Paediatric Pain Management: Using Complementary and Alternative Medicine

Subhadra Evans, Jennie C.I Tsao and Lonnie K. Zeltzer.

Paediatric Pain Program, Department of Paediatrics, David Geffen School of Medicine at UCLA

SUMMARY POINTS

- Children undergo acute painful procedures and many also experience chronic pain.
- Due to their developing systems, infants and children may be at greater risk than adults for protracted pain sensitivity.
- There is a need to manage acute and chronic paediatric pain to reduce children's suffering and to prevent future pain problems.
- Consistent with a biopsychosocial perspective, complementary and alternative medicine (CAM) should be considered in management of acute and chronic paediatric pain.
- Although research is limited for paediatric pain, CAM interventions receiving the most empirical attention include hypnotherapy, acupuncture and music therapy. Evidence also exists for the therapeutic benefits of yoga, massage, humor therapy and the use of certain biological based therapies.

Pain in children

Children of all ages deal with pain. Acute pain can take the form of diagnostic and therapeutic interventions, including venipunctures and immunizations, as well as common childhood misfortunes, such as playground injuries. Some children are also subject to chronic or disease-related pain, as in the case of childhood cancers or juvenile arthritis. Many otherwise healthy children may experience chronic functional pain, including chronic daily headaches, abdominal pain, and limb pain. These children often show no signs of disease, but rather, seem to have impaired neurosensory pain signaling systems. Certain children may be further vulnerable to pain, such as premature infants who undergo a myriad of painful procedures, often without sufficient analgesia. The sheer number of encounters with pain as well as children's vulnerability makes them particularly in need of appropriate pain management. Unfortunately, many children and adolescents are inadequately treated for acute and chronic pain (1).

While it was once believed that infants were less sensitive to pain than adults because of underdeveloped neural networks, it is now known that pain in infancy is associated with increased reactivity and stress responses to further procedures (2). It appears that infants are born with full pain transmission systems but not fully developed pain inhibitory systems, creating opportunities for the development of pain vulnerability with even brief painful episodes. Repetitive acute pain experiences likely create central neural changes in the newborn's pain processing systems that may have long-term consequence for later pain vulnerability and cognitive effects (3). Studies have demonstrated the serious short-term and longer-term consequences of untreated pain in infants, especially in pre-terms. Furthermore, a child's nervous

system continues to develop until early adulthood. Taken together, this research suggests that finding efficacious treatment for child pain is paramount in preventing protracted sensitivity to pain.

Complementary and Alternative Medicine for Paediatric Pain

A number of conventional pain treatments, such as pharmacologic therapy, psychotherapy and physical therapy have proven a certain level of efficacy in children. Yet current paediatric pain management still leaves much to be desired. It is estimated that between 15% and 30% of children experience chronic pain despite conventional treatments (4,6), and many also undergo acute pain that could be better managed. As acceptance of the biopsychosocial model of pain has increased, so has our understanding of how therapies and remedies outside of conventional medicine may act upon the mind and the body to relieve pain. A recent increase in the popularity of complementary and alternative medicine (CAM) for pain and illness in adults and children underscores a shift towards approaches that may complement conventional treatments. There is also a dire need for knowledge regarding the availability, efficacy and safety of such CAM modalities. In this review we hope to increase interest and awareness of CAM interventions, including the need for further research on safety and efficacy issues. As discussed herein, a number of CAM treatments are available for acute and chronic paediatric pain. Efficacy may vary according to the pain condition and the child's age.

CAM is defined as therapeutic interventions not widely used in conventional health care practice (7). The National Center for Complementary and Alternative Medicine, groups CAM therapies

