Otitis media with effusion in children

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ABSTRACT

INTRODUCTION: Up to 80% of children have been affected by otitis media with effusion (OME) by the age of 4 years, but prevalence declines beyond 6 years of age. Non-purulent middle-ear infections can occur in children or adults after upper respiratory tract infection or acute otitis media. Half or more of cases resolve within 3 months and 95% within 1 year, but complications such as tympanic membrane perforation, tympanosclerosis, otorrhoea, and cholesteatoma can occur. METHODS AND OUTCOMES: We conducted a systematic review and aimed to answer the following clinical questions: What are the effects of interventions to prevent otitis media with effusion in children? What are the effects of pharmacological, mechanical, and surgical interventions to treat otitis media with effusion in children? We searched: Medline, Embase, The Cochrane Library, and other important databases up to March 2010 (Clinical Evidence reviews are updated periodically; please check our website for the most up-to-date version of this review). We included harms alerts from relevant organisations such as the US Food and Drug Administration (FDA) and the UK Medicines and Healthcare products Regulatory Agency (MHRA). RESULTS: We found one systematic review and one RCT that met our inclusion criteria. We performed a GRADE evaluation of the quality of evidence for interventions. CONCLUSIONS: In this systematic review, we present information relating to the effectiveness and safety of the following interventions: adenoidectomy, antibiotics, antihistamines, autoinflation, bottle feeding, decongestants, exposure to other children, intranasal corticosteroids, mucolytics, oral corticosteroids, passive smoking, and ventilation tubes.

QUESTIONS

INTERVENTIONS

Key points

- Otitis media with effusion (OME, glue ear) usually presents with concerns about the child's behaviour, performance at school, or language development.
  - Children usually only have mild hearing impairment and few other symptoms.
  - Up to 80% of children have been affected by the age of 4 years, but prevalence declines beyond 6 years of age.
  - Non-purulent middle-ear infections can occur in children or adults after upper respiratory tract infection or acute otitis media.
  - Half or more of cases resolve within 3 months and 95% within 1 year, but complications such as tympanic membrane perforation, tympanosclerosis, otorrhoea, and cholesteatoma can occur.
- Risk of OME is increased with passive smoking, bottle feeding, low socioeconomic group, and exposure to many other children.
  - However, there is no evidence to show whether interventions to modify these risk factors reduce the risk of OME.
- Autoinflation with purpose-manufactured devices may improve effusions over 2 weeks to 3 months, but long-term efficacy is unknown.
- We don't know whether non-purpose-manufactured devices are effective in treating otitis media with effusion. Children may find autoinflation difficult.

- Oral antibiotics, antihistamines plus oral decongestants, or mucolytics may be of no benefit in OME, and can cause adverse effects.

  Antibiotics can cause adverse effects in up to one third of children with OME.

  Antihistamines can cause behavioural changes, seizures, and blood pressure variability.

- Oral corticosteroids are unlikely to improve symptoms in OME, and can cause growth retardation.

  Intranasal corticosteroids are unlikely to be of benefit in children with bilateral otitis media with effusion.

- Ventilation tubes may improve short-term outcomes, but the clinical effect size is small. They may also increase the risk of tympanic membrane abnormalities.

  Ventilation tubes improve hearing for the first 2 years, but have no longer-term benefit, and may not improve cognition or language development.

  Adenoidectomy may improve hearing when performed with tympanostomy, but the clinical relevance of the improvements is unclear.

- Combination treatment with ventilation tubes plus adenoidectomy may be more effective than adenoidectomy alone.

DEFINITION

Otitis media with effusion (OME) or "glue ear", is serous or mucoid, but not mucopurulent, fluid in the middle ear. Children usually present with hearing impairment and speech problems. By contrast with those with acute otitis media (see review on acute otitis media), children with OME do not suffer from acute ear pain, fever, or malaise. Hearing impairment is usually mild and often identified when parents express concern regarding their child's behaviour, performance at school, or language development.

INCIDENCE/ PREVALENCE

OME is commonly seen in paediatric practice, and accounts for 25% to 35% of all cases of otitis media. [1] One study in the UK found that, at any time, 5% of children aged 5 years had persistent (at least 3 months) bilateral hearing impairment associated with OME. [2] The prevalence declines considerably beyond 6 years of age. [3] Studies in the USA and Europe have estimated that about 50% to 80% of children aged 4 years have been affected by OME at some time. [3] [4] One study in the USA estimated that, between the ages of 2 months and 2 years, 91% of young children will have one episode of middle-ear effusion, and 52% will have bilateral involvement. [5] OME is the most common reason for referral for surgery in children in the UK. [6] The number of general practitioner consultations for OME increased from 15.2 per 1000 (2–10 year olds) per year to 16.7 per 1000 per year between 1991 and 2001. [7] Middle-ear effusions also occur infrequently in adults after upper respiratory tract infection or after air travel, and may persist for weeks or months after an episode of acute otitis media. [8]

AETIOLOGY/ RISK FACTORS

Contributory factors include upper respiratory tract infection and narrow upper respiratory airways. [8] [9] Case-control studies have identified risk factors, including age 6 years or younger, day care centre attendance, large number of siblings, low socioeconomic group, frequent upper respiratory tract infection, bottle feeding, and household smoking. [3] [8] These factors may be associated with about twice the risk of developing OME. [9]

PROGNOSIS

Data from one prospective study of children aged 2 to 4 years showed that 50% of OME cases resolved within 3 months and 95% within 1 year. [10] In 5% of preschool children, OME (identified by tympanometric screening) persisted for at least 1 year. [10] [11] One cohort study of 3-year-olds found that 65% of OME cases cleared spontaneously within 3 months. [11] Most children aged 6 years or older will not have further problems. [2] The disease is ultimately self-limiting in most cases. [2] [5] [6] However, one large cohort study (534 children) found that middle-ear disease increased reported hearing difficulty at 5 years of age (OR 1.44, 95% CI 1.18 to 1.76) and was associated with delayed language development in children up to 10 years of age. [12] Hearing impairment is the most common complication of OME. Most children with OME have fluctuating or persistent hearing deficits with mild to moderate degrees of hearing loss, averaging 27 decibels. The type of hearing impairment is usually conductive, but it may be sensorineural, or both. The sensorineural type is usually permanent. [13] Tympanic membrane perforation, tympanosclerosis, otorrhoea, and cholesteatoma occur more frequently among children with OME than among those without OME.

AIMS OF INTERVENTION

To improve hearing and wellbeing; to avoid poor behavioural, speech, and educational development; to prevent recurrent earache and otitis media, with minimal adverse effects.

OUTCOMES

Symptom improvement: hearing impairment, assessed by audiometry or tympanometry (although the positive predictive value of these tests has been reported to be as low as 49%); [14] and resolution of effusion (both speed and completeness) assessed by otoscopy, tympanometry, or global

clinical assessment. **Developmental and behavioural outcomes:** language and speech development. **Adverse effects** of treatment. Hearing losses as small as 15 decibels may have disabling consequences in children, and so changes of this magnitude are likely to be clinically significant. Patient-centred outcomes in children with OME (e.g., disability or quality of life) need further development and evaluation. Adequate follow-up for a single episode of OME is about 1 to 3 months, but relapses are common and so follow-up for quality-of-life outcomes should ideally be for at least 3 months.

