

Comparative study of systemically and perineurally administered tramadol as an adjunct for supraclavicular brachial plexus block

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Abstract

Background and Aims: 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.

Material and Methods: A prospective, randomized, controlled, double-blind study was undertaken in patients scheduled for upper limb surgeries under supraclavicular block. All the three group patients received either of the following drugs mixtures: Group A — bupivacaine 0.5%-18 ml + normal saline-7 ml for block and normal saline-10 ml intravenously. Group B — bupivacaine 0.5%-18 ml + normal saline-7 ml mixture for block and tramadol (100 mg) diluted to 10 ml — intravenously. Group C — bupivacaine 0.5%-18 ml + tramadol (100 mg) + normal saline-5 ml mixture and normal saline 10 ml intravenously. 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 during intra-operative and postoperative period. Pain-free period and demand for rescue analgesia was noted in all the patients.

Results: The study demonstrates that the mixture of tramadol and bupivacaine injected perineurally for supraclavicular brachial plexus block hastens the onset of sensory block, motor block and provides a longer duration of motor blockade and demand for rescue analgesia as compared to other two groups.

Conclusions: In conclusion, 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.

Key words: Bupivacaine, tramadol, supraclavicular brachial plexus

Introduction

Pain is a personal and subjective experience that involves sensory, emotional and behavioral factors associated with actual or potential tissue injury as defined by the International Association for the Study of Pain.^[1]

Pain has also been included as the “fifth vital sign” by the Joint

Commission on Accreditation of Healthcare Organizations, thereby consideration of the pain in the care of the patients as well as discharge decision,^[2] is of utmost importance.

The consequences of severe postoperative pain such as prolonged hospital stays, increased hospital readmissions, and increased opioid use with a subsequent increase in postoperative nausea and vomiting, and results in overall low patient satisfaction and potentially greater cost, as concluded by Indelli *et al.*^[3]

In orthopedic surgeries, the degree of postoperative pain is closely related to diminish joint movements leading to arthrofibrosis, as suggested by Singelyn *et al.*^[4] In orthopedic surgeries, regional anesthesia has been shown to reduce the incidence of major perioperative complications including deep vein thrombosis, pulmonary thromboembolism and respiratory complications.

Brachial plexus block is a popular and very reliable regional anesthetic technique for upper limb surgeries and help us

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in avoiding general anesthesia. Modern local anesthetics are sufficiently effective and safe for the majority of clinical practice, but the search for agents with longer duration of action, better nerve fiber selectivity, and lesser degree of motor blockade and lower incidences of systemic toxicity continues. Various adjuncts to local anesthetics for brachial block have been used, which enhance the quality and duration of anesthesia and postoperative analgesia without causing adverse side effects or increasing duration of motor block. Midazolam,^[5] magnesium,^[6] opioids,^[7] clonidine,^[8] and dexmedetomidine^[8] are few examples.

Tramadol, a 4 phenyl-piperidine analog of codeine has been found to have a unique mechanism of action that suggests its efficacy as an adjunct to local anesthetics in brachial plexus block.^[9] Tramadol has been tried as an adjunct to local anesthetics in the past, but many studies have been contradictory and inconclusive.

We, therefore, intended to study the variability in the effects of systemically administered tramadol and perineurally administered tramadol as an adjunct to bupivacaine in supraclavicular brachial plexus blocks on onset of sensory, motor block and postoperative analgesia along with demand for rescue analgesic in the postoperative period.

Material and Methods

After approval by Institutional Ethical Committee, this study was carried out on 104 American Society of Anesthesiologists (ASA) I/II patients of either gender, in the age group of 20-60 years over a period of 1-year, having fractures of forearm bones for open reduction and internal fixation under supraclavicular brachial plexus block.

Patient's refusal for block, having bleeding disorders, getting opioid analgesics or monoamine oxidase inhibitors prior to surgery, local infections at the site where needle for block is to be inserted, history of seizures, respiratory or cardiac diseases, pregnancy were the exclusion criteria. Patients in whom the block effect was partial and required supplementary anesthesia also were excluded.

