

Otitis Media in Rabbits

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INTRODUCTION

Otitis media is a common condition in rabbits that is often underdiagnosed in clinical practice.⁴ Previous studies have indicated a high prevalence and although the disease may be difficult to definitively diagnose and often subclinical on initial presentation it has the potential to progress to more serious conditions and should be treated accordingly. Medical management is often unsuccessful due to a number of factors and surgical intervention should be considered in these cases. There are a number of different surgical treatments described; their indication and use will be summarised in this paper.

PREDISPOSING FACTORS AND INCIDENCE

Otitis media is generally caused by either the spread of infection along the Eustachian tube from the upper respiratory tract or the progression of otitis externa through the tympanic membrane.

In rabbits it is thought that the most common cause is the spread of bacteria from either an upper respiratory tract infection or from maxillary cheek teeth abscessation.^{8,10} The role of fungal or viral infections in this process is not well known or reported.³

The progression of otitis externa is another possible cause. Common causes of otitis externa in rabbits are bacterial infections and *Psoroptes cuniculi* infestation. Rabbits do not generally develop ceruminous gland hyperplasia that is commonly seen in other species; however, many breeds are susceptible to otitis externa due to their predisposition for ear canal stenosis.^{1,2,4}

Lop-eared breeds commonly have stenotic ear canals and there is association between disease of the middle ear and lop ear conformation.³ In rabbits it has been proposed that it is more common for otitis externa to occur secondarily to otitis media rather than vice versa.⁴

The reported prevalence of otitis media in rabbits varies considerably in the literature. One study in meat rabbits showed a prevalence of 32% in asymptomatic adult rabbits.⁵ Other reports vary from 5.5–24% in studies of rabbits with neurological disease and up to 63% in a study looking at rabbits with vestibular disease.^{3,4} The prevalence was increased to 78–84.9% in rabbits that were showing signs of upper respiratory disease.^{3,4} It is important to note that most of the studies published were based on meat or research rabbits and there is limited information on the true prevalence of otitis media in pet rabbits.³

CLINICAL SIGNS

Early diagnosis of otitis media is important; however, it can be challenging as clinical signs can often be non-specific or absent and the tympanic bulla cannot be easily palpated on physical examination.²

Clinical signs vary and often relate to concurrent otitis externa or interna; these include:

- Upper respiratory tract disease.

- Lethargy.

- Hearing deficits.

- Weight loss.

- Auricular pain.

- Vestibular signs including a head tilt, nystagmus and ataxia if the inner ear is concurrently affected.

- Facial nerve dysfunction.

- Hypoglossal nerve dysfunction.
- Horner's syndrome.
- Auricular pruritis.
- Ear base abscesses.
- Head shaking.
- General ill-thrift.
- Recurrent gastrointestinal hypomotility episodes.⁶
- Purulent exudate in the external ear canal on otoscopic examination. This should be differentiated from normal waxy debris that many rabbits have in their ear canals. Differentiation can be made on appearance (wax is generally a yellowy brown colour whereas purulent material is often a creamy white colour) as well as cytological analysis.
- Central neurological system (CNS) signs including seizures if the infection spreads inwards along the vestibulocochlear nerve to the brain.^{7,10}

It is also worth mentioning that otitis media can lead to respiratory disease by acting as a reservoir of infection and spreading along the Eustachian tube.¹⁰ This chronic source of infection means that the resolution of respiratory disease may rely on the treatment of otitis media in some cases.¹⁰

DIAGNOSIS

The diagnosis of otitis media generally relies on the use of imaging modalities and the confirmation of infection by culture and sensitivity analysis or cytology.

