# Effects of Single Shot Femoral Nerve Block Combined with Intrathecal Morphine for Postoperative Analgesia: A Randomized, Controlled, Dose-Ranging Study after Total Knee Arthroplasty

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***Objective:*** *Pain after total knee arthroplasty (TKA) is severe, thus adequate pain control can be a challenge. Intrathecal morphine (ITM) provides excellent postoperative analgesia for TKA, but may have side effects. Femoral nerve block (FNB) also has been used for postoperative analgesia in TKA. We examined postoperative analgesia efficacy and side effects of ITM combined with single shot femoral nerve block (SSFNB) after TKA, over the dosage range of 0.0 to 0.3 mg.*

***Material and Method:*** *Sixty patients undergoing elective TKA received SSFNB (0.5% bupivacaine 20 ml) and spinal anesthesia with 15 mg of hyperbaric bupivacaine (0.5% Heavy Marcaine) were included in this study. They were randomized to receive ITM (0, 0.1, 0.2, and 0.3 mg). A patient-controlled analgesia (PCA) device provided additional intravenous morphine. Morphine consumption, pain score, and side effects were recorded at 0, 1, 4, 8, 12, and 24 hour postoperative. Patient satisfaction was rated at the 24-hour postoperative visit.*

***Results:*** *Morphine consumption was significant higher in 0 mg ITM group (control) than other groups, but there was no difference between ITM groups. Pain score was significant lower in 0.3 mg ITM group compared to 0 mg at 1 hour (0.5 vs. 3.5, respectively; p-value = 0.013) and 4 hour (1.5 vs. 4.5, respectively; p-value = 0.037) postoperative period. Side effects were not different in all groups.*

***Conclusion:*** *The present study concluded that, low-dose ITM combination with SSFNB provided good pain relief with low side effects and reduced morphine consumption during the first 24 hours post TKA.*

***Keywords:*** *Knee arthroplasty, Femoral nerve block, Postoperative Pain, Spinal Morphine*

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Total Knee Arthroplasty (TKA) is a major procedure that can improve patients mobility and quality of life. Pain after TKA is severe and does not noticeably subside for 48 to 72 hours after surgery[1]. Adequate pain control can be a challenge. There are many modalities for pain control after TKA including intravenous patient-controlled analgesia (PCA), peripheral nerve blocks, periarticular infiltration, and neuraxial technique[2-4].

The peripheral nerve block procedure has been increasing in popularity as an augmentation to spinal or general anesthesia for postoperative pain control. Femoral nerve block (FNB), both single shot and continuous infusion techniques, has been proven adequate in postoperative pain control. Further benefits include reduction in the use of analgesic rescuer drugs as well as lower pain score[5]. Single-shot femoral nerve block (SSFNB) has also been studied to improve postoperative analgesia and to reduce patient's hospital stay[6].

Although The PROSPECT Working Group, that conducted systematic reviews of postoperative pain management following TKA[7] recommended the use of general anesthesia combined with FNB for surgery and postoperative analgesia, but spinal anesthesia with local anesthetic plus spinal morphine was also recommended for alternative method. The patients are usually elderly with comorbid diseases thus it is important to choose an anesthetic and analgesic regimen that minimize side effect and providing suitable pain relief. Regional anesthesia has the advantage of reducing stress response in surgery and decreasing morbidity and mortality in high-risk

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surgical patients[8]. These were reasons for the authors to choose spinal anesthesia with intrathecal morphine (ITM). It is a simple and effective method, providing optimal surgical conditions and analgesia extending into the postoperative period. In addition, ITM may be a useful additive for providing analgesia in the sciatic nerve distribution.

Intrathecal morphine (ITM) provides excellent postoperative analgesia for knee arthroplasty[9-11]. However, ITM may result in undesirable side effects including nausea, pruritus, sedation, urinary retention, and respiratory depression. These conditions led to the drawback of ITM. The side effects and analgesic efficacy of ITM are dose related. The authors hypothesized that the combination of SSFNB and low dose ITM would provide adequate pain control after TKA. The authors studied the dose-range of ITM to establish an appropriate formula when in combination with SSFNB. The purpose of this present was to achieve an optimum postoperative pain analgesia with minimum side effects.

