Original Article

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Comparative Study between Bupivacaine Alone and Bupivacaine with Fentanyl in Axillary Plexus Block for Upper Limb Surgeries.

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Abstract

Background: Brachial plexus blocks provide a useful alternative to general anesthesia for upper limb surgeries. They achieve near ideal operating conditions by producing complete muscle relaxation, maintaining stable intra-operative hemodynamics and associated sympathetic block. The sympathetic block decreases post-operative pain, vasospasm and oedema. **Subjects and Methods:** This study conducted in Department of Anaesthesiology, Mount Zion Medical College. Two groups were included in this study .Each group were contain 50 patients. Group A were administered with 40ml of .25% Bupivacaine and group B were administered by 40ml of .25% Bupivacaine with free fentanyl 2.5 µg/ml. **Results:** In group A 52% male & 48% female were found but in case of group B 42% male & 58% female were found in this study. In the present study, 38% patient belongs to 26-35 age in group A whereas in group B 30% cases were belongs to 36-45 age groups. In our study, mean time & duration of sensory & motor block were 19.08±1.7 & 16.48±2.62 and 13.65±2.01 &7.23±1.01 in group A whereas 24.82±1.66 & 15.3±2.09 and 6.87±0.89 & 6.17±0.77 in group B respectively. **Conclusion:** No significant difference found in hemodynamic variables i.e., pulse rate, systolic BP, diastolic BP and oxygen saturation. No serious complications were observed. So, use of fentanyl as adjuvant with bupivacaine for brachial plexus block is more effective and safe compared to bupivacaine alone.

Keywords: Bupivacaine, Bupivacaine with free fentanyl, brachial plexus block, anesthetic technique.

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Introduction

For surgeries involving upper limb, the most commonly used regional anesthetic technique is brachial plexus block. Surgical procedures have become more complex with new developments in the field of surgery. The operating time has increased manifold with a consequent need to increase the duration of brachial plexus block.[1] Brachial plexus blocks offer a beneficial alternative to general anesthesia. They accomplish ideal operating conditions by producing complete muscle relaxation, maintaining stable intra-operative hemodynamics and associated sympathetic block. Post-operative pain, vasospasm and oedema are decreased by the sympathetic block.[2] In modern anaesthesia practice, peripheral nerve blocks have assumed a prominent role as it provide ideal operative conditions without any sedation or systemic hemodynamic effects.[3]

There are several approaches like supraclavicular, infraclavicular, interscalene and also the axillary approach to achieve brachial plexus block. But the easiest approach to achieve the brachial plexus block is supraclavicular approach. It the most consistent method for anesthesia in surgeries below the shoulder joint. William Halsted (1852–1922) performed the first brachial plexus block.[4,5] He applied cocaine to the plexus by using surgical approach. The approaches like supraclavicular and infraclavicular are associated with the utmost diffusion of local anesthetic solution after a single injection because the brachial plexus is the most compact at these levels.

After orthopedic surgeries, pain can be intense.[6] It is associated with neuroendocrine response, catecholamine release, and increased morbidity. It has been suggested that regional techniques have been produced better analgesia in comparison to systemic opioids. It may improve outcomes, and decrease the adverse side effects of narcotics. It increase the degree of patient's satisfaction.[7] Infraclavicular block can provide analgesia for the upper extremity. It is considered a best approach for analgesia below the elbow. It blocks the brachial plexus below the level of clavicle.[8] This provides adequate anesthesia for lengthy surgeries. It also reduces pain in the immediate postoperative period.[9] For long duration analgesia from nerve block, researchers have tried various mixtures of local anesthetics with adjuvant drugs.[10] Corticosteroids used to prolong the duration of regional blocks. Theories have shown that on nociceptive C-fibers, dexamethasone increases the activity of inhibitory potassium channels, thus decreasing their activity.[11,12] Few clinical studies have shown that addition of opioids to local anesthetics injected to brachial plexus increases the success rate. It also prolongs the duration of block and improves postoperative analgesia.[13]

The present study is a comparative study. It compared the effectiveness of adding fentanyl (2.5µg/ml) to Bupivacaine (0.25%) with plain Bupivacaine (0.25%) for upper limb surgeries. This study used axillary approach technique of brachial plexus block.

The parameters which are studied

1. Onset of sensory and motor blockade.
2. Duration of sensory and motor blockade.
3. Sedation score, intra and post-operatively.
4. Haemodynamic variables (HR, BP, O2 saturation).
5. Number of rescue analgesics given in post-operative period

Subjects and Methods

Study Population

Two groups were included in this study .Each group were contain 50 patients. Group A were administered with 40ml of .25% Bupivacaine and group B were administered by 40ml of .25% Bupivacaine with free fentanyl 2.5 µg/ml.

Study Area

This study conducted in Department of Anaesthesiology, Mount Zion Medical College.

Duration of study:-The duration of the study one year.

