Continuous Femoral Nerve Block for Knee Arthroplasty: A Comparison of Three Evolving Regimens

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Objective: *Continuous femoral nerve block (CFNB) for knee arthroplasty can provide adequate postoperative pain relief, however it also can cause muscle weakness and delay ambulation. The present study attempted to determine the optimal CFNB regimen for pain control, without compromising postoperative physical therapy (PT).*

Material and Method: *The medical records of 214 patients who had undergone knee replacement with three different CFNB regimens were reviewed. Group 1: bolus with 0.5% ropivacaine or bupivacaine, followed by 0.2% or 0.25% bupivacaine infusion; Group 2: bolus with 0.5% ropivacaine or bupivacaine, followed by 0.125% bupivacaine infusion; Group 3: bolus with 1.5% mepivacaine, followed by 0.125% bupivacaine infusion. The primary outcome assessed was the ability to participate in PT on postoperative day (POD) 2, and was compared between groups. Additionally, the association of demographic variables, pain score, opioid consumption, and anesthetic data with impairment of PT participation was investigated.*

Results: *The incidence of impaired PT was 8% in group 1, 0% in group 2, and 7.8% in group 3. There were no differences in pain scores between the three groups, but group 3 had higher opioid consumption and shorter time to first analgesic, as well as higher average pain score on POD1. Impaired PT performance on POD2 was associated with regimens 1 and 3, older age, higher ASA class and general anesthesia, and associated with longer hospital stay.*

Conclusion: *A more aggressive femoral nerve block regimen may result in motor weakness, but a less aggressive regimen may lead to inadequate pain control. A mid-level regimen improved PT performance without compromising pain control.*

Keywords: *Femoral nerve block, Local anesthetics, Knee arthroplasty, Posteroperative pain, Motor weakness, Physical therapy*

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Continuous femoral nerve blocks provide excellent pain control, enhance rehabilitation, and lead to earlier discharge after total knee arthroplasty (TKA)[1-5]. Continuous femoral nerve blockade is not associated with significant side effects such as hypotension, which is relatively frequent with epidural analgesia. However, one of the major concerns with femoral nerve blocks remains the potential for persistent motor weakness, which could lead to impaired ambulation, failing to meet physical therapy (PT) goals, delayed discharge, or even falls, fractures, and reoperations[6-9]. As higher local anesthetic concentrations and/or doses predictably cause more pronounced sensory and motor blocks, defining the optimal regimen that can provide adequate pain control, while minimizing motor weakness, continues to be a challenge.

The present study was a retrospective cohort study from a single tertiary-referral institution. We analyzed the evolving femoral nerve block regimens used for anesthesia and analgesia in patients that underwent knee replacement, performed during a transitional period of eight months. During this time, a multidisciplinary team was empirically attempting to optimize the local anesthetic type, concentration and volume used for bolus and continuous femoral nerve blockade, resulting in three distinct clinical protocols, of varying degree of block aggressiveness. These changes in protocol produced three distinctive historical cohorts, which could be retrospectively analyzed for the efficacy of analgesia and the impact on performance of PT. Because of an increasing emphasis on quick recovery and hospital discharge, we defined our primary outcome as the ability to participate in PT. We hypothesized that more aggressive

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regimens would lead to superior pain control but more motor weakness, while less aggressive regimens would result in less motor weakness but less effective pain control.

Material and Method

After the Institutional Review Board approval, the inpatient medical records of all patients who had undergone primary unilateral knee replacement with continuous femoral nerve block at Brigham and Women's Hospital (BWH) between July 2010 and February 2011 were reviewed (n = 218). The chart review included patients with unilateral primary knee replacement (mostly total knee replacement, with only five patients receiving partial knee replacement). We excluded two patients with failed blocks and two patients with missing data about type of local anesthetics. Patients' demographic data (sex, age, American Society of Anesthesiologists (ASA) class), numerical pain scores, and opioid consumption during the first 48 hours after operation were collected, and the amount and type of local anesthetic bolus, rate, and time of initiation of local anesthetic infusion was verified in the medical record. PT performance, fall incidence, postoperative nausea and vomiting, and complications of anesthesia were also collected from the electronic medical records.

