Original Research Article

Indian Journal of Anesthesia and Analgesia
2019;6(4) (Part - II): 1361-1366
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6419.42

Comparison of Low Dose Fentanyl with Low Dose Dexamethasone as an Adjuvant to 0.5% Bupivacaine in Supraclavicular Block via Multipoint Injection Technique under Sonographic Guidance

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Abstract

Background: To see effect of low dose fentanyl vs low dose dexamethasone in ultrasound guided supraclavicular block via multipoint injection technique. *Methods:* This double blinded randomized controlled study was carried out on 60 patients belonging to ASA grade I and II, undergoing surgeries of the upper limb under USG guided supraclavicular block via multipoint injection technique. Group I (NS) received 20 ml 0.5% bupivacaine with 1 ml normal saline. Group II (Fenta) received 20 ml 0.5% bupivacaine with 10 µg (1 ml) fentanyl. Group III (Dexa) received 20 ml 0.5% bupivacaine with 4 mg (1 ml) dexamethasone. *Results:* The onset of sensory blockade in group 1 (NS) was 9.6430 ± 1.19025 min, in group 2 (Fenta) it was 10.3395 ± 0.59338 min, whereas in group 3 (Dexa) it was 3.9735 ± 0.41802 min. The onset of motor blockade was 17.9025 ± 1.13816 min in group 1 (NS), 17.9530 ± 0.85577 min in group 2 (Fenta), 8.6145 ± 1.15154 min in group 3 (Dexa). The mean duration of sensory blockade in group 1 (NS) was 259.200 ± 36.3544 min, in group 2 (Fenta) it was 406.350 ± 20.1240 min, whereas in group 3 (Dexa) it was 1031.500 ± 173.8676 min. The mean duration of motor block in minutes was 197.900 ± 31.8878 in group 1 (NS), 339.250 ± 26.2616 in group 2 (Fenta) and 934.950 ± 168.9181 min in group 3 (Dexa). *Conclusion:* The dosage of fentanyl and dexamethasone do not linearly correlate to the degree of blockade. Dexamethasone is superior to fentanyl as an adjuvant in supraclavicular block.

keywords: Bupivacaine; Supraclavicular Block; Dexamethasone.

How to cite this article:

Kunaal Kumar Sharma, Rajesh Kumar Verma, Surinder Singh *et al.* Comparison of Low Dose Fentanyl with Low Dose Dexamethasone as an Adjuvant to 0.5% Bupivacaine in Supraclavicular Block via Multipoint Injection Technique under Sonographic Guidance. Indian J Anesth Analg. 2019;6(4):1361-1366.

Introduction

It is an old belief "to be strong is to never feel pain" Perhaps this is the main reason that through the generations of medical science, pain became the most neglected symptom of all, be it in acute trauma scenario or in chronic debilitating diseases. We should realize that the strongest people are the ones who have felt pain, understood it, accepted it and learned from it. Postoperative pain relief is the core component of rehabilitation programmes and early ambulation. The IASP advocates that relief of pain should be recognized as a human right.[1] The

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Received on 08.05.2019, **Accepted on** 08.06.2019

supraclavicular approach to the brachial plexus characteristically is associated with a rapid onset of anesthesia and a high success rate. Ultrasound application allows for non-invasive visualization of tissue structures. The ability to image the plexus, rib, pleura and subclavian artery with ultrasound guidance has increased safety due to better visualization of anatomy and needle placement.

The aim of our study was to research about low doses of adjuvants for supraclavicular blocks in this present era of multipoint injection techniques / targeted intracluster injection technique under sonographic guidance for perineural blocks. The use of opioids in medical science has been present since 18th century when Friedrich Wohler discovered alkaloid from coca leaves which alleviated pain. In 1879 Vassily von Anrep recommended cocaine usage for surgical anesthesia. Fentanyl has been used in brachial plexus block for last three decades, and we believe that we are using it in a low dose of 10µg for the very first time. Dexamethasone is a glucocorticoid which exerts its effects on brachial block by a complex action and we used it in a low dose of 4 mg.

