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Psychological Approaches to Pediatric Pain Relief

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Starting at birth, infants will experience a host of routine medical procedures, which can be painful and distressing. Through school years children and adolescents will continue to endure pain and anxiety associated with planned and unplanned medical events. Although the distressing immunizations, sutures, venous accesses, and surgeries are at least necessary if not life-saving, they can also result in unplanned negative consequences, such as heightened future sensitivity to pain and negative attitudes toward and avoidance of healthcare (e.g., Pate, Blount, Cohen, & Smith, 1996; Taddio, 1999). Fortunately, psychological science has produced an arsenal of approaches to help children cope with distressing and painful medical events.

This chapter details the evidence-based psychological interventions for pediatric procedural pain. At the outset, appropriate assessment of children's medical anxiety and pain will be briefly discussed. Correlates of children's pain will be presented to provide some context and nuances to consider when considering preparation and procedural intervention approaches. Subsequently, psychological approaches that focus on pre-procedure preparation are highlighted. Lastly, the focus will turn to the research base of psychological approaches to intervening during children's medical procedural distress.

Assessment

The assessment of pain is challenging given that it is an internal and subjective experience (Merskey & Bogduk, 1994). Measurement of pain and anxiety is especially daunting in children who might have a limited vocabulary for describing their experience. Acknowledging that there is no gold standard for pediatric pain assessment, it is typically recommended that measurement be made from various perspectives (Blount & Loiselle, 2009). For example, pediatric procedural pain might be quantified via children's self-report, parents' or nurses' ratings, behavioral observation instruments, and physiological indices. Each approach has pros

and cons and provides unique perspectives; thus, using multiple measures is recommended (e.g., Cohen et al., 2008). For in depth reviews of pediatric pain assessment approaches and specific instruments, see Cohen et al. (2008), Stinson, Kavanagh, Yamada, Gill and Stevens (2006), and von Baeyer and Spagrud (2007).

Individual Differences

Pain responses vary widely with some children seemingly needing no assistance in managing the distress and others inconsolable despite the best efforts of parents and staff. Identifying individual differences predictive of distress is critical in determining how to best select and tailor pain management efforts. Factors that have been explored include the pediatric patient's age, sex, and temperament.

Age. Data consistently indicate that younger children report and exhibit greater anxiety and pain than older children (Kleiber et al., 2007). Although it was previously believed that newborns and infants experienced dampened pain due to immature nervous systems (e.g., Derbyshire, 1999), more recent data suggest that their experience is as great if not more acute than older individuals (Porter, Wolf, & Gold, 1997; Porter, Grunau, & Anand, 1999; Felt et al., 2000). Some provocative studies with rats (for a review, see Schellinck & Anand, 1999) and humans (e.g., Taddio, 1999) suggest that early pain might influence neurological development and lead to heightened or dampened pain sensitivity later in life. Taking the patient's developmental status into consideration is critical when using pain management approaches. For example, newborns and infants will not have the cognitive abilities to appreciate preparation for future events; however, classically conditioned anticipatory distress can be seen in newborns in response to alcohol swabs (Taddio, Shah, Gilbert-MacLeod, & Katz, 2002). The developmental literature indicates that as children age their understanding of pain and techniques for coping

with pain change as a result of maturation, cognitive development, and socialization (McGrath & Craig, 1989). By adolescence, acute pain behavior is generally dampened with grimacing and verbal pain replacing crying and screaming (Cohen, Blount, Cohne, Schaen, & Zaff, 1999). However, pain ratings can be high suggesting that the internal experience is significant and deserving of assistance. Developmentally, adolescents have greater cognitive flexibility and can more readily use imagery and other internal coping efforts for pain relief. It is also expected that their understanding of the rationale for the medical procedure would provide some comfort and enhanced trust.

