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A Study to Compare Efficacy of Ultrasound Guided Saphenous Versus Genicular Nerve Block in Osteoarthritis Knee Pain

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ABSTRACT

Background and aim: The most prevalent cause of disability among older persons is osteoarthritis (OA). We compared the efficacy of ultrasound-guided saphenous nerve block (SNB) with genicular nerve block (GNB) in osteoarthritis knee pain.

Material and methods: We included 50 patients of either gender, aged 50 years or older, with knee pain from osteoarthritis. The patients were then split into two groups of 25 each. Patients in Group G had a genicular nerve block, and those in Group S received a saphenous nerve block. All patients in either group were given us-guided blocks using 8ml of 0.25% bupivacaine with 1ml (40 mg) of triamcinolone acetonide. Visual analogue scale (VAS) score, patient satisfaction, The Western Ontario and McMaster Universities Index (WOMAC) score (for quality of life), and side effects were assessed to determine the efficacy of the blocks.

Results: The mean VAS score was statistically significantly decreased at all-time intervals compared to the baseline score in both groups. WOMAC index was statistically significant ($p<0.05$) at two and three months but otherwise comparable at all time intervals during the study period. Patient satisfaction was similar in both groups; however, group S exhibited statistically higher satisfaction levels at two months.

Conclusions: Ultrasound-guided saphenous nerve block and ultrasound-guided genicular nerve block are functional treatment modalities for OA knee pain before going towards knee surgeries. Both these techniques provide good pain relief and improvement in physical disability to the patients at all-time intervals in our study.

1. Introduction

Osteoarthritis (OA) is a chronic degenerative disorder with multifactorial etiology. Osteoarthritis is also the single most common cause of disability in older adults. It is a significant cause of distress, disability, reduced quality of life, and increased healthcare expenditure by exerting a significant burden on the individual and the community.[1] The hallmark symptom of OA is chronic pain, particularly after prolonged activity and weight bearing. It affects the functioning and well-being of individuals. Also, there may be stiffness and immobility because of the degenerative process of articular cartilage, subchondral sclerosis, osteophyte formation, and low-grade inflammation. The risk factors for developing osteoarthritis include increasing age, genetics, large body mass, certain occupations, trauma, repetitive knee bending, or heavy lifting.[2, 3] The goals of managing osteoarthritis involve a multidisciplinary approach, including non-pharmacological, pharmacological, and surgical interventions. The non-pharmacological treatment measures are conservative therapy like participating in management programs consisting of low input aerobics, quadriceps strengthening, gait training, weight loss with BMI $\leqslant$ 25, acupuncture, manual therapy, electrotherapeutic modalities, use of valgus diverting force brace and lateral wedge shoes.[3, 4] Pharmacological treatments recommended for knee pain include acetaminophen, non-steroidal anti-inflammatory drugs (oral or topical), or tramadol. Opioids, skin patches, and glucosamine are the other pharmacological agents used. Some procedural treatment modalities are intra-articular corticosteroids, nerve blocks, hyaluronic acid, growth factor injections, and needle lavage. Surgical treatments commonly used are arthroscopic lavage and debridement, joint replacement arthroplasty, or osteotomy. Current therapies to help alleviate joint pain have limited effectiveness, and certain drugs produce unwanted side effects, thereby precluding their long-term use. Millions of patients are suffering from debilitating effects of joint pain for which there is no satisfactory treatment.[3, 5] There is a genuine need for simple, minimally invasive, cost-effective methods to give prolonged results. Saphenous nerve block (SNB) and Genicular nerve block (GNB) can be methods. The efficacy of blockade of conduction of the saphenous and genicular nerve is further improved using

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ultrasound. The introduction of ultrasound-guided nerve blockade (USGNB) has allowed the visualizing of nerve structures, facilitating various types of regional anesthetic blocks.[6] Therefore, the purpose of the study was to compare the efficacy of ultrasound-guided saphenous nerve block with genicular nerve block for the treatment of osteoarthritis knee pain and to assess the improvement in pain and disability using saphenous and genicular nerve block, ease of administration of block and procedural complications.

2. Material and methods

This clinical trial was approved by the Institutional Review Committee and registered as a clinical trial by the National Institute of Medical Statistics (India Council of Medical Research); the Clinical Trial identifier no. CTRI/2020/03/023919. After the institutional Ethics Committee approved the protocol, the prospective, randomized, single-blind study was conducted on 50 patients of both genders and ages 50 years and older with complaints of knee pain due to osteoarthritis knee. Patients with X-ray knee joint findings corresponding with the clinical symptoms and who failed to respond to conservative treatment of six weeks were enrolled in the study. Patients with known hypersensitivity or allergy to local anesthetic, steroids, patients with bleeding disorders, infection at the site of block, previous history of genicular or saphenous nerve block, arthroscopic lavage and debridement of the knee joint and knee surgery, pregnant and lactating females, uncontrolled diabetes mellitus and hypertension, history of cardiac, liver or kidney disease and psychiatric illness were not included in the study. After taking written informed consent, patients were allocated to two groups of 25 each:

Group-G (n=25): Patients were administered a USG-guided genicular nerve block.

Group-S (n=25): Patients were administered a USG-guided saphenous nerve block.

