



Exotics Club

Approach to Ear and Nose Diseases in Rabbits

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Chronic upper respiratory disease and neurological disease are commonly seen presentations in the pet rabbit population. The diagnostic approach taken to these will be discussed as well as newer diagnostic procedures and treatment options.

Ear disease in rabbits.

How do we confirm we have ear disease (or how do we confirm there is no *E. cuniculi*)?

Head tilt or nystagmus are common presenting clinical signs in rabbits. The classical two differentials listed for this presentation is *Encephalitozoon cuniculi* infection or otitis media caused by *Pasteurella multocida*. Typically presumptive treatment for these cases has centred on treating these two different conditions and many cases are treated with fenbendazole orally alongside systemic antibiotics such as enrofloxacin. Steroidal therapy or non steroidal therapy may also be given. Supportive care measures are also important as many of these cases are unable to feed and gastrointestinal slowdown is inevitable. In severe cases sedation or euthanasia is indicated. Vestibular disease is listed at the most frequently manifestation of *E. cuniculi* infection. The situation is much more complex than this and we can do much better in identifying the exact cause and treating the patient more appropriately.

The first steps in treating these cases is to identify which of these two main pathological processes are involved and then further diagnostics can be undertaken. It is important to note that both may be present.

Rabbits with peripheral vestibular disease (where the vestibular nerve cranial nerve VIII and the labyrinth of the inner ear are affected) typically present with horizontal nystagmus, which can be positional or evoked. These are likely to be a consequence or an extension of otitis media into the vestibular system.

Those with central vestibular disease where the lesions reside in the brainstem may present with vertical nystagmus. This is more likely with central disease due to *E. cuniculi* for example. Other nervous defects may be present with central disease including reduced mentation.

Until recently the most appropriate test for *E. cuniculi* was an ELISA IgG serological test. In a UK study 52% of rabbits were found to be positive. Generally clinicians have acted on this result by concluding the rabbit has *E. cuniculi* and treated for this condition.

IgG takes three to four weeks to elevate post infection and peak after nine weeks. However this test did not produce titres to aid in understanding the clinical significance of the result. Additionally IgG has been shown to decline slowly after infection and is more appropriate to diagnose exposure to the organism.

The lack of an IgG antibody response, does not rule out *E. cuniculi*, but a positive titre may simply indicate exposure, but not an active infection causing clinical signs. Thus a seroprevalence of 52% this does not indicate the numbers of rabbits actively infected.

IgM titres elevate quickly after infection and decrease to a low level by four weeks after infection and so a high titre may indicate recent active infections allowing the clinician to differentiate between those animals exposed and those with active (new or reactivated) infections.

An ELISA capable of measuring IgM titres has recently become available in the UK and is used in combination with IgG titres. A study on 500 rabbits demonstrated 68% with positive IgG titres, but only 32.8% with positive IgM titres. IgG titres were present in 86.1% and IgM titres in 54.4% of neurological cases.

This would suggest that half of the neurological cases do not have active *E. cuniculi* infection. However it is important to note that in experimental infections lesions in the CNS do not occur until 70 -100 days after infection. Thus high IgM titres would not be expected in neurological cases.

Despite these findings 24.4% of clinically healthy rabbits had IgM antibody titres (this may reflect subclinical active infection).

Of course rabbits may have concurrent infection with *E. cuniculi* and otitis media.

It is important to try to correlate antibody titres with histopathological evidence of an active inflammatory response consistent with *E. cuniculi* infection for a definitive diagnosis. Laparoscopic biopsies of the liver or kidney or evaluation of CSF may aid diagnosis with actively infected neurological rabbits demonstrating a lymphomonocytic pleocytosis. This however is not specific to *E. cuniculi* and ruling out other CNS diseases such as *Toxoplasma* is important to confirm the diagnosis.

Antemortem diagnostic tests for *Encephalitozoon cuniculi* according to clinical manifestation.

Disease state	Most reliable antemortem diagnostic tests
Latent carrier (asymptomatic)	Immunoglobulin G antibody levels elevated – depends on the level of spore exposure. Reduced serum phosphorus
Acute active infection (renal disease)	PCR on urine is reliable for five weeks following seroconversion. Urine microscopy and special staining. Immunoglobulin G and immunoglobulin M levels elevated. Reduced serum phosphorus
Chronic infection (central nervous system disease)	Renal biopsy and DNA detection by PCR. Immunoglobulin G elevated. Reduced serum phosphorus
Phacoclastic uveitis	Clinical signs, aspiration of liquefied lens material and DNA detection by PCR.

Other differentials to note include Toxoplasmosis, Herpes simplex, listeriosis or other degenerative CNS lesions.

Aural anatomy in rabbits.

Rabbit ears are different to dog and cat ears and the clinical approach taken to disease is also different.

The external ear is made of a vertical canal that extends into a pinna. In the pinna there is a central artery with marginal veins. The size of the ear pinna is hugely variable and some breeds have an upright pinna and others a pinna folded downwards (lop breeds). The central artery is often avoided for venepuncture or sampling due to preconceived risks of occlusion and subsequent aural necrosis. The veins are complex and although there are two marginal veins (both of which can be used for catheterisation), the whole ear actually consists of a series of veins, any of which can be catheterised if large enough and neovascularisation (to bypass previous sites of catheterisation) is very common.

