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Main Articles

The natural history of otitis media with effusion – a three-year study of the incidence and prevalence of abnormal tympanograms in four South West Hampshire Infant and First schools

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Abstract

Otitis media with effusion (OME) is both extremely common in young children, and variable in its duration and severity. This study aims to gather and consider new and reliable information about the incidence and prevalence of OME in British school children.

Eight hundred and fifty-six school children aged five to eight years from four South West Hampshire schools were examined over a three-year period by tympanometry, a method used to detect OME (>90 per cent specificity and sensitivity) performed once per school term. Normal ears were recorded in 54.9 per cent of children throughout with 27 per cent recording evidence of effusion. However in only one out of 10 of the affected children did the fluid persist for a year or more. This impressive clearance is due in part to natural resolution, with the intervention of surgery occurring in about one in eight of the children with identified effusions.

OME is more common in five-year-olds with an annual prevalence of 17 per cent compared to six per cent in eight-year-olds and is more common in the winter months. Because of the variability of the condition at least two screenings are recommended as a basis for good management.

Key words: Otitis media with effusion; Acoustic impedance tests; Child; Schools; United Kingdom

Introduction

A knowledge of the natural history of otitis media with effusion (OME) is essential for good management of children thought to be suffering from its effects. However no sizeable descriptive longitudinal studies have been undertaken in Britain. Current knowledge of the epidemiology of OME from British studies is based on either somewhat limited numbers or on cross-sectional designs (Brooks, 1976; Portoian-Schubaiber and Cullinan, 1984; Strachan *et al.*, 1989) or inferred from larger New Zealand (Chalmers *et al.*, 1989), European (Fiellau-Nikolajsen and Lous, 1979; Ingvarsson *et al.*, 1982; Pukander, 1982; Tos, 1984; Zeilhuis *et al.*, 1990), or American studies (Teele *et al.*, 1980; Casselbrant *et al.*, 1985). Translation of data from one country or continent to another carries with it demographic implications with respect to climate, genetic factors and race, type of early schooling, timing and frequency of exposure to respiratory infection and the effects of social mores, etc. This study aims to provide new information on the incidence and prevalence of OME in a population of Southern English school children over time. This information is intended to provide ENT surgeons with complementary knowledge to that obtained from their normal working practice, and describes the history of effusions in a population of five to eight-year-old children, few of whom were actually attending hospital.

The timing of the study examines the secondary rather than the primary incidence peak of OME and in this respect gives information around the mean timing of surgical intervention. The variability of effusions in terms of their persistence can be described in different ways and this study assesses the effects of age and season. It also generally describes these effects in terms of children rather than ears, in contrast with much of the literature, as aetiological factors which operate on one ear will almost certainly operate on the other.

Subjects and methods

Four adjacent Infant and First schools in the South West Hampshire area took part. The school catchment areas were of similar social group mix, predominantly suburban

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TABLE I
PREVALENCE OF B TYMPANOGRAMS BY AGE AND SEASON*

Age in years	Autumn Term % (n)	Spring Term % (n)	Summer Term % (n)	Annual mean
5	13 (413)	20 (470)	17 (480)	17%
6	9 (399)	13 (461)	8 (500)	10%
7	4 (278)	10 (326)	7 (472)	7%
8	0 (34)	6 (139)	6 (226)	6%
All ages	9%	14%	10%	

*n = number of children tested.

and situated within three miles of the coast. Invitation to participate was by letter to the parents of the 1142 children aged between five and eight years attending these schools, including each successive group of school entrants over the three-year study period.

Where no reply was received a second letter was sent. Eight hundred and fifty-six (75 per cent) children were recruited. The main phase of recruitment began in September 1988, and was completed in March 1989. The study finished in the Summer Term of 1991. Children were screened by tympanometry once per term at a four-monthly interval until they left primary school: 4308 screenings were performed on 8616 ears. The mean number of screenings was 5.05 (SD = 2.19) for boys and 5.10 (SD = 2.12) for girls. Seven hundred and twenty children had a minimum of three screenings and 369 had a minimum of six screenings. On average 2.6 per cent of children were missed at each screening. The Autumn Term screenings occurred mainly in September and October with some in November; the Spring Term screenings in January, February and March (Winter season); and the Summer Term in May, June and July.

Children were selected for screening from individual class lists in alphabetical order. Tympanometry was performed in the school medical room. A calibrated and maintained Grayson-Stadler Earscan impedance audiometer was used throughout the study. The data collected was classified according to Fiellau-Nikolajsen's (1983) modification of Jerger's system (1970).

