CHAPTER **47**

PERIOPERATIVE PAIN MANAGEMENT

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INTRODUCTION

When it comes to surgical planning and decision making, it is imperative to understand and appreciate the role and necessity of a comprehensive pain management regimen. Contrary to popular belief, this is an entity that is not undertaken solely during the immediate postoperative period, but rather an integral part of the equation from the initial patient visit. As physicians we have the inherent responsibility of protecting the overall health and well being of all patients. By means of continuous education and time-devoted consideration, one can assure that patients are receiving treatment that not only meets, but actually supersedes the standard of care. The aim of this article is to provide a primitive foundation for understanding the basics of pain physiology in the perioperative setting, as well as discuss current recommendations to successfully manage acute pain postoperatively.

PHYSIOLOGY OF PAIN

The first step to understanding pain and the management of pain begins by recognizing pain as a basic science. There are various types of pain, including visceral, somatic, and neuropathic. Postoperative pain is a type of somatic pain also known as nociceptor pain. This pain experienced after surgery is due to the inflammatory process initiated by trauma to the tissues, whether it is soft-tissue dissection, manipulation of nervous tissue, or resection of bone and insertion of hardware, they all incite a cascade of events leading to the body's perception of pain (1) (Figure 1). Tissue injury produces the physiologic release of multiple inflammatory mediators from the damaged cells including bradykinin, histamine, 5-hydroxytryptamine (5-HT), ATP, nitric oxide, and cellular ions. Of these, bradykinin, histamine and 5-HT are known to initiate the arachadonic acid pathway, which produces prostaglandins and leukotrienes. Immune cells recruited to the area release additional mediators including growth factors and cytokines, which are responsible for activating peripheral nociceptors responsible for pain. In addition, the inflammatory mediators modify the response of primary afferent neurons causing peripheral sensitization leading to hyperalgesia. At the peripheral terminal of nociceptors, the noxious chemical stimuli are converted into electrical energy that creates the action potential. Neurotransmitters like glutamate and substance P carry the message to the central nervous system leading to conscious awareness of pain (1, 2). Now that we have the basics established we can delve into the multifaceted concept of pain management in today's health care system.

