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Continuous Adductor Canal Blocks Provide Superior Ambulation and Pain Control Compared to Epidural Analgesia for Primary Knee Arthroplasty: A Randomized, Controlled Trial

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ABSTRACT

Background: Adductor canal blocks (ACBs) are an alternative to femoral nerve blocks that minimize lower extremity weakness. However, it is unclear whether this block will provide analgesia that is equivalent to techniques, such as epidural analgesia. The purpose of this randomized controlled trial was to compare continuous ACBs with epidural analgesia for primary total knee arthroplasty.
Methods: Following institutional review board approval, 145 patients were randomized to 1 of 3 groups: combined spinal-epidural (CSE), spinal + continuous ACB (CACB), or general + CACB. Epidural analgesia was used postoperatively in the CSE group, and an adductor canal catheter was used in the CACB groups. Power analysis determined that 84 patients per group were needed to demonstrate a 35% increase in ambulation with an alpha of 0.05 at a power of 90%.
Results: At interim analysis, 13 patients were removed for protocol deviations, leaving 45 in CSE, 41 in spinal + CACB and 46 in general + CACB groups. Patient demographics were similar in all comparisons suggesting appropriate randomization. Patients in the CACB groups walked further on postoperative day 1, 2, and 3 ($P = .02$). Mean daily pain scores were lower in the CACB groups (4.1 CSE, 3.0 spinal + CACB, 3.4 general + CACB, $P = .009$). There was no significant difference in total opioid consumption between groups (158 morphine equivalents CSE, 149 spinal + CACB, and 172 general + CACB). More patients reported being "very satisfied" in CACB groups (68% general + CACB, 63% spinal + CACB, and 36% CSE; $P = .001$).
Conclusion: Continuous adductor analgesia provides superior ambulation, lower pain scores, faster discharge, and greater patient satisfaction when compared to epidural analgesia for primary total knee arthroplasty.

Total knee arthroplasty (TKA) is associated with varying degrees of pain postoperatively, ranging from mild to severe despite the use of comprehensive multimodal analgesic regimens [1]. Optimizing pain relief is vital for functional recovery after TKA [2]. Postoperative pain control can be achieved through various methods such as intravenous (IV) opioid administration, epidural analgesia, and peripheral nerve blocks.

While continuous femoral nerve blocks provide effective pain relief with improved side-effect profile compared to epidural analgesia and patient-controlled analgesia (PCA) [2,3], quadriceps weakness due to motor blockade of the femoral nerve can result in decreased ambulation and worse knee extension for patients undergoing TKA [4,5]. Profound quadriceps weakness causes functional impairment and can lead to an increased risk of falling postoperatively [6]. Thus, there has been interest in finding a suitable alternative to femoral nerve blocks that preserves motor function while providing effective postoperative analgesia.

Recently, adductor canal blocks (ACB) have gained interest as a possible motor-sparing alternative. The adductor canal is