Two hundred and fourteen patients were categorized into three groups according to concentrations of initial bolus and continuous infusion of local anesthetic, evolving chronologically and pharmacologically from group 1 (most aggressive) to 3 (least aggressive):

Group 1 ("long-acting" bolus, high infusion) (n = 75): initial bolus with a long-acting local anesthetic (0.5% ropivacaine or 0.5% bupivacaine), followed by 0.2% or 0.25% bupivacaine 10 ml/hour.

Group 2 ("long-acting" bolus, low infusion) (n = 62): initial bolus with a long-acting local anesthetic (0.5% ropivacaine or 0.5% bupivacaine), followed by 0.125% bupivacaine 10 ml/hour.

Group 3 ("short-acting" bolus, low infusion) (n = 77): initial bolus with 1.5% mepivacaine, followed by 0.125% bupivacaine infusion 6 to 8 ml/hour (average 7.3 ml/hour).

The sequence of protocols historically started with regimen 1 (which replaced epidural analgesia for TKA), representing the most aggressive regimen. In order to decrease the incidence of anecdotal reports of motor weakness, the protocol was changed in terms of continuous infusion concentration (lower) to regimen 2, and then in terms of type of local anesthetic bolus ("shorter"-acting) to regimen 3.

Nerve block placement and anesthetic management

Patients typically received preoperative femoral nerve blocks with ultrasound guidance (only one block was performed with nerve stimulator guidance alone). An initial bolus of 25 to 35 ml local anesthetic was followed by placement of perineural femoral nerve catheters. The patients underwent knee arthroplasty under general or spinal anesthesia without neuraxial opioids. Continuous femoral nerve block infusions were started with bupivacaine 0.125 to 0.25% at 6 to 10 ml/hour, depending on protocol, at the end of surgery and before the patients were transferred to the recovery room. The infusions were continued overnight and stopped at 6:00 AM the next morning, regardless of the time of surgery, and the perineural catheters were removed within the next six hours. Assessment of opioid consumption in the first 48 hours included preoperative, intraoperative, recovery room and ward consumption of fentanyl, hydromorphone, morphine, oxycodone, and oxycontin. As intravenous hydromorphone was the most commonly used opioid in our practice, we converted all oral and intravenous opioids to equivalent doses of intravenous hydromorphone[10].

Mobility assessment

According to the accelerated clinical pathway[11], PT was performed beginning the first day after surgery, twice a day (AM and PM), until the patients were discharged from the hospital. Patients were evaluated and their progress assessed by the following parameters.

Muscle strength was graded by the ability to perform a straight leg raise and quadriceps muscle motor power grading, which was accomplished via assessment of an isometric quadriceps contraction. Muscle strength was categorized as "poor" if patients had no visible contraction or only muscle fasciculation, "fair" if patients had some visible knee joint extension movement observed with a 5-second hold, and "good" if patients had visible knee joint extension movement with pressure exerted down into the tester's hand or the bed.

Mobilization was graded by the patient's ability to move in bed, transfer to chair, ambulate on flat surfaces with an assistive device, and ascend/descend stairs. Each level of mobilization was also classified by the level of assistance needed into

four levels, "independent" if the patient was safely able to ambulate with no assistance from a physical therapist, "minimal assistance" if the patient required approximately 25% assistance from physical therapist to safely mobilize (including aspects of balance, safety and physical strength), and "moderate" and "maximal assistance" if the patient required approximately 50% and 75% or more assistance, respectively.

As the goal for discharge time was 48 hours after this operation, patient performance during PT on the afternoon of the second postoperative day (POD) was specifically evaluated. PT goals are achieved if patients are able to ambulate on flat surface with minimal assistance on afternoon PT session of POD2. Patients were judged to have impaired PT performance if there was evidence of quadriceps muscle weakness (poor quadriceps strength or inability to do straight-leg raising) combined with inability to mobilize without minimal assistance (n = 12). If subjects were able to mobilize with minimal assistance or did not present with motor weakness, their performance on PT was not considered to be impaired (n = 187). Even though motor strength grading data was missing for a large minority of patients (roughly 30% in all groups), most of the patients had sufficient data for the interpretation of PT performance. Patients in whom data for motor strength and mobility were insufficient for interpretation, were excluded from the analysis of variables associated with impaired PT (n = 15). The flow of patient selection and analysis was shown in Fig. 1.