**Material and Method**

After approval for a clinical study by the Mahidol University Ethics Committee for the Protection of Human Subjects (MU-IRB), 60 informed and consenting patients, who were scheduled for a single TKA, were enrolled. Inclusion criteria consisted of primary TKA for a diagnosis of osteoarthritis, age 45 to 75 years with American Society of Anesthesiologists (ASA) physical status I-III. Patients were excluded from the study if they a) had contraindications to spinal block or regional anesthesia, b) had significant chronic obstructive pulmonary disease, c) had a history of chronic pain that was unrelated to knee pathology and chronic opioid analgesic use, d) were allergic to the drugs designated for the study, and e) were unable to use a PCA device. In addition, once enrolled, patients were removed from the study if they a) experienced a failed femoral nerve block or spinal anesthesia, b) operated for an alternative means to TKA, or c) refused to participate in the study.

Patients were randomly divided into four groups (15 patients per group) using computer-generated random numbers on the day of surgery. These groups were designated by an ITM dose: 0.0 (control), 0.1, 0.2, or 0.3 mg of morphine sulfate. After standard monitoring, all patients received a single injection of femoral nerve block under a nerve stimulation (B Braun, Stimuplex HNS12). A 22-gauge insulated Stimuplex (B Braun) needle was inserted lateral to the femoral pulse at the level of the inguinal crease. 0.5% Bupivacaine 20 ml was injected after eliciting a quadriceps contraction at 0.2 to 0.5 mAmp. Success was evaluated within 30 minutes of the block. Success of FNB was defined as decreased of sensation to cold and pinprick test with blunt needle in anterior aspect of the thigh and knee. Failure of FNB was defined as absent sensory blockade presented within 30 minutes of the block. After success of FNB, patients received spinal anesthesia with an administered 15 mg of 0.5% hyperbaric bupivacaine (0.5% Heavy Marcaine) combined with ITM by the same anesthesiologist (with a randomized dose as described above).

After the operation, patients were monitored in the postanesthetic care unit (PACU). PACU nurses, who were unaware of the study, gave routine postanesthetic care. Incremented doses of morphine at 2 to 3 mg were intravenously (IV) administered until the patient reported a rate of pain less than 4 on the numerical rating scale (NRS), where 0 = no pain and 10 = worst possible pain. NRS scores were obtained at rest. Thereafter, during the first 24 hour, postoperative time period, all patients received IV morphine via a patient-controlled analgesia (PCA) device. Specifics of dosage for this period were as follows: no basal infusion, 1-mg/dose, 5-min lockout, 20 mg/4 hour limit.

The time patients arrived at the PACU was defined as 0 hour. The data of NRS scores, IV morphine supplement dose, sedation score, nausea/vomiting severity and pruritus severity were recorded at hours 0, 1, 4, 8, 12, and 24. The incidences and severity of nausea/vomiting and pruritus were assessed on a scale of 0 to 3 (0 = none, 1 = mild, no treatment required, 2 = moderate, required treatment, and 3 = severe, treatment not improved, required more than conventional treatment). Sedation scores were measured on a numerical score of 0 to 3 (0 = completely awake, 1 = sometime drowsy, easily roused, 2 = often drowsy, easily roused, and 3 = often drowsy, difficult to roused). Patient satisfaction was rated by patients during the 24 hour. Postoperative period on the basis of overall pain relief perception (1 = unsatisfactory, 2 = fair, 3 = moderate, 4 = good, and 5 = outstanding). All data was collected by ward and anesthetic nurses who were not involved in the administration of anesthetic medication.

