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Randomized Controlled Trial

The Effects of Ultrasound-Guided Genicular Nerve Blocks Used with Local Anesthetics Alone or in Combination with Corticosteroids on Patients with Knee Osteoarthritis: A Placebo-Controlled Randomized Clinical Trial

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Disclaimer: This study was registered with EudraCT and received the number 2022-003885-19. Additionally, this study was registered with the Spanish Clinical Trials Registry (REEC), managed by the Spanish Agency of Medicines and Medical Devices (AEMPS) (www.reec.aemps.es/reec/public/web.html).

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Background: The genicular nerve block (GNB) is an emerging minimally invasive treatment for knee osteoarthritis (OA) pain. While corticosteroids are often combined with local anesthetics in GNBs, the added clinical value of this combination remains unclear.

Objective: To evaluate the efficacy of the GNB with local anesthetics alone versus local anesthetics plus corticosteroids and a placebo for patients with knee OA.

Study Design: A prospective, randomized, double-blind, placebo-controlled trial with 3 parallel groups.

Setting: Outpatient rehabilitation and orthopedic clinics at a tertiary care hospital.

Methods: Adults with symptomatic knee OA were randomized to receive an ultrasound-guided GNB that used one of the following substances: (1) 0.5% bupivacaine plus 20 mg triamcinolone (BC group), (2) 0.5% bupivacaine alone (B group), or (3) 2.5 mL saline placebo (S group). The primary outcome was pain intensity, measured using the numeric rating scale (NRS) and the) pain subscale of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC at 4, 12, and 24 weeks. Secondary outcomes included scores on the WOMAC function and stiffness subscales, the Knee Injury and Osteoarthritis Outcome Score (KOOS), the Kujala score, and mood as measured on the Escala de Valoración del Estado de Ánimo (EVEA).

Results: A total of 102 patients completed the study (BC: n = 33; B: n = 35; S: n = 34). Both the BC and B groups achieved greater pain reduction than did the placebo group (interaction P = 0.001). At 4 weeks, the mean NRS pain reduction was 2.24 (95% CI: 0.93–3.55) in the BC group, 2.94 (95% CI: 1.67–4.21) in the B group, and 1.29 (95% CI: 0–2.58) in the S group. These effects were maintained at 24 weeks. Scores on the WOMAC pain and function subscales saw significantly greater improvement in the BC and B groups than did the placebo group (interaction $P < 0.05$). No significant differences were observed in KOOS, Kujala, or mood scores. No serious adverse events occurred.

Limitations: This study was a single-center trial with a modest sample size. Some secondary outcomes may have been too underpowered to detect group differences.

Conclusions: GNBs with bupivacaine provide effective and sustained pain relief for knee OA. The addition of corticosteroids did not yield additional benefits, suggesting that the use of local anesthetics alone may be a safer and sufficient option.

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Osteoarthritis (OA) affects approximately 654 million people worldwide, with the knee, hip, and hands being the most commonly affected locations (1,2). Knee OA is highly prevalent ligaments. The superior and inferior medical genicular and increasing due to aging, obesity, and the progressively sedentary lifestyle of the population. According to recent epidemiological studies, knee OA has a prevalence of 29.3% of the Spanish population (3).

Currently, multiple treatment options for knee OA have been described, ranging from conservative measures to surgical procedures. Within conservative treatment, various tools benefit patients and may even prevent the need for surgery. These nonsurgical options include patient education, weight control, physical exercise, orthopedic devices, oral analgesics, topical anti-inflammatories, and interventional procedures (1,4). Nevertheless, there is a lack of comparative studies demonstrating the superiority of one approach over another, and many existing trials do not extend the follow-up beyond 3 months (5-7).

When conservative treatment is ineffective, surgical intervention is usually considered. Therapeutic options include knee arthroscopy, high tibial osteotomy, total knee replacement, and unicompartmental knee replacement in patients without lateral compartment disease (8).

Traditionally, rest and caution in exercise were recommended for knee OA pain. However, this paradigm has been strongly rejected in recent years. One of the latest first-line treatments for knee osteoarthritis is physical exercise, with the strengthening of quadriceps being the most indicated practice (9). Most patients seek recommendations on what type of exercise to perform, including the duration, intensity, and frequency for better adherence. No training regimen has been shown to be superior to another, and yoga and tai chi exercises are the most studied (10).

Despite the well-documented benefits of exercise for patients with knee OA, one emerging procedure for pain release is the genicular nerve block (GNB) (11). This treatment option, which can facilitate progress in the exercise program, is also indicated for patients who have previously received successful genicular blocks, those who do not wish to undergo surgery, individuals who are not eligible for surgery, or post-surgical patients, to achieve better pain control (12-14).

