ORIGINAL ARTICLE



# Efficacy and Safety of Genicular Nerve Block with Intraarticular Morphine in Knee Arthroscopic Procedures under Spinal Anaesthesia

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## Abstract

**Background:** Knee arthroscopy, a minimally invasive procedure, often results in significant postoperative pain, which may delay recovery. Traditional approaches, including non-steroidal anti-inflammatory drugs and opioids, can result in various adverse effects and often do not provide sufficient analgesia. The genicular nerve block (GNB) may be a preferable alternative for pain relief, as it specifically targets the sensory nerves surrounding the knee. However, because the duration of action of local anesthetics is brief, they may not provide lasting analgesia. Therefore, the addition of intra-articular morphine in the knee joint can extend the analgesic effects, ensuring optimal pain relief. This study aims to assess the efficacy and safety of the combination of genicular nerve block (GNB) and intraarticular morphine compared to genicular nerve block alone for postoperative pain management in knee arthroscopic procedures.

**Methods:** This was a double-blind, randomized controlled trial in which patients were enrolled after obtaining informed written consent, who were scheduled for knee arthroscopic surgery under spinal anaesthesia at Bangladesh Medical University. Participants were randomized into two groups: Control group (Group GN) received ultrasound-guided genicular nerve block (GNB) with intraarticular normal saline and intervention grouap (Group GM) received ultrasound-guided genicular nerve block with intraarticular morphine. Postoperative pain scores were assessed by Numeric Rating Scale (NRS) scoring system immediately at recovery, every hourly up to 6 hours followed by at 12 hours and 24 hours. Total opioid consumption (mg) in 24 hours, time to first rescue analgesia (hours), incidencea of postoperative nausea and vomiting (PONV), and haemodynamic parameters (systolic blood pressure,diastolic blood pressure,mean arterial pressure in mmHg and heart rate in beat/min) were assessed for up to 24 hours.

**Results:** A total of 30 patients were enrolled in this study. They were randomized into 2 groups (15 in each group). Baseline demographic and clinical parameters were comparable between groups. Group GM showed significantly lower total morphine consumption (mg) in 24 hours ($4.16 \pm 0.88$) compared to group GN ($5.93 \pm 1.79$) , with a p value of 0.02. The time to first analgesic request (hours) was significantly longer in Group GM ($5.91 \pm 1.48$) compared to Group GN ($4.2 \pm 1.87$) with a p value of 0.03. No significant differences were found in the incidence of postoperative nausea vomiting ($p = 0.54$).

**Conclusions:** Combining a genicular nerve block with intraarticular morphine is safe and effective for postoperative pain management after knee arthroscopy. This strategy prolongs analgesia and reduces total morphine consumption compared to the genicular nerve block alone.

**Keywords:** Spinal anaesthesia, Genicular nerve block, Intra-articular morphine, Knee arthroscopy, Postoperative analgesia

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## Introduction

Knee arthroscopy, one of the most important minimally invasive orthopedic surgery is used to treat intra-articular disorders such as meniscal tears, ligament injuries and cartilage pathologies. It has the advantage of shorter hospital stays, faster recovery time and lower complication rates compared to open surgery[1]. Around 60% of patients may experience moderate to severe pain after knee arthroscopic surgery[2]. Appropriate pain management remains important to such patients, which can delay rehabilitation and increase the risk of postoperative complications. Therefore, adequate postoperative pain control is essential and can improve postoperative convalescence.

Opioid analgesics and non-steroidal anti-inflammatory drugs (NSAIDs) have conventionally been applied for the management of pain after knee arthroscopy. NSAIDs, while effective for pain relief, have been shown to have detrimental effects on bone healing by inhibiting osteoblastic activity, which is crucial for bone remodeling and repair[3]. This inhibition can potentially slow down the healing process and affect the overall success of the arthroscopic procedure.

Genicular nerve block is a safer substitute for postoperative pain management after knee arthroscopy. Genicular nerve block (GNB) allows for knee-targeted analgesia that does not disrupt motor function and enables early ambulation by blocking the sensory branches of the knee[4]. The genicular nerves are a network of sensory nerves that supply the knee joint. They include the superomedial, superolateral, inferomedial and inferolateral genicular nerves, originating from femoral, common peroneal and tibial nerves, respectively. Genicular nerve block might be helpful in early ambulation faster discharge since it selectively blocks the articular branch and provide sensory innervation to different areas of the knee. Thus using genicular nerve block reduced need of systemic medication and associated side effects and complications[4].

