Perioperative Analgesia in Pediatric Patients Undergoing Otolaryngologic Surgery

Andrew J. Maroda, MD[a,b], Kimberly K. Coca, BS[b], Jennifer D. McLevy-Bazzanella, MD[b], Joshua W. Wood, MD[b], Erica C. Grissom, CRNA[c], Anthony M. Sheyn, MD[a,d,e,*]

KEYWORDS

• Acute pain • Analgesia • Children • Otolaryngology • Outpatient • Day surgery • Ambulatory care • Nonopioid

KEY POINTS

- Management of peri-operative pain is an important component of surgical management of pediatric patients and affects the post-operative course.
- The best strategies for managing pain include a combination of behavioral and pharmacologic interventions.
- Very little literature exists on pain management for medically complex children such as those with head and neck cancer and sickle cell disease.

INTRODUCTION

Pediatric perioperative pain control presents a unique dilemma for medical providers, especially given the immature physiology of children and challenges in communicating about pain with the pediatric population. Historically, severe postoperative pain has been shown to be an underacknowledged surgical complication associated with increased overall morbidity and mortality in the pediatric population.[1] Some studies

[a] Department of Pediatric Otolaryngology, Le Bonheur Children's Hospital, Memphis, TN, USA; [b] Department of Otolaryngology—Head and Neck Surgery, University of Tennessee Health Science Center, Memphis, TN, USA; [c] Department of Anesthesiology, Le Bonheur Children's Hospital, Memphis, TN, USA; [d] Department of Otolaryngology—Head and Neck Surgery, University of Tennessee Health Science Center, 910 Madison Avenue, Suite 400, Memphis, TN 38163-2242, USA; [e] Department of Pediatric Otolaryngology, St. Jude Children's Research Hospital, Memphis, TN, USA

* Corresponding author. Department of Otolaryngology—Head and Neck Surgery, University of Tennessee Health Science Center, 910 Madison Avenue, Suite 400, Memphis, TN 38163-2242.
E-mail address: asheyn@uthsc.edu

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have also demonstrated that patients with inadequately controlled pain may become more sensitive to subsequent painful stimuli and experience decreased efficacy of future analgesics, thereby increasing risk of developing chronic pain.[2–4] In pediatric otolaryngology, uncontrolled postoperative pain is often associated with adverse events, such as airway compromise, restless sleep, behavioral changes, and difficulty tolerating oral fluids, all of which can significantly complicate the recovery period.[1,5] Recognizing the impact of perioperative pain on a patient's physical, emotional, and psychological well-being is crucial for physicians to improve surgical outcomes and reduce overall morbidity following otolaryngologic surgery.

Assessing perioperative pain in pediatric patients can often be quite challenging. Young children generally lack the verbal and cognitive abilities necessary to describe their level of pain, and certain medications have variable sedative and analgesic effects in children. Although the sensation of pain is both subjective and unique to each patient, multiple tools have been used in order to monitor and quantify a patient's pain experience. For example, these widely used tools include self-reporting (eg, faces scales), behavioral cues (eg, Parents' Postoperative Pain Measure and FLACC Pain Assessment Tool), and even tracking vital signs and physiologic reactions.[6–9] Despite these measures, a child's postoperative pain often remains inadequately recognized by both physicians and parents alike.[5,10,11] Thus, using evidence-based pain management strategies may compensate for these initial challenges.

