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Characterization of severely and profoundly hearing impaired adults attending an audiology clinic

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Abstract

Despite the fact that around 12 per cent of adult patients attending an audiology department will be severely hearing impaired (pure tone averages of 0.5, 1, 2 and 4 kHz of 70 dB HL or worse in the better hearing ear), their clinical and audiometric characteristics have not been well documented.

These characteristics were collected prospectively in 132 adult patients attending a Severe Impairment Clinic, set up to manage their specific problems. The inability to provide sufficient masking makes audiometric assessment of the severity of the impairment uncertain in the poorer hearing ear in 52 per cent of these patients. In addition, the limited bone conduction output makes it almost invariably impossible to assess the masked bone conduction thresholds and hence the air-bone gap in the poorer ear. Hence, accurate characterization is only practical of the better hearing ear in such patients.

In 67 per cent of the better hearing ears, there was a mixed hearing impairment, the air-bone gap being 20 dB or greater. The aetiology of the conductive component was almost equally otosclerosis and chronic otitis media. In only 19 per cent was the impairment of a pure sensorineural type, broken down as 6 per cent congenitally acquired, 5 per cent due to meningitis and 9 per cent being adult in onset. In the remaining 14 per cent of patients the type of impairment could not be classified as the bone conductive thresholds were off scale.

Having had experience of managing these patients at a special clinic and knowing the workload involved, it is argued that consideration be given to setting up such clinics in most departments.

Introduction

Within the adult population of Great Britain there is a range of hearing impariment which has been well described in the MRC National Study of Hearing (Davis, 1989). Taking the pure tone average (PTA) over 0.5, 1, 2 and 4 kHz in the patient's better hearing ear to define the degree of impairment this study has defined the prevalence in the recognized impairment categories (Table I). In the majority the impairment is progressive, the incidence of sudden onset of a hearing impairment being only 0.3 per cent. As might be expected, those with more marked impairments are also those that are most likely to have sought advice. So that, although only 0.8 per cent of the population have a severe or profound impairment (PTA ≥70 dB HL), virtually all have sought advice.

Such severely hearing impaired patients are particularly important to manage because without aiding they will not hear speech or most environmental sounds and even when aided, the understanding of speech will rely heavily on lipreading. Hearing aid provision can be time-consuming, mainly because of the difficulties of eliminating acoustic feedback with the high-powered aids that are required. In 1986 the Departments of Otolaryngology and Audiology at Glasgow Royal Infirmary set up a Severe Impairment Clinic to address these problems. Since then individuals with a PTA ≥70 dB HL in their better ear, attending the Infirmary, have been tertially referred to this clinic.

The specialized nature of this clinic and the attention given to accurate otoscopy and audiometry, offered the opportunity to characterize this population in detail.

TABLE I

PREVALENCE OF HEARING IMPAIRMENT IN THE BETTER HEARING EAR OF THE ADULT BRITISH POPULATION FROM THE MRC NATIONAL STUDY OF HEARING (DAVIS, 1989). CONDUCTIVE IS WHERE AIR BONE GAP ≥20 dB

Category impairment	Pure tone average dB HL	Prevalence % (95% confidence intervals)	% sought advice	% Aided	% Conductive	% Female	Median age (yrs)
Normal	>30	89 (88–90)	19	0.2	1	54	41
Mild	31–50	8 (7–9)	52	17	7	49	67
Moderate	51–70	2 (1.3–2.4)	75	56	18	45	69
Severe	71–90	0.5 (0.3–0.9)	95	87	40	58	71
Profound	90+	0.3 (0.1–0.6)	100	97	40	42	63

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Surprisingly, this has not been done previously, and only by doing so will the resource implications of managing this patient group become more clearly defined.

Methods

Patients

One hundred and thirty-two patients attending the Severe Impairment Clinic over an 18-month period from January 1987 to July 1988 were reviewed. All had a hearing impairment of at least 70 dB HL, averaged over 0.5, 1, 2 and 4 kHz in their better hearing ear. Their mean age was 68 years with a range of 16 to 95 years. There was a female/male ratio of 2:1. In keeping with the social class distribution of the hospital population, 76 per cent from the manual occupational groups.

