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A Comparative Evaluation of the Effects of Fentanyl and Dexmedetomidine as an Adjuvant to Bupivacaine in Ultrasound-Guided Supraclavicular Brachial Plexus Block

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ABSTRACT

Objective:
The purpose of this research was to compare Bupivacaine with ultrasound-guided supraclavicular brachial plexus block with Dexmedetomidine and Fentanyl for upper-extremity surgery analgesia.

Methods:
Patients receiving surgery on their upper limbs were split into two groups: those who received Dexmedetomidine as an adjuvant to Bupivacaine, and those who received Fentanyl. Sensorial and motor block onset, duration, quality, and cardiorespiratory side effects were tracked.

Results:
When compared to Fentanyl, the onset of sensory and motor blocks was shown to be much quicker when Dexmedetomidine was added. The length and quality of sensory and motor blocks were also improved by Dexmedetomidine. There were no significant compaint with the heart or lungs in either group.

Conclusion:
In ultrasound-guided supraclavicular brachial plexus block, both Dexmedetomidine and Fentanyl are effective adjuvants to Bupivacaine; however, Dexmedetomidine displays better efficacy in terms of onset, duration, and quality of block with no cardiorespiratory side effects.

I. INTRODUCTION

In contemporary anaesthetic treatment, peripheral neural blocking has emerged as a prevailing practise, supplanting general anaesthesia and systemic analgesia. These benefits include a reduced duration of stay in the Post-Anesthesia Care Unit (PACU), less postoperative pain, and a decreased incidence of post-surgical nausea and vomiting. Nevertheless, the constrained duration of action shown by local anaesthetics imposes limitations on their immediate benefits. Increasing the dose of local anaesthetic has the potential to extend the duration of pain alleviation; nevertheless, this practise also heightens the risk of systemic toxicity. Various perineural adjuvants have been experimentally used to varying degrees of efficacy in order to extend the duration of analgesic effects.

The brachial plexus block is a dependable regional anaesthetic technique often used for upper extremity treatments, offering effective pain management both during and after the surgical intervention. This therapeutic approach offers significant benefits to those afflicted with severe respiratory and cardiovascular ailments, as well as those who may have difficulties in respiration.

The supraclavicular brachial plexus block is well recognised as a very dependable and effective method of regional anaesthesia for upper limb surgeries. Technological developments have led to the replacement of peripheral nerve stimulation with ultrasound guidance as the preferred method, owing to its higher success rates and fewer dangers.

Bupivacaine is extensively used as a local anaesthetic due to its high effectiveness and prolonged duration of effect. Nevertheless, the occurrence of cardiotoxicity cannot be ruled out. Opioids, including fentanyl, and α2 agonists, such as dexmedetomidine, are often included as adjuvants in anaesthetic formulations to mitigate this adverse reaction.

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Studies have shown that the use of adjuvants, such as fentanyl and dexmedetomidine may enhance the effectiveness and durability of analgesic effects. Fentanyl has the potential to augment the effects of a local anaesthetic via many mechanisms, one of which is its direct impact on the peripheral nervous system. In contrast, dexmedetomidine has distinctive characteristics that contribute to the preservation of stable hemodynamics and the reduction of need for anaesthetics and analgesics.

II. METHODOLOGY

Study Design

The study provides comprehensive information on the research conducted. The study titled "A Comparative Evaluation of the Effect of Fentanyl and Dexmedetomidine as an Adjuvant to Bupivacaine in Ultrasound-Guided Supraclavicular Brachial Plexus Block" was conducted as a randomised, double-blind clinical trial. The research received permission from the institutional ethics committee of the Jawahar Lal Nehru Medical College and Hospital.

Study Population

The study included individuals with ages ranging from 15 to 60 years, including both genders, and with body mass index values ranging from 40 to 80 kg, specifically included those classified as American Society of Anesthesiologists grades 1 and 2. The participants in this research had Ultrasound-Guided Supraclavicular Brachial Plexus Block for elective upper-extremity operations in the absence of any premedication.