Every patient underwent a thorough clinical history and examination. Blood tests were obtained needed routinely. All patients gave informed, written consent after being fully informed about the procedure. Before the study began, each patient received an explanation of their Visual Analogue Scale (VAS) score and the Western Ontario and McMaster University's Index of Arthritis (WOMAC) index7 for pain assessment. All patients received 8ml of 0.25% bupivacaine with 1ml (40 mg) of triamcinolone acetonide. Lignocaine (2%, 2ml) was used for subcutaneous infiltration.

Technique

The procedure was performed under strict aseptic precautions. A high-frequency linear composite M-Turbo ultrasound machine was used.

Group-S (n=25)

The patients were placed in the supine position with the extremity to be blocked slightly externally rotated and flexed 30 degrees at the knee and hip joint. The transducer probe was placed in transverse orientation at the medial side of the distal thigh 7-10cm from the knee joint line. The superficial femoral artery, vein, and saphenous nerve (vascular bundle) were visualized on the posterior aspect of the sartorius muscle. The saphenous nerve appears as a hyperechoic structure behind the sartorius muscle in a vascular bundle and is located medial to the femoral artery in the distal thigh. Once the femoral artery is identified (in the plane), under sonography guidance, a 23G spinal needle was inserted posterior to the fascia of the sartorius muscle, where it enters the fascia overlying the superficial femoral artery, vein, and saphenous nerve. Once the needle tip was visualized medial to the artery and after careful negative aspiration of blood, 1 to 2 ml of normal saline was injected to confirm the proper injection site. Once the correct position of the needle tip was confirmed, a total of 9ml of drug solution was injected.

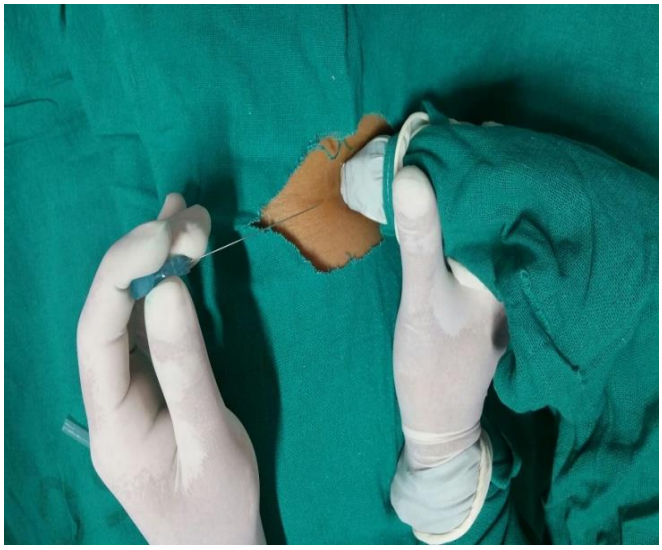

Fig. 1. Showing the position of the USG probe in plane approach and direction of the needle at the medial side of the thigh.

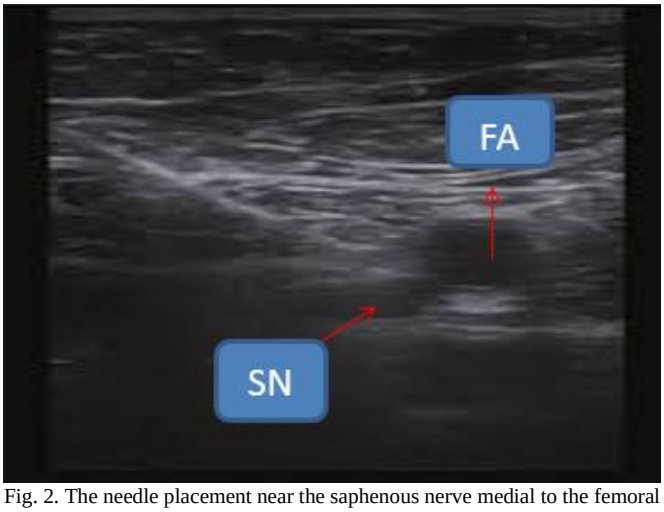

Fig. 2. The needle placement near the saphenous nerve medial to the femoral artery is shown under ultrasound guidance (the arrow shows the saphenous nerve and femoral artery).

Group-G (n=25)

The patients were made to lie supine, with a cushion positioned behind the popliteal fossa to allow knee flexion. The study's target anatomical areas are the superior lateral, superior medial, and inferior medial nerves. A percutaneous technique provides easy access to these three branches. The transducer was initially positioned parallel to the long bone shaft and then shifted up or down to locate the long bone's epicondyle. The genicular arteries were located close to the periosteal regions. Using color Doppler ultrasonography, the points where the epicondyle and the shafts of the femur and tibia meet. The superior lateral, medial, and inferior medial genicular arteries followed the genicular nerve. Hence, the GNB target locations were following each genicular artery. Following confirmation of the genicular artery with a color Doppler, 2 ml of 2% lignocaine local anesthetic was injected into the skin. A 23G spinal needle was advanced (in-plane) towards

the target nerve under sonographic guidance. The superior-medial genicular nerve (SMGN) was blocked at the junction of femoral medial epicondyle and shaft of femur, the superior-lateral genicular nerve (SLGN) was blocked at the junction of femoral lateral epicondyle and shaft of femur, and the inferior-medial genicular nerve (IMGN) was blocked at the junction of tibial medial epicondyle and the shaft of tibia. After careful negative aspiration of blood, 1 ml of normal saline was injected to confirm the proper injection site. Then, 3 ml of drug solution was injected at each of the three sites.