METHODS

Clinical Evidence search and appraisal March 2010. The following databases were used to identify studies for this systematic review: Medline 1966 to March 2010, Embase 1980 to March 2010, and The Cochrane Database of Systematic Reviews 2010, February (online version; 1966 to February 2010). When editing this review we used The Cochrane Database of Systematic Reviews 2010, issue 1. An additional search within The Cochrane Library was carried out for the Database of Abstracts of Reviews of Effects (DARE) and Health Technology Assessment (HTA). We also searched for retractions of studies included in the review. Abstracts of the studies retrieved from the initial search were assessed by an information specialist. Selected studies were then sent to the contributor for additional assessment, using predetermined criteria to identify relevant studies. Study design criteria for inclusion in this review were: published systematic reviews of RCTs and RCTs in any language, at least single blinded, and containing more than 20 individuals of whom more than 80% were followed up. There was no minimum length of follow-up required to include studies. We excluded all studies described as "open", "open label", or not blinded unless blinding was impossible. We included systematic reviews of RCTs and RCTs where harms of an included intervention were studied applying the same study design criteria for inclusion as we did for benefits. In addition we use a regular surveillance protocol to capture harms alerts from organisations such as the US Food and Drug Administration (FDA) and the UK Medicines and Healthcare products Regulatory Agency (MHRA), which are added to the reviews as required. To aid readability of the numerical data in our reviews, we round many percentages to the nearest whole number. Readers should be aware of this when relating percentages to summary statistics such as relative risks (RRs) and odds ratios (ORs). We have performed a GRADE evaluation of the quality of evidence for interventions included in this review (see table, p 29). The categorisation of the quality of the evidence (high, moderate, low, or very low) reflects the quality of evidence available for our chosen outcomes in our defined populations of interest. These categorisations are not necessarily a reflection of the overall methodological quality of any individual study, because the Clinical Evidence population and outcome of choice may represent only a small subset of the total outcomes reported, and population included, in any individual trial. For further details of how we perform the GRADE evaluation and the scoring system we use, please see our website (www.clinicalevidence.com).

QUESTION **What are the effects of interventions to prevent otitis media with effusion in children?**

OPTION **MODIFYING RISK FACTORS**

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Risk of OME is increased with passive smoking, bottle feeding, low socioeconomic group, and exposure to many other children. However, there is no evidence to show whether interventions to modify these risk factors reduce the risk of OME.
- We found no clinically important results from RCTs about the effects of modifying risk factors such as passive smoking or bottle feeding, in preventing otitis media with effusion.

Benefits and harms

Modifying risk factors:

We found no systematic review or RCTs of interventions aimed at modifying risk factors for OME (see comment).

Comment:

Clinical guide:

There is good epidemiological evidence that the risk of otitis media with effusion is increased by passive smoking, [3] bottle feeding, [5] low socioeconomic group, and exposure to a large number of other children. [14] Feasible preventive interventions may include strategies to reduce household smoking and encourage breastfeeding.

QUESTION **What are the effects of pharmacological, mechanical, and surgical interventions to treat otitis media with effusion in children?**

OPTION AUTOINFLATION USING PURPOSE-MANUFACTURED DEVICES

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Autoinflation with purpose-manufactured devices may improve effusions over 2 weeks to 3 months, but long-term efficacy is unknown.
- Children may find autoinflation difficult.

Benefits and harms

Autoinflation using purpose-manufactured devices versus no treatment:

We found two systematic reviews (search date not reported [15] and search date 2006 [16]) comparing autoinflation versus no treatment. Both reviews included RCTs that used purpose-manufactured devices and also other non-purpose-manufactured devices. We have only reported data on purpose-manufactured devices in this option. The reviews identified 4 RCTs between them, and two RCTs were common to both reviews. However, the reviews differed in the analysis they undertook and the outcomes they reported so we report both here. The first review included three RCTs, which reported results by child or by ear. [15] The second review [16] included the two published RCTs included in the first review (both using the Otovent device) [17] [18] and one RCT subsequent to the first review (using the ear-popper). [19] It did not separately analyse purpose-manufactured devices as a group versus no treatment. It performed a different analysis to the first review on the basis of intention to treat and by calculating an adjusted risk ratio, to correct for the fact that one of the RCTs had reported by ears but had randomised by children.

Symptom improvement

Autoinflation using purpose-manufactured devices compared with no treatment Autoinflation with a purpose-manufactured device (Otovent device or ear-popper) may be more effective than no treatment at improving outcomes (measured by tympanogram, audiogram, or composite outcomes). However, results varied by the analysis undertaken and the specific outcome reported (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Cure					
[15] Systematic review	386 children or ears 3 RCTs in this analysis	**Cure , 2 weeks to 3 months** 63/195 (32%) with autoinflation with purpose-manufactured nasal balloons 27/191 (14%) with no autoinflation Not clear what proportion of results relate to ears cured or children cured Two RCTs included in the analysis measured outcomes using tympanograms, and one RCT reported "recovery" (not further defined)	OR 3.53 95% CI 2.03 to 6.14 For details on quality and methods of studies, see further information on studies	●●○	Autoinflation
Hearing, effusion, or both					
[16] Systematic review	85 children aged 3 to 10 years Data from 1 RCT	**Improved tympanograms , 1 month or less** with autoinflation using the Otovent device with no treatment Absolute results not reported	RR 2.42 95% CI 1.24 to 4.70 For details on quality and methods of studies, see further information on studies	●●○	Autoinflation using the Otovent device
[16] Systematic review	100 children aged 3 to 10 years Data from 1 RCT	**Improved tympanograms , 1 month or less** with autoinflation using the Otovent device with no treatment	RR 4.29 95% CI 2.24 to 8.22 For details on quality and methods of studies, see further information on studies	●●○	Autoinflation using the Otovent device

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		Absolute results not reported			
[16] Systematic review	185 children aged 3 to 10 years 2 RCTs in this analysis	**Improved tympanograms , over 1 month** with autoinflation with no autoinflation Absolute results not reported	RR 1.89 95% CI 0.77 to 4.67 For details on quality and methods of studies, see further information on studies	⟷	Not significant
[16] Systematic review	85 children Data from 1 RCT	**Improvement of pure tone audiogram (10 dB or greater improvement)** with autoinflation using the Otovent device with no treatment Absolute results not reported	RR 1.37 95% CI 0.63 to 2.94 For details on quality and methods of studies, see further information on studies	⟷	Not significant
[16] Systematic review	94 children aged 4 to 11 years Data from 1 RCT	**Composite outcome (tympanogram or audiometry) , over 1 month** with autoinflation using the ear-popper with no autoinflation Absolute results not reported	RR 2.76 95% CI 1.75 to 4.36 For details on quality and methods of studies, see further information on studies	●●○	Autoinflation using the ear-popper
[16] Systematic review	94 children aged 4 to 11 years Data from 1 RCT	**Pure tone audiometry threshold** with autoinflation using the ear-popper with no autoinflation Absolute results not reported	Mean difference 14.30 95% CI 8.80 to 19.80 For details on quality and methods of studies, see further information on studies	○○○	Autoinflation using the ear-popper

Developmental and behavioural outcomes

No data from the following reference on this outcome. [15] [16]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[16] Systematic review	People (predominantly children) with otitis media with effusion (OME)	**Adverse effects** with autoinflation with no autoinflation Absolute results not reported The review reported that none of the included RCTs found significant differences in adverse effects between autoinflation and no autoinflation			

No data from the following reference on this outcome. [15]

Further information on studies

[15] One RCT was unpublished, and children in this RCT also had myringotomy (further details not reported by the review). The review noted that methods varied between RCTs (e.g., selection criteria [whether by tympanometry, audiometry, otoscopy], unilateral or bilateral disease, level of data analysis [by child or by ear]) and all were unblinded.

[16] The review noted that follow-up in the RCTs was short, and that none of the RCTs were of high quality. In one RCT using the Otovent device, 12% of children aged 3 to 10 years were unable to use the balloon. [17] The adherence level in one RCT using the ear-popper (97.5%) [19] is not likely to be achieved in practice.

Comment: The studies conducted to date are small, carried out in selected populations, and had methodological problems (e.g., different devices, selection criteria, duration of treatment, outcome measures), and so the data are suggestive rather than conclusive.

Clinical guide:
Autoinflation may be used as a short-term measure – but its short- and long-term efficacy is unknown. Empirical use of autoinflation is reasonable, especially in older children, because it is associated with minimal adverse effects.

OPTION ANTIBIOTICS (ORAL)

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Oral antibiotics may be of no benefit in OME, and can cause adverse effects.
- Antibiotics can cause adverse effects (such as nausea, vomiting, and diarrhoea) in up to one third of children with OME.