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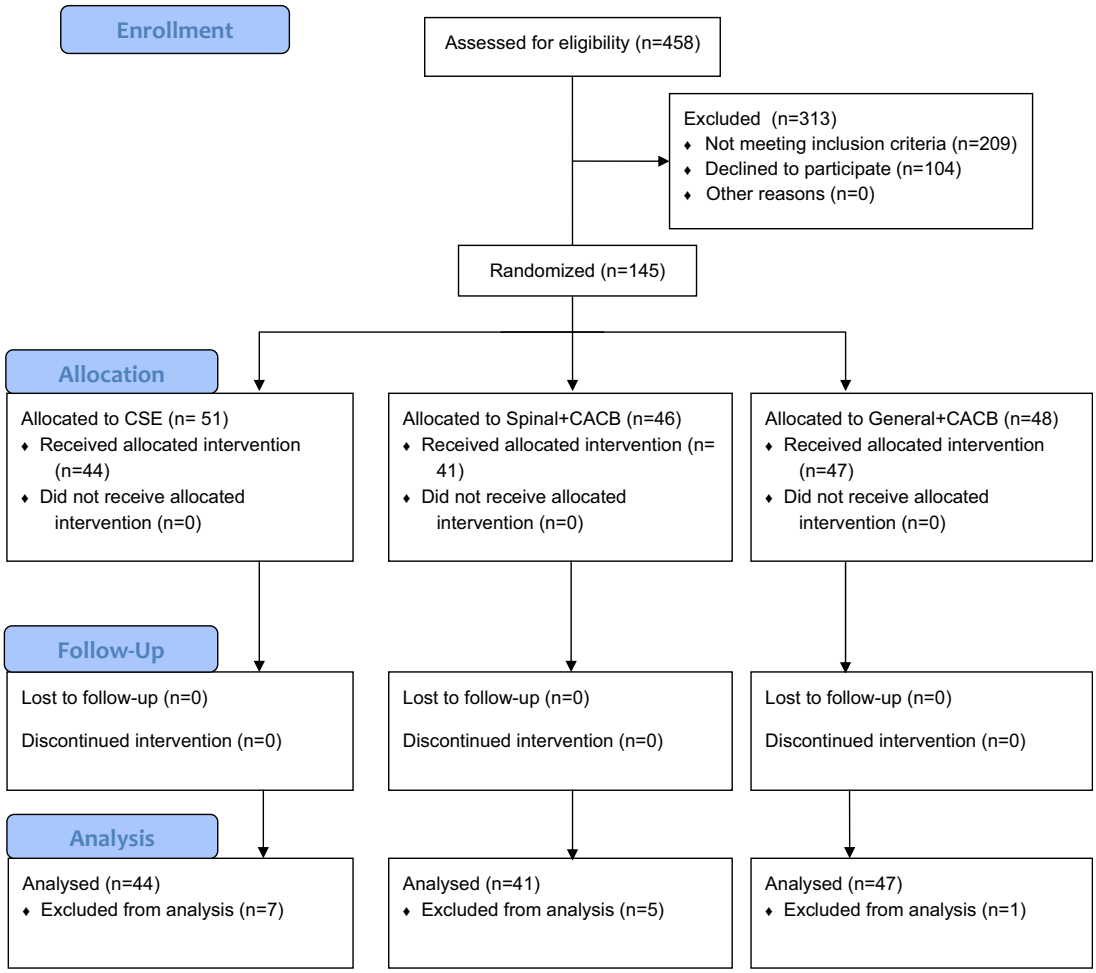

Fig. 1. CONSORT enrollment flow diagram of patients.

triangle-shaped passage bordered by the sartorius muscle superiorly, the vastus medialis laterally, and the adductor muscles of the thigh medially. The saphenous nerve, the major sensory contribution from the femoral nerve to the knee [7,8], passes through this canal and exits on the medial aspect of the distal thigh through the adductor hiatus. ACB have been shown to preserve quadriceps muscle strength and ability to ambulate better than femoral nerve blocks, while providing equivalent analgesia [8–12]. However, while studies exist comparing femoral nerve blocks to epidural analgesia and femoral nerve blocks to continuous adductor canal blocks (CACB), there have been no studies directly comparing CACB to epidural analgesia in terms of postoperative pain control and ambulation.

Thus, we performed a randomized, controlled trial to compare the analgesic and functional outcomes between CACB and epidural analgesia in the setting of primary TKA. We hypothesized that CACB would be superior to epidural analgesia at facilitating earlier postoperative mobilization, function, and time to discharge with equivalent postoperative pain control.

Materials and Methods

Study Design and Patients

This was a prospective, randomized, controlled study designed to compare CACB, combined with a general or spinal anesthesia intraoperatively, to combined spinal-epidural (CSE) anesthesia in the setting of a primary TKA. CSE anesthesia has been the standard at our institution for primary TKA for the past 20 years. With institutional review board approval, the study was registered at ClinicalTrials.gov (NCT02415465). Patients scheduled to undergo primary unilateral TKA for a diagnosis of osteoarthritis were eligible for enrollment. Patients were excluded if they had a body mass index (BMI) greater than 40, had a history of drug or alcohol abuse, were taking opioid pain medications chronically (longer than 6 months), had a contraindication to either spinal or general anesthesia, did not ambulate at baseline, or refused to participate.

Patients were enrolled between January 2015 and March 2016 by a research coordinator. During the course of the study, the operating surgeons performed 458 primary TKAs; 209 (46%) were not eligible for the study based on BMI >40 (117, 56%), chronic narcotic use (45, 22%), contraindications to spinal or general anesthesia (31, 15%), or inability to ambulate at baseline (16, 8%). Of the remaining 249 patients, 145 were enrolled in the study, while 104 declined to participate (Fig. 1). Enrolled patients were randomized by the research coordinator into 1 of 3 groups using opaque, sealed, numbered envelopes before their scheduled surgery. The envelopes were created using a computer-generated randomization algorithm. Fifty-one patients were randomized to a CSE, 46 to the spinal anesthesia combined with a CACB catheter (spinal + CACB), and 48 to the general anesthesia combined with a continuous adductor canal catheter (general + CACB).