

Benefits of ultrasound-guided peripheral nerve block on enhanced recovery in outpatient total knee arthroplasty

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Total knee arthroplasty (TKA) is one of the most common elective surgeries in the United States, with 680,150 procedures performed in 2014, a number that is projected to increase by 189% to 1.28 million primary knee replacements by 2030, according to a study presented at the 2018 Annual Meeting of the American Academy of Orthopaedic Surgeons.

For appropriately selected patients, outpatient TKA provides safe, cost-effective care, with a recent study reported a cost savings of \$8,527 per patient for ambulatory and short-stay knee replacement procedures, as compared to the standard length of stay (LOS) group.

Demand for outpatient TKA has risen dramatically. Between 2012 and 2015, the rate of outpatient total joint arthroplasty (OTJA) grew 47%, and it is expected that OTJA will grow by 77% over the next ten years, with inpatient TJA only growing 3% during the same period. Contributing to the rising popularity of outpatient TKA for appropriate patients are Enhanced Recovery After Surgery (ERAS) protocols. Designed to standardize care of the surgical patient with best practices, these protocols have demonstrated significant

clinical and economic benefits in nearly all surgical specialties, with a 30% to 50% reduction in length of stay (LOS), similar reductions in complications, and decreased costs and readmissions.

ERAS protocols often include regional anesthesia, which a recent review of the evidence has identified as “the optimal ERAS technique” for TKA, resulting in superior analgesia, decreased operative time and improved outcomes. A large body of evidence has demonstrated that ultrasound-guided regional anesthesia (UGRA) produces longer block durations, faster onset times, improved block success and a reduced need for opioids. Moreover, advancements in point-of-care ultrasonography (POCUS) have enabled the development of new nerve block techniques that may have important advantages for improved patient safety and faster recovery, facilitating outpatient knee replacement surgery for appropriate patients.

This review offers an overview of the role of UGRA in enhancing recovery after outpatient TKA, based on recent literature and the author’s experience leading the outpatient joint replacement program at Illinois Sports Medicine and Orthopedic Surgery Center, which has performed hundreds of knee replacement procedures on carefully selected patients ranging in age from the late 30s to 81, with excellent outcomes and high patient satisfaction.

Superior Analgesia for Total Knee Arthroplasty, with a Minimal Need for Opioids

Optimal pain control has been shown to accelerate functional recovery, reduce postoperative complications and improve patient satisfaction after TKA, a procedure that involves extensive bone resection and soft tissue manipulation. To spare patients the severe

pain that may otherwise occur in the early postoperative period, our center uses a multimodal pain management protocol that includes UGRA, an approach strongly recommended in evidence-based guidelines from the American Pain Society, the American Society for Regional Anesthesia and the American Society of Anesthesiologists for a range of procedures, including those of the extremities.

The availability of POCUS to guide regional anesthesia has contributed to several advancements in patient safety. Experience at our center, as well as robust published evidence, has revealed that use of UGRA helps minimize opioid use, an important public health priority. Nationally, more than 70 million patients receive opioids for postsurgical pain annually, with more than 10% of these patients continuing to take them one year later. Opioid prescriptions, which often exceed the amount required to manage postoperative pain, may serve as a source for diversion and drug-related harm. Since 1999, overdose deaths involving prescription opioids have quadrupled in the U.S. and every day, more than 1,000 patients are treated in hospital emergency departments for misuse of these drugs.

Ultrasound-guided peripheral nerve blocks (PNBs) are increasingly used as a component of multimodal opioid-sparing analgesia in ERAS protocols for knee replacement and may be administered as a single injection or continuous infusion via a perineural catheter. Meta-analyses of randomized controlled trials (RCTs) have demonstrated superior postoperative pain control and reduced opioid requirements in patients receiving PNBs versus those receiving intravenous (IV) opioids for a range of upper and lower extremity surgical procedures. Experience at our center bears this out: Despite minimal use of IV narcotics, our knee replacement patients are typically able to start mobilizing one hour after their

surgery and are ready for discharge within two to three hours.

The Optimal Ultrasound-guided Block for Knee Replacement Surgery

POCUS has contributed to the development of innovative nerve block techniques that would be difficult or even impossible to perform using traditional “landmark” methods. One major reason why our patients get back on their feet so quickly after total knee arthroplasty is our adoption of a relatively new ultrasound-guided PNB: adductor canal block (ACB), which was described in a recent publication as “the optimal nerve block for knee replacement surgery.” At our center, this block typically takes less than 10 minutes to take effect, with patients typically reporting that after the block has been administered under ultrasound guidance that, “my knee feels better.”

