Beyond traditional cognitive-behavioral therapy: Novel psychological and alternative approaches to pediatric pain

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Abstract: This article highlights recent studies on novel psychological and complementary and alternative medicine (CAM) approaches for acute/procedural and chronic/recurrent pediatric pain. Computerized databases were searched from 1996-2006 to identify controlled trials on CAM therapies and psychological interventions that extended beyond traditional cognitive-behavioral therapy (CBT), defined as clinic-based individual (therapist-child) psychotherapy. Existing data supports the efficacy of novel psychological therapies for both acute and chronic pain reduction. Computer-based and distance (e.g., internet/phone) interventions have emerged as inexpensive new modes of treatment delivery. Well-conducted studies on CAM approaches are limited. Evidence supporting biofeedback for recurrent headaches and hypnosis for acute/procedural pain is the most robust. Compared to the literature on novel psychological interventions, there are relatively few rigorously conducted CAM investigations and thus further well-designed trials are warranted. For novel psychological approaches, additional large-scale studies are needed to replicate initial positive findings.

Keywords: pain, children, complementary therapies, alternative therapies, psychological intervention

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Submitted: Revised: Accepted:

INTRODUCTION

In the past 20 years, an extensive body of literature has demonstrated that cognitive behavioral therapy (CBT) can benefit pediatric patients with acute or chronic pain. CBT has been designated a "well-established treatment" for procedural pain in children (1) and systematic reviews/meta-analyses support the efficacy of CBT in ameliorating chronic/recurrent pain including headache (2), sickle cell disease (3), and recurrent abdominal pain (4). Researchers have now begun to investigate novel psychological approaches incorporating elements of CBT but going beyond traditional clinic-based CBT in which a therapist treats a child individually. There has also been a burgeoning interest in complementary and alternative medicine (CAM) approaches for pediatric pain (5). CAM has been defined as therapies not
generally provided by hospitals and clinics, nor widely taught in medical schools (6).

The purpose of this article is to highlight key findings from recent studies investigating novel psychological and CAM approaches for pediatric pain. Most existing reviews have focused on a single chronic pain condition or only one type of pain (e.g., procedural pain). This article aims to bring together studies on a wide range of pain complaints, including both chronic/recurrent pain and acute/procedural pain in order to provide a broad overview of the field. The intent is to call attention to the advantages and disadvantages of these novel approaches and to identify critical issues in planning future research. PubMed and PsychINFO databases were searched from 1996 to 2006 using the terms, “child,” “children,” and “pain” to identify relevant studies. Due to the lack of information on randomization among CAM trials, studies with a control group were included even if they did not use randomization or if randomization could not be determined. Effect sizes could not be calculated for the majority of CAM studies and thus were not included. Trials examining novel psychological approaches representing an extension of traditional CBT, defined as clinic-based individual (therapist-child) psychotherapy were included. The following delivery systems are discussed below: brief interventions testing a single component of CBT vs. a complete CBT treatment package; use of parent and nurse coaches (vs. psychotherapists); new technologies (e.g., computers). CAM interventions that have been the subject of at least one controlled trial were also included. Within the two broad categories (i.e., Novel Psychological Approaches; CAM Approaches) studies are grouped according to whether the intervention was used for chronic/recurrent or acute/procedural pain. Within pain categories, studies examining similar types of interventions (e.g., computer-based) are grouped together.

**NOVEL PSYCHOLOGICAL APPROACHES: ACUTE/PROCEDURAL PAIN**

**Brief memory-based interventions for procedural pain**

Traditional CBT involves multiple components delivered over several sessions. In a departure from this time-intensive approach, Chen et al (7) evaluated a brief intervention aimed at reframing negative memories in 50 children (3-18 years) with leukemia during 3 consecutive lumbar punctures (LPs). Relative to controls, children in the intervention group reported reductions in anticipated pain before the second LP, reductions in pain and distress during the third LP, and more positive memories of their previous LP’s. More recently, Salmon and colleagues (8) tested a brief intervention employing a cartoon video for procedural pain in 62 children (2-7 years) without chronic medical conditions undergoing a VCUG (voiding cystourethrogram, a radiological diagnostic test of the urinary tract and requiring catheterization). Children were randomly assigned to receive complete procedural information (CPI) with cartoon video, limited procedural information (LPI) with cartoon video, or standard care with LPI. Compared to LPI standard care, children in the CPI condition were less distressed during the procedure and appraised the procedure as less painful a week after the procedure. No differences were found between the two LPI conditions. These results suggest that a simple memory-based intervention is efficacious for reducing procedural pain, and that children’s memories play an important role in their experience of procedure-related pain and anxiety.
Distraction training: Parents and nurses as “coaches” during immunization