Sex. A recent literature review suggests that women are generally more sensitive to pain and at greater risk for pain disorders (Fillingim, King, Ribeiro-Sadilva, Rahim-Williams, & Riley, 2009). However, sex differences appear to emerge beginning in adolescence (LeResche, Manci, Drangsholt, Saunders, & Korff, 2005; Roth-Isigkeit, Thyen, Stoven, Schwarzenberger, & Schmucker, 2005) and data are equivocal regarding whether male or female infants (Fuller, 2002; Rosmus, Johnston, Chan-Yip, & Fang, 2000) or preadolescent children differ in pain experience (Fillingim et al., 2009). However, given socialization of boys and girls it might be expected that distracting toys, non-procedural conversation topics, and other techniques might vary by gender. That said, given that there might be greater within group variance than between group variance, a skilled clinician might identify unique interests and coping in individuals.

Temperament. Arguably, temperament might be the single most significant differentiating individual characteristic in infants and children (Chen, Craske, Katz, Schwartz, & Zeltzer, 2000; Chess & Thomas, 1986; Goldsmith et al., 1987, Ranger & Campbell-Yeo, 2008). A number of researchers have found that temperament is related to children's behavioral distress during painful medical procedures (e.g., Bournaki, 1997; Bustos, Jaaniste, Salmon, & Champion,

2008; Chen et al., 2000; Grunau et al., 1994; Lee & White-Traut, 1996; Piira, Champion, Bustos, Donelly, & Lui, 2007; Schechter, Bernstein, Beck, Hart, & Lawrence, 1991; Sweet, McGrath, & Symons, 1999; Young & Fu, 1988). In a review of the literature, low adaptability, low mood, low approach, and high emotionality were some of the temperament constructs predictive of distress (Ranger & Campbell-Yeo, 2008), and thus, children with these tendencies should be especially targeted for behavioral assistance. Unfortunately, no research to date has linked temperament to intervention approaches to best match psychological approach to temperament.

Preparation

Preparing the pediatric patient and parent are effective distress management interventions for surgery (Kain & Caldwell-Andrews, 2005; Margolis et al., 1998), venous access (Cohen, 2008), dental procedures (Melamed, Yurcheson, Fleece, Hutcherson, & Hawes, 1978), imaging (Pressdee, May, Eastman, & Grier, 1997), hospitalization (Gross, 1986; Melamed, Meyer, Gee, & Soule, 1976; Nelson, & Allen, 1999), and ear piercing (Spafford, von Baeyer, & Hicks, 2002). As detailed in a review of the literature, the timing, format, content, coping skills, and parent involvement are crucial components to consider when preparing children for medical events (Jaaniste, Hayes, & von Bayer, 2007).

Timing. Data suggest that equipping children with accurate expectations and coping skills results in lower medical distress and greater post-procedure adjustment (Melamed & Ridley-Johnson, 1988). Preparation information is best provided sufficiently in advance of the event so that the child has time to process it (Kain, Mayes, & Caramico, 1996). It should be noted that preparation given too far in advance of the procedure might lead to increases in anticipatory anxiety and forgetting of relevant information (Eiser & Patterson, 1983; Melamed et al., 1988). The invasiveness and severity of the procedure is related to timing. Specifically, minor

procedures, such as immunizations or blood draws may be well-suited to same-day information provision, whereas major surgeries might require advanced delivery of information (Kain, et al., 1996). However, children might not agree on what is a serious or routine procedure. In other words, children's perceptions might be critical when attempting to gauge whether a procedure as minor or major.

Format. A range of preparation formats have been described in the literature, such as videos (Melamed & Siegel, 1975; Peterson & Shigetomi, 1981), computer programs (Franck & Jones, 2003; Rassin, Gutman, & Silner, 2004), puppets (Cassell, 1965) written summaries (Felder-Puig, et al. 2003), live modeling (Klingman, Melamed, Cuthbert, & Hermecz, 1984), hospital tours (Gross, 1986; Peterson, Ridley-Johnson, Tracy, & Mullins, 1984), and packages employing various techniques (Kain et al., 2007). Many approaches include information about the medical procedure and advice on how children might cope with related anxiety and pain. When choosing a format, it is largely dependent on the maturity of the pediatric patient. For example, younger children may not have the cognitive capacity to understand that puppets or dolls represent him or herself; modeling (in person, video, or computer) may be more developmentally appropriate (Salmon, 2006). Modeling may be especially useful for children with limited experience with the medical procedure or environment. Research suggests that the addition of visual illustrations to written or verbally presented material may optimize memory retention (McGuigan & Salmon, 2005).

