

A to Z of Rabbits Mini Series

Session Two: The Adult Rabbit

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The A-Z of Rabbits: Part 2 The Adult Rabbit

- **Preventive Health Care**

- a) Vaccination strategies: All healthy adult rabbits should be regularly vaccinated. Because neither myxomatosis or rabbit haemorrhagic disease require direct contact with infected rabbits for spread, it is very difficult to prevent disease simply by using environmental or biosecurity methods. In the case of myxomatosis, good control of biting flies using screens and fly strips can be helpful while with RHD making certain that the origin of any used cage furniture is known and avoiding using farm hay if living in an area where RHD is endemic is sensible, none of these methods are infallible. The vaccine currently licensed in the UK (Nobivac Myxo-RHD, MSD) requires a booster injection once every year. This particular vaccine does not contain an adjuvant or any preservative, so it is less likely to cause toxic effects. While there can be effects on immunological function, these have not been shown to be to the long term detriment of the recipient. There are no reports of chronic disease being caused by this vaccine. So at this time due to the likely serious nature of both myxomatosis and RHD (even in previously vaccinated rabbits whose immunity is waning), regular vaccination is warranted.
- b) Control of External Parasites: Rabbits commonly suffer from fleas, mites and lice. There are products licensed for the control of ectoparasites in rabbits under the SAES. It should however be noted that in many cases other medical factors affect the presence of ectoparasites in rabbits (ie poor mobility affecting the ability to groom, or the presences of female hormones stimulating the presence of stick tight fleas) and infestations should not merely be taken at face value. Clearly the infestation needs to be appropriately addressed but be aware that additional examination and possibly diagnostics may be required.
- c) Control of Encephalitozoonosis: Encephalitozoonosis is a disease caused by the microsporidian parasite *Encephalitozoon cuniculi* (EC). Infection is usually by ingestion of spores shed in the urine of infected animals, although it can also be transplacental, via aerosol spread and through the faeces. More than half of rabbits in the UK are serologically positive for EC although most of these animals will never show any clinical signs. Seropositivity is easy to determine however EC as a potential cause of compatible clinical signs (certain central neurological signs and renal disease) is not. Because it is questionable whether the magnitude of the serological reaction equates to the severity of clinical signs and because seropositivity lasts for up to seven years, titres can be difficult to interpret. Titres also fluctuate depending on the degree of contamination of the environment and hence the amount of spores being taken in. There are products licensed under the Small Animal Exemption Scheme (SAES) for the treatment and control of EC. The basis of use of these products is a paper from the Veterinary Record in 2001, where researchers demonstrated that fenbendazole was effective in preventing experimental infection with EC if given for 7 days prior and 21 days after infection with EC, and also was effective in eliminating spores from the CNS of naturally infected rabbits (28 days treatment). However the drug these products contains (fenbendazole) is not wholly benign in rabbits, and its use without strong clinical justification is questionable, particularly since courses of between 9 and 28 days are recommended. Bone marrow suppression has been reported in several other species and also anecdotally in rabbits (I have personally recognised this). Because fenbendazole is poorly absorbed from the gut, its main route of excretion is through the faeces. The half life in the rabbit is 13 hours, so with twice daily dosing, there will over a period of time be some drug build up. For rabbits this means that with a prolonged period of dosing they are potentially re-ingesting active drug during this time and the dose (possibly only slightly) is therefore ever increasing. So how should we be diagnosing and treating EC? Firstly: does the animal have compatible clinical signs? If so take EC titres (if negative this largely rules out EC because clinical signs generally only occur after the animal becomes seropositive) but formulate a differential diagnosis list and take steps to rule these in or out. If all reasonable DDX are ruled out and the patient is seropositive then EC is a reasonable working diagnosis.

At this point, symptomatic treatment (for example treating seizures, vestibular signs, or renal disease), fenbendazole and consideration of serologically testing in-contact rabbits is an appropriate plan.

