Adductor Canal Block for Total Knee Arthroplasty: A Review of the Current Evidence

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Abstract
The positive impact of regional anesthesia on surgical outcome has continued to evolve. In recent years, the focus of acute pain management strategies following total knee arthroplasty has shifted from femoral nerve block to adductor canal block. We systematically analyzed the safety and efficacy of adductor canal blocks by reviewing 78 peer-reviewed publications, including 13 randomized controlled trials. There are a number of studies supporting the adductor canal nerve block as a viable alternative for postoperative analgesia after total knee arthroplasty. This novel block has been consistently demonstrated to have equivalent analgesic efficacy compared to femoral nerve block, while simultaneously reducing quadriceps weakness significantly less than femoral nerve block, thus facilitating earlier active mobilization. With focus on early rehabilitation, adductor canal block may be considered a contributory factor preventing complications such as deep vein thrombosis and joint rigidity from the lack of early mobilization. These advances could potentially result in a reduction of total length of hospital stay and therefore a reduction in associated health care costs. Based on the current evidence, we recommend that an adductor canal block could replace a femoral nerve block as the primary regional analgesic following total knee arthroplasty.

Keywords: Adductor canal block; Total knee replacement; Femoral nerve block

Introduction
In the United States alone, over 600,000 total knee arthroplasties (TKAs) are performed annually[1]. The estimation for primary TKA surgery is projected to increase to over 3 million per year by 2030 and knee joint revision procedures are estimated to increase by 600% between 2005 and 2030[2]. While the per capita number of primary TKA surgeries has doubled from 31 to 62 per 10,000, the length of hospitalization stay has decreased drastically[3]. Such a reduction in length of hospitalization may be due to a combination of less invasive surgical approaches, widespread implementation of enhanced recovery clinical pathways (“fast-track” programs), and novel perioperative analgesic techniques[4,5].

Conventional systemic opioid therapy has previously been the primary modality to control pain after TKA. However, post-operative analgesia has evolved over the past decade due to perioperative multimodal medications[6-8], local infiltration analgesia[9], and the advancement of regional anesthetic techniques. The focus of peripheral nerve blocks has shifted the acute pain management strategies following TKA from continuous lumbar epidural analgesia[10], to single injection or continuous Femoral Nerve Block (FNB)[11], and more recently, to the Adductor Canal Block (ACB)[12].

Anatomical considerations
The adductor canal, (also known as the sub-sartorial or the Hunter’s canal) is located within the middle third of the anterior-medial thigh and extends from the apex of the femoral triangle to the adductor hiatus. The apex of the femoral triangle is where the medial border of the sartorius muscle crosses over the medial border of the adductor longus muscle, while the ad-
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Adductor hiatus is an opening in the aponeurotic distal insertion of the adductor magnus muscle. In cross-section, the adductor canal is a triangular-shaped intermuscular channel bounded by the sartorius muscle (anteromedial), vastus medialis muscle (anterolateral), and both the adductor longus as well as the adductor magnus (posteromedial) muscles\(^{[13,14]}\). The roof of the adductor canal is formed by the subsartorial fascia, which extends across the adductor canal from the medial border of the vastus medialis to the lateral border of the adductor longus proximally and adductor magnus distally. The distal aspect of the subsartorial fascia is also known as the vastoaductor membrane\(^{[15,16]}\).

Within this triangular space, the contents of the adductor canal have traditionally been described as the femoral artery and vein, two fascicular branches of the femoral nerve; the saphenous nerve and the nerve to the vastus medialis, and the articular contribution of the obturator nerve, which enters the distal adductor canal just proximal to the adductor hiatus\(^{[17]}\). However, a recent detailed anatomical study indicates that while the nerve to the vastus medialis courses distally along the anteromedial border of the vastus medialis muscle in close proximity to the adductor canal and parallel to the saphenous nerve (Figure 1), it may not actually be located within the adductor canal proper\(^{[15]}\). Furthermore, the nerve to the vastus medialis muscle is contained within a bilayer fascial tunnel that lies between the adductor longus and vastus medialis muscles, separated from the adductor canal\(^{[18]}\). The saphenous nerve initially is located lateral to the femoral artery, then courses anteriorly and eventually located medial to the femoral nerve in the distal aspect of the adductor canal. The saphenous nerve exits through the vastoaductor membrane where the femoral vessels course deeper into the distal thigh passing through the adductor hiatus to become the popliteal vessels. The descending path of the saphenous nerve, most consistently found within the adductor canal, has been well described by Mansour\(^{[19]}\).