All patients in the present study were monitored for respiratory depression by assessing respiratory rates, which were routinely collected by

**Table 1.** Demographic and perioperative data of patient

| Group | 0 mg | 0.1 mg | 0.2 mg | 0.3 mg |
|---|---|---|---|---|
| n | 15 | 15 | 15 | 15 |
| Age (years) | 68.87±6.51 | 69.27±5.24 | 70.47±4.42 | 65.67±4.45 |
| Gender (M/F) | 3/12 | 4/11 | 3/12 | 3/12 |
| BW (Kg) | 68.58±9.59 | 65.86±14.84 | 67.44±16.55 | 60.93±8.09 |
| Height (cm) | 158.87±7.69 | 158.87±6.7 | 158.27±6.78 | 159.87±8.94 |
| ASA (I/II/III) | 0/11/4 | 0/12/3 | 1/11/3 | 1/12/2 |
| Tourniquet time (min) | 130.53±24.12 | 126.20±36.05 | 119.00±36.76 | 136.27±18.18 |
| Operation time (min) | 161.47±40.79 | 142.00±34.63 | 132.33±41.48 | 145.00±26.72 |

Values are mean ± SD except gender and ASA
0 = 0 mg ITM or control group, 0.1 = 0.1 mg ITM, 0.2 = 0.2 mg ITM, 0.3 = 0.3 mg ITM
M = male; F = female; BW = body weight; ASA = American Society of Anesthesiologists; ITM = intrathecal morphine

hospital staff. Respiratory rate was assessed by ward nurses every hour. Respiratory depression was defined as a respiratory rate less than eight breaths per minute. Supplemental oxygen was not placed routinely; however, if at any time respiratory rate was lower than eight breaths per minute, oxygen 6 L/minute via mask would be administered. Intravenous naloxone was also readily available for treatment of respiratory depression. All patients had indwelling urinary catheters prior to surgery; no attempt was made to determine the incidence of urinary retention.

The primary outcome was reduction in intravenous morphine consumption with lower pain score during the first 24 hours postoperative period. Secondary outcomes were lower incidence and lower severity of side effects from morphine as well as higher patient satisfaction score.

The SPSS for Windows version 18.0 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis. The power of analysis based on previous dose-response study[12] of ITM recorded a 30% reduction of IV PCA morphine use during the 24-hour post-operative period. The participation rate ($1-\beta = 0.8$, $\alpha = 0.05$) indicated 15 patients per group. Quantitative demographic data (age, height, weight, and ASA physical status), operation time, tourniquet time (TQ-time), NRS and IV morphine consumption were analyzed with repeated measure ANOVA to detect significant differences among 4 treatment groups (0.0, 0.1, 0.2, and 0.3 mg). Pairwise comparisons were performed at 0, 1, 4, 8, 12 and 24 hour and were corrected for multiple comparisons by using the Bonferroni Correction Method. Discrete variables (pruritus severity, nausea/vomiting severity, sedation scores and satisfaction scores) were analyzed with Chi-square test. All data were given as mean ± SD, statistical significance was considered at $p<0.05$.

## Results

Sixty patients were enrolled in the study. No patients exited, or were excluded from the study. Demographic data of patients in each group are shown in Table 1. There was no statistical difference in demographic data between groups. However, operation time in group 0 mg ITM trend to be longer than group 0.2 mg but there was no statistical difference between groups.

Total morphine consumption in 24 hour postoperative periods were 22.8 mg, 8.0 mg, 7.8 mg, and 7.4 mg in group 0, 0.1, 0.2, and 0.3 mg ITM respectively (Table 2). Total morphine requirement was significantly highest in control group (0 ITM) than other groups. There was no statistical difference in morphine consumption between group 0.1, 0.2, and

**Table 2.** Cumulative IV morphine (mg) used at 0, 1, 4, 8, 12 and 24 hour postoperative

| Hour | ITM dose | | | | p-value |
|---|---|---|---|---|---|
| | 0 mg | 0.1 mg | 0.2 mg | 0.3 mg | |
| 0 | 0.8±1.84 | 0 | 0 | 0 | 0.048[a] |
| 1 | 2.3±3.4 | 0.4±0.8 | 0.3±0.6 | 0.06±0.2 | 0.004[a] |
| 4 | 6.6±4.6 | 1.5±2.0 | 1.0±1.9 | 1.1±2.7 | <0.001[a] |
| 8 | 11.6±7.1 | 2.8±3.3 | 2.4±3.0 | 2.8±3.7 | <0.001[a] |
| 12 | 15.1±8.9 | 4.3±4.7 | 5.0±5.8 | 5.0±4.7 | <0.001[a] |
| 24 | 22.8±11.3 | 8.0±7.1 | 7.8±5.9 | 7.4±5.6 | <0.001[a] |

