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Original Research Article

To Evaluate the Efficacy of Chloroprocaine with Fentanyl in Comparison with Bupivacaine with Fentanyl in Supraclavicular Brachial Plexus Block

Manju[1], Amit Kumar[2], Neeraj Jindal[3], Vijaypal Nehra[4]

[1]Assistant Professor, Department of Anaesthesia, UCMS and Guru Teg Bahadur Hospital, Delhi
[2]Associate Professor, Department of Anaesthesia, UCMS and Guru Teg Bahadur Hospital, Delhi
[3]Junior Specialist, Department of Anaesthesia, District Hospital Ramganjmandi, Kota, Rajasthan
[4]Senior Specialist, Department of Anaesthesia, Government Community Health Centre, Sikar

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Corresponding Author: Dr. Manju
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Abstract:

Introduction: Peripheral nerve block is now a well-accepted component of comprehensive anaesthetic care. Almost all upper limb surgeries can be performed by blocking of brachial plexus using local anaesthetic solution, with the advantage of providing isolated and dense motor and sensory anaesthesia with lesser drug requirement, good surgical field, haemodynamic stability, post-operative analgesia and patient satisfaction, minimally affecting other systems of the body. This study was undertaken to compare bupivacaine and chloroprocaine with addition of opioids (fentanyl), in brachial plexus block with respect to onset, duration, quality of sensory and motor block, side effects, and effectiveness of anaesthesia for short upper limb surgeries, thereby reducing the hospital stay.

Method: A prospective, randomized, double-blinded study was performed after obtaining Ethical approval from the institution and consent from patients. A total of 100 patients, who were scheduled for upper limb orthopaedic surgery with ASA type I and II, of either sex or age, ranging from 20 to 50 years old, were taken in 2 groups of 50 each.

Group C (n = 50): Patients were given 30 ml of 1% chloroprocaine with 1 ug/kg of fentanyl.

Group B (n=50): Patients were given 30 ml 0. 5%Bupivacaine with 1 ug/kg of fentanyl.

Result: The onset of sensory and motor block was earlier in group C compared to group B. The duration of sensory and motor blocks was significantly shorter in group C as compared to group B. The mean duration of analgesia was prolonged in group B in comparison with group C, and the data was statistically significant.

Conclusion: Chloroprocaine and fentanyl combination, has a better profile for supraclavicular brachial plexus block in terms of early onset of sensory and motor block with rapid recovery and a shorter time to discharge in comparison with bupivacaine and fentanyl combination for ambulatory surgeries.

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Introduction

The key role of anaesthesia is to relieve patients from misery and pain, thus enabling the implementation of surgery without any pain. [1] An orthopaedic surgeon routinely encounters upper limb surgeries; for this type of surgery, supraclavicular brachial plexus block is a proven regional anaesthetic procedure [2] which also relieves postoperative pain. [3] Various types of anaesthetic drugs, like bupivacaine, ropivacaine, lignocaine, levobupivacaine, chloroprocaine, and mepivacaine, are used for brachial plexus block. Bupivacaine has been one of the most frequently used peripheral nerve-blocking agents for many years. It is mostly used for peripheral nerve block owing to its good results. It blocks Aβ, Aδ, and C fibers, and impedes sensory and motor nerves. [2] Among conventional local anesthetics chloroprocaine is a local drug with a shorter duration of action like lidocaine and is considerably less toxic. It is an ester type of drug. This drug has a motor block that lasts for 40 minutes and a speedy onset time of 3-5 minutes. This drug has fewer side effects and complications and requires less postoperative care. There is an earlier regression of motor and sensory block with chloroprocaine in contrast to bupivacaine. Many techniques, like the use of adjuvants and ultra-sound-guided blocks, are used to improve the quality and efficiency of brachial plexus blocks. Some authors consider that opioid use in brachial plexus block increases the success rate and postoperative effect of analgesia. However, others did not find any profound effects of opioid use. [4,5]

Methods

This was a prospective, randomized, double-blinded study performed in the department of Anaesthesiology and critical care at Govt. Medical College and Associated Hospital, Kota. 100 patients scheduled for upper limb orthopaedic surgery with ASA type I and II, of either sex or age, aged from 20 to 50 years old, were enrolled after getting ethical approval from the institution and consent from patients.

Inclusion Criteria: Age 20–50 years, BMI 18–35 kg/m^2, ASA physical status 1 and 2.