Criteria for Participation

To be considered for inclusion in this study or procedure, participants must meet the following conditions:

- **ASA Classification:** Participants should be classified as either ASA Grade I or Grade II. The American Society of Anesthesiologists (ASA) Physical Status Classification System is used to evaluate a patient's overall health status before undergoing anesthesia or surgery. Specifically:
  - ASA Grade I refers to a healthy individual with no underlying medical conditions.
  - ASA Grade II indicates a person with a mild systemic disease, but they are not incapacitated by it.
- **Age Range:** The age of participants should be between 15 and 60 years old. This range has been chosen to ensure that the participants are beyond early adolescence but not at a higher age where complications could potentially be more prevalent.
- **Weight Restrictions:** The weight of potential participants should range from 40 to 80 kilograms. This criterion ensures that patients are neither underweight nor significantly overweight, which could impact the study's results or the surgical procedure.
- **Type of Surgery:** Only those patients who are set to undergo elective surgery for their upper limbs are eligible. This narrows down the study or procedure to a specific surgical intervention, ensuring consistency in the type of surgical procedure among all participants.

Conditions for Exclusion

Individuals will be deemed ineligible for participation in the study or procedure if they present with any of the following health concerns or conditions:

- **Cardiovascular Issues:** Patients who have diagnosed heart-related diseases or conditions are excluded. This encompasses:
  - Coronary Artery Disease (CAD): This condition involves the narrowing or blockage of the coronary arteries due to plaque buildup, potentially leading to a heart attack.
  - Hypertension: Also known as high blood pressure, it's a condition where the force of the blood against the artery walls is too high, increasing risks of heart disease and stroke.
  - Heart Blocks: This refers to a delay or interruption in the normal flow of electrical impulses that regulate the heartbeat.
- **Endocrine and Nervous System Disorders:**
  - Diabetes: Exclusion of patients with this condition ensures that potential complications related to blood sugar management and wound healing are avoided.
  - Peripheral Neuropathy: A condition where the peripheral nerves, which transmit messages between the brain, spinal cord, and rest of the body, are damaged or dysfunctional.
  - Coagulopathy: Patients with blood clotting disorders or abnormalities are excluded to prevent potential bleeding complications during or after the procedure.
- **Infection Concerns:** Patients showing signs of infection at the intended location for the anesthetic block are not eligible. Infections could complicate the procedure and heighten the risk of further complications.
- **Allergic Reactions:**
  - Any patient with a known history of allergies to local anesthetics cannot participate. This is

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crucial to avoid potential adverse reactions during the procedure.

- Additionally, those with known allergies to adrenoceptor agonists or antagonists — drugs that influence the adrenergic receptors, affecting the sympathetic nervous system — are also excluded. This ensures the safety and well-being of the patient, particularly if such medications are planned to be used during the study or procedure.

Study Duration and Sample Size

During a three-year period, a cohort of 90 patients was monitored by researchers. Based on the methodology used in clinical research, it was established that a minimum sample size of 21 individuals was necessary. In order to account for attrition, the researchers opted to augment the sample size to 90.

Assigning and Categorizing Patients

Participants were assorted in a random manner into three distinct categories:

- Group I, often referred to as the Fentanyl Group or Group F: These patients were given a 30 ml concoction. This mixture consisted of 25 ml of bupivacaine at a concentration of 0.3%, combined with fentanyl. The quantity of fentanyl was determined by the individual's weight, with a rate of 1mcg per kilogram of their body weight.
- Group II, commonly known as the Dexmedetomidine Group or Group D: Participants in this category were administered a 30 ml blend. This blend contained 25 ml of bupivacaine at a 0.3% concentration, supplemented with dexmedetomidine. The amount of dexmedetomidine was weight-dependent, provided at a ratio of 1mcg for every kilogram of the patient's weight.
- Group III, which is the Control Group or Group C: Members of this group received a 30 ml solution. The solution was formulated with 25 ml of bupivacaine having a concentration of 0.3%. The remaining 5 ml was made up of normal saline.

Study Procedure

Prior to the commencement of the surgical procedure, patients underwent a comprehensive evaluation during which they were informed about the available treatment choices. Subsequently, patients provided their final consent before being accompanied to the operating room, where their vital signs were recorded as a baseline measurement. An 18-gauge intravenous cannula was placed, and a drip infusion of Ringer's Lactate solution was started. The patients were positioned using ultrasound prior to administering the blocks. The assessment of sensory and motor impairments was conducted in accordance with established standards.

