ORIGINAL RESEARCH PAPER

Volume-8 | Issue-4 | April-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

DEXAMETHASONE AS ADJUVANT WITH 0.5% LEVOBUPIVACAINE FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

Anaesthesiology

Dr. Jayanta Kumar Das Postgraguate Trainee, Department of Anaesthesiology, Medical College, Kolkata, West Bengal, India

Dr. Rita Haldar (Dasgupta)* Associate Professor, Department of Anaesthesiology, Medical College, Kolkata, West Bengal, India *Corresponding Author

ABSTRACT

Objectives: To compare the effect of levobupivacaine with and without dexamethasone on the characteristics, efficacy and duration of analgesia in supraclavicular brachial plexus block. **Methodology:** 100 patients of either sex, aged between 18-60 years posted for elective surgery of forearm and hand under supraclavicular brachial plexus block were divided into two groups – Group C (control group) and group DS (dexamethasone group). Group C (n=50) received 30 ml of 0.5% isobaric Levobupivacaine with 2 ml of isotonic normal saline and Group DS (n=50) received 30 ml of 0.5% isobaric Levobupivacaine with 2 ml of dexamethasone (8mg) for supraclavicular brachial plexus block. **Results:** The mean onset time of sensory and motor blocks were faster in Group DS than control group. Mean duration of analgesia, sensory and motor block in Group DS were prolonged compared to Group C. Mean arterial pressure and heart rate variation in two study groups were statistically not significant at any point of study. **Conclusion:** Dexamethasone when added to levobupivacaine for brachial plexus block, is superior to levobupivacaine alone.

KEYWORDS

brachial plexus block, levobupivacaine, dexamethasone.

Introduction:
Regional anaesthesia was first introduced by Harvey Cushing in 1901 to describe pain relief by nerve block. Regional nerve blocks are based on the concept that pain is conveyed by nerve fibres, which are amenable to interruption anywhere along their pathway. For upper limb surgery, brachial plexus block has evolved into a valuable and safe alternative to general anaesthesia. Since its introduction by William Steward Halsted in 1885, who performed this block by exposing the roots, it has undergone many modifications and changes to arrive at a better technique. It is an excellent method of regional anaesthesia for surgeries of upper limb to maintain complete muscular relaxation and haemodynamic stability. It also decreases risk of aspiration due to intact pharyngeal and laryngeal reflexes, avoids difficult intubation, preserve better mental functions, decreases post-operative complications of general anaesthesia and provides better post-operative analgesia without undue sedation facilitating early mobilization and discharge[1]. Among the various approaches of brachial plexus block, supraclavicular approach is considered easiest and effective. This approach provides the most complete and reliable anaesthesia available for upper extremity surgery. It is performed at the trunk level, where brachial plexus is presented compactly. The first supraclavicular brachial plexus block was performed by Kulenkampff in 1912[2].

The classical approach using paraesthesia technique being a blind technique, may be associated with higher failure rate and injury to the nerves and vascular structure[3]. To avoid some of these problems, use of peripheral nerve stimulator was started which allowed better localization of the nerves/ plexus[4].

Nowadays different drugs have been used as adjuvant with local anaesthetics in brachial plexus block to achieve quick, dense and prolonged block like opioids such as morphine, fentanyl, sufentanil, tramadol, buprenorphine and calcium channel blocker such as verapamil and alpha2-agonist like clonidine and dexmedetomidine[5]. Various studies have been done using dexamethasone as an adjuvant to local anaesthetics mixture in brachial plexus block resulting in variable effects on onset but prolonged duration of analgesia and motor block[6,7].

Aims and objectives:
This study was done to compare the effect of dexamethasone with levobupivacaine on brachial plexus block.

Primary Outcome:
1. Onset and duration of sensory block
2. Onset and duration of motor block
3. Duration of analgesia

Secondary Outcome:
1. Incidence of any cardiac complications like dysrhythmia or changes of blood pressure.
2. Incidence of any other complications.

Methodology:
Study population: After obtaining permission from institutional ethical committee, 100 consented patients of either sex, aged 18-60 years, ASA physical status I or II posted for elective orthopaedic, general or plastic surgical cases of forearm and hand of less than 3 hour duration under supraclavicular brachial plexus block were taken for our study.

