Inflammatory polyps and ventral bulla osteotomy in cats

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Abstract

Inflammatory polyps are benign pedunculated masses consisting mostly of fibrous tissue, blood vessels and inflammatory cells, and are covered with epithelial tissue. They most likely arise from the mucosa of the nasopharynx, Eustachian tube, or middle ear. Their causative agent being unknown, most theories are leaning towards inflammatory etiology. After lymphoma, inflammatory polyps are the second leading cause of nasopharyngeal disease in cats.

Otitis media typically develops as a result of otitis externa. Clinical signs include otorrhea, difficulty breathing, balance disorder, head shaking, and sneezing. Diagnosis is based on rhinoscopy, retro pharyngoscopy, otoscopy or video otoscopy, clinical examination of the oral cavity, rentgenography of the head, computed tomography, magnetic resonance imaging, palpation of the soft palate and nasopharyngeal biopsy.

Commonly found bacteria are from the genera Staphylococcus spp., Streptococcus spp. and Corynebacterium spp. Using only conservative treatment is ineffective, therefore ventral bulla osteotomy is recommended for the removal of such polyps. In this article, the etiology, surgical anatomy and surgical approach are described. Complications after surgery are Horner’s and vestibular syndrome, permanent otorrhea and recurrence of polyps.

Horner’s syndrome in a cat. Visible miosis and prolapse of the third eyelid. Ptosis is not visible due to manipulation with the cat

Key words: nasopharyngeal polyps, surgical anatomy, ventral osteotomy.

Introduction

Inflammatory polyps are benign pedunculated masses mainly consisting of fibrous tissue, blood vessels and inflammatory cells, and are covered with epithelial tissue (1). They most likely arise from the mucosa of the nasopharynx, Eustachian tube, or middle ear. They usually arise from the middle ear or at the junction between the tympanic cavity and Eustachian tube (tuba auditiva).
The polyp can then expand into the external auditory canal (meatus acusticus externus), while penetrating the tympanic membrane (membrana tympanica), or go rostrally through the Eustachian tube towards the nasopharynx (2). Some authors also refer to them as otopharyngeal, nasopharyngeal, or middle ear polyps (2, 3).

After lymphoma, inflammatory polyps are the second leading cause of nasopharyngeal disease in cats. Their causative agent being unknown, most theories are leaning towards inflammatory etiology. Although inflammatory polyps mainly occur in young cats, they are also found in older cats, dogs, horses, sheep, and humans (1-4).

**Inflammatory polyps and nasopharyngeal polyps**

Otitis media typically develops as a result of otitis externa (5). In otitis media, the tympanic membrane, tympanic cavity, Eustachian tube, auditory ossicles and the tympanic nerve are affected. Otitis media can also occur due to upper respiratory diseases, injuries, foreign bodies, neoplasms, parasites, and bacterial infections (6, 7). As a result, inflammatory polyps occur and they can expand through the external auditory canal or through the Eustachian tube towards the nasopharynx. Clinical signs depend on the polyp's location and growth rate and the course of the disease (6).

**Nasopharyngeal polyp**

Otorrhea and head tilt are clinical signs, which are typical for polyps expanding through the external auditory canal, while nasal discharge, sneezing, stertor and anorexia are typical for nasopharyngeal polyps (6).

**Etiology**

No sex or breed predilection is known (1). Nonetheless, several theories considering inflammatory polyps' etiology exist. Some authors associate their occurrence with congenital, secondary, viral or bacterial infections (6).

Congenital infections are a possible cause for polyps in young cats. Their presence has also been found in cats, which were related to affected individuals or were even from the same litter. It is not yet known if otitis media is a primary or secondary cause for the emergence of polyps.

The obstruction of the auditory canal, which is caused by inflammation (allergic reactions, bacterial and viral infections), anatomical abnormalities and foreign bodies, creates negative pressure inside the tympanic cavity, which then causes transudation and inflammation of the middle ear.

The attempt of ligating the Eustachian tube causes mucociliary dysfunction, mucus hypersecretion and otitis media with a discharge appropriate for bacterial colonization. Granulation tissue in the middle ear can cause metaplasia of respiratory epithelium and the formation of stratified squamous epithelium, which forms the polyp (7).