Statistical analysis

Data were presented as percentages for categorical variables and mean ± standard deviation (SD) for continuous variables. Our primary outcome, the ability to participate in PT (yes/no, as defined above) was compared between treatment groups using a Chi-square test. Intergroup differences on other secondary variables of interest were evaluated with analysis of variance (ANOVA) for continuous variables and the Chi-square or Fisher's exact test, as appropriate, for categorical variables. All statistical tests were two-sided, with a type I error of 0.05. A *p*-value of less than 0.05 was considered to be statistical significant. Statistical analyses were performed with SPSS version 19 (SPSS Inc., Chicago, IL).

We performed a power analysis in order to determine the sample size needed to detect differences between groups in the ability to participate in PT (our primary outcome). In consultation with our colleagues in surgery and PT, we judged that a 10% increase in the number of participants not being able to participate in PT because of weakness or pain would constitute a clinically meaningful difference, large enough to change clinical practice or hospital policy. Allowing a two-sided type I error of 5%, we calculated that a sample of 71 in each group would provide the study with 80% of power to detect a 10% difference in incidence of non-participation in PT between groups.

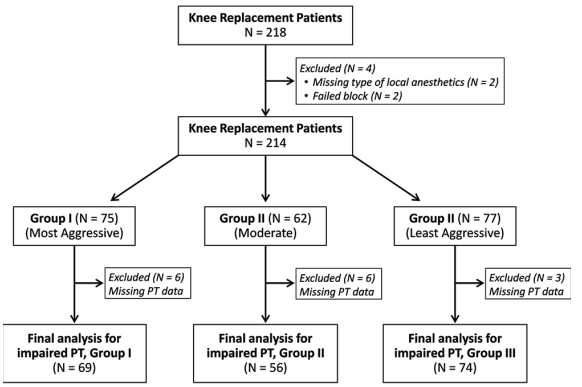


Fig. 1 Flow of screening process for patient selection and data analysis.

Results

Patient demographic data are shown in Table 1. Age, BMI, ASA, type of procedure, and tourniquet time were not different between groups, but there were more men in group 3 (short bolus, low infusion) than 1 and 2. Use of general anesthesia was more common than spinal anesthesia in group 1 (long bolus, high infusion).

The infusion rate and total amount of local anesthetic agent were different among the groups corresponding to the protocol. However, even though the protocol intended to have the same local anesthetic bolus volume, the data showed statistically, but not clinically significant difference of average bolus volume among the groups due to variation of individual provider preferences. We excluded mepivacaine from the calculation of total amount of local anesthetics because we considered mepivacaine to be a short-acting local anesthetic, with effect duration of 4 to 6 hours[12,13], and therefore, unlikely to be present at the time of PT on POD2.

There was no difference in pain scores between the three groups when averaged over 48 hours. However, group 3 had a higher total opioid consumption and shorter time to first analgesic administration (Table 2). Average pain scores from several time periods (PACU, POD1, and POD2) also showed

Table 1. Patient demographic data

Variable	Group			*p*-value
	1 [most aggressive] (n = 75)	2 [moderate] (n = 62)	3 [least aggressive] (n = 77)	
Age (year), mean ± SD	64.4±11.2	66.7±10.9	65.6±10.6	0.480
BMI (kg/m^2), mean ± SD	30.9±7.5	30.5±6.7	30.5±7.7	0.950
Gender, n (%)				0.032
Male	23 (31)	22 (35)	39 (51)	
Female	52 (69)	40 (65)	38 (49)	
ASA class, n (%)				0.215
1	2 (2.7)	0 (0)	0 (0)	
2	40 (53.3)	38 (61.3)	51 (66.2)	
3	33 (44.0)	24 (38.7)	26 (33.8)	
Procedure, n (%)				0.740
Total knee arthroplasty	73 (97)	60 (97)	76 (99)	
Partial knee arthroplasty	2 (3)	2 (3)	1 (1)	
Choice of anesthesia, n (%)	47 (63)	50 (81)	59 (77)	0.041
Spinal anesthesia	28 (37)	12 (19)	18 (23)	
General anesthesia				
Tourniquet time (minutes), mean ± SD	50.2±19.9	49.6±21.6	55.8±18.1	0.110
Nerve block variable, mean ± SD				
Initial bolus volume (ml)	31.4±5.1	29.6±3.5	29.5±3.3	0.005
Infusion rate (ml/hour)	9.9±0.6	9.8±1.0	7.3±1.9	<0.001
Total amount of local anesthetic (mg)	527.0±87.4	329.5±44.4	163.4±51.5	<0.001