**Research Methods**

We performed a systematic review of all contemporary relevant publications on Medline and Embase (Figure 2). Population search MeSH terms included the following: “Replacement,” “Arthroplasty,” and “Nerve Block” with combined of specific nerves “saphenous,” and “adductor”. In addition, date range from 2009 to November 2015 was used to identify a total of 78 abstracts. A search prior to 2009 showed no relevant abstracts to the purpose of this article. All articles were reviewed, which included 13 randomized controlled trials Tabel with Jadad scores ≥ 4\(^{[20]}\).

**Figure 1:** Dissection of the adductor canal at mid thigh level. The sartorius muscle is retracted laterally to expose the adductor canal contents. The saphenous nerve and the nerve to the vastus medialis course laterally to the superficial femoral artery (SFA). FN- Femoral nerve; FA- Femoral artery

**Figure 2:** Flow diagram of the literature search.

**Ultrasound-guided technique for performing adductor canal block**

To perform an ultrasound-guided ACB, patients are typically placed in the supine position. The operative extremity is abducted and externally rotated with the skin prepped and draped over the middle third of the anteromedial thigh. Typically, a high frequency linear array ultrasound transducer is used to identify the target location where the Superficial Femoral Artery (SFA) can be identified deep to the middle third of the sartorius muscle (Figure 3). The hyperechoic saphenous nerve is usually located anterior-lateral to the pulsatile anechoic SFA. After obtaining the appropriate short-axis view of the target anatomical structures, a block needle is then advanced in-plane immediately inferior to the saphenous nerve, and local anesthetic is incrementally injected to achieve perineural distribution within the

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aductor canal. Most published studies report an initial bolus volume of 30 milliliters (mL)\(^2\) but others have been successful with as little as 15 mL of local anesthetics\(^3\). A catheter may also be deployed at this location for a continuous infusion or an intermittent bolus technique\(^2\). To date, there is no rigorous evidence to support either the optimal minimum local anesthetic volume and concentration or perineural distribution to achieve a successful adductor canal block. Confirmation of successful adductor canal block after total knee arthroplasty should be confirmed with sensory loss along the medial lower leg (distribution of the distal sartorial sensory branch). Testing sensory loss in the infrapatellar sensory distribution may be hampered by the presence of bandages around the knee, as well as a high percentage of postoperative hypoesthesia in the infrapatellar distribution due to surgical trauma\(^2\).

![Figure 3: Ultrasound imaging of short-axis view of middle of the thigh. Superficial femoral artery (FA) is identified deep to the sartorius muscle. The hyperechoic saphenous nerve is located anterior-lateral to the artery. A branch of the vastus medialis nerve is shown laterally as it courses to the vastus medialis muscle.](image)

Analgesic efficacy

The knee joint is primarily innervated by the femoral, the obturator, and the sciatic nerves\(^4\). Although, minimally invasive surgical techniques have resulted in less tissue trauma, the question remains regarding to the optimal postoperative analgesic regimen. With recent insurance reimbursement model changes\(^5\), attention has shifted to focus more on the further improvement of analgesia for patient satisfaction\(^6\) and in efforts to decrease the length of hospitalization.