Study period: January 2017 to June 2018

Sample size: As per previous study by Ritu Baloda et al. mean duration of sensory block without dexamethasone was 657.5 minute and with dexamethasone was 923 minute[3]. So, the sample size calculated as per formula for determining difference between two means came as 47 in each group. Taking into account of the (alpha) error as 5% and power of the study (beta) taken as 80% and to rule out any dropout during the study period as well as to enhance the power of study, 50 patients were taken in each of the study groups i.e. total 100 patients.

Study design: Prospective randomised double blinded study done at Medical College and Hospital, Kolkata.

Premedication:
Tablet Ranitidine 150 mg and tablet Lorazepam were given at night before surgery. In the early morning of operation, tablet Ranitidine 150mg was given orally.

Monitoring:
After arrival of the patient at the operation theatre, non-invasive monitors were attached to monitor ECG, heart rate, blood pressure and SpO2. Baseline parameters was recorded. Intravenous infusion of Ringers' lactate was started according to body weight and oxygen was given at the rate of 2 litres/minute via nasal prong. All patients received Inj. Midazolam 0.04 mg/kg intravenously before the procedure. Both patient and observer were blinded to the group allocation which was done according to computer generated randomization table.

Technique of Supraclavicular Brachial Plexus Block:
After proper explanation of the technique, block was performed aseptically in supine position with the head turned away from the side to be blocked. A mark was made approximately 1.5cm to 2cm posterior to the midpoint of the clavicle and a 22- gauge 50 mm. insulated nerve locator needle was introduced and position of the needle was considered acceptable when an output current of <0.4 mA elicited a slight distal motor response in forearm and hand.[8] On negative aspiration of blood, a total volume of 32 ml solution (30 ml 0.5%

levobupivacaine and 2 ml dexamethasone or normal saline respectively) was injected slowly in Group DS (n=50) and Group C (n=50).

Assessment of Sensory and Motor Blockade:

Sensory and motor blockade of radial, median, musculocutaneous, medial cutaneous nerve of arm and forearm, and ulnar nerves (C5-T1 dermatomes) were assessed every 2 minutes after completion of injection till complete sensory and motor blockade. Sensory blockade of each nerve was assessed by pinprick[9] on skin using a 26-gauge needle and evaluated using a 3-point scale:

Grade 2 = normal sensation
Grade 1 = loss of sensation to pinprick
Grade 0 = loss of sensation to light touch.

Motor block was tested by thumb abduction and wrist extension (radial nerve), thumb adduction and ulnar deviation of the hand (ulnar nerve), flexion of the elbow in supination (musculocutaneous), thumb opposition and wrist flexion (median nerve) and were measured using a 3-point scale[10] where:

Grade 2 = normal movement
Grade 1 = paresis
Grade 0 = absent movement

Onset time of sensory block is defined as the time interval between the end of local anaesthetic injection and loss of sensation to pinprick in all of the nerve distributions. Onset time of motor blockade is defined as the time interval between the end of local anaesthetic injection and paresis (motor score=1) in all of the nerve distributions. The duration of sensory block is defined as the time interval between the onset of sensory block and the first postoperative pain. The duration of motor block is defined as the time interval between the onset of motor block and complete recovery of motor functions. When VAS was ≥ 4 it was considered as the termination of analgesic effect of the drug and injection diclofenac sodium (rescue analgesic) 75 mg was given intramuscularly.

The null hypothesis of this study was that the equal amount of the dexamethasone and normal saline added to levobupivacaine would have similar onset and duration of sensory and motor block and similar duration of analgesia.

Results:

The data collected was entered into a database Microsoft Excel sheet. The results were expressed as mean ± standard deviation. The statistical analysis was done using SPSS software version 21, the chi-square test was used to test the association between different study variables under study. The difference was considered to be statistically significant when P value < 0.05 and highly significant when P<0.001.

