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Practice Guidelines

Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the 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

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The American Association of Hip and Knee Surgeons, The American Academy of Orthopaedic Surgeons (AAOS), The Hip Society, The Knee Society, and The American Society of Regional Anesthesia and Pain Medicine have worked together to develop evidence-based guidelines on the use of regional nerve blocks in primary total knee arthroplasty (TKA). The purpose of these guidelines is to improve the treatment of orthopedic surgical patients and reduce practice variation by promoting a multidisciplinary evidence-based approach to the use of regional nerve blocks following primary TKA.

The combined clinical practice guidelines are meant to address common and important questions related to the efficacy and safety of regional nerve blocks in primary TKA. Utilizing the *AAOS Clinical Practice Guidelines and Systematic Review Methodology*, the committee members completed a systematic review and meta-analyses to support the clinical practice guidelines [1]. For each question, we have provided a recommendation, assessed the strength of the recommendation, and elaborated on the rationale of the recommendation, which should be interpreted in accordance with the *AAOS Clinical Practice Guidelines and Systematic Review Methodology* [1]. The current clinical practice guidelines were based on the available evidence, so future updates may become necessary as additional literature becomes available with future research.

Guideline Question 1

For patients undergoing primary TKA, is there a difference between regional nerve blocks in postoperative pain, opioid consumption, and/or complications?

Block versus Control Recommendations

Response/Recommendation 1A

Regional nerve blocks, including single-shot or continuously administered femoral nerve block or adductor canal block, effectively reduce postoperative pain and opioid consumption without an increase in adverse events, but femoral nerve blocks are associated with decreased quadriceps strength after primary total knee arthroplasty.

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Strength of Recommendation 1A

Strong.

Response/Recommendation 1B

The infiltration between Popliteal Artery and Capsule of Knee (iPACK) may reduce postoperative pain, but iPACK does not effectively reduce postoperative opioid consumption after primary TKA.

Strength of Recommendation 1B

Limited.

Block versus Block Recommendations

Response/Recommendation 1C

There is no difference between a single-shot or continuous femoral nerve block in postoperative pain, opioid consumption, or adverse events after primary TKA; however, providers should consider the side effects of quadriceps weakness associated with femoral nerve blocks when selecting a regional nerve block.

Strength of Recommendation 1C

Strong.

Response/Recommendation 1D

There is no difference between a single-shot femoral nerve block or adductor canal block in postoperative pain, opioid consumption, or adverse events, but a single-shot femoral nerve block is associated with decreased quadriceps strength after primary TKA compared to a single-shot adductor canal block.

Strength of Recommendation 1D

Strong.

Response/Recommendation 1E

There is no difference between a continuous femoral nerve block or adductor canal block in postoperative pain, opioid consumption, or adverse events, but a continuous femoral nerve block is associated with decreased quadriceps strength after primary TKA compared to a continuous adductor canal block.

Strength of Recommendation 1E

Strong

Response/Recommendation 1F

Continuous adductor canal block could reduce postoperative pain and opioid consumption without an increase in adverse events compared to a single-shot adductor canal block following primary TKA.

Strength of Recommendation 1F

Moderate.

Rationale

We reviewed 29 randomized clinical trials, which represented the best available evidence, including 20 high quality and 9 moderate quality studies to evaluate the effectiveness of a single-shot or continuous femoral nerve block or adductor canal block or iPACK to reduce pain and/or opioid consumption following primary TKA [2–30]. Among the included studies comparing a regional nerve block to control, 13 studies investigated a single-shot femoral nerve block, 8 studies investigated a continuous femoral nerve block, 6 studies investigated a single-shot adductor canal block, 4 studies investigated a continuous adductor canal block, and 1 study investigated iPACK [2–30]. Although additional regional nerve blocks have been studied with randomized clinical trials following primary TKA, the workgroup excluded these alternative regional nerve blocks because of limited evidence or lack of clinical relevance. For instance, a combined femoral and sciatic nerve block effectively provides total analgesia of the lower extremity, but it causes significant motor weakness not conducive to early postoperative mobilization. Similar to prior clinical practice guidelines on postoperative analgesia, only a limited number of meta-analyses were capable of being performed to support the recommendations [31–34]. Inconsistencies in the reporting of outcomes and timepoint for reporting of outcomes frequently resulted in substantial heterogeneity in the meta-analyses.

