

# Pain Management Associated with Total Joint Arthroplasty: A Primer

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## ABSTRACT

This primer presents a synopsis of pain management strategies associated with total joint arthroplasty. Patients considering total joint arthroplasty often experience moderate to severe pain, which places them at risk of opioid abuse or addiction. Currently, the best practice strategies involve the development of individualized multimodal perioperative approaches to pain management. These practices include prescribing opioids at their lowest dose and for the shortest duration necessary to control symptoms, with close monitoring of common adverse effects. Implementing these practices is essential to battling the ongoing opioid crisis in the US.

## INTRODUCTION

The intent of this article is to deliver a concise introduction to pain management in total joint arthroplasty (TJA) in the midst of the ongoing opioid crisis in the US. The goals are to provide the reader with a synopsis of the current understanding of the opioid crisis and discuss its implications for pain management in patients with end-stage osteoarthritis who undergo TJA, most notably total knee arthroplasty (TKA) and/or total hip arthroplasty (THA). The effects of opiate pain management education on clinical outcomes and patient satisfaction are also described. Please see the Sidebar: Advance Organizer Quiz to Retrieve, Use, and Organize the Materials Presented.

## THE OPIOID OVERDOSE CRISIS

The US is experiencing the worst overdose epidemic in history, with prescription drug abuse as the leading cause of accidental death.<sup>1</sup> In 2015 alone, there were 52,404 lethal drug overdoses, of which almost 40% were related to legal prescription pain relievers.<sup>2</sup> Between 1999 and 2010, there was a 340% increase in prescription opioid-related fatalities.<sup>3</sup>

The Centers for Disease Control and Prevention (CDC) has designated opioid overdose prevention as one of the leading public health issues that requires prompt attention by the medical community and public.<sup>2</sup>

According to the CDC, a major cause of the overdose epidemic is that opioids (eg, oxycodone, hydrocodone, and methadone) are overprescribed.<sup>1</sup> In 2012, there were 259 million opioid prescriptions—as many prescriptions as there were adults in the US at that time. In 2016, more than 66 opioid prescriptions were issued for every 100 people.<sup>4</sup> While controversial, it has been reported that although the US makes up less than 5% of the global population, it consumes nearly 80% of the global opioid supply.<sup>5,6</sup> A spiraling increase in opioid prescriptions in the US is believed to be the most important factor leading to lethal opioid drug overdoses. Studies document that the opioid crisis primarily originates from the misuse of opioid prescriptions.<sup>7</sup> Opioid prescriptions, obtained either directly from or indirectly through prescribers, are linked to long-term opioid therapy and a major risk of opioid misuse and addiction.<sup>7</sup>

The proportion of elderly patients being prescribed opioids at least once for management of osteoarthritis increased from 31% in 2003 to 40% in 2009.<sup>8</sup> Although osteoarthritis is frequently considered to be a disease of the elderly, the median age at diagnosis of knee osteoarthritis is 55 years, leaving a considerable number of years for patients to live with osteoarthritis and to have the potential to become addicted to prescription opioids.<sup>7</sup> In some patients undergoing TJA, postoperative pain management with opioids may serve as a trigger for long-term opioid use and addiction.<sup>9,10</sup>

In the face of serious risks and the absence of evidence concerning the long-term effectiveness of prescription opioids, there was a dramatic increase before 2013

in the acceptance and use of prescription opioids for surgical pain management.<sup>1</sup> Noteworthy is that despite the increase in use of prescription opioids, there has not been a corresponding change in pain reduction reported by Americans.<sup>1</sup> Now, however, there is close scrutiny in the US on prescribing opioids to patients because of the adverse consequences associated with long-term use and dependence.

