Perioperative Pain Management in Hip and Knee Arthroplasty

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KEYWORDS

• Pain • Multimodal pain management • Total hip arthroplasty • Total knee arthroplasty

KEY POINTS

- Adequate pain control after hip and knee arthroplasty is essential to maximize postoperative rehabilitation, minimize complications, and ensure patient satisfaction.
- Opioid use, preoperatively and postoperatively, is associated with acute side effects, slower rehabilitation, increased complications, and the risk of tolerance and dependence.
- Multimodal analgesia is a strategy to reduce opioid consumption using various pharmacologic and interventional techniques: cryotherapy, NSAIDs, neuromodulators, peripheral nerve blocks, intra-articular injections, among others.

INTRODUCTION

Osteoarthritis (OA), also known as degenerative joint disease, affects approximately 27 million people in the United States.[1] For OA of the hip and knee, nonoperative management is directed at reducing pain and functional impairment. Conservative measures include weight loss, activity modification, physical therapy, acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and intra-articular injections of glucocorticoids and hyaluronic acid. When nonoperative treatment fails, and intolerable pain and disability are present, total joint arthroplasty is a widely accepted treatment.

Total knee replacement (TKA) and total hip replacement (THA) are two of the most common surgeries performed today. The alleviation of pain, usually stemming from OA, is a primary indication for TKA and THA. Both surgeries predictably alleviate pain in most patients postoperatively. However, in the acute postoperative period, TKA and THA can cause significant pain. The fear of acute postoperative pain has been cited as a reason why patients put off arthroplasty surgery.[2] TKA, in particular, has a reputation for being an especially painful procedure from which to recover. It is not uncommon for patients to be thrilled with the results of their TKA surgery months afterward, but often state that they are unsure whether they would undergo the procedure again, now knowing how intense the immediate postoperative pain would be.

In 1995, the American Pain Society declared that pain is "the fifth vital sign." Shortly afterward, the Joint Commission on Accreditation of Healthcare Organizations said that patients should have a "right" to adequate pain management. These declarations came as evidence continued to mount demonstrating the impact of pain in patients' lives. Indeed, the orthopedic and pain literature show that if pain is not adequately controlled after TKA or THA, several detrimental pathophysiologic processes are set in motion. These processes increase the risk of

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complications and morbidity, disrupt sleep, cause cognitive dysfunction, and increase patient anxiety. Specific medical morbidities associated with inadequate pain control include venous thrombosis, coronary ischemia, myocardial infarction, and pneumonia.[3] In addition, uncontrolled pain hinders physical therapy and rehabilitation, thereby increasing the length of hospital stay and escalating the cost of care. Furthermore, the failure to control pain also leads to worse patient satisfaction with their surgery. As such, orthopedic and anesthesia providers must recognize the importance of managing pain after TKA and THA.

THE BIOLOGY AND PSYCHOLOGY OF SURGICAL PAIN

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage."[4] From the time the incision is made for either TKA or THA, the nociceptor pain system is activated. This includes the activation of pathways in the peripheral and the central nervous systems. Unavoidably, tissue is damaged during total joint arthroplasty. This direct damage produces a noxious stimulus that is detected by nociceptors in the peripheral nervous system. The signal is transmitted, via action potentials, to the spinal cord and then to the central nervous system. In addition to the noxious stimulus from the direct tissue damage, postoperative inflammation also leads to cell injury, and serves as a second source of pain. Furthermore, Dalury and colleagues[5] have noted that following direct tissue injury and postoperative inflammation, there is a release of inflammatory substances and cytokines including hydrogen and potassium, histamine, serotonin, prostaglandins, leukotrienes, thromboxane, and substance P.

Knowledge of the physiology of acute pain has improved greatly in recent years. Information is gathered from basic science and clinical studies from various disciplines. Although the mechanisms and physical chemistry of pain are well understood, patients have variable responses to pain.

The psychology of pain seems to be just as important as the biology, and effective pain control must take this into consideration. For example, Riddle has explored how patients' psychological status influences their perception of pain after TKA by focusing on the roles of depression, anxiety, and coping mechanisms. His group found that pain catastrophizing was a consistent predictor of poor outcome after TKA.[6] Given there are physiologic and psychological components of pain, surgeons must consider the many options available to best manage the impact of perioperative pain and improve patient outcomes.

OPIOIDS

Opioid therapy has traditionally provided the foundation of pain control in the postoperative period for orthopedic surgery and other surgical disciplines. Oral, intravenous (IV), intramuscular, subcutaneous, transdermal, and other delivery methods are available, in a myriad of strengths and combination formulas. Some of the most commonly used opioids are morphine, hydromorphone, oxycodone, hydrocodone, and fentanyl. Morphine is one of the earliest, and still most commonly used opioids. Its use is so ubiquitous, that opioid use is often measured in terms of the equivalent morphine dose.

Opioids act by binding to opioid receptors, which are principally found in the central nervous system, the peripheral nervous system, and the gastrointestinal tract. These receptors mediate the somatic and psychoactive effects of opioids. Somatic effects include the desired pain control, and itchiness, nausea, somnolence, respiratory depression, and constipation. Psychoactive effects include euphoria in some patients. Tolerance and dependence develop with continuous use, requiring increasing doses to achieve the same effects. Withdrawal symptoms also develop if long-term use is discontinued abruptly.

The most common strategy for treating postoperative pain is to administer opioids in response to escalating pain. When managed *pro re nata* (translated as "in the circumstances"), opioid administration is often delayed by the patient waiting too long to request it and the nurse being able to provide the medicine. This process has been shown to reduce the effect of the medicine.[7] Alternatively, IV opioids are administered via a patient controlled analgesia (PCA) device that administers a dose of IV opioid when the patient pushes a button. Although appealing in that it shortens the time from pain sensation to medicine administration, adverse effects are associated with PCA use. These include sedation and somnolence, respiratory depression, nausea and vomiting, and constipation and urinary retention.[8] These side effects, coupled with the lack of evidence showing that PCA is superior to nurse-provided analgesia, has led to PCA losing popularity for pain control after arthroplasty.[9]