ENDOSCOPIC EVALUATION OF OTITIS AND ITS MANAGEMENT IN DOGS

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THESIS

Thesis submitted in partial fulfilment of the requirement for the degree of

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DECLARATION

I hereby declare that this thesis, entitled **"ENDOSCOPIC EVALUATION OF OTITIS AND ITS MANAGEMENT IN DOGS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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- -2010

CERTIFICATE

Certified that this thesis, entitled **"ENDOSCOPIC EVALUATION OF OTITIS AND ITS MANAGEMENT IN DOGS"** is a record of research work done independently by **Reshmi, P.,** under my guidance and supervision and it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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We, the undersigned members of the Advisory Committee of **Reshmi P.,** a candidate for the degree of **Master of Veterinary Science in Surgery**, agree that this thesis entitled **"ENDOSCOPIC EVALUATION OF OTITIS AND ITS MANAGEMENT IN DOGS"** may be submitted by **Reshmi P.**, in partial fulfilment of the requirement for the degree.

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EXTERNAL EXAMINER

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Introduction

1. INTRODUCTION

Ear disease is one of the commonest conditions and a frustrative problem to resolve in canine patients. Otitis externa, the inflammation of the external ear canal, extends from the pinna to the tympanic membrane and otitis media, the inflammation of middle ear including the tympanic membrane and tympanic bulla. Although the prevalence of otitis externa ranges from 5 to 20% (Krahwinkel, *et al.* 1993), otitis in general is not a life threatening condition in canine patients, but it seriously affects the utility of the animals and diminishes their quality of life.

Otitis occurs with greatest frequency in breeds, which are heavily haired within the pinna and external ear canal like Poodles, Spaniels and German Shepherd Dogs. Dogs with pendulous ears are further predisposed to the disorder because, their pinnae decrease ventilation and increase humidity within the ear canal. The ear canal in dogs, with its peculiar anatomy, traps cerumen and moisture predisposing it to otitis externa. In disease conditions composition of the secretions in the ear canal will be altered and consequent production of fatty acids leads to inflammation. The bacteria or yeast which found associated with otitis externa are the usual opportunists and are not primary pathogens that are solely responsible. Hyperaemia, oedema, hypersecretion of cerumen and hypertrophy of the aural epithelium are the consistent changes secondary to inflammation. Most patients have an abundance of malodorous discharge and pruritus as evinced by shaking of head and pain. Chronicity leads to hyperplasia and mineralization of the ear canal.

The primary factors leading to otitis includes parasites, foreign bodies, hypersensitivity diseases, disorders of keratinization, autoimmune diseases and immunodeficiency diseases. The predisposing factors include ear canal conformation abnormalities, maceration of the ear canal, climatic variations and

treatment errors like use of irritating cleaner solutions, obstructive ear diseases and certain systemic diseases like hypothyroidism.

Otitis has many aetiologies which all seem to converge into a final common pathway as the condition become chronic (Little, 1996 a). When evaluating a patient with otitis externa, it is important to determine the primary cause as well as the predisposing and perpetuating factors of the otitis so as to manage it properly (Rosser, 2004). Detecting changes in the normal anatomy, physiology of the ear canal, microflora, tympanic membrane, and middle ear cavity are essential for successful treatment of otitis. Apart from clinical examination, the diagnostic work plan of otitis externa involves a direct visualization of the ear canal with the aid of an otoscope to assess the extent of damage to the ear canal and tympanic membrane. Visual inspection of tympanic membrane was seldom possible with otoscopy even after lavage of the ear, due to stenosed ear canal obstructing the view. When the ear is inflamed, painful or filled with purulent material, anaesthesia is required to perform a thorough cleaning and examination. Apart from otoscopy, collection of samples for cytologic evaluation or culture, and myringotomy are other diagnostic techniques important for treatment of otitis in practice.

Video otoscopy employs the use of video cameras and endoscopic lighting combined with an otoscope to examine the external and middle ear (Rawling, 2009). The vertical and horizontal ear canal and tympanic membrane are brightly illuminated and magnified, allowing greater visualization of these structures and also to detect foreign bodies, lesions, exudate, and pathologic changes that have occurred in the ear canal (Griffin, 2006).

Otitis externa become refractory to treatment when the infection extends, through the tympanic membrane, into the tympanic bulla causing otitis media. This secondary otitis media occurs in approximately 16% of acute otitis externa cases

and as high as 50% of chronic cases (Gotthelf, 2004). Rarely otitis media may also occur without otitis externa and obvious symptoms, making the diagnosis difficult.

The involvement of the middle ear accompanied by otitis externa can be easily evaluated by radiography. Survey radiography can be effectively used for evaluation of external ear canal and tympanic bulla because of the air contrast and the findings can support a diagnosis of otitis media. Plain radiographs are performed to visualize the bony integrity of the tympanic bulla and soft tissue changes in the external auditory canal, middle ear, and inner ear. They are also used as a prognostic indicator for the success of medical management of otitis media.

In clinical situations, frequent recurrence of otitis, its progression and treatment failures are the major factors which may often cause frustration for both the patient owners and veterinarians. Early diagnosis of changes in the ear canal and adopting the appropriate treatment suitable for each animal will prevent chronic inflammation requiring surgical resection of the ear canal and the consequence of otitis media.

Presently the availability of video-endoscope with enhanced capability to visualize structures of ear would ultimately facilitate early diagnosis and enable the clinician to provide improved management practices in otitis in dogs. Hence this study was undertaken with the objective to assess the efficacy of endoscopy as a diagnostic tool;

(i) to evaluate the changes of otitis in dogs

(ii) to adopt appropriate treatment for its management.

Review of Literature

2. REVIEW OF LITERATURE

Anatomy

Cole (2009) described the canine ear which consists of the pinna, external ear canal, middle ear and inner ear. The external ear is composed of auricular and annular cartilage. The auricular cartilage of the pinna becomes funnel shaped at the opening of the external ear canal. The vertical ear canal runs for about 1 inch, and then forms the horizontal ear canal, which is composed of auricular and annular cartilage. The middle ear consists of an air-filled tympanic cavity, three auditory ossicles, and tympanic membrane. The tympanic membrane is a semitransparent membrane divided into the pars flaccida and pars tensa. The tympanic cavity consists of a small epitympanic recess, a large ventral bulla and the tympanic bulla proper. On the medial wall of the tympanic cavity is the promontory, which houses the cochlea. The cochlear (round) window is located in the caudo-lateral portion of the promontory, covered by a thin membrane. The vestibular (oval) window is located on the dorso-lateral surface of the promontory, covered by a thin diaphragm over which the footplate of the stapes is attached. The auditory tube is a short canal that extends from the nasopharynx to the rostral portion of the tympanic cavity proper. The auditory ossicles are the bones that transmit and amplify air vibrations from the tympanic membrane to the inner ear. The inner ear is housed in a bony labyrinth in the petrous portion of the temporal bone. The bony labyrinth contains the membranous labyrinth with its sensory organs responsible for hearing and balance.

Clinical evaluation

Fraser *et al.* (1970) reported a greater incidence of otitis in dogs between three and six years with a peak incidence in dogs of four years of age. The author

also reported in a study on otitis, bilateral ear involvement in 73.59 %, left ear alone in 13.5 % and right ear alone in 12.9 % cases.

Rycroft and Saben (1977) suggested the importance of clinical examination for the successful treatment of otitis externa. Trauma, foreign bodies, and hirsute ear canals were the obvious causes but microorganisms isolated from an established otitis might actually be a secondary infection and not the primary cause of the condition. In their study dark brown/black discharge were reported in 36.5% of the dogs and 53% had pale/ yellow discharges. Flushing of the ear canal was considered as a necessary prelude to the successful treatment of otitis externa.

Nesbilt (1983) described the common clinical signs associated with otodectic otitis caused by *Otodectus cynotis* were pruritus and head shaking with dark waxy discharge observed in the ear canal. Excoriation posterior to the base of the ear were common.

August (1988) classified the causative factors of otitis externa as primary factors, predisposing factors and perpetuating factors. The primary factors of otitis externa are parasites, foreign bodies, hypersensitivity diseases, disorders of keratinization and autoimmune diseases. The predisposing factors include conformation of the ear canal, ear canal maceration, climatic variation, treatment errors, obstructive ear diseases, pyrexia and systemic diseases. The perpetuating factors of otitis externa include bacteria, yeast, otitis media and progressive pathologic changes.

Kowalski (1988) opined that the normal ear canal had small amount of ceruminous discharge with no ulceration or inflammation of the epidermal lining. Infected ears with more amount of yellowish, fluid exudate were caused by gram negative bacteria such as *Pseudomonas aeruginosa* and *Proteus* spp. Ear wax

characterized by a brownish black exudates was due to infections associated with ear mites, *Malassezia* spp. or infection caused by coagulase positive *Staphylococci*.

Mansfield (1988) stated that examination of the external meatus and tympanum cannot be completed until the canal was cleaned. Debris left in the ear may impede ventilation, prevent drainage of normal secretions, provide a medium for growth of microorganisms and serve as an irritant to the lining of the canal. Topical medications cannot make contact with the skin lining the canal or reach organisms present in the debris.

Rosser (1988) considered a detailed systematic examination as mandatory for to rule out persistent systemic diseases as well as a thorough dermatologic examination to eliminate the possibility of a primary dermatologic disease while evaluating patients with otitis externa. The author also suggested that the external ear canals should be palpated carefully from the exterior for any evidence of fibrosis or calcification of tissues around the external ear canal. Presence of these changes indicates a chronic, irreversible problem with a poor prognosis for a medical cure.

Shell (1988) reported the clinical signs of otitis *viz;* discharge from the ear canal, pawing or rubbing of the affected ear, head shaking, auditory deficits, and/or pain while touching the head. The head tilt was occasionally due to discomfort rather than abnormal vestibular function and some dogs became depressed, anoretic and/or febrile.

Muller *et al.* (1989) categorized infective group of otitis as acute purulent, chronic purulent, chronic ulcerative, parasitic otitis and fungal otitis. The reactive group of otitis was classified as acute erythematous and chronic proliferative types. The most common cause of chronic recurrent otitis externa in dogs was an undiagnosed otitis media resulting from tympanic rupture.

Akerstedt and Vollset (1996) opined complex aetiology of canine otitis externa and several different factors that predispose to the condition like the long and narrow external ear canal of dog that turns halfway along its length from a vertical to horizontal direction and the hair within the canal in many breeds with long hairy pendulous ear flaps. The skin and the external meatus were colonized by *Staphylococcus* sp. and yeast, which would infect the ear canal epithelium when suitable conditions arise.

Dowling (1996) opined that potentially pathogenic bacteria were normally present in low numbers in the external ear canal and when a primary disease damaged the ear canal, these normal floras seize the opportunity to cause a secondary infection.

Kiss *et al.* (1997 b) reported in a study of otitis in 515 dogs of 22 breeds, 28.5 % were German Shepherd dogs. Males comprised 55.9 % of the dogs studied. Of the total 51 percent of dogs affected with otitis were in between two and five years of age. The case history data frequently included the causes as bathing in rivers or lakes, depilation of hairs from the ear canal and the unsuccessful treatment of chronic inflammations. Acute erythematous-ceruminous otitis externa was diagnosed in 83% of dogs with German Shepherds and Poodles being frequently affected, characterized by erythema and moderate swelling of the skin and accumulation of large quantities of dark brown, greasy cerumen with rancid smell in the ear canal and intensive pruritis. Suppurative otitis externa was diagnosed in 17% of dogs, of which Cocker spaniels were the highly affected, characterized by erythema, swelling, hyperaesthesia of the skin of the ear canal with egg-white-like or a yellowish-greenish purulent, foul smelling content.

Nuttall (1998) examined twelve dogs with purulent and proliferative otitis externa. In all cases there was a profuse and malodorous, purulent, bilateral otic discharge, with moderate to severe inflammation, thickening, ulceration and

hypertrophy of the ear canals with ruptured tympanic membranes in four cases. Culture and sensitivity confirmed *Pseudomonas aeruginosa,* resistant to enrofloxacin and gentamicin, but sensitive to ticarcillin.

Sylvestre (1998) observed that German Shepherd Dog had ulcerative lesions within the ear canals and only a small amount of proliferation whereas several cocker spaniels had been presented with a fleshy mass attached to the external ear canal which occluded all or a portion of the canal. Histological examination confirmed that the mass was inflammatory, not neoplastic, in nature. The author also opined that there were significantly fewer females than males in dogs affected with otitis.

Gotthelf (2000 a) opined that dogs with otitis media had clinical signs like liquid like discharge from the ear canal, pruritis, shaking of head, pain on palpation of the base of the ear and difficulty to open the mouth.

Rosychuk and Luttgen (2000) stated the *Otodectus* infestation was common in dogs less than one year of age. Increased ambient temperature, humidity, rainfall and swimming had direct correlation with the incidence of otitits externa.

Griffin and DeBoer (2001) opined atopic dermatitis as a cause of otitis externa and aural pruritis with self induced alopecia, lichenification and hyperpigmentation of ear pinna.

Murphy (2001) stressed that most fundamental part of the diagnostic work plan was a complete history taking including the details of onset, duration and progression of ear disease, previous medications and response to the therapy. The author suggested that each external ear canal and the tympanic bulla should be palpated. Thickened, firm and less pliable canals were found to be associated with chronic proliferative changes and implied a more guarded prognosis. Mineralized

and ossified ear canals were found to be rock hard. Pain on palpation of the tympanic bulla suggested concurrent presence of otitis media.

Angus *et al.* (2002) reported that the cocker spaniels were at the increased risk for chronic severe otitis externa which had predominantly ceruminous tissue response pattern when compared to fibrotic reactions in other breeds. Cocker spaniels with chronic severe otitis externa require total ear canal ablation with lateral bulla osteotomy, indicating earlier and more aggressive management of otitis externa.

Chaudhary and Mirakhur (2002) reported that German Shepherds were the most affected (31.14%), followed by the Spitz (29.87%), mongrel (18.8%) and Cocker Spaniel (6.49%). It was also found out that 63.34% were males and 36.36% were females.

Yoshida *et al.* (2002) examined a total of 187 dogs, 110 with clinical signs of otitis externa, and 77 without history or clinical signs of otitis externa, for the microenvironment and microbiological analysis of their ear exudates. The aural temperature and humidity of 160 dogs were measured and there were no significant difference between healthy dogs and dogs with otitis externa. German Shepherd dogs showed relatively lower aural temperature and higher humidity. The study concluded that the relative humidity in the ear canals unlikely predispose specific breeds to otitis externa, and ear type (pendulous or erect) did not affect the retention of heat and moisture in the ear canal.

Sarierler and Kirkan (2004) opined an increased tendency of otitis externa in dogs of 5 to 8 years of age which might reflect an overall increase in prevalence of skin disorders.

Gotthelf (2004) mentioned the dogs with otitis media had history of recurrent or chronic bacterial external ear infections. Dogs with otitis media and an

open eardrum often had a copious malodorous liquid discharge present when the ear canal was examined with the otoscope and copious mucoid exudate was observed along the floor of the horizontal canal. Pain on palpation of the base of the ear canal or pain on manipulation of the pinna was also seen in otitis media.

Venkes-van-Haagen (2005) opined the signs of external ear disease as pain and pruritus, the pain would cause the dog to turn its head slightly with the painful ear downwards. Rubbing and scratching of the ear and resulting injury of the skin were found leading to bacterial infection, increasing the inflammation and pain.

Fossum (2007) described otitis externa as an inflammation of the epithelium of the horizontal and vertical ear canals and surrounding structures (external auditory meatus and pinna). The author reported that among the erect eared breeds German Shepherd were most commonly affected with otitis externa. Calcification of the external auditory canal was seen in chronic otitis externa. A sharp painful response on deep palpation of the ear indicated middle ear infection, whereas a head tilt indicated severe pain in the ear on the lower side or otitis media or interna.

Nuttall and Cole (2007) reported that animals suffering from acute suppurative otitis, with severe inflammation, ulceration, discomfort and pain were associated with Pseudomonas infection.

Saridomichelakis *et al*.(2007) reported in a study on 100 cases of canine otitis the age of the dogs ranged from 3 months to 14 years (median: 4.75 years) and they included 45 males and 55 females. In the majority of the cases, otitis externa was chronic–recurrent (63%) or bilateral (93%).

Khosravi *et al.* (2008) reported in a study, the prevalence of *Malassezia pachydermatis* in 83.3% of healthy ears and 70.27% in dogs with otitis externa. The highest percentage of animals having Malassezia species in both of groups were seen in 1-5 years age group with Terrier as the most frequently diseased breed.

Oliveira *et al.* (2008) in a study on fifty dogs affected with bilateral otitis externa observed the clinical signs like presence of lesions on the pinna (72%), haemorrhagic lesions on the integument (80%) and foreign bodies (43%). Canine otitis externa in many cases remains refractory because of the complexity of the etiological agents and emergence of resistant bacteria among the microorganisms involved.

Cole (2009) opined the pendulous pinnae coupled with hair in the ear canal resulted in retention of heat and moisture in the ear canal. The humidity of the ear canal due to hair or from the environment had been suggested as a factor that might influence the occurrence of otitis externa.

Huang *et al.* (2009) stated that sebaceous tissue increases gradually from the proximal to the distal parts of the ear canal, whilst ceruminous gland tissue by contrast decreases. Otitic ears had a significantly greater proportion of sebaceous glands than healthy ears, and the distribution of sebaceous and ceruminous glandular tissue was similar to normal ears but the glands became larger and hyperplastic. Long-haired dog breeds generally had better developed sebaceous and ceruminous gland tissue in their ears than short-haired breeds, which might explain the higher incidence of otitis externa in long-haired breeds. The density of hair follicles had no difference between healthy and otitic ears but the hair follicles became hyperplastic in otitic ears.

Etiology

Nesbilt (1983) opined that acute otodectic otitis caused by *Otodectus cynotis* cause hyperplasia of ceruminous gland and in chronic otodectic otitis there would be formation of a crusted layer of dried serum, ceruminous secretions and exfoliated epithelium.

Schunk and Averill (1983) stated a strong association between otitis externa, abnormalities of the tympanic membrane, and existence of otitis media/interna indicating that infection frequently originates in the outer ear canal and extends through the tympanic membrane into the middle and inner ears. They opined that the samples for culture should be taken from the outer ear canal near the tympanic membrane or from the middle ear cavity.

August (1988) stated that *Otodectus cynotis*, responsible for otoacariasis produce 5 to 10 percent of otitis externa in dogs. Mites frequently leave the inflamed ear canal to inhabit ectopic sites and some animals develop hypersensitivity response to mite antigen.

Devaya *et al.* (1994) recommended lavaging of the ear canal to remove the exudates. Acetic acid (1-2%) was used to create an acidic medium which would be detrimental to the multiplication of pathogenic bacteria and chlorhexidine was used to remove the debris.

Little (1996 a) summarized primary causes of otitis externa as atopy, ear mites, foreign bodies, food intolerance/hypersensitivity, aural tumours, keratinisation disorders (including endocrinopathies) and autoimmune diseases. Predisposing factors were conformational abnormalities, excessive moisture (eg. swimming, climatic effects), and effects of treatment, pyrexia, immune suppression, systemic diseases etc and perpetuating factors as bacterial overgrowth, yeast overgrowth, progressive alteration in the aural integument and otitis media. In chronic disease of the ear canal, radiographs of the ear canal and middle ear cavity facilitated an early decision for surgical management.