BMI = body mass index; ASA = American Society of Anesthesiologists

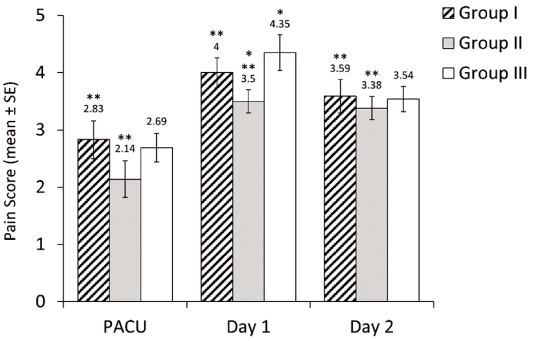
Table 2. Pain scores, opioid consumption, and time to first analgesic

Variable	Group			*p*-value
	1 [most aggressive] (n = 75)	2 [moderate] (n = 62)	3 [least aggressive] (n = 77)	
Average pain score, mean ± SD	3.8±1.9	3.5±1.1	3.9±1.5	0.240
Opioid consumption (mg), mean ± SD	12.8±6.0	11.9±8.1	16.2±11.4	0.009
Time to first analgesic (hours), mean ± SD	1.4±1.4	1.9±1.7	0.7±1.2	<0.001

group 3 patients with significantly higher pain scores on POD1, compared to the group 2 patients (Fig. 2).

Patients receiving the most aggressive regimen (group 1) had an incidence of impaired PT of 8%, while those with the moderate regimen (group 2) had no incidence of impaired PT. However, those receiving the least aggressive regimen (group 3) also had 7.8% incidence of impaired PT (p = 0.024 and 0.029, respectively, see Fig. 3). Due to incomplete PT assessment data, which did not contain a record of muscle strength testing in some cases, we were not able to determine whether failure to mobilize was due to pain or motor weakness. Importantly, missing data were observed with roughly equal frequency across all three groups (Fig. 3). There was no difference between the groups in length of hospital stay (3.9, 4, and 4.2 day in group 1, 2, and 3 respectively, p = 0.19).

Since impairment on PT may represent a significant limitation of patients' functional recovery, we investigated whether other factors may have



** Group I vs. Group II; *p*-value = 0.049, 0.007, 0.010 on PACU, POD1, POD2 respectively
* Group II vs. Group III; *p*-value = 0.018 on POD1

Fig. 2 Time course of average pain scores by nerve block regimen.

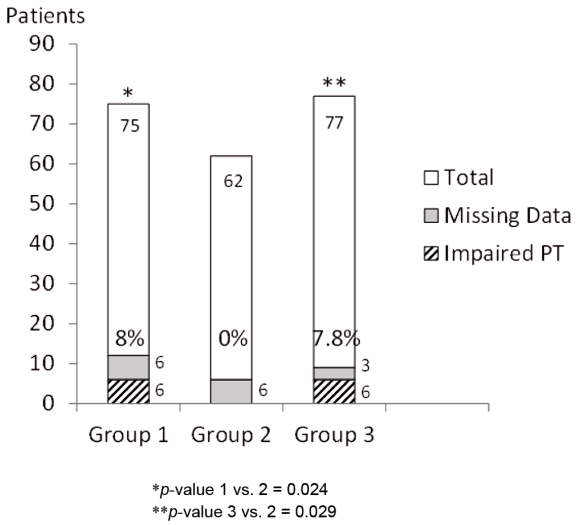


Fig. 3 Incidence of impaired physical therapy.

