
Ultrasound Guided Supraclavicular Brachial Plexus Block

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Abstract

Purpose:

To evaluate the effect of adding dexamethasone 5mg or dexmedetomidine 1ug/kg on levobupivacaine action during ultrasound guided supraclavicular brachial plexus block technique.

Materials and Methods:

In this prospective randomaized double blind clinical study, 120 patients were equally divided into four groups according to the injectate LA into : Group B: 30 ml of bupivacaine 0.25%. Group L : 30 ml of levobupivacaine 0.25%. Group L +D : 30 ml of levobupivacaine 0.25 % + 5mg of dexamethasone. Group L + DEX: 30 ml of levobupivacaine 0.25 % + 1 ug/kg of dexmedetomidine .

All patients had recieved single shot ultrasound guided supraclavicular brachial plexus block with using nerve stimulation. Parameters recorded in the study include the following: Onset and duration of both sensory and motor block and duration of analgesia. Haemodynamic changes (blood pressure and heart rate) and a verbal numerical pain rating scale (V.N.P.R.S.) during the first 24 hours. Serum cortisol level at 1 and 4 hour post injection. Total analgesic requirements calculated.. Any evidence of complication. The patients satisfaction with the anesthetic technique was assessed. Data were analyzed with the paired sample t-test, analysis of variance ANOVA, post hoc test and the Chi-square test. P < 0.05 was considered statistically

significant. P < 0.001 was considered highly significant.

Results:

Regarding onset of sensory and motor block there was high significance between the four groups being shorter onset of block in group L , group L+D and group L+DEX than group B with no significance in between group L, group L+D and group L+DEX. The duration of sensory, motor block and the duration of analgesia were significantly longer in group L+D than group L+DEX, group L and group B respectively. Haemodynamics were better cotrolled in group L+D and group L+DEX than group B and group L but in group L+DEX there was significant hypotension and decrease heart rate. Also pain scores were significantly low in group L+D and group L+DEX than group L and group B. Serum cortisol levels at 1 and 4 hours were non significantly changed in group L+D and group L+DEX denoting better suppression of stress reponse to surgery than group L and group B. Patients were satisfied with the anesthetic technique.

Conclusions:

The addition of dexamethasone or dexmedetomidine to levobupivacaine prolongs sensory and motor block duration and duration of analgesia with no effect on onset of block and better control of haemodynamics and serum cortisol .

Keywords: ultrasound supraclavicular, dexamethasone, dexmedetomidine and levobupivacaine

Introduction

Ultrasound guided regional anesthesia facilitates brachial plexus blockade in several ways including enhanced visualization of the neural target and surrounding structures, assessment of proper needle tip position and spread of local anesthetic plus identification of anomalous anatomy or pathology.[1] Racemic bupivacaine is most commonly used local anaesthetic as it provides longer duration of action and favourable ratio of sensory to motor neural block. However, the dextroenantiomer in the racemic mixture of bupivacaine results in cardiac and central nervous system toxicity. Levobupivacaine the s-enantiomer of bupivacaine is a recently introduced local anaesthetic that possess similar anaesthetic qualities as racemic bupivacaine.[2]. Numerous perineural adjuvants have been used with local anesthetics in regional anesthesia in an attempt to optimize block characteristics and improve clinical outcomes. Dexamethasone has been shown to prolong nerve blockade in proportion to their anti-inflammatory potency.[3]. Dexmedetomidine is a clinically used anesthetic and belongs to high selective α_2 -adrenergic receptor agonists. Dexmedetomidine action have been shown to be a dose dependent and peripherally mediated action.[4]

The aim of our study was to evaluate the effect of adding dexamethasone 5mg or dexmedetomidine 1ug/kg on levobupivacaine action during ultrasound guided supraclavicular brachial plexus block technique.

Methods This study was conducted in Benha university hospital between the period of January 2014 and December 2015 after obtaining approval from the Institutional Ethics Committee. The inclusion criteria in this prospective, double-blind, randomized study include a

written informed consent from all the patients, scheduled for elective upper limb orthopedic surgeries involving arm and forearm. Age ranged between 18 -60 years, American Society of Anesthesiologists (ASA) I-II. Methods of randomization: Closed envelope. 136 patients had received the block and 16 patients had been excluded due to unsuccessful block and 120 adult patients with successful block (figure 1). These patients were randomly allocated into four equal groups according to the injectate LA they had received:

Group B: 30 ml of bupivacaine 0.25%.