Pure tone audiometry

After the removal of any obstructing wax or debris, pure tone audiometry was performed in a sound deadened booth with a Kamplex AC4 audiometer using THD 39 earphones with MX41/AR cushions and a Radioear B71 bone vibrator. The maximum outputs available from this system are 120 dB HL for air conduction (AC) and 70 dB HL for bone conduction (BC) at 0.5, and 75 dB HL at 1, and 2 kHz. Audiometry was performed using the recommended procedures from the British society of Audiology (1981, 1985, 1986). Air conduction (AC) was tested at octave frequencies from 0.5 to 4 kHz and bone conduction (BC) from 0.5 to 2 kHz.

Results

Pure tone audiometry

With the Kamplex AC4, the maximum output for narrow band masking is 100 dB of effective masking across the speech frequencies. This restricted output severely limits the proportion of the 132 patients whose thresholds could be fully masked. Because of this, and to avoid unnecessary confusion, the data presented is based on not-masked AC and BC thresholds.

Overall, 11 per cent of the 1056 (4 points in two ears in 132 patients) AC thresholds were off-scale, the majority (40 per cent) occurring at 4 kHz. Table II shows the percentage of the better and poorer hearing ears that had off-scale AC thresholds. One or more off-scale thresholds were present in 12 per cent of better ears and 30 per cent of poorer ears. For these ears a rule has to be devised for computing a pure tone average (PTA). It was decided that if one out of the four thresholds were not measurable then the audiometer maximum output at that frequency plus 5 dB ie (125 dB HL) was subsituted into the four frequency average. It is accepted that this strategy will tend to underestimate the severity of the impairment.

TABLE II

DISTRIBUTION IN 132 INDIVIDUALS OF OFF-SCALE POINTS FOR AIR AND BONE CONDUCTION ANALYSED AS TO THE BETTER AND POORER HEARING EAR

No. of off-scale BC thresholds	% Patients (n = 132)	
	Better ear	Poorer ear
None	88	70
1	7	12
2	4	9
3	0	2
4	1	7

As might be expected, because of the more limited output levels, a higher proportion (37 per cent) of the individual BC thresholds were off-scale. As with AC thresholds, an arbitrary rule has to be used to deal with these. If there was only one measurable, not-masked BC threshold, this was considered likely to be vibrotactile and was discounted. This applied in 18 (14 per cent) patients. If two or more BC thresholds were available, the average was taken as the average of those that were available. In all instances, the air-bone gap (ABG) was calculated from the difference between the two or more available AC and BC thresholds at the same frequencies.

Severity and symmetry of impairment

Figure 1 charts the pure tone average in the better against the poorer hearing ear of the 132 patients. From this the distribution of the severity of the impairments in the better and poorer hearing ears can be tabulated (Table III). One patient had a bilateral total hearing impairment and 13 a total unilateral hearing impairment. Of the ears with a total impairment, seven (47 per cent) had previously been operated upon, five having had a stapedectomy and two having had surgery for chronic otitis media.

Choice of an appropriate criterion for asymmetry depends on the purpose of identifying such patients. If the object is to identify patients for investigation to exclude an acoustic neuroma, a difference of 20 dB might be appropriate. However, in terms of managing a patient's disability by surgery, the object is to identify any better/poorer hearing ear. For this purpose, a PTA difference of 10 dB is considered material. Using this definition, 40 per cent (54 of 132) of patients had asymmetric thresholds.

The above data are based on unmasked AC thresholds. Masking of the AC is only necessary when there is a difference of 40 dB or greater between the AC

