I. Introduction

A. Otitis externa is defined as an acute or chronic inflammation of the epithelium of the external ear canal which may also involve the pinna. The condition is characterized by erythema and increased discharges or desquamation of the epithelium with varying degrees of pain or pruritus.

B. Reported incidences range from 3.9 to 20% in the dog and 2.0 to 6.6% in the cat. All breeds, ages and sexes are represented. However, miniature poodles, cocker spaniels, fox terriers, Kerry blue terriers, Labrador retrievers and breeds with abundant hair growth in the ear canal have been reported to be at greater risk. Himalayan and Persian cats may also be over-represented. Dogs most commonly present with otitis externa between 5 and 8 years of age (allergies), while cats are more commonly affected at 1 to 2 years of age (ear mites).

C. Causative predisposing factors for otitis externa must be evaluated or the condition is likely to become chronic resulting in an irritable patient and an unhappy owner.

D. General clinical signs include head shaking, scratching, alopecia, excoriations, exudation, odor and pain.

II. Anatomy and Pathophysiology

A. The external ear canal is comprised of the pinna, the vertical canal and the horizontal canal. The pinna is a mobile structure important for directional hearing. It has vastly different breed confirmations and is highly vascular for heat exchange and to protect against ischemic injury. The amount of hair on the pinna also varies widely among the
different breeds. The pinna becomes the vertical canal at the large tubercle of the antihelix on the medial surface of the auricular cartilage. The vertical canal wraps forward to form a tube with a slight overlap rostrally. There is a distinct medial turn at the junction of the vertical and horizontal canals. The tympanic membrane separates the external ear canal from the middle ear. A large number of chronic otitis externa cases will have concurrent otitis media due to degeneration and rupture of the tympanic membrane. To further complicate matters, the tympanic membrane may pouch in and form a false middle ear or cholesteatoma. These cases will be refractory to topical medication.

B. The normal shape of the ear canal predisposes an animal to ear problems. Moisture, foreign debris and glandular secretions can be trapped in the canal. Sebaceous glands are larger and more numerous in the ear canal than in other areas of the skin. Ceruminous glands (modified apocrine glands) are found below the sebaceous glands in the deep dermis. Thus, there is a relatively high production of secretions which may be altered by diseases associated with the seborrhea complex leading to irritation and inflammation.

C. The normal ear canal is inhabited by various bacteria and yeast including coagulate positive and negative staphylococci, *Micrococcus* spp., *Streptococcus* spp., *Malassezia*, and rarely *Pseudomonas* spp. and *Proteus* spp.

III. Predisposing Factors for Otitis Externa

In addition to the normal anatomy of the ear canal, other factors may predispose an animal to acute or chronic otitis externa.

A. Variations in breed confirmation
   1. Small ear canals
   2. Hairs within the ear canal
   3. Long, pendulous pinna

B. Chronic abnormally high moisture content of the ear canal (obstruction, high humidity, frequent swimming or bathing) causes maceration of the stratum corneum, the major protective barrier of the skin. This leads to bacterial and fungal colonization and infection.
C. Inappropriate previous therapy

1. Mechanical trauma of the canal during cleaning (cotton swabs) or plucking of hairs
2. Irritant antiseptic solutions
3. Improper antibiotic usage leading to opportunistic bacterial or fungal infections

IV. Primary Causes of Otitis Externa

It should be remembered that most cases of otitis externa have a multifactorial etiology and, therefore, there will be great variation in clinical signs and pathologic changes.

A. Parasites

1. *Otodectes cynotis*
   a. The most common parasite causing 50% of the otitis externa cases in cats and 5 to 10% in dogs (probably underestimated for dogs)
   b. The mites may be extremely hard to detect in the dog and even very low numbers may cause severe otitis by initiating an Arthus-type hypersensitivity reaction.
   c. The life cycle is 3 to 4 weeks and is completed entirely on the host.
   d. The mites appear to irritate ceruminous glands resulting in a thick, dark brown, granular ceruminous crust which provides a favorable growth medium for *Malassezia pachydermatis*.
   e. Secondary bacterial and/or fungal infections are commonly seen as well as ectopic infestations of other areas of the skin manifested by pruritus, scaling and crusting (miliary dermatitis in cats).
   f. Diagnosis is made by otoscopic examination or microscopic examination of ear swabs.
   g. Therapy
      1) Cleaning with a ceruminolytic agent
      2) Topical miticides such as pyrethrins, thiabendazole, carbaryl, and rotenone
      3) Selamectin (Revolution, Pfizer)
      4) Ivermectin (Ivomec 1%, Merial) at 200 mcg/kg, SQ or PO, at 2 week intervals for 3 treatments (not approved)
      5) May also need to treat the environment as for fleas

