

# Standards of Care: The Rabbit

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State-of-the-art improvements in how we feed and provide medical and surgical care for the pet rabbit (*Oryctolagus cuniculus*) has resulted in a greater lifespan for this beloved family pet. The rabbit is the most popular exotic patient seen in the author's small animal and exotics practice and many rabbit owners are dedicated to the health and well-being of their pets and expect the best in medical care. All hospital team members need to be aware of anatomical and physiological parameters unique to the rabbit when a rabbit is presented for illness or surgery. Hind-gut fermentation, an unusual calcium metabolism, teeth that continue to grow for most of the rabbit's life, a very small thoracic size in comparison to body mass, high metabolic rates, and being a catecholamine driven prey animal that stresses easily; are all factors that need to be taken into consideration when practicing rabbit medicine.

## Nutrition

As a general rule, rabbit owners are educated and well informed and appreciate a discussion on rabbit gastrointestinal physiology and how diet affects the overall well-being of the rabbit. An understanding of the rabbit's unusual digestion as a hind-gut fermentor and the role of fiber in maintaining balance, helps to explain the potential complexities involved when considering the proper way to provide nutrition.

Ultimately, a diet with 20-25% fiber, low starch, and appropriate protein levels will help prevent many gastrointestinal problems. As a general rule, a maintenance diet of one ounce of high fiber pellets per kg of body weight and ad libitum grass (timothy, oat, orchard grass, meadow) hay is recommended. High fiber pellets that are over 20% fiber and less than 16% protein are recommended. Keeping fresh, leafy greens on hand is not only a great way to show clients appropriate produce to provide herbivores, but also serves as an aid in testing patient inappetence in suspect ileus cases. For nutritional support of anorexic rabbits Oxbow Critical Care for Herbivores can be syringe fed and is an excellent source of fiber and nutrition.

## Diagnostics

### Clinical pathology

Upon completion of the history and physical exam the rabbit veterinarian may choose to initiate a diagnostic workup which benefits from the availability of diagnostic equipment well suited to the exotic mammal. Maximal rabbit safe blood sampling amount is 1 ml/100g body weight with the blood volume of the adult rabbit being 55-65 ml/ kg. (1) Venipuncture options include the jugular, lateral saphenous, cephalic and marginal ear veins. For most rabbit blood draws the author prefers to use 1 ml tuberculin syringes with 25-ga x 5/8 inch (0.50 x 16mm) needles for lateral saphenous venipuncture. Alternatively, Monoject (Tyco Healthcare Group, Mansfield, MA) has available 0.5cc tuberculin syringes with attached 28-gauge (0.36mm) needles that may allow for easier collection from cephalic or lateral saphenous veins in the smaller dwarf breeds

### Serodiagnosis

Most commercial labs use enzyme-linked immunosorbent assays (ELISA) to aid in serologic diagnosis of rabbit disease. Several labs that serve primarily the laboratory animal research community offer DNA based assays including DNA amplification polymerase chain reaction (PCR) and multiplex fluorometric immunoassay in addition to ELISA testing to screen for disease in research and biotechnical facilities. The sensitivity and specificity of serologic diagnosis varies both with the disease in question and the modality used. For the pet rabbit practitioner, single rabbit samples are accepted by several labs including the University of Miami Comparative Pathology Laboratory and Sound Diagnostics, Woodinville, WA for serological testing (Table 1). Paired titers to demonstrate active disease are ideal.

**Table 1.** Sound diagnostics, inc. offers ELISA serologic screening for detection of antibodies to the following infectious diseases of rabbits.

