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RABBIT GASTRO-INTESTINAL DISEASE

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There is probably no facet of rabbit medicine and husbandry that has been subjected to as much myth, lore, misconception and anecdote as the management of gastro-intestinal disease and basic nutrition. Unfortunately, the majority of the basic science, and there is a tremendous amount, is buried within obscure physiology and laboratory animal medicine literature. Additionally, the majority of the readily available information is applicable to the production rabbit, not the pet rabbit. As a result, the practicing veterinarian is typically faced within conflicting information and opinion, all too often resulting in the mismanagement of this aspect of the rabbit. This manuscript will attempt to clarify some of the confusion and lay a basis for the scientific management of diseases of the gastro-intestinal tract of the pet rabbit.

ANATOMY & PHYSIOLOGY OF THE GASTRO-INTESTINAL TRACT

The rabbit is a mono-gastric, hindgut fermenting herbivore. While their strategy appears similar to that of the horse, their smaller size limits the amount of coarse fiber that may be stored for bacterial and protozoal digestion. The rabbit's system allows the rapid removal of coarse fiber from the GI tract, while retaining the more digestible, less coarse portion of the diet. Of particular interest is the fact that, while it is not important as a fermentable nutrient, the coarse fiber is critically important for the maintenance of normal gastro-intestinal motility.

The rabbit's stomach is a simple structure, acting primarily as a storage vessel for ingested food. In health, it is rarely empty. The arrangement of muscle in the cardiac sphincter precludes vomiting. In the normal, adult rabbit, the pH is very low, between 1.5 and 2.2. Such a low pH tends to allow the maintenance of an essentially sterile stomach and small intestine. Young, nursing rabbits have a substantially higher pH of 5.0 to 6.5, which allows colonization of the colon with normal microflora.

The small intestine functions in a fashion very similar to that of other mono-gastric mammals. The lumen is relatively narrow and the walls rather thickened in comparison to the comparable dog or cat. The proximal duodenum leaves the pylorus to form an acute angle near the liver. This acute angle is an area in which intestinal obstruction may occur.

The terminal aspect of the ileum has been modified to form a round, muscular area called the sacculus rotundus or cecal tonsil, which appears to have an immune system function. The valve located at this ileo-cecal-colic junction precludes retrograde movement of ingesta, and is the second common location for foreign body impaction.

The cecum comprises approximately 40% of the total volume of the gastro-intestinal tract. It is a blind-ended sac with a delicate, thin wall, which is easily torn when mishandled in surgery. The terminal appendage of the cecum is a thick walled vermiform structure containing lymphoid aggregates. The anaerobic environment of the cecum is ideally suited for the fermentation of foodstuffs. The primary microbes involved in this fermentation include the non-sporulated, gram-negative bacillus, *Bacteroides*; several

other species of gram negative and metachromatic bacteria; a large, ciliated protozoa, *Isotrichia*; and a rabbit-specific yeast, *Cyniclomyces guttulatus*, which may be confused with coccidia by inexperienced clinicians.

The colon is divided into several sections. The first five parts, components of the ascending colon, progress through a series of flexures and have a number of sacculations or haustra. The transverse colon is a short structure ending in a muscular structure known as the fusi coli. This portion of the colon acts as a "pace maker" by managing the separation of the coarse fiber from the more digestible material.

The coarse material is thereby eliminated as fecal material. The more digestible material is moved in a retrograde manner by coordinated movements of the sacculations and haustra into the cecum for fermentation. The distal aspect of the colon and rectum are more simple and more durable to the rigors of surgical manipulation.

A unique aspect of rabbit gastro-intestinal physiology is cecotrophy, or the ingestion of the nutrition rich cecal contents, or cecotrophs. Following the selective digestion of foodstuffs, the fermented cecal material is passed separately from the fibrous fecal material. Their presence in the anus stimulates a reflex licking of the anal area thereby resulting in the consumption of the cecotroph. In this fashion, nutrition that would not be available is ingested.

