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PAIN MANAGEMENT AFTER TOTAL KNEE ARTHROPLASTY

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Keywords: total knee arthroplasty, postoperative pain, multimodal analgesia, adductor canal block, periarticular infiltration analgesia, opioid-sparing, rehabilitation, physical therapy.

Summary

Postoperative pain after total knee arthroplasty (TKA) remains a major determinant of early rehabilitation, hospital recovery, and long-term outcomes. Acute pain is most severe during the first 72 hours after surgery and, if inadequately controlled, may delay mobilization, impair participation in physiotherapy, increase complications, and contribute to later opioid use. Persistent pain after TKA is also common and is influenced by nociceptive, neuropathic, and psychosocial factors.

Aim of this narrative review was to summarize current evidence on modern pharmacological, regional, and non-pharmacological strategies for pain management after TKA.

Methods: A literature search was performed in PubMed/MEDLINE using terms related to TKA, postoperative pain, analgesic techniques, and rehabilitation modalities, with priority given to systematic reviews, meta-analyses, and randomized controlled trials.

Results: The findings support multimodal, opioid-sparing analgesia as the preferred approach. Acetaminophen and nonsteroidal anti-inflammatory drugs or cyclooxygenase-2 inhibitors form the basis of systemic treatment, with glucocorticoids as useful adjuncts for early pain and nausea control. Adductor canal block is favored over femoral nerve block because it preserves quadriceps strength, while periarticular local infiltration analgesia is effective and easily integrated into enhanced recovery pathways. Early supervised mobilization, physiotherapy, cryotherapy, and swelling control further optimize recovery and reduce opioid requirements.

Introduction

Total Knee Arthroplasty (TKA) is one of the most common orthopedic surgeries, used for advanced knee osteoarthritis, when conservative treatment options prove to be ineffective. TKA is highly effective in improving joint function and patients' quality of everyday life. However, postoperative pain remains a concern. Acute pain due to soft tissue trauma, inflammation, periarticular tissue irritation is typically most severe during the first 72 hours, particularly with movement. Pain management in this period is critically important. Inadequate analgesia can delay mobilization and limit patient participation in physiotherapy, in turn increasing the risk of complications such as thromboembolism. Furthermore, poorly controlled pain can increase prolonged opioid use, which is associated with various adverse effects. Contemporary perioperative practice favors multimodal, opioid sparing analgesia, which combines systemic non-opioid drugs with regional and local techniques to achieve adequate pain relief while preserving muscle function needed for early rehabilitation [1-2].

Despite progress in acute pain pathways, a considerable part of patients develop pain that persists beyond the normal healing period. Chronic postoperative pain is commonly defined as pain lasting more than three to six months after surgery, with reports often suggesting approximately one in five patients experiencing persistent or bothersome pain after TKA. The development of chronic pain is multifactorial and may involve neuropathic mechanisms, central sensitization, and residual nociceptive stimuli. In addition, susceptibility to chronic pain is influenced by demographic, clinical, and psychosocial risk factors. Thus, pain management should be based on the pain mechanism, multidisciplinary approach, shifting away from an opioid based strategy [3-5].

Therefore, postoperative pain management after TKA is crucial not only for patient satisfaction, functional recovery, and the rehabilitation process, but also for long-term to quality of life. Optimal care should be based on a multidisciplinary, multimodal and opioid avoidant tactic.

The aim of the study is to summarize the findings of current literature search and provide an overview of the

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modern regional, systemic and non-pharmacological pain management tactics post TKA.

Methods

The literature search was conducted on PubMed/MEDLINE. The following keywords and their combinations were used: *Pain OR acute/chronic/preoperative/postoperative pain AND management AND TKA*; *Adductor canal block/femoral nerve block/Periarticular local infiltration AND TKA AND postoperative pain*; *TENS/CPM/Physical therapy AND TKA AND postoperative pain.* Systematic reviews, meta-analyses, and randomized controlled trials addressing pain management after total knee arthroplasty were prioritized. Included publications were selected based on clinical relevance and level of evidence, emphasizing the following outcomes: pain at rest and during movement, opioid consumption, early mobilization and muscle function, postoperative nausea and vomiting, risk of falls, length of hospital stay, and persistent postoperative pain. A narrative review of literature findings was performed.

Results and discussion

1. The preoperative and intraoperative determinants of postoperative pain following TKA

The variability in severity of postoperative pain following TKA is not random. Literature search revealed that patients who experience greater preoperative damage to knee joint structures related pain, especially, together with symptoms of depression, tend to report higher pain after the surgery. Also, patients with greater overall pain sensitivity or lower pain tolerance (determined by quantitative sensory testing or pain threshold assessments) are associated with significantly higher postoperative pain caused by movement. Surgeon's technique, soft tissue handling and total surgery time are also factors determining postoperative pain [6].