Table 1. CAM designations with associated interventions for paediatric pain

CAM	Therapies	Pain States	Appropriate Age
Alternative Systems	Acupuncture	Procedural pain (hernia repair)	1 yr - adolescence
		Chronic pain (endometriosis, reflex sympathetic dystrophy; possibly headaches, abdominal pain, fibromyalgia, and complex regional pain)	younger children may be wary of needles
		Migraine headaches	
Biologically based	Sucrose	Procedural pain (circumcision, VP, heel stick)	Neonatal infants
	Peppermint	Chronic pain (IBS)	8 yrs – adolescence; dose depends on weight
	Naturopathic herbs	Acute otitis media	6-18 years of age
Body-based	Kangaroo care	Procedural pain (heel stick)	Infants
	Massage	Procedural pain (burn dressings) Chronic pain (RA, fibromyalgia, cancer)	2 yrs- adolescence
Mind-body	Yoga	Chronic pain (IBS; mood, energy, sleep, anxiety)	School age – adolescence
	Meditation	General stress	School age - adolescence
	Hypnotherapy	Procedural pain (bone marrow aspiration, VP, lumbar puncture)	School age - adolescence
		Chronic pain (possibly headache, abdominal pain, fibromyalgia, and complex regional pain)	
	Biofeedback	Chronic pain (headache & migraine)	8 yrs- adolescence
	Laughter Therapy	Procedural pain (immunizations)	All ages
	Music Therapy	Procedural pain (injection, VP, circumcision, burn dressing and surgery)	All ages

VP: Venipuncture; IBS: Irritable bowel syndrome; RA: Rheumatoid Arthritis

into five categories: alternative medical systems, biologically based therapies, manipulative and body-based therapies, mind-body interventions and energy therapies. Alternative medical systems are built upon complete systems of theory and practice, such as traditional Chinese medicine. Biologically based therapies include herbal remedies, as well as vitamins and other dietary supplements. Manipulative and body-based methods may include chiropractic, osteopathic manipulations, and massage. Mind-Body interventions relate to a variety of techniques that aim to increase the mind's capacity to enhance bodily function and reduce symptoms, such as mental healing, expressive therapies such as music, art, or dance therapy, and spiritual practices such as meditation and prayer. The medical uses of hypnosis, yoga and relaxation are also included here. Energy therapies typically refer to Reiki and the unconventional use of electromagnetic fields, such as pulsed fields, alternating current or direct current fields. Many of these CAM interventions attempt to restore balance and harmony in the mind and body, similar to the goal of Western medicine to restore homeostasis.

As presented in Table 1 and discussed below, at least one CAM therapy from 4 of the 5 CAM designations have established therapeutic benefits

in treating paediatric pain. As yet, research regarding energy therapies is insufficient to make definitive recommendations.

Alternative Systems

Acupuncture

The precise analgesic mechanisms have not been identified but it is likely that the body's nervous system, neurotransmitters and endogenous substances are involved in needle stimulation (8). Studies with children and adolescents have demonstrated usefulness in chronic nausea, fatigue, and a variety of chronic pain states, including migraines (9), and endometriosis and reflex sympathetic dystrophy (10,11). One uncontrolled study combined acupuncture and hypnotherapy to treat headaches, abdominal pain, fibromyalgia, and complex regional pain syndrome type I (10). Although the results supported the feasibility of this combined acupuncture/hypnotherapy intervention, further controlled trials are needed to establish the efficacy of this multimodal CAM intervention.

Only one randomized controlled trial (RCT) has examined acupuncture for children's chronic pain. Pintov et al (9) administered either true acupuncture or a placebo intervention (superficial needling) for 10 weeks to 22 patients, aged 7-15 years, complaining of migraine headaches. Children, parents, and nurse-raters who administered the pain measures were all blinded to study group assignment. The true acupuncture group reported reductions in migraine frequency and severity, and panopioid activity in plasma and β -endorphin levels also rose significantly. No such changes were observed in the placebo group. These findings, in a rigorously-designed study, provide good evidence supporting the efficacy of acupuncture in the treatment of paediatric migraine. However, there are several caveats, including a small sample size, limited generalizability due to exclusion of patients taking prophylactics, and omission of refusal rates which limits knowledge of treatment acceptability. Finally, no follow-up data were presented and it is not known whether or how long after the study treatment gains persisted. One RCT of acupuncture for paediatric acute pain exists, although traditional acupuncture was not used. In this study, 108 children aged 4 months to 9 years undergoing hernia repair were randomized to receive capsicum plaster at designated acupoints, or to control groups (sham capsicum plaster and placebo tape) (12). There were no differences between groups for the first 6 hours, after which the acupoint group showed significantly less pain and opioid consumption. The results are promising and warrant further studies employing acupressure and acupuncture for acute pain.

