Original Article

Efficacy of Adenoidectomy versus Tympanostomy on the Otitis Media with Effusion: A Systematic Review and Meta-Analysis

Abdullah A. Alamri, Hosam A. Amoodi[1,2], Shahad A. Alsubaie[3], Areej A. Alsehly[3], Razan O. Alshuaibi[3], Leena A. Alotaibi[3], Sahar J. Almaghrabi[4], Sarah F. Mozahim[4], Naif F. Mozahim[4], Albaraa Tonkal

Department of Otolaryngology, Head and Neck Surgery, King Abdulaziz University Hospital, [1]Department of Otolaryngology, Head and Neck Surgery, Jeddah University, [2]Department of Otolaryngology, Head and Neck Surgery, Fakeeh Hospital, [3]Department of Otolaryngology, Head and Neck Surgery, Faculty of Medicine in Rabigh, King Abdulaziz University, [4]College of Medicine, King Abdulaziz University Hospital, Jeddah, Saudi Arabia

Abstract

Background: This systematic review and meta-analysis aimed to investigate the current evidence on the efficacy of tympanostomy and adenoidectomy in children with otitis media with effusion in comparison with tympanostomy alone following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. **Materials and Methods:** We completed a comprehensive search of PubMed, Web of Science, Scopus and Cochrane Library databases for relevant studies published in the literature with no date restrictions. We collected the results of the databases search and removed duplicated studies by Rayyan QCRI and EndNote Software X8. We used an Excel sheet for screening titles and abstracts, full text and data extraction. For quality assessment, we used Cochrane Handbook of Systematic Reviews of Interventions 5.1.0 using the quality assessment table provided in Part 2 and Chapter 8.5, and quantitative data synthesis was done using Review Manager (RevMan) software version 5.4. **Results:** The literature search showed 1510 studies, of which five studies were included in data synthesis. The study measured the effect through number of acute otitis media (AOM) episodes, cumulative number of AOM episodes, siblings with Otitis media (OM), hearing level hearing loss scale of the left, and right ears. The pooled effect estimates showed significant difference between tympanostomy with adenoidectomy versus tympanostomy alone in hearing level hearing loss scale of both ears (SMD -0.17, 95% CI [-0.29, -0.05], *P*-value=0.005). However, the pooled results were not heterogeneous ($P < 0.25$, $I^2 = 24\%$). **Conclusions:** Tympanostomy with adenoidectomy improves hearing compared to tympanostomy alone, but both treatments have similar effects on ear infection rates. Further research with larger samples is needed to confirm these findings and assess long-term benefits.

Keywords: Adenoidectomy, middle ear effusion, myringotomy, tympanostomy tube

Introduction

Otitis media with effusion (OME) is a middle ear inflammatory disorder characterised by the presence of endotympanic fluid without signs or symptoms of acute infection,[1] which can cause hearing loss (HL) or long-term sequelae and have a negative impact on speech development and behaviour.[1,2] Up to 90% of children are anticipated to have at least one episode before reaching school age, 60% of episodes occur in the first 2 years of life.[1]

OME has a relatively low rate of spontaneous recovery (<30% in children aged <4 years) and medical therapy is often ineffective.[2] Therefore, the recommended treatment is surgery. Surgical treatment can take the form of myringotomy or myringotomy with adenoidectomy.[2] Otolaryngologists commonly practice adenoidectomy as part of the treatment of medically refractory OME.[3-5] Although some studies have linked enlarged adenoids to otitis media (OM),[3,4] others have casted doubt on this association.[6,7] Children with OME accompanied with post-nasal blockage, chronic rhinosinusitis or adenoiditis, or those who have already undergone repeat surgery for OME, are recommended to undergo adenoidectomy alone, which has been shown to be most effective in children aged more than 3 years regardless of adenoid size.[8]

Address for correspondence: Dr. Abdullah A. Alamri, Department of Otolaryngology, Head and Neck Surgery, King Abdulaziz University Hospital, Jeddah, Saudi Arabia.
E-mail: dr.abdullah125@gmail.com

