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General

The Ramifications of Opioid Utilization and Outcomes of Alternative Pain Control Strategies for Total Knee Arthroplasties

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Morbidity and mortality related to opioid use has generated a public health crisis in the United States. Total knee arthroplasty (TKA) is an increasingly common procedure and is often accompanied by post-operative opioid utilization. Unfortunately, post-operative opioid usage after TKA has been shown to lead to higher rates of complications, longer hospital stays, increased costs, and more frequent need for revision surgery. Pre-operative opioid utilization has been shown to be one of the most important predictors of post-operative opioid usage. Additional risk factors for continued post-operative opioid utilization after TKA include pre-operative substance and tobacco use as well as higher post-operative prescription dosages, younger age, female gender, and Medicaid insurance. One method for mitigating excessive post-operative opioid utilization are Enhanced Recovery After Surgery (ERAS) protocols, which include a multidisciplinary approach that focuses on perioperative factors to optimize patient recovery and function after surgery. Additional strategies include multimodal pain regimens with epidural anesthetics, extended duration local anesthetics and adjuvants, and ultrasound guided peripheral nerve blocks. In recent years, opioid prescribing duration limitations have also been put into place by state and federal government, hospital systems, and ambulatory surgery centers making effective acute pain management imperative for all stakeholders. In this regard, as rates of TKA continue to increase across the United States, multidisciplinary efforts by all stakeholders are needed to ensure adequate pain control while preventing the negative sequalae of opioid medications.

INTRODUCTION

OPIOID EPIDEMIC AND SEQUELAE

In the past two decades, the staggering increase in use and misuse of prescription opioids has generated a public health crisis. This crisis is characterized by increasing overdose related deaths and addiction treatments, which has placed strain on our healthcare system. In 2017 alone, 47,000 deaths were attributed to opioid overdose in America, which increased to 80,816 deaths in 2021.[1–3] The dramatic uptick in opioid related mortality prompted the US Department of Health to declare the opioid epidemic a public health emergency in October of 2017, which was recently renewed in April of 2022.[3,4]

OPIOID PRESCRIPTIONS AND SURGERY

An important contributing factor to the rise in opioid use can be attributed, in part, to aggressive opioid prescribing practices following surgical procedures. Pain control following surgery is an important aspect of post-operative care, however a careful balance must be maintained in order to provide pain control and prevent opioid misuse. Aggressive prescribing practices are especially relevant in the American healthcare system. In a study by Lindenhovius et al. comparing opioid prescriptions following surgery for ankle fractures in the United States and the Netherlands, 82% of US patients received opioids after undergoing ankle fracture open reduction and internal fixation versus 6% of Dutch patients.[5] In a study conducted between 2004 and

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2012 analyzing opioid prescriptions for low-risk outpatient procedures, such as carpal tunnel repair and knee arthroscopies, researchers found there to be significant increases in amount of opioids prescribed over time.[6] A combination of factors including provider training and cultural attitudes towards pain management likely contribute to prescription of opioids in situations where they may not be indicated.[7]

OPIOID USE AND TOTAL KNEE ARTHROPLASTY

Total knee arthroplasty (TKA) is a surgical procedure that often includes the use of outpatient opioids, with over-prescribing being of concern in this population.[8] The proportion of opioid-naive patients with a new opioid prescription within 7 days after total knee arthroplasty (TKA) increased from 79.1% in 2004 to 82.0% in 2012.[8] Despite this increase in opioid prescriptions, there has not been a clinically meaningful improvement in post-operative pain at discharge or at 2-month follow up.[8]

Another concerning trend is long-term opioid use that occurs in previously opioid-naïve patients after undergoing TKA. A study by Goesling et al. found that 42% of opioid-naive TKA patients on opioids at 3 months were still on opioids at 6 months.[9] Focusing on TKA patients who are not opioid-naive, a retrospective study by Bedard et al. noted that approximately one-third of TKA patients used opioids within 3 months prior to surgery, with preoperative use being most predictive of increased opioid refills following TKA.[10] More aggressive opioid prescribing practices have major clinical consequences including post-operative complications, need for revision, and increase hospital length of stay (LOS).[9] These sequalae can negatively impact surgical outcomes and given that TKA is a commonly performed procedure in the United States, it is important to analyze and address opioid prescribing practices to improve surgical outcomes and reduce strain on the American healthcare system.