Social practice can be an integral part of children's learning (Vygotsky, 1978), and research has found that by approximately two months of age, children are able to engage in active interaction (Bateson, 1979). In short, the format of the preparation intervention should construct an environment where the child is not merely a passive observer or recipient of

information. The child should be encouraged to participate in an interactive dialogue where they can ask questions and be fully engaged. In addition to explicit learning, children also engage in implicit learning. Children observe the medical environment, which includes a range of potentially anxiety-provoking visual and auditory stimuli. They may view other children crying, children being pushed in wheel chairs, or healthcare providers with wary expressions and they may hear other children screaming, medical providers speaking amongst themselves in terms they do not understand, or parents attempting to comfort their children. Thus it is critically important to encourage children to actively engage and ask questions as they arise.

Content. Given that children's attention may be divided, and younger children might have difficulty anticipating and understanding future physical and emotional states, the content and language must be clear, concrete, and developmentally-appropriate. Research suggests that preparation programs should include both sensory and procedural information for optimal effectiveness (Sokolov, 1963; Spafford, et al., 2002; Suls & Wan, 1989; Tak, & van Bon, 2006). In other words, children should be able to predict what will take place during the procedure as well as what they will feel. Thus, the information should be simple and clear and linear in terms of the procedural steps. When discussing expectations for emotional or physical sensations, awareness of developmental level and language is important because the terminology children often use to describe pain, discomfort, or fear varies as a function of age (Stanford, Chambers, & Craig, 2005). Providing specific sensory and procedural information allows the child to both develop a sense of mastery over the information and an ability to apply the information to their experience. During the medical procedure, the medical provider should continue to guide the child through the steps by outlining the procedural and sensory information in a calm voice with age-appropriate language.

Coping style and skills. Lazarus and Folkman (1984) defined stress as the relation between life events and one's responses to those events. Thus, pediatric pain only becomes a stressor when the child's ability to manage or cope with the stressor is either insufficient or overwhelmed. Although some coping might be effective, other efforts might be maladaptive or exacerbate the stress. Commonly used coping skills training components include instructing the child to engage in active relaxation (e.g., diaphragmatic breathing, imagery, progressive relaxation) or distraction techniques (e.g., counting backwards, imagery, repeating a mantra, solving problems).

Parent behavior. Parents' behaviors accounts for a significant amount of the variability in children's coping and distress (Cohen, Bernard, Greco, & McClellan, 2002). Whereas parents' presence alone has not been shown to be instrumental in decreasing children's pre-surgical anxiety (Piira, Sugiura, Champion, Donnelly, & Cole, 2005), parents' behavior has been shown to be an important factor (Caldwell-Andrews, Blount, Mayes, & Kain, 2005). Thus, many preparation programs seek to engage the parents directly through targeting their own anxiety (Jay & Elliott, 1990) or indirectly through teaching them to be coaches for the pediatric patient (Cohen, Blount, & Panopoulos, 1997). Though there appears to be no research evaluating whether variability in the quality of information provision provided by different sources is associated with child outcomes, adult modeling of distraction and appropriate coping behaviors have been shown to be associated with decreases in child distress. In contrast, specific parent behaviors have been identified that are positively correlated with child distress include criticizing, apologizing, and providing excessive reassurance (McMurtry, McGrath, & Chambers, 2006).

