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PSYCHOLOGICAL INTERVENTIONS FOR ACUTE PEDIATRIC PAIN

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ABSTRACT

In the last two decades there have been a number of effective psychological interventions developed for the reduction of anxiety, distress, and pain prior to, during, and after children's medical procedures. This review was designed to consolidate the findings from these interventions to guide researchers in selecting procedures and targets for change when developing or refining pediatric pain interventions. The literature on cognitive behavioral interventions, hypnosis, and virtual reality for reducing acute pain for children and adolescents, and approaches for decreasing pain for infants was reviewed. In addition, a variety of intervention targets were identified, including children, parents, and clinicians. Cognitive behavioral strategies, including distraction, relaxation, and multi-component interventions, have been the most widely researched and empirically supported. The literature indicates that distraction immediately prior to and during painful procedures results in decreased distress. Although hypnotic strategies have received less attention in the literature, the data are encouraging. Virtual reality (VR) is similar in principle to cognitive behavioral and hypnotic

techniques in that it is also a distraction-based intervention. The literature on the effects of virtual reality is encouraging. However, it currently is a costly intervention to research and disseminate.

Examination of the infant literature revealed a surge of studies supporting the importance of environmental, behavioral, and pharmacological interventions that target pain reduction for infants during medical procedures. This review demonstrates that while significant developments have been made in identifying interventions that effectively reduce distress and pain for pediatric patients, important areas requiring further investigation remain.

INTRODUCTION

Medical treatments are a part of life for every child, whether healthy or ill. Many of these medical procedures have the potential to cause anticipatory anxiety before and high levels of distress and pain during and after the painful procedure. There are indications that experiencing frequent and/or painful medical procedures during infancy or childhood can result in enduring adverse psychological[1] and physiological[2] effects. Due to both the ubiquitous nature of acutely painful medical procedures and the short- and long-term consequences for children who endure them, researchers across disciplines have turned their attention to identifying ways to help children during these distressing experiences.

In the last two decades this field witnessed the development of a number of effective psychological interventions for the reduction of anxiety, distress, and pain prior to, during, and after children's painful medical treatments. These interventions have employed techniques that vary from basic distraction[3] to more complex multi-component treatment packages[4] and advanced technological interventions including virtual reality[5].

After the development of a sufficient literature base in this field, there was an effort to review acute pediatric pain intervention research and determine the empirically supported treatments, also referred to as evidenced-based treatments (refer to Powers[6]). The results indicated that cognitive behavior therapy is an empirically supported treatment for acute pediatric pain. Specific techniques in this area include distraction, relaxation, and rewards for using coping skills.

Since this review[6], research in this area has continued at a rapid pace, with the development of additional therapeutic interventions and extension to other pediatric populations. The purpose of this paper is to review and examine the effectiveness of cognitive behavioral

therapeutic approaches for helping children cope with medical procedures, as well as other intervention strategies, including hypnosis and virtual reality. We will also review the developing body of research on psychological interventions for infants undergoing painful medical procedures. In addition to this, the recipient of the intervention (child, parent, and/or medical staff) will be addressed. It is expected that this review will help guide researchers in selecting targets for change when developing or refining pediatric pain interventions.

MATERIALS AND METHOD

Articles identified for review were selected from several sources. Primary among these were the 13 studies previously included in the review by Powers[6] and the 23 articles listed on the Society of Pediatric Psychology (SPP; Division 54 of the American Psychological Association) website in January, 2004 as a part of their Empirically Supported Treatments Updates 2003 section (http://www.apa.org/divisions/div54). The SPP website included articles published subsequent to the review conducted by Powers[6]. These sources primarily included studies which were cognitive behavioral in orientation and which focused on children and adolescents. In addition, we searched PsycINFO and MEDLINE for additional studies employing cognitive behavioral approaches, articles which included hypnosis, approaches to decrease pain in infants, and novel technological interventions such as virtual reality for reducing acute pain. Studies representing these different areas of inquiry are included in this review.