Materials and Methods

The study was conducted in a randomized controlled manner in a multispecialty tertiary care centre. The inclusion criteria of our study was met by only 60 out of the total 67 patients enrolled for the study. They underwent surgeries of the upper limb under USG guided supraclavicular brachial plexus block via multipoint injection technique. Patients were divided into three groups of twenty patients each and 21 ml injectant mixture was administered by a 20G needle in an in-plane approach, under direct sonographic visualisation with 6-13 Hz linear probe. Group I (NS) received 20 ml (0.5%) bupivacaine with 1 ml normal saline, group II (Fenta) received 20 ml (0.5%) bupivacaine with 10 µg (1 ml) fentanyl, whereas group III (Dexa) received 20 ml (0.5%) bupivacaine with 4 mg (1 ml) dexamethasone.

Heart rate, mean arterial pressure, respiratory rate and SpO_2 were noted before anesthesia in operation theatre, thereafter at the time of administration of nerve block, and then at 2 min, 5 min, 10 min intervals. Thereafter, the parameters were noted at every 15 min till 180 min. The block parameters like latency, duration, quality, postoperative analgesia and postoperative complications were also recorded. The Quality of block was assessed by four point scale The results were analyzed using IBM-SPSS software by ANOVA and Tukey test.

Results

Demographic distribution: There was no significant difference between the age groups of the patients in the three groups (*p*-value = 0.965157). Also no significant difference was found between the weight of patients in the three groups (*p*-value = 0.313619). (Fig. 1)

Onset of Blockade: The mean onset of sensory block

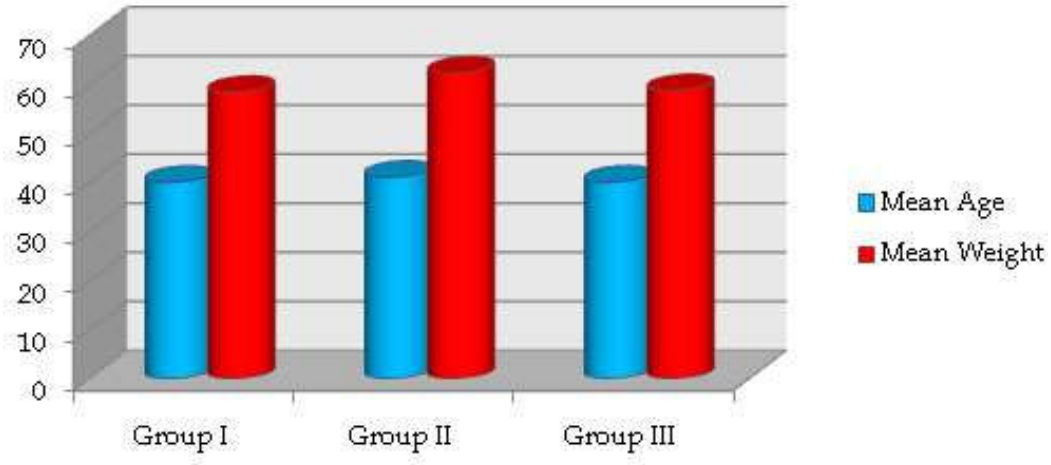

Fig. 1: Mean age and weight distribution

in group 1 (NS) was 9.6430 ± 1.19025 min, in group 2 (Fenta) it was 10.3395 ± 0.59338 min, whereas in group 3 (Dexa) it was 3.9735 ± 0.41802 min. As per post hoc analysis of ANOVA by Tukey test, these results were significant when group 2 was compared with group 1 (*p*-value 0.022), and when group 3 was compared with groups 1 and 2 (*p*-value 0.000). The mean onset of motor block in group 1 (NS) was 17.9025 ± 1.13816 min, in group 2 (Fenta) it was 17.9530 ± 0.85577 min and in group 3 (Dexa) it was 8.6145 ± 1.15154 min. (Fig. 2) As per post hoc analysis of ANOVA by Tukey test, these results were significant.

Duration of blockade: The mean duration of sensory blockade in group 1 (NS) was 259.200 ± 36.3544 min, in group 2 (Fenta) it was 406.350 ± 20.1240 min, whereas in group 3 (Dexa) it was 1031.500 ± 173.8676 min.(*p*-value 0.000). The mean duration of motor block was 197.900 ± 31.8878 min in group 1 (NS), 339.250 ± 26.2616 min in group 2 (Fenta) and 934.950 ± 168.9181 min in group 3 (Dexa). (*p*-value 0.000). (Fig. 3) (Table 1).

