

Otologic effects of environmental conditions at high-altitude

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Abstract

Purpose: The aim of this study was to investigate the otologic effects of high-altitude environmental conditions. **Materials and Methods:** Study was performed at altitude of 2200 m. Medical records between August 2007 and March 2009 were investigated retrospectively. Previously healthy patients with no history of otological and infectious diseases, no medication, no trauma, no evidence of radiological and laboratory pathology were included this study. **Results:** 41 patients with otologic complaints were concordant with inclusion criterias. The most common otologic complaints were sudden onset tinnitus (n:15) and ear fullness (n:11). The other otologic problems were vestibular disorders (n:7), otalgia (n:7) and sudden hearing loss (n:1). Except the sudden hearing loss, tinnitus and vestibular disorders were resolved after descending to low altitude without any medication. Sudden hearing loss was restored after hyperbaric oxygen treatment. Otagia and ear fullness were recovered spontaneously within 10 days. **Conclusions:** High-altitude conditions are one of the causes of otologic disorders. The exact pathogenesis of the otologic problems is not known. We think that not only hypoxia, but also other factors are necessary to give rise to otologic disorders. Immediate descent is the treatment of choice. Physicians and high-altitude travelers must be aware of these entities.

INTRODUCTION

Altitude-related illnesses are a frequent cause of morbidity and everyone traveling to high altitude is at risk. Low atmospheric pressure, hypoxia, dry and cold weather are the environmental factors at high-altitude (HA). Hypoxia is the main contributor to HA illness (1). Despite the presence of a number of HA illness reports in the literature, otological effects of HA have received little scientific attention. This article summarizes signs and symptoms, treatment and prevention of otologic disorders related to HA conditions. The literature on this topic reviewed and clinical-diagnostic approach discussed in detail.

MATERIALS AND METHODS

This retrospective study was carried out in a HA hospital located at a height of 2200 metres. Patients considered for the study were seen in consultation for symptoms that occurred within 7 days after ascent. They were all previously healthy patients and had no risk factors for otologic diseases. They were questioned about previous drug use, previous or concurrent viral or upper respiratory tract infections. Past medical history of other diseases associated with otologic disorders was also questioned. None were taking any medication. Patients underwent otologic surgery were also

excluded. None of the patients had undertaken air flight or showed sign of barotrauma.

Complete otorhinolaryngologic examination was performed. Test results were normal or negative for full blood count. Audiometry, tympanometric screening were performed on all patients. Except sudden hearing loss, the results of the pure-tone audiometry tests showed normal hearing sensitivity in the conventional and high-frequency region in all patients. Plain radiographs and temporal computed tomography were performed for the differential diagnosis regarding several other otologic disorders. No radiological evidence of otologic disease was noted.

The diagnosis of high-altitude related otologic disorders (HAROD) was made in the absence of identifiable otologic disease or other specific etiology in addition to normal findings in physical examination, audiometric tests, laboratory tests and radiological examination. One major criterion for the diagnosis of HAROD was the spontaneous recovery after descent with or without hyperbaric oxygen (HBO) treatment.

RESULTS

1548 patients with otologic disorders were applied to our

hospital during the period. Among these patients, 41 cases diagnosed and treated in our department with the diagnosis of HAROD.

Sudden hearing loss (SHL): One male patient admitted to our clinic with complaints of SHL without tinnitus and vertigo. Complaint was occurred 4 days after ascent. The audiometry tests showed the mean hearing thresholds changed to 70 dB HL (Hearing level) and relatively flat sensorineural hearing loss. The absence of clinical, laboratory and radiological evidence of a possible cause for SHL, an association between HA conditions and SHL was suggested. A conservative therapy (bed rest, low salt diet, avoidance of noise exposure) was ordered. The patient was also recommended to descent. Daily audiologic examinations were not showed a noticeable reduction in the degree of SHL after approximately 24 hours after descent. HBO treatment was suggested. As treatment continued, there was progressive improvement in the clinical picture and in the results of audiologic tests. After 3 HBO treatments, patient had complete improvement.

Tinnitus: 15 patients were admitted to our clinic with complaint of tinnitus. 11 patients had bilateral and 4 patients had unilateral tinnitus. On examination all patients appeared otologically and systemically well. A conservative therapy was ordered. 2 patients subjectively reported that their tinnitus worsened with the treatment. After 2 weeks, only in 9 patients there was a noticeable reduction in the degree of tinnitus. 4 patients reported no change in the level of their tinnitus. All patients were recommended to descent. Complete recovery of tinnitus was noted in the majority of patients within 10 days after descent.

Vestibular disorders: 7 patients presented at the otolaryngology clinic complaining of vertigo or disequilibrium without hearing loss or tinnitus that all patients had experienced continuously for slightly more than 2 days. All patients with vertigo had medical treatment. Within the first few days of treatment, 4 patients reported partial improvement, while 3 reported no response to treatment. All patients were recommended to descent. All patients achieved complete recovery during follow up period at low altitude within one week.