It is important to note that there is no horizontal canal in rabbits, although descriptions of the horizontal canal are still common. This is in part due to the anatomical variations due to captive breeding. Most clinical cases presenting are in lop breeds which have a stenotic canal and altered cartilage which have different anatomy to wild rabbits. The vertical canal extends dorsally from the bony acoustic meatus to the external ear canal. There are multiple cartilaginous plates that make up the vertical canal. In addition rabbits have a bony acoustic duct that extends dorsally and distally to the tympanic membrane. The acoustic duct terminates in a narrow entrance point into the bulla via the tympanic membrane at its base. The bulla consists of very thick bone laterally and thinner bone ventrally and products ventral and lateral to the base of the acoustic duct. The bulla is 5 mm deep and 7.5 mm high and 11 mm long.

Rabbits have a much wider mandible than dogs and cats which extends ventrally in a semicircular fashion. This limits the ability to palpate the bulla in a conscious rabbit. The angular process protrudes caudally just below the entrance point to the bulla.

Clinical signs associated with ear disease in rabbits.

Otitis externa

Clinical signs include scratching at the base of the ear, head shaking, pain, lethargy or anorexia. Primary bacterial otitis externa is rare. The wax of rabbits can be thick and appear to be similar to pus. Wax is typically yellow or beige in colour. Pus is typically white or creamy in colouration. Cytology of any suspicious material should be performed to confirm the presence of large numbers of white cells or bacteria. Scratching the ear base is another sign seen commonly in rabbits.

Psoroptes cuniculi is of course a common parasitic problem and the diagnosis is essentially clinical. However skin scrapes can be taken to confirm infection.

Otitis media

These cases can be clinically silent and identified on imaging of a rabbit for other reasons. However they often present with non-specific clinical signs, lethargy, inappetence, pain, pruritus associated with the base of the ear, painful swelling at the base of the ear, head wobble, Facial paralysis or spasticity may occur on the side of the lesion. Owners may occasionally report hearing deficits.

Both unilateral and bilateral disease is seen. Purulent material may be present in the external ear if the tympanic membrane has ruptured. Lop eared rabbits have a higher incidence of otitis media and this may be an extension of otitis externa with the ear drum rupturing and the infection entering the tympanic bullae. Otitis media may of course extend to cause otitis interna and other signs may be evident.

Otitis interna

Head tilt, nystagmus, ataxia and circling may be evident. Facial nerve spasticity or paralysis may also be present as the facial nerve exits ventral to the vestibulocochlear nerve in the internal acoustic meatus. Horner's syndrome is also possible with drooping of the upper lip, eyelid and ear (which may mimic facial paralysis).

Pathogenesis of otitis externa.

A rabbit's reaction to chronic otitis externa is different to dogs and cats in that ceruminous gland hyperplasia does not occur even with severe infection. In dogs and cats is this hyperplasia that contributes to the narrowing of the external ear canal. These are primarily in the vertical canal and so total ear canal may be indicated.

In rabbits primary cases of otitis externa can extend into the middle ear. In addition many cases reported of otitis externa are not otitis externa they are simply an extension of otitis media which has ruptured through the tympanic membrane resulting in infection sitting at the base of the vertical canal. It is possible in severe cases for the local tissues to become involved and a soft tissue swelling or degeneration of the ear canal results. However the infection rarely tracts up the vertical canal, nor does it lead to marked histological changes of the dorsal section of the vertical canal. Mild cases have minimal histopathological changes in the vertical canal.

It can be very difficult to distinguish between these two disease processes but otitis media extending to otitis externa is by far the most frequent presentation.

Pathogenesis of otitis media or interna.

Pasteurella multocida is present in the nasal chambers and then spreads to other tissues by direct extension or septicaemic spread. It is commonly implicated as a cause for otitis media in rabbits having gained access via the Eustachian tubes. In one study *Pasteurella multocida* was isolated in most clinical and subclinical cases of otitis media and interna. The isolation of *Pasteurella multocida* does not equate to disease with some studies finding up to 95% of rabbits positive. Thus evaluation of the patient for underlying respiratory disease is important and many rabbits have concurrent upper respiratory tract disease. Up to 30% of rabbits with respiratory Pasteurellosis had subclinical otitis media. It is also possible for a rabbit to have a positive culture from the bulla but be negative on nasal swabs.

Other agents cultured from otitis media cases include *Bordetella bronchiseptica*, *Staphylococcus*, *Escherichia coli* and *Pseudomonas aeruginosa*.

Diagnosis.

Clinical examination may yield clinical signs consistent with otitis externa with purulent material being present in the external ear canal or a soft tissue swelling noted at the base of the ear. A detailed neurological examination directed to assessing the function of cranial VII, VIII, IX nerves.

The facial nerve (VII) provides motor activity to the eye lids, maxilla and mandible and relays sensory information from these areas. The rabbit should be able to open its mouth, blink and a small needle can be used to elicit a twitch of the muscles of the face, head shaking or moving away indicating a central component to the response. The vestibulocochlear nerve (VIII) is evaluated by a hearing test and many owners may be able to provide some useful clinical history. The nerve is also responsible for balance and so nystagmus or placing/balancing tests can be used. The glossopharyngeal nerve (IX) is best assessed by taste and enrofloxacin or metronidazole can be dropped on the tongue.

Conscious otoscopic examination or endoscopic examination under anaesthesia may confirm the extent of the infection. The rabbit is placed in lateral or ventral recumbancy. Some clinicians prefer to use saline insufflation to visualise the ear.

Even with good image quality it can be difficult to demonstrate the material entering or exiting the tympanic bulla due to large amounts of exudate. If large amounts of wax is present endoscopic examination and grasping forceps can be used to remove the wax to allow increased visualisation. Biopsies of material deep within the canal can be taken for culture and histopathology. As the biopsy is sterile until it is passed out the end of the biopsy sheath this tends to yield more reliable results than a culture swab passed down the ear canal, which may pick up superficial contaminants.

