Reexamination of the Acoustic Method in Measurement of Eustachian Tube Function

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Summary. In order to assess the reliability of the acoustic method in examination of Eustachian tube function, 30 subjects with normal, obstructive or patent tubes were examined twice, by the acoustic method, and by the aerodynamic method which we have developed. The reliability of the aerodynamic method has been confirmed by repeated clinical examinations. 60% of the results of the acoustic method were found to disagree with both the results of the aerodynamic method and the clinical findings of the tested ears. One cause of this disagreement was shown to be the influence of motion accompanying deglutition upon the sound transmission.

Since Perlman (1939) reported an acoustic test for examination of the Eustachian tube function, it has been used as one of the most physiologic methods for evaluating this function (Tukamoto, 1957; Elpern et al., 1964; Satoh et al., 1970). However, we were rather suspicious of its reliability because several factors other than the tubal function might influence the test results.

As an alternative, we developed a simple aerodynamic test and through accumulated clinical use of this test, its reliability was confirmed (Kumazawa et al., 1974, 1977). In this study, an attempt was made to reexamine the acoustic method through a comparison of the two test results.

Subjects and Methods

A total of 30 subjects with normal, obstructive or patent tubes were selected for this study. For normal tubes, ten subjects with normal ear drums, normal hearing levels and no complaints about the ear were selected. For obstructive tubes, ten subjects with retracted ear drums and a sensation of fullness in the ear were selected; and for patent tubes, ten subjects whose ear drums moved synchronously with respiration and who complained of autophony were chosen.
The acoustic method was performed as follows, with slight modification of the procedure reported by Elpern et al. (1964). A pure tone of 250 Hz and 100 phones was introduced into the nostril and the change of sound pressure due to deglutition was picked up by a microphone connected to the external ear canal.

The aerodynamic test was performed as shown in Figure 1. Both inflow of air into the tube by Valsalva's maneuver and outflow by swallowing were recorded through pressure transducers connected to the ear canals. Thus air flow in the tube was recorded as shown in Figure 1.

Results

Table 1 shows that the results of the acoustic method were inconsistent with those of the aerodynamic method in 60% of cases. In the following, some representative cases of the inconsistency between the two test results are presented.

1. Normal Tubes

Case 1. The aerodynamic pattern showed a steep initial rise and immediate return to atmospheric pressure in a single swallow, indicating normal tubal function of both ears (Fig. 2). On the other hand, the results of the acoustic method indicated bilateral obstructive tubes; in the right ear the amplitude during deglutition increased only slightly and in the left ear it decreased.