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Abstract

Rehabilitation professionals work with a variety of people with various disabilities and disease states. Oftentimes, those disease states are treated with medications. An understanding of the most common types of medications that can cause ototoxicity, such as aminoglycides, cisplatin and loop diuretics can assist in the vocational rehabilitation process. Rehabilitation professionals are encouraged to establish positive communication with the consumers in order to foster a relationship of trust. Furthermore they are encouraged to establish relationships with pharmacists for an understanding of the implications of commonly used medications on hearing.

Keywords: deaf, ototoxic, drugs, hearing loss, treatment

Introduction

Both general and specialized rehabilitation professionals need to have an understanding of the effects of mediations on their consumers.. State, federal and private rehabilitation professionals can work with homogeneous or heterogeneous populations with regards to the type of disability reported in each population. For example, some homogeneous caseloads may focus on people with hearing loss, spinal cord injuries, traumatic brain injuries, or learning disabilities, to name a few. These are specialized caseloads in which, ideally, the rehabilitation professional is an expert. This is often the case with people who are blind, as is evident from several states having separate rehabilitation agencies to address the specialized needs of this population. Another common caseload focus is serving people who have hearing loss. Some states have a designated agency to serve the individualized needs of this population while others specify certain caseloads to best serve this population. However, the ability to set aside an entire agency, or even a caseload, is often not feasible, especially in sparsely populated states (Watson, Jennings, Tomlinson, Boone & Anderson, 2008). Sometimes, in rural areas, the distance the consumer and/or the rehabilitation professional

need to travel for basic services is excessive; therefore, it is not feasible to have a specialized counselor. In light of not all consumers being served by specialty counselors who focus on their type of disability, being served by a general rehabilitation professional is the likely scenario for the majority of consumers.

Ototoxic Medications

This paper focuses on commonly used medications that may cause ototoxicity and the implication for rehabilitation professionals serving the people who experience this side effect. Ototoxicity is a serious adverse drug reaction, and may result in cochleotoxocity, or permanent irreversible bilateral sensorineural hearing loss. It can also cause ataxia, nausea, and vertigo (vestibulotoxicity; Xie, Talaska, & Schact, 2011). These possible reactions warrant attention. The consumer may or may not start the caseload with severe irreversible hearing loss, but it is possible for this to occur because of the types of medications consumers are prescribed for the various other health conditions they may have.

Aminoglycosides

Aminoglycosides (AGs) are a class of antibiotics (e.g., gentamicin, tobramycin, amikacin, neomycin, streptomycin) commonly used to treat infections. Ototoxic effects vary within this class. The ranking of AGs from most toxic to least toxic to the auditory system are as follows: neomycin, tobramycin, kanamycin, gentamicin and amikacin (Rybak, 2007).

When properly administered, AGs rapidly enter the inner ear (Fisman & Kaye, 2000). However, AG concentration levels do not appear to correlate well with incidence of ototoxicity. Prolonged use of AGs over five to six months has shown evidence of AGs in sensory cells (Barza, Ioannidis, Cappelleri, & Lau, 1996; Dulon, Aran, Zajic, & Schacht, 1986). This prolonged use may be the cause of damage to type 1 sensory hair cells in the vestibular organ and the outer hair cells in the origin of Corti (Rybak, 2007). Damage begins gradually from the base of the cells that detect high frequency sounds and progresses to the apex of the cochlea, which detects low frequency sound (Huizing & deGroot, 1987). Conversely, Hinojosa and Lerner (1987) discovered cochlear ganglion cell destruction without damage to the hair cells.

In addition to taking the medication, there are other factors that can increase the ototoxic effects of the AGs. Noise induction (Zimmerman & Lahav, 2012), concurrent use of other ototoxic medications (Ding & Salvi, 2010; Garcia, Martinez, Agustí, Mencía & Asenjo, 2001), mutations in an individual's sequences of mitochondrial ribosomal RNA (Fishel-Ghodsian, et al., 1997; Xing, Chen, & Cao, 2007) and other biomedical reasons (Guan, Fischel-Ghodsian, & Giuseppe, 2000) may exacerbate the ototoxic effects of the AGs.

