Original Research Article

Indian Journal of Anesthesia and Analgesia
November - December 2019; 6(6) (Part - II): 2089-2094
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6619.33

Dexmedetomidine Vs Fentanyl in Scalp Nerve Block for Blunting Response to Skull Pin Insertion and Post-operative Pain: A Randomized Double Blinded Study

Anyapu Praveena[1], Abhiruchi Yeshwant Patki[2], K Prasad Rao[3], Padmaja Durga[4]

[1]Junior Resident, [2,3]Associate Professor, [4]Professor and Head, Department of Anesthesiology and Intensive Care, Nizam's Institute of Medical Sciences, Hyderabad, Telangana 500082, India.

Abstract

Background: Dexmedetomidine and Fentanyl have both been used as adjuvant to prolong the effect of local anesthetics in various peripheral nerve blocks. The primary aim of this study was to compare these two in scalp nerve block for obtunding pain response to skull pin insertion. The secondary aim was to study their effect on post-operative pain relief, time required for extubation and post-operative sedation score. *Methodology:* A total of 80 American Society of Anesthesiologists' physical status Grade 1 and 2 patients between 18 to 60 *years*, electively posted for supratentorial craniotomy for space occupying lesion, were randomly divided into two groups to receive either Dexmedetomidine 1 *µg/kg* (Group D) or Fentanyl citrate 1 *µg/kg* (Group F) added to 20 *ml* of 0.25% Bupivacaine in bilateral scalp nerve block, 10 *minutes* before May field pin insertion. Hemodynamic parameters were assessed at regular time intervals and time taken for extubation after surgical closure was noted. Post-extubation pain scores and sedation scores were assessed periodically and time taken for first rescue analgesic was also noted. The observer was blinded to randomization, preparation of drug syringes and statistical analysis. Chi-square test, Fischer-exact test, Post-hoc tukey test and student's t-test were used for analysis. *Results:* Requirement of propofol was significantly lower in Group D than Group F, ($p = 0.013$) one minute after pin insertion. Hemodynamic variables, Extubation time and sedation scores were comparable in both groups. Pain-free period was longer in Group D, ($p = 0.045$). *Conclusion:* Addition of dexmedetomidine as adjuvant to local anesthetic in scalp nerve block provides superior attenuatation of hemodynamic response to skull pin insertion and prolongation of analgesia than Fentanyl used for the same purpose.

Keywords: Scalp block; Fentanyl; Dexmedetomidine.

How to cite this article:

Anyapu Praveena, Abhiruchi Yeshwant Patki, K Prasad Rao et al. Dexmedetomidine Vs Fentanyl in Scalp Nerve Block for Blunting Response to Skull Pin Insertion and Post-operative Pain: A Randomized Double Blinded Study. Indian J Anesth Analg. 2019;6(6 Part -II):2089-2094.

Introduction

The intense nociceptive stimulus produced by application of the skull-pin head holder is known to cause an abrupt rise in blood pressure and cerebral blood flow even under general anesthesia.[1] A severe fluctuation may also potentially cause brain oedema and tissue damage.[2] A scalp nerve block with a local anesthetic is an effective and well-established method to reduce this sympathetic response. In addition to this benefit, scalp nerve block also gives an added advantage of relieving

Corresponding Author: Abhiruchi Yeshwant Patki, Associate Professor, Department of Anesthesiology and Intensive Care, Nizam's Institute of Medical Sciences, Hyderabad, Telangana 500082, India.

E-mail: abhiruchipatki2204@yahoo.co.in

Received on 29.08.2019, **Accepted on** 23.10.2019

craniotomy pain in the immediate post-operative period.[3]

Addition of an adjuvant to a local anesthetic agent not only improves the quality and depth of the block but also prolongs its effect. The opiod Fentanyl citrate is the most widely used adjuvant which has been extensively studied so far, in improving the efficacy of various nerve blocks throughout the body.[4,5] Recent studies have also recommended the use of Dexmedetomidine, a selective a_2 agonist, to prolong the duration and improve the quality of different nerve blocks.[6,7]

This study was conducted with an aim to compare Fentanyl and Dexmedetomidine, both as adjuvants to 0.25% bupivacaine in scalp nerve block, for their effect on the quality and duration of block. Secondly, as both the study drugs exhibit sedative properties we also compared their influence on recovery from general anesthesia if any, by observing time required for extubation and post-operative sedation scores.