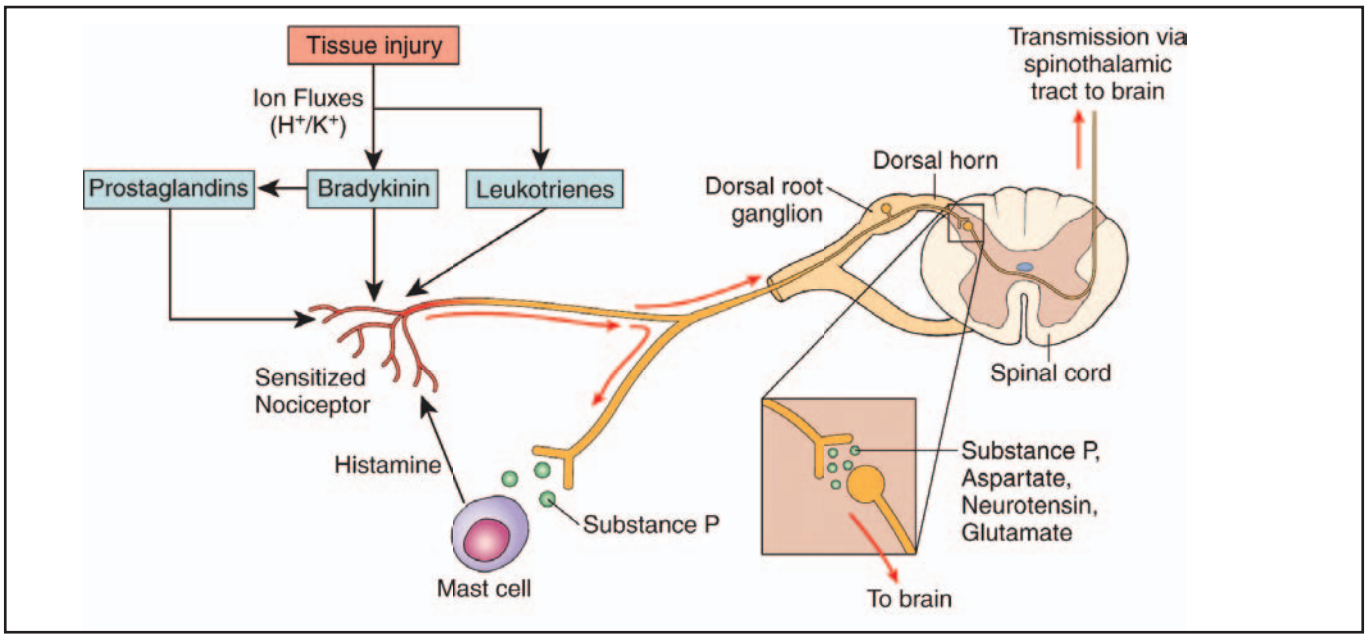

Figure 1. Physiology of pain.

PREMPTIVE ANALGESIA

Analogous to preoperative antibiotics as a prophylactic measure, is the theory behind preemptive analgesia. Administering analgesics prior to the onset of a noxious stimulus, before surgery, acts by blocking pain receptors and exudes an inhibitory effect on pain associated neurotransmitters. Those actions therefore help to modify central and peripheral nervous system processing of noxious stimuli and significantly reduce hyperalgesia and allodynia before it has a chance to start (2, 3). Patients are reported to have an insidious onset of a controlled type of pain in contrast to abrupt pain that is out of proportion and difficult to manage. Additional benefits of preemptive analgesia include a reduction in the amount of intravenous (IV) sedation and general anesthesia agents required during surgery, related to the absence of the patient's central nervous system reacting to the pain stimulus. Patients benefit by having a more favorable recovery from anesthesia with less side effects. Recent studies exemplify decreased use of postoperative opioids, and therefore opioid related side effects when preemptive analgesia is ordered (3, 4). There are two current recommendations for preemptive analgesia, local anesthetic block and pharmacologic agents. Injection of local anesthetic to the surgical site prior to initiation is a common practice and remains a popular choice of preemptive analgesia, however it is less effective as a standalone treatment. Local anesthetic alters the signal conduction of the nerves, and with adequate doses can actually prevent depolarization and transmission of the action potential completely. Though local anesthetic can reduce or obviate the transmission of pain signals to the brain, this is not indefinite (1-4). The local anesthetic will begin to wane in a matter of a few hours. Pharmacologic preemptive analgesics have proven to effectively decrease proinflammatory cytokine production with attenuation lasting into the postoperative period. Multiple pharmacologic agents in use today include Ibuprofen 800 mg by mouth, Celecoxib 400 mg by mouth, Ketorolac 30 mg IV, and Gabapentin 600 mg by mouth. All are given as a single dose preoperatively. These agents reportedly show increased benefit when used as combination therapy, explained by their various mechanisms of action (1, 2).

INTRAOPERATIVE ANALGESIA

Postoperative pain management begins intraoperatively and should be a collaborative effort between the surgeon and anesthesiologist. Research has shown intravenous pain medication administered prior to the patient awakening from anesthesia leads to diminished pain and anxiety in the immediate postoperative phase as well as a slower onset of acute pain during recovery. Two intravenous, nonopioid medications gaining popularity today are acetaminophen and ibuprofen, sold under the trade names Ofirmev and Caldolor, respectively (5, 6). Both drugs are approved for moderate to severe pain control as well as reduction of fever. In a side-by-side comparison, Ofirmev has the added benefits of pediatric dosing, 15-minute infusion time and no contraindications other than in patients with acetaminophen allergy and those who have hepatic impairment. Caldolor is not dosed for pediatric patients, has a 30-minute infusion time and multiple contraindications as well as black box warnings for cardiovascular and gastrointestinal risks. Ketorolac is a nonsteroidal anti-inflammatory drug (NSAID) that is commonly used intraoperatively today. It can be dosed as 30 mg IV once or every 6 hours for a maximum of 5 days. When used appropriately, it has been shown to reduce narcotic consumption by up to 45% (7, 8).

