The Manifestation of Middle Ear Pathology in an Elderly Group

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ABSTRACT

There is a lack of clarity in the literature regarding the manifestation of the structural changes due to aging in the middle ear and the pathology which occurs in the elderly. In order to determine the incidence and manifestation of middle ear problems in an elderly group, acoustic immittance measurements and otoscopy were carried out on 94 subjects over the age of 65 years. Thirty eight percent of all the subjects tested had abnormal tympanometric results in one or both ears. These abnormal results were due to either pathologies which were medically diagnosed, or other unidentified factors such as possible structural changes in the middle ear as a result of increased age. Otoscopy and acoustic immittance measures should always be carried out as part of the test battery for the elderly.

OPSOMMING

In die literatuur is daar geen duidelikheid oor die manifestasie van strukturele veranderinge in die middeloor weens veroudering en middeloorpatologie by die geriatriese bevolking nie. Ten einde die insidensie en manifestasie van middeloorprobleme by 'n geriatriese groep na te gaan, is akoestiese immittansiemetings en otoskopiese ondersoeke uitgevoer op 94 proefpersone oor die ouderdom van 65 jaar. Agt en dertig persent van al die proefpersone het abnormale timpanometriese resultate in een of beide ore vertoon. Die abnormale resultate was die gevolg van verskillende middeloorpatologieë wat gediagnoseer is asook ongeïdentifiseerde faktore soos moontlike strukturele veranderinge in die middeloor weens veroudering. Otoskopiese ondersoeke en akoestiese immittansiemetings behoort deel uit te maak van die toetsbattery vir geriatriese persone.

Many physical and behavioural changes differentiate the elderly population from younger persons (Wofford, 1981). These physical changes include structural changes, specifically in the middle ear, such as degeneration of muscles and the stiffening of ossicular joints.

There is no consensus in the literature as to the significance of these structural changes. Such changes could have an effect on the functioning of the middle ear and should be detectable through acoustic immittance measurements. There is also a lack of clarity in the literature as to whether these structural changes lead to an increase in middle ear pathology (Chermack, 1981).

Some studies have examined acoustic immittance measurements in the elderly. Blood and Greenburg (1977) examined the static acoustic immittance measurements in persons between the ages of 50 and 70. They found a significant decrease in values and concluded that there was a need for a different set of norms to be used when testing people over 70 years of age. Nerbonne, Bliss and Schow (1978) investigated the static acoustic immittance measurements in subjects between the ages of 20 and 79 years. They found a slight but non-significant tendency for values to decrease with age. They recommended, however, that further study is neccessary in subjects over 79 years of age.

Degeneration of middle ear muscles results in an increase in acoustic reflex thresholds (Chermack, 1981). However, studies by Gelfand and Piper (1981) indicated that there was no difference between the acoustic reflex thresholds of an elderly population with normal hearing and that of a young population with normal hearing.

These studies have only investigated single aspects such as static immittance measurements or acoustic reflexes. The optimal use of acoustic immittance measurement is achieved when all three tympanometric parameters are assessed, viz. tympanometric peak pressure, tympanometric shape, as well as static immittance (Margolis and Shanks, 1985).

It is also still uncertain whether there is an increase in middle ear pathology due to the structural changes. Turner (1982), states that middle ear pathology is common among older patients. He found perforations of the tympanic membrane, otitis media with effusion, usually resulting from upper respiratory infection of influenza and otosclerosis. Otitis media often occurs because of Eustachian tube dysfunction (Meyerhoff and Paparella, 1978). Eustachian tube dysfunction in the elderly is frequently a result of the degeneration of the veli palatine muscles (Chermack, 1981).

The literature indicates therefore that middle ear pathology does in fact occur in the elderly. There is no indication of the incidence of the pathology or whether the incidence is significant.

These shortcomings in the literature have important implications for the audiologist. Firstly, if these structural changes in the middle ear have a significant effect on immittance measurement, a different set of acoustic impedance (immittance) norms would be necessary for the elderly. Secondly, if these structural changes lead to an increase in pathology, the audiologist should identify potential dis-

orders for referral, as many of these problems can be remedied medically or surgically (Turner, 1982). Thirdly, a significant incidence of middle ear disorders can motivate the inclusion of acoustic immittance measurement in the test battery for the elderly.