The approach to anesthetize the saphenous nerve within the adductor canal has been long entertained to provide analgesia to the medial aspect of the ankle and foot\(^7\). However, the concept of using this block for TKA is a fairly recent innovation. In 2011, Lund et al. were the first to image the spread of a 30 mL local anesthetic bolus within the adductor canal through magnetic resonance imaging\(^8\). The authors believed that the administration of local anesthetic into this canal may be an effective adjunct to postoperative analgesia for TKA. One year later, this hypothesis was tested in a proof-of-concept RCT in patients with established severe knee pain within 30 minutes after emergence from general anesthesia for TKA\(^9\). There was no significant reduction in dynamic (45-degree active knee flexion after ACB with 30 mL either of ropivacaine 0.75% or saline placebo) VAS pain scores. The lack of difference in immediate active VAS scores may have been influenced by the relatively large amounts of systemic opioids (200 - 225 micrograms fentanyl and 12 - 13.5 mg morphine) administered to the patients 30 minutes prior to emergence from anesthesia. However, there was a significant reduction in active VAS scores between 30 minutes and 360 minutes (secondary outcome) after ACB was measured by area under the curve\(^10\). To model the effect of a continuous infusion, Jenstrup et al. reported results in a subsequent RCT using a continuous ACB (initial loading dose of 30 mL ropivacaine 0.75%, followed by intermittent bolus of 15 mL of either ropivacaine 0.75% ropivacaine or saline) at time intervals of 6, 12, and 18 hour postoperatively\(^\)). In this trial, both cumulative morphine consumption at 24 hours (primary outcome) and dynamic analgesia pain scores were significantly improved compared to placebo. The authors postulated that intermittent boluses, as opposed to a true continuous infusion, may have resulted in a wider spread of local anesthetic and contributed to the improved analgesic efficacy. This benefit of an intermittent bolus regimens has been demonstrated in labor analgesia\(^11\) and continuous interscalene analgesia\(^12\).

Many have previously questioned whether a continuous adductor canal infusion can provide satisfactory analgesia after TKA. Hanson et al. investigated the opioid-sparing effect of a continuous infusion of 0.2% ropivacaine versus sham catheter (placed in the sartorius muscle) with saline in TKA patients who initially received a single-injection femoral nerve block\(^13\). Of the 76 patients, cumulative 48-h postoperative morphine consumption, the primary outcome, was recorded. Although pain scores were different only during the first 30 hours, total morphine used was significantly reduced by 16.7 mg, with the greatest effect noted between 16 - 48hrs, presumably when the analgesic effects of the single injection femoral block had dissipated.

In a different study design, patients undergoing TKA with a standardized multimodal analgesic regimen (oral multimodal medications, a single 8-mg dose of intravenous dexamethasone, and high local infiltration analgesia with 200 mg ropivacaine) were randomized to continuous adductor catheters initially bloused with 15 ml of ropivacaine 0.75% followed by twice daily 15 mL dosing (8:00 AM and 8:00 PM) with either ropivacaine 0.75% or saline placebo through the evening of postoperative day 2\(^14\). The authors reported that a continuous ACB provided significantly improved resting and dynamic analgesia, but only in the evening of the day of surgery. Although this study did not show any benefit of continuous ACB beyond the day of surgery, the true analgesic benefits may have been underestimated due to scheduled acetaminophen and extended-release opioids (20 mg sustained-release morphine daily total) and high incidence of catheter dislodgement from the adductor canal.

Further studies also supports the analgesic efficacy of ACB after TKA\(^15\). In one trial, continuous adductor canal catheters with intermittent bolus dosing of ropivacaine 0.75% or saline after revision TKA reported significant reduction in dynamic pain only at 4 hours after the initial loading dose. All other postoperative VAS (resting and dynamic) scores and opioid re-
requirements over the first 48 hours were not significantly different[39]. However, this study was likely to be influenced by type-2 errors due to a large dropout rate (thus falling short of the minimum sample size requirement), the high incidence (60% of all patients in both groups) of chronic preoperative opioids, and the heterogeneous surgical population (with more than 50% in each group presented for either 2nd or even 3rd revision TKA). However, positive results were also conveyed in two other RCTs where pain scores and opioid consumption (secondary outcomes) with ACBs were not inferior to FNBs[38,40]. Most recently, Memtsoudis and colleagues have shown there was no significant difference in VAS scores between FNB and ACB groups during rest and passive movement[41].