Commonly found bacteria in otitis media are from the genera Staphylococcus spp., Streptococcus spp. and Corynebacterium spp. (5, 8).

Feline calicivirus and feline herpesvirus do not seem to play a key role in the occurrence of polyps (1). Normally, polyps are found in young cats, otitis media in adult cats, and neoplasms in geriatric cats (7).

More recent theories suggest that polyps are aberrant growths of the embryonic branchial arches. Others consider them as an outcome of inflammation (2).

**Diagnosis**

Polyps mainly occur in young cats (from 4 weeks to 6 years of age), but can also occur in older animals. Clinical signs are various. The most typical signs in cases of nasopharyngeal polyps are dysphagia, stertor, nasal discharge, sneezing, phonation changes and ventral displacement of the soft palate.

During the examination of the polyp, a substantial amount of earwax and discharge, which can be purulent or bloody, can be seen in the
At otoscopy, a mass in the ear canal, a changed tympanic membrane, signs of otitis externa and otitis media are visible. If the polyp did not penetrate the tympanic membrane, the tympanic membrane can still be toned and pus can be seen through it. Horner’s and vestibular syndrome are typically present (1, 3, 9).

Diagnosis is based on rhinoscopy, retro pharyngoscopy, otoscopy or video otoscopy, clinical examination of the oral cavity, rentgenography (RTG) of the head, computed tomography (CT), magnetic resonance imaging (MRI), palpation of the soft palate and nasopharyngeal biopsy.

A thorough clinical examination of the oral cavity and pharynx, palpation of the soft palate, and otoscopy are usually sufficient to establish the final diagnosis (9). Rhinoscopy, retro pharyngoscopy, RTG, CT and MRI allow us to assess the polyp's size and extent and also the involvement of the surrounding tissue (1). Proliferative periosteal response, thickening of the bulla wall and soft tissue opacity within the bullae can be seen in chronic otitis media (10).
Thickened irregular wall of tympanic bulla. Shadows of soft tissue density in the cavity of bulla tympanica

Some authors also recommend biochemical blood analysis, a complete blood count, urine analysis, and testing the patient for feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV) (3).

Differential diagnoses to be considered are neoplasms in older cats, upper respiratory disease, nasal foreign bodies, otitis externa, otitis media, and fungal diseases (2).

**Treatment**

Using only conservative treatment for inflammatory polyps is ineffective, therefore surgical treatment is recommended. Surgical techniques that are used for the removal of such polyps are ventral bulla osteotomy, myringotomy, traction-avulsion of the polyp, ear canal ablation combined with lateral bulla osteotomy, and laser debulking with sterilization of the middle ear (10).

When using the traction-avulsion technique, the polyp's base remains, therefore in these cases recurrence of nasopharyngeal polyps with concurrent use of prednisolone is still 11%, and for polyps of the external auditory canal 50%. After ventral bulla osteotomy the recurrence is only 2-5% (3, 10).

**Surgical anatomy of the ear**

The ear has three parts: The inner ear consists of a membranous and a bony labyrinth (cochlea). The cochlea is filled with fluid. Different vibrations cause the hair cells' stereocilia to move. The detected information is then transferred along the auditory nerve to the hearing center in the brain.

The inner ear is also responsible for balance. The inner and middle ear are separated by the oval window (fenestra ovalis or fenestra vestibuli). The middle ear is composed of the tympanic membrane, tympanic cavity and three auditory ossicles (the malleus, the incus and the stapes). The middle ear is connected to the pharynx via the Eustachian tube. The Eustachian tube serves to equalize pressure between the tympanic cavity and the atmosphere.

The external ear is formed by the pinna and the external auditory canal, which gather sound and focus it towards the tympanic membrane. Vibrations are transmitted through the external auditory canal to the tympanic membrane and then to the auditory ossicles. The auditory ossicles transfer and also enhance the vibrations, which then cause the cochlear endolymph to move. Two antagonistic muscles - the tensor tympani and tensor stapedius - are responsible for the enhancement of the vibrations (2, 11).

