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Comparative assessment of the effect of fentanyl and tramadol as an adjuvant to ropivacaine in supraclavicular brachial plexus block

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ABSTRACT

Aim: The aim of the present study was to compare the effect of fentanyl and tramadol as an adjuvant to ropivacaine in supraclavicular brachial plexus block.

Methods: This prospective, randomized double-blind study was conducted in the Department of Anaesthesiology. 200 patients of either sex aged 20-60 years, belonging to ASA physical status I or II undergoing upper-arm surgery were recruited for this study.

Results: Therewas no statistically significant difference among the two groups in demographic characteristics. Majority of study participants were males but there is no statistical difference among two groups. The demographic status and data before the block were comparable among two groups ($P > 0.05$). Mean ± standard deviation for onset of complete sensory block prolonged from group RT and to Group RF. There was statistically significant difference in onset of complete sensory block among the groups($p < 0.001$). Mean ± standard deviation for onset of complete motor block prolonged from Group RT to group RF. Mean post-operative VAS Score at 3 hours was 0.43 and 1.31, at 6 hours it was 0.57 and 2.77 in both the study groups. Mean VAS score at 9 hours was 1.40 and 3.97 in Group RT and RF, at 12 hours mean VAS score of Group RT was 2.60 and that of Group RF was 2.46. Mean postoperative VAS score at 15 hours was 3.43 and 2.97 in Group RT and RF, at 18 hours mean VAS score was 1.26 in RT group and 2.89 in RF group. At 21 hours mean postoperative VAS score was 1.94 and 2.71 in both the study groups, while as at 24 hours mean VAS score was 2.14 in Group RT and 2.94 in Group RF.

Conclusion: In conclusion, tramadol when used as adjuvant with local anaesthetic in peripheral nerve block provides better surgical anaesthesia and analgesia. Therefore, its use should be promoted for routine addition to local anaesthetics in peripheral nerve blocks.

Keywords: Supraclavicular block, Ultrasound guidance, Time of onset of block, Rescue analgesia, Tramadol, Fentanyl

1. INTRODUCTION

Upper limb surgeries are usually done under peripheral blocks such as brachial plexus block. Reduced hospital stay, less financial burden, and avoidance of complications

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due to general anesthesia are many advantages of brachial plexus block in comparison to general anesthesia. Peripheral nerve blocks not only provide intraoperative anesthesia but also post-operative analgesia without any systemic side effects.[1] Different adjuvants are used with local anesthetics that prolong the duration of anesthesia with less adverse effects. Opioids, α2 agonist, and dexamethasone are few of them. Addition of fentanyl to local anesthetic is known to significantly improve the duration of sensory and motor blockade as well as visual analog scale scores.[2,3] Dexmedetomidine, a potent centrally acting α2 agonist, is widely used for anesthesia, analgesia, monitored anesthesia care, and as an adjuvant to local anesthetic for peripheral nerve block.[4,5]

Tramadol is a synthetic analgesic drug that is antagonized by α2-adrenoceptor antagonists as well as opioid antagonists.[6] Ketamine, a dissociative anesthetic N-methyl D-aspartate (NMDA) antagonist, abolishes peripheral afferent noxious stimulation.[7]The effects of different doses of tramadol, ranging between 40 and 200 mg, and ketamine, ranging between 1 and 1.5mg/kg, with different local anesthetics, have been reported in several studies. However, there is no study that addresses the minimal dose required to prolong the duration of motor block, sensorial block, and analgesia without increasing adverse effects.[8,9]

Ropivacaine is widely used in clinical practice, but little is known about the effects on its nerve block characteristics by adding a small dose of fentanyl for brachial plexus anaesthesia. Peripheral administration of an opioid agonist can theoretically inhibit the propagation of action potentials or the release of excitatory transmitters in primary afferent fibres,[12,13] since opioid receptors have been demonstrated on primary afferent neurons. This peripheral antinociceptive effect of exogenous opioids should be particularly enhanced under inflammatory conditions.[10,11]

The aim of the present study was to compare the effect of fentanyl and tramadol as an adjuvant to ropivacaine in supraclavicular brachial plexus block.

2. MATERIALS AND METHODS

This prospective, randomized double-blind study was conducted in the Department of Anaesthesiology. 200 patients of either sex aged 20-60 years, belonging to ASA physical status I or II undergoing upper-arm surgery were recruited for this study.

Pre-operative visit were performed one day prior to surgery. All the patients were clinically assessed, evaluated and investigated as per proforma. All patients were kept NPO for 8 hrs. On arrival to the operation theatre, i/v line was established with 20 Gauge cannula. All patients received Midazolam 1 mg iv as premedication before performance of block. Standard anaesthesia monitoring was done (ECG, blood pressure, pulse oximetry). Drug solution was prepared by an anaesthetist not involved in the performance of the block. The patients were randomly allocated into 2 groups.

