Seminars in Anesthesia, Perioperative Medicine and Pain (2007) 26, 141-148

ELSEVIER

Seminars in Anesthesia, Perioperative Medicine and Pain

Selected topics in perioperative multimodal pediatric pain management

Michael H. Joseph, MD

From the Department of Anesthesiology Critical Care Medicine, Childrens Hospital Los Angeles, Los Angeles, CA.

KEYWORDS:
Pediatric pain management;
Multimodal pain management

The term multimodal pain management often refers to the use of multiple pharmacological agents simultaneously in the postoperative period in order to improve efficacy and minimize adverse effects. In this article, this therapeutic approach is discussed with a pediatric focus and expanded to include cognitive, behavioral, and complementary therapies. The overall goal being safe, effective management that can be easily delivered in any busy pediatric setting.

Multimodal therapy

Multimodal pain management refers to a practice of combining multiple pharmacological therapies at the same time as psychological and complementary therapies to achieve improved outcomes. To be realistic, pharmacologic pain management in the postoperative period is the primary intervention. Nevertheless, the goal of utilizing multiple interventions is to reduce the amount of adverse medication effect, distress, and trauma the patient and family experience, and improve overall satisfaction. This article is not a comprehensive coverage of this topic. Its purpose is to address selected topics that are encountered in the daily practice of pediatric peri-operative multimodal pain management.

Sharek et al. present an example of this multimodal approach. In their study, all pediatric liver transplant patients during the intervention received pre-transplant parental education and support, pre- and post behavioral pediatric therapy, post-transplant physical and occupational therapy consultation, and other non-pharmacologic strategies. The intervention group was compared with a control group of similar pre-intervention and post-intervention time pediatric liver transplant patients. A total of 27 children were evaluated (13 historical control, 14 intervention). No differences were found in PICU stay, total post-op stay, total inpatient stay, time to extubation, total cost, or opioid use POD 6. There was a decrease mean pain score between POD 0 and 6 (2.82 vs 2.12; $P = 0.047$), mean parental pain perception score (3.1 vs 2.1; $P = 0.001$), and an increase in number of pain assessments (3.43 vs 6.79; $P < 0.005$).[1] This study demonstrates that these patients all had good pharmacologic pain management, as their mean pain score even without intervention was less than 3 on a 10-point scale. Even in the environment of good medication therapy, a cost-neutral non-pharmacologic intervention was still able to have positive effect on pain perception.

What is pain?

The first step in treating pain in children is knowing what you are treating. Pain is a perception and thus not easily defined. The definition is further complicated by the fact that everyone has experienced pain and therefore has the sense that they understand it. Pain is much more than the sum of nerve signals originating from A∂ and C fibers, traveling through the spinothalamic tract, and culminating in the somatosenory cortex.

Address reprint requests and correspondence: Michael H. Joseph, MD, Physician Director Comprehensive Pain Services, Columbus Children's Hospital, 700 Childrens Dr., Columbus, OH 43205.
E-mail: josephm@pediatrics.ohio-state.edu

0277-0326/$ -see front matter © 2007 Elsevier Inc. All rights reserved.
doi:10.1053/j.sane.2007.06.006

There have been many definitions of pain. One of the most widely accepted is the International Association for the Study Pain 1974 definition: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." This statement had to be later modified to include non- and pre-verbal people and explain that the presence of tissue damage is not necessary for the perception of pain. Due to the subjective and individual nature of pain perception, a more clinically relevant pain definition is Margo McCaffery's statement that: "Pain is whatever the experiencing person says it is, existing whenever he says it does."

In 2001 the America Pain Society issued a position statement on "The Assessment and Management of Acute Pain in Infants, Children, and Adolescents." This statement asserts: "The pediatric acute pain experience involves the interaction of physiologic, psychological, behavioral, developmental, and situational factors." The authors go on to state that pain in children "is an inherently subjective, multifactorial experience and should be assessed and treated as such." Lastly the position asserts: "Physicians are responsible for eliminating or assuaging pain and suffering in children when possible."

When treating postoperative pain, it is important to remember that the patient is awake and therefore utilizing all of their mental capacity to interpret and cope with their clinical situation. A child's level of arousal and how much attention they focus on their pain is directly associated to the intensity of the pain perception. This perception is further modulated by cognitive factors, such as perceived control, parental responses, previous pain experiences, and situational context. Assessment and understanding of this complex interplay allows the practitioner to utilize more than the traditional intermittent opioids to ameliorate a child's postoperative pain (see Figure 1).