Agent	Disease
<i>Clostridium piliforme</i>	Tyzzer's Disease
<i>Encephalitozoon cuniculi</i>	Encephalitozoonosis
<i>Pasteurella multocida</i>	Pasteurellosis
<i>Treponema cuniculi</i>	Syphilis

## Imaging

Digital radiology has revolutionized the taking and reading of radiographic images. It must be kept in mind that even with the technological improvements associated with digital radiology there are many determinants to image quality. The hardware and software used to generate images will have a dramatic effect on image quality. Image quality will also depend on the user of the system and in the wrong hands any digital radiography system will give inferior images. Some systems are very easy to use while others are very user dependent in order to get image repeatability with good exposure contrast and clarity with good anatomic detail. For rabbit radiology consistency in achieving these types of images is the goal, especially when it comes to skull films. Radiology is used routinely to assess the gastrointestinal, urogenital, respiratory, cardiac and skeletal systems, and is also part of an overall oral health assessment.

Ultrasonography records echoes of ultrasonic wave pulses directed into tissues and reflected by tissue planes where there is a change in density. Ultrasonography is a dynamic modality and using the Doppler unit is especially useful in assessing cardiac contractility and blood flow. A fluid:gas interface creates a highly reflective surface resulting in an artifact called reverberation. This makes imaging through gas/air difficult because it is impossible to distinguish these from real echoes. This fact along with the large size of the herbivore cecum makes abdominal ultrasonography more challenging in rabbits. It is vital that the ultrasonographer be familiar with both the practice of ultrasonography as well as the normal anatomy of the species under examination.

### **Fluid therapy**

As the level of rabbit medicine and surgery has matured and become more sophisticated so has the need for appropriate intravenous fluid therapy and patient monitoring. Physiological patient stabilization is the goal whether associated with illness or surgery. Catheterization with 24 to 26 (0.56 to 0.46 mm) gauge indwelling IV catheters, using the cephalic vein, is routine in rabbits. Most calm rabbits tolerate catheterization with sedation and local infiltration of lidocaine. The fluid chosen will vary with serum chemistry and electrolyte results, underlying metabolic disease and duration of therapy. For replacement fluids the author uses an isotonic crystalloid solution such as Plasmalyte-A (Baxter Healthcare, Deerfield, IL) or 0.9% saline (Baxter Healthcare, Deerfield, IL) with or without added dextrose to form a 2.5 or 5% solution. An IV fluid warmer, such as this TempCare unit (Elltec Co. Ltd. Nagoya, Japan), will aid in maintaining patient thermoregulation and maximize patient recovery from surgery or illness. If unsuccessful at passing an IV catheter or if the peripheral veins have collapsed as a result of patient condition (severe dehydration, shock), then intraosseous vascular access should be considered. For rabbits the author uses a 22 gauge (0.72mm X 3.81 cm) spinal needle introduced through the greater tubercle of the humerus. The rate of fluid administration varies with daily requirements, hydration status, presence of underlying metabolic disease (e.g. renal or cardiac disease) and daily fluid loss. The goal of fluid therapy is to provide fluids and electrolytes to replace ongoing losses, meet metabolic demands, and restore intracellular water balance until the patient is eating and drinking on its own or recovered from surgery. This may be from several hours to several days depending on patient health and recovery. An infusion pump is a necessity in accurate administration of maintenance fluids at rates of 4-10 mL / kg / hr.

### **Recognizing and treating shock**

In the very sick rabbit, fluid losses need to be treated aggressively or early decompensatory shock may develop where there is a reduction of blood flow to the skin, kidneys, gastrointestinal tract and muscles. Clinical signs of early decompensatory shock in rabbits include hypothermia, prolonged capillary refill time, pale mucous membrane, cool limbs and skin, bradycardia and hypotension. Aggressive fluid therapy using crystalloids and potentially colloids is needed at this stage.