Benefits and harms

Antibiotics versus placebo:

We found one systematic review (search date 1997, 8 RCTs, 1292 children with otitis media with effusion [OME], age range not reported), [20] which compared antibiotics versus placebo. We found one further systematic review (search date 1992, 10 RCTs, 1041 children with OME, age range not reported) that reported on adverse effects of antibiotics. [14] The review gave no comparative data and so is reported in the comments section.

Symptom improvement

Antibiotics compared with placebo Antibiotics may be no more effective than placebo at increasing the proportion of children with cure (not further defined) at 2 to 5 weeks (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Cure rate					
[20] Systematic review	1292 children with otitis media with effusion (OME), age range not reported 8 RCTs in this analysis	**Cure rate , 2 to 5 weeks** 179/813 (22%) with antibiotics 85/479 (18%) with placebo	ARI of cure: +4.3% 95% CI –0.1% to +8.6%	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [20]

Adverse effects

No data from the following reference on this outcome. [20]

Antibiotics plus oral corticosteroids versus antibiotics alone:

We found one systematic review (search date 2006, 5 RCTs, 418 children) comparing antibiotic (cefixime, amoxicillin, or sulfafurazole) plus oral corticosteroid (betamethasone or prednisolone) versus antibiotic alone. [21] We found one further systematic review (search date 1992, 10 RCTs, 1041 children with OME, age range not reported) that reported on adverse effects of antibiotics. [14] The review gave no comparative data and so is reported in the comments section.

Symptom improvement

Antibiotics alone compared with oral corticosteroids plus antibiotics Antibiotics alone may be less effective than antibiotics plus oral corticosteroids at decreasing the proportion of children with persistence of effusion at 2 weeks, but we don't know about longer than 2 weeks (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Persistent otitis media with effusion					
[21] Systematic review	418 children 5 RCTs in this analysis	**Rate of persisting otitis media effusion , 2 weeks** 112/214 (52%) with antibiotics plus oral corticosteroid 153/204 (75%) with antibiotic alone Longer-term effects were not sufficiently recorded for inclusion	OR (for non-clearance *v* antibiotic alone) 0.37 95% CI 0.25 to 0.56 Significant statistical heterogeneity among studies (P <0.01); see further information on studies	●●○	Antibiotics plus oral corticosteroid

Developmental and behavioural outcomes

No data from the following reference on this outcome. [21]

Adverse effects

No data from the following reference on this outcome. [21]

Antibiotics plus intranasal corticosteroids versus placebo plus antibiotics:

See option on intranasal corticosteroids, p 9 .

Further information on studies

[21] The trials included in the review were small and showed significant heterogeneity (P <0.01). Use of secondary care populations weakens the applicability of results to primary care.

Comment: **Adverse effects**

One review (search date 1992, 10 RCTs, 1041 children with otitis media with effusion [OME], age range not reported) found that adverse events were frequent with antibiotics. [14] The review reported that amoxicillin was associated with diarrhoea (reported in 20–30% of children) and rash (reported in 3–5% of children). For amoxicillin–clavulanic acid (co-amoxiclav), diarrhoea was reported in 9%, nausea and vomiting in 4%, and skin rashes and urticaria in 3% of children. [14] However, the review included RCTs that were heterogeneous in study design, and was criticised by another review for pooling data from studies with and without placebo controls, which introduced a significant bias toward antibiotic efficacy. [20] For antibiotics in general, nausea and vomiting, diarrhoea, or both have been reported in 2% to 32% of children, and cutaneous reactions in less than 5%. [22] Adherence to long courses of antibiotics is poor. Prescribing antibiotics for minor illness has been reported to encourage further consultations [23] and increase antibiotic resistance. [24]

OPTION CORTICOSTEROIDS (ORAL)

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Oral corticosteroids are unlikely to improve symptoms in OME, and can cause growth retardation.

Benefits and harms

Oral corticosteroids versus placebo:

We found one systematic review (search date 2006, 11 RCTs, 862 children in secondary care and selected [air force base] settings), which identified three RCTs comparing oral corticosteroids versus placebo. [21]

Symptom improvement

Oral corticosteroids compared with placebo Oral corticosteroids may be more effective than placebo at increasing the proportion of children with clearance of effusion at 2 weeks, but we don't know about longer than 2 weeks (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Persistent otitis media with effusion					
[21] Systematic review	108 children in secondary care and selected (air force base) settings 3 RCTs in this analysis	**Rate of persisting otitis media with effusion (OME) , 2 weeks** 42/56 (75%) with oral corticosteroid (either prednisolone or dexamethasone) 49/52 (94%) with placebo Effusion was assessed clinically by pneumatic otoscopy, tympanometry, and audiometry after 7 to 14 days of treatment Longer-term effects were not sufficiently recorded for inclusion	OR (for clearance with oral corticosteroids *v* placebo) 0.22 95% CI 0.08 to 0.63	●●○	Oral corticosteroids

Developmental and behavioural outcomes

No data from the following reference on this outcome. [21]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[21] Systematic review	Children with otitis media with effusion (OME) in secondary care and selected [air force base] settings	**Adverse effects** with corticosteroids with placebo Six RCTs in the review found no severe or lasting adverse effects of corticosteroids. The other RCTs mentioned that mild possible adverse effects might include vomiting, diarrhoea, dermatitis, transient nasal stinging, and epistaxis			

Oral corticosteroids plus antibiotic versus oral antibiotics alone:

See option on antibiotics, p 6 .

Further information on studies

Comment: One systematic review in children with cystic fibrosis has found that long-term treatment with oral corticosteroids was associated with growth retardation compared with placebo. [25]

OPTION CORTICOSTEROIDS (INTRANASAL)

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Intranasal corticosteroids are unlikely to be beneficial at reducing effusion in children with bilateral otitis media with effusion.

Benefits and harms

Intranasal corticosteroids versus placebo:

We found one systematic review (search date 2006, 11 RCTs, 862 children in secondary care and selected [air force base] settings), which identified one RCT comparing intranasal corticosteroids versus placebo. [21] We found one subsequent RCT. [26]

Symptom improvement

Intranasal corticosteroids compared with placebo Intranasal corticosteroids may be no more effective than placebo at increasing resolution of otitis media with effusion (OME) in at least one ear (assessed by tympanometry) at 1 to 3 months in children aged 4 to 11 years with bilateral OME, or in reducing persistence of effusion at 3 weeks in children in a secondary care setting (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Rate of otitis media with effusion					
[27] RCT	45 children with otitis media with effusion (OME) in secondary care and selected (air force base) settings	**Persistence of effusion , 3 weeks** with intranasal dexamethasone with placebo Absolute results not reported	OR 2.12 95% CI 0.65 to 6.90	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
	In review [21]				
[26] RCT	217 children aged 4 to 11 years with bilateral OME (tympanometry type B/B or B/C2) See further information on studies for description of tympanometric classifications	**Resolution of OME in at least one ear as assessed by tympanometry , 1 month** 39/96 (41%) with intranasal mometasone 44/98 (45%) with placebo nasal spray Tympanomic criteria was at least one ear with type A or C1 tympanogram	RR 0.91 95% CI 0.65 to 1.25 P = 0.55 The RCT may have been underpowered to detect a clinically significant difference (see further information on studies)	⟷	Not significant
[26] RCT	217 children aged 4 to 11 years with bilateral OME (tympanometry type B/B or B/C2) See further information on studies for description of tympanometric classifications	**Resolution of otitis media in at least one ear as assessed by tympananometry , 3 months** 50/86 (58%) with intranasal mometasone 45/86 (52%) with placebo nasal spray Tympanomic criteria was at least one ear with type A or C1 tympanogram	RR 1.11 95% CI 0.85 to 1.46 P = 0.44 The RCT may have been underpowered to detect a clinically significant difference (see further information on studies)	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [21]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
General adverse effects					
[21] Systematic review	Children with otitis media with effusion (OME) in secondary care and selected (air force base) settings	**Adverse effects** with corticosteroids with placebo Six RCTs in the review found no severe or lasting adverse effects of corticosteroids (includes oral corticosteroids). The other RCTs mentioned that mild possible adverse effects might include vomiting, diarrhoea, dermatitis, transient nasal stinging, and epistaxis			
Nasal adverse effects					
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Stinging in nose , 1 month** 9/96 (9%) with intranasal corticosteroids 10/102 (10%) with placebo	RR 0.96 95% CI 0.41 to 2.25 P = 0.92	⟷	Not significant
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Stinging in nose , 3 months** 9/85 (11%) with intranasal corticosteroids 9/85 (11%) with placebo	RR 1.00 95% CI 0.42 to 2.40 P = 1	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Nosebleed , 1 month** 8/97 (8%) with intranasal corticosteroids 7/101 (7%) with placebo	RR 1.19 95% CI 0.45 to 3.16 P = 0.73	⟷	Not significant
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Nosebleed , 3 months** 10/86 (12%) with intranasal corticosteroids 6/84 (7%) with placebo	RR 1.63 95% CI 0.62 to 4.28 P = 0.32	⟷	Not significant
Cough as an adverse effect					
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Cough , 1 month** 23/97 (24%) with intranasal corticosteroids 19/102 (19%) with placebo	RR 1.27 95% CI 0.74 to 2.19 P = 0.38	⟷	Not significant
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Cough , 3 months** 19/86 (22%) with intranasal corticosteroids 11/83 (13%) with placebo	RR 1.67 95% CI 0.85 to 3.29 P = 0.13	⟷	Not significant
Throat adverse effects					
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Dry throat , 1 month** 13/96 (14%) with intranasal corticosteroids 14/102 (14%) with placebo	RR 0.99 95% CI 0.49 to 1.99 P = 1	⟷	Not significant
[26] RCT	217 children aged 4 to 11 years with bilateral OME	**Dry throat , 3 months** 10/85 (12%) with intranasal corticosteroids 7/83 (8%) with placebo	RR 1.40 95% CI 0.56 to 3.49 P = 0.47	⟷	Not significant