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Adenoidal hypertrophy and proximity to the ostium of the eustachian tube (ET) appear to be the most important factors in the pathogenesis of OME. Studies recently discovered that adenoidal bacterial biofilms (known causes of OME) are significantly more prevalent near the ostium, implying that the adenoids are a reservoir for biofilm-producing bacteria that can spread through the ET to colonise the middle ear.[9] Therefore, the goal of surgery in patients with OME and enlarged adenoids should be the entire removal of the adenoids, not only to restore ET patency but also to eradicate bacterial biofilms completely.[8,9]

The aim of this study was to assess and investigate the current statistical evidence on the efficacy of tympanostomy and adenoidectomy in children with OME in comparison with tympanostomy alone.

Materials And Methods

The review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[10] A measurement tool for the "assessment of multiple systematic reviews," AMSTAR (A measurement tool for assessment of multiple systematic reviews) is used to assess the quality of the manuscript using an improved quality assessment questionnaire that consists of 11 items. The study protocol was prospectively registered on PROSPERO (CRD42022343881).

Literature search strategy

We provided a comprehensive and accurate search of PubMed, Web of Science, Scopus and Cochrane Library databases for relevant studies published in the literature during November 2021. The identification and investigation terms used in the databases were the following: (Adenoidectomy OR Adenoidectomies) AND (Tympanostomy OR "Middle Ear Ventilations" OR "Grommet Insertion" OR "Tympanostomy Tube Insertion" OR Tympanostomies OR Myringostomy OR Myringostomies) AND ("OME" OR "Secretory OM" OR "Serous OM"). We retrieved the results of the database search and the duplicates have been removed by Rayyan QCRI[11] and EndNote Software X8. We used an Excel sheet for screening (1) title and abstract, (2) full text and (3) data extraction. Any disagreements were resolved by discussion, and a consensus was reached. We screened all studies independently and included only the studies meeting our criteria.

Inclusion and exclusion criteria

We included all clinical trials that report the efficacy of adenoidectomy versus tympanostomy on the OME and studies available in English only. Moreover, the exclusion criteria involved: (1) animal studies; (2) *in vitro* studies (tissue and culture); (3) observational studies (cohort, case–control, cross-sectional, case series and case report); (4) press article; (5) editorial letter; (6) conferences abstract; (7) reviews; (8) the meta-analysis and (9) book and book chapters.

Data extraction

All authors contributed to the following data extraction from the included studies using Rayyan QCRI[11] and four formatted Excel sheets as (1) Summary sheet for basic information of the studies, (2) Pre-treatment sheet for the baseline characters of the patients, (3) Post-treatment sheet for the patients' outcomes and (4) Meta-analysis sheet for preparing the data of the including study to analysis. We extract variables as (acute OM [AOM] episodes, the cumulative number of AOM episodes, hearing level decibel (dB), HL scale-left ear, hearing level dB HL scale-right ear, and siblings with OM).

Quality assessment

To assess the risk of bias in the included clinical trials, we used Cochrane Handbook of Systematic Reviews of Interventions 5.1.0 using the quality assessment table provided in Part 2 and Chapter 8.5,[12] based on the following domains: Random sequence generation (selection bias), allocation concealment (selection bias), blinding of outcome assessment (detection bias), blinding of participants and personnel (performance bias), selective reporting (reporting bias), incomplete outcome data (attrition bias) and other potential sources of bias.

Statistical analysis

We performed the statistical analysis by Review Manager (RevMan) software version 5.4. Results with a $P < 0.05$ were considered significant in the *Z*-test, with the standardized mean difference (SMD) and its 95% confidence interval (CI) presented the result of meta-analysis for continuous outcomes. The odds or risk ratios (RR) presented the result of the meta-analysis for dichotomous outcomes. The Chi-square test was used to measure the significance of heterogeneity, a potentially significant heterogeneity when Chi-square test $P < 0.1$, and the degree of heterogeneity was then examined using the I^2 test. We solved the present heterogeneity by changing the effects model, effect measure or statistical methods.

