The Rabbit digestive system

A delicate balance

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By vet Anna Meredith,Head of Exotic Animal and Wildlife Service at the Royal (Dick) School of Veterinary Studies, University of Edinburgh

The rabbit gastrointestinal (GI) tract is a highly complex structure that processes and digests food, largely with the help of a huge population of bacteria. The normal functioning and movement of the GI tract and the health of its bacterial flora is vital to the rabbit's health, but with such a complex system, things can easily go wrong and it can be imagined that many rabbits are on a 'knife-edge' where any disturbance can tip the balance into a state of disease which may rapidly become life-threatening.

Normal movement of the gut is essential to keep the food that is eaten moving through quickly, so the rabbit can extract energy from it. The control and co-ordination of normal GI motility is highly complex and influenced by many factors. It is important to remember that as soon as a rabbit is stressed in any way, or stops eating, the motility of the GI tract will be affected. Thus, even if a rabbit does not start off with a GI motility problem, if it is ill for any other reason or has undergone a stressful event or procedure (such as a surgical operation) GI motility will be affected and can cause serious problems.

The normal and abnormal functioning of the gut

Gastrointestinal (GI) stasis is an important problem in rabbits and occurs when the normal motility and peristaltic movement (squeezing along of gut contents) is reduced or absent. The term ileus is also used to describe this failure of peristalsis.

In order to understand what happens in GI stasis it is important to understand the normal function of the rabbit GI tract. Rabbits are hind-gut fermenters, adapted to digest a high fibre diet consisting mainly of grass. The gastrointestinal tract makes up 10 - 20% of a rabbit's body weight. Food passes rapidly through the gut and fibre is eliminated from the digestive tract as soon as possible. This permits a rabbit to be quite small and light, which is advantageous in a prey species.

The rabbit's stomach is large and thin-walled, and is never empty, with food, caecal pellets and ingested hair present in a loose latticework. The stomach is very acidic (pH 1 - 2) in an adult rabbit, and food is effectively sterilised. Pre-weaned rabbits have a much less acidic stomach with a pH of 5 - 6.5, which allows bacteria to be introduced and become established in the GI tract. Weaning is a critical time and can often be associated with GI disease.

The hindgut is where sorting and fermentation of food occurs. The colon sorts food into indigestible and digestible components. The rabbit wants to eliminate indigestible fibre as quickly as possible, as it has no nutritional value. However, indigestible fibre plays an important role in stimulating normal motility of the gut. The indigestible fibre is passed out as hard faecal pellets. The digestible parts of the diet are moved backwards from the colon into the caecum, which is essentially a bacterial vat where fermentation takes place. The products of fermentation (volatile fatty acids) are absorbed and used by the rabbit as an energy source, and the bacteria also supply a large amount of

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the rabbit's protein requirements. Three to eight hours after eating (and thus mainly at night), soft, mucus-covered caecal pellets are expelled and eaten directly from the anus (a process known as caecotrophy, coprophagy, refection, or pseudorumination). Arrival of the caecotrophstriggers a reflex licking of the anus and ingestion of the caecotrophs, which are swallowed whole and not chewed. A specialised nervous structure in the colon called the *fusus coli* or "pacemaker of the gut" regulates colonic contractions and controls production of the two types of pellets.

The mucus covering protects the caecal pellet bacteria from the high acidity of the stomach. Caecotrophs remain in the stomach for up to six hours, and eventually the mucus layer dissolves and the bacteria are killed. This process of caecotrophy allows absorption of nutrients and bacterial fermentation products (amino acids, volatile fatty acids and vitamins B and K), and the digestion of previously undigested food. A food item can thus pass twice through the digestive tract in 24 hours.

Movement of the gut

Control of gastrointestinal motility is very complex.

Motility is under the influence of:

- **Diet** – motility is largely stimulated and maintained by a high throughput of indigestible fibre (lignocellulose).
- **The autonomic (involuntary) nervous system** – stress will have an adverse effect on motility.
- **Prostaglandins and other hormones**. For example the hormone motilin, which promotes motility, is inhibited by excess carbohydrate in the diet.

Diet

The best diet for rabbits is one that mimics as closely as possible their natural diet in the wild. The bulk of the diet should consist of grass and/or good quality hay, and this should be available at all times. Green foods are also important and should be fed daily – examples are broccoli, cabbage, chicory, dandelion, chickweed, chard, parsley, watercress, celery leaves, endive, raddichio, bok choy, dock, basil, kale, carrot and beet tops.

Fruit should be regarded as a treat item and fed in limited quantities only. High fat or carbohydrate items should be avoided altogether. These include most commercial 'treats', beans, peas, corn, bread, breakfast cereal, nuts, seeds and chocolate.

Commercial concentrate rabbit diets are not essential if ad lib good quality hay, grass and greens are available, and caecotroph intake is normal. However, many owners like to feed these diets for convenience. They should not be fed exclusively or ad-lib, and it must be emphasised that hay or grass should always be available.