Data collection

All data were collected by recoded duration & onset of sensory and motor block in group A as well as in group B. Hemodynamic variable were also recorded at 0 min, 5 min, 15 min, 30 min, 60 min, 2 hour, 6 hour, 12 hour, 24 hour.

Inclusion criteria

Age from 15-55 year along with systolic & diastolic blood pressure (100-139mmHg & 60-89 mmHg) were included in this study.

Exclusive criteria

Patients with hypersensitivity & septicemia were excluded in this study.

Data analysis

Data were analyzed by statistics.

Results

Table 1: Distribution of patients according to gender

Gender	Group A(only Bupivacaine)	Group B (Bupivacaine with free fentanyl)
Male	26 (52%)	21(42%)
Female	24(48%)	29(58%)
Total	50	50

Table 2: Distribution of patients according to age.

Age	Group A	Group B
15-25	10(20%)	12(24%)
26-35	13(26%)	11(22%)
36-45	19(38%)	15(30%)
46-55	8(16%)	12(24%)

Table 3: Mean time onset of sensory block.

Group A	Group B	P value
19.08±1.7	24.82±1.66	<0.05

Table 4: Mean time onset of motor block.

Group A	Group B	P value
16.48±2.62	15.3±2.09	<0.05

Table 5: Mean Duration of sensory block

Group A	Group B	P value
13.65±2.01	6.87±0.89	<0.05

Table 6: Mean Duration of motor block

Group A	Group B	P value
7.23±1.01	6.17±0.77	<0.05

Table 7: Number of rescue analgesic in post-operative

Rescue analgesia dosage	Group A	Group B
1	74% patients required	-
2	26% patients required	76% patients required
3	-	24% patients required

Table 8: Hemodynamic variable at 0min, 5min, 15min, 30min, 60min, 2hour, 6hour, 12hour, 24hour

	Pulse Rate (SD)			Systolic BP (SD)			Diastolic BP (SD)			Oxygen saturation (SD)		
	Group A	Group B	P value	Group A	Group B	P value	Group A	Group B	P value	Group A	Group B	P value
0 min	6.8	6.6	>0.05	9.9	9.5	>0.05	7.71	7.11	>0.05	0.57	0.59	>0.05
5 min	6.6	6.7	>0.05	10.1	10.5	>0.05	7.56	7.59	>0.05	0.51	0.54	>0.05
15 min	6.5	6.4	>0.05	10.1	10.3	>0.05	7.21	7.31	>0.05	0.63	0.65	>0.05
30 min	6.8	6.7	>0.05	10.3	9.9	>0.05	6.59	7.81	>0.05	0.65	0.53	>0.05
60 min	6.6	6.2	>0.05	9.9	9.7	>0.05	7.29	7.42	>0.05	0.58	0.4	>0.05
2 hour	6.5	5.6	>0.05	9.6	9.9	>0.05	7.40	7.58	>0.05	0.64	0.48	>0.05
6 hour	6.4	5.6	>0.05	9.3	9.6	>0.05	7.33	7.39	>0.05	0.56	0.47	>0.05
12 hour	6.2	6.1	>0.05	9.8	10	>0.05	7.75	7.83	>0.05	0.75	0.55	>0.05
24 hour	6.5	7.8	>0.05	9.4	9.4	>0.05	6.87	6.93	>0.05	0.53	0.53	>0.05

In the present study, total 100 patients were included in both groups. Group A were administered with 40ml of .25% Bupivacaine and group B were administered by 40ml of .25% Bupivacaine with free fentanyl 2.5 µg/ml. In group A 52% male & 48% female were found but in case of group B 42% male & 58% female were found in this study. In the present study, 38% patient belongs to 26-35 age in group A whereas in group B 30% cases were belongs to 36-45 age groups. In our study, mean time & duration of sensory & motor block were 19.08±1.7 & 16.48±2.62 and 13.65±2.01 & 7.23±1.01 in group A whereas 24.82±1.66 & 15.3±2.09 and 6.87±0.89 & 6.17±0.77 in group B respectively .P

value were not significant in hemodynamic variable at 0 min, 5 min, 15 min, 30 min, 60 min, 2 hour, 6 hour, 12 hour, 24 hour.

Discussion

Brachial plexus block is mostly used for analgesia and anesthesia. In comparison to general anesthesia, it carries less risk. To enhance the onset of analgesia and prolong the duration of analgesia, several other adjuvant drugs like Opioids, Clonidine, Neostigmine and hyaluronidase have been assessed in combination with local anesthetics. At the central or spinal cord level, the primary effects of opioid antinociception are mediated. It is still uncertain to determine the exact mechanism of action of opioids at the peripheral nerve. There are some pieces of evidence that supports the presence of peripheral opioid receptors.[14-18] Therefore, the possible mechanism of prolonged analgesia by peripheral opioid administration might be through direct binding at opioid receptors of dorsal nerve root aided by axonal flow, diffusion through brachial plexus sheath to extradural or subarachnoid space to dorsal horn and central action after peripheral systemic uptake.[19]

Fentanyl, a phenylpiperidine derivative, is known to produce antinociception. It enhances the effect of local anesthetics when given epidurally or intrathecally. Fentanyl is extremely selective μ receptor agonist, that is usually responsible for its analgesic properties. Hence, in the present study, an attempt has been made in brachial plexus block (axillary approach) to assess the efficacy of Fentanyl as an adjuvant to Bupivacaine (0.25%) in terms onset time, duration of analgesia and sedation. In the first 24 hours, hemodynamic variables and rescue analgesic requirements were also studied.

