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MASTOIDITIS

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THE number of mastoid operations performed in the Otolaryngological departments has decreased greatly during the time antibiotics have been available. Most cases of acute otitis heal rapidly after myringotomy combined with antibacterial treatment. Complications following mastoid disease have also decreased considerably.

The reduced incidence of mastoiditis has led some clinicians to question the value of mastoidectomy in the treatment of mastoid disease. More emphasis is now laid upon prolonged treatment with large doses of antibiotics. Even such a basic procedure as myringotomy and aspiration of the middle ear has been considered unnecessary in some quarters and its disappearance from use has been predicted.

In an earlier paper from this clinic we analysed the case records of 36 ears treated with simple mastoidectomy during the years 1950 to 1953. Special emphasis was laid on the effect on hearing, and it was concluded that if an ear does not heal in three weeks in acute otitis under treatment with proper antibiotics, operation should be seriously considered to avoid permanent loss of function. Results of prolonged, unsuccessful antibiotic treatment were shown to result in one case in hyperplastic mastoiditis and adhesive otitis in the middle ear, and permanent hearing loss.

In this paper we wish to deal more closely with the points which in our opinion characterize acute or subacute mastoiditis and require serious attention with a view to successful end-results. We have also studied the

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audiological features of mastoid disease in its various stages in order to throw light on the cases in which hearing loss has become irreversible.

Short Review of Earlier Studies

Since the publication of our earlier report (Palva and Siirala, 1954) some authors have discussed mastoid operations and mastoiditis. No attempt will be made here to deal with all these publications; we will confine ourselves to the opinions of some of the outstanding authors.

F. W. Davison (1955) discusses the great decrease in the percentage in cases with otitis media and mastoiditis needing mastoidectomy (58.9 per cent. in 1937 and 3 per cent. in 1954). He is inclined to the opinion that in the treatment of these cases mastoidectomy is not needed at all. He favours large doses of penicillin, in children 3-5 million units and in adults as much as 10 million units a day until the disease is healed, which usually occurred in his cases in less than 12 days. Davison also stresses the use of pneumatic ear speculum in determining the fluid levels in the ear and the importance of repeated myringotomies and aspirations.

Houser and Dietrich (1955) emphasize that while myringotomy was earlier done largely to prevent complications by giving the pus a free drainage, it is now mainly done in the interests of hearing by draining the important area around the ossicles. They point out that tenderness behind the ear is not a very important sign initially, but if it persists during treatment, it increases in value. If the hearing deteriorates after some initial improvement, or if the ear has discharge over 3 weeks with decreased hearing, simple mastoidectomy should be done. An ear that needs daily paracenteses and aspirations for several days simply needs a thorough mastoidectomy.

Goodale and Montgomery (1955) agree with the above authors in advocating early myringotomy. In their experience the incidence of mastoiditis in otitis media material is about 6 per cent.; they also cite Richardson's figure of 5.3 per cent. in a series of 625 cases.

McKenzie (1958) considers the value of mastoidectomy from various angles. He agrees that the operation works well and the ear is healed in a few days; this made him wonder whether the operation was necessary at all. He also lists the objections, viz. stenosis of the ear canal, dislocated ossicles, damage to the facial nerve and scarring in the attachment of the mastoid muscles. McKenzie states that the complications of mastoiditis have also become exceedingly rare: he has had no case of lateral sinus thrombosis since 1945 and he is inclined to treat mastoid infection with a full antibiotic course of four weeks duration.

In the 50 cases presented by McKenzie, there were 9 in which the hearing remained permanently below the 30 db. level for the speech frequencies; in no others is the final level discussed. He doubts the value of myringotomy and favours the use of antibiotics.

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An article by Weller (1958) deals with fibrosing mastoiditis. He describes in detail 11 cases in which simple mastoidectomy was performed. He points out that the pathological picture of mastoiditis in cases first treated conservatively with various antibiotics shows the development of hyperplastic epithelium and granulation tissue in the mastoid cells. These granulations in turn reduce the effectiveness of any type of medical therapy, and drainage from the infected cells is impeded. Generally there is also an oedematous infiltration of the mucosa of the middle ear and of the epitympanic space. Eventually this results in varying degrees of adhesive otitis and a conductive, permanent hearing loss. It is possible in the early stages to make this process reversible by removing the foci from the mastoid cells; the earlier this is done, the better are the chances of good post-operative hearing.

In our earlier report (Palva and Siirala, 1954) we pointed out the dangers to hearing caused by waiting too long before doing mastoidectomy in hyperplastic mastoiditis. The resulting fibrous adhesions in the middle ear can in some instances be removed by a later tympanotomy approach, but it seems to us wise to hinder the development of chronic adhesive otitis by performing an early, thorough mastoidectomy in hyperplastic mastoiditis.

