When does secretory otitis media affect language development?

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SUMMARY Secretory otitis media is a very common disorder in early childhood, but its effects on language development are still uncertain. We describe 10 children with secretory otitis media and illustrate the wide range of disability attributable to this. It is suggested that the impact of secretory otitis media on language development depends on at least five factors: age of onset, duration of the episode(s), severity of the hearing loss, intrinsic qualities in the child, and the linguistic environment. The implications of this hypothesis for clinical practice and research are discussed.

Secretory otitis media is characterised by an effusion of variable viscosity behind an intact eardrum.¹ It is extremely common, and probably at least one third of preschool children suffer one or more episodes.² Some children have a single transient attack; others have repeated episodes, each followed by complete recovery; and a minority have the disorder for months or even years without any remission.³ By far the most important clinical feature is hearing loss, which may vary from negligible to 50 to 60 dB, with a mean of 28 dB.¹ Pain in the ear may also occur, often in association with episodes of acute infection or with Eustachian tube dysfunction.

There has been much concern over the possible effects of middle ear disease on learning in general and language development in particular. This relation has been examined in over 30 published reports, and in most, significant correlations have been shown.^{4–6} The majority of these studies, however, contain serious flaws in design. Most are retrospective, and therefore the precise diagnosis is often uncertain in the children with a history of ear disease; conversely the absence of previous ear disease in the control group cannot be shown. For the same reason, the number and duration of attacks, the severity of the hearing loss, and the distinction between unilateral and bilateral disease are seldom documented. Lastly, matching of cases and controls for psychosocial variables is seldom adequate, yet accurate matching is essential since the prevalence and perhaps the management of secretory otitis media are related to race, size of household, and social status, and these variables also influence development. It must therefore be

said that the case for a cause and effect relation between secretory otitis media and learning problems remains unproved.⁷

Despite shortcomings of published research, most clinicians with an interest in this field are convinced that secretory otitis media is indeed an important cause of developmental problems in young children. The purpose of this paper is to present some illustrative case histories; to derive from these a working hypothesis on the nature of the relation between secretory otitis media and developmental problems; and to discuss the type of research design needed to investigate this hypothesis.

Methods and case reports

The children described here were seen in two children's audiology clinics over a three year period. They represent a small proportion of the total case load and were selected because they exemplify particular clinical problems. All except cases 4 and 7 lived in the catchment area of our hospital. The age when the child was first assessed by us is stated in each case. In all patients the diagnosis of secretory otitis media was based on the history, hearing tests, otoscopy, and impedance measurements, and in all except cases 9 and 10 it was subsequently confirmed at surgery. The details are summarised in the Table.

Hearing was tested by the most appropriate combination of the standard methods; distraction techniques, McCormick toy test (sometimes equivalent pictures were substituted), 'go' game, freefield audiometry, and pure tone audiometry. Only pure tone audiometry gives a direct measure of hearing

Table Details of the 10 children with secretory otitis media (SOM)

Case no (sex)	Age when assessed (mths)	Probable age at onset of SOM (mths)	Minimum duration of episode (mths)	Estimated hearing loss (+=<30 dB ++=30-45 dB +++>45 dB)	Intrinsic language or learning problems (0-+++)	Environmental deprivation (0-+++)	Immediate postoperative improvement (0-+++)	Language catch up at follow up >6 months (0-+++)
1 (M)	12	5	7	+++	0	0	++	+++
2 (M)	18	9	4	+	0	0	+	+++
3 (F)	66	36	30	+++	0	0	++	+++
4 (M)	38	?	?	++	0	++	+	+++
5 (F)	50	36 (?)	14 (?)	+	++	0	+	+
6 (F)	39	?	?	++	+	+++	+	++
7 (M)	35	12	23	++	+++	+	++	+
8 (F)	72	60	12	+++	0	0	+	0
9 (M)	22	21 (?)	1	++	0	0	0	0
10 (F)	34	30	4	++	0	0	0	0

loss, and with all the other techniques it is necessary to estimate the likely hearing loss. Sound levels were monitored with a sound level meter, and are stated in decibels sound pressure level (dB SPL). Language scores were all based on the Reynell developmental language scale which has two subsections, one for expressive language and one for comprehension.