Group L: 30 ml of levobupivacaine 0.25%.

Group L +D : 30 ml of levobupivacaine 0.25 % + 5mg of dexamethasone.

Group L + DEX: 30ml of levobupivacaine 0.25 % + 1 ug/kg of dexmedetomidine .

Exclusion criteria included: Patients refusal, Patients with chronic pain, patients with chronic analgesic medication, coagulopathy, history of brachial plexus injury, allergy to any of the drugs used. Patients on medications with Alpha - 2 adrenergic blocking effects, hepatic or renal insufficiency, systemic infection or infection at the site of injection and patients with block failure.

Patients were interviewed and detailed history, examination and routine investigations were fulfilled. Verbal numerical pain rating scale (VNPRS) (0 = no pain to 10 = most severe pain) was explained to patients. Patients were admitted to the operating room fasted and a peripheral intravenous line was inserted and standard monitoring was conducted and recorded, including heart rate (HR), noninvasive arterial blood pressure, electrocardiogram (5 leads), and peripheral oxygen saturation (SpaO2). A nasal cannula was applied and supplemental oxygen was given throughout the

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procedure at 3 L/min. Patients had received 1mg midazolam and 50 ug fentanyl before block technique to maintain moderate sedation and arousable on command. Position of the patient was supine with head turned to opposite site of surgery and the arm involved is adducted. Sterilization was done and spnoscape ultrasound linear probe 12 MHZ was used to scane the supraclavicular region. The pulsatile subclavian artery is a hypoechoic “a bunch of grapes” or black circle and pulsatile. The artery sits on the hyperechoic line of the first rib or pleura. The stimulating needle was inserted with an in plane technique. The location end point of the needle was a distal motor response with an output lower than 0.5 mA (miliampers) with biceps contraction or triceps contraction. After negative aspiration the injectate was given by another anaesthesiologist blinded to the study with repeated aspiration test and looking for spread of local anesthetic around the brachial plexus and extending up between the plexus and the artery. Once total volume was injected the time was noted and this was recorded as Time 0.

The patients were randomly divided (using the block randomization method) to four groups according to the injected LA solution used. The studied solutions were prepared at the bedside before the injection and provided in patient specific, sealed packaging by a member of staff not otherwise involved in the study.

The ultrasound block technique was performed by the team experienced in these techniques who was blinded to the kind of LA solution used. The patients also were blinded to the LA solution used.

The sensory block for each nerve (radial, median, ulnar, musculocautnous nerve) was evauated by using alcohol soaked gauze and graded as follow : 0 = no difference from unblocked extremity ; 1 =

loss of cold than unblocked extremity ; and 2 = no sensation of cold .

The motor block was evaluated using the forearm flextion (musculocuataneous nerve) , thumb abduction (radial nerve) , thumb and second digit pinch (median nerve) , and finger adduction (ulnar) and scored as follow : 0 = no loss of force , 1 = reduced force compared with the contra lateral arm and 2 = inability to overcome gravity. Sensory and motor blocks were evaluated before surgery every 3 minutes until 30 minutes after injection or adequate block had been established and then every 30 minute after surgery until they have resolved.

Adequacy of block was evaluated by Allis clamp test before handing over the patient to surgeon. The reading was recorded as follows:

a) Adequate block. b) Inadequate block or block failure if complete sensory and motor block was not achieved and the patients were excluded from our study

Parameters recorded in this study were as follows:

A) Primary outcome

1- Onset and duration of sensory block. Onset of sensory block is defined as the time between the end of local anesthetic injection and loss of cold sensation in any branch of brachial plexus. The duration of sensory block is defined as the time between the onset of block and the total recovery of sensation.

2- Onset and duration of motor block. Onset of motor block is defined as the time between the end of local anesthetic injection and reduction of force compared with the contra lateral arm any branch of brachial plexus. The duration of motor block is defined as the time between the onset of block and the total recovery of motor block.