The more serious complications of mastoiditis have also greatly decreased thanks to the antibiotics. Thus Courville (1955) reports that the percentage of deaths due to intracranial complications (25/10,000) is only one-tenth of the pre-antibiotic figure. During the antibiotic era meningitis was the most common cause (78 per cent.) while cerebral abscess held the next place. Deaths due to sinus thrombosis were extremely rare.

It is clear, however, that complications of mastoiditis still occur and they may appear without any stormy symptoms when antibiotics have been used continuously during the earlier stages of the disease. This is well demonstrated by Morrow's (1958) series of 90 cases with mastoiditis; complications occurred in 21 cases. In this series, 43 patients had acute or subacute mastoiditis, and 11 of them had complications. Meningitis, lateral sinus thrombosis, epidural abscess and brain abscess were the most alarming conditions, meningitis being the most frequent (9/21).

Morrow considers it wise to go ahead with mastoidectomy if any of the classical signs of mastoiditis are present, such as post-auricular swelling, mastoid tenderness, sagging of the posterior canal wall, or unmistakable evidence of bony breakdown. Surgery is indicated in the presence of persistent unexpected malaise, low-grade fever, anæmia, leucocytosis, pain in and around the ear, headache or vertigo.

Material

The study covers the period from the beginning of 1954 to the first of March, 1959, and is based on the records of the patients with acute otitis

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media treated in the Out-patient Department of the University Ear, Nose and Throat Clinic or admitted for treatment in the Clinic.

The top curve in Fig. 1 shows the annual number of cases of acute otitis media in which myringotomy and aspiration of the middle ear was made in the four-year period 1954-1958. The figures vary from 1,998 cases in 1956 to 3,113 in 1954, making a total of 12,781 cases.

The middle curve in the figure represents the cases admitted to the Clinic either because of definite initial signs of mastoiditis or because the acute otitis did not respond satisfactorily to antibiotic treatment. Generally we admit patients to the hospital if the otitis does not heal in two weeks when treated with myringotomies and antibiotics. As a rule

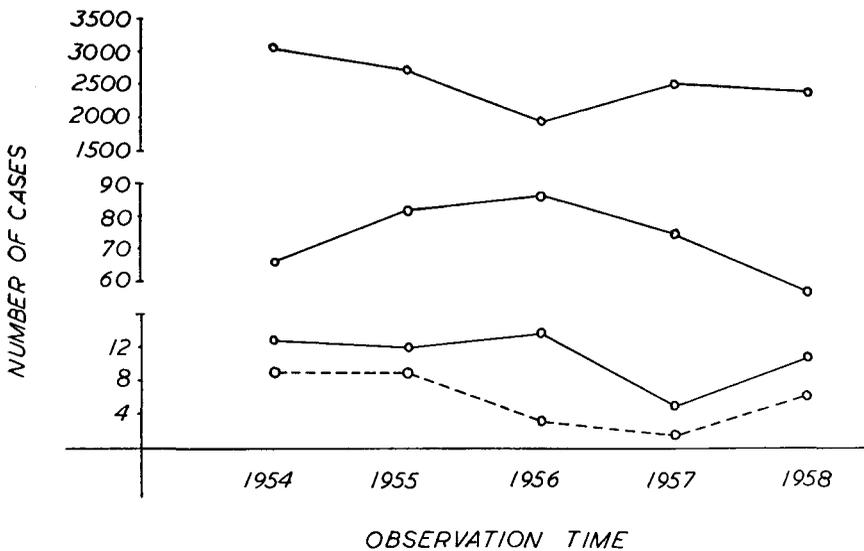


FIG. 1.

Annual frequency of otitis media. The top curve indicates the number of myringotomies each year between 1954 and 1958; the middle curve shows the number of cases hospitalized because of mastoiditis or prolonged otitis. The bottom curve shows the annual frequency of mastoidectomies. The broken line curve indicates the number of mastoidectomies in chronic otitis.

we give intramuscularly 4-600,000 units penicillin daily until the bacterial analysis is obtained. If indicated by the sensitivity tests, the antibiotic is then changed.

The bottom curve finally shows the annual frequency of mastoid operations performed in the Clinic. Excepting in the year 1957, when only 5 mastoidectomies were made in acute or subacute otitic infections, there is little variation: the figures are between 11 and 14 per annum. A total of 58 mastoidectomies were made during the observation period.

On the basis of above figures it can be calculated that a mastoiditis

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necessitating operation developed in 0·43 per cent. of the cases. This figure, however, is probably rather too high because part of the cases with acute otitis media had been treated outside the Clinic by private practitioners whereas all cases operated upon in this area are admitted to the Clinic.

