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Buprenorphine Vs Clonidine as Adjuvant for Ultrasound Guided Popliteal Sciatic Nerve Block in Lower Limb Surgeries a Double Blinded Randomised Study

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KEYWORDS

Ultrasound, adrenaline, requirement, randomized, Buprenorphine, saturation, anesthesia.

ABSTRACT:

Background: and aims: The aim of the study was to compare the effectiveness of ultrasound-guided popliteal nerve block with two different additives with 2% xylocaine adrenaline in below knee surgeries. The primary objective is to determine the duration of effect of ultrasound guided popliteal sciatic nerve block with dose of 15 ml 2% lignocaine with additive buprenorphine and 15 ml of 2%lignocaine with clonidine, to find out the onset and duration of anaesthesia, and to determine the requirement of tramadol as rescue analgesia in the first 24 hours.

Materials and Methodology: Sixty-eight patients were selected, randomized, and grouped into two. Patients under ASA1 and ASA 2 and ASA 3 scheduled to undergo elective and emergency below knee surgeries were included. In Group A participants, using high frequency ultrasound,a 23-G quincke needle is introduced at least 7-cm superior to the popliteal crease. With the probe parallel to the popliteal crease and at a level proximal to the nerve split, the needle is inserted at the lateral aspect of the probe and advanced toward the nerve. After the sciatic sheath is penetrated and the nerve is stimulated, inject 16 mL of 2% xylocaine with adrenaline and clonidine 0.5ml. In Group B participants, using high frequency ultrasound, a 23-G quincke needle is introduced at least 7-cm superior to the popliteal crease and approximately 1 cm lateral to the apex of the popliteal triangle, 16 mL of 2% xylocaine with adrenaline, Buprenorphine 0.5ml is injected. Comparison between the two groups with regard to age, sex, ASA classification, heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation, VAS at rest, VAS at movement, requirement of tramadol and duration of block distribution were analyzed.

Results: Age, sex, ASA classification, and pain outcomes were similar between both groups.Buprenorphine as additive,showed improved onset times, extended analgesia duration, and fewer rescue analgesics were similar in both groups as well. Both Groups exhibited similar fluctuations in heart rate and systolic blood pressure, suggesting some external influences on these parameters. Both groups maintained stable oxygen saturation, and no significant safety concerns or complications were observed.

Conclusion: Buprenorphine as additive with 2% xylocaine in ultrasound popliteal nerve blocks can improve anesthetic effectiveness, reduce rescue analgesic needs, and prolong block duration without compromising safety. Both groups showed similar baseline characteristics, confirming the potential benefits of volume adjustments in regional anesthesia

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INTRODUCTION

Evolution of peripheral nerve blocks has significantly influenced modern anesthetic practices. Initial techniques for nerve blocks relied on anatomical landmarks and were performed without imaging, leading to inconsistent results and a higher risk of complications.[18] The introduction of nerve stimulation in the 1960s provided a means of identifying nerve proximity, improving accuracy and success rates. However, this technique was limited by the inability to visualize surrounding anatomical structures, such as blood vessels.

"Ultrasound-guided nerve blocks originated in the late 1990s as a revolutionary technology. The capacity to observe nerves, adjacent tissues, and the dispersion of local anesthetic in real time represented a significant transformation in regional anesthesia. Ultrasound guiding for the popliteal nerve block has increased accuracy, decreased the necessary anesthetic volume, and enhanced safety profiles. It has established itself as the benchmark for executing popliteal blocks, providing enhanced dependability and patient outcomes relative to conventional methods."

Buprenorphine is a semi-synthetic opioid that is commonly used in the treatment of opioid dependence and for pain management. It was first synthesized in the 1960s by the pharmaceutical company Reckitt & Colman. Buprenorphine is considered a partial agonist at the opioid receptor, which means it can activate the receptor but with less intensity compared to full agonists like morphine or heroin. It has a high affinity for the mu-opioid receptor, which contributes to its effectiveness in managing withdrawal symptoms and cravings in opioid dependence.