Results

Characteristics of the included studies

The literature search showed 1510 studies; we exclude 600 duplications by EndNote software. After completing the title and abstract screening, 99 articles were eligible for full-text screening. Finally, five studies[3,13-16] were included in our meta-analysis as in the PRISMA flow chart [Figure 1]. The risk 38 of bias assessment revealed that the five included studies were 39 low risk of bias [Figure 2a]. A summary of the assessment of 40 the risk of bias domains is shown in Figure 2b. Study characters are presented in Table 1.

Efficacy measurement

Acute otitis media episodes

The pooled effect estimate showed no significant difference between tympanostomy with adenoidectomy versus tympanostomy alone (odds ratio [OR] 0.89, 95% CI [0.61, 1.28], $P = 0.53$). The pooled results were homogeneous [$P < 0.94$, $I^2 = 0\%$, Figure 3].

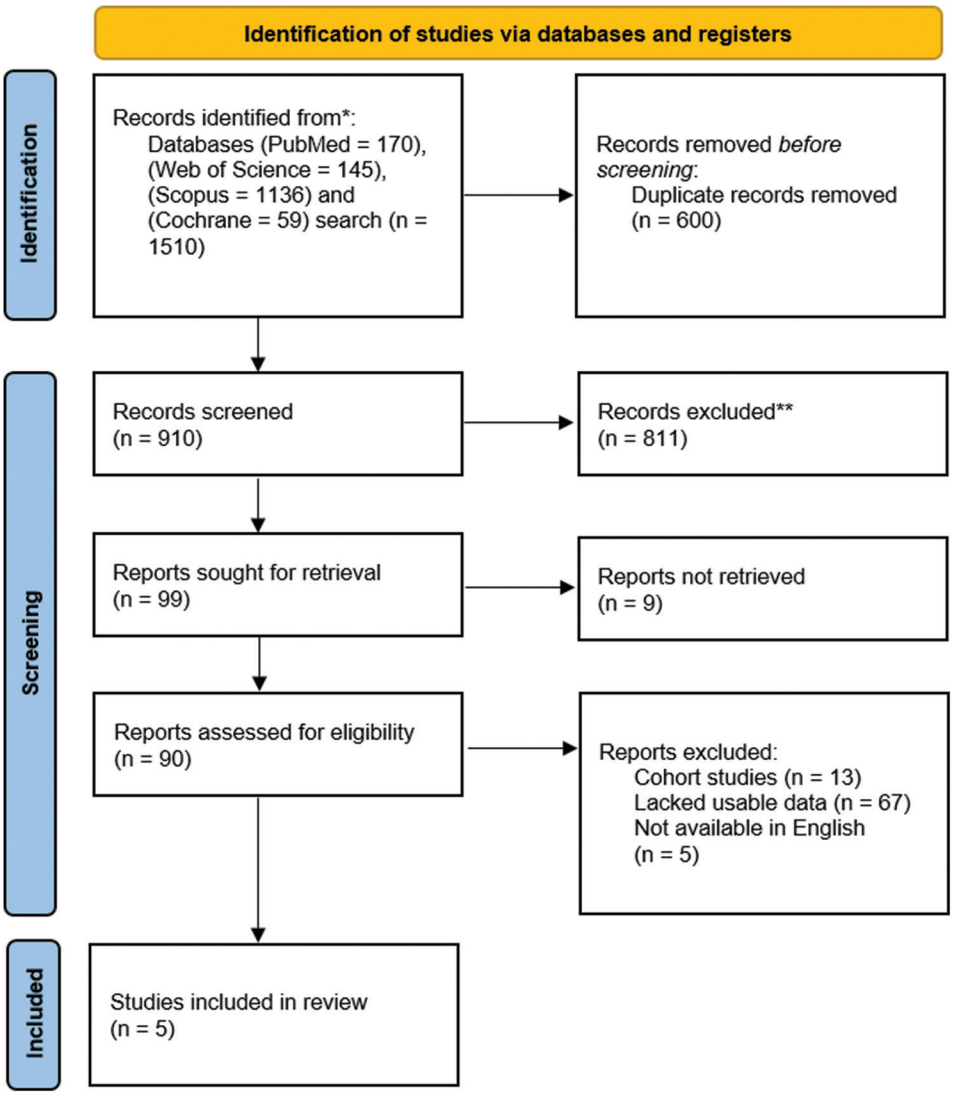


Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-analyses flow chart for study screening and selection process. *The databases that we used, **Exclusion criteria that mentioned in methods section