Distraction is defined as any intervention intended to focus the subject's attention away from pain or discomfort; it has been shown to be an effective technique for managing pain related to medical procedures (9). Cohen and colleagues have conducted a series of investigations on distraction interventions for immunization pain provided by parents and nurses. In the first study, they assigned 92 children (4-6 years) to a nurse coach intervention, a nurse coach plus parent coach intervention, or standard care (10). The intervention consisted of children viewing a cartoon movie and being coached to attend to the movie. Compared to the control condition, in the two intervention conditions, children coped more and were less distressed; nurses and parents exhibited more coping-promoting behavior and less distress-promoting behavior. However, the two interventions did not differ on any of the outcome variables. The Cohen group (11) also tested the effectiveness of movie distraction on immunization distress in 136 infants (1-21 months)(12). Parents in the distraction group were briefly trained to redirect the infant’s attention to the movie using animated gestures or speech. The distraction group displayed fewer distress behaviors than the standard care group, suggesting that a simple distraction intervention for parents can provide some distress relief to infants during routine injections.

Cohen and colleagues (13) provided 31 children (3-7 years) with brief training in breathing and positive self-statements prior to immunization in the absence of trained nurse or parent coaching, compared to 30 children who did not receive training. Although children understood the training, they did not use the coping strategies during the procedure, suggesting that such training in young children might be insufficient without the inclusion of adult coaches. On the other hand, a study of 69 older children (7-12 years) found that watching a TV cartoon reduced venipuncture pain even more than a mother distraction or control condition. Whereas this study might suggest that parent involvement is not needed if there is a good distractor, the mothers were not trained in how to distract their child. One tentative conclusion is that training of parents to improve distraction skills in children might be necessary for maximal benefits (14).

Virtual reality as a distraction tool for acute and procedural pain

New developments in media technology, such as virtual reality (VR), computers, and the internet, create unprecedented opportunities to deliver pain management programs for children in alternative, efficient ways. Growing up with these new technologies, children and adolescents may be particularly receptive to interventions using these techniques. VR is an exciting new approach that has recently been used as a distraction method in managing acute and procedural pain. In a preliminary study with seven children (5-6 years) with acute burn injuries (15), VR combined with routine pharmacological analgesia led to lower pain reports than analgesia alone during burn dressing changes. Similarly, in a pilot study of 20 children (8-12 years) (16), VR reduced pain relative to a control condition during pediatric intravenous (IV) placement. VR pain distraction was positively endorsed by children, parents and nurses in both studies. VR as a distraction method appears to be promising and attractive for children, and further studies with larger samples are warranted.
NOVEL PSYCHOLOGICAL APPROACHES: CHRONIC/RECURRENT PAIN

Computer and internet based interventions

Newer technologies for treatment delivery have also been tested for chronic/recurrent pain. Connelly et al (17) examined the effects of a CD-ROM program in 37 children (7-12 years) with recurrent headache. Treatment consisted of a CD-ROM program (including education, relaxation, thought-changing, and pain behavior modification) self-administered on home computers. Children in the CD-ROM group evidenced significant improvements in headache activity compared to controls by 3-month follow-up. Although encouraging, these finding require replication in a larger sample.

Distance methods have considerable potential for making effective treatments more accessible with lower associated costs. Hicks (18) examined distance treatment delivered via internet and telephone in 47 children (9–16 years) with recurrent headache or abdominal pain. The intervention employed a Web-based manual with CBT techniques (e.g., relaxation; cognitive strategies) with weekly therapist contact by telephone or e-mail. The control group was a standard medical care waitlist group who were reminded to see their physician as needed. At the 1- and 3-month follow-ups respectively, 70% and 72% of the treatment group achieved clinically significant improvement (50% reduction in pain), whereas only 19 and 14% of the control group achieved the criterion. With an average treatment time per participant of approximately 3 hours, the distance treatment was estimated to be 5.5 times more cost-effective in the consumption of therapist time than office-based individual therapy. Nevertheless, 35% of patients who expressed initial interest in the study did not complete baseline measures suggesting that attrition may be high for such distance interventions.