In addition to its role in opioid dependence, buprenorphine is also used as an analgesic for pain relief, especially for moderate to severe pain. It is often combined with naloxone in formulations designed for opioid addiction treatment to reduce the risk of misuse and abuse. Buprenorphine's ability to partially stimulate opioid receptors while also blocking other opioid effects makes it an effective alternative for opioid users who need a safer approach to manage their dependency.

Clonidine is primarily an alpha-2 adrenoceptor agonist which causes central hypotensive and anti-arrhythmogenic effects. The alpha-2 adrenoceptor is coupled to the G-proteins inhibits adenylyl cyclase and activates opening of a potassium channel that causes hyperpolarization.

It have effects such as lowering blood pressure, sedation, and hyperpolarization of nerves The stimulation of alpha-2 adrenoceptors in the locus coeruleus may be responsible for the hypnotic effects of clonidine Clonidine does not affect proprioception like local anesthetics. Respiratory depression, itching, nausea and vomiting, which occur with opioids, are not seen with clonidine.The potency of clonidine as an analgesic increased when given in nerve blocks. Side effects like hypotension, bradycardia and sedation can occur

MATERIALS AND METHODOLOGY

The study was performed in the Department of Anesthesiology, Chettinad Hospital and Research Institute, Kelambakkam, Chennai. Approval from Institutional Human Ethics Committee was obtained and informed and written consent were also obtained from all the participants.

Sixty eight patients were selected, randomized, and grouped into two. Patients under ASA1 and ASA 2 and ASA 3 scheduled to undergo elective and emergency below knee surgeries were included. Patient who refused surgery, who were known allergic to local anesthetics, patients with bleeding diathesis, who were on any anti-coagulants, patients who were unable to provide informed consent, patients with severe kidney or liver disease and patients with psychiatric disorders were excluded.

All patients will be premedicated with alprazolam 0.5 mg orally. Heart rate, noninvasive blood pressure, and peripheral O2 saturation will be continuously monitored during surgery and in the postoperative period

Group A and Group B post patients in the prone position with the surgical leg elevated below the knee. The knee must be bent slightly and the foot free over the bed. Bending the knee against opposition emphasises the popliteal fossa. The semitendinosus and semimembranosus muscles produce the popliteal triangle medially, the biceps femoris muscle laterally, and the popliteal crease at the base. A 23-g quincke needle will be inserted using high-frequency ultrasound at least 7 cm superior to the popliteal crease and 1 cm lateral to the triangle apex. Insert the needle at the lateral

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side of the probe and move it towards the nerve at a 45° to 60° angle to the skin in a cephalad direction, parallel to the popliteal crease and proximal to the nerve split. After penetrating the sciatic sheath and stimulating the nerve, inject 15 ml of 2% xylocaine with clonidine 0.5ml in Group A, and 16 mL of 2% xylocaine with adrenaline, Buprenorphine 0.5ml in Group B.

RESULTS

Both groups (Group A and Group B) had a similar age distribution, with the majority of participants in the 41–60 age range. There were no significant age-related differences between the groups, with proportions of participants under 40 years and over 60 years being comparable.

Table 1: AGE DISTRIBUTION

Age	Group A		Group B		p value
< 40 years	3	8.8	3	8.8	.070
41 – 60 years	21	61.8	24	70.6	
> 60 years	10	29.4	7	20.6	
Total	34	100.0	34	100.0	

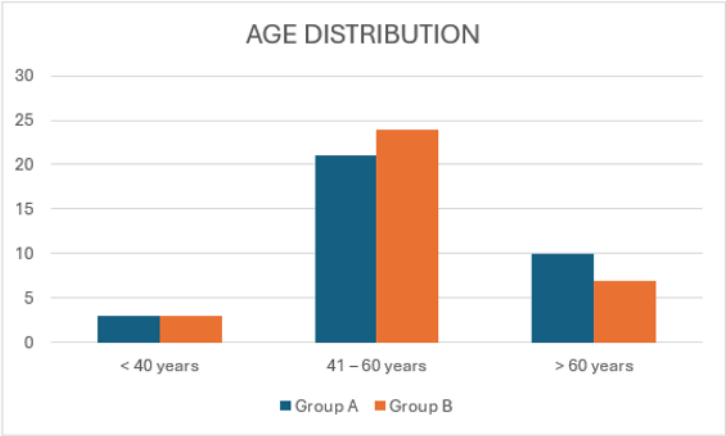

Figure 1: Age Distribution

The sex distribution in both groups showed a higher proportion of females than males. Group A had 61.8% females, and Group B had 58.8%. The difference in male proportions (38.2% for Group A and 41.2% for Group B) was not significant, indicating a balanced gender representation.