Table 1: Demographic Parameters

	Group DS	Group C	P-value
Age(years)	33.42 ± 7.85	35.19 ± 8.83	0.41 (NS)
Sex (M: F)	14:11	31:19	0.93 (NS)
BMI (in kg/m2)	24.29 ± 3.18	24.53 ± 1.96	0.72 (NS)
ASA I:II	31:19	16:9	0.81 (NS)

Group DS= dexamethasone and levobupivacaine, C= Normal saline and levobupivacaine
NS – Not statistically significant

The analysis showed two study groups were comparable for age, gender, BMI and physical status.

Table 2: Onset of Sensory Block

Groups	N	Mean (minutes)	Std. Deviation	P value
DS	50	7.6400	1.30556	<0.0001
C	50	12.8400	2.29783	<0.0001

Onset of sensory block was significantly faster in dexamethasone group than control group (p<0.0001).

Table 3: Onset of Motor Block

	N	Mean (minutes)	Std. Deviation	P value
DS	50	8.6000	1.37024	<0.0001
C	50	15.2600	2.69398	<0.0001

The onset of motor block was significantly faster in dexamethasone group (p<0.0001).

Table 4: Duration of Sensory Block in Two Groups (hours)

	N	Mean (hours)	Std. Deviation	P value
DS	50	10.6940	1.09496	<0.0001
C	50	4.7094	1.13825	<0.0001

Duration of sensory block was prolonged in dexamethasone group (p<0.0001).

Table 5: Duration of Motor Block in Two Groups (hours)

	N	Mean (hours)	Std. Deviation	P value
DS	50	10.7240	1.05028	< 0.0001
C	50	4.6730	1.02615	< 0.0001

Duration of motor block of DS group was significantly longer than group C (p<0.0001).

Table 6:- Duration of Analgesia (hours)

	N	Mean (hours)	Std. Deviation	P value
DS	50	10.98	.98	<0.0001
C	50	5.089	1.07	<0.0001

Duration of analgesia of DS group was longer in dexamethasone group than group C (p<0.0001).

Table 7: Average Mean Arterial Blood Pressure In Two Groups (Mm Hg)

MAP	Group DS (Mm Hg)	Group C (Mm Hg)	p value
Baseline	89.90± 2.08	90.00± 2.10	>0.9
30 minutes	89.66 ±2.29	89.67± 2.30	>0.9
60 minutes	90.20± 2.30	90.00± 2.33	>0.9
90 minutes	69.40± 3.95	70.00± 4.00	>0.9
240 minutes	85±5.10	85.12±5.12	>0.9
480 minutes	89.56±10.17	89±10.20	>0.9
720 minutes	90.06±4.30	90±4.33	>0.9

Table 8:- Average Heart Rate in Two Groups

Time interval	Group DS (Heart beats per minute)	Group C (Heart beats per minute)	p value
Baseline	77.58± 12.16	71.80± 12.61	0.95
30 minutes	71.30 ±7.55	73.30± 8.47	0.10
60 minutes	69.75± 7.83	71.70± 8.01	0.98
90 minutes	74.20± 7.63	72.00± 7.60	0.14
240 minutes	79±7.19	77±9.63	0.24
480 minutes	77.04±6.80	79±7.60	0.06
720 minutes	79.48±6.14	79.50±6.14	0.99

Mean arterial pressure in two groups were statistically not significant at any point of study. Heart rate variation was also clinically insignificant throughout. The clinical variations that were present did not need any interference or management as per study protocols.

Discussion:

Surgical pain is a universal phenomenon, affecting all patients in the perioperative period, causing several deleterious effects on the patient's body and mind. The unrelieved surgical pain has been incriminated for the development of chronic pain syndromes.

In fact, the apprehensions of post-surgical pain sometimes overpowers the fear of surgery in patients and their relatives. It therefore becomes the moral responsibility of perioperative physicians like anaesthesiologists and surgeons to provide adequate intra and postoperative analgesia not only to suppress the adverse physiological responses to pain but also to improve the quality of patient care following surgery.

Levobupivacaine produces 3-4 hours of peripheral nerve blockade, which is sufficient for most upper limb surgeries but not enough duration for post-operative analgesia. Addition of 8 mg of dexamethasone effectively and significantly prolongs the duration of analgesia. The block prolonging effect of dexamethasone is due to its local action and not a systemic one[11]. This effect is mediated via glucocorticoid receptors.