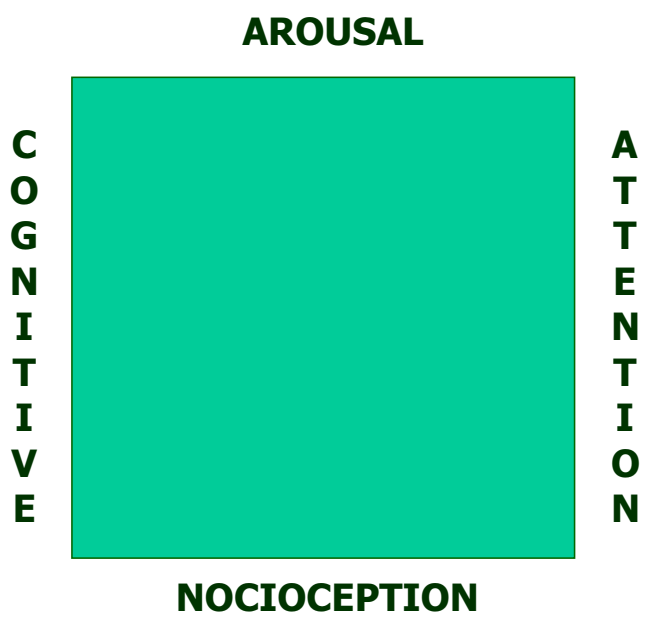

Figure 1 The area inside the box represents pain intensity. The length of each side contributes to the area inside the box and therefore the pain intensity. Each side can be therapeutically modulated to decrease the perception of pain. (Color version of figure is available online.)

Pharmacological intervention

Pharmacological therapy is the foundation of postoperative pain management. This section will highlight some of the concepts and considerations when choosing medication therapy for children during the perioperative period.

What do children fear when coming to the doctor? They fear needle sticks. The level of anxiety generated by the anticipation of a needle stick can reach the same intensity as a general anxiety disorder. This fear has been well recognized in the pre-surgical arena with the standard of practice being oral premeditation prior to IV insertion. What happens after surgery when the patient is on the ward, their IV infiltrates, and they need a new insertion? They are held down, traumatized, and all of the great pre-operative preparation is forgotten, as all they remember is the pain of that IV insertion.

Topical local anesthetics should be used prior to any venipuncture in a non-anesthetized child. There are many choices, including EMLA, LMX_4, Synera, Lido-site, and others, but the gold standard is still buffered lidocaine. Lidocaine injections sting because it is bottled at a pH of 5.0-7.0 to prolong shelf life. Mixing lidocaine with 8.4% sodium bicarbonate in a 9:1 ratio by volume adjusts the pH to a comfortable 7.2-7.4. Buffering of lidocaine does not change the effectiveness, onset time, or overall duration of action. In addition, buffered lidocaine has been shown to be effective in ameliorating the pain of IV insertion for children.[2] Unfortunately, buffering lidocaine decreases its shelf life to 1 week, making this an impractical solution for many pediatric institutions.

Another and equally important use of local anesthetics is regional anesthesia. Epidural and regional local anesthetic have been shown to reduce the intra and post-operative pain of many procedures in children, but what can you add to prolong the analgesia? Opioids such as morphine and possibly fentanyl have been shown to increase the efficacy and duration of epidural analgesia. Unfortunately, these medications also increase the adverse effects. Clonidine has been used successfully as an adjuvant in the epidural space in children. It has been shown to be as effective as morphine with fewer adverse effects.[3-5] Other studies, such as Wheeler et al.,[6] found that there was no benefit to adding Clonidine to local anesthetic over local anesthetic alone for single-injection epidural anesthesia in pediatric outpatient surgical procedures below the umbilicus.[6] Other epidural adjutants, such as ketamine and even midazolam, have been shown to have a possible role in improving epidural analgesia, but preservative-free ketimine is not available in the

United States and the neurotoxicity of these agents has not been fully investigated.

