

Review Article

Postoperative analgesia in total knee arthroplasty

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ABSTRACT

Total knee arthroplasty is commonly performed in patients with end-stage osteoarthritis or rheumatic knee arthritis to relieve joint pain, increase mobility, and improve quality of life. Despite advances in surgical techniques, postoperative pain management in these types of patients is still deficient. An exhaustive review was performed with the available literature, using the PubMed, ScienceDirect, Scopus and Cochrane databases from 2004 to 2021. The search criteria were formulated to identify reports related to total knee replacement and pain management. Pain after total knee arthroplasty has been shown to involve both peripheral and central pain pathways, which is why various postoperative pain management strategies are currently applied, including patient-controlled analgesia, continuous peripheral nerve blocks, or single injection or local infiltration analgesia. Today local techniques such as periarticular injections are becoming more common in total knee replacement due to their effectiveness in controlling pain without causing muscle weakness. The development of minimally invasive techniques associated with multimodal and preventive analgesia improves recovery rates and early rehabilitation in patients undergoing total knee arthroplasty, reducing in-hospital costs, risk of complications, and improving patient satisfaction with chronic osteoarthropathy.

Keywords: Pain, Postoperative pain, Total knee arthroplasty, Pain control, Multimodal analgesia

INTRODUCTION

Total knee arthroplasty (TKA) has become one of the most practiced orthopedic surgeries today, reaching 130,000 annual joint replacements in the United States, an increase of approximately 143% is expected by the year 2050, compared to the year 2012.^{1,2} TKA is commonly

performed in patients with end-stage osteoarthritis or rheumatic knee arthritis to relieve joint pain, increase mobility, and improve quality of life.³ Despite advances in surgical techniques, management of the postoperative pain in this type of patient is still deficient.⁴ The term pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or

described in terms of such damage.⁵ Postoperative pain in TKA is a factor that can cause complications in the short and long term, since it inhibits ambulation, limits range of motion, and may increase the risk of thromboembolism.⁶ Of all TKA patients it is estimated that approximately 60% of TKA patients experience severe postoperative knee pain and 30% experience moderate pain.⁷

There are at least 10 different pain management modalities for TKA. It would be prohibitively expensive and impractical to conduct a randomized trial comparing them all simultaneously, so this manuscript aims to compare the currently available analgesia options. The optimal pain management modality also allows for a wide range of motion, facilitating physical therapy and rapid functional recovery.⁸

METHOD

An exhaustive review was performed with the available literature, using the PubMed, ScienceDirect, Scopus and Cochrane databases from 2004 to 2021. The search criteria were formulated to identify reports related to total knee replacement and pain management. We use the following keywords: pain, postoperative pain, total knee arthroplasty, pain control, multimodal analgesia. We also include the author's experience in the management of these patients.

RESULTS

Post-TKA pain has been shown to involve both peripheral and central pain pathways, so various postoperative pain management strategies are currently applied, including patient-controlled analgesia, single or continuous peripheral nerve blocks, injection or local infiltration analgesia. Evidence has shown that monotherapy alone is not sufficient to provide postoperative pain relief, therefore multimodal analgesia is considered an effective tool for pain control; first introduced by Wall in 1988, and refers to a combination of various drug types and routes of administration, including preventive analgesia, neuraxial anesthesia, peripheral nerve block, patient-controlled analgesia, local infiltration analgesia, and medication oral opioid and non-opioid, includes preoperative and intraoperative analgesia, and postoperative analgesic regimens.^{9,10} Although opioids are effective in pain management after TKA, there are some adverse effects associated with them, such as itching, nausea, drowsiness, respiratory depression, urinary retention and constipation, long-term use of opioid drugs can lead to tolerance and dependency.¹¹ The anatomy of the knee joint makes effective analgesia complex, the innervation of the knee skin comes from the femoral nerve, the obturator nerve, the tibial nerve and the common peroneal nerves (the last two are branches of the sciatic nerve). The innervation of the knee joint can be divided into: the anterior group, which consists of the articular branches of the femoral, common peroneal, and saphenous nerves, and the posterior

group, which consists of the posterior articular branch of the tibial nerve and obturator nerves.^{12,13}