The MAP, HR, RR and SpO_2 remained stable throughout the procedure, during the study period. During the postoperative period, mean VAS score at the time of first requirement of rescue analgesic

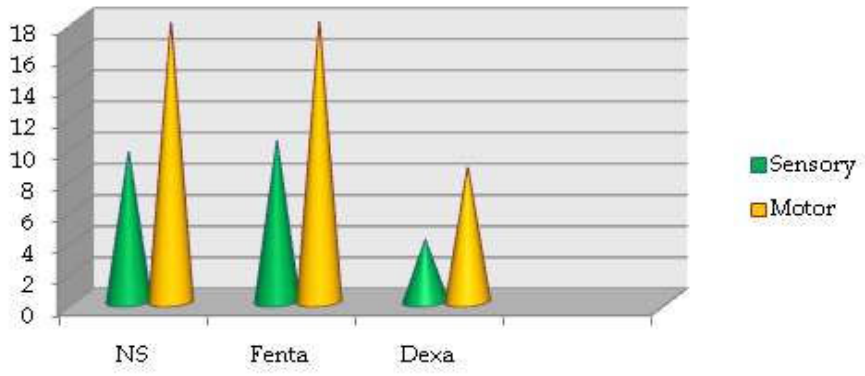

Fig. 2: Onset of blockade

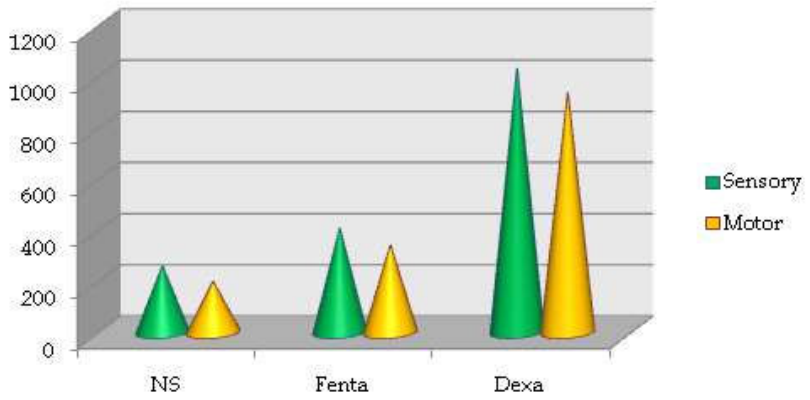

Fig. 3: Duration of blockade

Table 1: Monitored parameters of blockade

Parameters	Group I	Group II	Group III	*p*-value
Mean Sensory onset (in min)	9.6430 ± 1.19025	10.3395 ± 0.59338	3.9735 ± 0.41802	0.000
Mean Sensory duration (in min)	259.200 ± 36.3544	406.350 ± 20.1240	1031.500 ± 173.8676	0.000
Mean Motor onset (in min)	17.9025 ± 1.13816	17.9530 ± 0.85577	8.6145 ± 1.15154	0.000
Mean Motor duration (in min)	197.900 ± 31.8878	339.250 ± 26.2616	934.950 ± 168.9181	0.000
Postoperative VAS score	7.950 ± 0.9445	5.400 ± 0.5982	1.200 ± 1.7045	0.000
Postoperative analgesic consumption (in mg)	221.25 ± 16.7705	127.5 ± 49.271	26.25 ± 36.702	0.000
Quality of block	3.15 ± 0.3663	3.2 ± 0.4104	3.9 ± 0.3078	0.000