The 365 cases represented by the middle curve all had otitis media with some degree of mastoid cell involvement. In a few of them the classical signs of acute mastoiditis led to an early operation, in others the medical treatment combined with myringotomies were first given a trial in the Clinic, the patients being under constant supervision. The 58 cases operated upon in this group of cases account for 15 per cent. of the total.

The age of the operated patients is shown in Table I. As can be seen, acute otitis media with mastoiditis is a disease of childhood and adolescence: only occasional cases occur in the older age groups.

TABLE I.
AGE OF PATIENTS.

Diagnosis	Age Groups									Total
	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	
Acute or sub-acute mastoiditis ..	14	17	15	8	1	1	2			58
Chronic mastoiditis ..				2	4	8	10	3	1	28

For purposes of comparison patients with chronic mastoiditis operated upon by simple mastoidectomy are included in this study. Their total number was 28; the broken line in Fig. 1 indicates their annual frequency and Table I the various age groups. As may be expected most of the chronic cases occurred in adult age groups with long duration of disease.

Indications for Operation

As a rule we perform operation in all acute cases showing signs of classic mastoiditis with swelling and tenderness behind the ear combined with displacement of the auricle. If a complication seems likely, e.g. lateral sinus thrombosis, meningitis, epi- or subdural abscess, or only subperiosteal abscess, we do not hesitate to clear the infection in the mastoid cells. Of the 58 mastoidectomies 19 were done because of these acute symptoms.

In the subacute cases the indications are not so clearly defined. Although we consider that general sequelae of inflammation, such as leucocytosis and increased sedimentation rate, together with haziness in

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the mastoid cell x-rays, support the diagnosis of mastoiditis, the decision to operate is made mainly on the basis of the audiological findings and the appearance of the middle ear. During the observation period the patients receive antibiotics in accordance with bacteriological analyses, and myringotomies are made to give the secretions a free drainage out. If the audiogram does not reach normal values, the tympanic membrane remains thick, there is œdema in the posterior canal wall and repeated myringotomies are necessary, we do a mastoid operation.

The duration of this observation period varies; in some cases it may be only a few days. In others, in which the otitic infection has a more lingering course, it may be a couple of weeks. The length of this period of waiting cannot be definitely fixed: we have earlier suggested that it should generally not exceed three weeks counted from the beginning of the otitic infection, and this still seems valid.

In chronic cases the operations have been done to clear the ear of the mastoid infection and so create possibilities for occlusion of the tympanic membrane defect later, when the ear is dry.

Clinical Observations

Bacterial analyses were done on the secretions obtained mostly by myringotomy and aspiration; in some cases, the cultures were made on pus secured at operation. Table II shows that β -hæmolytic streptococci,

TABLE II.

BACTERIOLOGICAL FINDINGS IN ACUTE OR SUBACUTE CASES.

<i>Streptococcus</i> β -hæmolyticus	..	..	..	..	..	15
<i>Streptococcus</i> α -hæmolyticus	..	..	..	..	..	1
<i>Streptococcus non-hæmolyticus</i>	..	..	..	..	..	1
<i>Diplococcus pneumoniae</i>	..	..	..	..	..	6
<i>Micrococcus pyog. v. aureus</i>	..	..	..	..	..	5
<i>Micrococcus pyog. v. albus</i>	..	..	..	..	..	1
<i>Hemophilus influenzae</i>	..	..	..	..	..	2
<i>Pseudomonas pyocyaneus</i>	..	..	..	..	..	1
<i>Escherichia coli</i>	..	..	..	..	..	2
<i>Proteus</i>	..	..	..	..	..	1
Culture negative	..	..	..	..	..	13
Not cultured	..	..	..	..	..	11

diplococcus pneumoniae, *micrococcus v. aureus* and *hemophilus influenzae* were the most frequent organisms responsible for mastoiditis. However, in the *micrococcus v. aureus* infections the cocci were combined in two instances with β -hæmolytic streptococci and in one case with *diplococcus pneumoniae*, the latter two strains being the primary agents. *Proteus* and *coli* strains were also found in subacute cases with primary streptococcus or diplococcus infections. In thirteen instances the bacterial culture was negative; this was evidently due to the antibiotic given before the analyses.

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The pre-operative leucocyte count and sedimentation rate appear in Table III. The leucocyte counts, grouped according to the classification of Koskinen (1938), in the great majority of cases exceed 8,000 cells/c. mm. The sedimentation rates (Leffkowitz scale 1937) are in good accord with the leucocyte counts, the great majority showing values over 30/1 h.

