Research Article

Effects of buprenorphine and fentanyl in brachial plexus block on operative and post-operative analgesia: a clinical comparative study

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Abstract

Introduction: Surgical pain is an acute pain and is defined as conscious perception of noxious stimuli. Peripheral neural blockade has brought a new dimension in regional anaesthesia and is now a well accepted component of comprehensive anaesthetic technique. **Aim:** The study aimed to compare the quality of intra-operative analgesia and the duration of post-operative analgesia with use of buprenorphine and fentanyl administered with lignocaine with adrenaline in the brachial plexus block through the catheter technique of axillary brachial plexus blockade for upper limb surgeries. **Materials and Methods:** The study included 30 patients in group A (buprenorphine) and 30 in group B (fentanyl) with ASA I and ASA II physical status of either sex, in the age group of 15 to 60 years weighing between 45 to 85 kg undergoing upper limb surgeries. **Results:** The onset of analgesia in the operative and post operative doses was earlier with fentanyl than buprenorphine. The duration of analgesia in operative dose and post operative doses was more with buprenorphine. Quality of analgesia is found to be better with fentanyl. **Conclusion:** patients suffer needlessly due to improper post operative analgesia. So, the results of this study can be incorporated in anesthetic technique to reduce patient's post operative pain.

Keywords: Brachial plexus block, Fentanyl, buprenorphine, Quality of analgesia, Onset of analgesia

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Introduction

The word "pain" is the bitterest experience in the lives of the mankind. Surgical pain is an acute pain and is defined as conscious perception of a noxious stimulus. Many patients continue to suffer needlessly from inadequate post-operative analgesia [1]. Peripheral neural blockade like brachial plexus block has brought a new dimension in regional anaesthesia and is now a well accepted component of comprehensive anaesthetic technique because it bypasses the side effects of general anesthesia [2]. Among the various peripheral blockades, brachial plexus block is the most commonly practicised peripheral neural blockade. But it is performed mostly with local anaesthetic drug alone, which is unable to provide sufficient post-operative analgesia. Following the clinical efficacy of intrathecal and epidural narcotics in 1970's, demonstration of opioid receptors in the peripheral nervous system was documented [2]. Opioid receptors exist in peripheral nevous system and they also have been discovered in the immune cells, sympathetic nerve fibres and peripheral neurons [3, 4]. The mu, delta and kappa receptors are found throughout the nervous system and produce analgesia. Inflammatory cells play a major role in peripheral opioid analgesia by migrating to and delivering opioid peptides to the receptors expressed by sensory nerve terminals at the very site of tissue damage [5].

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Aim of the study

The study aimed to compare the quality of intra-operative analgesia and the duration of post-operative analgesia with use of buprenorphine and fentanyl administered with lignocaine with adrenaline in the brachial plexus block through the catheter technique of

axillary brachial plexus blockade for upper limb surgeries.

Materials and Methods

Setting: The present study has been conducted in the orthopeadic operation theatre of Gauhati Medical College and hospital under the Department of Anaesthesiology & Critical Care, from August 2014 to July 2015.

Type of study: the study conducted was evaluative study to compare the quality of intra operative analgesia and post operative analgesia with buprenorphine and fentanyl.

Sample and sampling technique: 60 patients were selected with random sampling technique and randomly divided into two groups.

Inclusion criteria: The study included sixty patients with ASA I and ASA II physical status of either sex, in the age group of 15 to 60 years weighing between 45 to 85 kg and the patients undergoing upper limb surgeries.

Exclusion criteria: Patients with local infection at site of the block, respiratory disease, fever, under anti-coagulant therapy and those sensitive to local anaesthetics were excluded from the study.

Method of study: The patients were explained in details about the procedure of the study during the pre-anaesthetic visit and their co-operation was sought. All the patients were secured with an intravenous infusion line and Injection ranitidine hydrochloride 50 mg i.v. administered prior to application of catheter in the axillary brachial plexus block.

None of the patients were given any analgesic or sedation in the pre, intra and post operative period. The pulse rate, mean arterial pressure (MAP) and respiratory rate, spo_2 were recorded at interval of 10 minutes. In post operative period, time of patient's first complaint of pain was recorded and postoperative analgesia was continued upto 24 hours.

Onset of analgesia, quality of analgesia, duration of analgesia and VAS score [6] along with Pulse rate, mean arterial pressure and respiratory rate were recorded immediately after completion of surgery. Pain was assessed by visual analogue scale (VAS) score where in a scale of 0 to 10.

