Auris Nasus Larynx xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Auris Nasus Larynx

journal homepage: www.elsevier.com/locate/anl

Stria vascularis and cochlear hair cell changes in syphilis: A human temporal bone study

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ARTICLE INFO

Article history:
Received 3 November 2015
Accepted 14 January 2016
Available online xxx

Keywords:
Syphilis
Cochlea
Hair cell
Temporal bone
Histopathology

ABSTRACT

Objective: To observe any changes in stria vascularis and cochlear hair cells in patients with syphilis.
Materials and methods: We examined 13 human temporal bone samples from 8 patients with syphilis (our syphilis group), as well as 12 histopathologically normal samples from 9 age-matched patients without syphilis (our control group). We compared, between the two groups, the mean area of the stria vascularis (measured with conventional light microscopy connected to a personal computer) and the mean percentage of cochlear hair cell loss (obtained from cytocochleograms).
Results: In our syphilis group, only 1 (7.7%) of the 13 samples had precipitate in the endolymphatic or perilymphatic spaces; 8 (61.5%) of the samples revealed the presence of endolymphatic hydrops (4 cochlear, 4 saccular). The mean area of the stria vascularis *did not* significantly differ, in any turn of the cochlea, between the 2 groups ($P > 0.1$). However, we *did* find significant differences between the 2 groups in the mean percentage of outer hair cells in the apical turn ($P < 0.026$) and in the mean percentage of inner hair cells in the basal ($P = 0.001$), middle ($P = 0.004$), and apical ($P = 0.018$) turns. In 7 samples in our syphilis group, we observed either complete loss of the organ of Corti or a flattened organ of Corti without any cells in addition to the absence of both outer and inner hair cells.
Conclusion: In this study, syphilis led either to complete loss of the organ of Corti or to significant loss of cochlear hair cells, in addition to cochleosaccular hydrops. But the area of the stria vascularis did not change.

1. Introduction

Syphilis, caused by the spirochete *Treponema pallidum*, can cause cochlear and vestibular dysfunction. Both congenital and acquired syphilis can be associated with sensorineural hearing loss [1]. Otosyphilis should be considered in patients with syphilis and a history of vestibular symptoms, tinnitus, and fluctuating sensorineural hearing loss [2]. Endolymphatic hydrops can be seen during a routine pathologic evaluation of an ear specimen from patients with a history of otosyphilis [3,4]. However, any association of endolymphatic hydrops with other pathologic findings and symptoms remains unclear, as does its causative mechanism. In this study, using human

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http://dx.doi.org/10.1016/j.anl.2016.01.001
0385-8146/

temporal bone samples from patients with syphilis, we investigated the area of the stria vascularis, the organ of Corti, and cochlear hair cells.

2. Materials and methods

2.1. Samples

We examined a total of 25 human temporal bone samples from 17 deceased patients: 13 samples from 8 patients with syphilis (our syphilis group), as well as12 histopathologically normal samples from 9 age-matched patients without syphilis (our control group). In our syphilis group, the mean age of the 8 patients (5 male, 3 female) was 70 ± 7 years (range, 58–78). In our control group, the mean age of the 9 patients (6 male, 3 female) was 67 ± 7 years (range, 60–77).

Excluded from our study were temporal bone samples from patients known to have had the following conditions that might affect the cochlea: head trauma, systemic autoimmune disorders, ototoxic drug use, and any defined otologic diseases (e.g., active otitis media, labyrinthitis, and internal auditory canal tumor).

We obtained samples from the archived human temporal bone collection of the University of Minnesota. All temporal bones had previously been removed at autopsy, fixed in 10% formalin solution, decalcified, and embedded in celloidin. Each temporal bone was serially sectioned in the horizontal plane at a thickness of 20 μm from superior to inferior. Every 10th section was stained with hematoxylin and eosin. The institutional review board of the University of Minnesota (0206M26181) approved this study.