Case 1. This 12 month old white boy was thought by his parents to have had a variable hearing loss from approximately 5 months of age. The onset was associated with a respiratory infection. He was said to hear loud sounds such as shouting, noisy music, or a football rattle but did not respond to quiet sounds. The parents described him as an unusually quiet baby.

Distraction testing produced responses to high and low frequency sounds at around 70 dB SPL but the responses were hesitant and were only confident and accurately localised at 75 to 80 dB SPL upwards. The diagnosis of severe secretory otitis media was confirmed at surgery shortly afterwards.

A substantial improvement in hearing was noted by the parents beginning about one week after surgery and he began to vocalise more freely. When tested two weeks later, distraction tests produced responses to 35 to 40 dB SPL to high frequency sounds and at 45 dB to low frequency sounds, indicating a considerable improvement in hearing. At 18 months of age he had several words with age appropriate understanding and normal hearing responses at low and high frequencies, but at 20 months there was evidence of further secretory otitis media and hearing impairment.

Comment

A hearing loss of this severity is unusual in secretory otitis media. The postoperative improvement in

both responsiveness and vocalisation suggests that the hearing loss had inhibited the development of normal listening behaviour and would have affected language acquisition had it not been treated.

Case 2. This white boy aged 18 months had repeated episodes of acute otitis media starting at age 9 months. At 13 months grommets were placed because of persistent effusion. He was seen for assessment at 18 months because he had no speech, little 'jargon', and no evidence of verbal understanding apart from the word 'no'. His parents were confident that he could hear and recognise ordinary household sounds. His non-verbal abilities were at least normal, and possibly superior.

Distraction tests produced high frequency responses at 40 to 45 dB SPL and low frequency responses at 45 to 50 dB SPL, suggesting a mild persisting hearing difficulty. The grommets were in situ and patent. The parents were advised to speak with deliberate slowness and clarity. At 26 months comprehension was within normal limits, expressive language was only slightly delayed, and distraction tests produced brisk responses at 30 to 35 dB SPL.

Comment

A hearing loss of several months duration at the age when first words are usually spoken might be expected to have a serious affect on language acquisition. It is impossible to be certain that his subsequent progress was attributable to appropriate management, but evidently any deleterious effects of secretory otitis media in this child were entirely reversible.

Case 3. A white girl aged 5½ years had been assessed elsewhere for speech delay and a suspected hearing loss at age 3 years. The parents were told that there was no serious hearing problem, but their

description of the hearing test suggested that inappropriate techniques had been used. At age 5½ years she had Reynell scores of 3 years on both expression and comprehension scales. Non-verbal abilities were normal. Pure tone audiometry showed a bilateral conductive hearing loss of 45 to 55 dB and this was confirmed by speech discrimination testing. Her parents confirmed that they had been worried about her hearing for several years. She made rapid postoperative progress, and at age 6½ years was reported to have 'almost normal' language development.

Comment

The history suggests that this girl had had a moderate hearing loss for at least two years. The severity and the duration together probably accounted for her severe language delay, and this hypothesis was supported by her rapid progress after surgery.

Case 4. A white boy aged 3 years 2 months presented because of severe language delay and behaviour problems including aggression, tantrums, and short concentration span. His parents were both in busy full time professional careers and he had been cared for by a succession of at least six au pairs speaking four different languages. He showed no evidence of language or non-verbal skills above the 2 year level. Cooperative hearing tests were impossible, but repeated distraction testing and impedance measurement suggested a variable conductive hearing loss. Secretory otitis media was found at subsequent operation. His mother suspended her career to spend time with him and reported a dramatic improvement after surgery. His progress was excellent, and at age 5 years he was able to enter the reception class of a normal preparatory school.

