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Conceptual Paper

Eustachian Tube Dysfunction

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Eustachian tube dysfunction (ETD) is the failure of the Eustachian tube in maintaining pressure equalization or mucociliary transport. This is categorized as either acute (less than 3 months presentation) or chronic ETD (more than 3 months). ETD affects 1% of the population, with symptoms including aural fullness or 'popping sounds,' reduced hearing, tinnitus, autophony, otalgia, and imbalance. It can be broadly categorized into baro-challenged induced, patulous, and dilatory ETD.

Objectives

Describe the typical patient history associated with dysfunction of the Eustachian tubes.

Review the pathophysiology of Eustachian tube dysfunction.

Identify the treatment considerations for patients with Eustachian tube dysfunction.

Outline the importance of collaboration and communication among the interprofessional team to improve outcomes for pediatric patients affected by Eustachian tube dysfunction, who are at risk of speech and language delay.

Introduction

The Eustachian tube, also termed the pharyngotympanic or auditory tube, is vital in regulating middle ear homeostasis, with complex anatomy designed to achieve this function. It travels medially from the middle ear, directing down and forwards to open just posterior to the end of the inferior turbinate—the bony lateral third travels past both squamous and petrous portions of the temporal bone. The medial two-thirds is fibrocartilaginous, opening out into the nasopharynx as a mucosal elevation known as the torus tubarius. The tube opens on positive pressure, e.g., yawning, sneezing, swallowing, and the Valsalva maneuver, by contraction of the levator veli palatini and tensor veli palatini muscles. Through the Eustachian tube's complex structure, it can carry out its three main functions:

- Firstly, by having a patent and open Eustachian tube, the pressure of the middle ear is equalized to that of the nasopharynx (i.e., towards atmospheric pressure). This has assistance from active mucosal gas exchange within the middle ear. With the maintenance of middle ear pressure, tympanic membrane compliance is optimized for hearing.
- Secondly, it contains tube mucociliary transport. This consists of ciliated cells that clear inflammatory products and secretions from the middle ear and Eustachian tube, transporting them towards the direction of the nasopharynx for elimination.
- Lastly, a functioning Eustachian tube protects the middle ear from loud sounds and potential hazards, including pathogens and secretions from the nasopharynx.

Causes of eustachian tube obstruction

- Upper respiratory infection (viral or bacterial)
- Allergic rhinitis
- Nasopharyngeal acid reflux
- Deviated nasal septum/Sinusitis/Nasal polyps
- Hypertrophic adenoids/Nasopharyngeal tumour/mass
- Cleft palate/Submucous cleft palate/Down syndrome
- Granulomatous diseases/cystic fibrosis/Samter's triad/Kartagener syndrome.

Methods of clinical examination of eustachian tube

In addition to the otoscopic examination, an examination of the nasopharynx and middle ear can tell us about the basic underlying pathology at both ends of the ET system. The examination can be done in the following ways.

Posterior rhinoscopy. Indirect mirror examination of the nasopharyngeal end of the ET system.

Otoscopic examination of the tympanic membrane, its position, colour, degree of translucency, and mobility.

Rigid nasal endoscope for the examination of the nasal cavity and nasopharyngeal end of the ET system Flexible nasopharyngoscope. For examination of both ends of ET system.

Operating microscope or otoendoscope. For examination of the tympanic end of the ET system through the pre-existing perforation. The microscope may also reveal retraction pockets or fluid in the middle ear.

Eustachian tube endoscopy or middle ear endoscopy can be done with very fine flexible endoscopes.

Etiology

Baro-challenge-induced Eustachian tube dysfunction describes the failure of the Eustachian tube to open with the surrounding pressure changes, thereby inhibiting the regulation of middle-ear pressure. Patients will have normal otoscopy and tympanometry findings, as the failure of tube opening is situation-specific and arise with increased atmospheric pressure, e.g., deep-sea diving or descent from altitude. The stress imposed on the mucosal surfaces of the Eustachian tube by repetitive equalization maneuvers from the increased atmospheric pressure leads to localized inflammation and mucosal edema. This affects the ability for subsequent attempts at opening and clearance. By applying oral or topical decongestants for the treatment of baro-challenge induced ETD, it is thought that mucosal edema and local tissue hyperemia is reduced, thereby shrinking the nasopharyngeal mucosa and improving Eustachian tube patency.