Two types of commercial diet are readily available – the 'muesli-type' mix, and the pellet. Fibre content of many concentrate diets can be as low as 13 - 14%, and rabbits need a dietary intake of at least 25% fibre. Muesli-type diets have the added problem of the rabbit being able to selectively eat the low fibre, starchy components such as maize and peas, which are also low in calcium, so can affect tooth and bone quality. In recognition of this, the newer pelleted/nuggeted diets are grass based and can offer fibre content of up to 28% with good calcium levels. A general guideline of 25g of a pelleted diet per kg bodyweight/day would seem appropriate.

Overfeeding of concentrate diets can be a significant factor in GI disease and dental disease, and also leads to obesity and boredom. However, concentrate diets have a role in the feeding of growing, pregnant and lactating and diseased rabbits, and can be used to ensure nutrient requirements are fulfilled in rabbits that are unwilling to consume significant amounts of hay or green vegetables.

GI stasis

If a rabbit's gut motility slows down, gastric (stomach) stasis often occurs first, and if untreated or unresolved will usually progress to intestinal stasis, caecal stasis or impaction. In my experience however, gastric stasis alone is uncommon and some degree of more generalised ileus or stasis is usually present by the time is the owner notices that the rabbit is unwell and takes it to the vet.

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Appetite, food intake and GI motility are co-dependent; thus anorexia (when the rabbit stops eating) will cause hypomotility (lack of gut movement); and hypomotility will also cause anorexia. As fibre is one of the major driving factors of normal GI motility, a low-fibre, high-carbohydrate diet predisposes a rabbit to gastric stasis and ileus. The list below gives the factors that can lead to reduced GI motility in the rabbit. There can be many contributing causes in an individual rabbit.

- Lack of dietary fibre
- Anorexia
- Chronic dehydration
- Environmental stressors:
  - Proximity of predators
  - Proximity of a dominant/competitive rabbit
  - Change/destabilisation of group hierarchy
  - Sudden change of diet
  - Change of housing
  - Transport
  - Extremes of weather/temperature
  - Loss of a companion
- Pain
- Post-surgical adhesions
- Ingestion of toxins (eg lead)
- Foreign bodies

Reduced gut motility leads to the dehydration of the gut contents, which decreases motility further.

Gastric stasis leads to dehydration and impaction of the normal stomach contents, which include hair that the rabbit ingests through grooming. This is commonly referred to as a hairball, trichobezoar or "woolblock". The impacted material can be felt by the vet and seen on an X-ray as a mass in the stomach surrounded by a halo of gas.
True "hairballs" can be found in long-haired rabbits such as Angoras, which can ingest excessive amounts of long hair.

Clinical signs commonly associated, but not always seen, with gastric stasis are:

- Gradual reduction in appetite over days/weeks, eventually leading to the rabbit stopping eating. (The rabbit usually remains bright initially after stopping eating).
- Decrease in output and size of faecal pellets, eventually stopping completely.
- The rabbit may chew paper/cardboard, or wood in an attempt to obtain fibre.
- There may be a progression of signs to depression, lethargy, dehydration and death.

Non-obstructive ileus will follow on from untreated gastric stasis and is a continuation of the same process. In practice the two conditions are often present together. The clinical signs are similar, but with ileus, pain is a prominent feature, and the rabbit may grind its teeth, hunch up and be reluctant to move.

Treatment of GI stasis

Rapid intervention and treatment is required to prevent GI stasis becoming life-threatening. Any rabbit that has not eaten or passed droppings for 24 hours should be taken to the vet for treatment. Treatment is medical, and aimed at supporting the rabbit and restoring normal gut motility. Rabbits should be hospitalised in quiet surroundings away from potential predators to minimise stress.

Treatment should consist of:

- **Fluid therapy** - to maintain the circulation and to rehydrate the contents of the GI tract. In mild cases, oral fluids (by mouth) may be all that is required, but in more severe cases intravenous fluids are indicated.
- **Analgesia** – such as buprenorphine (an opiate). Stasis is painful, and pain in itself will cause stasis.
- **Motility modifying drugs** – metaclopramide, ranitidine.
- **Assisted feeding** via syringe – commercially available high-fibre herbivore recovery diets, or slurries of ground rabbit pellets. Hay, grass and other high fibre foods should always be offered. Tempting items like dandelion and parsley can help stimulate appetite. Gradual introduction to grazing outdoors (30 minutes at first, extending by 30 minutes per day, for example) is a good idea if access is available.
- **Exercise** – this helps to stimulate GI motility.

It may take up to three days or more for the rabbit to begin producing faeces once more. I do not advocate the use of antibiotics in uncomplicated gastric stasis/non-obstructive ileus. The usefulness of enzymatic products (eg papain) to digest hairballs is debatable – these products do not actually digest hair but may help to break down the matrix holding the material together. Pineapple juice is often advocated as it contains the enzyme bromelain, (and papaya contains the enzyme papain) but these are high in simple sugars and low in fibre, which may promote an imbalance of 'good' and 'bad' bacteria in the gut. In reality anecdotal reports of pineapple juice helping with hairballs is probably due to it providing rehydration and being an energy source.

True obstruction is a surgical emergency and the rabbit will need rapid surgery to remove the blockage.

This article is based on a lecture presented at the recent RWF Health Matters conference