

## Review Paper

# Updates in Nursing Interventions of Pediatric Angiography: A Narrative Review



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## ABSTRACT

**Background and Aim:** Children with heart defects who need angiography are increasing. They have high anxiety and stress. Implementing an effective program for children undergoing angiography is one of the tasks of nurses. This article aims at reviewing nursing interventions for children under angiography.

**Materials and Methods:** Elsevier, SID, Magiran, Scopus, PubMed, and Google Scholar databases were searched using keywords such as coronary angiography, nonpharmacological interventions, nursing interventions, pediatric, infant, children, and complementary therapies during 1984-2021. From 60 studies in the initial search, 12 studies were maintained.

**Results:** Several solutions can reduce stress in children under angiography including music therapy and play therapy such as digital games, distraction, and relaxation therapy.

**Conclusion:** Pediatric nursing interventions under angiography can play an effective role in the recovery process. Children undergoing angiography have interventions to reduce stress according to their developmental age. Depending on the environmental, psychological, and social conditions of the child, solutions can be adopted and implemented so that children and their parents experience less stress.

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## 1. Introduction

**T**he prevalence of cardiovascular and circulatory diseases is increasing worldwide accounting for 48% of all deaths. Heart disease is a serious problem for children because children are more prone to heart diseases. Diagnosis is fast and accurate treatment with medication or surgery will help children have a normal life. The number of children with heart defects undergoing cardiac catheterization has increased. Pediatric heart catheterization is a life-threatening and dangerous procedure. More than 260000 heart angiographies are performed annually in Iran [1, 2]. This danger worries parents and relatives and they are stressed and afraid that the child will be in danger. Patients not only suffer from anxiety due to the aggressive nature of this procedure but also have pain and discomfort for several hours after the operation. Most diagnostic tests are aggressive for patients with anxiety. In addition to diagnostic tests, hospitalization creates different levels of anxiety. Lack of patient familiarity with coronary angiography is one of the main causes of anxiety. This lack of information leads to over-stimulation of their nervous system [3].

Nurses have an important role in helping medical practices and achieving the goals and quality of patients' safety. Despite the growing trend of work over the past few decades that defines the roles and value of nursing, the limited information that describes the impact of nurses on health care outcomes in specialized treatment areas such as radiology is still limited [4]. Nurses need to create an environment that minimizes stress. Nurses in intensive care units such as coronary angiography laboratories should balance the potential benefits of reducing anxiety with the potential side effects of sedatives such as drugs and benzodiazepines, and discover alternative, cheaper, and more effective ways to reduce patients' anxiety. Various methods have been used to reduce patients' anxiety before coronary angiography. The use of anti-anxiety drugs and nursing care is not always done and patients' perception of anxiety is not reduced [5]. Additional non-pharmacological interventions are needed to reduce children's stress and anxiety, but there are few articles in this area since most studies have focused on adult patients.

## 2. Materials and Methods

Elsevier, Scientific Information Database (SID), Magiran, Scopus, PubMed, and Google Scholar databases were searched using keywords such as coronary an-

