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Autoimmune Inner Ear Disease

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1. Introduction

Substantial insights into our understanding of autoimmune inner ear disease (AIED) have occurred since McCabe first described this condition in 1979 (McCabe 1979). Harris proved that the inner ear is not an immunologically privileged site, as was once theorized (Harris 1983). Extensive evidence exists that the immune response of the inner ear can be extremely beneficial in protecting the auditory and balance systems from pathogens, but can also cause tremendous destruction and damage to the delicate inner ear. This chapter describes the basic immunology of the inner ear, the pathophysiology of AIED including experimental animal models, as well as the clinical presentation, diagnosis, and current treatment of this disorder.

2. History and Epidemiology

2.1 History

Although autoimmune damage to other organ systems has been acknowledged for centuries, the inner ear was not implicated as a possible autoimmune target until the 1950s. The first clinical report of autoimmune inner ear damage came in 1958 from Lehnhardt, who reported on 13 patients with progressive bilateral sensorineural hearing loss. He proposed anticochlear antibodies as the likely cause of the inner ear damage, as 9 of the 13 patients had hearing loss that involved the contralateral ear in a delayed fashion (Lehnhardt 1958).

Over the ensuing years, scattered reports of steroid-responsive sensorineural hearing loss appeared in the literature. Schiff and Brown in 1974 described the use of adrenocorticotropin hormone (ACTH), corticosteroids, and heparin for the treatment of sudden deafness (Schiff and Brown 1974). In a review article, Clemis (1975) stated “antigen-antibody reactions do occur within the inner ear and are associated with progressive sensorineural hearing losses.” He goes on to discuss treatment for fluctuating hearing loss, including corticosteroids, histamine, antihistamines, and heparin. However, it was not until McCabe’s review in 1979 that AIED became an established clinical entity (McCabe 1979).
He described 18 patients who had vestibular dysfunction as well as progressive bilateral hearing loss worsening over several weeks to months. In each case, an extensive workup for neoplastic and infectious etiologies was negative. Nearly all of the patients went on to demonstrate a dramatic response to immunosuppressive therapy, specifically dexamethasone concurrent with cyclophosphamide. This landmark publication began a new era where otolaryngologists became aware of AIED as one of the few treatable causes of sensorineural hearing loss.

2.2 Epidemiology

The true incidence of AIED is difficult to estimate. Confounding factors include similarity in presentation to Ménière’s syndrome, a much more common audiovestibular disorder, as well as a lack of confirmatory laboratory tests or radiological imaging diagnostic for AIED. Current estimates of AIED’s incidence place it behind idiopathic sudden sensorineural hearing loss (Rauch 1997), which has been estimated to involve 1 in 5,000 to 1 in 10,000 individuals per year (Ruckenstein 2004). AIED is therefore currently considered a rare disorder. Although AIED can affect patients at any age, it is more common in adults than in children. A recent review of 67 AIED patients found an age range from 18 to 70 years old with an equal male to female ratio (Harris et al. 2003).

AIED can be divided into two subtypes: patients with a known systemic autoimmune disease and patients without systemic autoimmune symptoms or diagnosis. The AIED patients without other systemic autoimmune disease constitute the majority of cases (70%), making the recognition of this illness difficult to separate from other progressive forms of hearing loss (genetic, viral, metabolic, toxic) that may have similar presentations (Hughes et al. 1988; Harris and Keithley 2002).

3. Immunology of the Inner Ear

Analogous to the central nervous system, the inner ear is separated from the systemic circulation by a blood–labyrinthine barrier that allows the inner ear to generate separate compartments containing high concentrations of both potassium in the endolymph and sodium in the perilymph, compartments that are critical for the normal functioning of the vestibular and auditory systems. Although the passage of immunoglobulins through the blood–labyrinthine barrier is restricted, immunoglobulins can be found within the inner ear at roughly 1/1000th the level present within the serum. IgG is the most abundant immunoglobulin found within the inner ear, with IgA and IgM also present (Palva and Raunio 1967, Mogi 1982).

Because of the existence of this blood–labyrinthine barrier, the inner ear has long been considered an immunologically privileged end organ incapable of participating in the immune response. However, research by Harris and coworkers has disproved this premise, and we now understand that the inner