Table 2: SEX DISTRIBUTION

Sex	Group A		Group B		p value
Male	13	38.2	14	41.2	.486
Female	21	61.8	20	58.8	
Total	34	100.0	34	100.0	

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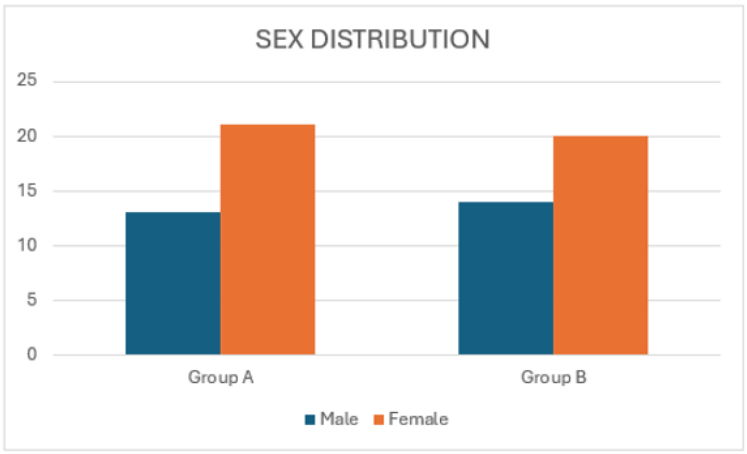

Figure 2: Sex Distribution

Table 3: ASA DISTRIBUTION

ASA	Group A		Group B		p value
I	3	8.8	4	11.8	.374
II	29	85.3	29	85.3	
III	2	5.9	1	2.9	
Total	34	100.0	34	100.0	

The distribution of ASA (American Society of Anesthesiologists) classifications was similar between the groups, with the majority in both groups categorized as ASA II (85.3%). A small number of participants were categorized as ASA I or III, with "no significant differences observed between the groups.

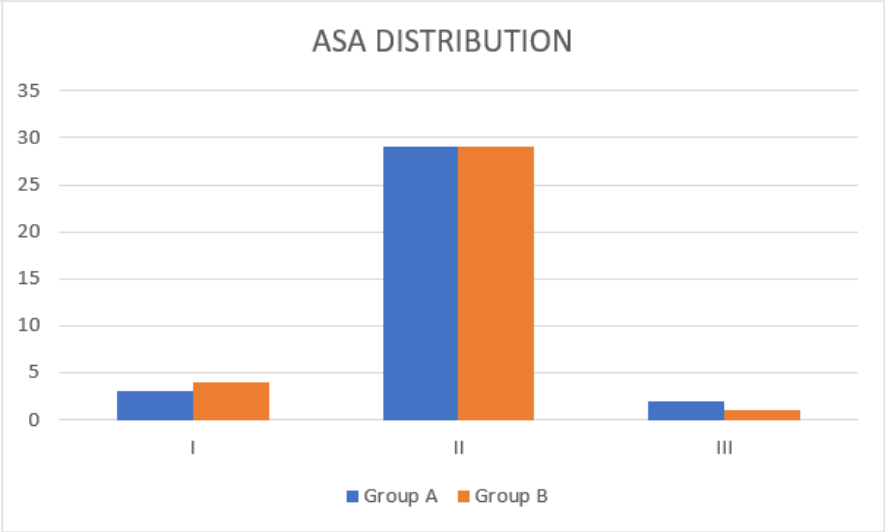

Figure 3: ASA DISTRIBUTION

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Table 4: Heart Rate distribution

Heart Rate	Group A		Group B		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
0Hours	77.65	9.351	89.5000	9.95825	.000
1Hour	73.35	7.058	71.8529	5.42236	.004
2Hours	74.41	7.361	79.7941	7.46214	.039
3Hours	71.24	7.228	67.6765	6.56769	.000
4Hours	70.15	6.770	72.0000	8.04156	.000
8Hours	77.18	7.000	76.4412	9.06940	.000
12Hours	78.06	6.362	63.0588	5.23358	.000
24Hours	79.24	5.614	77.7941	7.76854	.000

Heart rate measurements across various time points showed "no significant differences between the two groups, with" p-values consistently above 0.05. Group A's mean heart rate was slightly higher than Group B's at most time points, but this difference was not statistically significant.