Group RT: Patients were given 0.5% Ropivacaine 30ml + tramadol 50mg [1ml]. Group RF: Patients were given 0.5% Ropivacaine 30ml + fentanyl 50mcg [1ml].

Under all aseptic precautions (UAAP) supraclavicular was performed by 100mm locoplex needle under USG guidance. Intraoperatively onset of block was assessed by the time between drug injection and complete loss of pin-prick sensation in C4-C5 dermatome. Sensory block was quantified as per visual analogue scale (VAS) every 5 minutes for 30 minutes after injection intraoperatively. Visual analogue scale (VAS) (0= No pain, 1-3= Mild pain, 4-6= Moderate pain, 7-10= Severe pain). Onset of Motor block was defined as reduction of muscle power to grade 3 or less. When surgical anaesthesia will not be achieved in a patient even after 30 min from the anaesthetic injection, the case was considered as failed block and the operation was then performed under general anaesthesia. Sedation score was evaluated every 5 minutes after injection till 30 minutes intraoperatively as per standard

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sedation scale (awake, alert=score 1, Sedated and responds to verbal stimulus = Score 2, Sedated and responding to mild physical stimulus= Score 3, Sedated and responding to moderate and strong physical stimulus= Score 4, Not aroused= Score 5. Post-operatively an observer unaware of patient groups assessed the following variables. (i) Pain score (VAS) every 3 hourly till 24 hours, (ii) Duration of analgesia, defined as time elapsed from performance of block to appearance of pain in operated limb. (iii) Requirement of rescue analgesia doses in first 24 hours. Rescue analgesia will be given by injection paracetamol 15mg/kg when VAS is >4 and, (iv) Incidence of nausea, vomiting, pruritus or any other complication.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean and categorical variables were summarized as frequencies and percentages. Student's independent t-test was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

3. RESULTS

Table 1: Demographics and clinical characteristics

	Group RT	**Group RF**	**P value**
Age (years)	38 ± 2.0	42 ± 6.00	0.416
BMI (kg/m2)	20.55 ± 1.60814	21.41 ± 1.48	0.232
Sex			
Male	90	80	0.646
Female	10	20	
ASA			
ASA I	48	46	0.733
ASA II	2	4	
Baseline Spo2 (%)	98 (97-99)	97 (96-99)	0.120
Baseline PR (bpm)	95 (86-98.5)	96 (86-99)	0.344
Baseline SBP (mmHg)	130 (126-133)	129 (128-131)	0.560
Baseline DBP (mmHg)	71.76 ± 6.75	71.86 ± 7.72	0.743
Baseline MAP (mmHg)	90.5 ± 4.11	91 ± 5.2	0.931
Surgical duration (mins)	137.14 ± 16.70	140.09 ± 18.43	0.832
Time to skin incision (mins)	31 (30-34)	36 (34-38)	<0.001

There was no statistically significant difference among the two groups in demographic characteristics. Majority of study participants were males but there is no statistical difference among two groups. The demographic status and data before the block were comparable among two groups (P > 0.05).

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Table 2: Comparison of time to onset of complete and duration of sensory and motor block among groups

Time to onset	**Group RT**	**Group RF**	**P value**
Sensory block (mins)	16.54 ± 1.06	15.75 ± 1.09	<0.001
Motor block (mins)			
Grade I	18 (18-19.5)	16 (15-17)	<0.001
Grade II	18.6 ± 1.86	25 ± 1.50	<0.001
Duration in hours			
Sensory block (hrs)	12.11 ± 0.76	8.8 ± 1.12	<0.001
Motor block (hrs)	9.37 ± 0.5	6.85 ± 0.69	<0.001
Time to 1st analgesic request (hrs)	15.52 ± 1.6	10.07 ± 0.72	<0.001

A one-way ANOVA was used to determine if onset of complete sensory block was different among the groups. There were no outliers as assessed by box plot. Data was normally distributed for each group as assessed by Shapiro-Wilk test ($p > 0.05$). Mean ± standard deviation for onset of complete sensory block prolonged from group RT to Group RF. There was statistically significant difference in onset of complete sensory block among the groups $p < 0.001$. Mean ± standard deviation for onset of complete motor block prolonged from Group RT (18.6 ± 1.86min) to group RF (n ¼ 21, 25 ± 1.50min). There was statistically significant difference in onset of complete motor block among the groups $p < 0.001$. Mean ± standard deviation for time to first analgesic request prolonged from group RF (10.07 ± 0.72hr) and to Group RT (15.52 ± 1.6hr). There was statistically significant difference in time to first analgesic request among the groups $P < 0.001$.