IMPACT ON OUTCOMES

CLINICAL SIGNIFICANCE OF OPIOID USE

Significant changes have been implemented to improve surgical outcomes following TKA. These include, but are not limited to patient education, cardiac optimization, nutritional support, and more widespread use of Enhanced Recovery After Surgery (ERAS) protocols.[11] Pain management is of particular importance related to its direct impact on the physical and mental health of patients in addition to its cultural perception. Multimodal pain management programs are now more commonly used in healthcare systems in order to decrease reliance on opioids and reduce the prevalence of opioid use disorder following TKA.[11]

Multimodal pain management protocols are still not implemented in all practices, however, even though aggressive opioid prescribing practices have been shown to negatively impact patient outcomes. One such negative outcome is the increased need for revision TKA. In a study of 35,894 primary TKA patients, 413 underwent early revision of TKA. 29.2% of early revisions filled an opioid prescription within 3 months prior to TKA.[10] Preoperative opioid users were also significantly more likely to undergo TKA revision (1.6% vs. 1.0%, $P < .001$).[10] Jain et al. also conducted a study on chronic opioid users undergoing TKA and found that opioid prescriptions for greater than 6 months were associated with a higher risk of TKA revision within 1 year after surgery, and that a 3-month opioid-free period prior to surgery reduced risk of TKA revision.[12]

Aside from revision surgery, other complications of preoperative opioid use on TKAs include, but are not limited to, wound complication, infection, readmission, sepsis, thromboembolic events, and increased length of stay.[13] Wilson et al. compared complication rates in opioid-naive patients vs. patients with opioid prescriptions of varying time lengths. In the study, continuous preoperative use of opioids was associated with higher odds of all complications including extended LOS, non-home discharge, wound complication, pain-related ED visit, infection, prosthetic joint infection, sepsis, thromboembolic events, revision surgery, and opioid overdose.[13] This same group of patients was also shown to have increased healthcare utilization such as emergency department visits following TKA.

Opioids are a commonly used tool for pain management following TKA, as controlling pain in the post-operative period is paramount. Opioid related adverse effects (ORAE) are an important consideration when trying to achieve adequate pain control. Gonzalez et al. conducted a study on ORAE of 41,072 TKA and 3,817 revision TKA patients whose pain regimens consisted of primarily opioid analgesics. At 90 days, respiratory complications were the most common complication (TKA: 6.12%; RKA: 8.01%; $p < 0.01$), followed by postoperative nausea and vomiting (TKA: 2.86%; RKA: 3.95%, $p < 0.05$), and urinary retention complications (TKA: 2.79%; RKA: 3.20%; $p < 0.05$).[14] The average Medicare payment for treating complications within 90 days of a TKA was $6206.[15]

Postoperative length of stay (LOS) in hospitals and rehabilitation facilities also has an important impact on surgical outcomes in addition to the cost of care. A retrospective study by Sahota et al. looked at LOS at inpatient musculoskeletal rehabilitation facilities among patients in these facilities that received a primary TKA or THA. This study showed that patients who were opioid naïve had a significant mean LOS of 11.7±5.4 days versus 14.5±9.5 days in those who were opioid tolerant ($p <0.05$).[16] Additionally, opioid dosage was associated with LOS in inpatient rehabilitation. Patients whose post-op day 3 opioid requirement was greater than 50 morphine milligram equivalents (MME) had on average 3 more days of stay than patient's receiving a lower dose.[16] Cost of care is also significantly higher in total joint arthroplasty (TJA) with preoperative opioid use. In a study of 3,211 TJA patients who either used opioids, tramadol, or were opioid-naive preoperatively, cost of care was $19,229 versus $19,403 versus $17,572, respectively ($P < 0.001$).[17] Overall, while opioid use preoperatively and post-operatively is often indicated for adequate pain control, they should be utilized carefully in light of emerging evidence about their multifaceted effects.