Patulous ETD is caused by an overtly patent Eustachian tube, whereby the failed tube closure at rest provides continuous communication between the nasopharynx and the middle ear. This creates the reported symptom of autophony, with habitual 'sniffing' to help alleviate self-vocalization.

Physiological causes of dilatory ETD involve the development of inflammation and mucosal edema, caused by episodes of rhinitis, upper respiratory tract infection, or gastro-oesophageal reflux disease, which leads to blockage of the orifice and dysfunction. Malignancy such as nasopharyngeal carcinoma can present with unilateral obstruction and must be excluded, with benign causes of obstruction including adenoidal hypertrophy and sequelae following adenoidectomy. Aural fullness is a common symptom due to the build-up of negative middle ear pressure.

Evaluation

Tympanic insufflation is performed to demonstrate active negative pressure, and a type C Tympanogram suggests negative resting middle ear pressures. Audiological tests need to be completed with pure tone audiometry and Rinne's and Weber's tuning fork tests.

Differential diagnosis

Autophony is not limited to patulous Eustachian tube dysfunction- symptoms may present in conditions including superior canal dehiscence and the presence of a foreign body within the external ear canal. Temporomandibular joint dysfunction may present with 'popping' noises and associated reduced hearing; however, it is also associated with discomfort upon jaw movement.

Treatment

Treatment of Eustachian tube dysfunction is dependent on the likely cause of dysfunction.

Gastro-oesophageal reflux disease is addressed with lifestyle changes, including losing weight and dietary modifications to reduce acid production. Anti-acid medication, e.g., proton pump inhibitors, may be considered.

Lifestyle changes to avoid potential allergens, if possible, should be tried. Medical interventions include antihistamines and nasal corticosteroid medication.

Treatment of rhinosinusitis should be commenced if indicated. Immunosuppressive agents will be required for granulomatous disease, e.g., sarcoidosis, granulomatosis with polyangiitis (Wegener disease).

Surgical dilatation of the Eustachian tube is performed using a Eustachian tube balloon catheter, with studies demonstrating improvement of the ETDQ-7 score at 12 months follow-up. ETD from

otitis media with effusion is commonly managed with tympanostomy tube insertion.

Patients should be considered for adenoidectomy if adenoid hypertrophy is thought to be the main contributing factor to ETD. This is more common in children, who may present with middle ear effusion. The use of auto-inflation devices for reopening the Eustachian tube by raising the pressure in the nose has shown favorable results for correcting middle ear pressure and fluid clearance

Treatment options depend on the cause and severity of the condition. Often, no treatment is needed In many cases, the ETD is mild and does not last longer than a few days or a week or so. For example, this is common following a cold. No particular treatment is needed and the symptoms often soon pass. Try to get air to flow into the Eustachian tube Air is more likely to flow in and out of the Eustachian tube if you swallow, yawn or chew.

Try doing the following:

- Take a breath in
- Then, try to breathe out gently with your mouth closed and pinching your nose (the Valsalva maneuver) No air is blown out but you are gently pushing air into the Eustachian tube. You may feel your ears go 'pop' as air is forced into the middle ear. This is a particularly good thing to try if you develop ear pain when descending to land in a plane.

Decongestant nasal sprays or tablets

A decongestant may be advised by your provider if you have a cold or other cause of nasal congestion.

- Phenylephrine and pseudoephedrine are the most common oral decongestants
- Relieve a blocked nose for several hours, some products up to 12 hours
- Nasal spray works more quickly
- DO NOT USE a decongestant spray for more than 3 days at a time, or spray may cause a worse rebound congestion in the nose Antihistamine tablets or nasal sprays Antihistamines may be advised by your provider if you have an allergy such as hay fever. In this situation they will help to ease nasal congestion and inflammation. Antihistamines also come in combination with a decongestant to maximize effectiveness (certralizine-D, loratadine-D for example).

Steroid nasal spray A steroid nasal spray may be advised if an allergy or other cause of persistent inflammation in the nose is suspected.

- Reduces inflammation in the nose
- Takes several days for a steroid spray to build up to its full effect
- No immediate relief of symptoms when you first start it
- If inflammation is reduced in the back of the nose, then the Eustachian tube is able to work better.

Complications of untreated Eustachian tube dysfunction include conductive hearing loss, chronic otitis media, otitis media with effusion (glue ear) and its sequelae, and eardrum retraction.

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