Choice of pain medication for pediatric patients in the postoperative period has also evolved over time. Depending on the nature, location, and extent of the surgical intervention, different pain management strategies may be more effective than others. Formerly, codeine was commonly prescribed to manage a broad range of postoperative pain. However, codeine and other narcotics have now been associated with numerous adverse events in children. For example, duplication of the gene encoding cytochrome PD4502D6 (CYP2D6) is associated with ultrarapid metabolism of codeine. These patients may metabolize codeine too efficiently, leading to morphine intoxication. Furthermore, the rapid metabolism of codeine was linked to severe respiratory depression in these patients, causing multiple fatalities.[12] In 2013, the American Academy of Otolaryngology–Head and Neck Surgery adjusted clinical practice guidelines in response to the Food and Drug Administration (FDA)'s boxed warning to discontinue codeine usage in the pediatric population.[13,14] Given these catastrophic risks with narcotics, simple analgesics, such as acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs), have become preferred alternatives to control postoperative pain with minimal adverse effects. In 2012, the World Health Organization (WHO) presented guidelines for the treatment of children with persistent pain and medical illness, which can be appropriately applied to patients in pediatric otolaryngology.[15] This article focuses on current trends in the management of perioperative pain following otolaryngologic surgery in the pediatric population.

METHODS OF PEDIATRIC PAIN ASSESSMENT

The first step in postoperative pain management is to assess the severity of pain being experienced by the patient. As mentioned previously, this task can often be difficult in children, especially in patients less than 3 years of age, because they frequently lack the cognitive development to express themselves reliably. Children with developmental disabilities may also lack the communication skills or sensory perception to effectively express associated pain and discomfort. Because uncontrolled pain impacts multiple systems, various physiologic changes may be monitored to determine the level of pain being experienced.[16]

In addition to clinical impression and monitoring, several strategies and validated tools have been developed in order to adequately assess the severity of pain in the pediatric population.[17] These tools include behavioral assessment, facial scales, self-reporting methods, projective methods, and structured interview. Behavioral assessment has been shown to be most useful in the preverbal phase. Although useful, facial analog scales have been determined to be an imprecise measure of pain when used alone, because children often have difficulty separating pain from mood when using these scales.[18] Therefore, facial analog scales are best used in combination with other self-reporting methods, such as projective methods and questionnaires. However, these methods generally require the patient to be cognitively developed enough to communicate freely and reliably with caregivers.[17]

Medication Strategies

Based on the 2012 WHO guidelines for the treatment of children with persistent pain and medical illness, a 2-step approach is recommended, using 1 type of analgesia for mild pain followed by a second type of medication for moderate to severe pain.[15] An example of this would be the utilization of NSAIDs and acetaminophen following surgery with the addition of morphine prescribed as needed for uncontrolled or breakthrough pain. However, routine rotation of opioids is not recommended.[15] In addition, these pain medications should be dosed in regular intervals in the early postoperative period even in the event of mild pain, rather than given as needed, to prevent development of moderate or severe pain. Using the appropriate route of administration is also important when considering your patient population. When administering medications in pediatric patients, the WHO recommends oral and intravenous (IV) delivery methods over intramuscular injections in order to limit any additional burden of pain.[15] Ultimately, although these guidelines are highly recommended, they are not prescriptive, and adjustments can be made so that treatment can be tailored to the specific needs of the individual child.

SURGERY SPECIFIC RECOMMENDATIONS

Otologic Surgery

Most otologic procedures in the pediatric population are generally well tolerated and do not require extensive prescription pain medication during the postoperative period. Despite an imbalance of literature discussing bilateral myringotomy and tympanostomy tube placement (BMT), many principles across otologic procedures remain consistent. Because otologic surgery is frequently performed on an outpatient basis, effective perioperative pain management may help reduce the need for excessive postoperative opioid prescriptions.[19]

BMT is one of the most common surgeries performed in pediatric otolaryngology and is generally indicated for patients with recurrent acute otitis media or chronic serous otitis media with effusion.[19–22] Effective ambulatory anesthesia for children requiring myringotomy and ventilation tubes is key to improving the child's experience and overall parental satisfaction.[20] Because tympanic membranes are primarily innervated by the auriculotemporal nerve, myringotomy incisions can be quite stimulating, and periprocedural analgesic requirements in children undergoing surgery may be variable. General anesthesia is recommended and can be maintained with either an IV or an inhalational technique. Because of the brevity of this operation and the general health of these patients, the procedure is generally performed without placement of an airway device or IV cannula.[21] Intranasal fentanyl or intranasal dexmedetomidine, both

short-acting inhaled agents, are the preferred intraoperative sedatives for this procedure.[20]