Exclusion Criteria: Obesity (BMI > 35), patient refusal, patients having history of allergy, Cervical spine abnormalities, Reactive airway disease, neuromuscular disorder, haemodynamic instability, Class 3rd and 4th of the Mallampati classification, previous nerve injury, pregnancy, antenatal and lactating females, emergency surgeries, and hepatic and renal failure patients. Surgery requiring more than 60 minutes or complicated surgery in which regional anaesthesia was converted to general anaesthesia.

These patients were divided into two groups of 50 patients each.

Group C (n = 50): Patients were given 30 ml of 1% chloroprocaine with 1 ug/kg of fentanyl.

Group B (n=50): Patients were given 30 ml 0.5% Bupivacaine with 1 ug/kg of fentanyl.

Detailed pre-anaesthetic evaluation and routine investigation (Haematological, Fasting / Random blood sugar, Blood urea, Serum creatinine, Chest X-ray and ECG) were done.

Procedure: The patient was placed in supine position, and different basal parameters using sphygmomanometer, pulse oximeter, and ECG were taken. An IV administration was done using an 18-gauge cannula, and ringer lactate was started. (An intravenous line was secured using 18-gauge cannula, and ringer lactate solution was started.) Visual analogue scale (VAS) was described to patients, and they were asked to score their pain on this scale.

A wedge was placed in between the scapulae and the head turned towards the opposite side. On the operative side, the arm was adducted and rotated internally while the hand was stretched along the ipsilateral side with the shoulder down.

The midpoint of the clavicle in the interscalene groove is 2 cm above the supraclavicular approach. For minimization of pain, a small skin wheal was raised, and a 22G, 50 mm stimulator needle with a peripheral nerve stimulator was directed just above and posterior to the subclavian arterial pulse and caudally at a very flat angle against the skin. The needle was advanced until the flexion of the finger was noted. If contraction was observed with the intensity of the stimulating current, then the current intensity was decreased to 0.5 mA. If contractions still persisted at this intensity, then local anaesthetic solutions were slowly injected with frequent aspirations. Parameters like onset of sensory and motor block, duration of sensory and motor block, VAS score along with haemodynamic effects, side effects, and complications were noted.

Statistical analysis was done using SPSS (version 21). Qualitative data was presented in numbers (percent), and comparison was done using Chi square test. Mean and standard deviation were analysed using student t-test. The results were considered significant if the p-value was less than 0.05.

Observation

In our study, the mean age of patients in group C was 34.58 years. Majority (42%) of them were in the age group of 31–40 years, whereas in group B, the mean age was 35.36 years, and the majority (44%) were in the age group of 31–40 years. We found male predominance in both groups (68% and 66% in groups C and B, respectively). The mean BMI of patients in both groups was 19.46±2.68 and 19.40±2.95 kg/m^2 in groups C and B, respectively. As age, sex, and BMI were not statistically significant, this shows that there was no difference in the demographic characteristics of patients in both groups (Table 1).

Table: 1 Demographic characteristics of the patients

	Group C	**Group B**	p value
Age (Mean±SD)	34.58±8.68	35.36±8.28	0.689 (NS)
Male/Female (N)	34/16	33/17	
BMI	19.46±2.68	19.40±2.95	

Table: 2 Onset of Sensory and Motor Block

	Group C	**Group B**	**p value**
Onset of sensory block	8.13±1.35	12.06±1.53	p<0.001 (S)
Onset of motor block	10.06±1.36	14.02±0.82	p<0.001 (S)

Table: 3 Duration of Sensory and Motor Block

	Group C	Group B	p value
Duration of Sensory Block	72.40±4.94	391.64±19.49	p<0.001 (S)
Duration of Motor Block	65.54±4.12	340.22±14.75	p<0.001 (S)
Duration of analgesia	73.02±6.95	420.12±8.37	P<0.001(S)

We also found that the onset of sensory and motor block in group C was approximately 4 minutes earlier than in group B. The duration of sensory and motor blocks was significantly shorter in group C than in group B. Mean duration of analgesia was prolonged in group B than in group C. Data were statistically significant.

The adequacy of sensory blocks was graded on hollmens scale. The intensity of sensory block was more intense in the bupivacaine group (3+++ in 60% of patient's vs. 40% in the chloroprocaine group). The degree of motor block was assessed by modified bromages scale. Most of the patients in group B (70% grade 3) had a higher degree of motor block than group C (20% grade 3) and the data was statistically significant (Table 4).