The need for further study in this field is evident. The goals of this study are, firstly, to determine how structural changes in the middle ear affect acoustic immittance measurement. This evaluation will include tympanometric peak pressure, tympanometric shape, static immittance and acoustic reflexes. Secondly, this study will examine the incidence of middle ear pathology within the test group (Cilliers, 1987).

METHODOLOGY

Goals

The goals of the study are:

- To determine the types of tympanograms which occurred most frequently in a specific group of elderly subjects. This can supply information regarding the influence of age on the tympanogram.
- To relate the acoustic immittance results to the diagnosis of pathology in order to determine whether the results are influenced by pathology or other factors such as structural changes due to aging.
- To determine what effect aging has on the static immittance values and, if this varies significantly from the prescribed norms, a different set of norms for the elderly should be considered.
- To record the presence or absence of acoustic reflex measures in the group of elderly subjects.

Experimental design

A one-group design was used for this study. The same group of subjects was subjected to the test battery and each subject underwent the same procedure.

Subjects

Criteria for Selection

- *Age:* The subjects had to consist of persons over the age of 65 years as sixty-five was accepted for medical-legal purposes as the start of "old age". Many physiological changes occur in this age group. These include structural changes of the auditory system (Wofford, 1981).
- *Health:* All the subjects had to be capable of undergoing acoustic immittance testing and an otoscopic examination.
- *Sex:* The subjects could be either male or female. This is essential as some research claims that there is a difference between static immittance values of males and females (Jerger, Jerger and Mauldin, 1976). Therefore both male and female subjects were selected for this study.

Selection of Subjects

Ninety-four people from three old age homes in Pretoria were randomly selected for this study. The ages of persons in the experimental group varied between 66 and 95 years of age. There were 11 male subjects and 83 female subjects.

The age spread and sex of the subjects are presented in table 1.

Table 1: The age-spread and sex of subjects used for this study

AGE OF SUBJECTS	NO OF SUBJECTS	SEX OF SUBJECTS MALE	FEMALE
65—69 years	5	0	5
70—74	6	0	6
75—79	27	2	25
80—84	34	5	29
85—89	14	3	11
90 +	8	1	7

Apparatus

Acoustic immittance data were obtained on each subject with a calibrated (to standard -ISO 389, 1979) Grason Stadler GSI 28A Auto Tymp, utilizing a 226 Hz probe tone. Acoustic reflex measures were obtained at 500, 1000, 2000 and 4000 Hz.

Experimental procedure

Each subject tested underwent the following procedure:

A short interview was carried out to obtain personal information, viz. name and date of birth.

A preliminary visual examination of the external auditory canal had to be carried out to determine whether immittance measurement could be obtained. Immittance measurements cannot be carried out if fluid is running from the ear canal or if there is an obstruction (Meyer, Hurter and Van Rensburg, 1987).

The acoustic immittance protocol was then carried out. The probe was placed in the ear canal and an airtight seal was obtained. The test sequence proceeded automatically. The pressure sweep began at +200 daPa and proceeded in a negative direction until it reached -400 daPa. The ear canal volume in ml, immittance peak in ml, and the pressure peak in daPa were recorded (Margolis and Shanks, 1985). Acoustic reflex measures were then obtained ipsilaterally at 500, 1000, 2000 and 4000 Hz in dB HL (Hearing level).

An otoscopic examination was then carried out by a clinical assistant in otorhinolaryngology in order to determine the presence of any middle ear pathology.

Data analysis

Since all the acoustic immittance measures were carried out on the GSI 28A, the norms were used as set out in the instruction manual.

- *Static immittance:* The normal range is 0,3 ml to approximately 1,8 ml. A static immittance peak which falls between these two ranges indicates normal mobility of the middle ear system.
- *Pressure peak:* For most applications a normal pressure range of -150 daPa to +100 daPa is used (Margolis and Shanks, 1985). However, strict rules for a normal middle

ear pressure indicate a pressure range of -50 daPa to +50 daPa (Brooks, 1981).

