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Clinical Comparative Evaluation of Bupivacaine with Fentanyl and Ropivacaine with Fentanyl in Upper Limb Surgery Under Supraclavicular Brachial Block

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ABSTRACT

Peripheral nerve blocks have become important in clinical practice because of their role in post operative pain relief, decreases the need for postoperative analgesics, decreases the incidence of nausea, shortens the postanaesthesia care unit time and increases the patient satisfaction. To compare effects in terms of onset and duration of sensory and motor block, duration of analgesia of ropivacaine 0.5% with fentanyl and bupivacaine 0.5% with fentanyl in supraclavicular brachial plexus block. A prospective comparetive interventional study was conducted on 60 patients posted for upper limb surgeries in orthopaedics and surgery admitted at Basaveshwara teaching and general hospital attached to Mahadevappa Rampure medical college Kalburgi, NOV 2019 to April 2021. Mean onset of sensory blockade was delayed with 30ml 0.5% Inj. Bupivacaine+inj Fentanyl (1mcg/kg) [9.67(±1.56)] compared to 30 ml 0.5% Inj. Ropivacaine+inj Fentanyl(1mcg/kg). [7.3(±1.51)].Mean onset of motor block was was delayed Mean duration of total sensory block was prolonged. Mean duration of motor blockade was prolonged. Time to first rescue analgesia was earlier Post-operative analgesia was longer in D group, as compared to F group. Addition of fentanyl with Bupivacaine (Group D) in supraclavicular brachial plexus block prolongs both onset and duration of sensory and motor blockade and post operative analgesia.

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Key Words
Bupivacaine, supraclavicular brachial plexus block, onset, duration of sensory, motor blockade

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INTRODUCTION

Peripheral nerve blocks can be customized and used for anaesthesia, postoperative analgesia and diagnosis and treatment of chronic pain disorders. The regional technique chosen depends upon the surgical site, the anticipated length of the procedure, ambulation requirements and the desired duration of postoperative pain control. In addition, important side effects and complications of peripheral regional techniques must be understood. With appropriate selection and sedation these techniques can be used in all age groups. Supraclavicular brachial plexus blocks are among the most commonly performed peripheral neural blocks for upper extremity surgeries in clinical practice[1]. Blockade occurs at the distal trunk-proximal division level[2]. At this point, the brachial plexus is compact and a small volume of local anaesthetic produces rapid onset of reliable blockade of the brachial plexus. An additional advantage is that the block can be performed with the patients arm in any position.

Bupivacaine 0.5% has been most frequently used as local anaesthetic agent for brachial plexus block for many years because of its favourable ratio of sensory to motor neural block and longer duration of action. However, bupivacaine has disadvantage of cardiac and central nervous system toxic effects in some patients attributed to its high plasma concentration after accidental intravascular administration[3].

Ropivacaine is an amino-amide local anaesthetic agent with chemical structure, onset and duration of similar to that of bupivacaine[4]. Ropivacaine has been shown to produce less cardiotoxic, even with accidental intravascular administration and central nervous system toxic effects, less motor block and similar duration of sensory analgesia when compared to bupivacaine[5,6].

A number of opioids have been used as adjuvant with the local anaesthetics into brachial plexus sheath with possibility of increasing duration, quality of analgesia and to reduce dose of local anaesthetic agents. Opioids like morphine, tramadol and fentanyl have been added to enhance the block characteristics of local anesthetic agent[7].

In view of the safety profile of ropivacaine compared to bupivacaine, the present study is thus undertaken to compare effects in terms of onset and duration of sensory and motor block, duration of analgesia of ropivacaine 0.5% with fentanyl and bupivacaine 0.5% with fentanyl in supraclavicular brachial plexus block.

MATERIALS AND METHODS

A prospective comparetive interventional study was conducted on 60 patients posted for upper limb surgeries in orthopaedics and surgery admitted at Basaveshwara teaching and general hospital attached to Mahadevappa Rampure medical college Kalburgi, NOV 2019-April 2021

Inclusion Criteria:

- ASA grade I or II of either sex
- Ages between 18-60 years of either sex

Patients undergoing elective upper limb surgeries

Exclusion Criteria:

- Parents/Guardian refusal or not giving consent.
- Patients with Neurological disease.
- Local skin infections or disease.
- Patients with bleeding diathesis.
- History of drug allergy to bupivacaine, Ropivacaine and Fentanyl.
- Coagulopathy.
- Sever liver or kidney diseases.