2.2. Qualitative histopathologic assessment

We used light microscopy to examine all 25 human temporal bone samples (13 in our syphilis group and 12 in our control group). We assessed each labyrinth for the presence or absence of precipitate within the endolymphatic and perilymphatic spaces. We defined hydrops by any distention of the membranous walls of the saccule and utricle or any distention of Reissner's membrane of the cochlea. In our syphilis group, we excluded at this point 1 sample from a patient with a history of otitis media, except for purposes of evaluating endolymphatic hydrops, so our final syphilis group comprised 12 samples for statistical analysis.

2.3. Area of stria vascularis

We measured the area of the stria vascularis in the lower basal turn, the upper basal turn, the lower middle turn, the upper middle turn, and the apical turn of the cochlea in the midmodiolar section and in the 2 adjacent sections above and below. We then determined the mean area of those 3 sections in the 12 remaining samples in our syphilis group and in the 12 samples in our control group. To examine the sections, we used conventional light microscopy with a digital camera connected to a personal computer, whose monitor displayed the sections. We determined the area of the stria vascularis using commercially available image analysis software (SPOT Advanced software, SPOT Imaging Solutions, Sterling Heights, MI, USA). We included only the cellular part of the stria vascularis, excluding all observed cystic-like structures and concretions.

2.4. Spiral ganglion cells

To evaluate total number of spiral ganglion cells, we used the method defined by Otte et al. previously [5]. 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 and for the cochlea as a whole by multiplying their summed counts by 10 to account for the un-mounted sections and by a factor of 0.9 to account for cells that would be counted because of their location at the interface between sections. The percentages of spiral ganglion cell loss were calculated using the age-matched normative data determined previously [6].

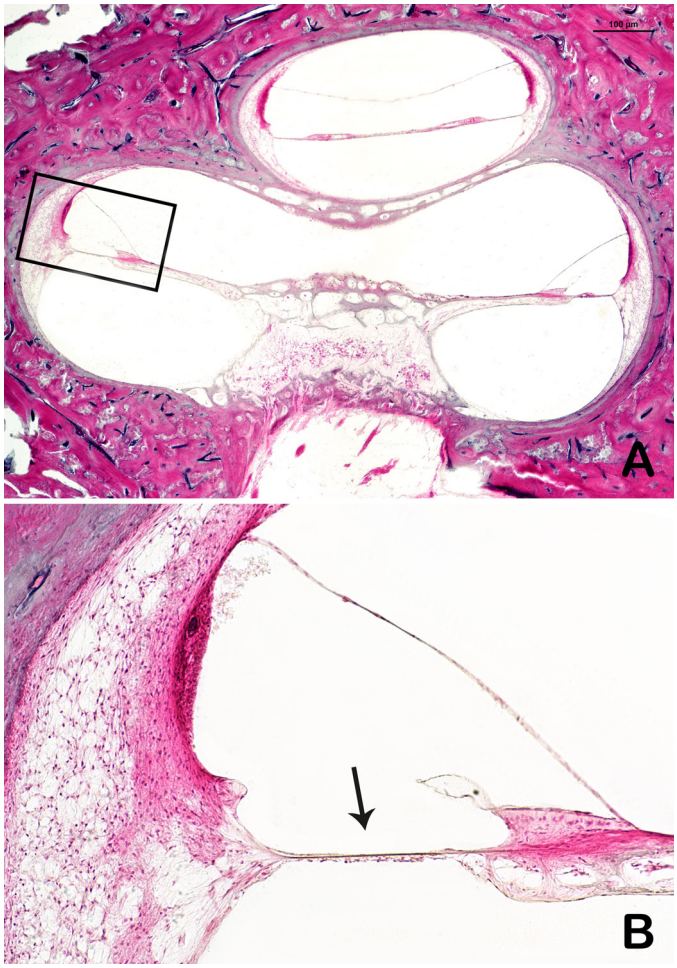

Fig. 1. Light photomicrograph of the cochlea from a 68-year-old woman with syphilis: (a) lower-magnification image, (b) magnified view of boxed area. Arrow = complete loss of the organ of Corti.

Please cite this article in press as: Hızlı Ö, et al. Stria vascularis and cochlear hair cell changes in syphilis: A human temporal bone study. Auris Nasus Larynx (2016), http://dx.doi.org/10.1016/j.anl.2016.01.001