In chronic cases the picture is different. Although the leucocyte count in many cases was increased before the operation, the sedimentation rate shows only slightly elevated values.

TABLE III.
LEUCOCYTE COUNT AND SEDIMENTATION RATE IN ALL CASES.

Leucocyte count			Sedimentation rate/1 h.		
Leucocytes	Acute cases	Chronic cases	Sed. rate	Acute cases	Chronic cases
< 8,000	9	8	2-5	1	9
8,000-15,000	30	5	6-10	4	6
15,000-20,000	3	—	11-20	5	9
Not studied	16	15	21-30	3	3
			31-60	19	—
			61	26	—

A biopsy specimen was obtained at operation in 33 instances of the acute or subacute group. In 29 cases the pathologist's report was purulent mastoiditis with oedematous, hyperplastic, partly granulomatous mucosa heavily infiltrated with leucocytes; in some the bone fragments included showed evidence of necrotizing osteitis. In 4 cases the inflammatory changes had subsided to some extent and there were proliferative reactions.

Fifteen specimens of chronic cases were examined. In four of these there were obvious subacute inflammatory changes while the others showed signs of chronic mastoiditis with granulomatous reaction, round cell infiltration, foreign body giant cells and slits of cholesterol crystals.

In two of the cases with symptoms for two months before hospitalization the pathologist's report indicated tuberculous tissue changes associated with subacute mastoiditis. Bacilli were found in neither of these cases.

The operative notes show that in thirteen cases of the acute group there was subperiosteal abscess accompanied by infected mastoid cells. In four cases a lateral sinus thrombosis was found; the sinus was incised and the thrombi evacuated. Peri-sinuous abscess occurred in one case and meningitis in another.

In the remaining 39 cases the mastoid cells were filled with granulomatous hyperplastic mucosa, mostly associated with trapped pus in many of the cells. In all cases with a longer observation period the antrum

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was filled with thick granulomatous tissue extending into the middle-ear area. The antral area was always as far as possible stripped of mucosa and granulations so that the short process of the incus and the beginning of middle ear could be visualized.

All operations were made by the post-auricular route care being taken to open all mastoid cells thoroughly. In seven cases a musculo-periosteal flap was formed behind the ear for separating the middle ear permanently from the mastoid cavity. This plastic operation, suggested by Popper in 1935, should in our opinion be used more often; it prevents any later infection from spreading into the mastoid area. Moreover, a subsequent sclerosing of the mastoid bone takes place as the flap prevents the newly-formed bone from becoming pneumatized from the middle ear.

In two of the operated cases in this series there was a mastoid re-infection, in one case three months, and in another one year after mastoidectomy. Popper's plastic flap had been used in neither of these cases. In the former, a myringotomy combined with aspiration of the subperiosteal abscess was made. The latter case was re-operated on. Both made an uneventful recovery.

Audiological Observations

Hearing tests by pure-tone audiometry were made in as many cases as possible. In older persons speech audiograms were also obtained. In young children only spoken and whispered voice tests were made. In the case of very young children no reliable hearing tests were possible.

The audiometer used was a Peters SPD 2 equipped with PDR 10 ear-phones. The calibration of the audiometer was made by using a 2 c.c. artificial ear; the zero-line referred to in this paper represents the db. values over 0.0002 microbars as indicated in the Table IV.

TABLE IV.
SOUND PRESSURE LEVELS OF THE PETERS SPD 2 AUDIOMETER
AT 0-DB. HEARING LOSS.
(DB. ABOVE 0.0002 MICROBAR)

Frequency	..	..	250	500	1,000	2,000	4,000
Intensity	..	..	43	25	16	15	15

Pre-operative tests were generally made the day preceding the operation. Post-operative tests were made at intervals, at least when the ear was dry and the patient discharged from the hospital. If required, audiograms were made later when the patients were followed in the Out-Patient Department.

Fig. 2 shows the operative results in 38 cases of acute or subacute mastoiditis; the thin lines indicate the level of the pre-operative average hearing level (average of 500, 1,000 and 2,000 c.p.s. thresholds) and the black bars show the post-operative improvement. The hearing charts were

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incomplete in seven cases, and the tests could not be performed on thirteen young children.