Outcome Measures

Outcomes were measured in terms of:

- Onset of sensory block
- Duration of analgesia
- Duration of motor block
- Overall quality of block
- Hemodynamic parameters
- Any complications or side effects

Ethical Clearance

The study received ethical clearance from the Board Of Studies,Department of Anesthesiology, and thereafter Ethical Committee, Jawaharlal Nehru Medical College, affiliated with Aligarh Muslim University, located in Aligarh, Uttar Pradesh, India.

Statistical Analysis

Descriptive and inferential statistical analyses were conducted using SPSS software, specifically version 23.0. Means and standard deviations were used to analyse continuous data, while percentages were utilised to examine categorical variables. The chi-square test was used to analyse and establish correlations between variables, while the analysis of variance (ANOVA) test was utilised to compare means across many groups. The threshold for statistical significance was established at a p-value of less than 0.05.

In order to assess the effectiveness of fentanyl and dexmedetomidine as supplementary agents to bupivacaine in supraclavicular brachial plexus block guided by ultrasonography, the present study will apply this methodology.

III. RESULTS

Demographic Parameters

A comprehensive review was carried out on the ages of the patients participating in the study. As illustrated in Table 1 below, a significant portion of the participants fell into the age bracket of 21 to 40 years. When comparing the age distributions across the groups, no marked difference was found to be statistically significant, with p-values greater than 0.05, indicating the age distribution was relatively even among the groups.

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Table 1: Distribution of Age Brackets Across Different Groups

Age Range (in years)	Group D (Total: 30)	Group F (Total: 30)	Group C (Total: 30)	Statistical Comparison (D & F)	Statistical Comparison (F & C)	Statistical Comparison (D & C)
Below 20	6 (20.0%)	3 (10.0%)	5 (16.7%)	0.856	0.911	0.947
21-30	11 (36.7%)	12 (40.0%)	10 (33.3%)	-	-	-
31-40	6 (20.0%)	8 (26.7%)	8 (26.7%)	-	-	-
41-50	5 (16.7%)	5 (16.7%)	4 (13.3%)	-	-	-
Above 50	2 (6.7%)	2 (6.7%)	3 (10.0%)	-	-	-

Statistical Analysis Utilized: Chi-Square

Visual Representation:

Figure 1 showcases a bar graph that visually represents the age group distribution among the three groups. The graph provides a clear visual on how ages are distributed across Groups D, F, and C, allowing for an easy comparison and understanding of the participant demographics.

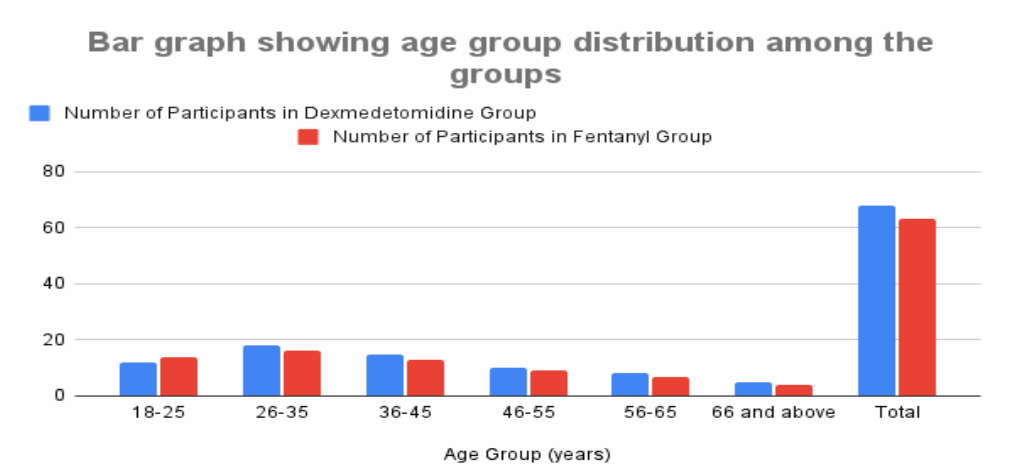

Figure 1: Bar graph showing age group distribution among the groups

Gender Distribution

The gender composition of patients across all three groups was notably skewed towards males. As depicted in Table 2, the data illustrates that this gender difference did not reach statistical significance, with p-values exceeding 0.05.

