are believed to cause an increase in parasite numbers, resulting in severe diarrhea and death. Signs of giardiasis include a cyclic sequence of appetite loss and diarrhea associated with a declining body and hair coat condition.[3]

Diagnosis. Evaluation of husbandry and diet is important in assessing the cause and precipitating factors that may be associated with the diagnosis of diarrhea in a chinchilla patient. *Giardia* spp. can be identified on a fresh fecal smear or fecal trichrome stain.

Treatment. If the diarrhea is acute, withholding food for the first day and adding a palatable oral electrolyte replacement solution such as Pedialyte (Ross, Columbus, OH USA) or Rebound (NPS Inc., Atlanta, GA USA) to the drinking water is recommended. A well-dried, high-quality hay should be offered on the second day, and an electrolyte solution administered SC if the animal is dehydrated.[3,37]

If giardiasis is suspected, treat with metronidazole (20 mg/kg PO every 24 hours), albendazole (25 mg/kg PO every 12 hours for 2 days), or fenbendazole (30 mg/kg PO every 24 hours for 3 days).[3]

Rectal prolapse may occur with diarrhea. Reduce the prolapse as described previously; however, the underlying diarrhea must be treated if the secondary prolapsed condition is to resolve.[3]

Rats

Murine Respiratory Disease Complex

Features. Respiratory disease caused by infectious agents is the most common rat health problem treated at veterinary hospitals. The major pathogens that cause overt clinical respiratory disease are: *Mycoplasma pulmonis*, *Streptococcus pneumoniae*, and *Corynebac-*

terium kutscheri. Other organisms such as Sendai virus, pneumonia virus of mice, rat respiratory virus, cilia-associated respiratory bacillus, and *Haemophilus* spp. are minor respiratory pathogens that by themselves rarely cause overt clinical disease. However, these organisms interact synergistically as copathogens with the major respiratory pathogens to produce 2 major clinical syndromes: chronic respiratory disease (CRD) and bacterial pneumonia.[3]

Mycoplasma pulmonis is the major component of CRD, also known as murine respiratory mycoplasmosis. Rats may live 2 to 3 years with CRD. The disease expression varies greatly because of environmental, host, and organism factors that influence the host-pathogen relationship.

In contrast, bacterial pneumonia is almost always caused by *Streptococcus pneumoniae* but seldom develops in the absence of other infectious agents.

Diagnosis. Clinical signs are highly variable for CRD, and the initial infection develops without any clinical signs. Early clinical signs involve both the upper and the lower respiratory tracts and may include snuffling, nasal discharge, tachypnea, weight loss, hunched posture, ruffled coat, head tilt, and red tears (Fig 5).[39,40] Thoracic radiographs may be helpful in the diagnosis of CRD.

With bacterial pneumonia, onset can be sudden, and young rats are more severely affected than older rats. Often the only sign an affected rat patient will exhibit is sudden death. Purulent exudate may be seen around the nares and on the front paws from wiping of the nostrils. A tentative diagnosis may be based on identifying numerous Gram-positive diplococci on a Gram stain of the respiratory exudates or in a sample submitted for cytologic examination. Severe bacteremia is an important consequence of advanced disease and results in multiorgan abscesses and infarction.

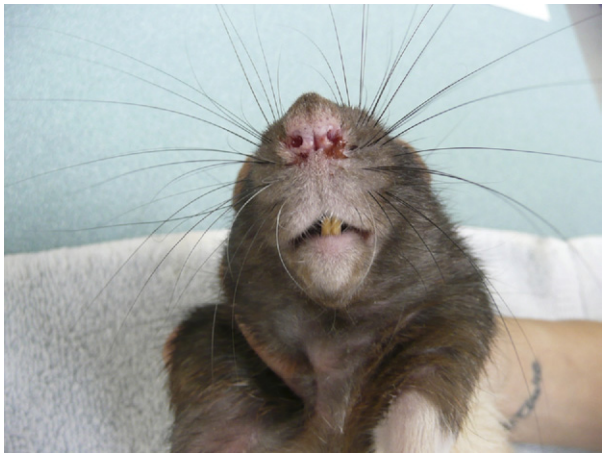

Figure 5. Rat with respiratory disease presenting with nasal discharge.