When steroid alone is used in regional blocks, the blockade is not produced. Local application of methylprednisolone has been found to block transmission in C-fibres but not in alpha and beta fibres. The effect was reversible, suggesting a direct membrane action of steroids.

Many literature reviews concluded that analgesic effect of dexamethasone works by

- reducing the transmission in unmyelinated C-fibres through inhibiting the activity of potassium channels thereby decreasing the amount of pain sensed by patient
- causing a degree of local tissue vasoconstriction and providing a slower uptake of local anaesthetic
- exhibiting a potent anti-inflammatory effect and inhibiting the release of inflammatory mediators like interleukins and cytokines
- promoting the release of anti-inflammatory mediators leading to decreased postoperative pain[12].

Addition of steroid to local anaesthetics effectively and significantly prolongs the duration of analgesia[13]. Adverse effects with a single dose of dexamethasone are probably extremely rare and minor in nature and previous studies have demonstrated that short-term (24 hours) use of dexamethasone is safe[14].

In our randomized prospective double blinded study, we have evaluated the effects on onset and duration of sensory and motor block among 2 groups-Levobupivacaine (0.5% 30 ml) with dexamethasone (8mg in 2ml) and Levobupivacaine (0.5% 30 ml) with normal saline (2 ml) in supraclavicular brachial plexus block named as- Group DS and Group C respectively.

The groups were comparable in respect to demographic parameters.
The mean onset time of sensory block was significantly faster in groups DS as compared to group C. In DS and C, groups the onset time of sensory block were 7.64±1.30 minutes and 12.84±2.29 minutes respectively with a $p<0.0001$.

The mean onset time of motor block was also significantly faster in groups DS as compared to group C. In DS and C, groups the onset time of motor block were 8.60±1.37 minutes and 15.26±2.70 minutes respectively with $p<0.001$ which was statistically significant.

The above findings correlate with the studies of Golwala MP et al[15], Islam et al[16] and Srestha et al[17].

In our study, mean duration of analgesia, sensory and motor block in the dexamethasone containing local anaesthetic group (Group DS) were 10.98±0.98 hours, 10.69±1.09 hours and 10.72±1.05 hours respectively. In the study of A Naveen et al (2014), mean duration of analgesia, sensory and motor block in the dexamethasone containing local anaesthetic group were 14.5 hours, 10.5 hours and 7.81 hours respectively[18].

The mean onset time and duration of sensory and motor block in dexamethasone group (DS) and control group (C) were similar to the results of the study by Islam et al[16] and the mean onset time and duration of analgesia, sensory and motor block in control group of our study (C group) were similar to the results of the study by A Naveen et al[18].

There was no statistically significant difference in two groups with respect to postoperative heart rate and blood pressure. None of the patients required additional oxygen at post anaesthesia care unit. None of the patients developed respiratory depression.

From the available data, statistically it proves that dexamethasone containing local anaesthetic group had significantly longer duration of sensory block, motor block and duration of analgesia than the control group.

The 8mg of dexamethasone was chosen because it has been used previously for perineural injection as adjuvant and within this dose range, it is used clinically for postoperative nausea. Also Tandoc MN et al[19] (2011) in their study evaluated the effect of dexamethasone on the duration of interscalene brachial plexus block with bupivacaine, ropivacaine etc. and used 8 mg dexamethasone.

From this study, we would like to suggest that dexamethasone can be safely used with local anaesthetic in peripheral nerve blocks and it is statistically proven that addition of it reduces the onset of sensory and motor block and prolongs the duration of analgesia; however, further trials to determine the exact dose-response and effects on complex nerve structures such as in brachial plexus block are necessary.

Strength of the Study

- In all the cases supraclavicular block was given by experienced anaesthesiologists. So, there is minimum interference in result due to different levels of skill.
- All the readings were taken by the single observer to minimize inter-observer's bias.

Limitations of the Study

- Use of ultrasound-guided nerve block may have the advantage of injecting local anaesthetic mixture in near proximity of nerve bundle. We did not use ultrasound-guided block because of its unavailability in our institution during the study period.
- We did not study the impact of perineural dexamethasone on glucose homeostasis and wound healing.
- Further randomized trials need to be conducted to validate the findings of our study.

