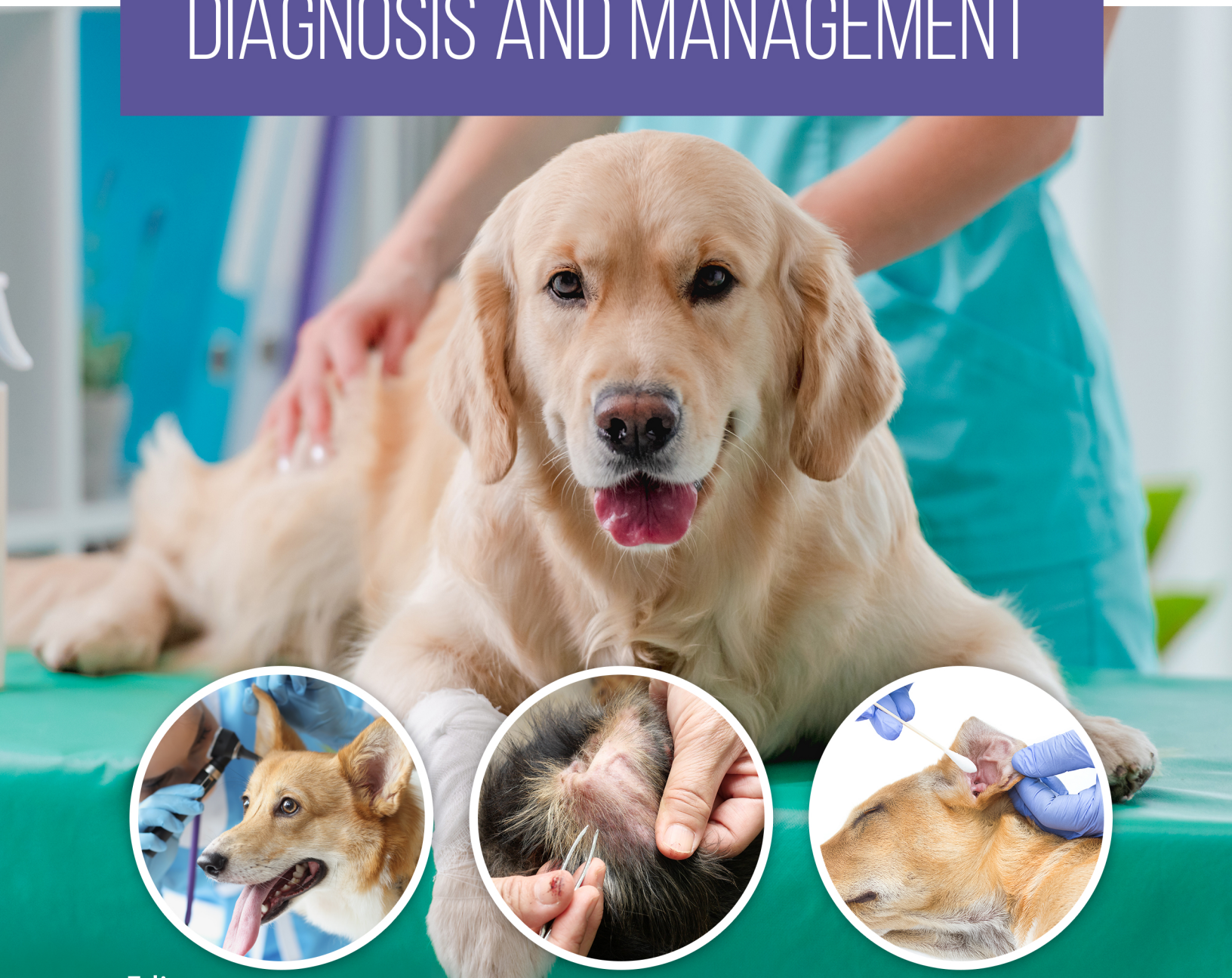
COMMON EAR DISEASES IN DOGS: DIAGNOSIS AND MANAGEMENT



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Common Ear Diseases in Dogs: Diagnosis and Management

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Editor: Tanmoy Rana

ISBN (Online): 978-981-5313-59-8

ISBN (Print): 978-981-5313-60-4

ISBN (Paperback): 978-981-5313-61-1

First published in 2025.

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PREFACE

Common Ear Diseases in dogs: Diagnosis, and Management 1e book cover otic disease as a serious ailment at the forefront of veterinary medicine. The book covers updated information for practicing veterinarians in identifying small animal ear diseases. It also illustrates the anatomy of the ear, examination techniques, pathophysiology, and treatment strategy to prevent the disease. Various predisposing factors, primary causes, and perpetuating factors associated with ear diseases in dogs are elaborately described in the book. Various therapeutic options with new drugs, and nutritional products may prove to be valuable in the prevention and treatment of ear diseases in dogs. The book covers an extensive study of the diseases of the pinna, external ear canal, middle ear, and inner ear. Various photos are included in the book for easy identification of diseases. The book is an invaluable resource for both veterinarians in training and in practice for gathering knowledge about the ear diseases of dogs. The contributors are specialized in their knowledge for the writing of the individual chapter. This book is especially intended for pet practitioners, academics, researchers, veterinarians, and DVM graduate students engaged with a special interest in pet animal health, and management. I hope that this book serves new paradigms for the stimulus to further research in clarifying the pathomechanisms, diagnosis, and treatment of ear diseases in dogs. I expect that the reader will find this book interesting as well as up-to-date information about ear diseases and will utilize the knowledge in the research and teaching to the new generation. I always welcome constructive feedback and encouragement from my veterinarian colleagues all over the world.

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CHAPTER 1

Introduction

Apoorva Mishra[1,*], **Randhir Singh**[1], **Babita Das**[1] and **Shobha Jawre**[1]

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Abstract: This chapter discussed some common ear illnesses such as otitis, haematoma, tumors *etc*. and establishes the groundwork for understanding the significance of ear health in dogs. We will go more into each ear ailment and examine diagnosis and treatment options in the upcoming chapters. It is crucial for any veterinarian to comprehend the anatomy of a dog's ear, identify common ear illnesses, and know how to diagnose and treat them.

Keywords: Anatomy of ear, Common ear diseases, Diagnosis and prevention.

INTRODUCTION

The ears are a crucial part of a dog's anatomy, serving not only as sensory organs but also playing a significant role in maintaining balance. Otitis externa, or inflammation of the skin lining the ear canal, is the most common cause of canine ear illness and can result in otitis media, a secondary infection of the middle ear chamber. The majority of the time, ear inflammation is a symptom of a more widespread skin condition. As a result, dogs with ear issues frequently lick or chew at their feet or experience irritation elsewhere. In addition to the ear illness, more severely infected dogs may also exhibit obvious signs of skin allergies throughout other body regions. Because of the environment inside the ear, the ears are frequently more seriously impacted by this generalized skin irritation than other parts of the body. The hypersensitivity or skin allergy first results in a mild degree of inflammatory processes, which promotes the growth of bacteria and yeast organisms that are ordinarily found on the skin. Most skin locations in dogs with moderate cases can escape considerable overgrowth of these organisms, but the warm, moist environment inside the ear canal creates the perfect conditions for these organisms to proliferate and subsequently exacerbate inflammation. As the organisms proliferate, more inflammation and skin damage are brought on by

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Tanmoy Rana (Ed.)

their presence, creating a vicious cycle. Unfortunately, due to their unique structure and susceptibility to various environmental factors, dogs are prone to a range of ear diseases. In this chapter, we will delve into the world of canine ear health, exploring the anatomy of a dog's ear, common ear diseases, their causes, symptoms, and preventive measures [1].

ANATOMY OF A DOG'S EAR

Before we delve into the specifics of ear diseases, it's essential to understand the basic anatomy of a dog's ear. A dog's ear consists of three main parts:

Outer Ear (Pinna)

The visible part of the ear is called the pinna, which varies in shape and size among different breeds. It's designed to capture sound waves and funnel them into the ear canal.

Middle Ear

The middle ear begins with the ear canal and includes the eardrum (tympanic membrane) and a system of small bones (ossicles). Sound waves are transmitted through the ear canal to the eardrum, where they are converted into vibrations.

Inner Ear

Beyond the eardrum lies the inner ear, which contains the cochlea, responsible for converting vibrations into electrical signals sent to the brain. The inner ear also plays a crucial role in balance and orientation.

The canine ear canal is more vertical than that of a human, forming an L-shape that tends to hold in fluid. This makes dogs more prone to ear infections. Ear infections are typically caused by bacteria, yeast, or a combination of both. In puppies, ear mites can also be a source of infection.

The pinna, middle ear, inner ear, and external ear canal form the canine ear. The cartilage of the auricle and annulus constitute the external ear. At the external ear canal opening, the pinna's auricular cartilage takes on the appearance of a funnel. After approximately one inch, the auricular and annular cartilage that makes up the horizontal ear canal emerges from the vertical ear canal. The three auditory ossicles, the tympanic membrane, and the air-filled tympanic cavity are part of the middle ear [2]. The pars flaccida and pars tensa make up the semitransparent tympanic membrane. The little epitympanic recess, the huge ventral bulla, and the tympanic bulla proper make up the tympanic cavity. The cochlea is located on the promontory, which is the medial wall of the tympanic cavity. A thin membrane

covers the cochlear (round) window, which is situated in the caudolateral section of the promontory. The stapes footplate is linked to a thin diaphragm that covers the vestibular (oval) window, which is situated on the dorsolateral surface of the promontory. The auditory tube is a brief canal that connects the rostral region of the tympanic cavity proper to the nasopharynx. The bones that carry and intensify air vibrations from the tympanic membrane to the inner ear are called auditory ossicles (Fig. **1**). The petrous part of the temporal bone contains a bony labyrinth that houses the inner ear. The membrane labyrinth, with its auditory and vestibular organs, is housed within the bone labyrinth [3].

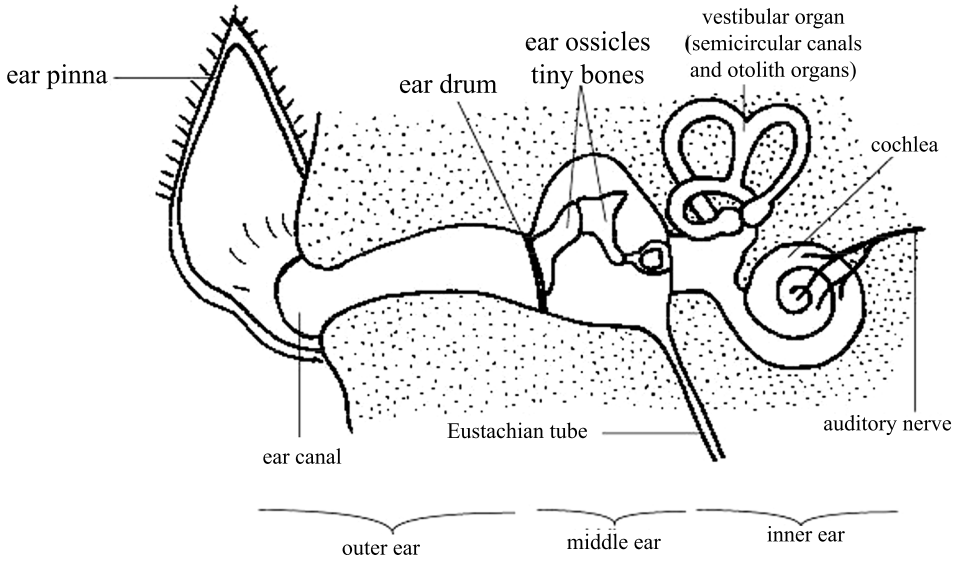

Fig. (1). Internal structure of ear of dog.

COMMON EAR DISEASES IN DOGS

Now, let's explore some of the most common ear diseases that affect dogs. There are three types of ear infections, known formally as otitis externa, media, and interna. The most common is otitis externa, in which inflammation affects the layer of cells lining the external portion of the ear canal. Otitis media and interna refer to infections of the middle and inner ear canal, respectively. These infections often result from the spread of infection from the external ear. Otitis media and interna can be very serious and may result in deafness, facial paralysis, and vestibular signs. That’s why it’s important to prevent infections and seek early treatment when problems arise [4].

CHAPTER 2

Normal Structure and Function of Ears

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Abstract: Hearing is one of the fundamental sense. Ear also known as the vestibulocochlear organ, is subdivided into three parts namely external, middle and inner ear. Auricle and external acoustic meatus comprise external ear. Sound waves are transmitted from the external ear to the middle ear. In dogs, breed-specific variances of external ear is noticeable. The auricle has a funnel-like shape which helps in sound collection. Auricle is divided into the proximal conchal cavity and distally located scapha. Anthelix divides the conchal cavity from the scapha and is located close to the conchal cavity. External acoustic meatus is made up of a proximal osseous portion and a distal cartilaginous portion. The cartilaginous portion of carnivores is relatively long and curved which hampers the passage of the straight otoscope for examination. The tympanic membrane consist of two parts, namely the pars flaccida and the pars tensa. The middle ear comprises the auditory ossicles (malleus, incus and stapes), muscles and auditory tube. Tympanic cavity is contained in the petrous temporal bone and has dorsal (epitympanicum), middle (mesotympanicum) and ventral (hypotympanicum) section. Auricular ossicles are located in the dorsal portion. The tympanic membrane is located on the lateral wall of the middle portion. The tympanic bulla is known as the ventral hypotympanicum. Internal ear has membranous and osseous labyrinth. The membrane labyrinth is filled with endolymph and includes the vestibular labyrinth which houses the receptor organ for balance and cochlear labyrinth containing the organ of hearing. The osseous labyrinth consists of vestibule, semicircular canals and cochlea. While defects in the inner ear may result in sensorineural hearing loss, defects in the outer, middle, and middle ear can cause conductive hearing loss. Therefore, it is crucial to research the anatomy and physiology of the ear. This chapter's main objective is to explore the fundamental anatomy and physiology of numerous components of the canine ear that plays a vital role in hearing.

Keywords: Auricle, Cochlea, Conchal cavity, Ear, Scapha, Tympanic membrane, Vestibule.

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Tanmoy Rana (Ed.)

INTRODUCTION

Ear houses both the hearing and the balancing organs thus known as the vestibulocochlear organ [1]. The cochlea receives and converts mechanical impulses from sound waves into electrical signals, and the vestibular organ provides animal a sense of position and movement in relation to gravity. The inner ear contains the receptors for both organs. The vestibulocochlear nerve is the physical and physiological relationship between the two organs. The ear can be divided into three subdivisions (Fig. **1**):

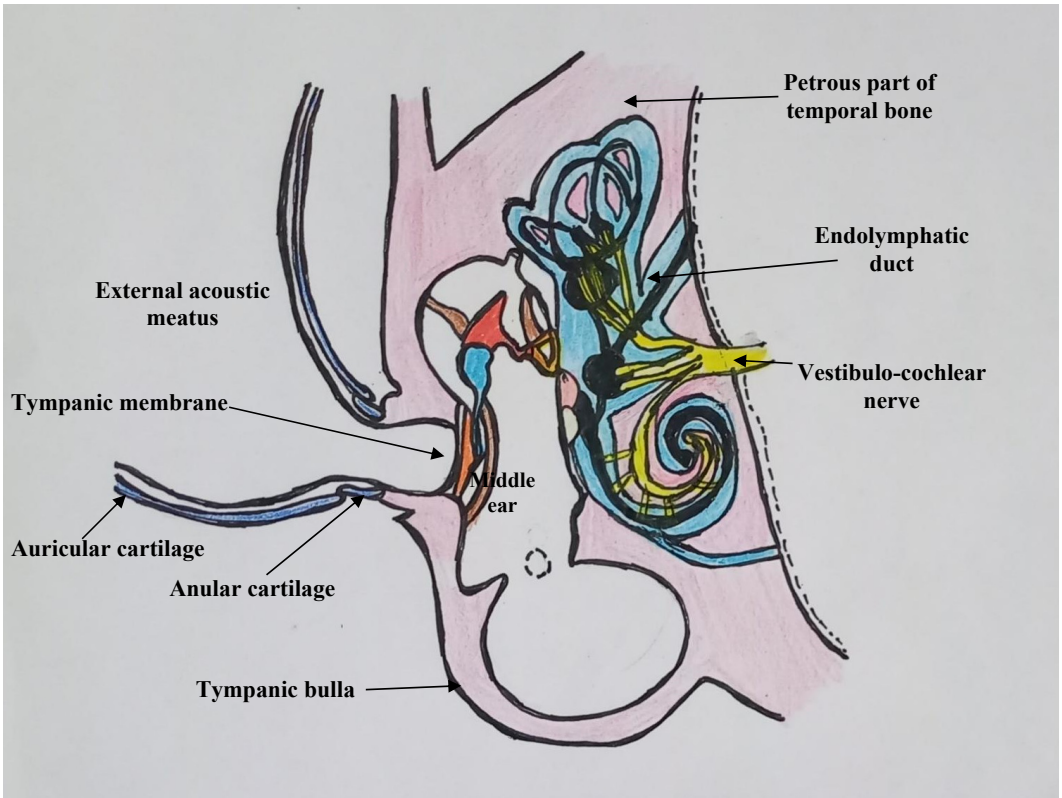

Fig. (1). Schematic diagram showing external acoustic meatus, middle ear and inner ear.

- External ear
- Middle ear
- Internal ear

The organ of balance (vestibular system) is restricted to the internal ear.

EXTERNAL EAR

The external ear consists of the following parts:

- Auricle along with the auricular cartilage.
- External acoustic meatus.
- Tympanic membrane.

When upright, the ears can be used independently to locate and gather sound. The tympanic membrane, located deep within the external acoustic meatus, receives sound waves *via* the external acoustic meatus.

Auricle

Auricle is also known as the ear leather to dog fanciers [2]. The size and shape of the external ear in domesticated animals varies widely between species and breeds (Fig. **2**). In dogs, breed-specific variances are particularly noticeable. Konig and Liebich [1] reported breed-specific ear forms as summarized in Table **1**.

	
Golden Retriever	**Labrador**

(Fig. 2) contd.....