Fig. 3. Showing the position of the USG probe in plane approach at the superior-medial aspect of the thigh.

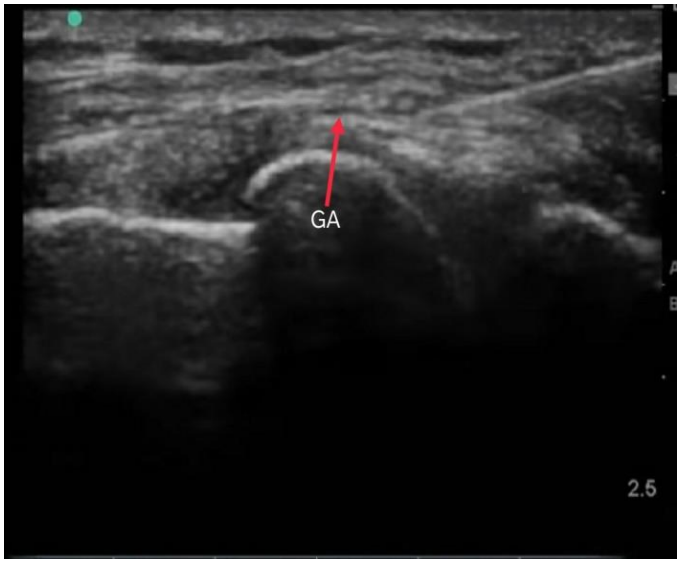

Fig. 4. Showing placement of needle near SMGN. Arrow (GA) showing superior-medial genicular artery.

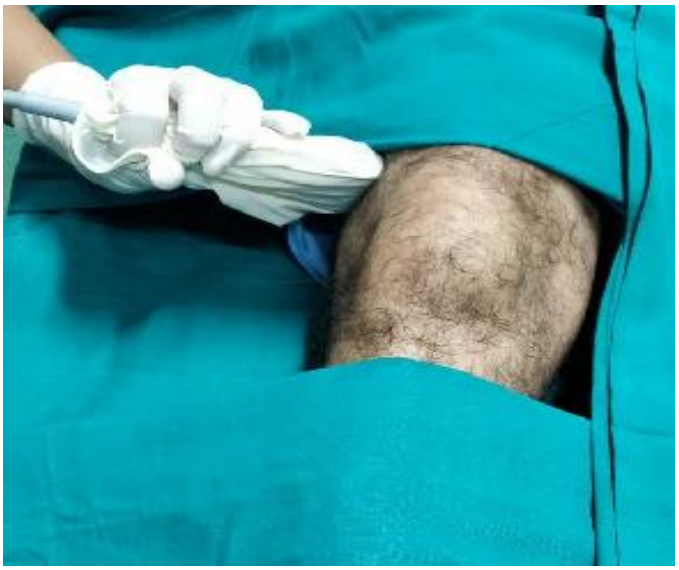

Fig. 5. Showing the position of the USG probe in plane approach at the superior-lateral aspect of the thigh.

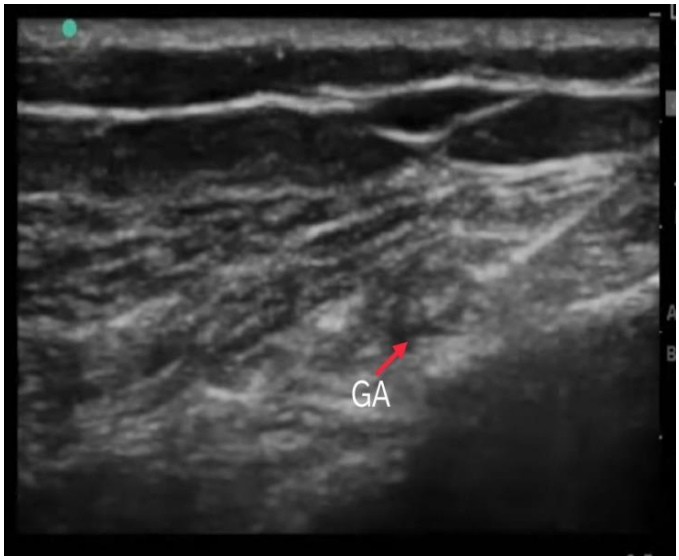

Fig. 6. Figure showing placement of needle near SLGN. Arrow (GA) showing superior-lateral genicular artery.