A fluid resuscitation plan, to restore tissue perfusion and oxygenation, involves the type, quantity and rate of fluid to be administered. The primary goal is to give the least amount of fluids possible to reach the desired end points of resuscitation based on correction of the clinical signs associated with decompensatory shock. Resuscitation of hypovolemic shock is accomplished using a combination of crystalloids and colloids. Crystalloids fluids consist primarily of water with a sodium or glucose base, plus the addition of other electrolytes or buffers. They are capable of distributing to all body compartments and thus replace both interstitial and intravascular fluids losses. Colloids are fluids containing large molecular-weight substances that in general are not able to pass through capillary membranes and aid in expansion of intravascular volume. Colloids include blood products such as whole blood or plasma, synthetic colloids including hetastarch (Braun Medical, Irvine, CA) and dextran70 (Pharmacosmos A/S, Holbaek, Denmark). Colloids help maintain intravascular osmotic pressure and when administered with crystalloids reduce interstitial volume depletion resulting in a 40-60% reduction in total fluid volume needed for resuscitation if crystalloids alone were used.

A summary of the therapeutic approach for rabbits in decompensatory shock is as follows. [modified from Lichtenberger M. Shock and cardiopulmonary-cerebral resuscitation in small mammals and birds. *In: Emergency and Critical Care* (Lichtenberger, ed.), Veterinary Clinics of North America, Exotic Animal Practice 2007; (10) 1: 275-291.]

- Administer a bolus infusion of isotonic crystalloids at 10-15 mL/kg.
- Administer hetastarch at 5 mL/kg or Oxyglobin at 2mL/kg over 5-10 minutes.
- Monitor blood pressure and once greater than 40mm Hg systolic administer maintenance crystalloids.
- Aggressively warm patient with a forced air heating system such as the Bair Hugger® (Arizant Healthcare, Eden Prairie, MN)
- Monitor rectal temperature frequently until approaches 98.0 °F (37°C) recheck blood pressure and administer crystalloid (10 mL/kg) with hetastarch at 2 mL/kg increments repeated over 15 minutes until systolic pressure increases to greater than 90 mm Hg.
- Begin rehydration phase of fluid resuscitation once systolic pressure is maintained greater than 90 mm Hg.
- Continue a constant rate infusion of hetastarch at 0.2- 0.4 mL/kg/hr during the rehydration phase.

Indirect blood pressure monitoring by the Doppler method is preferred by most veterinarians. Doppler flow detection (Parks medical Electronics, Inc, Aloha, OR) uses ultrasonic waves for audible monitoring of blood flow by using a probe placed as close as possible to the blood flow in an artery or the heart. The Doppler is used wherever major arteries are close to the skin and in the rabbit the front limb is more reliable and most commonly used. The transducer probe crystal is placed in a bed of ultrasound gel on the shaved medial midshaft of the radius-ulnar area in order to assess blood pressure of the radial artery. Ideally a cuff size approximately 40% of the circumference of the humerus is used.

## **Analgesia**

Confirming pain in animals is difficult because of differences between and within species in the behavioral response to noxious stimuli. Many behaviors are consistent with, but not invariably indicative, of pain, and confirming the presence of pain in an animal is further complicated by the fact that normal behavior is not always indicative of a pain-free state. Like humans, the exotic mammal may show individual variability in both its pain threshold and tolerance, and recognition of pain in these animals relies on skill, experience and professional judgement. The following are behavioral changes that have been used in the assessment of pain.

- Searching/exploring behavior; frequency and duration
- Movement frequency and duration
- Food consumption duration
- Grooming behavior duration
- Conspecific interaction duration
- Changed posture, tucking of abdomen, tensing of muscles
- Guarded or aggressive behavior
- Attempting to hide
- Squint eyed
- Grinding of teeth

Nociception is the neural response to the application of a noxious stimulus. The process of nociception and pain involves multiple steps and pathways and an effective pain management plan includes drugs of different classes that act at different pathway locales; a process known as multimodal analgesia. This approach allows for smaller doses of each drug to be used because the effects are additive or synergistic, and thus reduces the undesirable side effects expected when larger doses of individual drugs are used alone. (6) Multimodal pre-emptive analgesia with use of opioids, nonsteroidal anti-inflammatory drugs (NSAIDS), alpha agonists, dissociatives or local anesthetics, will prevent the wind up effect of surgical pain that occurs when neurons that mediate nociception in the dorsal horn of the spinal cord are repeatedly stimulated.