CHAPTER 3

Physiology of Ear and Hearing

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Abstract: Sense organs that is eye, ear, nose, tongue and skin provide a true sense to communicate with the outer world. Ear is the organ of hearing and balance. Ear is a complex organ consisting of three divisons, the outer, middle, and inner ear. The structures of the external ear are auricle, external auditory meatus and outer layers of the tympanic membrane. The middle ear is an air filled cavity (tympanum) consists of ear ossicles, auditory tube (Eustachian tube), middle ear muscles, inner layer of the tympanic membrane. The internal ear consists of the osseous labyrinth consisting of cochlea, vestibule and semicircular canals and membranous labyrinths and the vestibular and acoustic (spiral) ganglia associated with the eighth cranial nerve (vestibulocochlear nerve). The auditory system of ear convert sound waves into neural signals. The auricle acts as a condiut to collect the sound waves. The middle ear acts as a precochlear amplifier and impedance matching device. Transduction of sound occurs in the cochlea by spiral organs (formerly known as organs of Corti) resulting in an action potential that transmits along the auditory nerve to cochlear nucleus in the brainstem for hearing. The vestibular system plays an important role in maintaining the equilibrium and balance of the animal. It is a primary sensory organ consisting of vestibule and semicircular canals which orients with respect to the gravitational field of the earth and co-ordinates the movement of various sensory organs and thus the linear, rotatory, acceleration and deacceleration movements of the animal.

Keywords: Auricle, Balance, Basilar membrane, Cochlear duct, Crista ampullaris, Ear, Ear ossicles, External auditory meatus, Hair cells, Hearing, Impedance, Macula, Membranous sacculus, Membranous utriculus, Organ of Corti, Semicircular duct, Stereocilia, Tectorial membrane, Tympanic attenuation reflex, Tympanum.

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Tanmoy Rana (Ed.)

INTRODUCTION

Human beings enjoy the companionship and benefit of dogs from the utility of many breeds. Domestication trained dogs communicate with humans in the best possible way that other animals cannot [1]. Ear is the organ of hearing and equilibrium. Hearing acuity in dogs is critically important for service, assistance, rescue, police and at military bases. Accurate hearing assessment is crucial as these dogs work on the auditory clues received in potentially life-threatening situations [2 - 4]. The form and function of ear will provide a deep insight for the hearing assessment.

STRUCTURAL COMPONENTS OF THE EAR

Ear is a complex organ consisting of three divisions, the outer, middle, and inner ear. The outer and middle ear are derived from the first and second pharyngeal arches, first pharyngeal cleft and pharyngeal pouch. The inner ear develops from the bilateral thickening of ectodermal otic placode placed lateral to the hindbrain. The principal structures of the ear are enclosed in the petrous temporal bones of the skull [5].

The structures of the external ear are auricle, external auditory meatus and outer layers of the tympanic membrane. The middle ear is an air filled cavity (tympanum) consists of ear ossicles, auditory tube (Eustachian tube), middle ear muscles, inner layer of the tympanic membrane. The internal ear consists of the osseous labyrinth consisting of cochlea, vestibule and semicircular canals and membranous labyrinths consisting of cochlear duct, membranous utriculus and sacculus, semicircular ducts and the vestibular and acoustic (spiral) ganglia associated with the eighth cranial nerve (vestibulocochlear nerve) [5].

PHYSIOLOGY OF HEARING

Energy waves produce the sound. These waves travel through a medium which causes movement of the molecules thereby increasing and decreasing the pressure waves (*i.e.*, alternating compression and rarefaction) of air within the environment [6].

The structures of ear convert sound waves into neural signals. The neural signals are sent directly to the brain *via* the auditory nerve (Fig. **1**). This transduction of sound occurs in the cochlea resulting in an action potential that transmits along the auditory nerve to cochlear nucleus in the brainstem. The external, middle and internal ear along with auditory nerve constitute peripheral auditory pathway. The brainstem and the brain constitute the central auditory pathway [7].

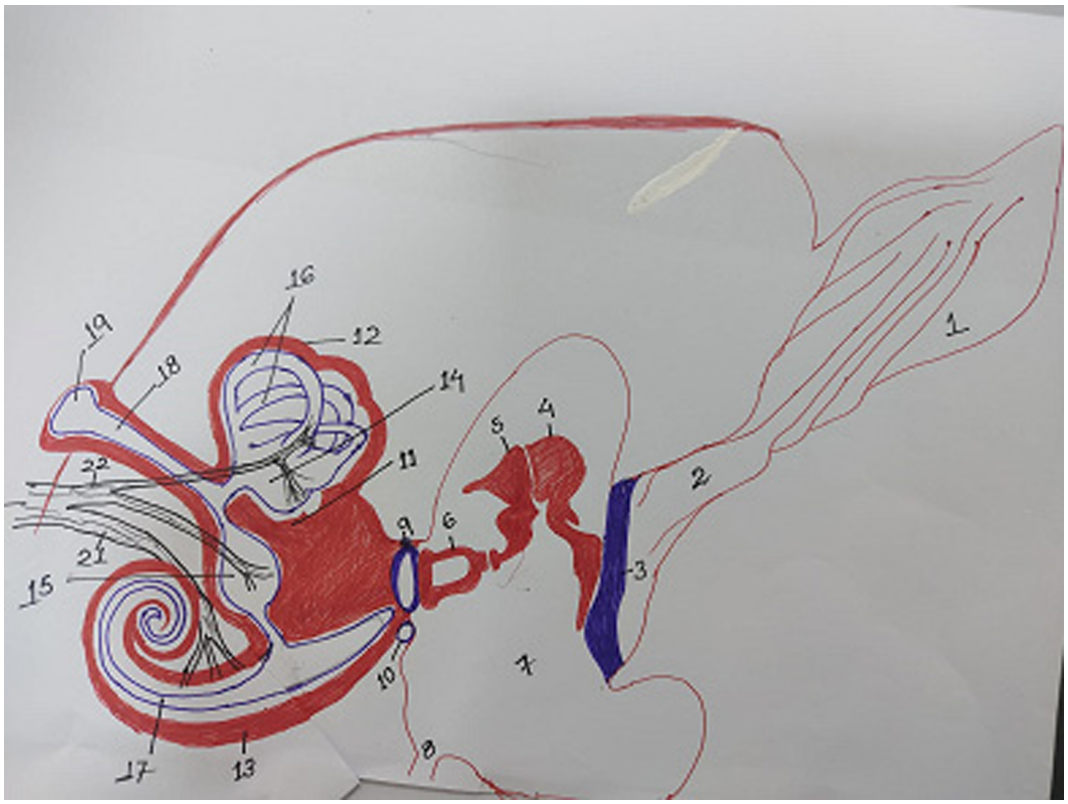

Fig. (1). Schematic diagram of canine ear exhibiting the structural component of outer, middle and inner ear. 1- Auricle, 2- External auditory meatus, 3-Tympanic membrane, 4-Malleus, 5-Incus, 6-Stapes, 7-Tympanic cavity, 8- Auditory tube, 9-Vestibular window, 10-Cochlear window, 11-Vestibule, 12-Semicircular canal, 13-Cochlea, 14-Utriculus, 15-Sacculus, 16-Semicircular duct, 17- Cochlear duct, 18- Endolymphatic duct, 19-Endolymphatic sac, 21-Cochlear branch of vestibulocochlear nerve, 22-Vestibular branch of vestibulocochlear nerve.

Function of the Outer Ear in Hearing

The auricle acts as a condiut to collect the sound waves. The well-developed muscles of the auricle of dog can direct it toward source of sound. There is variation in length of auricle in different breeds of dog. Dogs with large erect ears are good at localizing distant sounds. The ability to regulate the orientation of auricle improves hearing sensitivity up to 28 dB in dogs at higher frequencies [8, 9]. Many dogs are able to perceive the ultrasonic vocalization produced by mice and some insects [10]. The sound waves from the auricle are conveyed to auditory canal. The ear canal is long and L-shaped in dogs which helps to protect the tympanic membrane and amplify certain frequencies of sound. In the auditory canal these waves reach at the end of the external ear that is separated from the middle ear by tympanic membrane or ear drum (Fig. **2**).

CHAPTER 4

Microbiology of Ear

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Abstract: Otitis is an inflammation of ear in dogs, can be noted following primary, secondary, perpetuating and predisposing factors. Otitis externa is more frequent than otitis interna and otitis media. Globally the prevalence of otitis externa is 5-20% which reach up to 30-40% in tropical environment. Infections in otitis externa is generally secondary after inflammation. The mycotic microorganism reported from otitis are *Malassezia pachydermatis*, *Aspergillus* spp., *Candida* spp. While, the predominant bacteria belongs to *Staphylococcus* spp., *Enterococcus* spp., *Pseudomonas aeruginosa*, *Streptococcus* spp., *Corynebacterium* spp., *Proteus* spp., *Escherichia coli* and *Klebsiella* spp. In culture, the yeast *Malassezia pachydermatis* and bacteria *Staphylococcus pseudintermedius* predominates. With advent of metagenomics *Finegoldia magna*, *Peptostreptococcus canis* and *Porphyromonas cangingivalis* anaerobic bacteria were identified. Colonization of ears by antibiotic resistant microorganism makes the treatment challenging for the veterinarian. The bacterial culture along with antibiotic susceptibility test is recommended.

Keywords: Bacteria, *Malassezia pachydermatis*, Otitis, Otitis externa, *Staphylococcus pseudintermedius*, Yeast.

INTRODUCTION

Otitis is the inflammation of different parts of the ear. On the basis of location of inflammation it is classified as otitis externa, otitis media and otitis interna. Inflammation of epithelium and lining of the external auditory canal is termed as otitis externa. Otitis media is the inflammation of the middle ear. Otitis interna refers to a group of inflammatory conditions of the internal ear. The most common ear infection is otitis externa, it can be unilateral or bilateral. Globally the prevalence of otitis externa is 5-20% which reach up to 30-40% in tropical environment. Infections in otitis externa is generally secondary after inflammation. The main cause of otitis externa is Allergic dermatitis, which is

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more than 60% [1]. *Malassezia pachydermatis* from the yeast and *Staphylococcus pseudintermedius* among the bacteria are prevalent microorganisms [2]. A large diversity of bacteria and fungi are habitat of the ear. Culture of bacteria and fungi are still gold standard tests, but it is time consuming. But only about 1% of all microorganisms are in fact culturable [3].

PCR-based methods are usually limited to a panel of only selected microbes. On the basis of metagenomics analysis, the three most predominant bacteria were *Cutibacterium acnes* (previously known as *Propionibacterium acnes*; 4.5%), *S. pseudintermedius* (3.8%) and *Streptococcus sp.* (1.1%). *M. pachydermatis* (6.1%), *Capnodiales* (3.7%) and *Pleosporales* (1.0%) were among the yeast [4] while, *Finegoldia magna, Peptostreptococcus canis,* and *Porphyromonas cangingivalis* are the anaerobic bacteria. Previously, in canine ear infections, these anaerobic microbes were not identified as pathogens. As in clinical laboratory, usually only aerobic bacteria are cultivated until and unless specified. Now a days molecular methods like next gen sequencing can be applied for identification of microbes from as single sample without culturing them. Multiple etiological agents can be identified leading to judicious use of antibiotics and antifungal agent.

Etiology and Classification of Otitis

Wide variety of causative agents leads to Otitis in dogs. The predisposing factors can be classified as primary, predisposing and perpetuating. Normal ears of the dogs can be affected by primary causes of otitis externa. Primary causes include causes such as, parasites, foreign bodies, hypersensitivity and allergic diseases, keratinization disorders, autoimmune diseases initiate otitis externa. Primary cause changes the environment in the ear, often allowing a secondary infection to develop (Fig. **1**). The predisposing factors such as anatomic and conformational factors, excessive moisture, iatrogenic factors and obstructive ear disease make the ear more susceptible to the development of otitis externa but do not cause it alone. Perpetuating factors of otitis are bacteria, yeast, otitis media, progressive pathologic changes which are responsible for aggravation of otitis and prevents normal healing [5, 6].

- Allergy (adverse food reaction, atopic dermatitis, contact).
- Parasites (*Otodectes, Demodex, Sarcoptes*).
- Autoimmune/immune-mediated (pemphigus foliaceus, vasculitis, others).
- Endocrine disease (hypothyroidism, hyperadrenocorticism).
- Epithelialization disorders (sebaceous adenitis, zinc-responsive dermatitis).
- Foreign bodies.
- Glandular disorders (sebaceous gland hyperplasia).
- Fungal (*Aspergillus*).

- Viral (Canine distemper).
- Miscellaneous (proliferative necrotizing otitis of cats, juvenile cellulitis).

Fig. (1). Depicts ear infection of the ear of dogs.

Regardless of the primary ear lesion, the microbial contamination is the predominant cause of acute and suppurate otitis in case of dogs. *Staphylococcus intermedius* and *Malassezia pachydermatis* are the most common microorganisms isolated from canine otitis externa [7]. Otitis externa may occur irrespective of breed, gender or age of dog but predisposing factors are long pendulous ear, hairy pinna, higher density of compound hair follicles and ceruminous glands in the ear canal leading to heat retention and increase moisture.

Bacterial Etiology of Otitis

Among bacteria, 16 different bacterial species consisting of *Pseudomonas aeruginosa, Staphylococcus pseudintermedius/delphini*, *Proteus mirabilis, Streptococcus canis* were isolated by conventional method by conventional method. While, external ear canal 16S amplicon profiling resulted in 180 bacterial species from seven different phyla. The major species were *Pseudomonas aeruginosa, Corynebacterium auriscanis, Corynebacterium jeikeium/amycolatum, Porphyromonas cangingivalis* and *Staphylococcus delphini/pseudintermedius* [8].

Clinical Signs

The clinical signs of infected dogs include, anorexia, inflammation of mucosa and pain with violent head shaking, scratching and rubbing of ears, ceruminous or dark purulent discharge with foul odour.

CHAPTER 5

Cytology of Ear in Health and Diseases

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Abstract: Ear diseases represent one of the most common clinical presentations in dogs seen by small animal practitioners. These conditions can arise from primary causes, secondary causes, and perpetuating factors, all of which are essential to identify for successful management. Cytology, the study of cells, offers a nonexpensive, readily available, and low cost diagnostic tool that can be utilized to screen dogs with ear diseases. The ear infection can be judged by the clinical examination, ear examination by otoscopy, imaging diagnostics, cytological intervention, and proper treatment should be undertaken based on the severity and duration of the infection in the ear. Cytology proves useful to clinicians for assessing the origin of types of infectious, such as yeast, mites, and bacteria; presence of types of leukocytes. In cases of recurrent or non-responsive ear diseases, cytology should be complemented with culture and susceptibility testing. Yeast, including *Malassezia* and *Candida*, can be identified on cytology by their specific morphology on cytology, which is crucial for selecting appropriate topical ear medications. Cytology also provides valuable information about mite infestations and the intensity of mite populations. It serves as a useful tool to assess the endpoint of therapy and ensure the resolution of infection. Additionally, cytology aids in decision-making by guiding the selection of antimicrobial medications and /or proceeding with further diagnostic methods, while also determining the endpoint of therapy. In cases where first-line therapy fails or bacilli are present, bacterial culture with an evaluation of antibiotic susceptibility is recommended. A comparison of healthy control dogs and clinical cases revealed significantly higher levels of organisms and inflammatory cells in the latter, with *Malassezia pachydermatis* isolated in both infected and healthy ears of dogs. Cytological examination of impression smears is a straightforward, readily applicable, and minimally cost-involved diagnostic method to provide the identification of etiological agents, which include bacteria, fungi, and mites. Processing and making the dermatological diagnostic cytological slide requires only professional skill without any special equipment, which can be evaluated in less time in routine clinical settings. Before receiving culture and sensitivity results, the immediate results of cytology are invaluable for making informed diagnostic decisions during consultations.

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Keywords: Bacteria, Cells, Cytology, Dog, Diagnosis, Ear diseases, Fungi, Mites.

INTRODUCTION

Ear diseases in dogs are often multifactorial and can pose significant challenges in management. Cytology, which involves the study of cells, is a crucial diagnostic tool in veterinary medicine. The term "cyto" originates from the Greek word "kytos," meaning "cell," and "logos" which means "science." Cytology enables quick, easy, and cost-effective diagnosis, making it one of the most important and commonly used diagnostic techniques in veterinary medicine. The presence of recurrent dermatological diseases, improper therapeutic regimens, treatment failures, and progressive loss of physical barriers in the ear canal can convert simple ear diseases into complicated ear diseases [1]. Ear diseases are a prevalent clinical presentation in dogs seen by small animal practitioners. These conditions can stem from primary, secondary, and perpetuating factors, all of which are crucial to diagnose, for successful management. Cytology, the study of cells, offers fast, low cost and immediate diagnostic facilities that can be utilized to screen dogs with ear diseases. When combined with clinical examination, ear examination by otoscopy, for assessing the primary infections, imaging diagnostic facilities and serial cytological procedures are useful in the assessment of secondary infections; along with the evaluation of therapeutic response to modify the appropriate managemental procedures. Cytological evaluations of ear swabs are vital for assessing and managing non-responsive or recurrent ear infections in small animal practice. It is recommended to perform cytology at each follow-up visit to assess therapeutic response or modify therapeutic protocols as needed [2]. The duration of cytological examination during revisits varies depending on the type of etiology for ear disease development and the treatment of affected patients. Many dermatological disorders share similar clinical signs and physical characteristics, making them challenging to differentiate from one another. Cytology serves as a crucial tool for evaluating ear diseases, enabling the assessment of the inflammatory response type and the identification of underlying causes. It aids in determining the presence of overgrowth and in guiding appropriate management strategies [3]. Cytology proves to be a reliable tool for rechecking examinations, assisting in the monitoring and adjustment of therapy as needed. *Malassezia* yeasts, characterized by their specific peanut shape, are normal commensals of canine skin. Ear diseases often have multifactorial etiologies and are classified into predisposing, primary, and perpetuating types. Predisposing factors include ear conformation, favorable environmental conditions, inappropriate treatment, and immunosuppressive diseases. Primary causes encompass foreign objects, parasites, hypersensitivity disorders, keratinization disorders, and immune-mediated diseases [4]. Effective management of ear diseases necessitates accurate diagnosis of primary diseases

and perpetuating factors, followed by appropriate management strategies. Cytology provides a clear quantitative analysis of the organisms present, while microbiological analysis aids in identifying specific infectious organisms. Over time, various grading techniques have been employed in the cytological analysis of ear discharge to assess the severity of infection [5]. Cytological examination of ear discharges often reveals the presence of epithelial cells, bacterial organisms, *Malassezia* spp. Yeast organisms, and fungal hyphae [6, 7]. Persistent low-grade inflammation can increase the likelihood of developing neoplastic cells and ultimately result in permanent hearing loss [8, 9].

