

# Study to Compare the Effects of Adding Fentanyl and Buprenorphine to Local Anaesthetics in Brachial Plexus Block via Axillary Approach

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## ABSTRACT

**Introduction:** Brachial plexus block is used as a regional anaesthetic technique for elbow, forearm and hand surgery and popular because of its ease, reliability and safety. The addition of opiates to local anaesthetics provides effective and long-lasting analgesia. This study was conducted to compare the effects of adding Fentanyl and Buprenorphine to local anaesthetics in brachial plexus block via the axillary approach under ultrasound guidance.

**Materials and Methods:** A cross-sectional analytic study was conducted on 48 patients aged 18-60yrs old belonging to ASA I & II posted for forearm, wrist and hand surgeries with axillary brachial plexus block and allotted to 2 groups of 24 each. In both the groups volume of drug used was 25ml. Group A received 12ml of 2% Lignocaine with adrenaline (1:200000), 12ml of 0.5% Bupivacaine and 50mcg Fentanyl.

Group B received 12ml of 2% Lignocaine with adrenaline (1:200000), 12ml of 0.5% Bupivacaine and 300mcg Buprenorphine. The total duration of motor and sensory blockade with adverse events during the perioperative period were recorded.

**Results:** The mean total duration of sensory and motor block was prolonged in Group B (TDSB- 306.25+/-10.759, TDMB- 338.75+/-8.373) when compared to Group A (TDSB- 241.67+/-10.286, TDMB- 262.50+/-12.247). There were no serious complications in the perioperative period in any of the groups.

**Conclusion:** Buprenorphine as an adjuvant to local anaesthetics prolongs the duration of sensory and motor block than Fentanyl without any significant clinical side effects.

**Key Words:** Axillary plexus block, Ultrasonography, Fentanyl, Buprenorphine.

## INTRODUCTION

Regional anaesthesia is a well-known anaesthetic technique. The advantage of the regional block is it has minimal effects on the cardiovascular and respiratory system; and is inexpensive compared to general anaesthesia.<sup>[1]</sup> Peripheral nerve blocks provide operative anaesthesia and postoperative analgesia. One among them is brachial plexus block.

Brachial plexus is conveniently arranged to allow regional nerve block. It is used in surgeries involving upper limb from the shoulder to hand. The axillary approach

avoids the potential complications like diaphragmatic paresis, pneumothorax and cervical sympathetic nerve blockade associated with the other routes of brachial plexus block.<sup>[2]</sup>

Local anaesthetics have a limited duration of action. The addition of opiates to local anaesthetics provide effective and long-lasting analgesia.<sup>[3]</sup>

This study is conducted to compare the total duration of analgesia and motor blockade by adding adjuvants like Fentanyl and Buprenorphine to local anaesthetic Bupivacaine and Lignocaine in brachial

plexus block via axillary approach under ultrasound (USG) guidance; and also, to look for any complications.

## **MATERIALS AND METHODS**

After obtaining approval from the institutional ethics committee and patients' informed consent, this cross-sectional analytic study was conducted through 2019-2020 in Father Muller Hospital, Mangalore, India. The study population included the patients undergoing surgery on forearm, wrist and hand.

Inclusion criteria included American Society of Anaesthesiologists physical statuses I and II, between 18-60yrs of age. Patients with the history of allergy to local anaesthetics, infection at the site of injection and pre-existing neuropathy, significant pulmonary, cardiovascular, hepatic and renal diseases, coagulopathy were excluded from the study.

The study population of 48 were selected and divided into 2 equal groups A and B based on standard department protocol by the treating consultant.

Group A received 12ml of 2% Lignocaine with adrenaline (1:200000) + 12ml of 0.5% Bupivacaine + 50mcg Fentanyl.

Group B received 12ml of 2% Lignocaine with adrenaline (1:200000) + 12ml of 0.5% Bupivacaine + 300mcg Buprenorphine.

On the previous day of surgery, patients were kept nil per oral from midnight and premedicated with oral diazepam 5mg and ranitidine 150mg.

On arrival at the operating theatre, monitors were connected and baseline heart rate, systolic, diastolic, and mean arterial blood pressure was recorded. Intravenous line with 20G cannula was secured, and patients were premedicated with Inj. Midazolam 0.05mg/kg. Patients were positioned supine with the arm abducted 90 degrees and head turned towards the contralateral side. Under all aseptic precaution, the USG probe was placed over axilla; axillary artery and vein were

visualised in cross-section. Brachial plexus was identified surrounding the artery. The needle was inserted lateral to the transducer and advanced inferiorly and medially towards plexus under direct visualisation (In-plane technique).