Positive contrast canalography can be used to diagnose a ruptured tympanic membrane. In the event of a suspected otitis media without externa the tympanic membrane can be evaluated endoscopically and an injection/aspiration needle used to obtain samples from within the bulla should fluid or purulent material be identified behind the tympanic membrane or if there is swelling

of the tympanic membrane. A myringotomy (opening the tympanic membrane) will allow for this material to pass into the external ear canal but is usually not indicated.

Radiography is often the next step. Lateral, dorsoventral, oblique views and open mouth cranial caudal views are often used for evaluation of the tympanic bullae. Oblique views should be between 30 and 70 degrees to visualise the bullae separately. The dorso ventral view is reported as being the most useful. Anaesthesia is indicated for proper positioning.

Increasing radioopacity of the bulla or increased sclerosis of the bone are often reported to be the identifying signs of otitis media. However radiography is a poor diagnostic technique and many cases of otitis media will be missed. This generally results in a tentative diagnosis at best and many cases are treated medically as a result.

In dogs the accumulation of fluid within the tympanic bulla is an important diagnostic indicator to confirm otitis media. In a cadaveric study CT was confirmed as the most reliable method of diagnosis, although ultrasound was found to provide better results compared to radiography. Radiography yielded accurate results only in 56% of cases. In another canine study mild disease was detected at similar rates on radiography and CT. In rabbits ultrasound has also been found to be useful in achieving a diagnosis.

CT is the best imaging modality for evaluation of the tympanic bullae. High resolution images can be obtained with a lightly sedated rabbit in a short space of time. Contrast is generally not required. Interpretation is simple as both otitis media and externa are clearly identified due to increased soft tissue density being present where the ear canal and bulla should be gas filled. In some cases the material can be seen to emanate from the external ear canal, in others the bullae is completely filled with a soft tissue density. At our clinic radiographic assessment is no longer used for the identification of otitis media.

The difficulty arises not with the diagnosis of otitis media but linking its clinical significance with the current clinical signs. Many rabbits will have subclinical infections and it is unclear at what point clinical disease will if ever become evident. In one post mortem study in food rabbits xx% of the tympanic bullae were found to have purulent contents (otitis media) which was clinically silent at the time of slaughter.

However it is impossible to quantify the level of chronic pain present with this condition and it is the author's opinion that all cases of otitis media that are evident on CT examination should be treated, with a view to obtaining a complete resolution. It is also unclear if neurological signs will resolve with medical or surgical treatment of otitis media. It is this author's opinion that, prior to undertaking invasive surgical intervention the rabbit should have an acceptable quality of life and have accommodated for its neurological signs.

Treatment options.

Medical treatment for otitis externa is often used and many cases can respond to treatment as rabbits do not have canal narrowing due to ceruminous gland hyperplasia. If proliferation of tissue is present then fungal or neoplastic disease should be suspected and a histopathological biopsy is indicated.

Treatment can include a variety of techniques such as aggressive systemic antibiotic therapy for a protracted period, ear wicks soaked in antibiotics or ear drops combined with topical cleaning and flushing of the ear.

Repeated flushing can inflame the ear canal. Iatrogenic rupture of the ear canal is also possible, spreading infection into the middle ear. Ear cleaning is important to allow effective treatment from topical antibiotic therapy.

If ear wicks are used they should be removed every five to seven days. These generally are placed in the ear canal after it has been cleaned and dried. Typically they need to be cut to 75% of their original length to get them seated well down the vertical canal. Once placed topical therapy is applied daily to keep them moist. Non steroidal and opioids may also be administered as this condition is painful.

Repeat otoscopic examination is required to evaluate effectiveness and should be used pre and post flushing procedures to assess the effectiveness of these techniques.

If presumptive antibiotic therapy is being administered agents effective against *Pasteurella multocida* should be chosen but it is wise to provide anaerobic cover and use bactericidal antibiotics. Typical agents used include narrow spectrum penicillins (parenterally) or enrofloxacin (parenterally or orally). Cultures can be taken from material in the external ear canal. Aerobic, anaerobic and fungal cultures should be requested. Medical treatment should be continued for four to six weeks (six weeks is the standard regime at the RDSVS). If treatment fails then surgical intervention should be considered.

Otitis media may also be treated medically following a similar regime to that used for otitis externa. Cultures can be taken via aspirating the tympanic membrane or material from the vertical canal. Myringotomy has also been suggested as a method treatment allowing drainage of the purulent material from the otitis media. However medical treatment is unlikely to be successful due to the large amount of purulent material within the bulla itself which is unlikely to achieve therapeutic levels.

If neurological signs are present prochlorperazine can be used which is a phenothiazine derivative that acts on the vestibular nervous pathways. Midazolam or diazepam are often used to suppress acute neurological signs. Conversely rabbits respond quicker and better if attempting normal activity and feeding where possible as opposed to having enforced confinement. Metoclopramide has also been used.

Repeat CT examination can be performed to evaluate the success of medical treatment. Surgical intervention is generally indicated due to a failure to eliminate the infection or due to recurrence. In many cases the infection is in the tympanic bulla and not in the bone (i.e. there may not be an osteomyelitis present) and in either case achieving therapeutic levels of antibiotics at this site is going to be limited. Either way the solid caseous purulent material will require surgical removal to clear out the bulla. At the R(D)SVS all cases of otitis media identified on CT are encouraged to undergo surgical intervention as soon as possible.

Surgical intervention.

Careful technique is required to minimise the risk of complications and recurrence. Reviewing the local anatomy on a prepared skull is most useful prior to surgery.