The term "genicular nerves" refers to a group of nerves responsible for the sensory innervation of the knee joint capsule and the internal and external ligaments. The superior and inferior medial genicular nerves are sensory branches of the tibial nerve, whereas the superior and inferior lateral genicular nerves are branches of the common peroneal nerve (15). These nerves are named for the arteries they accompany, which are located using ultrasound during the procedure (16,17).

The GNB technique as an adjunct treatment for the management of knee OA pain is routinely performed in clinical practice, using a combination of local anesthetics and corticosteroids. Omitting corticosteroids may reduce the risk of systemic and metabolic adverse effects. This study aims to evaluate the GNB's effects at 4, 12, and 24 weeks on patients' pain, functioning, stiffness, and moods, as well as the safety of the procedure, by comparing the use of local anesthetics alone, the combination of local anesthetics with corticosteroids, and a placebo control group. The primary objective of the study is to compare the effectiveness of GNBs that use local anesthetics alone to that of GNBs that use local anesthetics plus corticosteroids in reducing pain experienced by patients with knee OA. The primary hypothesis is that GNBs that use local anesthetics alone provide similar pain relief to the combination of local anesthetics with corticosteroids and that both active treatments are superior to a placebo.

Methods

Study Design and Patients

This double-blind, randomized controlled trial with 3 parallel treatment arms was conducted at a tertiary hospital between April 2023 and January 2024. The patients and the recruiting physician were all blinded to the type of intervention. Additionally, the outcome assessor was also blinded to ensure an unbiased evaluation of the treatment response.

The study includes patients who have presented anterior knee pain lasting over 3 months due to gonarthrosis, as seen in outpatient rehabilitation and traumatology clinics, as well as patients on the surgical waiting list for total or unicompartmental knee replacement surgery with a waiting period exceeding 6 months.

Prior to their inclusion in the study, all patients provided informed consent after receiving a comprehensive explanation of the study design and potential adverse effects. The trial complied with the principles of the Declaration of Helsinki, and, before trial initiation, the research protocol was approved by the Research Ethics Committee (Unique Protocol ID: 22/149) and registered in the European Clinical Trials Database (EudraCT) prior to patient enrollment. Access to the registry can be gained at the following website: www.clinicaltrialsregister.eu/ctr-search/search.EudraCT registration number: 2022-003885-19. Additionally, the study is listed in the Spanish Clinical Trials Registry (REEC), managed by the Spanish Agency of Medicines and Medical Devices (AEMPS) (https://reec.aemps.es/reec/public/web.html).

Outcome Measures

- Primary outcome: reduction in pain, measured using the Numeric Pain Rating Scale (NPRS) at baseline and at 4, 12, and 24 weeks after the procedure.
- Secondary outcomes:
  - Improvement in functionality using validated scales (18): Knee Injury and Osteoarthritis Outcome Score (KOOS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Kujala Scale
  - Score on the Escala de Valoración del Estado de Ánimo (EVEA) (19)
  - Reduction in analgesic medication usage
  - Incidence of adverse events

Baseline assessments included pain, functionality and mood assessment evaluations, as well as demographic and clinical data (gender, age, comorbidities, sport, knee mobility, and previous nerve block). Follow-up evaluations were conducted via telephone at 2 weeks and in person at 4, 12, and 24 weeks.

Sample Size Calculation

This study was, to our knowledge, the first to compare the aforementioned 3 treatment arms (GNB with local anesthetics plus corticosteroids, local anesthetics alone, and placebo) in the management of knee OA. Due to the absence of previous studies with identical designs and endpoints, a priori sample size calculation could not be performed. For that reason, and after reviewing the available literature—which showed that similar studies had used sample sizes in the range of 25-30 patients per group—we set the sample size arbitrarily at 30 patients per group. To account for an expected dropout rate of over 10%, the final planned sample size was increased to a total of 102 patients.

Randomization

Patients were randomized into 3 groups: BC (bupivacaine + triamcinolone), B (bupivacaine), and S (saline). The randomization sequence was computer-generated using the blockrand software package with a 1:1:1 allocation and block size of 6, implemented using sealed opaque envelopes to ensure concealment. The recruiting physician performed the randomization once eligibility was confirmed. Details of the GNB technique are available in the supplementary material.

All patients followed a standardized quadriceps-strengthening program performed 3 times per week, with progressive resistance according to pain levels. No patients were excluded from treatment, and all 3 groups followed the same exercise program.

