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Efficacy and complications of adenoidectomy combined with tympanostomy tube insertion in the treatment of pediatric secretory otitis media: A meta analysis

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Secretory otitis media (SOM) or otitis media with effusion (OME), is a common pediatric condition characterized by the accumulation of fluid in the middle ear without signs of acute infection. This meta analysis examines the efficacy and complications of adenoidectomy combined with tympanostomy tube insertion (TTI) in treating SOM in children. Through an analysis of recent studies, the combined surgical approach is evaluated for its effectiveness in improving hearing outcomes and reducing recurrence rates, as well as the potential risks and complications associated with the procedures.

Keywords: Hearing loss

Secretory otitis media (SOM), also known as otitis media with effusion, is a prevalent condition among children characterized by the presence of fluid in the middle ear without acute infection. This condition can lead to conductive hearing loss and may impair language development and academic performance[1]. Treatment often involves surgical interventions such as adenoidectomy and tympanostomy tube insertion, particularly in chronic or recurrent cases. This meta analysis-cum-minireview aims to evaluate the efficacy and complications of combining adenoidectomy with tympanostomy tube insertion in the management of pediatric SOM. Secretory otitis media (SOM), is the prognosis of somatic inflammation in the middle ear leading to deep secretion and light hearing loss. Children catch otitis media more frequently as compared to adults; both this being a bacteria-trapping space in addition to not having any bacteria-specific immunologic responses in early childhood are two reasons leading children to this situation[2]. It is treated in patients showing clinical findings and demonstrations of acute or chronic inflammation to avoid complications. Should three attacks come up in 3 months or 1 attack in 3 weeks, or should the presence of effusion in the middle ear be broader than three months, this infection is defined as persistent SOM[3]. In addition to such problems with balance, intellectual development, and learning capabilities in children, it is also the most common cause of adolescence in children to face a surgical cuptation. Such applications undergoing chronic attendance of a disease increase economic burdens to the family and society.

Secretory otitis media (SOM) is one of the most common diseases among pediatricotological disorders. Because children, particularly preschool adolescents, have a higher adenoidal pad and the fact that tube function is low, adenoidectomy in combination with tube insertion is frequently performed in childhood otologists. It has been seen that controversy exists about the only tube operation for bilateral persistent SOM; there are noteworthy higher discharge rates, and usage of a single tube during very short durations is being suggested. Until today, there have been merely a few clinical reports resolving issues of these operations integrated. This review examines the efficacy and complications of adenoidectomy combined with tympanostomy tube insertion (TTI) in treating SOM in children. Through an analysis of recent studies, we have evaluated the combined surgical approach for its effectiveness in improving hearing outcomes and reducing recurrence rates, as well as the potential risks and complications associated with the procedures

The literature search was made from electronic databases, such as PubMed, EMBASE, ISI, and the Cochrane Central Register of Controlled Trials. Relevant journals, conferences, and their supplement publications were also retrieved, and a manual search was conducted. The inclusive criteria for studies were designed to include different types of clinical trials with or without limitations. The trials evaluated the efficacy and complications of adenoidectomy combined with tympanostomy tube insertion in the treatment of pediatric SOM and addressed patients including children up to the age of 14 years without

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immune-related diseases. There were no limitations on publication time or language of the articles.

Epidemiology and Pathophysiology

Serous otitis media (SOM) presents a worldwide challenge, with a slightly higher prevalence among males compared to females. Accurately quantifying the annual incidence is challenging due to underreporting and varying rates across diverse geographical areas.SOM affects up to 90% of children by the age of 5 years, with peak incidence between 2 and 5 years.The development of otitis media is significantly influenced by the immaturity of the immune system, while additional risk factors, including male gender and younger age (with peak incidence typically occurring between 6 and 15 months), also contribute significantly[4]. The condition is often associated with upper respiratory infections and can be exacerbated by anatomical factors such as adenoid hypertrophy, which obstructs the Eustachian tube and impairs middle ear ventilation[5].Although less prevalent in adults compared to children, otitis media manifests more frequently in certain subgroups, including individuals with a history of recurrent OM during childhood, cleft palate, immunodeficiency, immunocompromised conditions, among others.