3- Duration of Analgesia. Time to first dose of postoperative systemic analgesic that it was on the basis of demand of the patient.

B) Secondary outcome

- 1- Haemodynamic changes (Pulse and blood pressure) in the first 24 hours.
- 2- Pain score was assessed using verbal rating scale (VNPRS) (0 no pain – 10 most severe pain) where pain was evaluated during 0, 1, 2, 4, 6, 12, 24 hour postoperative
- 3- Total analgesic requirements in the form of breakthrough pain relief Diclofenec Sodium 75mg IM.
- 4-Serum cortisol level at 1 hour and 4 hour post ingestion .
- 5-Any evidence of neurological, gastrointestinal, cardiopulmonary complications and any adverse drug reaction was recorded.
- 6- Patient satisfaction with the anesthetic technique was assessed after arrival to post anesthesia care unit using a 2 points scale (0 = unsatisfied ; 1 = satisfied).

The statistical analysis of our results was conducted using the computer program SPSS version 19.0 for Windows (SPSS, Chicago, IL, USA). Data were expressed as mean ± SD or number (percentages). The quantitative data was analysed by using paired student t-test. One way ANOVA test and post hoc test to determine differences between and within groups. Qualitative data was analysed by using Chi-square test. $P < 0.05$ was considered significant. $P < 0.001$ was considered highly significant. $P > 0.05$ was considered non significant.

Results

This study demonstrated comparable results with no significance as regards age, sex, weight, A.S.A classification and duration of surgery. 136 patients had received the block and 16 patients had been excluded due to unsuccessful block and 120 adult patients with successful block (figure 1). As regard onset of sensory and motor block there was high significance between the groups (P

< 0.001). It was shorter in L, L+D and L+DEX groups than B group with no significance in between the three group ($P > 0.05$). Denoting that the addition of dexamethasone or dexmedetomidine to levopubivacaine does not affect the onset of block. Table 1.

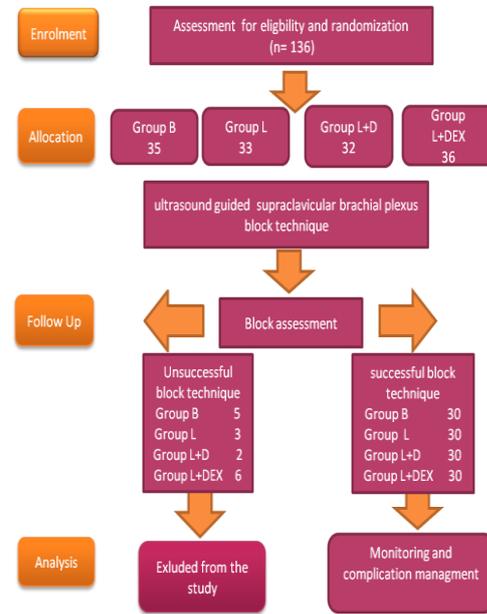


Figure 1. Consort flow chart

There were high significance ($P < 0.001$) between the groups regarding the duration of sensory, motor and duration of analgesia which were longer in L+D group than L+DEX group than L group than B group respectively. Table 1.

Regarding hemodynamic parameters (figure. 2) (heart rate and blood pressure) there was no significance between the groups till 30 minutes after block. Also there was no significance between B group and L group during the technique ($P > 0.05$) but in L+D group there was better control in more prolonged period due to the extended duration of analgesia. Also in L+DEX group there was significant hypotension and bradycardia than other

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groups due to systemic absorption of the drug.

Regarding verbal numerical pain rating scale there was no significance between the four groups at 0,1hr and 2 hr (**P > 0.05**). But highly significant at 4hr, 6hr, 12hr and 24 hrs (**p < 0.001**). The lower score due to the prolonged duration of analgesia in L+D group, L+DEX group, L group and B group in the same order. As regard serum cortisol level (figure 3) there was no significance between 1 h and 4 h serum sample level in L+D group and L+DEX group (**P > 0.05**), but there was significance in B group and L group (**P < 0.05**). There

was reduction in total analgesic requirements in the form of number of diclofenac injections in L+D and L+DEX groups than L group and B group with lesser number in L+D group. Patients were satisfied with the anaesthetic technique.