2. *Demodex canis* - infrequently causes ceruminous otitis externa without generalized skin disease

B. Foreign bodies

1. Plant material (foxtails in California), dirt, sand, dried medicaments, cross-lodged
2. Usually acute, unilateral and painful and easy to diagnose with a complete otic examination

3. Diagnosis more complicated if bilateral or if the condition has progressed with the appearance of a purulent discharge which may be confused with a primary bacterial disorder

4. Primary danger is perforation of the tympanic membrane with development of otitis media.

C. Allergic diseases

1. Atopy
   a. Causes a bilateral pruritic otitis externa in a large percentage of cases and the otitis may be the only clinical sign in 10% of atopic dogs
   b. Usually manifested by head shaking and ear scratching
   c. In the early stages of the disease pinnal lesions will be present but the ear canals will appear normal or only slightly inflamed.
   d. Later a more severe atopic otitis externa develops with secondary bacterial and/or fungal infection.
   e. Many lateral ear resection failures have allergies as the primary cause of the pruritic otitis.
   f. Biopsy of the external ear canal may suggest an allergic cause for the otitis.

2. Food allergy
   a. Causes a bilateral pruritic otitis externa in a large percentage of cases and the otitis may be the only clinical sign in 25% of food allergic dogs
b. Similar history and clinical signs to those seen for atopy but the pruritus is usually more intense and refractory to corticosteroid therapy.

c. The condition can occur at any age and, therefore, unlike atopy should be considered in dogs under one year of age.

d. Intense pruritus limited to the face and head with ear involvement is a common clinical presentation in the cat and is seen occasionally in the dog.

3. **Contact allergy**

   a. A rare cause of dermatitis and otitis in small animals
   
   b. The non-haired portion on the inside of the pinna and the external ear canal may be involved along with other non-haired contact areas of the body.
   
   c. Topical medications such as neomycin may result in sensitization and a subsequent contact allergic otitis.
   
   d. This should be suspected when a case of otitis fails to respond or worsens after appropriate topical medication is administered.

D. **Seborrhea complex**

Any of the primary idiopathic, metabolic or secondary causes of seborrhea may result in abnormalities in keratinization and glandular activity in the external ear canal resulting in a ceruminous otitis externa with or without secondary infection. The most common to cause otitis are primary idiopathic seborrhea and hypothyroidism.

E. **Autoimmune diseases**

1. Pemphigus foliaceous and systemic lupus erythematosus are the two most common immune-mediated diseases which may affect the pinna and ear canals.

2. Other cutaneous lesions are almost always present on physical examination.
F. Ear tumors and polyps

1. Patients with ear canal tumors or polyps will present with unilateral otitis externa and possibly otitis media.

2. Common tumors include sebaceous gland adenomas and adenocarcinomas, ceruminous gland adenomas and adenocarcinomas, carcinomas of undetermined origin, and squamous cell carcinomas.

3. Tumors are more common in dogs than in cats but the feline otic tumors have more tendency to be malignant with much shorter patient survival times.

4. Inflammatory polyps of the feline ear canal and nasopharynx result in a purulent or serous otitis externa with possible dysphagia and sinusitis.

5. All masses within the ear canal should be surgically removed as soon as possible and positively diagnosed by biopsy.

V. Perpetuating Factors for Otitis Externa

A. Bacteria

1. In most cases bacterial infections are secondary to a predisposing cause but in certain instances bacteria may be the primary cause of otitis externa.

2. In the interpretation of ear cultures it should be remembered that a low number of commensals and potential pathogens are normal, thus, cytology is important to estimate numbers of organisms.

3. The most common pathogens include *Staphylococcus intermedius*, *Pseudomonas aeruginosa*, *Corynebacterium*, *Enterococcus*, *Proteus* and *B-Streptococcus*.

4. Swimmer’s ear can be a problem in dogs resulting from a combination of water retention epidermal maceration and secondary infection with *Pseudomonas* spp.
5. Whether the infection is primary or secondary it should be treated with appropriate antibacterial therapy.

