Original Research Article

Comparative Study Between Bupivacaine and Bupivacaine with Tramadol in Different Doses for Supraclavicular Brachial Plexus Block

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Abstract

Background and Objectives To find minimal and effective dose of tramadol as an adjuvent for brachial plexus block for faster onset of motor, sensory block and duration of analgesia.**Material and Methods** This prospective, randomized, comparative, double blind study was conducted on 75 patients undergoing upper limb surgeries under supraclavicular brachial plexus block among three groups of 25 each (Group B, Group BT 1 and Group BT 2). Block was given with 20 mL of 0.5% Bupivacaine + 10 ml NS in Group B, 20 mL of 0.5% Bupivacaine with Tramadol 1 mg/kg and 1.5 mg/kg in 10ml NS in Group BT1 and Group BT2 respectively. Onset of sensory and motor block, duration of analgesia and motor block, side effects associated with tramadol were observed and compared among groups.**Observations and results** Onset of sensory and motor blockade was significantly faster statistically ($p < 0.05$) in Group BT2 (11.2 minutes and 6.00 minutes respectively) compared to Group BT1 (13.6 minutes and 9.00 minutes respectively) and Group B (18.8 minutes and 10.5 minutes respectively). Duration of analgesia among groups was significantly longer statistically in Group BT2 (326.20 minutes) compared to other groups. Duration of motor blockade among groups significantly longer in the BT2 (270.8 minutes) compared to Group BT1 and Group B. There were statistically insignificant side effects among groups.**Conclusion** Tramadol in various doses ,as an adjuvant to local anaesthetics can be used safely and effectively with insignificant side effects.

Keywords: Tramadol , Adjuvant , Local Anaesthetics , Sensory, Motor Blockade.

Introduction

Regional nerve blocks are centred on the belief that pain is carried by the nerve fibres. The pain sensation can be interrupted anywhere along the pathway of the nerve. Braun established that if adrenaline is added in small amount to an anaesthetic solution, it could increase the duration of analgesia. Peripheral nerve blocks can be used as the sole anaesthesia of choice, as they not only deliver intraoperative anaesthesia but also avoid undesirable side effect of general anaesthesia specially in patients whom general anaesthesia is not the first choice and provide extended postoperative analgesia. [1,2]

Injuries to the upper extremities are very common and elective and emergency surgical procedures for upper limb injuries are frequent. Brachial plexus block is a very reliable regional anaesthesia procedure. With appropriate selection of patient and sedation, this block not only provides favourable conditions for surgery but also provides excellent postoperative analgesia. The supraclavicular block delivers very effective anaesthesia of entire upper extremity as compared to other brachial plexus block techniques.

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The supraclavicular technique is effective because it provides superior anaesthesia for arm, forearm and hand operative procedures. [3,4]

Anatomical landmark with paraesthesia, nerve stimulator aided and ultrasound guidance are frequent methods for localizing brachial plexus and deposition of local anaesthetic for block. The introduction of nerve stimulator technique in 1980s raised the popularity of brachial plexus block and their subsequent use allowed better localization of the nerve plexuses for performing effective and successful block. [5]Among various local anaesthetics, bupivacaine is frequently used as it provides comparatively long duration of anaesthesia. Addition of local anaesthetic adjuncts helps in faster onset and prolonging duration of analgesia especially for postoperative period. Neostigmine, clonidine, soda-bicarb, opioid and epinephrine have been used experimentally as well as conventionally as local anaesthetic adjunct. Clonidine use has been associated with side effects like sedation, hypotension and bradycardia. Opioids have been used and studied for brachial plexus block but they are found to be more prone to the adverse effects like heavy sedation, psycho mimetic effects and respiratory depression. Neostigmine, hyaluronidase, corticosteroids and verapamil have been tried and found to have inconstant and questionable results. The pursuit for an ideal adjunct with right dose for brachial plexus block

which extends durations of analgesia without adverse effects is still going on. [6-8]