In the longer term (especially if the rabbits have access to outdoor space which is difficult to decontaminate) then regular short courses of fenbendazole will keep the number of spores in the environment (and hence the number being ingested) to a minimum as well as clearing out anything that may have been recently taken in. (NB seropositivity does not confer immunity: this is largely cell mediated). For rabbits with unknown EC status and no clinical signs then advising regular courses of medication just in case is perhaps more of a complicated question and must be dealt with on a case by case basis balancing the perceived risk with the potential benefit. Indoor rabbits that are EC negative do not require fenbendazole treatment. Indoor rabbits that are EC positive but kept with good hygiene (ie robust cleaning so there is no organic debris left, then good disinfection) also have less need for regular treatment. The more difficult question is when there are rabbits of unknown EC status kept in environments where EC cannot be controlled (eg access to outside). For these rabbits short (9 day) regular courses of fenbendazole with careful monitoring is sensible as is rotation of the grassed areas used to allow the number of viable spores to reduce in between use. Spores can remain viable outside for up to 22 days in favourable conditions. In an ideal world regular treatment without knowledge of EC status should not happen, particularly in rabbits with no clinical signs.

- d) **Body condition scoring:** This is a very useful tool to employ during consults, whilst rabbits are hospitalised and to teach owners. The advantage of body condition scoring is that provides another method of checking whether the balance between nutrition and the health/disease of the body is normal. In simple terms if too many calories are consumed then weight increases, if too few are consumed weight reduces. However other factors such as activity levels and disease can modify this. Equally weight gain and weight loss is not as simple either: how and from where the weight is gained or lost is also relevant and this is what BCS can give an insight into. For example: in the case of a rabbit with gut stasis a significant amount of fluid can be lost into the gut leading to clinical dehydration without weight loss. Equally in the case of a rabbit with a neoplastic lesion the body weight may remain the same but muscle mass may be lost. Both of these scenarios this are easily appreciable when you BCS a rabbit as well as weighing it. In rabbits the body condition scoring system employs categories 1-5, with 1 being emaciated and 5 being markedly obese. Obviously there is a degree of subjectivity in any system such as this but using consistent markers such as the ribs, the pelvis and the back bone can be helpful. The Pet Food Manufacturers Association has published a rabbit body scoring system that is readily available for practitioners to use. There is another similar system suggested in an article by Brigitte Reusch/Lord in *Rabbiting On*.

- **Maintaining your rabbit's health through nutrition**

- a) **Weight control and avoiding obesity:** Nutrition is critically important to the health of the rabbit, in terms of provision of energy, nutrients and fibre to promote dental wear and gut motility. With the way that rabbits are commonly kept however, obesity is increasingly becoming a problem. This is compounded by the fact that both owners (and vets) are obsessed about how much each rabbit is eating and it becomes counterintuitive to try and limit food intake. As previously stated calories in vs calories used can predict weight gain/loss although this equation is modified by other factors such as disease. In general terms each rabbit should consume a body sized pile of hay (although how tightly packed this is will affect the amount of calories), a head sized handful of fresh leafy greens and around 25g/kg of good quality pellets each day. Obviously these amounts are somewhat open to interpretation, but despite the limitations these guidelines at least provide a starting point. Hand in hand with this goes the provision of somewhere safe to exercise (where there is no risk of predation, the perception of predation is minimized and there is enough room for a rabbit to display normal behaviours such as hopping, standing on the hind legs, 'binkying' and digging). So obviously dietary measures alone perhaps are not enough. Keeping rabbits in pairs can improve activity levels, as can providing the rabbit with suitable toys and human company if another rabbit is not available. Other dietary factors that need to be considered include the nutritional profile of the diet.