## **Medical therapy**

Various diseases and health problems are unique to the rabbit. The following is a summary of several common medical problems and the standards of care in developing a diagnostic and treatment plan.

### **Respiratory disease**

For rabbits with recurrent upper respiratory disease and nasal discharge; rigid endoscopic exam of the nasal passage for biopsy and sampling for histopathology with fungal and bacterial culture and antibiotic sensitivity as indicated. Ultrasonic nebulization, is a worthwhile adjunct therapy especially if pneumonia is suspected. Most rabbits tolerate the nebulizer face mask for 10 to 15 minute nebulization sessions of saline, antibiotics and mucolytics to ease respiratory infection and congestion. Dwarf rabbits with respiratory distress secondary to pneumonia can be placed in an anesthetic induction chamber for minimal-stress nebulization therapy several times a day.

### **Gastrointestinal stasis**

Gastrointestinal (GI) stasis is a syndrome where the normal muscular contractions of the stomach and intestines are greatly diminished and with time the normal intestinal/cecal bacterial flora is thrown off balance. Several factors can be involved including environmental stressors, pain from other underlying conditions such as dental/tooth points or spurs, and most commonly inappropriate diet. Feeding simple carbohydrates such as breadstuffs or cereals along with a lack of crude fiber may predispose to GI stasis. In the absence of adequate fiber the gastrointestinal tract slows down, which may result in subsequent changes in the cecum pH fermentation and bacterial populations and subsequent worsening of GI stasis. The rabbit with GI stasis will be anorexic or have a reduced appetite. An affected rabbit produces very small stools or none at all and may be hunched-up or grind its teeth in response to painful gastrointestinal gas formation. Diarrhea with mucous may or may not be present. Abdominal auscultation may reveal normal or hyperactive gut sounds early in the course of the disease with decreased to no gut sounds with disease progression. The sooner the problem is recognized the better the chance for full recovery and survival.

Rabbits presented in obvious distress and with a palpably enlarged, non-compressible stomach warrant close monitoring and critical care. Rabbits with intestinal obstruction are occasionally presented and create a diagnostic and therapeutic dilemma. Most commonly due to a small trichobezoar or hair filled cecotroph mistakenly ingested and just large enough to obstruct the small intestine. The distal duodenum is a common site of obstruction, followed by pylorus or ileoceocolic junction. The case may be surgical depending on whether this obstruction is moving or not. This condition has an acute onset and is associated with severe lethargy/depression and a palpably huge stomach palpable behind ribs on the left. Radiographically, the stomach is filled with gas and/or fluid and food and loops of dilated intestine proximal to site of obstruction may be seen. If the obstruction passes through the ileoceocolic junction, gas is seen in the cecum and more gas-filled loops of intestine are seen on serial radiographs and the patient is treated medically. If the obstruction is not moving, as determined by serial radiographs, then the case becomes surgical. If the rabbit is taken to surgery it is ideal to try and gently milk the obstruction down through the ileocolic junction and into the hind gut instead of performing an enterotomy due to thin and friable nature of the rabbit small intestine.

Depending on the severity of the condition and clinician discretion a variety of treatment measures may include:

- Analgesics as needed; if showing signs of pain or if evidence of increased GI gas. In some severely ill or stressed patients, handling and restraint may worsen clinical condition and the use of sedation and analgesia is recommended by the author to relieve patient stress and anxiety, as well as relief of pain. Midazolam in combination with an opioid is recommended.