Preanaesthetic Evaluation:

- All the patients were subjected to detailed pre-anaesthetic evaluation with clinical history, thorough physical and systemic examination, routine investigation which include complete blood count, urine (routine and microscopy), blood sugar, renal function test, serum electrolytes, X-ray chest PA view, ECG and any special investigation if required was done for the study. An informed written consent was taken from all the patients after explaining every patient in detail regarding nature and purpose of the study and also for the possible risks and complications.

Procedure: Intravenous access obtained in the limb opposite to that undergoing surgery in the preoperative area, with a large bore i.v cannula. Patient then shifted to the operation theatre. Standard multiparameter monitors, ECG, Pulse oximeter, non invasive blood pressure were connected and monitored in all the patients and recorded at interval of 5 minute in the first 30 minutes and every 30 minutes thereafter.

- Patient lies supine, arms by the side and head turned slightly to the other side.
- The interscalene groove and mid-point of clavicle identified.
- After aseptic painting of area, at a point 1.5 to 2.0cm posterior and cephalad to mid point of clavicle, subclavian artery pulsations are felt. A skin wheel is raised with local anaesthetic just cephalo-posterior to the pulsations.
- Next, a 22 gauge, 5cm needle, connected on a 20ml syringe, passed through the same point, parallel to the head and neck, in a caudad, slightly

medial and posterior direction, until either paraesthesia was elicited or first rib was encountered.
- If the first rib is encountered, the needle was moved over the first rib until a paraesthesia was elicited either in the hand or arm.
- After eliciting paraesthesia and negative aspiration of blood, the study medication was injected.
- All patients monitored for vitals, Spo2, analgesia any adverse effects for upto 24 hours post-operatively.

Assessment of Sensory Block: Sensory block was assessed by pin prick with 23g hypodermic needle in skin dermatomes c4-t2 once in every minute for initial 30 minutes and then after every 30 minutes till patient regained normal sensations and graded according to Visual analogue scale (VAS).

Assessment of Motor Block:
- Motor blockade was assessed by a 3 point motor score as described by bromage.
- Grade 0-full flexion and full extension of elbow, wrist and fingers.
- Grade 1-Ability to move fingers only.
- Grade 2-Inability to move fingers.
- The effect on the following parameters were observed.
- Onset time of Motor blockade.
- Onset time of Sensory blockade.
- Duration of Motor blockade.
- Duration of Sensory blockade.
- Duration of Analgesia.

It was assessed by visual analogue scale (VAS) which consisted of a 10 cm scale with gradations marked as '0' means no pain and 10 means worst pain. Patients were asked to rate the degree of pain by making a mark on the scale. Thus the score was obtained by measuring the distance from the '0' end to the indicated mark.

10	9	8	7	6	5	4	3	2	1	0
Worst Pain		Severe Pain		Uncomfortable Pain			Mild Pain		No Pain	

RESULTS AND DISCUSSIONS

Out of 60 patients, randomly 30 were given Bupivacaine with Fentanyl and 30 were given Ropivacaine with Fentanyl. Out of 60 patients, in group D, 4 patients were of age group 21-30, 11 of age group 31-40, 8 of age group 41-50, 7 of age group 51-60. In group F, 10 people of age 21-30, 8 of age 31-40, 8 of age 41-50, 4of age 51-60. There was statistically not significant difference found in distribution of study subjects according to drug used and gender. (p>0.05).

Out of 60 patients, randomly 30 were given Bupivacaine with Fentanyl and 30 were given Ropivacaine with Fentanyl. Out of 60 patients, 6 were female and 24 were male in group D and 12 female and 18 in group F. There was statistically not significant difference found in distribution of study subjects according to drug used and gender. (p>0.05).

Out of 60 patients, randomly 30 were given Bupivacaine with Fentanyl and 30 were given Ropivacaine with Fentanyl. Out of 60 patients, 27 Patients were of ASA-I and 3 patients were of ASA-II in group D. 25 Patients of ASA I and 5 patient of ASA II in group F. There was statistically not significant difference found in distribution of study subjects according to drug used and gender. (p>0.05).

