BRITISH MEDICAL JOURNAL VOLUME 290 29 JUNE 1985

minimum. The general practitioner could use part of the consultation time to take a more detailed drinking history in those with positive responses to the questionnaire, intervening where appropriate with advice to reduce consumption. Evaluation of the effectiveness of such intervention should now be carried out, preferably by means of a randomised controlled trial.

We thank Sir Julius Thorne Charitable Trust and the Royal College of General Practitioners for the award of the Research Fellowship in General Practice, our colleagues Dr Bowman, Gellert, and Teuten for their kind cooperation, Angela Burrows, Dr Richard Budgett, Dr Peter Goldring, Diana Loveday, Paula Morgan, and Janet Stride for help in carrying out the study, Sheila Forman for her invaluable secretarial help, Richard Allen, Patrick Brennan, and Douglas Jones for help with the data analysis, Jane Wadsworth and Judith Diamond for undertaking statistical analysis, Dr Hugh Marlowe for helpful comments, Professor T. Whitehead for undertaking biochemical analyses, and the Department of Haematology, Northwick Park Hospital for the measurements of mean corpuscular volume. We gratefully acknowledge financial support for the study by the Brewers' Society.

References

- 1 Office of Health Economics. *Alcohol: taking up the battle*. London: White, 1981.

Study of middle ear disease using tympanometry in general practice

RANDALL REVES, RICHARD BUDGETT, DAVID MILLER, JANE WADSWORTH, ANDREW HAINES

Abstract

Tympanometry was used to provide evidence of middle ear effusions in a prospective study of middle ear disease in 264 children aged 3 months to 6 years in general practice. Adequate measurements on both ears were obtained in 220 children, of whom 68 (31%) had evidence of middle ear effusion at entry to the study, 28 (42%) of the 68 children persistence of the tympanometric findings was recorded for at least three months. Children of European descent were more likely to have evidence of middle ear effusion at the initial examination compared with African and West Indian children, as were those children whose siblings had a positive history of otitis media compared with those whose siblings had no such history. Children under 3 years were more likely to have evidence of an effusion than older children. Middle ear effusion as shown by tympanometry was not associated with a previous history of otitis media in the child but was associated with recent symptoms of respiratory infection or otitis. A previous consultation for otitis media was, however, strongly associated with a greater likelihood of a consultation for otitis media during the follow up period. Comparing evidence

of effusion by tympanometry with that by pneumatic otoscopy showed that using the appearance of the eardrum alone the sensitivity of otoscopy was 55%; the addition of mobility improved the sensitivity to 76% with little reduction in specificity. Further studies on populations using tympanometry are needed to determine the natural history, aetiology, and indications for referring children with middle ear effusion.

Introduction

Middle ear effusion is a common cause of hearing impairment in children but may be undetected by otoscopic examination.¹ For epidemiological purposes audiology alone seems to be inadequate for the detection of middle ear disease since a proportion of children with effusion have no evidence of clinically relevant hearing loss. The use of tympanometry in addition to audiology in screening programmes in schools has been proposed, with repeat testing to reduce the number of referrals of children with transiently abnormal tympanograms.² There is concern that some children with chronic effusions but normal hearing may remain otherwise undetected until they present later in life with irreversible middle ear disease and mastoid complications. The results of a recent study in London³ suggest that 20% of 5 to 6 year old children may need referral because of persistently abnormal tympanograms. Even in those children in whom deafness is associated with effusion parents may be unaware of conductive hearing losses of 30-35 db. Such losses may lead to delay in speech and cognitive development.^{4,5} Although a persistent effusion may follow an episode of otitis media, many children with middle ear effusion have no such history. Community studies of children younger than 5 years with tympanometry have been undertaken in other countries, such as Denmark, but apparently not in the United Kingdom.^{6,7}

We carried out this study to provide data on the prevalence of tympanometric "abnormalities" in British children, to examine the factors associated with tympanometric evidence of middle ear