Intranasal corticosteroids plus oral antibiotics versus placebo plus oral antibiotics:

We found one systematic review (search date 2006, 11 RCTs, 862 children in secondary care and selected [air force base] settings), which identified one RCT comparing intranasal corticosteroids plus oral antibiotics versus placebo plus oral antibiotics. [21]

Symptom improvement

Intranasal corticosteroids plus oral antibiotics compared with oral antibiotics alone Intranasal corticosteroids plus oral antibiotics may be more effective than oral antibiotics alone at reducing effusion at 4 to 12 weeks in children aged 3 to 11 years (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Effusion					
[28] RCT	59 children aged 3 to 11 years in secondary care and selected (air force base) settings In review [21]	**Effusions , 4 weeks** with intranasal corticosteroids plus antibiotics with placebo plus antibiotics Absolute results not reported	P <0.005	○○○	Intranasal corticosteroids plus oral antibiotics

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[28] RCT	59 children aged 3 to 11 years in secondary care and selected (air force base) settings In review [21]	**Effusions , 8 weeks** with intranasal corticosteroids plus antibiotics with placebo plus antibiotics Absolute results not reported	P <0.005	○○○	Intranasal corticosteroids plus oral antibiotics
[28] RCT	59 children aged 3 to 11 years in secondary care and selected (air force base) settings In review [21]	**Effusions , 12 weeks** with intranasal corticosteroids plus antibiotics with placebo plus antibiotics Absolute results not reported	P <0.001	○○○	Intranasal corticosteroids plus oral antibiotics

Developmental and behavioural outcomes

No data from the following reference on this outcome. [21]

Adverse effects

No data from the following reference on this outcome. [21]

Further information on studies

[26] **Power** The initial power calculation suggested that 240 children should be recruited. However, only 217 were recruited and so the study was slightly underpowered. However, statistical assessment suggested that further recruitment would be unlikely to reverse the main findings. **Resolution** Resolution was defined as tympanogram type A or C1 in at least one ear (type A and C1 are accepted as normal). The RCT did assess hearing as an outcome, but the measure was felt to be unreliable methodologically. **Generalisability** Children enrolled in the RCT had tympanograms B/B or CB/C2 (positive predictive value for otitis media with effusion [OME], type B = 88%, type C = 54%). The RCT reported that the results should be generalisable to most children seen with OME.

Comment: None.

OPTION ANTIHISTAMINES PLUS ORAL DECONGESTANTS

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Antihistamines plus oral decongestants may be of no benefit in OME, and can cause adverse effects. Antihistamines are associated with hyperactivity, insomnia, drowsiness, behavioural change, blood pressure variability, and seizures. Decongestant nose drops given for 3 weeks or more can lead to iatrogenic rhinitis.

Benefits and harms

Antihistamines plus oral decongestants versus placebo:

We found two systematic reviews (search date 1992, 4 RCTs, 1202 infants and older children, age range not reported; [14] search date 2006, 16 RCTs, 1737 people, predominantly children [29]). Two RCTs were included in both reviews.

Symptom improvement

Antihistamines compared with placebo Antihistamines plus oral decongestants are no more effective than placebo in clearing effusion at 4 weeks and 12 weeks (high-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Effusion clearance/persistence					
[14] Systematic review	1202 infants and older children, age range not reported 4 RCTs in this analysis	**Effusion clearance rate (as assessed by history, otoscopy, and tympanometry) , 4 weeks** with antihistamines plus oral decongestants with placebo Absolute results not reported	Mean difference –0.9% 95% CI –3.6% to +5.4% For details of heterogeneity of population and generalisability of results, see further information on studies	⟷	Not significant
[29] Systematic review	901 people (predominantly children) 4 RCTs in this analysis	**Effusion persistence , 4 weeks** 334/457 (73%) with antihistamines plus decongestant 337/444 (76%) with placebo	RR 0.97 95% CI 0.89 to 1.04	⟷	Not significant
[29] Systematic review	158 people (predominantly children) 3 RCTs in this analysis	**Effusion persistence , 12 weeks** 51/81 (63%) with antihistamine plus decongestant 45/77 (58%) with placebo	RR 1.09 95% CI 0.85 to 1.40	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [14] [29]

Adverse effects

Antihistamines plus oral decongestants compared with placebo Antihistamines plus oral decongestants are associated with an increase in adverse effects compared with placebo at 4 weeks (high-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[29] Systematic review	972 people (predominantly children) 5 RCTs in this analysis	**Adverse effects , 4 weeks** 90/487 (18%) with antihistamine plus decongestant 35/485 (7%) with placebo	RR 2.54 95% CI 1.76 to 3.67	●●○	Placebo
[14] Systematic review	Infants and older children with otitis media with effusion (OME), age range not reported	**Adverse effects** with antihistamines with Absolute results not reported Adverse effects of antihistamines include hyperactivity, insomnia, drowsiness, behavioural change, blood pressure variability, and seizures			

Further information on studies

[14] The RCTs in the review included clinically heterogeneous groups (e.g., infants and older children) and selected individuals from ambulatory care or waiting lists. However, the review suggested that the evidence could be generalised to a child of any age.

Comment: One RCT in healthy volunteers found that decongestant nose drops given for 3 weeks or more led to iatrogenic rhinitis. [30]

OPTION MUCOLYTICS

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Mucolytics may be of no benefit in OME.

Benefits and harms

Mucolytics versus placebo or no treatment:

We found one systematic review (search date 1993, 6 RCTs, 428 children aged 3–11 years, 2 adults). [31] We found three small additional RCTs (155 children and 195 ears) comparing another mucolytic (bromhexine) versus placebo, which found inconclusive results. [32] [33] [34]

Symptom improvement

Mucolytics compared with placebo or no active treatment We don't know whether mucolytics (bromhexine, carbocisteine, or carbocisteine lysine) are more effective than placebo or no treatment at increasing the proportion of children with complete resolution (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution of otitis media with effusion (OME)					
[31] Systematic review	313 children 6 RCTs in this analysis	**Complete resolution , 15 to 90 days** 80/161 (50%) with mucolytics (carbocisteine or carbocisteine lysine, or both) 54/152 (36%) with placebo	OR 2.25 95% CI 0.97 to 5.22 For details on heterogeneity and generalisability of results, see further information on studies	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [31]

Adverse effects

No data from the following reference on this outcome. [31] [32] [33] [34]

Further information on studies

[31] The RCTs in the review were heterogeneous in their clinical outcomes and treatment duration. However, the RCTs combined in the meta-analysis were homogeneous regarding dosage and outcome

Comment: None.