Table: 4 Degree of motor and sensory block

		Group C	Group B
Degree of motor block	0	0 (0%)	0 (0%)
	1	0 (0%)	0 (0%)
	2	40 (80%)	15 (30%)
	3	10 (20%)	35 (70%)
Degree of sensory block	2 (++)	30 (60%)	20 (40%)
	3(+++)	20 (40%)	30 (60%)

On comparison, the basal VAS score was similar in both groups, but after administration of block, the decrease in VAS score was greater in group B as compared to group C. Increase of mean VAS score in group B occurred at 2 hrs while in group C increase was seen at 60 min. The VAS score remained significantly at a low level in group B as compared to group C until 6 hours after the block, and the difference was statistically significant. It clearly represents that due to the prolonged duration of analgesia in the bupivacaine group, there was less requirement for rescue analgesia.

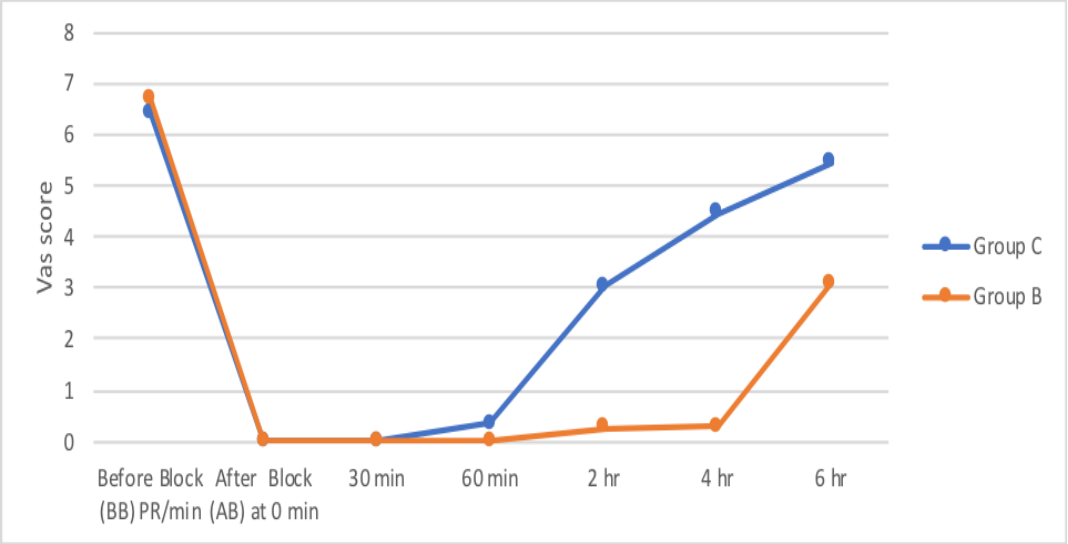

Figure 1: VAS score (post-operative analgesia)

We did not find any significant difference in pulse rate, mean arterial pressure or SPO_2 level (Figs. 2a, 2b, and 2c). There was no significant difference in complications in both groups. Drug reactions in form of rashes and hypotension in group C and bradycardia, vomiting, and neurological complications (tingling and numbness) in group B were seen. All the complications were managed according to standard protocol.

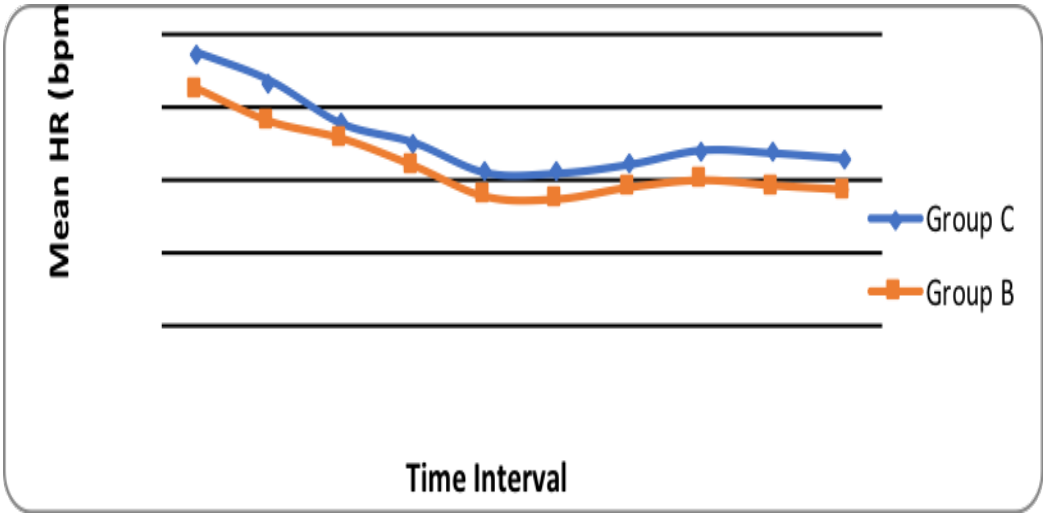

Figure 2a: Pulse rate (per minute)

