

Music Therapy as a Treatment for Pediatric Surgical Patients

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The Greek philosopher Plato once said, “music gives wings to the mind”. He believed that playing and listening to different kinds of music had an effect on different emotions, which is a very similar concept to music therapy. Data supporting the effectiveness of music therapy dates back to the post-World War II era when musicians were hired to play for war veterans, who were hospitalized with physical and emotional traumas. Clinicians started to see that music had positive effects on their patients and hired more musicians over time (Nizamie & Tikka, 2014). Music therapy is now defined as “clinical and evidence-based use of music interventions to accomplish individualized goals” (American Music Therapy Association, para. 2). Music therapy could involve the client performing or listening to music, and has been proven to be effective in benefiting a variety of conditions, examples of which include dementia, asthma, pain, Autism Spectrum Disorder, and Parkinson’s Disease (American Music Therapy Association).

Every year in the United States, approximately 450,000 pediatric patients (under the age of 18) have inpatient surgeries every year; about one-fourth of those children are under the age of 3 years old (Tzong et al., 2012). Additionally, the amount of pediatric surgeries in the United States has massive increases annually (National Quality Forum, 2017). There are many factors that may cause a child to feel anxiety about an operation, such as a fear of never waking up from anesthesia, loss of control, pain, or facing isolation in their social life (Karakul & Bolışık, 2018). Between 50 and 75 percent of children undergoing surgery experience significant fear and anxiety preoperatively; starting at planning the surgery with anxiety levels hitting an all-time high as they enter the hospital (Baghele et al., 2019). Additionally, all surgical operations will result in a level of pain during healing; the severity of which will be due to the location and nature of the surgery. There are numerous options for postoperative pain treatment options, common ones including nonsteroidal anti-inflammatory drugs (NSAIDs), and opioid analgesics (painkillers), which are the first line of treatment in the majority of surgical settings (Garimella & Cellini, 2013).

The focus of this paper will be on music therapy being an effective treatment option to decrease pain and anxiety after operations for pediatric surgical patients. In music therapy studies with pediatric surgical patients, the children listened to music before, during, or after their operation, and their pain and anxiety were measured before and after hearing the music. An additional purpose of this paper is to discuss the medical importance of lowering the patient's perceptions of these feelings; as well as how music interacts with the brain to produce the desired effects. For medical professionals, the goal of their work is to help restore their patients to their desired level of health, which combines physical and mental wellness. Listening to music is proven to do both in a safe way, with none of the potential side effects from pharmacological treatments. For example, the brain's perception of music releases endorphins that causes vasodilation, which is the widening of blood vessels (Nizamie & Tikka, 2014). This allows more blood to rush to injured tissue which promotes healing and decreases pain. Additionally, different aspects of music have a variety of anxiety reducing effects, such as a steady beat (Gadberry, 2011). For these and additional reasons, music therapy is a beneficial treatment for pain and anxiety in postoperative pediatric patients.

Studies Show Music Therapy Decreases Pain and Anxiety

Throughout the literature about music therapy studies, one common tool for measuring a patient's change in pain and anxiety is assessing their vital signs. The five vital signs are blood pressure, heart rate, respiration rate, temperature, and oxygen saturation. Increased heart rate, breathing rate, and blood pressure are normal responses to pain (Casa Palmera Staff, 2013), as well as anxiety (Leonard, 2019). Therefore, studies where postoperative experimental groups (patients that listen to music) have lowered heart rate, respiration rate, and blood pressure, support the claim that music therapy is beneficial to decrease pain and anxiety. Some studies also use the State Trait Anxiety Inventory (STAI) for kids. The STAI is a tool that is used to standardize scores of self reported anxiety. It consists of a variety of simple statements, such as "I feel calm", "I am tense" and "I am worried" (Nilsson et al., 2012). The patient then rates how

much they agree with each statement on a scale of 1 to 4, with 1 representing “not at all” and 4 being “very much” (Nilsson et al., 2012).

One study followed forty children ranging from ages seven to twelve who would be receiving a lumbar puncture; all of whom had experienced a lumbar puncture in the past. Half of the children listened to no music, while the other half listened to music that they liked for ten minutes prior to the procedure. The researchers included self-reported pain and anxiety scores from the patients before, during, and after the procedure; as well as vital sign measurements. After the procedure, the average self-reported pain score of a child in the music group was 1.8 points lower than a child in the control group, and the anxiety score was 4.9 points lower than the control group. Additionally, the mean values for heart rate, respiration rate, and blood pressure were lower in the music group compared to the control group. Another noteworthy piece of information is that the people in the music group stated that this experience was favorable in comparison to their last lumbar puncture. This is a strong statement that encompasses that the children’s overall feelings during the procedure with the music was better than previous experiences (Nguyen et al., 2010).