Classification of Tympanograms Used

There were four types of tympanograms used which measured middle ear pressure in decapascals. Type A was plus 200 to minus 99 showing a normal middle ear pressure; type C1 was minus 100 to minus 199 showing a negative middle ear pressure; C2 was minus 200 to minus 400 showing a marked negative pressure in the middle ear; and type B showed a lack of a defined compliance maximum usually denoting fluid.

All children who had a B tympanogram recorded had a repeat examination after swallowing. The correlation between readings was high (> 95 per cent) but where there was disagreement the more normal reading was recorded. Ears with B tympanograms were also assessed by otoscopy to exclude any false positives due to grossly indrawn drums or wax. In addition otoscopy was performed as a random, invited, sample of 410 children in order to detail findings and assess correlations between tympanometry and otoscopy.

TABLE II
CUMULATIVE PREVALENCE OF B TYMPANOGRAMS BY AGE AND SEASON*

Age in years	Summer Term	Autumn Term	Spring Term
5	13	26	46
6	4	7	13
7	6	10	19

Total n = 426 children; total screenings = 997.

Results

Over the study period 232 children (27 per cent) had at least one B tympanogram recorded: 54.9 per cent of children had 'normal' ears (A or C1 tympanograms) throughout the study. Overall analysis of tympanogram types revealed 59.3 per cent A, 18.4 per cent C1, 12.5 per cent C2, and 7.7 per cent B type tympanograms with 0.25 per cent unclassifiable and 1.8 per cent with grommets.

Correlation between tympanometry and otoscopy

All the examinations were performed by the first author (I.G.W.). A clinical diagnosis of OME was compared to the 'relative standard' of a B tympanogram giving a specificity of 82 per cent, sensitivity of 54 per cent and a positive predictive value of 38 per cent for otoscopy.

Prevalence

The prevalence or percentage of children identified with B tympanograms per screen varied considerably from 0–25 per cent. A summary of prevalence for age and school term is given in Table I. There was no difference between genders.

The period prevalence or percentage of children with B tympanograms, based on three successive screenings over a one-year period, was calculated to control for the effects of season. Period prevalence could then be compared between the different one-year age bands. The period prevalence is approximately three times higher in five-year-olds (46 per cent) than in six-year-olds (13 per cent) (Table II).

Throughout the study there were 467 type B tympanograms of which 186 (40 per cent) were bilateral. Bilateral effusions are more frequently found in five-year-olds than in six, seven and eight-year-olds with prevalences of 7.4, 4.5, 1.9 and 0.9 per cent respectively; prevalence thus appears to approximately halve with each successive year, whereas unilateral effusions have prevalences of 8.9, 6.1, 4.3 and 4.8 per cent respectively.

Incidence

The incidence of new cases on the basis of a four-

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TABLE III
INCIDENCE AND CUMULATIVE INCIDENCE OF B TYMPANOGRAMS IN EARS AND CHILDREN*

	5 years	6 years	7 years	8 years	All ages
Incidence in ears	6.7%	3.6%	2.7%	2%	3.8%
Incidence in children	8.3%	4.5%	3.8%	3.4%	5%
Cumulative incidence in ears	19.8%	11.7%	6.9%	5.7%	11%
Cumulative incidence in children	27.8%	15.1%	11.1%	6.5%	15.1%

*n = 2519 children; 5058 ears.

monthly screening interval was highest in five-year-olds at 8.3 per cent and lowest in eight-year-olds at 3.4 per cent (Table III). The cumulative annual incidence was also highest in five-year-olds at 27.5 per cent, more than four times the rate in eight-year-olds (6.5 per cent). The effect of season on incidence by age group is shown in Figure 1. The winter of 1989–1990 gave the highest incidence and also happened to be associated with an increased rate of absenteeism due to an influenza epidemic. The increase in incidence was most marked in the youngest children, i.e. five-year-olds.

Children screened in their first school term are significantly more likely to have a B tympanogram than on their second or third screening (χ^2 = 5.58; d.f. = 1). The observed differences between the proportions (of B tympanograms per screen) = 0.081 95 per cent; CI = 0.019 to 0.143; (CI = Confidence Interval).