Cisplatin

Cisplatin is an antineoplastic agent used to treat cancers such as ovarian, testicular, and bladder cancer. This drug has been found to be ototoxic to the point of causing irreversible hearing loss in the cochlea (Schacht, Talaska, & Rybak, 2012). Similar to AGs, cisplatin affects the hair cells in the cochlea from the base to the apex. In other words, the ability to hear high frequencies will be affected first, and then the continuum of loss will progress to the lower frequencies (Church, Blakley, Burgio, & Gupta, 2004; Estivill, et al., 1998; Harris, Gilbert, Lormore, Musunuru, & Fritsch, 2011; Hinojosa, Riggs, Strauss, & Matz, 1995). Other factors, such as the dose administered, combined with noise exposure may also contribute to a higher risk of cisplatin-induced ototoxicity (Bokemeyer et al., 1998; Li, Womer, & Silber, 2004).

Loop Diuretics

Edema, defined as swelling, and occurs as a result of excess fluid trapped in the interstitium. It is often caused by disease states such as heart failure, renal insufficiency, or liver cirrhosis. Edema is most commonly treated with loop diuretics that include furosemide, bumetanide, and ethacrynic acid. Furosemide, administered orally or intravenously, is most commonly associated with ototoxicity (Chiodo & Alberti, 1994). This is caused by the blockage of fluid movement out of the stria vasularis affecting the marginal cells. However, unlike AGs and cisplatin, loop diuretics have very little effect on the hair cells (Ikeda, Oshima, Hidaka, & Takasaka, 1997). The hearing loss is usually temporary and correlates with the amount received; the higher the amount of furosemide given, the greater the hearing loss (Chiodo & Alberti, 1994). Additionally, when the loop diuretic is discontinued, the hearing may be restored.

Implications for Rehabilitation Professionals

Rehabilitation professionals whose primary responsibility is assisting consumers in obtaining and maintain employment need to have an understanding of the types of medications the consumers may take. The consumers may have issues in regards to adjusting to new hearing loss. For example, they may not know the types of technology available to them or how to use these technologies. Furthermore, in the event they are to interview, not knowing how to use technology or simple communication strategies may have negative effects in terms of employment outcomes. As rehabilitation professionals work on such cases, they are encouraged to be cognizant of changes in the consumers' health, and be knowledgeable of the medications the consumers are prescribed. Developing a positive supportive working relationship with the consumer is vital to the exchange of this type of information. Furthermore, it behooves the rehabilitation professional to establish a relationship with a pharmacist. This healthcare professional is better able to explain the effects of the consumer's medications. The rehabilitation professional can use this information, in conjunction with information from a comprehensive assessment, to develop a plan of services. Establishing this relationship may take a bit of effort, and one must be cautious not to share confidential information. There are several ways to do this, and each situation will be different; the salient factor is communication. The rehabilitation professional may simply make an appointment with an area pharmacist and discuss ototoxicity. Pharmacists may also be invited to speak at the rehabilitation professional's monthly quarterly or annual meetings or at local professional meetings.

If a more self-directed search is needed, several websites list the various medications that can cause hearing loss. A search of "organizations with ototoxic medication list 2014" resulted in about 275,000 results, with the first result being from the Northern Virginia Resource Center for Deaf and Hard of Hearing People (http://www.nvrc.org/hearing-loss-deafness/ototoxic-drugs/). Another reliable source is from the World Health Organization (WHO: http://www.who.int/mediacentre/factsheets/fs300/en/).

Conclusion

In addition to understanding the medications, rehabilitation professionals need to understand the potential ototoxic effects some medications can cause. As previously mentioned, a noisy environment (Zimmerman & Lahav,

2013) and other genetic issues (Fishel-Ghodsian, et al., 1997; Xing, Chen, & Cao, 2007) may compound hearing loss in consumers. An understanding of hearing loss types, whether permanent or temporary, and the severity of the loss, is important for working with consumers.

In addition to counseling, other psychological services may be necessary for those who expect a slow recovery or permanent loss. Consumers may need to learn coping strategies for communication in their usual environments, which could have service implications. The consumers may need training and counseling on the roles and functions of additional assistive technology, learn visual forms of communication, or even be trained for another career.

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