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Original Article

The efficacy of audiovisual distraction as an anxiety-minimizing technique during echocardiography in preschool children

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Abstract

Background Echocardiography procedures can cause fear and anxiety in children, especially at preschool age. Audiovisual distraction is a simple, harmless, and low-cost technique that does not interfere with the procedure.

Objective To assess the effect of audiovisual distraction on the anxiety levels of children aged 2-5 years during echocardiography.

Methods This quasi-experimental study included children aged 2-5 years who were admitted for echocardiography. Patients with hearing or visual impairment, Down syndrome, autism, or attention-deficit/hyperactivity disorder were excluded. We administered anxiety-reducing intervention in the form of cartoon audiovisual media shown on a ceiling-mounted television during the echocardiography procedure. Anxiety levels were assessed using the *Visual Analogue Scale - Anxiety* (VAS-A) before and after the intervention was given. We compared the subjects' pre- and post-procedure VAS-A scores and heart rates.

Results Of the 43 subjects who underwent echocardiography during the study period, the mean age was 3.2 (SD 0.9) years, with an equal sex distribution. Most subjects had a history of repeated echocardiography procedures and hospitalizations. Thirty-nine (90.6%) of subjects demonstrated anxiety during the echocardiography procedure. There was a significant mean difference of 11.9 (SD 13.2) bpm (95%CI 7.8 to 15.9 bpm, P<0.001) in heart rate pre- vs. post-intervention. Median pre- and post-intervention VAS-A scores were 5 (range 0-10) and 1 (range 0-4), respectively (P=0.001). Post-intervention, almost all (97.7%) subjects had no or mild anxiety.

Conclusion Audiovisual content presented on television serves as an effective distraction method to reduce children's anxiety during echocardiography. **[Paediatr Indones. 2023;63:328-34; DOI: https://doi.org/10.14238/pi63.4.2023.328-34**].

Keywords: *echocardiography; children; audiovisual distraction; anxiety*

Echocardiography is a commonly used modality to evaluate cardiac structure and function in congenital or acquired heart disease.[1] This procedure has showed high accuracy in detecting cardiac abnormalities, although accuracy is dependent on the machine, the defect complexity, the operator, the patient's age and body weight, and the need for sedation or anesthesia.[2] The completeness and accuracy of an echocardiography study are also reliant on the patients' and their parents' cooperation.

Younger patients, especially those under five years old, often experience anxiety during medical procedures involving various objects unfamiliar to them, including echocardiography.[3] *The American Academy of Pediatric Dentistry* has introduced behavioral management as a non-pharmacological approach to help manage fear and anxiety alongside the use of pharmacological agents, such as sedatives.[4] Midazolam and chloralhydrate are commonly prescribed premedication drugs in children undergoing echocardiography. However, such pharmacologic

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sedation has been associated with documented adverse events and increased cost. Therefore, a less invasive and costly intervention to reduce anxiety is desired in the pediatric population.[5]

In preschool children, previous studies have shown the efficacy of multiple audiovisual distraction strategies, such as video goggles or eyeglasses, or a tablet device in reducing anxiety during dental care.[3,6-9] Listening to classical Mozart music has been found to reduce dental anxiety, measured by the *Visual Analogue Scale - Anxiety* (VAS-A), in 76.67% of patients.[10] Responses to animated cartoons with children's songs viewed on a mobile phone helped increase compliance in children younger than five years who underwent ultrasound examination.[11] In this study, we attempted to reduce children's anxiety levels using animated cartoons and children's songs during the echocardiography examination. We hypothesized that audiovisual distraction might minimize anxiety in preschool children undergoing echocardiography.

Methods

This quasi-experimental study with pre-and-post design was conducted from October 2021 to April 2022. We included pediatric patients aged 2-5 years who required an echocardiography examination and obtained written informed consent from parents. Patients with hearing or visual impairment, Down syndrome, autism, or attention-deficit/hyperactivity disorder (ADHD) were excluded. The study was approved by the *Universitas Udayana Institutional Review Board*.

Before the echocardiography examination, a baseline assessment was conducted for each patient. Eligible participants were assigned consecutively. Using the sample size formulae for differences in proportion and mean difference for paired groups with a $Z\alpha$ of 1.96, a power of 0.842, a smallest detectable mean difference of 0.2, and a smallest detectable proportion difference of 0.17, the a minimum required sample size was 33 subjects.