Once you make the decision of what goes into the epidural space, there are choices of how it is to be delivered. As mentioned above in the discussion of pain perception, the concept of control is significant in a child's pain perception. The simple choice of which leg a child wants to receive a vaccination reduced the perceived pain of that injection. Having control over one's pain medication can similarly reduce overall pain perception. Patient Controlled Epidural Analgesia (PCEA) has been shown to be effective in children.

Birmingham et al.[7] demonstrated in 128 children (132 procedures, youngest 5.4 years old) that PCEA was effective. Using mostly bupivacaine 0.1% (range, 0.0625% to 0.125%) with 5 μg/mL of fentanyl (range, 2-10 μg/mL) with a continuous infusion started at 0.2 mL/kg/h and demand doses ranging from 1 to 3 mL, with a lockout of 15-30 min (bupivacaine dose continuous plus demand $\leq$0.4 mg/kg/h), they obtained "satisfactory analgesia" in 119 patients (90.1%) for up to 103 h. Satisfactory analgesia was defined as pain scores less than 6 on a 10-point scale. They reported no episodes of desaturation, toxicity, or serious adverse effects. Five patients were switched to intravenous PCA because of inadequate analgesia, and 8 patients with satisfactory analgesia were converted to intravenous PCA because of adverse effects.[7] Overall they make a very strong argument for the safety and effectiveness of PCEA in children.

Now that you have chosen PCEA as the patient's primary pharmacologic therapy, what can you do to improve analgesia? The addition of a non-steroidal anti-inflammatory drug (NSAIDs) has been shown to be safe and effective. The American Society of Regional Anesthesia and Pain Medicine in the report of the Second Consensus Conference on Neuraxial Anesthesia and Anticoagulation (April, 2002) state that "NSAIDs appear to represent no added significant risk for the development of spinal hematoma in patients having epidural or spinal anesthesia. The use of NSAIDs alone does not create a level of risk that will interfere with the performance of neuraxial blocks." Ketorolac is the most frequently used medication dosed at 0.5 mg/kg/dose and given every 6 hours for not more than 5 days. Although there is no added risk of epidural hematoma, caution must be taken in renal disease and surgeries, resulting in significant blood loss.

When regional anesthesia is not a practical alternative for the patient or surgical intervention, opioid therapy is the next most effective intervention. There are some basic concepts to using opioids effectively in children. The first concept is titration to effect. Start with a small and reasonable dose of morphine (0.02-0.03 mg/kg) or hydromorphone (0.003-0.005 mg/kg) and repeat the dose within 10 minutes if the medication is not effective. In this way, the patient's blood level of medication gradually rises to an effective range, minimizing both adverse effects and duration of pain.

The second concept is that the maximum safe dose of an opioid is determined by effect and side effects only. The goal is to provide adequate analgesia with the lowest dose possible. The dose of an opioid is limited only by the tolerability of these adverse effects. For patients with normal cardiorespiratory systems and primarily post surgical pain, sedation or respiratory depression should only occur when opioid blood levels are higher than those required for analgesia. The adverse effects of itching, nausea, sedation, and constipation are cause primarily by direct opioid effect. If these adverse effects occur and cannot be ameliorated, then either the opioid dose must be lowered or a different opioid chosen.

The last concept is that of dosing schedule. Immediate post-surgical pain is most often constant in nature or occurs whenever the patient moves. The standard practice of ordering pain medication on a PRN or "as needed" schedule can produce delays in administration and intervals of inadequate pain control. On a PRN schedule, the child must first perceive pain, then call the nurse who must then retrieve and administer the next dose of medication, all while the patient's pain is worsening. The worse the pain becomes, the greater the amount of opioid the child requires to be comfortable. This approach results in increased pain and decreased sense of control for the child and decreased efficiency for the nurse.

Patient-controlled analgesia (PCA) has been well established to be safe and effective for use in children as young as 5 years of age. PCA therapy enables the children to self inject an opioid, whenever they are uncomfortable. By allowing the patient to titrate their pain medication, this therapy provides the child greater control over their pain. There is increased privacy for the patients as they don't have to ask for pain medication and there is no delay in delivery so patients often require less opioid to achieve good pain control.

Most PCA pumps can deliver both a continuous infusion as well as demand doses when the child pushes the PCA button. Although postoperative pain is constantly present, it waxes and wanes with activity and time of day and many other factors. In order for the patient to have the most flexibility in titration of their pain medication, it is recommended to keep the continuous infusion dose small or not use one at all. In addition, keeping the lockout interval (the allowed time between doses) less than 10 minutes allows the patient to receive doses when they need them. The goal is to link the patient's need for pain medication as closely as possible with the delivery of that medication.