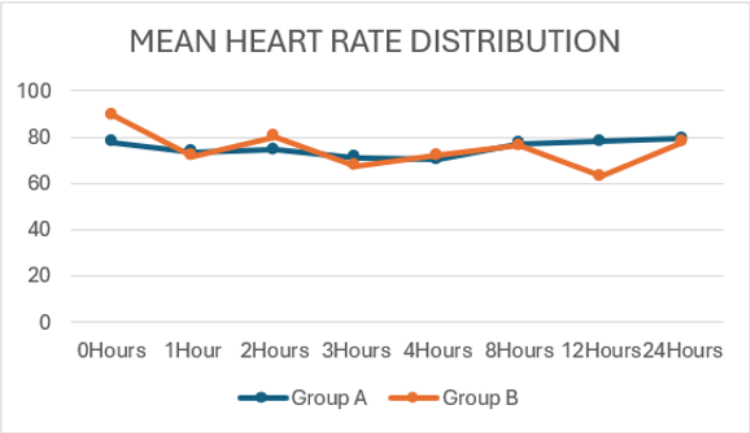

Figure 4: Mean Heart rate distribution

Table 5

Systolic Blood Pressure	Group A		Group B		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
0Hours	141.5294	35.86442	131.2941	7.92590	.000
1Hour	110.1471	8.04582	115.4118	10.28420	.000

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2Hours	111.7353	8.97575	111.9412	8.76267	.000
3Hours	117.4118	8.51422	120.9412	9.57567	.000
4Hours	122.2059	11.77511	114.7353	8.62803	.000
8Hours	123.3529	7.69842	120.5000	6.74312	.000
12Hours	122.0882	4.60808	126.1176	6.52159	.000
24Hours	124.9118	6.30713	115.7059	21.22824	.000

Systolic blood pressure showed no significant differences between the groups at most time points, though Group A generally had higher systolic blood pressure, particularly at 0 and 1 hour. However, the differences did not reach statistical significance by 24 hours

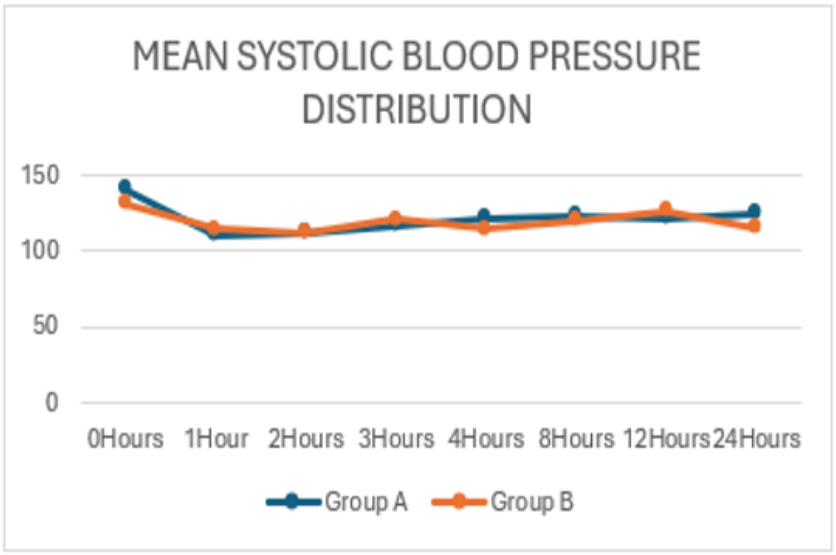

Figure 5: Systolic blood pressure distribution

Table 6: DBP DISTRIBUTION

Diastolic Blood Pressure	**Group A**		**Group B**		**p value**
	Mean	**Std. Deviation**	**p value**	**Std. Deviation**	
0Hours	73.3235	6.48411	72.8824	5.29588	.000
1Hour	69.2647	5.33319	69.0000	5.64613	.000
2Hours	68.2647	5.84812	65.6176	19.17229	.000
3Hours	72.0000	5.31436	67.2647	7.44397	.000
4Hours	68.3235	5.92744	71.0588	6.97589	.000