Duration of analgesia was taken as the period between time zero and the time at which VAS score is ≥ 4. When the patient is having pain (VAS $\geq$4), then next top –up dose of local anesthetic and opiods were given as:

Group A – 10 ml of 2% lignocaine with adrenaline 1: 200000 diluted to 19 ml by distill water plus1ml (0.3mg) of buprnorphine through the catheter in situ. (lignocaine percent becomes 1%)

Group B – 10 ml of 2% lignocaine with adrenaline 1:200000 diluted to 18 ml by distill water plus 2 ml (100 mcg) of fentanyl through the catheter in situ. (Lignocaine percent becomes 1%).

Statistical methods used: frequency, percentage, mean, standard deviation, SPSS software

Results

Results were reported as mean ± standard deviation. P value of <0.05 was considered statistically significant. In group A majority of the patients (40%) were 15-24 years of age, whereas in group B the majority (36.66%) of the patients were from 25-34 years of age. Majority of the patients in both the group were found in between weight 50 – 70 kg. Majority of operation performed in both groups were open reduction and internal fixation of both bone forearm fracture which is about 24% and 30% respectively.

70% of the patients were males in group A and 66.67% in group B. Majority of patients (76.67%) belonged to ASA I in both the groups and 23.33% belonged to ASA II.

Onset of analgesia after the 1st operative dose- It was observed that 43.33% patients required 1-5 minutes, 56.67% patients required 6-10 minutes in group A and while in group B 86.67 % required 1-5 minutes , 13.33% patients required 6-10 mins, from the injection of local anesthetic and opioids into brachial plexus sheath to complete sensory loss. The mean onset time in group A is 6.93 minutes and in 4.56 minutes in group B. (Table 1)

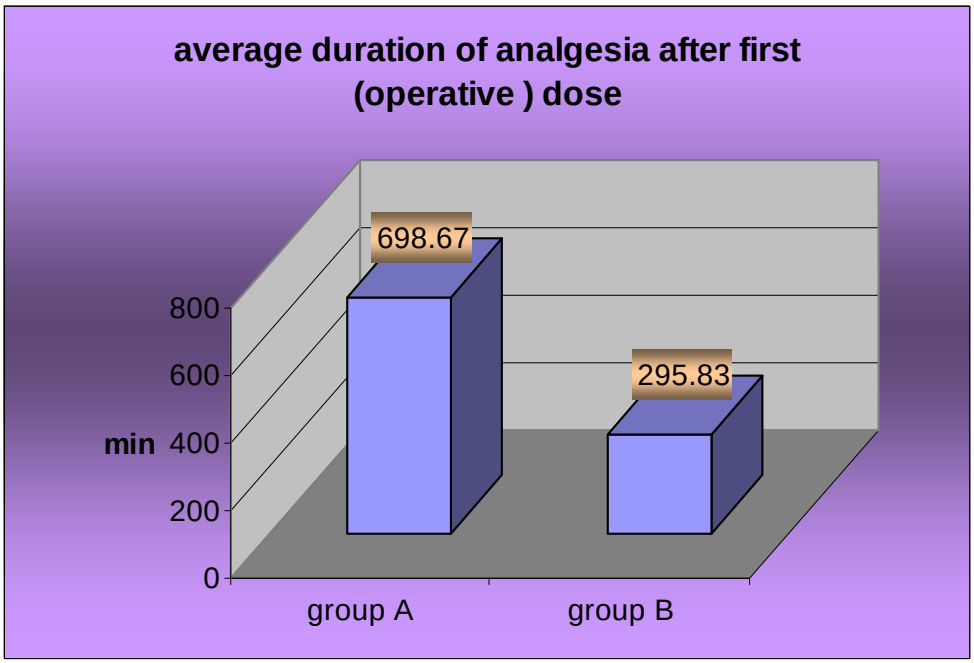
Duration of analgesia after the 1st operative dose- In group A, duration of analgesia was between 401-600 minutes with a mean duration of 516.5 minutes. The average duration of analgesia after the first dose of drug in group A was 698.67 minutes. In group B, duration of analgesia was 201 -300 minutes with a mean duration 253.37 minutes. The

average duration of analgesia after first dose of drugs in group B was 295.83 minutes. The mean duration of analgesia of first (operative) dose was much longer in group A than in group B which is highly significant statistically (P<0.001). (Figure 1)

Table-1: onset of analgesia after 1st operative dose

Time in minutes	Group A			Group B		
	No. of case	Percentage (%)	Mean onset time (min)±SD	No. of case	Percentage (%)	Mean onset time (min)±SD
1-5	13	43.33%	6.93± 2.43	26	86.67%	4.56± 2.06
6-10	17	56.67%		4	13.33%	

