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RESEARCH ARTICLE
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EVALUATING THE SYNERGISTIC EFFECT AND SAFETY PROFILE OF FENTANYL 0.5% VERSUS CLONIDINE IN COMBINATION WITH 0.5% BUPIVACAINE FOR SUBARACHNOID BLOCK IN ELECTIVE LOWER LIMB SURGERIES

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Introduction:

Subarachnoid block (SAB) stands as a cornerstone in regional anesthesia for various surgical procedures, offering effective analgesia and muscle relaxation while minimizing systemic side effects. In elective lower limb surgeries, the choice of adjuvants to enhance the efficacy and safety of local anesthetics remains a subject of ongoing research and clinical interest [1].Among the adjuncts explored for SAB, fentanyl and clonidine have gained significant attention due to their potential to augment analgesia and prolong the duration of sensory and motor blockade [2, 3]. Fentanyl, a potent opioid analgesic, and clonidine, an alpha-2 adrenergic agonist, have distinct mechanisms of action that complement the effects of local anesthetics [2]. Fentanyl acts primarily on mu-opioid receptors in the spinal cord, modulating pain perception, while clonidine exerts its effects through the modulation of norepinephrine release, leading to analgesia and sympatholytic properties [3]. These adjuncts have been widely studied individually in SAB, demonstrating promising results in terms of prolonging the duration of anesthesia and reducing the need for supplemental analgesia [4, 5]. However, the comparative efficacy and safety of fentanyl and clonidine when combined with 0.5% bupivacaine in SAB for elective lower limb surgeries remain to be fully elucidated [1, 6]. While both adjuncts have demonstrated beneficial effects, their potential synergistic interactions and respective safety profiles warrant further investigation [1, 6]. Understanding the relative merits and drawbacks of these adjuncts is crucial for optimizing perioperative pain management strategies and enhancing patient outcomes. Therefore, this study aims to assess the synergistic effect and safety of adding fentanyl 0.5% compared with clonidine to 0.5% bupivacaine in SAB for elective lower limb surgeries.

Methods

This study was a prospective, randomized, double-blind controlled trial conducted at ----------.The study included adult patients aged 18 to 65 years planned to undergo elective lower limb surgeries under subarachnoid block (SAB). Patients with ASA physical status I or II were eligible for inclusion. Exclusion criteria were patients with contraindications to spinal anesthesia, history of opioid or alpha-2 agonist allergy, significant cardiac, respiratory, or renal diseases, coagulation disorders, chronic pain syndromes, or psychiatric disorders. Patients unwilling to participate or those unable to provide informed consent were also excluded from the study.

Randomization and Blinding:

Participants meeting the inclusion criteria were randomized into two groups using computer-generated randomization codes. Both participants and investigators assessing the outcomes were blinded to the intervention allocation throughout the study period.

Participants were allocated into two groups:

1. Group BF: Participants received subarachnoid block with 0.5% bupivacaine combined with fentanyl 0.5% (1 mg/kg) as an adjuvant.
2. Group BC: Participants received subarachnoid block with 0.5% bupivacaine combined with clonidine (1 mg/kg) as an adjuvant.

Anesthesia Technique:

Subarachnoid block was performed in the sitting position at the L3-L4 or L4-L5 interspace using aseptic technique. After confirming free flow of cerebrospinal fluid, the study drug was injected intrathecally. Blood parameters (heart rate, blood pressure, oxygen saturation) were monitored intraoperatively. The primary outcome measure was the duration of sensory blockade assessed using pinprick test. Secondary outcome measures included the onset of sensory and motor blockade, duration of motor blockade, intraoperative hemodynamic stability, postoperative analgesic consumption, incidence of adverse events (nausea, vomiting, hypotension, bradycardia, respiratory depression, pruritus), and patient satisfaction scores.

Data Analysis:

Data were analyzed using appropriate statistical methods. Continuous variables were presented as mean ± standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages. Student's t-test was used for continuous variables, and Chi-square test was used for categorical variables. A p-value < 0.05 was considered statistically significant.

Ethical Considerations:

The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment.

Results

A total of 60 participants were recruited for this study, with an equal distribution of patients enrolled in two groups.

Table 1: Distribution of Subjects by Sex and Groups

Sex	Group	Total	P-value
Female	BC	10(33%)	0.787
	BF	11(37%)	
Male	BC	20(67%)	
	BF	19(63%)	

While comparing gender, no significant difference in gender distribution between groups.

Table 2: Mean Age Comparison

Group	Mean Age	Std. Deviation	P-value
BC	45.00	8.730	0.609
BF	43.53	12.934	

The table displays a comparison of the mean age between two groups: BC and BF. The mean age for the BC group is 45.00 years with a standard deviation of 8.730, while for the BF group, it is 43.53 years with a standard deviation of 12.934. The p-value associated with this comparison is 0.609, indicating no statistically significant difference in age between the two groups.
Significant difference was observed in the below parameter

Table-3: Comparison of different Parameters Between Groups BC and BF

Parameter	Group Comparison	Mean Difference	P-value
Time of motor block bromage 3	BC vs. BF	-0.50	0.039
Time of 2 segment regression	BC vs. BF	22.53	<0.001
Total duration of motor block	BC vs. BF	54.67	<0.001
Duration of Analgesia	BC vs. BF	35.83	0.001
Highest sensory level achieved	BC vs. BF	T10	0.012

The above table presents a comparison of various parameters between two groups, BC and BF of the study. The parameters include the time of motor block (Bromage 3), time of two-segment regression, total duration of motor block, duration of analgesia, and the highest sensory level achieved.Time of motor block (Bromage 3),the mean difference between groups BC and BF is -0.50 , with a p-value of 0.039, suggesting a statistically significant difference.Similarly, time of two-segment regression, the mean difference between groups BC and BF is 22.53, with a p-value of less than 0.001, indicating a highly significant difference.The comparison of the total duration of motor blockalso shows a significant difference between groups BC and BF, with a mean difference of 54.67 units and a p-value of less than 0.001. Moreover, the duration of Analgesia significantly differs between groups BC and BF, with a mean difference of 35.83 units and a p-value of 0.001.Finally, the comparison of the highest sensory level reveals that both groups showed a sensory level of T10, with a negligible mean difference of 0.012 units, which was not statistically significant.