Magnifying surgical loops are incredibly helpful for these procedures. There are essentially a number of techniques that can be used. The surgical treatment options to resolve diseases involving the rabbit ear are also comparable with those used for canine and feline species. However, there are key anatomic and physiologic differences that must be accounted for to perform proper surgical treatment on a rabbit that has been diagnosed with ear disease.

If there is severe otitis externa, without otitis media, then the lateral wall of the vertical canal can be resected (LWR). In dogs and cats the lateral wall of the vertical canal is removed and an opening created at the end of the horizontal canal. This increases drainage and ventilation of the ear canal and allowing medication to be topically applied. This has the benefit of being less invasive than a TECA/LBO. However even in dogs the outcome can be less than acceptable and in one study 55% had an unacceptable outcome. In rabbits the procedure is different as they lack a horizontal canal.

Lop breeds are predisposed to otitis externa due their pinna anatomy. The whole of the ear is shaved and surgically prepared. Two incisions are made from the base of the ear following the line of the pinna. The subcutaneous tissue is then dissected from the cartilage of the ear canal. Two incisions are then made in the cartilage following this line and the tissue reflected ventrally. It is important to dissect down close to the tympanic bulla. The cartilage is then incised and removed. At this point the skin can be sutured directly onto the mucosal lining ventrally and the incisions closed up towards the pinna. It is possible to create a downward flap of cartilage as an alternative and suture this ventrally to ensure the section of vertical canal left is as open as possible. The wound is gently cleaned but no flushing is performed. However this technique may not resolve the otitis externa so cases should be selected very carefully and on-going treatment is likely. This is partly due to the anatomy as the remaining canal (the bony acoustic meatus) is still vertical so drainage and ventilation are not achieved. An ear canal ablation is usually preferable and this procedure is not recommended in rabbits.

A total ear canal ablation and lateral bulla osteotomy (TECALBO) is the most commonly performed procedure for otitis media and otitis externa (which is the most typical presentation). Even if there is no evidence of middle ear involvement, it is still recommended that the lateral bulla osteotomy is still performed. Simply performing the TECA can be deleterious with the risk of infection being left behind. This means that there is no tympanic membrane to act as a drainage site and typically the Eustachian tube is blocked by discharge and a facial swelling will develop. It is difficult to assess the Eustachian tube for patency clinically and confirm it is free from infection. It is safer to assume there is likely to be pathology and perform the LBO as well.

The whole of the ear is shaved and surgically prepared. A single incision is made from the ear pinna down to the base of the ear. The vertical canal is then dissected free of subcutaneous tissue and this is extended behind the vertical canal. This dissection must be close to the canal to avoid haemorrhage and the facial nerve. A cotton bud or Q tip can be passed into the canal to help in localisation and help provide close dissection. The top of the vertical canal can be cut which will allow for the complete dissection of the canal from the ear pinna. Tissue forceps can be applied to allow the surgeon to apply some traction and allow fine dissection. Once the vertical is totally free the bone of the external acoustic duct can be palpated. Sharp dissection is used to free the cartilage

from this which reveals the external acoustic opening. In most cases the incision reveals purulent material in the vertical canal that extends into the external acoustic duct. All of the cartilage of the vertical canal must be removed otherwise abscesses may form creating fistulas.

The lateral wall of the external acoustic duct is removed with rongeurs and this provides access to the bulla. This is a harder section to remove as the entrance is only large enough to insert the jaws from a fine pair of rongeurs, but the bone thickness of the lateral aspect of the bulla actually requires a much stronger instrument. Kerrison forceps can be used but even the small forceps can be difficult to place in a small rabbit. Larger rongeurs will work if held at an acute angle to break down the thick lateral wall. The ventral aspect is incredibly thin and may shatter or need to be removed using fine rongeurs. It is important to remove as much of the lateral and ventral walls as possible. If this is performed it is simple to visualise the soft tissues and ensure all infection is removed. Volkmann spoons are ideal for this. The pus produced is very caseous. Any lining of the bulla must be removed and any fluid drained. Gentle flushing can be performed at the time of surgery. If a smaller amount of bone is removed an endoscope can be inserted into the bulla to confirm all the infection and lining has been removed. The facial nerve exists the skull from the stylomastoid foramen and courses along the ventrolateral aspect of the bulla and should be avoided.

Some clinicians prefer to marsupialise the tissues of the bulla to the skin and suture the skin to the mucosa along the entire length of the ear canal. This allows for post-operative flushing, but allows for the ingress of infection and at the RDSVS 90 degree head tilts have occurred during flushing where presumably otitis interna has been generated. It is our policy that wounds are completely closed.

An alternative to this is to place antibiotic impregnated poly methyl methacrylate beads (AIPMMB) into the surgical site or bulla. These provide a high local concentration of antibiotic with minimal systemic absorption. However this is not typically performed in other species and not required if surgery is meticulous and the access gained to the bulla (or what is just the side of the skull now) is sufficient for good visualisation. So in this case the beads would be placed in the soft tissues of the head and not in a bone cavity.

In addition these are typically made from gentamycin bone cement with the addition of other agents such as clindamycin to extend the spectrum of activity. As gentamycin is potentially ototoxic and is being placed right next to the oval and round windows of the internal ear the author is concerned regarding side effects and at the RDSVS AIPMMB are not used in cases of otitis media.

Closure of the tissues over the bulla is performed using a monofilament material and then the skin incision is brought together over the length of the surgical wound. The tissues at the top of the wound can be closed in a T shape, but caution is advised as it can be difficult to retain normal aural anatomy as there is a tendency for the ear to be tilted laterally.