POSTOPERATIVE PAIN CONTROL

Current literature investigating postoperative management of acute pain endorses a treatment approach referred to as multimodal or balanced analgesia (9-15). This approach recommends utilizing multiple modalities for controlling pain, such as medications that are of different classes with varying mechanisms of action working either peripherally or centrally on the nervous system. Oral and intravenous anti-inflammatory medications are combined with narcotics as well as neurotransmitter inhibitors to provide balanced pain relief. Decreased narcotic use and decreased side effects, early oral intake, high level of participation, early physical therapy and early hospital discharge are some of the benefits attributed to prescribing multimodal analgesia (13, 15). Morphine, hydromorphone, and fentanyl are the most commonly used intravenous narcotics. Meperdine is not recommended for postoperative pain because of the dysphoric effect it has on patients as well as lowering the seizure threshold, which can be particularly dangerous in patients with renal or hepatic impairment leading to build up of toxic metabolites. When ordering IV opiates intermittently it is important to remember that steady state analgesic plasma levels are unlikely to be reached, therefore a loading dose is recommended. The loading dose for morphine is 0.1-0.3 mg/kg; the loading dose for hydromorphone is 0.01-0.03 mg/kg. The loading dose is most effective when administered just prior to the patient leaving the operating room (12, 15). A common dosing regimen can be found in Table 1. An added benefit of narcotics is the option of using patient controlled analgesia (PCA) pumps with patients who will require a basal level for adequate pain

control. The pumps are traditionally dosed and managed by anesthesia; however the clinical decision of when to transition off a pump is done by the surgeon. When transitioning a patient off PCA to oral pain medications, an IV form of the narcotic should be ordered for breakthrough pain to allow for smooth transitioning. Fentanyl can safely be used in patients with hepatic disease, while hydromorhpine is generally regarded as safe for use in patients with renal disease (16, 17). NSAIDs serve as an effective treatment option, especially when combined with narcotic therapy, which produces a synergistic effect. Synergism happens when multimodal agents taken concomitantly provide superior pain relief and decrease the overall need for narcotics.

PEDIATRIC PAIN MANAGEMENT

Managing pain in pediatric patients can pose a challenge in the postoperative setting. Studies have proven that the nervous system of children mounts a larger scale inflammatory reaction to noxious stimuli than adults, while also lacking a fully developed central inhibitory response mechanism. Therefore it is thought that young children may experience a heightened pain sensation and greater pain related distress when compared to adults. Acute, long-lasting pain that is inadequately treated can have lasting effects on children mentally and physically by lowering their pain threshold far into the future (18). Essential to effectively treating pain in children are proper communication tools and understanding of drug therapy. Using a visual analog pain scale (Figure 2) that is based on a series of faces is recommended for children ages 3-11 years, while adolescents may use the numerical pain scale (19).

The World Health Organization has developed an analgesic ladder to provide clinicians a safe and reliable outline for treating pain in children. Acetaminophen is considered the drug of choice for mild pain in children, and is generally free of any adverse side effects. NSAIDS are the drug of choice for mild pain control when acetaminophen is ineffective. Ibuprofen is the NSAID of choice for children, having minimal side effects while being equally effective. Moderate pain in children should be treated with weak opioids, Tramadol being the drug of choice for its stronger analgesia and lower risk of respiratory depression. Pediatric patients suffering from severe pain should be treated with stronger opioids, oxycodone and morphine being drugs of choice for efficacy and safety. PCA is not recommended in very young children, however it may be a viable option in mature adolescents. Pain medication should always be dosed based on weight in pediatric patients. The recommended pediatric dosages of NSAIDs and narcotics are shown in Tables 2 and 3. Additional considerations for managing pain in the pediatric population involves play therapy, relaxation, massage techniques, and mental distractions (18, 19).