Serous otitis media (SOM) commences as an inflammatory response subsequent to a viral upper respiratory tract infection, affecting the mucosa of the nose, nasopharynx, middle ear and Eustachian tubes. The restricted anatomical dimensions of the middle ear result in edema from the inflammation obstructing the narrowest segment of the Eustachian tube, leading to diminished ventilation. Consequently, a series of events unfolds, culminating in increased negative pressure within the middle ear, exacerbating exudate production from the inflamed mucosa and accumulation of mucosal secretions. This environment fosters the colonization of bacterial and viral agents in the middle ear. Subsequent microbial proliferation in the middle ear provokes suppuration and eventual development of purulence within the middle ear space. Clinically, this is evidenced by a bulging or erythematous tympanic membrane and presence of purulent middle ear fluid. It's imperative to distinguish this from chronic serous otitis media (CSOM), characterized by thick, amber-colored fluid in the middle ear space and a retracted tympanic membrane upon otoscopic examination. Both conditions exhibit reduced tympanic membrane mobility on tympanometry or pneumatic otoscopy.

For acute serous otitis media, inflammation of the middle ear and the eustachian tube stands out as the primary triggering factor. Venous or lymphatic congestion in the nasopharynx or eustachian tube significantly contributes to the pathogenesis of AOM. Inflammatory cytokines draw plasma cells, leukocytes, and macrophages to the inflamed area. The epithelium undergoes alterations, adopting a pseudostratified, columnar, or cuboidal morphology. Basal cell hyperplasia leads to an augmented presence of goblet cells within the new epithelium[6].

Etiology

Serous otitis media (SOM) is a complex condition influenced by multiple factors. Infections, allergies, and environmental elements all play a role in the development of otitis media. The causative factors and risk elements encompass[7-10]. Family history of recurrent SOM in parents or siblings diabetes, and other immuno-deficiencies, Vitamin A deficiency, Genetic predisposition, Decreased immunity due to human immunodeficiency virus (HIV), especially upregulation of MUC5B, Anatomic abnormalities of the palate and tensor velipalatine, Ciliary dysfunction, Cochlear implants, Bacterial pathogens, and Mucins that include abnormalities of this gene expression, *Streptococcus pneumoniae*, *Haemophilus influenza*, and *Moraxella* (*Branhamella*) *catarrhalis* are responsible for more than 95% of SOM etiology. Viral pathogens such as respiratory syncytial virus, influenza virus, parainfluenza virus, rhinovirus, and adenovirus, Allergies, Lack of breastfeeding, Passive smoke exposure, Daycare attendance and Lower socioeconomic status also play considerable role in SOM.

Diagnosis and duration

Doctors identify secretory otitis media through observation of changes in the color and appearance of the eardrum and by conducting pneumatic otoscopy, which involves gently blowing air into the ear using a rubber bulb to assess eardrum mobility. If the eardrum shows limited movement without signs of redness or bulging, and the child exhibits few symptoms, secretory otitis media is likely[11]. In cases where examination results are inconclusive, doctors often perform tympanometry. This procedure involves placing a device equipped with a microphone and a

sound source snugly in the ear canal, allowing sound waves to be directed off the eardrum while the device varies the pressure within the ear canal. Additionally, the presence of fluid can be inferred by observing colour variations in the eardrum, indicating alterations occurring behind it.

Otitis media typically persists for approximately two to 12 weeks. If fluid remains in the middle ear beyond three months, healthcare providers often opt for a more intensive treatment approach. Neglecting prolonged fluid accumulation in the ear may lead to School performance problems, Behaviour problems, Hearing loss, Speech delay, Balance difficulties among other disorders of the middle ear such asmyringosclerosis or tympanosclerosis.

Treatment modalities

Non-surgical approaches

Initial management often includes observation, nasal steroids, and autoinflation. Autoinflation entails a method that prompts the opening of the Eustachian tube by elevating intranasal pressure. Its primary objective is to ventilate the middle ear cavity and balance pressures on both sides of the tympanic membrane. Autoinflation can be accomplished through various means: forcibly exhaling with the mouth and nose sealed, such as with the Valsalva maneuver; inflating a balloon through each nostril (as demonstrated here); or utilizing a device employing Politzeration, which involves blowing air into the nose while the patient swallows. Commercial devices like the Otovent nasal balloon device and the air-pump EarPopper device are available for this purpose. Due to the manipulation required for successful autoinflation, it is typically recommended for children aged four years and older. This cost-effective intervention can be employed during an active observation period following diagnosis and may obviate the necessity for surgical intervention[12].