Although acupuncture has been used successfully with children as young as 1 year of age (13), concerns exist regarding children's willingness to tolerate needles. Preliminary research has found that adolescents find the experience acceptable (11), and at least one study has reported acceptability with children as young as 6 years of age (10). Children may be less averse to acupuncture than many adults would anticipate.

Biologically-based therapies

A number of studies have examined the efficacy of sucrose for acute pain in the early neo-natal period. The literature supports the use of sucrose, usually administered on a pacifier thus capitalizing on the non-nutritive sucking (NNS) benefits for infants' procedural pain, including circumcision, venipuncture and heel stick (14). A sweetened substance with or without NNS is generally as effective as current treatments, such as EMLA, for circumcision, with many studies finding superior benefits (14). Further evidence for biologically-based therapies has been demonstrated in older paediatric populations experiencing acute and chronic pain conditions. The use of oral peppermint oil to treat irritable bowel syndrome in children has been shown as efficacious (15). In addition, two RCTs have demonstrated the efficacy and safety of a naturopathic herbal extract for ear pain associated with acute otitis media in children older than 5 years of age (16,17). Despite these promising findings, research is still needed into the safety and efficacy of a wider variety of herbal supplements and biological based therapies given that several have been shown to adversely interact with other conventional medications through pharmacodynamic or pharmacokinetic mechanisms (18).

Body-based therapies

Kangaroo care/Touch

In Kangaroo care, the parent holds the child skin-to-skin against his/her body at an upright 40° to 60° angle and covers the child with a blouse or shirt; a second covering may be used to provide additional warmth. Skin-to-skin contact is associated with pain reduction and decreased arousal in full-term and pre-term infants undergoing procedural pain such as heel sticks (19,20). Further, it appears that a technique called sensorial saturation combining sucrose, NNS and massage or skin contact is highly effective in reducing infant heel stick pain (21). Swaddling also appears to have a calming effect on infants in pain. Despite the promise of kangaroo care and other remedies involving touch, a number of limitations are common in the literature. These include difficulty in blinding raters, lack of information regarding inter-rater reliability with respect to pain coding, and difficulty controlling the intervention group, as some caregivers may inadvertently provide verbal or other forms of comforting (22).

Massage

Massage therapy is designed to improve circulation in the muscles, increase the flow of nutrients and eliminate waste products in the body. Massage likely involves parasympathetic activity and a relaxed physiologic state (23). Massage has been found to reduce pain and cortisol levels, and improve sleep and mood in children, especially for juvenile rheumatoid arthritis, cancer and fibromyalgia (24). A review of randomized controlled trials of paediatric massage found children may benefit through reduced anxiety and joint pain, and increased muscle tone, although much of the literature has low power and unclear procedures (25). In addition, limited research exists for acute paediatric pain, although one study found massage (to unaffected body parts) was effective in reducing children's distress during burn treatment (26). A weakness in most massage studies is the omission of a physical contact (such as light touch) control group.

Mind-body Therapies

Therapeutic yoga

Iyengar yoga has specific therapeutic uses to achieve balance in mind, body, and spirit. This system of yoga uses props such as blankets, bolsters and blocks to assist with the performance of asanas (body poses) designed to heal specific maladies. Iyengar yoga is especially effective for chronic pain and also for improving mood, energy, sleep, and anxiety. Young people's use of Iyengar yoga is associated with improvements in mood and function, and may be especially beneficial for chronic musculoskeletal conditions, headaches and stomach complaints. A study of a 4 week home-practice intervention for children and adolescents with irritable bowel syndrome found that compared to a standard intervention control group, the yoga group exhibited significantly improved disability, coping, and anxiety scores (27). However, it is not known to what degree participants actually practiced yoga and to what extent they adhered to the prescribed

yoga protocol. Another study with college students with moderate depression found that a five week, twice-weekly program was sufficient to significantly reduce depressive symptoms and enhance function (28).

Meditation

Mindfulness meditation involves the conscious monitoring of attention and being in the moment. Although many forms of meditation exist, a type of mindfulness meditation called Vipassana meditation involves a concentrated focus on the breath with the goal of stabilizing the mind and promoting calmness. It is likely that mindfulness meditation minimizes pain through the individual's acceptance of pain by distancing oneself from the somatic experience by noticing it and a corresponding reduction in stress. Mindfulness meditation has been found to decrease pain symptoms in adults living with a wide variety of pain conditions including cancer (29). Meditation also has anti-stress benefits, by affecting blood pressure and heart rate in adolescents (30). At the present time there are no empirical studies documenting the use of meditation for children's pain, although case studies suggest that mindfulness is effective in dealing with nausea and epigastric pain in children.