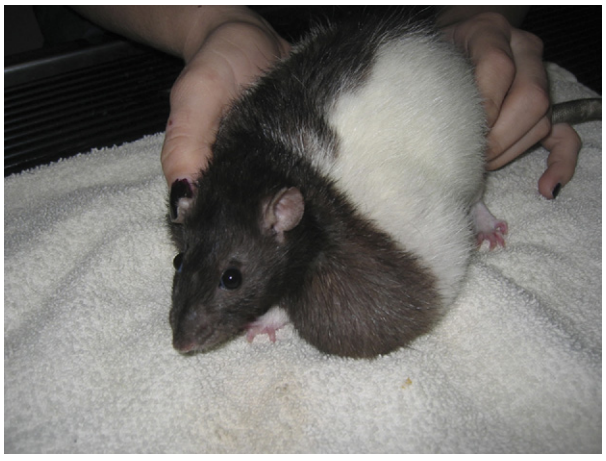

Figure 6. Rat with mammary fibroadenoma (photo courtesy of Amy Beth Worell, Dip. ABVP (Avian)).

Treatment. For CRD, treat with enrofloxacin (10 mg/kg PO every 12 hours for 7 days) alone or in combination with doxycycline hyclate (5 mg/kg PO every 12 hours for 7 days). Alternatively, azithromycin (20 mg/kg every 24 hours 7 days) has been used with success.[41] Although *Mycoplasma pulmonis* and CAR bacillus are susceptible to this antibiotic therapy, the respiratory viruses are not. Warn owners that antibiotic treatment will not cure CRD but may alleviate clinical signs. Reducing ammonia levels in the animal's environment by changing the substrate daily and supplementing the diet with vitamins A and E may help decrease the clinical signs associated with CRD. With advanced cases, treatment with bronchodilators (e.g., aminophylline, theophylline) and antiinflammatory drugs (Meloxicam) are also indicated. Nebulization or use of a steam vaporizer is also recommended to enhance the efficacy of the treatment protocol.[42]

Mammary Neoplasia

Features. The most common subcutaneous tumor in rats is fibroadenoma of the mammary glands. The distribution of mammary tissue is extensive, and the tumors can occur anywhere from the neck to the inguinal region (Fig 6). Tumors can become very large and develop in both males and females.[3]

Diagnosis. Physical examination: The masses are usually palpable and are often the presenting complaint. Use fine needle aspiration cytology or surgical biopsy to confirm the tumor type.

Treatment. The recommended treatment for mammary tumors is surgical excision, with survival rates after the surgery being good if the tumor is benign.[43]

Although survival after tumor removal is good with benign masses, recurrence is common and the owners should be informed of this possibility.[3] The extensive mammary tissue almost makes it impossible to remove all of the affected tissue to prevent tumor regrowth, even with benign masses. Adenocarcinomas represent fewer than 10% of mammary tumors in rats. The prevalence of mammary tumors is significantly lower in ovariectomized rats than in sexually intact Sprague-Dawley rats. Therefore, spaying female rats is recommended to prevent mammary tumors. The surgery is easier to perform in a young rat before the animal becomes obese, but it can still be done in the older rat at the time of a mammary tumor removal to reduce the incidence of recurrence.

Abscess

Features. Subcutaneous abscesses often occur secondary to traumatic injury or bite wounds. Abscesses are often associated with *Pasteurella pneumotropica*, *Corynebacterium* spp., *Staphylococcus aureus*, and *Staph. pyogenes*. These bacterial isolates are considered opportunistic invaders. Abscesses appear as localized soft to firm, usually nonpainful swellings that contain a caseous exudate. Lesions are most commonly found on the head and limbs but may be located anywhere on the body.[3,8]

Diagnosis. Diagnosis is usually based on history, palpation, and clinical findings. Rule out neoplasia, dermal cysts, and cuterebriasis when a subcutaneous mass has been identified on a rat patient. Cytologic findings from these exudates typically consist of suppurative inflammation with a mixed-bacterial population. Gram stain, anaerobic and aerobic culture and sensitivity, and *Pasteurella* spp. serology should be considered in the diagnostic testing protocol when trying to confirm the causative agent(s) of a rat abscess.[44,45]