The Table shows that improvement in hearing was good in the majority of cases, the final level being as a rule better than 20 db. It was a common observation that if the patients were operated upon during the first days of mastoiditis, or during the first two to three weeks of prolonged otitis media and quiescent mastoiditis, the final hearing was comparable to normal. In those cases in which the post-operative hearing levels

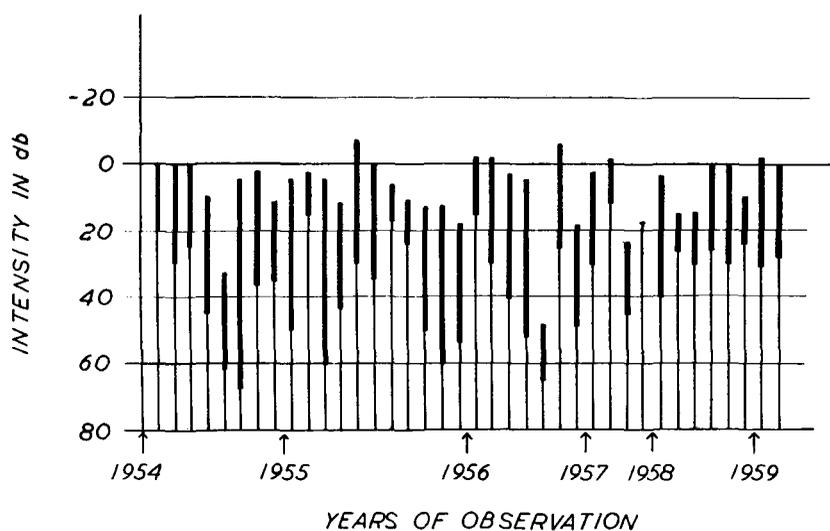


FIG. 2.

Hearing improvement in 38 cases with acute or subacute mastoiditis. The thin lines indicate the pre-operative hearing level; the length of the black bars shows the improvement following mastoidectomy. The hearing levels represent the averages of the frequencies 500, 1,000 and 2,000 c.p.s.

are close to the 20 db. line, the ear symptoms had lasted from three weeks to two months. In these cases the granulomatous reaction in the antrum and around the ossicles was also most distinct.

Fig. 2 shows three cases in which the post-operative result, in spite of clear improvement, remained below the 20 db. line, in one case as low as 48 db. This was a patient with two months duration of symptoms; the biopsy specimen showed tuberculous tissue. Clinically the antrum was filled with granulations and it was impossible to clear the entrance to the middle ear without damaging the ossicular chain. The result was an adhesive otitis. In the other two cases the symptoms had lasted about a month; although most of the granulomatous tissue could be removed from the aditus of the middle ear, there evidently remained enough of it to cause permanent hearing loss.

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When the results in hearing improvement in chronic cases (Fig. 3) are compared with those in Fig. 2, it is seen that the improvement was much less in the former. Exceptions are the four cases in which the symptoms had lasted from three to six months and which might also be classified as prolonged subacute mastoiditis. However, even then, only one of these, with an improvement of 43 db., was raised above the 20 db. line. In general the operation as such had very little effect upon hearing.

In three cases there was a loss about 10 db.; this was probably due to the fact that there was a perforation in the tympanic membrane, and as the ear became dry, the phase differences changed from the pre-operative conditions with fluid in the round window niche.

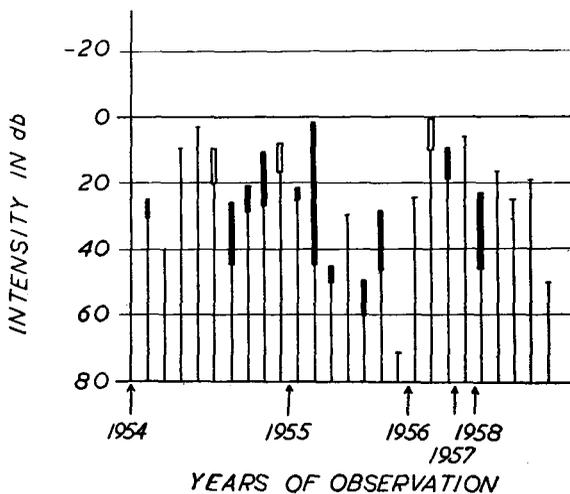


FIG. 3.

Pre- and post-operative hearing in 25 cases of chronic mastoiditis. Black bars indicate the amount of improvement, the open bars a corresponding loss.

The relation between the pre- and post-operative bone conduction thresholds also seemed to us of considerable interest. In the group of acute and subacute cases we have twenty-four complete records in which these data are satisfactory for analysis. In these cases pre- and post-operative masking of the opposite ear was made with white noise having the same intensity. From the results in Fig. 4 it can be seen that in the majority of cases there was clear improvement of bone conduction, in some even of the order of 30 db.