Clearance of effusions and grommets

Overall 27 children (3.15 per cent) had grommets *in situ* during the study period. Twelve of these were unilateral and 15 bilateral. The study also identified 130 children (15 per cent of the sample size) who had a B tympanogram on more than one occasion. Only 14 children (1.6 per cent of the sample) however had a B tympanogram recorded over three consecutive screenings. Of these 50 per cent had grommets inserted but 50 per cent did not; bilateral OME was found in both groups (Table IV).

To further assess clearance of effusions a sample of 50 children with 67 B tympanograms; i.e. all the positives screened in the Spring of 1990, was analysed over three further consecutive screens. Fifty-two per cent of ears and 44 per cent of children showed clearance after four months. At the second eight-month screen, 78 per cent of ears and 76 per cent of children had shown clearance. After one year only six (nine per cent) of the original ears and five (10 per cent) of the original 50 children still had an effusion. However, five of the ears in four of the children that had improved, showed a recurrence during the year follow-up period. Over this year 10.4 per cent of the original ears (six children) were treated with grommet insertion.

Discussion

This study has confirmed a high prevalence of OME in a cohort of Southampton school children and described important and considerable natural variations by age and season.

The value of tympanometry in general practice has recently been aired (De Melker,[1] 1992; Maw,[2] 1992). There is no doubt that tympanometry can substantially improve diagnostic precision, but it is oversensitive with the danger of labelling 'non-problems' as cases. Perhaps the cost of tympanometers and lack of a skill base in using them has been the largest obstacle to developing more

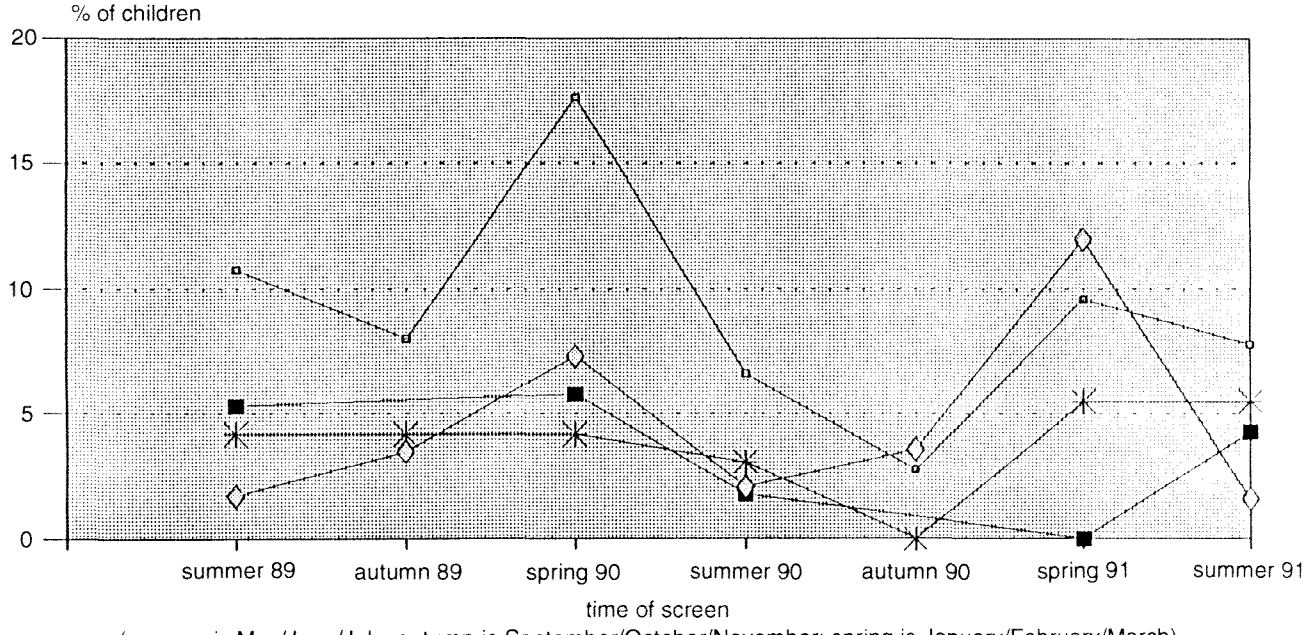

FIG. 1

Seasonal variation in the incidence of otitis media with effusion (four-month screening interval; n = 2868 screenings). -□- 5-year-olds; -◆- 6-year-olds; ✳ 7-year-olds; -■- 8-year-olds.