Several preoperative medications and alternative therapies have been proposed for BMT over the years, but none have become formally adopted in practice because of their low comparative clinical benefit. For example, Watcha and colleagues[22] conducted a double-blinded, placebo-controlled study reporting that preoperative administration of oral ketorolac, but not acetaminophen, provided better postoperative pain control than placebo in children undergoing bilateral myringotomy ($P<.05$). However, several respondents, such as Bean-Lijewski and colleagues,[23] concluded that the slight analgesic benefit from ketorolac did not justify its cost in BMT surgery. Postoperatively, nonopioid oral analgesia should be encouraged where possible. Overall, because postoperative discomfort from BMT rarely extends beyond 48 hours, parents are advised to focus on administering simple analgesia, such as acetaminophen and NSAIDs, and regular assessment of their child's pain at home.[20]

In children undergoing tympanomastoid surgery, adequate analgesia may typically be achieved with NSAIDs or local anesthetic plus fentanyl injection at the surgical site.[19] At this time, there is still conflicting evidence for greater auricular nerve blocks in the management of postmastoidectomy pain, although these may have the largest potential to reduce the need for opiates in the perioperative period.[24,25] Other studies have reported postoperative analgesic benefit from the combination of bupivacaine and higher-dose fentanyl (100 μg vs 50 μg) for operative field infiltration.[26] However, regardless of technique, postoperative pain control is easily achieved with nonopioid medications following this procedure.[19]

Based on available literature encompassing middle ear surgeries (MES), such as stapedectomy and tympanoplasty, there are primarily data regarding systemic administration of opiates (remifentanil or fentanyl) or α-agonists (dexmedetomidine) at this time.[19] According to Mesolella and colleagues,[27] remifentanil has been found to decrease intraoperative and postoperative reactions and complications, such as dizziness, nausea, vomiting, and pain. In addition, 2 double-blinded randomized control trials by Nallam and colleagues[28] and Parrikh and colleagues,[29] respectively, found dexmedetomidine to be similarly effective to midazolam plus fentanyl in tympanoplasty and superior in combination with nalbuphine compared with nalbuphine plus propofol for MES.[19] Given the nature of these procedures and based on the available literature, it remains unclear whether nonopioid medications can provide sufficient analgesia in these patients.

Cochlear implantation surgery is another otologic surgery that is generally very well tolerated in pediatric patients. According to a prospective study of 61 patients conducted by Birman and colleagues,[30] postoperative pain in these patients was found to be minimal. In their study, 19 children required no postoperative analgesia, and 42 children used paracetamol, with an average use of 1.9 days after discharge from the hospital. In addition, children undergoing cochlear implant surgery experienced low rates of dizziness in the first 1 week postoperatively. In rare cases, infection and skin breakdown may present as postoperative complications causing patient discomfort. However, under normal circumstances, these patients require minimal pharmacologic therapy for postoperative pain management, and opioid pain medications are generally unnecessary. In general, the reported adverse events from analgesic agents used in otologic surgeries are minor and transient.

Sinonasal Surgery

Despite the wealth of literature regarding perioperative analgesia for sinonasal surgery in adults, there is a paucity of published data regarding the pediatric population.

However, some lessons learned from pain management in the adult population may also be applied to the pediatric population. In both pediatric and adult populations, there has been a focus on decreasing the use of opioid medications following sinonasal surgery.[31] A recent review of pain control following endoscopic sinus surgery demonstrated the utility of NSAIDs, acetaminophen, and gabapentin as viable alternatives to opioids in controlling postoperative pain.[32] In the authors' experience, opioids have not been necessary in treating postoperative pain following common sinonasal procedures, including septoplasty, closed reduction of nasal fractures, or endoscopic sinus surgery. Overall, reflecting other outpatient otolaryngologic procedures, alternating acetaminophen and ibuprofen as needed has demonstrated sufficient perioperative analgesia in this pediatric population.