2. Systematic pharmacological treatment

2.1 Nonsteroidal anti-inflammatory drugs (NSAIDs), cyclooxygenase-2 selective inhibitors and acetaminophen

NSAIDs are responsible for the reduction of inflammatory component of postoperative pain and are the main elements of opioid-sparing strategies [1]. Celecoxib is one of the most frequently studied and used cyclooxygenase-2 selective inhibitors after TKA. A meta-analysis found that celecoxib reduces the need for opioids after surgery compared with placebo [7]. Acetaminophen is one of the most recommended baseline non-opioid analgesics after TKA because of its safety and compatibility with other medications. It should be included as a scheduled, regularly administered component, especially during the first postoperative days, to maintain a stable pain reducing background and reduce opioid need. In the procedure specific postoperative pain management recommendations, nonsteroidal anti-inflammatory drugs or cyclooxygenase-2 selective inhibitors are recommended systemic components together with acetaminophen [1].

However, the decision to prescribe nonsteroidal anti-inflammatory drugs or cyclooxygenase-2 selective inhibitors must consider renal function, bleeding risk, cardiovascular profile, and other prescribed medication. And for acetaminophen – total daily dose, liver function, and the presence of combination products must be considered to avoid exceeding safe daily limits.

2.2 Glucocorticoids

A meta-analysis found glucocorticoids to be a safe and effective method of pain management after TKA [8]. Even though, a more recent double-blind randomized controlled trial found that dexamethasone did not reduce persistent or chronic pain after TKA, it is a reliable choice for early postoperative pain management and can be used as an adjuvant because of its antiemetic and anti-inflammatory effects. Thus, glucocorticoids are rational for early postoperative management, but current evidence is insufficient to support a reliable role in preventing long-term pain [9].

2.3 Gabapentinoids

Gabapentin and pregabalin are incorporated into multimodal regimens in hopes of reducing opioid requirements and addressing a neuropathic pain component. However, literature indicates that the analgesic benefit of gabapentinoids after knee arthroplasty is limited; in some analyses of the total knee arthroplasty subgroup, movement-related pain was reduced in early postoperative period, while evidence for long-term benefit remains insufficient [10]. In practice, gabapentinoid use should be careful and reflect individual risk factors, due to sedation, dizziness, and falls, particularly in older patients and when combined with opioids.

2.4 Opioids

Even though opioids remain effective for pain relief, they should only be reserved for breakthrough pain, when alternative options are exhausted, due to the risk of adverse effects. In other words, opioids can be used but should be reserved as a last resort [1].

3. Regional and local analgesia

3.1 Adductor canal block and femoral nerve block

Both the femoral nerve block (FNB) and the adductor canal block (ACB) are used to manage postoperative pain, however, evidence suggests meaningful differences in their clinical effects [11]. While FNB has been associated with less severe postoperative pain, ACB demonstrates advantages in functional outcomes. In particular, by preserving quadriceps muscle strength, ACB is linked with earlier mobility and rehabilitation [11]. Continuous postoperative ACB after TKA has been shown to significantly reduce opioid consumption

and lower pain scores (measured using Visual Analogue Scale) after the surgery [12].

3.2 Periarticular local infiltration analgesia

Periarticular local infiltration analgesia (LlA), which involves local anesthetic combined with additional adjuvants, is considered the fastest and safest method of postoperative analgesia. This technique is as effective as femoral or sciatic nerve block and may be associated with lower opioid consumption in practice [13].

3.3 Combining an adductor canal block with periarticular local infiltration analgesia

Combining ACB with periarticular LIA targets multiple nociceptive pathways, providing reduced sensory pain and localized tissue analgesia. Some studies report, that combining periarticular infiltration with continuous ACB or FNB present the most effective management of postoperative pain [14].