Despite the numerous high and moderate quality studies on single-shot or continuous femoral nerve blocks, the meta-analyses related to pain and opioid consumption were omitted from consideration in the recommendations due to the presence of substantial heterogeneity. However, qualitative analyses of studies on single-shot or continuous femoral nerve block consistently demonstrate a significant reduction in postoperative pain and opioid consumption for both types of blocks compared to controls [4,9–11,13,14,16–19,22–30]. In direct meta-analysis and with no heterogeneity single-shot adductor canal block demonstrate reduced opioid consumption compared to controls (−0.46 standard mean difference [SMD]; 95% confidence interval [CI] −0.78 to −0.13; $I^2 = 0\%$) [3,21]. Similarly, continuous adductor canal block demonstrated with no heterogeneity in direct meta-analysis to reduce opioid consumption compared to controls (−0.54 SMD; 95% CI −0.81 to −0.27; $I^2 = 0\%$) [6,15,20]. Because meta-analysis was not available to evaluate postoperative pain, qualitative assessment demonstrated evidence of a reduction in postoperative pain for a single-shot or continuous adductor canal block compared to controls [3,5–8,12,15,20,21]. Among the 15 studies reporting on adverse events, the studies consistently demonstrate no increase in adverse events with a single-shot or continuous femoral nerve block or adductor canal block compared to controls [3,9,12–16,19–23,26–28].

One study evaluated the iPACK block. In this high-quality randomized clinical trial of 69 patients, iPACK reduced postoperative pain but not opioid consumption following primary TKA [2]. The workgroup chose to downgrade the strength of the recommendation from moderate to limited strength based on the inconsistency in the results of the reported outcomes on postoperative visual analog scale pain with and without activity.

Although strong evidence demonstrated that single-shot and continuous femoral nerve and adductor canal blocks are safe and effective methods to reduce postoperative pain and opioid consumption following primary TKA, we reviewed 23 high and moderate quality randomized clinical trials comparing the efficacy and safety between regional nerve blocks [4,5,16,35–54]. Among the included studies, the following comparisons were made between regional nerve blocks: (1) single-shot femoral nerve block versus continuous femoral nerve block, (2) single-shot femoral nerve block versus single-shot adductor canal block, (3) continuous femoral nerve block versus continuous adductor canal block, and (4) continuous adductor canal block versus single-shot adductor canal block. The qualitative analysis demonstrated no difference in postoperative pain, opioid consumption, or adverse events between single-shot and continuous femoral nerve blocks following primary TKA [4,16,36,48]. Single-shot femoral nerve and adductor canal blocks demonstrated (with no heterogeneity in direct meta-analysis) no difference in postoperative pain at 24 hours (−0.10 SMD; 95% CI −0.40 to 0.19; $I^2 = 0\%$), pain at 48 hours (0.08 SMD; 95% CI −0.21 to 0.38; $I^2 = 0\%$), or opioid consumption (−0.06 SMD; 95% CI −0.35 to 0.24; $I^2 = 0\%$) following primary TKA

[39,41,43,44,51,54]. However, the 5 studies reporting on motor function consistently demonstrated decreased quadriceps strength persisting as long as 24 hours with a single-shot femoral nerve block [39,41,43,51,54]. Similarly, continuous femoral nerve and adductor canal blocks demonstrated (with no heterogeneity in direct meta-analysis) no difference in rescue opioid consumption on the first postoperative day (1.5 SMD; 95% CI −0.51 to 4.44; I^2 = 0%) while qualitative analysis demonstrated no difference in pain following primary TKA, but continuous femoral nerve block was associated with the presence of decreased quadriceps strength persisting up to 24 hours [37,40,47,49,53]. Continuous adductor canal block demonstrated (with limited heterogeneity in direct meta-analysis) reduced postoperative pain at 8 hours (−1.26 SMD; 95% CI −1.56 to −0.96; I^2 = 0%) and 36 hours (−0.59 SMD; 95% CI −0.89 to −0.29; I^2 = 0%) and reduced 48-hour opioid consumption (−0.32 SMD; 95% CI −0.64 to −0.001; I^2 = 23%) following primary TKA compared to single-shot adductor canal block [5,35,38,42,45,46,50,52]. Despite the evidence demonstrating improved efficacy for continuous compared to single-shot adductor canal block, the workgroup downgraded the recommendation from strong to moderate due to concerns regarding the associated cost, increased resource utilization, and risk of retained catheters with a continuous adductor canal block.