— *Tympanometric shape:*

— Type A tympanogram has static immittance values of between 0,3 ml and 1,8 ml and has a pressure peak at or near 0 daPa although a range between -150 daPa and +100 daPa is considered normal (Hodgson, 1980; Margolis and Shanks, 1985).

— Type Ad signifies a tympanogram with an unusually high static immittance peak of 1,8 ml or more. Peak pressure is usually at or near 0 daPa (Hodgson, 1980; Margolis and Shanks, 1985).

— Type As denotes a tympanogram with reduced amplitude of 0,2 ml or less. The pressure peak is usually at or near 0 daPa (Margolis and Shanks, 1985).

— Type B tympanogram is flat, typified by the absence of a pressure peak (Hodgson, 1980; Margolis and Shanks, 1985).

— Type C tympanogram has a negative tympanometric peak pressure, usually smaller than -150 daPa (Hodgson, 1980, Margolis and Shanks, 1985).

— *Acoustic reflex measures:* The reflex usually occurs between 70 and 90 dB HL above the hearing threshold in normal-hearing people (Wiley and Block, 1985).

Data Processing

For the analysis of the data obtained in this study descriptive statistical techniques were used. The aim of descriptive statistics is to sum up and condense the measurable characteristics of results obtained. The following techniques were used: percentages and frequency tables.

RESULTS

The results are presented in the sequence outlined according to the goals of this study.

The types of tympanograms which occurred

Table 2 presents a summary of the salient data obtained in this study. It shows the number of subjects with normal acoustic immittance results bilaterally, with abnormal acoustic immittance results unilaterally and with abnormal immittance results bilaterally. The types of tympanograms which occurred are indicated as well as the number of ears which presented each type of tympanogram. Table 2 also shows the various types of pathology which were diagnosed.

Of the 94 subjects tested 58 (62%) had Type A tympanograms bilaterally. Type A tympanograms are associated with normal middle ear function. This pattern reflects normal mobility and peak pressure (Hodgson, 1980). Twenty three of the subjects (24%) had abnormal results unilaterally and 13 subjects (14%) had abnormal results bilaterally. Therefore 38% of all the subjects tested had abnormal acoustic immittance results in one or both ears. These results are extremely high, compared with a study by Jerger (1976). Jerger found that the highest incidence of abnormal tympanometric results (31%) occurred in the age group 2 to 5 years. It was suggested that this age group is the highest risk group for otitis media. Jerger found that there was a gradual decrease in abnormal results with an increase in age.

With reference to the number of ears tested in this study 188 ears were examined in total. Of these 139 (74%) yielded Type A tympanograms. Of the remaining ears 38 (26%) presented Type As tympanograms. Type As denotes a tympanogram with a reduced amplitude characteristic of ossicular fixation, tympanosclerosis and some forms of otitis media (Margolis and Shanks, 1985). The Type As tympanogram therefore predominates over the other abnormal tympanograms in this elderly group. This differs from findings in children where tympanograms associated with otitis media, eg. Type B and Type C tympanograms, occur most frequently (Hodgson, 1980). The reason that the Type As tympanograms occurred more often in the elderly group could be due to the calcification and ossification of the joints between the ossicles in the middle ear (Kahane, 1981).

There were 3 Type B tympanograms. Type B tympanograms occur in the presence of middle ear effusion and other space-occupying lesions of the middle ear. They can also occur in cases of tympanic membrane perforation and impacted cerumen (Hodgson, 1980; Margolis and Shanks, 1985). Most of these pathologies associated with Type B tympanograms can be remedied medically or surgically and therefore can be identified and referred for further treatment (Turner, 1982).

There were 5 ears with Type C tympanograms. This type of tympanogram is often an indication of Eustachian tube dysfunction or otitis media (Hodgson, 1980; Margolis and Shanks, 1985).

