# The influence of music therapy on preoperative anxiety in pediatric oncology patients undergoing invasive procedures

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## *Abstract*

The influence of music therapy (MT) on preoperative anxiety in children affected by leukemia undergoing invasive diagnostic procedures (IP) was evaluated. The participants were assigned to two different types of preoperative preparation for IP: MT intervention or standard care. Preoperative anxiety scores were measured with the Modified Yale Pre-operative Anxiety Scale. Interviews with medical staff were performed.

A lower preoperative anxiety score in the MT group (n = 29) compared with standard care (n = 19) was observed. Results support the potential effectiveness of integrating music therapy with a pharmacological approach to reduce preoperative anxiety in IP. More than 90 % of the medical staff (n = 19) were very satisfied with the ability of MT to distract the patient and support the staff.

## *Keywords*

Music therapy Pediatric Analgesia Sedation Procedures Cancer

## *Introduction*

Pediatric patients treated for oncological and hematological pathologies repeatedly undergo diagnostic procedures, such as bone marrow aspiration (BMA), lumbar puncture (LP) and bone marrow biopsy (BMB). These procedures cause fear, anxiety and pain before, during and after the procedure (Ortiz et al., 2019). Pain is considered one of the worst experiences in children with cancer (Hedstorm, Hanglund, Skolin, & von Essen, 2003). Anxiety affects the sympathetic nervous system, the endocrine system and the immune system, causing tachycardia, hypertension, increased myocardial consumption of O2, arrhythmias, increased peripheral resistance, crying with mucus secretions, hypercoagulability, immunodeficiency and catabolic response. The World Health Organization (WHO) and the American Academy of Paediatrics (AAP) recommend combining sedative and analgesic medication during painful interventions in children with hematologic diseases (Coté, Wilson, AAo, & Dentistry, 2006). The prevention and treatment of these signs and symptoms is considered essential for the quality of life of pediatric patients (Flowers & Birnie, 2015). As reported in the literature, patients who have previous negative associations with medical procedures are more likely to develop fears and show distress responses when faced with a medical procedure again. Having these patients successfully complete a medical procedure with little to no distress behaviors could prevent or reduce future negative associations (DeLoach, 2005). Multidisciplinary and multimodal prevention, integrating non-pharmacological techniques, may be preferable (Dileo & Bradt, 2005), because pharmacological analgesia and sedation are hampered by potential risks and side effects, such as respiratory depression, nausea and vomiting, itching, constipation, that must be carefully balanced for each patient and procedure (Baroncini, 2012).

Music medicine (MM) and music therapy (MT) are increasingly used as non-pharmacological techniques integrating analgo-sedation (Stegemann, Geretsegger, Phan Quoc, Riedl, & Smetana, 2019). They are based on the influence that music is shown to have on enhancing developmental goals, self-expression, communication, relaxation and support in children (Clark, Siden, & Straatman, 2014).· Music represents a very immediate and spontaneous way for children to access and regulate these aspects, because of its intrinsic nature involving bodily sensations, feelings, emotions and thoughts.

MM consists of passive listening to pre-recorded music provided to the patient by a nurse or other medical staff. No therapeutic relational process is present through the music, nor is there a systematic evaluation of the sound elements

or music. MT involves the systematic use of musical experiences aimed at achieving therapeutic goals by a trained music therapist (MTt) and implies the establishment of a relationship between patient, music and MTt (Bradt, Dileo, & Shim, 2013). The effectiveness of MT in pediatric oncological contexts has been documented (Barrera, Rykov, & Doyle, 2002) (Zanchi, 2015), but research in the context of LP for children affected by cancer is minimal (Nguyen, Nilsson, Hellstrom, & Bengtson, 2010).·MT may be administered to help children cope with their emotional distress, fear, anxiety, and coping skills.

Music therapy compared with pharmacological sedation is a cost-effective alternative. It has no apparent risks and can provide patients and families with physical, emotional, and cultural benefits (Loewy, Hallan, Friedman, & Martinez, 2006; Ostermann, Keenan, Seiferling, & Sibbald, 2000; Loewy, Stewart, Dassler, Telsey, & Homel, 2013). MT-assisted procedures may save money, time, and staff/equipment resources during pediatric care (DeLoach, 2005) and reduce procedural time with MTt support during IP (Chlan, Heiderscheit, Skaar, & Neidecker, 2018).

The primary objective of the study was to evaluate the influence of MT as a complementary/non-pharmacological intervention to reduce preoperative anxiety and promote more compliant behaviors during anesthesia induction.