When to Perform the Cytology

Dogs exhibiting signs of ear diseases such as head shaking, ear scratching, erythema of the ears, pain upon palpation, foul odor from the ears, and ear discharges should undergo cytology. Ear cytology plays a crucial role in identifying primary, secondary, and perpetuating factors [10]. The primary pathogens identified in the literature are *Malassezia pachydermatis* and *Staphylococcus pseudintermedius*, which together account for over 70% of bacteria culture from ear discharges. Dogs with chronic ear infections, recurrent otitis, or non-responsive ear infections often present with suppurative otitis [11]. Common bacteria isolated from dogs with otitis include *Staphylococcus pseudintermedius, Enterococcus spp., Pseudomonas aeruginosa, Streptococcus spp., Corynebacterium spp.,* and *Escherichia coli* through bacterial isolation and culture. Initial treatment for most dogs with ear diseases typically involves first-line therapy, followed by assessing the response to treatment. If necessary, bacterial culture with the evaluation of antibiotic susceptibility is recommended [12]. In daily routine practice, discrepancies often arise between direct cytology and bacterial culture examinations. Differences exist between the examination of ears by cytology and the subsequent performance of sensitivity tests. This inconsistency may be attributed to the presence of uncultured bacteria or the emergence of rapidly growing bacterial strains [13, 14].

Indications of Ear Cytology

Indications for cytology in dogs with ear diseases include: assessing various cell types in the ears, distinguishing between inflammatory and neoplastic origins of cells, detecting underlying etiological causes such as parasites, bacteria, fungi, or allergies, differentiating clinical signs of ear diseases from systemic diseases, determining the extent of ear infections, evaluating the status of microbial populations, formulating effective therapeutic strategies, assessing the therapeutic efficacy of drugs against otitis, and monitoring therapeutic responses [13, 15].

CHAPTER 6

Procedure of Clearing of External Ear Canal

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Abstract: The chapter underscores the vital role of ear health in dogs, covering various aspects of the subject. It highlights the importance of a dog's ears in maintaining overall health and well-being, focusing on sensory perception, communication, balance, and orientation. The anatomy of the external ear is detailed, explaining the functions of its components. The diagnostic approach for otitis externa is described, involving observations, external ear canal cytology, diagnostic imaging, and differential diagnosis. Basic principles of ear cleaning are outlined, including restraint and handling, observation, and the cleaning process itself, performed manually or using advanced techniques and solutions. Prevention strategies are provided, promoting routine ear care, proper drying after water exposure, regular inspections, allergy management, and collaboration with veterinarians. This abstract offers a comprehensive overview of canine ear health, serving as a valuable resource for veterinarians, and dog owners interested in this subject.

Keywords: Cytology, Ear cleaners, Pus in ear, Wax.

INTRODUCTION

Ears are the natural openings of the body that directly communicate with the environment and play crucial roles in sensory perception, communication, maintaining balance, orientation, and thermoregulation, ultimately contributing to overall health. Anatomically, it divided into three parts: the external ear, middle ear, and inner ear. The term “otitis” indicates inflammation of the ear and it can be otitis externa, otitis media or otitis interna depending upon involvement of parts of ear. Otitis externa is inflammation of the external ear canal and is the most frequently reported ear disorder in dogs, with a prevalence range of 8% to 30% [1]. Otitis externa may be acute or chronic (persistent or recurrent otitis lasting for 3 months or longer). It is caused by multiple etiological agents including bacteria, fungi, foreign objects, mites, allergens, or excessive moisture. Various factors contribute to ear infections in dogs, including ear shape, breed characteristics like

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long floppy ears, excess hair in the ear canals, swimming or bathing, and overproduction of earwax [2]. Common symptoms of otitis externa in dogs includes head shaking, scratching, bad odor, redness, swelling, discharge, severe pain and behavior changes. Cleaning the external ear of a dog is an essential aspect of routine grooming and hygiene maintenance [3]. Proper ear cleaning helps prevent ear infections, discomfort, and potential health issues.

UNDERSTANDING THE EXTERNAL EAR ANATOMY

Understanding the external ear anatomy of dogs is important for recognizing normal variations among breeds and for identifying any potential issues or conditions, such as infections (like otitis externa) or foreign bodies lodged in the ear canal. Regular inspection and care of the external ear can help maintain your dog's ear health and overall well-being. Anotomically, the external ear includes following structure:

Pinna (Auricle)

The pinna is the visible, outer part of the dog's ear. It is made of cartilage covered by skin and serves to capture and funnel sound waves into the ear canal. The shape and size of the pinna can vary widely among dog breeds.

Ear Canals (External Auditory Meatus)

This is a tube-like structure that extends from the pinna towards the middle ear. It's slightly curved and has a vertical orientation of about an inch before it turns horizontally towards the eardrum. It can be divided in to

Vertical Ear Canal

The initial part of the ear canal that runs vertically is important for funneling sound waves and protecting the middle ear.

Horizontal Ear Canal

After the vertical portion, the ear canal turns horizontally and leads to the tympanic membrane (eardrum). This part is important for protecting the inner structures of the ear.

Glands

The external ear canal contains sebaceous glands (which produce sebum, an oily substance) and ceruminous glands (which produce earwax or cerumen). These

glands contribute to the health of the ear by moisturizing and protecting the ear canal.

Hair

Some dogs may have hair in and around the ear canal. Excessive hair in the ear canals can contribute to ear problems and should be regularly checked and, if necessary, trimmed.

Tympanic Membrane (Eardrum)

The eardrum separates the external ear from the middle ear. It vibrates in response to sound waves and transmits these vibrations to the middle ear's auditory ossicles (tiny bones), which then send the signals to the inner ear for processing.

IMPORTANCE OF EAR CLEANING

Cleaning your dog's ears is an integral part of pet care. Neglecting ear hygiene can lead to painful ear infections, discomfort for your dog, and even hearing loss. Regular cleaning helps remove debris, excess wax, and prevents the buildup of moisture, all of which contribute to a healthy ear environment.

Common Etiology and Predisposing Factors Associated with Ear Discharge in Dogs

The common etiology of ear discharge in dogs can be attributed to a variety of factors as described by Paterson, *et al.* [4], and Saridomichelakis [5].

Bacterial Agents

Various bacteria, including *Staphylococcus spp, Pseudomonas spp, Proteus spp, Enterococcus spp, Streptococcus spp, and Corynebacterium* spp, can lead to otitis externa in ear of dogs [6, 7]. These infections can cause inflammation, irritation, and discharge.

Parasites

Ear mite (*Otodectes cynotis*) is a common parasite that can infest a dog's ear canal, causing irritation, inflammation, and discharge. Other parasites like ticks, sarcoptic mange mites, demodex mites and ticks can also contribute to ear problems.

CHAPTER 7

Aural Haematoma and its Clinical Management

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Abstract: Ear hematoma is collection of blood between skin and cartilage of ear, and it is one of common surgical condition. This occurs due to self-inflicted trauma or many other multiple reasons which leads to rupture of blood vessels and capillaries. Dog breeds with pendulous or heavy floppy ears are prone to ear hematoma. Both Surgical and non-surgical methods are adopted to treat this condition but surgical method have better treatment results as compare to later. Reoccurrence is one of the most common post operative complications irrespective of available treatment methods. However, control of inflammation, edema and drainage are important determinants for an effective treatment strategy.

Keywords: Cushing's disease, External ear, Hematoma, Hypothyroidism, Marshall putney's, Pendulous, S-shaped.

INTRODUCTION

An ear hematoma is also called an Ot, aural, or auricular hematoma. It is an abnormal accumulation of blood or serum and fibrin, usually between the cartilage and skin of the ear pinna [1]. More specifically, blood, serum, and fibrin clots are accumulated in between the cartilage and skin of the ear, usually involving the concave surface of the pinna, but less often may be present on the convex surface also [2]. It is one of the most common surgical conditions of the external ear [3]. Hematoma may appear as a focal, purplish, rounded, and hard area of swelling or may involve the whole surface of the pinna engorged with blood, leading to drooping of the affected pinna [2, 4, 5].

SURGICAL ANATOMY

The ear is composed of three parts: the internal, middle, and external ear. The internal ear consists of a bony labyrinth and a membranous labyrinth, which con-

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Tanmoy Rana (Ed.)

tain the cochlea, semicircular canals, and vestibule for hearing and balancing. The middle ear has ear ossicles, a tympanic membrane, and a tympanic cavity, which have connections with the pharynx *via* the eustachian tube (auditory tube). The external ear, which consists of the external acoustic meatus and pinna. Pinna again consists of skin, scutiform cartilage, annular cartilage, and auricular cartilage. Most aural hematomas occur in the auricular cartilage. The auricular cartilage is elastic in nature and is a thin, single-layered sheet that is pliable at the apex. On the convex side, the skin is relatively mobile, while on the concave side of the pinna, it is adherent to the cartilage tightly. The helix has medial and lateral borders, which are the free margins. Branches of the cranial auricular and the great posterior auricular arteries provide blood supply to the pinna. They provide branches to the margin of the auricle cartilage and pass through the foramina supplying the lateral surface. The venous drainage is provided by the maxillary vein [2].

ETIOLOGY

Generally, aural hematoma in dogs occurs due to self-inflicted trauma to the ear. Vigorous head shaking or scratching of the ear with paw causes rupture of blood vessels and capillaries, resulting in bleeding. The maxillary vein and the large posterior auricular artery are the main sources of the haemorrhage that arborizes over the pinna. This leads to the accumulation of blood and serosanguineous fluid in the space between skin and cartilage, leading to the formation of “haematoma”. Due to this, the ear flap becomes initially soft and then thickens later on. The bleeding continues from the arteries until the pressure created by the accumulating blood equalizes with the pressure from the arteries themselves. Among other reasons, violent shaking of the head and pinna due to ear pain, otitis externa or media, neoplasia, hypersensitivity, and allergic dermatitis [6, 7]. In most allergic dermatitis cases, intradermal eosinophil and mast cell infiltrations have been described [8]. Water pouring in the ears during bathing can also result in violent head shaking, which can predispose the dog to hematoma formation. Parasites such as ear mites or ticks and foreign bodies (plant awns, grass seeds, or other debris) in or near the ear canal are also some predisposing factors for aural hematoma [9 - 12]. The association of otitis externa with aural hematoma and otodectic mange has been reported in most of the cases. Endocrine disorders such as hypothyroidism or Cushing’s disease are also predisposing factors for hematoma. Hypothyroidism can lead to changes in the skin and coat quality due to which dogs may develop dry and itchy skin, which can contribute to ear scratching, while Cushing disease is associated with making the capillaries fragile, leading to early rupture and hematoma formation. In Cushing disease, the immune system of the dog is also compromised, which results in increased susceptibility to infection and irritation of the external ear canal. Some authors

have proposed an immunological aetiology based on serological and immune histochemical examinations, which was supported by a successful response to corticosteroid therapy, but it is still a matter of debate and scientific validation [1, 13]. Certain haematological conditions, such as clotting disorders or immune-mediated thrombocytopenia, can increase the likelihood of spontaneous bleeding or poor clot formation. These underlying disorders can predispose dogs to ear hematomas. Although ear hematomas in dogs do not disturb other systemic functions.

BREED PREDISPOSITION AND OTHER RELATED FACTORS

Auricular hematoma is commonly associated with medium to large-sized canine breeds. Dog breeds with pendulous or heavy floppy ears, like the Cocker Spaniel, Labrador Retriever, Golden Retriever, German Shepherd, Basset Hound, Pit Bull, Boxer, and Spitz breeds, are more prone [14 - 16]. Dog breeds with long and droopy pinnas are more prone to bacterial infection as the droopy ear obscures the natural airing and drying of the ear canal. Droopy ears maintain darkness by blocking light, warmth, and a moist environment, which is suitable for yeast and bacterial infection. Middle to older-aged dogs are more likely to develop hematomas due to the association with cleavage of the cartilage plate because senility changes are associated with cartilage disruption that leads to hematoma [8, 17]. But sex-related predisposition associated with the occurrence of hematomas have not been recorded yet [15, 18, 19].

CLINICAL SIGNS AND DIAGNOSIS

The dog becomes restless and loses its pleasing looks due to pain. The dog frequently shakes his head and often scratches the affected ear. Clinical signs depend upon the duration of hematoma formation, the level of morphological changes in the ear, and the extent of the hematoma. Head tilting and circling towards the affected side are generally seen, which must be differentiated from otitis interna and media, encephalitis, and cerebellar ataxia. The diagnosis is based upon the history, clinical signs, symptoms, and clinical examination. On clinical examination, hematomas initially appear soft, fluctuating fluid-filled bulging mostly towards the concave side of the pinna, but gradually may become firmer and thicker due to fibrosis [2]. Confirmatory diagnosis of underlying otitis externa or media should be done with skull radiography in an appropriate radiographic view or by computed tomography. Other disease conditions like ear mites, hypersensitivity, Cushing's disease, and hypothyroidism must be considered to determine the aetiology of hematoma.

CHAPTER 8

Traumatic Injuries and its Clinical Management

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Abstract: Traumatic ear injuries in dogs are relatively common due to their propensity to play, fight, scratch, and explore. Trauma to the ears can result from an external source or it could also be self-inflicted. Ear injuries can happen as a result of vehicular accidents, dog bites, ear burns, exposure to cold temperatures, faulty ear cropping techniques, and sharp objects. Mite and tick infestation, insect bite dermatitis, food allergies, and fly bites lead to intense pruritus and discomfort. Intense itching associated with such conditions can lead to excessive scratching and head shaking-associated traumas. Such trauma can lead to conditions like an aural hematoma, ear lacerations, broken ear cartilages, separation of auricular and annular cartilages, avulsion injuries, ear tip injuries, fractures of the tympanic bulla, tympanic membrane rupture *etc.* Medicinal treatment helps in management of ear infections but surgical intervention is required to deal with traumatic injuries.

Keywords: Aural hematomas, Avulsion injuries, Accidents, Broken cartilages, Bulla fracture, Ear burn, Frostbite, Lacerations, Tympanic membrane rupture.

INTRODUCTION

Trauma to the pinna is frequent in dogs. It can occur as a result of various accidents or incidents which may range from mild to severe. Traumatic injuries include hematomas, lacerations, burns, frostbite, fractures, torn ear tips, otitis externa. When trauma is left untreated, as might occur in some cases, it may lead to complications. Though with critical care and suitable treatment, most dogs recover fully. Head shaking leads to more pinnal trauma than fighting. Fight wounds may cause tearing of pinna, often with profuse bleeding. Trauma to pinna, particularly to the periphery may also be caused by Otodectic mange, otic foreign bodies, otitis media and facial pruritus.

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Aural Hematoma

Aural hematoma most commonly occurs as a result of traumatic injury of ear in dogs [1]. Inflicted trauma from the ipsilateral rear foot or from vigorous head shaking due to underlying otitis externa may be there. Trauma may also result from ectoparasite infestations, allergy, and otic foreign bodies [2]. Otitis externa is not often associated with aural hematoma [3]. Lesion develops at the base of concave aspect of the ear initially which progresses towards the apex causing acute pain and discomfort to the dog. Aural hematomas present as warm, tense, rounded, occasionally bluish-purple fluid filled lesions and require surgical intervention. Surgical preparation of pinna is followed by a single, straight incision along the long axis of the ear. Drainage of the cavity is done, fibrin is curetted out, and then sterile saline is used for further flushing of the cavity. Longitudinal placement of full-thickness sutures minimizes the risk of blood vessel damage. Sutures are removed after a period of 2-3 weeks. Inadequate post-operative management of pain leads to violent head shaking and self-inflicted trauma which results in hemorrhage (Figs. **1a, b, & c**).

Figs. (1a, b, & c). Typical appearance of an aural hematoma, its operative procedure including curation and placement of horizontal mattress sutures.

Ear Laceration

Ear laceration may occur as a result of fighting or other trauma associated with sharp objects and invariably results in wound infection. Such wounds may involve only one skin surface and are superficial while others may perforate cartilage involving both skin surfaces. They may have more aesthetic appearance when sutures are placed or maybe left to heal by secondary intention. Cleaning, debridement, tissue apposition, protection, and prevention of secondary infection are the general principles of treatment [4]. Conservative treatment by simply clipping and cleaning can be done for small lacerated wounds. Small lacerations are managed by the use of adhesive, hydroactive dressings. Although in an ideal circumstances, where general anesthesia is not indicated, not much efficient can be achieved with careful surgical apposition and suturing. 1 cm overlap of margin should at least be there when dressing is cut to shape and applied over clean dried wound. Gentle handling of the dressing for few minutes should be done until it gets adhered. These dressings are considered to be advantageous since they are light weighted and are also tolerated well by the patient. Also, epithelialization is encouraged as there is suppression of bacterial infection, if any. When hydro active dressings breaks down, there is often presence of a discharge beneath them. Gentle peeling off the remains of these dressings after a period of two weeks is recommended. Large lacerations require early surgical intervention [4]. Surgical preparation and careful debridement of pinna is done and first sutures are placed at margins of the pinna ensuring better alignment. Closure of full-thickness lacerations is done either with rows of simple interrupted sutures on both aspects or with simple interrupted sutures on one face and vertical mattress sutures on the other face (Fig. **2**).

Fig. (2). Ear laceration in dog.