Based on the best available evidence, the workgroup believes that a femoral nerve block has a limited role in primary TKA due to the association of quadriceps weakness and demonstrated efficacy of an adductor canal block. We recommend the use of a single-shot adductor canal block when regional anesthesia is used in primary TKA; however, the workgroup would recommend consideration of a continuous adductor canal block in patients at risk for poor postoperative pain control.

Guideline Question 2

For patients undergoing primary TKA, is there a difference between perioperative regional nerve blocks, periarticular local anesthetic infiltration, or combination of these methods in reducing postoperative pain, opioid consumption, and/or complications?

Response/Recommendation 2A

There is no difference between a single-shot adductor canal block or periarticular local anesthetic infiltration in postoperative pain, opioid consumption, or adverse events after primary TKA.

Strength of Recommendation 2A

Moderate.

Response/Recommendation 2B

Combined single-shot adductor canal block and periarticular local anesthetic infiltration could reduce postoperative pain with no difference in postoperative opioid consumption or adverse events compared to periarticular local anesthetic infiltration alone after primary TKA.

Strength of Recommendation 2B

Moderate.

Response/Recommendation 2C

Combined single-shot adductor canal block and periarticular local anesthetic infiltration could reduce postoperative pain and opioid consumption compared to a single-shot adductor canal block alone after primary TKA.

Strength of Recommendation 2C

Moderate.

Rationale

We reviewed 11 randomized clinical trials, which represented the best available evidence, including 10 high quality and 1 moderate quality study to evaluate the effectiveness of regional nerve blocks and periarticular local anesthetic infiltration to reduce pain and/or opioid consumption following primary TKA [3,7,8,12,55–61]. Because the workgroup recommends the use of an adductor canal block over alternative regional nerve blocks, these recommendations only focused on a single-shot adductor canal block. Among the included studies, the following comparisons were made in the recommendations: (1) single-shot adductor canal block vs periarticular local anesthetic infiltration, (2) combined single-shot adductor canal block and periarticular local anesthetic infiltration vs periarticular local anesthetic infiltration alone, and (3) combined single-shot adductor canal block and periarticular local anesthetic infiltration versus single-shot adductor canal block alone. Although direct meta-analysis was utilized to evaluate the individual comparisons, network meta-analysis would have provided more clarity to the potential differences or similarities between combined single-shot adductor canal block and periarticular local anesthetic or either procedure in isolation. However, network meta-analysis must rely on the assumption of transitivity to compare between treatments not directly compared in a study [62]. Because of the variability in multimodal analgesic protocols, network meta-analysis cannot control for differences in multimodal analgesic protocols as well as direct meta-analysis. Therefore, no network meta-analysis was performed in the formulation of the recommendations.

Compared to periarticular local anesthetic infiltration, single-shot adductor canal block demonstrated (with limited heterogeneity in direct meta-analysis) no significant difference in postoperative pain with activity at 72 hours (−0.21 SMD; 95% CI −0.55 to 0.13; I^2 = 7%) or opioid consumption at 12 hours (−0.03 SMD; 95% CI −0.36 to 0.30; I^2 = 0%) or 72 hours (0.24 SMD; 95% CI −0.04 to 0.53; I^2 = 0%) following primary TKA [7,56,58,60]. Although the quantitative analysis that included 4 studies shows no significant difference between a single-shot adductor canal block or periarticular local anesthetic infiltration, the qualitative analysis of all 8 studies demonstrates conflicting results with the quantitative analysis [7,55–61]. Of the 8 studies reporting on postoperative pain, 5 studies favored single-shot adductor canal block, 2 studies favored periarticular local anesthetic infiltration, and 1 study had no difference in pain following primary TKA [7,55–61]. Of the 7 studies reporting on opioid consumption, 3 studies favored single-shot adductor canal block, 1 study favored periarticular local anesthetic infiltration, and 3 studies had no difference in opioid consumption following primary TKA [7,55,56,58–61]. The workgroup chose to downgrade the strength of the recommendation from strong to moderate strength based on the inconsistency between the quantitative and qualitative analysis. Because a strong recommendation represents future research is not likely to change the recommendation, the workgroup believes additional research has the potential to clarify the discordance in the analyses.