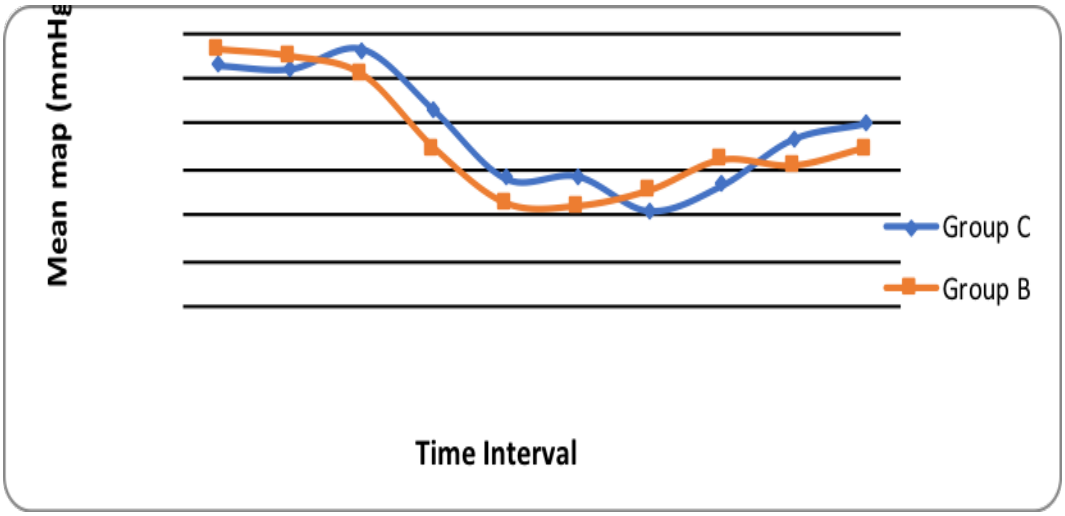

Figure 2b: Mean arterial pressure (mmHg)

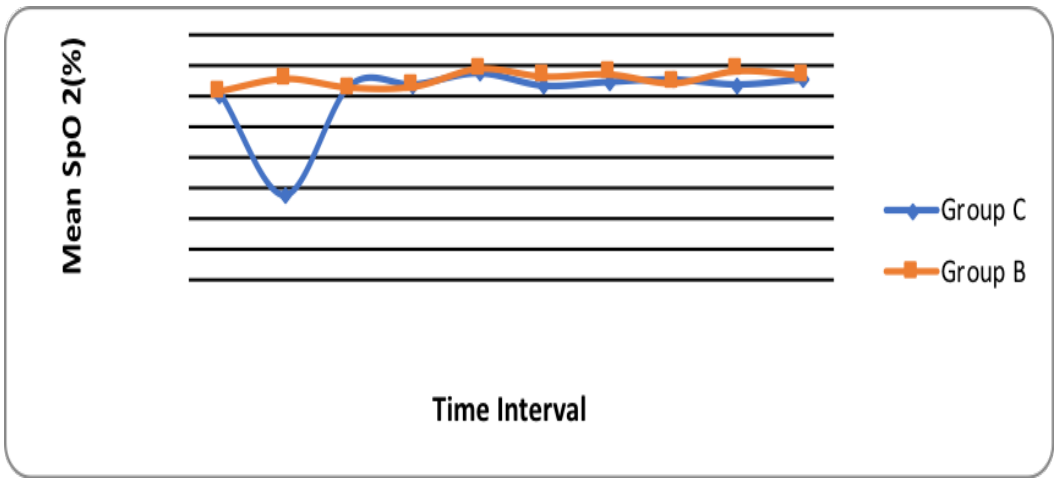

Figure 2c: Spo2 (%)

Discussion

Brachial plexus block is one of the most dependable forms of general anaesthesia for surgeries involving upper limb.

