Evaluation of inner ear pathology in Weddell seals

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Last year, it was reported that several noise sources, located in McMurdo Sound, are potentially damaging to the hearing of marine mammals. To determine whether or not the hearing organ (organ of Corti) of Weddell seals had evidence of permanent sensorineural damage, we processed for microscopic examination, one temporal bone from each of 11 Weddell seals which were killed in January, 1985, as part of the New Zealand Antarctic Research Program. The techniques used to collect the seals and to fix and embed their temporal bones were described last year (Bohne et al. 1985). This report briefly describes the techniques used to obtain surface preparations of the organ of Corti and to analyze the specimens microscopically. The normal and pathological findings in the 11 Weddell seal cochleas are also summarized.

The cochleas were fixed in osmium tetroxide, dehydrated in alcohol and embedded in plastic. Once the plastic had polymerized, the cochlear bone which surrounds the soft tissue of the inner ear was removed with a sharpened steel pick. Pieces of razor blade were used to divide the cochlear duct into small segments which ranged in length from 0.6 to 4.9 millimeters. Each segment was then trimmed to remove most of the plastic filling scala tympani. The trimmed segments were re-embedded in a thin layer of plastic. After the layer polymerized, simplified images of the segments of the organs of Corti were made, their lengths were measured with a graphics tablet/computer system, and the histological appearances of the sensory cells and eighth nerve fibers were determined using a phase contrast microscope.

As noted in the previous report, all 11 temporal bones sustained some acute damage (e.g., detachment of the organ of Corti from the basilar membrane) due to the exploding bullets used to produce instant kills. The presence of acute damage prevented detailed analysis of the entire organ of Corti in each specimen. Nevertheless, in most specimens, a sufficient amount of tissue remained for the determination of some normal cochlear parameters and for the assessment of the presence of pre-existing (i.e., prior to gunshot) cochlear pathology.

The average length of the organ of Corti from the 11 Weddell seal cochleas was found to be 31.2 ± 1.1 millimeters. The average density of inner and the three rows of outer hair cells per millimeter length of the organ of Corti were found to be 98 and 395, respectively. These values should be considered as rough approximations because the cell counts could be made in only a small portion of each of the 11 organs of Corti. However, it is interesting to note that these densities are similar to the inner and outer hair cell densities in several terrestrial mammals (human—109, 418 (Bredberg 1968); chinchilla—100, 405 (Bohne, Kenworthy, and Carr 1982); guinea pig—92, 354 (Thorne and Gavin 1984]).

Five of the 11 cochleas had no evidence of previous damage to the organ of Corti. Due to extensive acute damage, the organ of Corti was not visible in a sixth cochlea. In these six cochleas, the entire population of eight nerve fibers was intact. On this basis, it was concluded that none of these ears had sustained severe injuries to the organ of Corti prior to death.

The remaining five cochleas had clear evidence of previous damage. These injuries ranged from scattered loss of outer hair cells to degeneration of an entire portion of the organ of Corti and its replacement by squamous epithelium. This latter lesion was accompanied by degeneration of the corresponding eighth nerve fibers. It should be noted that since only a small portion of the organ of Corti could be examined in each cochlea, additional sensory cells may have been missing but their losses would have been masked by the acute damage.

Although the etiology of the cochlear damage in the five Weddell seal cochleas cannot be determined with certainty, noise is the one ototraumatic agent which is known to have been present in their environment.

The effect these cochlear lesions had on the hearing ability of the seals is unknown. However, based on studies in terrestrial mammals in which hearing loss has been correlated with sensory cell loss (e.g., Bohne and Clark 1982), it is highly unlikely that any of the seals had a significant hearing impairment.

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References