## WHAT ARE OPIOIDS?

Opioids are drugs that interact with specific receptors in the central nervous system to relieve pain.<sup>11</sup> Beyond their direct mechanism of action to control pain, opioids are also known to activate the reward pathway by producing a euphoric sensation that helps patients overcome pain.<sup>4</sup> It is this euphoria that addicted individuals seek.<sup>12,13</sup> Opiates are a subclass of opioids and include the commonly abused drugs morphine, codeine, and oxycodone.<sup>14</sup>

## WHAT IS ADDICTION?

According to the American Psychiatric Association, *addiction* is a complex condition, a brain disease that is manifested by compulsive substance use despite harmful consequence.<sup>15</sup> People with addiction (severe substance use disorder) have an intense focus on using a certain substance or substances, such as alcohol or drugs, to the point that it takes over their lives.<sup>16</sup> They keep using alcohol or a drug even when they know it will cause problems.<sup>15</sup>

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## ADDICTION TO OPIOIDS

Symptoms of opioid addiction include intense urges for the drug, taking increasing amounts of the drug, and stealing or illegally obtaining opioids not prescribed. To address the potential for addiction with opioid use, the CDC has recommended preventive approaches for use by clinicians when prescribing opioids to patients. Because the risk of long-term opioid use increases with each additional day the drug is supplied,<sup>15</sup> one approach to reduce the risk of dependence and addiction is by limiting the supply of prescription opioids. This notion of limiting prescription opioids is supported by the CDC, which reported that the risk of long-term opioid use increased 125% between patients with at least 1 day of opioid therapy and those with more than 8 days.<sup>1,17</sup>

## Opioid Withdrawal

Once a patient ceases taking opioid medication, s/he may experience unpleasant withdrawal symptoms (see Sidebar:

Common Symptoms of Opioid Withdrawal),<sup>14</sup> causing his/her return to opioid medication to avoid the withdrawal symptoms. As a result, addiction may develop.

## Risk Factors for Misuse of Prescription Opioids

Certain factors increase the risk of the misuse of prescription opioids leading to persistent use. *Persistent opioid use* is defined as having any number of opioid prescriptions or dosing at least 90 days continuously, or use of opioid prescriptions for 120 nonconsecutive days.<sup>18</sup> Examples of certain factors that increase the risk of persistent use are the patient's sex and age.<sup>19</sup> Women may become dependent on prescription pain relievers more quickly than men because women are more likely to have chronic pain, be prescribed prescription pain relievers, be given higher doses, and use them for a longer period of time than do men.<sup>20</sup> It is estimated that between 1999 and 2010, approximately 48,000

women died of prescription pain reliever overdoses.<sup>20</sup> The CDC reported in 2015 that approximately 276,000 adolescents (12-17 years old) were current nonmedical users of pain relievers, with 122,000 having an addiction to prescription pain relievers.<sup>17</sup> Although the prescriptions for opioids among adolescents and young adults has nearly doubled from 1994 to 2007, most adolescent addicts receive their drugs from friends or relatives.<sup>17</sup> There is some evidence that younger patients, particularly teenagers ages 15 to 19 years, but even as early as 13 years, and young adults in their early twenties, are at a higher risk of persistent opioid use in the general surgical population<sup>21</sup> and that younger patients in their teens use higher opioid amounts perioperatively.<sup>22</sup>

Among surgical patients, female sex; age older than 50 years; and preoperative history of drug abuse, alcohol abuse, depression, benzodiazepine use, or antidepressant use are associated with chronic opioid use.<sup>23</sup> In one study, being female was associated with a 40% higher risk of long-term opioid use after surgery, and specifically after THA surgery.<sup>19</sup>

Patients, including elderly individuals, who are prescribed opioids recommended for treatment of osteoarthritis before TJA, are at increased risk of exposure to opioids for a longer time.<sup>18</sup> Elderly patients often experience other adverse effects from taking opioids, including dizziness and sedation, which increases their risks of falls and fractures.<sup>24</sup>

Use of opioids persistently for 4 months or longer before TJA is a strong predictor of persistent use of opioids after the surgery.<sup>25</sup> Patients known to be taking opioids for other comorbid painful conditions, including back pain and diabetes mellitus, are more likely to be exposed to opioids for longer periods, increasing their chance of experiencing potentially dangerous opioid-related adverse effects.<sup>19</sup> One such adverse effect includes the development of tolerance to an opioid which refers to a decreased response from the drug at the same dosage previously prescribed.<sup>26</sup> Another adverse effect to long-term opioid use is hyperalgesia, which is an abnormally heightened sensitivity to pain.<sup>26</sup> Patients with depression and preoperative use of

