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Hyperbaric Oxygen Therapy for Acute Acoustic Trauma*

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Summary. We conducted a study on the effect of hyperbaric oxygen therapy on 122 soldiers following acute acoustic trauma. The patients included in this study, after the effect of spontaneous recovery had largely been excluded, were randomly allocated to four treatment groups. The results of our studies show that hyperbaric oxygen therapy shortens the course of healing with respect to high-pitch perception dysacusis. The results of treatment after an observation period of 6 weeks is also more favorable when patients are treated with oxygen when compared to patients given infusions or vasoactive substances. Similarly, the use of hyperbaric oxygen therapy also reduces the frequency of relapse following discharge from hospital. In contrast, the vasoactive substance chosen in our studies (betahistine) failed to have a favorable effect on the course of healing. Our study has also shown that no method can compare with hyperbaric therapy in eliminating tinnitus following acoustic trauma.

Key words: Inner ear – Tinnitus – Hyperbaric oxygen – Vasoactive substances – Acoustic trauma

Acoustic trauma can be a significant reason for young men experiencing problems when transferring to a civilian occupation or at the start of training after completing military service. High-pitch tinnitus and high-pitch perception dysacusis can be the consequences of one or more acoustic traumas resulting from the close use of firearms or explosives during military service.

In patients with acoustic trauma, the hearing loss incurred is usually unilateral, shows little progressive character, and may initially tend to regress. A C_5- or C_6-depression can be found, when evoked audiometric testing is done, while rupture of the eardrum may be found in rare cases. There is frequently an

* Dedicated to Prof. Dr. Chlodwig Beck (Freiburg) on his 60th birthday

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associated tinnitus, which is often the factor most detrimental to the affected person [22].

In studying the pathophysiology of acoustic trauma, the most significant effects of explosion leading to damage of the inner ear involve mechanical insults in the region of the organ of Corti [2, 10, 23, 25, 26, 28]. The impact of high sound energy on the inadequately protected inner ear leads to a loss of function in the outer hari cells. There may also frequently be loss of the associated supporting Deiter's cells from the end of the first turn of the cochlea to the middle of the second turn. The damaged sensory cells which cease to function are kept in a transitional phase over a prolonged period, and remain in a state intermediate between regeneration and cell death.

Experimental studies following acute acoustic trauma in the guinea pig have shown the development of swollen nuclei in the sensory cells of the inner ear [1]. These changes are the same following oxygen deficiency. In contrast, Lamm et al. [15] found that oxygen applied under hyperbaric conditions has a positive influence on acutely damaged sensory cells in the guinea pig inner ear.

Since the rate of spontaneous recovery can be high in cases of acute acoustic trauma, recovery of hearing frequently occurs even without therapy [5]. As such, there is still no concensus of opinion as to the most effective method of treatment [6, 11, 12, 14, 18, 24, 29].

In the few studies utilizing hyperbaric oxygen therapy in cases of acute diseases of the inner ear, it has hitherto never been possible to demonstrate whether or not treatment has been effective in managing hearing loss due to acute acoustic trauma [4, 27]. In these cases, no suitable control groups were available or the structure of the basic study did not permit a definitive statement concerning treatment to be made. The following study investigated the effects of vasoactive infusions and hyperbaric oxygenation on a defined group of soldiers following acute acoustic trauma.

Material and Methods

Exclusion from the Study. The following parameters led to exclusion of patients from the study: (a) acoustic trauma occurring more than 48 h before examination; (b) loss of hearing not reaching 40 dB in any frequency; (c) loss of hearing of 40 dB no longer detectable in any frequency on audiometric control 24 h after admission, or spontaneous improvement in hearing of more than 20 dB in any frequency in the first 24 h after admission; (d) history of acoustic trauma (or "retrauma"); (e) involvement of the middle ear as in explosion trauma; and (f) other severe general illnesses, especially of the respiratory organs (second vital capacity or vital capacity severely restricted), known tendency to convulsions or hyperventilation tetany, or other medical contraindications.

Patients. A total of 122 soldiers were investigated in the present study. The average age was 21.2 ± 4.6 years, the average height 178.2 ± 13.4 cm, and the average weight 75.2 ± 6.9 kg; 71% of the patients were soldiers on active military service.

Infusion of Vasoactive Substances. All 122 soldiers received i.v. infusions of 500 ml 5% (25 g) sorbitol solution and 10% (50 g) dextran-40 solution daily for 14 days during their stay in hospital. The vasoactive substance betahistine (24 mg daily) was also administered.