Behavioral Treatment

In addition to preparing families in advance of the procedure, psychology has evaluated a number of approaches to use during the pediatric medical procedure. Interventions include relaxation (Jay, Elliott, Katz, & Siegel, 1987), breathing exercises (Kazak, Penati, Boyer, Himelstein, Brophy, Waibel, et al., 1996), positive reinforcement (Jay, et al., 1987), and imagery (Jay, Elliott, Fitzgibbons, Woody, & Siegel, 1995); in fact, these approaches have met criteria for "empirically-supported treatments" (Powers, 1999). Distraction, an integral component of the aforementioned interventions, has been supported through a meta-analysis (Kleiber & Harper, 1999). Sucrose administration has been shown to be an effective pain management intervention for neonates and young infants (e.g., Barr et al., 1995; Stevens, Yamada, & Ohlsson, 2010). In addition to these behavioral approaches, positioning is important pediatric patient, especially for infants and toddlers (Halimaa, 2003; Stephens, Barkey, & Hall, 1999).

Distraction. Distraction appears to function through manipulation of attention. McCaul and Mallott (1984) hypothesized that the brain has a limited capacity to focus attention on stimuli. Thus, once this system is depleted via an engaging activity (e.g., movie), there are few resources left for the child to devote to attending to a painful stimuli. In addition to the diversion of attention framework, Cohen (2002) argues that distraction disrupts classical condition, whereby attention is diverted away from pain-inducing stimuli in the environment. Distraction has been shown to minimize children's fear, anxiety, and pain while simultaneously maximizing their coping. Many different forms of distraction stimuli have been researched including movies (Cohen, 2002), interactive toy robots (Pringle et al., 2001), virtual reality goggles (Hoffman et al., 2004), music (Fowler-Kerry & Lander, 1987), bubble-blowing (Sparks, 2001), and short stories (Mason, Johnson, & Wooley, 1999). Regardless of the theoretical explanation or type of strategy, distraction appears to be an effective intervention for pediatric pain management.

Virtual reality distraction, which might include a head mounted display with interactive auditory and visual input has been supported for pediatric burn debridement (Das, 2005; Lange, Williams, & Fulton, 2006), burn rehabilitation (Hoffman, et al., 2000), and cancer-related procedural pain (Gershon, Zimand, Pickering, Rothbaum, & Hodges, 2004; Wint, Eshelman, Steele, & Gizzetta, 2002). A variety of virtual reality stimuli have been utilized including videogames, interactive toys, and environmental manipulations. Limitations of virtual reality include its high cost and necessity of technical expertise.

When selecting distraction stimuli, it is advised to take into account multiple sensory modalities such as vision, hearing, and touch in addition to consideration of both timing and individual factors. Further, distraction can promote a positive emotional state (e.g., happy, laughing), which can be incompatible with pain and distress (Demore & Cohen, 2005). A meta-analysis found distraction to be an equally effective intervention for pediatric pain management across gender and ethnic groups with increased success in children less than 7 years of age (Kleiber, et al., 1999). More detailed analyses, examining specific procedural phases suggests that the introduction of distraction stimuli is dependent on the child's affective state. Distraction interventions implemented prior to the medical procedure reduce anticipatory anxiety whereas interventions implemented during or after the procedure enhance recovery (Blount, Piira, & Cohen, 2003).

Cognitive-behavioral treatments (CBTs). At the core of cognitive-behavioral approaches is that patients' beliefs interact with emotional factors and behavioral responses to reinforce adaptive and maladaptive ways of thinking, feeling, and behaving (Turk, 2002). In a review of the literature, Powers (1999) outlined several empirically-supported CBT approaches including behavioral rehearsal, breathing exercises, emotive imagery, and positive reinforcement. When

compared with pharmacological agents such as valium (Jay, et al., 1987) or EMLA cream (Cohen, et al., 1999), CBT was found to be as effective or superior in decreasing children's pain and distress. CBT approaches have been used with several pediatric pain populations including children undergoing bone marrow aspirations (BMAs) or lumbar punctures (LPs; Blount, Powers, Cotter, Swan, & Free, 1994; Kazak, et al., 1996;), injections and venipuncture procedures (Dahlquist, Gil, Armstrong, Ginsberg, & Jones, 1985; Manne, et al., 1990), and routine immunizations (Gonzalez, Routh, & Armstrong, 1993).