Tramadol has been used in all variations and approaches of brachial plexus block as well as in caudal block. Tramadol as an additive in brachial plexus block has been found to be effective with minimal and acceptable side effects in most of the studies with few exceptions. Tramadol is a centrally acting analgesic drug. The analgesic effect is μ-opioid receptor mediated. In addition to μ-opioid receptor agonist effect, it inhibits reuptake of noradrenaline and serotonin from the nerve endings. Tramadol is a synthetic 4-phenyl-piperidine analog of codeine. Its mechanism of action has some characteristics in common with clonidine and opioids. Not only does tramadol display central analgesic effects as the result of its monoaminergic and mu-receptor agonistic activity, it also has peripheral local anesthetic properties [4–6] and has a small potential for serious adverse effects. Tramadol does not cause respiratory depression as seen with opioids. [6-9]

Various doses of tramadol as an adjunct to local anaesthetic for brachial plexus block have been studied. This study was aimed to find minimal and effective dose of tramadol without losing its advantages as an adjunct for brachial plexus block for faster onset of motor, sensory block and duration of analgesia. Side effects related to different doses of tramadol (nausea and vomiting) were also compared.

Materials and Methods

This prospective, randomized, comparative, double blind study was conducted in a tertiary health care centre over 18 months after approval from ethical committee. 75 patients undergoing upper limb surgeries under regional anaesthesia by supraclavicular brachial plexus block were recruited after informed consent. These patients were divided among three groups of 25 each (Group B, Group BT 1 and Group BT 2) by random selection method.

Inclution and exclution criteria :

Patients giving valid consent, adult patients aged between 18-60 years (both sexes), ASA I and ASA II physical status (ASA = American Society of Anaesthesiologist) scheduled for elective Upper Limb Surgeries (Arm, forearm and hand) were included in this study. Patient refusing to participate in study, patients with coagulation abnormalities, sepsis, compromised cardio-pulmonary profile, severe obesity (BMI >35 kg/m2), pregnancy, bony deformities at regional anaesthesia site, ASA physical status III or more, history of allergy to local anaesthetic and tramadol, history of alcohol or drug abuse, patients who needed supplementation with general anaesthesia, with patchy or inadequate analgesia and development of subsequent pneumothorax following block were excluded from this study.

Methodology:

All the patients underwent thorough pre-anaesthetic evaluation on the day prior to surgery. The procedure to be carried out was explained to the patient and patient information sheet was given. Written informed consent was obtained from each patient before the procedure. An intravenous line was secured with 18 G intravenous cannula on the contra lateral upper limb and standard monitoring was applied. Preparation to give general anaesthesia, emergency management and pre-operative anaesthesia machine check were done before performing supraclavicular brachial plexus block.

After randomly assigning group, local anaesthetic solution was prepared by anaesthetist other than anaesthetist involved in performing supraclavicular brachial plexus block and assessing the block parameters to avoid bias. The anaesthetic solution was prepared as following.

- **Group B** – Prepared by addition of 10 ml of normal saline to 20 ml of 0.5% Bupivacaine in Group B.
- **Group BT1** – In Group BT1, 1 mg/kg of tramadol (2 mL = 100 mg) was diluted with normal saline to make it into 10 ml, which was added to 20 ml of 0.5% Bupivacaine. This did not change the colour of prepared solution.
- **Group BT2** - In Group BT2, 1.5 mg/kg of tramadol (2 mL = 100 mg) was diluted with normal saline to make it into 10 ml, which was added to 20 ml of 0.5% Bupivacaine. This did not change the colour of prepared solution.

Onset of sensory and motor block, duration of analgesia, duration of motor block, side effects (Nausea, Vomiting) and other parameters (Pulse Rate, Blood pressure, Respiratory rate, oxygen saturation) were recorded.

Onset of sensory block was assessed with application of cold spirit swabs and response to atraumatic prick with the blunt needle in the different areas innervated by radial, ulnar, median, musculocutaneous and antebrachial cutaneous nerves and compared in the anaesthetized and contralateral upper limb. It was assessed every 1 minute after injection of local anaesthetic solution. Onset of sensory block was defined from injection of local anaesthetic solution till complete sensory blockade of assessment area and measured in minutes.