Early postoperative functional outcome

Inpatient falls are considered hospital-acquired events and categorized as “never events” by the Center for Medicare and Medicaid Services[42]. These falls cost an average of $4000 per incident and are usually not reimbursed by Medicare[43,44]. Recently, FNBs have fallen out of favor in many lower extremity surgeries due to the potential fall risk from quadriceps weakness[45,46]. The risk of fall with FNBs has been quoted as high as 7 percent[47,48], but Memtsoudis et al. argued that this association may not completely be anesthesia related. In this large analysis of 191,570 patients from a national insurance database, they reported a fall incidence of only 1.6% after TKA, and the only two independent risk factors were advanced age and high comorbidity[42]. These findings highlight that one must remain cautious in assuming that lower extremity peripheral nerve blocks are the sole cause of inpatient falls after TKA. In fact, despite a comprehensive fall prevention program, the incidence of inpatient falls in the setting of continuous FNBs was still as high 2.7%[49]. Quadriceps muscle weakness after TKA may be likely due to confounding factors such as soft tissue trauma and interstitial edema[50].

ACB has been consistently shown to preserve the majority of Quadriceps Motor Strength (QMS) and may enhance objective measures of functional mobility to facilitate earlier ambulation and attainment of functional milestones[51-53]. In two volunteer RCTs[52,54], ACBs and FNBs were directly compared using a randomized crossover sequence design. Both trials demonstrated significantly less reduction of QMS in the ACB groups. However, because the volunteer subjects did not actually undergo TKAs, the authors cautioned that a definitive correlation should not be extrapolated to TKA patients. Nevertheless, targeting healthy volunteers eliminated confounding variables such as pain response, opioid consumption, surgical dressing, and psychosocial issues related to surgery and hospitalization.

The first double-blinded RCT comparing ambulation function with either continuous ACB or continuous FNB after TKA was performed by Jaeger et al[40]. The authors demonstrated that postoperative QMS (measured as percentage of baseline Quadriceps Maximal Voluntary Isometric Contraction [Q-MVIC]) was significantly higher in the ACB than the FNB group (52% vs. 18% of baseline Q-MVIC, P = 0.004). However, this study failed to show any significant difference between the two groups in terms of mobility testing (Timed-Up-and-Go test and the 10-point mobility scale). Subsequent RCTs provided further evidence that ACBs (single-injection or continuous technique) preserved QMS and enhanced measures of functional mobility after TKA, directly as compared to placebo[23], and to FNBs[38,55,56]. Additionally, recent retrospective cohort studies also provided evidence that ACB enhanced early ambulation, while maintaining equivalent analgesic efficacy[51,52]. However, none of these studies demonstrated a reduction in hospital length of stay.

Despite the advantages of QMS preservation and early enhanced mobility with ACB, a recently published RCT demonstrated that while a continuous ACB (48hr duration) provided significantly better analgesia compared to a single-injection, there was no difference between the techniques in terms of time to attain functional milestones (time to ambulation with a walker, staircase competency, or ambulation distance and maximal flexion at discharge)[57]. Thus, the optimal delivery of ACB and its role in enhancing early recovery and discharge within established clinical TKA pathways merits further clinical investigation.

Adverse effects

The incidence of nerve injury with peripheral nerve blocks depends on the particular definition of injury. Reported frequency of permanent neuropathy ranged between 1.5/10,000 to 9/10,000[38,59], while this incidence was reported to be higher with continuous catheters[60-61]. Henningsen et al. followed 97 patients after ACB catheter and found no definitive saphenous nerve injury related to the block itself. But 84% of the patients had signs of injury to the infrapatellar branch in the anatomical distribution of the surgical incision[24], which may attributed to surgical injury.

A unique effect to the ACB is the potential cephalad spread of local anesthetic within the adductor canal, with potential blockade of the more proximal femoral motor nerve branches within the femoral triangle. Such spread patterns were previously described in two reports of single injection[62,63] and continuous infusion in vivo[64]. This phenomenon has been well described in cadaveric dye studies[64,65]. Rarely, unrecognized cephalad spread of local anesthetic can lead to substantial quadriceps weakness. Gautier et al. reported a case where continuous ACB was performed with initial bolus of local anesthetic for anterior cruciate ligament repair and resulted in dorsiflexion weakness of the foot[66]. Subsequently, contrast was injected into the catheter and computer tomography revealed there was spread into the popliteal fossa and contacted the sciatic nerve[67]. However, Yuan et al. have demonstrated that contrast injection under controlled pressure did not routinely reach the lesser trochanter, or the location of the common femoral nerve[68]. In this study, sixty percent of subjects had contrast spread within either the same sector as the catheter tip, or one sector distally. This study demonstrated that there was limited catheter infusion spread within the adductor canal in both cephalad and caudal direction. However, the potential cephalad spread of local anesthetic within the adductor canal may place the patient at risk of quadriceps muscle weakness and fall.