Hypnotherapy

Hypnosis involves a state characterized by increased suggestibility, attention and relaxation and is designed to capture attention, change sensory experiences, reframe pain and dissociate from it, and enhance a sense of self-efficacy and self-control. Hypnosis is known to be effective for analgesia in adults (31), and may be even more effective for use in children who often have enhanced susceptibility. Although the precise mechanisms are unclear, neuroimaging studies show that hypnosis is associated with brain areas involved in reduced arousal, visual imagery and possible reinterpretation of perceptual experiences (32). Hypnosis has been used in children to alleviate a number of painful medical procedures, including bone marrow aspirations (33), venipuncture and lumbar punctures (34), although its therapeutic benefits may be reduced in children of preschool age and younger (35). A recent review of psychological interventions for needle-related procedural pain reported hypnosis was a promising intervention for self-reported pain in children and adolescents (36). Self-hypnosis may be effective for children who are highly hypnotizable (37).

Hypnotherapy is strongly indicated for paediatric pain, but the research is not without limitations. Inappropriate or lack of control groups, difficulty blinding and variation in techniques employed are concerns pertinent to a number of studies (24). Further research is required to establish efficacy for paediatric chronic pain, although as referenced under the section on acupuncture, hypnotherapy has been used with acupuncture to successfully treat headaches, abdominal pain, fibromyalgia, and complex regional pain syndrome type I (38). Hypnosis is recommended alongside standard analgesic medical procedures to reduce procedure-related pain and anxiety in children of school age and above.

Biofeedback

This system uses a computer or other feedback device to assist children in managing pain symptoms by increasing awareness of and learning to control the physiological stress response. Monitored changes may include muscle tension, skin temperature, sweat gland response, brain wave activity, or breathing rate. The majority of the studies on biofeedback (BFB) for paediatric pain have focused on paediatric migraine and a few on tension headaches. Recent conceptualizations of a continuum model in which both migraine and tension headaches involve vascular and muscular components have modified the application of BFB for head pain in children. Biofeedback can reduce migraine and headache pain by as much as 50%, and also assists with a sense of mastery (24). A well-designed RCT compared thermal biofeedback to an attention placebo (hand cooling) and a waiting list group for paediatric migraine (39). The authors found that 53.8% of the thermal biofeedback group achieved a 50% or greater reduction in symptoms at post-treatment, and at 3-, and 6-month follow-ups, compared to only 10% of the hand cooling group reporting a comparable reduction. The wait list group showed no significant changes during the monitoring period. These findings demonstrate a clinically significant improvement with thermal biofeedback, and are consistent with existing published evidence of its efficacy in paediatric migraine. Biofeedback is recommended for use in children aged 8 and above; younger children may not possess sufficient cognitive skills and physiological awareness to control stress responses.

Humour and laughter therapy

Laughter and humour have been linked to pain control in adults and children (40) and have potential positive effects on immune function. A pilot study found that watching a funny video reduced children's laboratory pain responses and lowered their levels of the stress hormone cortisol (41). Based on a number of empirical studies, a recent review of pain reduction during paediatric immunizations concluded that use of humour can effectively distract children from the distress of the procedure (42). Clearly additional studies are required to validate the use of humour interventions (i.e. do all children find the same material funny? Are TV shows more effective than live performances or stories?), but preliminary evidence for laughter and humour for acute pain is encouraging. Further empirical work is required to establish the therapeutic benefits of humour therapy for chronic pain in children.

Music therapy

A number of studies recommend the therapeutic benefits of music for paediatric acute pain, including for injection, venipuncture, circumcision, burn dressing and surgery pain. Therapeutic delivery methods include recorded lullabies played on speakers or through headphones and live music. However, much of the literature lacks a clear reference to music *therapy*, which is a clinical and evidence-based systematic intervention. In this discipline, therapists are trained to assist patients' recovery through an active musical experience, in which the patient is typically engaged in the music making process. The effects of active music therapy are thought to be more pronounced and

therapeutic than simply listening to music. A number of studies using a stringent definition of active music therapy have shown benefits. A recent RCT using active music therapy for 108 children aged 4-13 years undergoing venipuncture found lower distress and pain scores in the music group compared to a control group receiving support from parents (43).