BRITISH MEDICAL JOURNAL VOLUME 290 29 JUNE 1985

effusion: 16 (23%) of 71 compared with 49 (38%) of 130 ($\chi^2 = 4.56$, $p < 0.05$). The prevalence of a type B tympanogram in one or both ears was 17 (26%) in 66 children without siblings, whereas, 29 (28%) of 102 children whose siblings had no history of otitis media as recalled by their parents had type B compared with 29 (44%) of 64 children whose siblings had a positive history of otitis media ($\chi^2 = 4.19$, $p < 0.05$).

A history of illness in the preceding two weeks was associated with the prevalence of type B tympanograms in one or both ears as follows: 32 (29%) of 111 children without illness, 10 (20%) of 51 with cough and cold or cough only, 19 (39%) of 48 with sore throat, fever, otitis, or vomiting, and seven (70%) of 10 with earache ($\chi^2 = 12.1$, 3 df, $p < 0.007$). There were no significant associations of type B tympanograms with a history of otitis media in the parents; previous episodes of otitis media in the child as recalled by the parent; history of upper respiratory tract infection, or exema; mother's smoking, breast feeding, supine bottle feeding, or social class of the father.

A review of the parents' records before entry into the study showed that 5% of children under 1 year and 28% of children aged 1 to 2 years had previously been diagnosed as least once as having otitis media (fig 2). Of those 2 years and older, half had been diagnosed as having otitis media, and there was little change in the proportion with single or multiple episodes. As Table IV shows, when the parents' consultations for otitis media and the tympanogram results at entry into the study were considered the best predictor of a consultation for acute otitis media in the follow up period was

Fig. 2—Previously diagnosed otitis media according to parent records in 257 children, excluding seven children whose records were not available.

Table III—Association of previous history of otitis media and tympanogram classification for otitis media during follow up period

Tympanogram classification	History	+	-	Total
A	2 (5.4)	4 (26.7)	8 (31.0)	14
B	4 (8.1)	13 (83.3)	17 (66.7)	27
Total	6 (13.5)	17 (100.0)	25 (97.7)	43

* Classified by the parents of 64 children. 36 of 64 children classified as B had history B. † Classified by the parents of 102 children. 49 of 102 children classified as B had history B. Effect of tympanogram classification on $\chi^2 = 4.56$, $p < 0.05$. Effect of previous consultation on $\chi^2 = 12.1$, 3 df, $p < 0.007$.

previous history: 33% of those with a positive history subsequently consulted for acute otitis media. This was pronounced among children under 3 years, all but one of the 17 consultations for otitis media during the follow up period were with children who had a previous diagnosis episode.

At least one repeat tympanogram was obtained on 181 (82%) of the 220 children in whom an initial tympanogram had been recorded. Follow up was less complete for those with a bilateral type A than in those with types A or B, reflecting the greater emphasis placed on follow up of abnormal results. Table V gives the results of the follow up tympanograms; 10% of the repeat tympanogram type classified according to the child's worst ear. Of children who had type B initially, 35 (55%) remained type B at follow up, and in 28 (41%) follow up was longer than three months. The children with type A or

C tympanograms were more changeable, with only 23 (40%) remaining in the initial classification on follow up. Less than 20% of those who had type A, A or C, or C tympanograms at entry had a type B tympanogram at follow up.