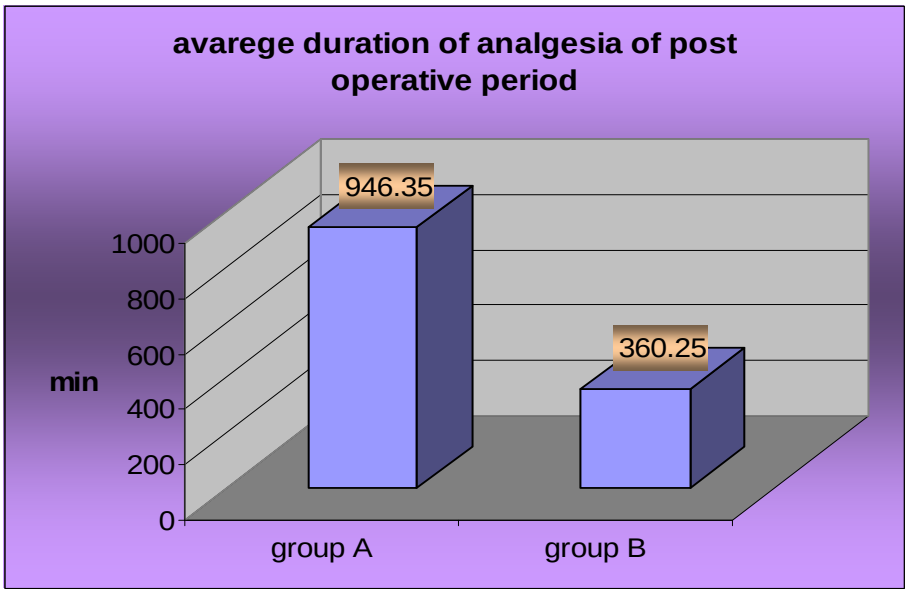
Figure-1: average duration of analgesia after 1st operative dose



Mean onset of analgesia in the post operative period- Mean onset time was calculated by adding the onset times for each dose and later dividing by no. of doses in every patient. In post-operative period in group A, 16 patients required 6-10 minutes and 10 patient required 1-5 minutes for onset of analgesia. The average onset of analgesia in group A is 5.99 minutes. But in group B, analgesia was achieved in all cases in 1-5 minutes and average was 1.26 minutes.

Average duration of analgesia with post operative doses- In group A, majority of the patients did not require more than one post operative dose of drugs. In group B, majority of patients require 4th post operative doses of drugs for pain relief. Among all, first post operative dose have highest duration of analgesia seen in our study. The average duration of analgesia in post operative period in group A is 946.35 minutes (15.77 hours) and in group B is 360.25 minutes (6.004 hours), which is found in present study. (Figure 2)

Figure-2: average duration of analgesia in post operative period



Degree of motor blockade in operative doses- 22 patients in group A and 21 patients in group B had complete motor blockade. 8 patients in group A and 9 patients in group B had partial motor blockade. No patient in either group found to be non motor blockade. (Table 2)

Table-2: degree of motor blockade in operative doses

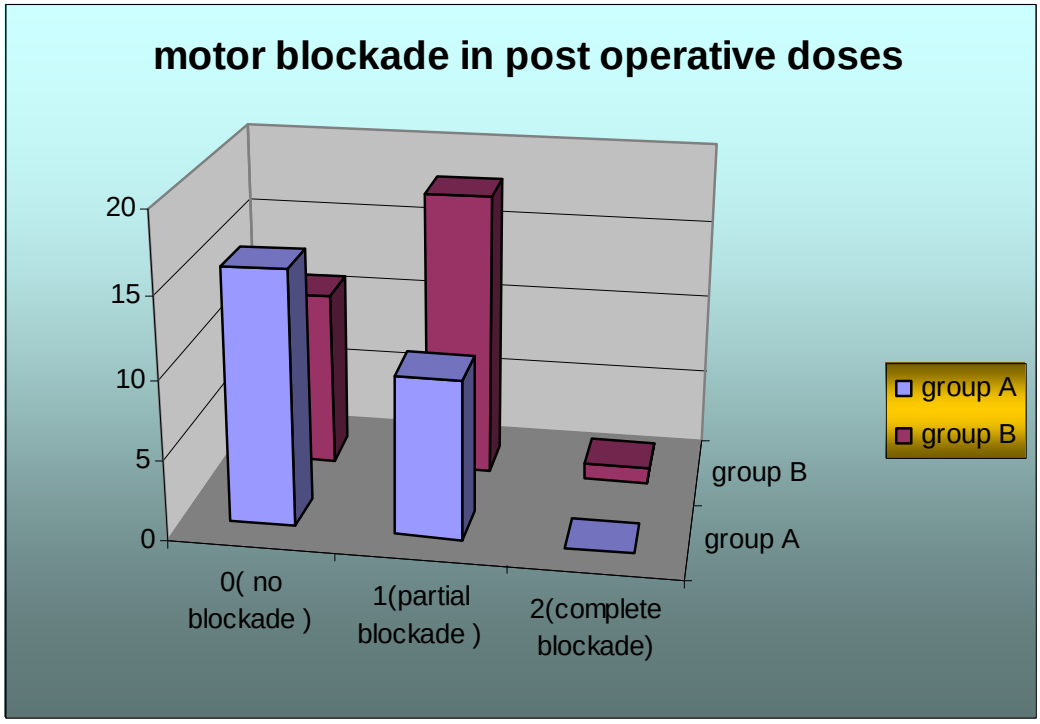
Degree of motor block	**Group A**		**Group B**	
	No of cases	**Percent**	**No of cases**	**Percent**
0 (no blockade)	0	0%	0	0%
1(partial blockade)	8	26.67%	9	30%
2(complete blockade)	22	73.33%	21	70%

