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USING MUSIC THERAPY AS AN ADJUNCT TO PHARMACOLOGIC THERAPIES FOR
CHRONIC PAIN

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ABSTRACT: Chronic pain affects more than 1 in 4 individuals in the United States. Many patients are being prescribed opioids to manage this pain, leading to an immense problem involving addiction, overdoses, and preventable deaths. Music therapy has been shown to provide “music analgesia,” improving anxiety, depression, and mobility problems associated with chronic pain conditions. The most benefit was seen when the music was known to the patient, the patient had a role in choosing the music, and when the music had a beat of less than 120 beats per minute. These promising results include a wide variety of chronic pain conditions and therefore have application for numerous patients across a spectrum of specialties within a variety of care plans. Music therapy has the potential to decrease the devastating effects of chronic opioid use and misuse that are becoming increasingly prevalent in the United States.

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III. Introduction

Pain is defined as a “biopsychosocial phenomenon that includes sensory, emotional, cognitive, developmental, behavioral, spiritual, and cultural components.”¹ Chronic pain, which is any pain lasting for longer than 12 weeks despite appropriate medication and/or treatments, is one of the most common ailments suffered by Americans, affecting over 25% of individuals. It can be subdivided into 4 main causes: neuropathic, musculoskeletal, inflammatory, and mechanical/compressive. Neuropathic pain is divided into peripheral and central; peripheral causes include postherpetic neuralgia and diabetic neuropathy. Central causes include post-stroke pain or multiple sclerosis. Musculoskeletal pain includes conditions such as chronic back pain and myofascial pain syndrome. Inflammatory pain represents inflammatory arthropathies or pain secondary to infection. Examples of visceral/compressive pain include pain from expanding tumor masses or renal calculi.² As a whole, chronic pain currently accounts for 20% of all outpatient visits, 12% of all prescription medications, and over \$100 billion in direct and indirect expenses annually; this exceeds total expenditures for cancer, heart disease, and diabetes combined.³

Chronically enduring these levels of pain is associated with more frequent use of healthcare, increased disability, and an increased likelihood of using narcotic medications, however due to provider concerns about dependence and drug diversion, some chronic pain patients may actually suffer from under-treatment of their pain.^{3,4} A significant amount of chronic pain patients also have chronic psychiatric comorbidities, specifically depression, anxiety, posttraumatic stress disorder, and substance abuse. These can lead to sleep disturbances, lack of energy, and diminished physical activity, which can exacerbate the pain or lead to heightened emotional distress surrounding the pain.² The scope of the problem and the significant consequences associated with chronic pain highlight the importance of proper multidisciplinary and nonjudgmental evaluation and responsible treatment for all chronic pain sufferers.

The current treatment for chronic pain includes an individualized treatment plan based on the type of pain. The first line treatment is nonpharmacologic modalities. These are typically introduced in a stepwise fashion, starting with treatments such as hot/cold packs, cognitive behavioral therapy, biofeedback, relaxation therapy, acupuncture, physical and/or occupational therapy, chiropractic manipulation, ultrasonic stimulation, and electrical neuromodulation (i.e. transcutaneous electrical nerve stimulation). If these are not helpful the patient may progress to interventional approaches such as ablative techniques, Botulinum toxin injections, nerve blocks, trigger point injections, or epidural steroid injections.⁵

Patients commonly start non-opioid analgesics (i.e. aspirin, acetaminophen, NSAIDs, and COX-2 inhibitors) at the same time as these nonpharmacologic therapies. If the patient's pain is not improving with these modalities, they may progress to opioids, antidepressants, antiepileptics, muscle relaxants, NDMA receptor antagonists, benzodiazepines, and topical

aesthetics. The patients should then be reassessed every 4-6 weeks for efficacy and possible adverse effects. Recently there has been a movement for the use of cannabinoids as an adjunct for chronic pain, although this historically has been used exclusively for cancer-related pain, which will not be discussed specifically as part of this review.⁵

Given the efficacy of opioids in improving chronic pain, they have become a mainstay in chronic pain management; over the past 20 years there has been a significant increase in prescriptions of opioids for chronic pain.⁶ There was a notable increase starting 2006 and there was a prescribing rate of 81.3 prescriptions per 100 people in the United States. Although there was a decline from 2012 to 2017, the prescribing rates remain quite high and in 16% of counties throughout the United States there were enough opioid prescriptions for every person to have one.⁷ Although there are positive effects of opioids, such as relief from acute pain, anxiety, depression, and shyness along with increased relaxation, many patients do not respond adequately to a single agent. This means they require a combination of medications, exposing them to the risks and side effects of each medication along with an increased chance of medication interactions and medication errors at home.⁵ Additionally, aberrant drug-related behaviors occur in up to 24-30% of patients using opioids for chronic pain. Aberrant behaviors are likely to associated with abuse or addiction and can include obtaining opioids from non-medical sources, forging prescriptions, resistance to changing medications, and/or recurrent episodes of prescription loss/theft, increases in dosing without provider's instructions, and running short of the supply too soon.⁸ This makes the prescription patterns even more concerning; with this rise in opioid prescriptions and aberrant use, there has been a concurrent increase in opioid-related emergency department visits, admissions to the drug treatment facilities, and overdose deaths. There are at least 16,000 opioid-related deaths per year in the