Comment

It is impossible to determine the relative contributions of secretory otitis media and environmental deprivation to this patient's problems, but an interaction between these two factors is the most plausible explanation.

Case 5. This white girl aged 4 years 2 months was seen elsewhere at age 3 years because of parental concern over hearing and language development. Hearing was said at a local clinic, to be 'within normal limits', but the parents were not satisfied with the child's responses during testing and had disagreed with the clinic's conclusions. At age 4 years 2 months, a Reynell developmental language test indicated a comprehension level of around 2 years 6 months and an expressive language ability of

about age 2 years. The non-verbal intelligence quotient (Snijders-Oomen) was 120. Pure tone audiometry showed a bilateral conductive hearing loss of 25 dB. She had evidence of long standing secretory otitis media in the right ear, but there were only minor changes in the left. After surgery she progressed well with intensive speech therapy in a language unit, but at age 5 years 11 months, her Reynell language development scale scores were lower than those normal for her age (comprehension 4·02, expression 4·08, English picture vocabulary scale 2·11).

Comment

This patient's language problem seemed out of proportion to the hearing loss, which was only modest at the time of testing. The unexpectedly slow progress after hearing was restored (compared for example with that of case 3) could be attributed either to the residual effects of a longstanding hearing loss on auditory function (see below) or to an interaction between a hearing loss and a pre-existing 'developmental language disorder'.

Case 6. A black girl aged 3 years 3 months was assessed because she had no speech and no demonstrable understanding of language. Enough non-verbal ability was observed to exclude severe retardation. Cooperative hearing tests showed a 30 to 40 dB hearing loss, and severe secretory otitis media was found at operation. Her family had suffered a series of tragedies and upheavals and her mother was profoundly depressed and socially withdrawn. After surgery her demeanour, play, and hearing in the assessment nursery steadily improved but at least six months elapsed before progress in language was observed. Although her hearing had returned to near normal, a unit for those with partial hearing seemed the most appropriate placement. At age 5 years, her language was still 12 to 18 months behind, but by age 7 years she was ready to return to normal schooling.

Comment

It is likely that this girl's handicap was the product of a similar interaction to that in case 4. As in case 5, there are several possible explanations for the relatively slow progress after surgery. The hearing loss may have led to impairment of auditory perception, or it may have been of no importance at all—the main causative factor may have been her deprivation at home.

Case 7. This white boy aged 2 years 11 months was assessed because he had only three single words and very little understanding of speech. Since the age of

12 months he had suffered frequent ear infections and was a quiet, lethargic child. The Griffiths assessment showed global retardation with scores appropriate for age 2 years in social, non-verbal, and motor areas. Distraction tests produced responses at around 50 to 55 dB SPL, suggesting an appreciable hearing loss. At surgery, thick fluid was found in both ears. After this he became much more lively and began to vocalise and to show evidence of understanding, though six months later he was still showing considerable delay in overall development.

Comment

Serial assessments of this boy's abilities showed evidence of retardation in all areas of development. It seems likely that his intrinsic retardation and placid temperament subtly reduced the number of language interactions to which he was exposed. This unintentional 'secondary' deprivation in combination with secretory otitis media produced severe language delay.

Case 8. This 6 year old white girl had mild spastic diplegia with normal language and intelligence quotient. She had always had a pleasant, extroverted personality. Her mother noted a hearing loss at age 5 years, together with increasing moodiness and a 40 to 50 dB conductive hearing loss was confirmed. This persisted for about eight months before surgery was undertaken, and operation showed obvious secretory otitis media. After surgery an improvement in hearing and mood was noted, but there was no change in her highly competent language abilities.

Comment

Although she had suffered a moderate hearing loss for at least eight months, this had had little effect on her development, presumably because at this age her good intellect and personality enabled her to overcome the disability.