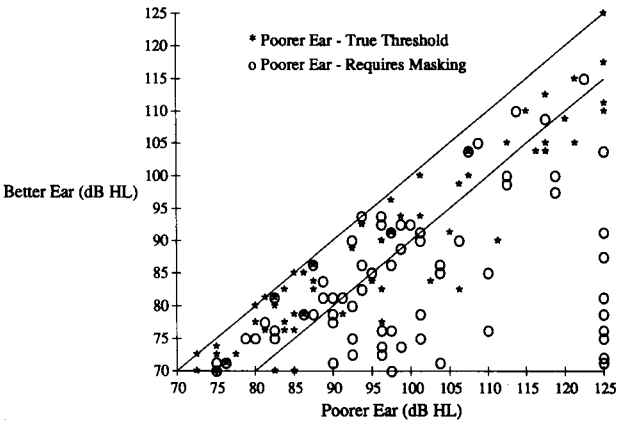

FIG. 1

Graph of the PTA (over 0.5, 1, 2 and 4 kHz) in the better against the poorer ear in the 132 patients. *indicates patients whose threshold in the poorer ear did not require masking and can be taken as a true threshold. Zero indicates patients whose threshold in the poorer ear required but was not technically possible to mask and which consequently could be even poorer.

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TABLE III
PURE TONE AVERAGE DISTRIBUTION FOR THE BETTER AND POORER HEARING EARS

Pure-tone average dB HL n	Better ear (%)	n	Poorer ear (%)	
70–79	50	(38)	12	(9)
80–89	35	(27)	32	(24)
90–99	23	(17)	37	(28)
100–109	16	(11)	19	(14)
110–125	8	(6)	19	(14)
Off-scale	1	(1)	13	(10)
Totals	132	(100)	132	(100)

in the poorer ear and the not-masked BC threshold. This was the case in 51 per cent (68 of 132) of the patients and they are identified as circles in Figure 1. In them the thresholds in the poorer ear could, if masking were to be possible, be even poorer.

Type of impairment

Although in 27 per cent (35 of 132) of patients the mean not-masked BC thresholds were off scale (ie greater than 73 dB HL), in patients whose PTA in the better ear was 83 dB the ABG in that ear could not be greater than 10 dB and in those whose PTA was 93 dB the ABG could not be greater than 20 dB. Such patients could be assumed not to have a surgically relevant conductive component (ABG less than 20 dB) to their impairment. In only 14 per cent (18 of 132) of patients was the mean BC off scale and the mean AC threshold greater than 93 dB, hence the magnitude of any ABG in the better ear unknown.

The distribution of the magnitude of the ABG in the 88 per cent (114) of patients in whom it was assessable is shown in Figure 2. In them 68 per cent (78 of 114) had an ABG of greater than 20 dB, 55 per cent a gap of greater than 30 dB and 28 per cent a gap of greater than 40 dB. It is just as likely that the incidence of ABG's would be the same in those in whom it could not be measured because of the limited BC output. The prevalence of conductive defects in the poorer hearing ear is almost certainly higher but again cannot be ascertained without masked BC thresholds.

Otoscopy

The main abnormalities detected were variants of chronic otitis media (Table IV). Of the 11 active ears

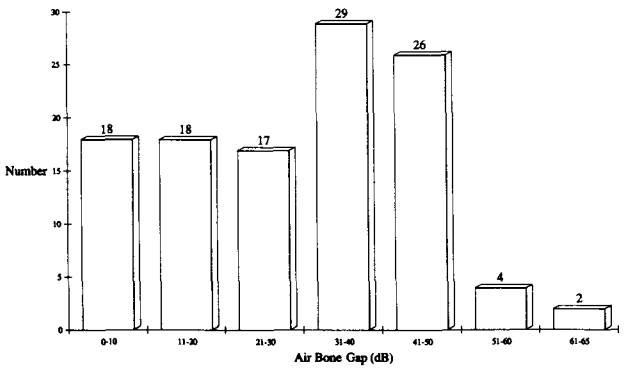

FIG. 2
Histogram of the ABG in the better ear in the 132 patients.

(nine patients) a cholesteatoma was present in one, the remainder being active mucosal disease. Of the total of 54 patients with variants of chronic otitis media, 20 (37 per cent) had previously undergone unilateral and four (7 per cent) bilateral middle ear surgery. Of this total of 28 ears an open mastoid cavity had been created in 15 (53 per cent). The remainder had various forms of tympanoplasty.

Subsequently, when this population of 132 severely impaired individuals was reviewed, 20 per cent of them accepted middle ear surgery with the object of lessening their hearing disability (unpublished data).