Onset of motor blockade was assessed every 1 minute after injection of local anaesthetic solution using Bromage three-point score (0 = Normal motor function with full flexion and extension of elbow, wrist and fingers, 1 = Decreased motor strength with ability to move fingers &/or wrist only 2 = Complete motor block with inability to move fingers). Onset of motor block was defined from injection of local anaesthetic solution till complete motor blockade (Bromage three-point score = 2) of assessment area and measured in minutes.

A successful supraclavicular brachial plexus block was considered if both sensory and motor block were obtained within 30 minutes of injecting local anaesthetic. Patients with failed block were removed from the study.

Duration of analgesia was defined from the time elapsed from the onset of complete sensory block to first requirement of analgesics (at Visual Analog Scale 4) and was assessed by Visual Analog Scale (VAS, 0 = no pain and 10 = worst pain imaginable). Patients were given additional analgesics after first demand of analgesic or VAS ≥ 4. Duration of analgesia was assessed at every half hour for first eight hours then at every hour for 24 hours.

Duration of motor block was defined from the time of onset to complete recovery of motor power (Bromage three-point score of 0). It was assessed at every half hourly interval for eight hours then every hour for 24 hours from onset of motor block. Rescue analgesic injection aqueous diclofenac sodium 1.5 mg /kg was given intravenously slowly when patient complained of pain (VAS≥4). If any side effects related to the technique (e.g., pneumothorax) or drug such as nausea, vomiting, respiratory depression occurred, they were recorded and treated accordingly. For nausea and vomiting injection ondansetron 0.1mg/kg was given intravenously.

Observation Chart

Seventy-five patients aged between 18 and 60 years, who were posted for surgeries involving the upper limbs, were inducted in the study. These patients were equally divided in three groups (Group B, Group BT1 & Group BT2) by draw of lots. Patients were not aware of their group allotment. All the patients were between 18-60 years in the three groups

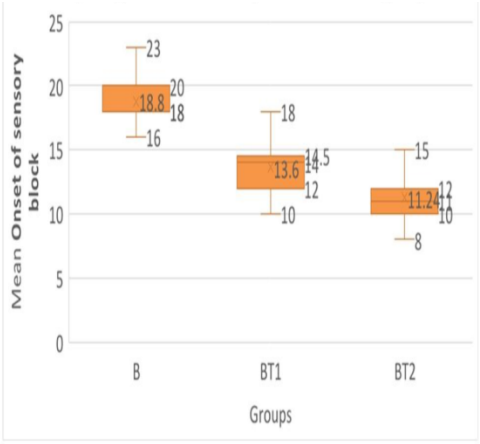

Figure -1

Fig 1:Comparing onset of sensory block between groups

On group comparison using tukey's Post hoc analysis it was found that there was significant difference between all the three groups in onset of complete sensory block as revealed by the significant p value of <0.001.

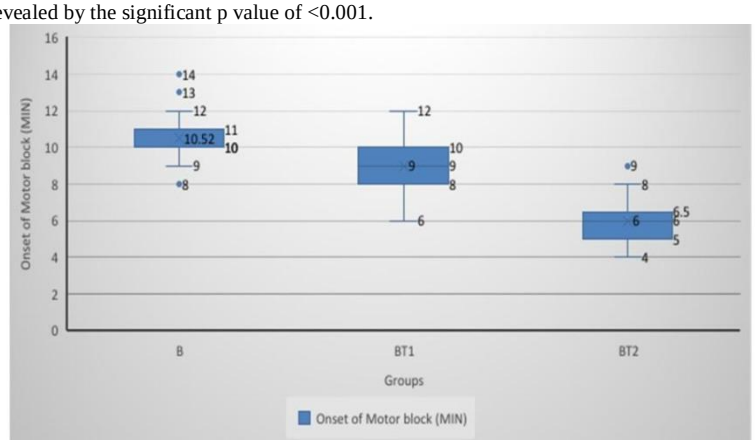

Fig 2:Comparing onset of motor block between groups

Table 1: Duration of analgesia (min)