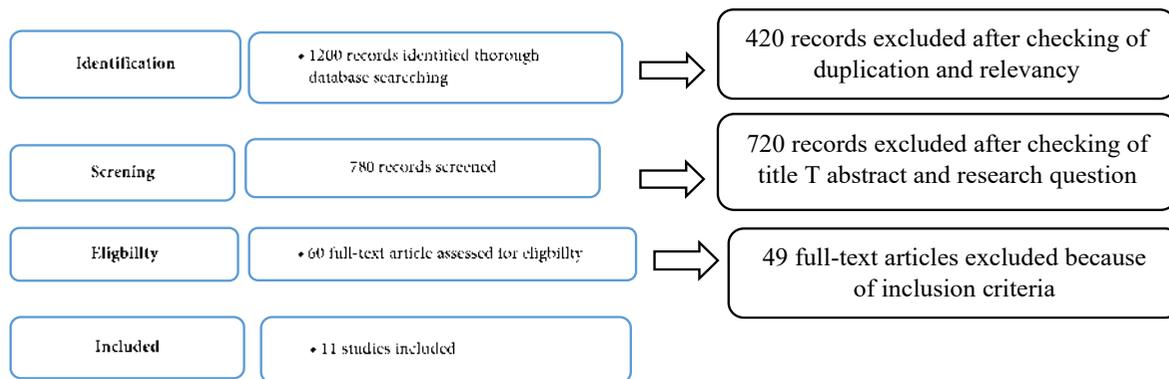
giography, nonpharmacological interventions, nursing interventions, pediatric, infant, children, and complementary therapies during 1984-2021. The main inclusion criteria were all studies conducted on children aged Birth to 22 years [6], cases studied by children or their mothers who underwent angiography or cardiac catheterization. The exclusion criteria were studies conducted on patients who were not in the mentioned age range. After studying the full texts of the articles by 1 researcher, based on the inclusion and exclusion criteria, appropriate articles were included in the study as shown in Figure 1. All selected articles were discussed by 2 researchers, and then the final articles were selected by the agreement between these researchers. Research questions were reviewed for answers in the two sections: [1] What nursing care is there for children undergoing angiography? and [2] What is the role of nurses in reducing stress in children under angiography and what effective interventions they can implement?

The initial search revealed 60 studies that were reviewed for eligibility by 2 researchers in terms of relevancy and quality. Eventually, 12 studies were included in the narrative review. The quality of the studies was examined based on the critical appraisal checklist for articles. In this study, the checklist presented by Downs and Black [7] was used for critical appraisal of the studies. The final studies were reviewed by 2 researchers. Then, the name of the author, year of the study, country, sample size, study design, type of intervention, anxiety measuring instrument, and overall study results were extracted using a standard form.

## 3. Results

From 60 studies in the initial search, 12 studies were maintained. The articles were collected in English, except for two articles, which were done in Thai due to the small number of articles in this field. These two articles were translated into English and studied. Publications included in the review are listed and described in Table 1 which provides a descriptive snapshot of the methods, findings, and participant groups.

Before performing any process, the conditions of the family and the child should be evaluated, including the amount of growth and development, the speed of dealing with the stressful conditions created, previous experiences, especially undesirable ones from the hospital, and cultural and spiritual factors to supply the most effective intervention for them. Understanding the stages of cognitive development in children is a key to



**Figure 1.** Flow Diagram of the study selection

understanding children’s perceptions of health-related events and information-processing abilities. Previous hospital experiences play a crucial role in determining child and adolescent responses to invasive medical procedures, particularly when those experiences are perceived negatively. Studies suggest that naive children demonstrate decreased anxiety after viewing hospital-relevant audiovisual materials, whereas children with previous hospital experiences may have increased levels of tension or remain unaffected [10, 12, 13]. Nurses can also play a role in the recovery and treatment of children under angiography with effective intervention [14-19] (Table 2).

Research regarding the efficacy of procedure preparation generally indicates that outcomes are enhanced by [1] active participation by children and family members/caregivers; [2] personal interaction with health professionals (compared with only watching a videotape or reading a pamphlet); [3] developmentally appropriate timing and content; and [4] comprehensive stress management programs that provide information, supportive counseling, and coping skills training. Issues about intensity, rehearsal, reinforcement, and timing require further investigation. In younger children (age 3 to 5 years), anxiety levels are managed most effectively with preparation the night before surgery, whereas older children (aged 5-12 y) respond optimally when the knowledge is presented 1 week before surgery. Pre-procedure interventions attempted within 24 hours of surgery may very well increase school-age children’s anxiety levels. When only limited preparation time is out there, re-focusing techniques or distraction could also be more practical than other methods [20-22].

Information is provided by a range of methods including [1] verbal discussions with the physician, nurse, child life specialist, and other health care team members; [2] videotapes of hospitalization or pro-

cedure; [3] written information or picture books; [4] preoperative classes; [5] hospital tours; [6] structured-play sessions or puppet shows; and/or [7] via computer/Internet. It is important to recollect that informatics is stricken by multiple factors including anxiety as well as developmental/cognitive level; thus, ongoing validation of the child’s and parents’ understanding is required. Verbal information should be simple, realistic, and honest. When communicating with children, it is necessary to supply concrete information using child-sensitive language and avoid words that will be threatening or misinterpreted [10, 23-26].