contributed to this outcome by comparing the demographic, medical, surgical, and anesthetic variables between these groups (Table 3). Besides receiving the most and least aggressive femoral nerve block regimen, increased age, higher ASA class, and general anesthesia were significantly associated with impaired PT, with correlation coefficients of 0.227, 0.199, and 0.194, respectively. Importantly, patients with impaired PT had significantly longer hospital stays by an average 1.22 days (5.08 days vs. 3.86 days, $p = 0.011$). There was no significant correlation of any single local anesthetic parameter (bolus volume, rate of infusion, or total long-acting local anesthetic dose) with impairment of PT.

Finally, analysis of association among risk factors of impaired PT revealed that age, ASA, and choice of anesthesia were independent from each other. Regarding the choice of anesthetic type, general anesthesia was also associated with a higher total opioid consumption at 48 hours (15.86 mg in general anesthesia vs. 12.16 mg in spinal block, $p = 0.017$), higher PACU pain score ($p<0.001$) and higher POD1 pain score ($p = 0.052$) (Fig. 4).

Discussion

The present study demonstrated that a moderate femoral nerve block regimen (group 2) had the lowest incidence of impaired PT, without compromising pain control. Additional analysis also showed older age, higher ASA and general anesthesia were independently associated with increased risk of impaired PT. Finally, impaired PT was associated with longer hospital stay of 1.22 days on average.

Table 3. Correlation analysis of cause of impaired physical therapy

Variable	Impaired physical therapy		*p*-value
	No (n = 187)	Yes (n = 12)	
Age (years), mean ± SD	64.6±10.6	74.8±6.7	<0.001
ASA class, n (%)			0.017
1	2 (1.0)	0 (0)	
2	121 (64.7)	3 (25.0)	
3	64 (34.3)	9 (75.0)	
Gender, n (%)			0.121
Male	73 (39.0)	2 (16.7)	
Female	114 (61.0)	10 (83.3)	
Choice of anesthesia, n (%)			0.006
Spinal block	43 (23.0)	7 (58.3)	
General anesthesia	144 (77.0)	5 (41.7)	
BMI (kg/m^2), mean ± SD	30.9±7.3	32.3±10.3	0.647
Volume of local anesthetic bolus (ml), mean ± SD	30.4±4.0	28.1±5.4	0.162
Infusion rate (ml/hour), mean ± SD	9.0±1.74	8.3±1.87	0.250
Total amount of local anesthetic (mg), mean ± SD	342.3±168.7	299.6±171.4	0.420
Average pain score, mean ± SD			
PACU	2.46±2.55	3.96±2.96	0.112
POD1	3.83±2.27	4.79±1.92	0.125
POD2	3.42±1.87	3.26±2.44	0.819
Opioid consumption (mg), mean ± SD	13.0±9.57	14.0±7.1	0.632
Hospital stay (days), mean ± SD	3.86±1.07	5.08±1.38	0.011

PACU = post-anesthesia care unit; POD = postoperative day

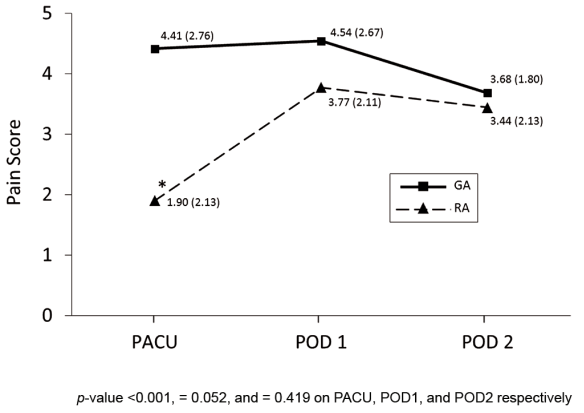


Fig. 4 Pain score, compared between general and regional anesthesia.