Of all the ears tested tympanograms with no peak were recorded in 3 ears. This could indicate a perforation or impacted cerumen (Margolis and Shanks, 1985).

Correlation between the acoustic immittance results and the types of pathology diagnosed

The question as to why this high percentage of abnormal acoustic immittance results occurred was posed and thus the acoustic immittance results are discussed in terms of the different types of pathology which were identified. This is also presented in table 2.

Type A tympanograms

Of the 139 ears which yielded Type A tympanograms 96 were diagnosed as having normal middle ear function. Forty of the remaining ears with Type A tympanograms were diagnosed as having cerumen, ear canal collapse or both. Although cerumen and ear canal collapse can affect pure tone audiometric results (Wofford, 1981), they do not necessarily affect acoustic immittance results (Randolph and Schow, 1983; Wofford, 1981). This could explain why Type A tympanograms occurred.

A further 2 ears that presented a Type A tympanogram were diagnosed as having healed perforations in the tympanic membrane. A mildly scarred tympanic membrane can result in increased mobility in the tympanic membrane (Jerger, Anthony, Jerger and Mauldin, 1976). In these 2 cases it appears as though the healed tympanic membrane had not necessarily affected the tympanometric results.

Table 2: Acoustic immittance results and the types of pathology diagnosed

	No. of subjects	Type of tympano-gram	No. of ears	Types of pathology diagnosed											
				Normal	Cerumen	Cerumen impaction	Ear canal collapse	Cerumen + ear canal collapse	Tympano-sclerosis	Cerumen + tympano-sclerosis	Perforation	Cerumen + retracted membrane	Repaired membrane	Otitis Media	Surgery on Tym. Mem.
Normal acoustic immittance results bilaterally	58	Type A	116	80	16	3	12	4					1		
Abnormal acoustic immittance results unilaterally	23	Type A	23	16	1	1	1	2					1	1	
		Type A_s	18	13	1	1		2		1					
		Type B	1		1										
		Type C	3				1							2	
		No peak	1								1				
Abnormal acoustic immittance results bilaterally	13	Type A_s	20	8	4		3	3	1						1
		Type B	2								1	1			
		Type C	2				2								
		No peak	2					1			1				

One ear with a Type A tympanogram was diagnosed as having otitis media. It should be noted that a peak pressure of -119 daPa was recorded. This could imply that the peak pressure norms that were used, viz. a pressure range of -150 to + 100 daPa, are not sensitive enough to identify all cases of otitis media.

Type As tympanograms

Thirty eight of the ears tested yielded a Type As tympanogram. Of these 21 were diagnosed as having normal middle ear function, 5 were diagnosed as having cerumen, 1 had impacted cerumen, 3 had ear canal collapses, 5 had both cerumen and ear canal collapses, 2 had tympanosclerosis and 1 ear had had surgery to the tympanic membrane.

The percentage of ears with Type As tympanograms that were diagnosed as normal is 55. This implies that factors other than pathology influenced the tympanometric results. Structural changes due to aging such as stiffening of the tympanic membrane and ossicular joints could have resulted in the Type As tympanogram (Wofford, 1981). The possibility that structural changes due to aging may have affected the tympanometric results, has important implications for the audiologist, as there will be a high percentage of abnormal tympanograms with no evidence of middle ear disorder. This implies that the occurrence of a Type As tympanogram does not always indicate the presence of middle ear pathology among the elderly.

Impacted cerumen can cause a Type As tympanogram (Margolis and Shanks, 1985). This accounts for the single case of cerumen impaction which yielded as Type As tympanogram. Ear canal collapse and cerumen do not necessarily influence the acoustic immittance results (Randolph and Schow, 1983; Wofford, 1981).

There were 13 ears with Type As tympanograms that were diagnosed as having cerumen, ear canal collapse or both. These tympanometric results could therefore be caused by factors other than pathology. Structural changes due to aging can cause stiffening of the middle ear system, which could result in Type As tympanograms.

There were also 2 ears which had tympanosclerosis and 1 case of surgery to the tympanic membrane that yielded Type As tympanograms. According to Margolis and Shanks (1985), both of these diagnoses could result in a Type As tympanogram.