Treatment. Treat with systemic antibiotics, based on culture and sensitivity results, for at least 2 weeks. A penicillin (22,000 IU/kg SC, IM every 24 hours) or cephalosporin antibiotic agent is often effective when treating rat abscesses. Lance and drain the abscess and debride necrotic tissue as needed. Flush the wound thoroughly with saline solution. Prognosis is generally good when a rat abscess is treated aggressively and the appropriate protocol is used.[3,44]

Mice

Ectoparasitism

Features. Alopecia and dermatitis are very often identified in mouse patients that have been diagnosed with fur mites and lice. Affected mice are often pruritic, have a generalized thinning of hair, have a greasy hair coat, and have self-inflicted wounds. The most common species of mouse mites are *Myobia musculi*, *Mycoptes musculinus*, and *Rhadfordia affinis*. *Polyplax serrata* are blood-sucking lice. Mites and lice are spread by direct contact or infested bedding.[3,44,45]

Diagnosis. Visualization with a hand lens, stereoscopic microscope, or on a skin scraping: Identify adult mites or lice, nymphs or eggs on hair shafts.

Skin biopsy: May help distinguish acariasis from dermal hypersensitivity.

Treatment. Treat all in-contact mice with ivermectin (0.2 to 0.4 mg/kg SC or PO) 2 to 3 times at 10-day intervals.[38] Topical application of diluted ivermectin solution (1:100 in equal parts of water and propylene glycol for 3 treatments) on the mouse's head is an alternative treatment.[46] More recently, Selamectin (Revolution; Pfizer Ltd., New York, NY USA) has been found effective at 1 drop from a 15 mg-pipette.[47,48] Fragrant wood chips such as cedar and pine have ectoparasiticidal properties, but the hydrocarbons in these products are associated with respiratory irritation, skin hypersensitivity, and liver disease, so their use is not recommended.[3,8]

Nonparasitic Alopecia/Dermatitis.

Nonparasitic alopecia or dermatitis includes behavioral disorders, husbandry-related problems, and infectious and idiopathic conditions.[3,8]

Social dominance is manifested as barbering and fighting. In group-housed mice, the dominant mouse nibbles off the whiskers and hair around the muzzle and eyes of subservient cage mates. There are no other lesions associated with this condition, and only the most dominant mouse retains all its fur. Removal of the dominant mouse may solve the problem, but another mouse might take its place in the cage hierarchy and engage in the same behavior. Fighting among cagemates, especially males, is common and mice can inflict severe bite wounds on each other.[3]

Mechanical abrasion on the cage bars or other cage components may result in alopecia alone or with associated dermatitis. Removing or replacing the offending part of the cage or cage component with better designed nonabrasive equipment often will solve the problem.[3]

Mice are social animals, and individually housed mice can display aberrant stereotypic behavior that may result in alopecia. Providing environmental enrichment toys such as running wheels or hollow tubes will usually resolve this condition.[3]

Many chronic or ulcerative skin problems are considered idiopathic with secondary bacterial infec-

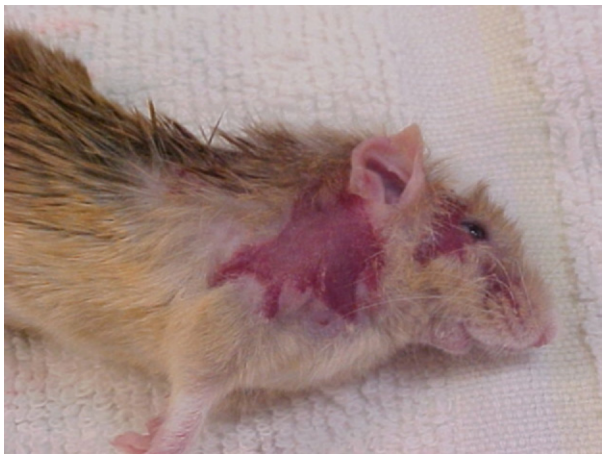

Figure 7. Mouse with nonparasitic dermatitis.