Intervention Targets

Before discussing the utility of techniques that have been used to improve children's coping and decrease their fear, pain, and distress, it is important to consider the target of the intervention efforts. The clinician has the option of intervening directly and primarily with the child to train him or her in coping behaviors or some other intervention. However, exclusive reliance on this approach requires the child to recall and effectively employ the coping behavior under the most difficult of circumstances. Training parents and/or medical staff is often necessary in order to effectively coach the child in the use of coping behaviors[3]. For this reason, we do not recommend relying solely on training the child.

When parents have been effectively trained as coaches, children as young as 2 years of age undergoing chemotherapy treatment, venipuncture, and needle sticks have been found to use a distracter (e.g., bubbles, party blower) more frequently and exhibit less distress during

medical treatment[3, 7-10]. During venipuncture and immunizations, parental coaching decreased the need for physical restraint of children between the ages of 3 and 9[7, 11-12]. Trained parents have the potential to be with the child when he or she undergoes treatments in different medical settings and across time, making it possible for these skills to generalize. However, this approach does require that every parent be adequately trained. This requirement has the potential of creating economic, personnel, and logistical demands that may limit widespread utilization. To address this concern, Kleiber, Craft-Rosenberg, and Harper[13] investigated the use of a brief videotape for instructing parents how to distract their child as a cost-effective option to training parents individually. Although results from this project were encouraging, replication is needed in other research labs.

As an alternative to training children and parents, medical staff who are effectively trained as coaches have the potential of increasing coping and decreasing distress of children receiving care in their clinic. Medical care providers are present in the setting in which the medical treatment occurs and can prompt coping by multiple children who require medical treatments. This represents a potentially important practical advantage over training the child only, or focusing only on the parent and child. Further, based on the findings of assessment[14, 15, 16] and treatment research[7], when one adult models effective coaching of the child to cope, other adults tend to take their cues from that model and also engage in similar coaching behaviors. This phenomenon has the potential to increase the total number of prompts to the child to cope that are given by untrained parents who imitate the medical staffs' behavior. Prior assessment research indicates a strong association between the number of prompts to the child to cope and the amount of child coping[14, 17].

Previous interventions have included training of medical personnel to coach the child prior to and during the medical procedures. In a well designed study, nurses were trained in one brief session to use the simple technique of instructing preschool children to attend to an appealing cartoon movie during key procedural events (e.g., cleaning prior to injection) or early signs of distress during immunization injections[18]. In this study three groups were compared: a nurse coaching intervention, a nurse coaching plus training the parents and children intervention, and a standard medical care control condition. Results indicated that, when compared to the control group, both intervention groups demonstrated more child coping behaviors, fewer distress behaviors, fewer incidents of restraining the child, less child self-reported pain, and lower parent and nurse ratings of both the child's and their own distress. In addition, in the nurse coaching condition, parents engaged in the same high level of coping-promoting

prompts to the child as when the parents and child were also trained. The costs of the two interventions were compared, and the nurse training intervention was demonstrated to be more cost-effective. Nurse coaching has also been successfully used in other investigations[19]. In spite of these encouraging results, we have found through observation and anecdotal reporting that not all medical staff are receptive to efforts to change their behavior, and that medical practices that are changed do not always maintain at the more therapeutic level. This is an area in need of further investigation.