Table IV—Follow up results by initial tympanogram type

Initial tympanogram type	No.	No. followed up	No. not of initial consultation	Final tympanogram type	%
				A	B
A	48	44	4	35	10
B	48	57	9	11	21
C	48	40	8	11	21
Total	220	181	40	56	31

Discussion

The prevalence of middle ear effusion as shown by tympanometry in a prospective community study in Denmark was approximately 20% of 3 year old children, the effusion persisting for three months in only 6% of the whole population.⁶ In our study, over a broader age range, 31% had evidence of middle ear effusion by tympanometry at the initial examination. In 28 children the middle ear effusion had lasted for at least three months as suggested by tympanometry—that is, 13% of the 220 children in whom two or more tympanograms were recorded. It seems unlikely that the evidence of middle ear effusion used in the study resulted in overdiagnosis of the condition. In fact it was probably underdiagnosed. Studies comparing tympanometry with evidence of middle ear fluid at myringotomy indicated that the association of middle ear effusion was 80-100% for type B tympanograms and less than 3% for type A. A small proportion of children with type B tympanograms may have had a thickened non-compliant drum rather than fluid. The association with effusion was more variable (8-75%) for type As. Roughly a quarter of ears with type C tympanograms had effusions.⁸⁻¹⁰

The use of tympanometry is not without methodological problems; on occasion a false positive tympanogram may be due to the lumen of the probe impacting on the wall of the auditory canal. In general, however, it will not produce a tracing when the lumen of the probe is occluded or when there is an inadequate seal between the rubber tip of the probe and the external meatus. The higher proportion of failed recordings among the younger children was due to the difficulty in obtaining a seal owing to their small auditory canals or to lack of cooperation for the seven to 10 seconds required per ear, or both. This study was undertaken in the winter; there may be seasonal variations in the prevalence of middle ear effusion.

Otoscope findings around to be somewhat subjective but fairly good agreement was obtained between otoscopy and tympanometry in the children on whom it was possible to perform both. Neither observer was specially trained in otoscopy, and even closer agreement may have been obtained with greater experience. A mobile drum does not necessarily indicate an absence of pathology—for instance, increased mobility may be associated with necrosis and thinning of the pars tensa.

The results of the repeat tympanograms suggest that types A and C are more likely to proceed to type B than type A is, at least over a relatively short follow up period. Thus types A and C tympanograms are probably associated with a relatively low prevalence of middle ear effusion in this population. They may represent varying degrees of eustachian tube dysfunction or resolving fluid, or both.

The study of middle ear disease is complicated because there seem to be several diagnostic entities—acute otitis media, recurrent otitis media, and persistent otitis media with or without superimposed acute otitis media.¹¹ The ability to detect middle ear effusion is a critical determinant in any study of the incidence, prevalence, natural history, and response to treatment of these conditions. The differences in age specific incidence that were described in studies in Finland and Denmark, in which the highest incidence was in children under 2, and the 1957 Medical Research

1954

BRITISH MEDICAL JOURNAL VOLUME 290 29 JUNE 1985

effusion, and to obtain preliminary data on the natural history of these tympanometric findings. We also wished to determine the relation between tympanometric and otoscopic findings.

Methods

The study was carried out in a general practice at a health centre in north west London that is situated on a council housing estate and serves a deprived population. Using the age-sex register, we identified all 295 children aged 3 months to 6 years on 31 October 1983 and sent letters to the parents explaining the study and requesting attendance at the health centre. From November 1983 to February 1984 264 children (89% invited) entered the study. In a brief standard interview questions were asked on previous history of otitis media in the parents, siblings, and the child; the number of siblings; the mother's smoking, and a history of allergy (hay fever, asthma, and eczema) in the child.

Otoscopy was performed by one of two observers with a pneumatic otoscope. This allows the observer to determine the mobility of the eardrum during alterations in pressure in the external canal that are produced by squeezing a rubber bulb. Both the appearance of the tympanic membrane (normal, absent light reflex, opaque, drum visible, bulging, inflamed, retracted, or perforated) and drum mobility (normal, reduced, or absent) were recorded. Tympanometry was undertaken after otoscopy to avoid introducing bias into the ear examination. A tympanometer 85 AR 11 (American Electro Medical) was used, which provides a graph of drum compliance at pressures from +200 to -400 mm H₂O in the external auditory canal. Tympanograms were classified into one of four groups, similar to the Jerger classification.¹² Middle ear pressure was considered to be normal from -100 to +50 mm H₂O and compliance considered to be normal at 0.1 or above, or at 0.1 or below if 0.1 or below on the tympanogram. Table I shows the types of tympanogram.