B. Mycotic infections

1. As with bacteria, the mycotics are usually considered to be secondary infections to some predisposing cause.

2. Fungal organisms isolated from cases of otitis externa
   a. *Malassezia pachydermatis*
   b. *Candida* spp.

C. Otitis media

1. Otitis media is an important cause of recurrent otitis externa and is thought to originate primarily as a direct extension of otitis externa through a ruptured tympanic membrane. However, an intact tympanic membrane does not rule out otitis media as the membrane defect may have closed, thus requiring something other than otoscopy for diagnosis. The middle ear infection may also originate from the nasopharynx via the eustachian tube or hematogenously.

2. Recently, extensive studies have been conducted under the direction of Dr. Lynette Cole at The Ohio State University to: 1) Evaluate various potentially useful techniques to diagnose otitis media and 2) Compare microbial flora from the horizontal ear canal and middle ear in dogs with otitis media.

3. Otoscopy, pneumotoscopy, bulla radiographs, otic endoscopy, and impedance audiometry were compared with findings consistent with otitis media on myringotomy. Otitis media was diagnosed in over 80% of these ears with chronic otitis. The tympanic membrane was intact in over 70% of the ears with otitis media at the time of examination and diagnosis. The various techniques evaluated for their ability to diagnose otitis media had high positive predictive values but low negative predictive values. Thus, a positive finding on one of these diagnostic tests is highly suggestive of otitis media, but a negative finding, will not rule out otitis media.

4. The three most common organisms isolated from the horizontal ear canal and middle ear were *Staphylococcus intermedius*,
yeast, and *Pseudomonas* spp. A difference in total isolates or susceptibility patterns between the horizontal canal and middle ear was found in 89.5% of the ears studied. In cases of chronic otitis, in order to choose appropriate antimicrobial agents, in addition to cytology, bacterial culture and susceptibility of both the horizontal ear canal and middle ear should be performed.

5. All *S. intermedius* isolates from the horizontal ear canal and middle ear were susceptible to amoxicillin-clavulanate, polymyxin B, and tobramycin, while greater than 70% of the isolates were susceptible to cephalothin, enrofloxacin, gentamicin, methicillin, and neomycin based on Kirby-Bauer susceptibilities. Low susceptibilities to ampicillin and penicillin were found due to beta-lactamases produced by *S. intermedius*.

6. *Pseudomonas* spp. isolates from the horizontal ear canal and middle ear were resistant to ampicillin, cephalothin, chloramphenicol, amoxicillin-clavulanate, penicillin, sulfisoxazole, or trimethoprim-sulfadiazine. Greater than 85% of the isolates from the horizontal ear canal and middle ear were susceptible to tobramycin and polymyxin B. Lower than expected susceptibilities were found for gentamicin (55-60%) and enrofloxacin (12-35%).

VI. Diagnosis

A. History

B. Complete physical examination

C. Otic examination

1. Pinnae

2. Otoscopic examination of the external ear canal
   a. If condition appears unilateral look at the unaffected side first.
   b. It is imperative to visualize both tympanic membranes which in an inflamed, infected, ulcerated ear canal may require a topical anesthetic, sedation or general anesthesia.
   c. If bacterial cultures are to be performed the sample
should be taken immediately after insertion of the sterile otoscopic cone.

d. In addition to condition of the tympanic membrane the external ear canal should be examined closely for inflammation, ulcerations, stenosis, foreign bodies, parasites, tissue masses, amount and type of exudation and abnormal confirmation.

e. If the canals cannot be fully examined down to the level of the tympanic membrane then empirical therapy using ceruminolytic agents, antibiotics or glucocorticoids may be necessary with reexamination after several days of therapy.

f. In general, the character of the exudate may be helpful in establishing a causative agent for the infection.

1) Gram negative bacteria - a purulent, pale yellow, thick, tenacious, sweet smelling exudate
2) Gram positive bacteria - a light brown, creamy exudate
3) Ear mites - dark brown to black crumbly exudate
4) Yeasts - dark brown sweet smelling exudate

D. Cytologic examination

1. Usually will not define the underlying cause of the otitis but will determine which infective agents and inflammatory cells are present and thus suggest initial therapy

2. After collecting of sample from the horizontal canal and middle ear, roll the swab onto a glass slide, allow to air dry and stain with a modified Wright’s stain (Diff-Quik).