The play could be a primary kind of communication for kids and provides a good method for the presentation and exploration of medical concepts while permitting insight into the child’s understanding of matters and level of coping. Play may be spontaneous or recreational, expressive, or therapeutic. The spontaneous or recreational play could be a play activity within which the kids choose the things and activities that can distract them from stressful circumstances. Expressive play provides a method for the expression of feelings, the discharge of energy, and relaxation. Medical play combines spontaneous and therapeutic play to organize children for medical or nursing procedures through the employment of hospital-related props like syringes, masks, and dolls with intravenous lines, incisions, and chest tubes. This stuff is used to convey information and provide children with opportunities for hands-on learning. During the play session, concrete simple explanations are offered, and misperceptions are corrected. Medical play employing a beloved doll or stuffed animal often works well, because it allows the kid to be in the very position of control as the doctor or nurse playing or acting accordingly [19, 21, 24].

Table 1. Summary of studies

Row	Authors/ Year	Title	Design	Intervention	Findings
1	Wang-sawat et al. 2019 [8]	The effect of education program on knowledge and role of the caregiver for children with congenital heart disease aged 0-3 years	Quasi-experimental	The research instruments were the supportive educational nursing program and handbook for caring for children with congenital heart disease.	The supportive educational nursing program is an appropriate guideline to educate caregivers so that they have effective knowledge and improve home care of children with congenital heart disease effectively.
2	Wahid Amer et al. 2021 [9]	The effect of educational guidelines on mothers' emotional status regarding children undergoing cardiac catheterization	Quasi-experimental	Educational guidelines were illustrated in the form of an Arabic booklet, and educational videos and pictures were also utilized and distributed to each mother. The instructional guidelines included knowledge about oral health as follow: <ul style="list-style-type: none"> <li>*Simple information about congenital heart disease</li> <li>*Cardiac catheterization (indications, preparation, and its complications) *Care of the puncture site,</li> <li>*Medications (antibiotics and pain management)</li> <li>*Hygienic care</li> <li>*Fluid intake</li> <li>*Activities</li> <li>*Follow up</li> </ul>	After implementation of the guidelines, significant relationship and improvements were detected between mothers' knowledge about their children's cardiac catheterization more than before and mothers' emotional status [9] were severe before implementation of the guidelines while these levels decreased after guidelines implementation.
3	Çetinkaya et al. 2018 [10]	Effect of listening to music on anxiety and physiological parameters during coronary angiography	RCT	After the patients were taken to the operating table, a headphone connected to an MP3 player was provided to the patient. A separate headset was used for each patient. The patients were not asked about the type of music they preferred. For music intervention, low-tempo (60–80 rhythm/minutes) flute music without strong beats and ripple rhythms was chosen. Sufi musical compositions (tune Hüseyini) were played during the angiography procedure (15–20 minutes on average) in the study intervention group. Sufi music played included both vocal and instrumental aspects and was performed using a Turkish classical instrument called "Ney" (a reed flute).	Music listening as an intervention for patients undergoing coronary angiography procedures was highly feasible. Although the intervention was not effective in reducing anxiety levels, systolic blood pressure and pain were significantly lower in patients who listened to music.
4	Rajan et al. 2017 [11]	Effect of recorded maternal voice on child's cooperation during cardiac catheterization	RCT	Explained the process of voice recording one day before the procedure. Mothers were encouraged to record conversations unrelated to cardiac catheterization. The maternal voice was recorded for 3 minutes in their native language talking about pleasurable events or activities by which the child was most likely to be happy. The voice recording was accepted when both the mother and the researcher were satisfied with the quality and content of the recording. The headphones were placed over the ears of children soon after shifting inside the catheterization laboratory. The headphones were connected to the same device that was used for recording maternal voice. The maternal voice was played in a loop for continuous auditory stimulation. It was ensured that the headphones did not interfere with the interaction between the operator and the child.	Children in the maternal voice group showed lower mean (SD) distress scores [13.2 (4.6) vs 16 (5.6), P=0.01]. The requirement for sedative agents during the procedure was not different (P=0.09)