Eger and Lindsay (1997) opined otitis externa as an inflammatory condition of the external ear canal which can have its genesis in generalized skin conditions such as atopy or in specific insults such as ectoparasitism or foreign body. Chronic

otitis externa can lead to stenosis or virtual obliteration of the vertical ear canal and obstruction with exudates. In advanced cases of otitis externa, mineralization of the cartilages of the ear canal occurs, reducing the elasticity of the canal and further inhibiting inspection and cleaning of the deeper areas.

Kiss *et al.* (1997 a) opined that the type of inflammation of ear canal and the nature of ear exudates were in close correlation with the microorganisms cultured from the ear canals. In a study on 515 dogs with otitis externa the common microorganisms isolated were *Malassezia pachydermatis* followed by *Staphylococcus intermedius* and *Pseudomonas aeruginosa*.

Crespo *et al.* (2000) opined *Malassezia pachydermatis* can play an important role in chronic dermatitis and otitis externa in carnivores, especially in dogs. Swabs from the external ear canals of 57 pet dogs (29 male and 28 female) with chronic otitis externa, they could obtain lipid-dependent isolates indicating that canine otitis externa was associated with lipid-dependent *Malassezia* species in addition to the nonlipid- dependent species *M. pachydermatis.*

Gotthelf (2000 a) reported that most dogs with otitis externa for about 45-60 days will have coexisting otitis media. The purulent exudates and proteolytic enzymes elaborated by inflammatory cells have a caustic effect on the epithelium of the tympanic membrane, causing it to weaken and eventually rupture. In some cases of otitis media tympanic membrane may appear intact but become opaque, grey and found bulging into the external ear.

Gotthelf (2000 b) opined that the failure of epithelial migration within the ear canal resulted in the formation of ceruminoliths which are seen lying along the floor of the horizontal canal. The accumulation of wax and keratin at the base of the ear drum resulted in formation of ceruminolith which might either be soft wax plugs or large, hard concretions.

Six *et al.* (2000) confirmed *Otodectus cynotis* infestation in dogs by direct or otoscopic examination of the external ear canal and by microscopic examination of aural canal debris. Each dog was also assessed for the presence of each of six clinical signs consistent with *Otodectus cynotis* infestation such as head shaking, pruritus/ear scratching, trauma or alopecia of the pinnae, erythema, ulceration and debris in the ear canal.

Harvey *et al*. (2001) opined that the bacterial flora of the canine external ear canal was principally a gram negative flora. Chronic inflammation was accompanied by increased number of gram negative bacteria. The vertical portion of the external ear canal contains more bacteria than the horizontal portion. The higher humidity and higher environmental temperature in tropical and sub tropical regions result in a higher degree of maceration within the ear canal and an increased carriage of gram negative organisms.

Yoshida *et al.* (2002) isolated *Pseudomonas* spp. and *Proteus* spp. from ears with otitis externa, indicating that the ears with detection of these bacteria may be considered as affected case with otitis externa.

Angus (2004) reported *Otodectus cynotis* as the most common parasite associated with otitis externa in dogs and cats. Presence of large numbers of mites in the external ear canal could be easily confirmed by direct visualization with a magnified operating-head otoscope or a fiberoptic video-assisted otoscopic endoscope. The mites could also be observed by microscopic examination of a mineral oil preparation of the otic exudate.

Fan and Lorimier (2004) described on benign ear canal tumors in dogs which include papilloma, sebaceous gland adenoma, basal cell tumor, ceruminous gland adenoma, histiocytoma, and others. Malignant canine ear canal tumors were

predominantly carcinomas arising from the ceruminous gland or squamous epithelium or of undetermined origin.

Rosser (2004) summarized the primary causes of otitis as parasites like ear mites, foreign bodies, hypersensitivity, allergic disorders, keratinization disorders and autoimmune disorders. The predisposing causes of otitis externa were conformational and anatomical disorders, excessive moisture, iatrogenic factors and obstructive ear disorders. Perpetuating causes of otitis externa include bacteria, yeast etc.

Yamashita *et al.* (2004) isolated Staphylococci from the external auditory meatus in 14 (48.3%) of 29 dogs affected with otitis externa and 28 (68.3%) of 41 dogs without otitis externa. Most of the isolates of *Staphylococcus* spp. were resistant to benzyl pencillin and ampicillin

Girao *et al.* (2006) reported the pathogenic role of *Malassezia pachydermatis* in canine otitis externa as a perpetuating factor. High levels of fatty acids could be an important predisposing factor for the high occurrence of *M. pachydermatis*. A higher presence of *M. pachydermatis* was seen in 1-3 year old dogs with otitis externa and in healthy dogs. Although the direct microscopic examination gave an immediate diagnosis, fungal culture was necessary for more accurate results.

Fossum (2007) mentioned that otitis externa was associated with other dermatologic diseases, particularly allergic or immune mediated skin diseases like food allergy dermatitis, atopy and contact dermatitis or systemic diseases like hypothyroidism. The author opined that purulent yellow or cream coloured otic exudates may be associated with gram negative infections especially *Pseudomonas* spp. and *Proteus* spp. Dark brown otic exudates are often associated with yeast infections or those caused by *Staphylococcus* or *Streptococcus*.

Saridomichelakis *et al*. (2007) reported in a study on 100 cases of canine otitis the most common primary causative factors were allergic dermatitis (43/100 dogs), grass awns (12/100) and otoacariasis (7/100). *Malassezia* spp. (66/100 dogs), cocci (38/100) and rods (22/100) were the secondary causative factors, while ear canal stenosis (38/100) and tympanic membrane perforation-otitis media (25/100) were the most important perpetuating factors.

Diagnosis

Blue and Wooley (1977) reported that of the 389 microorganisms isolated from the 323 ear swab specimens from otitic dogs, 49.6% were gram-positive aerobic bacteria, 2.6% were gram positive anaerobic bacteria, 43.4% were gram negative aerobic bacteria, 3.7% were yeast and 0.9% were fungi. *Staphylococcus aureus, Pseudomonas aeruginosa* and *Proteus spp*. were the most prevalent microorganisms. Comparison of the antibiograms of these isolates observed the emergence of a greater proportion of bacterial strains with resistance to antibacterial agents commonly used to treat otitis externa in dogs.

Lane (1979) opined that the key to the diagnosis of otitis media was evaluation of the tympanic membrane. Infection was likely to be present in the middle ear in rupture of tympanic membrane in a dog showing signs consistent with the diagnosis. Otoscopy of the tympanic membrane was not often satisfactory as discharges frequently inhibited the view.

Dickson and Love (1983) reported that as infectious otitis externa principally originate in the horizontal ear canal, contamination of swabs from other sites in the ear canal might give misleading results.

Nesbilt (1983) opined that the most common way to diagnose otodectic otitis were by visualizing the mites on otoscopic examination where small white ear

mites could be seen on the surface of the debris. Ear swabs and direct microscopic examination of the ear debris could also aid in diagnosis.

Schunk and Averill (1983) reported the clinical data and follow-up evaluations of 83 cases of peripheral vestibular syndrome in dogs. When grouped according to the cause of syndrome, most of the dogs were diagnosed as having either otitits media/ interna (49%) or idiopathic benign vestibular disease. Clinical evidence suggested that most of the cases of otitis media/interna were secondary to otitis externa.

Dwivedi and Sodhi (1987) reported *Staphylococcus aureus* as the predominating bacteria (25%) isolated from ear in dogs with otitis externa. The in-vitro drug sensitivity of all the isolates was carried out against 9 antibiotics and gentamicin, erythromycin and chloramphenicol were found to be very effective and pencillin (10 units) was the least effective. *Pseudomonas aeruginosa* was found to be the most resistant bacteria.

Little and Lane (1989) reported that under field conditions in otitis externa, visual inspection of tympanic membrane was seldom possible even after lavage of the ear due to stenosed ear canal obstructing the view. Otoscopy was considered as a subjective technique, which depended primarily on visibility of the lesion on the tympanic membrane.

Krahwinkel *et al.* (1993) stated that the prevalence of otitis externa as 5-20 % and they diagnosed end stage otitis in dogs on the basis of chronic proliferative lesions involving the horizontal and vertical portions of the external acoustic meatus, complete stenosis of the external acoustic meatus, calcification of the auricular and annular cartilages, failure of otitis to respond to other medical or surgical treatments and radiographic signs of otitis media.

Devaya *et al.* (1994) categorized otitis based on physical examination, otoscopic examination, radiological examination and probing into those with otitis externa, otitis media and otitis interna.

Eger and Lindsay (1997) conducted brainstem auditory evoked response testing in 86 normal ears and 105 ears with otitis to evaluate the degree of impairment of hearing. Severe hearing loss seemed to be present in dogs with severe otitis and no dogs were identified in which the cleaning and the examination processes had caused damage to hearing function. Cleaning of the ear canal produced measurable improvement in hearing in several dogs, indicating profound effect of physical obstruction of external ear canal by debris.

Cole *et al.* (1998) reported a difference in total bacterial isolates between the horizontal ear canal and middle ear in 34 out of the 46 otitic ears examined. To choose appropriate antimicrobial agents, in addition to cytological examination, bacterial culture and susceptibility testing of swab specimen from the horizontal ear canal and middle ear should be performed separately.

Barrasa *et al.* (2000) isolated gram positive bacteria in 61% and gram negative bacteria in 37% of the cases with chronic otitis externa.

Dickie *et al.* (2003) opined the presence of fluid within the lumen of the tympanic bulla as one of the most consistent changes associated with the presence of otitis media in the dog. In acute cases it might be the only abnormality present prior to the development of more chronic secondary changes.

Raj (2003) reported that total erythrocyte count, haemoglobin and VPRC values had no significant differences in otitic dogs. A significant reduction in total leucocyte count correlated well with the resolution of symptoms of otitis externa.

Sarierler and Kirkan (2004) reported in a study on 234 unmedicated dogs with otitis externa. *Staphylococcus aureus* was the most common bacterial organism isolated and *Trichophyton mentagrophytes* as the common fungal pathogen. The bacterial isolates were found to be sensitive to oxytetracycline, ciprofloxacin, kanamycin, pencillin and resistant to cefuroxime, erythromycin, gentamicin, ampicillin and cephoperazone.

Shenoy (2004) reported premedication with atropine sulphate (0.04 mg/kg body weight) and xylazine (1 mg/kg body weight) and anaesthesia with ketamine hydrochloride (5 mg/kg body weight) administered intramuscularly were adequate for the examination of the ear canal, otoscopic examination and radiographic procedures. A timely and systematic approach in diagnosis will help in accurate assessment of the degree of involvement of ear canal in otitis.

Oliveira *et al.* (2006) conducted study on 62 dogs and of the total, 46.8% (n=30) of the animals were positive for otitis media and the infection was monomicrobial in 76.6% of them. The most frequent isolated agents were coagulase-positive *Staphylococci* (55.0%) and *Pseudomonas* sp (10.0 %).

Suresh *et al.* (2007) reported premedication of dogs with atropine sulphate at the rate of 0.04 mg/kg body weight and xylazine hydrochloride at the rate of 1 mg/kg and general anaesthesia was induced with ketamine hydrochloride at the rate of 10 mg/kg body weight administered intramuscularly and diazepam at the rate of 0.5 mg/kg body weight administered intravenously for otoscopic examination.

Oliveira *et al.* (2008) opined in bilateral canine otitis externa sample from each ear should be cultured separately and considered as a unit which would help in choosing appropriate antimicrobial agent and improve the clinical efficiency of therapy for canine otitis externa.

Kent *et al.* (2009) opined the peripheral vestibular disorders should initially prompt a thorough examination of the external ear canal given the intimate anatomical relationship between the external, middle, and inner ear. Examination of the external ear canal could be performed with a hand-held otoscope or with video otoscopy. While the disease affecting the external canal commonly might be visualized, presence of an intact tympanic membrane did not eliminate the possibility of disease affecting the middle ear. Tumors involving the ear canal and tympanic bulla might cause peripheral vestibular disease. In addition to vestibular dysfunction, affected animals often present for signs consistent with chronic otitis that initially responds to treatment but recurs after cessation of treatment or otitis that became resistant to antibiotics. Additional signs include pain on opening the mouth, Horner's syndrome, and facial paralysis.

Otoscopy

Dickson and Love (1983) reported that on otoscopic examination of 31 dogs presented with otitis externa, 19 showed severe erythema of the walls of the ear canal.

Little *et al.* (1991 a) opined that in dogs with middle ear disease, the video-otoscopic examination revealed the affected ear canal was moderately to severely stenosed making the introduction of otoscope into the canal difficult.

Trower *et al.* (1998) reported in a clinical study of thirty one dogs, otoscopic examination could reveal 80% of otitis externa and tympanic membrane was visible in 66% of the cases. It was also noticed that the tympanic membrane may be obscured in dogs by cerumen, lesions, other debris or hairs in the horizontal canal which may prevent adequate otoscopic examination.

Eom *et al.* (2000) opined that wider diameter of the horizontal ear canal allowed insertion of the otoscope and the otoscopic examination becomes a simple

and useful technique to evaluate the tympanic membrane and ear disease. In the study conducted on 222 ear canals the tympanic membrane could not be seen otoscopically in 32% of the cases due to severely stenotic ear canals.

Gotthelf (2000 a) suggested video otoscopy as a new technology that enhanced the capability to visualize ear structures allowing a detailed magnified examination of the ear canal and tympanic membrane, and allowed procedures in the ear with excellent visualization.

Murphy (2001) suggested the use of multiple aseptic otoscopic cones of varying sizes in canines. He opined that fiberoptic video-enhanced otoscopes improved the visualization of the ear canal and the tympanic membrane. If the ear canal was found ulcerated, swollen and painful, the ear had to be first treated to reduce the inflammation and swelling and reexamined after 7 to 14 days, at which time a proper otoscopic examination could be performed. The lining of the canal was evaluated for erythema, ulcers, nodules and/or foreign bodies and the colour, quantity and quality of the exudates were noted. The character and degree of canal stenosis was assessed to determine whether it was oedematous due to acute inflammation, thickened with a cobblestone appearance or occluded due to hyperplasia or fibrosis. The location of the stenosis was also noted (vertical canal, horizontal canal or both) and presence of tympanic membrane as well as its overall appearance (normal, thickened or ruptured) was also noted.

Cole (2004) opined the otoscopic evaluation of the external ear canal and tympanic membrane as the first diagnostic procedure that should be performed in animals presented with otitis externa. Irrespective of unilateral otitis externa, both the ears should be examined with less severely affected ear first. The otoscopic cone should be changed between the examination of each ear when using a handheld otoscope, or the video otoscope should be wiped clean between the examination of each ear with a gauze sponge moistened with isopropyl alcohol. The

otoscopic examination could address the otitis by evaluating the condition of the ear, looking for any masses or foreign bodies; noting the presence, consistency, and color of any exudate and evaluating the patency of the tympanic membrane.

Palmeiro *et al*. (2004) reported video-otoscopic lavage of the tympanic bulla combined with medical management as an effective and viable option for the treatment of otitis media in dogs.

Shenoy (2004) reported that otoscopic examination was useful for the examination of the ear canal and tympanic membrane except in cases of extensive ear canal involvement like stenosis and obliteration.

Rosychuk (2005) stated that during video-otoscopy, the degree of inflammation, nature of debris, colour of debris, degree of proliferation, narrowing of canal, masses and nature and intergrity of tympanic membrane were assessed. The common problem associated with video-otoscopic examination was lens fogging which arised due to the temperature difference between a cold otoscope and a warm ear canal. The author opined that dogs were sensitive to manipulation deep within the horizontal ear canal and general anaesthesia was necessary to prevent movement of the patient, which minimizes the potential of damage to sensitive structures during otoscopic examination.

Griffin (2006) stated the goal of otoscopy to visualize the complete ear canal, amount of ear wax and cerumen, and tympanic membrane. Inflammation might make it difficult to complete an otoscopic examination without sedation. For otoscopic examination the pinna should be pulled up and out from the base of the skull, which helps to straighten the ear canal and minimize the blocking of the lumen by the cartilage fold that occurs near the junction of the vertical and horizontal canal. The cone should then be moved slowly into the vertical canal and the otoscope handle rotated downward so that the cone approaches a horizontal

position. Proper placement at the junction often allowed visualization into the horizontal canal and if necessary advancement into the horizontal canal. Deep penetration into the horizontal canal was only done if necessary to visualize the tympanum.

Suresh *et al.* (2007) recommended flushing the ear canal thoroughly with warm saline solution and the fluid inside the canal was aspirated using the cut end of scalp vein set with the needle removed and the ear canal was wiped dry with a cotton plugged applicator. While inserting the otoscope, the ear pinna was gently pulled upward and outward and the external ear canal was extended into a straight line. This helped to visualize the entire length of the ear canal and tympanic membrane. The orientation of the video otoscope in relation to the position of the dog was standardized which helped in better evaluation of the ear canal and tympanic membrane. On otoscopic examination two animals had thickening of the tympanic membrane, four animals showed ruptured tympanic membrane and three animals had bulging of tympanic membrane.

Ordeix and Scarampella (2008) stated that during video otoscopic examination the normal ear canal of dogs appeared pale pink and smooth with fine blood vessels on its surface. Fine hairs were frequently present at the entrance to the external ear canal and might be present in the vertical and horizontal canals with a tuft of hair present in front of the tympanic membrane. In video otoscopic examination the pars flaccida and pars tensa were distinctly visible. The pars flaccida appeared as a small pink region forming the upper quadrant of the tympanic membrane. The pars tensa appeared as a thin, translucent, tense portion of the tympanic membrane. Video otoscopic examination in otitis externa revealed stenosis of ear canal which was a resultant of swelling caused by oedema. Calcification manifested as a loss of flexibility of the ear canal and difficulty in passing the video-otoscope. They also opined that ulceration of the skin of the ear

canal was associated with bacterial infection, particularly with rod-shaped bacteria, such as *Pseudomonas aeruginosa.* Impacted wax in the ear canal occurred more commonly in older patients and those affected with otitis externa in the past. Usually presence of impacted wax produced signs similar to otitis externa, but signs of inflammation were absent.

Cole (2009) stated that the antitragus which is located caudal to the tragus and separated by the intertragic incisure is the anatomical region into which one inserts the otoscopic cone or otoendoscope for otoscopic examination.

Kraijer-Huver *et al.* (2009) opined that otoscopic examination in chronic otitis revealed a narrow external ear canal filled with purulent discharge with chronic ulcerative inflammation of the integument evident.

Kumar *et al.* (2009) observed a polyp like mass on otoscopic examination in the vertical portion of the ear canal.

Rawling (2009) opined that video otoscopy used video cameras and endoscopic lighting combined with an otoscope to examine the external and middle ear. A video otoscope was used to evaluate patients ears when awake, sedated, or under general anesthesia. The vertical and horizontal ear canal and tympanic membrane were brightly illuminated and magnified, allowing greater visualization of these structures.

Radiography

Gibbs (1978) employed radiographic assistance for the evaluation of disorders affecting the external and middle ear. Approximately 10% of cases of otitis media showed radiological abnormality of the petrous temporal bone. Accumulation of pus or granulation tissue produced an increase in density of the normally air filled cavity and chronic low- grade inflammatory changes resulted in

thickening and sclerosis of its wall. In long standing cases of otitis externa, ossification of annular cartilage also resulted. Changes in bulla tympanica consequent to otitis externa presented unfavorable prognostic signs in clinical cases and indicated need for radical and intensive treatment.

