Effectiveness of ERAS (enhanced recovery after surgery) protocol via peripheral nerve block for total knee arthroplasty

Hyun Hee Lee

Department of Medicine

The Graduate School, Yonsei University

Effectiveness of ERAS (enhanced recovery after surgery) protocol via peripheral nerve block for total knee arthroplasty

Directed by Professor Kwan Kyu Park

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Hyun Hee Lee

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This certifies that the Master's Thesis of Hyun Hee Lee is approved.

Thesis Supervisor : Kwan Kyu Park

Thesis Committee Member#1 : Hyuck Min Kwon

Thesis Committee Member#2 : Yong Seon Choi

The Graduate School
Yonsei University

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ABSTRACT

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The Graduate School, Yonsei University

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Introduction: Peripheral nerve block (PNB) for patients with total knee arthroplasty (TKA) is one of the recommended interventions in enhanced recovery after surgery (ERAS) protocols. This study aimed to evaluate the effectiveness of PNB in terms of immediate postoperative analgesia, length of hospital stay (LOS), and early functional outcomes in primary TKA.

Materials and Methods: Between March 2015 and March 2021, 236 patients who underwent primary TKA with PNB were included in this study, with 138 and 98 being unilateral TKA (UTKA) and simultaneous bilateral TKAs (BTKAs), respectively; those in the PNB group underwent femoral nerve and adductor canal block. The matched control and PNB groups—who received intravenous/epidural patient-controlled analgesia (IVPCA/PCEA) alone or IVPCA in addition to PNB after surgery, respectively—were compared. The primary outcome was the VAS scores, while secondary outcome evaluations included LOS and functional outcomes through a measurement of American

Knee Society (AKS) score and Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index.

Results: The VAS scores at rest until 48 hours after surgery were significantly lower in PNB groups compared to those in the IVPCA groups ($p<0.05$). At 0– 6 hours of activity, VAS scores of the UTKA with PNB group were also lower than the IVPCA group ($p=0.008$). Compared to PCEA groups, VAS scores at 0–6 hours of activity were higher in both the UTKA and BTKAs with PNB groups ($p=0.043$ and $p=0.039$, respectively). However, at 24–48 hours at rest, the scores of those in the UTKA with PNB group were lower than those in the PCEA group ($p<0.001$). There were no statistically significant differences during other periods and LOS among all groups. The control and experimental UTKA and BTKA groups had similar AKS scores and WOMAC indices 90 days postoperatively.

Conclusion: In primary TKA, PNB has great analgesic effects for immediate postoperative pain control and represents a similar analgesic effect to epidural PCA. There was no significant difference in hospital LOS and early functional outcomes between PNB with PCA and PCA alone.

Key words : peripheral nerve block, patient-controlled analgesia, total knee arthroplasty, enhanced recovery after surgery

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Department of Medicine
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I. INTRODUCTION

Total knee arthroplasty (TKA) is one of the most common and successful orthopedic procedures to treat patients with severe knee osteoarthritis. However, patients who undergo TKA often experience severe pain after surgery. Therefore, postoperative pain control in TKA has been the most crucial challenge for orthopedic surgeons[1]. Severe pain produces prolonged length of hospital stay (LOS), low patient satisfaction, and increased opioid consumption, which can potentially elicit side effects such as gastrointestinal problems, altered cognitive function, urinary retention, pruritus, and respiratory depression[2-5]. To manage these consequences, enhanced recovery after surgery (ERAS), first described by Henrik Kehlet in 1997[6], has begun to be discussed in the surgical field. The concepts of ERAS are being continuously investigated in the field of orthopedics.

Peripheral nerve block (PNB) for patients with TKA is a recommended intervention in ERAS protocols. Femoral nerve block (FNB), the most common PNB method, is reportedly effective in decreasing pain and facilitating early rehabilitation after TKA[7, 8]; further, it provides sufficient analgesia with fewer side effects, including neurological complications, vomiting, and nausea, compared to PCEA or IVPCA with opioids[1, 8, 9]. However, a disadvantage of FNB is the impairment of motor function, thus delaying the restoration of quadriceps strength.

