

Interventions for adult Eustachian tube dysfunction: a systematic review

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Scientific summary

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Background

The Eustachian tube is a narrow tube which links the back of the nose to the middle ear. It is normally closed but opens when we swallow, yawn or chew. It has three main functions: to protect the middle ear from sources of disease, to ventilate the middle ear, and to help drain secretions away from the middle ear. Eustachian tube dysfunction (ETD) is the inability of the Eustachian tube to adequately perform these functions.

Eustachian tube dysfunction may occur when the mucosal lining of the tube is swollen, or does not open or close properly. It can occur after the start of a cold and other nose, sinus, ear and throat infections. If the tube is dysfunctional, symptoms such as muffled hearing, pain, tinnitus, reduced hearing, a feeling of fullness in the ear or problems with balance may occur. Long-term ETD has been associated with damage to the middle ear and the eardrum. Complications include otitis media with effusion (glue ear), middle ear atelectasis (retraction of the eardrum) and chronic otitis media. The precise function and mechanisms of the Eustachian tube, the underlying causes of dysfunction and the broader problems associated with middle ear ventilation are complex and not fully understood. From a diagnostic perspective, ETD is also poorly defined.

There are a number of treatment options aimed at improving Eustachian tube function, but there is limited consensus about management.

Objectives

To determine the clinical effectiveness of interventions for adult ETD and to identify gaps in the evidence in order to inform future research.

Methods

A systematic review was undertaken. Twelve databases, including MEDLINE, EMBASE and the Cochrane Central Register of Controlled Trials (CENTRAL), were searched from inception up to October 2012 for published and unpublished studies. In addition, information on studies in progress, unpublished research or research reported in the grey literature was sought by searching a range of resources, including several trial registries and websites of regulatory agencies. The reference lists of all included studies and systematic reviews were also checked to identify studies. Only English-language studies were included.

Studies evaluating interventions to treat ETD in primary, secondary and tertiary care settings were eligible for inclusion: active observation, supportive care, auto-inflation, nasal douching, topical nasal decongestants, antihistamines, intranasal corticosteroids, oral corticosteroids, leukotriene receptor antagonists, antibiotics, simethicone, or surgery. Patients with a diagnosis of ETD were included. Given the current lack of consensus on diagnostic criteria for ETD, a strict definition of ETD was not applied and a pragmatic approach was adopted: primary study definitions of ETD were accepted, provided that they were based on symptomatology, and/or relevant clinical tests such as tympanometry. Patients with patulous Eustachian tube or nasopharyngeal tumours were excluded. Placebo, no intervention or another eligible treatment were relevant comparators. In the first instance, only studies of adults or studies of mixed populations of adults and children where adult data were reported separately were eligible for inclusion. Owing to a paucity of adult studies for non-surgical interventions, the protocol was amended to include comparative studies with mixed populations of adults and children.

The primary outcome was change in severity and/or frequency of symptoms. Other outcomes of interest included quality of life, improvement in middle ear function, improvement in hearing, tympanic membrane mobility, clearance of middle ear effusion, need for additional treatment, early tube extrusion (for pressure equalising tubes), adverse events of interventions, and complications related to ETD.

Randomised controlled trials (RCTs), non-RCTs and observational studies with a control group were included. Studies without a control group (e.g. case series) with at least 10 participants were also included for interventions where no controlled studies were found.

Two researchers independently screened studies for relevance based on the inclusion criteria. Disagreements were resolved by consensus or with a third researcher as needed. One reviewer extracted data; these were checked by a second reviewer. Quality assessment was performed independently by two reviewers. Disagreements were resolved by consensus and, if necessary, a third researcher was consulted.

A narrative and tabular summary of key study characteristics and quality assessment was undertaken. Outcomes were reported as risk ratios (RRs) and mean differences with 95% confidence intervals (CIs). Owing to heterogeneous interventions, outcome measurements and study designs, a quantitative synthesis could not be performed, and results were reported in a narrative synthesis. Studies were grouped by type of intervention (non-surgical and surgical) and then by outcome. Results were interpreted in the context of the quality of the individual studies and clinical heterogeneity.