Studies using passive listening have also reported benefits, but with more limited results (44,45). It is possible that the attentional demands of passive listening are not sufficient to ameliorate pain. Music also appears to have less analgesic effects for infant pain, such as circumcision pain (46). It is possible that music is more efficacious for older children, who possess increased cognitive skills to redirect their attention towards the music process. Music likely exerts its effect through distraction, either by distraction of attention, or through habituation to the pain (47), although the specific mechanisms behind the therapeutic effects of music remain unclear. The efficacy of music therapy for chronic pain is not known.

Art, dance, and aromatherapy

Each of these therapies has been associated with success for some children and pain conditions via anecdotal or clinical case reports. Music and the use of familiar scents (such as mother's breast milk) can be used to reduce distress associated with painful procedures such as heel sticks and circumcision in young infants and children (48). Art and dance therapy may be beneficial for older children and adolescents with chronic pain, as a means of coping and distraction.

Conclusion

Infants and children are particularly vulnerable to pain. A variety of medical procedures associated with acute pain are performed over infancy and childhood. Many children also experience chronic pain states that are difficult to manage. At the very least, health care professionals are well advised to consider the likely analgesic effects of relaxation and distraction. A number of CAM interventions listed herein have relaxing and distracting components, such as music and humour therapy. A number of other techniques can promote muscle relaxation and reduce pain-related anxiety. Depending on the child's interest and developmental level, fun strategies designed to help the child move attention away from pain can include bubbles, art, video games, television and play activities. Controlled breathing and progressive muscle relaxation are effective for children preschool age and older, and can be used to treat acute and chronic pain. Attending school also provides a major distraction for children with chronic pain.

CAM treatments offer a method for dealing with pain and pain-related functioning. As presented in Table 1, a variety of safe and efficacious interventions exist that health professionals may wish to consider implementing along with conventional treatment. Some of these interventions vary in suitability depending on the child's age and developmental level. For example, younger children may struggle with the attentional demands of yoga or meditation. CAM interventions

may prove to be effective for a wide range of conditions and age-groups, but further research is required to establish efficacy and safety. Clearly, paediatric CAM research is in its infancy and further work is required before recommendations can be made for a variety of pain states.

REFERENCES

1. Perquin CW, Hazebroek-Kampschreur AA, Hunfeld JA, van Suijlekom-Smit LW, Passchier J, van der Wouden JC. Chronic pain among children and adolescents: physician consultation and medication use. *Clin J Pain* 2000;16(3):229-35.
2. Peters JW, Schouw R, Anand KJ, van Dijk M, Duivenvoorden HJ, Tibboel D. Does neonatal surgery lead to increased pain sensitivity in later childhood? *Pain* 2005;114(3):444-54.
3. Anand KJS, Stevens BJ, McGrath PJ. *Pain in Neonates*: Elsevier; 2007.
4. Roth-Isigkeit A, Thyen U, Raspe HH, Stoven H, Schmucker P. Reports of pain among German children and adolescents: an epidemiological study. *Acta Paediatr* 2004;93(2):258-63.
5. Perquin CW, Hazebroek-Kampschreur AAJM, Hunfeld JAM, Bohnen AM, van Suijlekom-Smit LWA, Passchier J, van der Wouden JC. Pain in children and adolescents: a common experience. *Pain* 2000;87(1):51-8.
6. Mikkelsen M, Salminen JJ, Kautiainen H. Non-specific musculoskeletal pain in preadolescents. Prevalence and 1-year persistence. *Pain* 1997;73(1):29-35.
7. Eisenberg DM, Kessler RC, Foster C, Norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in the United States. Prevalence, costs, and patterns of use. *N Engl J Med* 1993;328(4):246-52.
8. Ma SX. Neurobiology of Acupuncture: Toward CAM. *Evid Based Complement Alternat Med* 2004;1(1):41-47.
9. Pintov S, Lahat E, Alstein M, Vogel Z, Barg J. Acupuncture and the opioid system: implications in management of migraine. *Pediatr Neurol* 1997;17(2):129-33.
10. Zeltzer LK, Tsao JC, Stelling C, Powers M, Levy S, Waterhouse M. A phase I study on the feasibility and acceptability of an acupuncture/hypnosis intervention for chronic paediatric pain. *J Pain Symptom Manage* 2002;24(4):437-46.
11. Kemper KJ, Sarah R, Silver-Highfield E, Xiarhos E, Barnes L, Berde C. On pins and needles? Paediatric pain patients' experience with acupuncture. *Pediatrics* 2000;105(4 Pt 2):941-7.