Aetiology

It is possible to characterize the aetiology of the impairment in the better ear in the majority of patients from a combination of the history, examination and audiometry (Table V). In most, the diagnosis was based mainly on the audiogram and otoscopy. Thus, where there was an ABG of 20 dB or greater and a normal tympanic membrane, the patient was considered to have otosclerosis. In 29 per cent (14 of 48) of such patients, this was confirmed by the history of a previous stapedectomy. No patient with a conductive component and a normal tympanic membrane gave a history of trauma or congenital impairment.

Only 6 per cent of the whole population had a prelingual, congenitally acquired sensorineural impairment and in a further 4.5 per cent meningitis was the aetiology. In only 1.5 per cent of the total population was noise exposure considered a potential aetiology for the sensorineural impairment, in that the patient has been continuously exposed to the equivalent of 90 dB over a lifetime of 40 years. As would be expected the incidence of chronic otitis media and otosclerosis was higher in the poorer ear, 40 per cent and 42 per cent respectively.

Discussion

The main, unexpected finding of this characterization of a sample of severely hearing impaired adults attending an NHS department is the presence in at least 68 per cent of a material (≥20 dB) conductive component to the impairment in the better hearing ear. The incidence in the poorer ear is likely to be even higher, though not quantifiable because of the inability to mask BC thresholds in this population. Thus the patients with a severe impairment attending a standard audiology clinic in an otolaryngology department are not primarily those with a sensorineural impairment and certainly not those with a prelingually acquired impairment.

TABLE IV
TYMPANIC MEMBRANE FINDINGS: NUMBER OF EARS AND PATIENTS

Tympanic membrane	Ears (n)	Patients (n)
Active CSOM	8	6
Active open cavity	3	3
Inactive CSOM	29	20
Inactive open cavity	12	9
Healed CSOM	18	14
Total abnormal	73 (27%)	54 (40%)
Total normal	191 (73%)	78 (60%)
Overall total	264	132

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TABLE V
AETIOLOGY OF THE SEVERE/PROFOUND IMPAIRMENT: BETTER EAR

Mixed impairment	Percentage	Male/Female (n)
Otosclerosis	36	12/36
Chronic otitis media	31	16/25
Total	67	28/61
Sensorineural impairment		
Unidentified	7	4/5
Congenital	6	4/4
Meningitis	5	1/5
Noise	2	2/0
Total	19	11/14
Indeterminate type of impairment	14	5/13
Overall total	100	44/88

The first question to ask is how typical are these severely hearing impaired patients of those in the general population. It is likely that they are representative of the type of patients seeking advice in the United Kingdom, there being no suggestion that patients attending our Audiology Department are in any way different from those attending other NHS clinics. There is the possibility that because of the tertiary nature of the Severe Impairment Clinic that patients were attracted from other hospital departments. This does not appear to be the case, virtually all patients that previously had had an aid had had this issued from our department. However, whether our patient population represent the severely hearing impaired population is another matter. They almost certainly do not. The major missing group are the congenitally impaired, there being only 6 per cent (n = 8) of such patients in this study. If one takes the incidence of severe congenital impairments to be one per 1000 livebirths, there ought to be about 250 patients in the catchment population (250,000) of our hospital. One might expect more than 3 per cent (eight of 250) of them to seek hospital advice over an 18 month period. The reason why individuals in the deaf community do not attend ORL clinics has been discussed on many occasions and is a combination of attempts by this community to keep a separate 'Deaf/Dumb' identity and a historical lack of interest in their problems in audiology/otology departments. It is unlikely that unless an effort is made to encourage them to do so, they will not constitute a higher proportion of clinic attenders anywhere. They should of course be encouraged to attend regularly mainly because ear moulds deteriorate with time and the consequent feedback limits the gain available.