Morphine is an opioid which is one of the most used analgesics which provides analgesia by activating the opioid receptors in the CNS and PNS. Intra-articular morphine provides little systemic effect and reduces inflammation and pain threshold via activation of local mu-opioid receptors[5]. In 20 to 40% of the patients, systemic opioids exacerbate postoperative nausea and vomiting (PONV)[6]. Intraarticular administration of morphine locally blocks the opioid receptors and provides better analgesia while avoiding systemic side effects[5].

Concerns about opioid use have increased, making it important to find better ways to manage pain. Poor pain control can lead to more cases of nausea and vomiting after surgery. It can also result in longer hospital stays and higher costs[6]. A combination of Genicular nerve block with Intraarticular morphine is a safe option with lower rates of nausea and vomiting. It is especially useful in places where advanced pain management techniques are not available.

In this study, we compare the efficacy and safety of genicular nerve block alone versus genicular nerve block combined with intra-articular morphine in knee arthroscopy under spinal anesthesia. We hypothesize that the combined approach will result in lower NRS scores and reduced opioid consumption. We also expect decreased PONV and stable hemodynamics. These effects may enhance pain control and rehabilitation outcomes.

## Materials and methods

This randomized controlled trial was conducted in the orthopaedic operation theatre under the Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University (BMU), Dhaka, from October 2024 to September 2025. The ethical permission of the study was obtained from the Institutional Review Board (IRB) of Bangladesh Medical University, Dhaka, Bangladesh. An informed written consent form was signed by all the participants before enrollment. The study recruited patients undergoing knee arthroscopic procedures under spinal anaesthesia. The estimated sample size was 30 to accommodate potential dropouts and maintain statistical power.

Patients who underwent elective knee arthroscopic procedures aged above 18-65 years, irrespective of gender, with ASA class I & II were included in this study. Patients with a history of hypersensitivity to local anaesthetics or morphine, infection at the site of block, chronic opioid use (More than 3 months), history of bleeding disorders and coagulation disorders such as hemophilia, thrombocytopenia, pre-existing neurological deficits in the lower limb such as peripheral neuropathy, motor weakness or sensory loss in the operating limb and diagnostic knee arthroscopy were excluded from this study. Following obtaining written informed consent regarding participation thirty patients were randomized into 2 groups (15 in each group): Group GN (Genicular nerve block + Intraarticular normal saline) and Group GM (Genicular nerve block + Intraarticular morphine) by using block randomization technique. Participants and assessor were blind about the group allocation.

## Study Procedure

Upon arrival in the operating theatre, standard monitors were attached, and baseline parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation ($SpO_2$) were recorded.A peripheral 18 or 20 gauge intravenous cannula was inserted. Intravenous Hartmann's solution was started at a rate of 5 ml/kg/hour. Under all aseptic precautions, with the patient in a sitting position, the skin was infiltrated with 1-2 mL of 2% lidocaine. A subarachnoid block was administered at L3-L4 intervertebral space using a 25-gauge spinal needle with 10 mg (2ml) of hyperbaric bupivacaine (0.5%) and 10 mcg fentanyl at a rate of 0.2 ml/sec after clear and free flow of cerebrospinal fluid. The patient was then positioned supine. Following spinal anaesthesia, nerve blocks were administered according to the group allocation.

In both groups, an ultrasound guided genicular nerve block was given in both groups in the supine position with the knee slightly flexed with a pillow under the popliteal fossa. Genicular nerve block was performed by using the GE MEDICAL SYSTEM (China) ultrasound machine to target the superolateral, superomedial, and inferomedial genicular nerves. Colour Doppler imaging was utilized to locate the genicular arteries, which served as landmarks for the corresponding nerves. Once the needle was positioned satisfactorily, 3 ml of 0.25% bupivacaine was slowly injected using a 22 G needle close to each of the three genicular nerves. The spread of the local anaesthetic was closely monitored adjacent to the target nerves. Throughout the surgery, vital parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation) were recorded every 15 minutes. In Group GN, at the end of the surgery, the surgeon administered a 2 ml intra-articular injection of normal saline. In Group GM, at the end of surgery,the surgeon administered 2 ml (2 mg) intraarticular injection of morphine.

