Some Aspects of Otospongiosis

S. K. Kacker

Surgery of otospongiosis has given us spectacularly successful results. This has revitalised the specialty of Otorhinolaryngology. A number of new aspects have emerged and some old beliefs have been questioned. In this paper the following aspects of otospongiosis will be discussed with data.

(A) Carhart's notch;
(B) Sensori-neural deafness in clinical otospongiosis;
(C) Sensori-neural hearing loss after successful stapedectomy;
(D) Revision Stapedectomy.

(A) CARHART'S NOTCH

No data is available on values of Carhart's notch in Indian subjects. Hence we ought to document our values on this.

Material and Methods

This study was conducted on Indian cases of Otospongiosis at the All India Institute of Medical Sciences. These cases were seen between 1967 and 1976, and operated upon in the department of Otorhinolaryngology.

The bone conduction values of 596 patients have been statistically analysed. All the cases had clinical otospongiosis which had caused enough diminution of hearing to need surgery.

All the post-operative bone conduction values have been analysed in the 596 patients after full recovery from surgery and stabilisation of hearing.

All values are ISO-1964, tested on an adequately calibrated audiometer, in sound treated rooms. Fifty cases having ascending air conduction audiograms and 50 cases having flat air conduction audiograms have been separately analysed.

Observations

Table I shows the pre-and post-operative results of bone conduction hearing in dB. H.L.

Table II shows the comparative study of 50 cases each with ascending and the flat audiogram.

Discussion

A reversible bone conduction hearing loss has been reported in cases of Otospongiosis (Wood, 1950 and Carhart, 1950). Shambaugh (1967) has called this “Carhart's Notch” and an average correction of 5 dB at 500 Hz, 10 dB at 1000 Hz, 15 dB at 2000 Hz and 5 dB at 4000 Hz has been recommended in predicting the hearing gain to be expected after surgery.

We have also seen improvement in bone conduction in cases of stapedectomy, myringoplasty and secretory otitis media (Kacker, 1977, Goodhill 1972). Thus mechanical factors can cause a dip in hearing by bone conduction and this can only be diagnosed, after improvement in hearing, following a successful cure of the mechanical defect. Whereas an occasional case will show marked


table I

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Post-operative</th>
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<tbody>
<tr>
<td>N=596</td>
<td>500 1000 2000 4000</td>
<td></td>
</tr>
<tr>
<td>Pre-operative</td>
<td>18.03 16.47 20.62 21.54</td>
<td></td>
</tr>
<tr>
<td>Post-operative</td>
<td>17.31 15.45 18.39 22.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(±3) (±6) (±7) (±5)</td>
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</tbody>
</table>

Figures in brackets represent standard error of difference between means. At the level of probability p=0.05 (5% confidence level) the difference between the means at 500, 1000 and 4000 Hz are not significant. However, at this probability level the difference between the means at 2000 Hz is significant and the null hypothesis is unlikely.

TABLE II

<table>
<thead>
<tr>
<th></th>
<th>Operated Ear</th>
<th>Unoperated Ear</th>
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<tbody>
<tr>
<td>N=50</td>
<td>500 1000 2000 4000</td>
<td>500 1000 2000 4000</td>
</tr>
<tr>
<td>(A) Ascending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Conduction Curve</td>
<td>Pre-operative</td>
<td>15-5</td>
</tr>
<tr>
<td>N=50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) Flat Air Conduction curve N=50</td>
<td>Pre-operative</td>
<td>21-84</td>
</tr>
<tr>
<td>N=50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17-5</td>
<td>15-97</td>
</tr>
</tbody>
</table>

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improvement in hearing of bone conduction after stapes surgery, as a group this phenomenon is not as marked and only a notch of 0-72 dB for 500 Hz, 1-02 dB for 1000 Hz, 2-23 dB at 2000 and an average difference which was a deterioration to the extent of 0-49 at 4000 Hz was detected in the present study. (Fig. 1 & 3). There seems to be no way to predict preoperatively with certainty the expected improvement in bone conduction after ear surgery.

The Carhart notch is thought to be maximum for 2000 Hz and this was borne out by our study. It was found to be 2-23 dB for 2000 Hz in our series.

The cochlea is a sense organ that functions in a fluid medium, and as sound waves enter it, this fluid medium is disturbed, and it could well be that some of the nutrition of the hair cells of Corti’s organ is dependent upon the movement of the fluid. If sound waves do not disturb it periodically then neural degeneration can occur e.g. Carhart’s Notch (Willis, 1963).

Willis (1963) has raised the question of whether the improvement of air conduction well above preoperative bone conduction was due to mobilisation of inner ear fluid media causing an improvement in the nutrition of hair cells and hence function of the inner ear. He favours this theory, because in his case of Mrs. J. W. the post-operative hearing continued to improve for 5 months. Moreover, in this case, the maximum hearing loss was at 1000 Hz. This explanation does not seem sound to us.

Carhart (1950) explained the reversible Sensori-neural deafness seen in Otospongiosis to fixation of stapes, which modified the mechanical constructs of the inner ear so that its frequency response to skull borne vibration is changed. He explained that fenestration surgery restores the mechanical constraints to approximately their earlier values, so that there is a reversal in acuity for bone conduction stimuli. He said that the initial drop in bone conduction is due to increased stiffness and is primarily in lower frequencies. Later there are additional changes in this type based on the mass increase, this converts the early ascending type of air conduction curve to a flat curve. This hypothesis was tested by taking 100 cases, 50 of ascending air conduction curve and 50 of flat air conduction curve the postoperative values show an average gain for B.C. for speech frequencies of 1 dB H.L. for ascending audiograms and 4 dB H.L. for flat audiograms. Thus improvement in bone conduction was more marked in cases with flat audiograms in the present series and this supports Carhart’s hypothesis.

(a) A reversible bone conduction hearing loss called Carhart’s Notch is seen in otospongiosis;

(b) The values of the Notch as a whole group are: 0-72 dB for 500 Hz, 1-02 dB for 1000 Hz, 2-23 dB for 2000 Hz;

(c) The Carhart’s notch was more marked in cases with a flat audiograms (4 dB) as compared to those with an ascending audiogram (1 dB);

(d) Other observations have shown that this phenomenon also occurs in tympanosclerosis, exudative otitis media and chronic supplicative otitis media.

The natural history of hearing loss in otospongiosis is variable and unpredictable. Some cases will have stable conductive hearing loss others will develop sensori-neural deafness. Glorig and Gaeillo (1962) do not feel that the Otospongiotics have a greater predilection to sensori-neural deafness than can be accounted for by their age. This part of the paper deals with data elucidating this problem.

Material and Methods

Various age groups with clinical otospongiosis have been analysed. The bone conduction audiograms have been compared to those seen in normal populations of various age