A ventral bulla osteotomy has been described for otitis media cases without otitis externa (as access to the external ear canal is not possible from this route). This allows removal of debris and epithelial lining within the bulla and placement of AIPMMB. Ventral drainage is also possible via this route. Rabbits have a wider mandible, which makes palpation of the bulla difficult and a thick lateral wall of the tympanic bulla so this technique has been advocated as an alternative. The ventral aspect of the mandible is surgically prepared. The entry point is parallel and medial to the mandible and

mandibular salivary gland and lateral to the digastricus muscle. The digastricus muscle is bluntly separated from the hyoglossal and styloglossal muscles whilst avoiding the hyoglossal nerve. The bulla can be palpated dorasally and blunt dissection reveals access to the ventral aspect. The jugular process of the skull lies laterally to the point of incision. Entry can be achieved with a small intramedullary pin and the entry hole can be enlarged with rongeurs. Post-operative drain tubes can be placed. Complications are identical to those for the TECALBO.

At Edinburgh a novel technique is under investigation to simplify these procedures and reduce patient morbidity associated with ear surgery. This is also an attempt to retain the cosmetic appearance of the rabbit and to speed the healing of the wound. In cases where there is otitis media extending to otitis externa there is minimal pathological change in the distal vertical canal (in contrast to dogs and cats) and removal of this tissue is unwarranted. As a result the surgical approach requires a shorter incision at the ear base. Soft tissue is dissected down to the proximal portion of the vertical canal and then this is bluntly dissected free of surrounding tissue (keeping close to the cartilages). The canal is then bisected with lower portion grasped with Allis tissue forceps holding the open end of the vertical canal closed. This is then completely freed down to the external acoustic duct. Sharp dissection is used to free the cartilage from this which reveals the external acoustic opening. In most cases the incision reveals purulent material in the vertical canal that extends into the external acoustic duct. All of the cartilage of the vertical canal must be removed otherwise abscesses may form creating fistulas.

The lateral wall of the external acoustic duct is removed with rongeurs and this provides access to the bulla. This is a harder section to remove as the entrance is only large enough to insert the jaws from a fine pair of rongeurs, but the bone thickness of the lateral aspect of the bulla actually requires a much stronger instrument. Kerrison forceps can be used but even the small forceps can be difficult to place in a small rabbit. Larger rongeurs will work if held at an acute angle to break down the thick lateral wall. The ventral aspect is incredibly thin and may shatter or need to be removed using fine rongeurs. It is important to remove as much of the lateral and ventral walls as possible. If this is performed it is simple to visualise the soft tissues and ensure all infection is removed. Volkman spoons are ideal for this. The pus produced is very caseous. Any lining of the bulla must be removed and any fluid drained. Gentle flushing can be performed at the time of surgery. If a smaller amount of bone is removed an endoscope can be inserted into the bulla to confirm all the infection and lining has been removed. The facial nerve exists the skull from the stylomastoid foramen and courses along the ventrolateral aspect of the bulla should be avoided.

The tissues over the bulla are closed with monofilament material. The vertical canal is also closed ensuring the mucosa is accurately opposed and the cartilage of the vertical canal closed with a horizontal mattress suture. The remaining soft tissues are closed and the skin closed using a subcuticular pattern. Cosmetically these rabbits appear perfectly normal after the procedure. It is much quicker, less painful and skin healing occurs promptly with no need for intensive management.

As most of the cases seen are otitis media cases with rupture of the tympanic membrane leading to otitis externa, it is important to note that in many cases primary otitis externa is not present.

Any of these three techniques allows ingress of inflammatory tissue and increases the blood flow to the area.

Analgesia is important at the R(D)SVS we use fentanyl (or morphine), dexmedetomidine and meloxicam pre operatively with a local block in the incision of lidocaine and bupivacaine. During surgery a continuous rate infusion of ketamine is used. Post operatively morphine should be used in the initial period along with the ketamine CRI. This is followed by buprenorphine and further meloxicam. Typically the rabbit is off opioids within 48 hours and is discharged on meloxicam.

Antibiotic therapy should ideally be based on culture and sensitivity taken from the bulla at the time of surgery. Success rates can be poor with less than 20% of cultures yielding positive growth. As a result antibiotic therapy post operatively can be empirical. Our preferred choice is for enrofloxacin intravenously and parenterally in the immediate post operative period, whilst the rabbit is an inpatient followed by parenteral procaine penicillin for six weeks administered by the owner.

Gastrointestinal motility agents should be used to stimulate bowel motility and at the RDSVS we routinely use ranitidine as this has the added bonus of being protective against gastric ulceration. Assist feeding is performed using fibre based critical care formulas intended for herbivores.

Complications include facial nerve paralysis (if damaged during the surgical procedure resulting in loss of palpebral reflex, exposure keratitis and an inability to move the muscles of the face) or spasticity (due to inflammation around the nerve after surgery), Vestibular dysfunction (head tilt, nystagmus, torticollis if otitis interna has occurred due to excessive curettage in the dorsomedial aspect of the bulla damaging the promontory, vestibular and cochlear window), tongue paralysis (due to hypoglossal nerve damage), horners syndrome (due to disturbance of the sympathetic nerve within cranial nerve VIII as it passes through the middle ear, presenting as miosis, ptosis and enophthalmos), haemorrhage (due to rupture of the rostral auricular artery), odema of local tissues, recurrence of infection leading to abscessation or fistulous tract formation (due to failure to removal all of the epithelial lining or a bone fragment). In the latter two cases repeat surgery is indicated.

Evaluating the middle ear for reoccurrence of infection is problematic as the surgical site should fill with granulation tissue post operatively. On CT examination it will be impossible to differentiate between this and infection, unless there are bone changes or a soft tissue swelling noticed laterally under the ear base.