## *Methods*

### *Participants*

Over a 10 month-period (from September 2017 to July 2018), children (ages 2–13) with cancer hospitalized at the Pediatric Oncology and Hematology Ward of the Polyclinic Hospital in Bari, Italy, were invited to participate in this study. Exclusion criteria were: a significant hearing and/or cognitive impairment, previous psychiatric disorders, and inadequate understanding of the Italian language. Study participation was voluntary and parents, after presentation of the project, signed an informed consent form.

### *Design and procedure*

The observational study protocol was approved by the Hospital Ethics Committee of Bari, n° 5340 12/7/2017 prot. 0064464. Children were assigned to the MT group Group 1, n = 29 or to the standard Care Group 2, n = 19 on the basis of the presence of the MTt's schedule in the ward. The MTt was present in the ward three days a week and offered MT to every child undergoing diagnostic procedures during those days. Children in Group 2 who received standard care preparation, were accompanied by their parents and received entertainment with leisure activities.

### *Music therapy intervention*

A 15−20 minute MT session was provided bedside in a hospital room (BPS) prior to the procedure by a certified MTt, with the collaboration of a psychologist. An interactive relational approach, developed from the model of "free improvisation therapy," was used (Bunt & Stige, 2014). This approach included both active and receptive techniques that involved the use of various musical instruments, free improvisation, singing and song-writing, together with the choice, creation of and listening to play lists with the MTt (Grocke & Wigram, 2007). Children could listen to songs with headphones (Bose Quiet confort 35II) or with audio speakers (Bose SoundLink® Bluetooth® III) from ipod®. The MTt tailored music to each child based on the results of a patient assessment. (Robb, Carpenter, & Burns, 2011). The volume was identical for all patients (and about 70 dB SPL, which was designated as a pleasant volume by all participant) and was controlled by the MTt. Parents could participate in the music therapy session if the child agreed. At the end of the session, the MTt accompanied the children and their parents to the operating room. The musical process - active or receptive - continued in the operating room until the analogo-sedation was administered. The MTt stayed with the child until he or she had fallen asleep. Analgo-sedation was administered based on the clinical judgement of the anesthesiologist.

### *Measures*

The Modified Yale Pre-operative Anxiety Scale (m-YPAS) was used to evaluate the behavior of the child in the hospital and operating room. The m-YPAS is an observational behavioral checklist developed by Kain, et al. (1997) to measure the levels of preoperative anxiety in young children. This instrument consists of 22 items divided into five categories: activity, emotional expressivity, state of arousal, vocaliza-tion and use of parents. The m-YPAS score ranges from 23 to 100, with higher scores indicating greater anxiety. The m-YPAS has been used in more than 100 studies evaluating preoperative anxiety in different health fields such as surgery, anesthesia and pediatrics (Jenkins, Fortier, Kaplan, Mayes, & Kain, 2014). In the present study, m-YPAS was administered by a specialized

psychologist, trained to use the instrument, at two datapoints: in the morning of the day of the procedure, within the holding room before the arrival of doctors and MTt (T1), and in the operating room just before the induction of anesthesia (T2).

The duration of the first BSP was measured for all children in the MT group. For children who underwent 3–6 IP, the average duration of all BPS was measured. The medical staff also completed a questionnaire containing 6 questions, 2 of which concerned the presence of the MTt during the MIP. The questionnaire edited by Zanchi and Acler (2016) has been used for similar projects in other pediatric oncological contexts to solicit staff opinions regarding the ability of music therapy to distract during the procedure as well as support the medical staff. Staff responses were recorded on a 5-point likert scale. Data collection was done by a researcher MTt.

*Statistical analysis*

Descriptive and inferential analysis were applied to the data to detect potential differences between groups in anxiety as reported on the m-YPAS. Two kinds of analyses were performed: 1) potential differences in anxiety scores for the MT group at T1 and T2 datapoints and 2) potential differences in anxiety scores between the two groups at datapoints T1 and T2, the p level was set at 0.01 for both analyses. Moreover, all variables were examined to investigate their nature, their probability distribution and possible relationships between their variances. In particular, the latter two were analyzed with the Kolmogorov-Smirnov and the Fisher test, both with a significance level of 0.01. The open source statistical software R (R Development Core Team, 2014) was used for the statistical analyses.

## *Results*

A total of 48 parent-child dyads participated in the study with 29 dyads receiving the MT intervention and 19 receiving standard care practices. In the Mt group 10 children received 1 session of MT, 8 children received 2 sessions of Mt, 5 children received 3 sessions of Mt, 5 children received 4 sessions of MT, and 1 child received 6 sessions of Mt.