The tympanic bulla gives structural integrity to the tympanic cavity, which is filled with air (Figure 1, white arrow). The tympanic bulla serves to protect the structures of the middle and inner ear. A bony septum in the tympanic bulla divides it into two compartments - a bigger ventromedial and a smaller dorsolateral (red arrow).

The lateral wall of the smaller compartment is formed by the tympanic membrane and in the dorsal part of the compartment is the entrance to the Eustachian tube. Both compartments are connected by a narrow fissure, which is near the round window (fenestra rotunda or fenestra cochleae) (green arrow) in the caudomedial part of the smaller compartment.

The caudal extremity of the fissure enlarges into the triangular foramen (foramen triangulare). Medial to the foramen is the oval promontory (promontorium) (blue arrow) (10, 11).
The sympathetic nerve fibres in the middle ear are postganglionic, originating from the cranial cervical ganglion (ggl. cervicale cran.) (orange arrow). These fibres course with the internal carotid (a. carotis interna) and enter the jugular foramen (foramen jugulare) (purple arrow), which is located caudomedially to the tympanic bulla, and then continue between the tympanic bulla and the petrosal bone (os petrosum), where they meet the glossopharyngeal nerve (n. glossopharyngeus) and enter into the ventromedial compartment.

After entering the ventromedial compartment they pass over the oval promontory, where they branch out to form the tympanic plexus (plexus tympanicus) (yellow arrow), and then continue through the communicating fissure into the dorsolateral compartment.

The nerves of the plexus continue rostral towards the eye and join the ophthalmic branch of the trigeminal nerve (n. ophtalmicus, n. trigeminus). Due to the position of these nerves, special care must be taken, since they are often injured during middle ear surgery. Horner’s syndrome is a result of such damage (10, 11).

Parasympathetic fibres also course through the middle ear and are responsible for the innervation of the parotid and mandibular salivary gland, but they appear to be less affected by iatrogenic trauma (11).

The facial nerve (n. facialis) leaves the petrous portion of the temporal bone (os temporale, pars petrosa) through the stylomastoid foramen (foramen stylomastoideum) (12).

The outer ear is made of cartilage, which is covered with skin. At the ear’s basis there are structures, which are important for orientation while performing surgery on the ear: the helix, the tragus, the medial and lateral crus of the helix, the antitragus and the intertragic notch.

The vertical canal, which opens outwardly, is called the external auditory canal. Several muscles are attached to the ear’s cartilage and enable its mobility and acoustic orientation (11, 12).

Surgical approach

In comparison to lateral bulla osteotomy, ventral bulla osteotomy is not suitable for accessing and removing changed tissue in the external auditory canal, but is more suitable for accessing changed tissue in the middle ear (13).

For ventral bulla osteotomy the patient is intubated and placed in dorsal recumbency. The cervical, intermandibular and facial area is clipped and aseptically prepared for surgery. The head is immobilized on the operating table by adhering it with adhesive tape at the mandibular symphysis. A folded surgical drape is placed under the neck for better visualization of the ventral part of the tympanic bulla (10, 14).

Before making the first incision, the position of the tympanic bulla is determined by palpating its ventral part. The ventral part of the tympanic bulla is easily palpable in cats, but for easier orientation the operating field can be divided into four quadrants by using a sterile surgical marker. The vertical line is drawn medially from the mandibular symphysis towards the pharynx.

The horizontal line is drawn behind the angular processes of the mandible (os mandibulae, processus angularis). The bottom quadrants are where the left and right tympanic bullae are located. The incision is made 1.5 cm away from the median line of the mandibular symphysis, from the angle of the mandible (angulus mandibulae) towards the wing of the atlas or respectively the bifurcation of the jugular vein. The incision is made through the skin, subcutaneous tissue, platysma and sphincter colli muscles (m. sphincter colli sup. and prof.). The mandibular salivary gland and the vein’s bifurcation (v. linguofacialis and v. maxillaris) are carefully retracted.