Meanwhile, adductor canal block (ACB), an alternative nerve block technique, selectively blocks the sensory branch of the femoral nerve. Given that the adductor canal is placed in the middle third of the thigh, runs from the apex of the femoral triangle proximally to the adductor hiatus distally, and consistently encloses the saphenous nerve and the nerve to the vastus medialis, ACB can spare the major motor branches of the femoral nerve[10, 11]. Resultantly, this can relieve pain without weakening the quadriceps. Based on recent studies, PNBs, such as FNB and ACB, may significantly reduce pain after TKA. However, most existing studies involved unilateral TKA, and the comparison between PNB versus epidural or intravenous PCA after both unilateral TKA and simultaneous bilateral TKAs appears insufficient.

Therefore, this study asked the following questions. Compared to PNB and PCA only, (1) how effective was postoperative pain control after both unilateral TKA and simultaneous bilateral TKAs, and (2) is there any difference in LOS and functional outcomes in the early postoperative period? Finally, (3) this study aimed to determine the effectiveness of FNB versus ACB.

II. MATERIALS AND METHODS

1. Data collection

This retrospective comparative study with a propensity score matching analysis was approved by the Institutional Review Board (4-2021-0772) of the authors' facility. The medical records of patients who underwent primary TKA for knee osteoarthritis after performing an imaging examination at a single center were retrospectively reviewed (Severance Hospital, Seoul, Korea). A total of 857 consecutive TKAs were performed by a single surgeon between March 2015 and March 2021. Only patients for whom all data elements were prospectively collected—including demographics, anesthesia type, and American Society of Anesthesiologists (ASA) class— were included. Patients with ASA class ≥ 4; with secondary arthritis due to rheumatoid arthritis or trauma; who needed special instrumentation due to severe instability, bone defect, or anatomical deformity; who required additional procedures other than TKA; or had a history of revision surgery were excluded. In this study, propensity score matching was used to minimize selection bias, with matched variables being age at operation, gender, BMI, and ASA class. After matching, 138 cases with PNB were matched with 138 cases with PCA alone in the unilateral TKA group, while 98 cases with PNB were matched with 98 cases with PCA alone in the simultaneous bilateral TKAs group (Figure 1).

The PNB group was defined as cases undergoing TKA under general anesthesia or spinal anesthesia with PNBs. The PNBs included femoral nerve block and adductor canal block. In unilateral TKA, PNB was performed with continuous FNB (CFNB) or continuous ACB (CACB). In simultaneous bilateral TKAs, the nerve block was performed on each knee by a combination of CFNB + single-shot FNB (SSFNB), CFNB + single-shot ACB (SSACB), CACB + SSFNB, CACB + SSACB, and CACB + CACB. After the TKA, all PNBs were performed by an anesthetist. In FNBs, a femoral catheter was inserted in the femoral canal just below the inguinal ligament. ACB was performed at the mid-thigh level using an ultrasound transducer. The regimen of continuous PNB was an infusion of 0.2% ropivacaine 6 mL per hour, for a total volume of 280 mL. For single-shot PNB, 20 mL of 0.2% ropivacaine was injected. After the PNB was performed, intravenous PCA was added in all PNB group patients.

The PCA group consisted of intravenous PCA (IVPCA) and patient-controlled epidural analgesia (PCEA). Fentanyl 10 μg/kg was used in IVPCA. Meanwhile, a PCEA device was connected to an epidural catheter, and 0.15% ropivacaine was infused when sensory levels dropped below T12. In the PCA group, the patient received either IVPCA or PCEA alone.

All operations were performed according to the standard protocol under pneumatic tourniquet inflation, with cemented PS type TKA prosthesis from nine manufacturers. For median skin incisions, a standard medial parapatellar arthrotomy approach was used, and patella resurfacing was not done. All patients started active and passive knee range of motion (ROM) exercises one day postoperatively under the same rehabilitation protocol.

2. Outcome measurements

The primary outcome was pain intensity score, which was measured on a visual analog scale (VAS; rated from 0–10, where 0 = no pain and 10 = worst possible pain). VAS scores at rest and activity were monitored during the first 48 hours after surgery at 3 intervals: 0 to 6 hours, 6 to 24 hours, and 24 to 48 hours. Secondary outcomes—hospital LOS (days) and, for determination of early functional outcomes, American Knee Society (AKS) scores and Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index—were evaluated preoperatively and at the 90-day postoperative follow-up.