United States, which outnumber motor vehicle accident deaths. In addition to opioid misuse, studies have demonstrated that these patients, when unable to obtain their opioids, may progress to heroin use to treat the pain.¹

Interestingly, in the United States the current treatment algorithms for chronic pain do not include music therapy at any stage. Medical communities around the world have long been utilizing music therapy as an adjunctive therapy for chronic pain. Ancient Egyptians used songs as a part of their traditional healing and Hippocrates believed that music and medicine were intricately intertwined.¹⁰ It has also been mentioned in the ancient Greco-Roman, Arab, Indian, and Chinese traditions, although music therapy was practiced within the realms of philosophy, culture, and religion as opposed to being used for purely medical purposes. In our modern era, the type of prevailing illness has shifted; degenerative, chronic diseases have surpassed acute, infective processes as the leading causes of pain and debilitation, thus presenting a key role for music therapy in the medical field.¹⁰ Music therapy is a very broad field and therapists are trained in many different methods to aide with patients' symptoms. These may include music improvisation, receptive music listening, song-writing, lyric discussion, singing, music-assisted relaxation, electronic music technology, and movement to music.¹¹ These all have potential to minimize associated symptoms, improve quality of life, and perhaps even decrease the overall use of pain medications.¹⁰ Music therapy is currently being utilized in developmental, medical, mental health, wellness, educational, and rehabilitative settings.¹¹

IV. Literature Review

Pain is commonly described through the gate theory, indicating pain is multimodal in origin and is altered by physiological and psychosocial processing. Pain is a complex sensory and emotional experience and is modulated centrally by the descending pain modulatory system

by either inhibiting or facilitating nociceptive input at the brainstem and spinal cord level. It can be impacted by a variety of factors, including expectations, attention, context, sensitization, emotion, mood, chemical pathways, and even an individual's genetic makeup.¹² The areas of the brain responsible for complex processing of pain include pathways involving reward, motivation, emotion, and arousal, and are actually very similar to the areas involved in the processing of music. Music-induced analgesia is the “subjective reduction of pain perception after listening to music.”¹¹ Music-induced analgesic effects are thought to be secondary to distraction, reappraisal, familiarity, emotion, belief, and reward.¹²

Using music as an additive therapy to traditional pharmacotherapies is becoming increasingly common and encouraged in the world of medicine. Music therapy takes advantage of the physiological, psychological, and emotional impact that music has on an individual during each session. Functional MRI analysis of individuals listening to music showed that the greatest dopamine release occurs in the striatum, which is an area associated with learned, reward-relevant connections; when music is found desirable to the listener, dopamine is released. Dopamine is also released when the patient expects to hear a song they like, anticipation while they wait, and the ultimate reward of hearing the music. In addition to dopamine release, there is also increased oxygen-dependent signal amplitude in the left angular gyrus along with enhanced functional connectivity between the dorsal striatal structures and the default mode network.¹³ These findings indicate that music influences the reward characteristics in the sensory processing of patients with chronic pain.

Garza-Villareal et al. suggest that listening to self-chosen, pleasant music may make patients feel in control over their pain and allow them to reevaluate the level of pain, which can add to the analgesic effect.¹³ Listening to lyrical music in particular may elicit an analgesic effect

secondary to distraction, shown by the fact that fMRI analysis indicated that processing portions of the angular gyrus were activated while listening to this type of music. These results together indicate that music-related analgesia is related to increased amplitude of the low-frequency signals in the left angular gyrus in addition to changes in connectivity between brain areas related to pain and analgesia.¹³ This could help practitioners and/or therapists pick the appropriate music to best mitigate the patient's pain.