tions (Fig 7). This group is commonly unresponsive to either topical or systemic treatment, and affected individuals are often euthanized. Treatment with Derm Caps (DVM Pharmaceuticals, Teva Animal Health, Saint Joseph, MO USA) 0.1 mL/d and persimmon leaf extract administered daily for 4 weeks may help some of the mouse patients that have been diagnosed with chronic or ulcerative skin problems.[49,50]

Murine Respiratory Disease Complex

Features. The most common causes of clinical respiratory disease in mice are Sendai virus and *Mycoplasma pulmonis*. Sendai virus is associated with an acute respiratory tract infection in which mice display chattering and mild respiratory distress. Although neonates and weanlings may die of this disease, adults often recover within 2 months. When the disease expression exceeds its common clinical presentation, there most likely is a concurrent mycoplasmal infection involved. *Mycoplasma pulmonis* causes chronic pneumonia, suppurative rhinitis, and occasionally otitis media, and results in purulent exudate accumulating in inflamed and thickened nasal passages, causing chattering and dyspnea. Survivors develop chronic bronchopneumonia, bronchiectasis, and occasionally pulmonary abscesses.[3,8]

Diagnosis. History and physical examination: as above.

Serology: Available, but the risk of sample collection in a compromised patient should be considered. Significance of the test that is currently being promoted and how the results are interpreted should be considered before testing the individual pet mouse.[8]

Treatment. Antibiotic therapy may alleviate clinical signs but does not eliminate the *Mycoplasma pulmonis* infection. For treatment, enrofloxacin (10 mg/kg) in combination with doxycycline (5 mg/kg) given every 12 hours PO for 7 days is sometimes helpful.[3] Reducing ammonia levels in the patient's environment by changing the cage bedding daily and supplementing vitamins A and E may also improve treatment response along with concurrent treatment with bronchodilators and antiinflammatory drugs.[3]

Hamsters

Enteropathies. Diarrhea may occur in hamsters of any age and is commonly referred to as "wet tail" (Fig 8). Enterocolitis and resultant diarrhea can be caused by a number of different enteric pathogens. Proliferative ileitis commonly occurs in 3- to 10-week-old hamsters and results in high mortality of the individuals affected. Wet tail is most commonly caused by the intracellular bacterium *Lawsonia intracellularis*. *Escherichia coli*, *Campylobacter jejuni*, *Helicobacter aurati*, *Salmonella* spp., and *Pasteurella pneumotropica* have also

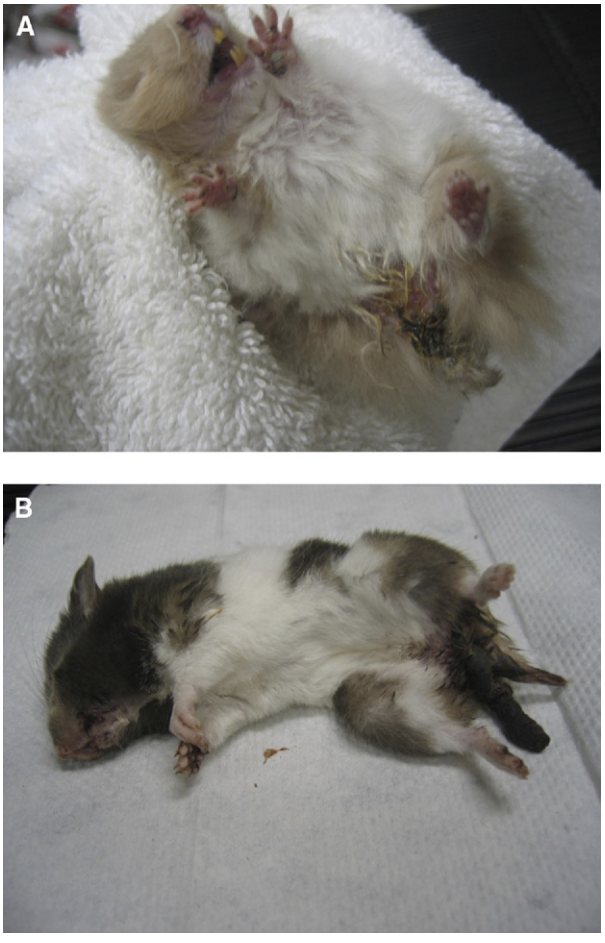

Figure 8. Hamster with "wet tail." (A) Typical clinical presentation with soiled feet, perineum, and chin. (B) Rectal prolapse secondary to severe enteropathy (photo courtesy of Amy Beth Worell, Dip. ABVP (Avian)).