The behaviors of both parents and medical staff are critical to children's reactions to medical procedures. In addition to potentially helpful behaviors, adults may engage in various counterproductive behaviors prior to, during, and after children's medical events[14]. These include making reassuring comments ("It'll be all right, baby"), apologizing ("I'm sorry you have to go through this"), making empathic comments ("I know it hurts"), giving too much control to the child ("Tell us when you are ready [to get this injection]"), and even criticizing the child ("You're being a baby!"). Each of these behaviors seems to promote higher child anticipatory anxiety and procedural pain. The most common of these behaviors, reassurance[14], has been shown to promote higher levels of fear and child distress in two subsequent experimental investigations[11, 20]. The commonality among reassurance, apologies, and empathy is that they focus the child's attention on the threatening and painful aspects of the medical procedure or on their own negative reactions. Focusing on the averseness of the experience immediately prior to and during the medical procedure seems to lead to a more distressing experience. The adult behavior of giving the child control over when the medical procedure begins may have the unfortunate effect of overwhelming the child, as well as focusing the child's attention on the imminent painful event. Though these particular behaviors have been found to be distress-promoting, instead of training parents or staff not to engage in them, we have found it to be generally more beneficial to train them to engage in effective behaviors[21]. If adults engage in the behaviors that promote child coping, they will necessarily have to do less of the things that promote child distress.

Successful treatments that employ parents and medical staff to guide the child during the medical procedure incorporate principles discovered in the assessment studies: they help the parent direct the child's attention *from* threatening and painful aspects of the medial procedure *to* other relatively calm, enjoyable, and engaging stimuli and/or activities. The degree to which parents and/or medical staff are effective in this pursuit is directly proportionate to the effectiveness of the therapeutic intervention.

Cognitive Behavioral Interventions

For at least two decades, cognitive behavioral interventions have been the standard among psychological interventions to reduce procedural pain[6]. The various approaches that have been designed to ameliorate child anxiety and distress range from simple to complex, involving assorted approaches such as distraction, relaxation, education/information, and reinforcement, and combinations of these approaches.

Distraction

Perhaps one of the simpler and most widely used interventions among children undergoing painful medical procedures is distraction. In fact, distraction is a common feature of most psychosocial interventions for reduction of acute procedural pain. Specific techniques include watching a movie[19], blowing a party blower[7], or playing with toys that engage the child's sensory and cognitive attention[3]. Interventions as simple as directing children's attention to a movie while they receive a vaccination have resulted in lower levels of child distress and greater child coping[18]. Additionally, directing children's attention away from the stressor has been found to help them more realistically estimate their pain during a medical procedure which, in turn, was related to a decrease in negative memories about past procedures and less anticipatory distress about future medical procedures[22]. Counting, talking about non-procedural activities, blowing a party blower, and attending to interactive toys or other distracting objects can lead to an immediate decrease in distress[10, 23] that may be maintained over repeated medical procedures and after the cessation of coping skills training[3]. In general, the more engaging the distraction, the better the outcome. A key principle in the use of distraction procedures is that they should effectively refocus the child's attention from their own fear, pain, and the threatening aspects of the medical procedure to relatively enjoyable and engaging activities.

A meta-analysis[24] also found that distraction was generally effective, accounting for 74% of variance in reduction of behavioral distress and 35% of variance in reduction of pain. The authors cited cost-effectiveness, minimal risk, and minimal training required to implement distraction techniques as reasons why distraction should be readily employed. Distraction is often the technique of choice among younger children who are less cognitively developed and may require more externally-directed interventions. This is particularly important, since younger children display higher levels of pain and distress[25-26]. As noted by Blount, Piira,

Cohen, and Cheng[27], distraction behaviors that children are prompted to engage in should be observable in order to verify that they are occurring. Counting, using a party blower, and talking about the cartoon characters on a television monitor are preferable to relying on less observable, primarily cognitively-based forms of distraction (e.g., “Think about something pleasant”), which are difficult to verify. In some cases distraction has occasionally been found to be equivalent to standard medical care[28]. For this reason, Piira et al.[29] has suggested that future research explain the mediating effects of various factors, including pain contexts, severity, duration, and individual differences.