Table-4: Comparison of physical signs and symptoms of BF and BC

Parameter	Group Comparison	Mean Difference	P-value
Sex	BC vs. BF	-	0.787
Age	BC vs. BF	-1.47	0.609
Height	BC vs. BF	0.33	0.809
Weight	BC vs. BF	-0.60	0.700
Duration of Surgery	BC vs. BF	-	1.000
Time of Onset of Sensory block	BC vs. BF	0.03	0.829
Time to reach highest sensory level	BC vs. BF	0.13	0.656
HR at various intervals	BC vs. BF	-	-
Nausea/Vomiting	BC vs. BF	-	0.554
Hypotension	BC vs. BF	-	1.000
Bradycardia	BC vs. BF	-	1.000
Pruritis	BC vs. BF	-	1.000

The above table provides a comprehensive comparison of various parameters between two groups, BC and BF, as observed in the study. The mean difference and p-values for the parameters Age,

Height, Weight, Time of Onset of Sensory block, and Time to reach the highest sensory level are provided. However, none of these parameters show statistically significant differences between groups BC and BF, as indicated by the p-values being greater than 0.05. No significant difference in mean age between groups.

Table-5: Comparison of anesthesia effect among two groups

Parameter	Time of motor block bromage- 3	Time of 2 segment regression	Total duration of motor block	Duration of Analgesia	Highest sensory level achieved
BC vs. BF Mean Difference	-0.50	22.53	54.67	35.83	T10, T6, T7, T8
P-value	0.039	<0.001	<0.001	0.001	0.012

In this study, no significant differences were found in demographic characteristics, including age, sex, height, weight, and ASA grade, between the two groups (BC and BF). There were no significant variations observed in vital signs, including heart rate, blood pressure, and oxygen saturation, between the BC and BF groups throughout the study period. While both groups showed similar mean durations of surgery and time to reach the highest sensory level, significant differences were noted in the onset and regression of motor block, duration of motor block, and duration of analgesia between the two groups.The BF group demonstrated a slightly delayed onset of sensory block compared to the BC group. However, the BF group exhibited a shorter time to reach the highest sensory level and a faster regression of motor block compared to the BC group. Both groups had comparable rates of side effects, including nausea/vomiting, hypotension, bradycardia, and pruritis, with no statistically significant differences observed.These findings suggest that the choice of anesthesia may influence the efficacy and duration of pain relief and the extent of sensory and motor blockade achieved during surgery, highlighting the importance of individualized anesthesia management strategies for optimal perioperative outcomes.

Discussion

The present study investigated various parameters related to anesthesia and its effects on patients undergoing surgery, particularly focusing on differences between two groups, denoted as BC and BF. Our findings, as summarized in Tables 4 to 30, revealed several noteworthy outcomes. Firstly, we observed no statistically significant differences in sex distribution, age, height, weight, ASA grade, duration of surgery, and several vital signs (such as SpO2, heart rate, SBP, DBP, and MAP) between the BC and BF groups. These results align with previous studies suggesting that factors like sex and age may not significantly influence the outcomes of anesthesia in similar patient populations [7,8].However, certain parameters did exhibit statistically significant differences between the groups. Notably, the mean time of motor block bromage3 and the mean time of 2-segment regression were significantly different between the BC and BF groups. This finding suggests that the type of anesthesia administered or other related factors may influence motor block onset and regression differently in these groups. Additionally, the mean total duration of motor block and the mean duration of analgesia were significantly different between the BC and BF groups. This implies variations in the efficacy and duration of pain relief between the two anesthesiaproceudre. These findings may have clinical implications for postoperative pain management strategies.Moreover, the highest sensory level achieved also exhibited a significant difference between the BC and BF groups, indicating potential differences in the extent of sensory blockade achieved with the two anesthesia techniques. However, it is essential to interpret these results in light of certain limitations. The study's sample size may have affected the generalizability of the findings. Additionally, factors such as surgeon experience, patient comorbidities, and variations in surgical procedures could have influenced the outcomes. Future research with larger sample sizes and controlled variables is necessary to validate these findings further. In conclusion,

our study provides valuable insights into the effects of different anesthesia on various parameters during surgery. While some parameters did not differ significantly between the groups, others exhibited notable distinctions, highlighting the importance of tailoring anesthesia techniques to individual patient needs for optimal perioperative outcomes.

Conclusion

In conclusion, our study compared anesthesia and their effects on patients undergoing surgery, specifically focusing on differences between two groups denoted as BC and BF. This study findings revealed several key findings regarding various parameters related to anesthesia administration and perioperative outcomes.While no significant differences were observed in most vital signs between the BC and BF groups, notable distinctions emerged in several anesthesia-related parameters. These findings suggest that the choice of anesthesiamay influence the efficacy and duration of pain relief, as well as the extent of sensory and motor blockade achieved during surgery.

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