3. Statistical analysis

Descriptive statistics were performed, and normality distribution analysis was assessed by the Shapiro-Wilk test. Continuous variables were analyzed using the Student's t-test or Mann-Whitney test for normal and non-normal distributions, respectively. Categorical variables were compared using the chi-square test. For evaluation of non-normal distributions of the continuous variables of multiple groups, the Kruskal-Wallis test was performed. The Bonferroni correction method was also done for post-hoc analysis. Data analysis was conducted using the Statistical Package for the Social Sciences software version 25.0 (SPSS, IBM Inc., Chicago, Illinois).

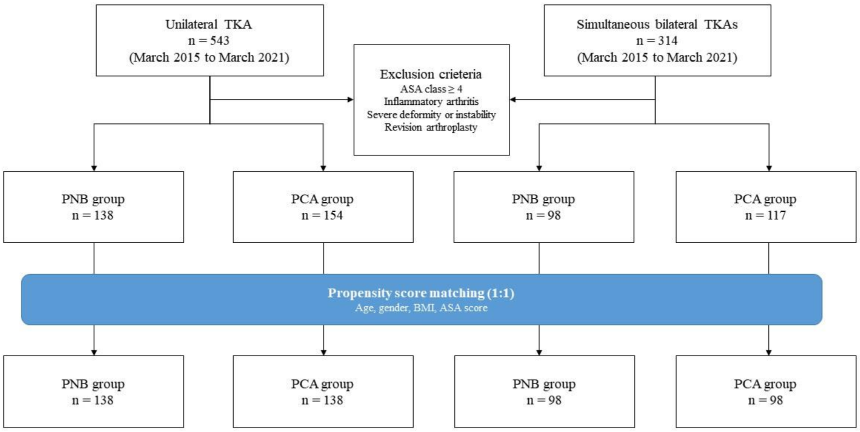

Figure 1. Flowchart of patient selection.

III. RESULTS

The baseline characteristics of patients in the PNB and PCA groups were comparable in terms of age, gender, BMI, ASA class, and types of anesthesia (Table 1).

Table 1. Baseline characteristics of the patients undergoing TKA

	UTKA				BTKAs		
	PNB group (n=138)	PCA group (n=138)	*P*-value		PNB group (n=98)	PCA group (n=98)	*P*-value
Age	71.3 ± 6.6	70.3 ± 6.9	0.244		71.2 ± 6.0	70.6 ± 5.5	0.487
Gender, No. (%)			0.084				0.578
Male	30 (21.7)	19 (13.8)			16 (16.3)	19 (19.4)	
Female	108 (78.3)	119 (86.2)			82 (83.7)	79 (80.6)	
BMI	26.4 ± 3.2	26.3 ± 3.4	0.821		27.0 ± 3.9	26.7 ± 3.7	0.566
ASA			0.918				0.642
1	6	7			9	5	
2	66	63			47	51	
3	66	68			42	42	
PNB method							
CFNB	49	NA		CFNB + SSFNB	42	NA	
CACB	89	NA		CFNB + SSACB	8	NA	
				CACB + SSFNB	21	NA	
				CACB + SSACB	22	NA	
				CACB + CACB	5	NA	
PCA							
IV	NA	82			NA	54	
Epidural	NA	56			NA	44	
PNB + IV	138	NA			98	NA	
Anesthesia			0.326				0.456
General	50	58			53	44	
Spinal	88	80			45	54	

Data are shown as mean ± standard for normally distributed variables.

UTKA Unilateral Total Knee Arthroplasty, BTKAs Simultaneous Bilateral Total Knee Arthroplasty, BMI Body Mass Index, PNB Peripheral Nerve block, CFNB Continuous Femoral Nerve Block, CACB Continuous Adductor Canal Block, SSFNB Single-Shot Femoral Nerve Block, SSACB Single-Shot Adductor Canal Block, PCA Patient-Controlled Analgesia, IV Intravenous, NA Not Applicable

1. Primary outcome

The VAS scores among those who underwent a UTKA were lower in the PNB group than in the IVPCA group at rest 0–6, 6–24, and 24–48 hours postoperatively ($p<0.001$, 0.003, and 0.001, respectively) and 0–6 hours postoperatively during activity of the knee ($p=0.008$). In BTKAs, the VAS scores of the PNB group at rest 0–6, 6–24, and 24–48 hours postoperatively ($p<0.001$, 0.008, and 0.001, respectively) were lower than in the IVPCA group (Figure 2,3). Compared to the PCA and PCEA groups among those who underwent a UTKA, the VAS scores of the PNB group at rest 24–48 hours postoperatively were lower ($p<0.001$). However, the pain scores of the PCEA group with both UTKA and BTKAs at 0–6 hours postoperatively during activity were lower ($p=0.043$ and 0.039, respectively) than those in the PNB group (Figure 4,5). There was no statistically significant difference in the VAS scores among groups with UTKA and BTKAs at the other monitored periods.