CHAPTER 9

Diseases of Pinna and its Clinical Management

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Abstract: Understanding pinna diseases is essential for veterinarians, pet owners, and anyone caring for dogs. The pinna, or external ear, plays a vital role in a dog's health and well-being, serving as a protective barrier for the sensitive inner ear, aiding in sound localization, and enhancing auditory perception. However, its anatomical features make it susceptible to various diseases, including infections, parasites, allergic reactions, traumatic injuries, and neoplastic conditions. Bacterial and fungal infections can cause inflammation, pain, and discharge in the pinna, necessitating proper diagnosis and treatment with antibiotics or antifungal medications. Parasitic infestations, such as ear mites and ticks, also target the pinna and require specific antiparasitic treatment. Allergic and immunologic disorders manifest as redness, swelling, and itching on the pinna, demanding accurate diagnosis and management strategies such as allergen avoidance, medications, or immunotherapy. Traumatic injuries, like hematomas, lacerations, and avulsion injuries, may affect the pinna, necessitating immediate attention to prevent infections and promote healing. Neoplastic diseases, both benign and malignant, require precise diagnosis and treatment planning. Understanding congenital and developmental disorders of the pinna is vital, as certain breeds may be predisposed to specific malformations leading to chronic ear problems. Genetic disorders affecting the pinna can contribute to hearing impairment or structural abnormalities, emphasizing the need for thorough assessment and management strategies. Recognizing the significance of pinna diseases enables early detection, intervention, and prevention strategies, emphasizing the importance of regular ear care and veterinary attention. By comprehending the anatomy and function of the pinna in dogs, optimal ear health and overall well-being for canine companions can be ensured.

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Keywords: Allergic reactions, Canine ear health, Diagnostics, Ear infections, Hearing impairment in dogs, Immunologic disorders, Infectious diseases, Medical treatment, Neoplastic conditions, Otitis externa, Parasitic infestations, Pinna diseases, Prevention, Surgical interventions, Symptomatic relief, Therapeutic management, Traumatic injuries, Veterinary care, Wound healing, X-ray imaging.

INTRODUCTION

Understanding pinna diseases is of paramount importance for veterinarians, pet owners, and anyone involved in the care of dogs. The pinna, also known as the external ear or ear flap, plays a vital role in a dog's overall health and well-being. As an external structure, the pinna is susceptible to a variety of diseases and disorders that can significantly impact a dog's quality of life. By comprehending the significance of pinna diseases and familiarizing ourselves with the intricate anatomy and function of the pinna in dogs, we can better diagnose, treat, and prevent these conditions, ensuring optimal ear health for our canine companions.

The pinna serves several essential functions in dogs. Firstly, it acts as a protective barrier, shielding the sensitive structures of the middle and inner ear from external elements. This includes preventing foreign objects, dust, and debris from entering the ear canal, which could potentially cause irritation or injury. Additionally, the pinna aids in sound localization, allowing dogs to determine the direction of sounds and facilitating their auditory perception. Through its intricate structure and position, the pinna captures and funnels sound waves, enhancing a dog's ability to detect and interpret auditory stimuli [1]. However, the unique anatomical features of the pinna also makes it susceptible to various diseases. Infections, both bacterial and fungal, can easily take hold in the warm, moist environment of the ear canal, spreading to the pinna and causing inflammation and discomfort. Parasitic infestations, such as ear mites, ticks, or fleas, can also target the pinna, leading to irritation, itchiness, and potential secondary infections. Moreover, allergic and immunologic disorders can manifest on the pinna, as it is a site prone to allergic reactions and hypersensitivity. Conditions like atopic dermatitis or contact dermatitis can result in redness, swelling, and the development of lesions on the pinna.

Traumatic injuries are another concern for the pinna. Hematomas, which are collections of blood under the skin, can occur from trauma or excessive shaking of the head, causing swelling and pain [2]. Lacerations, puncture wounds, and avulsion injuries may also affect the pinna, requiring immediate attention to prevent infection and promote proper healing. Neoplastic diseases, both benign and malignant, can develop on the pinna, necessitating accurate diagnosis, staging, and treatment planning. Early identification and intervention are crucial for achieving the best possible outcomes.

Understanding the congenital and developmental disorders of the pinna is equally important. Certain dog breeds may be predisposed to specific pinna malformations, such as folded or curled pinnae, which can lead to chronic ear problems. Genetic disorders affecting the pinna can also contribute to hearing impairment or structural abnormalities, emphasizing the need for thorough assessment and appropriate management strategies. By understanding the importance of pinna diseases and delving into the intricate anatomy and function of the pinna in dogs, we can enhance our ability to recognize, diagnose, and effectively treat these conditions. Additionally, prevention strategies can be implemented to mitigate the risk of pinna diseases, emphasizing the significance of regular ear care and prompt veterinary attention. Through a comprehensive understanding of pinna diseases, we can strive to ensure optimal ear health and overall well-being for our beloved canine companions [2].

IMPORTANCE OF UNDERSTANDING PINNA DISEASES

Understanding pinna diseases holds immense importance for veterinarians, pet owners, and anyone involved in the care of dogs. The pinna, or external ear, is a complex structure that can be affected by a wide range of diseases and disorders. By recognizing the significance of pinna diseases, we can better advocate for the health and well-being of dogs, improve diagnostic accuracy, provide effective treatment, and prevent complications associated with these conditions (Fig. **1**).

Fig. (1). Depicting ear infection in e.

CHAPTER 10

Food Allergy and Otitic Pruritus

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Abstract: Otitis due to allergy induced by dietary protein is a common problem in dogs and cats. Topical treatment mostly seems to be successful as temporary relief, but chronic recurrence of inflammation and infection can lead to permanent inflammatory changes, discomfort and anatomical dis-arrangements, with anti-microbial resistance. This makes the otitis condition difficult to treat by a veterinarian. Eventually, the changes can become irreversible and require a total ear canal ablation/lateral bulla osteotomy or ablative laser surgery. Proper diagnosis of subtle changes in an animal's lifestyle, diet and skin pattern is very important to be noticed. Most importantly, clinicians must appreciate that all recurrent ear infections in dogs are secondary. Treatment are usually in 2-3 phases: treating the root cause of the allergy, treating the ongoing damage and inflammation and pruritus, and elimination of secondary infections/ organisms. This will typically involve ear cleaning, topical anti-microbial therapy, and topical or systemic glucocorticoids. Novel treatments including herbs and special animal extracts for infection and inflammation may offer additional options in the future. Understanding the underlying causes and pathogenesis of the disease condition, diagnosing it at the right time and addressing the treatment in collaboration and association with primary veterinarian, referral dermatologist and pet parents can make a huge difference in the treatment outcome of food allergy induced otitis.

Keywords: Atpy dermatitis, Allergens, Cats, Cyclosporin, Dogs, Food allergy, Hypothyroidism, Licorice root extracts, Otitis, Palmitoylethanolamide.

INTRODUCTION

An allergy is an immune response where a pet's body responds to a stimuli/trigger allergen. Often these are environmental or food related [1, 2]. Be it any allergen, any pet parent, guardian and the veterinary clinician would always prefer to get to the bottom of the route of causative allergen.

Allergy induced ear infections in dogs can be painful and recurrent in nature. Allergies cause the skin barriers within the ears to break down. This leads to increased wax production which allows yeast, bacteria and inflammation of the

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ear, which is termed as otitis. Clinically allergy induced otitis are similar to otitis externa. When we tilt the ear flap and investigate the ear canal, they appear red, itchy and, pruritus, due to the allergy manifestation. Pain with discharge of various degrees and nature can be seen. In many of the cases this ear condition leads to stenosis of the ear canal. Most of the dogs with allergic otitis due to canine adverse food reaction will also have generalized skin infection. Groin and axilla regions may have erythematous spots with small pustules [3, 4].

CANINE ADVERSE FOOD REACTIONS - BRIEF

Canine food allergy is an undesired immunological reaction, when a certain protein ingredient of the pet's food is either changed or converted into molecules which are considered foreign molecules by the immune system. This triggers inflammatory and hypersensitivity reactions to various organs. In dogs and cats it's mostly in skin. Common food allergens (Jackson, 2023) known in canine pets are chicken, corn, eggs, potatoes and lentils. Dogs and cats with chronic otitis due to food allergy may also have dermatological manifestations of erythema, focal alopecia with discharges, rashes, and generalized alopecia. Many studies have reported a more close association of allergic diseases such ascontact allergy, food allergy, and atopic dermatitis, and also predisposition to be more prone to develop an otitis in many breeds, including the Dalmatian, Labrador retrievers, Pugs, American cocker spaniel, golden retriever, Chinese shar-pei, German shepherd dog, beagle, French bulldog, and Jack Russell terrier [5, 6].

In dogs, symptoms include facial itching, foot or limb chewing, itchy anal area, and recurrent ear infections.

1. No response to steroid therapy.

2. Five signs of canine food allergy.

3. Non seasonal generalized pruritus.

4. Accompanying signs of gastrointestinal disorders.

5. Recurrent ear and anal region infection and irritation.

6. Age of onset is either less than six months or more than five years.

One study of dogs with atopic dermatitis, food hypersensitivity, or both, showed that 58 of 120 dogs (48%) had inflamed ears without exudation and 62 dogs (52%) had otitis with an infectious component [7, 8].

CANINE FOOD ALLERGIC OTITIS - BRIEF

In recent years, canines and felines usually tend to have far more frequency of otitis than expected, sometimes as constant as throughout the year. It is often of multifactorial aetiology and may be part of a generalized skin disease or underlying systemic illness. Although initial symptomatic therapy is appropriate for early, acute cases of otitis externa, a systematic and thorough approach involving detailed history taking, complete physical and dermatological examinations, and appropriate diagnostic work-up is required when investigating and treating chronic otitis externa.

The internal ear canal structure pre-disposes the ears of cats and specially dogs. Unlike in humans, dogs ears are composed of two components - vertical component and horizontal component. This “J” shape of the dog's ear creates a predisposition to ear infections as debris must work its way upward rather than straight out [9, 10]. If ear wax cannot get out, it accumulates. Accumulation of earwax, skin oil, and other debris feed the bacteria and fungi that live in the normal ear canal leading them to proliferate. Other predisposing factors for chronic otitis are the presence of dense hair in the ear canal, a long and narrow ear canal, pendulous ears flaps, and climate or seasonal factors such as increased temperature and humidity are examples of predisposing factors [11, 12]. Both bilateral and unilateral otitis externa may be seen with food adverse reactions. Allergic skin disease affecting the ears is the most common cause for recurring increased ear wax production/ear infection. Allergens further facilitate the accumulation of the wax and infection [13]. A study reported that 52% of dogs with chronic otitis will end up with Otitis. With the deep internal structure of the ears are associated some important nerves. Damage of which can lead to signs and symptoms of a vestibular disease. Many studies have documented that *Malassezia* spp. yeast or cocci, and other infections like rods have been commonly found as secondary infectious organisms in dogs with food allergic otitis [14, 15].

The cause of otitis externa is often multifactorial. There have been several different classification schemes proposed to explain the pathogenesis of otitis [16]. Many studies have reported that of the allergy like atopy dermatitis with otitis in animals and have focused on the changes seen on the pinnae, specifically the erythema. Pinnal erythema is the predominant ear change seen in early and mild cases of allergic otitis [17, 18]. After chronicity of the allergic otitis, most dogs are found to have developed secondary bacterial with or without yeast infections, resulting to a more severe erythema, exudation, and proliferative changes characterized by hyperplasia of the epithelium and stenosis of the ear canal [19, 20].

CHAPTER 11

Ceruminous Otitis and its Clinical Management

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Abstract: Ceruminous otitis is the most common type of multifactorial disorder in dogs and is commonly associated with bacterial and/or yeast infections. The main diagnostic workup for Ceruminous otitis requires a detailed history, thorough physical as well as ear examinations, and cytologic evaluation. Diagnostic imaging may be essential tool for assessing the extent of mineralization of cartilage in the external ear and destruction of bone in the middle ear. If the ear canals are severely inflamed, pretreatment with systemic anti-inflammatory drugs is needed before flushing. Frequent ear cleaning with appropriate topical medication can control the odor associated with this condition. Steroids, cytotoxic drugs, and retinoic acid have variable effects to control ceruminous otitis.

Keywords: Ceruminous otitis, Chronic inflammation, Dog, Hyperplasia, Treatment.

INTRODUCTION

An inflammatory condition affecting the external ear canal, including the ear pinna, is known as otitis externa. Acute or chronic otitis externa can occur which is, Recurring or persistent otitis, and can last three months or more—. Chronic inflammation can cause changes in the external ear canal, such as glandular dilatation, glandular hyperplasia, hyperplasia of the epithelium, and hyperkeratosis. These alterations typically lead to an increase in the development of cerumen along the external ear canal, which raises the external ear canal's pH and local humidity and puts the ear at risk for secondary infection [1]. *Staphylococcus* species are the bacteria that are most frequently isolated from the ear canals of dogs that have otitis. Other bacteria that are frequently linked to otitis are *Corynebacterium*, *Pseudomonas*, *Proteus*, *Enterococcus* and *Streptococcus*. Certain bacteria, like *Staphylococcus* and *Pseudomonas*, have the ability to form biofilm, which can cause an infection to persist even in the face of

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appropriate treatment. This is because any antimicrobial therapy that aims to eradicate the infection must first break down the biofilm. Another prevalent cause of canine otitis externa is *Malassezia* yeast. It seems that certain dogs react allergically to *Malassezia* species, causing severe itching and pain. Treatment for acute and simple otitis externa is frequently successful; while more difficult for chronic or recurring otitis externa. Usually, there are underlying fundamental causes—including secondary otic infection—as well as predisposing and perpetuating variables at work. In addition to causing patient discomfort, severe glandular alterations, fibrosis, stenosis, and calcification along the external ear canal cause otitis media to evolve from acute to chronic and from simple to complex otic illness. These alterations are suggestive of end-stage ear disease, which is typically preventable with early intervention for both primary and secondary diseases [2].

ETIOLOGY

Chronic irritation of the ear canal's sebaceous and ceruminous glands can lead to hyperplasia, cystic dilatation of the ceruminous glands, and an increase in the activity of the sebaceous glands that cover them. The surplus cerumen secreted by ceruminous glands creates an ideal environment for the development of yeast and secondary bacteria. These organisms, which include *Pseudomonas* species, *Proteus* species, and *Malassezia pachydermatis*, are typical members of the ear flora. While some breeds with pendulous ears, can cause these organisms to develop excessively inside the ear canal as pendulous ears prevents air circulation and leads to incorrect drainage [3].

The external ear canal is obstructed by epidermal hyperplasia and inflammatory response in the majority of ceruminous otitis patients, making visual inspection challenging. Hyperplasia of the ear canal in dogs and cats can mimic neoplastic diseases, potentially resulting in incorrect diagnosis and therapy. Surgical surgery is frequently the preferred course of treatment when hyperplasia is unresponsive to medication and the ear canal becomes harder. Correct drainage is made possible by opening the ear canal surgically. For surgery to be successful, underlying infections must be found and treated.

Principal Elements

Primary factors include endocrine disorders like hypothyroidism, otic neoplasia, and foreign bodies. Otic parasites like *Otodectes cyanotis* and hypersensitivity diseases like food allergies, atopic dermatitis, and contact hypersensitivity are examples of diseases that directly affects the external ear canal and can cause otitis. The most frequent primary cause of canine otitis media is underlying hypersensitivity illness.

Contributing Variables

Predisposing circumstances are those that change the environment in the ear canal locally and raise the possibility of developing otitis externa. Excessive hair growth in the ears, stenotic ears, elevated cerumen production in the canals, otic masses, regular ear cleanings, variations in the outside temperature, and high levels of humidity may serve as risk factors [4].

Perpetuating Factors

Even after the underlying cause of the ear illness have been found and addressed, there are still elements that might exacerbate the inflammatory process without causing the disease itself. These factors are known as perpetuating factors. Common sustaining factors are bacteria like *Staphylococcus* and *Pseudomonas*, as well as yeast like *Malassezia*. The presence of the infection in the middle ear may also serve as a sustaining factor for repeated external ear infections if it spreads to the tympanic bulla. When treating dogs with recurrent otitis externa, perpetuating factors are frequently the primary cause of therapy failure (Fig. **1**).

Fig. (1). Ceruminous otitis in dog.

DIAGNOSIS

The history, otoscopic examination, and cytology are used to make the diagnosis.

Otitis externa is not associated with any particular sex distribution. More often affected animals are younger ones. Otitis media reflects the same breed tendencies as skin diseases (allergies in retrievers and terriers, for example). Any

CHAPTER 12

Ceruminoliths and its clinical Management

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Abstract: Epithelial migration plays a crucial role in maintaining the health of the ear canal and tympanic membrane. This process involves the movement of keratinocytes, and it serves to eliminate debris, prevent cerumen (earwax) buildup, and facilitates the healing of tympanic membrane damage. Keratinocytes not only acts as a physical barrier but also have immunological capabilities to protect the ear canal from contaminants. Failure of epithelial migration can lead to ceruminoliths, which are hard earwax concretions that can cause discomfort and even hearing loss. Ceruminoliths are commonly associated with factors like over production of cerumen, obstruction in the ear canal, and damage to the germinal epithelium. Diagnosis of ceruminoliths typically involves otoscopic examination and otic cytology. Management options include cerumenolytic agents, irrigation, and manual removal under vision, each with its own considerations and precautions. Treatment of the underlying cause, such as ear mite infestations, may also be necessary to prevent ceruminolith formation. This comprehensive review sheds light on the mechanisms, causes, diagnosis, and management of ceruminoliths, emphasizing the importance of ear health and the various strategies for effective removal.

Keywords: Abnormalities, Anatomy, Auditory, Balance organ, Canine, Causes, Cerumen, Ceruminoliths, Diagnosis, Ear, Ear canal, Earwax, Epithelial migration, Ear irrigation, Feline, Otic exam, Otoscopy, Pinnae, Treatment, Tympanic membrane.