Table 2: Breakdown of Gender Composition Across the Groups

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Gender	Group D (Total: 30)	Group F (Total: 30)	Group C (Total: 30)	Statistical Comparison (D & F)	Statistical Comparison (F & C)	Statistical Comparison (D & C)
Male	18 (60.0%)	19 (63.3%)	20 (66.7%)	0.789	0.787	0.592
Female	12 (40.0%)	11 (36.7%)	10 (33.3%)	-	-	-

Statistical Test Employed: Chi-Square

The results suggest that there was no significant disparity in gender distribution among the three groups, as indicated by the p-values, which were all above the threshold of 0.05.

Block Characteristics

Table 3 presents significant differences in sensory and motor block characteristics among three groups. Group D exhibited the fastest onset and longest duration of analgesia and motor block compared to Group F and Group C ($p<0.001$).

Specifically:

- The onset of sensory block in Group D was 5.42 minutes, whereas in Group F, it took 11.63 minutes, and in Group C, 15.85 minutes ($p<0.001$).
- The onset of motor block was 7.18 minutes in Group D, 13.48 minutes in Group F, and 18.03 minutes in Group C ($p<0.001$).
- Group D had the longest duration of analgesia (825 minutes), followed by Group F (502.60 minutes) and Group C (476.57 minutes) ($p<0.001$).
- For the duration of motor block, Group D had the longest (774.67 minutes), while Group F had 467.03 minutes, and Group C had 422 minutes ($p<0.001$).

In terms of sensory block quality, Group D had the highest percentage of excellent ratings (86.7%), while Group F had more good ratings (46.7%) and Group C had more fair (40.0%) and poor ratings (50.0%) ($p<0.001$).

In the case of motor block quality, Group D had complete block in all cases (100%), while Group F had mostly complete block (93.3%), and Group C had a majority with minimal block (60.0%) and no block (16.7%) ($p<0.001$).

Table 3: Block Characteristics Among Groups

Block Characteristics	Group D (n=30)	Group F (n=30)	Group C (n=30)	P-value
A. Onset of Sensory Block (minutes)				

- Mean ± SD	5.42±0.60	11.63±0.87	15.85±1.35	<0.001
B. Onset of Motor Block (minutes)				
- Mean ± SD	7.18±0.78	13.48±0.90	18.03±1.29	<0.001
C. Duration of Analgesia (minutes)				
- Mean ± SD	825±17.42	502.60±7.05	476.57±7.37	<0.001
D. Duration of Motor Block (minutes)				
- Mean ± SD	774.67±16.71	467.03±8.58	422±8.83	<0.001
E. Quality of Sensory Block (VAS)				
- Excellent	26 (86.7%)	4 (13.3%)	0 (0.0%)	<0.001
- Good	3 (10.0%)	14 (46.7%)	3 (10.0%)	
- Fair	1 (3.3%)	11 (36.7%)	12 (40.0%)	
- Poor	0 (0.0%)	1 (3.3%)	15 (50.0%)	
F. Quality of Motor Block (Bromage Scale)				
- 3 (Complete Block)	30 (100.0%)	28 (93.3%)	0 (0.0%)	<0.001
- 2 (Partial Block)	0 (0.0%)	2 (6.7%)	7 (23.3%)	
- 1 (Minimal Block)	0 (0.0%)	0 (0.0%)	18 (60.0%)	
- 0 (No Block)	0 (0.0%)	0 (0.0%)	5 (16.7%)	

Hemodynamic Parameters

Heart Rate (HR)

Heart rate (HR) showed significant changes after surgery, especially in Group D. The table below provides the details of HR differences among the three groups.

Table 4: Heart Rate Differences Among Groups

- Baseline HR was similar among all groups.
- Immediately after one minute, Group D had a significantly higher HR compared to Group F and Group C ($p<0.001$).
- At 5, 10, 20, 30, and 45 minutes postoperatively, Group D consistently had a significantly lower HR compared to the other two groups ($p<0.001$).
- At 60, 75, and 90 minutes postoperatively, Group D still showed significantly lower HR values compared to Group F and Group C ($p<0.001$).
- At 120 minutes postoperatively, Group D had a significantly higher HR compared to Group F and a similar HR to Group C ($p<0.001$).
- At 1, 2, 3, 4, 5, and 6 hours postoperatively, Group D consistently had a significantly lower HR compared to Group F and Group C ($p<0.001$).