This study is quite beneficial to showing that music therapy is an effective treatment for pain and anxiety after an operation. If the sample size had been larger, more data could’ve been gathered which would strengthen the points that were made in the research. Additionally, using a standardized tool to self-report their pain, such as the STAI, would make it easier to compare results of this study to others about the same topic. However, having multiple ways to measure pain and anxiety levels (self-reporting and vital signs), strengthens the results because both forms of measurement showed the same outcome; lower levels of pain and anxiety for the patients involved.

A study in Turkey recruited a group of 130 patients ages nine to seventeen undergoing surgery. The randomly-selected experimental group listened to classical music chosen by a musicology professor for twenty minutes during their recovery period. For both the experimental

and control groups, vital signs were taken and the State-Trait Anxiety Inventory (STAI) for children was filled out fifteen minutes before the operation and twenty minutes postoperatively; after the experimental group listened to the music. Similar to the previously mentioned study, there was no difference between the groups in terms of their initial state. However, postoperative pulse, blood pressure, and respiration rates were lower on average in the experimental group than in the control group. The preoperative State Trait Anxiety Inventory scores between the two groups had no significant difference. The average postoperative score for the experimental group was 35.01, while the control group's average score was 41.23 (Karakul & Bolışık, 2018).

This study, while larger than many of the others done about this topic, still has a relatively small sample size and a very limited population. Additionally, this study only focused on children who underwent a single day surgical intervention; not major operations with lengthy hospital stays. The selection of music that the patients listened to was standardized, which provides an even stage for all patients to be analyzed (Karakul & Bolışık, 2018). Although, the music could've had more beneficial effects if the patients selected their own music, and listened to songs that are enjoyable to them (Nizamie & Tikka, 2014).

Many studies about music therapy with postoperative pediatric patients focus on older children. Although, a study performed on 178 children, ages 0 to 3 years old, showed that music is effective to treat postoperative pain and anxiety in young children as well. Though it should be noted that there was less of a difference in pain and anxiety scores between control and experimental groups in young children than there was in the older children from other studies. There were three groups in this study; one listened to preoperative music, one listened to preoperative and intraoperative music, and the last listened to no music at all. The children were assessed using the COMFORT-behavior scale throughout the process, which measures their level of distress based on a variety of physical factors, such as heart rate, facial expression, crying, and the reaction to the care provider (Vet et al., 2016). The differences were small, but

the group who listened to preoperative and intraoperative music had the best average score on the COMFORT-behavior scale (Kühlmann et al., 2020).

Finding a study about younger children was beneficial to widen the population of this research. Although, there were some drawbacks to this study. First of all is the ever-present issue of a small sample size. Additionally, there are some downsides to how the results were measured. Since the patients were so young, they can not personally report their pain or anxiety levels using a tool such as the STAI; they had to be observed by healthcare providers. The behaviors measured by the COMFORT-behavior scale could be indicators of the patient's level of pain or anxiety; although they could also be signs of other feelings, such as hunger or exhaustion. Since the children are so young, they can not communicate why they're behaving the way they are; the healthcare providers must make assumptions about what is causing them to act the way they do. This could skew the results one way or another depending on the opinions of the person recording the child's COMFORT-behavior scale score. Additionally, studies suggest that listening to music that is enjoyable to the individual has more effective pain and anxiety reducing results (Nizamie & Tikka, 2014). Since these children are so young, they likely can not yet recognize specific music as enjoyable to them. This could be another contributing factor as to why the COMFORT-behavior scores between the experimental and control groups showed such a small difference.

What Characteristics of Music Cause Lower Pain and Anxiety?

Music can evoke countless emotions. Lively, upbeat songs make you want to dance, while slow songs with sad lyrics can make you cry. Many factors come together in a song to create feelings for those of us who listen to it; including beat, which is the basic unit of time in a song (Musical Dictionary, 2018). The beat varies greatly from song to song; it can affect the tempo, or speed (Musical Dictionary, 2018), of music. The beat could be steady throughout an entire song, or fluctuate between fast and slow. The American Music Therapy Association takes beat, along with other factors of a song, into consideration while providing recommended

guidelines for therapeutic music listening, including music content and health considerations (American Music Therapy Association, 2020).