### Advance Organizer Quiz to Retrieve, Use, and Organize the Materials Presented

Please answer true or false to the following items:

- 1. Prescribing opioids for acute postoperative pain management is associated with a greater likelihood of long-term opioid use.**  
True. Strategies to assess risk of overuse and overdose before prescribing opioids are advised.
- 2. The rise in prescription opioids among Americans corresponds with a corresponding reduction in pain control.**  
False. Best practices include prescribing opioids at their lowest dose and for the shortest duration necessary to control symptoms, with close monitoring of common side effects.
- 3. Americans who are 18 to 25 years of age have been associated with an increased risk of opiate abuse/misuse.**  
True. There is some evidence that younger patients in their teens and early twenties (ages 13-21) are at a higher risk of persistent opioid use in the general surgical population<sup>20</sup> and that younger patients use higher opioid amounts perioperatively.
- 4. Women may become dependent on prescription pain relievers more quickly than do men.**  
True. Women may become dependent on prescription pain relievers more quickly than men because women are more likely to have chronic pain, be prescribed prescription pain relievers, be given higher doses, and use them for a longer period of time than do men.
- 5. Opioid prescription is recommended for only short-term use in patients with severe joint pain awaiting total joint arthroplasty (TJA).**  
True. Prescription opioids (eg, morphine, codeine, and oxycodone) for patients with chronic joint pain and dysfunction with end-stage osteoarthritis who are awaiting TJA show restricted gains and are not encouraged.
- 6. The optimal strategy for pain management associated with total joint replacement consists of individualized multimodal therapy.**  
True. The optimal strategy for postoperative pain control consists of identifying risk factors for persistent opiate use among patients and using these indicators to stratify risk preoperatively.
- 7. Orthopedic physicians are the most common health care prescribers of opioids before and after TJA.**  
False. Primary care practitioners prescribe more opioids before and after TJA than orthopedic physicians.

hypnotic agents are at increased risk of persistently using opioids after surgery.<sup>19</sup> Similarly, patients subject to postoperative surgical management with opioids increase their potential for long-term use of opioids, increasing their chance of developing opioid-related adverse effects, including tolerance and hyperalgesia.<sup>19,27</sup>

Patients with end-stage osteoarthritis of the knee and hip who are awaiting TJA are in their own category of increased risk of opioid overprescription<sup>24</sup> and present their own risks for misuse. This occurs primarily because of the nature of severe pain experienced by patients with end-stage osteoarthritis and the perceived lack of efficacy of nonpharmacologic and other pharmacologic interventions in alleviating pain, improving function, and/or providing a sustainable quality of life. This perceived lack of efficacy of other therapeutic options is believed to account for the use of opioid prescriptions.<sup>24</sup> Studies show, however, that opioids offer limited benefit for management of osteoarthritis pain and are generally not advised.<sup>27</sup> It is recommended that opioid prescription, if necessary, be considered only for short-term use (less than a week) in patients with severe pain awaiting TJA. The potential for serious adverse effects, including the potential for drug misuse, abuse, addiction, and withdrawal symptoms, outweigh the perceived advantages of long-term use of opioids.<sup>26</sup> Most prescribers of opioids for patients before and after TJA are not orthopedic physicians.<sup>28</sup> Therefore, coordination of prescription opioids among health care practitioners is essential to improve narcotic pain management in patients with osteoarthritis undergoing TJA.<sup>28</sup>

