Pneumolabyrinth and Pneumocochlea: Natural History, Interventions, & Outcomes

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Introduction

Pneumolabyrinth is the presence of air within the cochlea, a very rare subset of the more numerous finding of pneumocochlea, which includes air within the cochlea, vestibule, or semicircular canals. These findings are generally identified on computed tomography (CT) of the head or temporal bones, many times in a trauma setting. Because of their inclusion in the differential diagnosis of perilymphatic fistula, pneumolabyrinth may present with vertigo. The presence of perilymphatic fistula is nearly universal. Recovery of hearing was greatest among patients with the smallest degree of loss, and was non-existent among those with profound loss, regardless of intervention. The potential for meningitis seems obvious with violation of the perilymphatic space, but no reported case has yet mentioned this as a complication. Medical interventions included bed rest, antibiotic therapy, diuretics, and steroids. Surgical interventions included tympanotomy, myringotomy, and mastoidectomy. Patients with these findings who have profound hearing loss may also be surgically managed, but the low likelihood of recovery should be discussed during the patient’s initial evaluation.

Case Report

A 24-year-old man presented after a 17-foot unheeled climbing accident onto his head and right side with complaints of right-sided hearing loss and pain with loss of consciousness at the scene. He also reported tinnitus, and right hand and foot pain, but had no complaints of facial paralysis, dizziness, nausea, or vomiting. His past history was unremarkable except for previous herniated disk with bilateral herniations.

The patient was obtunded and intubated. A CT scan revealed a right temporal bone fracture with right-sided facial nerve paralysis, and pneumolabyrinth of the scala tympani and scala vestibuli. The patient was then immediately transferred to the operating room, where a right transmastoid approach with stapedectomy was performed, resulting in clearing of air from both the scala tympani and scala vestibuli. The patient was discharged with hearing aid with some recovery of hearing.

Methods

A review of the literature examined all papers on Pneumolabyrinth and pneumocochlea. The references of these papers were also examined for any other cases that might have been overlooked with the initial survey and any additional case reports thus identified were also included. Cases were categorized by demographic information, presentation, symptoms, interventions, and outcomes, and were analyzed with Microsoft Access.

Results

Overall, a total of twenty papers were identified from this search describing one or more cases of pneumolabyrinth (1-23), five of which described cases involving pneumocochlea [24]. Additionally, two other cases of pneumocochlea were identified in further review of the references from the above case reports [25, 26]. With the current case, a total of thirty-two cases of pneumolabyrinth were identified for review.

Of the thirty-two cases, only twenty-four had accompanying demographic information. Of these cases, over seventy percent were male. The average age was 33 years for males, and 46 years for females. Seven cases of pneumolabyrinth including pneumocochlea were noted, of which one in addition to the current report was isolated pneumocochlea. The remainder of the cases were pneumolabyrinth without any known evidence of pneumocochlea. Thirty of the cases had etiologic information, and all but six were secondary to some sort of trauma. The rest were iatrogenic, at least in part. Of the traumatic cases, twelve were secondary to blunt trauma, including eight falls. For the cases of barotrauma and three other cases, the trauma was penetrating trauma. Five other cases were simply reported as “post-traumatic” without further details. Table 1 details etiologies of pneumolabyrinth among cases with Known Mechanism.

Discussion

Following the advent of high-resolution CT, pneumolabyrinth was first identified by Maete et al in 1984 as a radiologic sign indicating fracture of the stapes footplate [10] and was first reported following temporal bone fracture in 1986 [7]. A number of reports have examined the effects of pneumocochlea in an experimental setting in an attempt to explain the pathophysiology of perilymph fistula. After first observing air bubbles emerging from the round window membrane intraoperatively [20], Nishikawa and Yanagihara showed reversible changes in cochlear action potentials in the setting of air introduced to the apical cochlea in guinea pigs in 1986. They also demonstrated spontaneous passage of air into the scala tympani from the middle ear in guinea pigs. In 1997, the same authors showed that middle ear air pressure in excess of 40 cm H2O resulted in spontaneous passage of air into the scala tympani. In an attempt to further clarify the pathophysiology of this condition, it appears that pneumolabyrinth is likely best managed medically in the setting of mild hearing loss or tinnitus alone, and that surgical management should be considered in cases with moderate to severe loss, as well as those with progressive or fluctuating hearing loss or a known site that might be repaired, such as a subluxed stapes or a known round window lesion, as in cochlear implant recipients. Patients with these findings who have profound hearing loss may also be surgically managed, but the low likelihood of recovery should be discussed during the patient’s initial evaluation.

Conclusions

Pneumolabyrinth and with pneumocochlea occurs as a consequence of various etiologies, but the vast majority are post-traumatic. Management decisions should be made in regard to the degree of hearing loss and generally severe vertigo. Vestibular improvement is nearly universal. Recovery of hearing was greatest among patients with the smallest degree of loss, and was non-existent among those with profound loss, regardless of intervention. The potential for meningitis seems obvious with violation of the perilymphatic space, but no reported case has yet mentioned this as a complication. Medical interventions included bed rest, antibiotic therapy, diuretics, and steroids. Surgical interventions included tympanotomy, myringotomy, and mastoidectomy. Patients with these findings who have profound hearing loss may also be surgically managed, but the low likelihood of recovery should be discussed during the patient’s initial evaluation.

Future directions for a better understanding of pneumolabyrinth and pneumocochlea ought to include thorough reporting of future cases to improve ability for analysis of the natural history and benefit of any interventions. In addition to reporting the parameters included in the above review, it would be most interesting to obtain positional audiometry on any patient identified in the acute setting, as well as distortion product otoacoustic emissions and electrotocoagulometry.

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References