Type B tympanograms

There were 3 ears with Type B tympanograms. One was diagnosed as having a perforated tympanic membrane and the third had a retracted tympanic membrane and cerumen. All three of these types of pathology correlate with the acoustic immittance results (Margolis and Shanks, 1985). Referral for further medical attention is essential in these cases (Turner, 1982).

Type C tympanograms

Of the 5 ears which yielded C tympanograms 2 had otitis media. The remaining 3 ears all had an ear canal collapse. An ear canal collapse cannot influence tympanometric results (Wofford, 1981). The type C tympanogram could therefore be caused by Eustachian tube dysfunction.

Tympanograms with no peak

Three ears with tympanograms which had no peak were diagnosed. Perforated tympanic membranes were found in 2 of the ears. The third ear had cerumen and an ear canal collapse. No peak is registered in tympanometric measurement when the pressure that is required for the measurement of the middle ear function cannot be built up (Hodgson, 1980). Both the perforations and the ear canal collapse could result in no pressure being built up. There is therefore a correlation between the tympanometric results and the presence of pathology.

The effect of aging on static immittance values

In order to determine the effect of aging on the static immittance values a correlation was drawn between the two. Table 3 gives the mean and median static immittance values as a function of age.

Table 3: Correlation between age and mean and median static immittance results in millilitres (mℓ)

AGE IN YEARS	MEAN	MEDIAN
65—69	0,61 mℓ	0,65 mℓ
70—74	0,75 mℓ	0,65 mℓ
75—79	0,53 mℓ	0,4 mℓ
80—84	0,58 mℓ	0,4 mℓ
85—89	0,38 mℓ	0,4 mℓ
90 +	0,55 mℓ	0,5 mℓ

The results show that there is a significant decrease in both the mean and median static immittance values in the subjects of 75 years and older. This decrease does not, however, continue with an increase in age. There is in fact, a slight increase in the static immittance values of subjects over 90 years of age. This tendency contrasts with the findings by Blood and Greenburg (1977). They found a significant decrease in static immittance values. Their study examined subjects between the ages of 50 and 70 years. The fact that their population was considerably younger than the population used in this study may explain the resulting difference in findings.

The tendency for static immittance values to decrease slightly and then level off as was observed in this study, correlates with findings by Nerbonne, et al. (1978). They found a slight but non-significant tendency for values to decrease with age. Their subjects ranged in age from 20 to 79 years. They did recommend that further study of individuals over 79 years of age was necessary. This study examined subjects between the ages of 65 and 95 years, but the results did not differ from those found by Nerbonne, et al. (1978). A separate set of static immittance norms for the elderly is not necessary, as the mean and median values for all the age groups fall within the normal range of 0,3 mℓ — 1,8 mℓ.

Acoustic reflex measures

Table 4 presents the percentage of subjects as well as the percentage of ears with absent acoustic reflex measures.

Table 4: Percentage of subjects and ears with absent and present acoustic reflexes

	Percentage of ears	Percentage of subjects
Acoustic reflexes present	48%	29%
Acoustic reflexes absent	52%	71%

The acoustic reflex is usually elicited at 70—90 dB HL above pure tone threshold. The most likely cause of the absent reflexes is an increased pure tone threshold. Most elderly people have a sensory neural hearing loss due to presbycusis. Since pure tone audiometric testing was not carried out, the exact cause of the absent acoustic reflexes is unknown. The possibility exists that the absent reflexes could also be the result of the degeneration of the middle ear muscles. All the muscles in the body degenerate with increasing age. The muscles in the middle ear should not be an exception.

DISCUSSION OF RESULTS

The manifestations of outer and middle ear pathology

Outer and middle ear pathology occurred in 38% of all the ears tested. This high occurrence can partially be explained as a function of increased age.