Relaxation

Relaxation skills training has occasionally been used with older children. A tension-release relaxation procedure[30] was taught three children between the ages of 11 and 13 who were undergoing intravenous chemotherapy. Training sessions were recorded and played during the medical treatments. Following intervention, children’s scores on an observational measure of behavioral distress decreased between 46 and 68% for each patient, and all patients reported lower levels of distress during venipuncture. Relaxation has also been a feature of a number of multi-component treatment packages, as indicated below. Due to the complex nature and demand for internal control inherent with these strategies, they may be more useful with older children. We should also note that in addition to producing lower muscle tension, focusing on tension/relaxation sensations and instructions to relax incorporates some elements of attention refocusing or distraction from the medical procedure and unpleasant sensations to relatively enjoyable stimuli, sensations of relaxation, or instructions to relax.

Multi-Component Strategies

Many of the interventions that have been proposed to counter child anxiety and distress have been multifaceted in nature. They incorporate child-based as well as parent- and clinician-based strategies in an attempt to facilitate child coping and minimize the experience of pain. For example, children with leukemia undergoing bone marrow aspirations (BMAs) and lumbar punctures (LPs) were taught cognitive behavioral techniques, including filmed modeling, breathing exercises, relaxation, behavioral rehearsal, and imagery/distraction, and were given incentives for using them. They demonstrated a decrease in distress following the intervention, and the majority of participants experienced a further decrease in distress in subsequent sessions[31]. Jay and colleagues have conducted multiple intervention studies demonstrating the effectiveness of this intervention package. Coping instruction, in conjunction with filmed and

participant modeling for children undergoing LPs, was found to decrease the children's behavioral distress, lower their heart rate, and increase their self-efficacy[32].

Filmed and participant modeling and information/exposure-based techniques are typically conducted prior to relatively long-lasting medical procedures, such as surgery and hospitalization[25]. Although a thorough discussion of live or filmed modeling and other information-based approaches is beyond the scope of this paper, the reader may wish to examine a review by Vernon and Thompson[33]. Blount, Piira, and Cohen [25] also address the issue of when to use information-based versus distraction-based techniques. Briefly, they recommend the use of information-based approaches well in advance of the medical procedure, and distraction-based techniques immediately before and during the procedure.

The multifaceted nature of many of the interventions makes it difficult to determine which aspect(s) of the intervention is most effective in helping children cope. In addition, sometimes an individual component may have multiple functions, making the agent of change unclear. For example, practice of coping skills under conditions which simulate those present in the medical treatment room prior to a medical procedure may help a child use the skills simply because he/she is more familiar with their usage. Examples of situations in which a child may practice coping skills during training sessions include having the child get on the table, cleansing the injection site, using a toy syringe to simulate the injection, etc. In these kinds of practice environments, the training session may include some degree of gradual exposure and habituation to the anxiety and behavioral distress associated with the feared medical treatment. Treatments similar to this have been shown to be effective for a variety of child anxiety disorders[34]. In addition, props used in relaxation such as a party blower or bubbles may be intended to teach children deep breathing as a relaxation technique. However, they also serve the function of distracting the child from the procedure. It is advantageous to identify the agents of change in the above mentioned treatment packages so that relevant components may be implemented in a time-efficient and cost-effective manner, though this is not always an easy task.

Cognitive-Behavioral vs. Pharmacological Interventions

Anxiolytics/Sedatives. The effects of psychological interventions have been studied in conjunction with and compared to pharmacologic interventions. Jay, Elliot, Katz, and Siegel [4] provided children undergoing BMAs with either a cognitive behavioral intervention, diazepam, or a minimal treatment attention control intervention. Investigators found that the cognitive

behavioral intervention group reported significantly less behavioral distress, lower pain levels, and lower pulse rates than the children in two control conditions[4]. A later study was conducted [35] comparing a cognitive behavioral intervention with and without jointly administered diazepam found no difference between the groups in observed distress, pulse, and self-reported pain and fear scores. There was, in fact, a trend towards greater distress among those taking diazepam, suggesting they may not have learned the cognitive behavioral strategies as well. Kazak et al. [36] provided children receiving BMAs and LPs with either a pharmacologic (i.e., sedative and analgesic medication) or a combined pharmacologic/psychological intervention. Mothers in the combined intervention reported that their children were significantly less distressed before and during the procedure than mothers in the pharmacologic intervention. Nurses also rated the children receiving the combined intervention as less distressed during the intervention.