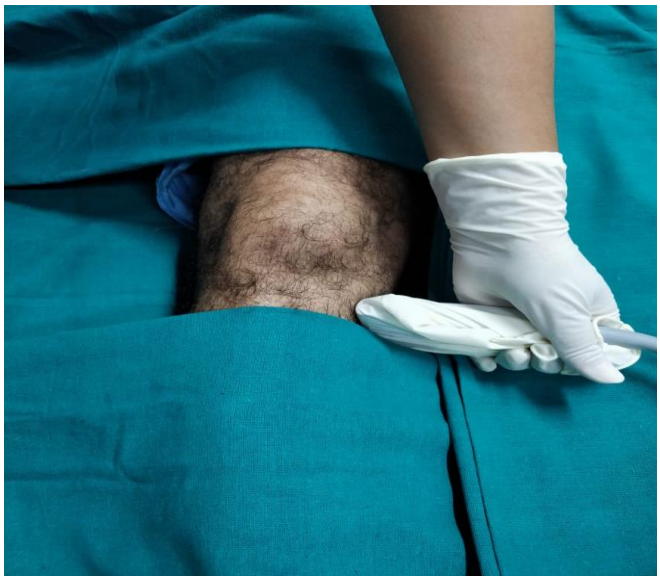

Fig. 7. Showing the position of the USG probe in plane approach at the inferior-medial aspect of the thigh.

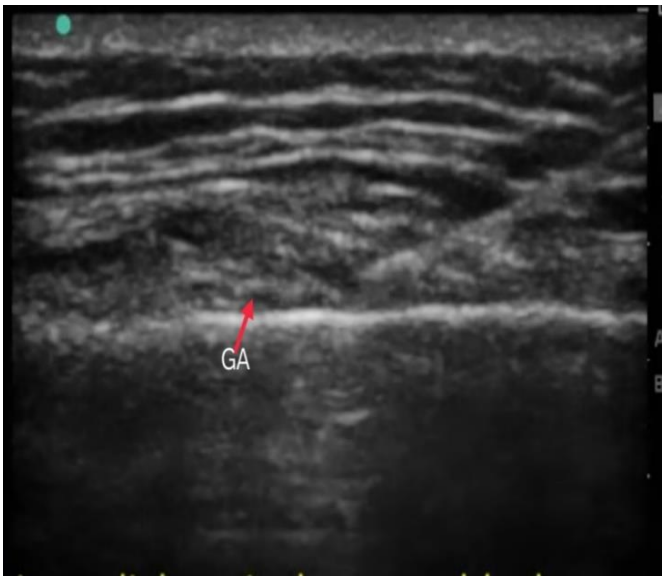

Fig. 8. Showing placement of needle near IMGN. Arrow (GA) showing inferior-medial genicular artery.

Rescue analgesic medication

After the nerve block, patients were advised to take a tab. Paracetamol 650mg thrice a day for three days to take care of needle prick pain. Rescue analgesic medications were given if the VAS >4. The initial rescue medication was a tab. Diclofenac sodium 50mg per oral to three such doses per day. If the pain is not controlled, tab. Tramadol 50mg per oral was added to a maximum of four doses daily. A record of rescue medications was kept**.** The following variables were noted in order to assess the effectiveness of the block:

1. Assessment of pain (VAS score).
2. Patient Satisfaction.
3. Assessment of quality of life (WOMAC score).
4. Outcome assessment (Number of attempts required for the correct needle placement and time to perform the block: the starting point was the administration of local anesthetic, and the end-point was the administration of drug solution).
5. Side effects.

3. Results

The relevant data: age, sex, weight, X-ray grades distribution, VAS score, WOMAC Index, WOMAC Subscales (Pain, Stiffness, Physical activity) scores, patient satisfaction, ease of administration of blocks, number of repeated blocks, rescue medications of each patient during the study period i.e. from the time of administration of saphenous nerve block and genicular nerve block to follow up at one hour, one week, two weeks, one month, two months and three months after saphenous nerve block and genicular nerve block were noted. All the data was compiled and analyzed statistically at the end of the study period. Both groups were comparable in age, weight, and sex distribution, with no statistically significant difference ($p>0.05$). When comparing the pain scores of groups S and G before and after the injection, there was a statistically and clinically significant difference in pain ($p<0.05$) between the two groups at different times after the block. Group S had a clinically lower pain score than group G when the two groups' pain scores were compared. However, this difference was statistically insignificant ($p>0.05$).

Table 1. Mean Visual Analogue Scale (VAS 0-10cm) Score.

	Group S Mean ± SD	Group G Mean ± SD	P-value
Before the block	8.00 ±1.08	8.04 ±1.04	0.89
1hr after the block	0.36 ± 0.56	0.56 ± 0.71	0.27
1week after the block	0.52 ± 0.58	0.80 ± 0.86	0.18
2 weeks after th block	1.16 ± 0.94	1.36 ± 1.07	0.48
1 month after the block	1.72 ± 1.20	1.88 ± 1.48	0.67
2 months after the block	1.80 ± 0.70	1.92 ± 0.81	0.58
3 months after the block	2.12 ± 0.83	2.56 ± 0.76	0.056