The examination was performed in the Pediatric Integrated Cardiac Care Polyclinic, Prof. Dr. IGNG Ngoerah Hospital, Denpasar, Bali. This room was specifically designed for this study, equipped with a ceiling-mounted television to provide children with an unobstructed view while they were lying in a supine position on the examination bed (**Figure 1**). The LED TV had a 32-inch monitor and had a smart Android system installed.

As intervention, we showed audiovisual clips selected based on parents' preferences or familiar audiovisual clips for children from *YouTube* channels, such as Baby Bus, Upin Ipin series, Baby Shark, or Little Baby Bump. A single pediatric cardiologist performed echocardiography with the help of a trained assistant nurse and the child's parents, following current recommendations for performing transthoracic echocardiography. The pediatric cardiologist and assistant nurse always wore the same work clothes and had similar attitudes and actions during the procedure, without using any additional distraction tools.

The examination was performed using a *Philips Epic 5* echocardiogram unit (*Philips BV*, Eindhoven) with a S8 MHz cardiac sector transducer. Before the procedure, we collected data on the subject's characteristics, including date of birth, sex, history of hospitalization, history of previous echocardiography, history of gadget or audiovisual use, and parents' education levels.

The primary outcome was subjects' anxiety levels, measured using the VAS-A score (**Figure 2**). The scale included five categories of anxiety scored between 0 and 10. A score of 0 indicated that the child was calm and relaxed, scores from 1 to 3 indicated mild anxiety, scores from 4 to 6 indicated moderate anxiety, scores from 7 to 9 indicated severe anxiety and a score of 10 indicated that the child was in panic or fearful. The pre-test score was obtained when the patient was lying down on the examination bed, immediately after the echocardiography probe touched the chest. The post-test score was evaluated by considering the entire procedure in which the intervention was administered. Anxiety was considered stable when there was no change between the pre-and post-test VAS-A scores. Anxiety was reduced when there was a reduction in the VAS-A score, and increased when there was an increase in the VAS-A score. Both pre-and post-test VAS-A scores were assessed subjectively by the same assistant during the echocardiography procedure.

Another objective measurement anxiety we

Figure 1. Examination room. (A) Position of examination bed, ceiling-mounted TV screen, and echocardiogram machine. (B) Photograph from the patient's point of view.

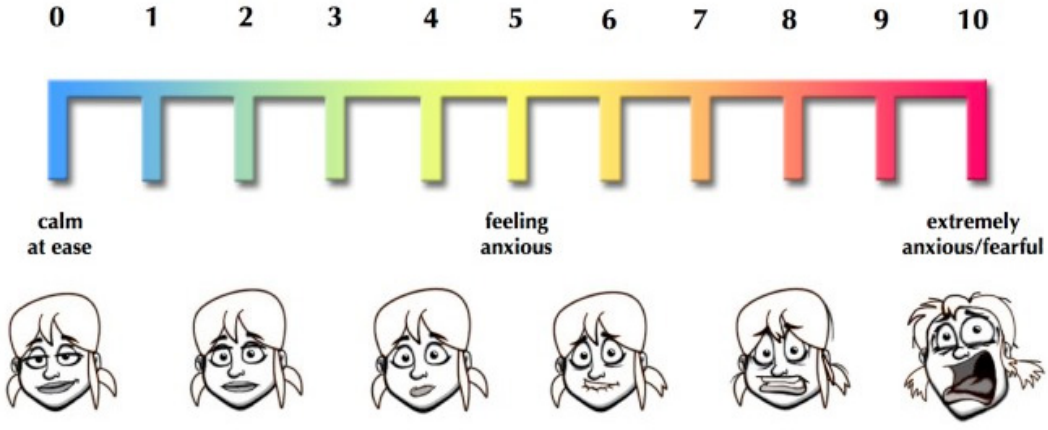

Figure 2. Visual Analog Scale - Anxiety (VAS-A)

employed was the subjects' heart rates, measured using fingertip pulse oximetry. A finger pulse oximeter was placed on the index finger and heart rate was monitored throughout their echocardiography procedure. The mean heart rates pre- and post-procedure were recorded. The duration of echocardiography was the time taken for the entire echocardiographic procedure, from the moment the probe was placed on the chest until the examination was completed, measured using a stopwatch in minutes. The quality of the echocardiography procedure was determined by the operator's impression of the procedure's implementation, which was classified as high quality if all examinations were completed according to standards,[12] moderate if complete but not up to standard, and poor if the examination was incomplete.