Douglas and Williamson (1980) described the positioning of the animal to obtain the rostro-caudal open mouth view of the skull. Placing the anaesthetized animal on its back, the head was supported so that the hard palate and the sagittal plane were at right angles to the film. The mouth was opened and the head was positioned with tapes. A successful projection was obtained if the central ray was directed vertically through the open mouth parallel to the hard palate.

Shell (1988) reported the usefulness of radiographs of tympanic bullae for evaluation of otitis media. As many cases of otitis media were sequalae of chronic otitis externa, narrowing of the external ear canal and/or ossification of the annular cartilages were evident on the ventro-dorsal skull radiographs. The oblique lateral and open mouth views were particularly useful for evaluating the air filled tympanic cavity. A soft tissue density became apparent in conditions of fluid, granulation tissue or neoplasia filling the cavity. Radiographs of the tympanic bulla were indicated in suspected cases of otitis interna because of close anatomical association between the inner and middle ear.

Love *et al.* (1995) reported that dorso-ventral (DV) and ventro-dorsal (VD) views allowed evaluation of the external ear canal, which was of benefit in clinical cases. Rostro-caudal open mouth (RcdOM) view was reported as the most useful position for evaluating the tympanic bulla. Presence of radiographic findings like change in tympanic bullae contour, bony proliferation or lysis and/or increased opacity in one tympanic bulla was sufficient for a test to be called positive for otitis media.

Little (1996 c) opined that the dorsoventral view of the skull was useful for examining the horizontal part of the external ear and the middle ear cavities. This view was indicated in chronic or recurrent external ear disease, suspected middle or inner ear disease, neoplasia or para- aural abscess. A rostrocaudal open mouth view was the most useful for the assessment of the middle ear cavities. Lesions within the horizontal canal were principally recognized by narrowing or obliteration of the air shadow within the ear canal. Also the calcification or true ossification of the ear cartilages was also radiographically marked.

Trower *et al.* (1998) reported in a clinical study of thirty one dogs stenosis and ossification of the horizontal canal was evident radiographically in 35% of the cases.

Gotthelf (2000 b) explained that in radiograph of dogs with minimal bony changes, the bullae appeared as normal, thin walled circular structures with thin cortical outline and the middle of the bullae was radiolucent. When the bulla was chronically infected, either the intraluminal or extraluminal bone might show new bone production and sclerosis and calcification of the cartilage of the external canal. Often the entire bulla would appear radio opaque, since there can be large volumes of thick exudates or tissue growth filling the air space.

Murphy (2001) stated that radiography was indicated in recurrent or refractory cases of otitis externa, in which otitis media and/or mineralization of the external ear canal was suspected and in cases in which surgical intervention was contemplated. Chronic changes such as ossification of the cartilage and thickening of the bulla could be identified radiographically.

Forest (2002) opined that radiographic evaluation of the external and middle ear was done for evaluation of otitis externa and media. A ventro- dorsal radiograph was suited for evaluation of the external ear canal where stenosis or mineralization

could be identified indicating otitis externa. Evaluation of tympanic bullae for the presence of increased opacity or thickening of the osseous bulla indicating otitis media were seen on lateral-oblique and open mouth projections. Unilateral otitis media could be diagnosed by internal comparison between the normally air filled tympanic bullae and the affected side.

Dickie *et al.* (2003) stated careful positioning was required when taking the radiographic views to ensure that each tympanic bulla was projected at the same angle to allow comparison and therefore general anaesthesia was required for an optimum radiographic investigation. In a study they carried out rostro-caudal open mouth (RCdOM) radiographic views of the tympanic bulla of all 33 heads with exposure settings of 60–66 kV and 16 mAs. The heads were secured in a vertical position with the nose pointing towards the X-ray tube and the hard palate and sagittal plane perpendicular to the cassette. The jaws were taped open, the tongue was taped to the mandible and the beam was directed parallel with the hard palate centering on the base of the tongue. On the RCdOM radiograph, the normal air filled tympanic bulla appeared as a hemispherical structure with a smooth, thin, complete, bone wall and a radiolucent lumen projecting from the ventral surface of the temporal bone and overlying the soft tissue of the pharynx. Radiographic changes associated with the presence of otitis media include an increase in soft tissue opacity within the normal air filled tympanic bulla lumen due to the accumulation of inflammatory fluid or debris. In chronic cases, an increased or decreased thickness of the tympanic bulla wall might be observed. They were also in the opinion that most of the findings associated with the radiographic diagnosis of otitis media are associated with chronic changes resulting from long standing and sustained inflammation.

Bischoff and Kneller (2004) opined that radiography was a widely available imaging modality familiar to veterinarians and often the initial modality used for

the evaluation of ear disease. Narrowing of the lumen of the horizontal canal with calcification of the cartilage of the ear canal was seen on radiography of head. Radiographic findings associated with the pathology of the middle ear like soft tissue opacity of the bulla, sclerosis of the wall of the tympanic bulla, bony proliferation of the petrous temporal bone etc. were evident in dogs with otitis

Gotthelf (2004) opined that the radiographic assessment of the bullae can be helpful in determining the extent of bony involvement and increased tissue or fluid filling the bullae. The cortical outline should be thin, and the middle of the bullae should be radiolucent, because the bullae were filled with air. When the bulla was chronically affected, either the intraluminal or extraluminal bone should show new bone production, proliferation, or bone lysis. The cartilage of the external canal might be calcified seen on a radiograph.

Shenoy (2004) adopted the exposure settings of 55-60 kV and 20-24 mAs were adequate for obtaining good quality radiographs in dorso-ventral, lateral-oblique, rostro-caudal open mouth views and also for ear canalography. Dorso-ventral views were ideal for evaluation of external ear canals and petrous temporal bone. Lateral- oblique views were ideal for evaluation of individual tympanic bullae and rostro-caudal open mouth view was adequate for evaluation of tympanic bullae without superimposition of other bony structures.

Treatment

Marshall *et al.* (1974) treated seventy-three clinical cases of otitis in dogs and cats with a preparation containing neomycin, monosulfiram and betamethasone. The bacteriological and clinical evaluations indicated that the preparation was highly effective in the treatment of otitis externa.

Chester (1988) opined that ear canal can be flushed with non irritating solutions like warm water, isotonic saline or hypertonic saline. Antiseptic solutions

of chlorhexidine (1%), povidone iodine (5%) and acetic acid (2%) also serve as effective flushing agents in otitis. The author stated that irritating medications should not be used when ulcers or abrasions were found in the ear. Topical drying agents like lactic acid, salicylic acid, boric acid etc may be necessary for treatment or prevention of maceration, especially in dogs with pendulous ears.

Wilcke (1988) studied the pharmacology of drugs used in otic preparations and classified them into keratolytics (benzoic acid and salicylic acid), buffers and flushing solutions (acetic acid and boric acid), glucocorticoids (hydrocortisone and prednisolone), non steroidal anti inflammatory drugs (dimethyl sulfoxide), local anaesthetics (tetracaine, lignocaine), antibacterials, antifungals, antiparasitic agents (pyrethrins, carbaryl) and vehicles and excipients (glycerine, squalene, propylene glycol, aloe and calamine).

Muller *et al.* (1989) opined that ear problems could be handled successfully if that were properly diagnosed and treated diligently and thoroughly for the first time. Small amount of correct medication, applied in a thin film to a clean canal produced a good response in 7 to 10 days. Treatment should be continued for an additional period of two weeks in improving conditions.

Little *et al.* (1991) summarized the advantage of otic lavage as improved visualization of the ear canal and tympanic membrane during otoscopy which removed moist debris and microbial by-products, reduced microbial population, allowed topical drug preparation to reach the site of action and provided a soothing effect. The author also stressed the relevance of selecting the vehicle for topical otic preparation. In case of exudative lesions within the ear canal, tinctures, aqueous and gels available as ointments or creams which promote evaporation of the skin surface were used. In chronically inflamed ears with scaling and lichenification, emollient ointments which reduced evaporation from the dermis were used.

Devaya *et al.* (1994) stated that treatment of otitis externa in dogs were found effective when treated both locally and systemically compared with dogs treated either topically or systemically.

Akerstedt and Vollset (1996) opined treatment of canine otitis externa mainly depended on thorough cleaning of the external ear canal. Canine otitis externa was caused by a combined bacterial and fungal infection which makes the use of treatments that include both antibacterial and antimycotic agents.

Dowling (1996) suggested treatment of uncomplicated cases of otitis externa with topical antimicrobials (along with appropriate therapy such as anti-inflammatory agents and ear cleaning). Most of the topical preparations contain combinations of glucocorticoids, antimicrobials, antifungals, and parasiticides. Systemic antimicrobial therapy was necessary in severe otitis externa so that topical antimicrobials could not reach the site of infection, or when otitis media or interna was present. Antimicrobial agents like fusidin, polymixin B, bacitracin, thiostrepton etc. which were not used systemically because of their toxic effects were effective as topical antimicrobials in the treatment of otitis.

Kiss *et al.* (1997 a) stated the successful therapy of otitis externa can be expected of a preparation which contains an antifungal agent, an antibacterial component, an antipruritic and antiinflammatory agent.

Kiss *et al.* (1997 b) developed effective drug combination for the therapy of canine otitis externa with the antimycotic active ingredient as ketoconazole, antibacterial component as gentamicin sulphate, and antiphlogistic constituent as mazipredone hydrochloride. A total of 210 dogs affected with otitis externa were treated with the combination and 94% of them became clinically symptomless and microbiologically negative in an average of 5 to 8 days. No adverse reactions were observed with the use of the drug combination. The duration of treatment and the

applied dose of the preparation greatly depended on the breed and the type of inflammation.

Nuttall (1998) reported that clavulanate potentiated ticarcillin was effective in resolving the infection in 11 out of 12 cases of otitis with multiple resistant *Pseudomonas aeruginosa.* Glucocorticoid therapy was initiated with 1 to 2 mg/kg prednisolone per os once daily to reduce inflammation and restore normal ear canal anatomy, facilitating treatment and making conditions less favourable for *Pseudomonas* growth. Topical administration of injectable ticarcillin solution was done four times daily. Dogs with ruptured tympanum received 15 to 25 mg/kg ticarcillin three times daily intravenously until the membranes had healed. Topical ticarcillin and the ear drops were continued twice daily for 14 days after clinical resolution. The duration of treatment ranged from 14 to 36 days. This study had shown that ticarcillin could be a safe and effective topical and systemic treatment for *Pseudomonas* otitis externa and media in dogs.

Sylvestre (1998) evaluated the records of 60 dogs that had resection of the lateral wall of the vertical ear canal by Zepps procedure. The outcome of surgery was acceptable in 45% and unacceptable in 55% of the cases.

Ihrke *et al.* (1999) stated that fluoroquinolones were the drug of choice for canine ear infections caused by *Pseudomonas aeruginosa.* In chronic cases the oral antibiotic medication was continued for 10 to 14 days beyond resolution of the clinical signs of otitis externa.

Gotthelf (2000 b) stated that ceruminoliths which are soft wax balls could be curetted or flushed out of the ear canal after treatment with a ceruminolytic agent like dioctyl sodium sulfosuccinate. Warmed flush solutions help to soften the waxy debris. To remove the hardened concretion type of ceruminolith video- otoscopy guided grasping forceps could be used.

Rosychuk and Luttgen (2000) summarized the general goals of therapy for otitis externa were to control or remove primary factors, reduce inflammation, resolve bacterial and yeast infections, clean and dry the ears. Glucocorticoids in the topical otic preparations had vasoconstrictive, antiproliferative, antiinflammatory actions and also reduce ceruminous and sebaceous secretions. In otitis complicated with bacterial infections, thickened canals with ulcerative changes and concurrent otitis media oral antibiotics were administered.

Six *et al.* (2000) in a study assessed the efficacy of selamectin, a novel ivermectin against *Otodectus cynotis* infestations in both dogs and cats by the presence or absence of live mites in the external ear canal. selamectin eliminated mites in 94–100% of cats by day 30 and in 90% of dogs by day 60.

Gortel (2004) opined that although many cases of acute otitis externa in dogs and cats could be managed with topical medications and ear cleaning, thorough otic flushing, was often essential for the successful resolution of otitis in chronic cases. Otic flushing was indicated in chronic otitis externa. Otic cleaning allowed topical antimicrobial agents to reach their target organisms and topical corticosteroids to reach their target tissues. Otic flushing was also recommended in otitis media, presence of foreign body, or neoplasia. In addition to cleaning the ear, the otic flushing procedure allowed full evaluation of the ear canal and tympanic membrane. It allowed sampling and removal of the material within the tympanic bulla in cases of otitis media, either through a naturally ruptured tympanic membrane or through a myringotomy incision. General anaesthesia was usually required for thorough otic flushing.

Morris (2004) stated that topical therapy as the key to the successful resolution of otitis externa. Unless the ear canal epithelium has been eroded or ulcerated extensively, systemic (oral) antimicrobials were unlikely to achieve therapeutic concentrations within the fluid and waxy exudates of the external canals

in which the infectious organisms were harbored. The concentrations of specific antimicrobial ingredients in topical preparations often greatly exceed those that could be safely achieved in the systemic circulation. The commonly used topical antibacterials in otitis were chloramphenicol, fusidic acid, aminoglycosides, neomycin, gentamicin, amikacin, tobramycin, fluoroquinolones, enrofloxacins, ciprofloxacin, carboxypencillins, polymixins and antifungal agents like nystatin, azole antifungals. Topical otic preparations also contained anti-inflammatory agents like dexamethasone, betamethasone, prednisolone and non steroid anti-inflammatory agents like dimethyl sulfoxide.

Sarierler and Kirkan (2004) stated the importance of testing the antimicrobial sensitivity of aetiological agents of otitis externa before starting the treatment in order to prevent the development of antibiotic resistance. In order to initiate an empiric treatment of otitis externa, application of oxytetracycline and ciprofloxacin in dogs could be recommended.

Tobias and Morris (2005) opined end-stage otitis, medically irresponsive otitis media, congenital anatomic abnormalities like infantile stenosis of the external ear canal and excessively hirsute canals as indication for surgeries like lateral ear canal resection, vertical canal ablation, total ear canal ablation and bulla osteotomy.

Venkes-van-Haagen (2005) recommended otic flushing when there was excessive scaling, cerumen or exudates within the canal. Water or 0.9% NaCl solution could be used to flush the ear. The fluid should have a temperature of 35 to 39° C in order to prevent dizziness and even a shock like reaction. The stream of water must be thin and forceful in order to wash the long and narrow ear canal.

Griffin (2006) stated the topical agents for otitis externa must reach the site to be treated and in many cases even cleaning would not facilitate adequate

application of topical agents. In some cases there was so much proliferative tissue that blocked adequate delivery of topical agents. The initial medical therapy of proliferative tissue causing moderate to severe stenosis of the canal lumen was systemic antimicrobial therapy for pathogens identified by cytology and possible culture and sensitivity testing. In addition potent topical glucocorticoids and systemic glucocorticoid therapy were utilized. Intra otic intralesional glucocorticoid therapy with triamcinolone acetonide was indicated when medical therapy for 2 to 4 weeks had been totally ineffective or fails to reduce the proliferative tissue to a mild to moderate degree and clients still elects to avoid surgery.

Hariharan *et al.* (2006) reported that among topically used drugs, the majority of all bacterial otitis of canine were most susceptible to gentamicin, followed by enrofloxacin. Susceptibility of *Pseudomonas aeruginosa* to gentamicin was 85% and to polymixin B 100%. For isolates other than the *Pseudomonas* sp., susceptibility was highest to amoxicillin-clavulanic acid.

Oliveira *et al.* (2006) conducted study on 62 dogs with clinical signs of otitis media and found that the microorganisms isolated had moderate to high resistance to penicillin G, ampicillin, erythromycin, clindamycin and tetracycline were detected.

Reddy *et al.* (2006) opined that in otitis, the most sensitive antibiotics enrofloxacin, ciprofloxacin, cefotaxime and gentamicin.

Ordeix and Scarampella (2008) stated that impacted wax should be dissolved with a ceruminolytic agent and then flushed out of the ear canal. In some cases impacted wax could be removed using the grasping forceps through the working channel of the video-otoscope.

Reeder *et al.* (2008) in a study on 40 dogs evaluated the systemic effects of topically applied glucocorticoids in dogs with otitis externa. Topical otic

preparation containing dexamethasone produced marginally significant adrenocortical suppression compared with the other three gluco-corticoid containing otic formulations containing betamethasone, triamcinolone and mometasone.

Guardabassi *et al.* (2009) opined the treatment with combination of chlorhexidine 0.15% and Tris–EDTA was active against all the pathogens most commonly involved in canine otitis although, the concentrations required for killing varied considerably with microorganism type. Rational use of antiseptics could also have a positive effect on prevention of antimicrobial resistance by reducing the use of systemic antibiotics and consequently by reducing antibiotic selective pressure.

Kent *et al.* (2009) summarized treatment of otitis media/interna consists of medical and surgical therapy. Empiric therapy may be initiated based on cytological evaluation of external ear debris. With appropriate treatment, improvement was typically observed within 1–2 weeks. Animals with extensive pathological changes, recurrent clinical signs, or cases refractory to medical therapy might require surgical intervention. They also opined that the administration of many compounds and the use of certain practices like ear flushing could result in ototoxicity. Caution should be exercised regarding the use of aminoglycoside antibiotics for their ototoxic and vestibulotoxic potential. Other drugs such as loop diuretics like furosemide or chemotherapeutic drugs such as cisplatin and nitrogen mustard drugs are potentially ototoxic.

Kraijer-Huver *et al.* (2009) opined that improper treatment of the ear canal, a short duration of treatment and inadequate amount of topical medication contributed to the persistence of otitis externa, with possible extension of the disease to the middle ear cavity. Otitis media become difficult to cure especially when the disease went unnoticed clinically, was not treated appropriately with systemic antibiotics and development of para-aural abscess.

Penna *et al.* (2009) stated that ninety-one of the 151 samples from otitic ears yielded *Staphylococcus spp*. in pure culture, representing 60.3% of the total isolates which showed sensitivity to amoxicillin combined with clavulanic acid and oxacillin, while resistance was widely observed for neomycin and erythromycin.

Materials and Methods

3. MATERIALS AND METHODS

The study was carried out in twelve dogs of either sex belonging to different breeds and age groups, with clinical signs of otitis presented to the Veterinary Hospital of College of Veterinary and Animal Sciences, Mannuthy and University Veterinary Hospital, Kokkalai.

The dogs were serially numbered from D_1 to D_{12} and subjected to detailed clinical examination to study the type and extent of lesions. The animals were subjected to endoscopic and radiographic evaluation of the ear canal to assess the extent of affection of the auditory system.

Anaesthesia

All the animals were subjected to examination of general condition. To facilitate proper restraint during endoscopy and radiography, atropine sulphate[1] at the rate of 0.045 mg/kg body weight and ten minutes later, xylazine hydrochloride[2] at the rate of 1.5 mg/kg body weight were administered intramuscularly for premedication. Fifteen minutes later ketamine hydrochloride[3] was administered at the rate of 5 mg/kg body weight to effect anaesthesia.