Row	Authors/ Year	Title	Design	Intervention	Findings
5	CLieber et al. 2018 [12]	Effects of music therapy on anxiety and physiologic parameters in angiography	systematic review and meta-analysis	<p>PubMed, Embase, and Scopus were searched to identify studies of interest. Inclusion criteria were studies reporting using music therapy in either cerebral, coronary, or peripheral angiography. Studies focused on a pediatric population; animal studies and case reports were excluded. Participant demographics, interventions, and outcomes were collected by two study authors. Bias and study quality of randomized controlled trials (RCTs) were assessed using the Cochrane Risk of Bias Tool. Separate meta-analyses of the RCTs were performed to compare State-Trait Anxiety Inventory (STAI), heart rate (HR), and systolic and diastolic blood pressure (SBP and DBP) in the music intervention group versus a control group. Heterogeneity was determined by calculating I<sup>2</sup> values, and a random-effects model was used when heterogeneity exceeded 50%</p>	<p>Recorded music and/or music therapy in angiography significantly decrease patients' anxiety levels, while it has little to no effect on HR and BP.</p>
6	Marofi et al. 2018 [13]	Evaluation of the effect of individual and group tours on the anxiety scores of 4-7-year-old hospitalized children and their mothers	Quasi-experimental	<p>For the personal tour group, each child with their mother visited the hospital and they were provided with basic information about the hospital's overview, different places, the photo gallery of the department, physicians, and nurses along with necessary explanations. Then, they were taken to different parts of the hospital including the yard, cafeteria, toy store, the corridors leading to their department, and the waiting room before undergoing surgery and necessary explanations were provided. The group tour was performed in a similar method as the personal tour for at least 5 children together. Each visit lasted from about 45 minutes to an hour. The control group only received routine education.</p>	<p>The results showed that the mean score of children's anxiety differed significantly between the three groups after the intervention (F=40.58, P&lt;0.001). In addition, the three groups were significantly different in terms of the mothers' anxiety after the intervention (F=4.12, P&lt;0.02). No significant difference was observed between the group tour and individual tour groups regarding the children's anxiety score (F=0.02, P=0.980) and mothers' state anxiety scores (F=0.054, P=0.950)</p>
7	Chambon et al. 2019 [14]	Electric toy car to reduce anxiety before cardiac cauterizations	RCT	<p>The study intervention consisted in having the child drive a toy electric ride-on car from the ward to the catheterization laboratory. In the intervention group, the orderly had received training about the car and had a remote control that could override the child's actions to ensure safety. All children in both groups received standardized preoperative information from a nurse, who used a play kit with figurines to represent the operating room and the course of the operation.</p>	<p>Riding to the catheterization laboratory on an electric toy car decreased anxiety at anesthesia induction in boys and decreased parental anxiety</p>
8	Koonaree et al. 2015 [15]	Effect of information education via a comic book on the anxiety of school-aged children undergoing a cardiac catheterization	Quasi-experimental	<p>The patient reads the book by himself or his parents. Read it aloud at least once, and then have the patient keep the book by the bedside. The patient reads as many times as he does throughout the night. Then the lead researcher read a storybook with cartoon pictures and returned the next morning before the patient went for cardiac catheterization.</p>	<p>The means of anxiety after receiving information when comparing between groups were not significantly different (P&lt;0.05). Although information education using a comic book did not affect anxiety in these children, nurses should find another way to provide information to them to reduce their anxiety.</p>