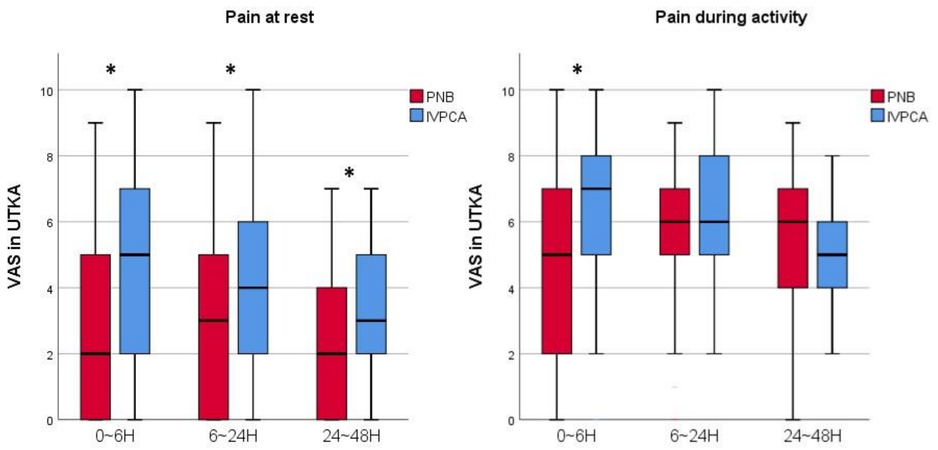

Figure 2. VAS score of PNB group and IVPCA group with UTKA.

* Significant difference between two groups

UTKA Unilateral Total Knee Arthroplasty, PNB Peripheral Nerve block, IVPCA Intravenous Patient-Controlled Analgesia, VAS Visual Analogue Scale, H Hours

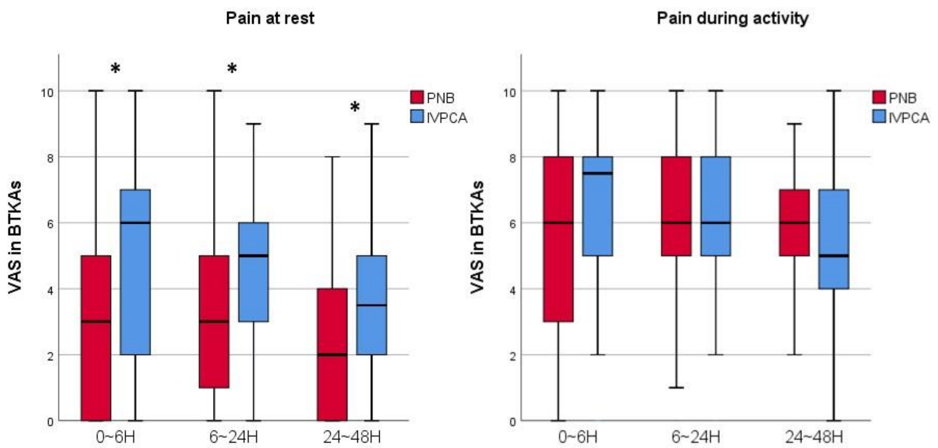

Figure 3. VAS scores of PNB group and IVPCA group with BTKAs.