OPTION AUTOINFLATION USING NON-PURPOSE-MANUFACTURED DEVICES

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Autoinflation with devices other than a purpose-manufactured nasal balloon has not been shown to be effective.
- Children may find autoinflation difficult.

Benefits and harms

Autoinflation using non-purpose-manufactured devices versus no treatment:

We found two systematic reviews (search date not reported [15] and search date 2006 [16]) comparing autoinflation versus no treatment. Both reviews included RCTs that used non-purpose-manufactured devices and purpose-manufactured devices. We have only reported data on non-purpose-manufactured devices in this option. The reviews identified three RCTs between them, and two RCTs were common to both reviews. However, the reviews differed in the analysis they undertook and the outcomes they reported. The first review included three RCTs, which reported results by child or by ear. [15] It did not statistically analyse the autoinflation devices as a group versus no treatment. The second review included two RCTs identified by the first review, and excluded the RCT using a modified anaesthetic mask because of weak methods (see comment below). [16] The second review did not pool data for the two remaining RCTs. It performed a different analysis to the first review on the basis of intention to treat and by calculating an adjusted risk ratio, to correct for the fact that one of the RCTs had reported by ears but had randomised by children. [16]

Symptom improvement

Autoinflation using non-purpose-manufactured devices compared with no treatment Autoinflation using non-purpose-manufactured devices (a carnival blower or a modified anaesthetic mask) may be no more effective than no treatment at improving outcomes (measured by tympanogram or audiometry) at 3 to 6 weeks (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Cure					
[15] Systematic review	Children with otitis media with effusion (OME; absolute numbers of children in RCT not reported) Data from 1 RCT	**Cure** with modified anaesthetic mask with no treatment Absolute results not reported The RCT reported "absence of effusion" as an outcome (not further defined)	OR presented graphically P value not reported For details on quality and methods of studies, see further information on studies	⟷	Not significant
[15] Systematic review	Children with OME (absolute numbers of children in each RCT not reported) 2 RCTs in this analysis	**Cure** with toy balloons (not further defined in the review) with no treatment Absolute results not reported The two RCTs measured improvement in hearing (not further defined)	ORs for each RCT presented graphically P values not reported For details on quality and methods of studies, see further information on studies	⟷	Not significant
Hearing, effusion, or both					
[16] Systematic review	40 children with unilateral or bilateral disease aged 3 to 10 years Data from 1 RCT	**Tympanogram improvement , 3 weeks** with autoinflation using a carnival balloon with no treatment Absolute results not reported	RR 0.27 95% CI 0.07 to 1.05 Results favoured the no intervention group For details on quality and methods of studies, see further information on studies	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[16] Systematic review	40 children with unilateral or bilateral disease aged 3 to 10 years Data from 1 RCT	**Improvement of pure tone audiogram (10 dB or greater improvement) , 3 weeks** with autoinflation using a carnival balloon with no treatment Absolute results not reported	RR 0.36 95% CI 0.09 to 1.46 Results favoured the no intervention group For details on quality and methods of studies, see further information on studies	⟷	Not significant
[16] Systematic review	85 children with bilateral disease, aged 3 to 12 years Data from 1 RCT	**Pure tone audiometry threshold , 6 weeks** with autoinflation using a carnival blower with no treatment Absolute results not reported	Mean difference +0.07 95% CI –3.44 to +3.58 For details on quality and methods of studies, see further information on studies	⟷	Not significant
[16] Systematic review	85 children with bilateral disease, aged 3 to 12 years Data from 1 RCT	**Mean change in middle-ear pressure (a tympanometry outcome) , 6 weeks** with autoinflation using a carnival blower with no treatment Absolute results not reported	Reported as not significant P value not reported For details on quality and methods of studies, see further information on studies	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [15] [16]

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[16] Systematic review	People (predominantly children) with otitis media with effusion (OME)	**Adverse effects** with autoinflation with no autoinflation Absolute results not reported The review reported that none of the included RCTs found significant differences in adverse effects between autoinflation and no autoinflation			

Further information on studies

[15] The review noted that methods varied between RCTs (e.g., selection criteria, unilateral or bilateral disease, level of data analysis [by child or by ear]), all were unblinded, and that one RCT did not provide direct data on the numbers who improved in treatment and control groups.

[16] It reported that one of the RCTs (40 children) did not report a comparison of groups at baseline, follow-up was short in both RCTs, and that neither RCT was deemed to be of high quality.

Comment: The second review also found one further RCT but this was predominantly in adults (age 16–75 years), so we have not reported it further here. [16] The eustachian tubes can be inflated by several methods, including blowing up a balloon through a plastic tube inserted into the nostril. The studies conducted to date have had methodological problems (e.g., different devices, selection criteria, duration of treatment, outcome measures), and so the data are suggestive rather than conclusive.

Clinical guide:
Autoinflation may be used as a short-term measure – its long-term efficacy is unknown. Empirical use of autoinflation is reasonable, especially in older children, because it is associated with minimal adverse effects.

OPTION ADENOIDECTOMY

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Adenoidectomy may improve hearing when performed with tympanostomy, but the clinical importance of the improvement is unclear.

Benefits and harms

Adenoidectomy versus no treatment:

We found two systematic reviews (search dates 1992 [6] and 2009 [35]), which identified the same three RCTs. All were multiple armed and all children in the studies had bilateral otitis media with effusion. We also found a report of a 5-year follow-up from one of the RCTs identified by the systematic review. The second review did not report results for this comparison. [35] The first review did not pool data for this comparison and so we have therefore reported data from the three identified RCTs separately as reported in the review.

Symptom improvement

Adenoidectomy compared with no treatment Adenoidectomy may be more effective than no treatment at reducing the median duration of otitis media with effusion at 5 years' follow-up, but we don't know whether adenoidectomy is more effective than no treatment in improving hearing at 6 to 12 months (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hearing					
[6] Systematic review **3-armed trial**	79 ears Data from 1 RCT The remaining arm evaluated adeno-tonsillectomy All children received unilateral myringotomy plus grommet insertion before randomisation; see further information on studies for full details	**Hearing , 6 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 16.1 dB Reported as significant 95% CI presented graphically	○○○	Adenoidectomy
[6] Systematic review **3-armed trial**	79 ears Data from 1 RCT The remaining arm evaluated adeno-tonsillectomy All children received unilateral myringotomy plus grommet insertion before randomisation; see further information on studies for full details	**Hearing , 12 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 7.7 dB Reported as significant 95% CI presented graphically	○○○	Adenoidectomy

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[6] Systematic review **4-armed trial**	74 ears Data from 1 RCT Children were randomised to receive adenoidectomy or no treatment. They were then randomised within the group to receive myringotomy in one ear and myringotomy and grommet in the other ear, or to receive no treatment in one ear and myringotomy and grommet in the other ear	**Hearing , 6 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 4.3 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review **4-armed trial**	74 ears Data from 1 RCT Children were randomised to receive adenoidectomy or no treatment. They were then randomised within the group to receive myringotomy in one ear and myringotomy and grommet in the other ear, or to receive no treatment in one ear and myringotomy and grommet in the other ear	**Hearing , 12 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 4.3 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review **4-armed trial**	72 ears Data from 1 RCT Children were randomised to receive adenoidectomy or no treatment. The ears in each child were then randomly allocated to have a tympanostomy tube inserted or not	**Hearing , 6 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 3.1 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review	72 ears Data from 1 RCT Children were randomised to receive adenoidectomy or no treatment. The ears in each child were then randomly allocated to have a tympanostomy tube inserted or not	**Hearing , 12 months** with adenoidectomy with no treatment Absolute results not reported	Mean difference 2.8 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
Duration of otitis media with effusion (OME)					
[36]	79 ears	**Median duration of otitis media with effusion , 5 years**	P = 0.001	○○○	Adenoidectomy

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
RCT Further report of RCT identified by review [6]		4.0 years with adenoidectomy 7.8 years with no treatment			

Developmental and behavioural outcomes

No data from the following reference on this outcome. [6] [36]

Adverse effects

No data from the following reference on this outcome. [6] [36]

Ventilation tube plus adenoidectomy versus ventilation tube alone:

See option on ventilation tubes plus adenoidectomy, p 22 .