In summary, Group D exhibited distinct and significant changes in heart rate compared to the other groups throughout the postoperative period.

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Table No. 4: Heart Rate distribution among groups

HR	Group D (n=30)	Group F (n=30)	Group C (n=30)	P-value		
				Group D & F	Group F & C	Group D & C
Baseline	81.33±3.11	80.90±2.64	81.23±2.87	0.563	0.642	0.898
Immediately after one min	85.00±3.38	81.93±2.55	82.10±1.67	**<0.001**	0.755	**<0.001**
5 min	83.33±2.17	80.13±2.19	81.27±1.68	**<0.001**	**0.028**	**<0.001**
10 min	65.30±2.96	79.50±1.59	80.50±1.31	**<0.001**	**0.010**	**<0.001**
20 min	81.67±1.77	80.17±2.12	83.60±3.48	**0.004**	**<0.001**	**0.009**
30 min	80.63±2.30	80.5±1.78	86.80±5.68	0.808	**<0.001**	**<0.001**
45 min	83.37±1.92	79.00±0.00	83.60±2.75	**<0.001**	**<0.001**	0.705
60 min	82.60±1.96	76.63±1.50	94.43±1.65	**<0.001**	**<0.001**	**<0.001**
75 min	82.23±1.79	78.57±2.10	81.87±1.85	**<0.001**	**<0.001**	0.439
90 min	81.67±1.52	78.60±1.69	82.40±1.30	**<0.001**	**<0.001**	**<0.001**
120 min	84.50±1.20	78.60±1.69	81.87±1.85	**<0.001**	**<0.001**	**0.003**
1 hours Post-Operative	83.30±1.74	76.63±1.65	81.87±1.85	**<0.001**	**<0.001**	**<0.001**
2 hours Post-Operative	82.47±1.83	78.60±1.69	84.53±1.70	**<0.001**	**<0.001**	**<0.001**
3 hours Post-Operative	81.50±1.76	76.63±1.65	84.93±1.57	**<0.001**	**<0.001**	**<0.001**
4 hours Post-Operative	81.43±1.81	78.60±1.69	84.53±1.70	**<0.001**	**<0.001**	**<0.001**
5 hours Post-Operative	81.43±1.22	78.57±2.10	84.93±1.57	**<0.001**	**<0.001**	**<0.001**
6 hours Post-Operative	81.87±1.46	78.60±1.69	84.53±1.70	**<0.001**	**<0.001**	**<0.001**

*One way ANOVA test

Mean Arterial Pressure (MAP)

Mean Arterial Pressure (MAP) showed significant changes over time, with no significant differences between the groups at baseline. The details are presented in Table 5.

Table 5: Mean Arterial Pressure Changes Among Groups

- Baseline MAP did not differ significantly among the three groups.
- Immediately after one minute, MAP significantly decreased in Group D and increased in Group F ($p<0.001$).
- At 5, 10, 20, 30, and 45 minutes postoperatively, Group D consistently had a significantly lower MAP compared to Group F and Group C ($p<0.001$).
- At 60, 75, 90, and 120 minutes postoperatively, Group D still had a significantly lower MAP compared to Group F and Group C ($p<0.001$).
- At 1, 2, 3, 4, 5, and 6 hours postoperatively, Group D showed a consistently lower MAP compared to Group F and Group C ($p<0.001$).

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Table No. 5: Mean Arterial Pressure distribution among groups