The type of pathology which occurred most frequently was excessive cerumen which may obstruct the external auditory canal partially or completely (Cohn, 1981). Copious secretion of wax occurs in individuals of all ages; Marshall (1985), however, indicates that excessive cerumen is more common among older people. An overaccumulation of cerumen can result in a conductive hearing loss and abnormal acoustic immittance results, depending on the degree of obstruction (Wofford, 1981). Excessive cerumen can also influence ear mould impressions for hearing aids.

Twenty two percent of all the ears tested were diagnosed as having cerumen, and of these, 64% had Type A tympanograms. The acoustic immittance results indicate that even a total occlusion of the ear canal due to cerumen impaction does not always result in abnormal tympanograms. The impaction may, however, influence the results, and this implies that an otoscopic examination should always be carried out prior to acoustic immittance testing in an elderly group. Excessive cerumen can be treated quickly and successfully.

Ear canal collapse or stenosis occurred in 17% of all the ears which were examined. Although ear canal collapse can occur in any age group, it is usually associated with old age which causes a loss of elasticity in the dermis. The cartilaginous portion also becomes more flexible (Wofford, 1981). The external auditory canal closes when an earphone is placed over it; this can result in a mild to moderate conductive hearing loss (Randolph and Schow, 1983). A Type A tympanogram can occur with reduced ear canal volume measurements. This correlates with the findings of this study where 64% of the ears diagnosed as manifesting an ear canal collapse had Type A tympanograms. The remaining 36% had additional factors which affected the results. In order to prevent incorrect interpretation of audiometric testing, otoscopy and tympanometry should always be performed prior to audiometric testing. A collapse of an ear canal during audiometric testing can be prevented by using circuaural or postaural cushions (Marshall and Grossman, 1982).

There were 3 cases of otitis media diagnosed and 1 case of retracted tympanic membrane, indicative of an early stage of otitis media (Cohn, 1981). The development of otitis media is most frequently related to Eustachian tube dysfunction. The Eustachian tube maintains middle ear ventilation and facilitates the clearing of foreign material as well as providing immunological defence (Cohn, 1981). Eustachian tube dysfunction is often associated with old age because the veli palatini muscles which open the Eustachian tube may degenerate or atrophy. Kahane (1981), says that degeneration of all the muscles occurs with old age. Otitis media may therefore be caused indirectly by increased age. However, it is also possible that these subjects have a history of otitis media, and thus the condition is not as a result of old age. Otitis media cannot always be detected through pure tone audiometry. It can yield a conductive hearing loss. Otoscopy and acoustic immittance testing can detect the presence of otitis media. As mentioned previously, a Type B or C tympanogram usually occurs (Hodgson, 1980) and this correlates with the tympanometric results obtained in this study. It is therefore essential that these examinations be carried out as part of the test battery for the elderly. Otitis media is therefore not exclusively associated with the very young, but can also occur among the elderly.

There were 3 ears with perforated tympanic membranes. Tympanic membrane perforation can result from excessive effusion, the erosive effect of middle ear lesions such as cholesteatomas or an external trauma (Wofford, 1981). In the 3 cases diagnosed in this study, the most likely cause was excessive effusion. A perforation may affect the audiometric results, depending on the size of the perforation (Wofford, 1981).

A perforation can be identified through otoscopy and acoustic immittance measurement. If the 3 cases identified in this study had perforations due to excessive effusion, the possibility exists that the otitis media was caused by a Eustachian tube dysfunction. The Eustachian tube dysfunction, as mentioned earlier, could be the result of increased age.

Tympanosclerosis and healed perforations occurred in 4 ears. Tympanosclerosis and healed perforations may result after tympanic membrane rupture and healing (Wofford, 1981). Tympanosclerosis can include stiffening of the tympanic membrane, tympanic mucosa, ossicular ligaments, tendons of the stapedius and tensor tympani muscles and fixing the malleus and incus in the epitympanic area. A scarred tympanic membrane is indicative of a healed perforation. The most likely cause of a healed perforation is effusive otitis media.

It is essential that the person with evidence of a healed perforation undergoes regular otoscopic examinations and acoustic immittance testing to detect the recurrence of otitis media.