Type	Tympanogram findings	Pathological associations ^{13,14}
A	Normal pressure, normal compliance, peak at normal pressure	Very small proportion—no clear effusion
B	Normal pressure, low compliance, peak at normal pressure	Variable proportion, 8-25%
C	Low compliance and middle ear pressure 100 mm H ₂ O or above, usually less than 100 mm H ₂ O	80-100% associated with effusion
D	Normal pressure, normal compliance, peak at negative pressure	80-100% associated with effusion

Follow up of children with types B, C, and A was attempted at intervals of two to four weeks until the symptoms resolved. An attempt was also made to re-examine all the participants in the study at least once in the six month follow up period. The medical records of all participants were reviewed to extract information on consultations, home visits, and hospitalisations in which the diagnosis of otitis media was made. Only episodes that occurred more than two weeks apart were considered to be separate events. During the six months from November to May the general practitioners who saw any of the children in the study with symptoms that suggested a respiratory infection or otitis media, or both, filled out a standard form recording their examination findings and clinical diagnosis. In the analysis ears with type B tympanograms were assumed to have middle ear effusion. Such a definition should provide a relatively specific, but probably conservative, estimate of the prevalence of middle ear effusion.

Proportions were tested for statistical significance using the χ^2 test with Yates' correction in 2-way contingency tables. Log linear analysis was used to assess the effects of main factors in the 3-way contingency tables. The sensitivity and specificity of otoscopic findings compared with tympanometric evidence of effusion were calculated. Sensitivity was defined as the true positives divided by the sum of the true positives and the false negatives, and specificity was defined as the true negatives divided by the sum of the true negatives and the false positives.

Results

A total of 452 ears in 232 children were successfully tested by tympanometry in 12 children only one ear was successfully tested. In children under 2 years 74% of ears were successfully tested by tympanometry compared with 91% in those over 2 years. Figure 1 shows the proportion of tympanogram types by age for the 452 ears. Type B tympanograms were

Fig. 1—Tympanogram types by age.

most common in children under 1 year (37%). Overall, the proportion of ears with type B was higher in those under 3 compared with children aged 3 and over (31% of 220 v 20% of 126, $p < 0.025$). The proportion of type As declined at older ages, whereas the proportion of type C tympanograms increased.

The appearance of the eardrum and assessment of mobility by pneumatic otoscopy were compared with tympanometry for the 366 ears that had complete otoscopic examinations and tympanometry. This comparison excluded the ears without adequate visualisation of the tympanic membrane ($n = 63$) and the ears for which mobility was not tested by pneumatic otoscopy ($n = 23$). Although a slightly higher proportion of type B tympanograms was found in this group (35%), the difference was not statistically significant. Table II gives the classification of the ears by appearance (normal v any abnormality) and by mobility (normal v reduced or absent) and the proportion of type B tympanograms in each category.

	Normal mobility	Reduced or absent mobility	Total
Normal appearance	27 (14.5)	18 (40.4)	45 (24.9)
Abnormal appearance	27 (29.7)	45 (51.6)	72 (35.1)
Total	54 (24.2)	63 (28.0)	117 (52.9)

Table III compares two definitions of abnormal otitis with the type B tympanogram. Appearance alone ignores the mobility assessment, whereas appearance and mobility together give a more complete picture of the ear. Both appearance and mobility are normal. Consideration of mobility alone to appearance increased the sensitivity of otoscopy from 55% to 76%. When we excluded the 12 children who had had tympanograms done on only one ear, the results on 220 children remained for further analysis. Type A was present normally in 43 (38%), type A or C in one or both ears in 69 (31%), and type B in at least one ear in 68 (31%). Type B was present bilaterally in 39 of the 68 children. Children of West Indian or African descent were less likely than those of European descent to have middle ear

Table III—Comparison of the appearance of the tympanic membrane alone with the appearance and mobility in identifying ears with type B tympanograms (percentages in parentheses)

	Appearance alone	Appearance and mobility
Normal	27 (14.5)	27 (14.5)
Abnormal	26 (29.7)	24 (21.1)
Total	53 (24.2)	51 (23.6)

* Normal v any abnormality, including decreased light reflex. † For appearance and mobility.