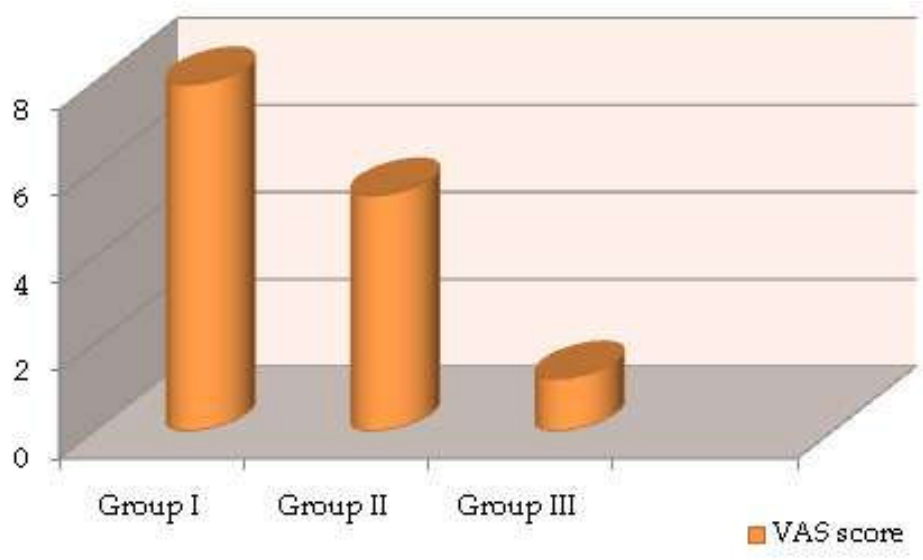

Fig. 4: Postoperative VAS at the time of first requirement of rescue analgesic

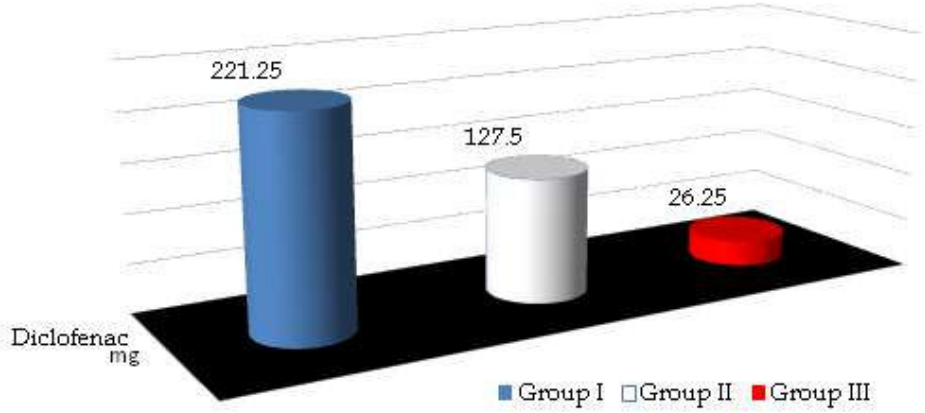

Fig. 5: Postoperative rescue analgesic consumption

(75 mg diclofenac), was least in group III (1.200 ± 1.7045) and maximum in group I (7.950 ± 0.9445). (Fig. 4). These results were highly statistically significant (p = 0.000). The rescue analgesia was given as 75 mg diclofenac intramuscularly. The mean postoperative rescue analgesic consumption (diclofenac) in group I was 221.25 ± 16.7705 mg, in group II it was 127.5 ± 49.271 mg, whereas in group III it was just 26.25 ± 36.702 mg (p = 0.000). (Fig. 5). The mean quality of block was in group III was 3.9 ± 0.30, in group II it was 3.2 ± 0.41 and in group I it was 3.15 ± 0.166.

Discussion

Supraclavicular block for upper extremity surgery anaesthetizes the brachial plexus at its divisions, where it is in its most compact form. Therefore it provides a complete and reliable block for upper extremity surgery.

Attardi *et al.*[2] showed that dexamethasone's mechanism of action in perineural blockade results from decreased nociceptive C-fibre activity via a direct effect on glucocorticoid receptors and inhibitory effect on potassium channels. It is also suggested that by local vasoconstrictive effect there occurs a reduction of local anaesthetic absorption, which leads to quicker onset and prolongation of blockade as demonstrated by Shishido *et al.*[3]. Also, Stan *et al.*[4] showed that glucocorticoids can prolong analgesia period by suppressing the synthesis of inflammatory mediators. Neurotoxicity to perineural corticosteroids is related mainly to the preservative benzyl alcohol,

vehicle polyethylene glycol and the presence of insoluble steroid particulate matter in the injectate. Dexamethasone is non-particulate and we used a preservative-free formulation. In addition, Ma *et al*.[5] have demonstrated neuroprotective effects of perineurally administered dexamethasone in murine studies. Perineural corticosteroid injections are widely used throughout the world. The time of onset of blockade with dexamethasone in our study group III (sensory onset 3.973 ± 0.418 min, motor onset 8.614 ± 1.151 min) was faster than that seen by Parveen *et al*.[6] (sensory onset 28.20 ± 3.02 min, motor onset 38.70 ± 4.25 min) and Alarasan *et al*.[7] (sensory onset 10.36 ± 1.99 min, motor onset 12 ± 1.64 min). Although, Parveen *et al.* and Alarasn *et al.* used a higher dose of dexamethasone (8 mg) in comparison to our dose of 4 mg, we were still able to get faster onset of block in our study group.