INTRODUCTION

Normal Anatomy of Ear Canal in Dog and Cat

The ear serves as both an auditory and a balance organ [1]. The structure of the canine and feline ear can be subdivided into several components, which include the pinnae, external ear canals (external acoustic meatuses), middle ear, and internal ear. Understanding the typical anatomy and function of the ear is essential

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for identifying any abnormalities that may affect or originate within these ear compartments [2, 3]. The shape of the pinna is designed to capture sound waves and direct them into the ear canal towards the eardrum. In dogs and cats, the pinnae are flexible and can move independently of each other. The size and configuration of the pinnae differ among breeds. In dogs, the ear canal is notably deeper than in humans, which enhances its capability to effectively channel sound towards the eardrum. However, this deeper canal is more prone to accumulating dirt and wax, potentially resulting in inflammation and secondary infections [4, 5]. The pinnae are constructed from auricular cartilage, which is enveloped on both sides by skin containing apocrine sweat glands, sebaceous glands, and hair follicles. In comparison to the inner, concave surface, which is thinner, the pinna's rounder exterior has more hair follicles per square inch [6]. There are numerous muscles in the pinna, each with specific functions to move the ear in particular directions. The external ear canal's opening is oriented dorso-laterally. The upper part of the auricular cartilage takes on a funnel shape, giving rise to the vertical ear canal. This vertical canal then curves inward just above the level of the eardrum to become the horizontal ear canal [7, 8]. There is a notable cartilaginous ridge that acts as a separation between the vertical and horizontal ear canals. In its normal position, this ridge can obstruct the examination of the horizontal ear canal, requiring the ear pinna to be grasped and lifted to access it. The epidermis lining of the external ear canal shares a similar histological structure to that of the pinna; however, in most breeds, there are fewer hairs, and these hairs do not extend the entire length of the ear canal [9]. A sparse number of fine hairs can be observed beyond the tympanic membrane. These hairs serve as a valuable reference point when performing ear flushing, aiding in the identification of the tympanic membrane in cases of abnormal ears. Additionally, the external ear canal houses sebaceous glands and ceruminous glands, which are specialized apocrine glands. Cerumen is a protective emulsion that lines the ear canal. It consists of shed keratinized squamous epithelial cells, in combination with the secretions from both the sebaceous and ceruminous glands within the ears. A remarkable characteristic of the tympanic membrane is its capacity to maintain an exceedingly thin and robust structure, even in the presence of ongoing secretions from the dermal adnexal glands. “Epithelial migration” is the principal mechanism responsible for maintaining the external ear's typanic membrane thinness and self-cleaning ability [10].

Epithelial Migration

Epithelial migration serves as a mechanism for both eliminating debris and facilitating the healing of any damage to the tympanic membrane [11]. The lateral (external auditory canal) surface keratinocytes of the tympanic membrane and the auditory canal epithelium migrate in a process known as epithelial migration [12,

13]. Within the ear canal, cerumen is created when these desquamated epithelial cells interact with the secretions of the apocrine and sebaceous glands [14]. This process functions as a self-cleaning mechanism, effectively removing debris from both the external auditory canal and the tympanic membrane. During this process, cerumen is carried away from the tympanic membrane and towards the opening of the distal auditory canal, thus preventing the buildup of cerumen that might otherwise cause conductive hearing loss [15, 16]. Additionally, the migratory process plays a significant role in the healing of post-operative tympanic membrane incisions and spontaneous tympanic membrane perforations [17]. The keratinocytes have been proven to have immunological capabilities in addition to serving as a mechanical barrier to protect the ear canal from outside contaminants. Keratinocytes store interleukin-1 (IL-1). When these cells are harmed, IL-1 is produced, which prompts further cells to generate IL-1. This leads to a series of immunologic events that cause granulocytes, monocytes, and macrophages to migrate to the site of injury. Loss of this protective immune system permits unregulated bacterial colonisation when a section of the ear canal has been damaged by trauma or ulcer formation, encouraging the development of otitis externa (Gotthelf, 2005). In many species, including humans [18, 19], gerbils [20], rats [21], and guinea pigs [22], the epithelial migration rate and pattern have now been described. For typical feline tympanic membranes, there is, little information on epithelial migration. However, canine tympanic membrane epithelial migration has, been studied [23].

CERUMINOLITHS

Skin flakes may build up in the ear canal as a result of failure in epithelial migration. But more frequently, wax and keratin buildup at the eardrum's base results in either soft wax plugs or large, hard concretions known as ceruminoliths. On the horizontal ear canal's floor, ceruminoliths appear lying adherent to the eardrum [24]. They are most frequently observed because of allergic otitis or ear mite infestations. This debris may cause the tympanum to become perforated, act as a nidus for infection, cause discomfort, block the passage of medicine to the deeper parts of the ear canal, and serve as a source of infection [25]. Hearing is hampered by ceruminoliths that block the horizontal ear canal. The weight of the ceruminolith pushes against the eardrum in certain head postures, which may raise air pressure in the middle ear cavity and result in vestibular disorder symptoms [26]. Due to its closeness to the tympanic membrane and movement into the middle ear when the dog shakes its head, the ceruminolith can not only cause discomfort but also tear the membrane and result in otitis media [27].

CHAPTER 13

Ruptured Ear Drums and its Clinical Management

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Abstract: The nervous system's vestibular system is primarily in charge of preserving the animal's balance and orientation in reaction to gravity. It recognises the head's rotational movements, static position, acceleration, and deceleration. After then, it synchronises the head's movement and position with the position of the eyes, trunk, and limbs. The vestibular system's structure and the symptoms of malfunction is covered in part one of this article. Part two explores the various illnesses that may be at the root of this and gives in detail the proper diagnostic procedures, available treatments, and associated prognoses.

Keywords: Dog, Rupture eardrums, Vestibular diseases.

INTRODUCTION

The outer ear, middle ear, and inner ear are the three portions of a dog's ear. The smallest bones in the body, the malleus, incus, and stapes, are found in the middle ear. Due to its extraordinary fragility, the eardrum is readily harmed by ear infections or ear cleaning. The three middle ear bones and the labyrinth are reached by sounds that are transmitted from the environment by the eardrum. Any condition that affects the eardrum's integrity and structure, including an infection or perforation, can drastically reduce a dog's hearing. The changes in the external ear canal caused by persistent inflammation can include glandular hyperplasia, glandular dilation, epithelial hyperplasia, and hyperkeratosis [1]. These alterations typically lead to increased cerumen production throughout the external ear canal, which raises the external ear canal's pH and local humidity levels and puts the ear at risk for secondary infection. *Staphylococcus* species are the bacteria that are most frequently isolated from the ear canals of dogs with otitis [2]. Other bacteria that are frequently linked to otitis are *Corynebacterium*, *Pseudomonas*, *Proteus*,

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Enterococcus, and *Streptococcus*. Certain bacteria, like *Staphylococcus* and *Pseudomonas*, have the ability to form biofilms, which can cause an infection to persist even in the face of appropriate treatment. This is because any antimicrobial medication used to treat the illness must first break down the biofilm. Another frequent cause of canine otitis externa is *Malassezia* yeast. Any problems with the ear drum should be handled seriously and with quick veterinarian care.

HOW TO SPOT A RUPTURED EARDRUM IN THE DOG?

Dog's ear has three sections— The tympanic membrane, often known as the eardrum, divides the middle ear from the outer ear. It is a crucial component for sound transmission into r dog's ear.

The eardrum is a sensitive, fragile flap of tissue— Most frequently, chronic inflammation or infection that started in the outer ear canal and moved down to the eardrum will cause the eardrum to rupture.

Middle and inner ear infections can cause serious issues— The dog may lose their balance or go deaf if the eardrum ruptures and inflammation and infection spread further inside the ear.

WHAT IS EARDRUM RUPTURE?

Should seek veterinarian care if the dog's eardrum has ruptured. If an eardrum perforation is not treated, dog may experience long-term complications, including deafness in the afflicted ear. Dog's eardrum may rupture or perforate for a number of reasons, such as abrupt and significant changes in air pressure, middle ear infections, extremely loud noises, trauma, and foreign objects.

The tympanic membrane, a thin membrane that serves as a barrier between the middle and inner ear and the external ear, is r dog's eardrum. The tympanic membrane and eardrum are hidden deep inside the dog's ear canal, so anyone cannot see them. The primary function of the eardrum is to transmit sounds that are captured to the middle ear's ossicles. The ossicles are three small bones that then transmit the sounds that have been captured to the labyrinth [3].

Symptoms of Eardrum Rupture in Dogs

Pain

Pain is one of the most blatant indications of a perforated eardrum. There are various ways that ear pain might present. When the damaged ear is handled, many dogs may whine, some may continue to scratch or rub the ear, while others may tilt their heads or continually shake them. Because opening and closing the jaw

tends to make the ear ache worse, affected dogs may also refuse to eat or open their jaws.

Discharge

The middle ear and the dog's ear canal are separated by the eardrum, also referred to as the tympanic membrane. The thin, drum-like tympanic membrane may become compressed by fluid accumulation in the middle ear, which can lead to rupture. This membrane may tear or develop a hole, allowing fluid from the middle ear to leak into the ear canal. This fluid may have the appearance of thick pus that is frequently tinted with blood. Note that the dog may experience improved comfort and reduced pain when pressure builds up and the eardrum bursts [4].

Neurological Signs

According to the Merck Veterinary Manual, paralysis of the facial nerves may be seen on the same side of the damaged ear because the dog's middle ear area is where the sympathetic and facial nerves travel through. As a result, a dog might not be able to blink, their eyes might totally close, and their lips and facial features might look drooping. A ruptured eardrum and an inner ear infection may also result in staggering, walking in circles, uncontrollable eye movements, and incoordination because the middle ear and inner ear both play a significant role in balance.

Hearing Loss

A damaged eardrum will impair the dog's hearing because it is the eardrum's job to transfer noises to the inner ear. However, if only one eardrum is harmed, the hearing loss might not even be visible. According to George M. Strain in his book Deafness in canines and Cats, even canines with unilateral hearing loss may still be able to respond to sound stimuli.

Visible Symptoms

Consult a veterinarian if you believe that a dog's eardrum is punctured. Aveterinarian may be able to detect a perforation or tear in the ear canal using an otoscope. Few dogs would consent to a complete eardrum examination, thus sedation or general anesthesia may be required. The tympanic membrane is visible once the otoscope has been placed into the ear canal. The jagged borders of the eardrum can be seen when this membrane is perforated. The eardrum may have a hole if it was torn [5].

CHAPTER 14

Otitis Externa and its Clinical Management

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Abstract: An ear is called a vestibule-cochlear organ since it enables to hear as well as sense of balance to animals. The external portion of the ear consist of a flap known as pinna and an opening at the base of the ear. Otitis externa is defined as an acute or chronic inflammation of the epithelium of the external ear canal which may also involve the pinna and it results from a combination of dynamic changes affecting the anatomical, psychological and microbiological status of the external ear canal. The etiological factors of the otitis externa can be categorised as predisposing factors, primary causes, perpetuating factors and secondary causes. Predisposing factors are those which increase the risk of developing otitis externa, whereas primary causes directly induces otitis externa. These long-term alterations causes the skin to be thicken, the canal to become stenosed, and a great deal of folds to form, all of which prevent the area from being cleaned effectively and serve as a breeding ground for secondary infections. Diagnosis of otitis externa is done by proper history and symptomatology, roll smear examination for mites and other cytological evidence, otoscopy, isolation and cultureantibiotic sensitivity test for selecting suitable antibiotic for treatment.

Generally otitis externa can be treated by application of suitable cleansers, topical antibiotic and anti fungal therapy along with corticosteroids. Sometimes it is difficult to treat chronic and recurrent otitis externa.

Keywords: Cerumen secretions, Cytology, Dog, Otits externa, Topical antibiotic, Wax.

INTRODUCTION

Vestibular-cochlear organ in the ear is the most important organ which enables to hear and also in balancing the body in animals. There are two parts in ear, a flap like organ called pinna and an external orifice into the ear canal.

At the external orifice of the ear, auricular cartilage begins to roll into a funnel shape that extends downwards forming a vertical ear canal which terminates with

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Tanmoy Rana (Ed.)

the tympanic membrane or eardrum. This anatomical structure is predisposing factor for most of the ear infections. Ear infection in dogs results from irritation caused by excessive accumulation of ear wax, tissue debris and oil from skin. Generally, sebaceous and ceruminous glands in stratified squamous epithelium of the ear canal can secrets an odourless white fluid which later combines with desquamated epithelial cells and forms cerumen or ear wax which helps in protection of skin from various injuries or microorganisms. But sometimes the excessive secretion of cerumen helps in growth of *Malassezia pachydermatitis* [1].

Otitis externa is one of the most important and multifactorial disease accounting for 10-20% of all other clinical conditions of canines. Otitis externa brings dynamic changes in anatomical, microbiological as well as psychological status of the ear canal with involvement of ear pinna resulting in acute or chronic inflammatory changes of epithelium [2].

OTITIS EXTERNA

Otitis externa is an inflammatory condition that affects the pinna and external ear canal. Acute or chronic (permanent or recurrent otitis lasting three months or longer) otitis externa are both possible. It can be quite difficult to treat canine chronic as well as recurrent otitis externa, which calls for multifactorial as well as step-by-step strategic planning. Recognizing the causes, and the factors that contributes to otitis is a crucial first step towards effective diagnosis and treatment.

Changes that occur in external ear canal in response to chronic inflammation may include glandular hyperplacia, glandular dilation, epithelial hyperplacia and hyperkeratosis. These changes are responsible for increased cerumen production which in turn causes increase in pH and local humidity, thus predisposing to secondary infection.

Epidemiology

Various authors reported that otitis externa accounts for up to 15-20% of different ailments presenting to the clinics [3, 4]. It is very important to know the age, breed and sex predisposition of dogs to the otitis externa. The dogs aged between 1 and 3 years are more susceptible for otitis externa by Malasezia [5, 6].

Otitis externa occurs more commonly in males than in females. However according to some authors there is no sex predisposition for canine otitis externa [7].

Etiology and Pathogenesis

The multifactorial etiology of otitis externa can be categorized into predisposing factors, primary causes, secondary causes and perpetuating factors. Among these primary factors are the direct inducers of otitis externa, whereas predisposing factors are those to elevate the risk of otitis.

Perpetuating factors are those which prevent resolution of otitis whereas secondary causes are those which contribute to pathology only in the abnormal ear or in combination with predisposing factors.

Because the infection occurs typically only in a portion of the tissue, it is crucial to comprehend the multifaceted nature of otitis and pay attention to the various causes as well as contributing variables (Fig. **1**). After initiating the inflammatory process inside the ear canal, change the aural environment, and promote the growth of infections as secondary complicating factors. When a secondary complicating problem first appears, the owner or even the veterinarian may not be aware of the underlying reason, which may be extremely mild (Fig. **2**).

Fig. (1). Otitis externa in german shepherd dog.

Primary Causes

Hypersensitivities (atopic dermatitis, food hypersensitivity) [8], parasites (*Otodectes cynotis, Demodicosis, Sarcoptes*), foreign bodies (like plant awns), epithelialization disorders or autoimmune diseases (sebaceous adenitis, Vitamin A

CHAPTER 15

Otitis Media and its Clinical Management

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Abstract: Otitis externa and otitis media are prevalent conditions in veterinary medicine, frequently encountered in dogs suffering from chronic ear ailments and in cats affected by upper respiratory diseases and polyps. Detecting otitis media necessitates a comprehensive evaluation of the patient's medical history and clinical manifestations, coupled with additional diagnostic techniques to ascertain the presence of disease within the bulla. In cases where the integrity of the eardrum cannot be definitively assessed, it is judicious to assume the presence of middle ear pathology and initiate appropriate management. An essential precaution is to abstain from employing potentially ototoxic ear cleansers and topical medications in suspected otitis media cases. The successful treatment of this condition often involves a combination of systemic and topical therapies within the thoroughly cleaned bulla.

Within the realm of veterinary practice, otitis media is an affliction that is all too common and frequently proves to be a vexing challenge. Its diagnosis can be a laborious and, at times, invasive process, incurring substantial costs. Otitis media typically emanates as an extension of external ear afflictions, often arising as a consequence of chronic otitis externa. Furthermore, the presence of otitis media can be a causative factor in cases where treatment for otitis externa has proven ineffective, underscoring the imperative of reaching a definitive diagnosis to guide appropriate therapeutic interventions. Otitis media, or middle ear pathology more broadly, poses a diagnostic conundrum, as the presenting clinical signs often mirror those of otitis externa, rendering differentiation difficult in the absence of evident facial and/or sympathetic nerve dysfunction. It is worth noting that otitis media can progress, in some instances, to otitis interna, giving rise to peripheral vestibular syndrome symptoms. This underscores the critical importance of recommending tomographic imaging in situations where chronic otitis externa manifests as a suppurative or proliferative condition.

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Tanmoy Rana (Ed.)

Keywords: Eardrum, Otitis, Otitis media, Otitis externa, Tympanic membrane.

INTRODUCTION

Secondary ear infections result from the presence of commensal microorganisms like *Staphylococci* and *Malassezia* or environmental opportunistic pathogens, such as *Pseudomonas*. The primary etiological factor represents the true instigator of the inflammatory response within the ear, necessitating precise identification and effective management. While predisposing factors alone seldom incite otitis, they do heighten the susceptibility of a dog to ear inflammation or the progression to severe disease. Ongoing issues manifest as a consequence of recurring bouts of inflammation and infection, ultimately culminating in an advanced stage of otitis, compelling the need for surgical intervention.

The term otitis refers to an ear infection, however it does not specify which region of the ear is affected. Otitis media is an inflammation and/or infection of the middle ear, whereas otitis externa is an infection that develops in the external ear canal. Because some nerves are directly related with the middle ear, infection there can damage them, resulting in the neurologic symptoms seen with this illness: head tilt, loss of balance, and nystagmus (back-and-forth eye movements). These are known as vestibular indications. Middle ear infections can also induce facial nerve paralysis, resulting in a slack-jawed look on that side of the face.

Otitis media is most commonly caused by an existing otitis externa and moves from the external ear canal *via* the tympanic membrane and into the middle ear. The external ear canal infection causes inflammation and damage to the ear canal and tympanic membrane, allowing the infection to invade the middle ear.

Otitis media has been discovered in 16% of dogs with acute (short-term) otitis externa and 52% of dogs with chronic (long-term) otitis externa. In comparison, 63% of cats with otitis media/interna had no prior history of ear infection [1].

ETIOLOGY

Otitis media is a middle ear infection. The following are the most common causes of otitis media in dogs:

1) Otitis externa spreading through the eardrum into the bulla.

2) Bacterial migration from the pharynx to the middle ear through the Eustachian tube.

3) Aural tumour.

4) Foreign body (plant awn).

The migration of germs from the outer ear to the inner ear is the most prevalent cause of otitis media in dogs. This happens in chronic otitis externa situations. Maceration and eventual destruction of the tympanic membrane are caused by continuous moisture in the outer ear. The infection subsequently spreads into the bulla from the ear canal. If the outer ear infection is mostly gone, the eardrum will mend. Unfortunately, the mended eardrum traps infection and exudate in the middle ear (Fig. **1**).