EMLA. Several studies have examined distraction interventions compared to or in conjunction with EMLA cream (eutectic mixture of local anesthetics). Results of these studies have been somewhat inconclusive. In some studies distraction was found to be more effective in lowering child distress when compared to EMLA[19, 37-38]. However, it was just as effective when assessed by pain ratings[22]. In one study examining retrospective recall, both distraction and EMLA resulted in accurate recall of lower pain levels during injections when compared to standard medical care[22]. However, in that same study, distraction was also found to be associated with an overestimation of procedural anxiety, whereas EMLA resulted in a realistic recall of low anxiety. At this point it appears that combining behavioral strategies such as distraction with pain-reducing medical advances such as EMLA may be the most effective approach for decreasing procedural pain[21, 23, 39].

Hypnosis

Cognitive-behavioral strategies such as distraction, relaxation, education/information, and reinforcement have predominated in the literature on acute pediatric pain. Rigorous operational definitions and standardized procedures characteristic of cognitive behavioral strategies are noticeably absent from other techniques. For this reason, other techniques have been relatively neglected in the literature. Of these techniques, hypnosis for pediatric patients undergoing acutely painful medical procedures holds substantial promise. However, its credibility has suffered due to difficulties developing an objective definition, identification of causal mechanisms, and possible negative attitudes toward the term “hypnosis.” Although the

popularity of hypnosis has waxed and waned in the past century, a renewed interest in hypnosis as a valid therapeutic technique is developing[40], as indicated by the accumulation of empirical studies examining hypnosis for acutely painful medical procedures with children[41-43].

When used as a treatment during acutely painful medical procedures, hypnosis can be conceptualized as a clinician-trained and guided approach that aims to help children focus attention away from fearful aspects of a procedure and turn attention to an imaginative experience that is viewed as comforting, safe, fun, or intriguing in order to enhance children's sense of mastery[44]. The goals of hypnotherapy are to direct attention, decrease distress, reframe painful experiences, and help children dissociate from the pain. This process typically involves three stages: 1) induction (assisting child in dissociating from the environment), 2) deepening the dissociation, and 3) directing (e.g., magic glove that reduces pain) or distancing (e.g., imagining going to a favorite place) suggestions to produce "hypnotic anesthesia" or a place of safety.

Research investigating the efficacy of hypnosis with pediatric populations has primarily involved pediatric oncology patients undergoing BMAs and LPs[45-46]. Early articles demonstrated decreases in pain and anxiety during BMAs and LPs for children following hypnosis training[46-47]. Although these preliminary investigations were promising, they lacked comparison groups.

In contrast, Zeltzer and LeBaron[48] examined hypnosis in comparison with distraction and encouragement of self-control. They found significant reductions in anxiety and pain for both interventions, but greater reductions for the hypnosis group, indicating that hypnosis provides incremental gains beyond those achieved from distraction alone. Another set of investigators[49], however, introduced a non-directed play condition and found equivalent reductions in self-reported pain and fear across groups, potentially eliminating the need for hypnosis training. A study by Kuttner, Bowman, and Teasdale[50] randomized two age groups, 3 to 6 and 7 to 10 years, and compared active distraction through bubble blowing, pop-up books, puppet play, and deep breathing with hypnosis. Observational ratings of distress indicated significant reductions in distress behaviors such as crying and clinging for the younger children in the hypnosis condition. However, for the older children, both distraction and hypnosis resulted in similar significant reductions in observer-rated pain and anxiety.

Investigators have examined the association between the child's hypnotizability and the amount of benefit derived from the hypnotic intervention. In general, more studies seemed to

support[46, 51-53] than did not support[54] the positive association between hypnotizability and clinical benefit.