[a] Control group (0 mg ITM) required significantly more morphine than ITM groups 0.1, 0.2 and 0.3 mg in all variant times postoperatively

0.3 mg. In group 0 mg ITM, cumulative morphine requirements were significantly higher at all variant time intervals as compared to others. Cumulative morphine consumption was similar among ITM groups at all time intervals (Fig. 1).

Pain scores were not difference among groups except at 1 and 4-hour periods where NRS rates were significantly lower in the 0.3 mg ITM group compared with 0 mg ITM group (Fig. 2).

Side effects were not different among all groups. Most common side effects were nausea/vomiting and pruritus shown in Table 3. Incidence of nausea/vomiting and pruritus were higher in 0.1, 0.2, and 0.3 mg ITM groups but no statistical difference with 0 mg ITM group. More than 50% of patients in each group had no symptoms of side effects. There were no incidence of serious side effects such as respiratory depression in the present study, neither incidence of the patients' sedation score 3. Moderate to deep sedation (sedation score ≥2) was experienced by one patient in 0 mg ITM group and one in 0.2 mg ITM group with no oxygen requirement. Overall, patient satisfactions were not different among groups. Mean patient satisfaction scores were 3.73, 4.2, 4.2, and 4.4 in 0, 0.1, 0.2, and 0.3 mg ITM groups respectively. A higher percentage of patients in 0 mg ITM group expressed poor satisfaction, but there was no statistical significant (Table 3).

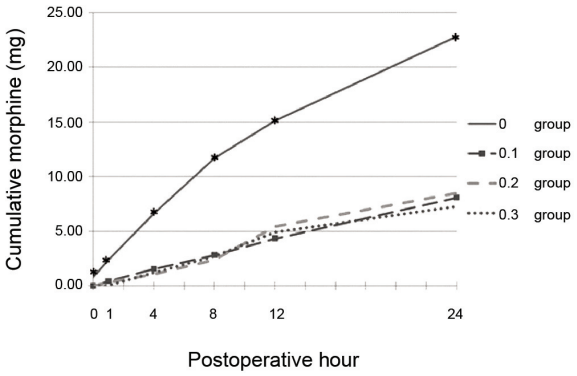


**Fig. 1** Cumulative morphine consumption in 24 hour postoperative after total knee arthroplasty among 4 treatment groups.
* $p<0.05$ (control group (0 mg ITM) required significantly more morphine than ITM groups 0.1, 0.2 and 0.3 mg in all variant times postoperatively).

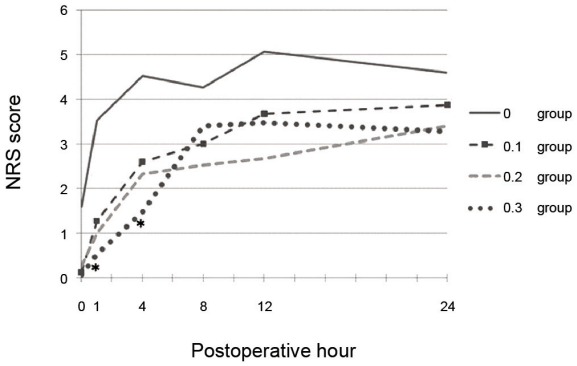


**Fig. 2** Numerical rating scale (NRS) at difference times in 24 hours postoperatively.
* $p<0.05$ (p-value = 0.013 and 0.037 at 1 hour and 4 hours, respectively between Control group (0 mg ITM) versus 0.3 mg ITM group).

## Discussion

The present study demonstrated the combination of low dose ITM with single shot femoral nerve block provided adequate analgesia and significantly reduced additional IV morphine requirements during the first 24 hours of postoperative total knee arthroplasty. The side effects of morphine were not different in all groups.