Materials and Methods

After approval from the institutional ethics committee, this prospective, randomized, double blinded, clinical investigation was carried out in 80 adult consenting patients scheduled to undergo elective supratentorial craniotomies for space occupying lesions within a period of *12 months*.

Sample size calculation

A sample size of 80 was calculated based on clinical findings from two similiar studies[8,9] considering their findings of duration of analgesia in minutes as the study parameter. We used the statistical software G power 3.1.9.2 (Universitat Dusseldorf, Germany) with 0.1 as effect size (Cohen small co-efficient), an *a* error of 0.05, and power of 80% (1–*β* error probability) using ANOVA repeated measures, within between interaction. Along with a routine pre-anesthetic checkup, an informed consent was taken from each participant one day before surgery.

Our exclusion criteria were extremes of ages (< *18 years* and > *60 years*), those with uncontrolled hypertension, patients with a pre-operative Glasgow coma score of < 15, longer surgeries (> *4 hours*), and cases with raised intracranial pressure or tense brain/bulging brain as an intra-operative finding.

All the remaining ASA Grade 1 or 2 patients were randomly divided into two groups of 40 each using a computer generated randomization table (Microsoft excel 2010, Microsoft corporation, Washington, (USA). The observer was blinded to the randomization process.

The two Groups received:

Group F (*n* = 40): Inj Fentanyl citrate *1 μg/kg* as adjuvant to *20 ml* 0.25% bupivacaine in scalp nerve block.

Group D (*n* = 40): Inj Dexmedetomiditine *1 μg/kg* as adjuvant to *20 ml* 0.25% bupivacaine in scalp nerve block.

The syringes were loaded by the same technician every time and the person who administered the scalp nerve block and later observed the findings was blinded to the contents of the syringes.

Demographic details and baseline heart rate, systolic, diastolic and mean arterial pressures were noted. This was followed by routine neuroanesthetic management as per our institutional protocol which included pre-medication with Fentanyl citrate (*2 μg/kg*), glycopyrrolate (*4 mcg/kg*), pantoprazole (*0.8 mg/kg*), induction with thiopentone (*5–7 mg/kg*) and atracurium besylate (*0.4 mg/kg*), followed by endotracheal intubation and mechanical ventilation with oxygen air mixture, a tidal volume of *7 ml/kg*, a PEEP of *3 cm* H_2O, and 1 MAC of isoflurane. Under sterile asceptic precautions, a bilateral scalp nerve block with *20 ml* of bupivacaine 0.25% with the study drug was administered by the investigator on the guidelines given by Pinosky *et al*. The Mayfield skull pin head holder was applied *10 minutes* after completion of block.

Heart rate, systolic, diastolic and mean arterial pressures were monitored at Baseline (T1), Endotracheal Intubation (T2), During block (T3), *1 min* before pin application (T4) and thereafter at *1 min* (T5), *3 min* (T6), *5 min* (T7) and *10 min* (T8) following pin application. If the MAP increased above *90 mm Hg* a bolus dose of *10 mg* propofol was given and requirement of propofol was noted.

Anesthesia was thereafter maintained with Inj atracurium infusion (*0.3 mg/kg/h*) and isoflurane at a MAC of 1. Dexamethasone (*0.08 mg/kg*) as anti-emetic and phenytoin as per requirement were given towards the end of surgery. Analgesic supplementation was avoided.

Extubation was done after ensuring adequate respiratory efforts and response to verbal commands. Time taken from surgical closure to endotracheal extubation was noted in minutes.

A visual analog scale was used to assess pain in the post-operative period which was assessed at

10 min (T9), *30 min* (T10), *1 hour* (T11) and *2 hours* (T12) after extubation. The Ramsay sedation scale[10] was used at the same time intervals to assess the sedation score.

Inj diclofenac *75 mg* was given as rescue analgesic when VAS score was observed to be above 4, and the time taken from surgical closure to requirement of first rescue analgesic (min) was noted. This time was taken as duration of analgesia.

The observations were analyzed statistically using student's *t*-test (continuous data), Chi-square test and Fisher-exact test (categorical data) and repeated ANOVA test with Post-hoc Tukey Kramer (two tailed, independent) for data within the group and in between the two groups, using NCSS software version 9.0. All values have been expressed in mean ± SD, and ratio for categorical data. Probability values of less than 5% were taken as significant. The investigator was also blinded to the statistical analysis.