Results

The searches yielded 3022 records. Nineteen studies were included: three RCTs and two non-RCTs evaluating pharmacological interventions and mechanical devices for middle ear pressure equalisation; and 13 case series and one retrospective controlled before-and-after study evaluating surgical interventions. None of the studies was conducted in the UK.

The included studies were small and the sample size ranged from 11 to 108. All of the surgical studies and three of the five non-surgical studies were at high risk of bias. One study had a low risk of bias, and one an unclear risk. All non-surgical studies except one explicitly reported including a minority of children or adolescents. Surgical studies only included adults. The results in several studies were poorly reported, limiting the outcome data that could be extracted.

The included studies rarely specified how they defined ETD or reported standardised procedures for assessment of symptoms. The presence of related conditions at baseline also varied between studies. Many of the surgical studies reported the use of co-interventions, which often included additional surgery for many or all of the patients. Outcome assessment and duration of follow-up were also sources of substantial heterogeneity.

Studies of several relevant surgical and non-surgical interventions were not identified despite extensive searches. In particular, no studies were found of active observation (monitoring to determine whether or not the condition resolves naturally) or supportive care (advice on self-management strategies, such as advice to swallow, yawn or chew).

Non-surgical interventions

None of the non-surgical interventions was evaluated by more than one study. There were single studies of nasal steroids, topical decongestant, antihistamine and two different types of mechanical equalisation devices.

There was no evidence from one RCT ($n = 91$) that a 6-week course of nasal steroids was effective at improving the severity and frequency of ETD symptoms among patients with otitis media with effusion

and/or negative middle ear pressure by the end of the treatment. This was the only study identified as having a low risk of bias, although the trial was underpowered and there were limitations in how the outcome data were reported. There were some data suggesting improvement in middle ear function for patients after receiving direct application of a topical decongestant on the pharyngeal opening of the Eustachian tube in a single RCT ($n = 36$) (RR 0.47; 95% CI 0.28 to 0.80). However, treatment only improved middle ear function when patients were subject to unphysiologically high pressure changes. The internal and external validity of this study are both unclear, notably due to multiple gaps in reporting of design characteristics and very short-term follow-up. One non-RCT ($n = 32$) found a significant improvement in middle ear function for patients receiving a single dose of antihistamine and ephedrine compared with placebo (RR 0.47; 95% CI 0.27 to 0.81). However, the reliability of these findings is uncertain, notably due to a high risk of selection bias and very short follow-up duration (3 hours). Two of the pharmacological studies reported measuring adverse events. Minor adverse events were reported in one study, and no events in the second.

Both studies of mechanical pressure equalisation devices were subject to a high risk of bias. One RCT ($n = 20$) found that self-administration of a manual device applying mild negative pressure to the external ear canal three times a day for 1 week was associated with a significant reduction in severity of fullness in the ear and middle ear function at 1 week compared with no treatment. A non-RCT ($n = 28$) found a statistically significant improvement in middle ear function (RR 0.36; 95% CI 0.15 to 0.87) and in hearing at 9 to 10 weeks' follow-up after receiving twice-weekly modified politzerisation for 6 weeks compared with no treatment. However, the difference in hearing reflected an unexplained deterioration in the control group rather than an improvement in those who received the intervention. Neither study reported data on adverse events of the interventions, making the safety of these interventions uncertain.

Surgical interventions

A variety of surgical interventions were evaluated. Eustachian tuboplasty, balloon dilatation and myringotomy were evaluated in multiple studies. The other surgical interventions, laser coagulation and myringotomy for direct application of topical steroids through a MicroWick tube (Silverstein MicroWick™, Anthony Products, Indianapolis, IN, USA), were each evaluated by a single study. All studies had a high risk of bias. Any interpretation of data from case series is limited by the uncontrolled study design; it is impossible to determine how much improvement in symptoms and other measures would have occurred in the absence of the intervention, especially in the case of a condition which may resolve naturally. Extensive use of co-interventions contributed to uncertainty.