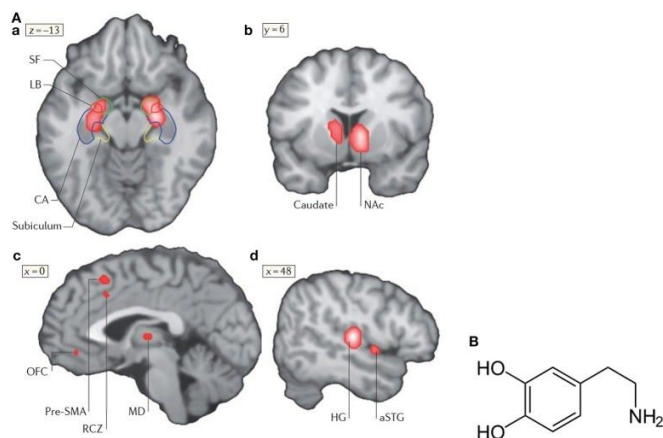
The American Music Therapy Association recommends music that promotes healthy emotions and behaviors (American Music Therapy Association, 2020). This recommendation is supported by the studies which state that music is the most therapeutic when it is personalized to whatever provides the patient with enjoyment and positive emotions. Lastly, the American Music Therapy Association has different music suggestions for people with specific health problems. For example, individuals with heart or breathing problems need to consult a music therapist before starting a music listening program to be sure that they're listening to music with ideal tempos for their heart and respiration rate (American Music Therapy Association, 2020). Additionally, an important psychological consideration is that individuals with strong negative feelings should avoid music that elicits or strengthens those feelings (American Music Therapy Association, 2020). This recommendation connects back to treating pain and anxiety with music therapy, because if a song makes a patient feel anxious or upset, they will not be in the ideal positive mindset for healing.

A study recorded by the Journal of Music Therapy shows that music with a slow, steady beat is effective in treating anxiety. The study measured state anxiety; which is anxiety felt at a present moment due to a specific situation, unlike the chronic, long term anxiety a patient suffers from with an anxiety disorder. While the study was performed, participants sat in a room alone for two minutes, either in silence or listening to the steady beat. The beat was at a rate of 66 beats per minute, which is considered to be a slow song; for reference, "The Lion Sleeps Tonight" is 66 beats per minute (*Most popular running songs at 66 BPM (Page 1)* 2020). They had to perform a test in which they were asked to state the ink color of 100 words with different color names as quickly as possible to induce anxiety. The people who listened to the steady beat reported lower anxiety levels (Gadberry, 2011).

Although this study does not directly relate to postoperative pediatric anxiety, it provides readers with information about what kind of music should be used in music therapy to treat anxiety. Since postoperative anxiety is an example of state anxiety, the findings can be connected. It shows that the music used for postoperative pain and anxiety should have a steady, slow beat. This type of music has been found to have an effect similar to guided meditation (Gadberry, 2011). Combined with the findings of other literature sources, a conclusion can be reached that the most effective music for lowering anxiety is that which is enjoyed by the patient, and is also slow with a steady, unchanging beat.

How Does Music Interact with the Brain?

Many sections of the brain are involved in processing music, starting when it is first heard by the ear. The neurological signal is first processed by the cochlea (Nizamie & Tikka, 2014), which is a bony labyrinth within the inner ear (*Merriam-Webster* 2020). From there it is sent to an area of the brain called the thalamus (Nizamie & Tikka, 2014), which is a major relay center for sensory impulses into and out of the brain (*Merriam-Webster* 2020). The impulse also reaches the auditory cortex (Nizamie & Tikka, 2014), which is located in the temporal lobe of the brain and is the primary organ of hearing (*Merriam-Webster* 2020). The emotions and rhythm of music are processed in many places, but two of the major regions are the parietal lobe and the amygdala (Nizamie & Tikka, 2014). The amygdala is an area of the temporal lobe that acts as the center for emotions and emotional behavior; the parietal lobe is the area of the brain concerned with bodily sensations (Nizamie & Tikka, 2014).