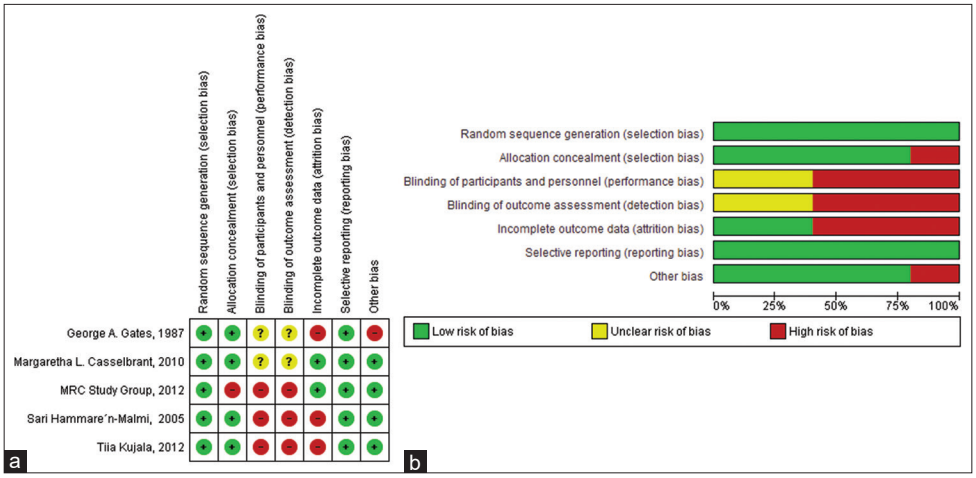


Figure 2: Summary of risk of bias assessment. (a) The risk 38 of bias assessment revealed that the five included studies were 39 low risk of bias. (b) A summary of the assessment of 40 the risk of bias domains

Table 1: Summary of the included studies

Study ID	Study arm	Age (years) (%)	Sex (males) (%)	Sample size	Conclusion
Gates *et al*., 1987	Myringotomy	4–6.5 (69)	61	107	We conclude that adenoidectomy should be considered when surgical therapy is indicated in children 4–8 years old who are severely affected by chronic OME
	Placement of tympanostomy tubes	4–6.5 (69)	58	129	
	Adenoidectomy and myringotomy	4–6.5 (73)	59	130	
	Adenoidectomy and placement of tympanostomy tubes	4–6.5 (74)	58	125	
Hammarén-Malmi, Sari *et al*., 2005	Adenoidectomy with tympanostomy, mean (SD)	1.9 (0.7)	51 (50)	102	Adenoidectomy does not significantly reduce the incidence of AOM in otitis prone children who are younger than 4 years and receive tympanostomy tubes
	Tympanostomy, mean (SD)	1.9 (0.7)	56 (58.3)	96	
Casselbrant, Margaretha *et al*., 2009	Myringotomy and tube (months)				Adenoidectomy with or without tube insertion provided no advantage to young children with chronic OME in regard to time with effusion compared to tube insertion alone. Fewer tympanostomy tubes were placed in children undergoing A-M as their initial procedure, but this should be balanced by the performance of the more invasive surgical procedure and their increased time with effusion
	24–35	19 (59.4)	19 (59)	32	
	36–47	13 (40.6)			
	Adenoidectomy with myringotomy and tube (months)				
	24–35	18 (56.3)	18 (56.3)	32	
	36–47	14 (43.8)			
	Adenoidectomy with myringotomy (months)				
	24–35	19 (55.9)	19 (55.9)	34	
	36–47	15 (44.1)			
Kujala, Tiia *et al*., 2012	Tympanostomy, mean (SD)	1.34 (0.33)	43 (43)	100	Insertion of tympanostomy tubes alone or with adenoidectomy was effective in preventing recurrent AOM episodes in children younger than 2 years of age
	Tympanostomy with adenoidectomy, mean (SD)	1.47 (0.35)	42 (42)	100	
	Control, mean (SD)	1.32 (0.31)	47 (47)	100	
MRC Multi-centre OM Study Group. 2012	VT placement, mean (SD)	5.2 (0.85)	48	126	In children aged 3.25–6.75 years with recurrent OME and at least a 20 dB HL in both ears, adjuvant adenoidectomy doubles the effect of short-stay VTs by prolonging improved hearing into the second year. The length of adenoidectomy benefit is proportional to the duration of function of the VTs employed. Adenoidectomy also lowers the chances of needing revision surgery
	VTs+ad adenoidectomy, mean (SD)	5.3 (0.85)	48	128	
	FWW, mean (SD)	5.2 (0.86)	51	122	