CAM APPROACHES FOR PEDIATRIC PAIN: ACUTE/PROCEDUREAL PAIN

Music for procedural pain

In contrast to these new technologies, music has been used since antiquity to enhance well-being (19). Two types of music-based interventions for procedural pain have been studied: 1) music therapy involving the live performance of trained therapists; 2) recorded music. The extent to which these modalities can be clearly differentiated is unclear. Music is thought to function as a form of distraction that may indirectly influence pain (20). Nevertheless, few studies have tested whether music offers any specific analgesic benefits by including placebo conditions to control for non-specific effects due to other types of distraction.

Mixed results on the benefits for music for procedural pain have been reported. Megel et al. (21) in 99 children (3 – 6 years) found that those who listened to lullabies during immunization displayed less distress relative to no intervention controls, although the groups did not differ in physiological responses or reported pain. However, this study suffered from serious methodological limitations including lack of information regarding randomization and how the distress ratings were conducted. Malone (22) tested the effects of live music therapy for pain related to intravenous starts, venipunctures, injections and heel sticks in 20 children (0-7 years) and 20 no intervention controls, matched for age and type of needle insertion. The music group displayed less behavioral distress than controls during pre- and
post-needle stages, although there were no group differences in distress during needle insertion. This study suffered from the same limitations as the Megel study regarding randomization and distress ratings. Null findings have also been reported. A very recent study found no significant differences in injection pain among 64 children (4 to 6.5 years) who listened to either music or a story while pointing to pictures, compared to no intervention controls (23). In accord, a recent Cochrane review (24) including 51 studies (eight pediatric) of music for pain relief concluded that although music reduced pain, the magnitude of the reductions was small and thus the relevance of music for clinical practice remains unclear.

**Hypnosis**

Hypnosis involves imaginative experiences in which the subject is guided to respond to suggestions for changes in subjective experience and alterations in perception and emotion. It is viewed as particularly appropriate for children due to their increased susceptibility to hypnosis relative to adults (25); this enhanced susceptibility has been attributed to children’s willingness to become absorbed in fantasy (26).

**Hypnosis for procedural pain in pediatric oncology**

Two recent comprehensive reviews have summarized the literature on hypnosis for procedural pain in pediatric cancer (27,28). Despite extensive overlap in the studies included in these reviews, their conclusions diverged. Wild and Espie assigned a grade of “D” to the quality of existing evidence indicating inconsistent results and generally poor methodological quality. The Richardson review was more positive, emphasizing that statistically significant reductions in pain were found despite a number of methodological limitations. These more optimistic conclusions were based in part on the results of Liossi and Hatira (29) who tested a manualized hypnosis intervention for procedural pain in 80 pediatric cancer patients (6-16 years) who received hypnosis, attention control, or standard medical care. Hypnosis resulted in less pain and anxiety relative to both control conditions. This study was methodologically superior to prior studies in that a treatment manual was used and adherence checks for treatment fidelity were conducted by an independent observer. However, there was only one study therapist and thus, additional replication studies are required to determine the generalizability of these findings.

Extending these results Liossi and colleagues (30) randomly assigned 45 pediatric cancer patients (6-16 years) undergoing LPs to receive either eutectic mixture of local anesthetics (EMLA) alone, EMLA plus hypnosis or EMLA plus attention. The hypnosis group demonstrated less distress and reported less anticipatory anxiety and less procedure-related pain and anxiety relative to the other groups. This study possessed several methodological strengths including the use of a treatment manual and good treatment fidelity, as well as high inter-reliability for behavioral observations of distress and data indicating raters were unaware of group assignment. Nevertheless, the use of only one study therapist (the principal investigator) points to the need for further replication in an independent research group.