Statistical analyses was performed using the *IBM SPSS 25* (*IBM*, Armonk, New York). Descriptive data

were presented as percentages for categorical data and as mean, standard deviation (SD), or median for continuous data. The Wilcoxon test was used to compare the median VAS-A score pre- and post-procedure when the data distribution was abnormal. The paired t-test was used to compare pre- and post-heart rates. Statistical significance was set at $P<0.05$.

Results

A total of 46 subjects met the inclusion criteria, while three were excluded due to suspected Down syndrome. Subject characteristics are shown in **Table 1**. The most frequent diagnoses were ventricular septal defect (VSD) in 16 subjects and patent ductus arteriosus (PDA) in 12 subjects). All subjects had normal cardiac function. There were significant differences in heart rate pre- and post-intervention (paired T-test, $P<0.001$).

Based on their VAS-A scores, most subjects (90.6%) developed anxiety during the echocardiography procedure. Levels of anxiety pre- and post-audiovisual intervention during the echocardiography procedure are shown in **Table 2**. Most children had pre-intervention anxiety levels in the mild and moderate range. Post-intervention, most children were either calm or had only mild anxiety levels. Median pre- and post-intervention VAS-A scores were 5 (range 0-10) and 1 (range 0-4), respectively ($P=0.001$). Due to the abnormal distribution of the VAS-A scores, we used the Wilcoxon test to compare pre- *vs.* post-intervention scores.

Table 1. Descriptive characteristics of subjects

Variables	N=43
Male sex, n (%)	25 (58.1)
Mean age (SD), year	3.2 (0.9)
Type of congenital heart defect, n (%)	
Cyanotic	4 (9.3)
Acyanotic	39 (90.7)
Mean duration of echocardiography (SD), minutes	10.7 (4.0)
Quality of echocardiography, n (%)	
Poor	0 (0)
Moderate	13 (30.2)
High quality	30 (69.8)
Frequency of echocardiography procedure, n (%)	
First time	9 (20.9)
Repeated	34 (79.1)
Patients with history of hospitalization, n(%)	34 (79.1)
Mean heart rate (SD), beats/min	
Pre-intervention	116.2 (16.3)*
Post-intervention	104.3 (12.0)
Nutritional status, n (%)	
Well-nourished	25 (58.1)
Mild malnutrition	13 (30.2)
Moderate malnutrition	5 (11.6)
Parents as caregiver, n (%)	43 (100)
Caregiver's education, n (%)	
High school	18 (41.9)
Bachelor	9 (20.9)
Diploma	3 (7)
Others	13 (30.2)
Subject's education, n (%)	
Preschool	2 (4.7)
Not school yet	41 (95.3)
Mean parent's age (SD), year	
Father	34.4 (6.2)
Mother	31.1 (6.4)
Prior audiovisual media use, n (%)	42 (97.7)
Type of audiovisual device used, n (%)	
Mobile phone	14 (32,6)
Television	6 (14)
Both	22 (51.2)
Duration of screen time per day, hours	0-5

*Paired T-Test mean difference: 11.9 (13.2); 95%CI 7.8 to 15.9; P< 0.001

Discussion

Echocardiography is the principal modality used to diagnose cardiovascular disease in children. The image quality of this echocardiography can be affected by various factors, including the machine used, defect complexity, the operator, the patient's age and body weight, and whether they are sedated or anesthetized.[2] The most important factor may be coordination between the operator, patients, and parents, as children under five years old usually experience irritability, anxiety, and fear during the echocardiography procedure, despite it being a painless procedure. Therefore, methods are needed to increase compliance during the procedure in children.