Morphine and hydromorphone are the most commonly used medications in PCA for children. Both medications have been shown to be effective and both have roughly equivalent adverse effects. The usual dosing for morphine PCA in children is 0.02-0.04 mg/kg/dose with a 6-10 min lockout with or without a continuous infusion of 0.02-0.04 mg/kg/hour. For hydromorphone, the recommended starting

PCA dosing is 3-5 μg/kg with a 6-10 min lockout with or without a continuous infusion of 3-5 μg/kg/hour.

Fentanyl is used in some institutions as an alternative to the more traditional medication.[8] The use of fentanyl PCA is usually reserved for patients with intolerable adverse effects from both morphine and hydromorphone. Meperidine should only be used for either post anesthesia shivering or brief pain management and not for PCA therapy. Normeperidine, a metabolite of meperidine, is a central nervous system irritant, and accumulation can cause serious side effects ranging from dysphoria, mood swings, and irritability to seizure activity.

Any child on a PCA requires close monitoring. Documenting pain scales (using a developmentally appropriate assessment tool), opioid usage, and pulse oximetry every 4 hours is essential. If a child's pain is uncontrolled on PCA therapy, the PCA should be increased. To adjust the dose, first total amount of opioids the child received over the last 24 hours, including the continuous infusion, demand doses, and all PRN boosters. Divide total by 24 to find the average hourly dose. If the child's pain is ≥6, increase the hourly total dose by 15-20%. Keep continuous rate same. Subtract continuous rate from hourly dose. Divide the remaining hourly dose by 2 to arrive at the new PCA demand dose and keep the lockout interval at 6-10 minutes.

There are many factors other than the child's pain perception that can affect their PCA usage and need to be considered when adjusting the PCA dose. The attitudes and beliefs of the staff, family, and child regarding pain and pain medication all influence the patient' PCA usage. The fear of addiction and dependence is pervasive in many families and children will often use less medication than they need in order to not appear weak to the family or staff.

Although the patient has increased control with the use of PCA therapy, the medical team still controls the dosing and lockout interval, and therefore their biases also effect the patient medication usage. The staff must be careful of the feedback they give to the patient. "You're pressing too frequently." Rarely does a child press their PCA simply because they are bored. The medical team must evaluate if the patient has poor pain relief and perhaps needs a different opioid or they may be depressed, anxious, or afraid. "You're not pressing enough." The child is still in pain but may be trying to avoid adverse effects or they see using their pain medication as an admission to illness or weakness. The social context of the patient's clinical situation needs to be considered when making adjustments in their narcotic medication.

At times, due to developmental factors or advanced illness, a child who needs PCA therapy is not able to press their PCA button. Unfortunately, deadly medication errors have happened from well-intentioned nurses and family members administering PCA doses to patients. The JCAHO has issued a statement regarding the prohibition of non-authorized individuals administering PCA dosing. Authorized Agent Controlled Analgesia (AACA) is defined as a pain management therapy in which an individual is identified by a prescriber and properly educated to activate the PCA button when a patient is unable. An authorized agent can be either a nurse (NCA) or a parent/caregiver (PaCA) who is continuously available and educated. Monitto et al.[9] in 2000 presented a 1-year prospective study of 212 children less than 6 years of age receiving NCA or PaCA. They achieved good pain control with a maximum pain score ≤3/10. Adverse effects of itching and vomiting were within normal limits. A total of 1.7% of the study patients received naloxone for respiratory depression. Monitto demonstrated both the effectiveness of this technique and the specific need for both good education and close monitoring.

Unfortunately, opioid therapy is inevitably accompanied by adverse effect. Itching, nausea/vomiting, and constipation are by far the most common adverse effects. It is recommended that therapy for these adverse effects be ordered as corollary orders whenever ordering around-the-clock opioid therapy. A corollary order is one that is automatically linked to the initiating order. For example, all morphine PCA orders would be accompanied by an order for diphenhydraminel for itching, IV Zofran for nausea, and a laxative stool softener combination for constipation.