Data Analysis

Data were analyzed using IBM SPSS 20 (IBM Corporation) and Stata© 17 (StataCorp LLC) under an intention-to-treat approach. Descriptive statistics summarized the patients' baseline characteristics. Primary and secondary outcomes were assessed using linear mixed models for repeated measures with an unstructured covariance matrix, including group, time, and group-by-time interaction. Results were reported as estimated changes from baseline with 95% confidence intervals. Pairwise comparisons were Bonferroni-adjusted, with statistical significance set at $P \leq 0.05$.

Results

Patients' Baseline Characteristics

A total of 176 patients were assessed for eligibility. Therefore, 74 individuals were excluded: 17 did not meet the inclusion criteria, and 57 declined to participate. A sample of 102 patients was recruited and randomly assigned to one of 3 groups: 33 patients in Group BC, 35 patients in Group B, and 34 patients in Group S (Table 1).

Table 1. *Characteristics of patients included at baseline*

		Total		Group BC		Group B		Group S	
		n = 102		n = 33		n = 35		n = 34	
		n	%	n	%	n	%	n	%
CLINICAL DATA									
AGE	Mean, SD	70.1	10.1	69.3	10.7	72.7	9.4	68.1	10.0
GENDER	Female	74	72.5%	22	66.7%	26	74.3%	26	76.5%
BMI	Normal wieigth	13	12.9%	5	15.2%	4	11.8%	4	11.8%
	Overweight	39	38.6%	12	36.4%	13	38.2%	14	41.2%
	Obesity class I	49	48.5%	16	48.5%	17	50.0%	16	47.1%
ANTICOAGULANT THERAPY	No	98	96.1%	31	93.9%	34	97.1%	33	97.1%
	VKA	4	3.9%	2	6.1%	1	2.9%	1	2.9%
HTN	Yes	62	60.8%	18	54.5%	24	68.6%	20	58.8%
DM	Yes	21	20.6%	5	15.2%	9	25.7%	7	20.6%
WALKING AIDS	Independent ambulation	77	75.5%	27	81.8%	24	68.6%	26	76.5%
	One cane	23	22.5%	5	15.2%	10	28.6%	8	23.5%
	Two canes	1	1.0%			1	2.9%		
	Walker	1	1.0%	1	3.0%				
DIAGNOSIS	Knee Osteoarthritis	75	73.5%	25	75.8%	25	71.4%	25	73.5%
	Surgical waiting list	27	26.5%	8	24.2%	10	28.6%	9	26.5%
PAIN DURATION	3-6 months	4	3.9%	2	6.1%	1	2.9%	1	2.9%
	6-12 months	17	16.7%	7	21.2%	5	14.3%	5	14.7%
	>12 months	81	79.4%	24	72.7%	29	82.9%	28	82.4%
INDEX KNEE	Right	54	52.9%	14	42.4%	20	57.1%	20	58.8%
PREVIOUS EXERCISE	None	65	63.7%	19	57.6%	25	71.4%	21	61.8%
	Home-based exercise	11	10.8%	4	12.1%	2	5.7%	5	14.7%
	Supervised excercise	26	25.5%	10	30.3%	8	22.9%	8	23.5%
PREVIOUS NERVE BLOCK	Yes	65	63.7%	21	63.6%	21	60.0%	23	67.6%
TYPE (n=65)	IA CS + LA	48	47.1%	15	45.5%	13	37.1%	20	58.8%
	Genicular nerve block	1	1.0%	1	3.0%				
	Genicular nerve block + RF	1	1.0%			1	2.9%		
	Hyaluronic acid	6	5.9%	2	6.1%	2	5.7%	2	5.9%
	Other	2	2.0%	1	3.0%			1	2.9%
NUMBER (n=65)	>= 3	14	13.7%	5	15.2%	4	11.4%	5	14.7%
ANALGESIC MEDICATION	No treatment	7	6.9%	1	3.0%	3	8.6%	3	8.8%
	Acetaminophen/metamizole	39	38.2%	12	36.4%	13	37.1%	14	41.2%
	NSAIDs	17	16.7%	8	24.2%	4	11.4%	5	14.7%
	Opioids	39	38.2%	12	36.4%	15	42.9%	12	35.3%
PAIN									
NRS	Mean, SD	7.7	1.5	7.5	1.4	7.9	1.6	7.7	1.5
WOMAC Pain	Mean, SD	10.1	3.7	9.9	3.3	9.9	3.2	10.6	4.5
FUNCTIONALITY									
KOOS	Mean, SD	54.6	16.4	52.2	15.0	54.7	17.7	56.8	16.4
KUJALA	Mean, SD	41.9	14.6	45.1	13.7	43.3	13.6	37.3	15.7
WOMAC Stiffness	Mean, SD	3.7	2.0	3.6	2.2	3.8	1.8	3.7	2.1

During the follow-up period, 28 patients were lost to follow-up: 16 underwent knee surgery, 6 did not attend follow-up visits, 3 received an alternative interventional procedure by another specialist, and 3 withdrew their consent to continue in the study. All patients were included in the intention-to-treat analysis (Fig. 1).