Mean Time of onset of sensory block was more among group D patients as compare to group F patients. It was 9.67 minute in group D and 7.30 in group F patients respectively. There was statistically highly significant difference found in mean Time of onset of sensory block between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl among study subjects. (P=0.00)

Mean duration of sensory block was more among group D patients as compare to group F patients. It was 658.73 minute in group D 574.33 in group F patients respectively. There was statistically highly significant difference found in mean duration of sensory block between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl among study subjects. (P=0.00)

Mean Time of onset of motor block was more among group D patients as compare to group F patients. It was 15.80 minute in group D and 11.30 minutes in group F patients respectively. There was statistically highly significant difference found in mean Time of onset of motor block between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl among study subjects. (P=0.00)

Mean duration of motor block was more among group D patients as compare to group F patients. It was 439.33minute in group D and 368.67 in group F patients respectively. There was statistically highly significant difference found in mean duration of motor block between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl among study subjects. (P=0.00)

Mean time of rescue of analgesia was significantly more among group D patients as compare to group F patients. It was 941.67 minute in group D patients and 832.00 minute in group F patients. There was statistically highly significant difference found in mean time of rescue Analgesia between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl among study subjects. (p=0.00)

Table 1: Comparative Evaluation of Mean VAS Score Between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at Different Time Interval among Study Subjects.

Variable Median(IQR)	Group D	Group F	p-value- Man whitney U test
PO VAS 00 HRS	0(0-0)	0(0-0)	1.00
PO VAS 02 HRS	0(0-0)	0(0-0)	1.00
PO VAS 04 HRS	0(0-0.25)	0(0-1)	0.14
PO VAS 06 HRS	1(1-1)	1(1-2)	0.00
PO VAS 08 HRS	1.5(1-2)	2(2-3)	0.00
PO VAS 10 HRS	2(2-3)	3(3-4)	0.00
PO VAS 12 HRS	3(2.75-3)	4(3-3.25)	0.32
PO VAS 24 HRS	5(3-4)	6(4-5)	0.13

Pain was evaluated at VAS Score. Till 4 hours follow up there was no pain then at 12 hours pain was noticed only among group F patients. Mean VAS Score was 4 and 6 among group F patients at 12 and 24 hours respectively. At 6 hours there was statistically significant difference found in mean VAS Score between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl. (P=0.00)

Table 2: Comparative Evaluation of Mean Intra Operative Heart Rate Between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at Different Time Interval among Study Subjects.

Variable[n1/n2]	Group D	Group F	p-value-Student t test
IO HR 00MIN	85.33(±8.9)	82.57(±7.15)	.190
IO HR 02MIN	82.07(±12.17)	80.7(±9.15)	.625
IO HR 04MIN	81.13(±10.71)	79.37(±9.86)	.509
IO HR 06MIN	82(±10.32)	78(±8.07)	.100
IO HR 08MIN	80.03(±9.5)	77(±6.07)	.146
IO HR 10MIN	79.23(±9.15)	75.07(±6.83)	.050
IO HR 15MIN	75.4(±7.75)	74.03(±8.45)	.516
IO HR 20MIN	73.17(±8.38)	73.03(±9.57)	.954
IO HR 25MIN	71.97(±9.83)	72.7(±10.87)	.785
IO HR 30MIN	72.93(±10.11)	75.8(±10.96)	.297
IO HR 35MIN	75.37(±9.91)	78.47(±11.68)	.272
IO HR 40MIN	77.73(±9.83)	78.33(±10.79)	.823
IO HR 45MIN [30/29]	79.8(±9.3)	82.34(±12.2)	.370
IO HR 50MIN [30/26]	82.23(±10.66)	83.65(±10.35)	.616
IO HR 55MIN [21/21]	83.38(±10.2)	85.86(±10.85)	.450
IO HR 60MIN [14/13]	84.07(±6.5)	85.54(±8.65)	.621
IO HR 70MIN [4/7]	82(±4.24)	86.29(±10.31)	.455
IO HR 80MIN [2/4]	85.5(±4.95)	83.5(±7.55)	.758
IO HR 90MIN [2/3]	89(±4.24)	82(±6)	.256
IO HR 100MIN [2/3]	93(±4.24)	80(±8.72)	.155
IO HR 110MIN [0/1]	0(±0)	74(±0)	#N/A
IO HR 120MIN [0/0]	0(±0)	0(±0)	#N/A

Hear rate was monitored from pre OP to till 120 min. At baseline (Pre OP) mean heart rate was85.33(±8.9) and 82.57(±7.15) in group D and F respectively. There was statistically not significant difference found in mean intraoperative heart rate between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects.(P>0.05).

Table 3: Comparative Evaluation of Mean Post Operative Heart Rate Between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at Different Time Interval among Study Subject

Variable[n1/n2]	Group D	Group F	p-value- Student t test
PO HR 00 HRS	89.23(±15.07)	88.47(±14.44)	.841
PO HR 02 HRS	86.13(±17.45)	83.93(±17.97)	.632
PO HR 04 HRS	86.6(±15.97)	86.2(±15.51)	.922
PO HR 06 HRS	86.1(±16.26)	85.1(±15.65)	.809
PO HR 08 HRS	83.9(±16.03)	83.3(±15.82)	.884
PO HR 10 HRS	83.03(±14.28)	82.37(±14.02)	.856
PO HR 12 HRS	79.47(±14.97)	78.37(±14.77)	.776
PO HR 24 HRS	77.33(±15.94)	76.2(±15.48)	.781

There was statistically not significant difference found in mean postoperative heart rate between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05).