	Sun of Squares	df	Mean Square	F	Sig.
Between Groups	**462248.000**	**2**	**231124.000**	**287.95**	**.000**
Within groups	**57790.000**	**72**	**802.639**		
Total	**5200038.000**	**74**			

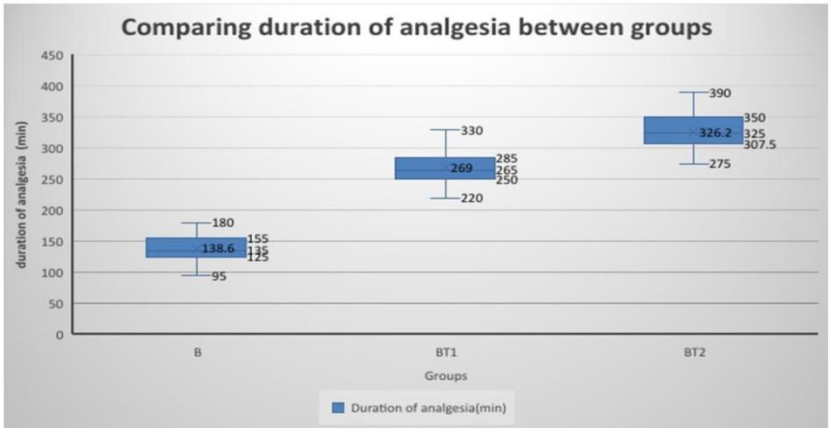

Fig 3:Comparing duration of analgesia between groups

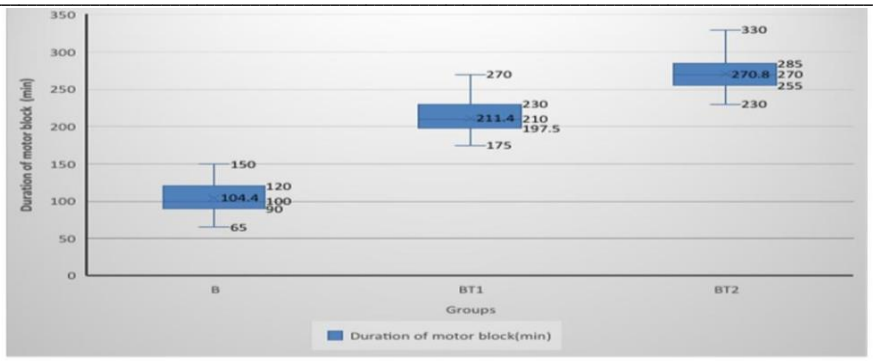

Fig 4:Comparing duration of motor block between groups

Results

The mean age in Group B was 44.00±8.534 years, in Group BT1 was 40.48 ± 9.996 years, and in Group BT2 was 42.68±9.724 years. There was no significant difference ($p > 0.05$) among groups for age, sex and weight distribution and groups were comparable.

On comparing the onset of complete sensory block between groups, it was revealed that in Group BT2 (11.24 min) the onset of sensory blockade was faster as compared to Group B and Group BT1 (13.60 min). Group B had the slowest onset of sensory block. The comparison was significant with p value of <0.001 (Figure - 1).

On comparing the onset of complete motor block between groups it was revealed that Group B has the slowest onset (10.52 min) of motor block. It was the fastest in Group BT2 (6.00 min). Onset of motor blockade in Group BT1 (9.00 min) was slower as compared to Group BT2. The comparison was significant with p value of <0.001. On group comparison using tukey's Post hoc analysis it was found that there was significant difference between all the three groups. P value between group B and group BT1 was <0.001, between B and BT2 was <0.001, between BT1 and BT2 was <0.001.