Degree of motor blockade in post operative doses-16 patients in group A, 11 patients in group B had no motor blockade in post operative doses of drugs. But in group A 10 patients and in group B 18 patients had partial motor blockade in post operative drug doses (Figure 3).

Table 3: Quality of analgesia in group A

Group A					
doses	**No. of patient with pain score (VAS)**				**Total no of patient**
	VAS (0)	**VAS(1)**	**VAS (2)**	**VAS (3)**	
1st	19	7	0	0	26
2nd	6	1	0	0	7
3rd	1	0	0	0	1

Figure-3: Motor blockade in post operative doses



Quality of analgesia in post operative period- 26 patients received 1st post operative dose of drugs, of which 19 patient felt no pain and 7 patients felt mild discomfort only. 7 patients received 2nd dose of which, 6 patients felt no pain and only one patient felt mild discomfort. Third post operative dose was given to only one patient who didn't feel any pain after that. (Table 3)

VAS= Visual Analog Score

Table-4: Quality of analgesia in group B

Group B					
Doses	**No. of patient with pain score (VAS)**				**Total no. of patient**
	VAS (0)	**VAS (1)**	**VAS (2)**	**VAS (3)**	
1st	27	3	0	0	30
2nd	29	1	0	0	30
3rd	22	0	0	0	22
4th	20	0	0	0	20
5th	7	2	0	0	9
6th	4	0	0	0	4
7th	1	1	0	0	2
8th	1	0	0	0	1

In group B, 30 patients received 1st and 2nd post operative doses of drugs of which, 3 patients felt mild discomfort in 1st dose and one patient felt mild discomfort in 2nd dose, rest remained pain free. (Table 4)

Quality of analgesia seems in our study to be better in group B as less number of patients feeling mild discomfort (VAS1) after post operative doses in comparison to group A.

Change in hemodynamic parameters at different post operative doses-In group A, there was decrease of mean pulse rate in every post operative dose. In group B there was increase in mean pulse rate in 1st, 3rd, 4th and 5th post operative doses.

In group A, there was decrease in mean MAP in 2nd and 3rd post operative doses of which was maximum after 2nd dose (3.99%). There was increase of MAP in 1st post operative dose. In group B, there was decrease of MAP in 1st, 2nd, 7th and 8th post operative doses.

There was increase of mean respiratory rate in 1st (3.66%) and 2nd (0.77%) post operative doses in group A. In group B, there were increase of mean respiratory rate in 1st, 2nd, 3rd and 8th post operative doses of which maximum increase seen in 2nd post operative dose. The overall increase & decrease of mean pulse rate, mean arterial pressure and mean respiratory rate were found statistically insignificant (P>0.05).