A clinical trial done by Alparslan et al. revealed that patients with fibromyalgia had significantly decreased pain on days 1, 7, and 14 when listening to music for 25 minutes in the morning and in the evening ($P = 0.026$). This effect did not occur in the control group ($P = 0.853$). Additionally, in patients with neuropathic pain, music significantly decreased their pain at 30 and 60 minutes. Elderly patients with osteoarthritis were also given a trial of 20 minutes per day of music therapy and demonstrated significantly decreased pain levels at 1, 7, and 14 days.¹⁴

Several studies have demonstrated that the *choice* of music is of the utmost importance. While we have seen that lyrical music provides appropriate distraction, it was found that patients do best when the music is self-chosen and peaceful with a rhythm under 120 beats per minute.¹⁴ At this time there are minimal studies creating formal music regimens for patients to follow, but there are many factors that go into creating these musical regimens. Chai et al. looked into the particular timing, type, and duration of music but also how this plays into patient preferences. They recommended using automated discovery, which is based on content-based modeling and collaborative filtering. Automated discovery itself occurs in popular music services such as Pandora and Spotify; they continuously provide new music choices to users based on their behavior. Content-based modeling assigns specific attributes to music and an algorithm then searches to find matching attributes in other genres and periods of music, creating a list of new

songs to recommend to a user. Collaborative filtering occurs when users with similar music preferences are matched, their playlists are indexed, and unique songs that a particular user may not possess is highlighted, resulting in a new song that is likely to be accepted. These together provide an ongoing stream of new music based on listener preferences and preferences of those with similar tastes.⁹ This would help to keep the user engaged and avoid getting bored, which could detract from the analgesic effect of the music.

As for the timing of the music therapy, Alparslan et al. showed that patients sent home with instructions for twice-daily music sessions had significant decreases in their pain after both 30 and 90 days.¹⁴ Johnson et al. also demonstrated that music can significantly decrease patients' reports of pain.¹⁶ Garza-Villarreal et al. demonstrated that when patients listened to music for 20-30 minutes twice daily (whether or not they were currently in pain), this significantly decreased pain levels.¹² It was also found in a randomized control trial that music reduced chronic pain in general ($P < 0.001$), with no difference between central and peripheral pain etiologies.¹²

Music's benefits are not solely limited to pain management in these patients, however; it has been shown to be helpful for the associated comorbidities. Patients reported their anxiety and depression improved following music interventions.¹² Similar results were found by Peng et al., who determined that patients had statistically significant decreases in nausea, depression, anxiety, and shortness of breath in addition to an increase in overall feelings of wellbeing.¹⁷

V. Methods

Chronic Pain

To compile background information regarding chronic pain, I searched PubMed using the terms "chronic pain AND United States" and "chronic pain AND treatment." This directed me to the

Estimates of Pain prevalence and Severity in Adults article. I then also reviewed UpToDate for “management of chronic pain.”

Opioid Use

To compile background information regarding opioids, their use, and their misuse, I searched UpToDate for “opioid use chronic pain” and “opioid use epidemic.” I also researched “opioid addiction.” To research further into aberrant use, I used a government website discussing “aberrant drug use.”

Music Therapy

Information regarding the history of the music therapy profession and its use in both ancient and modern cultures, Eastern and Western, was found using Academic Search Premier. I also utilized the American Music Therapy Association’s website.

Using Music to Decrease Pain

Search was completed using PubMed searches “music therapy AND chronic pain” and “music therapy AND opioid.” Studies were included if they discussed chronic, as opposed to acute, pain conditions including, but not limited to, fibromyalgia, gout, arthritis, abdominal pain, musculoskeletal pain, and inflammatory conditions. The focus of this review was to minimize pain and opioid use in individuals with chronic pain, so studies were excluded if they investigated intra-operative or post-surgical pain, pain during childbirth, or pain management during procedures.

VI. Discussion

Chronic pain, defined as pain lasting longer than 12 weeks, affecting nearly 1 in 4 Americans.² Typical regimens start with nonpharmacologic treatment and nonopioids such as NSAIDs, acetaminophen, and COX-2 inhibitors. If the pain is not well managed they may then

progress to opioids, antidepressants, antiepileptics, muscle relaxants, NMDA receptor antagonists, benzodiazepines, and topical anesthetics.⁵ Pain of this nature can be notoriously challenging to treat and narcotic medications, increasingly the mainstay of chronic pain treatment, have unfortunately led to devastating consequences including high rates of dependence, abuse, misuse, accidents, and lethal overdoses.¹ In addition to the difficulties of managing chronic opioid use, patients with chronic pain frequently have psychiatric comorbidities such as depression, anxiety, posttraumatic stress disorder, and substance abuse that can make treating their pain even more challenging.² A recent movement in the United States has been toward augmenting traditional pharmacologic therapies with more holistic treatments and this has made music therapy increasingly recognized within medical communities for its ability to improve pain with minimal adverse effects. Studies demonstrate that formulating a personalized, self-chosen music playlist that continuously adapts to the listener's preferences is best.⁹ The patient should listen to this playlist while in a comfortable, quiet environment several times daily for 20-30 minutes to significantly lower pain levels.¹¹

