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Hearing disorders

Mechanisms of bacterial meningitis-related deafness

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Bacterial meningitis is the most common cause of acquired postlingual profound sensorineural hearing loss and labyrinthitis ossificans. This article reviews the underlying mechanisms including bacterial etiology responsible for bacterial meningitis-related hearing loss, time course of hearing impairment, sites of histological damage, routes of infection from meninges to labyrinth, suppurative labyrinthitis and ossification, pathophysiological processes, roles of cytokines, and finally, roles of reactive oxygen species and reactive nitrogen species.

Introduction: Bacterial etiology responsible for bacterial meningitis-related hearing loss

Bacterial meningitis is a life-threatening infection of the meninges, the protective layers of the brain and spinal cord. It is caused by various bacteria, including *Neisseria meningitidis* (N. meningitidis), *Streptococcus pneumoniae* (S. pneumoniae), *Haemophilus influenzae* (H. influenzae), and *Listeria monocytogenes* (L. monocytogenes). Bacterial meningitis is a leading cause of acquired postlingual profound sensorineural hearing loss and labyrinthitis ossificans. This article reviews the underlying mechanisms including bacterial etiology responsible for bacterial meningitis-related hearing loss, time course of hearing impairment, sites of histological damage, routes of infection from meninges to labyrinth, suppurative labyrinthitis and ossification, pathophysiological processes, roles of cytokines, and finally, roles of reactive oxygen species and reactive nitrogen species.

Bacterial etiology

Bacterial meningitis is caused by various bacteria, including *Neisseria meningitidis* (N. meningitidis), *Streptococcus pneumoniae* (S. pneumoniae), *Haemophilus influenzae* (H. influenzae), and *Listeria monocytogenes* (L. monocytogenes). *Neisseria meningitidis* is the most common cause of bacterial meningitis, followed by *Streptococcus pneumoniae* and *Haemophilus influenzae*. *Listeria monocytogenes* is a rare cause of bacterial meningitis, but it is particularly dangerous because it can cross the blood-brain barrier and cause meningitis in immunocompetent individuals.

Time course of hearing impairment

Hearing impairment is a common complication of bacterial meningitis. The time course of hearing impairment varies depending on the bacterial etiology. In general, hearing impairment is most likely to occur within the first 24 hours of the onset of meningitis. However, in some cases, hearing impairment may not occur until several days after the onset of meningitis. The time course of hearing impairment is also influenced by the severity of the meningitis and the extent of the damage to the inner ear.

Pathophysiological processes

The pathophysiological processes underlying bacterial meningitis-related hearing loss are complex and involve multiple mechanisms. One of the primary mechanisms is the direct damage to the inner ear structures, including the cochlea and the vestibular system. Bacteria can enter the inner ear through the bloodstream or through the meninges. Once in the inner ear, they can cause inflammation and damage to the hair cells and the supporting cells. This damage can lead to hearing loss and labyrinthitis ossificans.

Another mechanism is the release of cytokines and other inflammatory mediators. These mediators can cause damage to the inner ear structures and lead to hearing loss. Additionally, reactive oxygen species and reactive nitrogen species can also cause damage to the inner ear structures and lead to hearing loss.

Reactive oxygen and nitrogen species

Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are highly reactive molecules that can cause damage to cells and tissues. In the context of bacterial meningitis, ROS and RNS are produced by both the bacteria and the host's immune system. These species can cause damage to the inner ear structures and lead to hearing loss.

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Sites of histological damage

2,3,5, 10,15 24

(A)

2

20

20 (41%), 41

20

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