Row	Authors/ Year	Title	Design	Intervention	Findings
9	Naylor et al. 1984 [16]	Reducing distress in pediatric cardiac catheterization	Quasi-experimental	<p>The families undergoing the rehearsal preparation received a preparatory packet in the mail containing a coloring book with crayons, a parent's manual, a teddy bear, and a personalized letter addressed to the child from Morgan, the character in the coloring book. The coloring book and parent's manual were designed to explain both the technical and the experiential aspects of catheterization. Various distraction strategies for coping with catheterization were demonstrated by the coloring book character. During the rehearsal, families toured the ward, the playroom, and the catheterization laboratory with the CNS. A doll, similar to the coloring book character, was first laid on the catheterization table and restrained. Afterward, the child was allowed to lie on the table, practice being restrained, and practice responses for coping with the distress and discomfort of the procedure.</p>	<p>Parents in the rehearsed group showed less anxiety following the catheterization, and negative reactions in children correlated significantly with parental anxiety. Participants' reactions were uniformly more positive in the rehearsed than in the control patients</p>
10	Rezaei-Adaryani et al. 2008 [17]	The effect of changing position and early ambulation after cardiac catheterization on patients' outcomes (Patients aged 18–20 years)	A single-blind RCT	<p>The experimental group was positioned as follows: In the supine position with the head of bed [HOB] elevated during the first and second hours, in the supine position with HOB elevated during the third hour, in the supine position with HOB elevated during the fourth hour, and respectively in the right and left lateral positions with HOB elevated in the fifth and sixth hours, and in Fowler's position in the seventh hour. After that, the patients were allowed to come out of bed [OOB], sit on the chair beside the bed for 10–15 minutes, and then walk around and undertake self-care activities. In the experimental group, the sandbag was taken away 3 hours after the procedure. While the patients in the experimental group were in the supine position for the first 3 hours, they were given a thin supportive pillow (4 cm/40 cm/100 cm) under one side of their body, either left or right, from the shoulder to the gluteus area. We changed the place of the pillow every half hour on the right or the left side of the body.</p>	<p>The results of this study showed that the levels of comfort, satisfaction, and fatigue after catheterization are related to the duration of bed rest and patients' position in bed. Changing patients' position accompanied by early ambulation after cardiac catheterization is associated with increased comfort and satisfaction levels and decreasing the level of fatigue without increasing the amount of bleeding and hematoma.</p>
11	Bradlyn et al. 1986 [18]	The effects of a videotape preparation package in reducing children's arousal and increasing cooperation during cardiac catheterization	Quasi-experimental	<p>The tour was conducted and narrated by an 11-year-old white male and contained scenes and descriptions of various people and settings in the hospital including the hospital room itself, nurses, physicians, social workers, X-ray, and playroom activities. This film was chosen and edited strictly to provide basic information about the hospital and the people who work there. There were no scenes describing or portraying medical procedures or the sensations associated with them. Patients in this group were also provided with the standard preparation described above. Patients in this group (n=8) were shown a 15 minutes color videotape portraying a child hospitalized for cardiac catheterization. The entire film was narrated by the child, and at various points, he verbalizes (via voice-over) his thoughts and feelings. The child's motor and verbal behavior were consonant with the behavior of a coping model, in that he initially expressed a degree of fear and apprehension concerning the forthcoming medical procedures but was able to overcome these fears and successfully complete each event. Further, this film contained an explicit instructional component, wherein the child model demonstrated the use of four specific coping mechanisms: (1) taking slow, deep breaths; (2) imagining being in a 'fun' place; (3) counting slowly to six; (4) positive self-statements. Patients in this group were also provided with the standard preparation described above.</p>	<p>Twenty-four children received the preparation routinely provided to such patients either alone, in combination with an attention placebo control, or in combination with the filmed modeling preparation. Group differences were not obtained for the type of preparation; however, several demographic and self-report measures were found to be predictive of behavior and ratings while hospitalized and during the catheterization itself. Possible reasons for these findings are discussed</p>
12	Tuncayl & Gunay 2019 [19]	The effects of playing digital games on the pain levels and mobility states of children post-angiography	RCT	<p>Standard care: Vital signs, oxygen saturation, and hemorrhage control of children who come to the ward after angiography are monitored regularly. In addition, adequate hydration is provided to all children. Digital games group: In addition to standard care, the children in the trial group played digital games for an hour after the effect of anesthesia decreased and after they had regained consciousness.</p>	<p>For post-angiography children, playing digital games decreased pain levels and mobility states</p>

