Introduction

It is known that the eustachian tube (ET) plays an important role in maintaining middle ear physiology and functions (1), and that the ET of an infant is short and located horizontally compared with that of an adult (2, 3). These anatomical features are speculated to be related to high susceptibility to otitis media with effusion (OME) in infants and children. Recent remarkable advances in the imaging technique of computed tomography (CT) are realizing clearer and clearer imaging of the anatomical features of the ET on the CT. The multiplanar reconstruction (MPR) technique is one of the new imaging techniques for CT, with which any arbitrarily reconstructed image desired can be obtained by changing the angle of the plane by 0.5 degrees and by changing the place of the plane by 1 millimeter. We previously reported the anatomical features of the ET in patients with patulous ET using this technique (4). The aim of this study is to clarify the precise anatomical features of the ET of infants and children with and without OME on CT using this MPR technique.

Materials and Methods

All the participants examined in this study were Japanese. The OME children group comprised 54 ears of 27 patients (15 males and 12 females; age range from 301 days to 8.9 years (3253 days); mean age 4.9 years old). Their OME was diagnosed by an otoscopy showing fluid behind the eardrum and tympanometry demonstrated type B or C. All of them were treated by tympanostomy tube at least once, because the fluid was still present after 12 weeks in spite of the treatment of an internal medicine. And all CT images of OME children group showed soft tissue density in the middle ear cavity. The control group (normal children group) comprised 50 ears of 25 patients (9 males and 16 females; age range from 281 days to 8.2 years (2975 days); mean age 4 years old) without middle ear problems. All of them had sensorineural hearing loss without middle ear problems. The OME children group showed soft tissue density in the middle ear cavity. The control group showed no soft tissue density in the middle ear cavity, and no inner or middle ear anomaly.

Measurement of Angle and Length of the Eustachian Tube

In this study, we examined the angle of ET in infants and children. We measured the angle of the ET on the CT, which is the angle from the pharyngeal orifice of ET to the tympanic orifice of ET. The angle of ET was defined as the angle of the straight line representing the ET length and perpendicular to the ET length, which is defined as the plane connecting between right infraorbital margin and upper margin of the external auditory meatus (Figure 1).

Results

The mean values and standard deviations (SD) of the angles and lengths of the ET on the right and left sides in any groups are described in Figure 2, indicating no significant difference between the right and left sides in any of the groups. Both the angles and lengths were significantly greater in OME children group than in either OME children group or normal children group (one-way ANOVA and Fisher’s PLSD tests, p<0.01), but there was no significant difference either in the angle or the length of the ET between OME group and normal children group (p>0.05). The distribution of the length of the ET of OME and normal children groups is shown as a function of the age. In addition to the angle, the lengths were observed to constantly increase with age. The length of ET was found to develop in early childhood, when OME is generally prevalent. This may be related to high susceptibility of OME in infants and children rather than otologic factors.

Abstract

Objectives: To obtain clear views of the anatomical features of the eustachian tube (ET) related to the susceptibility to otitis media with effusion (OME) in infants and children.

Methods: The angle and length of the ET in children (54 ears, OME children) and controls (50 ears, normal children) were measured on CT using the multiplanar reconstruction technique.

Results: The angles of the ET in OME children group, normal children group, and normal adult group were 20.4±3.9°, 21.2±4.8°, 19.9±4.3° and the corresponding lengths were 3.2±0.7 mm, 3.7±0.6 mm, 3.3±0.7 mm in the right and left sides, respectively. The angles of the ET in OME children group were significantly greater in the right and left sides in all groups. Both the angles and lengths were significantly greater in the right side of the ET in either the OME children group or normal children group (p<0.05), but there was no significant difference either in the angle or the length of the ET between the OME children group and normal children group (p>0.05).

Conclusions: The angle and length of ET are more horizontally shorter in infants, and there is no significant difference between infants with and without OME. These results suggest that the ET was found to develop in early childhood, when OME is generally prevalent. This may be related to high susceptibility of OME in infants and children rather than otologic factors.

Discussion

The present study was the first report measuring the angle the ET using CT images. The values of the angle of the ET in the present study was quite different from that in Proctor’s report (2), in which the angle of the ET to the horizontal plane is 45 degrees in adults, and 10 degrees in infants. Since there has been no anatomical report about the angle of the ET in Japanese infants and children, a race difference might be related to this discrepancy. However, since Proctor’s measurements were probably done by the gross anatomical method, the results may lack accuracy. Also in his report, it is not stated whether the angle of the ET was measured against the “Reid’s standard plane” or not. We think that it is extremely difficult to accurately measure the angle of the ET against Reid’s standard plane by the gross anatomical technique. We believe that the values of the angle and the length of the ET in the present study are more accurate, because we can precisely measure the angle and the length of the ET using the multiplanar technique (4, 5). As the angle of the ET in OME cases was not stated in previous reports (2, 3), the relation between the angle and the incidence of OME is unclear. In the present study, we demonstrated no significant relation between the angle and length of ET and the presence or absence of OME. Furthermore, the values of the angle and length of ET in 6 years-olds or 7 years-olds are similar to those in adults, regardless of the presence or absence of OME. These results suggest that a short and horizontal ET is not a major etiological factor of OME in infants and children. It is also interesting that the length of the ET was found to develop in early childhood, when OME is generally prevalent. This may be related to the high susceptibility of OME in infancy (6).

Bibliography