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Hydrogen-rich saline alleviates experimental noise-induced hearing loss in guinea pigs

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Abstract

Objective: To examine the efficiency of hydrogen-rich saline in the treatment of intensive noise-induced cochlear injury.

Materials and methods: Forty guinea pigs were assigned to one of four groups: HS+NOISE (i.p. injection hydrogen-rich saline), NS+NOISE (i.p. injection normal saline), NOISE ALONE (noise control), and NO TREATMENT (normal control) groups. The HS+NOISE, NS+NOISE, and NOISE ALONE groups were exposed to intensive noise (4 h at 115 dB SPL noise of 4000±100 Hz). The auditory brainstem response (ABR) was used to examine the hearing threshold in each group. Distortion product otoacoustic emission (DPOAE) was used to examine outer hair cell function. We also examined cochlear morphology to evaluate inner and outer hair cell trauma induced by noise exposure. Hydrogen-rich saline was administered twice daily for 6 days (2.5 ml/kg, i.p.) 24 h after noise exposure.

Results: Baseline ABR thresholds and DPOAE values were normal in all groups at the measured frequencies (2, 4, 8, and 16 kHz) before noise exposure. The ABR threshold shift was 50-55 dB across the frequencies tested, and average DPOAE declined in the NOISE ALONE, NS+NOISE, and HS+NOISE groups 24 h after noise exposure. However, the changes in cochlear parameters were different between groups. The HS+NOISE group showed a significantly decreased ABR threshold value as compared with the NS+NOISE or NOISE ALONE group ($P<0.01$) on day 7. The mean DPOAE recovered to some extent in the three noise exposure groups, but at most frequencies the HS+NOISE group showed significantly increased DPOAE on day 7 as compared with the NS+NOISE group or NOISE ALONE group ($P<0.01$). Surface Corti organ preparations stained with succinate dehydrogenase (SDH) showed that most outer hair cells (OHCs) were still dropsical and a few were missing 7 days after noise exposure in the NS+NOISE group. Only a few OHCs were slightly dropsical in the HS+NOISE group. The numbers of missing hair cells 7 days after noise exposure were significantly greater in the NOISE ONLY and NS+NOISE groups than the HS+NOISE group ($P<0.01$).

Conclusions: Hydrogen-rich saline can alleviate experimental noise-induced hearing loss in guinea pigs, partially by preventing the death of cochlear hair cells after intensive noise exposure.

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