Careful meticulous technique, with magnification, will help minimise the rate of complications and referral for the diagnosis and surgery may well be the best approach. Facial nerve spasticity is the most frequent post-operative complication but is usually transient.

Conclusions.

Rabbits with head tilts and nystagmus should undergo CT examination as soon as possible to enable appropriate therapy to be undertaken. In the case of otitis media surgical intervention is indicated to maximise the chances of success.

References:

- Chow E. P., (2011) Surgical Management of Rabbit Ear Disease. *Journal of Exotic Pet Medicine*. 20 (3) 182 -187.
- Deeb B. J. (1994): Torticollis in rabbits. *J Small Exotic Anim Med* 3(1):5-7.
- Dickie A. M., Doust R., Cromarty L., Johnson V. S., Sullivan M. & Boyd J. S. (2003) Comparison of ultrasonography, radiography and a single computed tomography slice for the identification of fluid within the canine tympanic bulla. *Res Vet Sci* 75 (3), 209-216
- Harcourt-Brown F. (2002). The rabbit consultation. In: *Textbook of Rabbit Medicine*. F. Harcourt-Brown (ed). p 68.
- Harcourt-Brown F. (2002). Neurological and locomotor disorders. In: *Textbook of Rabbit Medicine*. F. Harcourt-Brown (ed). p 310 - 312.
- Harcourt-Brown F. (2002). Cardiorespiratory diseases In: *Textbook of Rabbit Medicine*. F. Harcourt-Brown (ed). p 324 – 326.
- Jass A., Matiasek K., Henke J., Kuchenhoff H., Hartmann K. & Fischer A. (2008) Analysis of cerebrospinal fluid in healthy rabbits and rabbits with clinically suspected encephalitozoonosis. *Veterinary Record* 162:618-622.
- Jeklova E., Jekl V., Kovarcik K., Hauptman K., Koudela B., Neumayerova H., Knotek Z., Faldyna M. (2010) Usefulness of detection of specific IgM and IgG antibodies for diagnosis of clinical encephalitozoonosis in pet rabbits. *Veterinary Parasitology* 170: 143–148.
- Keeble E (2011). Encephalitozoonosis in rabbits – what we do and don't know. *In Practice* 33:426-435.

Keeble E., Shaw D. (2006). Seroprevalence of antibodies to *Encephalitozoon cuniculi* in domestic rabbits in the United Kingdom *Veterinary Record* 158:539-544.

King AM, Hall J, Cranfield F, et al (2007) Anatomy and ultrasonographic appearance of the tympanic bulla and associated structures in the rabbit. *Vet J* 173:512- 521.

Mayer J. (2011) Otolology of the rabbit: Anatomy, Physiology and Surgery. In: Saturday Proceedings of the AEMV congress, Seattle. p 47 – 52.

Raftery A (2005) Total Ear Canal Ablation and Bulla Osteotomy in the Rabbit. In: *Proc Autumn 2005 British Vet Zoological Society*. pp 77.

Rohleder J.J., Jones J.C., Duncan R.B., et al (2006) Comparative performance of radiography and computed tomography in the diagnosis of middle ear disease in 31 dogs. *Vet Radiol Ultrasound* 47:45-52.

Sylvestre A. M. (1998) Potential factors affecting the outcome of dogs with a resection of the lateral wall of the vertical ear canal. *Can Vet J* 39:157.

Thomas W. B. (2000). Vestibular dysfunction. *Veterinary Clinics of North America: Small Animal Practice*. 30:227 – 249.

Snyder S B, Fox J G & Soave O A (1973) Subclinical otitis media associated with *Pasteurella multocida* infections in New Zealand white rabbits (*Oryctolagus cuniculus*). *Lab Anim Sci* 23 (2), 270-272

Nasal diseases

Nasal anatomy in the rabbit.

Firstly rabbits are near obligate nasal breathers thus any impediment to clear air flow through the nares and nostrils can lead to marked dyspnoea. In other species this would simply be resolved by mouth breathing. It is also very easy for infection to pass caudally and pass up the Eustachian tube to the middle ear or down the trachea leading to a pneumonia.

Air enters via the external nares, pass the alar folds and into the nasal chambers. These are divided by a vertical cartilaginous septum and separated from the oral cavity by the hard palate. Each cavity consists of the dorsal and ventral nasal conchae (turbinates) and caudally the endoturbinates. The recesses between these are called the meati and in rabbits these are the dorsal, middle and lower meati.

Ostia connect these to the paranasal sinuses the conchal (ethmo) sinus dorsally and the maxillary sinus laterally. The drainage points are not on the most ventral aspect.

The incisor and pre molar teeth roots are closely associated with the nasal chambers minimal bone separates the roots and the nasal chambers so dental pathology can be linked to nasal pathology.

The nasal cavity progresses caudally where the epiglottis is engaged over the soft palate allowing unobstructed air flow into the larynx. This can be visualised from the ventral nasal meatus.

If approaching from the oral cavity, the soft palate can be visualised (and with an endoscope transilluminated) to reveal the epiglottis behind it. Advancing the endoscope flips the soft palate dorsally allowing the epiglottis to fall ventrally and the glottis can be directly visualised.

Clinical signs associated with nasal cavity diseases.

Nasal discharges may be evident which can be clear to white or yellow. Matted fur is often evident at the nares but also on the medial aspect of the forepaws. In some cases there may be no matting

evident around the nares but the matted fur on the forepaws would suggest the rabbit is highly efficient at cleaning its nose. Rabbits are near obligate nasal breathers so any partial obstruction of the nasal chambers can lead to marked dyspnoea. Audible breathing, sneezing and coughing may be heard. Open mouth breathing is possible in severely affected cases. Many owners may report wheezing at home. Anorexia can be the result of severe disease and many rabbits find it difficult to eat and breathe at the same time.