OM: Otitis media, OME: OM with effusion, AOM: Acute OM, HL: Hearing loss, FWW: Further watchful waiting, VTs: Ventilation tubes, VTs+ad: VTs with adjuvant, SD: Standard deviation

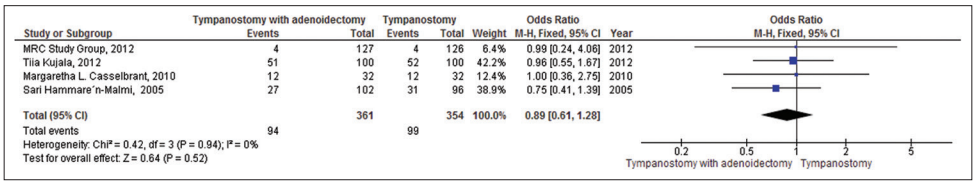


Figure 3: Pooled effect estimate of acute otitis media episodes. OR: Odds ratio, CI: Confidence interval

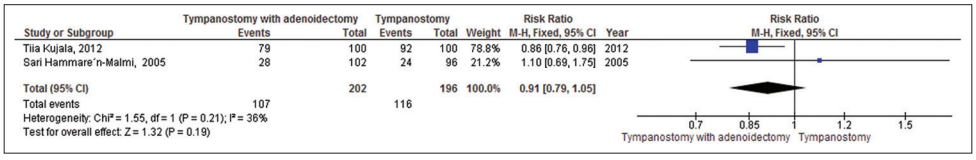


Figure 4: Pooled effect estimate of cumulative number of acute otitis media episodes. OR: Odds ratio, CI: Confidence interval

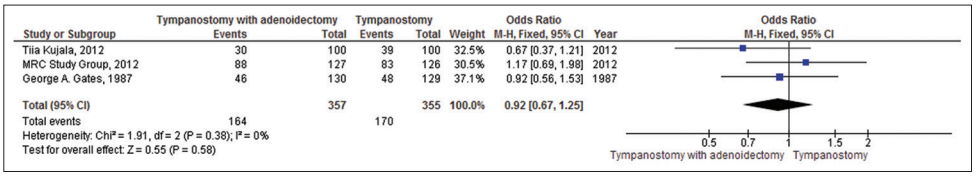


Figure 5: Pooled effect estimate of siblings with otitis media. OR: Odds ratio, CI: Confidence interval

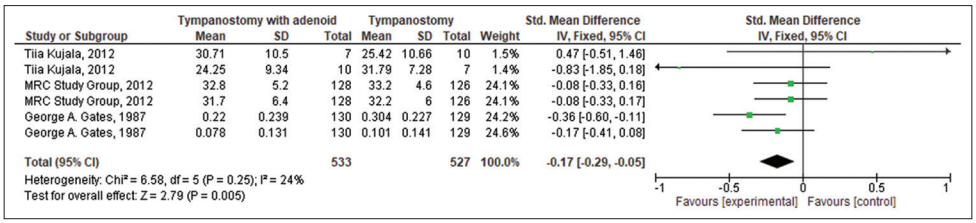


Figure 6: Pooled effect estimate of hearing level decibel hearing loss scale of the ears. OR: Odds ratio, CI: Confidence interval, SD: Standard deviation

Cumulative number of acute otitis media episodes

The pooled effect estimate showed no significant difference between tympanostomy with adenoidectomy versus tympanostomy alone (RR 0.91, 95% CI [0.79, 1.05], $P = 0.19$). The pooled results were homogeneous [$P < 0.21$, $I^2 = 36\%$, Figure 4].