Following the completion of the local anaesthetic injection, the sensory block was evaluated by a Hollmen scale Score.<sup>[4]</sup>

[1] = Normal sensation of pinprick

[2] = Weaker sensation of pinprick felt as compared with another upper limb

[3] = Pinprick recognised as touch with a blunt object

[4] = No perception of pinprick.

The findings were recorded at an interval of 2 min till a complete sensory block is achieved i.e.

Hollmen Score=4.

The motor block was evaluated by using the Modified Bromage Scale (MBS) for the upper extremity on the 3point scale.<sup>[5]</sup>

Grade 0-normal motor function with full extension of elbow, wrist and fingers

Grade 1-decrease motor strength with the ability to move fingers and or wrist only

Grade 2-complete motor blockade with inability to move fingers

After achieving an adequate sensory block of score 4 using Hollmen scale and motor block of grade 2 using MBS, surgery was started.

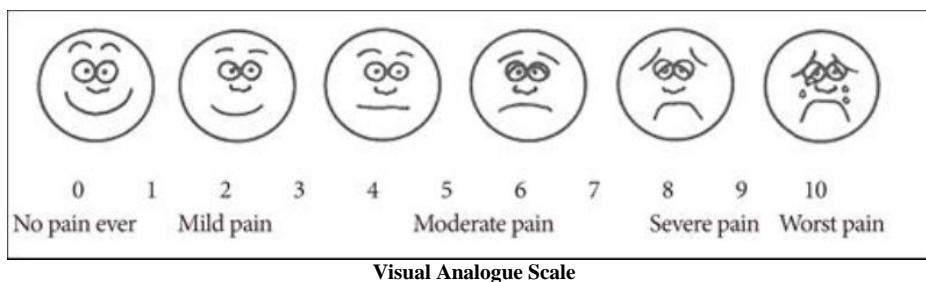
The block was considered to have failed if complete sensory and motor block was not achieved after 30 min and the failed block was converted to general anaesthesia and is recorded.

Intraoperative complications like vessel injury, hematoma, nausea and vomiting, dyspnea, fall in respiratory rate or oxygen saturation, any symptom/sign of local anaesthetic toxicity, ECG changes, etc. were recorded with their respective management.

Postoperatively, patients were explained about visual analogue scale consisted of a 10 cm line, where the patients were asked to mark the pain intensity on the line between 0 (no pain) to 10 (worst

possible pain). On complaint of pain (i.e. VAS>4), paracetamol was supplemented,

and the total time of the sensory block was recorded.



**SAMPLE SIZE ESTIMATION:**

Sample size was calculated at 95% Confidence Interval and 80% power.<sup>[6]</sup>

$$n = \frac{2(Z_{\alpha} + Z_{\beta})\sigma^2}{(x_1 - x_2)^2}$$

$Z_{\alpha} = 1.96$  at 95% Confidence Interval

$Z_{\beta} = 0.841$  at 80% Power

Mean  $\pm \sigma_1 = 261.84 \pm 53.3$

Mean  $\pm \sigma_2 = 225.12 \pm 34.06$

**STATISTICAL ANALYSIS**

Frequency, Percentage, Mean, S.D, 't' test and Chi-square test.

SPSS version 27 has been used.

**RESULTS**

**Table 1: Distribution of Age and Gender between the 2 groups.**

		Group				
		Fentanyl		Buprenorphine		
		Count	Column N %	Count	Column N %	
Age	20 and below	1	4.2%	1	4.2%	Fishers exact test p=.656, NS
	21 - 30	6	25.0%	8	33.3%	
	31 - 40	6	25.0%	3	12.5%	
	41 - 50	7	29.2%	5	20.8%	
	51 - 60	4	16.7%	7	29.2%	
Gender	F	10	41.7%	10	41.7%	Fishers exact test p=1.00 NS
	M	14	58.3%	14	58.3%	

Age					
	N	Mean	Std. Deviation	t test p value	
Fentanyl	24	38.21	12.375	.784	NS
Buprenorphine	24	39.21	12.748		
Total	48	38.71	12.439		

From the above data, it shows that there is no statistically significant difference in the distribution of age among Fentanyl and Buprenorphine group (p-value of 0.656).The mean age in the Fentanyl group was 38.21+/-12.375, and in the Buprenorphine group, it was 39.21+/-12.748. According to student t test, the p-value was 0.784, which shows that there is

no statistically significant difference between the 2 groups.

