

Role of Periarticular Multimodal Drug Injection Administered Intraoperatively in Pain Management and Opioid Consumption in Elderly Patients with Femoral Neck Fractures Undergoing Hemiarthroplasty

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ABSTRACT

Objective: To determine the effect of intraoperative periarticular multimodal drug injection (PMDI) on postoperative pain scores and opioid consumption compared with conventional systemic analgesia in elderly patients with femoral neck fractures undergoing hemiarthroplasty.

Methodology: Quasi-experimental study conducted in the Department of Orthopaedics, Pakistan Institute of Medical Sciences (PIMS), Islamabad, from 2nd October 2025 to 1st January 2026. A total of 136 patients aged 60–80 years with Garden type III or IV femoral neck fractures were enrolled using non-probability consecutive sampling and allocated equally into two groups (n = 68 each). The intervention group received intraoperative PMDI (0.25% bupivacaine 20 mL, ketorolac 30 mg, epinephrine 0.3 mg, with normal saline to a total volume of 40 mL), while the control group received standard systemic analgesia. Pain was assessed using the Visual Analog Scale (VAS) at 24 and 72 hours, and total tramadol consumption (mg per patient) was recorded over the first three postoperative days. Comparisons were made using the Mann–Whitney U test; $p \leq 0.05$ was considered significant.

Results: The median age was 65 years (IQR 6) and median BMI was 24.0 kg/m² (IQR 2.41). Baseline characteristics were comparable between groups. Postoperative VAS scores were significantly lower in the PMDI group than controls (median 2.0 [1.0–2.88] vs 4.5 [3.5–5.38]; $U = 525.5$, $Z = -7.807$, $p < 0.001$). Total opioid consumption was also significantly reduced in the PMDI group (median 100 mg [50–150] vs 250 mg [150–300]; $U = 390.0$, $Z = -8.465$, $p < 0.001$). No significant association was found between VAS scores or opioid consumption and gender, age category, or Garden classification (all $p > 0.05$).

Conclusion: Intraoperative PMDI significantly reduces postoperative pain and opioid consumption in elderly patients undergoing hemiarthroplasty for femoral neck fracture.

Keywords: Analgesia, Hemiarthroplasty, Multimodal, Opioid, Pain management, Periarticular injection.

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{3,4}Critical analysis and manuscript review; ^{5,6}Data analysis; Manuscript Editing.

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Introduction

With the growing elderly population, the number of osteoporosis-related femoral neck fractures is

increasing.¹ Hip arthroplasty combined with Enhanced Recovery After Surgery (ERAS) protocols is the standard management strategy. However,

postoperative pain remains a major concern, adversely affecting recovery and increasing the risk of deep vein thrombosis (DVT).² Adequate postoperative analgesia is associated with shorter hospital stay and improved patient satisfaction.³

Effective pain control requires multimodal management combining oral and parenteral agents, which reduces opioid dependence.⁴ Local anaesthetics, NSAIDs, steroids, clonidine, and epinephrine are commonly used in periarticular multimodal drug injection (PMDI); however, no standard regimen has yet been established.⁵

PMDI has been shown to reduce postoperative pain compared with conventional analgesia, with the effect evident at 8, 16, 24, and 60 hours after surgery.⁶ Other studies have reported reduced pain at 48 hours in the PMDI group.^{5,7} PMDI use has also been linked to lower opioid consumption compared with non-PMDI groups, supporting its effectiveness in reducing opioid requirements.⁸ It is further associated with fewer complications such as nausea and delirium, which are particularly concerning in elderly patients.⁹

Phruetthiphat et al. reported that, after hemiarthroplasty, patients receiving periarticular injection had a lower mean VAS score (2.87 ± 2.03) than the control group (4.70 ± 2.38). Similarly, mean opioid consumption was lower in the intervention group (1.47 ± 2.45 mg) than the control group (2.67 ± 2.52 mg).⁶

Locally, there is a paucity of data on the effectiveness of PMDI in managing postoperative pain and reducing opioid consumption in elderly patients with femoral neck fractures undergoing hemiarthroplasty. By addressing this gap, the present study aims to provide evidence-based insights that may enhance recovery, reduce complications, and improve quality of life in elderly patients. The findings will help healthcare providers in optimizing perioperative pain management strategies. The aim of this study was to determine the outcomes of PMDI in patients with femoral neck

fracture undergoing hemiarthroplasty compared with conventional analgesia.

Methodology

This quasi-experimental study¹⁶ was conducted in the Department of Orthopaedics, PIMS, Islamabad, from 2nd October 2025 to 1st January 2026. A total sample size of 136 patients, 68 in each group, was calculated using the OpenEpi online calculator based on opioid consumption, with a level of significance of 95%, power of 80%, mean $\pm$ SD of opioid consumption in the intervention group of 1.47 ± 2.45 mg, and in the control group of 2.67 ± 2.52 mg.⁶ non-probability consecutive sampling was used.