Recent authors have proposed the use of preventive analgesia, which proposes increases the pain threshold, contributing to a lower postoperative application of analgesics.⁶ Cyclooxygenase-2 (COX-2) inhibitors, such as parecoxib sodium and celecoxib, administered between 30 and 60 minutes before surgery significantly reduce postoperative pain and morphine consumption without increasing the incidence of other postoperative complications.^{14,15} COX-2 inhibitors have a favorable adverse effect profile with reduced gastrointestinal effects and risk of blood loss, so the efficacy and safety of parecoxib may reduce pain and opioid consumption after arthroplasty total knee exerting an analgesic effect by reducing the synthesis of peripheral prostaglandins alleviating inflammation and inhibiting the expression of peripheral and central COX-2, which ultimately prevents sensitization of the central nervous system.⁶ Lubis et al showed that a combination of pregabalin and celecoxib could be used as preventive analgesia in TKA through its synergistic effects, showing to be effective in reducing the postoperative use of morphine regardless of the dose.¹⁶ Numerous studies have shown that the preventive analgesia regimen significantly reduces pain at rest at 3 and 6 weeks, and pain due to movement at 1/3/6 weeks and 3 months postoperatively.¹⁷ The trend has been in the search for techniques, procedures or medications with less central influence to reduce the rate of adverse effects, therefore techniques such as local infiltration or ultrasound-guided regional anesthesia are considered a safe and effective technique for the management of postoperative pain.¹⁸ However, among the widely used techniques, nerve blocks have been used effectively as adductor canal block which involves injecting a solution into the deep adductor canal to the sartorius muscle. The femoral nerve block involves blocking the femoral nerve after it passes under the inguinal ligament, these procedures are usually easy to perform by trained personnel and provide good analgesia in the antero-medial aspect of the thigh, however in a meta-analysis it was found that femoral nerve block alone was less effective in terms of pain control and used less opioids versus other nerve blocks. Lumbar Psoas block involves injecting the solution into the compartment between the quadratus lumbar and the psoas, this type of block leads to blockage of the femoral, lateral cutaneous femoral, and obturator nerves as they run within the psoas major muscle.¹⁹ Obturator nerve block involves blocking the nerve about 5 to 10 cm below the pubic tubercle directly lateral to the adductor longus tendon. Sciatic nerve block can be blocked in several different locations. The most common approaches are the trans gluteus and anterior while the patient is supine.¹⁹ Multiple blocks have been shown to be preferable to single nerve blocks, and / or in conjunction with periarticular infiltration and epidural analgesia, a combination of femoral nerve block and sciatic nerve block is the optimal approach, combinations of blocks Peripheral nerve imaging minimizes pain and opioid

requirements while maximizing passive knee range of motion, however huge deficits are documented within the existing literature. Nowadays, local techniques such as periarticular injections are becoming more common in TKA due to their efficacy in controlling pain without causing muscle weakness.²⁰ A recent study found that the use of periarticular injections is associated with a slight decrease in the length of stay and a small increase in distance walked.²¹ The participation of anesthesiology in the multidisciplinary team must be active and direct, intervening in the immediate and short-term management of analgesia in these patients.²²

CONCLUSION

The development of minimally invasive techniques with little or no systemic penetration, associated with multimodal and preventive analgesia improves recovery rates and early rehabilitation in patients undergoing TKA, reducing in-hospital costs, risk of complications and improving patient satisfaction. patient with chronic osteoarthropathy. It is necessary, through multidisciplinary teams, to optimize perioperative algorithms with regard to pain control, and to refine clinical pathways to identify therapeutic targets for preoperative care, which could become the future of total arthroplasty care of knee.

