Adductor Canal Block versus Adductor Canal Block Plus Interspace between the Popliteal Artery and Capsule of the Posterior Knee Block for Postoperative Analgesia following Anterior Cruciate Ligament Reconstruction with Bone-Patellar Tendon-Bone Autograft: A Single-Blind, Randomized Controlled Study

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INTRODUCTION:
In an effort to reduce reliance on opioid analgesics, an increased emphasis has been placed on peripheral nerve blocks for pain control following anterior cruciate ligament (ACL) reconstruction. The commonly used adductor canal block (ACB) may provide inadequate postoperative analgesia, as it spares sensory function to the posterior aspect of the knee. This region can be specifically targeted using an IPACK (Interspace Between the Popliteal Artery and the Capsule of the Posterior Knee) block potentially leading to improved pain control. The purpose of the current study was to compare clinical outcomes of an isolated standard adductor canal block versus combined ACB and IPACK blocks with respect to level of postoperative pain, opioid consumption, and satisfaction in patients undergoing ACL reconstruction using a bone-patellar tendon-bone (BPTB) autograft.
METHODS: We prospectively recruited patients undergoing ACL reconstruction with BPTB autograft at a single institution. Subjects were randomized preoperatively to either control (ACB) or experimental (IPACK) groups using a pre-established block randomization and were blinded to their treatment group. Patients in the control group received the standard-of-care ACB consisting of 15-ml of Bupivacaine (0.25%). Patients in the experimental group received 20-ml of Bupivacaine (0.25%) injected into the interspace between the popliteal artery and capsule of the knee in addition to the 15-ml Bupivacaine ACB. Postoperative pain level, pain control, and pain satisfaction were collected at 24hrs (postoperative day [POD] 1), 48hrs (POD 2), 72hrs (POD 3) and one week (POD 7) postoperatively. Satisfaction with pain control was assessed using a 0-10 numeric scale, with 0 equal to not satisfied and 10 equal to completely satisfied. Pain level was measured using a Visual Analog Scale (VAS) from no pain to extreme pain. The type and quantity of pain medications including 325-5 mg Oxycodone, acetaminophen, and other pain medications were recorded at each timepoint. Variables were assessed using Shapiro-Wilks test for normality and T-test or non-parametric tests for continuous variables and Chi-squared tests for categorical variables. Continuous variables are reported as average ± standard deviation or average [95% confidence interval] based on normality. Multivariate regression analysis was conducted to examine the extent to which the use of IPACK predicted opioid use, pain scores (VAS), and patient satisfaction while controlling for demographic and clinical factors. Specifically, age, sex, BMI, and baseline scores were included as covariates in the regression model.
RESULTS:
A total of 102 patients were enrolled in the study, of which 6 were excluded due to changes in anesthetic medication (n = 2), discovery of multi-ligament injury during the operation (n = 1), or inability to be reached for outcome assessment (n = 3). The final analysis included 96 patients, with 47 in the control group (ACB) who received only ACB and 49 in the experimental group (IPACK) who received ACB and an additional IPACK block. The cohort was composed of 60.4% male patients with a mean age of 28.40 ± 7.51 years (range: 18 - 55) and a mean BMI of 25.67 ± 4.84. There were no statistically significant differences between the groups with respect to age, BMI, or sex ($p > 0.05$).
Patients in the IPACK group reported significantly lower opioid usage than the ACB group on POD 1 (18.2 [13, 23] vs. 32.1 [26, 38] MME, $p < 0.001$), POD 2 (22.0 [16, 28] vs. 37.6 [30, 45] MME, $p = 0.001$), and POD 3 (12.5 [8.5, 16] vs. 28.2 [21, 35] MME, $p < 0.001$). The VAS scores on POD 1 and POD 3 were statistically higher in the ACB group compared to the IPACK group (POD 1: 67.7 [62, 73] vs. 55.2 [48, 63], $p = 0.024$; POD 3: 55.2 [48, 63] vs. 44.4 [37, 51], $p = 0.037$). On POD 1, patient satisfaction was higher in the IPACK group (7.3 [6.6, 8.0] vs. 5.6 [4.8, 6.4], $p = 0.001$). No statistically significant differences were observed between group outcomes on POD 7.

On regression analysis, IPACK and male sex were a significant negative predictors for opioid use on POD 1 with a beta coefficient of -13 ($p = 0.03$) and -9.9 ($p = 0.024$) respectively. The other covariates did not significantly predict opioid use on POD 1. The negative relationship between IPACK use and opioid use persisted on POD 2 and POD 3, with beta coefficients of -12 ($p = 0.019$) and -15 ($p < 0.001$), respectively. However, sex was no longer a significant predictor of opioid use on Day 2 or Day 3 in the regression model.
DISCUSSION AND CONCLUSION: In conclusion, patients who received combined IPACK and ACB blocks exhibited lower narcotic use, better pain control, and higher satisfaction compared to those who received the standard-of-care ACB alone.

Table 1. Demographics and Patient Reported Outcomes by Randomization Group

Table 1. Patient Characteristics

Variable	Overall, N = 96	Study Arm		p-value
		ACB, N = 47	IPACK, N = 49	
Demographics				
Age	28.40 ± 7.51	27.38 ± 7.12	29.37 ± 7.81	0.19[a]
BMI	25.67 ± 4.84	26.09 ± 5.22	25.27 ± 4.46	0.63[a]
Length of Symptoms	21.98 ± 37.44	23.02 ± 38.72	20.95 ± 36.60	0.76[a]
Sex				0.56[c]
Female	38 (40%)	20 (43%)	18 (37%)	
Male	58 (60%)	27 (57%)	31 (63%)	
Baseline Scores				
VAS Score	22.11 ± 25.15	24.36 ± 26.24	19.96 ± 24.12	0.26[b]
McGill Score	5.07 ± 5.75	6.18 ± 7.18	4.00 ± 3.69	0.34[b]
KOOS-PS	72.12 ± 13.08	70.19 ± 13.35	73.97 ± 12.66	0.17[a]
KOOS Pain	73.45 ± 17.22	69.92 ± 19.58	76.91 ± 13.90	0.10[b]
Tegner Before	6.88 ± 2.10	7.02 ± 2.10	6.73 ± 2.12	0.51[b]
Tegner After	2.67 ± 1.16	2.60 ± 1.31	2.73 ± 1.00	0.20[b]
PACU				
Surgery Time (min)	75.93 ± 22.59	78.78 ± 26.38	73.21 ± 18.19	0.63[a]
Total PACU Time (min)	131.21 ± 44.34	131.22 ± 37.50	131.19 ± 50.47	0.42[c]
Pain	1.40 ± 2.20	0.94 ± 1.81	1.79 ± 2.46	0.38[b]

BMI, body mass index; VAS, Visual Analog Scale; KOOS, Knee Injury and Osteoarthritis Outcome Score-Physical Function Short form; PACU, post-anesthesia care unit