The digastric muscle (m. digastricus) and the mylohyoid muscle (m. mylohyoideus) are bluntly dissected, and the underlying muscles (m.hyglossus and m. styloglossus) are retracted by two Gelpi retractors. The tympanic bulla is located in a triangle, formed by the external carotid (a. carotis externa) laterally and by the lingual artery (a. lingualis) and hypoglossal nerve (n. hypoglossus) medially. After accessing the ventromedial surface of the tympanic bulla, a periosteal elevator is used to remove its periosteum. In close proximity to the medial part of the tympanic bulla lies the ascending pharyngeal artery (a. pharyngea ascendens), which has to be protected.

Osteotomy can be started with a surgical drill or a Steinmann pin and then continued by using a rongeur. The tympanic bulla is first drilled with a thinner pin or drill and then with a thicker one, until the opening is large enough to accommodate a rongeur. While drilling into the ventromedial surface of the tympanic bulla, great care has to be applied, since the bulla’s wall is more fragile due to disease and can therefore collapse and with this cause damage to underlying structures (10, 13, 14).
Quadrants system

Visible bifurcation of linguofacial vein and maxillary vein

Trepanation of the ventromedial compartment

Trepanated ventromedial compartment. Yellow line indicates the course of hypoglossal nerve, in the lower part of the picture violet line indicates the course of a. carotis externa and in the upper part of the picture the course of a. facialis

The revealed hipotympanic opening is filled with thick mucus and other debris, which is then removed by suctioning. Before suctioning, appropriate samples are taken for mycological and bacteriological evaluation and for making an antibiogram. According to some authors, most of the samples are negative, but nonetheless they recommend antibiotic therapy. The bony septum of the tympanic bulla is carefully removed, so as to gain access to the polyp’s place of origin. The osteotomy is done at the septum’s lateral part to avoid the sympathetic fibres coursing over the oval promontory. By using this approach, the risk of causing Horner’s syndrome is reduced (10, 13, 14).
Removal of bone with a rongeur. Bone of the bulla tympanica is thickened

Visible dorsolateral compartment

Removal of the septum between the two compartments

The open tympanic cavity is lavaged with warm saline and the remaining lavage is suctioned away. A small curette is used to remove the polypoid mass, which is attached to the wall of the mesotympanum and which can extend towards the external auditory canal. Rigorous curettage is avoided to prevent damaging sympathetic fibres and vestibular structures. When the polyp is extracted from the wall of the tympanic cavity, it may then also be removed by traction from the external auditory canal or nasopharynx. With a similar approach we can also remove other tumorous masses, such as granulomas, adenomas and cholesteatomas. The excised tissue is always submitted for histopathology. The wound is sutured in multiple layers and placing a drain is usually not necessary (10, 13, 14).

Pus underneath the tympanic membrane
Pus gathered underneath the tympanic membrane is removed after myringotomy

After the removal of the tympanic membrane and lavage polyp becomes visible

Postoperative complications and patient care

Possible complications after surgical removal of the polyp are Horner’s and vestibular syndrome, deafness, wound drainage, hemorrhage, facial and hypoglossal nerve damage, respiratory distress, or polyp regrowth due to a less radical tissue extraction. Horner’s syndrome normally resolves within 30 days after the procedure, but if it persists for more than 6 weeks, there is small chance of improvement.

The complication is most likely caused by rigorous curettage and the caused trauma to the sympathetic fibres. Signs of vestibular syndrome are also present due to excessive curettage and the inflicted damage to the round and oval window.

The vestibulocochlear apparatus can also be affected, partly because of the surgery, but can also be a result of the polyp’s expansion and pressure on the structures in the tympanic cavity. Clinical signs that can arise are head tilt, ataxia and nystagmus (10, 14, 15).

By using air-conducted brainstem auditory evoked response (BAER) it has been determined that the occurrence of hearing impairment is less likely (16).

Conclusion

Polyps in the tympanic cavity are quite often found in young cats and represent almost a third of nasopharyngeal diseases. Conservative treatment is ineffective, therefore surgical treatment is necessary, even though it has certain disadvantages and can also cause postoperative complications. Precise knowledge of the middle ear’s anatomy and correct approach to the tympanic bulla is needed for a well-executed surgery. An experienced surgeon and good postoperative care are essential for a successful outcome.

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