- Fluid therapy plan involves the type, quantity, and rate of fluid to be administered. The primary goal is to give the least amount of fluids possible to reach the desired points of rehydration and resuscitation. Type of fluid, route of administration and volume all depend on patient assessment on physical exam.
- Syringe feeding an enteral nutrition product such as Oxbow Critical Care in order to provide nutritional supplementation and fiber to stimulate GI motility. Nasogastric (NG) tube placement has been advocated in the treatment of GI stasis with one paper showing that nutritional support through a 5- to 8- Fr Argyle tube (Kendall, Mansfield, MA), passed ventrally and medially into the ventral nasal meatus and advanced to the stomach, not only provided for nutritional support but also helped stimulate gastrointestinal motility and early return to function.
- Appetite stimulants: The sooner the rabbit eats the sooner the intestinal motility will return to normal. Vitamin B complex injections or 1-4mg/rabbit PO q12-24h cyproheptadine (Periactin®, Merck, West Point, PA) may act to stimulate the appetite.
- GI motility stimulants: Prokinetics such as cisapride (available through a compounding pharmacy) dosed at 0.5mg/kg PO q8-12h and metoclopramide (Reglan®, Schwarz Pharm. Mequon, WI) at 0.5mg/kg PO, SC q8-24h.
- Simethicone: To help break down gas bubbles associated with bloating.
- Abdominal massage: Gentle, deep massage of the abdomen to stimulate intestinal contractions and to break down impacted stomach contents. If diagnosed early in the course of the disease; encourage movement and exercise as a way to stimulate gut motility.
- If suspect endotoxin-induced gut mucosal injury consider epidural analgesia to prevent functional and structural mucosal alterations.

### Dental disease

Numerous writings on rabbit dental disease have been published in the past decade with entire texts [Rabbit and Rodent Dentistry 2005, Zoological Education Network] and journals [Journal of Exotic Pet Medicine 2008; 17] being devoted to the subject. It is important to remember the direct association between diet and rabbit dental disease. Feeding the rabbit free-choice grass hay stimulates constant chewing action, which helps wear down the continuously growing incisors, premolars and molars and helps prevent acquired dental disease; primarily painful molar spurs or points. Metabolic bone disease associated with a poor diet and inadequate calcium, vitamin D and natural sunlight has also been incriminated as a cause of malocclusion, overgrown dental roots and mandibular abscesses.

A variety of special instruments have been designed to enhance visualization of the oral cavity and aid in treatment of dental disease in rabbits and smaller herbivorous species. The rabbit oral anatomy including the fleshy tongue, buccal skin folds, a long and narrow oral cavity and caudally placed cheek teeth make oral examination of the non-anesthetized patient difficult to impossible. When history and physical examination findings suggest dental disease, general anesthesia for thorough oral examination is indicated. General loss of condition, decreased appetite, digestive disturbances and ocular discharge may all be associated with dental disease in this species. The author finds the following invaluable in assessing and treating rabbit dental disease:

- Skull radiographs, preferably 6 views that evaluate lateral, ventrodorsal, dorsoventral, rostral-caudal, and right and left lateral oblique projections, are an invaluable aid in assessing rabbit dental health.
- Use specialized dental tools to aid visualization. To aid oral cavity visualization in the anesthetized rabbit: an oral dental speculum (Sontec, Englewood, CO) is inserted between the incisor teeth and opens the mouth from top to bottom and cheek dilators (iM3, Inc, NSW, Australia) that have spatulated wings are inserted in the mouth and open it from side to side with a spring action.
- A stainless steel spatula (Sontec, Englewood, CO), used to move oral soft tissues, allows for visual assessment of the premolars and molars and protects the oral mucosa and tongue during filing or burring of teeth.
- A diamond coated rasp (Sontec, Englewood, CO) may be used to manually smooth small dental points and spurs.
- Many veterinarians prefer to use a specially designed dental platform, the rodent table retractor restrainer (Jorgensen Laboratories, Loveland, CO), which allows hands-free elevation of the head and opening of the mouth.
- A high speed dental drill (iM3 Pty Ltd, Lane Cove, NSW Australia) is the preferred method of trimming or filing of overgrown incisors, in order to properly shape and contour teeth with minimal damage to the reserve crown located below the gum line. Alternatively a low speed dental drill with an LED light source (iM3 Pty Ltd, Lane Cove, NSW Australia) that significantly aids in visualization, is preferred for gently burring overgrown molars or severe molar points without over heating or damaging the reserve crown. For minor dental points a diamond coated rasp is an effective tool in manually smoothing these sharp edges.
- In rabbit oral surgery where endotracheal intubation will interfere with visualization and access; injectable maintenance anesthesia using drugs such as medetomidine alone (80-120µg/kg) or in combination with ketamine (25-30mg/kg) is preferred by many rabbit oral surgeons.
- Use of local anesthetic dental blocks with approaches extrapolated from those used in dogs and cats and a knowledge of rabbit skull anatomy. The author uses faster-onset 2% lidocaine (Vedco, Inc. St. Joseph MO) mixed with slow onset 0.5% bupivacaine (Hospira, Inc. Lake Forest, IL) at a rate of 1 mg/kg body weight for each drug and dilutes with saline to a final volume of 1 ml.
- Extraction of the incisor teeth is recommended for resolution of persistent malocclusion in rabbits. Extraction of the incisor teeth is recommended for resolution of persistent malocclusion in rabbits. Curved rabbit incisor luxators have been especially designed to insert into the periodontal space and help break down the periodontal ligaments of markedly curved incisor teeth.
- Periapical infection with abscessation and osteomyelitis require aggressive and prolonged therapy. When treating periapical infection and subsequent facial abscessation and osteomyelitis the author has found the following to be the key to long term resolution; extract all diseased teeth associated with the abscess, thoroughly debride necrotic and infected jaw or skull bone tissue, marsupialize abscess to facial skin and treat as an open wound. Pack marsupial site gauze strips impregnated with antibiotics, preferably based on bacterial

culture and antibiotic sensitivity and the proclivity of anaerobic bacteria. Change packing and flush daily or every other day until healing and wound granulation and contracture occur. If marsupial site healing is delayed; use of medicinal grade honey to pack marsupial site and discourage local infection has been advocated.

- Facial dermatitis as a result of chronic epiphora secondary to dacryocystitis is not uncommon in the rabbit. Many times this is in association with elongated incisor tooth roots and blockage of the nasolacrimal system. A topical ophthalmic anesthetic can be applied and in the sedated patient a 23 ga (0.64mm) lacrimal cannula, or small plastic irrigating cannula can be used to cannulate the *punctum lacrimale* in the medial canthus for gentle flushing with saline. This will help remove purulent debris and possibly relieve any blockage. This same cannulation technique can be used to infuse iodine-based contrast media in order to perform a contrast study to confirm severity of the blockage and aid in prognosis and long term management.

### Head tilt

Head tilt, most often an indication of vestibular dysfunction, can be central (cerebellum, brain stem) or peripheral (inner ear), and was the most common clinical sign noted in a retrospective study of rabbits with neurologic disease. Other vestibular signs include nystagmus and loss of balance and rolling. Causes include bacterial otitis interna and infection with the protozoa *Encephalitozoon cuniculi*. A diagnostic and therapeutic plan for head tilt includes:

- Diagnosis of otitis media/interna is based on clinical signs, aural exam, and imaging, including skull radiography and CT or MRI scanning where available.
- Bacterial culture and sensitivity of deep aural or nasal swabs taken under anesthesia are indicated when physical exam supports infection.
- Endoscopic exam performed under general anesthesia aids in visualization of the distal ear canal and tympanic membrane.
- Antimicrobial treatment of otitis interna should be long term, 4-6 weeks or longer, as antibiotics do not penetrate well into pus-filled tympanic bullae. Systemic antibiotics, preferably based on results of a bacterial culture and their ability to penetrate the CNS are recommended.
- In addition to antibiotic therapy, affected rabbits often benefit from nutritional supplementation, environmental support to minimize the rolling and severe ataxia associated with this disease, and medical therapy with 12.5- 25 mg/kg q12h oral meclizine hydrochloride (Meclizine HCl, Rugby Labs., Duluth GA), an antihistamine that aids in the control of associated dizziness.
- *Encephalitozoon cuniculi* is a microsporidium, obligate intracellular protozoan parasite. The most commonly recognized neurological sign in rabbits infected with *E. cuniculi* is vestibular disease. With encephalitozoonosis clinical signs may not be associated with presence of the protozoa itself, but rather with the inflammatory response that persists after the organism has been eliminated.
- Clinical means of diagnosing definitive antemortem encephalitozoonosis are limited. However, since *E. cuniculi* infection is persistent, antibodies continue to be produced and as a general rule the validity of antibody assays for the detection of *E. cuniculi* compares favorably with histology in rabbits.
- In the absence of controlled studies it is difficult to assess the efficacy of therapeutic agents against *E. cuniculi* as latent infections occur and some clinical cases may improve spontaneously without treatment, presumably as a result of the host's immune response.
- Several benzimidazole derivatives including albendazole (30mg/kg PO q24h for 30 days), oxbendazole (30mg/kg PO q24h for 7-14 days, then 15mg/kg PO q24h for 30-60 days), and fenbendazole (20mg/kg PO daily for 30 days) have been used to treat presumptive *E. cuniculi* infections in rabbits based on their anti-inflammatory actions and their in-vitro anti-protozoal activity including bioenergetic disruptions of membranes and microtubular (tubulin) inhibition of *E. cuniculi*.

### Perineal soiling and dermatitis

Rabbits often present with matted and soiled perineal fur with secondary dermatitis. Causes include inappropriate diet and subsequent soft stools or diarrhea, urine leakage as the result of infection or excessive crystalluria (bladder sludge syndrome), environmental factors resulting in behavioral urine retention, and decreased ability to groom due to obesity or pain. A work up includes using case history, physical exam and imaging to determine underlying cause.

- Ruleout inappropriate diet and subsequent soft stools or diarrhea as a cause.
- Assess patient history; dietary and environmental. Is the rabbit on grass-based hay and pellets? Does the patient get plenty of exercise and opportunities to urinate? Is the patient obese and unable to groom the perineum?
- Assess for underlying patient pain by history, physical exam and spinal and joint radiographs and response to judicious use of long-term analgesics where indicated. Spondylosis can contribute to gait abnormalities and the inability to flex the spine in order to groom the caudal body resulting in an unkempt fur coat and perineal soiling.
- Management also includes ruling out underlying infectious cystitis via bacterial culture and antibiotic sensitivity of an uncontaminated urine sample preferably obtained via cystocentesis.
- If suspect bladder sludge syndrome; realize it is often managed versus cured with the goal being to diminish the degree of crystalluria so that it is subclinical. Excessive crystalluria, resulting in bladder dysfunction, may cause clinical signs such as stranguria and pollakuria with or without perineal soiling. Treatment often requires administration of subcutaneous fluids with manual bladder massage/expression to "cleanse" bladder of excessive crystal buildup. Repeat as necessary until signs are managed and bladder function and health (based on clinical signs, physical exam and imaging) returns to normal. Encourage more water intake by improving access to fresh, clean water and feeding moistened greens. If non-responsive to treatment, catheterize the bladder and flush with warmed 0.9% saline under general anesthesia.

## Conclusion

The 21<sup>st</sup> century, what an exciting time to be practicing rabbit medicine. As one can see, rabbit medicine continues to mature and evolve. Nutritional management, ultrasound imaging, fluid therapy and use of colloids, blood pressure monitoring, pre-procedural sedation and multimodal analgesia; are now all considered standards of care for the pet rabbit. What will the future hold for rabbit medicine? Perhaps more definitive ways to diagnosis and treat *E. cuniculi*, more routine use of advanced imaging techniques such as Magnetic Resonance Imaging, better rabbit specific pharmacokinetics on many of the drugs we are presently using, and lastly, new rabbit-friendly antibiotics to treat anaerobes and Grams positive infections. At the rate we are going these advances in rabbit medicine may all be part of routine standards of care as we approach the year 2020.

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