Comparison among the three regimens

The successful care for patients undergoing TKA includes not only patient safety and adequate pain control, but also early ambulation and decreased length of hospital stay. Continuous improvement of surgical technique, analgesic therapies, and PT methods have resulted in decreased in-patient time after TKA over the last decade[14-16]. During the period studied of the present report, the optimal perioperative TKA protocol was evolving, with resultant changes in management of the analgesic strategies. Namely, the enhanced recovery targets have driven a major shift from epidural anesthesia/analgesia to continuous femoral nerve blocks in many combinations and modifications, and lately, to local anesthetic infiltration by surgeons. At our institution, the goals are currently for patients to have both adequate pain control and muscle strength with independent mobility by POD2 in order to be discharged either on POD2 (evening) or early on POD3 (morning).

A comparison of these historical cohorts revealed that although the most aggressive and the moderate femoral nerve block regimens showed similar analgesic efficacy, there was a decreased incidence of impaired PT with the transition from group 1 (long-acting bolus, high concentration infusion) to group 2 (long-acting bolus, low concentration infusion) (8%, compared to 0%, *p*-value 0.024). As group 2 received a lower concentration of bupivacaine infusion and thus a significantly smaller total amount of long acting local anesthetic, we speculated that a higher dose of long-acting local anesthetic, by concentration, infusion rate or total mass (mg) may have contributed to more intense block, greater motor weakness, and incidence of impaired PT[17,18].

However, a further decrease in the amount of long-acting local anesthetics, by bolusing with shorter-acting local anesthetics such as mepivacaine (duration 1 to 3 hours[12]), which should not have affected motor strength on POD2, was in fact not associated with an improved PT performance. Surprisingly, the group receiving this least aggressive regimen (group 3) had a higher incidence of impaired PT (7.8%, compared to 0%, *p*-value 0.029). In addition, group 3 had marginally higher POD1 pain verbal rating scale (VRS) and required more opioid to achieve adequate analgesia, which suggested inferior analgesia in group 3, compared to group 2. Higher opioid consumption itself is associated with impaired PT[19]. Additionally, inadequate pain control, even if earlier in the postoperative course (POD1), could have an impact on subsequent PT sessions (POD2), due to discouraging both patient and therapist from more aggressive pursuit of mobility.

Other theoretically possible explanations include our underestimating the potency and duration of mepivacaine, or possible synergy between mepivacaine and bupivacaine, resulting in longer motor block (from femoral nerve block and/or direct local anesthetic effects on the muscles including the iliopsoas, pectineus, and tensor fasciae latae muscles).

Our findings that the moderate femoral nerve block regimen (group 2) resulted in the best outcome (better PT performance than group 1 and lower opioid consumption than group 3) were consistent with several previous studies showing that continuous femoral nerve blocks with a bolus of long-acting local anesthetics (bupivacaine or ropivacaine), followed by a lower concentration of long-acting local anesthetics (0.125% bupivacaine or 0.1 to 0.2% ropivacaine) for 24 to 48 hours enhances early ambulation[14,20,21]. On the other hand, contrary to our finding that the least aggressive regimen had a worse outcome (higher opioid consumption, more pain and higher incidence of impaired PT), one prior prospective randomized study used a similar regimen of initial bolus with short-acting local anesthetics (1.5% mepivacaine), followed by 0.2% ropivacaine for 4 days, demonstrated improved PT with excellent pain control[22]. However, this protocol had some differences from the current regimens, prohibiting direct comparison.

Even though we sought to establish the contribution of various factors for the better PT performance in group 2, the correlation analysis failed to find an association of a single characteristic of the regimen (type of initial local anesthetic bolus,

concentration of infusion, rate of infusion, and total amount of long-acting local anesthetic) with impaired PT. We speculate that the better PT performance in group 2 resulted from the combination of adequate type, concentration, and rate of infusion of bolus and infused local anesthetic regimen. Additionally, although we observed a small gender imbalance among the groups, the analysis failed to associate this with impaired PT.

Analysis of risk for impaired PT

The ability to meaningfully participate in PT is a surrogate outcome of patient recovery, likely involving a more complex equation, including more than just pain and muscle strength[23]. In addition to the femoral nerve block regimen, we found that increased age, higher ASA, and general anesthesia were associated with impaired PT. Evidence that baseline functional status and general physical stamina impact the ability to participate in PT has been demonstrated in multiple previous studies. As higher age and ASA are associated with delayed recovery and ambulation[23-25], our results are consistent with this, and it is notable that no apparent relation between these variables was found on a correlational analysis.