Identification of risk factors that contribute to suboptimal clinical outcomes (including pain relief and successful restoration of joint function) after TJA is essential to achieve the objectives of eliminating the opioid crisis.<sup>29,30</sup> For some patients, pain relief after TJA is suboptimal, and their pain can be challenging to manage. Prolonged use of opioid pain medication in this group of patients has been found to be ineffective and to increase their risk of long-term opioid use. According to 1 study, approximately 20% of patients undergoing TKA and

about 10% of patients undergoing THA reported persistent or recurrent pain in the year after the surgery.<sup>31,32</sup> Another study investigated the relationship of prolonged use of opioid medication as a possible indicator of early THA failure.<sup>33</sup> Results indicated that persistent postoperative use of opioids from 3 months to 1 year after surgery was associated with higher risk of revision THA and may be an early indicator of potential THA surgical failures.<sup>33,34</sup>

### OPIOIDS AND TOTAL JOINT ARTHROPLASTY

When nonsurgical treatment options fail, surgical options, such as TJA, may be the only feasible alternative to manage a patient's moderate to severe pain. The objectives for performing TJA are to correct a deformity and/or restore function to an affected joint, and for many patients, to relieve substantial pain commonly derived from osteoarthritis, a substantial influencing factor associated with TJA.<sup>29</sup> TJA can be performed just about anywhere on the body where there is a joint. Before the surgical option of TJA is considered, nonsurgical interventions, including physical therapy, corticosteroid injections, and nonopioid pain medication, are preferred and often required for pain management associated with joint pain and dysfunction. In conjunction with physical therapy and corticosteroid

injections (which can be done in the office setting), nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen in safe doses are the preferred agents of choice.<sup>35</sup> Use of proton-pump inhibitors to counteract the effects of gastrointestinal ulcer disease and bleeding associated with NSAIDs is recommended.

Prescription opioids (eg, morphine, codeine, and oxycodone) for patients with chronic joint pain and dysfunction with end-stage osteoarthritis who are awaiting TJA show restricted gains and are not encouraged.<sup>14</sup> Observational studies have demonstrated that for patients planning to undergo total joint replacement, those receiving opioids preoperatively experience less pain relief until several years after surgery compared with those who did not use opioids preoperatively.<sup>36</sup> In addition, preoperative use of opioids independently predicted opioid requirement postoperatively and is associated with prolonged hospital stay, greater risks of inpatient hospital complications, and early revision surgery.<sup>36-38</sup> Thus, the rate of successful pain management among patients after TJA is unpredictable, and preoperative use of opioids may be a modifiable risk factor for poor outcomes.<sup>24</sup>

There is evidence suggesting that patients undergoing TKA are more likely to require opioid refills than those undergoing THA.<sup>30</sup> One review showed that the patients undergoing TKA were twice as

#### Common Symptoms of Opioid Withdrawal<sup>13</sup>

##### Early symptoms of opioid withdrawal.

Typically begin in the first 24 hours after you stop using the drug:

- restlessness
- anxiety
- lacrimation (eyes tearing up)
- runny nose
- excessive sweating
- insomnia
- yawning very often
- muscle aches and bone pain

##### Later symptoms of opioid withdrawal, which can be more intense.

Begin after the first day or so:

- diarrhea
- abdominal cramping
- goose bumps on the skin
- nausea and vomiting
- dilated pupils and possibly blurry vision
- rapid heartbeat
- high blood pressure

likely to require refills of opioid prescriptions and were prescribed a greater total morphine equivalent dose for a longer time postoperatively.<sup>30</sup> Additionally, TKA patients with a comorbidity or who were being treated for anxiety or depression were more likely to require a refill.<sup>30</sup>

### Mechanism of Postoperative Pain

Postoperative pain results from inflammation caused by tissue trauma (ie, surgical incision, dissection, burns) or direct nerve injury (ie, nerve transection, stretching, or compression). The patient senses pain through the afferent pain pathway, which is the target of various pharmacologic agents.<sup>7</sup> Use of direct numbing agents (eg, lidocaine) or drugs that diminish the local hormonal response to injury (NSAIDs, such as aspirin or ibuprofen) can be used to block pain receptor activity, thereby decreasing pain receptor activation.<sup>10</sup>