The most common imaging modalities utilized are radiography or computed tomography. Magnetic resonance imaging (MRI) can also be utilized if available. Ultrasound has also been

proposed as a possible method of identifying otitis media; however, the study⁹ was performed on rabbit cadavers and may not be clinically as useful. Contrast canalography may also be useful in some cases to investigate whether the tympanic membrane is ruptured; however, the presence of thick exudate in the external ear canal may prevent its passage into the middle ear and give false negative results.⁶

Radiography remains the most common method of diagnosing otitis media due to its common availability and familiarity.⁷ As with other species the rabbit must be positioned carefully to ensure that the radiographs can be accurately interpreted and that the views are repeatable.⁸ General anaesthesia or heavy sedation is generally indicated and lateral, dorsoventral and bilateral rostral-laterocaudal oblique views with a 'nose up' or 'tilted up' angle of between 20° and 50° is recommended.⁸ Radiographic changes consistent with otitis media include increased density within the bulla, osteomyelitis or periosteal proliferation and sclerosis of the bulla wall.² Disadvantages with radiography are that false negative results are common as the changes associated with otitis media may not always be severe enough to show up on routine radiography.⁶

Computed tomography (CT) allows cross sectional imaging without superimposition of other structures and is reported to be more sensitive than radiography for diagnosing and characterizing otitis media.³ It also allows soft exudates to be seen more clearly than radiography.⁶ CT is generally considered to be the most reliable method of diagnosis.⁴

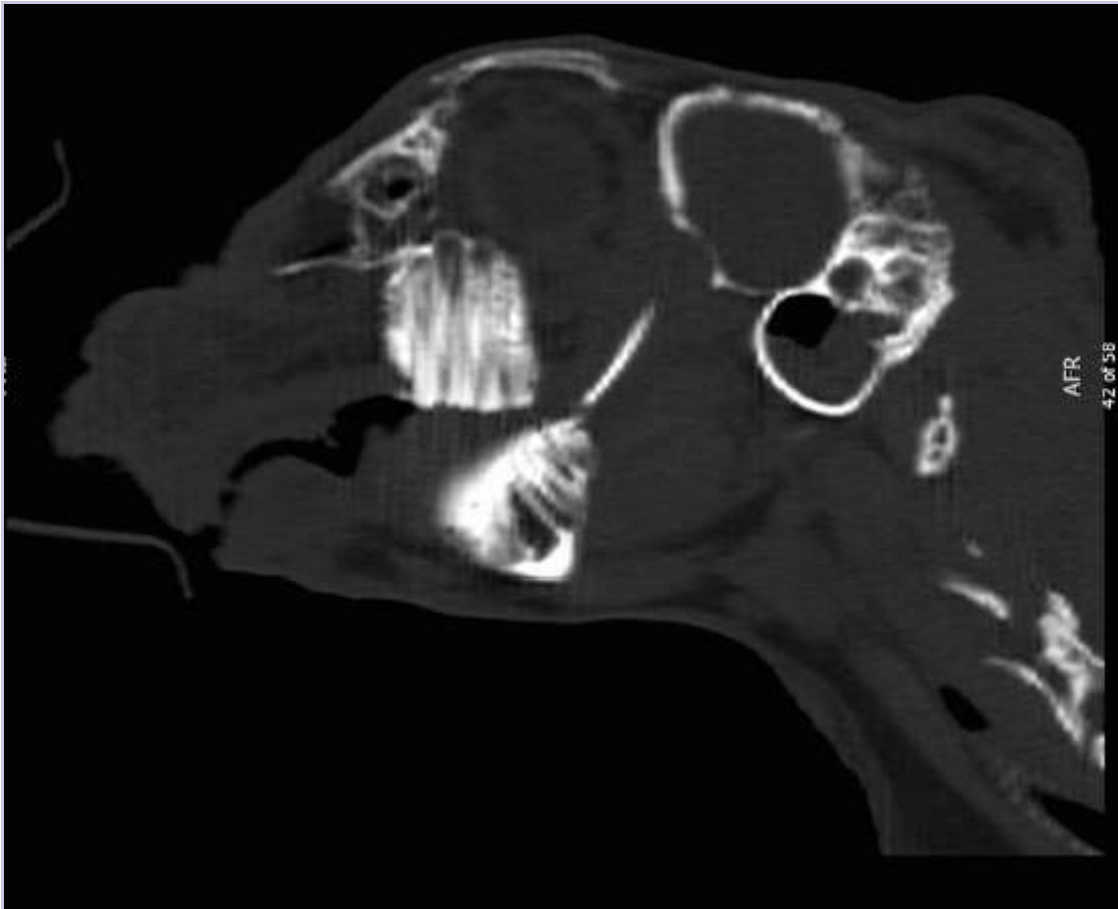
The diagnosis of otitis media can also be made by demonstrating the presence of a pathogenic organism within the middle ear. It is possible to collect samples from the tympanic bulla either directly through the tympanic membrane if ruptured or by performing a myringotomy.² An appropriately sized endoscope is often needed to allow adequate visualization and it is common to have a buildup of exudate in the external ear canal which makes this process challenging. Samples from within the tympanic bulla can also be taken during a bulla osteotomy. If upper respiratory signs are concurrently present then a deep nasal swab may also provide a means to identify what bacteria are likely to be present within the middle ear.⁶ Once samples have been obtained then antibiotic selection can be based on culture and sensitivity results.