Following the surgery, each patient was transferred to the post-anaesthesia care unit, Postoperative analgesia was maintained with intravenous paracetamol (15 mg/kg) every six hourly. During the postoperative period, Pain intensity was assessed using the Numeric Rating Scale (NRS) immediately upon recovery, then hourly up to 6 hours, and subsequently at 12 hours and 24 hours postoperatively.The following parameters were recorded for each patient - time to first request for rescue analgesic (morphine) in hours, total morphine consumption (mg) within the first 24 hours, incidence of postoperative nausea and vomiting ,haemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure) at specified intervals. All adverse effects, if any, were documented.

## Statistical analysis:

Statistical analysis was performed by using SPSS (Statistical Package for the Social Sciences) version 24.0. Continuous variables (Age, Total Morphine consumption, Time to first analgesic request were presented as mean ± standard deviation. Categorical variables (Gender, American Society of Anaesthesiologist Grade) were presented as number (percent). Data normality check was performed by Shapiro-Wilk test. Numerical variables were compared by using a student t-test, and categorical variables were compared by using a chi-square test. The p value of $< 0.05$ was considered statistically significant.

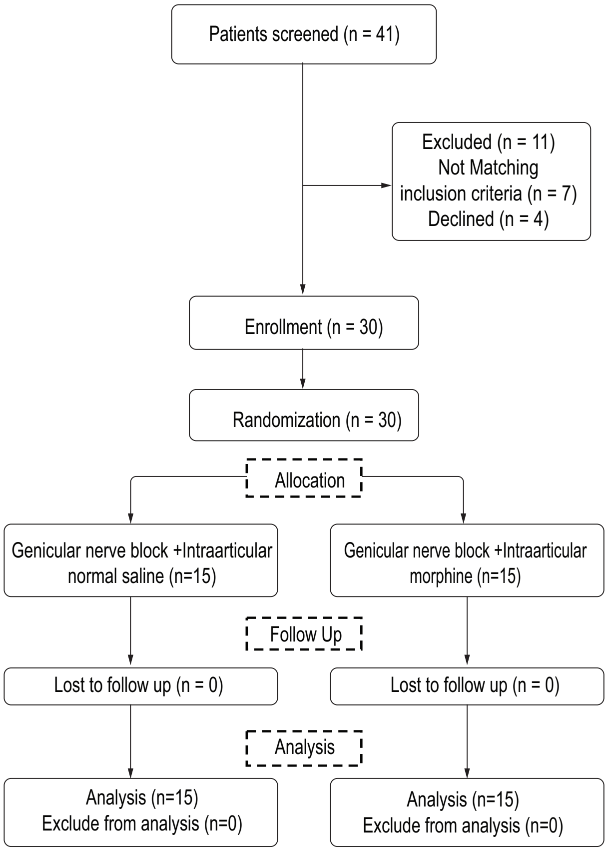


**Figure 1:** Consolidated Standard reporting trials (CONSORT) flow diagram

## Results

A total of thirty patients were included, selected based on predefined inclusion and exclusion criteria. The table presents the distribution of patients based on various demographic and clinical characteristics. The baseline characteristics of patients were comparable between the two groups. Mean age was 24.33 ± 4.95 years in the GN group and 24.20 ± 4.92 years in the GM group (p = 0.94). Gender distribution was similar, with men comprising 86% and 93% of patients in the GN and GM groups, respectively (p = 0.54). Mean BMI was slightly higher in the GN group (25.74 ± 2.3 vs. 24.14 ± 2.6, p = 0.085). ASA physical status was comparable between groups (ASA Grade 1: 80% vs. 74%; ASA Grade 2: 20% vs. 26%, p = 0.67). Overall, the groups were well balanced, though minor differences in BMI and ASA grade were considered potential confounders in subsequent analyses.

**Table I:** Demographic and clinical characteristics of study participants (n=30)

| Variables | Group GN (n=15) | Group GM (n=15) | p-value |
|---|---|---|---|
| Age (years) mean (±SD) | 24.33 (±4.95) | 24.20 (±4.92) | 0.94 |
| Gender | | | |
| Men (n%) | 13 (86%) | 14 (93%) | |
| Women (n%) | 2 (14%) | 1 (6%) | 0.54 |
| BMI (kg/m²) mean (±SD) | 25.74 (±2.3) | 24.14 (±2.6) | 0.085 |
| ASA Grade | | | |
| ASA Grade 1 (n%) | 12 (80%) | 11 (74%) | |
| ASA Grade 2 (n%) | 3 (20%) | 4 (26%) | 0.67 |

Values are expressed as mean±SD and number (percent). Data were analyzed by using the t-test for continuous variables and the chi-square test for categorical variables.