As one might imply, fiber has a critically important role in rabbit nutrition. The non-digestible fiber component, lignocellulose, has been shown to have a protective effect against enteritis. Fiber is the dietary component, which drives the system by stimulating motility, either directly or by the increased bulk of ingesta. A low fiber diet will decrease motility, thereby changing the cecal pH, decreasing cecal motility, and altering the cecal micro-flora. Such changes predispose the rabbit to overgrowth by potential pathogens, such as *E. coli* and *Clostridium*.

DIETARY RECOMMENDATIONS

The recommendations for a normal rabbit diet are among the most important that a veterinarian can make to the rabbit owner. In general, one would like to increase the quantity of fiber and decrease the quantity of readily digestible carbohydrate. Fresh, high quality grass hay (orchard, timothy or Bermuda grass) should be offered ad libitum. Alfalfa hay may contain excessive levels of calcium and protein for the adult, maintenance rabbit. That being said, however, one must bear in mind the dietary strategy of the lagomorph, browsing. As such, there are a number of rabbits, which are unable to maintain body weight on low calorie density rations such as those previously described. Those individuals are best managed with a combination of grass hay combined with alfalfa hay. Those rabbits should have weights, GI function and renal function monitored periodically. High fiber (18-24% fiber) pellets may be offered, but should be limited to 1/8 - 1/4 cup per 5 lb body weight. High fiber, fresh vegetables may also be offered, again not to exceed 1 cup per 5 lb body weight. The use of fruits in the diet should be restricted, not exceeding 1 TBS per 5 lb body weight. Sugar and starch based food, such as breakfast cereals, crackers, breads, cookies and candies should not be fed, as they encourage the growth of pathogenic bacteria.

DISEASES OF THE GASTRO-INTESTINAL TRACT

Prior to entering into a discussion of the specific diseases of the gastro-intestinal tract, there are several considerations warranting discussion, as they are uniformly applicable to all

GI tract pathology. First is the need for management of fluid and electrolyte balance. Alteration of GI function will severely impact fluid balance, which in turn influences GI function, creating a self-defeating viscous cycle.

Secondly is the need to assure adequate nutritional intake. In the absence of adequate caloric intake, hepatic lipidosis develops within just a few days. Aberrations in GI function are often associated with cessation of coprophagy. This results in a negative protein balance resulting from the decreased intake associated with the cecotrophs. Additionally, inherent vitamin stores are rapidly depleted without being replenished via cecotrophy. Therefore, nutritional supplementation should include not only fiber, but also protein and vitamins.

Finally, and perhaps most importantly, is the need to assure adequate pain relief. Rabbits appear to be exceptionally sensitive to the physiologic effects of pain which may result in immune suppression, impaired wound healing, decreased food and water intake, GI stasis, shock and even death. In the rabbit, the most common signs of pain include hunched posture, inactivity, vocalization, tooth grinding, a reluctance to move, and anorexia. It is safe to assume that any gastro-intestinal disease of any significance is associated with some degree of pain. Of particular note is the pain associated with ileus. Therefore, use of appropriate analgesics is critically important. The analgesic most typically utilized by the author is buprenorphine (0.05 – 0.1 mg/kg IM q 6 – 12 hrs). Others advocate butorphanol (0.1 – 2.0 mg/kg IM q 4-24 hrs); flunixin meglumine (0.1 – 2.5 mg/kg IM q 12 – 24 hrs); or carprofen (1 – 4 mg/kg PO, SC q 12 – 24 hrs). Although unavailable in the USA, meloxicam (0.1 – 0.2 mg/kg PO, SC q 24 hrs) has shown to be exceptionally safe and effective in rabbits.

HAIRBALLS, TRICHOBEZOARS, OR SUBACUTE TO CHRONIC GASTRIC STASIS

One of the most commonly implicated maladies of the rabbit GI tract is the "hairball." In most cases, the rabbit is presented anorectic, loosing weight and somewhat depressed. Often, an enlarged, doughy stomach is palpable, and the assumption is made that there has been excessive grooming and consumption of hair. One then assumes that this material is the cause of the rabbit's poor condition. Historically, most of these rabbits have been fed high carbohydrate, low fiber diets, have had limited exercise, and are subjected to some form of chronic stress. Radiographic examination may enhance the diagnosis, but is often unremarkable.