The mean age of the patients was 70 years, and 74 patients (72.5%) were female. Up to 48.5% of the total cohort were classified as obese based on their body mass index (BMI). Most patients (75.5%) ambulated without assistive devices, and 79.4% reported a duration of knee pain exceeding 12 months.

Table 1 cont. *Characteristics of patients included at baseline*

		Total		Group BC		Group B		Group S	
		n = 102		n = 33		n = 35		n = 34	
		n	%	n	%	n	%	n	%
WOMAC Function	Mean, SD	35.5	12.9	32.9	11.9	37.3	12.2	36.1	14.4
MOOD ASSESMENT									
EVEA Sadness	Median, IQR	9	2-19	15	4-22	10	0-19	8	2-17.5
EVEA Anxiety	Median, IQR	14	6-24	16	5-25	14	6-23	13	5.5-23.5
EVEA Hostility	Median, IQR	8	0-21	10	1-25	9	0-20	5	0-24.5
EVEA Happiness	Median, IQR	19	10-25	20	12-25	20	16-25	15	6.5-26

IQR: interquartile range, BMI: body mass index,VKA: vitamin K antagonist,HTN: hypertension, DM: diabetes mellitus,IA CS + LA: intra-articular corticosteroid + local anesthetic injection, RF: radiofrequency, KOOS: Knee injury and Osteoarthritis Outcome Score, WOMAC: Western Ontario and McMaster; Universities Osteoarthritis Index, EVEA: mood assessment scale