Patients aged 60 to 80 years presenting with femoral neck fracture, Garden type III or IV, scheduled for hemiarthroplasty, irrespective of gender or ethnicity, were included. Patients with a history of chronic pain or opioid use, contraindication to any component of PMDI, cognitive impairment or inability to provide informed consent, pathological fractures, or metastatic bone disease were excluded.

Patients were divided into two groups using alternate allocation in order of presentation, with the first eligible patient assigned to the control group and the next to the intervention group. The intervention group (Multimodal Analgesia [MMA] group) received an intraoperative periarticular multimodal drug injection, defined as a standardized mixture of 0.25% bupivacaine (20 mL), ketorolac (30 mg), epinephrine (0.3 mg), and normal saline to a total volume of 40 mL, injected into the periarticular soft tissues including the joint capsule, surrounding muscles, and subcutaneous tissue by a consultant orthopaedic surgeon. The control group underwent standard hemiarthroplasty without PMDI and received conventional postoperative pain management, including systemic analgesics such as opioids (tramadol) and NSAIDs as required. The control group was chosen as the contemporaneous comparator from patients meeting the same

eligibility criteria during the study period and managed by the same surgical and anaesthesia team, ensuring comparable perioperative care.

Postoperatively, pain was recorded at 24 and 72 hours using the VAS scale, with 0 indicating no pain and 10 the worst possible pain. Total opioid (tramadol) consumption in milligrams per patient was also recorded for the first three postoperative days.

Statistical analysis was performed using SPSS version 23. In addition to descriptive statistics, VAS scores and total opioid consumption between the intervention and control groups were assessed using the Mann–Whitney U test, since the Shapiro–Wilk test demonstrated that these continuous outcomes were not normally distributed, making a non-parametric test more appropriate than the independent samples t-test. Associations of gender, age category, and Garden fracture classification with VAS scores and opioid consumption were also analyzed using the Mann–Whitney U test. A p-value of less than or equal to 0.05 was considered statistically significant.

Ethical approval was taken from the Institutional Review Board of Pakistan Institute of Medical Sciences (PIMS), Islamabad (IRB Ref. No. F.1-1/2015/ERB/SZABMU/1042, dated 25-09-2025),

Results

The median age of the study population was 65 years with an interquartile range (IQR) of 6 years, and the median body mass index (BMI) was 24.0 kg/m² with an IQR of 2.41 kg/m². Median and IQR were reported rather than mean and SD because the Shapiro–Wilk test confirmed that age and BMI were not normally distributed.

Baseline categorical characteristics, including age category, gender distribution, BMI category, and Garden fracture classification, were comparable between the Control and MMA groups (Table 1), indicating adequate baseline homogeneity.

Variable	Category	Control (n = 68)	MMA Group (n = 68)
Age category	60–70 years	50 (73.5%)	55 (80.9%)
	71–80 years	6 (8.8%)	3 (4.4%)
Gender	Male	40 (58.8%)	44 (64.7%)
	Female	28 (41.2%)	24 (35.3%)
BMI category	Malnourished	1 (1.5%)	0 (0.0%)
	Good	44 (64.7%)	49 (72.1%)
	Overweight	18 (26.5%)	17 (25.0%)
Garden classification	Obese	5 (7.4%)	1 (1.5%)
	Class 3	26 (38.2%)	25 (36.8%)
	Class 4	42 (61.8%)	43 (63.2%)

BMI categories: Malnourished < 18.5 kg/m²; Good 18.5–24.9 kg/m²; Overweight 25–29.9 kg/m²; Obese ≥ 30 kg/m². Garden classification refers to the radiographic grading of displaced femoral neck fractures. MMA = Multimodal Analgesia.

Variable	Control Median [IQR]	MMA Group Median [IQR]	Mann–Whitney U	Z	p-value
Median VAS score	4.5 [3.5–5.38]	2.0 [1.0–2.88]	525.5	–7.807	<0.001
Total opioid consumption per patient (mg)	250 [150–300]	100 [50–150]	390.0	–8.465	<0.001

Mann–Whitney U test was used to determine significance. Total opioid consumption is reported per patient (in milligrams) over the first three postoperative days. IQR = Interquartile Range; VAS = Visual Analog Scale; MMA = Multimodal Analgesia.

The MMA group showed significantly lower postoperative pain scores compared with the Control group (median VAS: 2.0 [1.0–2.88] vs 4.5 [3.5–5.38]; U = 525.5, Z = –7.807, p < 0.001). Similarly, total opioid consumption per patient was significantly reduced in the MMA group (median 100 mg [50–150] vs 250 mg [150–300]; U = 390.0, Z = –8.465, p < 0.001) (Table 2).