A nasal foreign body is another possible alternative, this is typically hay that has become trapped behind the soft palate and leads to irritation and sneezing. Myxomatosis can also lead to rhinitis alongside other clinical signs. Trauma to the head can also lead to upper respiratory tract obstruction. Allergic disease is highly unlikely and has not been clinically reported. However poor environmental air hygiene will predispose a rabbit to upper respiratory tract disease.

Evaluating the rabbit for dental disease, ear disease and pneumonia is of critical importance as these conditions can be seen together.

It is also useful to perform a tear duct flush on both sides to evaluate the level of dacryocystitis present as this will contribute to nasal discharge.

Pathogenesis of rhinitis.

Pasteurella multocida is again implicated in this condition and rhinitis is reported to be the most common clinical presentation of Pasteurellosis. In one study 55% of cases yielded *Pasteurella multocida*. However identifying a *Pasteurella* on culture without evidence of an inflammatory response does not mean it is causing a problem nor does it require treatment. In fact a wide variety of bacteria can be involved in the condition (or not) and include *Bordetella bronchiseptica* (52%), *Pseudomonas* (28%) or *Staphylococcus* (17%) for example.

These bacteria can lead to infection within the nasal chambers, conchal sinuses, maxillary sinuses. Severe disease can lead to mucosal ulceration, osteomyelitis and nasal turbinate destruction. Thus histopathology or cytology confirming an inflammatory response is important to confirm that the bacteria isolates are clinically relevant.

Diagnosis of nasal cavity diseases.

Radiography is often the first diagnostic procedure undertaken to evaluate the nasal chambers. Left and right lateral and oblique views should be taken along with dorsoventral and ventrodorsal views. However it is fairly insensitive at identifying disease unless it is severe. Close and detailed of high definition images is required. However gross dental pathology is clearly evident.

CT examination is an extremely useful technique. Rabbits can undergo an examination under a light sedation only. CT allows a detailed evaluation of the conchal sinuses, maxillary sinuses and nasal chambers. CT is highly sensitive for the evaluation of atrophy or presence of pus within the upper respiratory tract. However mild disease with minimal anatomical change and limited build-up of purulent material will not be detected on CT. However it is unlikely that CT will be performed in mild cases as these will respond to medical treatment.

Nasal endoscopy compliments CT examination as it allows direct visualisation of the nasal chambers (but will not allow examination of the sinuses). Rabbits require a full anaesthetic and intubation to bypass the nasal chambers. Intranasal lidocaine has been used to provide analgesia in these cases as rabbits are highly sensitive to this procedure. Endoscopy is fast, less traumatic and more readily available in general practice.

In mild disease with minimal discharge endoscopy can be performed without insufflation. A 2.7mm endoscope with a surgical sheath will just about fit through the external nares of a 2 kilo rabbit. For smaller rabbits the 1.9 mm endoscope should be used either with an integral surgical sheath or a separate unit. In very small patients the 1.9mm endoscope can be used without a sheath, but this does not allow for biopsy or insufflation alongside the instrument. However intermittent flushing with saline can be performed and blind biopsies can be taken with a laparoscopic instrument.

Once through it is possible to obtain a deep swab or biopsy for culture under direct visualisation. This is preferred over a deep nasal swab as the swab is guarded in the sterile endoscope sheath and then is only exposed to bacteria at the back of the nasal chambers. A deep nasal swab is contaminated as soon as it is passed into the external nares.

In large animals it is possible to get as far back as the entrance to the nasopharynx.

Haemorrhage is very likely which will prevent further visualisation, this can be limited by passing the endoscope as medial as possible. Biopsies can be taken for histopathology. This is important as this can confirm chronic disease and identify pathogens which may not be evident on culture. Endoscopic biopsies are small (5 french) and using larger forceps and taking biopsies blind can still yield positive results with diffuse disease. However haemorrhage will be marked and further endoscopic evaluation will be impossible. It is also possible to use grasping forceps to reduce the amount of discharge present.

In more severe disease saline insufflation can be used to remove pus and improve visualisation. The rabbit must be intubated and the oropharynx is packed with gauze swabs. The rabbit should be placed on a towel to absorb saline and reduce the chilling effect of fluids on the rabbit. The nose should be positioned 10 – 20 degrees ventrally to allow fluid to drain cranially out of the mouth to reduce the risk of aspiration. A bag of warmed sterile saline is suspended above the patient and runs via a giving set onto the surgical sheath. This allows the operator to fine control saline flow using the port. An egress line can be fitted on the other port and left open.

After any biopsy procedure dyspnoea may deteriorate post operatively. Thus the rabbit should remain intubated as much as possible and be provided with supportive care (including oxygenation) and treatment of the rhinitis whilst awaiting culture or biopsy results.

Treatment of nasal cavity diseases.

Any underlying dental pathology must be treated prior to more specific treatments for rhinitis.

Medical therapy.

Mild cases of upper respiratory infection may well respond to medical treatment. This includes systemic antibiotics administered over a six week period. Antibiotics should ideally be chosen based

on culture, but typical presumptive treatments include parenteral penicillin, cephalexin, or oxytetracycline. Parenteral or oral enrofloxacin, metronidazole or trimethoprim sulphamide are other options. If cultures are negative gram stained smears can be used to guide the selection of an appropriate antibiotic.

Nebulisation with a variety of antimicrobials is often used as adjunctive therapy, particularly if there are concerns of toxicity as with the aminoglycosides.