3. Some of the important things to observe for include:

   a. Number and type of bacteria (cocci, rods, mixed infections)
   b. Number and type of yeast (primarily budding yeasts, fungal hyphae)
   c. Type and activity of inflammatory cells (neutrophils phagocytizing bacteria)
   d. Parasites (*Otodectes cynotis*, demodicosis)
   e. Keratinocytes and glandular secretions
   f. Neoplastic cells
E. Bacterial culture and sensitivity

1. Usually reserved for chronic recurrent or unresponsive cases of otitis externa, cases of otitis media and when cytology indicates many rods

2. Samples should be taken from the horizontal ear canal and middle ear.

3. There may not be a direct correlation between results obtained for blood levels of systemically administered antibiotics and topical preparations used in the ear canal.

F. Approach to chronic otitis externa

1. Since most dogs with chronic otitis of 6 months duration or longer have otitis media, a complete and aggressive diagnostic evaluation is done.

2. General anesthesia; bullae radiographs; cytology and culture of the horizontal canal through a sterile otoscope cone; flushing of the external ear canal with a bulb syringe and 12 cc syringe with a tomcat catheter using a ceruminolytic agent and/or sterile saline; myringotomy through a sterile otoscope cone with the first sample for culture and second for cytology; flushing of the middle ear with serile saline through a sterile tomcat catheter; use of ear currettes and alligator forceps as needed; instill an acetic acid cleansing and drying agent into the canal (see details in Treatment section B)

G. Additional diagnostic testing

1. Skin scrapings
2. Fungal cultures
3. Thyroid evaluation
4. Allergy testing (skin or serum testing for inhaled allergens and hypoallergenic diets)
5. Ear canal biopsy
6. Radiography
7. Hemogram and serum biochemistry profile

VII. Treatment

A. General principles

1. Always try to make a specific diagnosis of the underlying cause (primary) of the otitis and treat accordingly with specific therapy.

2. Treat any predisposing factors.

3. Clean and dry the ear canals prior to the application of topical medication - try to visualize the horizontal canal and tympanic membrane.
4. Use systemic and topical therapy if otitis media is present.

B. Cleaning and flushing

1. Ears with significant amounts of debris and exudate will need to be flushed prior to examination. Ear canals with ulcerations, hypertrophy, or hyperplasia may require 2-3 weeks of anti-inflammatory doses of systemic glucocorticoids before ear flushing and examination are possible. In cases where the ear canals are extremely stenotic and hyperplastic, both systemic and topical steroids are employed. A potent topical steroid such as Synotic (Fort Dodge) is used twice per day during this time period. If after 3 weeks of treatment the ear canals are “open” then the flushing and examination can be performed. If after 3 weeks of steroid treatment the canals are still so stenotic to prevent adequate flushing and examination, then the patient should be considered a surgical candidate for ear canal ablation.

2. The ear flushing procedure is best done under general anesthesia in order to completely clean the ear. Once the animal is under anesthesia, the external ear canal is soaked for 10 minutes with a ceruminolytic ear cleaner. The ear is then flushed with warm sterile isotonic saline and a bulb syringe to remove large debris and exudate. This is followed by flushing with warm sterile isotonic saline using an 8 French polypropylene urinary catheter attached to a 12 cc syringe passed through an otoscopic cone. Once the ear is clean, the tympanic membrane is visualized. If the tympanic membrane is not intact, cytology and bacterial culture and susceptibility (C/S) is performed from the middle ear cavity. The middle ear is then flushed repeatedly with warm sterile isotonic saline using a tom cat catheter attached to a 12 cc syringe passed through an otoscopic cone to completely remove any ear cleaner to reduce the chance of ototoxicity.

3. If the tympanic membrane is intact and otitis media is suspected, a myringotomy is needed to obtain samples for cytology and bacterial C/S, and to flush the middle ear cavity. Myringotomy is performed using a sterile culture swab (Calgiswab Type 1, Spectrum Microgon) to make the myringotomy incision. A sterile otoscopic cone is inserted into the horizontal ear canal and the tympanic membrane is visualized. Using the swab, an incision is made into the caudoventral quadrant of the tympanic membrane. If the tympanic membrane is not visible, the myringotomy procedure is performed “blind”. The swab used for the myringotomy incision is submitted for bacterial C/S. A second swab is inserted into the original incision and the sample obtained is used for cytologic analysis. The middle ear is flushed through the original incision with warm sterile isotonic saline using a tom cat catheter attached to a 12 cc syringe passed through an otoscopic cone. The normal tympanum has been shown experimentally to heal in 21 to 35 days. Therefore, if the ear is kept free from infection after the myringotomy procedure, the tympanic membrane should heal.