Anatomically, much of the space in the adductor canal is occupied by the femoral vessels. Hence, there is a potential risk for unintended vascular puncture during the placement of ACB. Recent data shown the risk of vascular puncture decreases with ultrasounds guidance, but significant bleeding and serious complications can still occur due to the inability to recognize and compress the source of bleeding[69]. Any uncooperative pa-
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tient may not be a candidate for this block due to the surrounding vascular structure. Finally, the adductor canal is bounded by intermuscular compartments. Although no published report currently exists, leaking of local anesthetic from the potentially fenestrated vastoadductor membrane or the migration of catheter tip outside of the adductor canal can result in possible delayed myositis or even local anesthetic systemic toxicity[10]. There has been one report of a patient developing a hematoma around the adductor canal injection site after catheter removal, who subsequently developed saphenous distribution neuropathy that required 4 months of gabapentin treatment before resolution of symptoms[16].

Future directions
The search for the optimal postoperative analgesic regimen for TKA continues. Perhaps one day we may discover a highly selective local anesthetic which targets only the sensory fibers while completely sparing motor function[69]. In a way, the ACB may already provide this goal by primarily blocking the predominant afferent sensation from the knee without significant effect on QMS[70]. For further improvement of clinical outcomes, we must focus our attention on the optimal anatomical approach and technique for adductor canal catheter placement, as well as the optimal delivery and duration of continuous infusions in order reduce to the potential block-related complications and retain the demonstrated analgesic benefits. As of yet, only a few studies have compared various approaches of the ACB, but none with clinically meaningful primary outcomes[71,72]. Additionally, while both continuous infusion and intermittent bolus techniques have been demonstrated to provide analgesic efficacy, there is a lack of evidence of which is the ideal method. Furthermore, the optimal volumes and concentrations for either continuous or intermittent bolus techniques require further investigation in quality RCTs.

Conclusions
The positive impact of regional anesthesia on surgical outcome has continued to evolve, most recently with the introduction of the ACB for TKA. It has enhanced patient recovery by not only providing analgesia that is non inferior compared to FNB, but has done so while preserving, and in some instances, actually improving QMS due to blunting of the well-known pain-mediated quadriceps dysfunction from TKA. In summary, the evidence supports that in the setting of varied comprehensive preoperative multimodal analgesic regimens (LIA, oral NSAIDs, acetaminophen, gabapentinoids, and opioid analgesic), ACB has been consistently demonstrated to provide non inferior analgesic efficacy compared to FNB. Furthermore, ACB minimizes the efferent motor weakness associated with FNB. Based on current evidence to date, we conclude that ACB could replace FNB, as the first option for peripheral regional anesthetic technique after TKA.

Conflicts of Interest: The authors declare no conflict of interest.