Recent studies employing blind observers, random assignment to groups, and/or manualized protocols[51-53] also support the use of hypnosis. For example, Liossi and Hatira[51] conducted a prospective controlled trial utilizing a manual-based clinical hypnosis intervention to alleviate pain in 80 pediatric cancer patients (6-16 years of age). Each intervention was conducted by a trained therapist. Although the hypnotic suggestions were standardized and sufficiently described for replication, the induction procedures were adapted according to each child's age, interests, and cognitive and social development[55]. This investigation employed four groups: direct hypnosis (e.g., request for numbness of an area), indirect hypnosis (e.g., a setting sun metaphor for cuing relaxation), attention control, and standard medical treatment. Patients in both hypnosis groups reported less pain and anxiety than those in the control groups. The two hypnosis groups did not differ.

Although the data on hypnosis are promising, the technique is somewhat limited in that it takes a considerable amount of time to train and implement properly. Also, in most of the research, data supporting the efficacy of hypnosis reflect the efforts of trained clinicians who practiced imagery with the child. There is some indication that the therapeutic benefit degrades when the patient switches from therapist-directed to self-hypnosis[51]. In this study, reductions in pain, anxiety, and observed distress maintained for only a short time after instituting self-hypnosis. Finally, as with most skills, children's ability to fully immerse themselves in the imagery may increase with practice. Therefore, time for rehearsal and repetition may be required from the child. For these reasons, hypnosis may be more applicable for frequent and regularly scheduled procedures rather than infrequent or unscheduled medical treatments.

Virtual Reality

Technological developments have been incorporated into medical procedures to produce a high level of distraction. In contrast to distraction that is produced by cognitive behavioral techniques and hypnosis, computer generated interventions such as Virtual Reality (VR) and Starbright World/Starbright Buddies (www.starbright.org) rely on neither training sessions nor coaches. Instead, these approaches provide children with a computer-assisted imaginative experience in which to engage. Although research evaluating Starbright World and Starbright Buddies for acutely painful medical procedures is being conducted, our literature search

indicates that this research has not yet been published. Therefore, only research with VR in acutely painful medical procedures will be reviewed.

VR is a computer generated, interactive experience in which a person sees and hears events as if he or she were in the virtual world. Typically the individual wears a helmet with speakers, a visual display and an orientation sensor, all of which are connected to a computer. Changes in head orientation and/or use of a joystick or keyboard change the visual and auditory stimuli. Immersion is achieved by real time auditory and sensory feedback that changes as it might if the person were actually in the virtual world. VR is similar in principle to cognitive-behavioral and hypnotic techniques in that it serves as a distraction-based intervention, drawing attention from unpleasant stimuli to pleasant or engaging stimuli. This technique has great therapeutic potential as it is active, does not require practice, and employs multiple sensory modalities to optimize engagement[56].

Recent investigations with burn patients[5, 57] and cancer patients[58-59] have yielded promising findings. In a case report of two burn patients, each patient reported a significant decrease in pain during wound care while engaged in VR compared to the video game control condition[57]. Similarly, another sample (*N* = 7) of burn patients reported decreased pain ratings during physical therapy when using VR distraction versus no intervention, and the effects of VR did not diminish over repeated use[5]. During a LP procedure with adolescents, investigators found a statistically non-significant reduction in pain among VR patients, but 77% of patients reported that VR helped to distract them during the procedure[58]. In a related study with chemotherapy treatment, all participants (N=11) reportedly enjoyed using VR and reported wanting to use it again[59]. Although the preliminary evidence is of limited statistical power, this new technique appears to be well received by its consumers.

Despite the high degree of promise that VR holds, its use is currently limited by a number of factors. Primary among these are availability and cost. More expensive computers and helmets with sophisticated audio and visual components are required to enhance the degree of immersion. Also, like movies, VR programs differ in their quality and the degree to which they engage the patient. Finally, equipment and programs can fail and require sophisticated technical assistance. In a few years some of these difficulties may be overcome as technological advances are made and the equipment becomes more affordable. Despite these limitations, the results are encouraging and indicate a need for future research.