Results

Demographic observations (age, gender, height, weight and ASA status) were comparable in both the groups, (Table 1). Surgical duration (min) taken as time from surgical incision to surgical closure was also comparable in both the groups (*236 ± 14.1 min* and *222.92 ± 1.5 min* ($p = 0.34$)).

Table 1: Demographic characteristics

	Group F	Group D	*p* - value
Age (*years*)	38.28 ± 13.79	42.33 ± 16.15	0.215
Height (*cm*)	160.83 ± 8.99	160.75 ± 8.94	0.970
Weight (*kg*)	60.75 ± 12.763	62.73 ± 11.71	0.471
Gender (M/F)	22:18	25:15	0.6
Surgical duration (*min*)	236 ± 14.1	222.92 ± 1.5	0.34
ASA status (I/II)	27:13	24:16	0.62

$n = 40$, values in mean ± SD, $p < 0.05$ = significant*, $p < 0.01$ = highly significant**

Heart rate was comparable at all the time intervals in both the groups, (**Fig. 1**). Mean arterial pressure from baseline at T5, was lower in the dexmedetomidine group clinically, (*106.72 ± 34.2* vs *83.12 ± 11.07 mm Hg*), although, this difference was not found to be of statistical significance ($p = 0.064$), (**Fig. 2**). Requirement of Propofol bolus to maintain MAP below *90 mm Hg* was however,

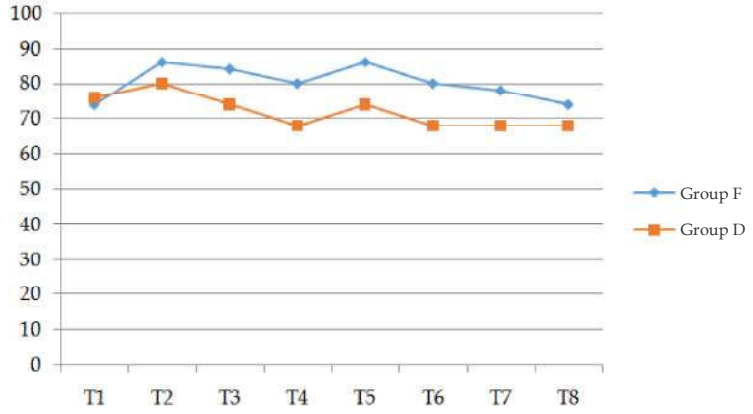

Fig. 1: Changes in mean heart rate in both the groups at different time intervals

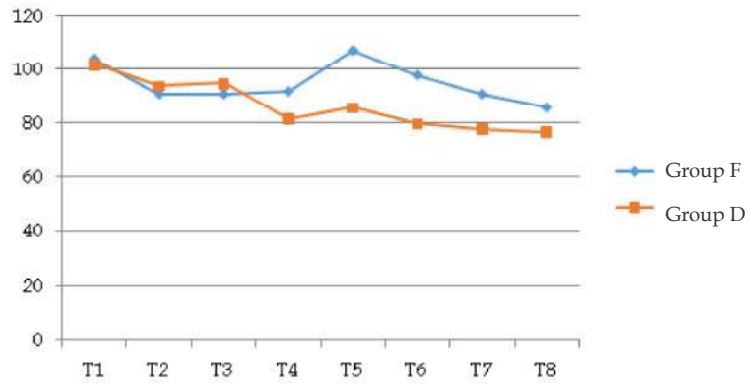

Fig. 2: Changes in mean arterial pressure in both the groups at different time intervals