Case 9. A 22 month old white boy was noted to have a hearing loss at a routine medical examination. This was confirmed by distraction tests, which produced no responses to stimuli less than 50 dB SPL. His father reported a recent respiratory infection. He had no other past or present worries about him, and the child was saying a few words. Two months later, hearing responses were normal and the child could perform a toy identification test without difficulty, had normal language development, and otoscopy and impedance were normal.

Comment

The history suggested that in this case the secretory

otitis media was associated with the respiratory infection, and the episode was of such brief duration that there was no noticeable effect on language development.

Case 10. This white girl aged 2 years 10 months was thought by her parents to have had impaired hearing since an ear infection three to four months previously. Language development seemed advanced for her age. Pure tone audiogram showed a bilateral 40-45 dB conductive hearing loss and there were obvious signs of secretory otitis media. Four months later the hearing loss had improved to about 30 dB but the otoscopic and impedance findings were essentially unchanged. The parents declined an offer of surgical referral, saying that they spoke clearly because they were aware of the problem and they could see no evidence of any effect on her developmental progress or behaviour.

Comment

In spite of an appreciable hearing loss for at least eight months, this girl's language development seemed unaffected. This may partly be explained by the fact that her language was already well established when she developed secretory otitis media, and perhaps the parents' efforts to speak clearly were also relevant.

Discussion

During the period in which these patients were seen, a much larger number of children who attended for audiological examination was found to have secretory otitis media without any abnormality of language development, and conversely there were many with language problems without evidence of this disorder. Since secretory otitis media is so common, it is difficult in the individual child to determine how much the disorder is affecting development. Parents often report an improvement in the child's hearing immediately after surgery, but it is much more difficult to document subsequent acceleration in language development.

Furthermore, the diagnosis of secretory otitis media with language delay is often followed by several simultaneous interventions in addition to surgery—for example, advice to parents, nursery placement, and beginning speech therapy. In spite of all these difficulties, the patients described above lead us to suspect that secretory otitis media can indeed have a devastating effect on some children, yet be of trivial importance to others. We postulate that at least five variables must be considered to explain these differences. These are:

- (1) The age at which the disorder occurs;

- (2) The duration of the episodes;
- (3) The severity of the hearing loss;
- (4) Intrinsic qualities in the child;
- (5) The child's environment.

Age of onset. There are both clinical and experimental reasons for the belief that the age of onset is important. Firstly, for obvious reasons, a congenital sensorineural hearing loss has much more devastating effects on language development than a hearing loss of similar magnitude acquired after the child has learned to talk. It is reasonable to assume that the same would apply to the conductive loss caused by secretory otitis media. Secondly, there is now overwhelming evidence that the infant learns a great deal about discrimination and production of speech sounds in the first year of life and this learning is an essential prerequisite for spoken language.⁸ The diminished quantity and range of babble and jargon noted in cases 1 and 2 suggests that secretory otitis media could have a considerable effect on this vital period of development. Thirdly, we suspect, but cannot at this stage confirm, that in longstanding secretory otitis media the ability to discriminate complex sounds such as speech may recover more slowly after surgery than does the ability to perceive pure tones as used in audiometry. This hypothesis is one of several possible explanations for the slow progress observed in cases 5 and 6 after surgery. There may be a neurophysiological explanation for these observations: it is known that normal visual stimulation is needed for the development of the visual pathways, and there is some evidence that the same is true for auditory development.^{9 10} If this is so, then secretory otitis media in infancy may well cause the auditory equivalent of 'amblyopia'. We can only speculate about the age range within which this might happen but it is an issue of particular importance because of the seemingly raised prevalence of secretory otitis media in preterm infants.