Unpaired t-test

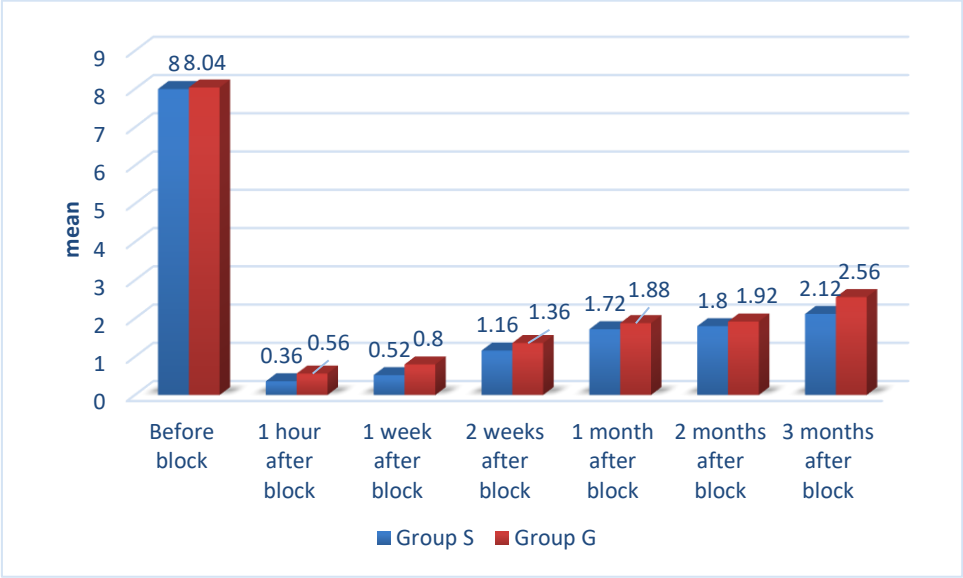

Fig. 9. Showing the graphical comparison of VAS score between two groups.

Patient satisfaction was clinically and statistically comparable (p>0.05) at one hour, one week, two weeks, one month, and three months following block when compared between the two groups. Group S exhibited a statistically and clinically significant improvement two months following the block (p<0.05).

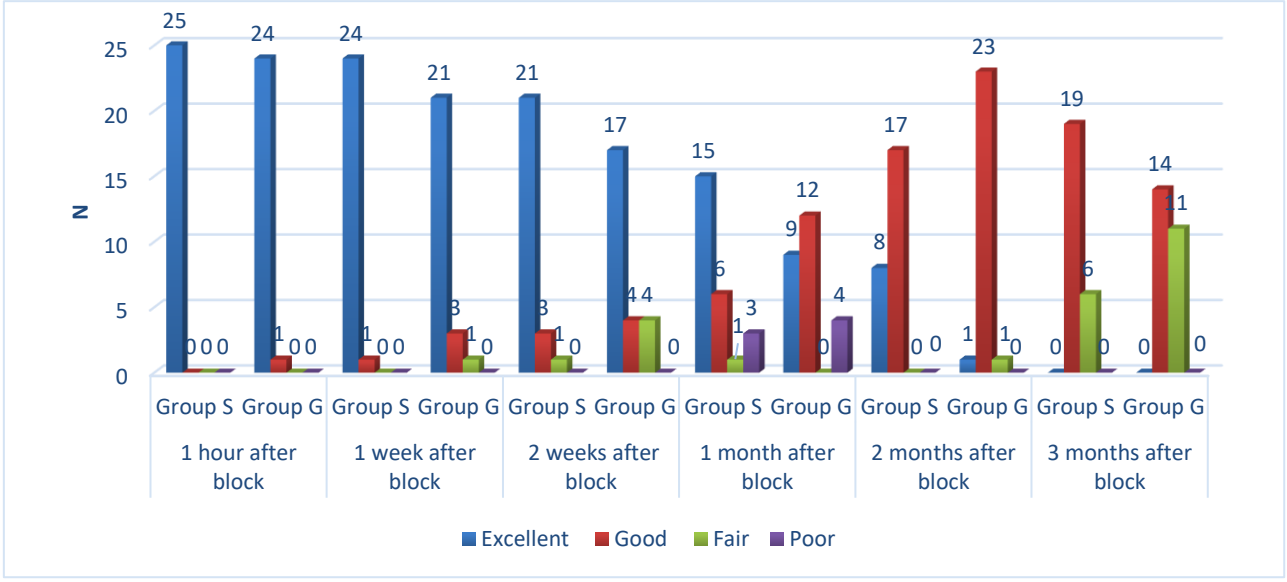

Fig. 10. Graphical representation of patient satisfaction between two groups at different time intervals.

When comparing the WOMAC index before injection to the index at various time intervals following the block, there was a clinically and statistically significant difference (p<0.05) in both groups. Upon comparing the WOMAC Index between the two groups, it was found to be statistically comparable at all time intervals during the study period. However, at two and three months, there was a statistically significant difference (p<0.05), indicating better results in group S.

Table 2. Mean WOMAC Index.

	Group S Mean ± SD	Group G Mean ± SD	P-value
Before the block	70.38 ± 8.49	73.99 ± 8.78	0.14
1hr after th block	3.06 ± 4.42	3.66 ± 4.78	0.64
1week after the block	4.82 ± 3.21	6.51 ± 7.28	0.29
Two weeks after the block	11.95 ± 6.84	15.91 ± 11.57	0.14
1 month after th block	23.86 ± 10.69	28.73 ± 14.15	0.17
Two months after the block	27.52 ± 2.58	30.42 ± 3.99	**0.004**
Three months after the block	34.91 ± 3.38	38.51 ± 4.94	**0.004**