4. Possible complications of ear flushing and myringotomy are Homer’s syndrome, facial nerve paralysis, vestibular disturbances, and deafness. Owners should understand these complications and sign a consent form prior to the procedure.

C. Cleaning and drying agents

1. Cleaning and drying agents are usually applied after the cleaning procedure. They can also easily be used by the owner in chronic otitis cases and for prophylactic treatment of dogs with “swimmer’s ear”.
2. Some of these products have excellent antiseptic properties so are useful in a maintenance program to keep infections from recurring. They usually contain isopropyl alcohol and some combination of acids.

   a. AloCetic, Clearx Ear Drying Solution, OtiCalm, and OtiRinse (DVM Pharmaceuticals)
   b. Epi-Otic Cleanser with Spherulites and Bur-Otic (Allerderm/Virbac)
   c. OtiCleen (Pfizer)
   d. Bausch and Lomb Acetic Acid 2% in Aqueous Aluminum Acetate Otic Solution (Bausch and Lomb)

D. Glucocorticoids

1. Antipruritic, anti-inflammatory, antiproliferative, decrease in sebaceous and apocrine secretions

2. Usually in combination with other agents but may be beneficial when used alone in allergic causes of otitis and some ceruminous otitis cases

   a. Synotic (0.01% fluocinolone acetonide in 60% DMSO), Fort Dodge
   b. Cort/Astrin (1% hydrocortisone in Burow’s solution), Vedco
   c. CortiSpray (1% hydrocortisone), DVM Pharmaceuticals
   d. Bur-Otic HC (acetic acid, propylene glycol, Burow’s solution, 1% hydrocortisone), Allerderm/Virbac
   e. Clearx Drying Solution (0.5% hydrocortisone, 2.5% acetic acid, 2% sulfur), DVM Pharmaceuticals

E. Topical antibiotics

1. Topical aminoglycosides such as neomycin and gentamicin have good activity against otic pathogens but ototoxicity is a concern. They are inactivated in the presence of organic material. Gentamicin and neomycin are available in many combination products.

   a. Neomycin sulfate, nystatin, thiostrepton, and triamcinolone acetonide (several generics)
   b. Neomycin sulfate in, thiabendazole, and dexamethasone (Tresaderm), Merial
   c. Gentamicin sulfate, betamethasone valerate (Gentocin Otic), Schering-Plough
   Gentamicin sulfate (Gentocin Ophthalmic), Schering-Plough
   d. Gentamicin sulfate, betamethasone valerate (Gentocin Otic), Schering-Plough
e. Gentamicin sulfate, betamethasone valerate, and clotrimazole (Otomax), Schering-Plough

f. Neomycin, polymyxin B, penicillin G, and hydrocortisone (Forte-Topical), Pharmacia and Upjohn
   1) Polymyxin has excellent in vitro activity against *Pseudomonas* with resistance rarely developing, even with chronic infections.
   2) This antibiotic is inactivated in organic debris so the ear must be kept meticulously clean during treatment.

g. Injectable amikacin (50 mg/kg) 3 to 5 drops per ear every 12 hours is effective against gram negative infections.

h. Tobramycin is available as an ophthalmic suspension or ointment with or without dexamethasone.

2. Fluoroquinolones have a broad spectrum of antibacterial activity against gram negative and gram positive bacteria.
   a. Ciloxan, a human ophthalmic solution contains ciprofloxacin, and Floxin Otic, a topical fluoroquinolone contains ofloxacin which is marketed for otitis externa in adults and pediatric patients. They are packaged in 5 ml bottles and both are very expensive.
   b. Enrofloxacin (Baytril, Bayer) is not available commercially in a topical otic preparation. An extra-label topical preparation may be formulated using 1 part of the injectable enrofloxacin (22.7 mg/ml) added to 4 parts of an appropriate vehicle such as Synotic, 1 % hydrocortisone, or saline. There have been no reports of clinical ototoxicity with this formulation; however, toxicity studies have not been conducted.