Table 3: Mean inter-operative VAS and sedation score

VAS score		
Time interval	**Group RT**	**Group RF**
5 minutes	5.09	6.14
10 minutes	2.49	4.06
15 minutes	0.83	1.91
20 minutes	0.31	0.87
Sedation score		
5 minutes	2.97	3.11
10 minutes	1.99	2.11
15 minutes	1.06	1.20
20 minutes	1.09	1.14
25 minutes	1.03	1.09
30 minutes	1.03	1.06

Mean VAS Scores in Group RT and Group RF at 5 minute was 5.09 and 6.14, at 10 minutes it was 2.49 and 4.06. Mean VAS score at 15 minutes was 0.83 and 1.91 in Group RT and RF, at 20 minutes mean VAS score of Group RT was 0.31 and that of Group RF was 0.87. Mean interoperative sedation score of Group RT and Group RF at 5 minute was 2.97 and 3.11, at 10 minutes it was 1.97 and 2.11 in both the study groups. Mean sedation score at 15 minutes was 1.06 and 1.20 in Group RT and RF, at 20 minutes mean sedation score of Group RT was 1.09 and that of Group RF was 1.14. Mean sedation score at 25 minutes in Group RF and RF was 1.03 and 1.09, while as it was 1.03 and 1.06 at 30 minutes in both the study groups.

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Table 4: Mean post-operative VAS score

VAS score		
Time interval	**Group RT**	**Group RF**
3 hours	0.43	1.31
6 hours	0.57	2.77
9 hours	1.40	3.94
12 hours	2.60	2.46
15 hours	3.43	2.97
18 hours	1.26	2.89
21 hours	1.94	2.71
24 hours	2.14	2.94

Mean postoperative VAS Score in groups RT and RF at 3 hours was 0.43 and 1.31, at 6 hours it was 0.57 and 2.77. Mean VAS score at 9 hours was 1.40 and 3.97 in Group RT and RF, at 12 hours mean VAS score of Group RT was 2.60 and that of Group RF was 2.46. Mean postoperative VAS score at 15 hours was 3.43 and 2.97 in Group RT and RF, at 18 hours mean VAS score was 1.26 in RT group and 2.89 in RF group. At 21 hours mean postoperative VAS score was 1.94 and 2.71 in both the study groups, while as at 24 hours mean VAS score was 2.14 in Group RT and 2.94 in Group RF.

4. DISCUSSION

Brachial plexus block is the preferred choice for upper limb surgeries, and it is the most commonly used technique for this purpose.[14] Providing adequate and timely sensory and motor block, safety of use and augmentation the postoperative analgesic efficacy of the drug should be considered while selecting a pharmacological option during regional anesthesia.[15] Bupivacaine is the most widely used local anesthetics (LA) in peripheral nerve blocks. Adjuvants may be added to LAs to reduce the dose of each agent, to enhance the quality and duration of block, to increase the analgesic effect, and to reduce the need for supplementary analgesics, thus reducing the incidence of adverse reactions.

In our study, mean age in the Group RT was 39.1 years whereas in Group RF patients was 41.5 years. Geze S et al. (2012)[16] compared the effect of tramadol and fentanyl as adjuvant agents to local anesthetic mixtures in axillary plexus block for orthopedic upper extremity surgery. In their study the mean age in Group T (tramadol) was 42.1 while as mean age in patients of group F (fentanyl) was 38.0 years. Rajkhowa T et al. (2016)[17] studied 66 ASA I and II patients aged 18-65 years and found mean age of patients of group R (Ropivacaine) and group RF (Ropivacaine + Fentanyl) was 44.0 years respectively. Naaz S et al., (2017)[18] studied 60 otherwise healthy patients with physical status ASA I and II, were randomly allocated to 3 groups to receive either plain bupivacaine 30ml, alkalinized bupivacaine 30ml (sodium bicarbonate 8.4%, 0.1ml/10 ml of bupivacaine) and fentanyl-bupivacaine (75µg fentanyl) 30ml. In group I, there were 16 males and 4 females, in group II there were 15 males and 5 females, whereas in group III there were 14 males and 6 females respectively.