12. Kim KS, Kim DW, Yu YK. The effect of capsicum plaster in pain after inguinal hernia repair in children. *Paediatr Anaesth* 2006;16(10):1036-41.
13. Duncan B, Barton L, Edmonds D, Blashill BM. Parental perceptions of the therapeutic effect from osteopathic manipulation or acupuncture in children with spastic cerebral palsy. *Clin Pediatr (Phila)* 2004;43(4):349-53.
14. Tsao JCI, Evans S, Meldrum M, Altman T, Zeltzer LK. A review of CAM for procedural pain in infancy: Part I. Sucrose and nonnutritive sucking. Evidence-based Complementary and Alternative Medicine; in press.
15. Weydert JA, Ball TM, Davis MF. Systematic review of treatments for recurrent abdominal pain. *Pediatrics* 2003;111(1):e1-11.
16. Sarrell EM, Mandelberg A, Cohen HA. Efficacy of naturopathic extracts in the management of ear pain associated with acute otitis media. *Arch Pediatr Adolesc Med* 2001;155(7):796-9.
17. Sarrell EM, Cohen HA, Kahan E. Naturopathic treatment for ear pain in children. *Pediatrics* 2003;111(5 Pt 1):e574-9.
18. Grootenhuis MA, Last BF, de Graaf-Nijkerk JH, van der Wel M. Use of alternative treatment in paediatric oncology. *Cancer Nurse* 1998;21(4):282-8.
19. Gray L, Watt L, Blass EM. Skin-to-skin contact is analgesic in healthy newborns. *Pediatrics* 2000;105(1):e14.
20. Johnston CC, Stevens B, Pinelli J, Gibbins S, Filion F, Jack A, Steele S, Boyer K, Vei lleux A. Kangaroo care is effective in diminishing pain response in preterm neonates. *Arch Pediatr Adolesc Med* 2003;157(11):1084-8.
21. Tsao JCI, Evans S, Meldrum M, Altman T, Zeltzer LK. A review of CAM for procedural pain in infancy: Part I. Sucrose and nonnutritive sucking. Evidence-based Complementary and Alternative Medicine. 2007;eCAM Advance Access published online on November 6, 2007 eCAM, doi:10.1093/ecam/nem084.
22. Tsao JCI, Evans S, Meldrum M, Altman T, Zeltzer LK. A review of CAM for procedural pain in infancy: Part II. Other interventions. Evidence-based Complementary and Alternative Medicine. 2007;eCAM Advance Access published online on October 25, 2007 eCAM, doi:10.1093/ecam/nem089.
23. Ireland M, Olson M. Massage therapy and therapeutic touch in children: state of the science. *Altern Ther Health Med* 2000;6(5):54-63.
24. Tsao JC, Zeltzer LK. Complementary and Alternative Medicine Approaches for Paediatric Pain: A Review of the State-of-the-science. *Evid Based Complement Alternat Med* 2005;2(2):149-159.
25. Beider S, Moyer CA. Randomized controlled trials of paediatric massage: a review. *Evid Based Complement Alternat Med* 2007;4(1):23-34.
26. Hernandez-Reif M, Field T, Largie S, Hart S, Redzepi M, Nierenberg B, Peck TM. Childrens' distress during burn treatment is reduced by massage therapy. *J Burn Care Rehabil* 2001;22(2):191-5; discussion 190.
27. Kuttner L. Favorite stories: a hypnotic pain-reduction technique for children in acute pain. *Am J Clin Hypn* 1988;30(4):289-95.
28. Woolery A, Myers H, Sternlieb B, Zeltzer L. A yoga intervention for young adults with elevated symptoms of depression. *Altern Ther Health Med* 2004;10(2):60-3.
29. Ott MJ. Mindfulness meditation in paediatric clinical practice. *Pediatr Nurs* 2002;28(5):487-90.
30. Barnes VA, Davis HC, Murzynowski JB, Treiber FA. Impact of meditation on resting and ambulatory blood pressure and heart rate in youth. *Psychosom Med* 2004;66(6):909-14.
31. Rogovik AL, Goldman RD. Hypnosis for treatment of pain in children. *Can Fam Physician* 2007;53(5):823-5.
32. Rainville P, Hofbauer RK, Bushnell MC, Duncan GH, Price DD. Hypnosis modulates activity in brain structures involved in the regulation of consciousness. *J Cogn Neurosci* 2002;14(6):887-901.
33. Lioffi C, Hatira P. Clinical hypnosis versus cognitive behavioral training for pain management with paediatric cancer patients undergoing bone marrow aspirations. *Int J Clin Exp Hypn* 1999;47(2):104-16.
34. Smith JT, Barabasz A. Comparison of hypnosis and distraction in severely ill children undergoing painful medical procedures. *Journal of Counseling Psychology* 1996;43:187-95.
35. Katz ER, Kellerman J, Ellenberg L. Hypnosis in the reduction of acute pain and distress in children with cancer. *J Pediatr Psychol* 1987;12(3):379-94.
36. Uman LS, Chambers CT, McGrath PJ, Kisely S. Psychological interventions for needle-related procedural pain and distress in children and adolescents. *Cochrane Database Syst Rev* 2006(4):CD005179.