Local anaesthesia is used efficaciously for multiple surgeries to generate regional blockades without affecting the patient's consciousness. Among such local anaesthetic drugs, chloroprocaine, an amino ester, is considered for its rapid onset of action (6–8 minutes) and longer duration of anaesthesia (60

minutes). Another local anaesthetic drug commonly used is bupivacaine for its longer duration of action and satisfactory ratio of sensory to motor neural block.

Demographics

The mean age in C and B groups was 34.58±8.68 years and 35.36±8.28 years, respectively. Both groups had male predominance (68% and 66% in groups C and B, respectively). The mean BMI of patients in C and B groups was 19.46±2.68 and 19.40±2.95 kg/m^2, respectively. Demographic parameters like age, sex, and BMI were not statistically significant showing that demographic characteristics of patients in both groups were not different. So, the two groups were evenly matched with respect to age. This has helped us to judge the clinical significance of our study, as the distribution, metabolism, excretion, and action of drugs undoubtedly vary in different age groups. Therefore, clinically insignificant variation helped to alleviate these confounding factors, which have a significant effect on the clinical action of the drug.

Block characteristics

Onset of sensory and motor block was found to be earlier in group C by approximately 4 minutes as compared to group B. The duration of sensory and motor blocks was significantly shorter in group C as compared to group B. The mean duration of analgesia was prolonged in group B in comparison with group C, and the data was statistically significant.

In concordance with our results, in the Lotfy M E et al (2020) [6] study, the onset of sensory block was (13.4±2.06) minute and motor block was (15.5±3.67) minute in bupivacaine 0.5% with fentanyl. The earlier onset of sensory and motor block in chloroprocaine group helped in reducing waiting time and allowed earlier start of surgery. Sulyok1 I et al (2021) [7] found the duration of sensory block in group chloroprocaine as 70.0±5.0 and in group ropivacaine 0.75% as (444.0±31.0 min), and also found a shorter duration of motor block (66.0±3.0 min) with chloroprocaine in comparison with the control group. Similar results of prolonged duration of sensory block with bupivacaine 0.5% were also found by Swaro S et al (2016) [8] where the duration of sensory block was (363.4±38.36 min) and motor block was (357±36.77 min) which was much longer compared to the chloroprocaine group.

With respect to the duration of analgesia, our results are in accordance with Kumar R et al (2019) [9] who also found prolonged duration of analgesia with bupivacaine (660.67+31.77 min). The shorter duration of sensory and motor block helps in discharging patients as a daycare surgical procedure. But this is associated with a shorter duration of analgesia despite the addition of fentanyl to the block mixture. This leads to an increase in pain incidence postoperatively in group C, requiring earlier and more frequent analgesia. This was the limitation of this study: where surgery was prolonged, patients needed rescue analgesia, while for some patients, anaesthesia was converted to general anaesthesia and those cases were excluded from this study.

Heamodynamic parameters

We did not find any significant difference in pulse rate, mean arterial pressure, and SPO2 levels (Figs. a, b, and c). The results are in accordance with Swaro S et al (2016) [8], Lotfy M E et al (2020) [6] Hamed M A et al (2018) [10] where there was no significant difference in hemodynamic parameters.

Complications

There was no significant difference in complications in both groups with drug reactions: hypotension, bradycardia, vomiting, and neurological complications. The results of our study are in accordance with those of Kumar R et al (2019) [9] where 3.3% of patients had nausea, 3.3% had bradycardia, and 6.7% suffered from hypotension, but all of these side effects were mild and manageable. Sulyok1 I et al (2021) [7] in their study found that 3.3% of their patients had some neurotoxicity such as tingling, numbness, and 6.7 % had pruritus, but these side effects were comparable with no significant difference.

Technical complications of supraclavicular brachial plexus block placement, like hematoma formation and pneumothorax, were not noted in our study.

Conclusion

Our results demonstrate that chloroprocaine, a short-acting local anaesthetic agent with fentanyl, has a better profile for supraclavicular brachial plexus block in terms of early onset of sensory and motor block with more rapid recovery and a shorter time to discharge in comparison with bupivacaine with fentanyl but a moderate degree of sensory and motor block. Thus, it promises to be yet another addition to the already vast armamentarium of present-day anaesthesia.

We would like to suggest the use of chloroprocaine for peripheral nerve block in short-day care surgeries, however further studies should be carried out to explore its effectiveness.

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