Table III: Association of Categorical Variables with VAS Score and Total Opioid Consumption					
Variable	Comparison	Mann–Whitney U (VAS)	p-value (VAS)	Mann–Whitney U (Opioid)	p-value (Opioid)
Gender	Male vs Female	2053.5	0.557	1996.0	0.394
Age category	60–70 vs 71–80 years	433.5	0.681	373.0	0.291
Garden classification	Class 3 vs Class 4	1902.0	0.231	2157.5	0.964

These differences were visually corroborated by boxplots (Figures 1a and 1b), which illustrated a marked downward shift and narrower interquartile ranges for both VAS scores and opioid consumption in the MMA group, reflecting superior and more consistent analgesic efficacy.

Further analysis revealed no statistically significant association between postoperative pain scores or total opioid consumption and gender, age category, or Garden fracture classification (all $p > 0.05$), indicating that these demographic and clinical variables did not confound the observed analgesic outcomes (Table III).

Mann–Whitney U test was used to assess associations. A $p\text{-value} \leq 0.05$ was considered statistically significant. VAS = Visual Analog Scale.

In terms of adverse effects, fewer patients in the MMA group reported minor side effects such as nausea and vomiting, which resolved spontaneously and required no intervention.

Discussion

Our study compared multimodal analgesia (MMA) with conventional systemic analgesia in patients undergoing hemiarthroplasty for femoral neck fracture. We observed significantly lower postoperative pain scores in the MMA group, a finding supported by multiple studies that have reported the superior effect of MMA in controlling postoperative pain in hemiarthroplasty patients compared with conventional systemic analgesia.^{5–9} A local randomized trial by Parvez et al. on intra-operative periarticular injection in total hip arthroplasty likewise demonstrated significantly reduced postoperative pain and improved early mobilization in the intervention group, mirroring our findings.¹²

However, Kang et al. observed only a minimal reduction in pain with MMA in their cohort, suggesting that factors other than the analgesic regimen itself, such as surgical technique, patient-related factors, and rehabilitation protocols, may also play a role in postoperative pain perception.³

We also documented a significant reduction in opioid consumption in the MMA group, which is consistent with several published reports.^{5–9} In a local study from a Pakistani tertiary care setting, Parvez et al. reported similar reductions in postoperative opioid requirement and improved patient comfort following intra-operative periarticular injection, reinforcing the generalizability of these findings to our population.¹² In contrast, Hofstad et al. and Lunn et al. reported no significant difference in postoperative opioid use between the MMA and conventional analgesia groups, possibly reflecting differences in the local infiltration drug regimen, anaesthetic technique, or background analgesia protocols used in their trials.^{10, 11}

We found no association between pain and gender in our study, whereas Ayers et al. reported that women had higher postoperative pain scores and required more opioids than men, which may be attributable to physiological and psychosocial differences in pain perception between genders.¹³ A local descriptive study on postoperative pain after orthopaedic procedures at a tertiary care hospital in Pakistan similarly observed comparable analgesic requirements across gender groups, in line with our findings.

We also demonstrated that age had no significant influence on pain score or opioid consumption in the MMA group, which is supported by Olson, who reported that MMA provides consistent analgesic

benefits across different age groups.¹⁴ On the other hand, Kim et al. reported increased opioid requirements in older patients, suggesting that age-related changes in pain perception and drug metabolism may influence analgesic needs.¹⁵

The strengths of our study include a prospective design with a clearly defined and standardized PMDI regimen, contemporaneous control and intervention groups managed by the same surgical and anaesthesia team, well-matched baseline characteristics, and the use of validated outcome measures (VAS and total tramadol consumption per patient). To our knowledge, this is one of the few studies from a Pakistani tertiary care orthopaedic setting addressing the role of intraoperative PMDI in elderly hemiarthroplasty patients, adding local evidence to a literature largely dominated by international cohorts.

Our study has certain limitations. Firstly, it was a non-randomized trial, which carries an inherent risk of selection bias despite the use of consecutive sampling and a contemporaneous control group. Secondly, it was a single-centre study, which may limit the generalizability of the findings. Thirdly, the follow-up period was short and did not capture long-term outcomes such as chronic post-surgical pain or functional recovery. Additionally, the VAS is a subjective assessment and is liable to reporting bias. Although the study was conducted prospectively, it was not registered in a clinical trial registry, and future trials of this nature should ideally be prospectively registered.

Conclusion

Intraoperative periarticular multimodal drug injection significantly reduces postoperative pain and opioid consumption after hemiarthroplasty compared with conventional systemic postoperative analgesia, and may be considered a useful adjunct in the perioperative care of elderly patients with femoral neck fractures.

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