- b) If rabbits are fed as recommended then there should be minimal simple carbohydrates being consumed, however many rabbits are not fed in this manner, meaning that simple sugars can lead to spikes and then troughs in blood glucose and the propensity to take in more food in response to this. What food items contain simple carbohydrates? Certainly parts of muesli type feeds are high in sugars and simple starches (eg maize flakes) and these items are often preferentially eaten by rabbits (they select food for energy primarily) equally treat items such as milk drops, honey sticks and some vegetables and fruits also contain a fair amount of simple carbohydrates. So many rabbits are fed a diet that has a lot of easily digestible calories, and are often not afforded the opportunity to exercise. Rabbits have evolved to maximise the potential of a fibrous energy dilute diet, and when fed contrary to this, obesity results.
- What effects does obesity have on the rabbit? Rabbits are very prone to the rapid development of hepatic lipidosis when they become anorexic: this is compounded in obese animals. Diabetes mellitus is not recognised as a naturally occurring entity in rabbits (although it can be precipitated by certain drug manipulations in the laboratory animal setting), however with the increase in rabbits being kept and treated to a high standard perhaps this is something that should still be considered as a potential diagnosis. Obesity also worsens the effects of osteoarthritis, hock sores, calcium sludging and cardiac disease.
- How should we encourage rabbits to lose weight? Weight loss in rabbits should be slow steady and sustainable. Gradual reduction in the amount of concentrates fed, a shift towards fibrous leafy greens and a reliance on hay as the primary energy source are all sensible strategies. However; many rabbits will resist this particularly if they have not been used to being fed this way previously, and there is very little leeway in terms of making them hungry enough to eat items that are not preferred foods, because gut stasis and hepatic lipidosis can occur rapidly. There are some proprietary pelleted foods that are reduced calorie, and these can be a good option, as can restricting the amount of pellets or even stopping these if the rabbit is consistently eating hay and vegetables. The difficulty presents itself when the rabbit is largely dependent on pellets and treat items and eats little or no hay. In cases such as this methods of encouraging hay eating such as scatter feeding the pellets (scatter pellets throughout the hay in order that the rabbit has to exert energy to find them and also at the same time has to interact with the hay when it is feeding), and putting hay within reach of the litter trays (rabbits will usually nibble when using the latrine) can be helpful. However planned weight loss with rabbits can be challenging.
- c) Good dental wear: Rabbits are reliant on a fibrous diet in order to wear down their constantly growing teeth. Both fibre and minerals in the diet are responsible for dental wear. Feeding hay and vegetables allow the jaw to move in a natural manner: laterally, antero-posteriorly as well as slightly vertically, whilst pelleted food generally requires a more vertical jaw motion in order to break the pellets up. Immediately it is clear that pelleted food alone does not require the rabbit to perform normal jaw movements. Rabbits are kept on a pellet only diet under laboratory conditions and are not reported to have a higher incidence of dental disease under these circumstances, however this type of management by definition is time limited and many of these rabbits are not kept for more than 2 years. Within a pet animal situation where uniformity is not required and longevity and the ability to express normal behaviours are key, a pellet only diet is not going to fulfil the needs alone.
- d) Avoiding calcium sludging: Rabbits, unlike any other mammal, take up calcium indiscriminately from the diet (without reliance on vitamin D, parathyroid hormone or calcitonin). Calcium is taken up in direct proportion to the amount found in the diet. At low calcium levels active transport mechanisms are required. Any excess calcium is excreted through the kidneys. It has been postulated that rabbits have evolved in this manner in order to cope with varying calcium and phosphorus levels found in pasture seasonally. In captivity, calcium will be largely constant and is unlikely to be a limiting factor in the diet. This means that there will always be some calcium needing to be excreted by the kidneys. In rabbits that do not have access to space for exercise, or perhaps are not able to be normally mobile or balance properly, any excess solute in the urine will sink to the ventral portion of the bladder while the rabbit is not moving.

- e) Over a period of time, this sludge is not removed from the bladder (Indeed the urine can appear unusually clear) and it forms a thick paste that prevents normal bladder emptying, it can also predispose to urethritis, cystitis and urine scalding. Dietary manipulation is only one of many treatment strategies that can help with this increasingly common problem. Reduction of calcium in the diet, means there is less solute load on the kidneys, and less solute in the urine ergo the sludging is reduced. However, dietary manipulation alone will not resolve the problem and the causes must be robustly investigated and addressed at the same time.