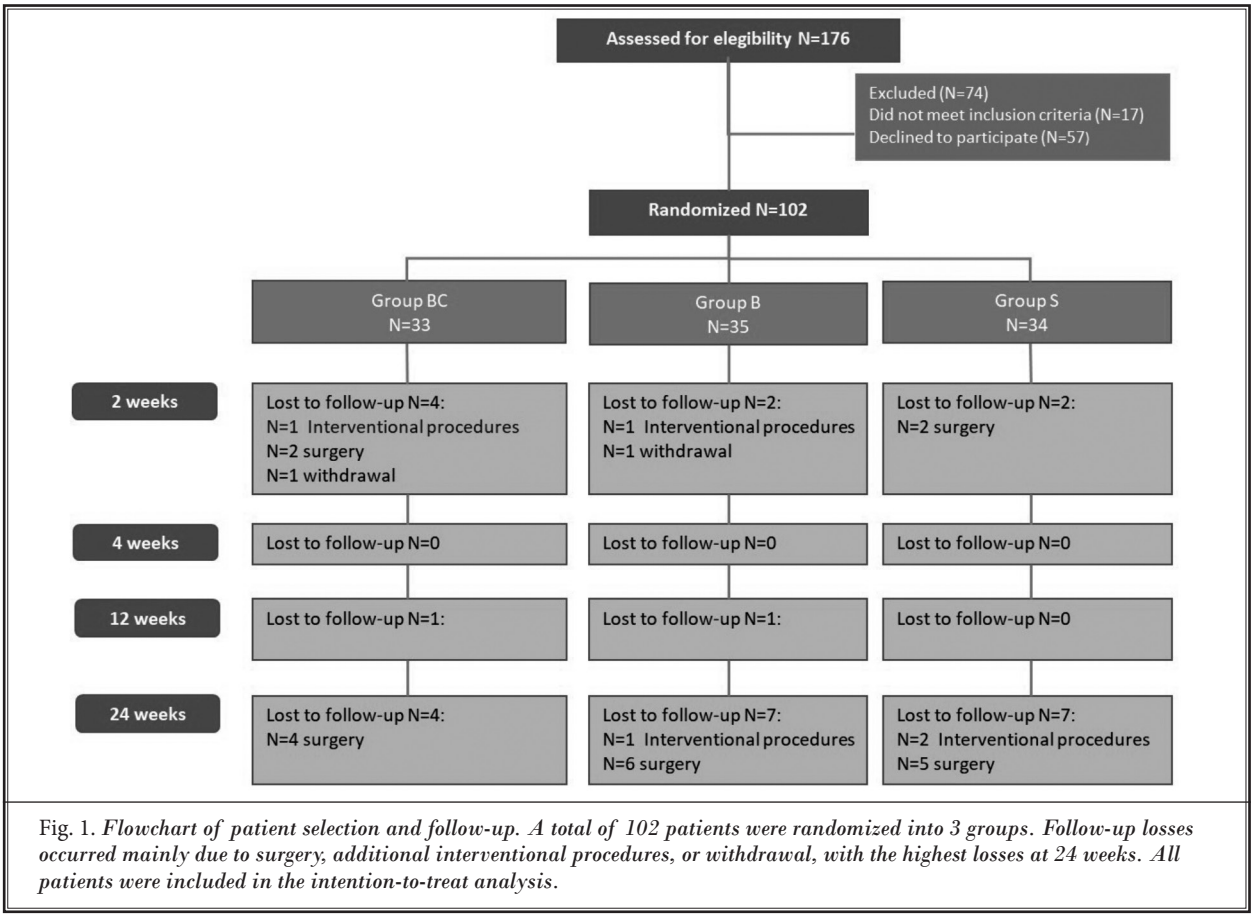


Fig. 1. *Flowchart of patient selection and follow-up. A total of 102 patients were randomized into 3 groups. Follow-up losses occurred mainly due to surgery, additional interventional procedures, or withdrawal, with the highest losses at 24 weeks. All patients were included in the intention-to-treat analysis.*

Regarding laterality, 54 patients (52.9%) had their right knees treated. A total of 65 patients (63.7%) had not previously undergone exercise-based therapy for knee pain, whereas more than half (63.7%) had received prior interventional treatments, most commonly intra-articular corticosteroid and local anesthetic injections (47.1%). The vast majority of the patients (93.1%) required analgesic treatment at baseline.

Baseline characteristics were similar across the 3 intervention groups, ensuring comparability before treatment. As for pain, the mean NRS score was 7.7 (SD 1.5), with no substantial differences among groups (7.5 in Group BC, 7.9 in Group B, and 7.7 in Group S). Similarly, the WOMAC pain subscale showed comparable scores (mean 10.1, SD 3.7).

Functionality assessments revealed slight variations. The mean KOOS score was 54.6 (SD 16.4), with Group S showing a slightly better score (56.8) than Group BC (52.2) and Group B (54.7). The Kujala score followed a similar pattern, with the highest functionality seen in Group BC (45.1) and the lowest in Group S (37.3). WOMAC stiffness and function subscales were consistent across groups, with no clinically relevant differences.

Mood assessments using the EVEA scale showed a tendency toward higher sadness and anxiety scores in Group BC than in the other groups, while hostility scores remained relatively similar. Notably, happiness levels were higher in Group BC and Group B (median 20) than in Group S (median 15).

Overall, the baseline data indicated no significant imbalance among the groups, supporting the validity of subsequent comparisons in treatment effects.

Pain Outcomes

NRS pain reduction was greater in both active treatment groups than in the control group (interaction P = 0.001). At 4 weeks, pain decreased by 2.24 points (95% CI: 0.93-3.55) in Group BC, 2.94 points (95% CI: 1.67-4.21) in Group B, and 1.29 points (95% CI: 0-2.58) in Group S.

Group B showed a continuous reduction in pain until week 12, whereas Group BC exhibited an increasing trend from week 4 onward. At 24 weeks, both active groups showed similar pain reductions (2.06 and 2.5 points, respectively), with no change in Group S (Fig. 2A).

A similar pattern was observed for the WOMAC pain subscale (interaction P = 0.022), with comparable reductions at 2 weeks in both active groups. However, this improvement was lost by week 24, with a faster decline in Group BC (Fig. 2B).

At 4 weeks, the need for analgesics had decreased by 36% in Group BC, 31% in Group B, and 21% in Group S (P = 0.355). Between weeks 12 and 24, Group S maintained a reduction of 25% and 22%, respectively; while Groups BC and B showed reductions of 46.4% and 43.8% at week 12 and 39% and 48% at week 24, respectively.