Side effects in post operative patients-10% had nausea- vomiting, 3.33% had sedation, 6.66% had dizziness and 3.33% had pruritus in the whole operative to post operative period in group A. In group B 10% had sedation and 6.6% had nausea, vomiting in the operative-post operative period. No patient had any intravascular complication, neurological sequele, bradypneoa, convulsion in our study. (Table 5)

Table-5: Side effects in post operative patients

Side effects	Group A		Group B	
	No of patient	Percent (%)	No of patient	Percent (%)
Nausea & vomiting	3	10%	2	6.6%
Sedation	1	3.33%	3	10%
Vascular injury	0	0%	0	0%
Bradypnoea	0	0%	0	0%
Convulsion	0	0%	0	0%
pruritus	1	3.33%	0	0%
Neurological	0	0%	0	0%
others	diziness(2)	6.66%	0	0%

Discussion

The onset of analgesia in first (operative dose) in group A i.e. where opioid buprenorphine was used, was 6.96 ± 2.43 minutes and this finding nearly correlates with the study of Nishikwa K et al. where they used only lignocaine 1.5% with adrenaline 1:200000, they found an onset time of 8.25 minutes [7]. The onset of analgesia of first (operative) dose of group B was 4.56 ± 2.06 mins, where opioid fentanyl was used.

The duration of analgesia of first (operative) dose is correlated with the study of Nisikawa K et al. whose duration of analgesia found in the fentanyl group was 3.5 hours [7]. Present study is also comparable to study of Gormely WP et al. where they found duration of analgesia was 5.3 hours [4]. The findings of the present study did not correlate with the studies conducted by Viel EJ et al. and Karakya et al. [8, 9]. The time of

onset of sensory blockade was 23.8 ± 1.8 mins. The reason for longer onset time is that, they used bupivacaine as local anesthetic whose onset time is generally more [9]. Another study reported to have slightly delayed onset time of analgesia which was 19± 9 minutes after using lidocaine with adrenaline [10]. Gaumann D et al. found delayed onset of analgesia with lignocaine with adrenaline 22 ± 7 minutes [11]. It was probably because they used lignocaine 1% which may have delayed the time of onset.

The average duration of post operative analgesia of post operative doses in group A was 946.35 min (15.77 hours) and in group B was 360.25 minutes (6.01 hours). The post operative analgesia in group A seems to be significantly longer than group B. The average duration of analgesia in post operative doses in our study is longer than average duration of analgesia in operative dose. It may be because in the operative period patients got excessive muscle pulling, vibration during bone drilling, a tourniquet in the arm (which may give early pain because musculocutaneous nerve was not blocked in 50% cases and above all, and anxiety of patient in the operating room. Moreover, the operative pain is a type of dynamic pain, and may be more severe than the resting pain (post operative) [12]. Our observation is comparable to Ang E et al.who found average duration of analgesia of 8 ± 2 hours [2]. Their finding was in the between group A and group B of our study because they used lidocaine mixed with bupivacaine without use of the opioids.

So far as motor blockade is concerned, in group A, 62 % had no motor blockade and 38% of patient had partial motor blockade in post operative period. In group B, 37% patient had no blockade, 60% had partial blockade and 1 patient had complete blockade in post operative period. Gobeux D et al. stated the enhancement of intensity of sensory and motor block after adding fentanyl in his study, which correlates to the enhancement of motor blockade in group B in post operative period in our study [13].

Regarding the quality of analgesia in group A, 26 patients received 1st post operative dose of drugs, of which 19 patient felt no pain and 7 patients felt mild discomfort only. 7 patients received 2nd dose, of which, 6 patients felt no pain and only one patient felt mild discomfort. Third post operative dose was given to only one patient who didn't feel any pain after that. The observation in the present study could not be compared well with studies of previous investigators due to obvious difference in the methodology.

In the present study, patients in the both the groups showed minimal heamodynamic changes. Previous studies demonstrated that the administration of buprenorphine in the brachial plexus blockade did not produce any significant cardiovascular system change [8, 14, 10, 15].

In the present study , observation were made for side effects and complication like nausea, vomiting, sedation, bradypneoa, pruritus, convulsion etc. Some studies reported that patients had nausea, vomiting and headache [14, 15].Charles P et al. found plasma concentration of bupivacaine more than 1.6 mcg/ml in 1 patient, the plasma concentration from which, neurologic signs of toxicity like vertigo, malaise can be seen [16]. The minor incidence of nausea, vomiting, dizziness, sedation and pruritus observed in the present and previous studies may be due to systemic absorption of opioids from the site of injection.

Conclusion

The present study was a randomized, clinical comparative evaluation of brachial plexus block performed with the local anesthetic combined with opioids, buprenorphine and fentanyl, for post operative pain relief. The onset of analgesia in the operative and post operative doses was slightly earlier with fentanyl than buprenorphine. The duration of analgesia in operative dose and post operative doses was more with buprenorphine. Quality of analgesia is found to be better with fentanyl as less number of patients felt mild discomfort after post operative dose. But large scale studies are required to generalize the study findings.

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Permission from IRB: Yes

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