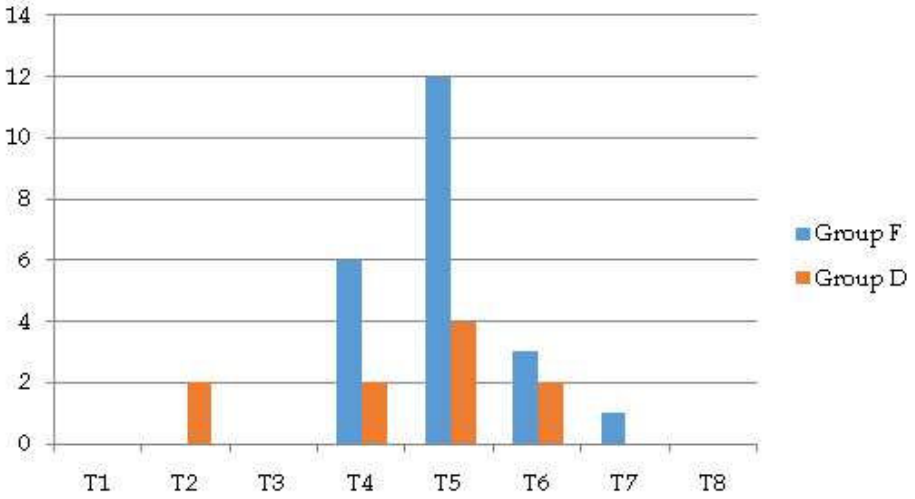

Fig. 3: Number of patients requiring Propofol boluses in both the groups at different time intervals

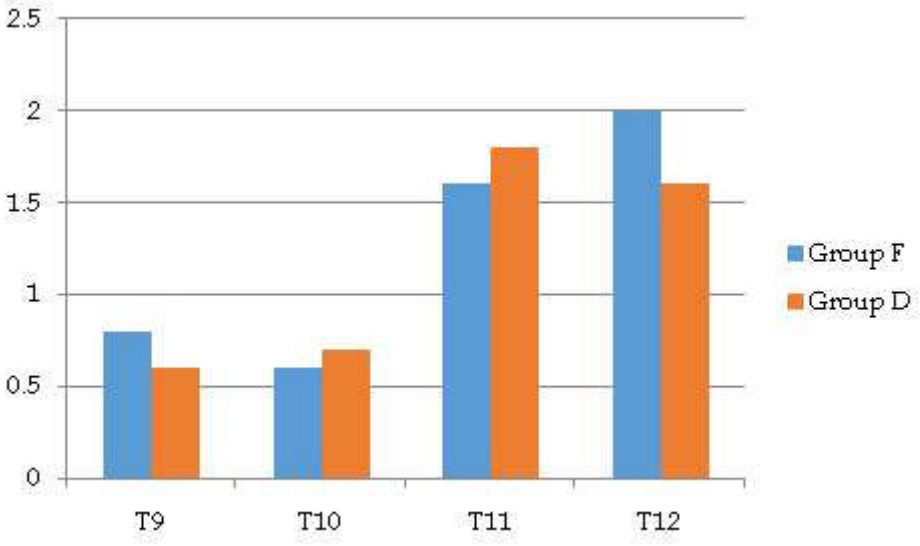

Fig. 4: Mean pain scores in the immediate post-operative period

seen to be significantly higher in the Fentanyl group at T5 (p = 0.013)*, (Fig. 3). There was no statistically significant difference in time taken for endotracheal extubation from surgical closure in both the groups, (Table 2).

Table 2: Time taken for endotracheal extubation after surgical closure (*min*)

	Group F	Group D	*p* - value
Time (min)	10.36 ± 14.7	11.02 ± 0.98	0.274

n = 40, n = 80, values in mean ± SD, $p < 0.05$ = significant*, $p < 0.01$ = highly significant**

Duration between surgical closure and demand of the first rescue analgesic, (duration of analgesia) was significantly longer in the dexmedetomidine group by *89.10 minutes*. (p = 0.045), (Table 3). However, mean VAS scores were found to be comparable in both the groups at *10 min*, *30 min*, *1 hour* and *2 hour* post-operatively, (Fig. 4) and so were the post-operative sedation scores, (Fig. 5).

Table 3: Duration of Analgesia

	Group F	Group D	*p* - value
Time (min)	483.87 ± 10.22	572.97 ± 5.86	0.045*

n = 40, values in mean ± SD, $p < 0.05$ = significant*, $p < 0.01$ = highly significant**