1.Atropine Sulphate 0.6 mg/ml, Hindustan Pharmaceuticals, Barauni

2. Xylaxin 20 mg/ml, Indian Immunologicals Ltd., Guntur

3. Ketmin 50, 50 mg/ml, Themis Medicare, Gujarat

Clinical evaluation of the patient

In all the animals, the external acoustic meatus was plugged with dry cotton and the hair around the external acoustic meatus and concave side of the pinna were clipped. The area around the external auditory meatus was cleared off the exudates and debris with cotton.

After removing the cotton plug, discharge from the ear canal was collected in sterile swabs for culture and antibiotic sensitivity test. The ear canal was cleaned with cotton swabs to remove as much of exudates as possible. The discharge from the ear canal was observed for its colour, nature, consistency, odour, presence of parasites, foreign bodies etc.

A video otoscopic evaluation of the ear canal was carried out to assess the extent of affection of ear canal and the status of the tympanic membrane. Radiographic evaluation of ear canal was done to identify abnormalities of the tympanic bulla and petrous temporal bone.

Anatomy of canine ear

The ear canal in canine has three parts, the external, middle and the inner ear. The external ear canal is a funnel- shaped tube of cartilage and bone extending from the external acoustic meatus at the base of the pinna to the tympanic membrane. The first part of the canal is formed by the rolled auricular cartilage, which joins with the short tube shaped annular cartilage to complete the canal. The vertical portion of the canal is formed by the auricular cartilage, which courses ventrally and slightly rostrally before turning medially to become the horizontal canal. The horizontal canal terminates in a short osseous external canal, which is a projection of the petrous temporal bone .The intertragic notch completes the caudal boundary of the opening of the ear canal and was seen between the antitragus caudally and the tragus anteriorly**.**

The external ear canal has a cutaneous lining of stratified squamous epithelium with glandular components and hair. Sebaceous glands are located below the epithelial surface and tubular apocrine (ceruminous) glands are in the deeper layers of the epithelium. Secretions from these glands combined with desquamated epithelium form the ear wax. The facial nerve leaves the skull through the stylomastoid foramen caudal to the osseous bulla and crosses the ventral surface of the horizontal canal before dividing to innervate facial structures. The second cervical nerve principally supplies caudodorsal sensory innervations to the concave surface of pinna and the auriculotemporal branches of the trigeminal nerve provide sensory innervations to the concave surface. The external ear muscles are innervated by the auricular branch (auriculopalpebral trunk) of the facial nerve. The principal arteriovenous system of the external ear is the great auricular arborisation of the external carotid artery and internal maxillary vein.

The middle ear comprises the tympanic cavity, tympanic membranes, auditory tube and ossicles. The tympanic cavity is a bony shell situated caudal and medial to the zygomatic and temperomandibular articulations. The cavity has dorsal, middle and ventral compartments and is lined with ciliated columnar epithelium, which is continuous through the auditory tube with that of the nasopharynx. The tympanic cavity is bounded laterally by a tympanic membrane, which separate the chamber from the external acoustic meatus laterally.

The tympanic membrane is a thin, translucent structure composed of an inner epithelium, a central fibrous layer and an outer stratified squamous epithelium derived from the outer ear. The membrane is divided into a smaller dorsal pars flaccida and larger ventral pars tensa. The lateral aspect of the malleus is embedded in the tympanic membrane and its medial head articulates with the body of the incus. The stapes is attached to the vestibular window or foramen.

The inner ear is located within the petrous part of the temporal bone and contains the end organs of the vestibular and cochlear divisions of the vestibulocochlear nerve. It consists of the bony labyrinth and tubes of membraneous labyrinth. The labyrinth consist of two parts, the vestibule which contains the otolith organs; saccule and utricle, the spiral canal or cochlea and three semicircular canals ie. posterior, superior, and horizontal. The semicircular canals contain the end organs of the vestibular nerve and conduct impulses resulting in an orientation of the body in space. The cochlea contains the end organ of the cochlear nerve and conduct impulses resulting in hearing. These two parts and the connecting vestibule form the labyrinth. Perilymph occupies the bony labyrinth supporting the endolymph containing membranous labyrinth. The inner ear is supplied by the eighth pair of the cranial nerves. The cochlear nerve component supplies the cochlea and the vestibular component supplies the vestibule and the semicircular canals. Auditory tube is also known as the eustachian tube or pharyngotympanic tube. It is a short canal that extends from the nasopharynx to the rostral portion of the tympanic cavity proper.

Main items of observation

Anamnesis and Signalment

The signalment of the animal *viz;* age, sex, and breed were recorded. Anamnesis including the symptoms exhibited by the animal which was narrated by the owner, duration of illness, previous occurrences and treatment given, if any, and other systemic affection were recorded.

Clinical observation

The general conditions of the animals were observed. Clinical observations of ear affected, whether the affection was unilateral or bilateral, presence of otic discharge, its colour, nature and consistency, temperament of the animal, head

shaking, carriage of the head and perception of painful responses on digital palpation at the base of affected ear were recorded.

Unusual signs exhibited by the animal like ipsilateral drooping or inability to move the ear/ lip, drooling of saliva, palpebral and corneal reflexes, and symptoms of Horner's syndrome (ptosis, miosis, enophthalmos and protrusion of nictitating membrane) were also noted.

Physiological observations

Respiration rate (per min.), pulse rate (per min.) and rectal temperatur (º C) of the animal were recorded on the day of otoscopic evaluation and on the fourteenth day of treatment.

Haematological evaluation

Whole blood samples were collected from the saphenous vein in EDTA coated vials for estimation of haemoglobin concentration (Hb), total leucocyte count (TLC) and volume of packed red cells (VPRC). Blood smears were prepared for differential leucocyte count (DLC). Haematological evaluation was done on the day of otoscopic evaluation and on the fourteenth day of treatment (Benjamin, 2001).

Culture and antibiotic sensitivity test

The otic discharge was collected in sterile swabs on the day of otoscopic evaluation for culture and sensitivity to identify the type of microbes and determine antimicrobial sensitivity patterns.

Endoscopic evaluation of the ear canal

Endoscopic evaluation of the ear canal was conducted by a video otoscope (Karl Storz Veterinary Endoscope) to provide better visualization of normal and pathologic changes within the ear canal through both enhanced magnification and improved clarification of images (Fig. 1).

The veterinary otoendoscope had an 8.5cm long conical telescope with a 5mm diameter tip (Fig. 2, 3). The telescope was having a 0-degree lens angle with a field of vision of 100-120 degree (Fig. 4) and was attached to an external halogen light source (Fig. 5). This telescope had a 2mm working channel, which exited the tip of the probe at the 12 □O clock position. The working channel of the otoendoscope allowed passage of 5 FG (French) catheter for irrigation and suction, biopsy forceps, foreign body graspers, laser fibers and semi rigid ear curettes.

The animal was restrained after effecting anaesthesia for endoscopic evaluation. The animal was placed on lateral recumbency with the affected ear above for performing all the procedures of endoscopy from the top of the head. The pinna was grasped and pulled up, away from the head, to minimize the prominence of the fold of cartilage for facilitating the introduction of telescope to vertical ear canal (Fig. 6). The tip of the telescope was placed in the intertragic notch which is the starting point of examination and advanced forward to the horizontal ear canal.

On otoscopic examination of the ear canal, status of the internal integument and visible changes in vertical and horizontal canal like the degree of inflammation, erythema of the wall, ulceration, nature of debris and stenosis of the ear canal were recorded. The ear canal was examined for the presence of foreign bodies, polyps, masses and ectoparasites. The colour and status of the tympanic membrane was also observed and recorded (Fig. 7). A review endoscopic examination of ear canal was conducted on fourteenth day of initiation of treatment.

Radiographic evaluation

The radiograph of the ear canal in either dorso-ventral, lateral oblique or rostro-caudal open mouth view were made using a standard X-ray machine with exposure settings of 55-60 kVp and 16-20 mAs (Siemens 125kV/500mA, Heliophos D/ Polyskop 2, India).

Dorso-ventral view

The animal was controlled on sternal recumbency with the head resting on the X- ray cassette. Gentle pressure was exerted on the cervical region with the hand to keep the head as close to the cassette as possible. The fore limbs were kept in the natural position along the side of the head out of the X-ray beam. The central beam of X-ray was directed at a point equidistant between the tympanic bullae to compare the both bullae. The dorso-ventral radiograph was taken to appreciate air filled horizontal canals, the density of petrous temporal bone and related structures (Fig. 8).

Lateral oblique view

The animal was controlled on lateral recumbency with the unaffected tympanic bulla towards the cassette. The head was extended and rotated so that the mandible was elevated and a plane between the midline of the nasal bones and the mandibular symphysis formed an angle of 20º with the film. The central beam was directed on the tympanic bulla of the affected side. The oblique lateral view of the ear was taken to observe the individual bullae with outlining of walls and tympanic cavity (Fig. 9).

Rostro- caudal open mouth view

The animal was controlled on dorsal recumbency with the head positioned in such a way that hard palate and sagittal plane were at right angles to the cassette. The mouth was held open by cotton tape and nose was pulled approximately 10-15º away from the central beam in cranial direction. Rostro- caudal open mouth radiograph was taken to observe the bullae (Fig. 10).

Treatment

The treatment of otitis was carried out with a combination of topical and systemic antibiotics. The antibiotic was selected based on the result of antibiotic sensitivity test and the oral antibiotics were administered for seven consecutive days. Topical preparation containing antibiotic, antifungal, anti-inflammmatory and analgesic agents was used for fourteen days. In stenosed ear canals, otic flushing was carried out using antibiotic solutions and normal saline.

The clinical cases which showed absence of apparent clinical signs in a period of two weeks and those which were not brought for review after two weeks, were considered as clinically cured. The cases which showed response to treatment, but not completely cured and which were brought for review endoscopy of ear affected after two weeks were considered to be of improved status and cases, which showed poor result inspite of medical treatment for two weeks, were considered to have no improvement.

Statistical analysis

All quantifiable data obtained were analysed and compared using paired ‘t’ test (Snedecor and Cochran, 1994).

Fig.1. Endoscopy unit

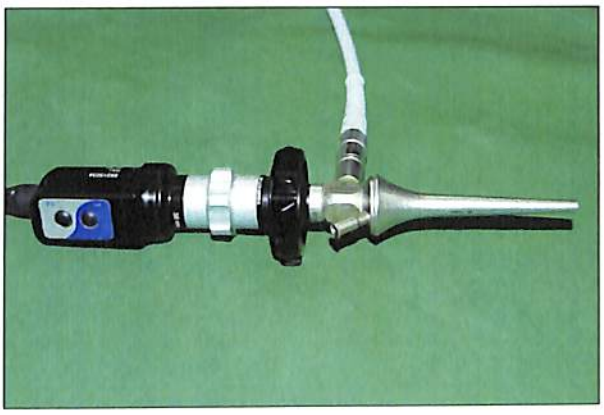

Fig.2. Veterinary Otoendoscope unit

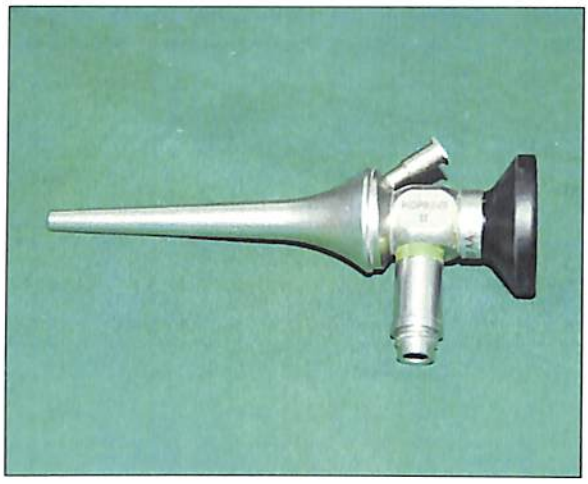

Fig.3. Otoscope cone with integrated working channel

Fig.4. Camera head

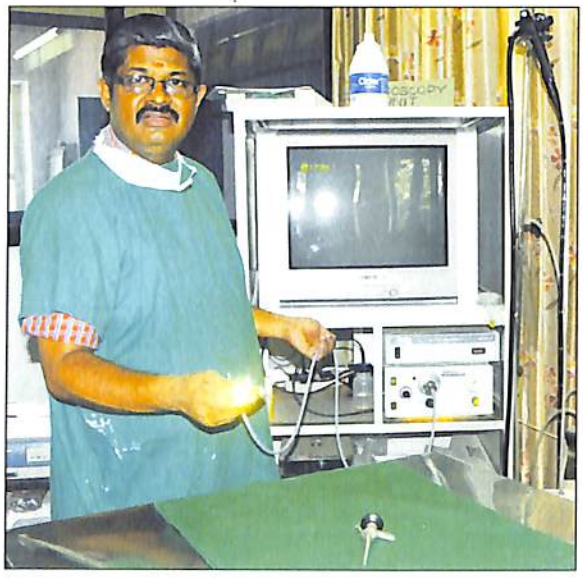

Fig.5. Halogen light source

Fig.6. Otoscope held in the right hand is introduced into the ear canal after grasping the pinna with left hand

Fig.7. Video-otoscopy procedure in progress

Fig.8. Radiographic positioning of head for dorso-ventral view

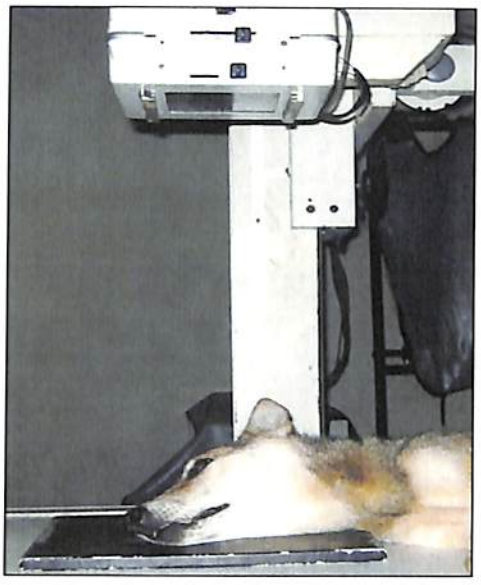

Fig.9. Radiographic positioning of head for lateral-oblique view

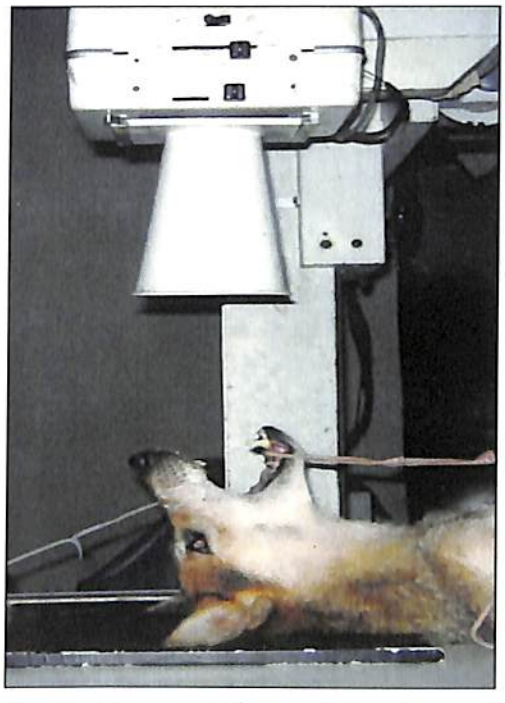

Fig.10. Radiographic positioning of head for rostro-caudal open mouth view

Results

4. RESULT

The endoscopic evaluation of otitis was conducted in twelve dogs of either sex, belonging to different breeds and age groups with a history of affection of ear canal presented to the Veterinary hospitals of the College of Veterinary and Animal Sciences, Mannuthy and University Veterinary Hospital, Kokkalai.

Anamnesis and Signalment (Table 1)

Out of the twelve animals selected for the study, the breeds affected were German Shepherd Dog (9), Cocker spaniel (1), Dachshund (1) and Labrador (1). Among the dogs, 10 were male and 2 were female. The age of the dogs ranged from 3 months to 8 years with a mean age of 4.56 years. The body weight of dogs ranged from 10.5 kg to 35 kg with a mean of 24.3 kg.

All the dogs were reported with symptoms of ear canal affections like shaking of head, foul smelling discharge from the affected ear, rubbing of ear, tilting of head to the affected side.

Out of the twelve dogs, seven dogs (D_1, D_2, D_3, D_4, D_6, D_8 and D_{11}) had chronic infection with the duration ranging from 15 days to 1 year. Four dogs (D_5, D_7, D_9, D_{10} and D_{12}) had acute infection with the symptoms of ear infection existing for three to four days.

Dogs D_1, D_3, D_4, D_8, and D_{11} had history of previous occurrence and were treated with topical and oral antibiotics and relapse of illness at frequent intervals. Dog D_2 had a history of maggot infestation two weeks back, and in three dogs D_3, D_7 (Fig. 11) and D_{12} maggots were observed at the time of presentation to the clinics. Dogs D_1, D_4 and D_6 had dermatitis at the time of presentation to the clinics, D_4 with fungal dermatitis which was positive for *Malassezia* spp. A previous

history of occurrence of aural haematoma resulted in puckering of ear pinna in dog D_2 (Fig. 12) and D_8. Dog D_{10} had tick infestation on the body during the period of clinical observation.

Clinical observation (Table 2 and 3)

Among the twelve animals examined three dogs had bilateral affection of the ear (D_2, D_3 and D_{10}) and nine dogs had unilateral ear affections. Seven dogs had affections in the right ear (D_4, D_6, D_7, D_8, D_9, D_{11} and D_{12}) and two were with affections of the left ear (D_1 and D_5).

Six dogs (D_5, D_6, D_7, D_8, D_9 and D_{10}) were active at the time of presentation to the clinics. Four dogs (D_1, D_2, D_3 and D_{11}) were aggressive in nature and two dogs (D_4 and D_{12}) were dull at the time of presentation. Rubbing of the affected ear and head shaking were exhibited by dogs in all cases and additionally four dogs (D_1, D_3, D_7 and D_8) were having tilting of head to the affected side of ear. All the dogs except D_9 and D_{10} evinced painful responses on digital palpation at the base of the affected ear.

The colour of the otic discharge was dark brown in seven dogs (D_1, D_3, D_4, D_5, D_7, D_9 and D_{12}), yellowish brown in two dogs (D_2 and D_8) and light yellow in three dogs (D_6, D_{10} and D_{11}).

The consistency of otic discharge was creamy in dogs D_1, D_2, D_3, D_6, D_8, D_{10} (Fig. 13) and D_{11} whereas in dogs D_4, D_5, D_9 and D_{12} it was waxy and in dog D_7 it was watery. The discharge was of abnormal smell in all cases.

Physiological parameters (Table 4)

The mean respiration rate (per min) of twelve animals on the day of endoscopic examination was 28.25 ± 0.9 and on the fourteenth day was 27.63 ±

1.74. The mean pulse rate (per min) on the day of endoscopic examination was 75.08 ± 2.82 and was 73.36 ± 2.64 on the fourteenth day. The mean rectal temperature recorded (º C) on the day of endoscopic examination was 39.13 ± 0.21 and 38.73 ± 0.18 on the fourteenth day. No significant variation could be observed between the values of mean respiration rate and pulse rate recorded on the first and the fourteenth day of endoscopic examination. Stastistically significant variation could be observed between mean rectal temperature recorded on the first and the fourteenth day of endoscopic examination with a significance level of 0.12.