Interventions for Infants

Interventions with infants have incorporated some of the principles of distraction that have been used effectively with older children. However, interventions for infants have historically been quite different from those for older children, presumably due to infants' inability to verbally express themselves. Interventions for infants have traditionally focused on techniques such as parental handling of the child and non-nutritive sucking. Overall, there has been a surge of studies supporting the importance of environmental, behavioral, and pharmacological interventions that target pain reduction in infants during acutely painful medical procedures.

Environmental Interventions

Although not a psychological technique per se, environmental interventions center on reducing noxious stimuli in the infants' environment, particularly in the NICU. These include bright lights, loud noises, frequent handling for medical assessment or treatment, and repeated painful procedures[60-62]. Implementation of individualized developmental care, such as the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), is recommended to optimize the environment for each infant[61, 63]. It is possible that reductions in noxious stimuli may mitigate the impact of required painful procedures, as well as help promote better overall development. Below are some techniques that have been successfully employed to reduce infants' procedural pain and distress.

Behavioral Interventions

There has been a recent increase in research on behavioral interventions during infants' painful procedures due to the relative ease of administration and low cost of these interventions. Experts recommend that behavioral interventions be employed whenever possible, and in combination with pharmacological treatments to minimize procedural pain[64-65]. Behavioral interventions generally employ one or more of the following: containing and positioning of the child (e.g., swaddling), non-painful sensory stimulation (e.g., massaging, rocking), non-nutritive sucking (e.g., sucking on a pacifier), and orally administering sweet-tasting substances or milk.

Positioning. Evidence for containing and positioning suggests that swaddling, facilitated sucking, and skin-to-skin contact, also known as Kangaroo Care, have been effective at reducing infant distress, as measured by physiological and behavioral indicators, such as duration of cry, facial actions, and heart rate[66]. In addition, sensory stimulation, such as massaging or rocking, has also been found to be effective at reducing infant pain[67-69]. Although

these types of positioning and sensory interventions have been shown to be effective, evidence for the oral interventions, including sucrose or sweet-tasting solutions and non-nutritive sucking, show more powerful effects on pain reduction.

Oral Stimulation. Many studies have found that administering sucrose orally prior to a minor procedure, such as heel-lancing or venipuncture, is an effective method for reducing pain[70-75]. Some studies have found trends that using sucrose followed by nonnutritive sucking has additive effects on pain reduction[70-71]. In addition, other sweet-tasting solutions such as glucose have been found to be as effective as sucrose[70]. One study found that the use of oral glucose was more effective than the local anesthetic skin cream EMLA[73]. There is also some evidence for the effectiveness of breast feeding in reducing infant distress during venipuncture[72].

Although the combination of sucrose and nonnutritive sucking has been found to be effective in reducing pain during procedures, evidence suggests that nonnutritive sucking alone is more effective than sweet-tasting solutions[67, 69-70]. In addition, providing an infant with a pacifier to suck is one of the easiest and most cost-effective solutions to reducing procedural pain. Although the exact mechanism of its effectiveness is not known, it has been proposed that non-nutritive sucking operates as a pain reducer through sensory dominance or by facilitating infants' self-regulation[62, 70]. Thus, it appears that sucking and sucrose also function, in large part, through the process of attention refocusing (distraction). Additional support for this position is provided in the next section.

Parent Training. Though many of the studies reviewed involved interventions administered by medical staff, some studies resembled child interventions involving training parents or providing information to parents with regard to how to perform a technique. Simply providing parents with an informational sheet explaining different behavioral interventions, including distracting with visual stimuli/toys, using a positive or neutral voice tone, giving a pacifier to suck, and rocking, resulted in parents using these strategies more and a reduction in behavioral and biochemical indicators of distress in the infants[68]. Although training parents can be effective, it has been suggested that the novelty of medical staff may capture an infant's attention more readily, providing the medical staff with unique opportunities to engage the infant in an intervention[76]. One study examined the effect of training a nurse to provide distraction before and during an immunization[77]. The nurse prompted the parent to provide distraction in addition to her own provision of distraction, and results indicated that the infants receiving distraction suffered significantly less distress. In addition, the nurse's use of

distraction was associated with greater use of distraction by the parents. These results provide additional support for the finding that one well trained adult in the treatment room prompts other adults to also coach the child to cope via the process of modeling[7, 14, 18].