Figure 1



CT image showing changes consistent with bilateral otitis media.

Figure 2



Sagittal CT image showing signs consistent with otitis media.

TREATMENT OPTIONS

Medical and surgical management of otitis media is possible and generally a combination of the two is warranted.

Medical Management

Medical management generally involves antibiotic therapy, analgesia and treatment of the inciting cause.² Wick therapy has also been used with some success in cases of concurrent otitis media and externa.⁶ The amount and type of analgesia needed depends greatly on the severity and associated clinical signs. Gentle repeat syringing and suctioning of the external ear canal with saline may help to temporarily relieve pressure on the facial nerve in cases where purulent material has ruptured from the middle ear through the tympanic membrane.⁶

Systemic antibiotic choice should be ideally selected from culture and sensitivity analysis. In the author's experience penicillin-based injectable medications given subcutaneously provide the best chance of treatment success in most cases. Treatment duration recommendations vary; however, in general most sources recommend treating for 4–12 weeks.^{2,6}

Medical management by itself is rarely successful in other species⁷ and in the author's experience the same can be said for rabbits. Topical antibiotics are often ineffective and systemic antibiotics may also not penetrate well into the tympanic bulla due to the lack of blood supply into the air filled space.^{1,2} The accumulation of thick caseous purulent material may also make antibiotic treatment less successful.^{1,2,7}

In cases where medical management is unsuccessful surgical intervention should be considered.

Surgical Management

The basic anatomy of tympanic bulla is similar to a dog or cat;^{7,8} however, the ear canal anatomy differs considerably. Rabbits do not have a true horizontal ear canal, instead they have a predominantly vertical ear canal that extends dorsally from a bony acoustic meatus.² The ear canal is made up of cartilage plates that link together to form the cylindrical canal.² The external acoustic meatus is composed of a prominent bone tube that leads to the tympanic membrane which forms the junction to the tympanic bulla.^{4,8} The tympanic bulla is composed of thick bone rostrolaterally and thinner bone over the ventral, medial and caudal aspects.²

There are two main surgical approaches to the tympanic bulla - ventral or lateral. The decision on the approach depends on whether otitis externa is concurrently present, as the ventral approach doesn't allow access to the external ear canal.

Total Ear Canal Ablation and Lateral Bulla Osteotomy (TECABO)

This approach involves placing the rabbit in lateral recumbency and making an incision over and along the external ear canal.² The ear canal is then bluntly dissected from the surrounding tissue.^{2,4} Once free the canal is then transected distally and removed as one long intact cylinder to the level of the bony external acoustic meatus.^{2,4} The meatus is then removed to expose the lateral wall of the tympanic bulla.² The bulla is then entered using fine tipped rongeurs held at

an acute angle or a pneumatic burr.² The lateral wall is removed and any infected tissue and purulent material is gently curetted away. Samples are taken for culture and sensitivity analysis and the bulla is then gently flushed out and suctioned repeatedly.^{4,10} The soft tissues around the osteotomy site can then either be marsupialised open (as has traditionally been recommended) to allow continued flushing of the bulla or alternatively the area can be closed.⁴

In the total ear canal ablation approach the canal is totally removed to the level of the ventral pinnae.