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TABLE IV
PROPORTION OF B TYMPANOGRAMS OUT OF SIX RECORDINGS: TREATED OR UNTREATED

Child no.	1	2	3	4	5	6	7
Grommets subsequently inserted	6/6	5/6	6/6	4/6	5/6	5/6	6/6
Child no.	8	9	10	11	12	13	14
No surgical intervention during study	6/6	3/6	6/6	5/6	6/6	4/6	3/6

effective diagnosis of OME in primary care. However, general practitioners are more crucially concerned with diagnosing auditory handicap from the history with excessive dependence on tympanometric diagnosis likely to lead to over-referral. The first author (I.G.W.) was independently assessed against tympanometry for 45 patients presenting with ear problems to the practice. In this situation the specificity for otoscopy was 65 per cent, sensitivity 88 per cent and the positive predictive value 76 per cent. It is possible that the test characteristics are different in the two settings and the expectation of finding a 'positive' must be higher in any practice selected group. This correlation also highlights the need for individual GPs to assess their diagnostic capabilities for this highly common condition with considerable cost implications where the predictive value is low.

Some doctors seem to prefer hearing disability to emerge in a proportion of children with OME by advocating a 'wait and see' policy as a basis for selective treatment, but it is post hoc, whilst others may too readily refer on the basis of a single assessment. The value of natural history information becomes increasingly apparent when faced with such management dilemmas.

A study screening interval of four months was chosen for practical reasons, and corresponded to a screen per school term. Although this interval was arbitrary there was no evidence that this rate significantly affected the yield from testing considering other literature in this area (Moller and Tos, 1990).

The observed frequency of the different tympanogram types in our study is close to that observed in the Danish study (Tos *et al.*, 1982) in which five screenings were performed over one year, among somewhat younger children (two to four-year-olds). In our study 27 per cent of children were affected and 32 per cent of children's ears in the Danish study (Tos *et al.*, 1982).

The mean point prevalences of 16.5 per cent in five-year-olds, 10.5 per cent in six-year-olds, 6.7 per cent in seven-year-olds and 5.6 per cent in eight-year-olds are within the range of the European literature reported by Zeilhuis *et al.* (1990). Contrary to earlier observations (Suehs, 1952) the coastal location of Southampton did not exhibit a higher prevalence of OME.

It is interesting that the cumulative prevalence is much higher in five-year-old children than in six or seven-year-olds, with significant differences in prevalence recorded depending on age and/or terms in school. Bilateral disease which is potentially more disabling also becomes less common with increasing age.

The particularly high prevalence of effusions in the winter months of 1990 in five-year-olds was associated with an influenza epidemic. This gave us the opportunity to demonstrate that the effects of infection, in terms of developing OME, are likely to be more pronounced in younger children, however this effect appears to be short-lived. Although high (25 per cent) this prevalence might be underestimated due to the fact that a proportion of ill children would have missed their screenings.

Surgical intervention is known to vary considerably (Black, 1985), thus confounding precise comparisons between studies, and was performed in 12 per cent of children with effusions in our study (1.8 per cent overall). Only one in 50 children with effusions had bilateral effusions after a year. This may have been partly due to surgical intervention since six children received grommets in this group. Of the 14 children in the study identified as having persistent OME, seven received grommets during the study period and seven had no surgical intervention. However at three-year follow-up one child in the no treatment group (number 11) had undergone adenoidectomy and myringotomy.

If one considers the study population as a whole, it is clear that effusions tend to resolve without intervention in five-year-olds after the first school term. If the national mean age for surgical intervention is 5.7 years (Curley, 1986), about the same time as the secondary incidence peak, then it is occurring at a stage when a 'wait and see' policy is most effective from a natural history perspective and probably also too late to help those children with significant educational disabilities in their first critical terms at school. This supports the case for generally earlier surgical intervention, with the important caveat that each child's case must be judged on its individual merits.

Conclusions

This data demonstrates OME's natural variability in young schoolchildren with a strong seasonal influence. We would argue therefore that like hypertension, OME should ideally be managed prospectively by serial measurement and risk assessment, rather than by a single evaluation or retrospective assessment after impairment has been allowed to occur. From this data we would recommend at least two screenings by tympanometry, although the second screening might reasonably be performed in hospital (when the child is clearly functionally disabled or 'at risk').

This study provides natural history data from a large population which doctors engaged in managing children with OME can use to assess risks of duration of effusion and advise on a prognosis.

However when evaluating a child with OME, in addition to the likely duration of an effusion, as indicated by this study, the observed hearing disability must also be taken into account.

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