Further information on studies

Adenoidectomy versus no treatment In the three-armed RCT, all children received unilateral myringotomy and grommet insertion and were then randomised to adenotonsillectomy, adenoidectomy, or no treatment.

Comment: **Clinical guide:**
Resolution after surgery takes longer in younger children and in those whose parents smoke, irrespective of treatment. [37]

OPTION VENTILATION TUBES

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Ventilation tubes may improve short-term outcomes, but the clinical effect size is small. They may also increase the risk of tympanic membrane abnormalities.
- Ventilation tubes improve hearing for the first 2 years, but have no longer-term benefit, and may not improve cognition or language development.

Benefits and harms

Ventilation tubes versus no ventilation tube/watchful waiting:

We found one systematic review (search date 2003, 11 RCTs) comparing unilateral or bilateral ventilation tubes versus no ventilation tubes or watchful waiting (see comment). [38]

Symptom improvement

Unilateral ventilation tubes compared with no treatment Unilateral ventilation tubes may be more effective than no ventilation tube at improving hearing at 2 years, but we don't know about at 5 years. Bilateral ventilation tubes may

be more effective than no ventilation tubes at improving hearing at up to 6 months, and at reducing the proportion of time spent with effusion in the year after surgery (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hearing					
[38] Systematic review	142 ears 2 RCTs in this analysis	**Hearing , 1 to 3 months** with unilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD 7.5 dB 95% CI 4.2 dB to 10.8 dB For details on study quality and heterogeneity, see further information on studies	○○○	Unilateral ventilation tubes
[38] Systematic review	432 ears 5 RCTs in this analysis	**Hearing , 4 to 6 months** with unilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD 9.4 dB 95% CI 4.3 dB to 14.5 dB For details on study quality and heterogeneity, see further information on studies	○○○	Unilateral ventilation tubes
[38] Systematic review	458 ears 5 RCTs in this analysis	**Hearing , 7 to 12 months** with unilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD 6.1 dB 95% CI 3.0 dB to 9.2 dB For details on study quality and heterogeneity, see further information on studies	○○○	Unilateral ventilation tubes
[38] Systematic review	282 ears 3 RCTs in this analysis	**Hearing , 2 years** with unilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD 4.1 dB 95% CI 1.7 dB to 6.4 dB For details on study quality and heterogeneity, see further information on studies	○○○	Unilateral ventilation tubes
[38] Systematic review	195 ears 2 RCTs in this analysis	**Hearing , 5 years** with unilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD +1.7 dB 95% CI +3.9 dB to –0.6 dB For details on study quality and heterogeneity, see further information on studies	⟷	Not significant
[38] Systematic review	25 children Data from 1 RCT	**Hearing , 1 to 3 months** with bilateral ventilation tubes with no ventilation/watchful waiting Absolute results not reported	WMD 9.8 dB 95% CI 2.2 dB to 17.4 dB For details on study quality and heterogeneity, see further information on studies	○○○	Bilateral ventilation tubes
[38] Systematic review	212 children 2 RCTs in this analysis	**Hearing , 4 to 6 months** with bilateral ventilation with no ventilation/watchful waiting Absolute results not reported	WMD 4.2 dB 95% CI 0.7 dB to 7.8 dB For details on study quality and heterogeneity, see further information on studies	○○○	Bilateral ventilation tubes
Effusion					
[38] Systematic review	574 children 3 RCTs in this analysis	**Proportion of time spent with effusion , 1 year after surgery** with bilateral ventilation tubes with no ventilation/watchful waiting Absolute results not reported	32% reduction with bilateral ventilation tubes 95% CI 17% to 48% For details on study quality and heterogeneity, see further information on studies	○○○	Bilateral ventilation tubes

Developmental and behavioural outcomes

Bilateral ventilation tubes compared with no treatment We don't know whether bilateral ventilation tubes are more effective than no ventilation tubes at improving language comprehension or expressive language at 6 to 9 months or cognition at up to 22 months (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Language					
[38] Systematic review	394 children 3 RCTs in this analysis	**Language comprehension , 6 to 9 months** with bilateral ventilation with no ventilation/watchful waiting Absolute results not reported	SMD +0.09 95% CI –0.21 to +0.39 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant
[38] Systematic review	393 children 3 RCTs in this analysis	**Expressive language , 6 to 9 months** with bilateral ventilation with no ventilation/watchful waiting Absolute results not reported	SMD +0.02 95% CI –0.45 to +0.49 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant
Cognition					
[38] Systematic review	559 children 2 RCTs in this analysis	**Cognition , up to 22 months** with with bilateral ventilation with with no ventilation/watchful waiting Absolute results not reported	SMD –0.03 95% CI –0.31 to +0.26 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant

Adverse effects

Ventilation tubes compared with no ventilation tube/watchful waiting Ventilation tubes may be associated with an increased risk of tympanosclerosis at 1 year and tympanic membrane abnormalities at 3 to 4 years compared with no ventilation tube, but we don't know about retraction or atrophy, perforation, or otorrhoea at up to 1 year (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[38] Systematic review	610 people or ears (population not defined) 4 RCTs in this analysis	**Tympanosclerosis , 1 year** 108/305 (35%) with ventilation tube 3/305 (1%) with no ventilation tube	RR 25.9 95% CI 9.0 to 74.9 For details on study quality and heterogeneity, see further information on studies	●●●	No ventilation tube
[38] Systematic review	562 people or ears (population not defined) Data from 1 RCT	**Tympanic membrane abnormalities , 3 to 4 years** 185/294 (63%) with ventilation tube 93/268 (35%) with no ventilation tube	RR 1.8 95% CI 1.5 to 2.2 For details on study quality and heterogeneity, see further information on studies	●○○	No ventilation tube
[38] Systematic review	218 people or ears (population not defined) 2 RCTs in this analysis	**Retraction or atrophy , up to 1 year** 15/109 (14%) with ventilation tube 10/109 (9%) with no ventilation tube	RR 1.5 95% CI 0.7 to 3.1 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[38] Systematic review	218 people or ears (population not defined) 2 RCTs in this analysis	**Perforation , up to 1 year** 1/109 (0.9%) with ventilation tube 0/109 (0%) with no ventilation tube	RR 3.0 95% CI 0.1 to 72.1 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant
[38] Systematic review	108 people or ears (population not defined) 2 RCTs in this analysis	**Otorrhoea , up to 1 year** 11/54 (20%) with ventilation tube 4/54 (7%) with no ventilation tube	RR 2.8 95% CI 0.9 to 8.1 For details on study quality and heterogeneity, see further information on studies	⟷	Not significant

Ventilation tubes versus no ventilation tube/watchful waiting:

See option on ventilation tubes plus adenoidectomy, p 22 .

Further information on studies

[38] Randomisation in the unilateral ventilation tube trials was by ear; the ear that did not receive a ventilation tube received either no surgery or myringotomy alone. Myringotomy is usually performed together with ventilation tube insertion but is not effective on its own. [6] None of the children included in the analyses of bilateral ventilation tubes received adenoidectomy. Some of the meta-analyses in the review showed significant statistical heterogeneity, but this was unlikely to lead to mistaken reporting of benefit or lack thereof in most cases, because all the RCTs tended to show the same trend in their results (i.e., favouring either treatment or control). Developmental outcomes used in the RCTs may have been relatively crude, and appropriate "softer" outcomes, along with speech-in-noise and binaural tests, have been recommended. The clinical significance of the hearing improvements seen in the review was variable. None of the RCTs in the review was placebo controlled, although some RCTs were conducted in children who had received ventilation tubes in one ear only, and in these cases the operated and non-operated ears were compared with each other. The validity of this approach is uncertain, and the more recent studies have randomised children rather than ears.