Table 1: Randomized Controlled Trials of Adductor Canal Block with Jadad scores ≥ 4.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Methodology</th>
<th>Primary Outcome</th>
<th>Significant Secondary Outcomes</th>
<th>Comments</th>
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<tr>
<td>Jenstrup et al.</td>
<td>2012</td>
<td>ACB placed in PACU. 30 mL loading dose followed by intermittent boluses via AC catheters with either 15 mL R 0.75% or NS every 6 hr. at 6, 12, 18 and 24 hr.</td>
<td>Morphone consumption significantly decreased with R vs. NS (40 ± 21 vs. 56 ± 21 mg) for 1st 24 hr., P=0.006</td>
<td>Active VAS scores lower with R (P=0.01), but not at rest (P=0.06). Ropivacaine group performed ambulation and TUG tests at 24 hr. better.</td>
<td>First RCT to demonstrate analgesic efficacy of ACB. VAS scores decreased and TUG improved significantly in NS group after receiving R bolus @ 24 h. Results may have been blunted due to large amount of IV fentanyl (200-225 mg) and MSO4 (12-13.5 mg) given in both groups. Post-hoc analysis revealed significant reduction in VAS score at 2 hr. post-block.</td>
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<tr>
<td>Jæger et al.</td>
<td>2012</td>
<td>ACB placed in PACU. Injected 30 mL of R 0.75% or NS.</td>
<td>Active VAS score (45o active knee flexion) were not improved with R = 58 (22) mm vs. NS 67 (29) mm, P = 0.23</td>
<td>Significant difference of VAS scores (AUC) between R vs. NS from 1 to 6 hr. (P=0.02). No difference in resting VAS pain and morphine consumption.</td>
<td>No analgesic benefit (vs. placebo) beyond POD1. High incidence of catheter dislodgement by POD2 (may be related to leg movements). One patient had 4-month duration of saphenous neuropathy.</td>
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<tr>
<td>Andersen et al.</td>
<td>2013</td>
<td>High volume intraoperative local infiltration analgesia (R 0.2%). AC catheters were placed post-operatively with 15-mL boluses of either R 7.5% or NS twice daily for 2 days.</td>
<td>Worst pain scores significantly reduced in R group during movement (3 vs 5.5, P=0.050) and at rest (2 vs 4, P=0.032) on the day of surgery.</td>
<td>Ropivacaine also improved sleep and ambulation. No difference in VAS scores beyond POD0, morphine consumption, PONV, or LOS.</td>
<td>No analgesic benefit (vs. placebo) beyond POD1. High incidence of catheter dislodgement by POD2 (may be related to leg movements). One patient had 4-month duration of saphenous neuropathy.</td>
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<tr>
<td>Authors</td>
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<td>Study Design</td>
<td>Patients</td>
<td>Interventions</td>
<td>Outcomes</td>
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<tr>
<td>Jæger et al.</td>
<td>2013</td>
<td>11 volunteers</td>
<td>16 patients</td>
<td>ACB vs. NS</td>
<td>Resting VAS pain score was significantly reduced (26%) with continuous ACB and notably separated starting at 16-48 hr. with resolution of single injection FNB. Quadriceps strength increased from 55% to 77% of preoperative baseline from POD1 to POD2 with continuous ACB vs. no improvement without continuous ACB.</td>
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<tr>
<td>Kwofie et al.</td>
<td>2013</td>
<td>48 patients received both AC and FN catheters</td>
<td>No difference in postoperative multimodal analgesic regimen. No difference in opioid consumption, or mobility testing. Confounding factor may have been the use of CLEA throughout evening of POD1. However, CLEA was used in both groups and quadriceps strength was preserved equally in the non-operative leg.</td>
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<td>Kim et al.</td>
<td>2014</td>
<td>93 patients</td>
<td>At 6 to 8 hr. after surgery, ACB group had significantly higher median quadriceps strength versus FNB (6.1 kgf vs. 0 kgf, P &lt; 0.0001). ACB was not inferior to FNB in terms of either VAS scores or opioid consumption. Continuous ACB preserved quadriceps motor strength better than continuous FNB after TKA, while providing non-inferior analgesic efficacy. Lack of improvement in mobility may have been influenced by use of full wheel walker in all patients.</td>
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<td>Hanson et al.</td>
<td>2014</td>
<td>76 patients</td>
<td>At 24 and 48 hr., there was no difference in quadriceps strength, pain scores, or opioid consumption between ACB and FNB groups. Continuous ACB significantly improved quadriceps strength (P=0.010) and ambulation (P=0.034) on beginning on POD2. Morphine consumption decreased (26%) with continuous ACB and notably separated starting at 16-48 hr. with resolution of single injection FNB. Quadriceps strength increased from 55% to 77% of preoperative baseline from POD1 to POD2 with continuous ACB vs. no improvement without continuous ACB.</td>