Out of 48 patients, there were 10 female patients each and 14 male patients each in Fentanyl and Buprenorphine groups. According to Fisher's exact test, the p-value was 1, which is statistically not significant.

From the above demographic data, there was no statistically significant difference between the 2 groups.

**Table 2: Total duration of sensory and motor block between the 2 groups.**

		N	Mean	Std. Deviation	95% Confidence Interval for Mean		t test p value	
					Lower Bound	Upper Bound		
					Total duration of sensory block	Fentanyl		
Buprenorphine	24	306.25	10.759	301.71		310.79		
Total duration of motor block	Fentanyl	24	262.50	12.247	257.33	267.67	.000	HS
	Buprenorphine	24	338.75	8.373	335.21	342.29		

From the above data, the total duration of sensory block in the Fentanyl group was 241.67±10.286, and in Buprenorphine group, it was 306.25±10.759, which was significantly higher in Buprenorphine group with a p-value of 0.000.

The total duration of motor block in the Fentanyl group was 262.50±12.247, and in the Buprenorphine group, it was 338.75±8.373, which was significantly higher in the Buprenorphine group with a p-value of 0.000.

## DISCUSSION

William Stewart Halstead first described the axillary brachial plexus block at St. Luke's Roosevelt Hospital Centre, New York City in 1884.<sup>[7]</sup> In 1911, G. Hirschel performed the first percutaneous axillary block.<sup>[8]</sup> It was only after Burnham's publication in 1959 that this block gained popularity among anaesthetists.<sup>[9]</sup> It is a commonly used regional anaesthetic technique for elbow, forearm and hand surgery and popular because of its ease, reliability and safety.

The axillary approach avoids the potential complications like diaphragmatic paresis, pneumothorax and cervical sympathetic nerve blockade. It is useful in patients with significant comorbidities like cardiovascular and respiratory disease and provides better analgesia.

Peripheral nerve blocks and an opioid-sparing analgesic have become standard anaesthesia practice all over the world. Since local anaesthetic has a short duration of analgesia, adjuvants are added to improve the quality, onset of the regional blockade and to prolong postoperative analgesia time.

As a feasible alternative to locate peripheral nerves, the implementation of Ultrasound guidance into clinical practice provides the potential benefit of optimizing the distribution of the local anaesthetic solution under sonographic vision around the nerves.<sup>[10]</sup>

In our study Group A patients were given axillary block with 12 ml of 2% Lignocaine with adrenaline (1:200000), 12ml of 0.5% Bupivacaine and Fentanyl 50 microgram. Group B patients were given axillary block with 12ml of 2% Lignocaine with adrenaline (1:200000), 12ml of 0.5% Bupivacaine and Buprenorphine 0.3mg.

In our study, the demographic data (age and sex) was comparable in both groups. The age of the cases was ranging from 18 to 60 years with the mean age in the Fentanyl group was 38.21±12.375, and in the Buprenorphine group, it was 39.21±12.748. Out of 24 participants in Group A, 14 were males and 10 were females. In Group B, 14 were males and 10 were females. The 'p' values of age and sex were 0.656 and 0.784, respectively. Thus, the demographic data of the two groups were not statistically significant.

In the Fentanyl group, the total duration of sensory block was 241.67±10.286 mins (Mean ± S.D) and the total duration of motor block was 262.50±12.247mins. In the Buprenorphine group, the total duration of sensory block was 306.25±10.759 min, and the total duration of motor block was 338.75±8.373, which is statistically significant (p-value being 0.000). Thus, the total duration of sensory and motor block was prolonged in the Buprenorphine group.

This was also seen in the study done by Candido et al. (2002),<sup>[11]</sup> evaluated the efficacy of adding Buprenorphine to local anaesthetic for brachial plexus block through supraclavicular approach to provide postoperative analgesia. Patients were divided into Group 1 and Group 2. Group 1 received 40ml local anaesthetic alone and group 2 received same local anaesthetic + Buprenorphine 0.3mg and concluded that addition of Buprenorphine provided threefold increase in the duration of postoperative analgesia with complete analgesia persisting for 30hrs and beyond the duration provided by local anaesthetic alone in 75% of the patients.

There were no complications observed in the perioperative period in any of the groups.

### Limitations of the study-

The calculated sample size was small.

Absence of control group receiving systemic opioids to consider central analgesic effects of absorbed opioids from the axillary site.

### CONCLUSION

Ultrasound guided Axillary block with local anaesthetics and Buprenorphine as an adjuvant provided significant longer duration of sensory and motor blockade than Fentanyl as an adjuvant with no complications.

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