Figure 1*Neural Correlation of Music-Based Emotions*

Note: The areas of the brain located in (a), (b) and (d) are the amygdala (Schaefer, 2017)

Another biological effect of listening to music is a decreased level of s-cortisol (Nguyen et al., 2010). High cortisol levels are associated with the body's reaction to stress (Schaefer, 2017); therefore, decreasing cortisol levels after an anxiety-inducing event, such as surgery, is beneficial to the patient's health. High cortisol levels can cause weight gain, muscle weakness, hypertension (high blood pressure), and osteoporosis (brittle bones) (Thau, 2020).

Endorphins are chemicals that, when released, mainly bind to opiate receptors; because of this, they have some of the same pharmacological effects as opioids, such as pain relief (Merriam-Webster 2020). When enjoyed music is processed by the brain, endorphins get released into the body (Nizamie & Tikka, 2014). The release of endorphins leads to vasodilation, which is the increase in diameter of blood vessels (Merriam-Webster 2020). Vasodilation promotes healing because it allows for more blood flow to be at the site of the injury. This brings more clotting factors to the wound, which again helps wound healing and reduces pain (Nizamie & Tikka, 2014).

Why Should Music Therapy be Used To Treat Pain?

Helping their patient reach the highest possible level of health should be a medical professional's first priority. Therefore, they should do anything to help lower their patient's pain, because pain has a negative effect on wound healing (Bachert & Abraham, 2009). While there are many ways to treat pain, some are safer than others, and it's important for healthcare providers to learn what's best for each individual patient, and build them a treatment plan accordingly. Some people are comfortable with taking intense pain medications, such as opioids, while others would prefer natural healing, or a mixture of both. Music therapy is an affordable, harmless example of one option to provide natural healing; either alone, or with smaller, safer doses of drugs such as opioids or NSAIDs.

Opioids such as oxycodone and percocet are the first-line pain treatment in postoperative care, with NSAIDs like aspirin and ibuprofen also being common pain treatment options (Garimella & Cellini, 2013). Opioids are very effective painkillers, but can cause serious adverse effects and they have an addictive quality; 772 adolescents died of opioid abuse in 2015 (Liesen & Tatebe, 2020). In a study of 90,000 patients, up to 15 percent of adolescent surgical patients continued using their prescription opioids 90 to 180 days after what was expected for the surgery they received (Study finds common surgeries may serve as pathway to nonmedical opioid use in adolescents, 2017). If opioids were prescribed in smaller doses, the patient's bodies would have less exposure to them, and therefore less risk of addiction. Prescriptions for opioids can also cost patients up to sixty dollars on average (Craig & Strassels, 2010); but that number can increase drastically depending on the medication that's prescribed and the patient's insurance plan, or lack thereof. While sessions with a music therapist do have an associated cost, listening to music is free for a vast majority of the population due to the staggering number of people who have access to music listening devices; 96 percent of Americans own a cell phone, and 81 percent own a smartphone (*Demographics of Mobile Device Ownership and Adoption in the United States 2020*).

The very broad description of the side effects of opioids is that they slow down the body's physiological systems. In the gastrointestinal system, opioids can cause constipation. Which can be treated, but if it goes unnoticed can lead to more serious complications, such as hemorrhoids or fecal impaction. A more serious adverse effect of opioids is respiratory depression. Respiratory depression could develop into sleep apnea (periods of not breathing during sleep) or carbon dioxide retention, which has a wide range of mild symptoms but could cause coma or death if severe (Scott, 2014).

Due to the dangerous side effects and addictive quality of opioids, it's recommended to give less dangerous painkillers to the pediatric population when necessary, such as NSAIDs and acetaminophen (Liesen & Tatebe, 2020). Although, those also can be dangerous in high doses. For example, ibuprofen, a common NSAID, is a blood thinner; which decreases clotting time and increases the patient's risk of bleeding after surgery (Garimella & Cellini, 2013). In combination with music therapy, lower doses of pain medications can be an effective form of pain treatment with a lower risk of dangerous side effects (Liesen & Tatebe, 2020).

Why Should Music Therapy be Used To Treat Anxiety?

In addition to being a complimentary pain treatment, music therapy can be used as a natural way to decrease anxiety. It's important to decrease anxiety in postoperative patients, because stress decreases the strength of the immune system. Stress causes the body to have low lymphocyte levels, which are a form of white blood cells that help the body fight off infections. With less lymphocytes, patients with anxiety or stress are at a higher risk for developing viruses (*What Happens When Your Immune System Gets Stressed Out?* 2020).