In present study, the authors found that patients who received low dose ITM with SSFNB required less additional morphine than with SSFNB as a sole procedure. However, operation time in group 0 mg ITM trend to be longer than group 0.2 mg, that may influence to pain score but there was no statistical difference between groups. Similar results were found

**Table 3.** Incidence of side effects and poor satisfaction after total knee arthroplasty

| Side effects | 0 mg ITM | 0.1 mg ITM | 0.2 mg ITM | 0.3 mg ITM | p-value |
|---|---|---|---|---|---|
| N/V requiring treatment (score ≥2) | 1 (6.7%) | 2 (13.3%) | 5 (33.3%) | 4 (26.7%) | 0.255 |
| Pruritus requiring treatment (score ≥2) | 0 | 3 (20.0%) | 1 (6.7%) | 1 (6.7%) | 0.252 |
| Moderate-deep sedation (score ≥2) | 1 (6.7%) | 0 (0%) | 1 (6.7%) | 0 (0%) | 0.523 |
| Poor satisfaction (score ≤3) | 5 (33.3%) | 2 (13.3%) | 1 (6.7%) | 1 (6.7%) | 0.134 |

Values are number (%)
ITM = intrathecal morphine; N/V = nausea and vomiting

in previous studies. Frassinato et al[13] found that after TKA, 0.1 ITM required less opioid consumption and recorded lower pain scores as compared to sole administered FNB. Otten et al[14] reported that patients receiving ITM alone requested more opioid than patients receiving ITM with FNB. Park et al[15] showed that the addition of low dose ITM to continuous 3-in-1 block was superior to sole administered continuous 3-in-1 block. The present study confirmed the consistency of previous results. The knee joint is innervated mainly by obturator, femoral and sciatic nerves. Administering a femoral nerve block exclusively will not achieve a complete sensible effect when applied to a knee surgery[6,16]. The results of additional sciatic nerve block, or obturator nerve block in knee surgery are dispersed[17,18]. By speculation, intrathecal morphine (ITM) might be needed to assure complete analgesia in other areas of nerve distribution.

Opioid related side effects including incidence of nausea and pruritus in this study were similar between ITM groups and control group. While the numbers of nauseated patients were greater in ITM groups, it was not significant in the statistical analysis. Sites et al[19] showed that 0.25 mg ITM had equal efficacy as compared with FNB during postoperative TKA. However, the same group had a significantly higher rate of nausea and pruritus. Whereas Rathmell et al[12] and Palmer et al[20] showed that ITM group had a similar rate of nausea as compared to control group. The present study showed that with low dose ITM, the side effect did not vary from control group.

In term of pain score, average pain scores were not different in all groups. Pain scores in ITM groups were lower than in control group but not statistically significant. Only 0.3 mg ITM group had pain scores significantly lower than control group, which were noted at 1 and 4-hour postoperatively. Bailey et al[21] found that maximal analgesic effect with ITM occurred between hour 4 and 7. Effectiveness declined after seven hours toward baseline at 10 to 15 hours. Average operation time, in the present study was 2 to 3 hours. Thus, the estimated time of maximal analgesic effect with ITM was 1 hour postoperative. This may justify the results of pain score rates in our study.

Low dose intrathecal morphine is an option for postoperative pain control. Various dose-ranging formulas have been studied for optimum effectiveness in IT morphine doses. Park et al[15] found 0.05 mg ITM combined with continuous 3-in-1 block seemed to be optimal for TKA. Whereas, 0.1 to 0.2 mg ITM provided equal pain control with greater side effects. Rathmell et al[12] found that hip and knee arthroplasty patients receiving 0.2 or 0.3 mg ITM had higher satisfaction scores than patients receiving 0.0 or 0.1 mg. Slappendel et al[22] showed that ITM doses less than 0.1 mg was not effective and recommended 0.1 mg ITM doses for hip surgery. Murphy et al[23] also reported that both 0.1 and 0.2 mg of ITM with PCA morphine provided effective postoperative analgesia after hip arthroplasty, whereas 0.05 mg of ITM did not provide an effective analgesia as compared with a placebo. In this present study, the authors were unable to define the optimal dose of ITM combined with SSFNB for effective TKA postoperative analgesia. The authors revealed that ITM 0.1, 0.2 and 0.3 mg were equal for pain control. However, ITM 0.3 mg group had a significantly lower pain score as compared to control group with similar side effects. Thus, ITM 0.3 mg seemed to be an appropriate dose relative to the lower pain scores. Further study should be conducted to confirm this hypothesis.