Function Outcomes

No statistically significant differences were found in functionality as measured on the KOOS (interaction P = 0.496) or Kujala (interaction P = 0.067) scales. Similarly, no significant changes were observed in the WOMAC stiffness subscale (interaction P = 0.077) (Fig. 3). However, the WOMAC physical function subscale showed statistically significant differences among the groups (interaction P = 0.007). In Group B, a decreasing trend was observed

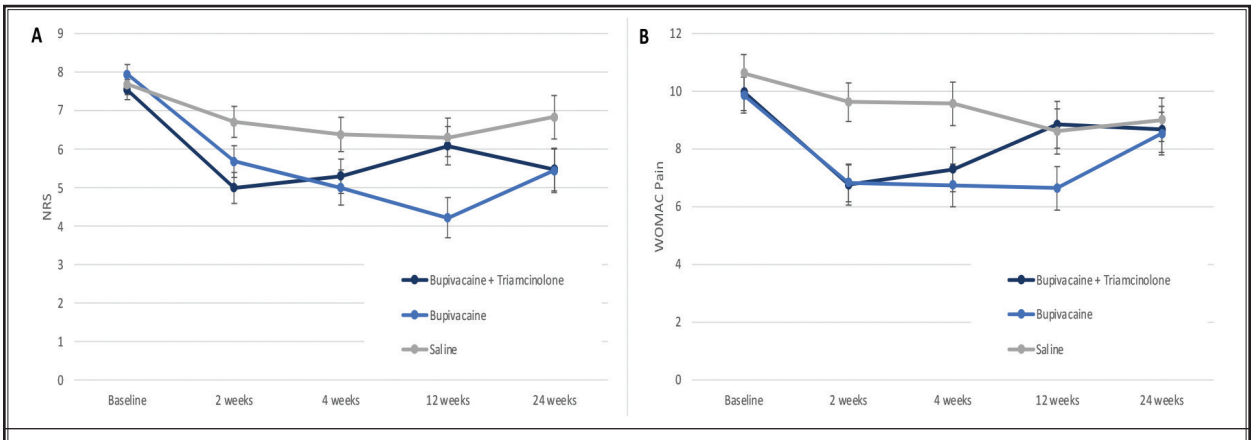


Fig. 2. *(A) NRS scores and (B) WOMAC pain subscale scores at different time points.*

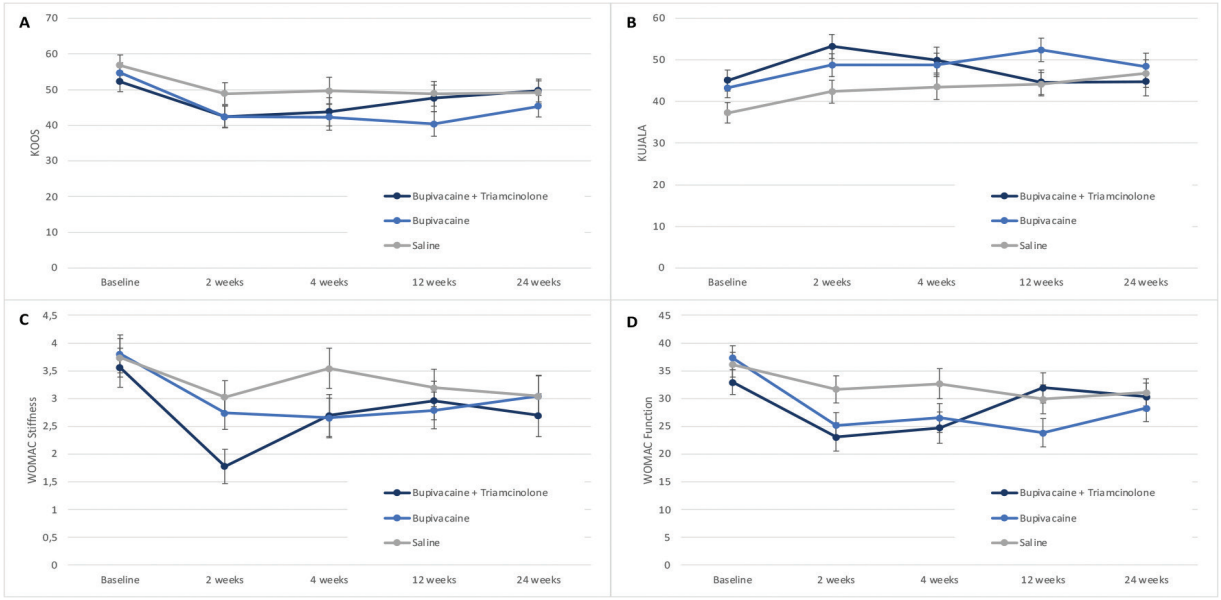


Fig. 3. *Functional and symptomatic outcomes over time.*
(A) KOOS, (B) Kujala score, (C) WOMAC stiffness subscale score, and (D) WOMAC function subscale score at different time points.

over time, with reductions of 12.2 (95% CI: 7.6-16.7) and 9 (95% CI: 4.3-13.8) at 2 and 24 weeks, respectively. In contrast, Group BC showed a decrease at 2 and 4 weeks but returned to baseline values by week 24. Meanwhile, Group S maintained relatively stable values throughout the follow-up period (Fig. 3).