Fig. (1). Ear infection of a dog.

Other causes of otitis media can include infections in the nose and throat, trauma, foreign bodies, fungal infections, inflammatory polyps, cancer, *etc.* In addition, developmental abnormalities of the external ear canal and pharynx can lead to otitis media. It is generally agreed that most cases of otitis media are caused by bacteria. Although *Staphylococcus* and *Streptococcus spp*. are among the most commonly isolated organisms, they have also been isolated from the middle ears of healthy dogs thus; their role as primary inducers of inflammation is questionable.

Pseudomonas and *Proteus spp.* are also usually cited as etiologic agents of otitis media, however they have not been isolated from healthy dogs' middle ears. *Clostridium spp.* and *Escherichia coli* have also been linked to otitis media. Otitis medium is commonly caused by yeast infections such as *Malassezia canis* or *Candida spp.*

CHAPTER 16

Otitis Interna and its Clinical Management

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Abstract: Otitis interna define as inflammation of inner ear, which will be an extension of infection from the otitis media or secondary to the chronic otitis externa. Improperly treated / untreated cases of otitis media can lead to development of otitis interna by involving the tympanic membrane. Clinical signs in otitis interna were impairment of hearing apparatus *i.e.* deafness and neurological indications such as tilting of the head towards the based on the side of the ear affected, development of the horizontal or rotary nystagmus, unequal legs coordination with diffused strength, circular walking pattern, sudden collapse, and even rolling towards the impacted side. Complication of otitis interna leads to development of life-threatening iotrogenic intracranial infections and meningitis by travelling the infectious organisms to the brainstem. In dogs with severe otitis interna that progressed to an intracranial infection, changes in mentation, ataxic changes, paresis, proprioceptive deficits, and development of seizures. Diagnosis of the otitis interna achieved by detailed history; dermatological, neurological and systemic examination along with the identification of underlying and/or associated factors. Otoscopic examination, cytology, microbial culture, antibiotic sensitivity test, radiography, computerized tomography scan evaluation and magnetic resonance imaging are helpful to differentiate the extent of lesions and severity. Medical management of otitis interna is carried out by identifying the suitable antibiotic by antibiotic sensitivity test followed by the correct dosage and duration approximately ranging from 4 to 8 weeks along with the systemic corticosteroids which have been advised to reduce the stenosis. When there is rupture of tympanic membrane, cautious utilization of topical antibiotic and/or anti-inflammatory preparations are advisable. If medical management fails to respond, surgical intervention are advised with vertical ear canal ablation, lateral ear canal resection, total ear canal ablation with lateral bulla osteotomy.

Keywords: Dogs, LECR, Nervous signs, Otitis interna, TECA, VECA.

INTRODUCTION

The internal ear structures of the dogs consist of three components *i.e.* the cochlea, the vestibule, and the semicircular canals. The cochlea is a spiral-shaped

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Tanmoy Rana (Ed.)

osseous tube, reminiscent of a snail's shell. The vestibule contains the utricle and saccule, responsible for detecting linear head movements. The semicircular canals, oriented perpendicular to each other, detect rotational head movements. Fluid movement within the semicircular ducts during head rotation deflects the cupula, leading to bending of the cilia and generation of impulses in the vestibular nerve. Overall, these intricate structures play vital roles in auditory and vestibular function in dogs (Figs. **1** and **2**) [1 - 3].

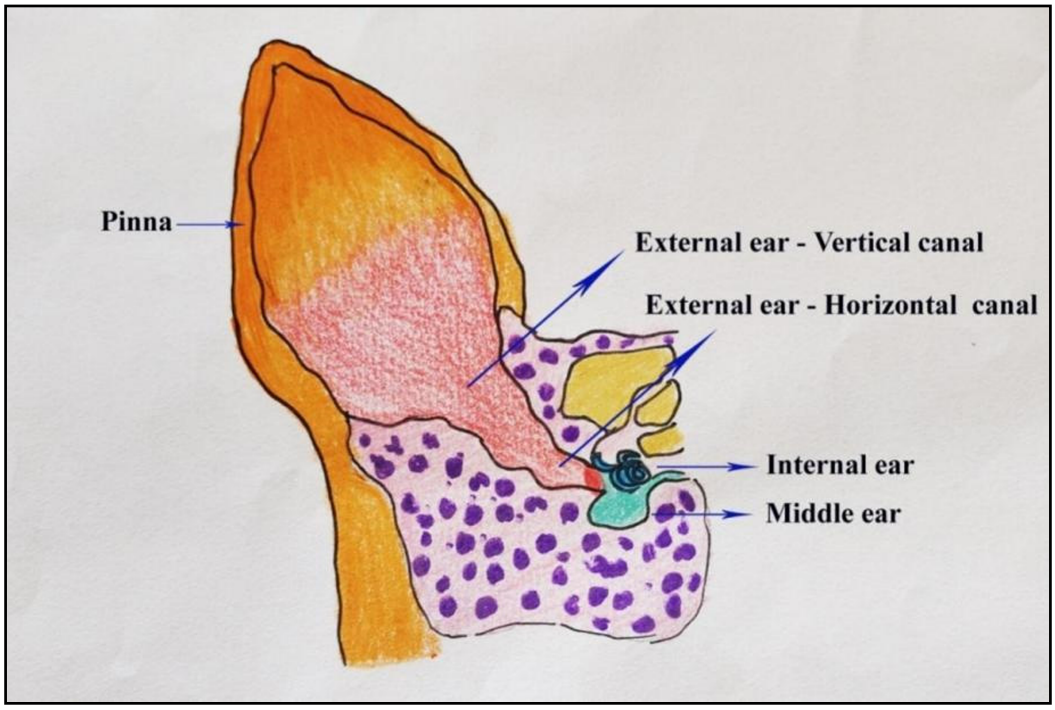

Fig. (1). Schematic diagram of the external, middle and internal ear, dog – Cross-section through skull (Courtesy of Ms. Syed Afreen).

OTITIS INTERNA

Otitis media is considered as an inflammation of middle ear which is a common clinical presentation in dogs and cats. Otitis media damages the tympanic membrane and bulla, and causing the variety of clinical signs ranging from severe pain to development of vestibular sympotoms. Otitis media results from the secondary to the chronic otitis externa that extends through the tympanic membrane and begins of primary factors such as a foreign body and iatrogenic rupture during ear cleaning [4]. Improperly treated / untreated cases of otitis media can lead to development of otitis interna which is considered as an inflammatory disease of inner ear. As a pathological change during the otitis

interna can results in impairment of hearing apparatus which leads to deafness and development of neurological signs [5]. In some of the cases it can cause severe otitis interna, a life-threatening iotrogenic intracranial infections and meningitis due to travelling of the infectious organisms from external ear to internal ear and to the brainstem by nerves and vessels located in the internal acoustic meatus. Otitis interna may arise, occasionally accompanied by osteomyelitis of the petrous portion of the temporal bone. As the condition advances in severity over time, lesions may extend retrogradely through the internal acoustic meatus into the cranial cavity, leading to complications such as meningitis, ventriculitis, and encephalitis [6 - 8].

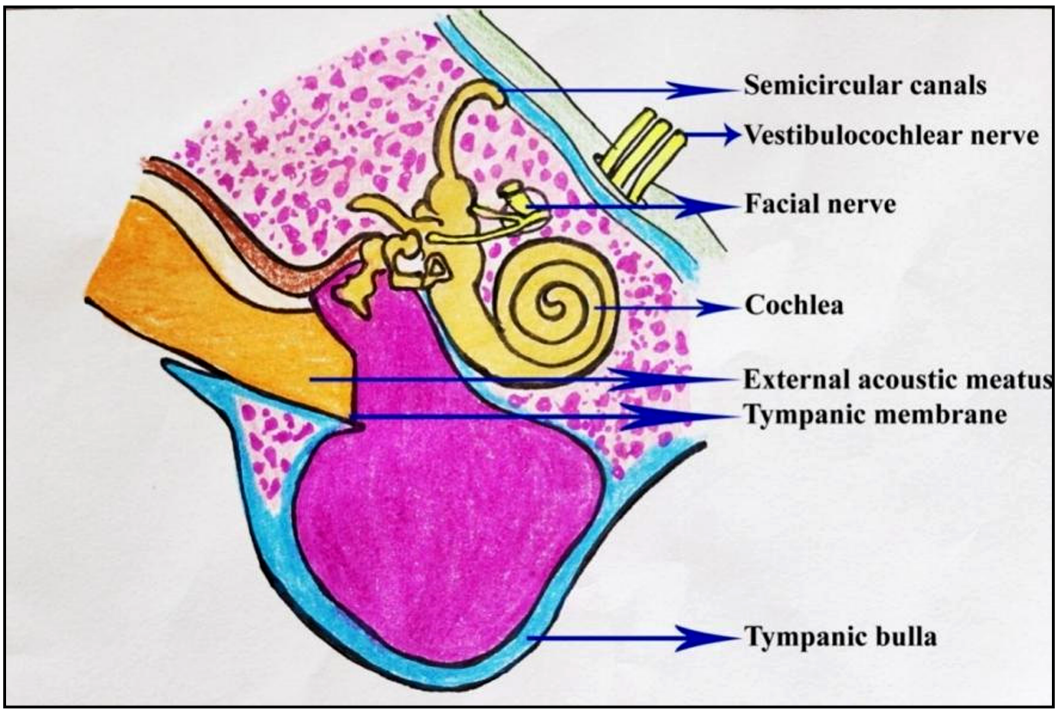

Fig. (2). Schematic diagram of the internal ear, dog – Close up view of the middle ear and internal ear (Courtesy of Ms. Syed Afreen).

Etiology and Pathological Changes

A connection has been observed between otitis externa and otitis interna. Consequently, primary cause for development of otitis interna by involving the diseases progression from external ear infection through the tympanic membrane into the middle ear [9]. Causes of the otitis classified as primary inflammatory origin with in the ear canal, changes in the aural environment and development of secondary complications such as infectious agents like bacterial and fungal

CHAPTER 17

Paradigm of Ear Canal Ablation (ECA) and Clinical Results of Bulla Osteotomy

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Abstract: Total Ear Canal Ablation (TECA) and Bulla Osteotomy are surgical procedures in veterinary medicine utilized to address various ear-related conditions, primarily in dogs and cats. TECA is indicated for chronic inflammatory ear diseases, trauma, neoplasia, cholesteatoma, congenital malformations, and failed prior surgeries. It involves the complete removal of the ear canal, often coupled with Lateral Bulla Osteotomy (LBO) for middle ear issues. LBO is essential for conditions like otitis media. Preoperative evaluations encompass physical exams, otoscopy, and imaging, with antibiotic and analgesic administration. Surgical equipment includes specialized instruments like rongeurs, curettes, and retractors. The surgical procedures require meticulous technique to ensure patient safety and involve incisions, dissection, and removal of affected tissue, with a focus on preserving vital structures like the facial nerve. Postoperative care includes pain management, bandaging, swelling control, antibiotic therapy, and drain/suture management. Potential complications include nerve damage and hearing loss. TECA and Bulla Osteotomy are crucial interventions for alleviating chronic ear problems in animals, enhancing their overall quality of life.

Keywords: Bulla osteotomy, Cholesteatoma, Ear canal, Otitis externa, Otitis media, Tympanic bulla, Total ear canal ablation.

INTRODUCTION

Ear infections in dogs are a prevalent issue that can inflict considerable distress and suffering on our beloved canine companions. These infections, scientifically referred to as otitis, commonly occur in the external ear canal due to the warm, moist environment that provides a breeding ground for bacteria, yeast, and other

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pathogens [1, 2]. The symptoms of ear infections in dogs can vary in severity but often include telltale signs such as persistent scratching or pawing at the affected ear, head shaking, redness or inflammation of the ear canal, odorous discharge, and evident discomfort or pain, sometimes manifested through vocalization or aggression when the ear is touched. Bacteria and debris can accumulate in the horizontal ear canal over time, leading to a middle ear infection when they access the tympanic cavity [3]. As the infection progresses, the tympanic membrane and ear canal lining thicken, and calcification can occur in the cartilage. In severe cases of middle ear infection, the ear canal lining may undergo metaplasia, and new bone can form within the tympanic bulla, a condition known as bulla osteitis, which becomes a persistent source of infection. Cholesteatomas, an unusual and aggressive consequence of chronic inflammatory middle ear disease, can develop from a displaced portion of the tympanic membrane that adheres to the inflamed mucosa in the tympanic cavity [4]. These cholesteatomas result from the shedding of cells from the keratinized membrane, forming a cystic structure that causes extensive bone resorption and remodeling in the bulla. Surgical intervention becomes necessary when medical therapy is ineffective or unlikely to succeed, particularly in cases of chronic and end-stage changes or the presence of cholesteatoma as revealed by radiographic imaging. Chronic otitis externa is the primary cause of middle ear disease, and the most common surgical procedure for accessing the tympanic cavity is the total ear canal ablation (TECA) combined with lateral bulla osteotomy (LBO) of the tympanic bulla (Smeak, 1988). This approach allows for the complete removal of chronically diseased ear canal tissue and exposure of the tympanic cavity through a single incision. In cases where epithelium and debris are not entirely removed from the tympanic cavity, or secondary infections are not effectively treated after TECA and LBO, severe deep-seated infections can occur. This complication can be more painful for the patient than the original ear condition and is challenging and costly to address [5]. Therefore, it is crucial to avoid this complication. Although some surgeons may be cautious about aggressive LBO due to concerns about potential complications like facial nerve or inner ear damage or excessive bleeding, it remains essential to ensure thorough debridement in the tympanic cavity. Achieving complete debridement is a critical aspect of the successful TECA and LBO procedure, and this article offers a detailed description of the relevant anatomy, a step-by-step surgical procedure with illustrations, and guidelines for safe debridement within the tympanic cavity, with a focus on minimizing risks.

PREOPERATIVE CONSIDERATIONS

Owner Education

Owners should be thoroughly informed about the purpose and expectations after TECA LBO, including the potential for serious postoperative complications. The primary goal of the surgery is to improve the pet's comfort by completely removing the source of chronic infection, eliminating the need for further ear cleaning, and alleviating the malodorous discharge (Beckman *et al.,* 1990). While some concerns about post-surgery appearance and potential hearing loss exist, TECA LBO is generally well-received by owners, especially when their pets experience relief from chronic ear problems (Book author).

Physical Examination

During the physical examination, the external ear, deeper ear canals, and regional lymph nodes are assessed. Blood-tinged ear discharge may raise suspicion of neoplasia [6]. A cranial nerve examination is performed to evaluate for facial nerve dysfunction, inner ear involvement, and Horner's syndrome, which may affect about 15% of dogs considered for TECA [7]. A dermatologic examination is essential in cases where chronic ear problems are linked to a systemic skin disorder [8]. Staging is performed in cases of suspected neoplastic ear disease, including palpation of local lymph nodes and fine-needle aspirates for cytology.

Otoscopic Examination

A thorough otoscopic examination is best performed under anesthesia. The ear canal is cleaned, examined, and samples are collected for bacterial culture, susceptibility testing, and cytologic examination [9]. Special attention is given to identifying tumors, growths, and assessing the degree of stenosis in the horizontal ear canal. Fine-needle aspirates of suspicious masses can aid in distinguishing between benign and malignant ear diseases [10].

Imaging Evaluation

Radiographic imaging, such as plain film radiography or positive-contrast ear canalography, is used to examine the external, middle, and internal ear [11]. Chest radiographs may be taken to assess for metastatic disease or other conditions in older patients. Imaging, such as computed tomography (CT) or magnetic resonance imaging (MRI), can help evaluate the external ear canal, tympanic membrane, and tympanic bulla. CT is recommended before surgery, particularly in dogs with neurologic deficits or signs of upper airway obstruction. CT has been found to be more sensitive than plain film radiography for evaluating otitis media

CHAPTER 18

Neurological Disturbances

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Abstract: Canine ear consists of external pinna, external ear canal, middle ear and inner ear. External ear with its cartilage structure catches the sound while middle ear through its three unique ossicle structures and tympanic membrane transmits the wave to internal ear. The bony labyrinth and associated structures of inner ear along with different nerve innervations in inner and middle ear acts as sensory organ for hearing and balance. The complex nerve structure which passes part of its course through middle or internal ear structures also innervates the surrounding facial, lip, ear, nose, eye, neck regions. Thus, a little obstacle or infection (otitis media or interna) in middle or inner ear affects the nerve function and creates different muscular or nueurogenic abnormality presented through different clinical symptoms. Among various canine ear problems, the most common vestibular diseases (peripheral and central), namely horner's syndrome, hemifacial spasm, deafness, facial nerve paralysis are discussed briefly in this chapter.

Keywords: Cranial nerves, Facial paralysis, Horner's syndrome, Otitis media, Vestibular disease.

INTRODUCTION

A large portion of animal communication depends on the auditory system, which is built to detect and analyze sound in the surroundings. With specific frequencies and amplitudes, sounds are pressure waves in the atmosphere. The auditory system interprets a sound's frequency as its pitch and its amplitude as its loudness. Having at least one ear is necessary for hearing, but having two allows the auditory system to detect differences in the timing or strength of sound waves impinging on the two ears. Animals' capacity to move their ears around to search

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the surroundings for various sounds and determine where the sound is coming from, improves their hearing as well. The cerebral cortex is responsible for hearing, but the brainstem mediates auditory reflexes like tilting the head in reaction to sound. The auditory system, which includes the external, middle, and inner ears, includes the organ of Corti, a sensory receptor. The cochlear nerve transmits auditory impulses to the cochlear nuclei in the medulla oblongata and innervates the organ of Corti in the inner ear. The medial geniculate nucleus of the thalamus, which in turn projects to the auditory cerebral cortex, receives axons from the organ of Corti as they ascend the brainstem (Fig. **1**).