We acknowledged that continuous nerve block has the advantage of permitting the delivery of analgesia for a longer postoperative duration than single-shot nerve block[24,25]. However, insertion of continuous catheter required additional time, skills and cost[26,27]. Many studies also showed that continuous catheterization increased risk of infection and nerve injury[28]. In a meta-analysis[5], SSFNB was found to be equivalent to continuous FNB in terms of morphine consumption and pain scores at both 24 and 48 hours. SSFNB was used in our study due to its simplicity and efficacy.

The present study has several limitations. The authors only measured respiratory rates intermittently and pulse oximetry was not utilized for continuous assessment of arterial oxygen saturation thus, significant hypoxemia during observations could not be excluded. However, there was no episode of respiratory depression that required treatment. We only collected data during the first 24-hour postoperative period. Given the resolution of ITM and peripheral nerve analgesia by postoperative day 1, we did not expect any significant differences beyond 24 hours. Finally, we did not measure secondary outcome variables such as physical therapy, term of hospital stay, and cost analysis.

In conclusion, low dose ITM combination with SSFNB provided good pain relief with low side effects and reduced IV morphine consumption during the first 24-hour post total knee arthroplasty. The opioid

related side effects did not vary among groups. The optimal dose of ITM in combination with SSFNB for pain control is not available in this present. However, ITM 0.3 mg appeared to be safe and effective with a higher percentage of high satisfaction scores. Further study with a larger sample size should be conducted to confirm this hypothesis.

**What are already known on this topic?**

Total knee arthroplasty (TKA) is major surgery that may produce severe post-operative pain. Multiple techniques of postoperative pain control have been used after TKA. Intrathecal morphine (ITM) was the classic and easily method, that had evidence support the analgesia produced by ITM is adequate for pain relief after many different types of surgery including major orthopedic surgery. However, postoperative analgesia with ITM is associated with dose-related side effects, including nausea and vomiting (N/V), pruritus, urinary retention, and respiratory depression. In an attempt to limit side effects, the use of small-dose spinal opioids has been advocated.

Femoral nerve block, either as a single shot or continuous with a catheter, has been increasing in popularity as an augmentation to spinal or general anesthesia for postoperative pain control after total knee arthroplasty. In addition, it has also been shown in reducing need for parenteral or oral analgesia and lower pain scores.

There had several systematic reviews and meta-analysis of postoperative pain management for total knee arthroplasty. The combination of multiple analgesic drugs with different mechanisms and pathways of action are the best way to achieve maximal control of pain after knee arthroplasty.

**What this study adds?**

The finding support the use of low-dose ITM combination with Single Shot Femoral Nerve Block (SSFNB) provided good pain relief with low side effects. It is simple and has efficacy for post-operative pain control during the first 24-hour period after knee arthroplasty. However, the authors cannot define the optimal dose of ITM combined with SSFNB for effective TKA postoperative analgesia, but ITM 0.3 mg seem to be safe and effective related to the lower pain scores.

**Potential conflicts of interest**

None.

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## *การศึกษาเปรียบเทียบประสิทธิภาพในการลดความปวดหลังผ่าตัดข้อเข่าเทียมของการให้ยาแก้ปวดมอร์ฟีนในช่องไขสันหลังและหาขนาดที่เหมาะสมร่วมกับการทำ single shot femoral nerve block*