**Table 2.** Nursing care

Nursing Care before Angiography	Nursing Care in Cat lab	Nursing Care after Angiography
<ul style="list-style-type: none"> <li>Identify if the patient has an existing cardiac condition. Note: There is a higher risk of complications in children less than 1 year of age. ECG</li> </ul>	<ul style="list-style-type: none"> <li>The betadine used for scraping should not be cold as it may cause hypothermia in the baby. It is also better than the contrast used for angiography having the correct temperature.</li> </ul>	<ul style="list-style-type: none"> <li>Frequent nursing monitoring in the first hours is effective in decreasing complications.</li> <li>Elevation of the bed should be at most, 15 to 30 and the patient lies flat.</li> </ul>
<ul style="list-style-type: none"> <li>IV line taken from the patient should be done in a warm environment and for small infants should be done in a warmer environment. The patient should not be hypothermic.</li> </ul>	<ul style="list-style-type: none"> <li>Since patients' limbs are fixed for immobility, the color and pulse of the distal limbs should be evaluated during angiography.</li> </ul>	<ul style="list-style-type: none"> <li>Bed rest for at least 4 to 6 hours, keeping the leg at the access site still is required for post-procedure</li> </ul>
<ul style="list-style-type: none"> <li>NPO for 6 to 8 hours before Because children, especially infants, are prone to hypoglycemia during fasting, they should consult a doctor during fasting.</li> </ul>	<p>Children do not need to put on a sandbag and the adhesive on the dressing should not be so strong to interfere with the return of blood to the veins of the legs.</p>	<ul style="list-style-type: none"> <li>Assess vital signs: bradycardia, tachycardia, hypotension, reduced level of hemoglobin, widening pulse pressure, and decreased peripheral perfusion as signs of retroperitoneal bleeding</li> </ul>
<ul style="list-style-type: none"> <li>Prepare the child using age-appropriate guidelines; use concrete explanations just before an event for younger children. Include information on what the child will experience through all senses. Suggest parents and the child bring a familiar, comforting item such as a blanket, pillow, or stuffed toy.</li> </ul>	<p>The measure of the capillary refill time</p> <p>Compare the blood supply of the limb with the opposite limb in terms of color change, temperature, and pulse</p> <p>During recovery in the angiography department, the patient should be monitored and controlled for bleeding, changes in the level of consciousness, saturation, and vital signs.</p>	<p>Monitor and record intake and output hourly</p> <p>Encourage parents and the child to engage in quiet activities such as storytelling, music, etc.</p>

Medical play sessions offer a perfect opportunity for assessment of children's current level of coping, medical information, and areas of misperceptions. The rising popularity of video games has seen a recent push towards the application of significant games, that is, video game-based technologies to teaching and learning, medical education, and training. Besides the popularity of the utilization of virtual simulation, serious gaming, and immersive technologies in medical education from an instructor-trainee point of view, they can also have an excellent impact on patient education, and more specifically, improve the patient's experience and awareness [26, 27]. Also, by imitating fictional characters that are defined to adapt children to stressful situations, they can confront reality and influence their stress. This imitation of real-world processes is widely used for the practice of skills, problem-solving, and decision-making that mirrors real-world situations and environments [28].

Children may perceive increased control over their environment by being given a choice of their favorite music tapes, compact disks, and available relaxation tapes. Music can be the voice of a mother or father singing a story or lullaby to their child. Comprehensive coping skills training is effective in children undergoing cardiac catheterization [24]. However, no program has been developed for the adaptation of children under angiogra-

phy in Iran, and nurses do not use programs such as play therapy, music therapy, etc. in their interventions.