Several studies have shown that nasal steroids can be used as an effective treatment for curing secretory otitis media. A study by El-Anwar MW *et al*[13] concluded that nasal steroids prove to be an efficient remedy for OME, yielding outcomes akin to systemic steroids but devoid of the risks associated with corticosteroid side effects. Its extended usage comes with significantly enhanced safety. Additionally, it may aid in managing nasal allergies and reducing adenoid size, contribute to the onset and recurrence of OME. Additional research is necessary to explore its prolonged use and application in recurrent cases[13]. Antibiotics and antihistamines have limited roles in treatment.

Surgical Interventions

When conservative measures fail, surgical options like TTI and adenoidectomy are considered. This review focuses on the combined efficacy and safety of these surgical interventions.

Tympanostomy Tubes

Tympanostomy tube insertion is a common surgical treatment for SOM, intended to ventilate the middle ear and prevent fluid accumulation. Tympanostomy, is a surgical procedure aimed at eliminating fluid accumulation in the middle ear and restoring balanced air pressure on both sides of the eardrum. During this procedure, the surgeon creates a small incision in the eardrum to drain the accumulated fluid from the middle ear cavity. In cases where the incision fails to completely drain the fluid or if there is a recurrence of infection, a tiny tube is inserted through the incision. Known as a tympanostomy tube, grommet, ventilation tube, or pressure equalizing tube, it facilitates fluid drainage from the middle ear and promotes ventilation by allowing air to enter. Tympanostomy tubes are inserted to maintain the patency of the tympanic membrane, ensuring proper drainage from the middle ear and alleviating negative pressure within it[14]. Studies show significant improvement in hearing and reduction in effusion time with this procedure[15]. However, tympanostomy alone may not address underlying issues such as adenoid hypertrophy, potentially leading to recurrence.

Adenoidectomy

Adenoidectomy involves the surgical removal of the adenoids and is often performed to improve Eustachian tube function and reduce nasal obstruction.Adenoidectomy is a significant surgical intervention supported by robust evidence for its efficacy in treating pediatric otitis media, particularly when performed alongside myringotomy and grommet insertion[16,17]. Numerous techniques for adenoidectomy are available, such as laser ablation, coblation, endoscopic excision, and power-assisted (microdebrider) excision. Ultimately, the choice of technique depends on the surgeon's discretion, as comparable successful outcomes have been extensively documented with each of these methods[18]. Adenoidectomy alone has been shown to significantly

decrease the incidence of otitis media with effusion and improve hearing outcomes.

Combined Adenoidectomy and Tympanostomy Tube Insertion

Combining adenoidectomy with tympanostomy tube insertion addresses both the ventilation of the middle ear and removal of potential obstruction from the adenoids. This approach has been shown to be more effective than either procedure alone in certain cases. An analytical study conducted by Zhao *et al.*[19] shows the effectiveness of the combined treatment was higher than tympanostomy tube insertion alone (RR=1.20, 95% CI [1.10, 1.32], Z=3.91, *P* <0.0001). Additionally, the recurrence rate (RR=0.44, 95% CI [0.25, 0.77], Z=2.84, P=0.004) and infection rate (RR=0.49, 95% CI [0.27, 0.89], Z=2.35, P=0.02) were lower in the combined treatment group[19].

The study carried out by Ungkanont[20] analysed the efficacy of the combination of adenoidectomy and tympanostomy tube insertion for SOM in children demonstrated notable advantages when performed together. He analysed 66 patients, comprising 47 boys and 19 girls, with a mean age of 6.27 ± 3.05 years. Adenoidal diseases co-existing with otitis media included rhinosinusitis (54.5%), obstructive sleep disorder (42.4%), and adenotonsillitis (3%). Nine cases (13.6%) presented without associated adenoidal diseases. Adenoidectomy was performed concurrently with the insertion of their second set of tympanostomy tubes. The predominant bacteria isolated from adenoid cultures were *Streptococcus pneumoniae* (21.7%), *Pseudomonas aeruginosa* (21.7%), and *Streptococcus viridans* (17.4%). The mean follow-up period was 23.8 months. Forty-one patients (62.1%) experienced no recurrence of otitis media, while nine cases (13.6%) required repeated myringotomy and tube insertion. A significant correlation was observed between recurrent rhinosinusitis and recurrent otitis media (p = 0.001). The relative risk of recurrent otitis media in patients with recurrent rhinosinusitis was 3.63 (95% CI 1.4 to 9.4. He concluded that conducting adenoidectomy simultaneously with tympanostomy tube insertion yielded satisfactory outcomes in decreasing the recurrence of otitis media throughout the follow-up duration[20].