Comment:

Reviews have found that the rate of otorrhoea after swimming in children with ventilation tubes is low, particularly in non-divers, and protection to the ear confers no proven benefit. [6] [39]

Clinical guide: About half of children who have ventilation tubes inserted will have reinsertion within 5 years. [40] Resolution after surgery takes longer in younger children and in those whose parents smoke, irrespective of treatment. [37]

OPTION VENTILATION TUBES PLUS ADENOIDECTOMY

- For GRADE evaluation of interventions for Otitis media with effusion in children, see table, p 29 .
- Combination treatment with ventilation tubes plus adenoidectomy may be more effective than adenoidectomy alone.
- Ventilation tubes may increase the risk of tympanic membrane abnormalities.

Benefits and harms

Ventilation tube plus adenoidectomy versus no treatment:

We found one systematic review (search date 1992, 3 RCTs, number of children not reported). [6] See option on ventilation tubes, p 19 for associated adverse effects.

Symptom improvement

Ventilation tube plus adenoidectomy compared with no treatment Ventilation tube plus adenoidectomy may be more effective than no treatment at improving hearing at 6 months, but we don't know about at 12 months (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hearing					
[6] Systematic review	Children with otitis media with effusion (OME; number of children not reported) 3 RCTs in this analysis	**Hearing , 6 months** with ventilation tube plus adenoidectomy with no treatment Absolute results not reported	Mean difference ranged from about 8 dB to about 20 dB Reported as significant 95% CI presented graphically	○○○	Ventilation tube plus adenoidectomy
[6] Systematic review	Children with OME (number of children not reported) 3 RCTs in this analysis	**Hearing , 12 months** with ventilation tube plus adenoidectomy with no treatment Absolute results not reported	Mean difference ranged from about 2 dB to about 10 dB Reported that only one of the three RCTs found a significant benefit with ventilation tube plus adenoidectomy Mean differences and 95% CIs for each RCT displayed graphically		

Developmental and behavioural outcomes

No data from the following reference on this outcome. [6]

Ventilation tube plus adenoidectomy versus adenoidectomy alone:

We found one systematic review (search date 2003, 8 RCTs). [38] See option on ventilation tubes, p 19 for associated adverse effects.

Symptom improvement

Compared with adenoidectomy alone Ventilation tube plus adenoidectomy may be more effective than adenoidectomy alone at improving hearing at 1 to 12 months, but we don't know about at 2 and 5 years (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Hearing					
[38] Systematic review	472 ears 5 RCTs in this analysis	**Hearing , 1 to 3 months** with ventilation tube plus adenoidectomy with adenoidectomy alone Absolute results not reported	WMD 5.3 dB 95% CI 3.5 dB to 7.1 dB	○○○	Ventilation tube plus adenoidectomy
[38] Systematic review	558 ears 6 RCTs in this analysis	**Hearing , 4 to 6 months** with ventilation tube plus adenoidectomy with adenoidectomy alone Absolute results not reported	WMD 3.7 dB 95% CI 2.0 dB to 5.3 dB	○○○	Ventilation tube plus adenoidectomy
[38] Systematic review	751 ears 7 RCTs in this analysis	**Hearing , 7 to 12 months** with ventilation tube plus adenoidectomy	WMD 1.4 dB 95% CI 0.1 dB to 2.8 dB	○○○	Ventilation tube plus adenoidectomy

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		with adenoidectomy alone Absolute results not reported			
[38] Systematic review	344 ears 3 RCTs in this analysis	**Hearing , 2 years** with ventilation tube plus adenoidectomy with adenoidectomy alone Absolute results not reported	WMD +1.0 dB 95% CI –1.0 dB to +3.0 dB	⟷	Not significant
[38] Systematic review	297 ears 2 RCTs in this analysis	**Hearing , 5 years** with ventilation tube plus adenoidectomy with adenoidectomy alone Absolute results not reported	WMD –0.88 dB 95% CI –4.4 dB to +2.6 dB	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [38]

Ventilation tube plus adenoidectomy versus ventilation tube alone:

We found two systematic reviews (search date 1992 [6] and 2009 [35]). The reviews identified the same 4 RCTs (3 RCTs assessed unilateral ventilation tube and 1 RCT assessed bilateral ventilation tubes) meeting our reporting criteria. However, the reviews carried out different analyses and reported on different outcomes and so we report data from both reviews here. See option on ventilation tubes, p 19 for associated adverse effects.

Symptom improvement

Ventilation tube plus adenoidectomy compared with ventilation tube alone Unilateral ventilation tube plus adenoidectomy may be more effective than unilateral ventilation tube alone at resolving otitis media with effusion (OME) at 6 and 12 months, but we don't know whether bilateral ventilation tubes plus adenoidectomy is more effective than bilateral ventilation tubes alone at reducing OME at 12 to 24 months. We don't know whether ventilation tube plus adenoidectomy is more effective than ventilation tube alone at improving hearing at 6 to 12 months (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Resolution of otitis media with effusion (OME)					
[35] Systematic review	297 children with bilateral OME 3 RCTs in this analysis	**Resolution of OME based on tympanometry , 6 months** 56/144 (39%) with adenoidectomy with unilateral tympanostomy tube 26/153 (17%) with unilateral tympanostomy tube The review reported that the non-operated ear was examined for comparison	Risk difference 0.22 95% CI 0.12 to 0.32	○○○	Adenoidectomy plus unilateral tympanostomy tube
[35] Systematic review	298 children with bilateral OME 3 RCTs in this analysis	**Resolution of OME based on tympanometry , 12 months** 68/143 (48%) with adenoidectomy with unilateral tympanostomy tube	Risk difference 0.29 95% CI 0.19 to 0.39	○○○	Adenoidectomy plus unilateral tympanostomy tube

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		31/155 (20%) with unilateral tympanostomy tube The non-operated ear was examined for comparison			
[35] Systematic review	153 children with bilateral OME 2 RCTs in this analysis	**Resolution of OME based on otoscopy , 6 months** 35/72 (49%) with adenoidectomy with unilateral tympanostomy tube 17/81 (21%) with unilateral tympanostomy tube The non-operated ear was examined for comparison	Risk difference 0.27 95% CI 0.13 to 0.42	○○○	Adenoidectomy plus unilateral tympanostomy tube
[41] RCT **3-armed trial**	169 children aged 2 to 14 years with persistent OME In review [38] [35] The remaining arm evaluated no treatment	**Resolution of OME , 12 months** 82% of ears with adenoidectomy with bilateral tympanostomy tubes 77% of ears with bilateral tympanostomy tubes Absolute numbers not reported 100 children in this analysis (50 children in the adenoidectomy plus bilateral tympanostomy tubes group, and 50 children in the bilateral tympanostomy tubes alone group)	Risk difference –5% 95% CI –8% to + 17%	⟷	Not significant
[41] RCT **3-armed trial**	169 children aged 2 to 14 years with persistent OME In review [38] [35] The remaining arm evaluated no treatment	**Resolution of OME , 24 months** 85% of ears with adenoidectomy with bilateral tympanostomy tubes 82% of ears with bilateral tympanostomy tubes Absolute numbers not reported 100 children in this analysis (50 children in the adenoidectomy plus bilateral tympanostomy tubes group, and 50 children in the bilateral tympanostomy tubes alone group)	Risk difference –3% 95% CI –10% to +15%	⟷	Not significant
Hearing					
[6] Systematic review	74 ears 3 RCTs in this analysis	**Hearing , 6 months** with with ventilation tube plus adenoidectomy with with ventilation tube alone Absolute results not reported	Mean difference 2.1 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review	74 ears 3 RCTs in this analysis	**Hearing , 12 months** with with ventilation tube plus adenoidectomy with ventilation tube alone Absolute results not reported	Mean difference 2.4 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review	79 ears 3 RCTs in this analysis	**Hearing , 6 months** with ventilation tube plus adenoidectomy with ventilation tube alone Absolute results not reported	Mean difference 1.1 dB Reported as not significant 95% CI presented graphically	⟷	Not significant

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
[6] Systematic review	79 ears	**Hearing , 12 months** with ventilation tube plus adenoidectomy with ventilation tube alone Absolute results reported graphically	Mean difference 1.1 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review	72 ears	**Hearing , 6 months** with ventilation tube plus adenoidectomy with ventilation tube alone Absolute results not reported	Mean difference 2.6 dB Reported as not significant 95% CI presented graphically	⟷	Not significant
[6] Systematic review	72 ears	**Hearing , 12 months** with ventilation tube plus adenoidectomy with ventilation tube alone Absolute results not reported	Mean difference 1.7 dB Reported as not significant 95% CI presented graphically	⟷	Not significant

Developmental and behavioural outcomes

No data from the following reference on this outcome. [6]

Adverse effects

No data from the following reference on this outcome. [6]

Further information on studies

Comment: **Clinical guide:**
Resolution after surgery takes longer in younger children and in those whose parents smoke, irrespective of treatment. [37] About half of children who have ventilation tubes inserted will have reinsertion within 5 years. [40] Myringotomy is usually performed together with ventilation tube insertion but is not effective on its own. [6]

GLOSSARY

High-quality evidence Further research is very unlikely to change our confidence in the estimate of effect.