Drug dosages commonly used for nebulisation

Amikacin	50mg in 10ml saline
Doxycycline	200mg in 15ml saline
Enrofloxacin	100mg in 10ml saline
Erythromycin	200mg in 10ml saline
Gentamycin	50mg in 10ml saline
Piperacillin	100mg in 10ml saline
Tylosin	100mg in 10ml saline
Acetylcysteine	200mg in 9ml sterile water
Aminophylline	25mg in 9 ml saline
Amphotericin	100mg in 15ml saline
Enilconazole	1:10 dilution imaverol
F10	1:250 dilution sterile water

NSAID's are also an important part of therapy reducing inflammation and pain associated with the condition.

Mucolytics such as N-acetyl-cysteine are often used as well by nebulisation. Bromhexine can be given orally as an alternative.

Failure to respond to medical therapy or an animal that quickly recrudesces after treatment is completed should undergo a repeat CT examination and surgical intervention should be considered.

Surgical intervention.

Large quantities of purulent material within the paranasal sinuses indicate that surgical intervention (alongside on-going medical treatment) should be considered. This allows an opportunity to physically remove purulent material but also to obtain samples for histopathology and culture from otherwise inaccessible areas.

A dorsal or a lateral approach can be used to gain access to a specific area. Reviewing the local anatomy on a prepared skull is most useful prior to surgery.

The conchal sinus is accessed caudally just lateral to the midline and if the trephination is extended cranially access into the nasal chambers proper is possible. To obtain access to the maxillary recess

this incision can be extended laterally or a lateral approach is possible to gain access just to this site. CT examination is used to guide the surgical approach.

The whole of the dorsal and lateral areas of the nose are shaved and surgically prepared. Then lidocaine and bupivacaine are used to block the incision and down onto the periosteum. The skin is incised in the midline in a rostrocaudal fashion and then retracted. This provides access to either side of the nasal septum. The periosteum is then elevated.

The initial entry into the sinuses or nasal chambers is performed using a sterile round headed dental burr in a sterile hand piece. The motor is covered using a camera sheath (this allows heat to be dissipated from the unit).

Typically the entry point starts at the nasal bone. The burr and fine rongeurs are used to increase the size of the opening to facilitate the surgical procedure. Once sufficient access has been gained Volkmann spoons and large Q tips are used to physically remove all purulent material. Flushing is then performed until no purulent material or mucous is dislodged.

An endoscope is used to confirm this and depending on the access point can reach as far back as the soft palate and cranial into the nasal chambers, reducing the need for an extensive osteotomy. A 1.9 mm 30 degree endoscope is most useful and biopsies can be taken from deep within the nasal chambers and sinuses for culture and histopathology.

If there is a secure airway flushing with saline infused with antibiotics is possible.

The surgical site can be left open for repeat flushing or a small irrigating catheter can be placed for on-going topical therapy. It is important to only perform this with a fully conscious rabbit with its nose held downwards. Taking this slow and steady is important to avoid respiratory distress.

Closing the surgical wound post operatively is another option. However it is impossible to close the periosteum and generally a bone defect remains. In the immediate post operative recovery period there will be movement of the skin closure site over the surgical field associated with every breath. Generally subcutaneous emphysema around the surgical site does not occur as soft tissue dissection does not need to be broad. Eventually the skin and periosteum surrounding the defect does heal and once the fur has grown back the movement becomes much less obvious.

There is no real need to keep any stoma open for more than one week and a constant rhinostomy is unnecessary.

Analgesia is important and at the R(D)SVS we use fentanyl (or morphine), dexmedetomidine and meloxicam pre operatively with a local block. During surgery a continuous rate infusion of ketamine is used. Post operatively morphine should be used in the initial period along with the ketamine CRI. This is followed by buprenorphine and further meloxicam. Typically the rabbit is off opioids within 48 hours and is discharged on meloxicam.

Antibiotic therapy should ideally be based on culture and sensitivity taken from the surgical site at the time of surgery. Culture success rates can be poor. As a result antibiotic therapy post operatively can be empirical. Our preferred choice is for enrofloxacin intravenously and parenterally in the

immediate post operative period, whilst the rabbit is an inpatient followed by parenteral procaine penicillin for six weeks administered by the owner.

Gastrointestinal motility agents should be used to stimulate bowel motility and at the RDSVS we routinely use rantidine as this has the added bonus of being protective against gastric ulceration. Assist feeding is performed using fibre based critical care formulas intended for herbivores.

Conclusions.

Chronic sinusitis is problematic to control and even with extensive surgery on-going medical treatment will be required. CT is the most important imaging modality to identify the severity of disease, plan the surgical procedure and subsequently evaluate the effectiveness of any treatment protocol.

References:

Divers S. J. (2011). Diagnostic endoscopy in exotic companion mammals. In: Proceedings of the AAV congress, Seattle. p 373 – 389.

Divers S. J. (2011). Rabbit Rhinitis: The good, the bad and the ugly! In: Proceedings of the AAV congress, Seattle. p 391 - 402.

Harcourt-Brown F. (2002). Cardiorespiratory diseases In: Textbook of Rabbit Medicine. F. Harcourt-Brown (ed). p 324 – 326.

Lennox A. M. (2011). Rhinostomy: Adjunct treatment for treatment of chronic rhinitis in rabbits. In: Proceedings of the AEMV congress, Seattle. p 141 – 143.

Rougier S., Galland D., Boucher S., et al (2006). Epidemiology and susceptibility of pathogenic bacteria responsible for upper respiratory tract infections in pet rabbits. *Veterinary Microbiology*. 115 (103):192 – 198.