The benefits of music therapy are clear, reaching beyond the clear reductions in overall pain levels. There is extensive cost involved with chronically requiring pain medications and that could be a significant burden for patients, potentially even preventing them from appropriately managing their pain. Music is extremely easy to use, it is accessible to all, and is often free or very low-cost (if a subscription is required). Patients may also access music at their closest public library. Additionally, music is suitable for all patients, as there are no contraindications, adverse effects, or significant risks associated with its use. Aleksiene and Lesinskiene found that there were positive results seen following music therapy when administered to patients in many different medical specialties, including developmental pediatrics, psychiatry, special education,

neurology, neonatology, oncology, primary care, and rehabilitation centers.¹⁶ Benefits from music therapy can include decreased pain levels, improved depression and anxiety, and an increased overall sense of wellbeing.¹⁷

Despite these benefits seen with the regular use of music therapy, there are still several challenges with its implementation into medical practice. First, there is minimal literature testing the difference in pain levels based on the method of delivery of music. Therefore, at this time it is unclear whether a stereo, headphones, or actual in-clinic visit with a certified music therapist is the best method to achieve the highest level of music-induced analgesia. Additionally, many studies look at a combination of passive (i.e. listening with headphones) and active (i.e. playing instruments with a music therapist) music therapy and it seems at this time that there is no significant difference, but this is certainly an area that warrants further study; perhaps initially active music therapy would be best for achieving an acceptable baseline level of pain and then this could be maintained with a twice-daily regimen for passive listening at home.

As this is not traditionally taught in medical programs and patients may not be aware of music therapy, it is certainly plausible that practitioners and patients would have questions about how it works and how its used as part of the treatment plan. These questions regarding patients' care plans would likely be best guided by a certified music therapist on the medical team. Unfortunately, music therapy has not become a common service offered to the majority of patients and this could be an integration problem within the American healthcare system. Few hospitals have the internal structures to support their use and there may not be a proper procedure to obtain a music therapist in the hospital, leading to staff and/or patients finding one themselves. Additionally, 94% of the healthcare professions surveyed by Chadder had "little to no knowledge" of music therapy and stated that they felt "restricted by what [they are] officially

allowed to recommend” and that music is a “niche interest.” Following a demonstration of live music therapy, 79% of participants (providers) would welcome it on the floors and felt a music therapist would be an appropriate addition to the medical team.¹⁷ Educating providers on these services and training medical students early on in their careers could allow these interdisciplinary teams to flourish. Additionally, all patients should be made aware of the services available to them to ensure they have the ability to opt into any cares that may simultaneously ease their pain and likely decrease their need for potentially addictive and dangerous pharmaceuticals.

VII. Conclusion

Following this literature review, it has been demonstrated that music has a positive effect on not only patients’ pain but also their anxiety, depression, nausea, and overall quality of life.¹⁵ Neurologically, music is processed by a similar pathway as pain and can augment the pain pathway by impacting expectations, decreasing attention and sensitization to pain, and improving overall mood.¹¹ The use of music therapy in conjunction with nonpharmacologic and pharmacologic treatments has been shown to effectively improve pain and associated symptoms in chronic pain conditions. It is low-cost, has no adverse effects, and is accessible to all patients. It would also likely lead to patients requiring lower doses or even less doses of their opioid treatments; Peng et al. monitored patients’ opioid use in the time period following musical intervention and found there was a trend toward a significant decrease in opioid use ($P = 0.10$); patients were using 1.29 morphine equivalents less than prior to listening to music.¹⁵ Based on this trend, incorporating the simple task of listening to calming music several times a day could lead to a decrease in the opioid-related dependence, overdoses, and deaths that have become so prevalent in our society.

Given these promising results, clinicians should be taught in their schooling about music therapy and its ability to improve quality of life in chronic pain conditions. Hospitals and clinics should work with local music therapy programs and find ways to integrate therapists into the healthcare team to make it accessible to as many patients as possible. Once this occurs, all members of the healthcare team should receive proper training into what music therapy is and how music therapists can help their patients. This approach would not only improve clinician outlook on adjunctive therapies but will also make patients aware of what is available to them, likely significantly improving their levels of pain and improving associated conditions such as anxiety and depression.

Further research should be completed to further identify the most effective regimens/algorithms based on the type of pain and provide best practice guidelines for clinicians. It would also be beneficial for clinical practice to perform further investigations into how music can best be implemented to decrease opioid use; there are few studies that consistently measured patients' opioid use prior to and following music therapy and bolstering this information with more data could be the push to make it a mainstream treatment for chronic pain patients and attempt to taper their opioid dosing.

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