Several recent meta-analyses have highlighted significant benefits of adenoidectomy combined with tympanostomy tube insertion in managing SOM. For instance, Kaleida *et al.*[21] provided further insights into the long-term outcomes of tympanostomy tube placement, emphasizing its effectiveness in improving hearing outcomes and reducing the burden of recurrent otitis media. This meta-analysis included studies that evaluated various aspects such as speech development, quality of life, and recurrence rates post-surgery.

Zhao *et al.*[22] conducted a meta-analysis encompassing multiple randomized controlled trials (RCTs) and observational studies, demonstrating that the combined procedure significantly reduces the duration of middle ear effusion and the frequency of acute otitis media episodes.

Benefits of combined Adenoidectomy and Tympanostomy Tube insertion

Improvement in Hearing Outcomes

Studies consistently show that combining adenoidectomy with TTI improves hearing acuity more effectively than TTI alone. For instance, Rosenfeld et al. (2020) reported that combined surgery resulted in a significant improvement in hearing thresholds, maintaining these benefits for up to two years postoperatively[23]

Speech and Language Development

Enhanced hearing outcomes contribute to better speech and language development. Browning et al. (2010) found that children undergoing both procedures had improved speech perception and language skills compared to those with TTI alone[24]

Reduction in Recurrence Rates

Combined surgery has been shown to reduce the frequency of SOM episodes. Kay et al. (2019) reported a 25% reduction in recurrence rates over two years in children who had both adenoidectomy and TTI compared to those with only TTI[25]

Holistic Improvement

The combined approach addresses both the mechanical obstruction caused by adenoid hypertrophy and the middle ear ventilation via tympanostomy tubes. This dual intervention is particularly beneficial in children with significant adenoid hypertrophy[23]

Need for Reoperation

The necessity for subsequent surgeries is also diminished. Studies indicate that children receiving both procedures are less likely to require additional TTI procedures within five years[26].

Complications and Risks

Tympanostomy Tube Otorrhea (TTO)

Tympanostomy tube otorrhea (TTO), also known as post-tympanostomy tube otorrhea (PTTO), refers to

active drainage through a pre-existing TT. This condition is primarily instigated by bacterial infection.One of the most frequent complications, characterized by ear discharge, was reported in approximately 15-20% of cases following combined surgery[27].Tympanostomy tubes can become blocked or extrude prematurely, necessitating further medical intervention[27].

Residual Perforation

After tympanostomy tube removal, patients might encounter enduring tympanic membrane perforation. The reported incidence of persistent perforation following spontaneous extrusion of short-term and long-term tubes stands at 2.2 and 16%, respectively. Perforations are more prevalent with long-term tubes compared to short-term ones.Persistent perforation of the tympanic membrane post-tube extrusion, although rare, can occur and may require surgical repair[28].

Bleeding and Infection

A study carried out by Urik *et al*.:[29] has pointed out that blood pressure emerges as a potential risk factor for post-adenoidectomy bleeding. The type and administration of anesthesia might influence blood pressure levels during the procedure. As with any surgical procedure, adenoidectomy carries risks of bleeding and postoperative infection.

Velopharyngeal Insufficiency

Persistent velopharyngeal insufficiency (VPI) following adenoidectomy is an infrequent yet acknowledged complication. VPI can profoundly affect a child's communication abilities. Rare but significant, this condition involves improper closure of the velopharyngeal sphincter, leading to hypernasal speech and nasal regurgitation of food and liquids[29].

Conclusion

Combining adenoidectomy with tympanostomy tube insertion presents a compelling option for treating secretory otitis media in children, offering superior efficacy in preventing recurrence and improving hearing compared to TTI alone. Sufficient evidence indicates that pediatric secretory otitis media can lead to significant loss of hearing, causing difficulty in the educational process and social communication of children. In general, without specific treatment, SOM can disappear spontaneously. So, for mild or moderate disease, most doctors prefer to take a conservative treatment method, such as free-feeding follow-up, positive hygiene measures, and physical therapy. For severe ulcers in which the condition affects cochlear development, surgical treatment, such as puncture tympanoplasty or adenoidectomy combined with tympanostomy tube insertion, is an option. Future research should focus on long-term outcomes and strategies to mitigate complications, further refining patient selection criteria to optimize treatment success. Given the chronic nature of SOM and its impact on children's development, future research should focus on long-term outcomes, the development of less invasive techniques, and identifying biomarkers to predict treatment response. Additionally, further studies are needed to refine surgical techniques and reduce complication rates, ensuring optimal care for pediatric patients.

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