The analysis suggests both the benefit of the MT treatment utilized within Group 1, as well as group differences with regard to levels of anxiety Assuming a normal probability distribution, a right-tailed t-test was performed on the difference variable (p-value = 2.486 10^-5) suggesting that differences in the anxiety levels were found between the two data points of treatment. These differences were confirmed as shown in Fig. 1. A symmetric distribution and positive mean value indicate a significant reduction in the anxiety levels in Group 1 patients from datapoint T1 to T2.

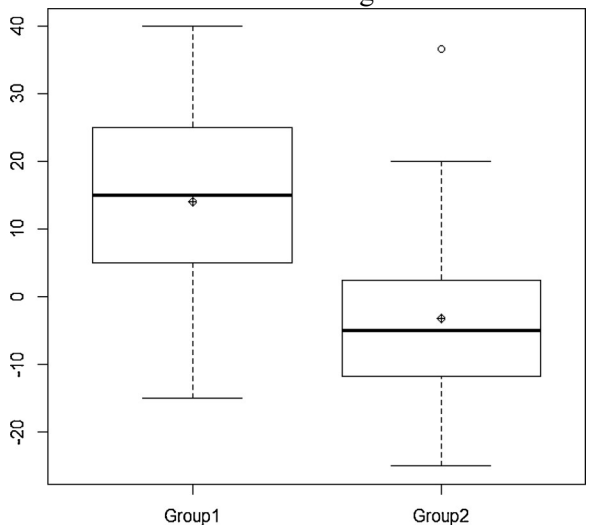


Fig. 1. Box-plot representation of the variables computed as difference between the two moments T1 and T2 for Group 1 and Group 2. Positive values of Group 1 and its mean greater than the one in Group 2 reflects the benefits of music therapy in the anxiety level reduction.

Results also point to the significant differences in anxiety between Groups 1 and 2, with the MT group having lower anxiety than the standard care group (Table 1).

Table 1
Contingency table describing the alteration of anxiety levels measured between the two moments of the experiment, in the two groups of patients.

| | *Group 1* | *Group 2* |
|---|---|---|
| *Increasing of anxiety level* | 20.69 | 57.90 |
| *Indifference* | 0 | 15.79 |
| *Decreasing of anxiety level* | 79.31 | 26.31 |

Assuming a normal probability distribution and equal variances (considerations confirmed with significance level 0.01 by the Kolmogorov-Smirnov test and Fisher test, respectively), a right tailed t-test performed on the variables (p-value = 4.661 10^-4), revealed a significant difference between the two groups. These data are shown in Fig. 1, which represents the box-plots of the two groups' variables. Positive values in Group 1 reflect the greater effect of music therapy in reducing anxiety levels compared to negative values in Group 2. The average duration time of the first BPS was 22.38 min. (σ 1.63), while the average time was 12.20 min (σ 3.77) for children who had from 3–6 sessions (Fig. 2). Regarding the responses of the staff to the two questions about music therapy, 66.7 % of the interviewees answered "very much," 30.3% "a lot" and 3 % "sufficiently" to the question concerning the ability of music therapy to distract the patient. In addition, 60 % of the staff reported "very much," 33.4 % "a lot" and 6.6 % "sufficiently" to the question regarding the ability of the music therapist to support the staff. None of the interviewees reported a negative opinion on the presence of MT during MIP.

## *Discussion*

This study supports the feasibility and effectiveness of integrating MT with a medical and pharmacological approach to reduce preoperative anxiety in children undergoing IP. IP in pediatric patients requires adequate analgesia and sedation; this is obtained by a combination of pharmacological agents, as there is no single drug that provides rapid onset and offset of effect, adequate cardiovascular and respiratory function control, amnesia and inactivity (Yazdi, Ayatollahi, Hashemi, Behdad, & Yazdi, 2013). MT can be considered an excellent support for anesthesia, because (1) it is rapid in onset and offset, (2) its metabolism does not depend on hepatic, renal or pulmonary function,
(3) there is no interaction or incompatibility with other drugs, (4) it is easily titratable to adequate sedation levels, (5) there are no side effects (nausea, vomiting, etc.), and (6) it causes neither anaphylaxis nor intolerance (Ostermann et al., 2000). MT has a positive effect on anxiety, potentially mitigating stressful environmental factors, and improving comfort (Geipel, Koenig, Hillecke, Resch, & Kaess, 2018). It has a distracting, holding and supporting effect. In the current study, MT was integrated into patient care throughout the entire interactive preparation process instead of immediately prior to IP. Compared to other kinds of approaches that use music listening only in the operating room, BPS allowed a co-creative process, active or receptive, structured by the child's own initiative. This allowed children a "greater sense of positive control over their environment as well as facilitating emotional self-regulation" (Uggla et al., 2016). When children use music to prepare themselves for an unpleasant experience, it is essential that they first get in touch with their emotions, such as fear, anxiety and pain, if these are to be held, supported and transformed by the music (Uggla et al., 2016). These processes not only refocus the patient's attention, but also distract from the procedure itself or from the waiting time beforehand (Loewy, 1999) and help the child acquire a sense of security and calm for future proceedings. Live, musical interactions tailored by the MTt to the in-the-moment needs of each child provide a deeply humanizing and validating experience: making music together, such as singing a song, improvising sounds and rhythms or listening to a chosen piece of music, can offer a sense of strong support and deeply contrast the passivity of submitting oneself to surgical procedures (Ghetti, 2012).