Airway Surgery

Balancing adequate analgesia with airway safety remains a challenge and requires attentive multidisciplinary care to achieve successful outcomes.[33] Because children have a smaller-caliber and more dynamic airway at baseline, any degree of edema increases the risk of airway compromise. Suboptimal pain control causes agitation and crying, therefore increasing the patient's risk of developing airway complications or compromise following surgery.[34] Strategies to reduce emergence agitation, optimize pain control, and avoid respiratory depression are crucial considerations for perioperative surgical airway management.

As with general pediatric postoperative pain management, the mainstay of therapy includes acetaminophen and ibuprofen. Ondansetron is also recommended to prevent nausea and vomiting in patients older than 2 years old. Retching and vomiting are potentially catastrophic events after an open airway surgery because these increase the risk of postoperative complications, such as disruption of the surgical site and aspiration of gastric contents.[35] Ondansetron is not needed in patients less than 2 years of age because of their underdeveloped chemoreceptor trigger zone. A single dose of intraoperative steroids, most commonly dexamethasone, is used to mitigate airway edema, unless there is a strong contraindication (eg, labile diabetic). Postoperatively, patients may be given 0.5 mg/kg of dexamethasone (a maximum dose of 10 mg) every 8 hours for 24 to 48 hours postoperatively Dexmedetomidine, a centrally acting alpha-2 adrenergic agonist, benefits postoperatively after airway surgery to prevent agitation, maintain pain control, and keep the patient breathing spontaneously.[36–38] Sevoflurane is an inhaled anesthetic with reduced risk of laryngospasm as compared with desflurane. It can be used in combination with propofol to provide adequate surgical sedation without paralysis in airway cases requiring spontaneous respiration.

In general, opioids suppress respiratory drive and are often avoided in airway surgery patients. If a patient requires opioids perioperatively, fentanyl is preferred over morphine. Morphine is difficult to dose and induces histamine release, risking airway spasm in patients with asthma or reactive airway disease.[39] Laryngotracheal reconstruction or high-grade laryngeal cleft repair often requires the patient to remain intubated and sedated postoperatively to allow adequate healing.[36] In these patients, opioids, such as fentanyl, are safe, appropriate, and fall within the standard of care.[39] In conclusion, effective postoperative pain management in pediatric airway patients centers on optimization of pain control, while avoiding agitation and respiratory suppression.

Sleep Surgery (Adenotonsillectomy)

Tonsillectomy is one of the most common operations in the pediatric population with more than a quarter million performed annually in the United States.[40] The operation is

associated with moderate to severe postoperative pain that is often difficult to control. This pain is likely secondary to inflammation and pharyngeal spasm, and persistent discomfort can last up to 20 days postoperatively.[41] Developing strategies to obtain optimal analgesia with few adverse effects has proven challenging and is a topic of continual discussion in the literature. Tonsillectomy is indicated in the surgical management of obstructive sleep apnea, among other things, and these patients present a particular struggle in perioperative pain management because they have increased risk of opioid-induced respiratory depression and a paradoxically enhanced pain sensitivity because of chronic systemic inflammation.[42] The most recent clinical practice guidelines on pediatric tonsillectomy discuss pain management with the following recommendations: perioperative pain counseling to patients and caregivers, single dose of IV dexamethasone intraoperatively, and postoperative ibuprofen and/or acetaminophen.[40] Notably, the guidelines strongly recommended against the use of perioperative antibiotics and postoperative codeine.[13,40,43]

Operative planning may play a role in the management of postoperative pain. Studies have shown that tonsillotomy significantly reduces postoperative pain and hemorrhage but maintains a risk of future tonsillar regrowth.[44] There is also some evidence that a cold-steel tonsillectomy technique results in decreased postoperative pain when compared with a hot technique.[44]