Postoperative infections are always a possible complication of surgery. They can range in severity, but even minor infections lead to prolonged hospitalization (Ruzic et al., 2020), because the healthcare provider needs to make sure that the infection doesn't become more serious, or progress to become sepsis. Sepsis is a life-threatening condition, and occurs when the body's response to an infection is out of balance, and leads to the damage of multiple

organs instead of harming the infection (Mayo Clinic, 2018). Between 2004 and 2012, 7.7 percent of pediatric surgical patients in the United States suffered from sepsis (Ruzic et al., 2020). Healthcare providers work tirelessly to keep hospitalized patients healthy. Even though medications are typically the treatment option of choice, complementary therapies such as music therapy, can be used either by themselves or in addition to pharmacological treatment methods to make a child less stressed; therefore keeping their immune system stronger.

Future Research

Many studies show that music therapy is effective to treat pain and anxiety in pediatric patients after they have an operation. Although, there are some details about common trends in music therapy studies that need to be discussed. First of all, the sample sizes were very small; the typical sample sizes that were seen in these studies were typically between 50-175 people. Therefore, even though the studies supported the effectiveness of music therapy, the data would be more strongly validated if a larger study found the same results. There would be more opportunities to prove that music therapy is effective, as well as higher, more eye-catching percentages.

There are three common factors measured in music therapy studies; vital signs, self-reported pain, and self-reported anxiety. Vital signs are measured by healthcare providers, the same way every time, and therefore have a defined “healthy” range and can be compared easily. Something that would help create more consistent data between studies is using one common scale or assessment tool to measure self-reported pain or anxiety. Some studies used the state-trait anxiety inventory, others used the COMFORT-behavior scale, and others simply called their data “self-reported”. If there was a single assessment tool, they would be more standardized and it would be easier to compare results between studies.

Finally, it seems that many studies only have patients listen to music for a maximum of twenty minutes. Pharmacological treatments for pain and anxiety are the most effective after the patient takes the full prescribed treatment regimen, which consists of multiple doses typically

over many days, or a couple of weeks. An interesting addition to this research would be to study if longer or more frequent sessions of listening to music are more effective than one-time music therapy sessions. If the effectiveness of music therapy is similar to medical options, it may be found that music therapy can be even more effective if it's done over a longer period of time, which would maximize the positive effect for the patients.

Conclusion

“Music is the art of sound in time, expressing ideas and emotions in significant forms through the elements of melody, harmony and color” (Nizamie & Tikka, 2014). Music has been used for centuries to celebrate, mourn, and emotionally heal; now as music therapy gains popularity and prevalence, evidence shows that music can also be beneficial to help patients physically heal. When music is heard and the impulses enter the brain, it's processed in many places. The parietal lobe and the amygdala are two of the prominent places, which are where the emotions and rhythm of a song are processed (Nizamie & Tikka, 2014). Additionally, when music is heard, the patient's stress level decreases, which is shown by a decreased level of s-cortisol (Nguyen et al., 2010). The body also releases endorphins when listening to music, which aid in pain reduction and the physical healing of a surgical site (Nizamie & Tikka, 2014).

Countless studies provided evidence that music therapy is an effective pain and anxiety treatment for pediatric postoperative patients, but none of those stated that music therapy is equally or more effective than pharmacological options. It's beneficial to do as much as possible to decrease a patient's anxiety to minimize their chance of developing an infection after the operation (*What Happens When Your Immune System Gets Stressed Out?* 2020), whether it's medication, an alternative treatment, or a combination of the two. Additionally, common pain medications can have dangerous side effects as well as a risk of addiction (Liesen & Tatebe, 2020), especially if taken in large doses. Therefore, the literature recommends that music therapy should be used as a complementary therapy, in addition to medications instead of replacing them. The effect of music therapy will decrease the patient's need to take potentially

dangerous medications like opioids, and therefore will decrease their risk of developing dangerous side effects.

I've been taught in recent years that music is a universal language. In the original context, I interpreted that to mean that anyone can be a musician; that there is no culture or language barrier to playing music. Which is true, although, there's more to the message than that. Music is more than a form of art or entertainment; it's a form of communication and expression as well. Music has the power to bring a group together despite any other differences those people might share. And finally, music has the power to heal. It has the power to chemically alter our bodies and improve our health, both physically and mentally.

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