Postoperative analgesic outcomes are summarized in Table II. The GN group had a higher mean 24-hour morphine consumption compared with the GM group (5.93 ± 1.79 mg vs. 4.16 ± 0.88 mg, p = 0.002). Time to first rescue analgesic was shorter in the GN group than in the GM group (4.26 ± 1.87 hours vs. 5.91 ± 1.48 hours, p = 0.012).

**Table II:** Comparison of Morphine consumption between the study participants (n=30)

| Variables | Group GN (n=15) | Group GM (n=15) | *p* value |
|---|---|---|---|
| Postoperative moiphine consumption in 24 hours (mg) | 5.93 ±1.79 | 4 16±0 88 | 0.002 |
| Time to first rescue analgesic (hours) | 4.26=1.87 | 5.91 ±1.48 | 0.012 |

Values are expressed as mean ± SD. p value derived from t-test.

Table III presents a comparison of postoperative pain scores between Group GN and Group GM at various time intervals, expressed as median (interquartile range) values. The Mann–Whitney U test was used to compare pain scores between the groups. At the 4th postoperative hour, a significantly lower NRS score was observed in Group GM compared to Group GN (p = 0.01), indicating better analgesic efficacy of the intervention. In contrast, at the 6th hour, the NRS score was significantly higher in Group GM (p = 0.02), suggesting earlier recurrence of pain.

**Table III:** Comparison of the numeric rating scale (NRS) score between study participants (n=30)

| Time Point (NRS Score after surgery) | Group GN | Group GM | p-value |
|---|---|---|---|
| 1" hour | 3.0(2-4) | 2.0(1-3) | 0.85 |
| 2™* hour | 3.0 (2-4) | 2.0 (1-3) | 0.25 |
| i'c hour | 4,0(3-5) | 3.0 (2-4) | 0.10 |
| 4* hour | 6.0 (4-7) | 3.0 (2-4) | 0.01 |
| 5"1 hour | 4.0 (3-5) | 4.0 (3-5) | 0.91 |
| 61h hour | 3.0 (2-4) | 6.0(5-7) | 0.02 |
| 12,h hour | 3.0 (2-4) | 3 0 (2 4) | 0.47 |
| 24,h hour | 30(2-3) | 3.0(2 3) | 0.66 |

Values are expressed as Median (IQR). Data were analyzed by using Mann-Whitney U test.

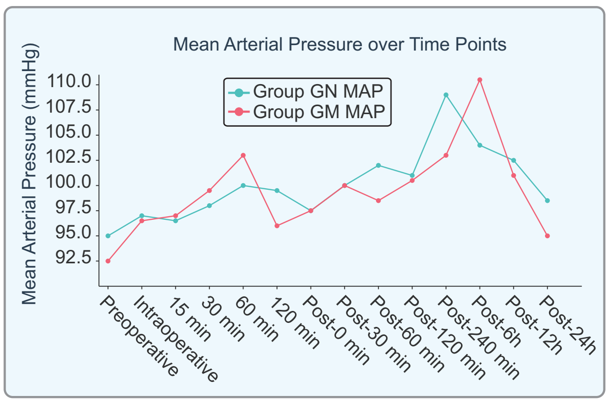


**Figure 2:** Comparison of mean arterial pressures (MAP) in Group GN and Group GM

The Mean Arterial Pressure (MAP) values over perioperative time points are shown in figure 2. Group GN showed MAP peaking at 240 min (p value<0.05), and in GM, MAP peaking at 6 hours (p value<0.05) after surgery.

The incidence of postoperative nausea and vomiting (PONV) was low and comparable between groups, occurring in 1 patient (6%) in the GN group and 2 patients (12%) in the GM group (p = 0.540). Given the similarity in baseline characteristics such as age, gender, BMI, and ASA grade, these factors are unlikely to have influenced the occurrence of PONV.