Routine posttonsillectomy analgesia uses acetaminophen with or without ibuprofen, and opioids for severe or break-through pain.[17,40] IV acetaminophen can be given during the operation to reduce usage of morphine postoperatively.[45] There has been concern about increased bleeding risk postoperatively with use of NSAIDs. Studies have shown that there is an increased risk of bleeding with ketorolac, but other NSAIDs do not confer this increased risk.[46] NSAIDs inhibit the COX enzyme pathway and thus reduce prostaglandins and inflammation.[17] Ibuprofen is the recommended NSAID in children and successfully treats mild to moderate pain.[17] It also reduces postoperative nausea and vomiting.[46] Although not first-line analgesia, opioids prescribed at safe dosages, such as morphine (0.2–0.5 mg/kg, every 4–6 hours), oxycodone (0.05–0.15 mg/kg, every 4–6 hours), and hydrocodone (0.1–0.2 mg/kg, every 6–8 hours), as needed are an appropriate option for breakthrough or severe pain after tonsillectomy.[47] These medications are relatively safe, and most complications are preventable. The oral route is recommended for most medications, followed by IV administration, and last, the intramuscular route.[48] Most complications secondary to opiate administration are due to a miscalculation either during the initiation of opioid medication or during a change to a different drug. The most recent clinical practice guidelines recommend that if opioids are needed postoperatively, they should be used at low doses with watchful titration and continuous pulse oximetry.[40] Although NSAIDs and acetaminophen can be stopped without side effects in most cases, a prolonged course of opioid medication requires weaning to avoid withdrawal symptoms. As ideal analgesic regimens shift away from the use of opioids, numerous alternative regimens have been described to reduce the usage of opioids postoperatively.

COX-2 selective agents represent potential therapeutic opportunity in pain management because they selectively inhibit the prostaglandin pathway without having an impact on platelets. A study on rofecoxib, no longer FDA approved, showed that COX-2 agents result in improved pain scores when compared with hydrocodone-acetaminophen in postoperative pediatric patients, with no difference in adverse effects.[23] Although these agents are not widely used or studied at this time, these findings highlight a potential opportunity for growth in pediatric postoperative pain management.

Steroids have become a generally recommended and reliable method to reduce pain postoperatively. Preoperative peritonsillar infiltration with dexamethasone 0.5 mg/kg (a maximum dose of 8 mg) significantly reduces both early and late posttonsillectomy pain, allows earlier oral intake, and reduces postoperative nausea and vomiting.[14,49,50]

Usage of preoperative and intraoperative IV dexmedetomidine, an alpha-2 adrenoreceptor agonist, at a dosage of 0.2 to 0.5 μg/kg, is an effective method to reduce opioid exposure perioperatively.[51] When used in combination with 1 to 2 mL peritonsillar bupivacaine (0.25%), usage of intraoperative opioids and volatile anesthetics was significantly reduced, and patients reported lower maximum pain scores postoperatively.[51] This therapy was associated with no increase in complications.

Montelukast is a cysteinyl leukotriene receptor antagonist and reduces inflammation.[52] Although it was developed to treat bronchial asthma, some studies have also shown it has been found to reduce posttonsillectomy pain and need for rescue analgesics when given orally the night before surgery.[52]

Lidocaine spray may be useful in reducing posttonsillectomy pain.[53] Alongside pharmacologic methods, maintenance of adequate hydration and scheduling medication help keep pain under control.[17] Because most tonsillectomies occur in an ambulatory setting, much of the burden of the child's pain management falls on the parent or caregiver. Studies have shown that clear written take-home directions regarding pain medication scheduling as well as caregiver education on basic pain management in children lead to better analgesic outcomes.[48]

Nonmalignant Head and Neck Surgery

There is remarkably little literature on perioperative pain management in nontonsillectomy pediatric head and neck surgery. The few reports that do exist tend to present low- to very-low-quality evidence. In regard to surgical treatment of infantile hemangiomas (IH) of the head and neck, the use of dynamic cooling with pulsed dye laser therapy allows reduced pain associated with therapy.[54] In addition, in ulcerated cases of IH, the use of a barrier ointment between debridement procedures may alleviate pain.[54] Future studies should be performed in nonmalignant head and neck procedures to optimize specific pain management strategies for postoperative care.

