Otoneuroscience and Space Vestibulo-Neuroscience in the New Century

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Key Words

Clinical otoneurology
Otoneurological diseases
Pathophysiology
Animal experiments
Evolution

Abstract

From a clinically oriented point of view, efforts of otoneuroscience should be directed toward an improvement of the management of dizzy and vertiginous patients. At present, the main obstacles in this field are: (1) the lack of specific therapies for many of the clinical diagnoses. This reduces the necessity of clinical vestibular diagnosis to a pragmatic exclusion of the few diseases with therapeutic consequences; (2) the lack of feedback to confirm or disprove clinical diagnoses; (3) poor knowledge of the pathophysiology of many of the otoneurological diseases; experiments in animal models may be helpful in this respect; (4) most progress in medicine originates from the results of numerous, poorly controlled 'unscientific' trial and error experiments obtained during treatment of patients; training clinicians in more scientific, critical thinking would help to increase the profits that can be realized from this important source of information; and (5) to date, information obtained during zero-gravity experiments in space have not yet led to important consequences in treatment of patients under 1-g conditions, but are important for a possible evolutionary step of mammals adapting to a new environment.

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The following thoughts, ideas and perspectives considering the direction of vestibular research in the next century represent my point of view as a physician working in clinical neurootologic research, who is, at the same time, constantly confronted with the daily problems and complaints of vertiginous patients. The main objectives of research are expected to be directed toward an improvement in the management of the large number of such patients. Clinical otoneurology today is still far away from the day cited by US Senator T. Harkin at the 1990 ARO meeting, the day when we can end otological research because we know all that is needed for the perfect management of all otological diseases. In contrast, our present situation is characterized by a lack of specific therapies for most patients. The absence of specific therapies furthermore interferes with the need for developing well-defined diagnoses in the management of vertiginous patients: unless one does not miss an acoustic neurinoma, one can do whatever test one likes to do and the diagnosis can be vague – the treatment will be symptomatic, and there is no feedback that confirms or disproves the diagnosis. Two different strategies could be used to obtain this needed feedback: (1) autopsies of patients with well-documented vestibular disorders, and (2) long-term follow-up of patients with strictly defined clinical diagnoses.

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The pathophysiology of nearly all neuro-otological diseases is poorly understood – nevertheless, some 'rational' surgical treatments are offered, e.g. for perilymph fistulas and Ménière's disease.

About 2% of otological surgery performed in the US are fistula explorations [1]. In spite of the numerous reports on fistula repairs, there is no clear evidence that this procedure has any effect on this condition. Animal experiments have demonstrated that fistulas of the inner ear windows do not produce significant hearing loss and, furthermore, they heal spontaneously in a few days. In patients with Ménière's disease, various surgical procedures are performed with the intent of decreasing inner ear pressure. The Danish double blind study on endolymphatic sac decompression [2] clearly demonstrated the lack of an effect of this procedure, and we do not know if inner ear pressure is increased at all in this disease. Direct pressure measurements in an animal model have demonstrated slightly increased endolymphatic over perilymphatic pressure in endolymphatic hydrops, but only in the late stages, long after the onset of low-tone hearing loss [3]. Animal models may help to better understand the pathophysiology of neuro-otological disorders and to establish more rational therapies.

Another important aspect of medicine, however, has to be kept in mind. A patient with disabling vertigo in 1993 does not want to wait for a thorough understanding of the etiology and pathophysiology of his disease which comes in the new century. The absence of a complete understanding today must not lead to a therapeutic nihilism. The old 'primum nihil nocere' has to guide the physician through this dilemma. Furthermore, scientists trained to approve only statistically verified data obtained under

well-controlled conditions have to accept that most of the progress in medicine originates from the results of numerous, but poorly controlled, 'unscientific' trial and error experiments obtained through the treatment of patients. Progress from this important source of information may be increased by training clinicians in more scientific, critical thinking.

The title of this paper asks specifically for space vestibulo-neuroscience. Data obtained in human subjects under prolonged zero-gravity conditions may have two main results: (1) they will provide the needed information to accelerate a possible evolutionary step of vertebrates, which has been compared to the stage when the first amphibians left the water and adapted to terrestrial life; and (2) they may contribute to a better understanding of vestibular function in man, especially the otolithic organs. However, the information I have gathered from space experiments until now has produced more confusion than clarification, e.g. the observation of caloric nystagmus during the Spacelab I mission in 1983 did not affect the way this important test is interpreted in the daily clinical evaluation of patients. It merely confirmed that the mechanism eliciting caloric nystagmus is more complex than Bárány postulated – but this we already knew from the Earth-based experiments of Coats and Smith [4] and Paige [5].

Even in the new century, the majority of people will encounter otoneuroscience (either actively as a researcher/physician or passively, as a patient/subject) under 0-g conditions. Communication between the exclusive scientific community that has access to space vestibulo-neuroscience and the broad majority of 'terrestrial' researchers and clinicians will become very important.

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