MAP	Group D (n=30)	Group F (n=30)	Group C (n=30)	P-value		
				Group D & F	Group F & C	Group D & C
Baseline	88.27±2.94	88.30±3.98	87.60±1.67	0.971	0.378	0.284
Immediately after one min	85.37±1.94	88.83±2.25	84.50±1.74	**<0.001**	**<0.001**	0.073
5 min	83.90±1.35	85.20±1.75	83.30±1.80	**0.002**	**<0.001**	0.150
10 min	81.67±1.77	85.13±1.83	85.00±2.18	**<0.001**	0.799	**<0.001**
20 min	80.63±2.30	85.20±1.75	84.43±1.63	**<0.001**	0.085	**<0.001**
30 min	81.67±1.77	86.17±1.72	84.73±1.96	**<0.001**	**0.004**	**<0.001**
45 min	81.43±1.22	88.27±1.53	86.50±1.74	**<0.001**	**<0.001**	**<0.001**
60 min	82.60±1.96	83.67±1.15	84.53±0.51	**0.013**	**<0.001**	**<0.001**
75 min	81.87±1.46	89.43±1.14	86.60±1.10	**<0.001**	**<0.001**	**<0.001**
90 min	85.03±1.63	89.43±1.14	88.53±1.17	**<0.001**	**0.004**	**<0.001**
120 min	85.27±1.76	90.13±1.07	90.50±1.74	**<0.001**	0.330	**<0.001**
1 hours Post-Operative	83.97±1.40	89.53±1.14	93.50±1.74	**<0.001**	**<0.001**	**<0.001**
2 hours Post-Operative	83.93±1.36	90.13±1.07	90.50±1.74	**<0.001**	0.330	**<0.001**
3 hours Post-Operative	85.00±1.68	92.60±1.10	93.50±1.74	**<0.001**	**<0.001**	**<0.001**
4 hours Post-Operative	85.00±1.68	90.13±1.07	88.57±1.14	**<0.001**	**0.020**	**<0.001**
5 hours Post-Operative	83.90±1.35	89.53±1.14	90.63±1.69	**<0.001**	**0.004**	**<0.001**
6 hours Post-Operative	90.40±1.92	89.43±1.14	90.50±1.74	**0.021**	**0.007**	0.833

*One way ANOVA test

In summary, there were significant changes in MAP over time, with Group D consistently showing lower MAP compared to the other two groups during the postoperative period, despite no significant differences at baseline. This indicates variations in hemodynamic measures among the groups.

(D) POST-OP ANALGESIA:

Table 6 displays post-operative pain scores among groups.

- At 6, 12, 20, and 24 hours after surgery, Group C had significantly higher average pain scores compared to Groups D and F ($p<0.05$).
- Group D, which received an additional dose of dexmedetomidine with bupivacaine, experienced less pain compared to Groups F and C, who received fentanyl and bupivacaine, respectively.

Table No.6: Post-operative Pain score distribution among groups

Post-operative	Group D (n=30)	Group F (n=30)	Group C	P-value

pain score			(n=30)	Group D & F	Group F & C	Group D & C
1 hour	0.00±0.00	0.00±0.00	0.00±0.00	--	--	--
2 hours	0.00±0.00	0.00±0.00	0.00±0.00	--	--	--
3 hours	0.00±0.00	0.00±0.00	0.00±0.00	--	--	--
4 hours	0.00±0.00	0.00±0.00	0.07±0.37	--	0.321	0.321
6 hours	0.27±0.45	0.23±0.43	0.83±1.34	0.770	**0.023**	**0.032**
8 hours	3.10±0.61	3.23±0.43	3.03±1.13	0.331	0.368	0.777
10 hours	3.07±1.72	3.07±1.72	2.43±1.89	1.000	0.180	0.180
12 hours	0.13±0.35	0.13±0.43	0.73±1.26	1.000	**0.016**	**0.015**
16 hours	0.90±1.24	1.13±1.167	1.17±0.95	0.456	0.904	0.354
20 hours	1.27±1.17	1.53±1.04	2.20±1.00	0.356	**0.014**	**0.002**
24 hours	1.07±0.69	1.73±1.01	2.23±1.17	**0.004**	0.082	**<0.001**

*One way ANOVA test

Table 7 shows the total analgesics received in 24 hours.

- The total amount of analgesics taken in 24 hours differed slightly between Groups C and D but was the same for Group F.

Table No.7: Overall analgesics received in 24 hours

	Group D (n=30)	Group F (n=30)	Group C (n=30)	P-value		
				Group D & F	Group F & C	Group D & C
Overall analgesics received in 24 hours	1.23±0.43	1.23±0.43	1.33±0.66	1.000	0.490	0.490

*One way ANOVA test

In summary, Group D had significantly lower post-operative pain scores compared to Groups F and C at various time points, indicating better pain control with the use of dexmedetomidine. However, the total analgesics consumed over 24 hours did not vary significantly between the groups.