One need only review the basics of rabbit gastro-intestinal physiology to question this interpretation of the pathogenesis of the "hairball." In the author's opinion, it is more likely that the improper diet, specifically inadequate fiber, and lack of exercise which is at the base of the problem. Low fiber results in decreased motility, as well as the changes previously mentioned in the discussion of cecal physiology. As the hair/ingesta mass remains within the lumen of the stomach, it loses fluid.

Similar in etiopathogenesis is the development of ileus, an exceptionally painful and potentially life threatening decrease in gastro-intestinal motility. Signs of ileus include decreased appetite or anorexia; abnormal stool (absent, decreased volume of size); pain (hunched posture, tooth grinding, tachypnea); abnormal borborygmus (decreased or increased); and hypothermia. Occasionally, there is a

noticeable abdominal distension associated with gaseous distension of the GI tract.

A number of potential causes have been suggested. For obvious reasons, attempts must be made to elucidate the etiopathogenesis; so future bouts may be prevented. Potential causes include improper diet (inadequate fiber, XS carbohydrate/sugar), dental disease, urinary system disease, hepatic disease, psychogenic stress, chronic inflammatory disease (chronic URI), or any other condition, which may alter food intake.

Theories for treatment have included use of laxatives, lubricants and digestive enzymes. In general, the response has been equivocal at best. Surgical removal will certainly eliminate the material from the stomach; however, the incidence of post-operative peritonitis and secondary hepatic lipidosis is high enough to suggest this is not the best approach. To be succinct, surgery is NOT recommended as a treatment for GI stasis or ileus. An aggressive medical approach designed to stimulate normal gastro-intestinal motility, rehydrate the stomach contents, as well as the rabbit, and ensure a positive calorie balance has been very successful.

Hospital care includes:

1. return to euthermia;
2. analgesics (as previously described);
3. fluid therapy, both systemically and orally, following return to normal body temperature (100 – 120 ml/kg/day);
4. gastro-intestinal motility stimulation (metoclopramide 0.5 – 1.5 mg/kg IM q 8 – 12 hrs; cisapride 1 – 1.5 mg/kg Q 12 hr) Once abdominal pain has been controlled gentle abdominal massage may be beneficial;
5. anti-gas compounds (simethicone 1 – 2 ml PO q 2 – 6 hrs prn);
6. nutritional support (syringe feed / naso-gastric tube / stomach tube) plus vitamin supplementation. Cyproheptadine may be beneficial;
7. control enterotoxemia (cholestyramine 2 gm in 20 ml water PO q 8 hr). It is obvious that treatment must be aggressive and initiated early on in the disease process. Even under the best circumstances, the prognosis is guarded.

Rabbits should be discharged to their owners once there is evidence of GI motility return. This is demonstrated by a return to normal GI sounds, appetite resumption, and defecation. In many instances, return to the home environment is quite beneficial. After discharge, the owner should continue simethicone as needed, SC and oral fluids, supplemental feedings, antibiotics (if indicated), and rectal temperature monitoring.

Hepatic lipidosis is a common sequela to any disease, which results in a negative calorie balance in the rabbit. Ketosis may be identified by use of a urinalysis. Diagnosis of this condition mandates a very aggressive approach to return the rabbit to a positive calorie balance. Use of IV or IO fluids with dextrose is important. Again, forced feedings, often aided by a naso-gastric tube, is beneficial.

ACUTE OBSTRUCTION

Acutely obstructed rabbits are occasionally presented. Typically, the obstruction is a mat of hair that has been ingested all at once, rather than gradually; or a mass of plastic or carpet fiber. Affected rabbits are presented with an acute onset of severe abdominal pain, which must be managed aggressively, and immediately for a successful outcome. Appropriate analgesics, buprenorphine (0.05 – 0.1 mg/kg IM/IV q 6 – 12 hrs); shock doses of crystalloid fluids IV or IO; corticosteroids, prednisolone Na succinate (11- 25 mg/kg IV) are indicated. While the rabbit is being prepared for surgical intervention, radiographic confirmation of the disease can be made. Additionally, the stomach should be decompressed by passing a stomach tube. Most obstructions occur in either the proximal duodenum or at the ileo-ceco-colic junction. Duodenal obstructions are often complicated by the necrosis of a section of the duodenum, necessitating resection of the organ. Prognosis in any obstructive disease is guarded to poor.