4. Non-pharmacological approach

After TKA, non-pharmacological pain management should emphasize early mobilization and structured physical therapy, since initiating movement within 24 hours is associated with reduced pain, better range of motion, shorter length of stay, and lower risk of complications, such as deep venous thrombosis [15]. Continuous passive motion (CPM) may be used as an adjunct in some rehabilitation programs, to promote early joint movement in the immediate postoperative phase. However, current evidence does not support its routine use for improving pain, function, length of stay, so it should not replace active exercise-based therapy [16, 17]. Electrotherapy, especially transcutaneous electrical nerve stimulation (TENS), is another useful adjunct; meta-analytic evidence suggests electrotherapy after TKA can reduce or delay opioid consumption, although its effect on pain intensity is less consistent across studies and protocols [18]. Cryotherapy is supported by systematic reviews showing reductions in postoperative pain, opioid use, blood loss, swelling, and improvements in early knee range of motion. Standard cold packs appear to perform similarly to more expensive continuous-flow devices [17, 18]. Positioning, elevation, and swelling control are also important, as postoperative knee positioning strategies and edema-management measures can reduce knee circumference, blood loss, and swelling, thereby improving comfort and supporting rehabilitation [15]. Overall, the best evidence supports combining early supervised mobilization, active physical therapy, cryotherapy, and basic swelling-control measures, while CPM and TENS should be reserved as adjuncts options rather than stand-alone interventions, particularly in enhanced recovery programs after primary TKA [15-18].

Conclusions

1. After TKA, optimal pain management is most often achieved through multimodal, opioid-sparing analgesia.

2. Preoperatively, patients with high baseline pain and psychological vulnerability should be identified and treated accordingly, and surgeons should aim for efficient, standardized TKA technique, minimizing tissue damage.

3. Acetaminophen and nonsteroidal anti-inflammatory drugs or cyclooxygenase-2 selective inhibitors form the basis of systemic analgesia after TKA, and celecoxib can be used to decrease the need for opioids.

4. Glucocorticoids can be used for their antiemetic and anti-inflammatory effect, while gabapentinoids should be carefully considered for neuropathic pain component.

5. Adductor canal block is often the preferred regional technique because it better preserves quadriceps strength and facilitates early mobilization compared with femoral nerve block while maintaining similar analgesia.

6. Periarticular local infiltration analgesia is effective and easy to integrate into enhanced recovery; combining it with continuous adductor canal block may provide additional early benefits and opioid sparing.

7. Non-pharmacological pain management should prioritize early supervised mobilization, active physiotherapy, cryotherapy, and swelling control, while reserving continuous passive motion and transcutaneous electrical nerve stimulation as adjuncts.

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SKAUSMO VALDYMAS PO VISIŠKO KELIO SĄNARIO ENDOPROTEZAVIMO

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Raktažodžiai: visiškas kelio sąnario endoprotezavimas, pooperacinis skausmas, kombinuota analgezija, pritraukiamojo nervo kanalo blokada, periartikulinė infiltracinė analgezija, opioidų vengiantis gydymas, reabilitacija, kineziterapija.

Santrauka

Pooperacinis skausmas po visiško kelio sąnario endoprotezavimo (VKSE) išlieka vienu iš svarbiausių veiksnių, turinčių įtakos ankstyvajai reabilitacijai, sveikimui stacionare ir ilgalaikiams rezultatams. Ūminis skausmas būna stipriausias pirmąsias 72 valandas po operacijos ir, jei nėra tinkamai gydomas, gali atidėti ankstyvą judėjimą, riboti dalyvavimą kineziterapijoje, didinti komplikacijų riziką ir prisidėti prie didesnio vėlyvo opioidų poreikio. Lėtinis skausmas po VKSE taip pat yra dažnas ir priklauso nuo nociepcinių, neuropatinių bei psichosocialinių veiksnių.

Šios literatūros apžvalgos tikslas – apibendrinti naujausius mokslinės literatūros duomenis apie sistemines farmakologines, regionines ir nefarmakologines skausmo valdymo strategijas po VKSE.

Metodai. Literatūros paieška atlikta PubMed/MEDLINE duomenų bazėje, naudojant su VKSE, pooperaciniu skausmu, analgezijos metodais ir reabilitacijos priemonėmis susijusius raktažodžius anglų kalba. Pirmenybė teikta sisteminėms apžvalgoms, metaanalizėms ir atsitiktinių imčių kontroliuojamiems tyrimams.

Rezultatai. Literatūros duomenys rodo, kad tinkamiausia skausmo kontrolės strategija yra kombinuota, opioidų vengianti analgezija. Paracetamolis ir nesteroidiniai vaistai nuo uždegimo arba ciklooksigenazės-2 inhibitoriai sudaro sisteminio gydymo pagrindą, o gliukokortikoidai gali būti naudingi kaip papildoma priemonė ankstyvam skausmui ir pykinimui kontroliuoti. Pritraukiamojo nervo kanalo blokada yra naudingesnė už šlauninio nervo blokadą, nes geriau išsaugo šlaunies keturgalvio raumens jėgą. Taip pat veiksminga periartikulinė infiltracinė analgezija, lengvai integruojama į pagreitinto sveikimo programas. Ankstyvas kelio sąnario išjudinimas, kineziterapija, šalčio ir tinimo kontrolė taip pat gerina sveikimą ir mažina opioidų poreikį.

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