Partial Ear Canal Ablation and Lateral Bulla Osteotomy (PECABO)

A novel approach was published in 2013 that described a modification of the total ear canal ablation where by the ear canal is instead removed at the level that is ventral to the tragus, resulting in a partial ear canal ablation (PECA).⁴ The reason for the proposed modification was that rabbits develop less extensive ear canal changes than many other species and when they do the changes are often limited to the base of the ear canal, hence removal of the whole ear canal may be unnecessary.⁴ The PECA also has the advantage of maintaining normal ear carriage post-op in most cases and generally being slightly quicker and technically easier to perform.⁴ The author has utilized this modified technique in 5 cases at the time of writing and has found it clinically useful.

Figure 3



The external ear canal has been transected ventral to the tragus as per the PECABO technique and is being elevated to allow careful dissection from the surrounding tissue.

Ventral Bulla Osteotomy (VBO)

The procedure involves a ventral approach to the bulla by incising medially and parallel to the caudoventral mandible.^{1,2} This has the advantage of improved exposure, ventral drainage if desired, less chance of damaging the facial nerve and allows the surgeon access to both bulla without the need to move the patient if bilateral disease is present.^{1,6} Disadvantages include no access to the external ear canal and an increased chance of damaging the hypoglossal nerve.⁶

POSSIBLE COMPLICATIONS

There are a number of potential complications associated with surgery of the middle and external ear and these should be discussed in detail before any surgical intervention is instigated.

Neurological deficits are considered to be a common complication; however, in most cases they generally resolve within 14 days unless a nerve is completely transected.⁶

Common neurological complications include:

- Facial nerve deficits: the facial nerve can be easily damaged as the external ear canal is being transected as it exits from the caudal border of the lateral tympanic bulla wall.⁶ Clinical signs associated with facial nerve damage include the loss of a palpebral reflex and the flaccid paralysis of the muscles of the face.^{2,6}
- Vestibular disease: peripheral vestibular nerve deficits can result if the dorsomedial area of the bulla is damaged during surgery.^{2,6}
- Hypoglossal nerve deficits: the hypoglossal nerve lies ventral to the bulla and can be damaged during surgery.² The author has seen this occur in one case where the tympanic bulla fissured upon use of the rongeurs to enter the bulla.
- Horner's syndrome.

Other possible complications include:

- Draining tract formation: if the entire epithelial lining of the infected bulla or the purulent exudate present isn't removed completely then recurrent infections can result.¹
- Hearing deficits: removal of the ear canal and bones of the middle ear affects the amplification of sound and can impact on hearing. Hearing deficits can be difficult to quantify in rabbits⁷ and in the author's opinion most rabbits that have otitis media also already have concurrently reduced hearing.
- Fracture of the bulla: in some cases the thick bone over the rostrolateral surface of the bulla can be difficult to break down with rongeurs and if the bone is diseased it can fracture and splinter easily. The author had this happen on one occasion and the vessels that run on the ventromedial surface of the bulla were damaged resulting in haemorrhage that was challenging to control.
- Surgical dehiscence.

- Avascular necrosis: generally caused by vascular damage during surgery or post-surgical swelling.⁶

As indicated above there are a large number of potential complications associated with surgery of the middle ear and this can often make clinicians feel less comfortable about recommending surgical treatment. Careful surgical technique and familiarisation with the anatomy of the area makes these complications less likely to occur.

CASE STUDIES

The author has utilized the PECABO technique on five occasions at the time of writing and has found it to be clinically useful.

The cases presented with a range of clinical signs consistent with possible otitis media. In each case a CT was then performed that identified changes consistent with middle ear disease. In most cases the most obvious change was the presence of soft tissue opacities within the bulla.