Low-quality evidence Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Moderate-quality evidence Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Very low-quality evidence Any estimate of effect is very uncertain.

SUBSTANTIVE CHANGES

Adenoidectomy One systematic review added (search date 2009). [35] The review compared adenoidectomy versus no treatment and reported three previously identified RCTs already reported in this *Clinical Evidence* review. No new data added. Categorisation unchanged (Unknown effectiveness).

Ventilation tubes plus adenoidectomy One review added [35] at update found that adenoidectomy plus unilateral ventilation tubes improved rate of resolution of otitis media with effusion at 6 and 12 months compared with unilateral ventilation tubes alone. Categorisation unchanged (Trade-off between benefits and harms).

Corticosteroids (intranasal) versus placebo One RCT added, [26] which compared intranasal mometasone versus placebo in 217 children aged 4 to 11 years. The RCT found no significant difference between intranasal mometasone and placebo in resolution of otitis media in at least one ear at 1 or 3 months as assessed by tympanometry. The sample was from primary care and so generalisable to most children. The cases were bilateral, but the histories were typical of those presenting in primary care. Categorisation changed from Unknown effectiveness to Unlikely to be beneficial.

Autoinflation using purpose-manufactured devices Existing evidence reassessed. There is insufficient evidence to draw conclusions on the effectiveness of autoinflation using purpose-manufactured devices. Categorisation changed from Likely to be beneficial to Unknown effectiveness.

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Otitis media with effusion in children

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Competing interests: IW is the first author of a number of the studies included in this review.

Disclaimer

GRADE **Evaluation of interventions for Otitis media with effusion in children.**

Important outcomes	Adverse effects, Developmental and behavioural outcomes, Symptom improvement								
Studies (Participants)	Outcome	Comparison	Type of evidence	Quality	Consistency	Directness	Effect size	GRADE	Comment
What are the effects of pharmacological, mechanical, and surgical interventions to treat otitis media with effusion in children?									
3 (at least 279) [15] [16]	Symptom improvement	Autoinflation using purpose-manufactured devices versus no treatment	4	–3	–1	–2	0	Very low	Quality points deducted for incomplete reporting of results, randomising by children but analysing by ear, and lack of blinding. Consistency point deducted for inconsistent results at different time points or by outcome. Directness points deducted for use of composite outcomes and inclusion of co-intervention (myringotomy)
8 (1292) [20]	Symptom improvement	Antibiotics versus placebo	4	–1	0	–1	0	Low	Quality point deducted for short follow-up. Directness point deducted for unclear definition of outcome
5 (418) [21]	Symptom improvement	Antibiotics plus oral corticosteroids versus antibiotics alone	4	–1	–1	–1	+1	Low	Quality point deducted for short follow-up. Consistency point deducted for heterogeneity between RCTs. Directness point deducted for uncertainty about generalisability of results. Effect-size point added for OR <0.5
3 (108) [21]	Symptom improvement	Oral corticosteroids versus placebo	4	–2	0	–1	+1	Low	Quality points deducted for sparse data and short follow-up. Directness point deducted for narrow population. Effect-size point added for OR <0.5
2 (262) [26] [27]	Symptom improvement	Intranasal corticosteroids versus placebo	4	–1	0	0	0	Moderate	Quality point deducted for incomplete reporting of results in one RCT
1 (59) [21]	Symptom improvement	Intranasal corticosteroids plus oral antibiotics versus placebo plus oral antibiotics	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and incomplete reporting of results. Directness point deducted for narrow population
18 (at least 1737) [14] [29]	Symptom improvement	Antihistamines plus oral decongestants versus placebo	4	0	0	0	0	High	
5 (972) [29]	Adverse effects	Antihistamines plus oral decongestants versus placebo	4	0	0	–1	+1	High	Directness point deducted for adverse effects not specified. Effect-size point added for OR >2
9 (583) [31] [32] [33] [34]	Symptom improvement	Mucolytics versus placebo or no treatment	4	–2	0	0	0	Low	Quality points deducted for incomplete reporting of results and unclear outcome measurement
5 (at least 125) [16]	Symptom improvement	Autoinflation using non-purpose-manufactured devices versus no treatment	4	–3	0	–1	0	Very low	Quality points deducted for inclusion of unpublished data, incomplete reporting of results, randomising by children but analysing by ear, and lack of blinding. Directness point deducted for unclear outcome
3 (225) [36] [6]	Symptom improvement	Adenoidectomy versus no treatment	4	–2	–1	0	0	Very low	Quality points deducted for incomplete reporting of results and randomising by ears rather than children. Consistency point deducted for conflicting results
at least 5 (At least 5) [38]	Symptom improvement	Ventilation tubes versus no ventilation tube/watchful waiting	4	–2	–1	0	0	Very low	Quality points deducted for randomising by ears and inclusion of myringotomy in control group. Consistency point deducted for heterogeneity between RCTs

Important outcomes	Adverse effects, Developmental and behavioural outcomes, Symptom improvement								
Studies (Participants)	Outcome	Comparison	Type of evidence	Quality	Consistency	Directness	Effect size	GRADE	Comment
At least 3 (At least 559) [38]	Developmental and behavioural outcomes	Ventilation tubes versus no ventilation tube/watchful waiting	4	–3	–1	0	0	Very low	Quality points deducted for incomplete reporting of results, inclusion of myringotomy in control group, and for unclear validity of outcomes used. Consistency point deducted for heterogeneity between RCTs
At least 4 (at least 610) [38]	Adverse effects	Ventilation tubes versus no ventilation tube/watchful waiting	4	–1	0	–1	0	Low	Quality point deducted for inclusion of myringotomy in control group. Directness point deducted for unclear clinical relevance
3 (not reported) [6]	Symptom improvement	Ventilation tube plus adenoidectomy versus no treatment	4	–1	0	–1	0	Low	Quality point deducted for incomplete reporting of results and incomplete reporting of included population. Directness point deducted for uncertainty of benefit, as the effectiveness is not known and there are no statistical analyses, with a range being reported instead
At least 7 (at least 751 ears) [38]	Symptom improvement	Ventilation tube plus adenoidectomy versus adenoidectomy alone	4	–1	–1	0	0	Low	Quality point deducted for analysing by ears rather than children. Consistency point deducted for inconsistent results at different endpoints
4 (398) [35] [41] [6]	Symptom improvement	Ventilation tube plus adenoidectomy versus ventilation tube alone	4	–2	0	0	0	Low	Quality points deducted for uncertainty over comparison in review and for analysing by ears rather than children for one outcome (hearing)

We initially allocate 4 points to evidence from RCTs, and 2 points to evidence from observational studies. To attain the final GRADE score for a given comparison, points are deducted or added from this initial score based on preset criteria relating to the categories of quality, directness, consistency, and effect size. Quality: based on issues affecting methodological rigour (e.g., incomplete reporting of results, quasi-randomisation, sparse data [<200 people in the analysis]). Consistency: based on similarity of results across studies. Directness: based on generalisability of population or outcomes. Effect size: based on magnitude of effect as measured by statistics such as relative risk, odds ratio, or hazard ratio.