### Factors to Consider in Postoperative Pain Management

A primary goal of pain management associated with TJA is patient comfort with a smooth transition from hospital care to home. When formulating a plan for postoperative pain control, use of regional or local analgesic techniques for certain procedures (ie, nerve blocks, patient-controlled analgesia pumps) or having patients take preoperative oral pain medication is recommended before a procedure. In addition, consideration of individual patient factors, such as age, history of long-term opioid use, and comorbidities, may affect the choice of analgesic options.<sup>32,39</sup> Elderly patients may be more sensitive to the effects of opioid pain medication, and the type of medication and doses should be adjusted accordingly. Patients with long-term use of opioids may require a varied and multimodal approach for optimization of postoperative pain control. Those in whom tolerance to opioids has developed may show no acute effects after use of the drug at a dose typical for that patient but may show signs of opioid withdrawal after surgery.<sup>14</sup> Patients with obstructive sleep apnea may be more prone to adverse effects of sedatives and opioids, requiring either dose modification or avoidance of these medications.<sup>10,40</sup> Therefore, specific

**Table 1. Example of opioid taper plan after total joint arthroplasty<sup>a</sup>**

| Date | Day | Maximum amount <sup>b</sup> | Amount taken |
|------|-----|-----------------------------|--------------|
|      | 1   | 10 tablets                  |              |
|      | 2   | 8 tablets                   |              |
|      | 3   | 7 tablets                   |              |
|      | 4   | 6 tablets                   |              |
|      | 5   | 5 tablets                   |              |
|      | 6   | 4 tablets                   |              |
|      | 7   | 4 tablets                   |              |
|      | 8   | 3 tablets                   |              |
|      | 9   | 3 tablets                   |              |
|      | 10  | 2 tablets                   |              |
|      | 11  | 2 tablets                   |              |
|      | 12  | 2 tablets                   |              |
|      | 13  | 2 tablets                   |              |
|      | 14  | 2 tablets                   |              |

<sup>a</sup> Personal communication: Chen EY, Betancourt L, Li L, Trucks E, Tornetta P. BMC Patient Safety Week 2017. Standardized, Patient-specific Opioid Prescribing after Inpatient Orthopedic Surgery. October 18, 2017. Poster. Department of Orthopedic Surgery, Boston Medical Center, Boston, MA, 2017, unpublished data.

<sup>b</sup> The opiate pain control plan is based on a calculated amount of a narcotic medication that the patient is taking at the time of discharge from the hospital.

individualized approaches to optimal opioid prescribing should be carefully planned preoperatively for patients requiring postoperative pain medication.

### Goals of Postoperative Pain Management in Total Joint Arthroplasty

Goals of postoperative acute pain management in patients undergoing TJA include relief of pain and suffering, achieving early mobilization postoperatively, reducing hospital length of stay, and achieving patient satisfaction. Prescription opioids should be prescribed at the lowest dose and shortest duration necessary to control symptoms, and close monitoring of adverse effects is advised. Use of prescription opioids should be avoided or limited whenever possible, especially in older adult and elderly populations, or in patients with a prior history of opioid abuse.<sup>11,40</sup> Mild to moderate pain can be expected in patients after TJA. Because of this expected pain, patients who undergo TJA generally require a prescription for higher-dose opiate pain medication for several days after surgery. Current practices recommend an opioid taper plan on hospital discharge (Table 1) and open communication with patients undergoing TJA. At one academic medical center, a specific goal is to ensure that all opioid prescriptions at the point of discharge on the surgical services meet

best practice. Best practice is defined as prescribing less than 90 morphine milligram equivalents per day, to specify the total number of days of the prescription, and not to exceed 7 days unless there is clinical justification for an extended course within the patient's medical chart (Eric L Smith, MD, personal communication, 2018 Oct 16).<sup>a</sup>