- **Dental Disease**

- a) Causes: While congenital dental malocclusions do occur, by far the more common form of dental disease in my experience is Acquired Dental Disease (ADD). Many rabbits have imperfect teeth but with a good diet and a good appetite these remain in good occlusion. However as soon as the diet is not good, there is potential for selective feeding or the appetite is reduced (all of which can affect dental wear) the occlusion becomes precarious and spurs form. Dental/oral pain in turn reduce the ability and willingness to eat compounding the problem. Equally in rabbits with good dentition, any episode of pain (of any type) can affect the appetite/willingness to eat and with reduced dental wear over a period of time, ADD can ensue. It is vitally important to remember that the rabbit mouth is a dynamic and constantly changing organ.
- b) Effects: The welfare level of the rabbit is reduced: the mouth is likely to be painful and eating (both the ability and willingness) reduced. Reduced food intake in turn leads to reduced dental wear, compounding the problem. The other effect of reduced food intake is reduced gut motility. Gut motility is stimulated by chewing, the presence of ingesta and long stem fibre in the gut. As soon as the rabbit stops eating, then gut motility will be compromised, leading to gut stasis, a potentially life-threatening situation.
- c) Imaging: Any rabbit with ADD particularly those undergoing dental work for the first time should at least have dental radiography undertaken. In order to understand fully what is going at least four and preferably five views of the skull should be taken: a straight DV, a straight lateral and 2 oblique views (one on each side). This allows evaluation of the reserve crown apices, the occlusal surfaces, the bones of the skull, the conformation and the growth pattern of the reserve crowns and true crowns. If advanced imaging is available then computed tomography gives an excellent three dimensional view of the skull and teeth, with which to plan dental interventions. Post-dental views should also be considered in order to visualise the effects of the intervention as well as demonstrating to the owner what has been achieved.
- d) Treatment plans: Dental disease is painful, so all patients with ADD will require some form of pain relief. In some cases analgesia will be sufficient to encourage the rabbit to resume eating. In cases where the rabbit still will not /is unable to eat after analgesia, then support feeding will be required. In general terms it is far more important to stabilise the condition of the rabbit, and re-establish gut motility than it is to immediately perform dental work. Once the gut is moving and faeces are being passed, then most rabbits will be stable enough to undergo dental treatment.
- e) Burring: Most dental interventions involve shaping the erupted crowns using slow or fast dental burrs (clipping is never appropriate). Ideally the individual teeth and the arcades as a whole should be shaped so that they are symmetrical and are at a physiological length. Removing large lengths off the reserve crowns can make it difficult for the rabbit to bring the teeth into occlusion because the masseter muscles can stretch over time. In cases where there is a lot of length to be removed, a staged approach may be more sensible. Once the teeth have been burred it is sensible to check the jaw mobility and to make sure that it can move within its usual range of motion symmetrically on both sides as well as antero-posteriorly, without catching.

f) Dental extractions: Occasionally teeth will need to be removed. This needs to be done on radiographic evidence, as well as clinical signs of disease. Removal of incisors is relatively straightforward as long as the correct tools are available (Crossley luxators) as long as ankylosis has not occurred: this can be visualised radiographically and is the body's reaction to the tooth becoming loose: bony remodelling tends to encourage the tooth socket to grip the reserve crown in order to stabilise the tooth. Teeth in this situation are difficult or impossible to remove. Removal of cheek teeth presents more of a challenge because there is limited oral access. In general terms for any tooth, the gingival margin should be incised surgically and the periodontal ligament stretched in a methodical manner. Insert the luxator gently but firmly on each aspect of the tooth reserve crown and stretch the periodontal ligament for 30 seconds, working around the tooth, going a little deeper each time until it feels loose in the socket. When attempting to extract the tooth, note the radiograph in order to determine the direction and curve of the reserve crown: this needs to be considered when planning the direction of traction: it is very easy to fracture the tooth in its socket if this isn't respected. Once the tooth has been loosened, and partially extracted, push it back down into the socket to disrupt the germinal cells of the reserve crown and reduce the likelihood of regrowth. It is always worthwhile advising owners that there will be potential for regrowth with any extraction. The sockets are generally left open to granulate. In terms of the cheek teeth historically it had been recommended to remove the opposing tooth in the occlusal arcade. However, because there is a degree of antero-posterior movement/grinding this is now not thought to be necessary.