RISK FACTORS

PREOPERATIVE OPIOID USE

The connection between preoperative opioid use and chronic postoperative opioid use is well established in orthopaedic literature.[10,18–24] This preoperative use is often a result of increased pain prior to surgery, as patients that report worse average knee pain prior to TKA use opioids more frequently in the preoperative period.[25] Additionally, preoperative opiate users are significantly more likely to refill their opioid prescriptions (95.9%) compared to those that are opioid naïve (72.0%).[26] One study of TKA patients demonstrated that both preoperative oxycodone and tramadol use were associated with increased postoperative opioid use. Patients who used preoperative tramadol had 4.8% lower chronic postoperative opioid dependence compared to preoperative oxycodone users, however.[24] Furthermore, preoperative use of a low-dose regimen of two 5mg hydrocodone daily is associated with additional adverse outcomes such as increased postoperative ED visits and readmission rates, while higher opiate doses are associated with increased risk of prosthetic infection and revision.[27] In addition, one study of 7356 patients who underwent hip or knee arthroplasty demonstrated that those with preoperative opioid use had worse absolute postoperative patient reported outcome scores compared to those with no preoperative opioid use.[28] Overall, there is an increased risk of chronic opioid use, complications, and decreased patient satisfaction in those using opioids before TKA. Within hip and knee arthroplasties, the preoperative discontinuation of opioids is associated with increased health outcomes and can be considered for patients scheduled for surgery.[29]

POSTOPERATIVE PRESCRIPTION CHARACTERISTICS

The amount of opioids prescribed following orthopaedic surgeries has shown to effect the total duration of use.[30,31] Lanzillotta-Rangeley et al. demonstrated that following orthopaedic procedures, a larger initial postoperative opioid prescription led to prolonged use and patients who received early prescription refills 0-30 days postoperatively were more likely to receive another refill from 30-60 and 60-90 days.[31] Regarding prescription strength following TKA, patients given initial prescriptions with higher MME (301) were associated with increased risk of second refill at 30 days compared to those with a lower MME (205.6).[32] Similarly, a study on veterans who received TKA exhibited correlations between high postoperative opioid dose and prolonged opioid use as well as lower postoperative dose and earlier opioid independence.[33] Overall, it is likely that many patients are prescribed more opioids than are needed for adequate pain control, which is associated with an increased risk of prolonged opioid use following TKA.[34]

SMOKING AND ALCOHOL

Among TKA patients, smokers are more likely to fill a second prescription at 30 days and among TKA and THA patients, smokers require an average of 90% more MME postoperatively than nonsmokers.[32,35] Alcohol use is also associated with increased postoperative opioid use in TKA patients.[31,36] One study also demonstrated marijuana use as a significant risk factor for prolonged postoperative opioid use.[37]

SOCIOECONOMIC FACTORS AND MEDICAL COMORBIDITIES

Both socioeconomic factors and medical comorbidities contribute to long-term opioid use following TKA. Younger age, female gender, Hispanic and African-American races, and Medicaid insurance are all well documented socioeconomic risk factors correlated with long-term opioid use following TKA.[24,31,38–40] Medical comorbidities such as diabetes, rheumatoid arthritis, liver disease, hypertension, chronic kidney disease, and psychological disorders such as anxiety and depression are also associated with prolonged postoperative opioid use.[23,31] Specifically in the veteran population, there is a connection between those who take antidepressants within one year of surgery and prolonged opioid use.[41] Chronic pain, including fibromyalgia, back pain, and nonspecific chronic pain syndromes are additional independent predictors for increased postoperative opioid use.[23,33] Furthermore, morbid obesity has been correlated with increased postoperative opioid consumption in TKA patients with individuals with a BMI >40 kg/m^2 consuming 82% greater MME following THAs and TKAs than individuals with a BMI <25 kg/m^2.[35,37]

OTHER

Other factors contributing to increased opioid use include specific characteristics of the surgery such as operative time and patient pain in the immediate postoperative period.[24,42–45] Cao et al. showed that longer operative times were independently associated with increased opioid use, which correlate with the previous findings of Polizer et al.[24,43] Increased pain on post-operative day one and increased opioid utilization in the 24-hours before hospital discharge are also independent predictors of prolonged opioid use following TKA.[42,44,45]