Anxiety is a manifestation that occurs when a person experiences fear without a clear cause, such as in relation to a medical procedure. Fear can cause acute distress and may lead to disruptive behavior,

Table 2. Anxiety levels pre- and post-audiovisual intervention based on VAS-A scores (N=43)

Variables	Pre-intervention anxiety levels	Post-intervention anxiety levels
Calm and relaxed, n (%)	4 (9.3)	15 (34.9)
Mild anxiety, n (%)	11 (25.6)	27 (62.8)
Moderate anxiety, n (%)	16 (37.2)	1 (2.3)
Severe anxiety, n (%)	6 (14.0)	0 (0)
Panic/fearful, n (%)	6 (14.0)	0 (0)

such as avoiding or terminating medical procedures.[13] Preschool children have been shown to have a higher level of fear and anxiety compared to school-age children, reflected in disruptive and difficult-to-control behavior.[14] In our study, children aged two to five years were included, and almost all of the subjects demonstrated mild to moderate levels of anxiety before the intervention. To the best of our knowledge, this is the first study on non-pharmacological intervention during echocardiography in children of this age group. A similar intervention using animated cartoons with children's songs viewed on mobile phone has been shown to be effective in reducing anxiety in children younger than five years undergoing abdominal and other body ultrasound.[11]

We chose this intervention because it was a highly applicable, straightforward technique with low cost which does not require specific skills. Some studies have shown that audiovisual distraction (e.g., cartoons, music, kaleidoscope) before or during medical procedures in young children can improve their behavior and reduce anxiety levels.[3,6,7-11,15-17] Our study observed a significant reduction in anxiety levels measured using VAS-A score after intervention during the echocardiography procedure. The proportion of subjects with VAS-A scores in the "calm and relaxed" and "mild anxiety" ranges were increased post-audiovisual distraction, compared to higher anxiety levels pre-intervention; these results are consistent with those of several studies that have reported that audiovisual distraction can reduce pain.[3,6,7-11,15-17] Preschool children commonly enjoy watching animated cartoons, and they become deeply engaged to the point of being oblivious to their surroundings, thereby ignoring verbal and tactile stimuli caused by medical procedures. All children in our study were familiar with audiovisual stimuli from their devices, such as mobile phones and/or television, which may have helped reduce their anxiety during the echocardiography procedure. However, audiovisual methods also have some disadvantages, as some children with high levels of anxiety do not respond well to this type of distraction.[18] Therefore, patients may not be completely distracted during procedures.

One of the body's physical adaptations during anxiety or stress is an increased heart rate through the activation of the sympathetic nervous system, specifically the autonomic nervous system.[19] In our study, we observed a decrease in heart rate after audiovisual intervention. Similar results were also found in studies that showed significantly lower mean heart rate values between study groups compared to control groups at different treatment times.[7,8] Another study reported contrasting results. There was no significant difference in heart rate of patients who used audiovisual eyeglasses, compared with those who did not, during dental visits. This discrepancy may have been due to the children's familiarity with the dentist office environment as well as the information about the procedure provided by the dentist, which has lowered the children's anxiety levels.[6] In addition, our study involved younger children who may have a different perspective on medical procedures. Our study has also demonstrated the effectiveness of audiovisual distraction in reducing anxiety during echocardiography, observed objectively through a reduction in mean heart rate.

There are several instruments available to measure anxiety levels during medical procedures, such as the *Visual Analogue Scale* (VAS), the *Children Fear Scale, the Face, Legs, Activity, Cry, and Consolability* (FLACC) scale, *Venham's Behavior Rating Scale*, the *Modified Corah Dental Anxiety Scale*, the *Wong-Baker Faces Scale*, and the *Frankl Behavior Rating Scales*. The VAS is a simple and rapid tool that has been widely applied in clinical studies. The VAS-A was first used in dental patients; however, in recent years, it has been

used less frequently for the assessment of both dental anxiety and other medical conditions. The VAS-A is a reliable indicator of preoperative anxiety and may help detect patients with depressive symptoms.[19] Similar to our study, a previous study has also used VAS-A to assess anxiety during medical procedures.[9]

The limitations of this study include the inability to perform randomization and blinding despite an outcome measure (VAS-A) that involved subjectivity. To address this, the evaluation was performed by an experienced investigator and a trained assistant to ensure reliability.

In conclusion, audiovisual content presented on television as a distraction method was effective in reducing children's anxiety levels during echocardiography.

Conflict of interest

None declared.

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