Duration. The duration of episodes of secretory otitis media is very variable and is often impossible to assess. It seems obvious that the most serious effects will be seen in those children who have prolonged or continuous attacks without remission. These children can sometimes be recognised by reference to previous audiological tests (provided these were competently performed) or by parental observation. There was evidence in our cases 1 and 2 that the disorder had been present for at least six months and for 12 to 24 months in cases 3 and 5. Conversely, in cases 9 and 10, spontaneous improvement after two to three months was observed.

Severity of hearing loss. The severity of the hearing loss is also unpredictable and varies from day to day. The reasons for this variability are not entirely clear, but probably the volume of the effusion and the degree of negative pressure in the middle ear are more important than the viscosity of the effusion.¹¹ It seems entirely logical to suggest that the extent of the hearing loss is an important factor in determining its effects on development, but this is difficult to confirm, firstly because hearing testing techniques in infancy do not define precise thresholds and secondly because a single test tells us nothing about the day to day variations. Furthermore, some young children with secretory otitis media (for example case 1) seem to have a rather more severe hearing loss than one would normally expect to find in patients with conductive deafness, possibly due to the 'amblyopia-like' effect postulated above. In most of our reported patients, the hearing loss seemed to be at least 30 dB in magnitude, although in case 3, it was only 25 dB. All these children had bilateral secretory otitis media which of course is likely to have far more serious effects than unilateral disease.

Factors in the child. Intrinsic differences between children in intelligence and temperament are also likely to interact with a hearing loss. One would expect the intelligent, extroverted child to seek communication more actively and to make more effort to comprehend sound than one who is placid or dull. The most serious effects probably occur when secretory otitis media coexists with global retardation, as exemplified by case 7, though our experience with case 4 suggests that the effects on behaviour and concentration may cause a spurious reduction of non-verbal as well as verbal skills during formal assessment.

Effect of environment. Lastly, it would be surprising if environmental factors did not also contribute. There are wide variations in children's exposure to constructive linguistic experiences¹² and in cases 4 and 6, there was good reason to suspect that this was seriously deficient. Conversely in cases 8 and 10 the child was probably exposed to a very stimulating environment. The amount of conversation between parent and child in close physical proximity, the effects of prolonged background noise, and perhaps the natural intensity and clarity of the parents' speech may also be important. Substantial differences in linguistic environment are found between families, independent of social class,¹³ and it is clear that social class cannot be a satisfactory measure of the language stimulation to which a child is exposed at home.

Conclusion. We recognise that our observations may have other explanations and that we are applying a certain circularity of argument. Nevertheless, the idea that secretory otitis media can be related to developmental problems is by no means new; many of the ideas outlined here have been mentioned individually in other publications, but do not seem to have been brought together as a single working hypothesis in any research study.

Most studies have shown a statistically significant correlation between middle ear disease and learning problems, but the magnitude of the effect is surprisingly small and might be regarded as unimportant in practice. We suggest that in certain children secretory otitis media has a very substantial effect on development, but that in research studies this effect is diluted by the inclusion of many children in whom the disorder is of brief duration and trivial importance.

Our clinical experience suggests that research designs that simply compare linguistic or developmental outcomes in children with and without middle ear disease are unlikely to be profitable.^{5 7} Studies on the effects of secretory otitis media on language development must be prospective and longitudinal, and must incorporate data on the changes in hearing and middle ear status over time, the linguistic and social environment, and the temperament and non-verbal skills of the child. A project of this magnitude is expensive but investment in detection and treatment of secretory otitis media is massive,¹⁴ and further research to confirm or refute our hypothesis is urgently needed.

If our hypothesis is wholly or even partly correct, there are important clinical implications. The clinician cannot be content with the diagnosis of a hearing loss caused by secretory otitis media, since the other factors discussed here must also be considered. It follows that secretory otitis media is not invariably an indication for surgery, particularly as the long term benefits are still uncertain.

Although careful assessment of these children is essential, it is still far from universal.

We are grateful for the help and advice of many consultant colleagues with whom we shared the management of these children.

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Received 2 September 1985