INTERVENTIONS TO REDUCE OPIOID USAGE AND THEIR OUTCOMES

ENHANCED RECOVERY AFTER SURGERY PROTOCOL

The first ERAS protocols were designed by Kehlet in 1997 as a multidisciplinary approach to surgery that aims to understand and address perioperative stressors that often lead to patient pain, complications, and morbidity.[46] Given the well-studied deleterious effects of opioid medications perioperatively, ERAS protocols are designed to reduce opioid consumption while decreasing length of stay (LOS), hospital costs, complications, and to increase patient satisfaction.[47–54] Favorable ERAS outcomes have been demonstrated in a wide variety of surgical specialties, including breast, plastic, cardiac, gynecologic, orthopaedics, and many others.[47,50–52] TKA is a prime candidate for standard-

ized ERAS protocol given its inherent invasiveness, pain management requirements, and increasing frequency in the general population in the US.[55–57]

Standardized perioperative protocols for TKA have proven to be effective in countries including Denmark and the United Kingdom (UK). These "fast-track" and "enhanced recovery pathway" protocols were shown to reduce LOS following TKA from 4-10 days to 1-3 days in select health systems.[58–62] Similar results have been noted in smaller studies of ERAS protocols in other countries, prompting a shift towards implementing these protocols on a larger scale.[63,64]

The ERAS Society, a group that provides consensus statements for perioperative care in a number of surgical subspecialties, recently published their consensus recommendations for patients undergoing total hip arthroplasty (THA) and total knee arthroplasty (TKA).[65] Recommendations for the preoperative period include patient education and counseling, smoking and alcohol cessation, management of anemia, physiotherapy and exercise, fasting of solid food for 6 hours prior to surgery, and intake of clear fluids until 2 hours prior to surgery.[65] Preoperative carbohydrate loading and pre-anesthetic medications such as sedatives or anxiolytics are not routinely recommended.[65] There were no recommendations regarding the use of nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, or gabapentanoid medications for pain management prior to surgery. Preoperative NSAIDs and acetaminophen have been shown to reduce postoperative opioid use following TKA.[66,67] Data varies regarding the effectiveness of preoperative gabapentanoid medications on postoperative opioid use.[67,68]

Intraoperative recommendations for TKA did not emphasize a preference of general or neuraxial anesthesia related to conflicting evidence regarding postoperative outcomes and complication rates.[60,69–71] Both types of anesthesia were recommended as part of multimodal anesthesia regimens. Meta-analysis data supports the use of local infiltration anesthesia (LIA) for TKA but not for THA.[65,72] Nerve blocks have been found to reduce postoperative opioid use following TKA, but are not routinely recommended by the ERAS Society because they are associated with prolonged motor blockade when compared to LIA.[65,73–76] Additionally, meta-analysis data suggests no difference in postoperative opioid use in patients receiving LIA or nerve blocks intraoperatively.[72] In this regard, numerous studies have shown various adjuvant agents can prolong local anesthesia duration of analgesia including the use of N-methyl-d-aspartate receptor antagonists such as ketamine, clonidine, dexmedetomidine, dexamethasone, neostigmine, epinephrine, and sodium bicarbonate; however, long-term studies are lacking vis-à-vis impact on effects on long-term opioid use.

Postoperative recommendations for TKA target postoperative nausea and vomiting (PONV), blood loss, analgesia requirements, antimicrobial and antithrombotic prophylaxis, drain and urinary catheter use, nutritional care, early mobilization, and criteria-based discharge.[65] Multimodal non-opioid pain management is a foundational component of ERAS pathways for TKA. Acetaminophen and NSAIDs are the main components of these regimens, however alternative analgesics such as ketamine, glucocorticoids, cannabinoids, and gabapentin have been documented with varying success in pain control following TKA.[65,77–82] Current recommendations support the use of acetaminophen for multimodal pain management following TKA. Gabapentinoids are not currently recommended as adjunctive analgesia, although some studies have demonstrated beneficial effects and future studies are indicated. There have been to date no explicit ERAS Society recommendations regarding the use of ketamine, glucocorticoids, and cannabinoids following TKA. While ERAS protocols attempt to minimize the postoperative use of opioids, their judicious use is often required for effective analgesia. It should also be noted that opioids such as oxycodone are recommended when used responsibly as part of a multimodal pain regimen.[65]