The high prevalence (68 per cent) of a mixed hearing impairment, though initially surprising, and indeed higher than in the MRC National Study of Hearing, should perhaps have been anticipated. Firstly, individuals with a conductive component to their impairment are more likely to consult than those with a comparable sensorineural impairment for several, interacting reasons. The main ones are that the pathology itself can cause organic symptoms such as a discharge in chronic otitis media. Conductive impairments are also more likely to cause asymmetric thresholds which is likely to be more readily noticed by the patient than a gradually deteriorating, symmetric sensorineural impairment. In addition, as 76 per cent of our population were in the manual economic group, one would expect a higher incidence of chronic otitis media but not otosclerosis (Browning and Gatehouse, unpublished data). However, in our group of severely impaired patients, these reasons are unlikely to be sufficient on their own for the high prevalence of a conductive component. Because conduction defects do not protect the inner ear from the ravages of time what is being seen is a combination of a pre-existing conductive impairment along with an idiopathic sensorineural impairment, frequently associated with aging. This is in part confirmed by the fact that our patients are on average no older than the mild and moderate sensorineural impaired patients attending the same Department. Whether chronic otitis media and otosclerosis can themselves cause a sensorineural impairment is a debatable issue that need not be addressed here.

Having characterized these patients, what are the management implications and how might these best be dealt with? In our practice, serving a population of about 250,000, there are around 90 patients with a severe hearing impairment requiring new management per year. Provision of binaural hearing aids is attempted in all but a few individuals, and in the majority these are accepted (Day *et al.*, 1988). Attention can also be paid to the manufacturing of well fitting moulds which do not feed back at the levels of gain used by these patients. On average this takes 2.7 visits per patient (McClymont, 1990). It is also important to consider environmental aids because even though most of these patients always wear their hearing aid/s, their disability is by no means totally alleviated by them. Whilst many might have already sought advice and modified their listening environment, for example by moving the position of alerting bells, about one in three will still have a residual disability which, by an as yet unproven assumption, environmental aids are considered likely to alleviate (McClymont, 1990).

Because of the high prevalence of mixed impairments, it would be ideal if an otologist were a member of the team managing these patients. If this is impracticable as it will be in many centres, we consider that at least an otological opinion should be sought in the 68 per cent with a mixed impairment. This is not solely because of the presence of middle ear pathology, such as active chronic otitis media, which requires management; the incidence of this being no higher than at any Hearing Aid clinic. Rather, it is only an otologist that is able to decide whether surgery is practical. Every 10 dB of improvement in hearing thresholds will markedly lessen an individual's auditory disability and lessen the requirements from a hearing aid system. As surgery to improve the hearing is usually carried out on the poorer hearing ear, the reliability of the air and bone conduction thresholds becomes important. Because of the inability to mask the bone conduction in the poorer ear, considerable experience is often required to ensure that the poorer hearing ear is indeed a hearing ear rather than a dead ear. Whilst advice on this might be better given by a senior technician, experienced audiological scientist or audiological physician, it is only the otologist that knows what this surgical potential is in a specific patient once he has examined the ear (Browning and Giles, unpublished data).

Age would appear to be no exception. Individuals of the age group involved are just as likely to accept surgery as younger groups: 40 per cent of those asked responded

t hat they would accept (Giles and Browning, unpublished data). Perhaps more relevant, in a proportion, surgery has already been attempted and advice as to whether revision surgery should be attempted can be difficult and require an experienced opinion. Increasingly stapedectomy and tympanoplasty are being performed under a local anaesthetic and the risk to life of these procedures is thus negligible. Of more relevance is the risk of post-operative balance problems, especially following stapedectomy which in this age group might be more difficult to compensate for. However, middle ear surgery is not the only surgical option to consider. Where feedback or ear discharge is a problem, a bone-anchored hearing aid system (Nobelpharma) may offer an important alternative.

It has been the experience of those involved in cochlear implantation that the profoundly impaired are a neglected group of patients for whom much can be done, apart from implantation, by an experienced team. It is our opinion that by having interested individuals working together at a tertiary referral clinic, the management of the severely hearing impaired has hopefully improved. Such patients form a major part of the workload of any audiology department and it is suggested that the establishment of a Severe Impairment clinics should be encouraged. The educational background of the staff manning such a clinic is not too relevant provided the individuals are interested, experienced and have a broadly based, management outlook.

Key words: Deafness; Hearing loss; Hearing aid

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