* Significant difference between two groups

BTKAs Simultaneous Bilateral Total Knee Arthroplasty, PNB Peripheral Nerve block, IVPCA Intravenous Patient-Controlled Analgesia, VAS Visual Analogue Scale, H Hours

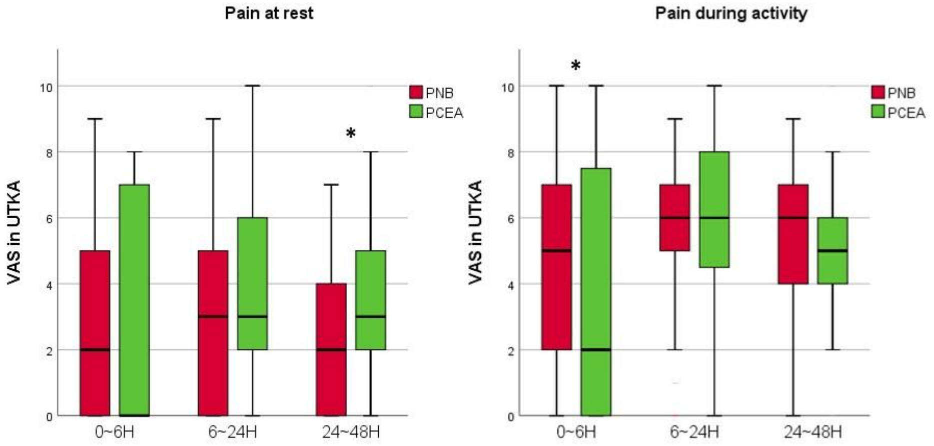

Figure 4. VAS scores of PNB group and PCEA group with UTKA.

* Significant difference between two groups

UTKA Unilateral Total Knee Arthroplasty, PNB Peripheral Nerve block, PCEA Patient-Controlled Epidural Analgesia, VAS Visual Analogue Scale, H Hours

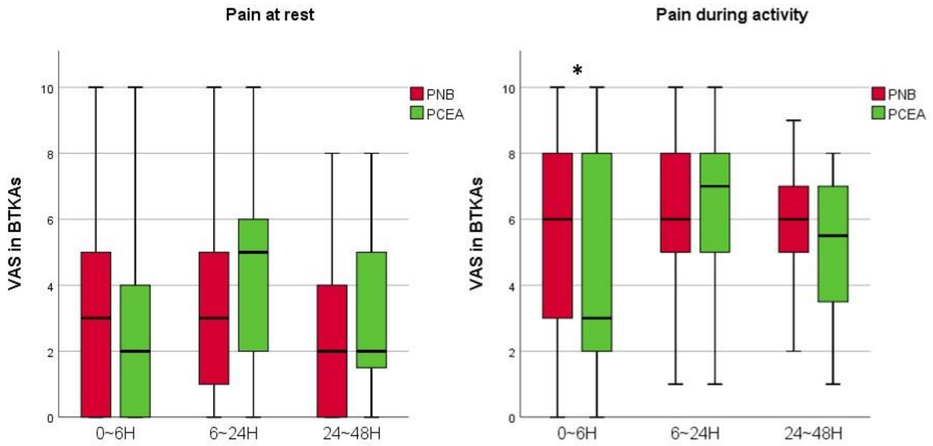

Figure 5. VAS scores of PNB group and PCEA group with BTKAs.

* Significant difference between two groups

BTKAs Simultaneous Bilateral Total Knee Arthroplasty, PNB Peripheral Nerve block, PCEA Patient-Controlled Epidural Analgesia, VAS Visual Analogue Scale, H Hours

2. Secondary outcomes

In general, the PNB and PCA groups did not differ in terms of hospital LOS or early functional outcomes, represented by AKS scores and WOMAC index (Table 2). However, preoperatively, the AKS function scores of the UTKA and BTKAs groups differed significantly (p=0.009 and <0.001, respectively).

3. Subgroup analysis

Subgroup analysis was also conducted to estimate the analgesic effect among PNB procedures. In patients with UTKA, there were no statistically significant differences in the VAS scores of the CFNB and CACB groups 48 hours postoperatively (Table 3). Compared to patients who underwent BTKAs, the VAS scores of the CFNB + SSFNB group at 6–24 hours and 24–48 hours postoperatively during rest were lower than those of the CACB + SSFNB group (p=0.002 and 0.001, respectively). The difference in pain intensity for each postoperative period compared to the other groups was similar (Table 4).