The complications in our study were few apart from hematoma formation with 6 cases, Phrenic nerve paralysis in 10 cases and Horner's syndrome in 7 cases. Regarding complication to anesthetic drug there was no local anesthetic toxicity, hypotension, bradycardia and prolonged sedation in L+DEX group.

Table (1a – b) . Comparison between groups as regard onset and duration of block and duration of analgesia.

	B group	L group	L+D group	L+DEX group	test	P-value (Sig.)
Onset of sensory block(min)	9.23±1.6	7.83±1.3	7.30±1.9	7.36±1.4	9.5*	<0.001
Onset of motor block(min)	10.8±1.3	9.80±1.2	9.03±0.9	9.16±1.0	14.8*	<0.001
Duration of sensory block(min)	186±31	220±36	678±57	505±44	876	<0.001
Duration of motor block (min)	150±31	180±29	396±33	304±33	397	<0.001
Duration of analgesia(min)	208±32	246±36	695±62	568±56	708	<0.001

Data are expressed as mean ± standard deviation (SD)

*One way ANOVA test .

Post hoc test

	B vs L group	B vs L+D group	B vs L+DEX group	L vs L+D group	L VS L+DEX group	L+D VS L+DEX group
Onset of sensory block	0 .005 (S)	<0.001	<0.001	.568 (NS)	0.669(NS)	0 .99(NS)
Onset of motor block	0 .005 (s)	<0.001	<0.001	059 (NS)	0.159(NS)	0.97(NS)
Durarion of sensory block	0 .016 (S)	<0.001	<0.001	<0.001	<0.001	<0.001
Duration of motor block	0 .003 (S)	<0.001	<0.001	<0.001	<0.001	<0.001
Duration of analgesia	.017 (S)	<0.001	<0.001	<0.001	<0.001	<0.001

P < 0.001 is considered high significance. P < 0.05 is significance (s). P > 0.05 is non significant(NS).

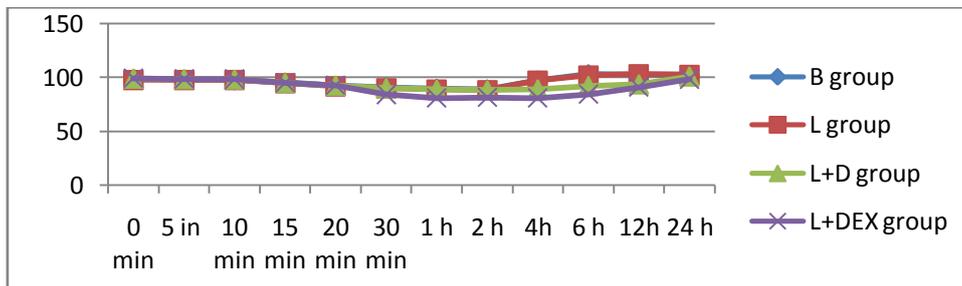


Figure 2 . Comparison between groups as regard MAP

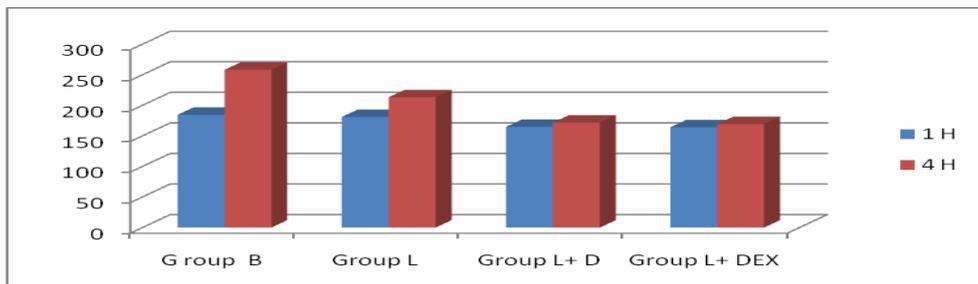


Figure 3. Comparison between groups as regard serum cortisol level (ng/ ml). High significance in group B and group L but no significance in group L+D and GROUP L+DEX by paired sample test.