PRESCRIPTION MEDICATIONS AND MULTIMODAL PAIN REGIMENS

Opioids are very effective in reducing pain in the acute postoperative period following TKA. However, current recommendations by the ERAS Society, American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society aim to reduce postoperative opioid use in order to avoid adverse effects which include nausea, vomiting, constipation, drowsiness, respiratory depression, and risk of long-term opioid addiction.[65,83] Multimodal pain regimens including medications are standard of care for control of postoperative pain management following TKA. Current regimens often employ a combination of opioids with one or more of the following: acetaminophen, NSAIDs, gabapentinoids, glucocorticoids, ketamine, and cannabinoids.[65,77–82,84]

Acetaminophen, also referred to as paracetamol or *N*-acetyl-*p*-aminophenol (APAP) is one of the most popular antipyretic and analgesic drugs in the world. APAP is understood to inhibit cyclooxygenase (COX) pathways in the central nervous system (CNS), while it lacks activity on peripheral COX pathways. Inhibition of these COX pathways limits conversion of prostaglandin (PG) G_2 to PGH_2, ultimately decreasing PG synthesis.[85] Several recent studies suggest that postoperative administration of intravenous (IV) APAP significantly reduces opioid requirements following TKA when compared to placebo.[86–88]

Another mainstay of multimodal pain regimens are NSAIDs, which act by inhibiting COX enzymes and thus, the generation of arachidonic acid metabolites.[89] NSAIDs have been shown to provide antipyretic, analgesic, and anti-inflammatory effects largely through the COX 2 pathway.[89,90] NSAIDs reduce supplemental opioid use following hip and knee replacement, however they carry a side effect profile that requires careful patient selection, particularly in patient populations with bleeding conditions, history of gastrointestinal ulcers, cardiovascular morbidity, and kidney disease.[65,91,92]

Gabapentinoids are a class of neuropathic amino acid medications including gabapentin and pregabalin that have

a chemical structure similar to the neurotransmitter γ-aminobutyric acid (GABA).[93] Gabapentinoids inhibit voltage-gated calcium channels present in the cell membranes of neurons throughout the nervous system. When these calcium channels are inhibited, release of excitatory neurotransmitters from the presynaptic nerve terminal is also inhibited, effectively dampening normal pain signaling mechanisms.[93–95] Meta-analysis data regarding gabapentin's effect on postoperative opioid requirement varies, with one recent study suggesting that gabapentin does not reduce postoperative opioid consumption at 48 hours following TKA when compared to placebo.[93,96]

Glucocorticoids have been used clinically for decades related to their potent immunosuppressive and anti-inflammatory effects as steroid medications.[97] They are routinely used perioperatively due to their favorable effects on PONV and pain scores.[98,99] Recent data from several meta-analyses suggests that perioperative glucocorticoid administration reduces pain scores and opioid consumption following TKA.[81,100]

Ketamine is a derivative of phencyclidine and functions as an antagonist of the N-methyl-D-aspartate (NMDA) receptor.[101] While ketamine provides antidepressant effects, low-dose ketamine has also been shown to provide pain relief and reduce opioid consumption following TKA and a number of other surgical procedures when compared to placebo.[80,101]

Lastly, cannabinoids act as ligands at the cannabinoid$_1$ receptor (CB_1R) and cannabinoid$_2$ receptor (CB_2R) throughout the endocannabinoid system and produce antinociceptive effects.[102] Some studies have investigated the effects of perioperative cannabinoid or cannabis use on outcomes and complications of TKA, but no studies have investigated the effects of cannabinoids on opioid use following TKA when compared to placebo.[103,104]

Multimodal pain regimens are well studied in orthopaedic surgery and other surgical fields, and there is recent interest in the efficacy of multimodal pain regimens at reducing opioid consumption following TKA. Medications are often used in a variety of combinations with the goal of providing analgesia while reserving opioid medications for breakthrough pain. While most of these medications have been shown to reduce opioid consumption following TKA when compared to placebo, more data is needed regarding the efficacy of specific combinations of these drugs and the overall efficacy of multimodal pain regimens in reducing opioid consumption.[105]