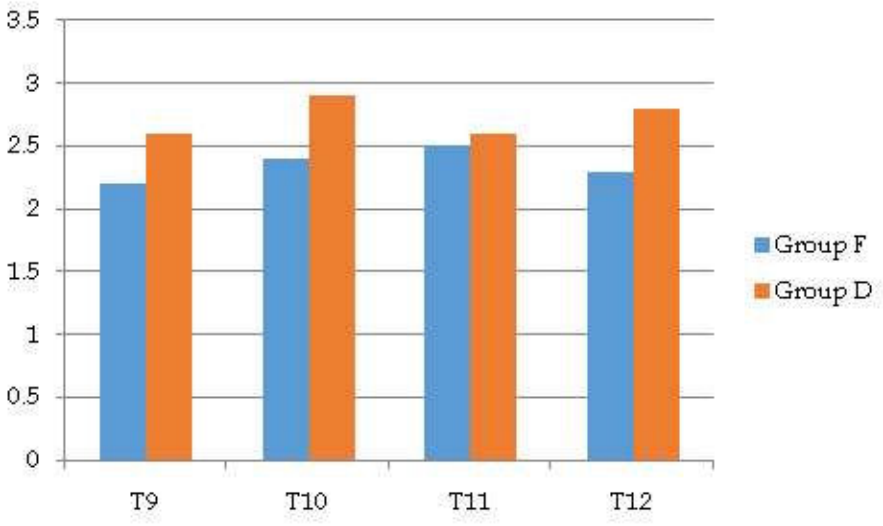

Fig. 5: Mean sedation score in the immediate postoperative period

Discussion

We observed that addition of dexmedetomidine to 0.5% bupivacaine in scalp nerve block prolonged the demand of a rescue analgesic by approximately *an hour* and a half compared to the addition of Fentanyl citrate for the same purpose. This property of dexmedetomidine can probably be attributed to its selective a_2-A receptor activation resulting in local vasoconstriction and delayed absorption of local anesthetic prolonging the analgesic effect.[11] Although Fentanyl is known to demonstrate similar properties by G-protein coupled receptor blockade causing hyperpolarisation of the afferent sensory neurons,[12] many studies comparing the two in various other regional blocks have documented superiority of dexmedetomidine in terms of longer duration of analgesia, over fentanyl as an adjuvant.[13–15] Hamed MA, Ghaber S, Reda A in 2018,[16] compared dexmedetomidine and Fentanyl as adjuvants to 0.5% bupivacaine, for supraclavicular brachial plexus block in 60 patients. The duration of analgesia in the dexmedetomidine group was significantly longer (*13.5 hours* versus *8.3 hours* respectively). The doses of study drugs used by us, were based on this clinical investigation.

High selectivity of a_2-A receptor activation by dexmedetomidine has also been shown to cause central sympathetic blockade, thereby, decreasing the heart rate transiently and leading to sedation or anxiolysis.[17] Some authors who used dexmedetomidine as an adjuvant to local anesthetics in peripheral nerve blocks have reported transient episodes of bradycardia in few of their patients.[18–20] We did not come across any episode of bradycardia in our study. However, in anticipation we were prepared with anticholinergic agents, to tackle the event if any. Similiarly sedation scores which were monitored in the post-operative period after extubation were low and comparable in both the groups.

The central sympathetic blockade by dexmedetomidine, however, was of merit to us in terms of blocking the sympathetic response to Mayfield pin head holder insertion. This was seen as lower requirement of propofol bolus doses needed to maintain the mean arterial pressure at *90 mm Hg* in the dexmedetomidine group (12 *vs* 4 at T5 (*one minute* after pin insertion) $p = 0.013$*).

The limitation of of the study is that hemodynamic changes were considered as surrogate markers of attenuation of pain, in addition to this, monitoring of depth of anesthesia by entropy or bispectral index would have added more valuable information to the study. The consequences of the hemodynamic responses were not included in the study and the surgeries with serious consequences to the hemodynamic changes such as intracranial aneurysm surgeries and significant increase in the intracranial pressure were not included.

Conclusion

Addition of dexmedetomidine as adjuvant to local anesthetic in scalp nerve block provides superior attenuatation of hemodynamic response to skull pin insertion and prolongation of the duration of analgesia than Fentanyl used for the same purpose.