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***วัตถุประสงค์:*** *ความปวดหลังผ่าตัดเปลี่ยนข้อเข่าเป็นความปวดที่มีความรุนแรงมาก การจัดการความปวดหลังผ่าตัดให้เพียงพอเป็นงานที่ท้าทายของวิสัญญีแพทย์ การให้ยาแก้ปวดมอร์ฟีนในช่องไขสันหลังเป็นวิธีที่ควบคุมความปวดหลังการผ่าตัดเปลี่ยนข้อเข่าได้ค่อนข้างดีแต่มักมีผลข้างเคียง การฉีดยาชารอบเส้นประสาท femoral เป็นวิธีที่มักถูกใช้เพื่อควบคุมความปวดหลังการผ่าตัดเปลี่ยนข้อเข่าเช่นกัน ผู้นิพนธ์จึงสนใจทำการศึกษาประสิทธิภาพในการลดความปวดของการให้ยาแก้ปวดมอร์ฟีนในช่องไขสันหลังในขนาดตั้งแต่ 0.0-0.3 มิลลิกรัม ร่วมกับการฉีดยาชารอบเส้นประสาท femoral (single shot femoral nerve block, SSFNB) ความต้องการยาแก้ปวดเพิ่ม ผลข้างเคียงจากยาแก้ปวด และหาขนาดยาแก้ปวดมอร์ฟีนที่เหมาะสมให้ได้ผลระงับปวดดีที่สุดและผลข้างเคียงน้อยที่สุด*

***วัสดุและวิธีการ:*** *ผู้ป่วย 60 ราย ที่เข้ารับการผ่าตัดเปลี่ยนข้อเข่าแบบไม่ฉุกเฉิน ทุกคนจะได้รับการทำ single shot femoral nerve block ด้วย 0.5% bupivacaine 20 มิลลิลิตร ก่อนการระงับความรู้สึกด้วยเทคนิค spinal anesthesia ด้วย 0.5% hyperbaric bupivacaine 15 มิลลิกรัม ผู้ป่วยจะถูกแบ่งเป็น 4 กลุ่ม โดยสุ่มด้วยการจับสลากให้ยาแก้ปวดมอร์ฟีนในช่องไขสันหลังในขนาดต่าง ๆ คือ 0.0, 0.1, 0.2, 0.3 มิลลิกรัม หลังการผ่าตัดผู้ป่วยจะได้ยาแก้ปวดมอร์ฟีนเพิ่มทางหลอดเลือดดำโดยเครื่องควบคุมความปวดด้วยตนเอง จากนั้นผู้ป่วยจะได้รับการประเมินและบันทึกความปวด บันทึกปริมาณมอร์ฟีนที่ใช้ และผลข้างเคียงที่เกิดขึ้นในช่วงเวลา 0, 1, 4, 8,12 และ 24 ชั่วโมงหลังผ่าตัด ส่วนคะแนนความพึงพอใจของผู้ป่วยจะได้รับการประเมินหลังผ่าตัด 24 ชั่วโมง*

***ผลการศึกษา:*** *ไม่พบความแตกต่างอย่างมีนัยสำคัญของปริมาณมอร์ฟีนที่ใช้ใน 24 ชั่วโมง ในกลุ่มที่ได้มอร์ฟีนในช่องไขสันหลังขนาดต่าง ๆ แต่คะแนนความปวดในกลุ่มที่ได้มอร์ฟีนในช่องไขสันหลังขนาด 0.3 มิลลิกรัม มีคะแนนความปวดน้อยกว่ากลุ่มที่ไม่ได้มอร์ฟีนในช่องไขสันหลังที่เวลา 1 และ 4 ชั่วโมง หลังผ่าตัดอย่างมีนัยสำคัญทางสถิติ ส่วนภาวะแทรกซ้อนต่าง ๆ ไม่แตกต่างกันในทุกกลุ่ม*

***สรุป:*** *การให้ยาแก้ปวดมอร์ฟีนในช่องไขสันหลังในขนาดต่ำ ๆ ร่วมกับการฉีดยาชารอบเส้นประสาท femoral แบบครั้งเดียว สามารถควบคุมความปวดหลังการผ่าตัดเปลี่ยนข้อเข่าได้ดี มีภาวะแทรกซ้อนต่ำ และสามารถลดปริมาณยาแก้ปวดมอร์ฟีนที่ใช้ใน 24 ชั่วโมงหลังการผ่าตัดได้*