Mood Assessment Outcomes

No relevant differences were observed in EVEA Mood Assessment subscales, with measures approximately constant over time (Figs. 4A-4D).

Safety

No serious adverse events were reported, and no patient discontinued the procedure due to poor tolerance or adverse effects.

Nine patients (8.8%) reported side effects related to the procedure: 6 experienced transient knee pain within 24 hours after infiltration, one patient developed a hematoma at the injection site, one reported a sensation of instability, and one experienced hypoesthesia affecting the fourth and fifth toes in the immediate post-procedure period.

Adverse events occurred in 6 patients (5.9%) in the bupivacaine group and 3 patients (2.9%) in the saline group.

Discussion

This randomized, placebo-controlled clinical trial involving 102 patients with symptomatic knee OA demonstrated that both active treatments—GNBs with bupivacaine alone and with a combination of bupivacaine and corticosteroids—were more effective in reducing pain than was the placebo. Statistically significant improvements were observed in pain reduction as measured on the NRS (95% CI 1.67 to 4.21 at 4 weeks, 2.20 to 5.24 at 12 weeks, and 1.01 to 4.00 at 24 weeks), as well as significant improvements in both pain and functionality as assessed on the WOMAC Index (95% CI 1.96 to 22.87 at 4 weeks, 4.81 to 23.95 at 12 weeks, and -0.12 to 18.82 at 24 weeks), following GNBs with bupivacaine at 4, 12, and 24 weeks. To our knowledge, this study is the first to directly compare local anesthetics alone, local anesthetics with corticosteroids, and a placebo for GNBs as treatments for knee OA (13,20-25).

The GNB is a simple, safe, and minimally invasive technique that reduces opioid use after knee surgery (13,15), facilitates rehabilitation by enabling exercise (26,27), and is guided by Doppler ultrasound targeting 3 key sensory nerves (16,17,20,23).

Anatomical and cadaveric studies have supported the use of 2-3 mL of local anesthetic per injection point,

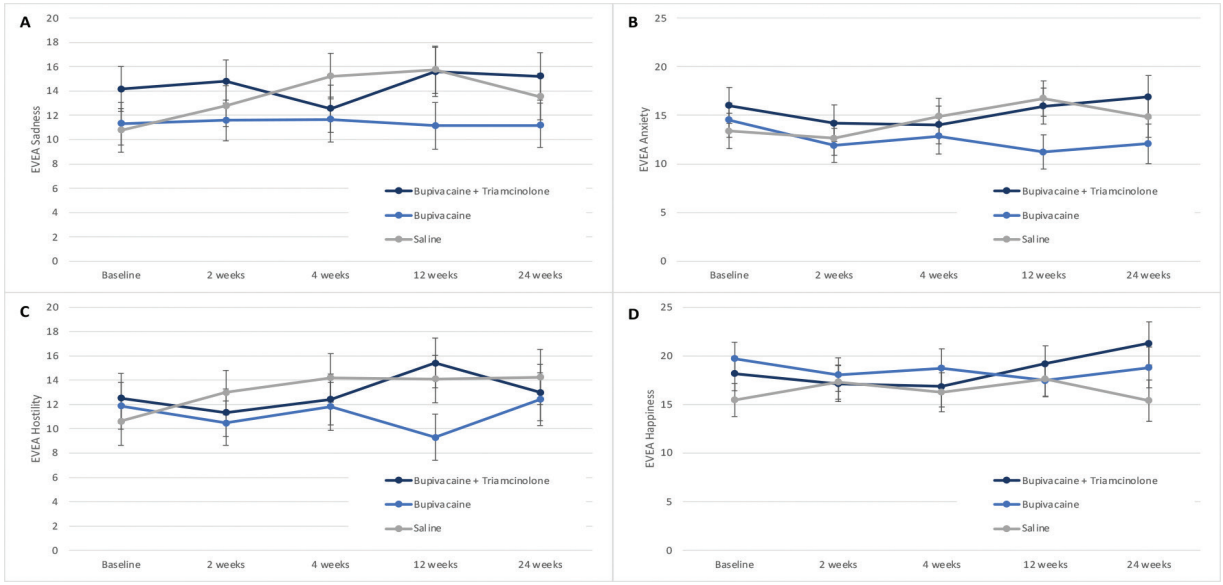


Fig. 4. *Emotional response outcomes over time based on the EVEA scale.*
(A) Sadness, (B) anxiety, (C) hostility, and (D) happiness scores at baseline and follow-up time points.

since this volume allows effective fluid dispersion over a broader nerve area (4,21,28,29).