Itching occurs in up to 80% of patients on opioid therapy and can often limit the dose that can be used. Contrary to popular dogma, the primary mechanism of opioid-induced itching is direct drug effect, not secondary histamine release. The evidence that antihistamines are effective for opioid-induced itching is quite limited, but they remain the mainstay of therapy. There is good evidence that naloxone as well as the agonist–antagonist medications are effective at reducing itching. Maxwell et al.[10] placed 46 children receiving morphine PCA on saline or naloxone 0.25mcg/kg/hr. They found itching was reduced from 77% to 20% and nausea was reduced from 70% to 35% with no difference in pain control.

To further reduce the adverse effects of opioids, it is always prudent to use the least amount of opioid required to keep the child comfortable. To that end, it is advisable to utilize either acetaminophen or an NSAID to potentiate the analgesia and reduce the child's opioid consumption. The most commonly prescribed and one of the most effective adjuvants for the post-operative patient is ketorolac. Ketorolac IV is dosed at 0.5 mg/kg (maximum dose 30 mg) every 6-8 hours. There is no evidence that a loading dose is of any significant benefit. As this medication is nephrotoxic, do not exceed 5 days of therapy. For patients in which bleeding is a great concern, trilisate 10 mg/kg PO q 6-8 hrs can be utilized as it does not impair platelet function. The analgesic dose of acetaminophen has not been conclusively demonstrated in children. Neither has the toxic dose, as there is evidence of hepaotoxicity even with standard dosing over long periods of time. This author is recommending the standard dose of 15-mg/kg/dose PO or PR q 6 hours. The maximum daily dose of acetaminophen is 4000 mg/day in adults. For children, 20 mg/kg/dose PO should be the max-

imum recurring dose, although single PR doses of 40 mg/kg have been shown to be opioid sparing when administered early in the surgical case.[11]

The last topic in the pharmacological is the adjuvant use of diazepam. Being the classic benzodiazepine, diazepam is well known for its anxiolytic properties. This effect is often very beneficial in post-op pain management but is actually a secondary effect. The primary use of diazepam in the postoperative setting is for its effect as a muscle relaxant. Diazepam may affect the contractile properties of muscle and, possibly, the electrical properties of the muscle membrane and is therefore clinically a quite good muscle relaxant. Although potentially caustic to the veins, it can be administered IV and is fast acting. As muscle spasm pain is poorly responsive to opioids, the use of diazepam also helps reduce the child's overall opioid requirement. The recommended dosing is 0.1 mg/kg/dose IV or PO (to a maximum of 5 mg) q 8 hours. Diazepam is especially helpful after orthopedic surgery of the spine, soft tissue, or placement of a spica cast.

Non-pharmacological strategies

The term "non-pharmacological strategies" is poor at best. Defining a category of pain management therapies by what they are not does not help illustrate the effectiveness of these interventions. This diverse group of therapies includes cognitive, behavioral, physical, and even animal-assisted therapies. These therapies are targeting the attentional, arousal, and cognitive aspects of a child's pain experience. The therapies in this section are proposed as adjuvants to good medication therapy and those that are readily deliverable at the bedside in the acute preoperative period.

Cognitive–behavioral therapies

The goal of cognitive therapies is to enhance active coping strategies and reduce negative thinking. Behavioral therapies focus on promoting coping behaviors that are functional and adaptive in nature. This category includes distraction, relaxation, imagery, and positive reinforcement. LaMontagne et al.[12] showed that simply providing coping instructions to young adolescents (age 11-14) having spinal fusion surgery prior to surgery was effective at reducing their pain scores on POD 4 when compared with standard of care.[12]

The overall goal for employing these therapies is to reduce fear and anxiety, thereby reducing pain perception. Zeev Kain et al.[13] demonstrated that, in 241 children aged 5 to 12 years having elective outpatient tonsillectomy and adenoidectomy, the more anxious children experienced significantly more pain both during the hospital stay and over the first 3 days at home. Preoperative anxiety was also associated with a higher incidence of sleep and behavioral problems postoperatively.[13]

The most effective strategy for reducing anxiety in a child and family is good bedside manner. When hospitalized, the family and child are giving you control over their lives and are they are anxious. Simply introducing yourself to the family and the patient goes a great way to reducing a child's fear of you. Sit down at the child's level, ask their permission before touching them, engage in friendly nonmedical conversation, and be respectful to their personal space as much as possible.