Randomization was achieved by computer generated random number table. Random group assigned was enclosed in a sealed opaque envelope to ensure concealment of allocation sequence. After shifting the patient inside operation theatre, sealed envelope was opened by anesthesiologist not involved in the study to prepare the drug solution for infusion according to randomization. The observer who collected the intra-operative data as well as the operating surgeon were blinded to the drug solution administered.

All patients were kept nil orally for at least 6 h before the procedure. They were given premedication in the form of tablet alprazolam 0.5 mg and tablet ranitidine 150 mg at 6 am on the day of surgery and tested for local anesthetic sensitivity. On arrival to the operation theatre, standard monitoring was established with starting of peripheral intravenous (I.V.) line by 18G cannula in the contralateral hand and ringer lactate infusion was started. After proper positioning of the patient and under all aseptic precautions supraclavicular brachial plexus block was performed by blinded anesthesiologist using subclavian artery as a guide, till paresthesia elicited or sensation of piercing the sheath felt.

Patients were assigned to receive either of the following drugs mixtures: Group A — bupivacaine 0.5%-18 ml + normal saline-7 ml for block and normal saline-10 ml intravenously. Group B — bupivacaine 0.5%-18 ml + normal saline-7 ml mixture for block and tramadol (100 mg) diluted to 10 ml-intravenously. Group C - bupivacaine 0.5%-18 ml+ tramadol (100 mg) + normal saline-5 ml mixture and normal saline 10 ml intravenously.

Routine monitoring of all the patients including blood pressure, pulse rate, SpO₂, electrocardiogram was done. We evaluated onset, quality and duration of sensory and motor block along with side effects if any. For sensory loss assessment, we used pin prick test with a three-point scale-0- no block, 1-analgesia (loss of sensation to pinprick), 2-loss of touch.

Motor block was assessed by modified Bromage scale^[10] for upper extremities using a 3 point scale. 0-total movement of fingers and wrist, 1-decreased motor strength with ability to move the fingers only, 2-inability to move fingers.

Block was evaluated every 5 min till complete motor and sensory block after the injection of local anesthetic. Further block assessment was done at hourly intervals up to 24 h by a blinded anesthesiologist.

Onset of sensory blockade was defined as the interval between the end of injection and sensory blockade and was demonstrated as loss of sensation to pinprick or by score 1 of pinprick response. Onset of motor blockade was the interval between the end of injection and complete motor paralysis of wrist and hand. The duration of sensory blockade being the time interval between sensory blockade and reappearance of pinprick response. The duration of motor blockade was defined as the time interval between maximum motor blockade and complete movement of wrist and fingers. Duration of analgesia was taken as the time interval between onset of sensory blockade and the first dose of rescue analgesic given to the patient.

Pain assessment in the postoperative period was done using verbal response score, being obtained by asking the patient to rate the intensity of pain perceived by him/her and express it on a numerical scale of 0 to 10, with.

0-no pain (one extreme). 10-worst pain possible (other extreme).

Rescue analgesia in the form of injection diclofenac 75 mg intramuscularly was given to patients with VRS >4.

Quality of block was assessed on the basis of two parameters. The number of partial/failed blocks among the three groups and surgeon's satisfaction score based upon the amount of muscle relaxation and ease of performing the surgery were taken as VRS ranging between 0 and 10. Score 0 for full satisfaction and score 10 for complete unsatisfaction.

All the patients were monitored intra-operatively and postoperatively in terms of hemodynamic stability, assessment of sedation by Ramsay sedation score^[11] and for any side effects.

Statistical analysis

The data was analyzed by package SPSS 15.0 (SPSS Inc. Chicago, IL, USA). Demographic and hemodynamic data were analyzed by Student's *t*-test. For statistical analysis of onset time and duration of sensory and motor blocks, duration of analgesia, unpaired *t*-test was applied. $P < 0.05$ was considered as statistically significant. For intra-group analysis, a repeated measure ANOVA was performed.

Results

Total number of patients enrolled during study period were 104, being 35, 34 and 35 in groups A, B, C respectively. The number of patients who had partial blocks or failed blocks was 5 in Group A, 4 in Group B and 5 in Group C. After excluding these patients, the total number of patients taken for study was 30 in each group. The three groups were comparable to each other with respect to age, gender, weight and duration of surgery [Table 1].