- **Abscesses**

- a) Diagnosis: Abscesses are a common diagnosis in rabbits. They can result from ADD, bite wounds, surgical intervention or as a result of infection with organisms such as *Pasturella multocida*. Diagnosis is generally easy and can often be made on examination, but if not fine needle aspiration can be confirmatory. When there is suspicion of abscessation within internal organs then diagnosis can prove more challenging and while imaging (ultrasound or CT/MRI) can be helpful it may be more pragmatic to perform exploratory surgery (both diagnostic and therapeutic). Differential diagnoses include neoplastic and granulomatous masses.
- b) Medical therapy: Rabbits are very effective at walling off infection, meaning that abscesses are surrounded by thick fibrous capsules. Oral and parenteral antibiotics have little hope of penetrating to where they are needed and rarely prove curative. They are however a useful adjunct to surgical treatment. The only authorised product is enrofloxacin, however this is not always the best choice as determined by culture and sensitivity so antibiotic choice may need to be modified. Procaine penicillin, doxycycline and azithromycin are all good, well tolerated choices however all of these products must be used under the cascade and the owner made aware of off license usage. Most abscesses will be at least uncomfortable, so analgesia should also be considered.
- c) Surgical therapy: The mainstay of abscess treatment is surgery. It has been suggested that rabbit abscesses be viewed in a similar way to neoplasms in terms of surgical intervention: ie early radical/aggressive surgery is the most likely to result in long term cure. If total removal is viable without damage to the structural integrity of the local area, then this should be the surgical option of choice. Where this is not possible, then as much of the abscess as possible should be removed whilst retaining the structural integrity, and the abscess capsule then marsupialised to the skin (this is commonly the case with dental abscesses). Because rabbits lack the enzyme myeloperoxidase (meaning that rabbit pus remains thick and does not flow) simply lancing an abscess and flushing the cavity out is unlikely to be effective. During the initial surgical intervention I generally place an antibiotic/antibacterial impregnated stent which I suture in place. This often takes the form of a soft cellulose type dressing (eg Covidien) that is soaked either in injectable antibiotics (eg marbofloxacin) or a product such as F10 (quaternary ammonium biguanidine disinfectant commonly used in exotic pet practice).

This stent stays in contact with the inside of the abscess capsule and serves two purposes: it allows the antibacterial agent to remain in contact with the inside of the abscess capsule (this is generally where most bacteria are found) and it also protects and retains moisture for the bed of granulation tissue forming underneath. The stent is removed around 5 days post-operatively and thereafter the cavity remaining is cleaned daily by the owner, allowing the abscess to heal from the inside out. With dental abscesses in particular, addressing the underlying dental issues and extracting the affected teeth is crucial in terms of promoting the success of the procedure. Despite all these strategies, the treatment of dental abscesses in particular does not always run smoothly and revision surgery may be necessary.

- d) Antibiotic Impregnated Polymethylmethacrylate (AIPMMA) beads: These are sterile beads that can be placed in abscess cavities to elute antibiotic in contact with the abscess capsule over a period of time. These can be bought but are commonly made up in practice and various different antibiotics can be used. These beads are best employed as part of an aggressive surgical approach where perhaps the location of part of the abscess is not amenable to marsupialisation or where it is prudent to close the skin above the capsule (ie in the case of a retrobulbar abscess). The beads should be placed after surgical debridement and thorough cleaning of the abscess cavity and not as a replacement for thorough surgical exploration. They can be sutured in place or the overlying tissue/skin can be used for retention. Because I often utilise these beads in very difficult cases or as part of a revision surgery, my general impression is that there are many cases where the beads either fail because they are placed prior to culture results (culture must be taken surgically in the case of abscesses as the pus is generally sterile) or because the area has not been debrided enough due to difficulty of access and there is a layer of purulent material remaining. In many cases the beads need to be removed eventually. This is because they can act as a nidus of infection once the antibiotic elution has dropped or because they are causing irritation to or distortion of the structure into which they have placed. So whilst the beads are a good adjunct to abscess treatment, they do not supervene the need for accurate determination of cause, suitably aggressive surgical management and appropriate antibiotics.