Several recent studies have also investigated the effects of combinations of non-opioid analgesics and their effect on opioid consumption. Schwinghammer et al. suggested that a postoperative pain management regimen for TKA should include at least 2 analgesic medications to control pain.[106] Results from other studies suggest that multimodal pain management regimens using different combinations of non-opioid analgesics resulted in favorable postoperative outcomes, recovery, and pain management following TKA.[105,107–109] For example, McCartney et al. suggested that APAP used in conjunction with a short course of NSAIDs are often the simplest regimen to improve pain control following TKA, while Golladay et al. recommended a combination of APAP, NSAIDs, and gabapentinoids to reduce postoperative opioid consumption while minimizing any adverse side effects.[105,109] Additionally, McKenzie et al. developed a multimodal pain management protocol for TKA and THA patients that utilized APAP, celecoxib, and pregabalin and resulted in significant reductions in opioid requirements and pain scores following surgery.[110]

EPIDURAL CATHETERS, PERIPHERAL NERVE BLOCKS, AND LOCAL INFILTRATION ANALGESIA

While the mainstays of multimodal pain regimens are enteral medications, local techniques have also proven useful in reducing postoperative opioid use and pain following TKA. Epidural catheters are one such method that allows medications to be deployed directly into the epidural space. Epidural anesthesia for TKA has become increasingly popular over the last few decades, with some reports citing its ability to provide comparable pain relief and fewer side effects than general anesthesia.[111,112] One randomized controlled trial found that of 110 patients undergoing TKA, those who received epidural morphine had less severe pain scores and consumed significantly less opioids at the 48-hour mark compared with patients who received placebo ($p < 0.002$).[113]

Intrathecal analgesia is an alternative to epidural analgesia in which medications are injected directly into the cerebrospinal fluid (CSF).[114] Intrathecal morphine (ITM) is commonly used, and when compared to control patients receiving bupivacaine spinal anesthesia alone, ITM administration has been found to improve pain scores at postoperative day zero and reduce initial postoperative opioid consumption following TKA.[115] However, a meta-analysis of studies using ITM for analgesia following TKA suggests that while ITM can reduce opioid consumption and pain scores, it also increases the likelihood of morphine-related adverse events including PONV and pruritis.[116] A more recent systematic review of patients receiving ITM following TKA and THA by Gonvers et al. found similar results; ITM effectively reduced postoperative opioid consumption but increased the risk of PONV, pruritis, sedation, and urinary retention when compared to control groups.[117] Consequently, Gonvers et al. determined that an effective ceiling dose for ITM is 100 μg to provide analgesic relief with a balanced side effect profile.[117] Given these results and other findings regarding epidural and intrathecal opioids for TKA, the ERAS Society recommendations do not support the use of either modality for additional analgesia.[65]

Peripheral nerve blocks represent another analgesic option for TKA. They include a block of the interspace between the popliteal artery and the capsule of the posterior knee known as the (iPACK) block, femoral nerve block (FNB), sciatic nerve block (SNB), and adductor canal block (ACB).[118] The iPACK block provides local anesthesia to the posterior knee by targeting the medial and lateral geniculate nerves and surrounding articular branches. This technique was developed in hopes of reducing the amount of motor and sensory blockade that result from more proximal

nerve blocks.[119] D'Souza et al. found no effect of an iPACK block on opioid consumption at 24 hours following TKA when compared to patients who did not receive an iPACK block.[119] Additionally, in patients receiving a multimodal pain management regimen following TKA, iPACK block was not shown to decrease postoperative opioid requirements compared to patients receiving a sham block.[120]

Femoral nerve block, sciatic nerve block, and adductor canal block are proximal alternatives to iPACK block that are frequently discussed in the literature regarding differences in functional and analgesic outcomes following TKA. A femoral nerve block anesthetizes the distribution of the femoral nerve in the anterior thigh and knee, and can be administered as a single injection or continuous FNB.[121] Both types of FNB with concurrent patient-controlled analgesia (PCA) have been shown to be superior to PCA alone for analgesia following TKA, and reduce opioid consumption at 24 and 48 hours postoperatively.[121]