References

1. Jamali S, Archer D, Ravussin P, *et al*. The effect of skull-pin insertion on cerebrospinal fluid pressure and cerebral perfusion pressure: Influence of sufentanil and fentanyl. Anesth Analg. 1997 Jun; 84(6):1292–6.
2. Basali A, Mascha E, Kalfas I, *et al*. Relation between peri-operative hypertension and intracranial hemorrhage after craniotomy. Anesthesiol. 2000 Jul;93(1):48–54.
3. Guilfoyle MR, Helmy A, Duane D, *et al*. Regional Scalp Block for postcraniotomy analgesia: A systematic review and meta-analysis. Anesth Analg. 2013 May;116(5):1093–102.
4. Rajkhowa T, Das N, Parua S. Fentanyl as an adjuvant for brachial plexus block: A randomized comparative study. Int J Clin Trials. 2016;3:64–67.
5. Chavan SG, Koshire AR, Panbude P. Effect of addition of fentanyl to local anesthetic in brachial plexus block on duration of analgesia. Anesth Essays Res. 2011;5:39–42.
6. Waindeskar V, Jain A, Jitendra K. Alpha-2 agonist dexmedetomidine as an adjuvant to bupivacaine in supraclavicular brachial plexus block. Int J Med Res Rev. 2016;4:855–60.
7. Bharti N, Sardana DK, Bala I. The analgesic efficacy of dexmedetomidine as an adjunct to local anesthetics in supraclavicular brachial plexus block: A randomized controlled trial. Anesth Analg. 2015;121:1655–660.
8. Farooq N, Singh RB, Sarkar A, *et al*. To evaluate the efficacy of fentanyl and dexmedetomidine as adjuvant to ropivacaine in brachial plexus block: A double-blind, prospective, randomized study. Anesth Essays Res. 2017;11:730–39.
9. Brummett CM, Hong EK, Janda AM, *et al*. Perineural dexmedetomidine added to ropivacaine for sciatic nerve block in rats prolongs the duration of analgesia by blocking the perpolarization-activated cation current. Anesthesiology. 2011;115:836–43.
10. Sessler CN, Grap MJ, Ramsay MA. Evaluating and monitoring analgesia and sedation in the intensive care unit. Crit Care. 2008;12 Suppl 3 (Suppl 3):S2.
11. Yoshitomi T, Kohjitani A, Maeda S. Dexmedetomidine enhances the local anesthetic action of lidocaine *via* an alpha-2A adrenoceptor. Anesth Analg 2008; 107:96-101
12. Kaniyil S, Radhakrishnan P. Does fentanyl prolong the analgesia of local anesthetics in brachial plexus block? A randomized controlled study. Int J Res Med Sci. 2017;5:583–87.
13. Vaswani J, Debata D, Vyas V, *et al*. Comparative study of the effect of Dexmedetomidine *vs* Fentanyl on hemodynamic response in patients undergoing elective laparascopic surgery. J Clin Diag Res. 2017 Sep;11(9):4–8.
14. Manohar P, Prakash M. Comparison of the effects of fentanyl and dexmedetomidine in supraclavicular brachial plexus block achieved with 0.5% bupivacaine. JMSCR. 2015;3:7131–38.
15. Paul A, Nathroy A, Paul T. A comparative study of dexmedetomidine and Fentanyl as an adjuvant to epidural bupivacaine in lower limb surgeries. J Med Sci. 2017 Dec;37(6):221–26.
16. Hamed M, Ghaber S Reda A. Dexmedetomidine and Fentanyl as an adjunct to Bupivacaine 0.5% in supraclavicular nerve block: a randomized controlled study. Anesth essays Res. 2018;12(2):475–79.
17. Vallapu S, Panda N, Samagh N, *et al*. Efficacy of dexmedetomidine as an adjuvant to local anesthetic agent in scalp block and scalp infiltration to control post-craniotomy pain: A Double blinded clinical trial. J Neurosci Rural P ract. 2018 Jan;9(1):73–79.
18. Uyar AS, Yagmurdur H, Fidan Y, *et al*. Dexmedetomidine attenuates the hemodynamic and neuroendocrinal responses to skull-pin head-holder application during craniotomy. J Neurosurg Anesthesiol. 2008; 20(3):174–79.
19. Bekker A, Sturaitis M, Bloom M, *et al*. The effect of dexmedetomidine on peri-operative hemodynamics in patients undergoing craniotomy. Anesth Analg. 2008 Oct;107(4):1340–47.
20. Singh A, Mahindra M, Gupta R, *et al*. Dexmedetomidine as an adjuvant to levobupivacaine in supraclavicular brachial plexus block: A novel anesthetic approach. Anesth Essays Res. 2016; 10(3):414.