Although some authors advocate for targeting up to 10 genicular nerves (4), clinical practice commonly focuses on 3 anatomical points (16,20). Notably, it has been demonstrated that as little as 0.5 mL of injected fluid can spread across an area of approximately 6 cm², suggesting that volumes of 2 mL are likely to cover additional nerve targets (4,29). The standard procedure typically involves the infiltration of a local anesthetic—such as lidocaine, bupivacaine, ropivacaine, or levobupivacaine—combined with 20 mg of corticosteroid (triamcinolone) (21,22,30). In some studies, this technique is complemented by radiofrequency ablation of the genicular nerves to enhance the analgesic effect (8,28,29).

Bupivacaine was chosen for its long-lasting effect and selective sensory blockade (31). Although corticosteroids are frequently included in treatments for knee OA (21,22,30), our results align with recent concerns about theeir systemic and local adverse effects (2,4,22,32).

No severe adverse effects were observed, underscoring the safety of the technique (33). Validated scales (NRS, WOMAC) were used to assess outcomes, ensuring methodological robustness and comparability with prior studies.

Strengthening Exercise Programs

All patients received guidance on quadriceps-strengthening exercises. While this element may have influenced outcomes, the effect is expected to be balanced across the groups. Evidence supports strengthening over stretching for improving pain and function in cases of knee OA (34-37), and simple, easy-to-follow protocols have been shown to enhance adherence. Similarly, variations in intensity, volume, and duration of the exercises do not appear to impact their effectiveness significantly, provided they are performed consistently (38-41). Although the program was home-based and unsupervised, previous studies have demonstrated that such approaches can yield results comparable to supervised interventions (42,43). Nevertheless, a notable limitation of the study is that adherence to the prescribed exercise regimen was not systematically recorded.

Meaning of the Study

Our study suggests that a GNB with bupivacaine provides superior pain relief and functional improvement than does the combination of bupivacaine and corticosteroids as a treatment for knee OA. Significant reductions in pain (measured on the NRS) and improved function (measured on the WOMAC) were observed in the bupivacaine group, while the placebo group showed no relevant changes, reinforcing the efficacy of the active treatments.

These results challenge the belief that corticosteroids enhance the analgesic effect of nerve blocks.

Although corticosteroids are anti-inflammatory, their lack of additional benefit in our study indicates they may not play as crucial a role as previously assumed. Avoiding corticosteroids may also be beneficial in populations who must limit their use due to side effects.

Limitations

Limitations include potential biases from individual pain perception, patient expectations, or the duration of the anesthetic effect, which may influence outcomes. While randomization and placebo control mitigate these risks, larger studies with longer follow-up times are needed to confirm long-term efficacy and safety.

Additionally, the 6-month follow-up period does not allow conclusions on long-term outcomes. However, our follow-up duration exceeds that of most previous studies on the use of GNBs for knee OA, which typically range between 4 and 12 weeks, thereby offering a more robust assessment of the medium-term efficacy of the procedures (24,25).

The study did not compare GNBs with other common interventions such as hyaluronic acid or platelet-rich plasma, though recent reviews question their efficacy (2,44).

The treating physician was not blinded due to procedural constraints, but outcome assessors were blinded to minimize bias.

An important consideration is the quadriceps-strengthening exercise prescribed to all patients. Because strengthening exercises are known to improve knee OA symptoms (45-50), part of the observed improvements in pain and function may be due to adherence to these exercises rather than the GNB alone. However, the GNB may aid rehabilitation by reducing pain, enabling patients to engage more effectively in strengthening exercises and improving long-term outcomes.

Because it was conducted in a tertiary hospital, our study may have limited generalizability. Future research should examine the long-term impact of GNBs combined with exercise programs to optimize treatment strategies for knee OA.

Conclusions

The findings of this study suggest that adding corticosteroids to local anesthetics in GNBs does not provide significant clinical benefits over using local anesthetics alone. Given the potential adverse effects of corticosteroids, including systemic and local complications, their routine inclusion in this procedure may not be necessary. Bupivacaine alone appears to offer comparable efficacy in pain relief and functional improvement while minimizing the risk of treatment-related side effects. Therefore, a GNB with bupivacaine alone may be a safer and equally effective option for managing knee OA.

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