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REFERENCES

- ShuYa Mei, ShuQing Jin, ZhiXia Chen, XiBing Ding, Xiang Zhao, Quan Li. Analgesia for total knee arthroplasty: a meta-analysis comparing local infiltration and femoral nerve block. 2015;70(9):648-53.
- Inacio MCS, Paxton EW, Graves SE, Namba RS, Nemes S. Projected increase in total knee arthroplasty in the United States-an alternative projection model. Osteoarthritis Cartilage. 2017;25(11):1797-803.
- Aso K, Izumi M, Sugimura N. Additional benefit of local infiltration of analgesia to femoral nerve block in total knee arthroplasty: double-blind randomized control study. Knee Surg Sports Traumatol Arthrosc. 2019;27(7):2368-74.
- Xu J, Chen XM, Ma CK, Wang XR. Peripheral nerve blocks for postoperative pain after major knee surgery. Cochrane Database of Systematic Reviews. 2014;(12):CD010937.
- Srinivasa RN, Daniel CB, Milton C. La definición revisada de dolor de la Asociación Internacional para el Estudio del Dolor: conceptos, desafíos y compromisos. DOLOR. 2020;161:1976-82.
- Li, Jing-wen, Ma, Ye-shuo, Xiao, Liang-kun. Postoperative Pain Management in Total Knee Arthroplasty. Orthopaedic Surgery. 2019;11:755-61.
- Hina N, Fletcher D, Poindessous - Jazat F, Martinez V. Hiperalgia inducida por el tratamiento con opioides en dosis bajas antes de la cirugía ortopédica: un estudio observacional de casos y controles. Eur J Anaesthesiol. 2015;32:255-61.
- Trang T, Al-Hasani R, Salvemini D, Salter MW, Gutstein H, Cahill CM. Dolor y amopolas: lo bueno, lo malo y lo feo de los analgésicos opioides. J Neurosci. 2015;35:13879-88.
- Weick J, Bawa H, Dirschl DR, Luu HH. El uso preoperatorio de opioides se asocia con mayores tasas de reingreso y revisión en artroplastia total de rodilla y cadera. J Bone Joint Surg Am. 2018;100:1171-6.
- Seo SS, Kim OG, Seo JH, Kim DH, Kim YG, Park BY. Comparison of the effect of continuous femoral nerve block and adductor canal block after primary total knee arthroplasty. Clin Orthop Surg. 2017;9:303-9.
- Hina N, Fletcher D, Poindessous - Jazat F, Martinez V. Hiperalgia inducida por el tratamiento con opioides en dosis bajas antes de la cirugía ortopédica: un estudio observacional de casos y controles. Eur J Anaesthesiol. 2015;32:255-61.
- Trang T, Al-Hasani R, Salvemini D, Salter MW, Gutstein H, Cahill CM. Dolor y amopolas: lo bueno, lo malo y lo feo de los analgésicos opioides. J Neurosci. 2015;35:13879-88.
- Weick J, Bawa H, Dirschl DR, Luu HH. El uso preoperatorio de opioides se asocia con mayores tasas de reingreso y revisión en artroplastia total de rodilla y cadera. J Bone Joint Surg Am. 2018;100:1171-6.
- Bian YY, Wang LC, Qian WW. Papel del parecoxib sódico en la analgesia multimodal después de la artroplastia total de rodilla: un ensayo controlado aleatorio doble ciego. Orthop Surg. 2018;10:321-7.
- Jianda X, Yuxing Q, Yi G, Hong Z, Libo P, Jianning Z. Impact of Preemptive Analgesia on inflammatory responses and Rehabilitation after Primary Total Knee Arthroplasty: A Controlled Clinical Study. Sci Rep. 2016;6:30354.
- Lubis AMT, Rawung RBV, Tantri AR. Preemptive analgesia in total knee arthroplasty: comparing the effects of single dose combining celecoxib with pregabalin and repetition dose combining celecoxib with Pregabalin: double-blind controlled clinical trial. Pain Res Treat. 2018;3807217.
- Xu Z, Zhang H, Luo J, Zhou A, Zhang J. Preemptive analgesia by using celecoxib combined with tramadol/APAP alleviates post-operative pain of patients undergoing total knee arthroplasty. Phys Sportsmed. 2017;45:316-22.
- Zamudio-Castilla LM, González Vera JF, Rodríguez-Conde JR, Dorado-Velasco FC. Implementación y evaluación de un protocolo de analgesia multimodal en el reemplazo total primario de rodilla que incluye bloqueo de canal de aductores guiado por ultrasonografía más infiltración de anestésico local

- periarticular. *Revista de la Sociedad Española del Dolor.* 2021;28(1):9-18.
19. Ilfeld BM, McCartney CJL. Searching for the Optimal Pain Management Technique after Knee Arthroplasty: Analgesia Is Just the Tip of the Iceberg. *Anesthesiology.* 2017;126:768-77
 20. Lee GC. What's new in adult reconstructive knee surgery. *J Bone Joint Surg Am.* 2018;100(02):166-75.
 21. Schneider J, Broome B, Keeley D. Narcotic-Free Perioperative Total Knee Arthroplasty: Does the
22. Johnson RL, Kopp SL. Optimizing perioperative management of total joint arthroplasty. *Anesthesiol Clin.* 2014;32:865-80.

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