Haematological examination (Table 4)

The mean heamoglobin concentration (g/dl) on the day of endoscopic examination and on the fourteenth day was 13.01 ± 0.31 and 12.12 ± 0.37 respectively. The mean leucocyte count ($10^3/mm^3$) was 11.75 ± 0.48 and 11.60 ± 0.49 on the first and the fourteenth day of endoscopic examination respectively. The mean differential leucocyte count was; neutrophil count (%) 73.33 ± 1.14, lymphocyte count (%) 24.42 ± 0.84, and eosinophilic count(%)1.33 ± 0.22 on the day of endoscopic examination. On the fourteenth day of endoscopic examination the mean differential leucocyte count was neutrophil count (%) 71.17 ± 1.03, lymphocyte count (%) 26.58 ± 1.00 and eosinophilic count (%) 1.75 ± 0.25 respectively. The mean VPRC (%) recorded was 35.45 ± 1.34 and 34.02 ± 0.09 on the first and the fourteenth day of endoscopic examination. No significant differences were observed between the haematological values obtained on the first day and the fourteenth day of endoscopic examination.

Culture and antimicrobial sensitivity (Table 5)

Gram negative coccobacilli were isolated from the otic discharge of six dogs (D_1, D_2, D_6, D_7 D_9, D_{11} and D_{12}) and Gram positive cocci from the discharge in two dogs (D_4 and D_5). Mixed culture of Gram negative short rods, Gram negative

coccobacilli and fungal spores were isolated from otic discharge of dog D_3. The otic discharge of dog D_{10} revealed presence of Pseudomonas organism and in dog D_8 Gram negative short rods alone were isolated.

The isolates of dog D_1, D_3, D_9, D_{11} and D_{12} were sensitive to the antibiotics such as enrofloxacin, ciprofloxacin, cefotaxime and gentamicin. Dog D_4, D_6 and D_7 were sensitive only to gentamicin, dog D_{10} was sensitive to polymixin B. The isolates obtained from dog D_8 were sensitive to enrofloxacin, chloramphenicol and nitrofurantoin. The isolates from D_2 and D_5 were resistant to all the antibiotics tested.

Endoscopic evaluation of the ear canal

Anaesthesia

Endoscopic evaluations of all 12 dogs were performed under Ketamine anaesthesia with atropine-xylazine premedication. Induction and recovery was smooth and uneventful in all the dogs.

Endoscopic evaluation (Table 6)

The observations on endoscopic evaluation of affected ear in each dog are as given under.

Dog D_1

Extensive ulceration and erythema of the lining of the vertical and horizontal ear canal of the left ear (Fig. 14). The ear canal was grossly inflamed and there was mild degree of stenosis of the lumen of horizontal ear canal. The tympanic membrane was intact with mild opacity of the membrane.

Dog D_2

Moderate inflammation of the right ear canal with erythema and severe ulceration on both the medial and lateral lining of the vertical canal. The floor of the vertical canal was filled with creamy exudates. The tympanic membrane was observed as intact, pearly white structure.

The lumen of the left ear canal was filled with dark brown wax obliterating the horizontal canal obscuring the advancement of the otoscope further (Fig. 15).

Dog D_3

Deep ulcerations with moderate degree of inflammation on the medial and lateral lining of the right ear canal with brown wax deposits. The tympanic membrane was intact and pearly white in appearance (Fig. 16).

There was complete erosions and excoriation of the conchal cartilage with inflamed integument of the left ear. Hence it was unable to advance the otoscope further into the ear canal.

Dog D_4

Erythema with bleeding ulcers and severe inflammation was observed on otoscopic examination of the right ear (Fig. 17). A small, soft pale pink nodular growth was noticed just below the orifice of the right ear canal. There was moderate degree of stenosis of ear canal lumen and the tympanic membrane was intact and transparent.

The left ear canal had mild degree of inflammation with areas of healing ulcers on the wall of the vertical canal. The presence of wax occluding the lumen prevented further advancement of otoscope into the horizontal ear canal.

Dog D_5

Mild erythema and inflammation (Fig. 18) and oedema of the lining of left ear canal with the presence of brownish exudate. Moderate degree of stenosis of the horizontal canal prevented further movement of otoscope and visualization of the tympanic membrane of the left ear.

Dog D_6

The right ear canal was extensively inflammed. The canal wall was lined with exudates and necrotic debris with ulceration on the wall of the vertical ear canal. The wall of the horizontal ear canal was inflamed and erythematous with purulent exudate adhering on the walls and floor of the canal. A tuft of hair was seen adhering to the tympanic membrane on its periphery (Fig. 19).

Mild erythema of the left ear canal with thick brown exudate was seen on otoscopic examination. Tympanum was intact and appeared as glistening translucent membrane.

Dog D_7

Bleeding ulcers were observed near the tragus of the right ear (Fig. 20). Extensive ulcerations, erythema and mild degree of stenosis of both the vertical and horizontal ear canal were noted. The canal wall was lined with purulent exudates and tympanic membrane appeared as intact and glistening structure.

Dog D_8

Numerous tiny ulcers and erosions of the wall of the right ear canal were observed on otoscopic examination (Fig. 21). There was stenosis of the ear canal and tympanic membrane appeared as intact, pearly grey structure.

Dog D_9

Mild inflammation with erythema and small areas of superficial ulcerations on the medial and lateral wall of the vertical ear canal was noticed (Fig. 22). The wall of the horizontal ear canal was erythematous. Tympanic membrane was intact and translucent.

Dog D_{10}

Extensive erythema and ulcerations with stenosis of the right ear canal was observed on otoscopic examination. The canal was lined with creamy otic exudates. The tympanic membrane was intact and translucent.

The left ear canal had mild inflammatory changes. Erythema of the wall of the vertical and horizontal ear canal was observed. Ear mites were noticed as small moving objects over the wall of the ear canal and few ear mites were seen in the horizontal ear canal towards the tympanum (Fig. 23). They were diagnosed as *Otodectus cyanotis* on microscopic examination of otic exudates. The tympanum appeared intact, translucent and pearly grey.

Dog D_{11}

Severe inflammation with bleeding ulcers were observed (Fig. 24) on the medial and lateral wall of the vertical ear canal. The wall of the horizontal ear canal was erythematous. Thickening of the integument of the horizontal canal with cobblestone appearance was noted. The floor of the horizontal ear canal was filled with creamy yellow exudates obstructing further vision forward (Fig. 25).

Dog D_{12}

Mild degree of inflammation of the right ear with wax deposits on the lining of the vertical canal. The integument of the horizontal canal was erythematous.

Tympanic membrane was intact and appeared as glistening, pearly grey structure (Fig. 26).

Radiographic evaluation (Table 7)

The observations on plain radiographs of the affected ear are as given under.

Dog D_1

On dorso-ventral view no significant radiographic changes suggestive of involvement of the left ear canal were evident (Fig. 27). Lateral oblique view revealed clearly outlined wall of tympanic bulla and air filled tympanic cavity (Fig. 28).

Dog D_2

Opacification of wall of the horizontal canal in the right ear was evident on plain radiograph in dorso-ventral view. Lateral-oblique view showed thickening of the outer wall of the tympanic bulla with air filled tympanic cavity (Fig. 29).

Dog D_3

There was opacification indicative of calcification (Fig. 30) of the wall of ear canal of both the ears in dorso-ventral view. Changes suggestive of extensive calcification and reduction in lumen diameter were evident in the left ear. Thickening of outer wall of tympanic bulla with air filled tympanic cavity was evident in lateral-oblique view.

Dog D_4

Opacification of the wall of vertical and horizontal ear canal of the right ear was evident in dorso-ventral view (Fig. 31). Opacification was also evident at the

region of the horizontal canal on the left ear. Lytic changes on the wall of the right tympanic bulla with radiolucent tympanic cavity was noted on lateral-oblique view(Fig. 32).

Dog D_5

Any significant radiographic changes suggestive of involvement of external ear canal were not observed on dorso-ventral view (Fig. 33).

Dog D_6

Radiography could not be performed on the day of endoscopic evaluation.

Dog D_7

Radiography could not be performed on the day of endoscopic evaluation.

Dog D_8

Thickening of the walls of right tympanic bulla evident in dorso-ventral, lateral- oblique and rostro-caudal open mouth view (Fig. 34) of the skull.

Dog D_9

Radiography could not be performed on the day of endoscopic evaluation.

Dog D_{10}

Any significant radiographic changes were not observed in the right ear canal. The right tympanic bulla appeared as moderately thickened in dorso- ventral (Fig. 35) and lateral-oblique view.

Dog D_{11}

Dorso-ventral view revealed opacification of the horizontal ear canal indicating calcification in the right ear (Fig. 36). Reduction in size of lumen was also evident. Thickening of the wall of the tympanic bulla with mild radioopacity of the right ear canal was noted in the oblique-lateral view.

Dog D_{12}

Radiography could not be performed on the day of endoscopic evaluation.

Treatment (Table 8)

Medical management of otitis was recommended in all cases. Hence antibiotic drugs were selected based on the result of culture and sensitivity of isolates from the otic exudates. Both oral and topical antibiotics were administered to all dogs except dog D_9 in which only topical antibiotic was recommend

In dogs D_3, D_4, D_5, D_6, D_7, D_8, D_{10}, D_{11} and D_{12} cephalexin at the rate of 20 mg/kg body weight was given orally twice daily for seven consecutive days. In these dogs treatment was initiated before the result of culture and sensitivity were obtained and the treatment was continued with the same antibiotic as the condition was responding. In dog D_1 ciprofloxacin at the rate of 10 mg/kg body weight and in dog D_2 enrofloxacin at the rate of 5 mg/kg body weight was given orally for seven consecutive days.

Topical otic preparation containing ofloxacin, clotrimazole, beclomethasone dipropionate and lignocaine was instilled 5-8 drops into the ear canal in all dogs. The topical otic preparation was instilled thrice daily for fourteen days. In order to loosen the wax and debris of the ear canal ceruminolytic agent containing ducosate disodium was recommended for dog D_2.

In dog D_1 and D_{11} considering their aggressive nature promethazine was administered to facilitate instilling of ear drops. Analgesic preparation, meloxicam oral suspension was administered to dog D_7 to relieve pain during the treatment period.

Response to treatment (Table 9)

The response to the treatment was evaluated by reviewing the clinical symptoms and otoscopic examination of affected ear after two weeks of the initial treatment. All the dogs except D_6 were presented for the review examination.

Dog D_1

There was clinical improvement with marked reduction in head shaking, tilting of head and discharge from the affected ear.

Dog D_2

There was considerable reduction in tilting of head, shaking of the ears and discharge from the ear. Otoscopic examination revealed marked improvement in condition and the integument was apparently regaining to normal status (Fig. 37). Three areas of deep ulcer were noticed in the vertical canal. Otic flushing was carried out in the left ear canal with 2ml gentamicin mixed in 18ml normal saline and the contents were suctioned and mopped dry.

Dog D_3

There was improvement in the condition with reduction in shaking of head. On otoscopic examination of the left ear, inflammation was evident with healing ulcers on the vertical canal. There was erythema on the wall of horizontal canal (Fig. 38). Stenosis of the lumen of horizontal canal prevented visualization of tympanic

membrane. Mild degree of inflammation was still evident in the right ear. Tympanic membrane showed slight bulging towards the horizontal canal.

Dog D_4

There was marked improvement in condition with reduction in head shaking and otic discharge. No ulcer points were observed on cleaning of the right ear indicating improvement in status of the integument of the ear canal. On otoscopic examination of the right ear canal the nodular growth adhering to the medial wall of the vertical canal, just below the orifice of the ear canal was obstructing the lumen of the canal partially upto 75% (Fig. 39). The mass was visible in the canal from outside.

Dog D_5

Improvement in condition with reduction in head shaking and aural discharge. Pain was elicited on palpation of the base of the ear. Slight erythema of the canal lining noticed on otoscopic examination (Fig. 40).

Dog D_6

Not presented for review, hence considered cured.

Dog D_7

Improvement was reported with occasional shaking of the of the horizontal ear canal head. Mild inflammation with erythema and few ulcers (Fig. 41) noted on otoscopic examination

Dog D_8

Improvement in condition with reduction in head shaking and discharge from the right ear. The integument of the right ear canal appeared normal with mild erythema and tympanum was intact (Fig. 42).

Dog D_9

Head shaking and rubbing of the ear have reduced. Ear canal appeared apparently normal on otoscopic examination (Fig. 43).

Dog D_{10}

Reported improvement in condition. Otoscopic examination revealed considerable reduction in the inflammation of the right ear canal. There was appreciable reduction in the erythema and ulcers of the canal wall (Fig. 44). In the left ear canal there was mild erythema and superficial ulceration of the wall of the horizontal ear canal.

Dog D_{11}

There was improvement in condition with occasional shaking of the head. Painful responses on palpating the ear have markedly reduced. On otoscopic examination of the right ear canal the inflammatory changes were reduced. There was only mild degree of reduction in erythema and ulceration and the horizontal canal was filled with creamy exudates (Fig. 45). The presence of exudates obscured the vision of tympanic membrane. The ear canal was flushed with 10ml of normal saline, suctioned and mopped dry.

Dog D_{12}

Not presented for review, hence considered cured.

Table 1. Observations on anamnesis and signalment of dogs affected with otitis

Animal No:	Age	Sex	Breed	Duration of illness	History
D_1	4 year	Male	German Shepherd dog	1 month	Foul smelling discharge, rubbing of the left ear with shaking and tilting of head to the left side.
D_2	6 year	Male	German Shepherd dog	1 month	Discharge from ears. History of maggot infestation and drooping of the right ear.
D_3	7 year	Male	German Shepherd dog	6 months	Otitis was recurring every two months. Maggot infestation in the left ear and shaking of the right ear
D_4	8 year	Male	German Shepherd dog	1 year	Chronic infection occurring several times a year with head shaking and discharge from the right ear.
D_5	1 year	Female	German Shepherd dog	1 week	Shaking of head and rubbing of the left ear. Ear pinnae matted with discharge.
D_6	6 year	Male	Dachshund	15 days	Foul smelling discharge from the right ear with painful responses when ear is touched.
D_7	7 year	Male	Cocker spaniel	1 week	Shaking of head and discharge from the right ear with maggot infestation.
D_8	4 year	Male	German Shepherd dog	6 months	Puckering and drooping of the right ear pinna. Head shaking and discharge of the right ear with pain while palpating the base of ear.
D_9	3 year	Male	German Shepherd dog	1 week	Discharge and scratching of the right ear.
D_{10}	3 months	Male	Labrador	1week	Right ear pinna matted with purulent discharge and head shaking.
D_{11}	4 year	Male	German Shepherd dog	1½ months	Recurring frequently after short intervals. Head shaking and discharge from right ear. Painful responses evinced resist ear examination.
D_{12}	8 year	Female	German Shepherd dog	1 week	Shaking of head and scratching of the right ear. Maggot infestation in left ear.

Table 2. Observations on clinical symptoms exhibited by the dogs affected with otitis

Dog no.	Ear affected	General status of behaviour	Otic discharge	Rubbing of the affected ear	Shaking of the head	Painful response on	Tilting of head	Unusual sign
D_1	Left	Aggressive	+	+	+	+	+	Nil
D_2	Bilateral	Aggressive	+	+	+	+	-	*puckering and drooping of of
D_3	Bilateral	Aggressive	+	+	+	+	+	Nil
D_4	Right	Dull	+	+	+	+	-	Nil
D_5	Left	Active	+	+	+	+	-	Nil
D_6	Right	Active	+	+	+	+	-	Nil
D_7	Right	Active	+	+	+	+	-	Nil
D_8	Right	Active	+	+	+	+	+	*Puckering and drooping of of
D_9	Right	Active	+	+	+	-	-	Nil
D_{10}	Bilateral	Active	+	+	+	-	-	Nil
D_{11}	Right	Aggressive	+	+	+	+	+	Nil
D_{12}	Right	Dull	+	+	+	-	+	Drooping of of left ear

* puckering due to previous occurrence of aural heamatoma

Table 3. Observations on nature of the otic discharge in dogs with otitis

Animal No.	Colour	Consistency	Odour
D_1	Dark brown	Creamy	Abnormal smell
D_2	Yellowish brown	Creamy	Abnormal smell
D_3	Dark brown	Creamy	Abnormal smell
D_4	Dark brown	Waxy	Abnormal smell
D_5	Dark brown	Waxy	Abnormal smell
D_6	Light yellow	Creamy	Abnormal smell
D_7	Dark brown	Watery	Abnormal smell
D_8	Yellowish brown	Creamy	Abnormal smell
D_9	Dark brown	Waxy	Abnormal smell
D_{10}	Light yellow	Creamy	Abnormal smell
D_{11}	Light yellow	Creamy	Abnormal smell
D_{12}	Dark brown	Waxy	Abnormal smell

Table 4. Observations on physiological and haematological parameters (mean ± SE) on the first day and the fourteenth day of endoscopic examination

(n= 12)

Parameters and units	Day 1 of endoscopic examination	Day 14 of endoscopic examination
Respiration rate (per min)	28.25 ± 0.9	27.63 ± 1.74
Pulse rate (per min)	75.08 ± 2.82	73.36 ± 2.64
Rectal temperature (º C)	39.13 ± 0.21	38.73 ± 0.18
Heamoglobin concentration (g/dl)	13.01± 0.31	12.12 ± 0.37
Leucocyte count (10^3/ cu.mm)	11.75 ± 0.48	11.60 ± 0.49
Neutrophil count (%)	73.33 ± 1.14	71.17 ± 1.03
Lymphocyte count (%)	24.42± 0.84	26.58 ± 1.00
Eosinophil count (%)	1.33 ± 0.22	1.75 ± 0.25
Basophil count (%)	0.00± 0.00	0.00± 0.00
Monocyte count (%)	0.00± 0.00	0.00± 0.00
Volume of packed red cells (%)	35.45 ± 1.34	34.02 ± 0.09

Table 5. Observations on the culture and sensitivity test of otic discharge collected from dogs with otitis

Animal No.	Isolates	Sensitive to	Resistant to
D_1	Gram negative coccobacilli	enrofloxacin, ciprofloxacin, gentamicin ,chloramphenicol	Oxytetracycline, cotrimazole
D_2	Gram negative coccobacilli	Nil	Oxytetracycline, cotrimazole, cephalexin enrofloxacin, gentamicin
D_3	Gram negative short rods, gram negative coccobacilli and yeast	cephalexin enrofloxacin, gentamicin,	Oxytetracycline, cotrimazole, chloramphenicol
D_4	Gram positive cocci	Gentamicin	enrofloxacin, chloramphenicol, amoxicillin, streptomycin
D_5	Gram positive cocci	Nil	enrofloxacin, gentamicin, chloramphenicol, cephotaxime, amoxicillin, streptomycin
D_6	Gram negative coccobacilli	Gentamicin, clindamycin	Amoxycillin, sulphadiazine, cephotaxime, ciprofloxacin,
D_7	Gram negative coccobacilli	Gentamicin, enrofloxacin	Chloramphenicol, amoxicillin, cefotaxime
D8	Gram negative short rods	Enrofloxacin, nitrofurantoin chloramphenicol	Gentamicin, ciprofloxacin, polymyxin B ,cefotaxime
D_9	Gram negative coccobacilli	Gentamicin, enrofloxacin, cefotaxime, ciprofloxacin, polymyxin B	Nil
D_{10}	Pseudomonas	Polymixin B	enrofloxacin, ciprofloxacin, gentamicin, chloramphenicol, cefotaxime
D_{11}	Gram negative coccobacilli	Gentamicin, enrofloxacin, ciprofloxacin, gatifloxacin	chloramphenicol, cefotaxime
D_{12}	Gram negative coccobacilli	enrofloxacin, ciprofloxacin, gentamicin, chloramphenicol	Oxytetracycline, cotrimazole