Medical treatment was attempted; however, was not successful at providing long-term resolution hence surgical options were discussed with the owners. All cases had concurrent otitis externa of the proximal ear canal with normal distal canal so the PECABO technique was recommended. The risks and possible complications were thoroughly discussed with each owner.

The patients were sedated with 0.3 mg/kg butorphanol (Butorgesic, butorphanol 10 mg/ml, Ilium), 8 mg/kg ketamine (Ketamil, ketamine 100 mg/ml, Ilium) 0.06 mg/kg medetomidine (medetomidine injection, medetomidine 1 mg/ml, Ilium) intramuscularly as well as given 0.5 mg/kg metoclopramide (Metomide, metoclopramide 5 mg/ml, Ceva) and 0.03 mg/kg of buprenorphine (Temgesic, buprenorphine 0.3 mg/ml, Reckitt Benckiser) subcutaneously.

Intravenous fluid therapy using Hartmann's solution (Compound Sodium Lactate 1L, Baxter) at 10 ml/kg/h was provided. Patient temperature was maintained using a heat mat as well as warmed heat bags placed around the patient.

In the first few cases a rabbit supraglottic airway device (V-gel, Docsinnovent) of appropriate size was initially placed after applying lignocaine spray to the larynx (Co-Phenylcaine Forte Spray, Enttech). The author found it difficult to maintain in the correct

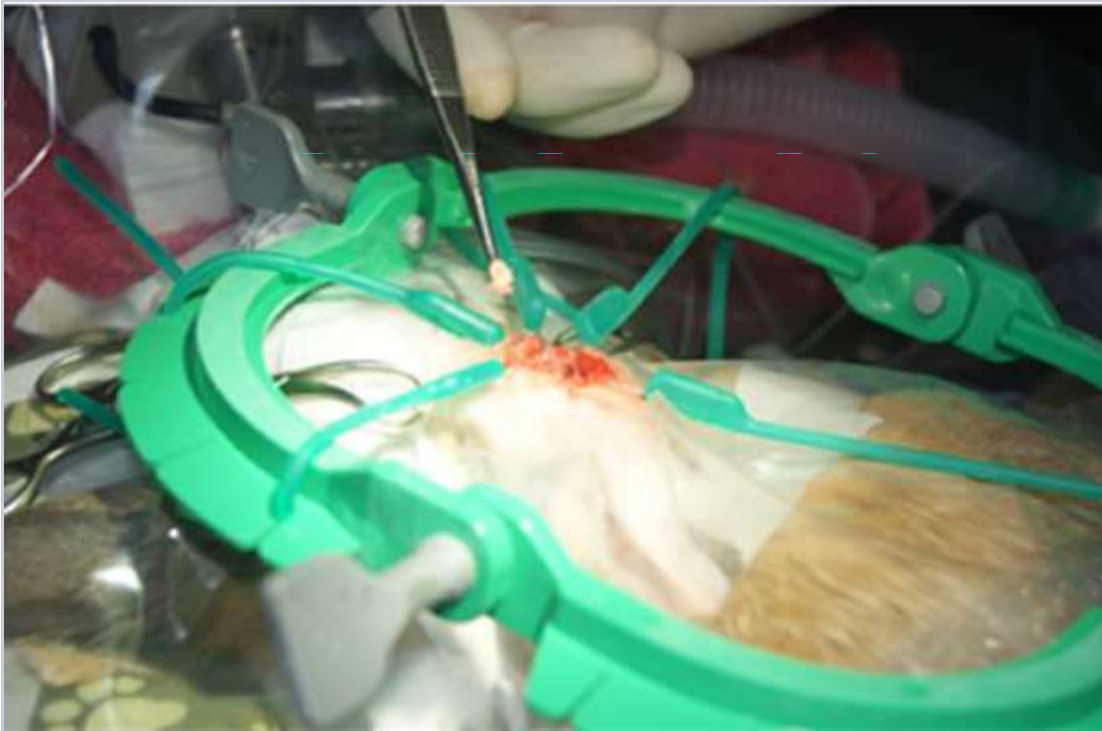
position given that the patient needed to be in lateral recumbency hence the V-gel was removed and an appropriately-sized non-cuffed endotracheal tube was placed.