**Hypnosis for procedural pain related to VCUG**

Butler et al (31) randomized 44 children (aged 4 -15 years) without chronic medical conditions undergoing VCUG to receive either hypnosis or routine
care. Compared to routine care, hypnosis resulted in lower parent ratings of child distress, less child distress as rated by an experimenter, less difficulty in performing the procedure as reported by medical staff, and shorter procedure time. One major limitation of this study is that the medical staff, experimenters and parents were all aware of group assignment.

**Hypnosis for pediatric burn-dressing changes**
A randomized controlled trial (RCT) on pediatric burn victims (32) examined 23 children (3-12 years) who received “familiar imagery” (i.e., imagery related to familiar experiences) or attention control during 3 dressing changes. Hypnosis did not result in decreased distress in the treated group relative to baseline, nor were there any differences between the treated and control groups. Based on these findings, it is unclear whether hypnosis holds promise as an intervention for pain related to pediatric burn-dressing procedures.

**Hypnosis for post-operative pain**
Lambert (33) found that children (7 to 19 years) who received hypnosis reported significantly lower pain ratings and shorter hospital stays than those given standard care, although the groups did not differ in the amount of pain medication received. In a well-conducted study, Huth et al. (34) randomly assigned 73 children (7-12 years) to imagery delivered via video- and audio-tapes or attention-control. Post-surgery, the imagery group reported less pain and anxiety than controls. However, this study did not include a placebo group since the authors maintained that children may have distracted themselves in some other way (e.g., watching TV). This consideration highlights an inherent difficulty in devising a suitable placebo condition beyond mere attention to control for non-specific effects in trials of hypnosis.

**CAM APPROACHES FOR PEDIATRIC PAIN: CHRONIC/RECURRENT PAIN**

**Acupuncture for pediatric migraine**
Acupuncture involves the use of needles, heat, pressure or other stimulation at points along the meridian to enhance flow of energy or Qi. Despite the conventional view that children are afraid of needles, uncontrolled studies have demonstrated the feasibility and acceptability of acupuncture for children with chronic pain problems (35). The sole RCT on acupuncture for recurrent pediatric pain (36) compared 22 patients (7-15 years) with migraine headaches who received either true acupuncture, or placebo acupuncture (superficial needling). The true acupuncture group evidenced clear reductions in migraine frequency and severity compared to no improvements in the placebo group. Although the study was rigorously conducted, the sample sizes were relatively small and patients receiving medication were excluded even though many migraine patients are on regular, prophylactic and/or as needed medications, suggesting that the findings may be of limited generalizability. Also, there was no follow-up data so it is unclear whether improvements persisted across time.

**Biofeedback for recurrent pediatric headaches**
The most frequently studied forms of biofeedback (BFB) are thermal biofeedback (TBF; volitional handwarming) which involves monitoring visual and/or auditory feedback from a thermistor placed on the fingers and
electromyographic biofeedback (EMG-BFB) which involves monitoring visual and/or auditory feedback from electric impulses generated from the frontalis muscle. BFB for recurrent headaches has been the subject of numerous reviews [e.g.,(37, 38)] and meta-analyses [e.g., (2, 39)]. The general conclusion of these investigations is that existing research supports the efficacy of BFB for recurrent pediatric headache despite methodological weaknesses such as wide age range of patients, differing or unspecified diagnoses, variation in headache severity and inconsistencies regarding medication usage (39).

Three studies on BFB for recurrent headache have been published in time period covered by this review. Scharff et al (40) compared TBF to a placebo (handcooling) and wait list in 36 children (mean age = 12.8 years) with pediatric migraine. A greater proportion of the TBF group (53.8%) exhibited at least a 50% reduction in symptoms compared to the placebo group (10%) at post-treatment, and 3-, and 6-month follow-ups; there were no changes in the wait list group. This study demonstrated that BFB evidenced analgesic effects beyond that of a credible placebo control. The second study found that 10 children with pediatric migraines (mean age 10.5 years) trained to self-regulate slow cortical potential (SCPs) reported reduced migraine frequency and migraine index (number monthly attacks X severity X duration) compared to 10 no intervention controls (mean age 11.6 years)(41); trained children were significantly more likely to report a >50% reduction in migraine days than control children. Although this study provides preliminary support for self-regulation of SCPs in pediatric migraine, additional work with larger samples is required. The third study (42) compared EMG-BFB to relaxation in 35 children (11 to 15 years) with tension headaches. Although the groups did not differ at 1-month post-treatment, by 6- and 12-month follow-ups, the EMG-BFB group achieved significantly greater symptom reduction compared to controls. Based on this study, it appears that TBF holds promise as an intervention in childhood tension headaches although further carefully controlled studies are needed.