Table 6. Observations on otoscopic examination of the affected ear in dogs with otitis

Animal no.	Ear affected	Lesions observed in the ear canal	Changes noted on tympanic membrane
D_1	Left	Extensive ulceration and erythema of the left ear canal. Slight stenosis of lumen of horizontal canal	Intact with slight opacity
D_2	Bilateral	Moderate inflammation with erythema and ulceration in the right ear canal. Canal filled with creamy exudates. Left ear canal filled with dark brown wax	Right tympanic membrane appeared intact and pearly grey. Unable to visualize left tympanic membrane
D_3	Bilateral	Deep ulcerations with moderate inflammation of right ear canal. Complete erosions and excoriation of the conchal cartilage with inflammed integument of the left ear	Right tympanic membrane appeared intact and pearly grey. Unable to visualize left tympanic membrane
D_4	Right	Erythema, bleeding ulcers and moderate stenosis of the right ear canal. A nodular growth just below the orifice of the canal	Tympanic membrane intact, transparent and pearly grey
D_5	Left	Mild erythema, inflammation, stenosis and oedema	Unable to visualize the left tympanic membrane
D_6	Right	Inflamed canal with ulcers, necrotic material and purulent exudate	Presence of exudates prevented visualization of tympanic membrane
D_7	Right	Extensive ulceration, erythema and mild stenosis of the ear canal	Tympanic membrane intact, transparent and pearly grey
D_8	Right	Ulceration and erosions on the wall of the right ear canal with stenosis of lumen	Tympanic membrane intact, transparent and pearly grey
D_9	Right	Mild inflammation with erythema and small areas of superficial ulcers	Tympanic membrane intact, transparent
D_{10}	Bilateral	Extensive erythema and ulceration of the right ear canal. Presence of ear mite (*Otodectus cyanotis)* in the left ear canal near the tympanum	Tympanum intact in both the ears
D_{11}	Right	Severe inflammation, bleeding ulcers of the right ear canal. The floor of the horizontal canal filled with creamy exudate	Presence of exudates prevented visualization of tympanic membrane
D12	Right	Mild degree of inflammation, erythema with wax deposits	Tympanic membrane intact, transparent and pearly grey

Table7. Observations on radiographic changes in the ear canals and adjacent structures of the dogs affected with otitis

Dog no.	Ear affected	View	Radiographic findings
D_1	Left	Dorso-ventral and oblique lateral	No significant radiographic changes
D_2	Bilateral	Dorso-ventral and oblique lateral	Opacification of right ear canal with thickening of the bullae
D_3	Bilateral	Dorso-ventral and oblique lateral	Opacification of both ear canals and thickening of wall of bullae
D_4	Right	Dorso-ventral and oblique lateral	Opacification of ear canal with lytic changes in bullae
D_5	Left	Dorso-ventral	No significant radiographic changes
D_6	Right		Not presented for radiographic evaluation
D_7	Right		Not presented for radiographic evaluation
D_8	Right	Dorso-ventral and oblique lateral open mouth view	Thickening of the right tympanic bullae
D_9	Right		Not presented for radiographic evaluation
D_{10}	Bilateral	Dorso-ventral and oblique lateral	Right tympanic bulla appeared slightly thickened
D_{11}	Right	Dorso-ventral and oblique lateral	Opacification of the ear canal with thickening of the wall of the tympanic bulla with mild radioopacity
D_{12}	Right		Not presented for radiographic evaluation

Table 8. Treatment given on the day of presentation to dogs affected with otitis

Dog no.	Oral antibiotic	Topical otic preparation	Other medications
D_1	ciprofloxacin[4] @ 10 mg/kg b.wt.**	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	promethazine[8] @ 1.5 mg/kg b.wt. **
D_2	enrofloxacin[5] @ 5 mg/kg b.wt.**	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	Dusocate disodium[10] ear drops
D_3	cephalexin[6] @ 20 mg/kg b.wt.**	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_4	cephalexin[6] @ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_5	cephalexin [6]@ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_6	cephalexin[6] @ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_7	cephalexin [6]@ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	meloxicam [9]oral suspension @ 0.25 mg/kg b.wt. **
D_8	cephalexin[6] @ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_9	nil	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_{10}	cephalexin [6]@ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil
D_{11}	cephalexin[6] @ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	promethazine [8]@ 1.5 mg/kg b.wt. ** (Oral)
D_{12}	cephalexin[6] @ 20 mg/kg b.wt. **	Preparation of ofloxacin, clotrimazole, beclomethasone and lignocaine[7]	nil

**b.wt.- body weight

[4] Tab. Ciplox 250 mg Cipla Ltd., Mumbai
[5] Tab. Enrocin 150 mg Vetcare division, Tetragon chemie Pvt. Ltd., Bangalore
[6] Tab. Sporidex 250 mg Ranbaxy Laboratories Ltd., Mumbai
[7] CALMEAR Drops 20 ml Scientific Remedies Pvt. Ltd., Vadodhara, Gujarat
[8] Tab. Phenergan 10 mg Nicholas Pharma India Ltd., Himachal Pradesh
[9] Melonex oral suspension, 5mg/ml Intas Pharmaceuticals, Dehradun
[10] Waxolve 10 ml. Bell Pharma Pvt. Ltd., Mumbai

Table 9. Observations on endoscopic evaluation of affected ears in dogs after two weeks of treatment

Dog no.	Ear affected	Otoscopic findings Day 1	Otoscopic findings Day 14
D_1	Left	Severe inflammation with extensive ulceration. TM*** intact but slightly opaque	Improvement in condition with reduction in ulceration
D_2	Left	Impacted wax obscuring the TM.***	Canal lumen almost normal with TM visible
D_2	Right	Moderate inflammation and horizontal canal filled with creamy exudate. TM ***intact and pearly white	Integument appeared normal with few deep ulcers
D_3	Left	Complete erosions and excoriations of conchal cartilage	Wall erythematous, ulcers started healing. Stenosis of canal impaired viewing TM
D_3	Right	Moderate inflammation with deep ulcers. TM*** intact and pearly white	Mild inflammation
D_4	Right	Severe inflammation, bleeding ulcers and moderate canal stenosis with a nodular growth in the vertical canal	Nodular growth was obstructing upto 75% of the canal lumen
D_5	Left	Mild inflammation. Stenosis and presence of wax obstructed viewing TM***	Slight erythema of the canal lining
D_6	Right	Moderate inflammation with ulceration. The wall of the canal lined with exudate and necrotic debris	Not presented for review
D_7	Right	Moderate inflammation with bleeding ulcers and mild stenosis. Canal lined with purulent exudate, TM*** intact	Mild inflammation with erythema and few ulcers
D_8	Right	Ulceration and erosions on the wall of the right ear canal with stenosis of lumen	Integument appeared normal with slight erythema
D_9	Right	Mild inflammation with superficial ulcers. TM ***intact	Ear canal appeared apparently normal
D_{10}	Left	Mild inflammation with erythema. Ear mites observed in the lumen of the horizontal canal near the tympanum	Mild erythema nad superficial ulceration noticed
D_{10}	Right	Extensive erythema, ulceration and stenosis of canal	Reduction in the inflammation, erythema and ulceration
D_{11}	Right	Severe inflammation with bleeding ulcers. Canal filled with exudate obscured viewing TM***	Only slight reductin in ulceration with exudate filling the horizontal canal
D_{12}	Right	Mild inflammation with erythema. TM*** intact	Not presented for review

*** Tympanic membrane

Fig.11. Ear affected with maggot wound (D_7)

Fig.12. Puckering of ear pinna (D_2)

Fig.13. Creamy otic discharge matting on to the pinna (D_{10})

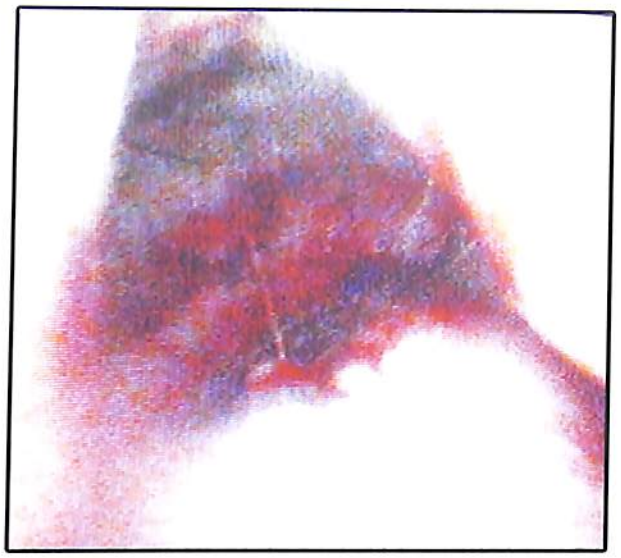

Fig.14. Ulceration and erythema of ear canal (D_1)

Fig.15. Dark brown ear wax obliterating ear canal (D_2)

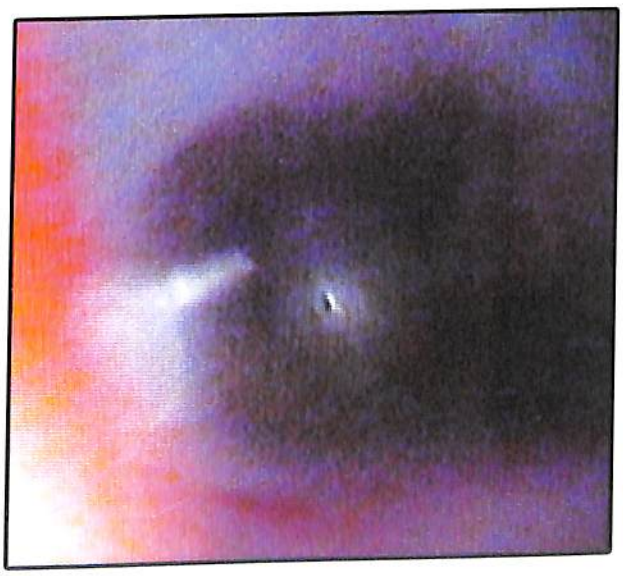

Fig.16. Tympanic membrane intact and pearly white (D_3)

Fig.17. Erythema with bleeding ulcers (D_4)

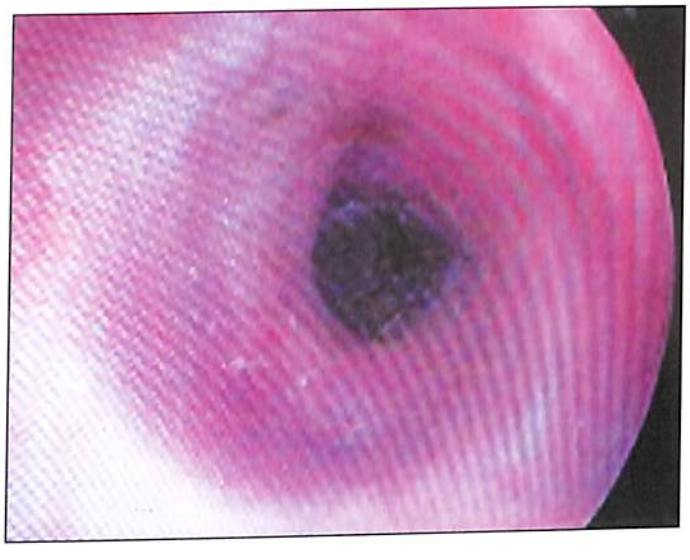

Fig.18. Mild erythema of the ear canal (D_5)

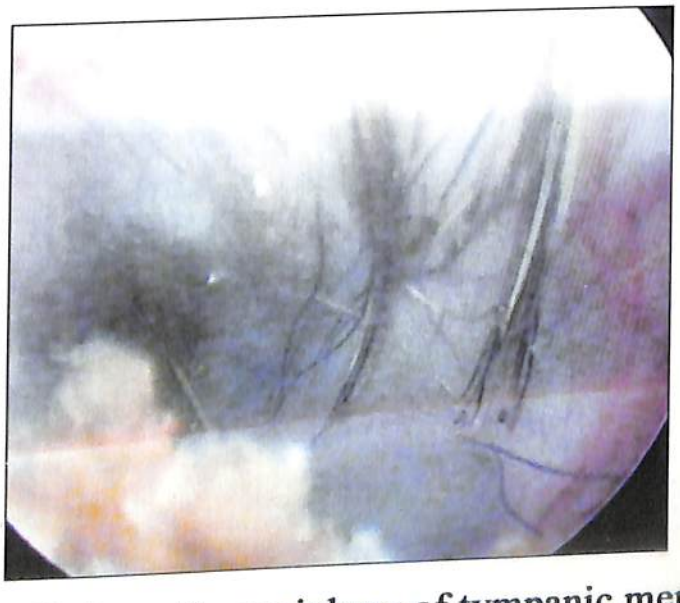

Fig.19. Tuft of hair on the periphery of tympanic membrane (D_6)

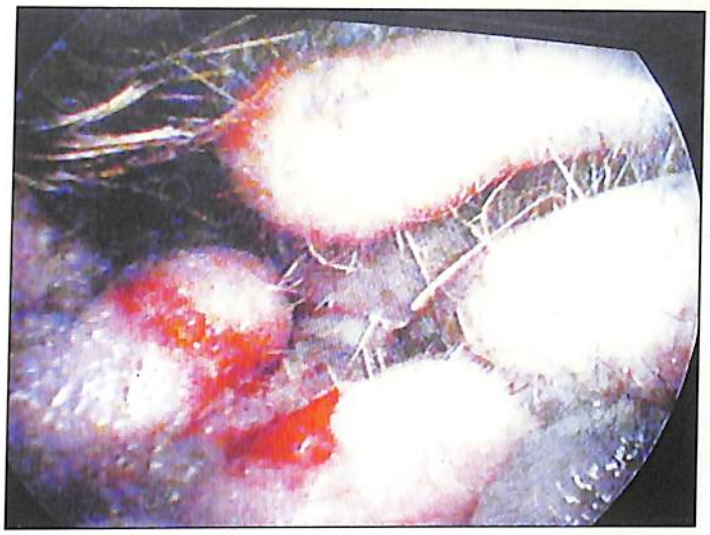

Fig.20. Bleeding ulcers near the tragus of ear (D_7)

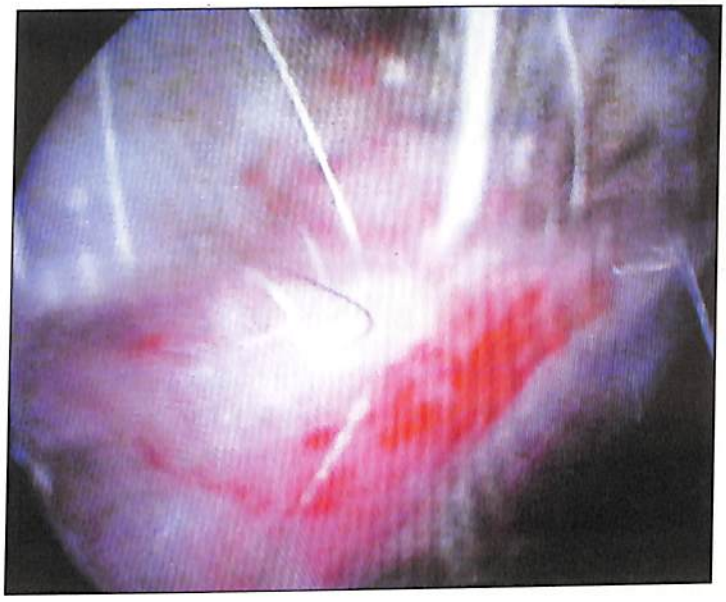

Fig.21. Ulcerations on the ear canal (D_8)

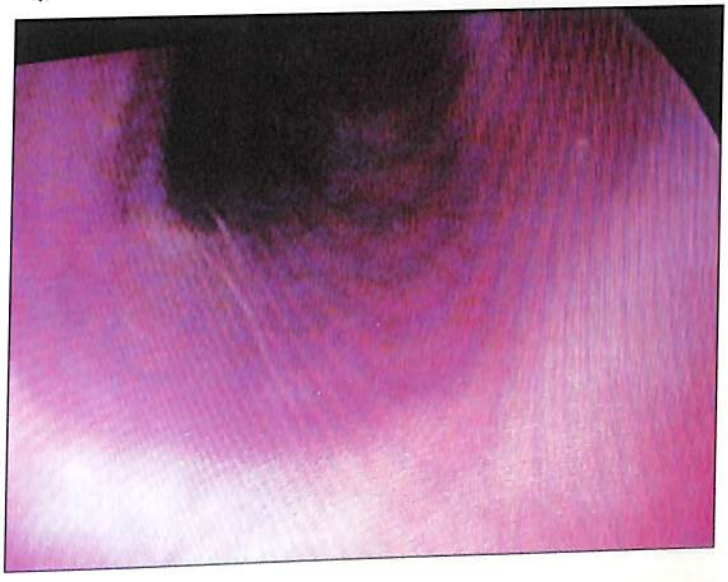

Fig.22. Erythema on the lining of ear canal (D_9)

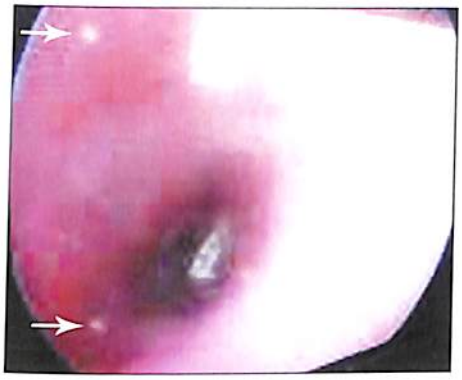

Fig.23. Ear mites inside the ear canal (D_{10})

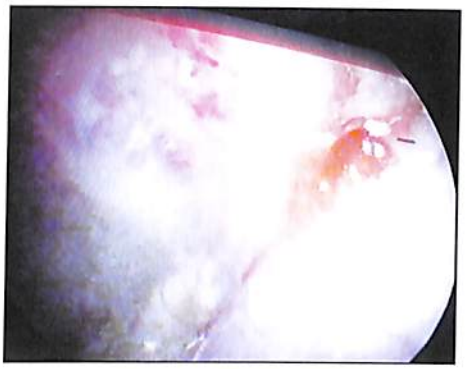

Fig.24. Bleeding ulcers and integument thickening of ear canal (D_{11})

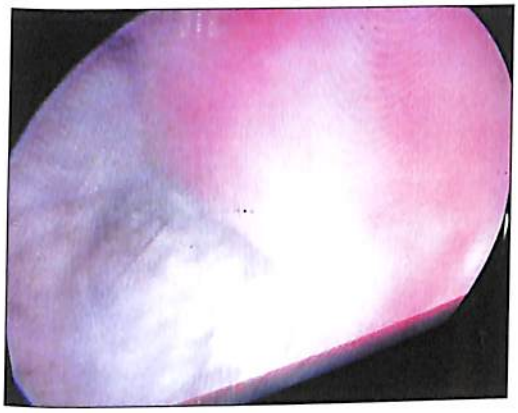

Fig.25. Creamy exudates filling the horizontal ear canal (D_{11})