We attribute this to the use of multipoint injection technique which resembles the targeted intracluster injection technique of Techasuk *et al.*, in which we injected 11 ml of the injectant mixture at the eight ball corner pocket, followed by injecting 5 ml at the middle trunks and 5 ml at the upper trunks. Techasuk *et al*.[8] have observed better results with targeted intracluster injection technique in comparison to double injection technique in supraclavicular block.

We have used 4 mg dexamethasone and the duration of sensory and motor block in our study is 17.192 ± 2.897 hrs and 15.582 ± 2.815 hrs. This is comparable to the study by El-Baradey *et al*.[9] which however used a higher dose (8 mg) of dexamethasone. We believe that dose of dexamethasone has little to do with prolongation of block duration and analgesia. This is evident in the study by Liu *et al*.[10], in which the addition of 1 mg, 2 mg and 4 mg dexamethasone to the local anaesthetic mixture significantly prolonged the analgesia duration to 22.3 hours, 23.3 hours and 21.2 hours in each of the respective groups which had received USG guided supraclavicular block.

Fentanyl is a proven adjuvant for perineural blockade, but its usage in low doses has not been widely studied. We believe that this is for the first time that fentanyl is being used in such a low dose of 10 µg in 20 ml bupivacaine (0.5%). And on the top of that, significance of prolongation of block even at this low dosage of fentanyl emphasizes the reason for need of more such studies with low dose of fentanyl.

The duration of sensory and motor block in group II (fentanyl) was significantly prolonged in comparison to the control group I (NS). Rajkhowa *et al*.[11] used higher dose (50µg) of fentanyl as adjuvant in supraclavicular block and got sensory and motor block of 7.75 ± 0.47 hrs and 6.56 ± 0.43 hrs duration, while we used 10 µg and obtained comparable result of sensory and motor block of 6.77 ± 0.335 hrs and 5.65 ± 0.437 hrs. We believe that as per the the study by Gissen *et al*.[12], the local anaesthetic properties of fentanyl were responsible for this effect. Also Stein *et al*.[13], have shown that the opioid receptors on the peripheral nerve terminals get up-regulated due to inflammation at the fractured site, thereby cytokines activate the endogenous opioid peptides and cause local analgesia at the site of inflammation. The opioids inhibit neuronal firing and transmitter release, and also inhibit the release of substance-P. We believe that this mechanism also came into play while we used the low dose of fentanyl for supraclavicular block in our study.

The intergroup comparison between the dexamethasone group and fentanyl group showed that dexamethasone is superior to fentanyl in terms of faster onset of blockade, prolonging the duration of block, quality of the block and postoperative analgesia. This deduction is analogous to the study by Yaghoobi *et al*.[14] who although had used higher doses of fentanyl (100 µg) and dexamethasone (8 mg) alongwith larger injectant volume in their study on axillary block.

Conclusion

The use of low dose dexamethasone (4mg) prolonged the duration of block to a far greater extent (sensory 17.192 ± 2.897 hrs, motor 15.582 ± 2.815 hrs) than the use of low dose fentanyl (10 µg), (sensory 6.772 ± 0.335 hrs, motor 5.654 ± 0.437 hrs). The postoperative VAS score at the time of first requirement of rescue analgesia was lowest in the dexamethasone study group. Likewise, the mean postoperative rescue analgesic requirement of diclofenac in dexamethasone group was least among the three study groups. Also, the quality of block was most superior in the dexamethasone group. So we advocate its use over fentanyl in supraclavicular block. Administration of supraclavicular block under sonographic guidance resulted in stable haemodynamics throughout the study period in all the three groups, and no patient developed any adverse effects related to supraclavicular block.

Limitations: The sample size of our study groups was small. We also did not measure the serum concentration and CSF levels of the adjuvants used in our study in order to quantify the systemic absorption of these drugs (if any).

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