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8Hours	68.3235	5.92744	69.7353	6.07184	.000
12Hours	63.4118	6.39658	68.5588	5.28687	.000
24Hours	72.6176	5.96969	77.9118	.37881	.000

The diastolic blood pressure was similar across both groups, with p-values above 0.05, indicating no significant differences. Group A had lower diastolic pressure at most time points, but these differences were not statistically significant, and the trend diminished over time."

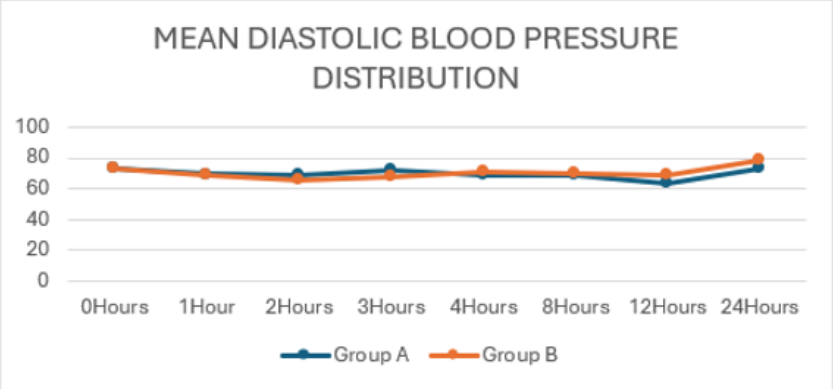

Figure 6: Diastolic blood pressure distribution

Table 7: MEAN ARTERIAL PRESSURE DISTRIBUTION

Mean Arterial Pressure	Group A		Group B		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
0Hours	68.3529	7.56740	58.8235	4.91424	.000
1Hour	68.2059	6.06919	57.3529	2.48489	.000
2Hours	59.7941	5.54201	59.6471	5.90266	.000
3Hours	65.3235	5.41446	59.7059	4.64190	.000
4Hours	65.7647	6.72426	60.8529	5.09386	.000
8Hours	67.0294	3.57165	62.8824	4.41598	.000
12Hours	65.9706	4.96951	91.2059	111.59770	.000
24Hours	67.2941	5.92135	66.5000	5.17131	.000

Mean arterial pressure (MAP) was "comparable between the two groups at most time points", with p-values above 0.05. Group A had slightly higher MAP, but no significant trend or changes were observed, except for a large standard deviation in Group B at the 12-hour mark.

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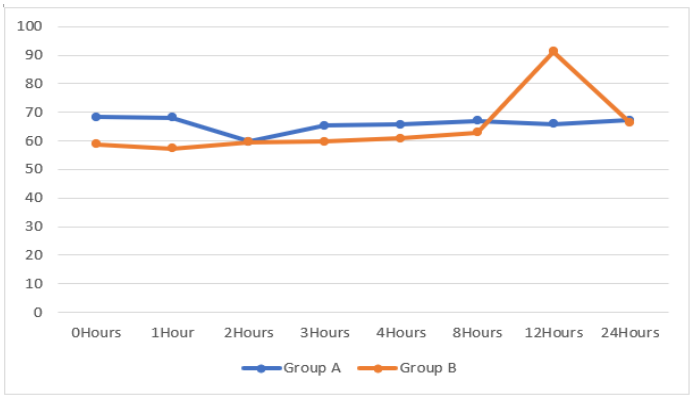

Figure 7: MEAN ARTERIAL PRESSURE DISTRIBUTION

Table 8: OXYGEN SATURATION DISTRIBUTION

Oxygen Saturation	Group A		Group B		p value
	Mean	Std. Deviation	p value	Std. Deviation	
0Hours	100.0000	.00000	100.0000	.00000	.000
1Hour	100.0000	.00000	100.0000	.00000	.000
2Hours	100.0000	.00000	100.0000	.00000	.000
3Hours	100.0000	.00000	100.0000	.00000	.000
4Hours	100.0000	.00000	100.0000	.00000	.000
8Hours	100.0000	.00000	100.0000	.00000	.000
12Hours	100.0000	.00000	100.0000	.00000	.000
24Hours	100.0000	.00000	100.0000	.00000	.000

Oxygen saturation remained stable at 100% across all time points for both groups, indicating that both groups maintained optimal oxygenation levels throughout the study.