MANAGING ACUTE PAIN IN THE CHRONIC PAIN PATIENT

Coralling complaints of acute pain in the chronic pain patient postoperatively can pose a challenging task to the unprepared physician. When committing to surgical intervention on a patient that uses narcotics long term, there are a number of things to consider. Patients on long-term narcotics will have a designated pain specialist they are in contract with. It is standard practice to discuss postoperative pain control recommendations with the patient's pain specialist for planned procedures. In general long-term narcotic users develop a tolerance to the multiple side effects of their medications. However, these patients may need closer monitoring postoperatively due to the increased risk of narcotic-related side effects with the addition of anything beyond regular dosing regimen. Patients are at the highest risk of sedation and respiratory depression during the first 24 hours postoperatively. In addition, the degree of sedation is a very predictable indicator of likely respiratory depression soon to follow (20-22). Remote telemetry and continuous pulse oximetry is not mandatory, though it can be reassuring to both the patient and the physician. When admitting chronic pain patients postoperatively, it is important to appreciate the requirement of basal level narcotics with the addition of shorter-acting agents to

Table 1

COMMON DOSING REGIMEN

Tramado	l50-100mg
Oxycodone	5-15mg
Morphine	10-30mg *q3-4h
Hydromorphone	2-4mg
Hydrocodone	5-10mg
Codeine	15-60mg
Meperidine	50-100mg *q3-4h

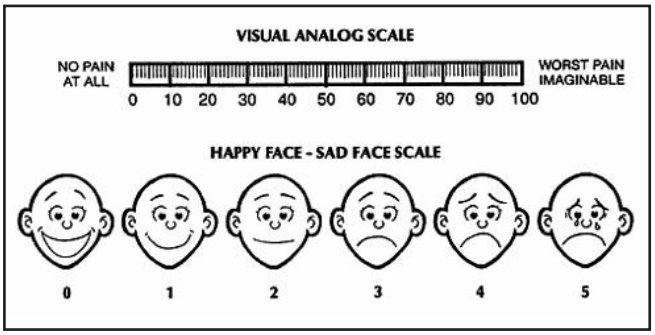

Figure 2. Pain scales.

Table 2

PEDIATRIC NSAID DOSAGES

Drug	Dose	Max Dose
Acetaminophen	10-15mg/kg q4-6h PO	100mg/kg total daily
Ibuprofen	4-10mg/kg q6-8h PO	40mg/kg total daily
Ketorolac	0.25-0.5mg/kg q6h IV	48h total duration

Table 3

PEDIATRIC NARCOTIC DOSAGES

Tramadol	1-2mg/kg
Oxycodone	0.15mg/kg
Morphine	0.1-0.3mg/kg
Hydromorphone	0.05mg/kg
Hydrocodone	0.1-0.15mg/kg
Codeine	0.5-1mg/kg
Meperidine	Do Not Use Due to Seizure Risk

manage acute pain. For ease of administration, a PCA that is titrated to their regular daily dose narcotic regimen is recommended. Another viable option for achieving basal narcotic levels is the use of long acting transdermal patches, such as a fentanyl patch (20-22).

CONCLUSION

Surgery can be a time of high stress and high anxiety for many patients, which in turn leads to patients' perception of increased pain. The road to successful recovery begins with preoperative planning for adequate pain control, patient education and reassurance. Combination, multimodal preemptive, intraoperative, and postoperative analgesics should be discussed prior to surgery with every patient. Understanding the benefit of multimodal pain management perioperatively will lead to better pain control among patients and improved patient satisfaction.

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