This study consisted of 100 patients within the age group of 15-55. Each group included 50 patients. The mean age of group A was 34.3 ± 11.89 years and the mean age of group B was 32.3 ± 10.51 years. So both groups were comparable in regard to age. Male to female ratio was nearly the same.

The study revealed that the addition of fentanyl to local anesthetics caused the significantly prolonged duration of analgesia but delayed the onset of both sensory and motor blockade in comparison to local anesthetics alone. The onset of the sensory block of group B and group A is 24.82 ± 1.66 min and 19.08 ± 1.7 min respectively. The onset of motor block of group B and group A is 16.48 ± 2.62 min and 15.30 ± 2.09 min respectively.

These results could be obtained due to the change in pH of the anesthetic solution resulting in slower penetration of nerve membrane by local anesthetics. In nerve block, alkalinization of local anesthetic agents has been shown to improve the onset, quality, and duration of analgesia.[20-23]

Tejwant Rajkhowa, Nilotpal Das, Samit Parua, et al, obtained similar findings on the effect of fentanyl as an adjuvant for brachial plexus block.[24] It was a single-blinded study of 66 ASA I and II patients aged 18-65 years. The sample was divided into 2 groups i.e. group R and RF. Supraclavicular brachial plexus block was performed in the group R using 0.5% ropivacaine 30 ml plus 1 ml NS (total 31 ml) and in group RF received 0.5% Compared to group R. In brachial plexus block, group RF showed a significant greater duration of sensory and motor blockade ropivacaine plus 50 micrograms fentanyl in 1 ml NS (total 31 ml). The study concluded that the addition of fentanyl to ropivacaine may prolong the duration of sensory and motor block but may delay the onset of sensory and motor block when ropivacaine used alone.

Another study of Kohli Nishikawa et alreported a decrease in pH by addition of fentanyl to lignocaine solution.[25] They concluded that a decrease in pH of lignocaine from 6.2 to 5.2 by addition of 100μg of fentanyl may have resulted in the slower onset of analgesia. There are some reports of no improvement with alkalinization also.[26-27]

In the present study, In our study, mean time & duration of sensory & motor block were 19.08±1.7 & 16.48±2.62 and 13.65±2.01 &7.23±1.01 in group A whereas 24.82±1.66 & 15.3±2.09 and 6.87±0.89 & 6.17±0.77 in group B respectively. The number of patients who required rescue analgesia and supplemental analgesic boluses were also significantly lower in patients in Group B. A similar observation was made in a study by Karakaya D, Büyükgöz F, Bariş S, et al.[28] In our study, Fentanyl used with bupivacaine prolonged the duration of sensory and motor blockade. It was probably by directly binding with opioid binding sites on the dorsal nerve roots aided with these axonal transports and then into the epidural and subarachnoid spaces. It may also have been central opioid receptor-mediated after systemic absorption of fentanyl.

On the use of opioids for brachial plexus block, a study was done by Viel et al.[29] They have reported prolonging the analgesic duration with or without the use of local anesthetics. In this study, for brachial plexus block (B group) improved the success rate of the nerve block with the addition of fentanyl to local aesthetics.

It has been shown in the present study that the Fentanyl causes central neuraxial block without any significant adverse effects in a dose of 2.5 μg/ml that others have also used. The mean sedation scores, 15 min after injecting the drug until 60 min after injection, were found to be higher in Group B patients in comparison to Group A ($P < 0.05$) in the present study. Similar results were observed in other studies as well.[5] This effect can be attributed to the partial vascular uptake of Fentanyl and its transportation and action on the central nervous system causing sedation. The lipophilic nature of Fentanyl and its faster diffusion into blood vessels by its rapid clearance (6-11 mL.kg-1.min-1) and short half-life (1-2 hrs.) are responsible for the limited duration of its sedation. No patient experienced airway compromise or required airway assistance during fentanyl sedation.

Conclusion

In this study conclude that, by adding of fentanyl 2.5 μg/ml to 40 ml of 0.25% bupivacaine in axillary approach of brachial plexus block caused significant prolongation of duration of sensory and motor block ($p<0.05$) but delayed the onset of both sensory and motor blockade compared to bupivacaine alone and reduced for rescue analgesics.

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