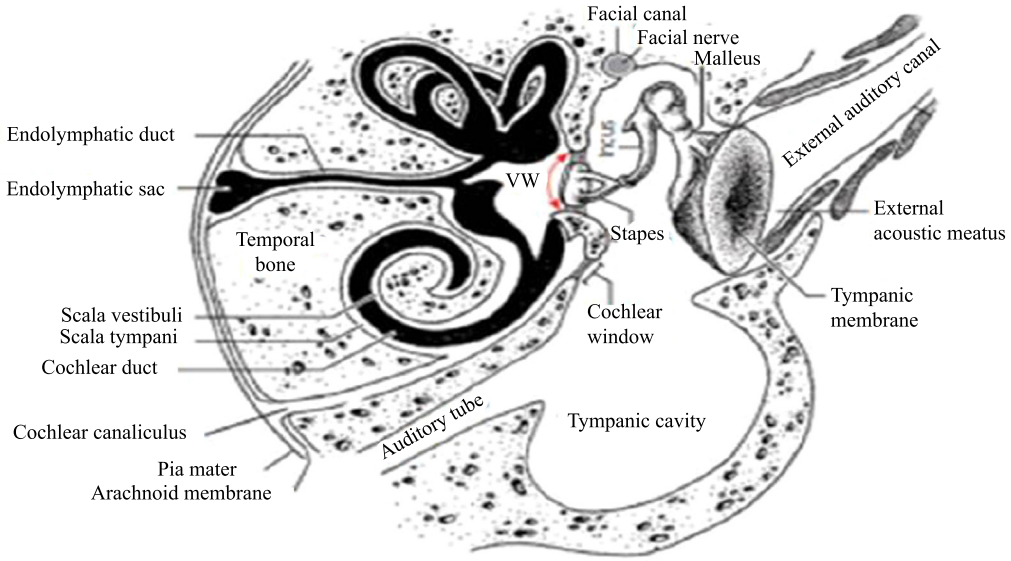

Fig. (1). The auditory system [22].

NEURO ANATOMY AND NEUROLOGICAL PATHWAYS RELATED TO EAR DISEASES

Anatomically ear comprises of external auditory canal, middle ear and inner ear (Fig. **1**). The external auditory meatus collects the sound and direct towards tympanic membrane. Middle ear starts with three small ossicles or bones named as malleus, incus, stapes and Eustachian tube. Malleus is attached with tympanic membrane and the incoming sound waves are amplified by the series of small ossicles and transfer to inner ear through stapes to oval window of inner ear. Eustachian tube maintains the air pressure in middle ear there by helps in proper transmission of sound waves. The bony labyrinth of the inner ear is made up of semicircular canals, vestibule and cochlea. The membranous labyrinth underlies the bony labyrinth. The semicircular canal and vestibules take care of vestibular function whereas cochlea is associated with auditory functions [1, 2].

The three semicircular canals are oriented perpendicular to each other representing the three planes in space and thus can detect movement in all planes. One end of theses canals is dilated to form ampulla and are attached with vestibule. The ampulla houses a structure called as crista ampullaris in the membranous labyrinth. They carry the receptors cells named hair cells that form synapsis with the vestibulocochlear nerve of CNS system and thus are responsible for detection of rotational head movement in different planes. The membranous labyrinth of vestibules, semicircular canal and Scala media of cochlea are filled with a fluid called endolymph. The rotation of head and eyeball is due to hydrodynamics of endolymph. The cilia of hair cells are extended into the cupula. The cupula is gelatinous poly saccharide mound [3]. The rotation of head creates a motion in endolymph deflecting cupula from its place, thereby creating a nerve impulse. The utricles and saccules are the two structures take care of the static position and linear acceleration of head. The saccule and utricle are attached to vestibules and placed in a vertical plane and horizontal plane respectively. The dilatation on these structures is called macula and lined by hair cells with the cilia extending into a gelatinous structure called otolithic membrane. There are calcium carbonate crystals called otoliths or statoconia [4]. The otoliths move faster due to its inertia when body starts moving in linear direction and thereby creating a sensation or nerve impulse in the hair cells and in turn stimulate the vestibulochoclear nerve. The axons of vestibular nerve after joining with cochlear branch of cranial nerve VIII runs through internal acoustic meatus to rostral medulla oblangata of brain stem. A mainstream of neurons joins with four vestibular nuclei but a few directly connect with the cerebellum by caudal cerebellar peduncle. The neural impulse acts through extensors muscles innervated by neurons. Suppose the head of an animal tilt towards right then the right extensor muscles are stimulated and the left extensor muscles inhibited, thereby preventing falling down to left.

The vestibular neurons also pass through the nuclei of cranial nerves III, IV and VI. These three neurons innervate different muscles of eyeball and are responsible for eyeball movement. The vestibular system in this way coordinates the changes required in eyeball movement with varied position of head and thereby keep the image stable in retina. These important neuroanatomy of ear plays a mainstream role in vestibular function of body [5].

The trigeminal, facial, vagus and second cervical nerves, in particular, are in charge of the sensory innervation of the pinna. The skin of the skull and the mucosa of the intraosseous portion of the external ear canal are sensory organs of the trigeminal nerve (mandibular branch). The mandibular nerve is released at the oval foramen by the auriculotemporal nerve, which then exits between the auricular cartilage on the caudal side and the base of the masseter muscle on the

CHAPTER 19

Ototoxicity and its Clinical Management

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Abstract: The adverse effects of many medications used in veterinary treatment might cause hearing or balance problems in an animal. Although the predominance and ototoxicity pathways in both humans and lab animals have been well explored, significantly less research has been done on domestic dogs and cats. Since these adverse effects are universal among species, one can extrapolate from them and provide the veterinarian with details regarding possible chemotherapeutic side effects.

Keywords: Aminoglycosides, Cochlear toxicity, Hearing loss, Ototoxicity, Vestibular toxicity.

INTRODUCTION

Many medications used in veterinary care have adverse effects that can impair an animal's ability to hear or balance. It is noteworthy that all these side effects, including the important discoveries on the ototoxicity (harm to hearing and balance) of cisplatin, aminoglycoside antibiotics and other drugs occurred in the 20th century, were first identified in humans [1].

In veterinary medicine, the main medications that might be problematic include loop diuretics like furosemide, the anticancer medication cisplatin, and the antimicrobial aminoglycoside antibiotics gentamicin and amikacin, which cause ototoxicity. Certain medications, such the antibiotic erythromycin and the anthelmintic arsenical melarsomine, may also be somewhat ototoxic when taken occasionally or infrequently (Figs. **1**, **2** and **3**). Lastly, environmental factors—like elderly age and even being around loud near kennels. We should not be disregarded when examining possible reasons why animals might lose their hearing.

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Fig. (1). Otitis externa (showing crusty lesions).

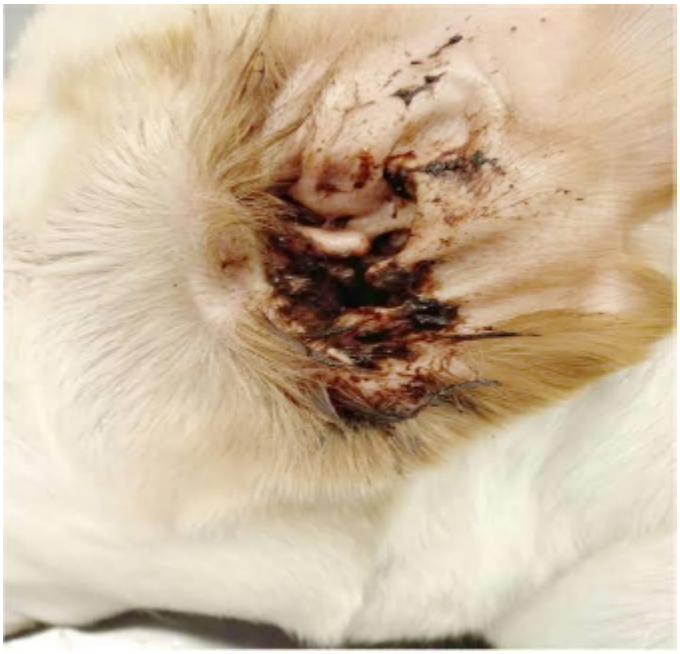

Fig. (2). Otitis interna (pus oozing from inner ear).

Fig. (3). Otitis interna (blood mixed with pus from inner ear).

INNER EAR PATHOLOGY

Long-term usage of aminoglycoside affects several types of internal ear cells, but the medications' main target is the sensory cells, namely the hair cells.

As the lesions deepen, the hair cells which are not regenerative start disappearing towards the middle and apical turns of the cochlear spiral, and disappears in the basal region.

Additionally, vestibular lesions and the resulting behavioural abnormalities can be caused by aminoglycoside drugs. The loss of sensory hair cells in the vestibule, also results in a compromised sense of balance [2].

The cells first disappear in the cristae ampullaris, the structure in charge of detecting angular acceleration and deceleration. Some areas of the maculae in the sacculus and utricle may also sustain the damage. The impact of cisplatin on the internal ear seems to be more complicated than that of aminoglycosides, affecting a range of cell types, even though loss of hair cells is a clinical characteristic feature (Table **1**).

Table 1. showing potential causes of hearing loss in dogs.

Aminoglycoside Antibiotics	**Streptomycin, Neomycin, Gentamicin**
Antineoplastics	Cisplatin, carboplatin
Diuretics	Ethacrynic acid, furosemide
Metallo Compounds	Arsenical, mercurial

CHAPTER 20

Para-aural Abscess and its Management

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Abstract: Para-aural abscessation refers to the extension of purulent inflammation and infection outside the deeper parts of the external ear canal or the middle ear cavity, into the surrounding soft tissues. It can arise from trauma, neoplasia, foreign bodies, chronic otitis externa and previous ear surgery. Clinical signs of pain upon opening the mouth, para-aural swelling and the development of draining tracts in the region of the ear base and parotid gland can appear followed by signs of otitis interna such as ataxia and head tilt toward the affected side, and of facial nerve paralysis. Otoscopy will usually allow recognition of obstruction; however, large abscesses can be opened and drained if indicated before definitive treatment. Apart from contrast radiography (fistulograms), CT imaging is recommended as a diagnostic technique as it provides useful information with respect to the cause of the condition and the recommended surgical approach. Various diagnostic procedures and surgical approaches recommended for the treatment of para-aural abscessation have been elaborated in this chapter. The success and outcome of a surgical procedure does not only depend on the knowledge, experience and instrument and tissue handling of the surgeon, but also on the best peri- and postoperative care. In this chapter, peri- and postoperative analgesia, peri- and postoperative antibacterial therapy, postoperative nutritional management and postoperative dressings and wound management of patients undergoing ear surgery will be discussed under different headings.

Keywords: Abscess, Antibiotics, Auricle, Bandage, Cat, Dog, Ear, Otoscopy, Pain, Pus, Surgery.

INTRODUCTION

The term “para-aural abscessation” describes the spread of purulent inflammation and infection into the soft tissues around the external ear canal or middle ear

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cavity. Compared to cats, dogs, particularly Cocker Spaniels, are more likely to develop para-aural abscesses [1 - 3]. Trauma, neoplasia, foreign objects, chronic otitis externa, and previous ear surgery are all potential causes of infection spreading outside the ear canal and/or middle ear cavity [4, 5]. Blockage and stenosis of the external ear canal as well as subsequent abscessation are caused by the traumatized separation of the auricular and annular cartilages [6 - 8]. Even though it is a rare occurrence, congenital atresia of the external ear canal should be taken into consideration when making a diagnosis of para-aural abscessation in young animals [1]. When suppurative secretions collect in the deeper region of the ear canal and penetrate the otic cartilage due to neoplastic obstruction of the external ear canal, para-aural abscessation may develop [9]. However, inadequate debridement of the epithelial lining of the external bone meatus during prior total ear canal ablation (TECA) is the most frequent cause of para-aural abscessation [5, 10]. In a series of 17 dogs with para-aural abscessations, Lane and Watkins [1] observed that 50% of the cases had previously had otic surgeries. Recurrent deep infection rates are still as high as 2-10% even with wide lateral bulla osteotomy (LBO) [11 - 15].

Recurrent deep infection rates are close to 50% when surgery is done for an auditory cholesteatoma [16, 17]. Inadequate middle ear drainage through the auditory tube, osteomyelitis of the ossicles, retained infected ear canal cartilage, incomplete removal of the secretory epithelium lining the tympanic bulla, and damage to the parotid salivary gland are all factors that may contribute to the a etiopathogenesis [2, 3, 10, 14, 15, 18]. There is no decreased risk of deep infection when TECA is performed using Ventral bulla osteotomy (VBO) rather than Long bulla osteotomy (LBO) [11]. After TECA-LBO, clinical symptoms such as pain when opening the mouth, para-aural edema, and the emergence of draining tracts around the parotid gland and ear base may manifest 1 month to many years later [2, 3, 10, 18]. Additionally, there could be symptoms of facial nerve paralysis and otitis interna, including ataxia and a head tilt to the affected side [2, 3].

Usually, otoscopy will enable blockage recognition [1]. FNAB can produce purulent material in a closed abscess that can be used for sensitivity testing and culture. If necessary, large abscesses might be opened and drained before receiving final treatment. Usually, a probe will allow exploration of any draining pathways to determine if the discharge is coming from the middle or external ear [1]. Although fistulograms (contrast radiography), particularly those with lateral oblique views, may be useful for diagnosing [2, 3], CT imaging is suggested as it offers useful evidence regarding the reason of the state and the suggested surgical methodology. A lateral approach is preferred if diagnostic imaging shows indications of residual tissue from the horizontal ear canal or tissue that may

indicate retained epithelium within the external bone meatus. It relies on the surgeon's preference in all other circumstances [2, 10]. The risks of facial nerve neuropraxia or retroglenoid vein hemorrhage are raised when doing VBO on dogs, as well as when taking a lateral approach in the absence of external ear canal landmarks [2, 13]. TECA with concurrent bulla osteotomy is also likely the preferred course of treatment in cases that arise spontaneously, unless avulsions of the ear canal can be corrected or blockages of the ear canal are repaired [1].

MANAGEMENT

A lateral approach to the middle ear or a ventral bulla osteotomy are two surgical options that may be used to treat a para-aural abscess that occurred after prior surgery [1, 2, 10, 18].

Total Ear Canal Ablation (TECA)

Surgery should be viewed as just one component of the total therapy strategy for dogs and cats with otitis externa, a complex, frequently systemic condition. The occurrence of generalized skin disorders, endocrine dysfunction, allergy diseases, and concomitant otitis media should be carefully taken into account. The success rate of the surgery will improve with appropriate treatment of underlying illnesses. TECA is reserved for:

• Cases where the recommended medical course of action has not been successful (often in the case of chronic ulcerative otitis externa or end-stage proliferative otitis externa with a *Pseudomonas* spp. superinfection).

• Para-aural abscessation.

• Chronic ear canal avulsions.

• Ear canal neoplasia [5, 15, 17, 19 - 30].

In earlier investigations, TECA had an overall complication rate of 82%, with chronic deep wound infection, abscessation, and severe fistula formation occurring in 10% of cases [13, 15, 31, 32]. Since then, it has been demonstrated that the primary cause of the majority of persistent infections was persistent epithelium within the bony ear canal and/or tympanic bulla [3, 8, 12, 18, 33 - 35]. As a result, for the past 20 years, TECA with extensive tympanic cavity exposure has been regarded as the gold standard treatment for end-stage ear canal illness [8, 34]. However, it has emerged in recent years that less invasive bulla osteotomies do not result in higher complication rates, provided that the whole epithelium lining of the ear canal up to and including the tympanic membrane is removed. The Venker-van Haagen procedure for reshaping the auricle provides great

CHAPTER 21

Analgesia and Pain Management

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Abstract: Inflammation is the main cause of ear pain and it is termed as otitis. Pain is an entirely subjective experience and in animal species the assessment of pain is more challenging compared to humans. The pain should be recognized as early as possible in companion animals and should be treated accordingly, particularly the acute pain. Any types of tissue injury in the animals can be generator of pain. At times pain may occur in the absence of such causative factors also. Understanding the mechanisms of pain is very important for successful prevention and treatment. Assessment of pain is a vital and essential part of patient evaluation not only in individuals presented with a problem of pain but also in routine check-up individuals. Different classes of pharmacological agents are available and they are used for the management of pain. The chapter intends to present a practical and logical approach to the assessment and management of acute and chronic pain in animals.

Keywords: Canine, Otitis, Pain effects, Pain assessment, Pain management.

INTRODUCTION

Otitis is a term used for inflammation of the ear. Inflammation can affect external, middle or inner ear. Otitis externa is inflammation of the external part; Otitis media is inflammation of the middle parts and Otitis interna is inflammation of the inner ear. However, Otitis externa is the most common of these three infections. Pain is an entirely subjective experience and it is not even possible to accurately assess two individuals who are experiencing a common level or depth of pain. In animal species the assessment of pain is more challenging compared to humans [1].Verbal communication regarding the alleviation of pain in human helps in effective selection and use of analgesic agents. In animals, the lack of such verbal communication not only confounds the diagnosis and characterization of the experience of pain but also challenges the evaluation and selection of the

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analgesic therapy. Pain can diminish well-being of animals due to its aversive nature. Distress arising from the pain sensations, and the secondary effects due to pain may adversely affect the quality of life in the animals. Pain may affect appetite, intestinal function, sleep habits, grooming, and ability to experience normal pleasures, temperament and may

prolong the time needed for recovery from the underlying condition (McMillan, 2003; Gruen, 2022; Demirtas, 2023). Untreated pain may also result in systemic problems like hepatic lipidosis as a result of inappetence and inadequate caloric intake [2].

Pain is generally associated with trauma, either accidental or surgical, in addition, the onset of acute pain may be associated with some infectious diseases. Animals possess the same neuronal pathways and neurotransmitter receptors as humans, so it is expected that their perceptions of painful stimuli will be similar, and this is a basis for the use of laboratory animals for selection of analgesics for human use. Thus, the standard human pain control strategies may be applied to animals. Analgesics, local anesthetics, non-steroidal anti-inflammatory drugs that are commonly used in humans are also effective in animal condition. Differences in metabolism and distribution between various species, as well as financial considerations, may limit their use [3].

TYPES OF PAIN

Any types of tissue injury in the animals can be generator of pain. Sometimes pain may occur in the absence of such causative factors also. Understanding the mechanisms of pain is very important to successful prevention and treatment. Pain can be classified based on its duration of action: acute or chronic and physiologic or pathologic. Neuropathic pain occurs due to damage to the peripheral nervous system or central nervous system. Acute pain has been defined as pain that exists during the period of inflammatory response. It can include nociceptive pain (pain caused by direct activation of special sensory pain neurons) and neuropathic pain [4].