been identified as organisms associated with diarrhea in hamsters. The etiology may be multifactorial in both youngsters and adults and precipitated by stressors such as overheating, high humidity, overcrowding, malnutrition, dietary changes, and shipping. Concurrent parasitic infection with a tapeworm (e.g., *Hymenolepis nana*) or protozoa (e.g., *Giardia* spp., *Entamoeba spp., Spironucleus muris*, trichomonads) may impair gut defense mechanisms and predispose the animal to secondary bacterial gastroenteritis.[3,51]

Treatment for hamsters diagnosed with diarrhea includes correction of electrolyte imbalance and dehydration, antibiotic administration, and nutritional support. Antibiotic treatments that have been recommended are tetracycline hydrochloride (400 mg/L drinking water for 10 days), tetracycline (10 mg/kg PO twice per day for 5-7 days), enrofloxacin (10 mg/kg PO or IM every 12 hours for 5-7 days), and trimethoprim-sulfa (30 mg/kg PO every 12 hours for 5-7 days). Symptomatic treatment with bismuth subsalicylate may be administered if diarrhea persists. Give electrolyte replacement fluids such as saline solution or lactated Ringer's solution at a dose of 20 mL/100 sg every 24 hours. Offer liquid or soft foods, or a nutritional supplement such as Critical Care. If the hamster does not eat, force-feed small amounts of the Critical Care formula. Potential sequelae to proliferative ileitis are obstruction, intussusception and rectal prolapse.[3,11]

Diarrhea in adult hamsters is often associated with enterotoxemia caused by *Clostridium difficile* and may develop 3 to 5 days after treatment with antibiotics such as penicillin, lincomycin, or bacitracin. Vancomycin given at 20 mg/kg PO every 24 hours for 3+ months has been reported as a treatment for enterotoxemia due to antibiotic administration.[52]

Tyzzer's disease is caused by infection of the gastrointestinal tract with *Clostridium piliforme* and is not observed in immunocompetent hamsters. Clinical signs of Tyzzer's disease in hamsters are nonspecific and include death, without premonitory signs; or an unkempt, scruffy pelage; depression; dehydration; and diarrhea. Gross necropsy generally reveals multiple necrotic hepatic foci and, if present, intestinal lesions. This GI disease may be precipitated by environmental factors, such as overcrowding, high environmental temperature, heavy parasite load, and poor diet. Treatment may be unrewarding but is based on supportive care and appropriate antimicrobial therapy.[3]

Pneumonia. A variety of pathogenic bacteria have been isolated from the respiratory tract of diseased hamsters. Cilia-associated respiratory bacillus infection causes mild disease in Syrian hamsters but produces clinical disease in the South African hamster. *Streptococcus pneumoniae* is commonly associated with respiratory disease in hamsters, but these animals can also harbor *Corynebacterium kutscheri* and *Pasteurella pneumotropica* without apparent clinical disease. All of the bacteria listed may subclinically affect the respiratory systems of hamsters and can eventually progress to pneumonia. Hamsters are resistant to *Bordetella bronchiseptica* infection.[11]

Clinical signs of bacterial pneumonia in hamsters include a purulent rhinitis and blepharitis and carry a poor prognosis. Streptococcal and other bacterial pneumonias may be transmitted from children to hamsters. The clinical diagnosis can be supported by finding Gram-positive diplococci in nasal or ocular discharge.[11] Follow-up culture and treatment with chloramphenicol (chloramphenicol palmitate, 50 mg/kg PO every 8 hours; chloramphenicol succinate, 30 mg/kg intravenously or IM every 8 hours) are recommended until antibiotic sensitivity results are available.[3,53]

Hematuria/Bloody Vaginal Discharge. A hamster may present for bloody discharge from the perianal area. Differentiation between bloody diarrhea, hemorrhagic vaginal discharge, and hematuria should be established by the veterinarian assessing the case. Observation for passage of urine, observation from which orifice the hemorrhage is coming from, and monitoring for passage of normal feces help identify the source of the bleeding. Radiographs and ultrasound will help identify ovarian, uterine, urinary bladder, or renal abnormalities. Urinalysis and urine culture are recommended if hematuria is present.