It was found that onset of sensory block was faster in Group C than Group A (23.00 ± 3.93) and Group B ($P = 0.018$) [Table 2]. The onset of motor block was faster in Group C than Group A and Group B ($P = 0.024$) [Table 3]. The mean duration of motor block was maximum in Group C followed by Group A and minimum in Group B ($P = 0.023$). The mean duration of sensory block was maximum in Group C followed by Group A and minimum in Group B ($P = 0.075$) [Figure 1]. The mean duration of analgesia was

Table 1: Demographic profile

Parameters	Groups		
	Mean \pm SD		
	Group A (n = 30)	Group B (n = 30)	Group C (n = 30)
Age (years)	40.40 \pm 14.63	40.93 \pm 12.77	35.53 \pm 12.16
Weight (kg)	54.63 \pm 8.86	55.90 \pm 8.42	55.50 \pm 7.92
Mean duration of surgery (min)	71.00 \pm 26.01	75.50 \pm 25.77	84.17 \pm 26.91

$P < 0.05$ = Significant, SD = Standard deviation

Table 2: Comparison of mean duration of onset of sensory block in three groups

Study group	Mean duration of onset of sensory block (min) mean \pm SD	df	P
A	23.00 \pm 3.93	4	0.018
B	22.83 \pm 4.08	3	
C	20.00 \pm 4.15	3	

SD = Standard deviation

Table 3: Comparison of mean duration of onset of motor block in three groups

Study group	Mean duration of onset of motor block (min) mean \pm SD	df	F	P
A	40.00 \pm 6.56	5	3.900	0.024
B	41.00 (5.78)	4		
C	37.00 \pm 4.84	4		

SD = Standard deviation

maximum in Group C followed by Group A and minimum in Group B ($P = 0.049$) [Figure 2].

None of the patients required rescue analgesia in first 3 h after completion of surgery in all three groups [Figure 3]. In the next 3 h (181-360 min), the number of patients who required rescue analgesia were 14, 19 and 8 patients (46.7%, 63.3%, 26.7% of total 30) in the Group A, B and C respectively. The patients requiring the analgesic after 6 h of completion of surgery were 53.3% of Group A, 36.7% of Group B and 73.3% of Group C ($P = 0.025$). Surgeon's satisfaction score measured in VAS (0-10) in three groups was insignificant ($P = 0.86$).

Discussion

Our study demonstrates that the mixture of tramadol and bupivacaine injected perineurally for supraclavicular brachial plexus block hastens the onset of sensory block, motor block and provides a longer duration of motor blockade and postoperative analgesia as compared to other two groups in which tramadol was either injected intravenously (systemic group) or was not given at all (control group). The block onset times and durations of sensory block, motor block and

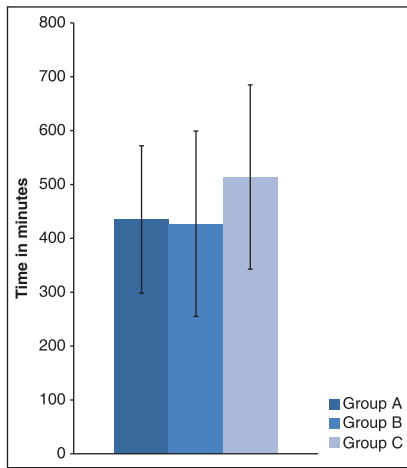


Figure 1: Duration of sensory block (mean ± standard deviation)

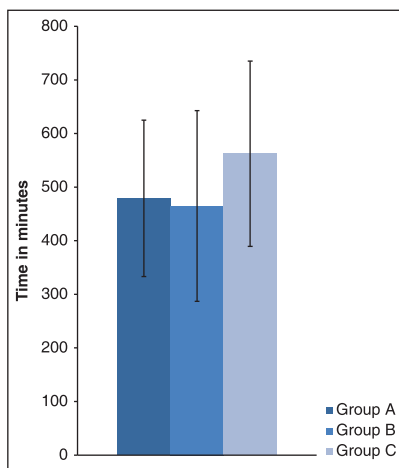


Figure 2: Duration of analgesia (mean ± standard deviation)