Table 2. Comparison of hospital LOS, functional outcomes with AKS score and WOMAC index between PNB group and PCA group

	UTKA			BTKAs		
	PNB group (n=138)	PCA group (n=138)	*P*-value	PNB group (n=98)	PCA group (n=98)	*P*-value
Hospital LOS	5.3 ± 1.3	5.2 ± 0.8	0.173	5.3 ± 1.4	5.4 ± 1.5	0.630
AKS knee score						
Preop	52.5 ± 15.6	52.9 ± 19.0	0.857	50.9 ± 11.3	50.6 ± 17.2	0.876
Postop 3M	87.3 ± 17.7	84.0 ± 17.1	0.171	87.7 ± 16.7	89.6 ± 11.9	0.217
AKS function score						
Preop	60.6 ± 16.7	55.3 ± 17.2	0.009*	60.1 ± 14.6	50.9 ± 20.1	<0.001*
Postop 3M	75.5 ± 18.2	73.4 ± 19.9	0.405	76.1 ± 15.7	75.5 ± 19.4	0.756
WOMAC						
Preop	53.3 ± 18.7	52.7 ± 21.1	0.797	55.7 ± 19.5	54.4 ± 25.5	0.550
Postop 3M	25.5 ± 25.2	26.7 ± 15.2	0.645	25.6 ± 22.6	25.8 ± 18.3	0.897

Data are shown as mean ± standard for normally distributed variables.

* Significant difference between two groups

LOS Length of stay, M Months, AKS American Knee Society, WOMAC Western Ontario and McMaster Universities Osteoarthritis Index, M Months

Table 3. Subgroup analysis of VAS scores between CFNB group and CACB group in patient with UTKA

	CFNB (n=49)	CACB (n=89)	*P*-value
0~6H Rest	1 (0,4)	2 (0,5)	0.252
0~6H Activity	4.5 (2,7)	5 (3,7)	0.208
6~24H Rest	2.5 (0,5)	3 (1,5)	0.152
6~24H Activity	6 (4,7)	6 (5,7)	0.373
24~48H Rest	2 (0,4)	2 (0,3)	0.613
24~48H Activity	5 (3,6)	6 (4,7)	0.138

Data are shown as median and interquartile ranges for variables that were not normally distributed.

VAS Visual Analogue Scale, CFNB Continuous Femoral Nerve Block, CACB Continuous Adductor Canal Block, H Hours

Table 4. Subgroup analysis of VAS scores among PNB groups in patient with BTKAs

	CFNB + SSFNB (n=42)	CFNB + SSACB (n=8)	CACB + SSFNB (n=21)	CACB + SSACB (n=22)	CACB + CACB (n=5)	*P*-value
0~6H Rest	3 (0,4)	3.5 (1,5)	2 (0,5)	2.5 (0,5)	6 (2,8)	0.533
0~6H Activity	6 (3,7)	5 (4, 7.5)	7 (3,8)	4.5 (3,8)	8 (6,9)	0.302
6~24H Rest	2 (0,5)	3 (0,6.5)	5 (3,6)	3 (2,6)	6 (3,8)	0.008*
6~24H Activity	6 (5,7)	6 (4,8)	7 (6,8)	6.5 (5,8)	8 (7,9)	0.058
24~48H Rest	2 (0,3)	1 (0,3.5)	4 (2,5)	2 (0,3)	3 (3,3)	0.010*
24~48H Activity	6 (5,7)	4.5 (3,6.5)	6 (5,7)	5 (3,7)	6 (5,6)	0.617

Data are shown as median and interquartile ranges for variables that were not normally distributed.

* Significant difference between two groups

VAS Visual Analogue Scale, CFNB Continuous Femoral Nerve Block, CACB Continuous Adductor Canal Block, SSFNB Single-Shot Femoral Nerve Block, SSACB Single-Shot Adductor Canal Block, H Hours

IV. DISCUSSION

The present study is a large-sample trial that evaluated the analgesic effect, hospital LOS, and early functional outcomes of PNB compared with PCA in patients undergoing UTKA and BTKAs. It found that there are significant differences in pain scores during the first 48 hours after surgery. The VAS scores 0–48 hours postoperatively during rest were lower in the PNB group than in the IVPCA group for both UTKA and BTKAs. At 0–6 hours postoperatively during activity, the VAS scores of the PNB group with UTKA were also lower. Compared to the PCEA group, pain scores were higher during activity 0–6 hours postoperatively, although scores at rest 24–48 hours postoperatively among those who underwent UTKA were lower. From these results, it was found that a very satisfactory analgesic effect was obtained when PNB was added to IVPCA, and comparable results were obtained compared with PCEA.