In addition to establishing a good bedside report, positive reinforcement is one of the easiest and most effective interventions. Praise, gifts, and privileges that are administered secondary to positive coping behavior both enhance a child's self-esteem and encourage more of the same behavior. Complementing a child's use of the incentive spirometer, their ability to walk with physical therapy or participate in a physical exam, helps them understand what is expected of them and feel better about their hospitalization. Positive reinforcement facilitates a child's efforts to cope, which increases their sense of control and therefore can reduce their pain perception.

Many children in the hospital setting are too anxious to respond to simple interventions and require more coaching and education. Many interventions are simple to teach and are easily deliverable at the bedside. Relaxation training is one such therapy. Deep rhythmic breathing has been shown to decrease acute pain and anxiety in children.[14] Devices such as party blowers and bubbles can facilitate a child controlling their breathing. For the older child, simple instruction are often adequate. "Rest your hands on your stomach. Breathe in as much as you can (feel stomach expand). Then breathe out all of the air (feel stomach deflate). Close your eyes and slow down your breathing."

In addition to deep breathing, relaxation can be accomplished through progressive muscle relaxation. The theory is that, through a two-step process of deliberately applying tension to certain muscle groups, and then stopping the tension, one learns to recognize associated feelings of a tense muscle and a completely relaxed muscle which promotes physical relaxation and decreases arousal and pain perception. Simple bedside instructions could be as follows. "For each of the muscle groups listed below: first tense one side of the body at a time, then tense both sides together, then relax. Squeeze toes (left side, right side, all, relax). Point toes forward. Stretch legs out and tense leg muscles. Clench fists. Bend elbows and tense biceps. Scrunch up shoulders. Squeeze face. Squeeze and tighten all muscle groups together, then relax."

Distraction

The amount of attention that a child focuses on his/her pain perception affects the intensity of pain. In general, the more

attention devoted to somatic sensation, the greater the perception of that sensation. This is why distraction can be a powerful therapeutic tool. Simple distractions such as blowing bubbles, doing arts and crafts, watching a movie, and talking with friends and families are all great distractions. The more immersive a distraction, the more effective it is. This means that the more of the child's attention that is occupied by the distraction, the less pain they will perceive. Being in a hospital unfortunately not only limits the distractions available to a child but also focuses attention on their illness by recurrent assessments and interventions.

Distraction therapies range in the intensity of immersion from the passive watching of TV to the encompassing experiences of hypnotherapy. There is evidence of effectiveness at all levels. Nilsson et al.[15] showed that simple exposure to music could reduce morphine usage after inguinal hernia repair when compared with exposure to white noise.[15] Sobo et al.[16] demonstrated that 25 children, ages 5-18, who underwent surgery reported less pain post-operatively after canine visitation therapy.[16]

There is very little that can be as distracting for children as their own imaginations. The use of a child's imagination through guided imagery and hypnotherapy can be very effective. Huth, Broome, and Good[17] divided 73 children (aged 7-12 years) having either tonsillectomy and/or adenoidectomy surgery into 2 groups. The intervention group watched a videotape on the use of imagery and then listened to a 30-minute audiotape of imagery for 1 week prior to surgery. The control group received standard care. The treatment group also listened to the audiotape after surgery and after discharge. Treatment group reported significantly less pain and anxiety immediately post-op, but there were no group differences in pain after discharge.[17] Lambert[18] also demonstrated that, when taught guided imagery prior to surgery, children have significantly lower post-operative pain and anxiety ratings and shorter length of hospital stays.[18] Unfortunately, both of these studies demonstrate the greater time commitment that the immersive therapies require.

There are some simple imagery scripts that you can use at the bedside. These are not as effective as when there is time to train the patient in relaxation and imagery, but they can diffuse a painful situation. First, attempt to help the patient relax through deep breathing: "I want you to take ten slow deep breaths. While you are breathing I want you to use your imagination to see the pain moving from your body into the air in your lungs. With each breath out some of the pain goes out with it. With each breath you notice you feel more comfortable and relaxed."

Another effective image for children is know as The Switch Trick. This image promotes the child's sense of control as they are using their imagination to distract from their pain. "Imagine that your brain has switches, and you can help to control discomfort by turning off the switches. Turn off the switch for your stomach. As the switch goes off, you notice your stomach feeling more comfortable and relaxed."