Although the relations between the air and bone conduction curves pre- and post-operatively can be seen to some extent from the preceding two figures, we have prepared another figure (Fig. 5) which shows this relation more clearly. It appears that although the black columns indicating

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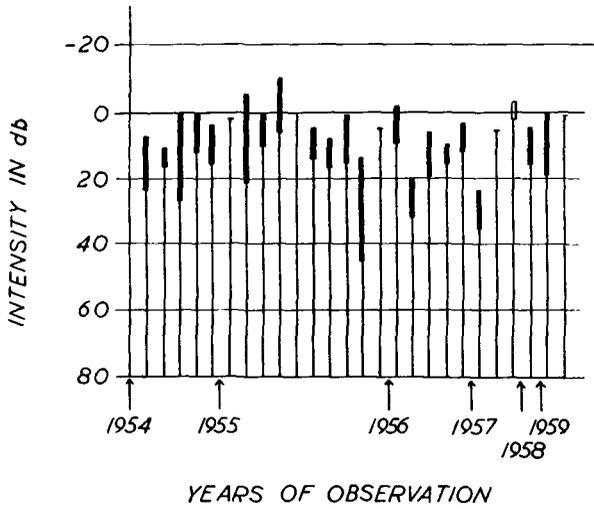


FIG. 4.

Changes in bone conduction thresholds (average of 500, 1,000 and 2,000 c.p.s.) following mastoidectomy. The pre-operative level is indicated by the thin lines, the post-operative symbols are the same as in Fig. 3.

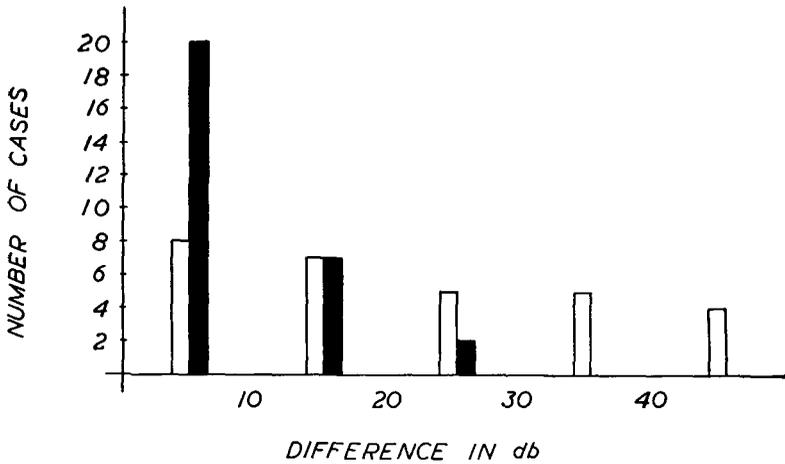


FIG. 5.

Pre- and post-operative air *vs* bone conduction differences. The abscissa shows how much bone conduction was better than air conduction and the ordinate relates the number of cases. Pre-operatively (white columns) bone conduction is much better than air conduction in a number of cases. Post-operatively (black columns) the gap is considerably narrowed although it is seen that in some cases there remains a permanent conductive loss.

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the post-operative conductive component are mostly at the left of the table, there remain some cases in which the conductive component is greater than the ideal one.

Discussion

In dealing with Fig. 1 it was pointed out that the figure reported by us for cases with otitis media developing into a mastoid infection necessitating mastoidectomy—0.4 per cent.—may be somewhat higher than the true figure because many cases are also treated outside the Clinic. However, the percentage would not be very much lowered if all these cases were available for study; according to information available to us it seems that 0.3 per cent. would be closest to the true figure.

The cases hospitalized for acute or subacute otitis media and mastoiditis represent 2.8 per cent. of our total of 12,781 cases seen between 1954-58. A mastoidectomy was necessary in 15 per cent. of these cases. This figure is considerably higher than Goodale and Montgomery's figure (6 per cent.) and much higher than Davison's, who was of the opinion that, with penicillin treatment, the incidence of mastoid operations should be close to zero.

We admit of course that in many of our cases, especially in those of acute mastoiditis with subperiosteal abscess, a prolonged conservative treatment with large doses of penicillin combined with repeated myringotomies and one or two punctures of the abscess would have led to healing without mastoidectomy. However, when a patient is operated upon, he can generally leave the hospital in seven days whereas a long antibiotic treatment as suggested by McKenzie and Davison, would unduly prolong the case, especially if there is shortage of hospital beds.

The virulence of otitic infections depends upon many factors and it may well be that the figures obtained in different countries are not directly comparable. Thus for instance in the series of Goodale and Montgomery, of Davison, and of McKenzie there were no cases of lateral sinus thrombosis; McKenzie even goes as far as saying (in 1958) that he has not seen a lateral sinus thrombosis since 1945. On the other hand Weller and Morrow have met this complication, and it occurred in four cases in our material also.