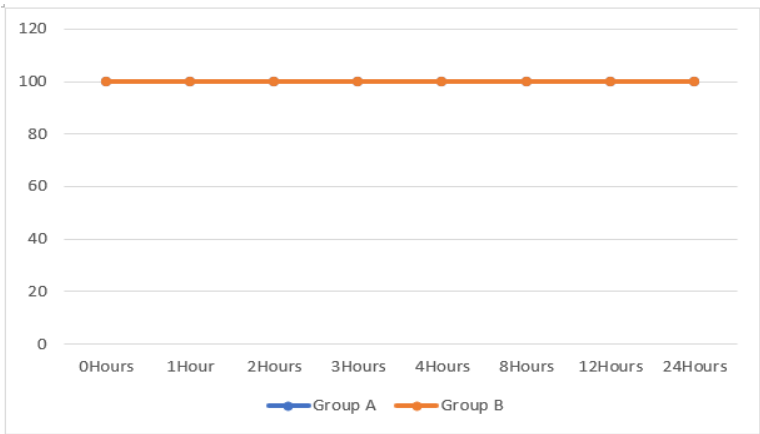

Figure 8: OXYGEN SATURATION DISTRIBUTION

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Table 9: VAS AT REST DISTRIBUTION

VAS At Rest	Group A		Group B		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
0Hours	3.0882	.83003	2.8824	1.22511	.000
1Hour	.0000	.00000	.0000	.00000	.000
2Hours	.0000	.00000	.0000	.00000	.000
3Hours	.0000	.00000	.0000	.00000	.000
4Hours	.0000	.00000	.0000	.00000	.000
8Hours	.0000	.00000	.0882	.28790	.000
12Hours	.6765	.47486	.3235	.47486	.000
24Hours	.7059	.46250	.8235	.45863	.000

VAS scores for pain at rest were similar between both groups, with negligible pain reported after the first hour. The pain scores were close to zero for most time points, showing no significant differences between the groups."

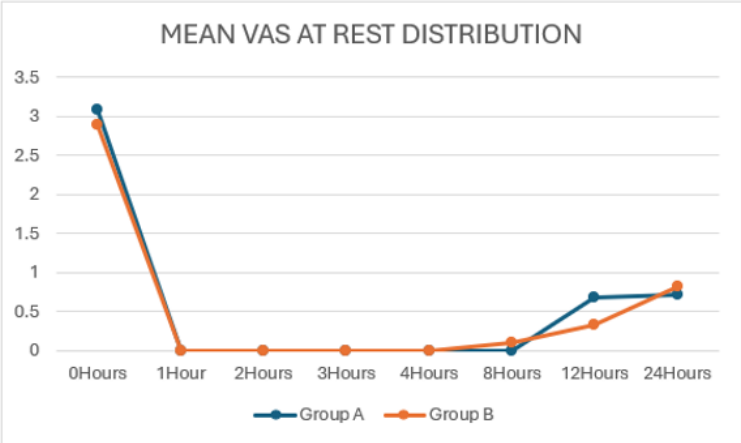

Figure 9: VAS Rest distribution

Table 10: VAS AT MOVEMENT DISTRIBUTION

VAS At Movement	Group A		Group B		p value
	Mean	Std. Deviation	Mean	Std. Deviation	
0Hours	4.0000	.77850	3.5588	1.21084	.000
1Hour	.0000	.00000	.0000	.00000	.000

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2Hours	.0000	.00000	.0000	.00000	.000
3Hours	.0000	.00000	.0000	.00000	.000
4Hours	.0000	.00000	.0000	.00000	.000
8Hours	.0000	.00000	.4706	.50664	.000
12Hours	.6765	.47486	.7353	.44781	.000
24Hours	.8824	.59108	1.3529	.48507	.000

VAS scores for pain during movement indicated that both groups experienced similar pain levels, with no significant differences observed. The pain scores were higher at 0 hours, but pain levels decreased in both groups after the first hour."