Severe pain after TKA has been shown to affect functional recovery[12]. Therefore, post-TKA pain control is an essential consideration. Various studies have evaluated the effectiveness of PNBs for postoperative analgesia compared with IVPCA[8, 13]. In this context, a meta-analysis by Paul et al.[14] reported that single-shot and CFNB was superior to PCA alone. In particular, CFNB with IVPCA has better outcomes compared to PCA alone regarding reduced morphine consumption, pain scores, and nausea[15]. In this study, PNB—consisting of FNB and ACB—was compared with IVPCA alone; similar results in postoperative pain control were obtained. Although not documented, it is expected that opioid consumption can also be reduced by adding PNB to IVPCA.

PNB provides intense site-specific analgesia and has lesser side effects compared to epidural techniques[16]. Fowler et al.[17] reported PNB to have a reduced side-effect profile, such as less urinary retention and hypotension, than that of epidural analgesia while representing a similar analgesic effect. Patients treated with a unilateral nerve block also experienced less restriction of motor function than those who received epidural analgesia[2]. Similarly, Barrington et al.[18] observed equivalent analgesia between CFNB and CEA groups after TKA; however, the regimen of each group was different (0.2% bupivacaine for femoral infusion and 0.2% ropivacaine with 4 mcg/mL fentanyl for epidural infusion). In this study, 0–6 hours postoperatively, both during rest or activity, VAS scores were significantly higher or comparable in the PNB group than the PCEA group, mainly due to the inability of the femoral approach to block sciatic and obturator components[16]. After this period, the pain scores became similar; in particular, the VAS score of the PNB group with UTKA was lower during activity 6–24 hours postoperatively.

Hospital LOS and early functional outcomes were also evaluated as secondary outcomes in this study. Hospital LOS reflects the economic burden of each patient[19]. Furthermore, hospital LOS is dependent on many factors, including preoperative hemoglobin, age, and gender[20, 21]. The current study shows that there is no statistically significant difference between PNB and PCA groups in terms of hospital LOS. Several studies similarly reported no difference in hospital LOS[22, 23]. At present, there is no conclusive evidence that PNB could reduce hospital LOS compared to PCA alone. To the researchers' knowledge, there is a lack of research comparing early follow-up results in functional outcomes between PNB and PCA alone. In this study, medical records measuring AKS score and WOMAC index (preoperatively and 90 days postoperatively) were collected and compared to assess early functional outcomes; this study found that there were no significant differences in scores except for preoperative differences in AKS function scores in both UTKA and BTKAs. The AKS score is divided into two categories, knee and function, and each category consists of detailed subjects measuring pain, range of motion, stability, quadriceps muscle power, and so on[24]. The WOMAC index also consists of subjects that measure pain, function, and stiffness for various situations[25]. There have been several studies of patient function in the immediate postoperative period. Chan et al.[26] found that patients receiving FNB had increased range of motion (MD = 6.48 degrees, 95% CI = 4.27 to 8.69 degrees) and higher patient satisfaction (SMD = 1.06, 95% CI = 0.74 to 1.38) compared with patients who received IVPCA with no PNB. Beaupre et al.[27] found similar mobility between patients who received PCA alone and those who received PCA and PNB. In this present study, we suggested that there was no difference in functional outcomes at 90 days after surgery through a comparison of AKS score and WOMAC index.

A meta-analysis by Gao et al.[28] reported ACB showed faster ambulation ability recovery after TKA compared with FNB, with no significant difference in postoperative pain control and opioid consumption in the early postoperative period. In this study, although quadriceps strength was not quantitatively measured in all cases, there were no reports of significant motor weakness in PNB groups. Regarding pain control, several studies have also reported that no significant difference between ACB and FNB groups[10, 29-32]. In the present study's subgroup analysis, a comparison of CFNB and CACB patients with UTKA showed no significant difference in analgesic effect. Patients with BTKAs received five combinations of blocks for each knee according to the method of PNB, which also showed similar pain control effects. The similar analgesic effect between the FNB and ACB groups may be explained by how most nerves in the adductor canal are sensory nerves dominating knee joints. Therefore, ACB seems to not compromise pain relief and may allow more preservation of quadriceps muscle strength than FNB with comparable pain control[28, 29]. The nerve block method applied to each knee in patients who underwent BTKAs was divided into five combinations to consider cost-effectiveness. The insurance policy issue of the country (Korea, Republic of) to which our institution belongs was also a consideration.