In general we agree with most above-cited authors in considering myringotomy, bacterial analysis, and adequate antibiotic treatment of very great value in the treatment of otitis media. After the preliminary two weeks in the Out-patient Department, however, we are not willing to pursue this course in the hospital for more than a week; if repeated daily myringotomies and aspirations are necessary and the hearing does not improve to the normal level, we are ready to do a mastoid operation. The operative findings in these cases are fully in accord with those in Weller's series: hyperplastic, granulomatous mucosa is seen filling the cells, there is purulent secretion in many cells, and the antrum is filled with

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œdematous, granulomatous tissue. No doubt many of these lesions heal with an antibiotic course of four to six weeks, but the lesions heal by fibrosis and this is inevitably followed by the formation of adhesions around the ossicles and in the middle-ear space. It is possible that hearing may be not unduly depressed after the antibiotic course, but any subsequent respiratory infection easily causes changes in the altered mucosa and many of these cases ultimately result in adhesive otitis.

As McKenzie points out, hearing does not always return to normal even after mastoidectomy; he lists 9 cases with an average post-operative

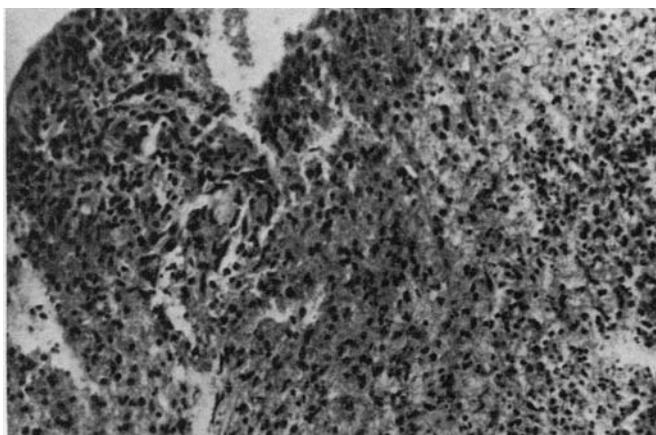


FIG. 6.

Biopsy specimen from antral granulations of a 7 years old boy whose symptoms had lasted for 6 days before mastoidectomy. At operation pus was found in the whole cell system but, in spite of mastoid swelling, there was no subperiosteal abscess. The figure shows granulomatous tissue in which leucocytes and lymphocytes fill the fibrinous network. Pre-operative hearing level was 35 db., post-operative 5 db. Medium power magnification.

hearing loss exceeding 30 db. There may have been other cases at the 20-30 db. level, but no mention is made of these. We insist, however, that this state of affairs follows if the mastoid operation is unduly postponed and the fibrous changes in the middle ear are allowed to become irreversible. If the operation is done early, the middle ears can be rendered normal (cf. Figs. 6 to 8).

This fact is well illustrated by our Fig. 2 in which the pre- and post-operative hearing levels are compared. In only two cases did the post-operative hearing loss remain greater than 30 db.: one of these had had otitic infections during many years and should have had a mastoid operation much earlier. Another was a 19-year-old boy whose ear had been discharging for two months in spite of treatment elsewhere; although the granulations could be removed from the antrum, there was no chance

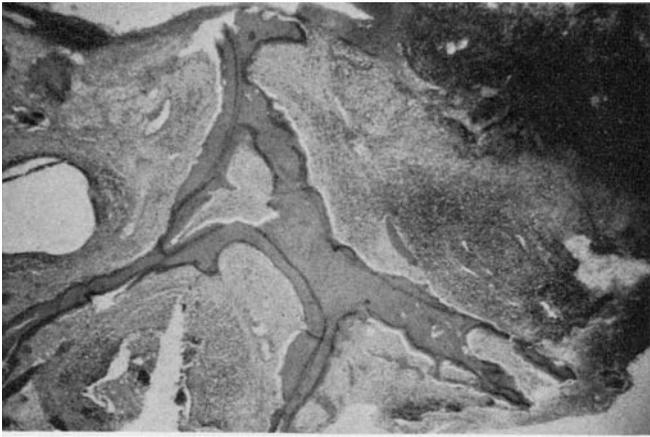


FIG. 7.

Biopsy specimen from the cellular mastoid of a 19-year-old boy whose otitis media had lasted for two weeks before operative intervention. A fistula, 3×3 mm., was found in the mastoid cortex leading to a cell system filled with pus and hyperplastic mucosa. The antrum was full of oedematous tissue which could all be removed. The figure shows bone chips with necrotic edges and heavy inflammatory cell invasion of the surrounding areas. In some areas proliferating fibroblasts were seen, and in some aircells macrophages were found in the exudate. Pre-operative hearing level was 30 db., post-operative 0 db. Low power magnification.