#### 4. Discussion

Children under angiography and their families need education. Silvio Simeone et al. stated that educating parents before surgery about expectations before, during, and after a child's heart surgery may improve parental knowledge and satisfaction and reduce anxiety. If the child feels pain, it may make the child move their legs and it may negatively affect their quality of life as well. Relieving the pain and distracting the child to keep the leg still may reduce the risk of hemorrhage. To relieve the pain of the child after angiography, non-pharmacological methods are used as well as pharmacological methods. These are distraction methods such as listening to music, art therapy, therapeutic touch, drawing pictures, reading books, and playing games. A game is the most important occupation of a child where the child participates and enjoys taking part. A game enables the child to define fears and worries without words and have fun. Therefore, it becomes easy for the child to cope with stressful situations. Farsi et al. stated that both methods of peer education and orientation tours decreased the anxiety levels in patients undergoing coronary artery angiography. Therefore, these approaches should be carried out according to the hospital's condition and facilities [26].

Post-angiography children who play digital games have decreased pain levels and mobility states [25]. Smelling the scent of lavender significantly reduced anxiety and pain in our patients, before and after coronary angiography [3]. This method can be used to reduce pain and stress in infants and soothe the baby with the smell of breast milk. As Sajjadi et al. showed, olfactory stimulation with breast milk has a positive effect on reducing neonatal pain during hepatitis B vaccination [27]. A telephone-based orientation program could be used when patients are waiting to have the procedure as a strategy for reducing anxiety in patients undergoing coronary angiography [28]. Listening to music for 20 minutes before coronary artery angiography was reportedly effective in reducing the patients' anxiety scores. This rapid systematic review revealed that complementary therapies, such as music therapy, reflexology, Benson's relaxation technique, aromatherapy, guided imagery, and yoga could be used as effective interventions separately or in conjunction with nursing interventions for reducing the level of anxiety among the patients undergoing coronary artery angiography [29].

Nick Farjam et al. stated that nursing consultation and guided imagery interventions reduced the stress and anxiety of adult patients undergoing angiography. In future studies, these techniques can be employed by nurses, depending on their ease of use and conditions to reduce stress and anxiety in pediatric angiography [30]. Relaxation and guided imagery have been shown to impact the autonomic nervous system. Ball et al. stated that the use of relaxation along with guided imagery is an effective and safe treatment for childhood recurrent abdominal pain [31]. Vagnoli et al. expressed children undergoing minor surgery received the relaxation-guided imagery before the induction of general anesthesia, which reduces preoperative anxiety and postoperative pain in children [32]. In an integrative review, Marcia Felix et al. stated that the knowledge synthesis resulting from this review indicates that evidence could be identified on the use of guided imagery associated with relaxation therapy for postoperative pain management [33]. This evidence, however, suggests that the quality of using this therapy is limited. The acknowledged benefits of guided imagery associated with relaxation therapy as a complementary approach to drug analgesia in postoperative pain control strengthen its indication for nursing practice [33]. Although information education using a comic book did not affect anxiety in these children, nurses should find another way to provide information to reduce their anxiety [25]. Ying Tsao et al. recommend that the picture book be routinely read and used during venipunctures to decrease procedural distress in preschool-aged children [34]. As an effective nursing intervention presenting no side effects, listening

to pleasant natural sounds can be helpful in the management of anxiety [2]. Discharge planning designed according to the care needs of children and their parents improved the quality of life of children undergoing heart surgery [35, 36].

Pediatric angiography is one of the specialized sections in which appropriate nursing interventions are one of the important factors in improving the quality of care [37]. Given that no intervention has been performed for children undergoing angiography in Iran and their families, it is suggested that future research be conducted to investigate the impact of effective interventions on children undergoing angiography as a high-risk group that needs more attention. In addition, the development of a guideline for nursing interventions in pediatric angiography is essential.

## 5. Conclusions

Significant advances in the treatment of cardiovascular diseases in the young have greatly expanded the therapeutic options available to children and families. These therapies often require invasive medical procedures, and some involve a staged approach with numerous surgical procedures and/or heart catheterizations during childhood. A significant body of scientific literature supports the efficacy of psychological preparation for this population, but the implementation of this knowledge requires an ongoing set of guidelines. We hope that these guidelines will facilitate the development, implementation, and evaluation of pre-procedure programs for children and adolescents who must undergo angiography procedures.

## Ethical Considerations

### Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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### Authors' contributions

All authors equally contributed to preparing this article.

### Conflict of interest

The authors declared no conflict of interest.

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