Ear fullness and otalgia: Respectively, 11 and 7 patients were presented at otorhinolaryngology clinic complaining of ear fullness and otalgia. All patients had experienced these complaints after 2 days to ascent. No medical treatment was ordered. Only wait and see procedure was accepted. All

patients recovered within two weeks without any complication.

DISCUSSION

Environmental factors may result in a number of clinical disorders that range from sudden hearing loss to tinnitus. HAROD are rare entities, which is not commonly suspected in clinical practice and can be confused with a number of other otological causes such as infections, trauma, tumors, etc. But HA conditions are completely different from other etiologies. Otologic disorders resolves rapidly with descent to low altitude, and one or two days of rest at a lower altitude may be adequate for complete recovery.

Sudden hearing loss has an incidence of between 5 and 20/100.000 people per year. Only in approximately 20% of cases, a causal factor can be identified. This can be a viral infection, trauma, ototoxic medication, malignancy. In the remaining 80 %, no clear cause can be found (2). The mechanism by which HA environmental factors cause this disorder is unclear. Further studies are needed to explain the mechanisms responsible for the HA related SHL. Hypoxia may play a role as a causal factor.

The spontaneous recovery rates for SHL are generally good. Conservative and medical treatments are also beneficial for SHL. Different factors such as the absence of vertigo, the presence of tinnitus etc may positively influence the prognosis of SHL (3). No reliable pre-therapeutic outcome predictors are available, imposing an urgent need for maximal treatment for all patients (4). Experimental research proves the increase of oxygen partial pressure in the inner ear and the improvement of the function under this condition (5). Although in literature, HBO treatment found statistically indifferent from steroid treatment, considering the cost of hyperbaric oxygen therapy and its inconvenience to patients, this treatment should only be considered in patients suffering sudden hearing loss if there are contraindications to standard medical treatment (6).

Tinnitus, the perception of sound or noise in the absence of acoustical stimulation, is common and disturbing clinical symptom and very difficult to treat (7,8). Tinnitus can result from various pathological conditions at different levels along the auditory pathways and may be of peripheral or central origin (9). About six percent of the general population has what they consider to be severe tinnitus. Tinnitus can come and go or be continuous (10). Most tinnitus comes from damage to the inner ear, specifically the cochlea. Tinnitus can also arise from damage to the nerve between the ear and

brain, much more rarely from injury to the brainstem (11). The mechanism by which HA environmental factors cause this disorder is unclear. Further studies are needed to explain the mechanisms responsible for HA related tinnitus. Hypoxia and vascular pathologies can be the main contributor.

There are a number of other things that may prove effective in controlling tinnitus. Other treatment modalities such as transmeatal low power laser irradiation have been tried to treat the symptoms of tinnitus (12). We recommended that persons with tinnitus limit salt, and refrain from drinking caffeinated beverages, other stimulants like tea.

Vertigo is the illusion of motion, usually rotational motion. The most common causes of this condition are benign paroxysmal positional vertigo, acute vestibular neuronitis or labyrinthitis, Meniere's disease, migraine, and anxiety disorders. Less common causes include vertebrobasilar ischemia and retrocochlear tumors. The most common causes of dizziness are peripheral vestibular disorders. The patient's history, neurologic examination, and imaging studies are usually the key to differentiation (13,14). Vascular origin should be considered in cases of positional vertigo and isolated vertigo or dizziness when the etiology remains unclear. In our study vestibular disorders seemed to be peripheral and related with hypoxia and vascular etiology.

Ear fullness can be due to several different problems. The most obvious possibilities are fluid in the middle ear, ear infection and eustachian-tube dysfunction. At HA, this pathology seems to be eustachian-tube dysfunction. The exact mechanisms of ear fullness, tuba dysfunction otalgia and heamatympanum at HA are unknown. Cold and dry weather may play a role in this pathology. The spontaneous recovery rates are generally good. We thus adopted a 'wait and see' approach.

CONCLUSION

The differential diagnosis of patient with rapid onset otologic problems should include HA environmental effect. HA environmental factors are seems to be one of cause of otologic disorders. Physicians and HA travelers must be aware of these entities. The exact pathogenesis of the

otologic problems are not known. Further studies are needed to confirm these preliminary observations and to identify the pathogenesis of otologic disorders at HA. Treatment of HAROD is indicated upon diagnosis. It may improve slightly with acclimatization, but does not usually resolve until descent. Descent to an altitude below is always effective treatment, and one or two days of rest at a lower elevation may be adequate for complete recovery. It should be consider and suggested to patients as a first-choice treatment before they are refered for alternative treatments. HBO is an additional treatment that can affect a physiologic descent when actual descent is not possible or sufficient.

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