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COMMENTARIES

Music Therapy: A Necessary Addition to the Treatment of Neurodegenerative Disorders?

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In 2019, a video rose to popularity on the internet: a woman, wheelchair bound and frail with age, can be seen listening to music from Tchaikovsky's ballet Swan Lake. As the music plays, her arms seem to move almost as if they have a mind of their own. The video then cuts to a young ballerina on stage performing with the same graceful movements, an example of perfect motor memory 50 years later.[1]

This woman, Marta Cinta González Saldaña, was a former ballet dancer who was later diagnosed with Alzheimer dementia, passing away several months after the video was filmed.[1] Despite dementia having ravaged her mental and physical capabilities, hearing the music she had spent so many years practicing and performing to seemed to spark this long-forgotten memory and allowed her to relive a truly precious moment of her life. As can be seen with Ms Saldaña, the intricate connection between music and memories suggests the possibility of using music as a method to overcome cognitive or behavioral barriers of neurodegenerative diseases such as Alzheimer dementia.

As of 2021, more than 6.2 million Americans older than 65 years have been diagnosed with Alzheimer disease (more than 1 in 9 people). Additionally, while 36% (2.3 million) of people 85 years or older have currently been diagnosed with dementia, this number is expected to rise to 48% (6.7 million) by 2060.[2] According to the Centers for Disease Control and Prevention, approximately 120 000 people died of Alzheimer disease in 2019 alone, which is a 145% increase since 2000.[2] With the continually increasing number of diagnoses and mortality rates of Alzheimer disease, understanding the true pathogenesis of the disease and creating therapeutic targets that can slow or even reverse the effects of the disease are integral to solving this problem. However, despite several decades of research on the pathogenesis of the disease, no clear and definitive answer has been discovered as to the onset and development of Alzheimer disease and treatments are mainly aimed at treating symptoms and slowing the progression of the disease rather than stopping or reversing the neurologic damage.[3] Nonpharmacological therapies, such as music therapy, are being used alongside the aforementioned medical therapies.[2]

Music therapy is particularly interesting because it can be used in a variety of settings, has no adverse effects, and is easily employed; although, its effectiveness is particularly ambiguous due to mixed results. Fundamentally, music therapy aims to improve cognitive well-being through individualized treatment and has a diverse number of effects, ranging from lowering blood pressure and managing pain to improving mood and memory.[4]

Jagmeet Kanwal, MD, an associate professor of neurology at Georgetown who primarily studies audiology, supports the validity of music therapy. In an interview, Dr Kanwal differentiated communication between humans and animals, such as songbirds. He noted that animals primarily communicate via sounds that mainly evoke emotion, whereas humans use language. However, music is processed in humans by similar regions of the brain as animals, revealing its intricate relationship with emotion.

Music, like all sounds, is encoded by the hair cells, which send signals via the cochlear nucleus bilaterally to the superior temporal gyri. From the temporal lobes, musical sounds can be seen to activate broad areas of the brain, indicating multicenter processing as opposed to a singular dedicated region for musical processing. According to Dr Kanwal, the diffuse cortical processing as well as connections to the amygdala also suggest that music is linked with both memory and emotion. Studies have shown less Alzheimer disease pathology (beta-amyloid plaque buildup and irregularities in glucose metabolism) in regions that processed music compared with the rest of the brain.[5] Furthermore, unlike the temporal lobe memory processing, which is greatly affected by neurodegenerative disorders like Alzheimer disease, the diffuse processing of music and storage in the limbic system could allow for the preservation of memories associated with music, just as Ms Saldaña experienced a moment of clarity when hearing a familiar song despite being in the end stages of dementia.[6,7] Together, these theories suggest that music processing is linked to emotion and memory in such a way that is preserved despite the neurodegenerative effects of dementias such as Alzheimer. In other words, music can be an effective tool to help patients recall memories.

The implementation of music therapy has been shown to affect cognition in patients with dementia, which could slow the progression of the disease. Due to the connections between musical processing centers in the brain and memory storage centers, music therapy can evoke autobiographical memories, which can in turn evoke emotions.[8] By strengthening neuronal connections, this process of invoking memories can help improve long-term autobiographical recall, one of the first processes to degenerate with dementias. Another theory suggests that by reducing cortisol levels and improving sleep through melatonin production, music therapy can help patients with dementia better encode memories.[9,10] Studies looking at different types of music demonstrate that more personalized songs that the patient experienced through their life have a stronger impact on evoking these autobiographical

memories and strengthening recall.[11] That is not to say that only personalized music can have an effect, but rather that personalized music can have a greater effect in modulating hormone levels. Recalling the multifactorial effects of music on hormones like cortisol and melatonin in reducing stress, improving sleep, and cementing memories through stronger synaptic connections, Dr Kanwal suggested music therapy has sufficient evidence to support its usefulness in treating patients with Alzheimer disease. Nonetheless, while the immediate effects of music therapy are known, it remains uncertain how much personalized songs can improve cognition and reduce neurodegenerative symptoms in the long-term.

Dr Kanwal assessed the difference between personalized and generalized songs for music therapy. He recalled a musician who became comatose after a stroke and was able to recover after his wife started playing some of his music to him every night. After his recovery, the musician began to create music for patients who had experienced stroke that Dr Kanwal and his team plan to assess on patients with stroke.

Music therapy is one of the nonpharmacologic therapies that is currently beginning to be implemented in the treatment of neurodegenerative conditions, alongside medications. Dr Kanwal hopes that one day music therapy can be prescribed to patients like any other medication. Unlike its pharmacologic counterparts, music therapy is practically without risk and is an extremely cost-effective strategy to implement. This facility of implementation would allow for future study of the therapy longitudinally in a variety of settings—from acute recovery from strokes or surgical procedures to chronic conditions such as dementias or autoimmune diseases. In fact, Georgetown University's Arts and Medicine group embodies these exciting possibilities as medical students regularly perform together for patients staying in the hospital. Despite Ms Saldaña passing from Alzheimer disease just a few months after her renowned video performance, her ability to recall intricate movements from her past performances suggests the power music therapy holds in connecting memory and emotion. Though not a substitute for pharmacologic therapies, music therapy helps to build both the cognitive and emotional strength to possibly slow the progression of neurodegenerative diseases such as Alzheimer dementia. As Dr Kanwal concluded, "Our mind has the ability to change our physiology" and music's intimate connection with emotion makes it a powerful tool to support the mind.

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