1956

BRITISH MEDICAL JOURNAL VOLUME 290 29 JUNE 1985

Council study in the United Kingdom in which the peak annual incidence was around 9 years of age may reflect differing diagnostic criteria.¹⁵ Our results suggest a higher prevalence of effusion in children under 3 than in older children. Follow up of children with recent respiratory infections or otitis may pick up some persistent effusions, but many will remain undetected as they are present in children without such a history.

The use of the tympanometer is acceptable to patients and easy to learn, but a comprehensive community screening programme does not seem to be indicated until further information is available, particularly on the natural history of middle ear effusion in general practice and its effect on child development and the probability of developing irreversible middle ear disease. Tympanometry can never replace audiology as a screening instrument because it does not detect neurosensory deafness. Until the role of tympanometry in general practice is clarified it seems reasonable for general practitioners to use pneumatic otoscopy in preference to standard otoscopy in view of the consequent improvement in detecting middle ear effusion.

We thank Jackie Bennett, Janet Stride, and Sheila Forman for clerical help, Drs S. L. Gellert, P. G. Waller, and G. Heron for their kind cooperation, and Professor D. J. G. Bain for advice and encouragement.

100 YEARS AGO

The conference between the Subcommittee for Medicine of the Executive Committee of the Association for promoting a teaching University for London, and representatives of the Medical Society in London, was commenced on Monday last, at the rooms of the Society of Arts. An outline of the proposed plan for the constitution of a teaching University was submitted, this plan, the substance of which has already been made public on more than one occasion, provided that the University should be founded on the faculties as constituent bodies, with Boards of studies appointed by the Faculties, and that there should be a "single governing body." It was proposed that the Faculty of Medicine should consist of the teachers and examiners in London, and the persons present, having all teachers, naturally assented; further, it was thought that only the senior teachers should be admitted, and that the younger men, the assistant-professors, the demonstrators and teachers of practical subjects, together with the whole body of the graduates of the future University, should be excluded. This very select body, made up of the Faculty of Medicine, would elect a Board of Studies which would regulate the curriculum, the examinations, and all other matters relating to degrees in medicine, subject to the final decision of the governing body. The board of Studies would therefore only have a consultative voice, and the narrow constituency by which it would be elected would have merely an indirect elective influence. It is, we understand, proposed to provide this University with a staff of professors, laboratories for research, and all the paraphernalia of teaching. The question whether representatives of the medical profession should have seats on the governing body, and how they should be chosen, was not discussed, but will probably be considered when the conference meets again on May 16th. We fear that this scheme will not solve the difficulty, or meet the wants of medical education in London; it is not sufficiently broad and liberal to command the hearty and general support which alone can obtain the endowments necessary to bear the projected University. The idea of having a local University for London, consisting of colleges linked together for the purpose of granting degrees, is no doubt, one worthy of consideration, and commanding many elements of success; but the scheme of the Association appears to be exceedingly inadequate just where it ought to be precise. What are to be the duties of the professors—to teach, or to make researches? If to teach, who are to be taught? All the undergraduates at all the schools, or is this to be an additional central service school? Why is the Faculty of Medicine—which, after all, would only have to meet once a year, or at worst, to fill up vacancies in a Board of Studies—to be so narrow a constituency? Have the Colleges of Physicians and Surgeons any place in this scheme? They are not teaching bodies in the ordinary acceptance of the term, and the Teaching University is the grant degrees to all London students, who, therefore, will not need the diplomas of the royal colleges. Or are these colleges to conduct the examinations, and to receive the fees and the Board of Studies? Finally, what is to be the body who is to decide on the amount of preliminary knowledge of arts and science who is to be required—be it of the Faculty of Medicine, or of the