Fig.26. Intact and glistening tympanic membrane (D_{12})

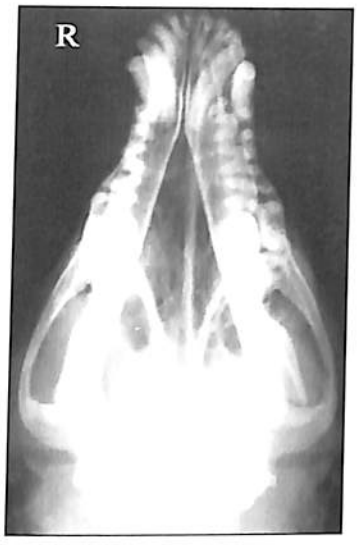

Fig.27. Normal ear canal lumen filled with air (Dorso-ventral view, D_1)

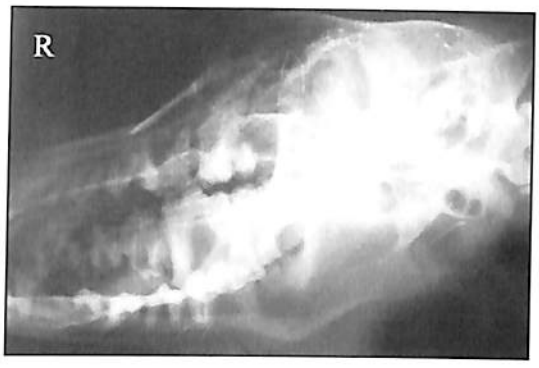

Fig.28. Clearly outlined tympanic bulla and air filled tympanic cavity (Lateral-oblique view, D_1)

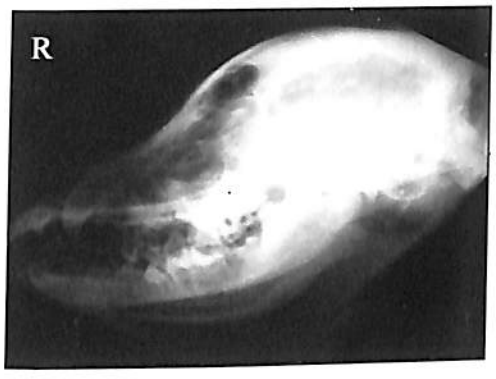

Fig.29. Thickening of wall of tympanic bulla and air filled tympanic cavity (Lateral-oblique view, D_2)

Fig.30. Opacification of wall of both ear canal (Dorso-ventral view, D_3)

Fig.31. Opacification of wall of both ear canal (Dorso-ventral view, D_4)

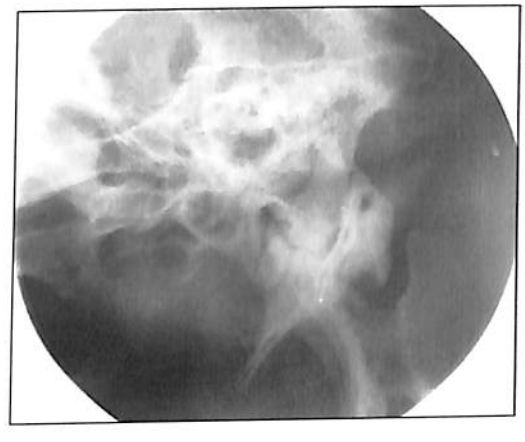

Fig.32. Lytic changes on the wall of tympanic bulla and radiolucent tympanic cavity (Lateral-oblique view, D_4)

Fig.33. Normal ear canal lumen filled with air (Dorso-ventral view, D_5)

Fig.34. Thickening of right tympanic bulla
(Rostro-caudal open mouth view, D_8)

Fig.35. Moderately thickened right tympanic bulla
(Dorso-ventral view, D_{10})

Fig.36. Thickening of the wall of the tympanic bulla
(Lateral-oblique view, D_{11})

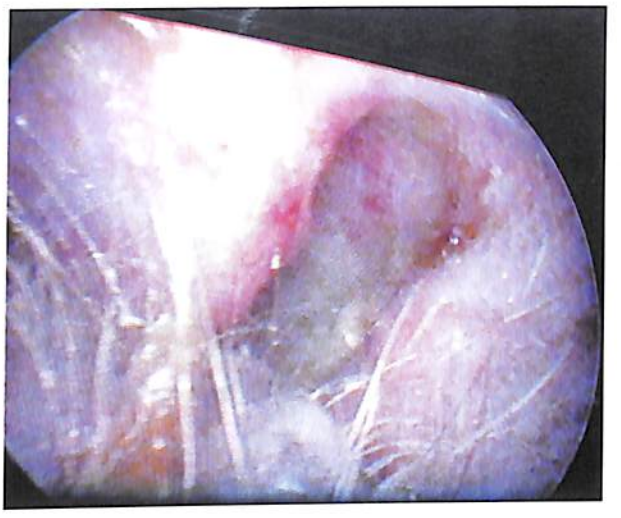

Fig.37. Integument regaining the normal status (D_2)

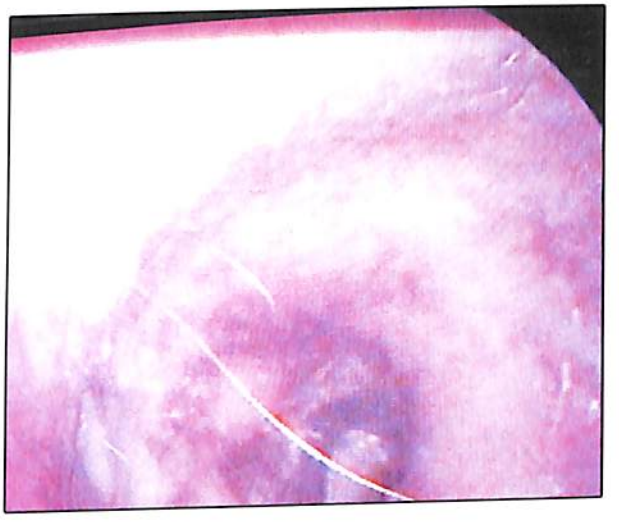

Fig.38. Erythema and stenosis of the lumen of ear canal (D_3)

Fig.39. Nodular growth obliterating the canal lumen (D_4)

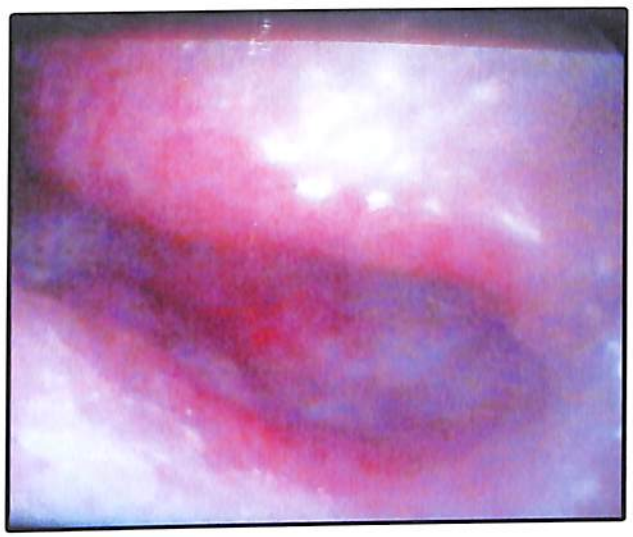

Fig.40. Erythema of the lining of ear canal (D_5)

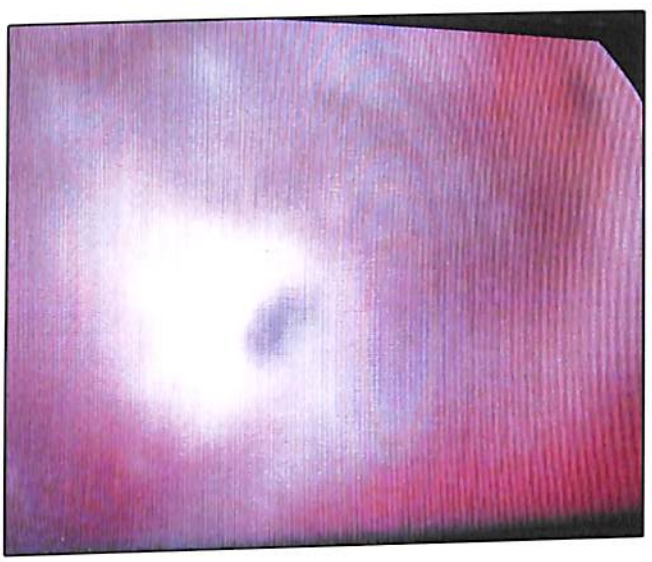

Fig.41. Ulcers in the healing stage (D_7)

Fig.42. Mild erythema of the canal and intact tympanum (D_8)

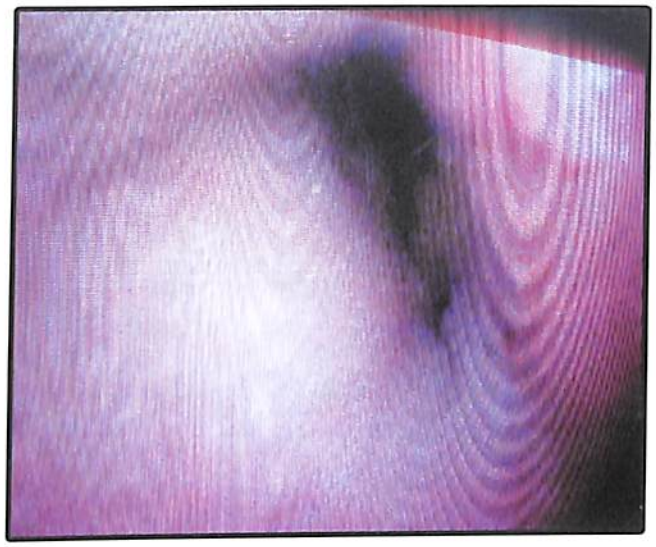

Fig.43. Ear canal in normal appearance (D_9)

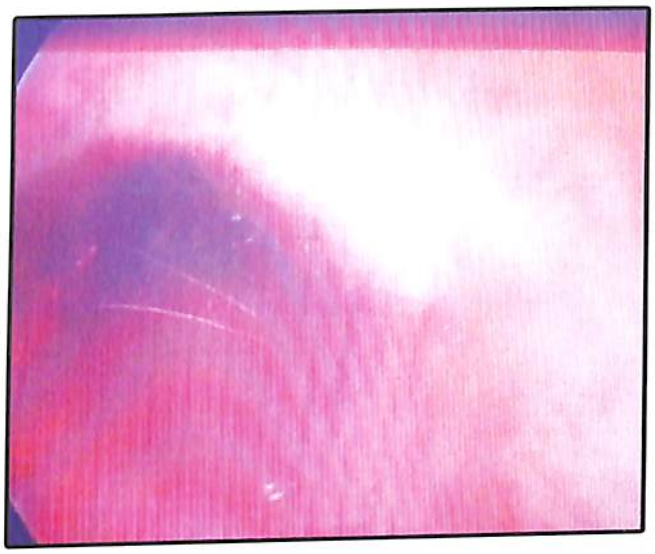

Fig.44. Ear canal with reduced inflammation, erythema and ulceration (D_{10})

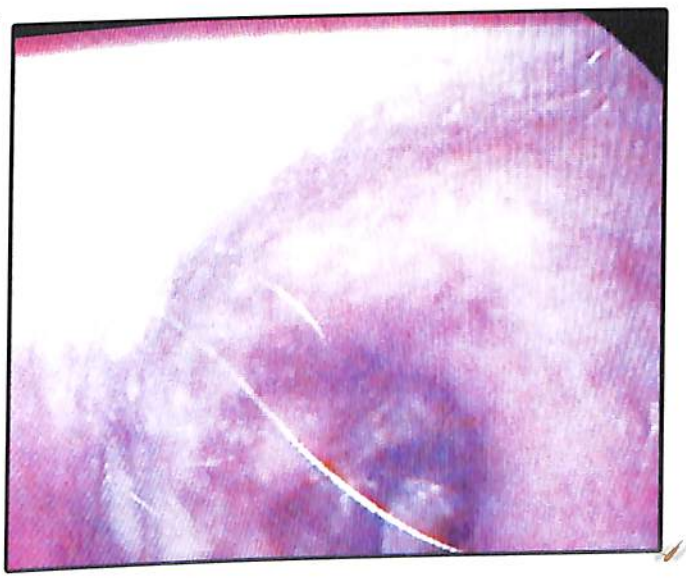

Fig.45. Mild erythema and ulcers and exudate filling the horizontal canal (D_{11})

Discussion

5. DISCUSSION

Otitis externa is a disease of multi-factorial etiology commonly affecting canines, often a diagnostic and therapeutic challenge to resolve. The present study was undertaken with an objective to evaluate the endoscopic changes associated with otitis in dogs and its management. Twelve clinical cases of otitis in dogs of different breeds and age groups of either sex presented to the Veterinary Hospitals of College of Veterinary and Animal Sciences at Mannuthy and Kokkalai formed the subjects of study. These animals were serially numbered from D_1 to D_{12} and were subjected to detailed history, clinical observations, antimicrobial sensitivity of the otic discharge, endoscopic and radiographic evaluation of the ear canal to assess the extent of the involvement.

Anamnesis and signalment

Among the twelve cases selected for the study, nine were German Shepherd Dogs, one each from Cocker spaniel, Dachshund, and Labrador retriever. Highest incidence was seen in German Shepherd Dogs which is in accordance with the findings of Kiss *et al.* (1997). Breed susceptibility might be the main predisposing factor for the higher incidence of the condition in these dogs. Yoshida *et al*. (2002) opined the high relative humidity in the ear canal predispose these breeds to otitis externa. Fossum (2007) reported that among the erect eared breeds of dog the German Shepherd Dogs were the frequently affected. German Shepherds were the most affected (31.14%), followed by the Spitz (29.87%), mongrel (18.8%) and Cocker Spaniel (6.49%) as reported by Chaudhary and Mirakhur (2002).

Age of the dogs ranged from 3 months to 8 years with the mean age of 4.56 years. Fraser *et al.* (1970) reported a greater incidence of otitis in dogs between

three and six years with a peak incidence in dogs of four years of age. August (1988) and Sarierler and Kirkan (2004) found an increased incidence of otitis externa in dogs of 5 to 8 years of age which reflect an overall increase in the prevalence of skin disorders whereas Kiss *et al*. (1997 b) reported that 51 % of dogs affected with otitis were in between two and five years of age.

Among the twelve dogs selected for study 10 were male dogs and two were female dogs which was similar to the findings of Sylvestre (1998). The author opined that there were significantly fewer females than males in dogs affected with otitis. In a study Kiss *et al*. (1997 a) reported that males comprised 55.9 % of the dogs affected with otitis externa. Chaudhary and Mirakhur (2002) found out that 63.34% were males and 36.36% were females.

The duration of illness ranged from one week to one year. Of the twelve cases studied, six cases were chronic in nature and duration of illness in such cases was from 15 days to 1 year. Gotthelf (2000 a) opined that dogs with otitis externa that had been presented for 45 to 60 days might be having a co-existing otitis media.

Of the twelve, 5 dogs had history of previous occurrence and were non-responsive, relapsing or recurrent. This was in accordance to the findings of Little (1996). Devaya *et al*. (1994) reported relapse or recurrence of ear infection with mere symptomatic treatment.

Three dogs, D_1, D_4 and D_6 had dermatitis at the time of presentation and one dog (D_{10}) had tick infestation. Rosser (1988) opined to conduct a thorough dermatological examination to eliminate the possibility of primary dermatological disease while evaluating patients with otitis externa. Eger and Lindsay (1997) also

opined that otitis externa had its genesis in generalized skin conditions such as atopy, ectoparasitism or foreign bodies.

Maggot infestation of the ear canal were observed in three cases similar to the observations of Shenoy (2004) who observed maggots in the ear canal of dogs affected with otitis. A history of occurrence of aural haematoma resulted in puckering of the ear pinna in two dogs.

Clinical observations

The clinical symptoms observed included discharge from the affected ears, pawing or rubbing of the affected ear, shaking of head which were in accordance with the findings of August (1988) and Shell (1988).

The condition was unilateral in nine dogs, with the right ear affected in seven dogs and the left ear affected in two dogs whereas, the condition was bilateral in three dogs. Fraser *et al.* (1970) reported bilateral ear involvement in 73.59%, left ear alone in 13.5% and right ear alone in 12.9% of the cases of otitis in dogs. In a study of chronic otitis in 42 dogs Barrasa *et al.* (2000) diagnosed bilateral otitis in 17 cases and unilateral otitis in 25 cases.

Among the twelve dogs, six dogs were active, four were of aggressive nature and two dogs were dull. Shell (1988) reported that some dogs with otitis become depressed, anorectic or febrile.

Head tilting to the affected side was observed in four dogs similar to the observations of Venkes-van-Haagen (2005). The author opined that the pain associated with the ear disease would cause the dog to turn its head slightly with the

painful ear downward. Fossum (2007) reported a sharp painful response on deep palpation of the ear which indicated middle ear infection, whereas a head tilt indicated severe pain in the ear on the lower side or otitis media or interna.

Dog (D_{10}) with otodectic otitis had clinical signs like pruritus and head shaking. This was in accordance with the findings of Nesbilt (1983) and August (1988) who reported pruritis, alopecia of the ear pinna, head shaking along with excoriations posterior to the base of the ear as clinical signs of otodectic otitis.

Nature of the otic discharge

The colour of otic discharge was dark brown in seven dogs, yellowish brown in two dogs and light yellow in three dogs. Rycroft and Saben (1977) reported dark brown otic exudates in 36.5% of dogs and 53% had pale yellow discharge.

The otic discharge was creamy in consistency in seven dogs, whereas it was waxy in four cases and in one dog it was watery. Kowalski (1988) and Fossum (2007) reported infected ears with more amount of yellowish fluid exudate associated with Gram negative bacterial infection and brownish black exudates with infections due to ear mites, *Malassezia* or with *Staphylococci*. Nuttall and Cole (2007) reported purulent malodorous otic discharge in otitis caused by *Pseudomonas* spp.

Antibiotic sensitivity testing

Out of the twelve cases, otic cultures revealed Gram negative coccobacilli in six cases, Gram positive cocci in two cases, Gram negative short rods in one case

and *Pseudomonas* in one case. These observations were similar to the findings of Harvey *et al*. (2001) who opined the bacterial flora of the canine external ear canal was principally a Gram positive flora. Chronic inflammation was accompanied by increased number of Gram negative bacteria. Barrasa *et al.* (2000) isolated Gram positive bacteria in 61% and Gram negative bacteria in 37% of the cases with chronic otitis externa. Yoshida *et al.* (2002) isolated *Pseudomonas* spp. and *Proteus* spp. from ears with otitis externa. Oliveira *et al.* (2006) conducted study on 62 dogs with otitis and the infection was monomicrobial in 76.6% of them.