Furthermore, our results indicate that the time needed for the preparation session may become shorter after the child has undergone the procedure accompanied by the MT several times and a MT process has been developed (Fig. 2).

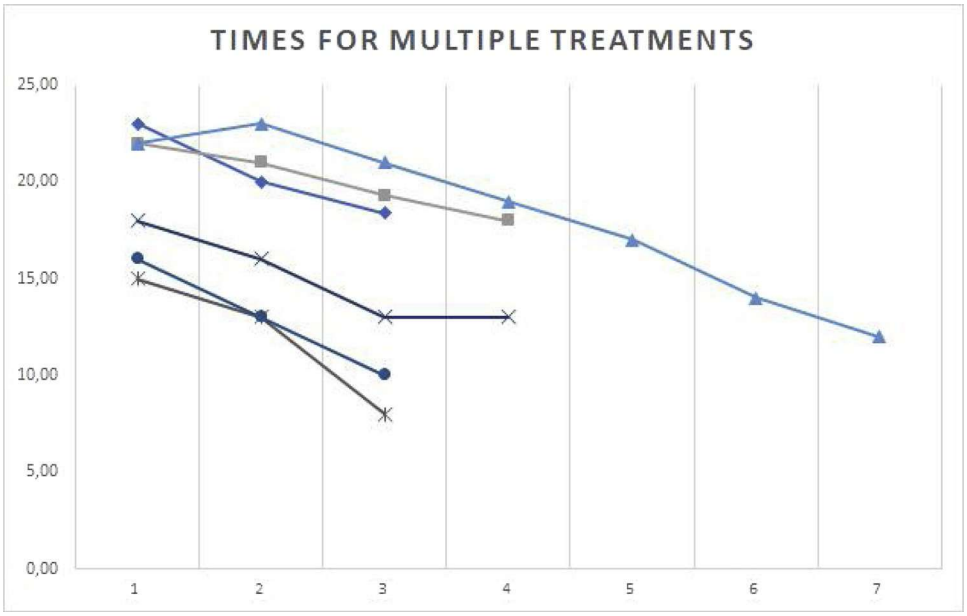


Fig. 2. Representation how the time needed for the preparation session becomes shorter after the child has undergone the procedure accompanied by MT several times and a MT process has been developed. The average time was 12.20 min (σ 3.77) for children who had from 3 to 6 sessions.

As this process progresses, and patients have the opportunity to interact with music in MT, the BPS shortens and, in some cases, disappears. Children progressively enter the operating room more quickly and without fear, and they interact with the MTt undisturbed and independently. In contrast, in the absence of MT, children find it harder to enter the room, and they are less compliant before the anesthesia is induced. It is interesting to note that during this study, 7 patients requested the presence of the MTt also on awakening. Thus, MT became an integral part of the whole medical process.

In the current study, the medical team also showed positive attitudes regarding MT (Lane, Palmer, & Chen, 2019). Those who were interviewed reported feeling more confident and serene, because the children who received MT were more peaceful and collaborative and, from their point of view, this situation was optimal for the procedures performed.

## *Limitations*

This current study was an exploratory, pilot study and the first experience of its type in Italy. Future studies will require a greater number of participants, possibly in the different contexts of pediatric oncology. It was not possible to use randomization procedures due to the nature of the treatment and the organization of the ward.

The anesthesiologists in this study observed that the absence of the MT called for a larger amount of anxiolytic drugs, with an increase in the residual effects of anesthesia, as well as greater emotional and psychological stress both for patients and for the anesthesiologists themselves. Given that it was not possible to collect specific data concerning this observation, it would be advisable to evaluate the pharmacological interaction and dosage of drugs in the pre-anesthesia phase, such as benzodiazepines, with MT in future studies.

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