**Massage therapy for juvenile rheumatoid arthritis**

Massage therapy refers to the manipulation of soft-tissue by trained therapists for therapeutic purposes. In the only RCT examining massage for children with chronic pain (43), 20 children with juvenile rheumatoid arthritis (JRA) (5-14 years) received either a daily 15 minute massage administered by their parents or a daily 15 minute relaxation session with their parents. After 30 days, the massage group experienced less pain according to children, parents and physicians compared to controls. Although this study used standardized massage protocols and assessments by an independent physician, the sample sizes were small and it is unclear how well parents adhered to the massage protocol. Future studies may include control conditions such as sham massage (light touch) to permit investigation of specific effects obtaining to massage while controlling for non-specific effects due to physical contact.

**DISCUSSION**

Notable advances in the delivery of psychological and CAM treatments for pediatric pain beyond the traditional CBT model have been reported. Regarding novel psychological approaches, brief memory-based interventions represent a less time-intensive yet effective approach for acute procedural pain (7,8). Work by Cohen and colleagues (10,12) supports the
use of parents and medical practitioners as cost-effective agents in the management of injection pain. The use of new technologies as treatment delivery systems has also gained support. For acute pain, preliminary work supports the utility of VR as a distraction tool during dressing changes for acute burn injuries (15) and procedural pain related to IV placement (16). For patients with chronic/recurrent pain, computer- and telephone-based interventions with minimal therapist contact have generated therapeutic benefits for children with recurrent headaches (17) and/or abdominal pain (18). These inexpensive approaches may be especially suited for children in rural communities, ethnic minorities, and those of limited economic means. Interventions employing the internet, CD-ROM and portable electronic devices (PDA) create cost-effective opportunities for pain management and potentially allow for outreach to geographically remote locations.

Several potential problems however, exist in conducting distance treatment studies. As discussed above, attrition rates in distance treatment might be higher than those observed in traditional settings. Establishing a good therapist-patient relationship in distance treatment might be more difficult compared to traditional settings. Hicks et al (18) recommended an initial face-to-face office visit to establish rapport and to ultimately combine both traditional and unconventional approaches to maximize effective service delivery resources, especially for distance treatments. Distance treatment may particularly benefit those who have chronic conditions that require multiple treatment sessions and who have difficulty accessing traditional treatment locations. Another caveat to these initial findings is that sample sizes have been relatively small. Future large-scale studies are needed to establish the generalizability of these results for newer technologies.

In general, there have been far fewer rigorously conducted CAM trials for pain compared to the large number of high quality studies examining psychological approaches. For modalities such as acupuncture and massage therapy, which have been the subject of only one controlled trial each, there is insufficient data to draw definitive conclusions regarding efficacy. Recent research on the effects of music for procedural pain has been mixed with some studies reporting positive results (21,22) but at least one recent investigation reporting null findings (23). In contrast, there is good evidence from high quality trials supporting the utility of hypnosis for procedural pain in pediatric oncology (29,30). Hypnosis has also demonstrated therapeutic effects on procedural pain related to VCUG (31) and post-operative pain (33,34), but no such benefits on pain related to burn dressing changes (32). There is also considerable support for the application of BFB for recurrent headaches (39), although fewer studies have focused on tension headaches compared to pediatric migraine. Due to a lack of controlled studies, several CAM interventions, including movement therapies (e.g., yoga), meditation, energy healing, were not discussed in this article. Additional work may be directed at the rigorous testing of these potentially useful CAM modalities for the management of pediatric pain.

ACKNOWLEDGEMENTS
This article was supported in part by R01DE012754, awarded by the National Institute of Dental and Craniofacial Research, and UCLA General Clinical Research Center Grant MO1-RR-00865 (PI: Lonnie K. Zeltzer), and by R01MH063779, awarded by the National Institute of Mental Health.
REFERENCES