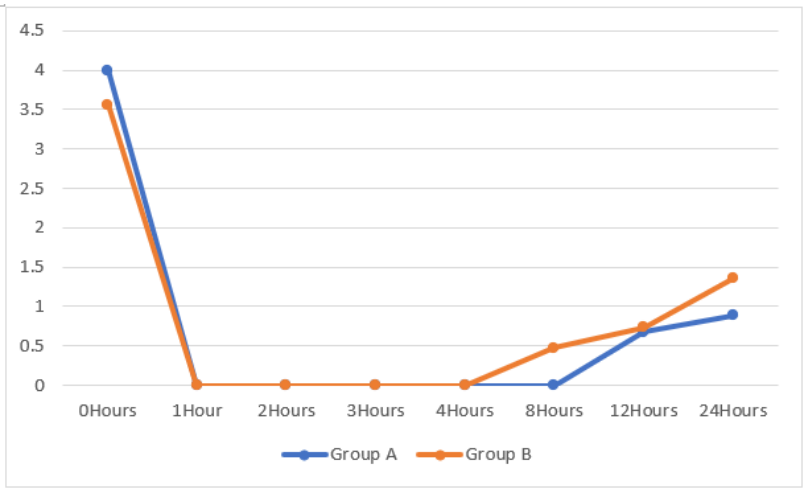

Figure 10: VAS AT MOVEMENT DISTRIBUTION

Table 11: REQUIREMENT OF INJ. TRAMADOL DISTRIBUTION

Requirement of Inj. Tramadol	**Group A**		**Group B**	
	No of Cases	**Percentage**	**No of Cases**	**Percentage**
	13	38.2	2	5.9

A significantly higher proportion of patients in" Group A (38.2%) required Inj. Tramadol for pain management compared to Group B (5.9%). This suggests that Group A experienced higher levels of pain requiring opioid analgesia.

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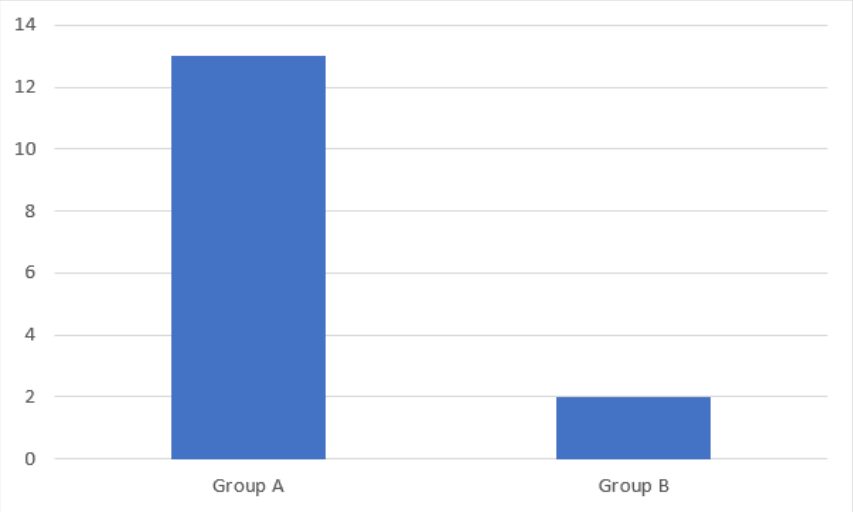

Figure 11: REQUIREMENT OF INJ. TRAMADOL DISTRIBUTION

Table 12: DURATION OF BLOCK DISTRIBUTION

Duration of Block Distribution	**Group A**	**Group B**
	Mean ± SD	**Mean ± SD**
	4.98 ± 1.49	5.78 ± 1.84

The duration of block was similar between the two groups", with Group A having a mean duration of 4.98 ± 1.49 hours and Group B at 5.78 ± 1.84 hours. This suggests that the block duration was comparable, though Group B had a slightly longer mean duration.