Combined single-shot adductor canal block and periarticular local anesthetic infiltration demonstrated (with no heterogeneity in direct meta-analysis) reduced postoperative pain at 24 hours (−0.38 SMD; 95% CI −0.65 to −0.10; I^2 = 0%) but no difference in opioid consumption at 24 hours (−0.07 SMD; 95% CI −0.34 to 0.20;

$I^2 = 0\%$), 48 hours (0.05 SMD; 95% CI −0.22 to 0.32; $I^2 = 0\%$), or 72 hours (−0.06 SMD; 95% CI −0.34 to 0.21; $I^2 = 0\%$) following primary TKA compared to periarticular local anesthetic infiltration alone [3,7]. However, the qualitative analysis among the 4 studies show the potential for reduced pain and opioid consumption for combined single-shot adductor canal block and periarticular local anesthetic infiltration [3,7,8,12]. Similar to the prior recommendation, the workgroup chose to downgrade the strength of the recommendation from strong to moderate based on the inconsistency between the quantitative and qualitative analysis. When comparing combined single-shot adductor canal block and periarticular local anesthetic infiltration to single-shot adductor canal block alone, qualitative analysis demonstrated reduced pain and opioid consumption following primary TKA for the combination treatment [7,61].

The workgroup recommends routine use of either a single-shot adductor canal block or periarticular local anesthetic infiltration for patients undergoing primary TKA. Although the current available evidence does not suggest the combination of a single-shot adductor canal block and periarticular local anesthetic infiltration is necessary in primary TKA, it could provide additional reduction in postoperative pain and opioid consumption compared to either alone.

Areas for Future Research

Despite the numerous high and moderate quality randomized clinical trials, we are still presented with the need for additional research to improve future clinical practice guidelines. We suggest that future research on regional nerve blocks focus on evaluation of the combination of a single-shot adductor canal block and periarticular local anesthetic infiltration or either treatment in isolation, as the current literature does not provide clarity whether the additional risks and costs associated with combined procedures is warranted to reduce pain and/or opioid consumption. Because continuous adductor canal blocks potentially provide reduced pain and opioid consumption compared to a single-shot adductor canal block, we suggest additional research to determine the ideal patient population whereby the additional cost and risks are warranted for the procedure. Finally, future research may help determine the optimal timing of performing a single-shot adductor canal block and the potential for the addition of other contents to the block injection to improve the efficacy or duration of action.

Peer Review Process

Following the committee's formulation of the Clinical Practice Guideline draft, it underwent a peer review by the board of directors from The American Association of Hip and Knee Surgeons, The American Society of Regional Anesthesia and Pain Medicine, and the Hip and Knee Societies. The AAOS Evidence-Based Quality and Value Committee reviewed the Clinical Practice Guideline draft for endorsement followed by the Council on Research and Quality, and finally the AAOS Board of Directors. Additionally, the publication of the systematic review and meta-analysis on regional nerve blocks in primary TKA that supported the formulation of the Clinical Practice Guideline has undergone peer review for publication.

Disclosure Requirement

All authors or contributors to the Clinical Practice Guideline have provided a disclosure statement in accordance with the publicly available AAOS Orthopedic Disclosure Program. In accordance with the *AAOS Clinical Practice Guidelines and Systematic Review Methodology*, all authors and contributors attest that none of the current disclosures are relevant to the Clinical Practice Guidelines, and no prior relevant financial conflict was within a year of initiating work on the guideline.

US Food and Drug Administration Clearance Statement

According to the US Food and Drug Administration, it is the prescribing physician's responsibility to ascertain the US Food and Drug Administration clearance status for all medications prior to use in a clinical setting.

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