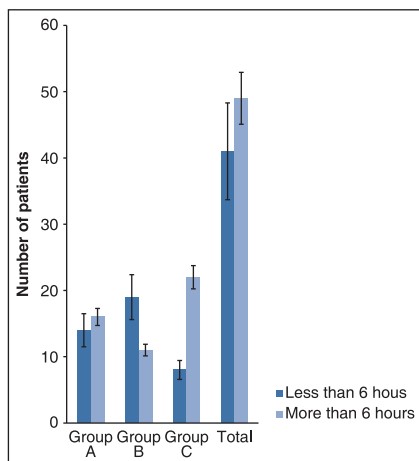


Figure 3: Time for rescue analgesic requirement

analgesia were not statistically different in tramadol I.V. group and control group.

Kapral *et al.*^[12] demonstrated that the addition of 100 mg of tramadol to mepivacaine 1% for axillary brachial plexus block

prolongs sensory and motor block as compared to mepivacaine given alone or mepivacaine given perineurally and tramadol 100 mg intravenously. Consequently, the results of that study suggest that tramadol has a specific analgesic effect on peripheral nerves. Their findings were same as that of our study, but there was no significant difference in the onset of sensory and motor block among all the three groups in their study. This finding of hastening the onset of sensory and motor block in tramadol perineural group may be contributed by a change in pH of the drug solution with addition of tramadol in our study, as we have not encountered quick onset in systemically administered tramadol group or it could be because of large volume (40 ml) of drug in their study in comparison to ours (25 ml) leading to comparatively decreased concentration of tramadol.

Chatopadhyay *et al.*^[13] evaluated the use tramadol 100 mg as an adjuvant to bupivacaine 0.25%, total volume being 40 ml, in supraclavicular brachial plexus block given for various upper limb surgeries and concluded that tramadol is a useful adjuvant and reduces the onset time of motor and sensory block and enhances the duration of sensory block, motor block and postoperative analgesia. All parameters were comparable to our study except for the fact that there was no systemic group in their study group.

Kaabachi *et al.*^[14] reported that the benefit of block prolongation associated with the addition of 200 mg of tramadol to lidocaine during axillary block was limited by the slow onset of the block. In their study delayed onset may be due to the fact that they have used lidocaine with a quicker onset and different pharmacodynamic properties than bupivacaine, which was used in our study.

Alemanno *et al.*^[15] observed that tramadol used as an adjuvant to levobupivacaine for single-shot interscalene block, given either perineurally or intramuscularly provides a longer duration of postoperative analgesia when compared to interscalene block performed with 0.5% levobupivacaine alone in patients who underwent arthroscopic repair of rotator cuff tear.

In our study, majority of patients in Group C required first analgesic after 6 h of surgery and the delayed requirement of analgesia postoperatively in Group C was statistically significant.

The results of our study were entirely different from study by Dikmen *et al.*^[16] who observed that the addition of 100 mg of tramadol to 3.75 mg/ml of ropivacaine does not have any beneficial effect on the nerve block characteristics of axillary brachial plexus anesthesia for arteriovenous fistula surgery in uremic patients.

In our study, only one patient in tramadol I.V. group had nausea and was managed symptomatically.

To summarize, our data support specific analgesic action of tramadol on peripheral nerves. This study is one in which tramadol has been given locally as well as systemically as an adjunct to bupivacaine in supraclavicular brachial plexus block. The results support the hypothesis that tramadol has effects on peripheral nerves that are not observed, when tramadol is given systemically.

Limitations

One of the limitations of our study was that we didn't use ultrasound guided block due to its nonavailability in our institution at the time of study, because with ultrasound guidance localization of brachial plexus is easy and the variability in different parameters caused due to clinical blocks can be reduced. Second limitation is unavailability of facilities for serum measurement of tramadol.