- **Urine Sludging**

- a) Causes: Urine sludging and the attendant urine scalding is becoming increasingly common in clinical practice. Whether this is because of an increase in the amount of calcium fed to rabbits (this was certainly the case around 10 years ago, when ADD was thought to be partly due to low levels of calcium/vitamin D in the diet) or perhaps because increasingly owners are seeking care for rabbits as valued family pets rather than assuming they are replaceable children's pets. High levels of dietary calcium are certainly a potential cause, as detailed above, however they are certainly not the only factor to be considered. Because calcium is excreted through the kidney into the urine, anything that affects activity levels (meaning that more solute can settle out of the urine and sit in the ventral bladder) such as osteoarthritis, pain of any origin, cardiac disease, lack of balance eg vestibular signs, upper or lower respiratory tract disease, obesity, lack of a place to exercise or perception of/actual predation must all be considered.
- b) Effects: the effects of bladder sludging can be variable. On occasion it can be recognised as a coincidental finding on radiography. If there are no clinical signs I tend to leave the bladder alone, but look for and address potential causes. In many cases however there will be pain on urination secondary to urethritis related to the calcium salts periodically being passed. The pain on urination affects the stance during urination, meaning that the rabbit may urinate on its perineal area. Once the perineal area is urine soaked the calcium salts matt into the hair causing tangles, and the skin becomes sore and irritated from contact with the urine. This is known as urine scalding and is a potentially very painful condition. Urine scalding also predisposes to flystrike during the summer months. Other effects include a reduced ability to fully empty the bladder, irritation of the bladder lining and even potentially interstitial cystitis. Where there are clinical signs both medical treatment and possibly bladder flushing are indicated.

- c) Treatment plans: The success of any treatment is based on identifying and treating the underlying causes of the condition in tandem with treating the skin, the bladder and changing the diet. A blood profile (biochemistry, haematology and EC serology) is a sensible starting point in addition to urinalysis. Reasons for increased drinking and evidence of urinary tract infection can be found. The next logical step is a general anaesthetic in order to perform radiography (in order to look for potential areas of pain) and evaluate the size and position of the bladder. At the same time any areas of urine scalding should be clipped free of hair, cleaned and dried, and barrier cream applied (Vaseline or Sudocrem are suitable choices). If the bladder is full of radiopaque urine, then the urine needs to be flushed out. Although older texts suggest expressing the bladder this can be risky and can lead to bladder rupture, so this is not something I would advise. Instead passing a urinary catheter and gently withdrawing urine and flushing with sterile saline until everything runs clear is a safer method. Passing a urinary catheter is relatively straightforward in rabbits: in males it is easy to visualise the urethral orifice and then pass the catheter as usual. In females, place the rabbit in sternal recumbency and insert the catheter into the vulva and advance it along the midline of the floor of the vagina: even without being able to visualise the urethral papilla, generally it is easy to pass the catheter into the bladder. Radiograph to confirm placement. Once the urine runs clear, there will be much less local irritation to the bladder and urethra. Antibiosis, skin barrier creams, analgesia as well as treatment of any underlying problems is indicated.
- d) Ongoing management: The key to ongoing management as well as initial clinical success is to identify and address the underlying problems. Very often these are related to mobility but in various guises. Owners need to understand that ongoing management will be required and that a single course of treatment is unlikely to be curative. So dependent on the diagnosis long term medication may be required, and certainly in these types of cases certain nutraceuticals (eg chondroitin, glucosamine) can be very appropriate adjuncts to therapy. Another important consideration is that of perception of predation. Many owners have multiple pet households and feel that their rabbit 'gets on' with their cat or dog. I would however challenge this and ask owners to suspend disbelief to be certain that the rabbits best interests are served by at least trying keeping the pets separately to see if this makes a difference to activity levels. A final point is that these rabbits will be very susceptible to flystrike. Owners should be encouraged to check their rabbits perineal areas daily and during the summer to use proprietary medications for the prevention of flystrike.