### Recommendations

Prescribing opioids for acute pain is associated with a greater likelihood of long-term opioid use,<sup>41</sup> and a greater amount of initial opioid exposure (ie, greater higher total dose) is associated with higher risks of both long-term use and overdose.<sup>41</sup> Thus, opioids should be prescribed only when necessary, at the lowest effective dose, and for the shortest duration necessary. To help monitor opioid use and potentially prevent overprescribing, prescription-monitoring programs available in the US and other countries can be used to identify patients prescribed opioid medications by multiple practitioners. In fact, regulations in some US states require clinicians to review this online resource before starting an opioid prescription for a patient.<sup>42</sup> It is important to keep in mind when prescribing opioid medication that no single or simple change in prescribing behavior

can be expected to alleviate all risks while properly managing pain.<sup>43</sup>

It is important to evaluate patients for tolerance to opioid pain medication before prescribing the drug.<sup>14</sup> Tolerance, the decreased response from a drug at the same dosage previously prescribed, can be concerning because patients then need to use a greater amount of the drug to receive the same therapeutic effect.<sup>14</sup> As mentioned earlier, by taking increased doses, especially for longer durations, patients are at a greater risk of addiction, medication adverse effects, or even death caused by overdose. In assessing for tolerance, physicians should ask patients whether they have been using increasing doses of pain medication to get the same effect. If so, a tolerance has likely developed, and that patient is more likely to experience withdrawal symptoms if s/he abruptly stops using the opioid. Patients who have recently consumed an opioid and are tolerant to its effects may not show obvious signs of intoxication or withdrawal. Any patient in whom opioid tolerance is identified before surgery should receive a specific plan for postoperative pain management and be followed-up closely after surgery by his/her primary care practitioner and/or a pain management specialist.

Pain control regimens should be designed to meet the needs of each individual patient, taking into account the patient's age; medical, psychological, and physical conditions; levels of fear or anxiety; personal preference regarding undergoing surgery; and tolerance and response to therapeutic agents.

The optimal strategy for postoperative pain control consists of identifying the risk factors for persistent opiate use among patients and using these indicators to stratify risk preoperatively. This approach to pain management can help target patient groups for multimodal therapy to minimize the needs for opioid pain medication.<sup>10</sup> Clinicians should develop an individualized approach to pain management for patients undergoing TJA. Use of both nonopioid and opioid medications to target central mechanisms involved in the perception of pain, each acting at different sites of

the pain pathway, may reduce a patient's dependence on a single medication and, more importantly, may reduce or eliminate the need for opioids.<sup>10,14</sup> Synergy between opioid and nonopioid medications reduces both the overall opioid dose and unwanted opioid-related adverse effects.

## CONCLUSION

The general approach for effective perioperative pain management involves prescribing opioids only when necessary, at the lowest effective dose, and for the shortest duration necessary.<sup>17</sup> With attention across the country now on the opioid crisis, judicious safe prescribing practices are actively advocated and required to avoid risks of opiate overuse and overdose and to help prevent opioid-related tragedies.

The general approach recommended for effective postoperative pain control in TJA starts early in the surgical process and involves an individualized multimodal approach to patient care. Risk stratification and identification of risk factors for persistent use are advised. Reducing the dependence on a single opioid medication and targeting central mechanisms involved in the perception of pain can minimize the use of opioids and avoid overuse. Coordination of opioid prescriptions among health care practitioners is recommended, as is improved communication with patients on expectations of narcotic use both preoperatively and postoperatively. Strategies to assess the risk of overuse and overdose before prescribing opioids are advised. One strategy is to use statewide electronic prescription drug monitoring programs that allow clinicians to identify patients prescribed opioid medications by multiple practitioners. Being cognizant of the signs and symptoms of dependence, tolerance, addiction, and overdose is essential knowledge before the implementation of any surgical pain management plan. Prevention through avoidance of overprescription of opiate medication is key to solving the opioid crisis. ❖

<sup>a</sup> Personal communication: Eric L. Smith, MD, Chief, Division of Arthroplasty, Associate Professor of Orthopaedic Surgery, Opioid Prescribing for Acute Pain. Boston Medical Center, Boston, MA, October 16, 2018, unpublished data.

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## Intent

Poisons and medicines are oftentimes the same substances given with different intents.

— Peter Mere Latham, MD, 1789-1875, British physician and medical educator, physician extraordinary to Queen Victoria