Conclusion

The use of tramadol as an adjunct to bupivacaine in supraclavicular brachial plexus block, hastens the onset of block, increases the duration of motor blockade. It also delays the requirement of the first dose of analgesic postoperatively without causing any side effects in comparison to systemically administered tramadol group and control group.

References

- International Association for the Study of Pain (IASP). Task force on taxonomy part III. Pain terms. A current list with definitions and notes on usage. In: Merskey H, Bogduk N, editors. Classification of Chronic Pain. 2nd ed. Seattle, WA: IASP Press; 1994. p. 209-14.
- Phillips WJ, Currier BL. Analgesic pharmacology: I. Neurophysiology. *J Am Acad Orthop Surg* 2004;12:213-20.
- Indelli PF, Grant SA, Nielsen K, Vail TP. Regional anesthesia in hip surgery. *Clin Orthop Relat Res* 2005;441:250-5.
- Singelyn FJ, Deyaert M, Joris D, Pendeville E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. *Anesth Analg* 1998;87:88-92.
- Jarbo K, Batra YK, Panda NB. Brachial plexus block with midazolam and bupivacaine improves analgesia. *Can J Anaesth* 2005;52:822-6.
- Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. *Reg Anesth Pain Med* 2006;31:233-6.
- Singh SP, Singh V, Kaushal D, Jafa S. Effect of alkalized bupivacaine and fentanyl mixture in supraclavicular brachial plexus block-a randomised double blind controlled trial. *J Anaesth Clin Pharmacol* 2009;25:25-8.
- Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double blind prospective study. *Indian J Anaesth* 2012;56:243-9.
- Robaux S, Blunt C, Viel E, Cuvillon P, Nouguiere P, Dautel G, et al. Tramadol added to 1.5% mepivacaine for axillary brachial plexus block improves postoperative analgesia dose-dependently. *Anesth Analg* 2004;98:1172-7.
- Sakar DJ, Khurana G, Chaudhary A, Sharma JP. A comparative study on the effects of adding fentanyl and buprenorphine to local anaesthetics in brachial plexus block. *J Clin Diagn Res* 2010;46:3337-43.
- Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. *Br Med J* 1974;2:656-9.
- Kapral S, Gollmann G, Waltl B, Likar R, Sladen RN, Weinstabl C, et al. Tramadol added to mepivacaine prolongs the duration of an axillary brachial plexus blockade. *Anesth Analg* 1999;88:853-6.
- Chatopadhyay S, Mitra LG, Biswas BN, Majumder P. Tramadol as an adjuvant for brachial plexus block. *J Anaesth Clin Pharmacol* 2007;23:187-9.
- Kaabachi O, Ouezini R, Koubaa W, Ghrab B, Zargouni A, Ben Abdelaziz A. Tramadol as an adjuvant to lidocaine for axillary brachial plexus block. *Anesth Analg* 2009;108:367-70.
- Alemanno F, Ghisi D, Fanelli A, Faliva A, Pergolotti B, Bizzarri F, et al. Tramadol and 0.5% levobupivacaine for single-shot interscalene block: Effects on postoperative analgesia in patients undergoing shoulder arthroplasty. *Minerva Anestesiol* 2011;77:1-2.
- Dikmen B, Gamli M, Horasanli E, Ornek D, Pekel M, Selcuk A. The effects of adding tramadol to ropivacaine on axillary brachial plexus blockade in uremic patients. *Turk J Med Sci* 2009;39:733-9.

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Conference Calendar 2015

Name of conference	Dates	Venue	Name of organising secretary with contact details
63 rd Annual National Conference of Indian Society of Anaesthesiologists ISACON 2015	December 25 th -29 th 2015	B. M. Birla Auditorium & Convention Centre, Jaipur	Dr. SP Sharma Organizing Chairman Dr. Suresh Bhargava Organizing Secretary C-1/516, Vashist Path, Chitrakoot, Vaishali Nagar, Jaipur - 302 021 Website: http://www.isacon2015jaipur.com/ A-4, Vivek Vihar, Opp. Dainik Bhaskar, JLN Marg, Jaipur, Rajasthan Contact No.: 0141-2711919 Email: secretariat@isacon2015jaipur.com