The research evidence overwhelmingly suggests that infant pain can be reduced through the use of a variety of environmental, behavioral, and pharmacological techniques. During painful procedures, the general consensus is to employ behavioral interventions, such as sucrose, non-nutritive sucking, and other forms of distraction, in combination with pharmacological treatments to reduce infant pain. Behavioral interventions should be employed in as many situations as possible since they are distress-reducing, easy to use, and cost-effective.

CONCLUSION

Current trends in psychology and pediatrics emphasize the importance of providing support for and disseminating evidence-based treatments to alleviate the suffering pediatric patients experience during acutely painful procedures. Based on this review, it is apparent that important advances have been made in the development and investigation of interventions for children experiencing acute pain. Studies have examined interventions targeted at children, parents, and healthcare personnel, and findings indicate that while they are all generally effective targets for intervention, training healthcare personnel may prove to be the most efficient and cost-effective approach.

Findings also point to a variety of cognitive-behavioral intervention techniques that appear to be effective in decreasing children's experience of pain. In particular, distraction techniques are especially promising interventions as they are, in general, consistently related to decreases in child distress, associated with increases in child coping, and pose little to no risk of harm to the child. Importantly, these interventions are also highly cost-effective as they do not typically require expensive specialized equipment or personnel. While pharmacologic interventions, such as EMLA, are now commonly used, there is evidence that suggests that a combination of EMLA and cognitive behavioral intervention techniques may be the most effective approach. Similarly, for infants, evidence suggests that the use of behavioral techniques in combination with pharmacological treatments is the most efficacious approach, as well as relatively simple and cost-effective, for reducing distress during painful procedures.

Virtual reality and hypnosis have recently received greater attention in the literature. The research generally indicates that both of these interventions have been associated with reductions in child distress. Additional research should be conducted with both. For virtual reality, efforts should continue to make the technique more cost-effective and to demonstrate the effectiveness of the technique with younger children and those undergoing different medical treatments. Research utilizing hypnosis has increased considerably in the last few years, providing additional indications that this can be a viable therapeutic approach. Currently, it seems that the need for specialized training creates a barrier to widespread dissemination of hypnotic techniques. Evaluations of the cost-effectiveness of hypnosis compared to other psychological approaches, such as highly engaging distraction, are warranted.

Research on psychological approaches to reduce procedural pain in infants is a particularly encouraging area of inquiry. The techniques used with this population often include approaches that are not typically utilized with older children and adolescents, such as the use of sucrose or Kangaroo Care. It is possible that these techniques activate unique pain modulating mechanisms, or that they represent developmentally different approaches that use the same underlying mechanism, such as attention refocusing from the pain to relatively pleasant stimuli.

While important developments have been made in identifying interventions that effectively reduce distress and pain for pediatric patients, several important areas requiring further consideration can be identified. In particular, future research should focus on identifying the essential components or “active ingredients” of interventions in order to maximize the potential benefits while minimizing cost and effort. Also, while a variety of psychological interventions have been shown to be effective in reducing acute pain and distress in pediatric patients, no interventions are effective at all times for all patients. Although beyond the scope of this paper, researchers should continue in their efforts to determine how individual patient and situational characteristics influence response to treatment. In addition, further exploration of emerging techniques, such a virtual reality, should be undertaken in order to establish the efficacy and practicality of these potentially beneficial interventions. Finally, attention should be given to the dissemination of effective programs for the alleviation of acute procedural pain with different pediatric populations.

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