References

- 1 Blomfield CE, Berry G, Pendlebury J. Audiology and tympanometry in relation to middle ear effusion in children. *Lancet* 1978;ii:104-6.
- 2 Berry G, Blomfield CE, Pendlebury J. Otology history, and audiology and tympanometry in a teaching programme for school children. *Lancet* 1979;ii:107-9.
- 3 Carstensen E, Blomfield CE, Fry J, Jones S, Berry G, Pendlebury J. Identification of otitis media with effusion in children. *Arch Dis Child* 1980;55:104-6.
- 4 Lewis N, Pendlebury J, Jones S, Fry J. Open closed tympanometry: a new concept. *J Otolaryngol* 1978;87:121-2.
- 5 Broek D. The use of the electronic audiometer in the examination of middle ear function. *Lancet* 1978;ii:104-6.
- 6 Pechillo-Schubert S, Colman TH. Middle ear disease assessed by otoscopy or primary school children. *Lancet* 1978;ii:104-6.
- 7 Vatter E, Blomfield CE, Pendlebury J. A population study of otitis media in childhood. *Arch Dis Child* 1980;55:104-6.
- 8 Haines A, Miller J. Effects of otitis media on cognitive development. *Ann Child Neurol* 1980;1:264-8.
- 9 Mervin P. Effects of persistent otitis media on language development. *Ann Child Neurol* 1980;1:264-8.
- 10 Tait D, Pendlebury J. Tympanometry in infants and young children. *Ann Child Neurol* 1980;1:264-8.
- 11 Feller-Schubert S. Epidemiology of secretory otitis media: a descriptive cohort study. *Ann Child Neurol* 1980;1:264-8.
- 12 Jerger CF. Clinical otoscopy with the pneumatic otoscope. *Arch Otolaryngol* 1970;92:111.
- 13 Blomfield CE. Treatment of otitis media with effusion. *Semin F Infect Dis* 1983;suppl 26:11.
- 14 Blomfield CE, Pendlebury J, Jones S, Berry G, Pendlebury J. Incidence of acute otitis media. *Arch Otolaryngol* 1983;110:447-51.
- 15 Medical Research Council. *Acute otitis media in general practice*. *Lancet* 1975;ii:104-6.

Accepted 20 March 1985

Multicultural medicine

Acker—This fruit is a delicacy in Jamaica and is used in "bush tea." The ripe fruit can be eaten after a meal without ill effects, but if it is unripe it may be poisonous. It may cause hypoglycaemia due to two factors: hypoglycin A and hypoglycin B. This may result in vomiting (Jamaican vomiting sickness), coma, and even death due to severe dehydration. Three quarters of the West Indians who live in the United Kingdom have come from Jamaica. They often go home on holiday and bring unripe ackee back with them, which may contain unripe fruit.

Gringer berries—Preserved ginger root is a popular Chinese snack and, if it is not chewed properly or eaten in a hurry, can cause small bowel obstruction at the ileocecal junction. The ginger root consists of cellulose, which is resistant to gastric juices, absorbs water, and swells up during transit through the gut. An elderly Chinese adult patient or a child may complain of pain in the right iliac fossa; this must be considered in the differential diagnosis of acute abdomen.

Tenth gridding—The British believe that this is a psychological symptom but Indians believe otherwise. They think that grinding the teeth is a symptom of threadworm infestation. An Indian father may bring his child to a British doctor with this problem, expecting to get a stool examination, to receive the test and find that the child is not infested. This is not done. Mutual understanding is required.

—BASHIR QURESHI, general practitioner, Hounslow, Middlesex.