Unpaired t-test

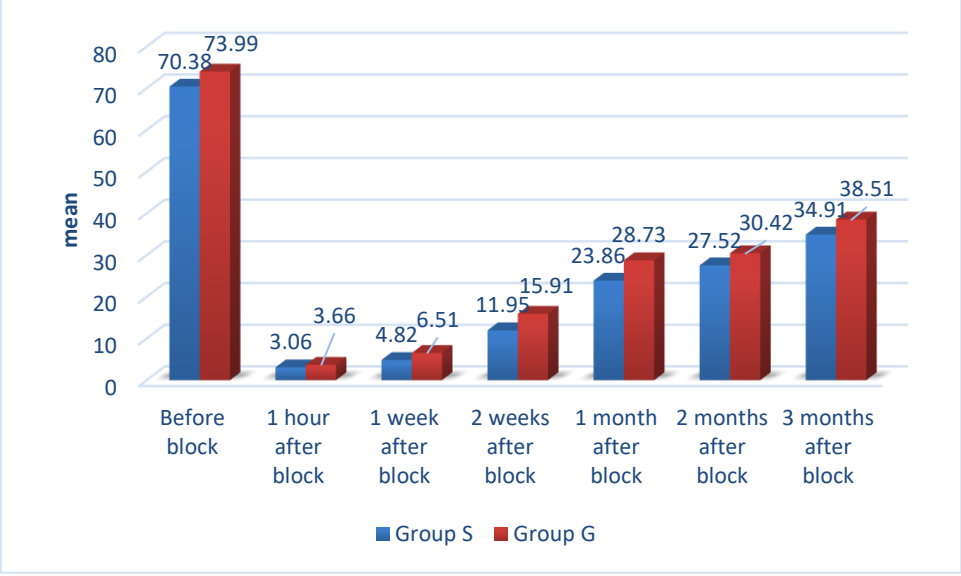

Fig. 11. Graph showing the comparison of th mean WOMAC index between two groups.

The pain subscale score of WOMAC was comparable between the groups, and no statistical significance was seen (p>0.05).

The Stiffness Subscale Score of WOMAC was clinically and statistically comparable (p>0.05) at all time intervals between the two groups except at three months after the block when the Score was statistically significantly better in group S (p<0.05).

The Physical Activity Subscale Score of WOMAC was statistically comparable between the two groups (p>0.05) after one hour, one week, two weeks, and one month of block. In contrast, the Score is statistically significant (p<0.05) in group S at two and three months after the block.

Block execution time in minutes differed statistically significantly (p<0.05) between the two groups. Regarding block attempts, there was no statistically significant distinction (p>0.05) between the two groups.

Table 3. Ease of administration of the nerve block.

	Group S Mean ± SD	Group G Mean ± SD	P-value
Time is taken to perform block in min	2.11 ± 0.304	3.76 ± 0.95	**0.001**
Attempt of block	1.12 ± 0.332	1.20 ± 0.408	0.45

Unpaired t-test

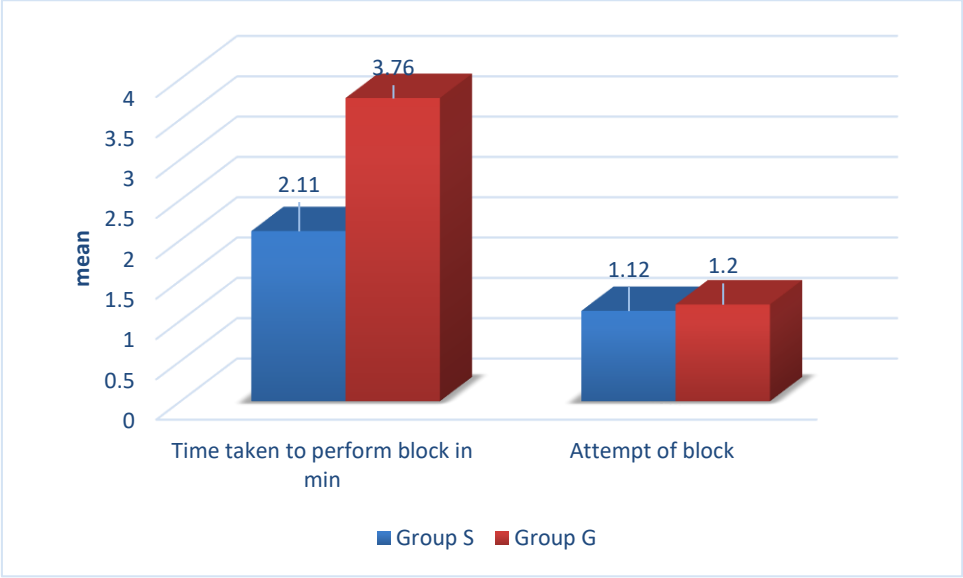

Fig. 12. Graph showing the time taken to perform block (in minutes) and attempts required by both groups.

Repeat block was given when pain relief was inadequate (VAS>4cm) with the same drug solution as before; three patients were repeated saphenous nerve block at one month, and four patients were repeated genicular nerve block at one month. Rescue medication was given to the eight patients from group S, and ten patients took rescue medication from group G.