## Discussion

Effective postoperative pain management is crucial for surgical outcomes, as it influences mobility after surgery, length of hospital stay, patient satisfaction, and overall results[7]. In this randomized controlled trial, we examined the effects of combining genicular nerve block with intra-articular morphine versus administering genicular nerve block alone during knee arthroscopic procedures. The findings demonstrated that postoperative analgesia was significantly improved in patients who received the combination treatment of genicular nerve block and intraarticular morphine.

In our study, postoperative numeric rating scale (NRS) scores were significantly lower in the genicular Nerve Block combined with intraarticular morphine group (Group GM) for an extended duration (p value < 0.05). The lower NRS scores can be attributed to the pharmacokinetics of intraarticular morphine, characterized by a slower onset and a longer duration of action[8]. Relying solely on a genicular nerve block may not provide prolonged analgesia, as the local anaesthetics used have a limited duration of effect. Agarwal et al. (2017)[9] studied analgesic effects of intraraticular morphine versus dexmedetomidine added with levobupivacaine in knee arthroscopic surgery and found statistically significant duration of analgesia in the intraarticular morphine group (p value<0.001), which is consistent with the present study. However, they administered diclofenac as rescue analgesia, whereas in our study, we do not use any NSAIDs. Therefore, it can be said that genicular nerve block is superior to intraarticular levobupivacaine. Chinachoti et al. (2012)[10] explored the use of intrathecal morphine in conjunction with femoral nerve blocks and periarticular infiltration of bupivacaine during total knee replacement. Their findings revealed that the addition of periarticular morphine significantly enhanced the quality of pain management post-surgery.

This study found that the time to the first request for rescue analgesic was extended in the group receiving the genicular nerve block along with intra-articular morphine (p value= 0.03). Additionally, the total morphine consumption over 24 hours was significantly reduced in the genicular nerve block with intraarticular morphine group (p value<0.02). Research has shown that intra-articular morphine prolongs the time until the initial analgesic request when compared to a local anesthetic alone[11]. These findings are consistent with existing evidence that indicates regional anesthesia combined with intra-articular opioids significantly delays the need for rescue analgesia after knee arthroscopy.

In the present study, we observed a reduced incidence of postoperative nausea and vomiting (PONV) in patients who received a combination of genicular nerve block and intraarticular morphine. This outcome can be attributed to the decreased need for systemic opioids. Furthermore, the postoperative hemodynamic parameters in the intervention group remained more stable compared to the control group, due to the lower rates of PONV and improved pain management.

Most prior studies have compared the efficacy of genicular nerve blocks (GNB) with that of adductor canal blocks in knee arthroscopic procedures, often finding similar levels of pain relief at the 24-hour mark. However, significant motor weakness was noted in the adductor canal block group[12]. This motor weakness can hinder early mobilization efforts post-surgery. In our study, we employed genicular nerve blocks, which do not affect the motor nerves, thereby facilitating earlier patient mobilization. A study by Abouseeda et al. (2025)[13] examined GNB in conjunction with the IPACK block versus GNB alone in total knee replacement surgeries and reported significantly lower pain scores at both the 6- and 12-hour intervals. Importantly, they utilized NSAIDs (ketorolac) for postoperative pain management, which may have contributed to extended analgesia. While NSAIDs are effective for pain relief, they have been shown to negatively impact bone healing by inhibiting osteoclastic activity, an essential process for bone remodeling and repair. This inhibition could potentially delay the healing process and affect the overall success of the arthroscopic procedure[13].

In this study, we observed the patients for 24 hours, as those undergoing knee arthroscopic procedures were discharged afterwards. Another limitation is that we did not assess the incidence of chronic post-surgical pain or functional recovery.

## Conclusion

The combination of genicular nerve block with intraarticular morphine offers a safe and effective strategy for managing postoperative pain after knee arthroscopic procedures, compared to using the genicular nerve block alone. This combined approach not only extends the duration of postoperative analgesia but also leads to a reduction in total morphine consumption.

## Declaration

Ethics approval: The study was approved by the Institutional Review Board (IRB) of Bangladesh Medical University, Dhaka, Bangladesh [Registration No.5262; BSMMU/2024/10711(4)].

## Author contributions

Conception and development of the idea: AKMA, MSI, NHK

Writing: NHK, KMA, SSM

Data analysis: NHK, SSM, MMK, KMA

Data collection: NHK, FZP, MAA, YA

Review and Editing: AKMA, MMK, KMA

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Conflict of interest: We have no conflicts of interest.

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