Siblings with otitis media

The pooled effect estimate showed no significant difference between tympanostomy with adenoidectomy versus tympanostomy alone (OR 0.92, 95% CI [0.67, 1.25], $P = 0.58$). The pooled results were homogeneous [$P < 0.38$, $I^2 = 0\%$, Figure 5].

Hearing level decibel hearing loss scale in both ears

The pooled effect estimate showed a significant difference between tympanostomy with adenoidectomy versus tympanostomy alone (SMD − 0.17, 95% CI [−0.29, −0.05], $P = 0.005$). The pooled results were not heterogeneous [$P < 0.25$, $I^2 = 24\%$, Figure 6].

Discussion

This study is a systematic review and meta-analysis that aimed to assess and compare between two surgical modalities in the treatment of OME that are tympanostomy with adenoidectomy and tympanostomy alone. A total of five studies were included for both qualitative and quantitative data synthesis. The study measured the effect through the number of AOM episodes, cumulative number of AOM episodes, siblings with OM and hearing level HL scale of the left and right ears. The pooled effect estimated only showed a significant difference between tympanostomy with adenoidectomy versus tympanostomy alone in hearing level HL scale of both ears (SMD − 0.17, 95% CI [−0.29, −0.05], $P = 0.005$). However, the pooled results were not heterogeneous ($P < 0.25$, $I^2 = 24\%$). None of the other pooled effect estimates showed statistically significant difference, and all of the non-significant results were homogenous.

One of the therapeutic approaches used in the treatment of OME is adenoidectomy, and several surgical strategies have been proposed in an attempt to enhance clinical results.[17,18] The significance of adenoidectomy in lowering the occurrence of OME is still a point of contention. Van den Aardweg *et al*.[19] observed in a recent Cochrane review that adenoidectomy has a considerable advantage in the clearance of middle ear effusion in children with OME, but the benefit to hearing is limited and the effects on alterations in the tympanic membrane are unclear. As a result, while deciding whether or not to perform adenoidectomy surgery, the risks of the treatment should be weighed against the potential advantages. A potential improvement of the functions of the ET is considered the main reason for performing adenoidectomy in the treatment of OME.[20]

Maintaining normal hearing functions is crucial for the development of language, better educational outcomes and prevention of many developmental disorders in young children. The study found a significant difference between tympanostomy with adenoidectomy versus tympanostomy alone in the hearing level HL scale of both ears. Studies reported that adjuvant adenoidectomy has a superior role in improving hearing in short and long term.[3,15,16] The insertion of ventilation tubes improves hearing in the short term, according to studies and meta-analyses,[21,22] and new recommendations support it as a first-line surgical treatment. Because HL is a risk factor for eventual linguistic, educational and developmental problems in OME patients, it is regarded as the most problematic and hence crucial clinical manifestation of the condition.[23,24] Long-term benefits of tube insertion have yet to be discovered,[22] whereas the risk of various problems and diseases such as tympanosclerosis or tympanic membrane atrophy is much higher.[21]

This study successfully reported the current statistical evidence on the efficacy of tympanostomy and adenoidectomy in children with OME in comparison with tympanostomy alone following the latest PRISMA guidelines. However, the data retrieved from the included studies were scanty, which limits the power of the findings, and therefore, caution should be taken while interpreting and implementing the results in health care practice. In addition, the study did not distinguish between traditional and endoscopic adenoidectomy.

Conclusions

This review found that there was a significant difference in the hearing outcomes of the left and right ears amongst children with OME who underwent tympanostomy and adenoidectomy in comparison with tympanostomy alone.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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