Chapter 16
Cancer and Hearing:
An Overlooked Aspect of Survivorship

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ABSTRACT

Cancer-induced hearing loss can arise from direct effects like tumors on auditory nerves or indirect effects such as ototoxicity from treatments, leading to significant impairments in hearing perception. Hearing impairment, a common consequence of cancer treatment, can significantly impact various aspects of life. Ototoxic effects are primarily associated with chemotherapy drugs such as cisplatin and carboplatin, as well as intense radiotherapy targeting the cochlea. This chapter explores how cancer can lead to hearing impairments. Assessing hearing loss related to cancer involves thorough screening protocols, following established guidelines, which include high-frequency testing, OAEs, and ABR tests. The chapter also covers various management strategies for cancer-induced hearing loss, which are aimed at alleviating hearing deficits and enhancing the quality of life for individuals with cancer-related hearing impairments.

INTRODUCTION

Our hearing system processes and interprets sounds from our surroundings, involving both peripheral and central structures. The peripheral auditory system includes the external ear, middle ear, and inner ear. The central auditory system consists of the cochlear nuclei, superior olivary nuclei, lateral lemniscus, inferior colliculus, medial geniculate nuclei, and auditory cortex (Peterson et al. 2023). The external ear, which includes the pinna, concha, and auditory meatus, collects sound energy and directs it to the tympanic membrane (Purves et al. 2001). The middle ear contains three of the body's smallest bones, known as the ossicles: the malleus, incus, and stapes. These bones facilitate the transmission of acoustic energy from the tympanic membrane to the inner ear (Seikel, 2023). The inner ear is crucial for both balance (the vestibular system) and hearing (the cochlea). The vestibular system processes head movements and, in conjunction with proprioception and visual input, helps maintain balance. This integrated

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system allows the body to sense changes in position and movement, enabling coordinated and stable posture. Whereas in the inner ear, sound waves are converted into electrical signals that are sent to the brain via. central auditory pathway, where it interprets as different sound frequencies. In the cochlea, vibrations in the endolymph fluid stimulate specific areas, converting these vibrations into electrical signals through the hair cells in the organ of Corti, creating a tonotopic map that helps humans perceive various sounds. The vestibulocochlear nerve (CN VIII) then transmits these signals to the brain's auditory cortex for interpretation.

Hearing loss or impairment is defined as either a partial or complete inability to perceive sounds. This condition may stem from issues affecting the outer, middle, or inner ear, as well as disruptions in the vestibulocochlear nerve (also known as cranial nerve eight or CN VIII) or the auditory system (American Speech-Language-Hearing Association). The classification of hearing loss can be based on ear anatomy, type, degree, and audiogram configuration, which is crucial for appropriate therapeutic management (Alshuaib, 2015). Further, hearing loss can be broadly categorized into three types: sensorineural, conductive, and mixed (Weber, 1999). Hearing loss can be caused by a variety of factors, including genetics, aging, exposure to noise, infections, birth complications, trauma, and certain medications (Kouilily, 2018; Rahim, 2023). These factors span both prenatal and postnatal periods, as well as environmental influences. Prenatal risk factors such as genetic factors, family history, consanguineous marriage, and maternal infection during pregnancy, as well as postnatal risk factors like prolonged mechanical ventilation, hyperbilirubinemia, birth defects, and consumption of ototoxic drugs, are also significant contributors (Rahim, 2023). Environmental factors, such as exposure to noise, aging, ototoxic drugs, and viral and bacterial infections, can also play a role in hearing loss (Mills & Going, 1982). Additionally, a tumor located in a specific part of the ear can lead to varying degrees of hearing loss.

TUMORS AND HEARING LOSS

An ear tumor, also known as an ear neoplasm, is an abnormal tissue growth within or around the ear. These tumours can be benign (non-cancerous) or malignant (cancerous), based on their potential for proliferation and invasion. Ear tumours are typically classified into three categories based on the location of the tumours: outer, middle, and inner ear (Ouaz et al., 2013). There can be benign or malignant tumour affecting these structures affecting the hearing. Tumors of outer ear can arise from pinna or external auditory canal (EAC). Tumors occurring in the EAC are uncommon, representing less than 0.2% of all cancers affecting the head and neck region. Examples of benign tumors in the outer ear include preauricular cysts, keloids, hemangiomas, osteomas, and exostoses. Malignant tumors in this area can include squamous cell carcinoma and melanoma, among others. Symptoms include sensations of fullness, hearing loss, itching, ear pain, ear discharge, tinnitus, bleeding, the presence of a lump, weakness in facial muscles, and facial paralysis (Ouaz et al., 2013).

Further, tumors of the middle ear and mastoid can be divided into primary and secondary types. Primary tumors include benign glomus tumors and malignant carcinomas and sarcomas, while secondary tumors can originate from adjacent areas like the nasopharynx, external meatus, and parotid, or be metastatic from cancers of the bronchus, breast, kidney, thyroid, prostate, and gastrointestinal tract. Common symptoms for middle ear tumors are hearing loss, ear pain, ear discharge and tinnitus (Dornhoffer, 2003). The most prevalent tumor originating in the middle ear is Glomus tympanicum, which develops from paraganglia cells located along the Jacobson's nerve (Larson et al., 1987).