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## A Note on Comfort in Pediatric Critical Care: Music and Mechanical Ventilation

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Admission into a PICU can be a highly stressful experience, with up to 62% of children demonstrating posttraumatic stress symptoms following a PICU admission (1). Children needing invasive and/or painful procedures during their PICU stay are particularly at increased risk of these sequelae, with most requiring titration of pain and sedation medications to facilitate care. Caregiver and provider concern for the unclear impact of pain and sedative medications on the developing brain and increased health risks (e.g., physiologic instability, ICU acquired weakness, withdrawal and dependence, delirium, and long-term health outcomes) are energizing interest trials investigating ancillary approaches to comfort (2, 3). It is therefore crucial to explore and validate nonpharmacologic interventions toward child comfort in the PICU to alleviate some of these hazards.

One potential approach to decreasing stress and improving comfort is music. Music and medicine have a long history of being entwined, going as far back as the Greek philosopher Pythagoras prescribing music to promote health (4). There is an increasing interest in studying music's impact on health outcomes (5). Among mechanically ventilated adults, music decreased physiologic and psychologic responses to stress (e.g., vital signs, self-reported anxiety) and sedative use (6, 7). In this issue of *Pediatric Critical Care Medicine*, Liu et al (8) are the first to publish a randomized, controlled nonblinded pilot trial examining the use of music for children receiving mechanical ventilation.

In this pilot study, conducted at a single PICU in a tertiary care hospital in China, 50 children receiving mechanical ventilation 1 month to 7 years old were randomized to receiving prerecorded music of child-preferred songs (delivered via MP3 player and headphones, 5 cm from the child's ear) or to a control group who did not receive music intervention. Their aim was to assess feasibility of implementing their music-based intervention with this population. Nurses played the music three times a day for an hour each time and assessed the child's comfort using the COMFORT Behavior (COMFORT-B) scale and vital signs 5 minutes pre and post intervention while intubated. Compared with the control group, the music group had improved postintervention COMFORT-B scores. Additionally, secondary outcomes (e.g., heart and respiration rates, systolic blood

pressure, oxygen saturation, ventilation time, and on-demand midazolam use) were more consistent with comfort in the music group. Feasibility was explored via an open-ended questionnaire with six nurses delivering the intervention. Feedback was primarily positive, with suggestions to allow for more flexible and personalized timing of music interventions, exploring dosage/time effects, and using wireless headphones. These are exciting preliminary results which warrant additional trials to build on this evidence base to inform clinical practice within the PICU. A few of the strengths and limitations of the study by Liu et al (8) warrant further discussion to aid the design of future trials.

Literature reviews on the efficacy of music are often limited by a lack sufficient clarity on the intervention, which prevents cross-study comparisons, generalizability, and clinical implementation (9). To combat this, music-based trials should provide sufficient details on their intervention, aligned with the reporting guidelines for music-based interventions (9). One of the strengths of the study by Liu et al (8) is their detailed description of their music-based intervention based on the above guideline (9). Additionally, aspects of their intervention such as the timing of the intervention and the use of patient-preferred music were well thought out. It would have been interesting, however, for the article to explore the science behind their intervention in more depth.

There are a variety of complex theories regarding the potential mechanisms in which music can impact health and improve outcomes to guide music-based interventions. For example, the gate control theory of pain suggests presentation of an alternate stimulus, such as music, decreases the perception of pain, thereby increasing comfort (10). Another proposed mechanism is that music-induced neurologic responses—specifically, music has been found to decrease Beta-endorphin and cortisol and increase regional cerebral blood flow within structures critical to reward and reinforcement (11, 12). Last, physiologic entrainment, in which an individual's heart rate and respiratory rate entrain to the external stimuli of music, may contribute toward music's positive health effects (13). A theoretical foundation is crucial to extend knowledge beyond “if” an intervention works to “why and how” it works, to achieve best results.

There are a few aspects of the study by Liu et al (8) that, if addressed, could improve the rigor of future efficacy trials. First, it is not clear whether on-demand midazolam dosing was prescribed by a blinded participant. Similarly, as children are typically treated with a combination of analgesia and sedation medications while intubated, it is unclear what was standard of care and whether children received medications in addition to midazolam. It is also important to note that, although not statistically different, the groups had different median ages, 5 versus 1.5 months, which could affect physiologic variables assessed by group.

Finally, we think it is important we differentiate between “music therapy” and the general provision of music, sometimes referred to as “music medicine”—the latter being the approach of the study by Liu et al (8). Both music therapy and music medicine have been found to decrease pain, increase physical, cognitive, and speech recovery, and improve quality of life (12, 14). Although music therapy is provided by a credentialed therapist who uses music-based interventions for individualized goal attainment, music medicine

is typically prerecorded music provided by a medical professional (14, 15). The use of live music may be more advantageous than recorded music with a critically ill population because a music therapist is trained to manipulate musical elements to facilitate the desired outcomes and can respond in the moment to the patient (16). Recorded music plays continuously regardless of circumstances. The efficacy of live versus recorded music for patients receiving mechanical ventilation warrant further exploration.

Given the paucity of literature on utilizing music within the PICU to provide comfort to children, the study by Liu et al (8) births exciting possibilities for improving PICU care and child and family outcomes. Considering the potentially negative effects of stress and medication that accompany mechanical ventilation, the study by Liu et al (8) provides preliminary evidence of the feasibility and potential efficacy of a vitally needed nonpharmacologic approach toward improving PICU care. Further studies are needed with this population to compare the efficacy of live versus recorded music, to explore family-centered approaches, and to identify dosage requirements to maximize comfort among children in the PICU.

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