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DISCUSSION

Supraclavicular Brachial plexus block is a common peripheral nerve block technique used for providing anesthesia for upper limb surgeries of the arm and the forearm. The use of Ultrasound has made the procedure safer as smaller amounts of local anesthetic can be given with more accurate needle placement thus avoiding injury to arteries, veins and other adjacent structures. The ultrasound can also be used to ensure that the local anesthetic spread is in the correct tissue plane and therefore decreases the direct nerve damage.

The results in the current study regarding the onset of sensory and motor block are consistent with those reported by **Deshpande et al** study who compare between racemic bupivacaine and Levobupivacaine in supraclavicular brachial plexus block which were in agree with the result of **Cox et al** who also found early onset & prolonged duration of sensory block & prolonged duration of analgesia in patient receiving levobupivacaine for supraclavicular brachial plexus block. [2, 5] In contrast to our study is **Ilham et al** study who found that the motor and sensory block onset times were shorter in Group B than Group L. [6]

In our study the addition of dexamethasone and dexmedetomidine to levobupivacaine had no effect on the reduction of the block onset time that is in agrees with the study of **Lee et al** and the study of **Naveen** in which the onset of action of block had no significant difference between the studying groups[7,4]. Also **Persec et al** had found that there were no differences between sensory and motor block onset time in between levobupivacaine group and dexamethasone group during supraclavicular block[8]. But In **Enas and Sahar** study there were reduction of block onset time after adding dexamethasone to

levobupivacaine during interscaline brachial plexus block [9]. **Noss et al** had found that dexamethasone had a variable effect on the time to block onset with five trials finding a significant reduction in latency time while two trials demonstrating no significant reduction in the block onset which is in agree with our study[3]. **Das et al** who had studied dexmedetomidine as adjuvant in supraclavicular brachial plexus block found that dexmedetomidine has no appreciable effect on the onset time of sensory and motor blockade. And this agrees with our study[10]. On the opposite side is **Dixit et al** who had demonstrated shorter onset time of dexmedetomidine group than levobupivacaine group during supraclavicular brachial block [11].

The results in the current study regarding the duration of sensory, motor and analgesic duration had showed that there was significance between group B vs. L ($p < 0.05$) and high significance ($p < 0.001$) between the other groups denoting significant prolongation which in agree with the study of **Deshpande et al** who had found that the longer duration of motor and sensory block with levobupivacaine as compared with bupivacaine provides prolonged postoperative analgesia. Levobupivacaine has vasoconstrictor activity as demonstrated in **Aps Reynolds** study which could explain the prolonged duration of action. [12]

A recent meta-analysis was conducted by **Choi et al** and included 9 trials with 393 patients receiving dexamethasone. This study concluded that dexamethasone prolongs brachial plexus blocks with long acting local anesthetics from 730 to 1306 minutes and intermediate acting anesthetics from 168 to 343 minutes and this in agree with our study[13]. Also **Liu et al** had demonstrated that dexamethasone prolonged analgesia by

approximately 10 hours compared to a control group (0.25% bupivacaine) for ambulatory shoulder surgery [14].

Our study agree with the study of **saumya et al** where the sensory and motor blockade duration were longer in group levopubivacaine + Dexmedetomidine (L D) than group L ($P < 0.01$). Duration of analgesia was significantly longer in group LD than in group L ($P < 0.05$). Motor and sensory block was significantly prolonged on addition of dexmedetomidine which provided for better patient compliance in the postoperative period [15]. This was what **Swami et al** had concluded in their study which showed significant increase in duration of analgesia on addition of dexmedetomidine to bupivacaine 0.25% in brachial plexus block.[16]

Our study agree also with the study of **Naveen** that the duration of motor block is significantly higher in dexamethasone group(D) and dexmedetomidine group(DEX) compared to bupivacaine group whereas motor block is more prolonged in group D Compared to DEX [4]. Also our study agrees with **Naveen** in which that the duration of sensory block is significantly higher in dexamethasone group and dexmedetomidine group compared to bupivacaine group. Whereas sensory block is more prolonged in group D Compared to DEX. [4]. Also in **Lee et al** study they demonstrated that both dexamethasone and dexmedetomidine had extended block duration compared to the control group in patients undergoing ultrasoundguided axillary brachial plexus block[7].