Hypnosis. Hypnosis can be described as focused attention and dissociation (Hilgard & Hilgard, 1983; Spiegel & Spiegel, 1978). More recently, advances in neuroscience have found that during hypnotic states, changes in blood flow and electrical activity have been observed in multiple cerebral regions and in descending pathways of the spine (Danzinger et al., 1998; Rainville e al, 1999). Research supports hypnosis as a behavioral intervention in the treatment of BMAs (Liossi & Hatira, 2003), fracture pain (Iserson, 1999), unspecified pain (Uman, Chambers, McGrath, & Kisely, 2006), and postoperative pain (Lambert, 1996). Though the limitations of hypnosis include the lack of a clear operational definition and a minimal understanding of its functional mechanisms, hypnosis appears to be a promising intervention that warrants further research.

Biofeedback. Olton & Noonberg (1980) define biofeedback as "any technique which increases the ability of a person to control voluntarily physiological activities by providing information about those activities". In the pediatric psychology literature, biofeedback has received empirical support in the treatment of acute and chronic pain (Allen, Elliott, & Arndorfer, 2002; Arndorfer & Allen, 2001; Spirito & Kazak, 2006). A meta-analysis revealed that thermal biofeedback in combination with propranolol (a beta-blocker commonly used in the

treatment of migraine headaches) yielded an average symptom improvement of 70% in pediatric migraine patients, which is much higher than is typically found in adult patients (Hermann, Kim, & Blanchard, 1993). Additionally, significant decreases in anxiety, analgesic use, headaches, pain intensity and number of pain episodes were found in children with sickle cell disease who participated in six biofeedback sessions (Cozzi, Tryon, & Sedlacek, 1987). Despite the fact that much of the research is confounded by small sample sizes and other treatment confounds, biofeedback appears to be a promising intervention for pediatric acute and chronic pain which requires further investigation.

Conclusions

In sum, given the high number of acute painful procedures that children experience and the potential for long-term negative repercussions, pediatric pain preparation and management is an important area of study. Various theories have guided our understanding of pain and thus informed research, providing strong evidence that children's acute pain can be managed through the implementation of psychological approaches. Behavioral approaches, broadly defined in terms of preparation and intervention programs have been proved useful in decreasing children's procedural anxiety and pain. Preparation programs, with integral features including timing, format, content, individual coping style, and parent behavior, have received support as effective tools in decreasing child distress either directly or indirectly. In tandem, distraction and CBT have been proven as empirically-supported interventions and the clinical utility of hypnosis and biofeedback is encouraging.

It is important to recognize that in order to bring about long-term change in the way pediatric pain is both conceptualized and treated, integration of factors outside of the realm of the

medical environment are needed. Parents, children, and healthcare providers come together with a prescribed set of values and beliefs, which need to be taken into consideration when developing future behavioral interventions. Second, a more encompassing view of the "patient" is in order; treatments targeting other important individuals such as siblings will ensure optimal pain management. Third, the downward extensions of adult-based interventions to children should be carefully considered given the unique developmental characteristics of children (McGrath, 2005). Variability in children's cognitive, emotional, and developmental functioning needs to be addressed throughout the intervention approach. Fourth, the link between clinical research and clinical practice needs to be strengthened. As it is the responsibility of the researcher to assure that their interventions are practical and feasible in terms of cost, time, and expertise, clinical practitioners should remain knowledgeable of advances in their field. Fifth, given that much of the research has successfully proven the efficacy of short-term pain relief, investigation into the long-term benefits of pediatric pain management is necessary. Lastly, integration of multiple disciplines such as medicine, nursing, pharmacology, social work, physical therapy, and other health related fields would continue to strengthen the body of literature aimed at alleviating child physical pain and psychological suffering. As science continues to advance, psychology in conjunction with many other disciplines will continue to need to work towards relieving unnecessary child pain through the implementation of evidence-based interventions and treatments.

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