ENTERITIS COMPLEX

The enteritis complex in the rabbit is a series of conditions ranging from soft stool to profound diarrhea, enterotoxemia, coma and death. In most cases, the disease is secondary to some external factor, such as diet change, antibiotic use, or stress. In the most simple case, merely increasing the fiber in the diet is curative.

A more profound presentation, enterotoxemia, is the result of dysbiosis and the overgrowth of *Clostridium spiroforme*, which produces an iota toxin. Affected rabbits are depressed, anorectic with a brown watery diarrhea, which may contain blood or mucus. As the disease progresses the rabbit becomes hypothermic, moribund and then dies. Aggressive, supportive care is indicated, however, the prognosis is grave in most cases. In some cases, the use of metronidazole (20 mg/kg po q 12 hrs) has been beneficial. Use of ion-exchange resin, cholestyramine 2 gm / 20 ml water q 8 hrs) may also decrease mortality.

A mucoid enteropathy may occur when dietary homeostasis has been severely disturbed. As the pH of the cecum drops and the fermentation of carbohydrate increases, the cecal micro-flora may be changed, stimulating the production of excessive amounts of mucus. As demonstrated with most GI diseases, simple return to a normal diet is typically curative.

BACTERIAL ENTERITIS

Colibacillosis. As previously stated, gram-negative enteric bacteria are not typically considered a normal component of the rabbit micro-flora. Therefore, conditions of exposure or overgrowth of these organisms may cause clinical disease. In neonates, a watery, yellow diarrhea is often noted with nearly a 100% mortality. In older rabbits, the mortality rate lessens, and the disease may become more chronic. Typically, the colon and cecum are affected. Intussusception and prolapse may be associated with the disease. A presumptive diagnosis may be based upon the identification of *E coli* on culture. Supportive care and appropriate antibiotic treatment is indicated.

Tyzzler's Disease. Caused by *Clostridium piliforme*, Tyzzler's disease affects not only rabbits, but also rodents and other mammals. Predisposing factors, such as overcrowding, poor hygiene, high temperatures, and other stressors are typically present before the development of clinical disease. Signs of depression, anorexia, watery

diarrhea and death, especially in younger rabbits are seen. In the chronically affected older rabbits, the characteristic white miliary foci in the liver and myocardial degeneration may be noted on post mortem exam. As the organisms have an intracellular component to their life cycle, treatment is typically unrewarding.

PARASITIC ENTERITIS

Coccidia. Twelve species of coccidia, *Eimeria sp*, may infect the rabbit, only one; *Eimeria stiedae*, is found in the liver. The presence of coccidia in the intestinal tract does not equate to disease, as many rabbits may be asymptomatic carriers of the organism. Typically, clinical coccidiosis is a disease of younger rabbits. Affected rabbits may present with diarrhea, inappetance, or sudden death. Trimethoprim potentiated sulfa drugs (30 mg/kg po q 12 hr x 10 days) and supportive care is generally curative. Prevention is based upon sound hygiene.

Oxyurids (pinworms). Pinworms are commonly found in pet rabbits. Generally, the oxyurid, *Passalurus ambiguus*, is the one found. Inhabiting the cecum and colon, *P ambiguus* rarely causes clinical disease. Heavy infections may cause unthriftiness and decreased reproductive efficiency. Treatment is often frustrating, but may be academic. Studies suggest that ivermectin is often ineffective and fenbendazole (10-20 mg/kg once, repeated in 10-14 days) has mixed results.

CONCLUSION

It is easy to see that the rabbit is subject to a variety of infectious and non-infectious gastro-intestinal diseases.

Of particular interest, however, is the role that nutrition, particularly fiber, plays in the maintenance of GI health. It is the opinion of the author that greater than 90% of the diseases that affect the rabbit's GI tract could be prevented merely by feeding an appropriate diet.

SUGGESTED READING

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