The mechanism of dexamethasone in prolonging the duration of nerve blocks is thought to arise from various factors. A degree of vasoconstriction which results in slow absorption of local anesthetics, suppression of the synthesis and secretion of inflammatory mediators, reducing the

transmission in unmyelinated C-fiber .[7] The mechanism of the analgesic effect of dexmedetomidine is possible may be related to a vasoconstriction property, altering locus ceruleus activity and a decrease in release of norepinephrine from the locus ceruleus .[7]

The results in the current study regarding the hemodynamic parameters (heart rate and mean arterial blood pressure) had showed that no significance ($p > 0.05$) between group B and group L all over the technique that is in agree with the study of **Deshpande et al** [2]. Also the results in the current study had showed that dexmedetomidine and dexamethasone both prolong duration of analgesia when added to levopubivacaine and suppress the stress response to surgery resulting in better haemodynamic parameters in addition dexmedetomidine has sedative and sympatholytic action through stimulation of alpha 2 adrenoreceptors that results in hypotension and slow heart rate more than occurred in the other groups which is in accordance with **Saumya et al** study [15]. On contrast to our study is **Dixit et al** study who found that the dose of 1ug per kg had resulted in stable haemodynamics in patients in both groups (levopubivacaine group and dexmedetomidine group) during supraclavicular block. [11]

The results in the current study regarding the verbal numerical rating scale had showed that there was good analgesic technique in suppression of pain transmission and stress response especially at 4hr, 6hr, 12hr and 24 hrs. ($p < 0.01$) due to the addition of the adjuvants. Our study agree with **Ammar and Mahmoud** had found that lower verbal rating pain scale during the first 48 postoperative hours when comparing bupivacaine vs dexmedetomidine group[17]. Also in **Persec et al** study and the study of **kim et al** had showed

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significantly prolonged analgesia effect and lower VNRS up to 48hours post surgery when low dose dexamethasone was added to levobupivacaine compared with levobupivacaine alone and this agree with our study[8 , 18] .

The results in the current study regarding serum cortisol level as a stress hormone had showed that the ultrasound guided supraclavicular brachial plexus block is a good regional block technique in suppression of stress response to surgery in addition to that the adjuvants dexamethasone and dexmedetomidine had led to prolonged control of serum cortisol level. Our study agree with **El Shamaa H** study[19] which stated that the circadian rhythm of cortisol hormone secretion is affected and disturbed by acute surgical pain, where a progressive rise in cortisol level was described in the early six postoperative hours, however, such effect was blunted by the block application . In the other side in **Enas and Sahar** study [9]they found that there was significant increase in plasma cortisol levels after 4 hours postoperative in the comparing groups but by the time it was significantly suppressed at 24hours in dexamethasone group than levobupivacaine group indicating that the neuroendocrine axis was least suppressed with the addition of dexamethasone .

The results in the current study regarding post operative analgesic diclofenac injection agree with **Vieira et al** study who found a significant reduction in the first postoperative day opiates with adjuvant dexamethasone. [20] Also our study also agree with the study of **Das et al** in which patients of dexmedetomidine group required significantly less number of diclofenac sodium injection in the first 24h of postoperative period than the control group . [10]

The complications in our study were in consistence with other studies in which the ultrasound usage had resulted in decreasing risk of complications such as pneumothorax and blood vessels puncture. There were no reported cases of pneumothorax and six cases with blood vessel puncture and hematoma formation . Horner's syndrome was observed in 10 cases which resolved after that with observation. Phrenic nerve paralysis also observed in 7 cases. The complications related to the drugs used in this study , there were no case with intravascular local anesthetic toxicity but in the group L+DEX there were hypotension and bradycardia in comparison to other groups and the patient in this group did not received any sedative drug due to the sedative effect of dexmedetomidine . **Saumya et al** and **Esmoğlu et al** also found significant bradycardia and hypotension in dexmedetomidine plus levobupivacaine group than levobupivacaine alone which was present in our study. [15, 21]

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