It is evident, therefore, that much of the pathology which occurs in elderly individuals could be as a result of increased age. Otoscopy and acoustic immittance testing are essential for the diagnosis of most of these disorders and must therefore be carried out prior to pure tone audiometric testing. Repeated testing is necessary to detect the recurrence of otitis media. The nursing staff who work in old age homes could also be trained to identify symptoms related to outer and middle ear disorders for early identification and referral.

The effect of structural changes due to aging on the acoustic immittance measurements

Eleven percent of abnormal acoustic immittance results

were diagnosed as having no middle ear disorders. This implies that there are factors other than a middle ear pathology which resulted in the abnormal acoustic immittance results.

One of the possible causes of these abnormal results could be attributed to structural changes to the middle ear system. Kahane (1981), noted that the structure of the adult laryngeal cartilages changes with increasing age. Calcification or ossification caused stiffening of the laryngeal joints. These changes do not only occur in the larynx, but occur in all the joints of the body including those in the middle ear. It seems possible, therefore, that a stiffening of the middle ear system could cause abnormal acoustic immittance results. Fifty five percent of the Type As tympanograms which occurred had a diagnosis of normal middle ear condition.

Abnormal results could also have been caused by a history of pathological conditions which are no longer evident, but which have caused a permanent effect on the middle ear system.

Since biological changes are known to occur with increasing age, it is unlikely that the middle ear should remain unaffected. These non-pathological changes which influence acoustic immittance measures have important implications for the audiologist. There will thus be a percentage of abnormal tympanograms with no middle ear disorders in the testing of the elderly. Although this percentage is not high enough to warrant separate static immittance or tympanometric norms for the elderly, it nevertheless should be taken into consideration.

It is also of interest that the static immittance values decreased in subjects over 75 years of age. This decrease did not continue with an increase in age. In addition, these values increased slightly in the age group over 90 years. The mean and median static immittance values of each age group fell within the normal range, i.e. 0,3 ml — 1,8 ml.

CONCLUSION

In this group of elderly subjects, acoustic immittance results indicating a normal middle ear system (Type A tympanogram) occurred most frequently. Of these normal acoustic immittance results, 43 ears were, however, medically diagnosed as having excessive cerumen, ear canal collapse, healed perforations or otitis media. These diagnoses do not necessarily influence acoustic immittance measurements.

Thirty-eight percent of the subjects had abnormal tympanograms in one or both ears. Of these tympanograms indicating middle ear dysfunction, eight ears presented with Type B or C tympanograms or had no peak, confirming the medical diagnosis of conditions such as otitis media. Two of the ears had Type C tympanograms but there was otoscopically no indication of middle ear pathology. These results could indicate a Eustachian tube dysfunction possibly caused by degeneration of the veli-palatini muscles.

Of the abnormal tympanograms, Type As, indicating reduced amplitude, occurred most often. This was otoscopically verified in 45% of the cases where a diagnosis of pathology such as tympanosclerosis or impacted cerumen occurred. However, 55% of these Type As tympanograms had no evidence of middle ear disorder. These results could therefore be due to unidentified causes such as non-pathological changes, associated with old age, which lead to a stiffening of the middle ear system.

The fact that there was a correlation between the decrease in static immittance values and an increase in age up to 90 years of age, seems to indicate that aging had an effect on the results.

Otoscopy and acoustic immittance measures should be carried out as part of the test battery for the elderly. Identification of pathology, which may influence further audiometric testing, eg, ear canal collapse, is essential as the effect of these disorders on audiometric testing can be prevented.

Middle ear pathology increases the total hearing loss in the elderly. There is a high incidence of sensory neural hearing loss in the aged. The conductive component of the hearing loss can be remedied medically or surgically. The audiologist therefore has an important role to play in the identification of these conductive components.

The last few decades have seen a rapid increase in the number of people over 65 years. The elderly can no longer be ignored, but must be recognised for the contribution they make to society. There is a shift in the orientation of the field of audiology towards the evaluation and rehabilitation of the elderly. The audiologist plays an important role in the identification and referral of individuals who have pathological conditions in the outer and middle ear.

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