In a recent systematic review of 78 peer-reviewed publications comparing the safety and efficacy of ACB with that of an older technique frequently used for TKA, femoral nerve block (FNB), Yuan and colleagues recommended that adductor canal block replace FNB as the primary regional analgesic following knee replacement. The review, which included 13 RCTS of the two blocks, concluded that both blocks provided similarly effective pain control for patients undergoing TKA, but adductor canal block offered the following important advantages:

- **Reduced risk for postoperative falls.** Considered hospital-acquired conditions (HACs), inpatient falls are classified as “never events” by the Center for Medicaid and Medicare Services. That means Medicare does not usually reimburse the cost of these falls, which average \$4,000 per event. Recently use of FNB for lower

extremity surgeries has declined due to concerns about fall risk due to the quadriceps weakness associated with use of this block, with various studies quoting the risk of falls at anywhere from 1.6% to 7%. ACB has consistently been shown to preserve the majority of Quadriceps Motor Strength (QMS), thus helping patients avoid falls after knee replacement surgery.

- **Faster recovery and fewer complications.** Preservation of QMS facilitates earlier ambulation after TKA. This suggests that use of ACB not only contributes to a more rapid rehabilitation and return to usual activities, but it may also help patients avoid such complications as deep vein thrombosis and joint rigidity from lack of active mobilization after knee replacement. In some cases, the review's authors report, use of ACB may actually improve QMS due to blunting of pain-mediated quadriceps dysfunction from TKA

- **Decreased length of stay and healthcare costs.** Taken together, the benefits of ACB may potentially reduce LOS and associated healthcare costs, while also decreasing risk for costly complications.

A number of other investigations of total joint arthroplasty have revealed that regional anesthesia techniques can significantly improve patient safety and outcomes, while also expediting surgical care. Pooled results from 21 RCTS of patients undergoing knee or hip replacement has shown that the use of regional anesthesia reduced operating time [odds ratio (OR) -0.19), the need for blood transfusions (OR 0.45) and rates of deep vein thrombosis (OR 0.45). In a systematic review and meta-analysis of 13 RCTS of peripheral nerve blocks, use of ultrasound guidance was shown to improve the success of PNBs [risk ratio (RR) for block failure 0.41], accelerate onset by 29%, increase duration by 25%, and shorten block performance time, as compared to electrical neurostimulation

techniques. Moreover, ultrasound guidance reduced risk for vascular puncture (RR 0.16).

Higher Patient Satisfaction and Optimal Recovery

Along with improving postoperative pain management, expediting recovery, and decreasing opioid use and its side effects, such as nausea and vomiting, regional anesthesia techniques have been shown in a number of studies to increase patient satisfaction after a variety of joint procedures. That has also proven true at our center, which has a consistently high level of patient satisfaction, as evidenced by many of our patients referring their friends or family members to us for surgical care. In a number of cases, our patients have been so pleased with the success of their TKA that they later returned to have their other knee replaced or to undergo other joint surgeries as needed.

A rapidly growing body of evidence has demonstrated the safety and efficacy of ERAS protocols for TJA. In 2017, the first meta-analysis and systematic review of ERAS protocols for hip and knee replacement was published, with the following findings:

- LOS after total joint arthroplasty can be safely reduced from four to 12 days to one to three days with no significant differences in complication rates or readmissions.
- Postoperative pain assessments in five studies show that ERAS groups achieved better analgesic results than non-ERAS groups.
- ERAS protocols are associated with significantly lower hospital costs for patients undergoing TKA and THA, compared to traditional surgical care.
- Most studies found that ERAS was safe and effective, expedited the patient's recovery, decreased reliance on costly pain medications, and was superior to traditional treatment for the

various afflictions of the postoperative period.

The investigators advocated that ERAS protocols, which are relatively new for joint arthroplasty, be more widely adopted, concluding that "improvements in orthopedic surgical techniques as well as those anesthesia technology have produced exciting clinical results in enhancing postoperative recovery, especially in joint surgery cases."

Among the ways that anesthesiologists can take a leadership role in implementing these evidence-based protocols are optimization of the analgesia protocol, use of preemptive analgesia, opioid-sparing peripheral nerve blocks, local infiltration anesthesia and use of ultrasound guidance to enhance the speed, safety and success of regional anesthesia techniques. It is through implementing these best practices that we can expedite and enhance our patients' recovery, while minimizing risks and reining in costs.

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