The present study has several limitations. First, are the inherent limitations of the retrospective comparative design of this study. There was also difficulty controlling all factors affecting outcomes. To counteract possible bias, this study analyzed relatively large cases of both UTKA and BTKAs. Further, propensity score matching was done to match the baseline characteristics of patients[33]. Second was the nonuniformity of the TKA implant manufacturer. There were nine brands, but they all had the same cemented PS type prosthesis design. Finally, there was a lack of measurement of postoperative functional aspects including mobilization, muscle strength, and range of motion.

V. CONCLUSION

In summary, PNB has great analgesic effects for immediate postoperative pain control after total knee arthroplasty. Even compared to PCEA, PNB represents a similar analgesic effect. There is no significant difference in hospital LOS and early functional outcomes between PNB with PCA and PCA alone. Finally, a comparison of FNB and ACB showed similar pain control. We suggest PNB as a component of an ERAS protocol for patients undergoing total knee arthroplasty that could relief immediate postoperative pain and encouraged return to daily activities. To determine which of the FNB or ACB is effective, further investigations are needed considering the prospective, larger sample size, and cost-effectiveness of these anesthesia modalities.

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ABSTRACT(IN KOREAN)

수술 후 조기 회복 프로그램에서 말초 신경 차단술이 슬관절 인공관절 전치환술의 결과에 미치는 영향

<지도교수 박 관 규>

연세대학교 대학원 의학과

성 명

이 현 희

서론: 슬관절 인공관절 전치환술 시행 환자들을 위한 말초 신경 차단술은 수술 후 조기 회복 프로그램에서 추천되는 시술 중 하나이다. 이 연구의 목적은 슬관절 인공관절 전치환술 후 수술 직후 통증 조절, 입원 기간, 조기 기능 회복에 대한 말초 신경 차단술의 유효성 평가이다.

대상 및 방법: 2015년 3월부터 2021년 3월까지 일차 슬관절 인공관절 전치환술 후 말초 신경 차단술을 시행한 총 236명이 연구대상으로 포함되었으며, 이 중 138례는 단측 슬관절 인공관절 전치환술 이었으며 98례는 양측 동시 슬관절 인공관절 전치환술 이었다. 이에 대한 대조군으로는 수술 후 정맥내 혹은 경막외 자가통증조절장치만 단독으로 시행한 환자 군이 설정되었다. 실험군은 말초 신경 차단술에 정맥내 자가통증조절장치가 추가적으로 시행되었다. 일차결과지표로는 시각통증척도 (VAS) 점수를, 이차결과지표로는 총 입원기간 및 AKS 점수와 WOMAC 지수 측정을

통한 기능적 결과를 설정하여 연구를 진행하였다.

결과: 수술 후 48시간까지의 휴식 시 VAS 점수는 정맥내 자가통증조절장치군과 비교했을 때 유의미하게 낮았다 (p<0.05). 단측 슬관절 인공관절 전치환술을 시행한 환자들에서는 수술 후 0~6시간 활동 시에도 낮은 VAS 점수를 보였다 (p=0.008). 경막외 자가통증조절장치군과의 비교에서는, 단측 및 양측 슬관절 인공관절 전치환술 시행 실험군 모두에서 수술 후 0~6시간 활동 시 VAS점수가 더 높았다 (p=0.043 및 p=0.039, 각). 그러나 단측 슬관절 인공관절 전치환술 시행 실험군에서의 수술 후 24~48시간 휴식 시 VAS 점수는 더 낮게 나타났다 (p<0.001). 그 외 수술 후 다른 구간내에서는 군간의 유의미한 통계적 차이는 없었다. 수술 후 90일째 AKS 점수 및 WOMAC 지수는 말초 신경 차단술군과 자가통증조절장치 단독시행군간 비슷한 결과를 보였다.

결론: 일차 슬관절 인공관절 전치환술에서 말초 신경 차단술은 수술 후 통증 조절에 있어서 뛰어난 진통 효과를 보였다. 경막외 자가통증조절장치와 비교에서도 말초 신경 차단술은 비슷한 진통 효과를 보였다. 총 입원기간 및 조기 기능적 결과는 말초 신경 차단술군과 자가통증조절장치 단독시행군간의 유의미한 차이가 없었다.

핵심되는 말 : 말초 신경 차단술, 자가통증조절장치, 인공관절 전치환술, 수술 후 조기 회복 프로그램