Unsurprisingly, patients who received spinal rather than general anesthesia had superior pain control in the immediate postoperative period. However, this appeared to extend beyond the pharmacologically predictable duration of spinal local anesthetics to POD1, resulting in marginally lower pain scores and significantly lower opioid consumption, and correlating with a favorable PT outcome. Spinal anesthesia provides a dense pharmacological block, which, although lasting only 4 to 6 hours, dampens the most intense period of nociceptor activation, and may have preventive analgesic effect[26]. Although still controversial, multiple studies suggest that regional anesthesia (neuraxial block) is superior to general anesthesia, in terms of recovery and postoperative outcomes (complications, ICU admissions, mortality, length of stay), independent of patient age and comorbidities[24]. The combination of less opioid consumption, slightly better pain control, and preservation from the impact of general anesthesia may all contribute to a more favorable PT outcome in those patients receiving spinal anesthesia. Thus, the choice of anesthesia was the only modifiable risk factor that potentially contributed to patient outcome and clinicians may consider this, especially in patients at greatest risk for impaired PT.

There are important limitations to the present study. Firstly, being retrospective in nature, patients were not randomized to treatment groups, but rather grouped according to historical cohort. Secondly, there were some differences in the proportion of gender and choice of anesthesia between groups. However, while general anesthesia was associated with poorer outcomes, there was no gender effect on PT impairment. Lastly, the incomplete availability of motor assessment data at time of PT precluded our ability to distinguish between motor weakness and increased pain as the cause of impaired PT performance. More detailed assessment of pain and motor strength at the time of PT, particularly when patients are unable to reach their PT goals, should be documented in future studies to explore this important distinction.

As there is more than one way to achieve the optimal outcome for a patient, optimal practices, or protocols for different hospitals may vary due to multiple factors, including local resources and institutional policy. Individual patient factors have to be taken into account and considered in tailoring anesthetic and analgesic approaches to achieve optimal results. A multidisciplinary team (orthopedist, anesthesiologist, and physical therapist) should set with the patients' mutual goals, expectations and strategies to apply and possibly modify evidence-based practice to individualized settings for the best functional recovery and overall patient outcomes.

Conclusion

A systematic clinical regimen change in continuous femoral nerve block infusion from 0.2% bupivacaine to 0.125% infusion was associated with a decreased incidence of impairment during PT, while maintaining superior pain control. However, subsequent alteration of the initial nerve block bolus from a longer-acting local anesthetic (ropivacaine 0.5% or bupivacaine 0.5%) to a shorter-acting local anesthetic (mepivacaine 1.5%) was associated with greater incidence of PT impairment as well as increased opioid consumption. Higher age and ASA class, as well as general anesthesia were also associated with impaired PT.

What is already known on this topic?

Continuous femoral nerve blocks provide excellent pain control and enhance rehabilitation, leading to earlier discharge after knee arthroplasty. However, the block can also cause motor weakness, impaired PT, and delayed discharge. Defining the optimal regimen of local anesthetics that can provide

adequate pain control, with minimal motor weakness, is challenging.

What this study adds?

The incidence of impaired PT was 0 to 8%, depended on the regimen. A more aggressive femoral nerve block regimen may result in motor weakness, but a less aggressive regimen may lead to inadequate pain control. Whereas a mid-level regimen improved PT performance without compromising pain control and had the lowest incidence of impaired PT. Older age, higher ASA class and general anesthesia were also associated with impaired PT.

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Potential conflict of interest

None.