Table 4: Comparative Evaluation of Mean Intraoperative Systolic Blood Pressure (SBP) Between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at Different Time Interval among Study Subject.

Variable[n1/n2]	Group D	Group F	p-value- Student t test
IO SBP 00MIN	123.97(±8.55)	122.53(±7.3)	.488
IO SBP 02MIN	120.47(±21.95)	121.33(±5.57)	.835
IO SBP 04MIN	119.17(±11.62)	119.93(±4.77)	.739
IO SBP 06MIN	114.67(±13.26)	118.13(±5.43)	.190
IO SBP 08MIN	111.2(±11.68)	115.6(±7.15)	.084
IO SBP 10MIN	111.4(±8.04)	109.83(±9.29)	.488
IO SBP 15MIN	110.53(±9.81)	108.73(±7.69)	.432
IO SBP 20MIN	109.8(±11.43)	109.4(±6.17)	.867
IO SBP 25MIN	108.67(±11.91)	108.27(±8.5)	.881
IO SBP 30MIN	109.93(±11.42)	110.13(±4.07)	.928
IO SBP 35MIN	112.77(±9.31)	110.27(±5.5)	.210
IO SBP 40MIN [30/29]	114.07(±9.19)	112(±6)	.313
IO SBP 45MIN [30/28]	115.23(±8.58)	114.36(±7.74)	.685
IO SBP 50MIN [28/26]	115.64(±6.69)	115.23(±6.28)	.817
IO SBP 55MIN [21/21]	117.9(±7.5)	117.52(±6.13)	.858
IO SBP 60MIN [15/11]	120.93(±7.7)	117.64(±4.54)	.219
IO SBP 70MIN [4/7]	122(±8.33)	117.14(±4.45)	.231
IO SBP 80MIN [2/4]	119(±12.73)	116.5(±4.12)	.713
IO SBP 90MIN [2/4]	123(±9.9)	116.5(±4.12)	.286
IO SBP 100MIN [0/2]	0(±0)	118(±0)	#N/A
IO SBP 110MIN [0/0]	0(±0)	0(±0)	#N/A
IO SBP 120MIN [0/0]	0(±0)	0(±0)	#N/A

There was statistically not significant difference found in mean intraoperative systolic blood pressure(SBP) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05).

There was statistically not significant difference found in mean postoperative systolic blood pressure(SBP) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05).

There was statistically not significant difference found in mean intraperative diastolioc blood pressure(SBP) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects.(P>0.05).

There was statistically not significant difference found in mean postperative diastolioc blood pressure(SBP) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05)

There was statistically not significant difference found in mean intraoperative saturation (SPO2) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05).

Table 5: Comparative Evaluation of Mean Postoperative Saturation(SPO2) Between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at Different Time Interval among Study Subject.

Variable[n1/n2]	Group D	Group F	p-value- Student t test
PO SBP 00 HRS	92.2(±10.05)	93.2(±10.29)	.705
PO SBP 02 HRS	90.47(±9.36)	91.07(±9.24)	.804
PO SBP 04 HRS	90.47(±9.82)	91.27(±9.58)	.751
PO SBP 06 HRS	90.73(±8.54)	91.4(±8.46)	.762
PO SBP 08 HRS	91.9(±9.11)	92.77(±8.98)	.712
PO SBP 10 HRS	93.53(±10.1)	94.47(±10.29)	.724
PO SBP 12 HRS	96.93(±9.98)	97.93(±10.14)	.702
PO SBP 24 HRS	100.43(±10.81)	101.63(±10.92)	.671

There was statistically not significant difference found in mean Postoperative saturation (SPO2) between Bupivacaine with Fentanyl and Ropivacaine with Fentanyl at different time interval among study subjects. (P>0.05).