ADJUNCT THERAPIES

Anesthesiology

Local nerve blocks can be used in numerous pediatric head and neck operations to help reduce pain associated with surgery. Nerve blocks are advantageous in that they provide highly effective local pain relief without the systemic side effects seen with oral or IV therapies.[55,56] As expected from the nonsystemic nature of the therapy, nerve blocks are shown to have lower incidence of postoperative bleeding, nausea, and vomiting.[55] The nerve block commonly uses a preparation of bupivacaine with epinephrine.[56] They are not without adverse effects, though, and rarely may cause hematoma and a variety of paralytic effects depending on the location of injection.[56]

Behavioral Strategies

Most studies evaluating the use of cognitive behavioral therapy (CBT) in pain management focus on forms of chronic pain, such as headaches, abdominal pain, and musculoskeletal pain. A Cochrane Review performed in 2018 focused on the utility of CBT in the management of pain associated with venipuncture, IV insertion, and

vaccine management.[57] Although the quality of evidence in this review was rated low to very low, there was some support for the use of CBT, breathing interventions, and distraction as being somewhat efficacious in reducing pain associated with the above procedures. Regarding perioperative analgesia, this information may help in providing nonpharmacologic pain control for placement of preoperative or postoperative IVs and other needle sticks that may be necessary during a perioperative hospitalization. When approaching pain control with behavioral therapy, it is often most effective as an integrative, multidisciplinary approach in combination with pharmacologic treatment.[58]

SUMMARY

The primary goals of perioperative pain management in pediatric otolaryngology include controlling, preventing, and reducing acute pain while maintaining functional capacity. Management of perioperative pain is an essential component of surgical planning and plays a major role in determination of hospital stay postoperatively. With any surgical procedure, perioperative analgesic selection will depend on several factors, such as the patient's pain tolerance, safety profile of the medications to be used, and especially, the type of surgical procedure performed.[19] As it stands, adenotonsillectomy patients represent the biggest challenge in postoperative pain management of the head and neck surgeries evaluated. The low rates of pain, nausea, and vomiting reported in the days following surgery for most other procedures suggest that children can be cared for at home with simple analgesia.[59] However, discharge information, caregiver education, and prescription analgesia prescribing should be tailored to the operation performed and the patient's reasonable needs.

Pain control strategies should include a combination of behavioral modifications and pharmacologic interventions and should be managed on a case-by-case approach, evaluating the specific needs and requirements of each patient in regard to their age, type of intervention, parental anxiety about certain medications, and societal factors.[17,21] In recent years, strong emphasis has been placed on an overall reduction of opioid consumption and prescription in perioperative care and remains at the forefront of active research interest in multiple medical specialties, including otolaryngology.[19] Perioperative analgesia is one of the most common reasons that opioids are prescribed to patients, and an in-depth assessment of efficacy of alternative methods for achieving analgesia is an important step toward reducing potentially unnecessary opioid-prescribing practices.[19] As efforts have been made to optimize the use of appropriate pharmacotherapy, it remains essential for providers to recognize and anticipate pediatric pain, using techniques and regimens that allow for responsible and effective management strategies. Pain management in the pediatric population can often be a delicate balance and may also require an individualized approach for optimal patient care. By addressing the impact of perioperative pain on a patient's physical, emotional, and psychological well-being, providers will ultimately be able to reduce overall morbidity and improve surgical outcomes.

DISCLOSURE

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