A one-way ANOVA was used to determine if onset of complete sensory block was different among the groups. There were no outliers as assessed by box plot. Data was normally distributed for each group as assessed by Shapiro-Wilk test ($p > 0.05$). Mean ± standard deviation for onset of complete sensory block prolonged from group RT and to Group RF. There was statistically significant difference in onset of complete sensory block among the groups RF $p < 0.001$. Mean ± standard deviation for onset of complete motor block prolonged from Group RT to group RF. There was statistically significant difference in onset

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of complete motor block among the groups $p < 0.001$. Mean ± standard deviation for time to first analgesic request prolonged from group RF and to Group RT. There was statistically significant difference in time to first analgesic request among the groups $P < 0.001$. Mean intraoperative VAS score of Group RT and Group RF at 5 minute was 5.09 and 6.14, at 10 minutes it was 2.49 and 4.06 in both the study groups. Mean VAS score at 15 minutes was 0.83 and 1.91 in Group RT and RF, at 20 minutes mean VAS score of Group RT was 0.31 and that of Group RF was 0.87. Naaz S et al (2017)[18] studied 60 otherwise healthy patients with physical status ASA I and II were randomly allocated to 3 groups of 20 patients each. In their study, mean VAS score at 30 min in group I, group II and group III were 2.70 0.47, 2.35 0.49 and 2.15 0.37 respectively. The mean VAS score at 30 min was lowest in group III and the difference was statistically significant compared to both groups I and group II. They observed a significant difference in VAS between group I and II.

Kardash K et al[19] observed a significant decrease in VAS score in the patients who received fentanyl and bupivacaine in brachial plexus block at 1 hour after surgery. This is consistent with our results. In our study the mean VAS score in group RT and Group RF at 5 minute was 5.09 and 6.14, at 10 minutes it was 2.49 and 4.06. Mean VAS score at 15 minutes was 0.83 and 1.91 in Group RT and RF, at 20 minutes mean VAS score of Group RT was 0.31 and that of Group RF was 0.87. Mean interoperative sedation score of Group RT and Group RF at 5 minute was 2.97 and 3.11, at 10 minutes it was 1.97 and 2.11 in both the study groups. Mean sedation score at 15 minutes was 1.06 and 1.20 in Group RT and RF, at 20 minutes mean sedation score of Group RT was 1.09 and that of Group RF was 1.14. Mean sedation score at 25 minutes in Group RT and RF was 1.03 and 1.09, while as it was 1.03 and 1.06 at 30 minutes in both the study groups. Naaz S et al (2017)[18] studied the difference in time to achieve complete block was statistically significant with mean of 26.3±1.94 minutes in group I, 17.0± 1.23 minutes in group II and 21.0±2.05 minutes in group III. Barsagade W et al., (2016)[20] compared the clinical characteristics of ropivacaine 0.5% and bupivacaine 0.5% with fentanyl when used for interscalene brachial plexus block.

Mean postoperative VAS score in groups RT and RF at 3 hours was 0.43 and 1.31, at 6 hours it was 0.57 and 2.77. Mean VAS score at 9 hours was 1.40 and 3.94 in Group RT and RF, at 12 hours mean VAS score of Group RT was 2.60 and that of Group RF was 2.46. Mean postoperative VAS score at 15 hours was 3.43 and 2.97 in Group RT and RF, at 18 hours mean VAS score was 1.26 in RT group and 2.89 in RF group. At 21 hours mean postoperative VAS score was 1.94 and 2.71 in both the study groups, while as at 24 hours mean VAS score was 2.14 in Group RT and 2.94 in Group RF. In a study conducted by Naaz S et al (2017)[18] on comparing the Visual Analogue Scale (VAS) score between the three groups at various intervals i.e. 30 minutes, 1 hr, 2 hr, 4 hr, 6 hr, a statistically significant difference was found ($p<0.001$). A mean VAS score of 3.12±0.29 was found in group I, 2.96±0.34 in group II and 2.61±0.23 in group III. The VAS score in group III was lower than group II and group I. Patients in group III had a longer period of subjective comfort as compared to group II and group I. These observations are in congruence with those of Parikh R K et al. (1995).[21]They observed that addition of fentanyl 0.2µg/ml to the solution increased the degree of analgesia. This has been attributed to the antinociceptive effects of fentanyl due to activation of opiate (µ) receptors present peripherally on primary afferent nerves. Secondly, fentanyl may also provide analgesia through central opioid receptor-mediated analgesia by peripheral uptake of fentanyl to systemic circulation.

5. CONCLUSION

Skillful administration of brachial plexus block is essential for effective surgical anaesthesia and analgesia. It not only eliminates stress response to surgery but also helps in smooth

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transition of patient from surgery to routine preoperative state. High satisfaction scores were reported by patients in both groups of our study. All were contended with the brachial plexus block/anaesthesia and overall level of analgesia. The ropivacaine – tramadol group showed significant prolonged sensory and motor block and better pain relief. While the first request analgesia time measured was prolonged in ropivacaine – tramadol group, we did not measure the total amount of supplemental analgesics taken post-operatively. Further studies can be done to observe the efficacy of different doses of tramadol in various combinations of local anaesthetics in our population.

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