The benefit of regional anaesthesia over general anaesthesia has been well recognised especially with respect to minimal anaesthetic exposure, reduced need of systemic analgesics and early discharge. Regional anaesthesia has its own problems like patchy nerve block, early wearing off, local anaesthetic toxicity, anxiety and requirement of intraoperative sedation. If these problems can be overcome, regional anaesthesia will be a safe and comfortable experience for most patients. Thus, anaesthesiologists started probing into new avenues searching for answers. Although intravenous benzodiazepines, barbiturates or opioids seemed to be the most obvious answer, the haemodynamic effects produced by these drugs could not be overlooked. With the advent of α2 agonists like clonidine and dexmedetomidine, intravenous sedation gained importance again as they were found to produce sedation without significant respiratory compromise. These goals gave birth to the concept of additives along with local anaesthetics in regional anaesthesia. The aim was to produce quick, dense and prolonged block as well as reduce the requirement of systemic analgesics and anxiolytics. But these too are not without side effects. Significant bradycardia, hypotension and even cardiac arrest have been reported with these agents at therapeutic doses.

The present study was aimed at comparing the block characteristics with respect to onset and duration action, postoperative analgesia, haemodynamic changes of ropivacaine with fenatanyl and bupivacaine with fentanyl .

In our study, there was delayed onset of sensory and motor block on addition of fentanyl to bupivacaine; it could be due to change in pH of anesthetic solution. Local anesthetic solution with a pH closer to physiological pH will have a higher concentration of non ionized base that can pass through the nerve cell membrane, and onset will be more rapid.

In the present study, the pH of the Bupivacaine solution is decreased from 5.8-5.0 by addition of fentanyl so there is delayed onset of sensory and motor block. pH of the solutions were measured with the help of Biochemistry department and duration of analgesia is significantly prolonged on addition of fentanyl to bupivacaine ($p<0.05$).

Prolonged analgesia produced by peripheral application of fentanyl is due to three possible mechanisms. First, fentanyl may penetrate the nerve membrane and transport to the dorsal horn by bidirectional axonal transport where it acts on opioid binding site. However, it is unlikely that the small dose of fentanyl (50 microgram) used in present study could have a local anesthetic action because higher concentration (50 microgram per ml.) required in vitro. Second, fentanyl may bind with opioid binding site by diffusion through brachial plexus sheath to epidural and sub-arachnoid space. To prove this cerebrospinal fluid fentanyl concentration should be measured. Third theory is that-fentanyl gets systemically absorbed, acts on central opioid receptors and thus potentiates the action of local anesthetic. However, amount of fentanyl absorbed systemically is too small to hpotentiating effect on action of local anesthetic. Similar to this study, other studies also concluded that duration of analgesia is prolonged by addition of fentanyl to bupivacaine.

The difference in perioperative heart rate, blood pressure, sedation score and oxygen saturation in both the groups were statistically insignificant ($p<0.05$). A comparative study conducted by Gohiya Sarita and Gohiya Vineet. (A Comparative study of efficacy of fentanyl added to Bupivacaine versus Bupivacaine alone used in supraclavicular brachial block for upper limb surgeries). On statistical analysis, results showed that onset of sensory block was significantly prolonged on addition of Fentanyl to Bupivacaine. There was no adverse effect observed on addition of Fentanyl and Hemodynamic variables are also not significantly affected[8].

In a study conducted by Anupreet kaur[9] (2012-2013) a prospective randomized study in 50 patients between 18-55 year, comparable in demographic variables, were randomly allocated to two groups of 25 each. Group I received 30ml 0.5% Bupivacaine, Group II received 30 ml 0.5% Ropivacaine in axillary brachial plexus block for forearm surgeries. Onset, Duration of sensory-motor block, Heart rate, Blood pressure, Oxygen saturation and Respiratory rate were recorded. On the basis of their study, they concluded that onset of action of sensory, motor block was early in Ropivacaine group with faster recovery of motor functions as compared to Bupivacaine group.

According to Suvarna Kaniyil, Priya Radhakrishnan[10] Does fentanyl prolong the analgesia of local anaesthetics in brachial plexus block? A randomized controlled study), Addition of fentanyl to local anesthetics in brachial plexus block significantly prolonged the duration of analgesia without any significant side effects though it had delayed the onset of block.

In a study conducted by Tejwant Rajkhowa[11] The addition of fentanyl to ropivacaine significantly prolonged the duration of analgesia compared to ropivacaine used alone for supraclavicular brachial plexus blocks in patients undergoing forearm surgeries.

CONCLUSION

The brachial plexus block via the supraclavicular approach instinctively is associated with brisk onset of anaesthesia and highly successful. It is great for procedures of the arm, forearm and hand. Ropivacaine is a less cardio toxic, neuro toxic local anaesthetic and equally potent with Bupivacaine in peripheral nerve blockade. Based on this study, I would like to conclude

that addition of fentanyl with Bupivacaine (Group D) in supraclavicular brachial plexus block prolongs both onset and duration of sensory and motor blockade and post operative analgesia.

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