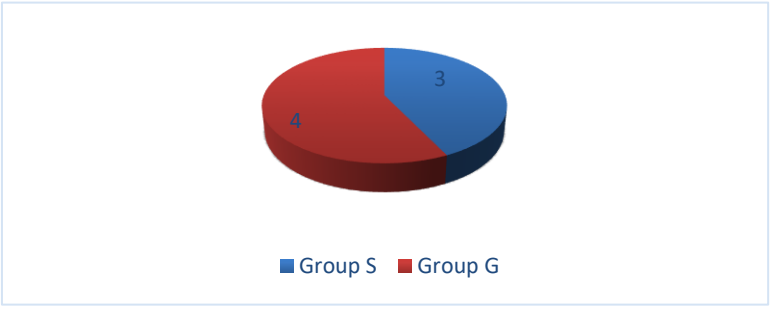

Fig. 13. Pie diagram depicting no. of patient's required repeat blocks in two groups.

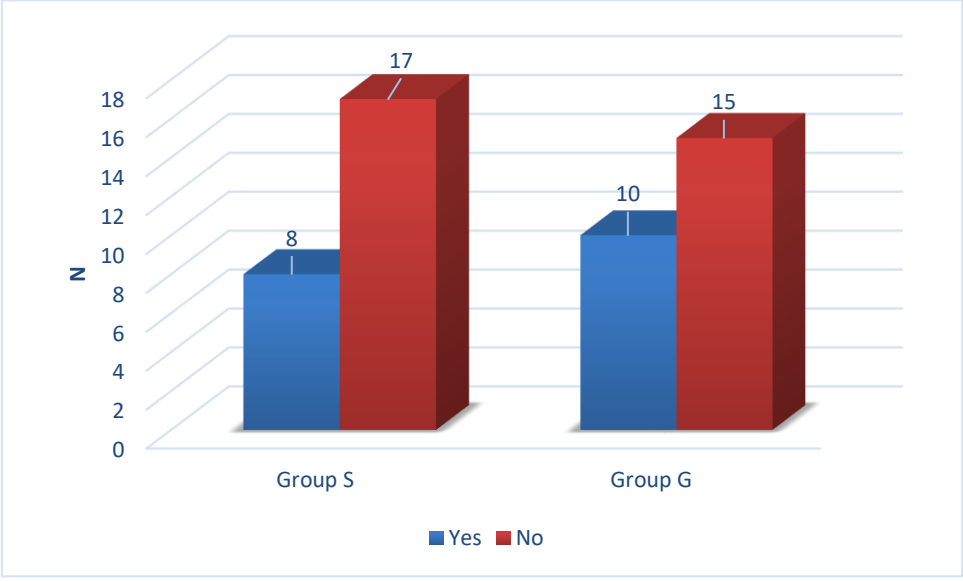

Fig. 14. Graph showing the number of patients who required rescue medication in both groups.

4. Discussion

Nerve blocks using ultrasound are becoming popular nowadays. Nerve blocks produce pain relief in patients suffering from chronic pain of OA and improve functional disability. The use of ultrasound guidance will help in better identification of structures and location of nerves. So we planned to compare the efficacy of ultrasound-guided saphenous nerve block (Group – S) with genicular nerve block (Group – G) using 8ml of 0.25% plain bupivacaine with 1ml (40mg) triamcinolone acetonide as an adjuvant for treatment of OA knee pain in both the groups. Follow-ups were conducted on these patients at one-hour, one-week, two-week, one-month, two-month, and three-month intervals to assess pain alleviation, functional disability improvement, need for repeat block, and procedural complications. In our study, the mean age in group S was 58.92±9.206 years, and in group G was 59.68 ± 6.511 years. The mean weight in group S was 65.24 ±6.827 kg, and in group G was 66.64 ± 8.616 kg. In Group S, the male-to-female ratio was 07:18, and in Group G, it was 09:16. There were more females than male patients. The demographic data with respect to age, weight, and sex distribution were comparable in the two groups, and there was no statistically significant difference ($p>0.05$). The two groups were comparable regarding mean VAS score before saphenous nerve block and genicular nerve block; there was no statistically significant difference ($p>0.05$) between the two groups. When compared to the baseline score, the mean VAS score following the nerve block was reduced in all 50 patients in both groups at all time intervals, and there was a statistically significant improvement ($p<0.05$). However, the patients in group S have more pain relief subsequently after the block on the VAS scale clinically than in group G. The pain relief in both groups was long, with low VAS scores even during the month's study period. Patients were advised to take rescue medications when VAS >4. Eight patients took rescue medication from group S, and ten patients took rescue medication from group G. Repeat block was given when pain relief was not adequate (VAS>4) with the same drug solution as given before in patients who had poor satisfaction with pain relief. The requirement of repeated blocks was higher in Group G compared to Group S. Repeat blocks were administered in three patients in Group S at one month and in four patients in Group G. This was statistically comparable, and no significant difference was observed ($p>0.05$). The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a tool to evaluate the effectiveness of treatment in osteoarthritis knee. It also informs about the patient's health status over time and the treatment's effect on the health status. The WOMAC Index was calculated by considering only the parameters that the patients answered. Thus, the WOMAC Index is a more accurate predictor of the effectiveness of treatment of osteoarthritis knee. The WOMAC index was computed before the nerve block, one hour after the nerve block, one week, two weeks, one month, two months, and three months following the genicular and saphenous nerve block. Throughout the study period, the two groups' mean WOMAC Index scores were comparable at all times, and neither group showed a statistically significant variation ($p>0.05$), except at two months and three months when it was statistically significant ($p<0.05$). Mean WOMAC Index scores after saphenous and genicular nerve block were decreased in all 50 patients across all times in both groups. When compared before the nerve block, the WOMAC index and at one hour, one week, two weeks, one month, two months, and three months after the nerve block was clinically and statistically significant ($p<0.05$). However, the decrease in the WOMAC Index in group S patients was more significant than in group G patients.