It should be noted that not all children respond well to distraction therapies. A subset of children prefer to focus on the stimulus as their natural coping strategy. Attempts to use imagery can lead to increase anxiety and pain for these children.[19] As with any pharmacological therapy, the clinician must assess the response to therapy. If an adverse effect is occurring, a different approach should be employed.

Physical strategies

Physical pain management therapies are those that are primarily body-based interventions, such as warm packs, acupuncture/acupressure, positioning massage, or even aromatherapy. There is not much pediatric data on these interventions in the postoperative period. On a daily basis, parents and nurses use interventions such as positioning, warm or cold compresses, and creating a comfortable environment to treat postoperative pain.[20]

Comfort positioning

A child's sense of control is directly linked to their pain perception. In general, the greater the child's sense of control during a painful procedure, the less pain the child perceives. Holding a patient down to start an IV does not foster a robust sense of control. Many procedures that traditionally require a child to be supine can be accomplished with the child in a sitting or modified sitting position. Mary Barkey and Barbara Stephens[21] proposed a model of positioning children during painful procedures. "The achievement of sitting up in infancy seems to be accompanied by a sense of control. When this developmental milestone is reached the mere act of making an infant or child lie down usually results in crying and struggling to get up, along with loud vocal protests. By using Positioning for Comfort, a secure comforting hold can replace the traditional restraining hold."

Acupuncture

Acupuncture is the insertion of single-use, disposable, sterile, fine-gauge, solid needles into specific body locations (acupuncture points). Each point is needled to a varying depth and angle relative to body location. Other methods are also used to stimulate points, such as heat or finger-pressure. The general theory of acupuncture is that proper physiological function and health depend on the circulation of nutrients, substances, and energy called Qi (pronounced "chee") through a network of "channels" or "meridians." This network connects every organ and part of the body, providing balance, regulation, and coordination of physiological pro-

cesses. Pain and ill-health result when the flow of Qi through the body is disrupted or blocked by many things, including disease, pathogens, trauma/injuries, and medication (side effects), as well as lifestyle factors such as overwork, poor diet, emotions, lack of rest, and stress. To date the pediatric literature on perioperative acupuncture has focused on anxiety and nausea. Kotani et al.[22] found that, in adults having abdominal surgery, preoperative acupuncture reduced postoperative pain (including deep visceral pain), nausea, vomiting, analgesic requirement (50% less postoperatively in acupuncture than in control group), and sympathoadrenal responses.[22]

Acupuncture is practiced as an adjuvant to anesthesiology at a variety of pediatric institutions. Unfortunately, not much of the experience has made it to the literature yet. There are some interesting findings. Wang[23] found that, when mothers of children presenting for surgery had auricular acupuncture, they had less anxiety compared with sham acupuncture. In addition, their children had less preoperative anxiety and less anxiety at the time of induction.[23] Ideally this would translate into reduced postoperative pain, but this was not addressed in the study.

Pericardium 6 (P6) is an acupuncture point located on the palmer surface of forearm between the tendons of the flexor carpi radialis and palmaris longus. P6 is a classic sedating acupuncture point that has been shown to control and reduce postoperative nausea in adults.[24] The pediatric literature is not as conclusive. Shenkman et al.[25] provided acupressure–acupuncture for children undergoing tonsillectomy; needles were placed pre-operatively and post induction. Either P6 or sham was needled and no benefit was reviled. Conversely, when Wang et al.[26,27] treated four groups of early post-surgical children, P6 acupuncture versus sham acupuncture combined with either intravenous normal saline or Droperidol acupuncture demonstrated greater effect than sham and equal effect to Droperidol. The effect was gone by 24 hours post-op.

Conclusions

Pediatric pain perception is a complex biopsychosocial process that is influenced by development, attention, arousal, and learning. Which clinically means, when treating postoperative pain in children, the whole child and their environment must be assessed in order to be consistently effective. There are some basic rules for multimodal pain therapy: 1) Believe the patient, they are experiencing pain if they are expressing pain; 2) Titrate to effect, whether you are using morphine or distraction; assess the quantity and quality of the response prior to another dose; 3) Combining therapies allows lower doses and fewer adverse effects; 4) Employ good cognitive and behavioral interventions as the patient's brain can be more powerful that pain medication; and 5) The goal is to reduce both the physical and emotional trauma of surgery.

Acknowledgments

Special thanks to Jeffrey Gold, PhD.

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