3. Silver sulfadiazine 1 % (Silvadene) is available in a cream formulation and should be mixed 1 part cream with 9 parts water prior to application in the ear 0.5 ml every 12 hours. This product is safe and appears non-ototoxic. It has been shown to be very effective against resistant *Pseudomonas*.

4. Injectable ticarcillin is a semisynthetic, beta-lactamasesusceptible penicillin. In humans, it is active against most isolates of *Pseudomonas* and some *Proteus* species. It is ineffective against *Staphylococcus* infections. In dogs, it may be formulated into a solution for topical application into the ear for susceptible *Pseudomonas* otitis infections.

F. Tris-EDTA

1. Enhances activity of topical antibiotics against otic pathogens by decreasing stability and increasing permeability of the cell wall, especially for *Pseudomonas*. 
2. Compounded using 1.2 g EDTA, 6.05 g Tris buffer, 1 L distilled water, pH 8, autoclave 15 min. A commercial veterinary preparation has recently been marketed.

3. Fill ear canal 15-30 mm before the topical antibiotic BID

G. Topical antifungal agents

1. Nystatin (Panolog, Solvay; generics)

2. Thiabendazole (Tresaderm, Merial) seems to be effective in spite of poor in vitro activity

3. Clotrimazole (Otomax, Schering-Plough; Lotrimin, human over-the-counter)

4. Miconazole (Conofite Lotion, Schering-Plough)

H. Systemic antibiotics for bacterial otitis

<table>
<thead>
<tr>
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I. Systemic antifungal agents

Ketoconazole (Nizoral, Janssen) at 5-10 mg/kg/day, and itraconazole (Sporanox, Janssen) at 5 mg/kg/day, may be used systemically for treatment of yeast otitis. Both of these drugs, but especially itraconazole, attain high levels in sebaceous secretions, hair follicles, stratum corneum, and nails.
The drug concentration of itraconazole, especially in the stratum corneum, remains at therapeutic levels for weeks and in some cases months after discontinuation of treatment. Therefore, an intermittent dosing schedule may be effective in dogs, and various schedules are currently under investigation.
e. Gentamicin sulfate, betamethasone valerate, and clotrimazole (Otomax), Schering-Plough
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<td>Marbofloxacin</td>
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<td>Orbifloxacin</td>
<td>Orbax (Schering-Plough)</td>
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<tr>
<td>Ormetoprim-Primor</td>
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<tr>
<td>Trimethoprim-Tribrissen</td>
<td>30 mg/kg, q24h or Sulfadiazine (Schering-Plough)</td>
<td>divided q12h</td>
<td></td>
</tr>
<tr>
<td>Trimethoprim-Sulfadiazine Generics (various)</td>
<td>20-30 mg/kg, q12h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I. Systemic antifungal agents

Ketoconazole (Nizoral, Janssen) at 5-10 mg/kg/day, and itraconazole (Sporanox, Janssen) at 5 mg/kg/day, may be used systemically for treatment of yeast otitis. Both of these drugs, but especially itraconazole, attain high levels in sebaceous secretions, hair follicles, stratum corneum, and nails. The drug concentration of itraconazole, especially in the stratum corneum, remains at therapeutic levels for weeks and in some cases months after discontinuation of treatment. Therefore, an intermittent dosing schedule may be effective in dogs, and various schedules are currently under investigation.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Description</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marbofloxacin</td>
<td>Zeniquin (Pfizer Animal Health)</td>
<td>2.75-5.5mg/kg, q24h</td>
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<tr>
<td>Orbifloxacin</td>
<td>Orbax (Schering-Plough)</td>
<td>2.5-7.5 mg/kg, q24h</td>
</tr>
<tr>
<td>Ormetoprim-then sulfadimethoxine</td>
<td>(Pfizer Animal Health)</td>
<td>27.5mg/kg, q24h</td>
</tr>
<tr>
<td>Oxacillin</td>
<td>Generics (various) Tribrissen</td>
<td>22 mg/kg, q8h</td>
</tr>
<tr>
<td>Trimethoprim-sulfadiazine</td>
<td>(Schering-Plough)</td>
<td>30 mg/kg, q24h or divided q12h</td>
</tr>
<tr>
<td>Trimethoprim Primor</td>
<td></td>
<td>20-30 mg/kg, q12h</td>
</tr>
</tbody>
</table>