Eustachian tuboplasty was the most commonly evaluated surgery (seven studies, $n = 182$). Where reported, a significant number of patients had an improvement in symptoms (from 36% to 92%) at follow-up ranging from 2 to 37 months, though improvement was defined in a variety of ways. Four studies reported an improvement in hearing, although improvements were generally small with limited clinical significance (pure tone averages improvements between -6 decibels (dB) and -10 dB, three studies; decrease in the air-bone gap of -12.3 dB, one study). Measures of middle ear function indicated low rates of conversion to type A tympanogram in the three studies that reported this outcome (from 13% to 36% of patients). As well as differences in the techniques used, there were wide variations among the patients in these studies, as well as differences in the outcomes reported and the measures used to assess outcomes. There was insufficient evidence to demonstrate the effectiveness of tuboplasty, or to determine either the details of the surgical technique which should be employed or the patients for whom it should be considered.

Three studies of balloon dilatation were identified ($n = 107$). Two reported on symptoms at follow-up (12 weeks and mean 30 weeks); both showed high levels of improvement in symptoms (92% and 71% of patients). Tympanometric measurement of middle ear function was reported in all three studies, and all reported conversion to type A tracings (from 36% to 96% of patients), although follow-up duration varied significantly between the studies (from 6 weeks to 1 year). None of the studies reported data on hearing. Two of the studies reported that all or a majority of patients had additional surgery and a minority of patients in the third also had additional treatment.

Two studies assessing procedures for myringotomy were identified. One small study ($n = 13$) reported efficacy in permitting patients to undergo hyperbaric oxygen therapy, while the other ($n = 108$) reported symptom alleviation in the subgroup of patients with an ETD diagnosis. The evidence base for topical application of steroids to the Eustachian tube and laser point coagulation each rested on a single study.

None of the interventions appeared to be associated with serious adverse effects, although minor complications of surgery were reported in a minority of patients in several studies. However, it was not clear that adverse events were systematically documented, and three surgical studies did not report any safety data. None of the studies reported follow-up beyond a maximum of 30 months; therefore, the long-term safety profile of the interventions is unknown.

Conclusions

Implications for health care

The evidence for treatments for adult ETD was limited in quantity and overall was of poor quality. Multiple sources of potential bias were identified in nearly all of the included studies. Additional confounding factors were present in many of the evaluations of surgical interventions, while clinical relevance was limited in two of the three pharmacological studies. Given the limitations of the evidence, it is not possible to make conclusions regarding the effectiveness of any of the interventions for the treatment of patients with a diagnosis of ETD.

Recommendations for research

Owing to the extent of the gaps in the evidence and poor quality of available evidence, the studies identified by this review do not provide a clear evidence base to recommend a trial of any particular intervention. One of the principal findings of the review was the variability in inclusion criteria and unclear and variable definitions of ETD used across the included studies. This indicated a lack of consensus as to what the population of interest is and how people should be evaluated for inclusion in any further studies.

A research priority setting exercise is required to identify the most appropriate avenues for further research. In the first instance, this should focus on developing an explicit definition of the population of interest and the diagnostic inclusion criteria that should be used to identify them. The specification of the population of interest should take into consideration the increasing recognition that the signs and symptoms previously attributed to ETD may also be related to other middle ear problems; for instance, gaseous exchanges within the middle ear mucosa may play a role in the development of middle ear ventilation problems. It should also address the question of criteria for consideration of surgical treatment in a patient diagnosed with ETD. The exercise will also need to address the lack of consensus as to what the important clinical outcomes are following treatment, and how these should be measured. This should include agreement on the duration of follow-up required for an intervention to be adequately assessed for both efficacy and safety. Only when a consensus on these key elements has been arrived at should the question of commissioning further primary research intervention studies be considered.

Study registration

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