Anaesthesia was maintained with isoflurane (Attane Isoflurane, Bayer) in oxygen with intermittent positive pressure ventilation provided as needed using a mechanical ventilator (SAV03 - Small Animal Ventilator, Vetronic Services Ltd).

Capnography, pulse oximetry, blood pressure, heart rate, respiratory rate and temperature were monitored throughout the procedures.

The PECABO technique was performed as previously described. A lone star retractor (Lone Star Surgical Retractor, Endotherapeutics) was utilized to aid visualization and increase exposure. Samples were taken from inside the bulla and sent for culture and sensitivity analysis.

Figure 4



Purulent exudate being gently curetted out of the tympanic bulla.

Figure 5



A lone star retractor being used to increase exposure to the tympanic bulla.

The remaining distal ear canal base and the area over the bulla was closed with 5-0 polydioxanone (PDO, SMI Surgicryl® Monofilament, Sound Veterinary Equipment). Closure of the remainder of the surgical site was achieved by placing subcutaneous and intradermal layers using 3-0 glycolide and e-caprolactone suture material (EC-3077D, Silverglide™).

The medetomidine administered previously was reversed with 0.3 mg/kg atipamezole (atipamezole injection, atipamezole 5 mg/ml, Ilium) intramuscularly.

The patients were administered 0.2 mg/kg meloxicam (meloxicam 5 mg/ml, Apex) subcutaneously and a 12 mcg/h fentanyl patch (Durogesic 12 mcg/h, Janssen-Cilag) was placed onto the skin over the intrascapular region. The patch was secured in place with a semi-adhesive wound dressing tape (Fixomull®, BSN). The patients were continued on meloxicam (meloxicam 1.5 mg/ml, Apex) orally at 0.2 mg/kg every 12 hours. The fentanyl patch was removed 72 hours after placement and the patients were weaned onto tramadol (Tramal, tramadol 100 mg/ml, CSL) orally at 4–10 mg/kg depending on patient tolerability.

Antibiotic therapy was commenced with penicillin (Norocillin LA Injection, 150 mg/ml procaine penicillin and 112.5 mg/ml benzathine penicillin, Norbrook) at 0.25 ml/kg

subcutaneously every 48 hours until the culture results were back. In all cases the culture results did not change the decision on which antibiotic use was indicated and the penicillin course was continued for 6 weeks.

All patients recovered well and were discharged 2–3 days after surgery.

Complications were seen in 2 cases. One patient developed persistent facial nerve deficits that have not resolved; however, they do not appear to impact clinically on his quality of life. Another patient developed both transient partial hypoglossal dysfunction and avascular necrosis of the pinnae following a fissure that developed along the bulla as it was being incised with the rongeurs. The fissure damaged the blood vessels that lie ventromedially to the bulla and created a moderate amount of haemorrhage that was challenging to control. The use of a pneumatic burr to enter the bulla in cases where the lateral bulla wall is extensively thickened may decrease the risk of this occurring and the author plans to try this with the next case if indicated.

SUMMARY

Otitis media is a common condition that is likely underdiagnosed in clinical practice. Clinical signs vary considerably and may be non-specific making the diagnosis challenging in some cases.

The potential for otitis media to progress to more serious conditions as well as the often ineffectiveness of medical management warrants consideration of surgical techniques. The potential complications associated with surgery of the middle and external ear should be considered and discussed with the owner in depth before any surgery is commenced. Careful surgical technique and familiarisation with the anatomy of the area will minimize the risk of complications occurring. In the author's experience the PECABO technique provides a reasonable surgical option for cases with concurrent otitis externa of the proximal ear canal and otitis media.

References

NB: More references are available on request.

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