37. Liossi C, White P, Hatira P. Randomized clinical trial of local anesthetic versus a combination of local anesthetic with self-hypnosis in the management of paediatric procedure-related pain. *Health Psychol* 2006;25(3):307-15.
38. Zeltzer LK TJ, Stelling C, Powers M, Levy S, Waterhouse M. A phase I study on the feasibility and acceptability of an acupuncture/hypnosis intervention for chronic paediatric pain. *Journal of Pain Symptom Management* 2002;24(4):437-46.
39. Scharff L, Marcus DA, Masek BJ. A controlled study of minimal-contact thermal biofeedback treatment in children with migraine. *J Pediatr Psychol* 2002;27(2):109-19.
40. Pasero CL. Pain control: Is laughter the best medicine? *The American Journal of Nursing* 1998;(98):12-14.
41. Zeltzer LK, Schlank C. *Conquering your child's chronic pain*. New York: Harpercollins; 2005.
42. Schechter NL, Zempsky WT, Cohen LL, McGrath PJ, McMurtry CM, Bright NS. Pain reduction during paediatric immunizations: evidence-based review and recommendations. *Pediatrics* 2007;119(5):e1184-98.
43. Caprilli S, Anastasi F, Grotto RP, Abeti MS, Messeri A. Interactive music as a treatment for pain and stress in children during venipuncture: a randomized prospective study. *J Dev Behav Pediatr* 2007;28(5):399-403.
44. Huth MM. Children's responses to immunizations: lullabies as distraction. *J Child Fam Nurs* 1999;2(6):432-3.
45. Malone AB. The effects of live music on the distress of paediatric patients receiving intravenous starts, venipunctures, injections, and heel sticks. *Journal of Music Therapy* 1996;33:19-33.
46. Marchette L, Main R, Redick E, Bagg A, Leatherland J. Pain reduction interventions during neonatal circumcision. *Nurs Res* 1991;40(4):241-4.
47. Arntz A, Dreessen L, Merckelbach H. Attention, not anxiety, influences pain. *Behav Res Ther* 1991;29(1):41-50.
48. Tsao JCI, Evans S, Meldrum M, Altman T, Zeltzer LK. A review of CAM for procedural pain in infancy: Part II. Other interventions. Evidence-based Complementary and Alternative Medicine; in press.

CORRESPONDENCE TO:

Subhadra Evans, Developmental Psychologist, UCLA Paediatric Pain Research Program, David Geffen School of Medicine at UCLA, 10940 Wilshire Blvd., Ste. 810, Los Angeles, CA 90024

Phone: 310 794 2936

Fax: 310 794 2954

email: suevans@mednet.ucla.edu

THE BRITISH PAIN SOCIETY