Sciatic nerve blocks can also be used as an adjunct to FNB to provide relief of posterior knee pain, and have been shown to reduce pain scores and opioid requirements at 12 hours following TKA compared to FNB alone.[122] An adductor canal block is an alternative to FNB that has been proposed to preserve the strength and mobility of the quadricep muscles in the first 48 hours after TKA.[123,124] This technique targets the saphenous nerve, articular branches of the obturator nerve, medial retinacular nerve, and the nerve to the vastus medialis.[125] A recent systematic review by Karkhur et al. did not find any difference in pain scores or opioid consumption between FNB or ACB following TKA.[125] While nerve blocks are commonly employed in multimodal pain management regimens, the ERAS Society does not recommend them as an essential component of multimodal analgesia following TKA.[65]

Additionally, local infiltration analgesia (LIA) can be used as an alternative or as an adjunct to nerve blocks, and was first described by Kerr et al. in 2008.[65,126] Local infiltration analgesia involves injecting an anesthetic agent (bupivacaine, ropivacaine, etc.) around the structures subjected to surgical trauma.[127] Other medications such as NSAIDs and epinephrine can be included for additional pain control.[127] Data varies regarding postoperative opioid consumption between LIA and nerve blocks. One systematic review indicated that LIA and FNB offer similar pain relief and result in equal levels of opioid consumption at 24 hours postoperatively.[128] However, when SNB is used as an adjunct to FNB, opioid requirements are less than those in patient cohorts receiving LIA for TKA.[129] Compared with ACB, LIA offers similar pain relief and results in similar levels of opioid consumption at 24 and 48 hours postoperatively.[130]

There is limited data comparing iPACK block and LIA in terms of analgesic efficacy, but one recent trial of 76 patients indicated that patients who received LIA and ACB consumed less opioids than those who received iPACK block and ACB.[131] While more data is needed to understand the true effect of LIA on opioid consumption following TKA, the ERAS Society currently recommends LIA as a component of multimodal pain management for TKA.[65]

PRESCRIBING LIMITATIONS AND PATIENT SAFETY INITIATIVES

Given that rates of TKA are increasing by 673%, overprescribing of opioid medications following surgery has the potential to contribute to opioid abuse, morbidity, and mortality.[57,132] One effective method to reduce the overprescribing of opioid medications is legislation at the national and statewide levels. Recent studies suggest that statewide legislation limiting opioid prescription regimens results in a significant reduction in the minimum and maximum median morphine milligram equivalents (MME) prescribed following THA and TKA.[132] The majority of legislation limits initial opioid prescriptions to 7-day regimens for acute postoperative pain.[133]

Another method to mitigate postoperative opioid abuse is encouragement of patient education and patient safety initiatives. Educating patients undergoing TKA about multimodal analgesia has been shown to significantly reduce postoperative opioid use following TKA when measured in required MME.[134] Additionally, implementation of patient safety initiatives have shown promising results in reducing postoperative opioid use and chronic opioid prescriptions following TKA. Specifically, one study analyzed outcomes of the Opioid Safety Initiative across the Veterans Health Administration and found that this initiative reduced opioid consumption following TKA and reduced the number of patients with chronic opioid prescriptions following TKA.[135] Given that current research regarding prescribing limitations and patient safety initiatives following TKA is limited, future studies are indicated to better understand how these interventions can limit opioid over-prescribing and abuse in patients undergoing TKA.

CONCLUSION

Opioid prescribing and utilization in the United States has led to a public health crisis with significant morbidity and mortality. Patients undergoing orthopaedic surgery, and specifically TKA, have been shown to utilize opioid prescriptions in excess of 80% of cases post-operatively. Negative sequalae of aggressive post-operative opioid regimens include increased post-operative complications, arthroplasty revisions, cost, and length of stay. As evidence regarding these negative outcomes has surfaced, strategies have been implemented to reduce post-operative opioid use and to improve outcomes. With an increasingly aging population in the United States, the number of TKAs is likely to continue to increase, making this a particularly important arena for responsible opioid prescribing and utilization. Further progress will continue to require multidisciplinary efforts involving prescribers, hospitals and ambulatory surgery centers, state and federal governments, and patient educators.

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