Important Information Owners Should Know to Maintain Good Health in Their Animals and Zoonotic Disease Potential

Guinea Pigs

Proper diet and husbandry are essential to maintain good health. Allergic responses to dander can cause cutaneous and respiratory allergies in susceptible people.

Humans affected with *Trichophyton* spp. may be asymptomatic or have alopecia and crusts. Active lesions in humans affected with *Microsporum canis* are most often found on the scalp.

Trixacarus caviae can be transmitted to pet owners, especially children, from direct contact with infected guinea pigs. Affected humans generally have a mild

dermatitis. Intensive environmental cleaning and management along with therapeutic treatment of the guinea pigs have been effective in treating *T. caviae* infestations.

Lymphocytic choriomeningitis virus is transmitted by horizontal and vertical routes in rodents. Affected guinea pigs are generally subclinical carriers, although clinical disease, including weight loss, photophobia, tremors, and convulsions, may occur. Humans can become infected from exposure to this virus through contaminated feces or urine or from a bite. Affected humans frequently report clinical symptoms consistent with a flu, including malaise, headaches, fever, myalgia, and arthritis.

Yersinia pseudotuberculosis has been associated with epizootics in guinea pig colonies. Affected animals generally exhibit weight loss and enteritis, and can serve as a reservoir of the bacteria in the human environment.[54]

Chinchillas

Overall, chinchillas represent a low potential zoonotic risk for pet owners. Many of the opportunistic bacterial pathogens (e.g., *Escherichia coli*, *Salmonella* spp.), fungi (e.g., dermatophytes), and protozoal infections (e.g., *Giardia* spp., *Cryptosporidium parvum*) found in chinchillas can infect humans. To minimize the likelihood of transmission, young children should not handle chinchillas diagnosed with these diseases during their treatment period. Gloves should be worn when treating infected chinchillas and when cleaning the animal's enclosure.[16]

Rats

Sanitation, ventilation, and prevention of obesity are important to maintain a healthy rat.

Zoonotic disease associated with pet rats is uncommon. Allergic reaction to rat dander and urine may be the most commonly reported zoonotic condition related to pet rat ownership. *Salmonella* spp. may colonize the intestinal tract of rats and may be infectious to humans. *Streptobacillus moniliformis* and *Spirillum minusare* are organisms that initiate the disease called rat-bite fever. A rat bite is required to seed the bacteria in a human, and, after a 6- to 10-day incubation period, the human begins to show clinical signs such as relapsing fever, chills, vomiting, myalgia, and regional lymphadenopathy.

Streptococcus pneumoniae can be shed by rats with respiratory disease and thereby has the potential for human exposure. Infected humans will have respiratory and meningeal disease signs.

Leptospira interrogans is transmitted from the infected urine of rats to humans. Infected humans have chills and fever and often develop septicemic conditions that can lead to organ dysfunction.[8,54] As with all pet animals, it is recommended that all humans wash their hands thoroughly with an antibacterial soap after contact with a rat.

Mice

Good sanitation and ventilation, proper diet and housing, prevention of escape and injury, and gentle handling are important for maintaining good health of pet mice.

Zoonotic diseases associated with mice maintained as pets are rare. The most commonly reported zoonotic condition associated with mice is an allergic reaction to their dander and urine. It is important that a handler wash his or her hands after interacting with a mouse. Contact with the feces or anus of a mouse may expose the handler to *Salmonella* spp.[8,54]

Hamsters

Prevention of trauma, injury, and escape, proper diet, sanitation, and housing animals individually are important in maintaining good hamster health.

The overall zoonotic risk to pet owners of captive-bred hamsters is low. The potential for rodents to carry zoonotic disease is minimized by eliminating exposure to wild rodents, eliminating parasitic infestation, and screening for viral agents. Important zoonotic diseases are generally limited to salmonellosis, hymenolepiasis, *Acinetobacter* spp., dermatophytosis, and lymphocytic choriomeningitis virus.[11]

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