In one case there was mixed infection with Gram negative short rods, Gram negative coccobacilli and yeast similar to the findings of Little (1996 b). He opined that in otitis externa mixed bacterial or bacterial and yeast infections were common. Blue and Wooley (1977) also reported in a study where 49.6% were Gram-positive aerobic bacteria, 2.6% were Gram positive anaerobic bacteria, 43.4% were Gram negative aerobic bacteria, 3.7% were yeast and 0.9% were fungi.

The isolates from eight dogs were most sensitive to the antibiotics enrofloxacin, ciprofloxacin, cefotaxime and gentamicin which were in accordance with the findings of Reddy *et al.* (2006). Dog D_{10} was sensitive to polymixin B. The isolates from D_2 and D_5 were resistant to all the antibiotics. Dwivedi and Sodhi (1987) found sensitivity of the otic isolates to gentamicin, erythromycin and chloramphenicol. Kiss *et al.* (1997) reported that pseudomonas showed sensitivity to gentamicin, polymixin B, and tobramycin. In contrast, Sarieler and Kirkan (2004) observed that the otic isolates showed resistance to cefuroxime, erythromycin, gentamicin, ampicillin and cephoperazone.

Anaesthesia

Under atropine sulphate and xylazine hydrochloride premedication followed by ketamine anaesthesia ear cleaning, endoscopy and radiography procedures were performed convieniently which were in agreement with Shenoy (2004) and Suresh *et al.* (2007). They reported premedication with atropine sulphate (0.04 mg/kg body weight) and xylazine (1 mg/kg body weight) and anaesthesia with ketamine hydrochloride (5-10 mg/kg body weight) was adequate for the examination of the ear canal, otoscopic examination and radiographic procedures. Griffin (2006) opined that inflammation may make it difficult to complete otoscopic examination without sedation.

Endoscopic evaluation of the ear canal

The endoscopic examination of the ear canal was done after placing the anaesthetised animal on lateral recumbency with the affected ear above. The otoscopic cone was inserted at the intertragic incisure as described by Cole (2009). While inserting the otoscope, the ear pinna was gently pulled upward and outward and the external ear canal was extended into a straight line. This helped to visualize the entire length of the ear canal and tympanic membrane similar to the procedure followed by Venkes-van Haagen (2005) and Suresh *et al*. (2007).

The otoscopic examination was carried out in fifteen ears of twelve dogs with otitis. Otoscopic findings like status of the integument of the ear canal, ulcerations, erythema, otorrhoea, presence of foreign bodies, parasites, masses, degree of stenosis and alterations in the morphology of the tympanic membrane were recorded (Rosser, 1988; Palmeiro *et al*., 2004; Rosychuk, 2005; Oliveira *et al*.,

2008). Otoscopic examination revealed mild inflammation in seven ears, moderate inflammation in three ears and severe inflammation in five ears.

Ulcerations were noticed in ten ear canals of which in five cases (D1, D_4 (Right), D7, D10 (Right) and D_{11}) the ulcers were of bleeding and deep nature. Small superficial ulcers were noticed in two ear canals (D_6 (Right) and D_9) whereas in the left ear canal of dog D_4, healed ulcers were seen. Ulcerations of the skin of the ear canal associated with bacterial infections was reported on otoscopic examination (Ordeix and Scarampella, 2008).

Erythema of the wall of the ear canal was noticed in twelve cases in accordance with the findings of Dickson and Love (1983). The authors reported that out of 31 dogs presented with otitis externa, 19 showed severe erythema of the walls of the ear canal.

Mild stenosis of the ear canal was noticed in three cases; D_1, D_7 and D_{12}. In dogs D_4 and D_5 and in the left ear canal of dog D_3 moderate degree of stenosis were present. Eom *et al.* (2000) reported that stenosis of the ear canal prevented visualization of the tympanic membrane in 32% of the cases.

Out of the fifteen ear canals examined, tympanic membrane was visible in eight cases. The tympanic membrane appeared intact, pale, transparent glistening structure in seven cases whereas in dog D_1 the tympanic membrane was slightly opaque. Trower *et al.* (1998) reported that on otoscopic examination, 80% of the dogs in the study had otitis externa and the tympanic membrane was visible in 66% cases.

In the right ear canal of dog D_6 and in dog $D_{11,}$ the presence of purulent exudate mixed with necrotic debris obscured visualization of the tympanic membrane similar to the observations of Nuttall (1998) and Gotthelf (2004). They observed copious mucoid exudate along the floor of the horizontal canal with open ear drum in dogs with otitis media. Trower *et al.* (1998) and Ordeix and Scarampella (2008) opined that the tympanic membrane was obscured in dogs with cerumen, debris or hair in the horizontal canal or by stenosis of the canal.

Impacted wax occluding the canal lumen prevented visualization of the tympanic membrane in the left ear canal of dogs D_2 and D_4. Eom *et al.* (2000) reported waxy or thick debris in 68% of ear canals on otoscopic examination. Ordeix and Scarampella (2008) reported that otitis was associated with occlusion of the ear canal with impacted wax especially in older patients affected with otitis externa in the past.

In dog D_6, a tuft of hair was seen adhering to the tympanic membrane in its periphery which is in agreement to the observations of Ordiex and Scarampella (2008). They opined that in some dogs with normal ear canal a tuft of hair was present in front of the tympanic membrane.

Otoscopic examination of dog D_4 revealed the presence of a growth just below the orifice of the right ear canal similar to the findings of Kumar *et al.* (2009). The growth was of smooth texture and pale pink in colour. The size of the mass was increasing thereby obliterating 75% of the canal lumen in a period of two weeks. Kumar *et al*. (2009) observed a polyp mass on otoscopic examination in the vertical portion of the ear canal. Intraluminal tumours might also act as foreign body in the external ear canal (Murphy, 2001). Ordiex and Scarampella (2008) reported that sebaceous and ceruminous glands become enlarged which may appear

as cystic or nodular growth and the masses may be inflammatory or neoplastic in nature.

Ear mite, *Otodectus cynotis* were seen during the otoscopic examination of the left ear canal in dog D_{10}. Few mites were seen moving on the wall of the horizontal ear canal near the tympanum similar to the observations of Little (1996) and Angus (2004). *Otodectus cynotis* appeared as pearly free moving mites associated with dark brown crumbly debris. Six *et al.* (2000) confirmed *Otodectus cynotis* infestation in dogs by direct or otoscopic examination of the external ear canal and by the microscopic examination of the aural exudate.

Presence of ear mite in dog D_{10} confirmed the primary cause of otitis in this dog as otodectic otitis. In dog $D_{4,}$ presence of nodular growth in the ear canal act as a predisposing cause for otitis. The primary causes of otitis include parasites like ear mites, foreign bodies, hypersensitivity, allergic disorders, keratinization disorders and autoimmune disorders. The predisposing factors include conformation of the ear canal, ear canal maceration, climatic variation, treatment errors, obstructive ear diseases, pyrexia and systemic diseases. (August, 1988; Rosser, 2004). Little (1996) reported that aural tumours alter the environment of the ear canal and interfere with the usual self cleaning mechanism of the ear.

Radiographic observations

Plain radiographs of the affected ears were taken in dorso-ventral, lateral-oblique and rostro-caudal open mouth views. The exposure settings used for radiography were found adequate for the technique, which was in agreement with the findings of Dickie *et al.* (2003) and Shenoy (2004).

Radiographic assessment of the external ear canal and the tympanic bullae were helpful in determining the extent of bony involvement as opined by Gotthelf (2004). Shenoy (2004) stated that dorso-ventral views were ideal for evaluation of the external ear canal and the petrous temporal bone and lateral –oblique view and rostro-caudal; open mouth views were ideal for evaluation of the individual tympanic bulla.

Opacification indicating calcification of the wall of the ear canal was evident in the dorso-ventral radiographic view of the skull in dogs D_2, D_3, D_4, and D_{11}. Reduction in the diameter of the canal lumen was evident in dogs D_3 and D_{11}. Similar findings with narrowing of the lumen of the horizontal canal with calcification of the cartilage of the ear canal were reported (Gibbs, 1978; Shell, 1988; Little, 1996 c; and Bischoff and Kneller, 2004). In a clinical study on 31 otitic dogs, stenosis and ossification of the horizontal canal were evident radiographically in 35% of the cases (Trower *et al*., 1998). Calcification of the external ear canal was common with chronic otitis externa, influencing the choice of the surgical technique (Fossum, 2002).No radiographic changes were evident in the dorso-ventral view of the skull in dog D_1 and D_5. Lateral- oblique view showed clearly outlined wall of the tympanic bulla with air-filled tympanic cavity in dog D_1 which were in agreement with the findings of Shell (1988) and Gotthelf (2004).

Thickening of the outer wall of the tympanic bulla with air filled tympanic cavity were seen in the lateral oblique view in dogs D_2, D_3 and D_{11}. Radiographic findings associated with the pathology of the middle ear like soft tissue opacity of the bulla, sclerosis of the wall of the tympanic bulla, bony proliferation of the petrous temporal bone etc. were evident in dogs with otitis (Bischoff and Kneller, 2004). Lytic changes in the tympanic bulla with radiolucent tympanic cavity was evident in dog D_4.

Treatment

Medical management of otitis was carried out in all the twelve cases. Both oral and topical antibiotics were administered in all dogs, except D_9 in which only topical antibiotics were used. The oral antibiotics (cephalexin in nine dogs, ciprofloxacin and enrofloxacin in one dog each) were continued for seven consecutive days and topical otic preparation containing ofloxacin, clotrimazole, beclomethasone dipropionate and lignocaine were instilled thrice daily for two weeks. Devaya *et al*. (1994) opined the treatment of otitis was effective when treated both locally and systemically. Morris (2004) stated that topical therapy is the key to the successful resolution of otitis externa. Unless the ear canal epithelium is eroded or ulcerated, systemic antimicrobials are unlikely to attain therapeutic concentration within the ear canal.

Otoscopic examination was done on the fourteenth day to evaluate the result of treatment as reported by Tobias and Morris (2005).

All dogs except dog D_6 was presented for review after two weeks. There was marked improvement in condition in seven cases with improvement in clinical signs of otitis and reduction in inflammation . In four cases moderate improvement was reported with slight reduction of inflammation and healing of ulcers. In Dog D_{11} the horizontal canal was filled with purulent discharge.

Otic flushing was carried out in three cases with normal saline. In dog D_2 antibiotic Gentamicin was also used for flushing. Otic flushing of the ear canal with normal saline was an important adjunct in the management of otitis. (Devaya *et al*.,

1994; Palmerio *et al*. 2004; Tobias and Morris (2005); Venkes-van- Haagen, 2005). Thorough otic flushing was essential for the successful resolution of otitis in chronic cases and general anaesthesia was required for otic flushing (Gortel, 2004).

In dog $D_{4,}$ the size of the nodule was found increasing, consequently obliterating the canal lumen and the mass was visible from outside. The owner was advised to present the dog for surgical removal of the mass if it was completely obliterating the canal lumen. In dog $D_{10,}$ ear mites were not seen on review examination after two weeks but ear canal showed moderate inflammatory changes.

Summary

6. SUMMARY

The study was conducted in twelve clinical cases of dogs of different breeds and age groups of either sex with a history of otitis presented to the Veterinary Hospitals of College of Veterinary and Animal Sciences at Mannuthy and Kokkalai, to evaluate the associated endoscopic changes in the ear and its management.

The animals were serially numbered from D_1 to D_{12} and subjected to detailed clinical examination to study the type and extend of lesions present. All the animals were subjected to endoscopy of the ear canal to assess the extent of affection of the ear.

The study revealed a higher incidence of otitis in German Shepherd Dogs with the incidence more in male dogs than females and majority of animals were with a mean age of 4.56 years.

The symptoms observed included discharge from the affected ear, pawing and rubbing of the affected ear, shaking of the head, painful responses on palpation of the base of the ear, tilting of head to the side of affection and drooping of the affected ear.

Physiological parametes like respiration rate, pulse rate and rectal temperature of all the animals were within the normal range on the day of otoscopic examination. There were statistically significant variation in the mean rectal temperature on the day of endoscopic examination and the fourteenth day. Heamatological parameters recorded were within the normal range and there was

no significant statistical variation between these parametes on the day of endoscopic examination and on the fourteenth day.

The colour of the otic discharge was dark brown in majority of the cases, yellowish brown and light yellow were seen in rest of the cases. The consistency of the otic discharge was creamy in majority of cases and in others it appeared as waxy and watery.

Gram negative coccobacilli, gram positive cocci, gram negative short rods, Pseudomonas sp., and mixed culture of gram negative short rods, gram negative coccobacilli and fungal spores were isolated from the otic discharge. Majority of the isolates were gram negative coccobacilli sensitive to gentamicin.

Premedication with atropine sulphate (0.045 mg/kg body weight) and xylazine hydrochloride (1.5 mg/kg body weight) and anaesthesia with ketamine hydrochloride (5mg/kg body weight) were satisfactory for the examination of the ear canal, endoscopic examination and radiographic procedures.

The endoscopic evaluation was carried out in fifteen ears of twelve dogs with otitis. Endoscopic findings like status of the integument of the ear canal, ulcerations, erythema, otorrhoea, presence of foreign bodies, parasites, masses, degree of stenosis and status of the tympanic membrane were recorded. Endoscopic examination revealed mild inflammation in seven ears, moderate inflammation in three ears and severe inflammation in five ears. Erythema, ulceration of the lining of the ear canal and stenosis of the lumen of the ear canal were recorded in most of the cases. Tympanic membrane was visible endoscopically in eight cases and in majority of the cases it appeared as a pale, transparent and glistening structure. In two cases presence of purulent exudates and necrotic debris within the horizontal

canal prevented visualization of the tympanic membrane. In another two cases impacted wax obscured viewing the tympanic membrane. Endoscopic examination revealed the presence of a growth just below the orifice of the right ear canal in dog D_4 and ear mites *Otodectus cynotis* were seen in the left ear canal in dog D_{10}.

The observations on plain radiographs of the ear taken in dorso-ventral, oblique-lateral and rostro-caudal open mouth views were recorded. Opacification indicating calcification of the wall of the ear canal was evident in the dorso-ventral radiographic view in five dogs. Thickening of the outer wall of the tympanic bulla with air filled tympanic cavity were seen in the lateral oblique view in three dogs. Lytic changes in the tympanic bulla with radiolucent tympanic cavity were evident in dog D_4.

Medical management of otitis was carried out in all the twelve cases where both oral antibiotics (cephalexin in nine dogs and one dog each with enrofloxacin and ciprofloxacin) and topical otic preparation containing ofloxacin, clotrimazole, beclomethasone dipropionate and lignocaine. Both oral and topical antibiotics were administered in all dogs except D_9 in which only topical antibiotics were used. The oral antibiotics were continued for seven consecutive days and topical ear drops were instilled thrice daily for two weeks. Otic flushing with normal saline was carried out in three cases.

Endoscopic examination of the ear canal was done on the fourteenth day to evaluate the response to treatment. Of the eleven dogs presented for review, seven dogs showed marked improvement and four dogs showed moderate improvement. The inflammation had started subsiding with reduction in erythema, ulceration and marked reduction in the clinical signs of the disease.

In dogs where the lesions of the ear canal were apparently healed and the condition had improved were graded as cured of the condition. The animals, which were not brought for review, were reported to be cured of the condition. The animals, which showed response to treatment but the complete cure, took a long course were graded as having improved status.

The following conclusions could be drawn from the study:

1. Higher incidence of otitis was recorded in German Shepherd Dogs.
2. Relapse or recurrence of ear infection was observed in dogs which underwent mere symptomatic treatment during previous occasions.
3. A systematic approach in diagnosis could help in accurate assessment of the degree of involvement of ear canal in otitis.
4. Microbial culture and antibiotic sensitivity of the otic exudates could help to select the most effective antibiotic for treatment.
5. The majority conditions of otitis were caused by Gram negative coccobacilli and the effective antibiotic was cephalexin.
6. Premedication with atropine sulphate and xylazine hydrochloride and anaesthesia with ketamine hydrochloride was satisfactory for endoscopic and radiographic evaluation of the ear canal in otitis.
7. Endoscopic examination of the ear canal could reveal the underlying pathologic lesions like erythema, ulceration, stenosis of the ear canal, presence of ear mites, foreign bodies, masses, occlusion of ear canal with otic discharge and integrity of the tympanic membrane and also helped to assess the status of the integument of ear.
8. Necessity of otic flushing to be choosen as a treatment procedure in condition of occlusion of ear canal with otic discharges.
9. Radiographic evaluation of the ear canal in dorso-ventral, oblique-lateral and rostro-caudal open mouth view were the ideal for assessing the changes in the ear canal and the tympanic bullae.

10. Oral administration of cephalexin as the antibiotic and topical application of otic preparation containing ofloxacin, beclomethasone dipropionate, clotrimazole and lignocaine were the most successful treatment for the management of otitis in dogs.
11. Response to the treatment of otitis could be judged by a review endoscopic evaluation of the ear canal so as to decide further intensive approach if necessary.

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ENDOSCOPIC EVALUATION OF OTITIS AND ITS MANAGEMENT IN DOGS

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ABSTRACT

The study was carried out in twelve clinical cases of dogs of either sex with history of affection of ear canal of different breeds and age groups presented to the Veterinary Hospitals of College of Veterinary and Animal Sciences at Mannuthy and Kokkalai to evaluate the endoscopic changes of the ear canal associated with otitis and its management.

The animals were subjected to detailed clinical examination to study the type and extent of lesions present. Microbial culture and antibiotic sensitivity of the otic discharge was done in all cases and animals were subjected to endoscopic evaluation of the ear canal to assess the extent of affection after administering atropine sulphate and xylazine hydrochloride for premedication followed by ketamine hydrochloride to effect anaesthesia.

The study revealed a higher incidence of otitis in German Shepherd Dogs. The incidence was more in male dogs than females with a mean age of 4.56 years. The symptoms observed included discharge from the affected ears, pawing and rubbing of the affected ear, shaking of the head, painful responses evinced while palpating the base of the ear, tilting of the head to the side of affection and drooping of the affected ear.

Physiological parameters of all the animals were within the normal range on the day of otoscopic examination. There were statistically significant variation in the mean temperature recorded on the day of endoscopic examination and the fourteenth day. Heamatological parameters recorded were within the normal range and there was no statistical variation between these parameters recorded on the day of endoscopic examination and on the fourteenth day.

Gram negative coccobacilli, Gram positive cocci, Gram negative short rods, Pseudomonas sp., and mixed culture of Gram negative short rods, Gram negative coccobacilli and fungal spores were isolated from the otic discharge. Majority of the isolates were Gram negative coccobacilli sensitive to gentamicin.

Endoscopic evaluation revealed inflammation of the ear canal with ulceration, stenosis and erythema of the lining of the canal. A nodular growth in the ear canal was observed in one case and presence of ear mite *Otodectus cynotis* were identified in another dog. The status of the tympanic membrane was assessed in cases were the tympanic membrane was visible otoscopically.

Radiographic changes noted in plain radiographs in dorso- ventral, lateral-oblique and rostro-caudal open mouth view include ossification of the external ear canal and thickening or lysis of the tympanic bulla.

Medical management of otitis was carried out with topical otic preparation containing ofloxacin, beclomethasone dipropionate, clotrimazole and lignocaine and oral antibiotics (cephalexin in nine dogs and one dog each with enrofloxacin and ciprofloxacin) and the response to the treatment was assessed endoscopically after fourteen days of treatment.