Effects of Intralabyrinthine Hemorrhage on the Cochlear Elements

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Abstract

Objective: To compare histopathologic findings in the cochlea of human temporal bones with vs. without intralabyrinthine hemorrhage.

Materials and Methods: We analyzed 46 human temporal bone samples from 23 patients with unilateral intralabyrinthine hemorrhage (23 samples from ears with intralabyrinthine hemorrhage and 23 samples from contralateral ears without). We noted the location of hemorrhage in the inner ear, the degree of endolympatic hydrops, the number of spiral ganglion cells and hair cells, mean loss of fibrocytes in spiral ligament, and areas of the stria vascularis and spiral ligament.

Background: Hemorrhagic labyrinthitis can cause sensorineural damage, sudden hearing loss, and vertigo. Yet to our knowledge, no studies have quantitatively described histopathologic effects of intralabyrinthine hemorrhage on the elements of the cochlea.

Results: Intralabyrinthine hemorrhage caused significant loss of outer hair cells in the lower basal (P = 0.001), upper basal (P = 0.005), and lower middle (P = 0.012) cochlear turns. There were no significant differences between the hemorrhagic and contralateral sides in the number of inner hair cells in any turn (P > 0.05). We found no significant differences between the 2 sides in the number of inner hair cells in any turn (P > 0.05).

Discussion

Since we observed pathologic changes in the cochlea adjacent to areas of hemorrhage, we speculate that local effects of hemoglobin breakdown products (such as thrombin) and/or the lack of blood supply to the cochlear elements could be the underlying mechanisms of cochlear damage. Hemolysis of erythrocytes gives rise to the release of hemoglobin, whose breakdown products include carbonmonoxide, iron, and biliverdin. We found the degree of endolympathic hydrops to be significantly higher in temporal bone samples with IH. The reason might be electrolyte imbalance as a result of an increase in reactive oxygen species and/or enzymatic disregulation.

Conclusion

IH can lead to a significant loss of outer hair cells in the cochlea and endolympathic hydrops, which could account for hearing loss and vertigo. Loss of damage to the inner hair cells, spiral ganglion cells, stria vascularis, or spiral ligament, suggest that patients with IH could be candidates for amplification with hearing aid or cochlear implant.

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Materials and Methods

We analyzed 46 temporal bone samples from 23 patients with unilateral IH (23 samples from ears with IH and 23 samples from contralateral ears without). The patients included 17 men (74%) and 6 women (26%), ranging in age from 1 day to 71 years (mean, 29.9 ± 25.5 years).

Hair Cells: We assessed the presence of outer and inner hair cells in each cochlear turn. The percentage loss of cochlear hair cells was counted to compare 2 groups.

Spiral Ganglion Cells: We divided Rosenthal’s canal into 4 segments as described previously: segment I (from base to 6 mm); II (6 to 15 mm); III (15 to 22 mm) and IV (22 mm to apex). All nuclei were counted in each section. The number of ganglion cells was determined for each segment.

Endolympathic Hydrops: We subdivided our temporal bone samples according to degree of hydrops, per classification of Cureoglu et al. (1): slight, moderate, and profound.

Stria Vascularis: In all of the cochlear turns at the modiolar level, as well as on the adjacent 2 sections, we obtained morphometric measurements of the stria vascularis.

Spiral Ligament: We divided the spiral ligament into 4 segments according to the appearance of different types of fibrocytes, per previous studies by Spicer and Schulte (2). To estimate and evaluate the mean loss of fibrocytes in each segment, we used a rating scale, per the methods of Hequembourg and Liberman (3). Morphometric measurements of spiral ligament’s area were made in all turns of the cochlea at the modiolar level and the adjacent two sections.

Introduction

Intralabyrinthine hemorrhage (IH), though a rare problem, can result in sudden sensorineural hearing loss and vertigo. The most common underlying cause is hemorrhagic diathesis, but other important causes may include trauma, leukemia, metastatic malignancy, Wegener’s granulomatosis, intracranial hemorrhage, and cocaine consumption. Intracranial hemorrhages can include intracerebral, subarachnoid, and subdural locations.

Yet to our knowledge, no studies have quantitatively described histopathologic effects of intralabyrinthine hemorrhage on the elements of the cochlea.

The purpose of this study was to evaluate the otopathic effects of IH on the structures of the cochlea. Specifically, we compared histopathologic findings in inner ears of human temporal bones with vs. without IH. A more thorough understanding of the pathology and mechanism of cochlear damage after IH will help clinicians plan medical or surgical treatment for such patients.

2. Spicer SS, Schulte BA. Differentiation of inner ear fibrocytes according to their ion transport related activity. Hear Res 1991;56:53-64.