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<td>Grevstad et al.</td>
<td>2014</td>
<td>50 patients with established severe dynamic pain after TKA on POD1 or POD2.</td>
<td>Dynamic VAS pain score significantly decreased (32 mm difference) with ACB vs. no ACB (P&lt;0.0001) at T45. Resting VAS pain score also significantly improved (15 mm difference) with ACB vs. no ACB at T-45. No difference in VAS scores 45 minutes after second injection (T-90). Only included patients with established severe dynamic knee pain despite a comprehensive postoperative multimodal analgesic regimen. Established analgesic efficacy of a “rescue” ACB by initial difference at after 1st block, followed by equivalent analgesia between groups at T90 after Group B received an ACB.</td>
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<tr>
<td>Study Authors</td>
<td>Sample Size</td>
<td>Interventions</td>
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<td>Shah et al. [56] 2014</td>
<td>100 patients</td>
<td>Continuous AC catheters vs. continuous FN catheters. 30 mL initial bolus dose R 0.75%, followed by intermittent repeat boluses of 30 mL R 0.25% every 4 hr. through morning of POD2.</td>
<td>Ambulation ability significantly better with CACB vs. CFNB (TUG test: 51 (7.9) vs. 180 (67); 10-m walk test: 67s (7.3) vs. 274s (103); and 30-sec chair test: 5.25 repetitions (0.7) vs. 1.5 repetitions (0.8)).</td>
<td>No significant difference in pain control between the two groups. ACB was neither superior nor inferior to FNB in terms of analgesic efficacy. Trend to decrease in hospital LOS of 3.08 vs. 3.92 (P &lt; 0.001) with CACB vs. CFNB (study not powered LOS outcome).</td>
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<td>Jäger et al. [58] 2014</td>
<td>30 patients</td>
<td>AC catheter with either 30 mL of R 0.75% or NS bolus followed by an infusion of R 0.2% or NS beginning 6 hrs after bolus.</td>
<td>Significant difference dynamic pain scores with knee flexion; 52 (22) mm with R and 71 (25) mm with NS (P = 0.04) only at 4 hr after initial block.</td>
<td>Underpowered study due to a large dropout rate. Heterogeneous population with about 50% in each group presenting for 2nd or 3rd TKA revision; and 60% in each group on chronic preoperative opioid therapy.</td>
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<td>Memtsoudis et al. [41] 2015</td>
<td>60 patients</td>
<td>Combined spinal epidural anesthesia for bilateral TKAs. Single-injection of FNB (30 ml bupivacaine 0.25%) and single-injection ACB (15 ml bupivacaine 0.25%), side to side, in the same patient.</td>
<td>No significant differences in VAS scores between FNB and ACB group at rest or continuous passive movement (P=0.4154).</td>
<td>Question contribution of epidural analgesia to bilateral quadriceps weakness, as well as the effects of pain, swelling, and physiological impact of bilateral TKAs vs. unilateral TKA.</td>
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<td>Grevstad et al. [55] 2015</td>
<td>50 patients with established severe dynamic pain after TKA on POD1 or POD2. Group ACB: Single-injection ACB with 30 mL R 0.2% and single-injection FNB with 30 mL NS. Group FNB: Single-injection of ACB with 30 mL NS and single-injection FNB with 30 mL of R 0.2%.</td>
<td>Two hr. after blocks performed, Q-MVIC increased to 193% from baseline in the ACB group vs. a decline to 16% of baseline values for the FNB group (P=0.0001).</td>
<td>No significant difference in either resting, dynamic, or “worst” VAS between ACB vs. FNB. 7 of 25 in the FNB group vs. 0 of 25 in the ACB group were unable to perform TUG test post-block. ACB group performed TUG test significantly faster (mean difference 20 seconds) vs. FNB group.</td>
<td>Only included patients with established severe dynamic knee pain. 1st clinical study to demonstrate that ACB can actually increase quadriceps strength (almost doubled from baseline pre-block strength). Further confirmation that ACB and FNB seem to have similar analgesic efficacy.</td>
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<td>Shah et al. [57] 2015</td>
<td>97 patients</td>
<td>Single-injection ACB vs Continuous ACB: Initial 30 mL loading dose of R 0.75% via catheter followed by intermittent 30 mL NS every 4 hr. through morning POD2.</td>
<td>Postoperative resting and dynamic pain scores decreased in CACB (mean difference 4-7/100 mm difference at rest and 7-10/100 with activity) through POD2.</td>
<td>No significant difference in ambulation ability (TUG test, 10-m walk test, 30-sec chair test), achievement of functional milestones, or hospital LOS.</td>
<td>All patients received single injection LIA with 20 mL 0.25% bupivacaine + 40 mg triamcinolone acetate.</td>
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References

1. Healthcare Cost and Utilization Project.


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