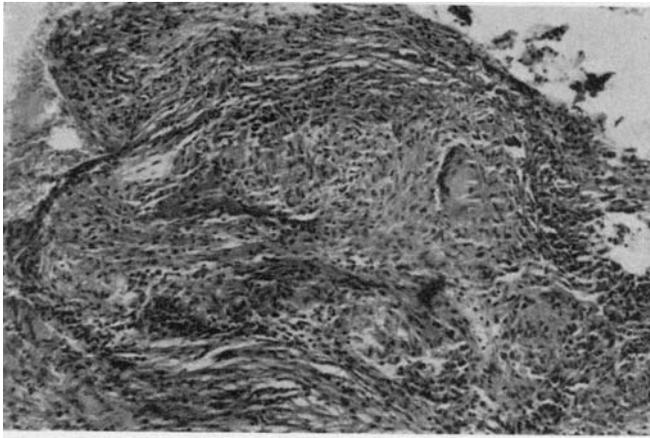


FIG. 8.

Biopsy specimen of antral granulations from a boy of 19 years, whose otitis media had lasted for two months before mastoidectomy. The large cell system was filled with hyperplastic mucosa and the antrum with granulomatous tissue. It was impossible to remove the granulations from the middle-ear area. In the figure a fairly large amount of fibrous tissue is seen together with epithelioid cells and giant cells. Pre-operative hearing level was 65 db. post-operative 48 db. Medium power magnification.

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of liberating the ossicles from this mass. In addition, the pathologist's report showed an additional tuberculous involvement (Fig. 8).

We (Palva and Ojala, 1955) pointed out earlier, in connection with bone conduction studies in acute otitis, that the lowering of bone conduction does not necessarily mean that there is an associated inner-ear component: it may be due to the impaired mobility of windows. This finding accords well with the present series (Fig. 4) which shows that, after healing of the otitic and mastoid infection, the initially lowered bone conduction values return to normal. The initial lowering of bone conduction depends largely on the extent to which the secretions in the middle-ear fill the window niches and on the degree of œdema and swelling of the middle-ear mucosa. In later stages, if the ears are not operated on and an adhesive otitis develops, the bone conduction values remain permanently lowered. It cannot be denied that in these chronic stages part of the bone conduction loss may also be due to toxic absorption products, which can easily cause damage to the basal coils in the cochlea. In these cases much emphasis should be placed on discrimination tests: if the patient scores well, then the lowered bone conduction probably results from occlusion of the windows, if not, there is probably an inner ear component.

In chronic cases, unless they can be regarded as prolonged subacute mastoiditis, the mastoid operation holds out little hope of improved hearing. The most important object of this operation is to clear the mastoid cells of infected material and thus create better possibilities for subsequent tympanic membrane repair.

Summary

Cases of acute otitis media have been studied with particular reference to the development of mastoiditis in the years 1954 through 1958. Of a total number of 12,781 cases in which myringotomy had been made, 365 were admitted to the Clinic because of acute mastoiditis or prolonged otitis media with suspected mastoiditis. Fifty-eight, or 15 per cent., of these patients were subjected to mastoidectomy; the others were cured with medical treatment. The number of cases needing mastoidectomy was 0.43 per cent. of the total cases observed; however, as all cases with otitis media are not seen in the Clinic, the frequency of mastoiditis was estimated to be about 0.3 per cent.

It is emphasized that if an ear with otitis media does not heal in three weeks under the proper antibiotics, and hearing remains impaired, it is advisable to perform mastoidectomy. If prolonged medical treatment is used, the mastoid cells and the antrum will be filled with œdematous, granulating mucosa in which fibrosing changes take place with healing. The result in many cases will be adhesive otitis with permanently impaired hearing.

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If operation is done early, hearing always returns to normal. The dangers associated with mastoidectomy are negligible in skilled hands, or with proper supervision. The use of Popper's musculo-periosteal flap has proved advantageous.

The final level of hearing is better than 20 db. (average of 500, 1,000 and 2,000 c.p.s.) if there has been no time for fibrosing changes in the middle ear to develop. It is shown that changes in bone conduction also occur, the post-operative levels being often better than the pre-operative. This is due to the fact that impaired mobility in the labyrinthine windows causes lowered bone conduction which disappears when the ear is healed. In adhesive otitis lowered bone conduction may be entirely due to these fibrous changes and does not necessarily indicate any inner-ear loss.

The value of myringotomy and aspiration and bacterial analyses in conservative treatment is stressed. It is now possible to treat conservatively a large number of cases that would, no doubt have required a mastoidectomy in earlier years.

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