The Western Ontario and McMaster Universities score of Osteoarthritis (WOMAC) Pain Subscale Score was computed at every time interval throughout the research. Throughout the study period, both the groups were comparable regarding mean WOMAC Pain Subscale Scores at all-time intervals, and there was no statistically significant difference ($p>0.05$) in the two groups. Our study observed that both groups significantly reduced nocturnal and rest pain after the nerve block. The Western Ontario and McMaster Universities score of Osteoarthritis (WOMAC) Stiffness Subscale Score was calculated throughout the study period. In our study, both the groups were comparable regarding mean WOMAC Stiffness Subscale Scores before saphenous and genicular nerve block, and there was no statistically significant difference ($p>0.05$) in the two groups except at three months where it was statistically significantly better in group S ($p<0.05$). Our study observed that following the nerve block, stiffness in both groups was significantly reduced in the morning and later in the day. The Western Ontario and McMaster Universities score of Osteoarthritis (WOMAC) Physical Function Subscale Score was always calculated during the research. Throughout the study, both groups were comparable in terms of mean WOMAC Physical Functions Subscale Scores. There was no statistically significant difference ($p>0.05$) in the two groups at one- hour, one week, two weeks, and one month after block. At the same time, the Score was statistically significant ($p<0.05$) in group S at two months and three months after the block. Saphenous nerve block and genicular nerve block with bupivacaine and steroids give better results for controlling knee pain and improvement in physical disability of OA patients with significantly decreased WOMAC index and subscale score (pain, stiffness, and physical function) compared to baseline score at three months study duration.[7] Ultrasound guidance helped in redirecting the needle and drug solution to the affected compartment of the knee. Similarly, saphenous and genicular nerve blocks were performed under ultrasound guidance, ensuring accurate needle placement and injectate spread around the nerves. Using ultrasound while performing procedures could have been a primary reason for significant improvement in pain scores and WOMAC index in the present study. Group S showed much higher levels of clinically meaningful patient satisfaction than group G, although there was no statistically significant difference ($p>0.05$) between the two groups. In our study, several attempts requiring needle placement at the block site assessed the ease of administration of both nerve blocks. It was 1.12 ± 0.332 in Group S and 1.20 ± 0.408 in Group G. Mean of time to perform a block in minutes was 2.11 ± 0.304in Group S and 3.76 ± 0.95 in Group G. The two groups were comparable regarding a mean number of attempts of nerve blocks. There was no statistically significant difference between the groups ($p>0.05$). There was a statistically significant difference ($P<0.05$) regarding the time taken to perform a block between the two groups. Longer time was required to perform ultrasound-guided GNB as nerve block had to be performed around the three genicular nerves, viz superior-medial, inferior-medial, and superior-lateral genicular nerves. Our investigation showed no post-block problems in either group's patients. The drug solution we used was 9 ml and included 8 ml of 0.25% bupivacaine hydrochloride and 1 ml triamcinolone acetonide (40 mg) in all the patients of both groups. The mechanism of the therapeutic effect of local anesthetic and steroids for providing long-term pain relief is still unclear. Bupivacaine alone as an anesthetic agent has only a few hours of duration of action. The addition of steroids further prolonged the duration of pain relief, making it potentially very useful in chronic pain conditions. Corticosteroid (Triamcinolone acetonide) is used as it has its own analgesic and anti-inflammatory properties, moderate potency, and prolongs the duration of action of bupivacaine. It remains longer at the injection site because of low solubility, which increases the efficacy of the block. However, more studies are needed to find out the exact pathophysiology as well as the mechanism of the prolonged effect of nerve block in this chronic debilitating pain condition.[8-10] The present study has a few limitations: Firstly, the study

results may have reflected the experience of one practitioner, which may have limited the generalizability of the study findings. Secondly, based on the outcomes of the short-term effects, the mid-and long-term effects should be assessed in the future. While trials could concentrate on long-term effects up to a year following the therapies, we followed patients for three months in our investigation.

5. Conclusion

Local anesthetic and steroid-assisted ultrasound-guided genicular nerve block (group G) and saphenous nerve block (group S) are safe and efficient methods for treating symptomatic arthritic knee. Throughout our trial, patients benefitted from improved physical impairment and effective pain alleviation. The ease of administration between the two techniques is comparable regarding the number of attempts. An ultrasound is used to perform a saphenous nerve block or genicular nerve block to guide the direction and depth of the needle. Also, the spread of drug solution in the affected compartment and around the nerves is visualized and confirmed. Regarding improving pain score, physical status, patient satisfaction, and the number of nerve blocks, ultrasound-guided saphenous and genicular nerve blocks are equally good.

Conflict of Interest

The authors declared that there is no conflict of interest.

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