When compared among the groups it was evident that period of analgesia was the shortest in Group B (138.60 min) and the longest in Group BT2 (326.20 minutes) as compared to Group BT1 (269.00 minutes). The comparison was significant difference with p value of <0.001 (Figure – 3). On group comparison using tukey's Post hoc analysis it was found that there was significant difference between all the three groups. P value between group B and group BT1 was <0.001, between B and BT2 was <0.001, between BT1 and BT2 was <0.001 (Table -1).

On comparing the duration of motor block between groups it was revealed that period of motor block was the shortest in Group B (104.40 minute) and the longest in Group BT2 (270.80 minute) as compared to Group BT1 (211.40 minute). The comparison was significant with p value of <0.001 (Figure – 4). On group comparison using tukey's Post hoc analysis it was found that there was significant difference between all the three groups. P value between group B and group BT1 was <0.001, between B and BT2 was <0.001, between BT1 and BT2 was <0.001.There was 1 episode of Nausea, vomiting each in Group B and Group BT2, which was statistically insignificant. No such episode occurred in Group BT1. None of the groups reported any side effect or complication which can be attributed to Tramadol (respiratory depression) and technique (intravenous injection or pneumothorax).There was no significant difference among groups with regard to pulse rate, blood pressure and oxygen saturation.

Statistical Analysis: For statistical analysis continuous variables were summarized as mean and standard deviation whereas nominal/categorical variables as proportion (%). Parametric test i.e. One Way ANOVA (Analysis of variance) followed by Post-hoc Tukey's HSD (honest significant difference) were used for comparison of continuous variable while Chi-square test was used for nominal/categorical variable. The P value of < 0.05 was considered significant. The statistical calculations were done with the use of software known as SPSS (Statistical Package for Social Science).

Discussion

The Brachial Plexus Block is a highly efficient nerve block for surgeries and operations of upper limb. It provides brilliant and superior operative conditions and post-operative pain relief. The local anaesthetics have a very limited period under which they can provide analgesia and anaesthesia. The purpose of adding other drugs and agents to local anaesthetics for the nerve block is mainly to extend and prolong the duration of analgesia. Many drugs and agents have been tried to fill this gap. An ideal adjunct does not produce any significant systemic side effects or very prolonged motor blockade.

Tramadol is an opioid type of analgesic drug which acts on the CNS. μ opioid receptors are considered as responsible for the pain-relieving action of Tramadol. Tramadol also has modulatory influence on central monoaminergic pathways and inhibits the neuronal uptake of serotonin and noradrenaline. The use of tramadol as an additive/adjunct to local anaesthetics in nerve blocks has been deliberated but its mechanism of action has not been understood clearly till date. Yu-Chuan Tsai and co-workers did study on Wistar Rats. In that particular study researchers tried to find out about the blocking effect of Tramadol on nerve fibres. Toxicity (neuronal) of Tramadol was also studied. Spinal somatosensory evoked potential (SSEP) measurements were used in this study. The results implied that both the amplitude and conduction velocity of SSEPs were reduced (dose dependently) when Tramadol was applied directly on sciatic nerves. This indirectly showed that tramadol may have local anaesthetic type action. [7-9]

Nagpal V et al did comparative study of systemically and perineurally administered tramadol. The study was designed to compare the effects of tramadol administered as an adjunct to bupivacaine in supraclavicular block to that of systemic administration, on postoperative analgesia and rescue analgesic requirement following upper limb surgeries. The patients were observed for sensory, motor onset along with the duration of sensory and motor block. Patients were monitored for sedation and hemodynamic parameters . The authors concluded that the addition of tramadol to bupivacaine mixtures as an adjunct for supraclavicular brachial plexus block provide better postoperative analgesia for orthopedic upper extremity surgery in comparison to control or systemic tramadol group without any side effects.[10]