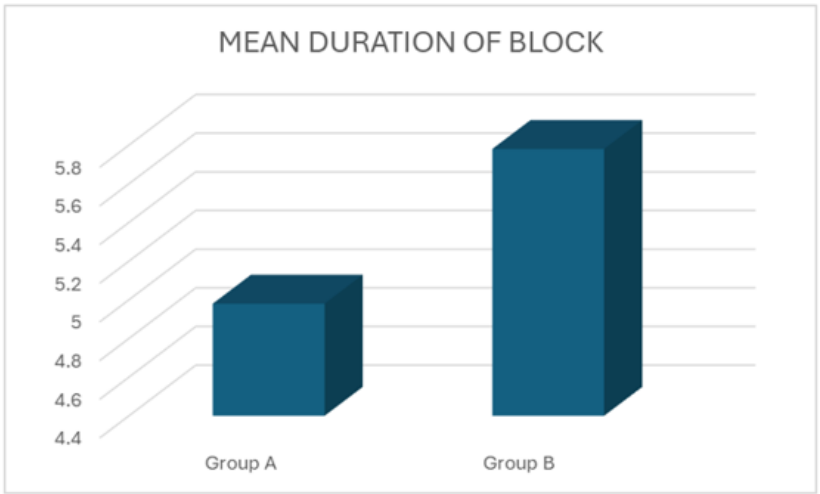

Figure 12: Duration of block distribution

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DISCUSSION

The primary aim of this study is to determine the duration of e ffect of ultrasound guided popliteal sciatic nerve block with dose of 15 ml 2% lignocaine adrenaline with additive buprenorphine and 15 ml of 2%lignocaine adrenaline with clonidine, to find out the onset and duration of anaesthesia and to determine the requirement of tramadol as rescue analgesia in the first 24 hours. Age, sex, ASA classification, and pain outcomes were similar between both groups. Additional volume of saline, showed improved onset times, extended analgesia duration, and fewer rescue analgesics were similar in both groups as well. Both Groups exhibited similar fluctuations in heart rate and systolic blood pressure, suggesting some external influences on these parameters. Both groups maintained stable oxygen saturation, and no significant safety concerns or complications were observed.

The studies reviewed highlight a range of advancements in regional anesthesia, particularly in the context of USG techniques and the use of adjuvants. Perias *et al.* (2012) and Byun *et al.* (2016) both emphasize advantages of USG in nerve blocks, improving precision and safety of anesthetic delivery. Perias *et al.*'s focus on the paraneural sheath technique suggests faster onset and more comprehensive anesthesia, while Byun *et al.*'s case study demonstrates the effectiveness of combining femoral and sciatic nerve blocks in complex procedures. In comparison, Choudary *et al.* (2016) and Maura *et al.* (2016) address the role of adjuvants and concentration optimization in improving the duration and quality of anesthesia. Choudary *et al.* found that dexmedetomidine outperformed clonidine in prolonging analgesia, while Maura *et al.* provided data on the lowest effective bupivacaine concentrations for femoral nerve blocks, emphasizing the need for lower concentrations to reduce risks. Finally, the study on lidocaine concentration confirms the efficacy of a 0.93% solution for femoral nerve blocks, contributing valuable data for practitioners aiming to optimize their anesthetic regimens.

These studies contribute to refining anesthetic techniques and improving patient outcomes by highlighting the importance of ultrasound guidance, appropriate adjuvant use, and careful concentration management. These findings support the ongoing evolution of regional anesthesia practices, aiming to achieve safer, more effective, and longer-lasting pain relief during surgeries.

CONCLUSION

The study demonstrates that the additive Buprenorphine with 2% xylocaine in ultrasound popliteal nerve blocks can improve anesthetic effectiveness, reduce rescue analgesic needs, and prolong block duration without compromising safety. Both groups showed similar baseline characteristics, confirming the potential benefits of volume adjustments in regional anesthesia. However, limitations such as the sample size period warrant further studies to validate the findings, explore alternative anesthetics or adjuvants, and assess long-term patient outcomes.

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