(E) COMPLICATIONS:

Table 8 presents post-operative complications among the groups.

- The majority of patients in all groups had no complications, with 90.0% in Group D, 96.7% in Group F, and 100.0% in Group C.
- Few cases of vomiting were reported, with 2 (6.7%) in Group D and none in Groups F and C.
- One case of hypotension was observed in Group D (3.3%).
- Group F had one case of pruritus (3.3%).

Overall, when comparing the rates of complications across the groups, there were no significant differences ($p>0.05$).

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Table No. 8: Post-operative complication in among groups

Complication	Group			P-value
	Group D (n=30)	Group F (n=30)	Group C (n=30)	
No complication	27 (90.0%)	29 (96.7%)	30 (100.0%)	0.226
Vomiting	2 (6.7%)	0 (0.0%)	0 (0.0%)	
Hypotension	1 (3.3%)	0 (0.0%)	0 (0.0%)	
Pruritus	0 (0.0%)	1 (3.3%)	0 (0.0%)	

*Chi-Square test

IV. V. DISCUSSION

The supraclavicular approach to brachial plexus block is widely recognized for its effectiveness and rapid onset, making it the method of choice for upper limb anesthesia. However, there is a gap in the research on the effectiveness and safety of adding other adjuvants to bupivacaine in ultrasound-guided supraclavicular brachial plexus blocks, such as dexmedetomidine and fentanyl. Our research aims to fill this knowledge vacuum by offering concrete evidence in favor of a science-based strategy to anesthesia care.

- **Demographic Findings**

The similarities between our sample and those of previously conducted research give us confidence that our findings are applicable to a wide range of patients receiving surgery on their upper limbs. The vast majority of the patients were middle-aged men (ages 21-40) who were classified as ASA Grade I, consistent with prior research.

- **Block Characteristics**
  - **Onset of Sensory and Motor Block**

In contrast to fentanyl and the control group, our research showed that the start of effects from using dexmedetomidine as an adjuvant was much quicker. This finding supports the conclusions of Hamed MA et al., Rajkhowa et al., and Bharti et al.

  - **Duration of Analgesia and Motor Block**

Analgesia and motor block lasted the longest in the dexmedetomidine group, followed by the fentanyl group, and lasted the least in the control group. Our results substantially support Hamed MA et al.'s conclusion that dexmedetomidine is preferable for extending anesthesia and postoperative analgesia.

- **Hemodynamic Variables**

The study's findings on the hemodynamic effects of these adjuvants are quite helpful. Although one case of hypotension was successfully treated, dexmedetomidine was frequently associated with reduced MAP and heart rate. Heart rate and mean arterial pressure were likewise reduced by fentanyl, but to a smaller extent than by dexmedetomidine.

- **Post-operative Analgesia**

Postoperative pain ratings were reduced in both groups treated with adjuvants, although the dexmedetomidine group's analgesic effects seemed to continue longer. This is consistent with the findings of Gupta R et al. and El-Attar A et al., suggesting that dexmedetomidine may be more effective in lowering the requirement for postoperative analgesia.

Complications

Our findings are consistent with previous researchers that both dexmedetomidine and fentanyl are safe adjuvants to local anesthetics in supraclavicular brachial plexus block.

VI. LIMITATIONS

The research had limitations by its single-center design and small sample size. Due to limited postoperative monitoring and a lack of follow-up after patient discharge, the requirements and effects of long-term analgesia are not completely acknowledged.

VII. CONCLUSION

- Dexmedetomidine demonstrates superiority as an adjuvant in ultrasound-guided supraclavicular brachial plexus blocks compared to fentanyl.
- Benefits of dexmedetomidine include faster block onset, extended postoperative pain relief, improved block quality, and a favorable safety profile.
- Acknowledged limitations of the study include a small sample size and single-center nature.
- Further research with larger sample sizes and diverse patient demographics is recommended for a more comprehensive understanding of dexmedetomidine and fentanyl in this context.
- Dexmedetomidine may be regarded as the preferred optionover fentanyl as adjuvant to Bupivacaine for supraclavicular brachial plexus blocks, untiladditional researchfrom larger multicenter research.
- This research has the potential to significantly impact clinical practice, enhancing anesthesia outcomes and patient comfort and satisfaction during and after surgery.

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