The additive effect of tramadol to Local anaesthetic in brachial plexus block has been studied many times. It has been studied with mepivacaine (1-1.5%), lignocaine (1-2%), ropivacaine (0.75%) and bupivacaine (0.25–0.5%). The axillary, interscalene and

supraclavicular approaches were very commonly used for brachial plexus block. In most studies peripheral nerve stimulator was used for accuracy and correct placement of the needle. Paraesthesia technique was used by Suman Chattopadhyay and co-workers'.Only Farhad Imani and co-workers didn't use a single needle technique out of the selected studies, instead they used continuous brachial plexus block technique. Other studies preferred single injection technique (This study also preferred single injection technique). Peripheral nerve stimulation/location technique was used in this study, for the precise needle placement.[11,12]

In this study, the total motor blockade duration was extended in Group BT2 (270.8 ± 24.7 min) in contrast to Group BT1 (211.4 ± 22.6min) and Group B, which had shorter duration of motor block (104.4 ± 23.06 min). This is an undesirable side effect of tramadol when it is used as an additive in supraclavicular block. In study done by Stephan Kapral and co-workers comparable finding was observed. Higher doses of200mg of tramadol has more motor block duration as compared to lower doses of 100 mg. [13]

In study conducted by Antonucci S and co-workers' tramadol was compared with sufentanil and clonidine, in brachial plexus block by axillary approach. They determined in their study that tramadol as an additive in blocks provides a noteworthy reduction of block onset and it also lengthens analgesia, as it was observed in our study.These advantages of tramadol were comparable to sufentanil and clonidine with lower incidence of side effects than clonidine and sufentanil.Stephan Kapral and co-workers witnessed in their study that tramadol with local anaesthetic did not produce significant hemodynamic changes, sedation, nausea and vomiting. Nausea and vomiting were reported in the group in which Tramadol was given intravenously. Findings were similar in our study. The incidence of side effects was statistically insignificant among the three groups.[13,14]

None of the patients had any respiratory depression during or after the surgery. This is because of the different receptor affinity profile of tramadol. In the study conducted by Se´bastien Robaux and co-workers it was witnessed that higher doses of Tramadol lead to higher incidence of side effects. Shin HW and co-workers concluded in their study that 100 mg of tramadol as an adjuvant to local anaesthetic helps in shortening the onset of sensory and motor block, prolongs the duration of sensory and motor block thus providing prolonged duration of analgesia without significant side effects to patients. These findings are similar to our study. [15-17]

Comparative study between tramadol and dexamethasone as an admixture to bupivacaine in supraclavicular brachial plexus block was done by Shrestha BR et al. Similarly Robaux S et al found tramadol added to 1.5% mepivacaine for axillary brachial plexus block improves postoperative analgesia dose-dependently. They designed a prospective, randomized, controlled and double-blind clinical trial to assess the effect of tramadol added to brachial plexus anesthesia. Their study suggested that tramadol added to 1.5% mepivacaine for brachial plexus block enhances in a dose-dependent manner the duration of analgesia with acceptable side effects. [17,18]

Conclusion

This study further validates the role of tramadol in faster onset of sensory and motor block, prolonging the duration of analgesia and motor block. Selection of tramadol dose was based on body weight of patient in this study and it was found that effects are dose dependent. We conclude that, when added to brachial plexus anesthesia, tramadol extends the duration and improves the quality of postoperative analgesia in a dose-dependent fashion. The incidence of adverse effects also increases with larger doses, but the side effect profile remained acceptable up to 200 mg tramadol in our study.

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Ethical approval : Taken

What This Study Add to Existing Knowledge

Adjuncts to local anesthetics for peripheral plexus blockade may enhance the quality and duration of anesthesia and postoperative analgesia. The analgesic, tramadol, has a unique mechanism of action that suggests efficacy as such an adjunct. It displays a central analgesic and peripheral local anesthetic effect.This study concludes and confirmes the efficacy of tramadol as an adjuvant to the local anaesthetics. This study further validates the role of tramadol in faster onset of sensory and motor block, prolonging the duration of analgesia and motor block. Tramadol as an adjuvant to local anaesthetics can be used safely and effectively in brachial plexus block for upper limb surgeries.

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