Pain generally arise from inflammation and massive tissue damage where a certain degree of peripheral and central sensitization is associated with extensive injury. This pain can be diffuse, disproportionate of injury potential, debilitative and often continues beyond the resolution of the inflammatory process [5, 6]. Pathologic pain is generally classified into inflammatory pain (somatic or visceral) of either an acute or chronic nature or neuropathic pain [7]. Chronic pain is defined as pain that exists beyond the expected duration. Chronic pain can develop from a variety of conditions and can be present in varying severities in

individuals as mild to excruciating, periodic to constant, or uncomfortable to fully debilitating (Table **1**).

Table 1. Showing pain scoring systems and their limitations.

Pain Scoring System	Limitation
Simple descriptive scale	• Significant variation between different observations • Absence of selection criteria for behavior record • Low sensitivity • Cannot identify small changes in pain response
Multidimensional scoring system	• Time consuming • No selection criteria for behavior change
Numerical rating scale	• Significant variation in between different observation • Evaluates one aspect of pain severity • Difference in pain severity between categories are undefined and inconsistent • It only evaluates pain experienced in the last 24 hours or average pain intensity"
Visual analogue scale	• Significant variation in between different observation • Sensitivity depends upon observer training and experience
Composite scoring system	• Time consuming • Few validated tool in small animals

THE NEGATIVE EFFECTS OF PAIN

• Pain stimulates inflammation, thus hampers wound healing.

• Pain stimulates sympathetic nerves which leads to decrease in peristaltic movement and therefore, prolongs repair of damages tissues.

• Pain causes patient suffering, which is also stressful for animal owners.

• Pain produces a catabolic state in the animals that may lead to wasting.

• The animal is more susceptible to infection as pain suppress the immune response.

• Pain cause release of stress hormones (Catecholamines), which can cause tachycardia and hypertension, which increase cardiac work and myocardial oxygen consumption [8].

CHAPTER 22

Diagnostic Perspectives

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Abstract: Dogs can get affected with several ear infections like parasitic ear diseases, bacterial disease, hormonal dysfunction, auto immune diseases as well as otitis externa and treatment may be initiated even in the absence of the diagnostic imaging. Nevertheless, animals suffering from infections like recurrent or severe otitis, and those having pronounced symptoms of para-aural inflammation, discomfort in mouth, vestibular syndrome or facial paralysis, require comprehensive check-up of the middle ear and contiguous structures. The anatomical complication and comparative inaccessibility of these structures is best dealt with diagnostic imaging of radiography, ultrasonography, computed tomography or magnetic resonance imaging technique. This article highlights the applications of certain imaging techniques for ear infections of dogs and cats and exemplifies some of the more representative findings.

Keywords: Canine, Dog, External ear, Inner ear, Middle ear, Otitis.

INTRODUCTION

The ear is an organ of hearing and balance and the external ear consists of the concha, the external auditory meatus along with ceruminous glands. The pinna is designed to capture and carry sound waves through the ear canal to the eardrum. The size and shape of the pinnae can vary with the breeds of dogs and can move their pinnae move independently of each other. When compared to human beings, the ear canal of the dog is much deeper and presents as a better funnel to carry sound to the eardrum. In comparison to the average person, the dog can hear about 4 times better and also detect the sounds at higher frequencies. The middle ear comprises of eardrum and a air-filled chamber containing three small bones named hammer, anvil and stirrup. It also contains two muscles, the oval window, and the Eustachian tube (a thin tube that connects the middle of the ear with the

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back of the nose and allows air to flow through middle ear), whereas, the inner ear is a complicated structure responsible for hearing and balance and have cochlea (for hearing) and the vestibular system (for balancing). Ear infections forms one of the most frequently diagnosed complications in dogs and are generally not problematic to detect. Around 20-30% of the dog approach to the pet clinics for some sort of ear infections. The ear disease may comprise of external ear, middle ear or internal ear. There may be many diverse reasons and numerous treatment regimens to effect a cure [1]. Hygiene is one of the major factors both in curing the problem and prevention of recurrence of infection. Ear infections can easily develop as chronic problem. So appropriate therapy during the early course of the disease is of paramount importance along with long term assurance to keep the ears clean. A primary source is an actual provoking agent that causes ear disease by itself without predisposing or perpetuating causes (Fig. **1**).

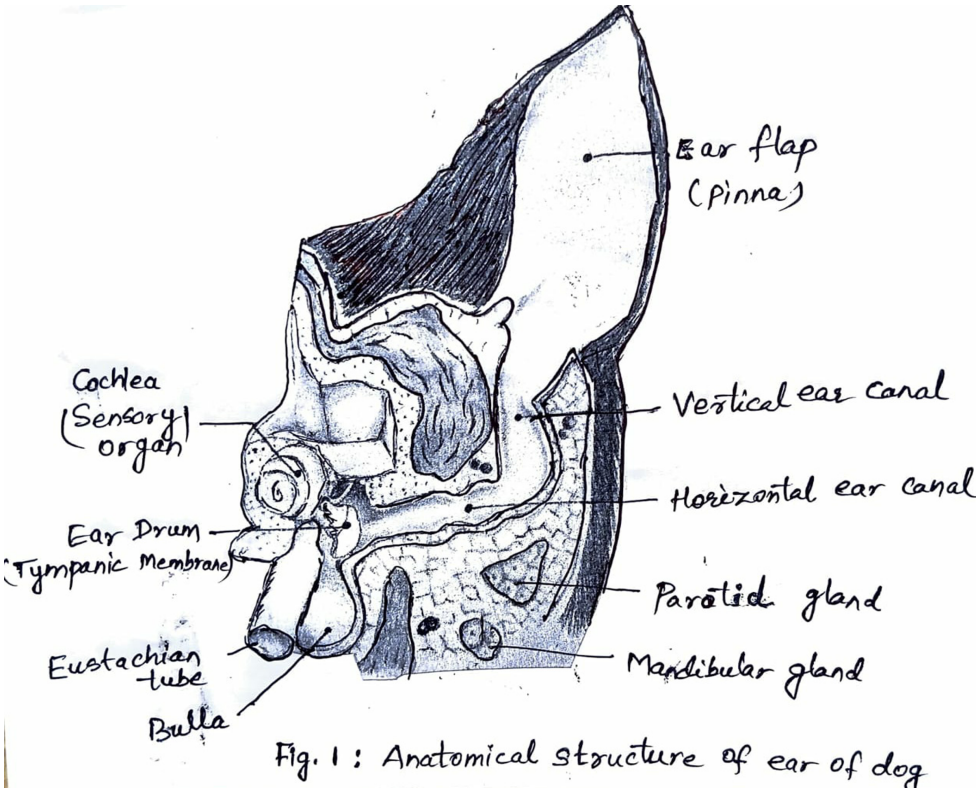

Fig. (1). Cytology examination of ear swab.

Parasites

Ticks, Ear mites (*Otodectescynotis*), several species of mites, namely *Demodex canis*, *Demodex cati*, *Sarcoptes scabiei*, *Notoedres cati* are some of the common

parasites found in ears. Ear mites are frequently observed parasites in the ears and are responsible for more than 50% of all the ear diseases in cats and about 5-10% in dogs. Ear mites can cause itching because of an allergic reaction to them, not because of a small number of mites. Mite infections are very contagious. If your dog is asymptomatic, it is possible that your dog is re-infected with a parasite that causes persistent ear disease. Cats with chronic waxy ears are more likely to have a *Demodex cati* infection [2].

Micro-organisms

In the majority of cases, the bacteria and yeast are the cause and not the main cause of Otitis externa. The bacteria will only become harmful when it reaches the ear with the help of liquid media, such as swimming in unclean water.

Ringworm (Dermatophyte) is one of the most common causes of Earflap disease (pinna). Yeast infection is harmful and can be inoculated in a poor hygiene grooming saloon. Ear canals with warm, moist and dark conditions provides a favorable breeding surface for microbes like bacteria and yeast. Hence, it may be more important to change the conditions of the ear canal than to kill the bacteria or yeast.

Hypersensitivity (Allergies)

Allergy to airborne pollen (atopy), food and contact allergy, for example ear canal atopy, allergic contact dermatitis can be caused by drugs used in the ear [3].

Seborrhea

Seborrheic ailments are common in dogs and indicate a shortcoming of the standard skin maturation cycle along with an overproduction of oils. Cocker spaniels, Irish Setters, Beagles and Basset Hounds are breeds that are prone to seborrhea.

Hormonal Disorders

Hormonal disorders like hypothyroidism is one of the most common cause of hormonal dysfunction in ear infections. Other causes may include Male feminizing syndrome, Sertoli cell tumors and some ovarian imbalances in females.

CHAPTER 23

Laser Surgery: A Practical Guide

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Abstract: Surgeries where light beams are used for different operative procedures by absorbing laser energy and controlling reflection, scatter, and transmission are simply termed laser surgeries. Photobiomodulation (PBM) is extensively known for its therapeutic benefit in the safeguarding and regeneration of tissues by employing visible light to excite biological functions in a non-thermal and non-cytotoxic mode. By using a twenty-watt CO_2 laser with a straightened handpiece and a 1.4 mm metal grip, aural hematoma of canines and felines can be easily done. Lateral ear canal ablation by the Lacroix-Zepp technique is done using CO_2 laser surgery. Special laser-induced thermotherapy (LITT) can be used in interstitial spaced organs where tumor cells need to be treated. In throat cancer, Neodymium Yttrium Al garnet, popularly known as Nd-yag lasers, is used successfully. Some lasers, like argon, only pass the external layer of skin in laser therapy.

Keywords: Ear, Hematoma, Granuloma, Laser, Otitis, Surgery.

INTRODUCTION

A laser beam is an exclusive, potent type of energy for beneficial work on special sense organs like the ear [1]. Laser operation is a kind of operation that exploits a particular light beam as a substitute for appliances used for operative procedures by absorbing laser energy and controlling reflection, scatter, and transmission. Actually, laser means "Light (by) Amplification (by) Stimulated Emission (discharge) Radiation". The laser was initially used in surgery and therapeutics in the early 1960s.

New laser variation persists to have a huge impact on veterinary medicine and operative procedures. A huge portion of its use has been found in the management of different dermatological lesions and remedies in veterinary field conditions [2].

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Some appropriate uses of lasers are indicated in various kinds of surgeries. The subsequent points are several general suggestions:

- For tumor surgery
- Haemostatic effect by sealing minute blood vessels
- Reduction of swelling by sealing lymph supply
- Decreasing the multiplication of tumor cells
- For treatment of some skin lesions by removing moles, warts, small masses, *etc.* [3] (Fig. **1**).

Fig. (1). Dog with otitis interna.

In spite of all the achievements made by scientists and veterinary practitioners, it has been noted that no single surgical procedure can act as an ideal procedure. Though the surgical procedure with which the operator is most familiar is probably the safest, adaptation to other techniques has a good prospect for successful outcomes of surgical maneuvers. Moreover, with variable sizes and shapes of the ear and with variable outcomes in different species or individuals in ear surgery, it is necessary to use the best possible procedure, like laser surgery, as the latest standard procedure in routine application [4] (Fig. **2**).

Photobiomodulation (PBM) is extensively known for its therapeutic potential to safeguard and regenerate tissues. PBM can reduce pain and inflammation and improve cancer management. It stimulates healing and tissue repair. The understanding of how PBM achieves its biological impact has identified endogenous photo acceptors that are widely expressed in special cell types,

including skin cells, as well as in the extracellular matrix [5]. PBM is defined by the employment of visible light to excite biological functions in a non-thermal and non-cytotoxic mode. Relationship between light and these photo acceptors have been established to modulate biological processes, including inflammation, the control of bacteria, angiogenesis, and signal transduction pathways that employ transcription factors activating several genes involved in multiple aspects of cell biology [6].

Fig. (2). Dog with granuloma on ear before laser surgery.

Fluorescence biomodulation (FB), a form of PBM that distinctively employs fluorescence light energy (FLE), has been verified to advance the healing of both acute and chronic wounds. A study has established that acute incisional wounds have reduced inflammation, along with more physiologic re-epithelization and collagen remodeling, resulting in better quality and less visible scars [7].

The LED-illuminated gel (*LIG*) consists of two parts: a light source comprised of blue light emitting diodes (LEDs; peak wavelength between 440 and 460 nm) and a topical substrate including chromophores. These FB substrates are generally constructed of silicone- or nylon-based membranes or amorphous hydrogels, optimized for different therapeutic uses and delivery of photonic energy [8] (Fig. **3**).

CHAPTER 24

Prevention and Control Strategy

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Abstract: Ear diseases are considered as one of the common disorders in small animal practice and the number one cause for veterinary visits among dog owners. Commonly reported clinical signs in dogs with ear disease were scratching or pawing at the ear, otitis, head tilting, head shaking, strong and unpleasant odour from the ears, abnormal ear discharges and pain evincing while palpation of ears. These ear infections can cause significant discomfort to the dogs as well as occurrence of recurrence. The first step in the control and prevention of ear infections is to identify the primary and/ or perpetuating factors. Followed by regular cleaning of the ears to facilitate the removal of debris, exudates, microbes and foreign bodies. In already existing ear diseases, to prevent further extension of the infection systemic and topical antimicrobial therapy is advised. Selection of the antibiotic must be based on the antibiotic sensitivity test in recurrent ear diseases, with the required dosage and duration of therapy. Most of the ear diseases, the combination of systemic and topical antimicrobial therapy along with steroids is advised to control the inflammation of the ear canal. In the case of ectoparasitic infestations, regular control measures are to be taken care of further by utilizing localized or generalized ectoparasiticidal drugs. Dogs who were allergic to grasses, trees and weeds should not allow for swimming in ponds and as a preventive measure always ear plugs should be applied while swimming and cleaning the ears with ear cleansers which will contain acetic acid. Dogs with *Malassezia pachydermatis* are more prone to the development of ear infections specifically dog breeds with high skin fold packets and it can be prevented by regular bathing with medicated shampoo containing the ketoconazole and chlorhexidine. Early diagnosis of adenocarcinoma, sebaceous gland tumour and basal cell tumour should be carried out by cytology and diagnostic imaging techniques. To maintain the immunity of the skin, nutrition supplements like omega-3 fatty acids, polyunsaturated fatty acids, linoleic acid, eicosapentaenoic acid and docosahexaenoic acid are advised.. To help prevent the recurrence of dermatological or ear diseases, it is recommended to provide food containing probiotics, essential amino acids, fatty acids, magnesium, pantothenic acid, pyridoxine, biotin and zinc. These nutrients play important roles in maintaining healthy skin and ear function, supporting the immune system, and reducing the likelihood of recurrent issues. Dogs with a history of atopic dermatitis can be offered a hypo-allergic diet and immunotherapy to prevent further development of ear infections. Breeds with

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floppy ears are more prone to ear diseases because of the presence of predisposing factors like floppy ears, hairy ear canal openings, perpetuating factors like easily inflammable ear canal glands and other common primary factors like high moisture and humidity. It can be controlled by frequent ear examinations, drying of the ears and early diagnosis of other dermatological issues. Dogs with endocrine disorders like hyperadrenocorticism and hypothyroidism can develop ear diseases more frequently than other dogs because these diseases can alter the dog's immunity, causing the thinning of the skin which is more susceptible to skin and ear infections.

Keywords: Control, Diagnosis, Ear diseases, Etiology, Prevention, Signs, Treatment.

INTRODUCTION

Ear diseases are considered one of the common disorders in small animal practice and they are the number one cause of veterinary visits among dog owners. Common clinical signs in dogs with ear diseases were: A. Scratching or pawing at the ear. During the beginning of the infection, dogs will exhibit this activity frequently and act as a resource for the development of secondary lesions. It is because of chronic itching around the ear or head region. During chronicity it may worse with time becomes as ear complications erythematic, oedema and pinnal disorders and otitis. In most of cases itchy ear is self-limiting and if it continues as such becomes otitis [1, 2]. B. Head tilting and shaking. Head shaking or tilting considered as one of the common clinical presentation to the clinic by the pets with ear infections and it is due to pressure building up in the ears from the infection as a result head tilting is noticed to relieve the pressure. Noticing only head tilt and head shaking is indicative of neurological problems in dogs which require further investigation to rule out the other causes [3]. C. Loss of balance. During chronic ear infections, dogs loss the balance may cause gait abnormalities and difficulty in going up and down stairs. D. Strong odour from the ears. The presence of an unpleasant and strong odour from the ears is indicative of otitis which originated from the ear exudates mixed with the bacteria [4, 5]. Swelling and redness of the ears. During the severity of infection from mild to moderate stage it can cause swelling of the ears and becoming red in colour which can be appreciated by physical examination and pain while handling [9, 10]. 6. Oozing of discharges from the ear. Oozing of the pus discharges from ears is indicative of infection and colour may from green, white, or brown (Fig. **1**) [5, 6].

Other documented signs of otitis were narrowing of the ear canal, development of the ear polyps, or loss of tympanic membrane integrity. If these conditions were not treated properly it leads to development of chronic pain and deafness.

Fig. (1). Dog with otitis and exfoliations due to atopy.

Prevention and control of ear diseases can be carried out by:

- Identification of primary/predisposing factors and addressing the issue.
- Systemic therapy and topical therapy.
- Management of ectoparasites.
- To prevent swimmer's ear.
- Management of *Malassezia* infection.
- Management of neoplasia.
- Ear health supplementations.
- Management of allergic conditions.
- Removal of foreign bodies.
- Early intervention of hormonal disorders.
- Care of floppy ears breeds.

Identification of Primary/Predisposing Factors

Recurrent ear infections are very common in small animal practice. The first step in the prevention of ear infections is to identify the primary/perpetuating factors. In dogs, ear canals are combination of two types of secretory glands: sebaceous and ceruminous glands. During the process of epithelial cell migration, accumulated cerumen and debris transported from the tympanic membrane to the external ear canal which facilitates the self-cleaning process, helping eliminate the underlying causes of ear infections [7]. Ear diseases are caused by primary factors, perpetuating factors, predisposing factors and secondary complications. All the factors responsible for the development of the inflammation of the ear

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