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การศึกษาเปรียบเทียบสูตรของยาชาที่ใช้ใน continuous femoral nerve block สำหรับการเปลี่ยนเข่า

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ภูมิหลัง: *Continuous femoral nerve blocks สามารถระงับความปวดหลังผ่าตัดเปลี่ยนข้อเข่าได้อย่างดี อย่างไรก็ตามขนาดและ/หรือความเข้มข้นยาชาที่สูงขึ้นที่ใช้ในการทำ continuous femoral nerve blocks ไม่เพียงยับยั้งเส้นประสาท sensory ซึ่งช่วยระงับปวดแต่ยังยับยั้งเส้นประสาท motor ซึ่งสัมพันธ์กับอาการกล้ามเนื้อต้นขาอ่อนแรงและอาจทำให้ความสามารถในการเดินหลังผ่าตัดลดลง การหาสูตรของชนิด ขนาด และความเข้มข้นของยาชาที่เหมาะสมจึงเป็นคำตอบที่น่าวิเคราะห์ และเป็นที่มาของการศึกษานี้*

วัสดุและวิธีการ: *เวชระเบียนของผู้ป่วย 214 ราย ที่ได้รับการผ่าเปลี่ยนเข่าและได้รับการระงับปวดด้วย continuous femoral nerve ได้รับการตรวจสอบและเก็บข้อมูลย้อนหลัง ผู้ป่วยถูกแบ่งเป็นสามกลุ่มตามชนิดของยาชาที่ได้รับ กลุ่มที่ 1 ได้รับ ropivacaine หรือ bupivacaine 0.5% ตามด้วย bupivacaine 0.2% หรือ 0.25% หยดต่อเนื่องหลังผ่าตัด กลุ่มที่ 2 ได้รับ ropivacaine หรือ bupivacaine 0.5% ตามด้วย bupivacaine 0.125% หยดต่อเนื่องหลังผ่าตัด กลุ่มที่ 3 ได้รับ mepivacaine 1.5% ตามด้วย bupivacaine 0.125% หยดต่อเนื่องหลังผ่าตัด การประเมินดูจากความสามารถในการเดินได้อย่างมั่นคงขณะทำกายภาพบำบัดวันที่สองหลังการผ่าตัด นอกจากนี้ข้อมูลเบื้องต้นของผู้ป่วย ระดับความปวด ปริมาณยา opioids ที่ใช้ และข้อมูลที่เกี่ยวกับการวางยาสลบก็นำมาวิเคราะห์ด้วย*

ผลการศึกษา: *พบผู้ป่วยที่ไม่สามารถเดินได้อย่างมั่นคงขณะทำกายภาพบำบัดถึงร้อยละ 8 ในกลุ่มที่ 1 ไม่พบเลยในกลุ่มที่ 2 และร้อยละ 7.8 ในกลุ่มที่ 3 ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของระดับความเจ็บปวดโดยรวมระหว่างกลุ่ม หากแต่ผู้ป่วยในกลุ่มที่ 3 มีความต้องการยาแก้ปวด opioids มากกว่าและไวกว่ากลุ่มอื่น นอกจากนี้ผู้ป่วยในกลุ่มที่ 3 ยังมีระดับความปวดในช่วงหลังผ่าตัดวันที่ 1 สูงกว่ากลุ่มอื่นอีกด้วย การวิเคราะห์ยังพบว่าผู้ป่วยในกลุ่มที่ 1 และ 3, ผู้ป่วยที่มีอายุมาก, ผู้ป่วยที่มีระดับ ASA มากกว่า และผู้ป่วยที่ได้รับการวางยาสลบแบบทั่วไป มีความเสี่ยงของการไม่สามารถเดินได้อย่างมั่นคงขณะทำกายภาพบำบัดสูงขึ้น ส่งผลให้ผู้ป่วยต้องอยู่โรงพยาบาลนานขึ้น*

สรุป: *การใช้สูตรของยาชาที่ออกฤทธิ์ยาวและมีความเข้มข้นสูงในการทำ femoral nerve block สัมพันธ์กับอาการกล้ามเนื้ออ่อนแรง ในขณะที่สูตรยาชาที่ออกฤทธิ์สั้นตามด้วยยาชาที่มีความเข้มข้นต่ำอาจสัมพันธ์กับการระงับปวดที่ไม่เพียงพอ สูตรยาชาที่ออกฤทธิ์ยาวในขนาดและความเข้มข้นที่เหมาะสมสามารถระงับความเจ็บปวดได้อย่างเหมาะสม และส่งผลให้ผู้ป่วยสามารถเดินได้อย่างมั่นคงขณะทำกายภาพบำบัดหลังการผ่าตัด*