Conclusion

Dexamethasone when added to levobupivacaine in supraclavicular brachial plexus block enhanced the onset of sensory and motor block compared to control group. Similarly, the duration of sensory and motor block were significantly prolonged in Dexamethasone group than the control group. The time required for rescue analgesia was much delayed in group of patients receiving Levobupivacaine and Dexamethasone than in the group receiving Levobupivacaine and normal saline. Perineural dexamethasone produces minimal side effects and is relatively safe. Side effects may be associated with dosage or individual sensitivity. Further studies to determine the safe optimal dose of dexamethasone adding to local anaesthetics for supraclavicular brachial plexus block are required.

Financial support and Sponsorship:
Nil.

Conflicts of interest:
There are no conflicts of interest.

REFERENCES:

1. Chandni M, Soni CM, Parikh H (2013), Comparison of the motor and sensory block by ropivacaine and bupivacaine in combination with lignocaine in supraclavicular block, National journal of Medical Research, 3(4):353-57.
2. Lee JA, Atkinson RS, Rushman GB (1987), A synopsis of anaesthesia, Bristol, 10th edition 1987; 618.
3. Baloda R, Bhupal JPS, Kumar P, Gandhi GS (2016, June 1), Supraclavicular Brachial Plexus Block With or Without Dexamethasone as an Adjuvant to 0.5% Levobupivacaine: A Comparative Study, JCDR, DOI:10.7860/JCDR/2016/18325.8048, 10(6):UC09-UC12
4. Haleem S, Siddiqui AK, Mowafi HA, Ismail SA, Ali QA (2010), Nerve stimulator evoked motor response predicting a successful supraclavicular brachial plexus block, Anesth Analg, 110(6): 1745-6
5. Sarma BA, Sundari MR, Suman KVJ, Rao DVBM (2015), Low dose dexmedetomidine as an adjuvant to bupivacaine in Supraclavicular brachial plexus block, IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 14(6) Ver.II:104-07.
6. Movafegh A, Razazian M, Hajimaohamadi F, Meysamie A (2006), Dexamethasone added to lidocaine prolongs axillary brachial plexus blockade, Anesth Analg, 102:263–7.
7. Vieira PA, Pulai I, Tsao GC, Manikantan P, Keller B, Connelly NR (2010), Dexamethasone with bupivacaine increases duration of analgesia in ultrasound-guided interscalene brachial plexus blockade, Eur J Anaesthesiol, 27(3):285-8.
8. Miller RD, Miller's Anesthesia, Philadelphia, 8th edition, Chapter 57; page 1727
9. Cousins MJ Bridenbaugh (2009), Neural blockade in clinical anaesthesia and pain medicine, Philadelphia, 4th ed. Lippincott Williams and Wilkins
10. McCaffery M., Pasero C. (1999), Pain, Clinical Manual, P67, St Louis, Mosby, Inc.
11. Castillo J, Curley J (1996, November), Glucocorticoids prolong rat sciatic nerve blockade in vivo from bupivacaine microspheres, Anaesthesiology, 85(5): p.1157-66.
12. Takimoto K, Levitan E (1994, December), Glucocorticoid induction of Kv1.5 K+ channel gene expression in ventricle of rat heart, Circ Res., 75(6): p. 1006-13.
13. Devor MD, Gorvin-Lippmann R, Raber P (1985), Corticosteroids suppress ectopic neural discharge originating in experimental neuromas, Pain, 22: 127-37.
14. Splinter WM, Rhine EJ (1998), Low-dose ondansetrone with dexamethasone more effectively decreases vomiting after strabismus surgery in children than does high-dose ondansetron, Anesthesiology, 88: 72-5.
15. Golwala MP, Swadia VN, Dhimar AA, Sridhar NV (2009), Pain relief by dexamethasone as an adjuvant to local anaesthetics in supraclavicular brachial plexus block, Journal of anesthesiology and clinical pharmacology, 25(3): p. 285-288.
16. Islam SM, Hossain MD, Maruf AA (2011, June), Effect of addition of dexamethasone to local anaesthetics in supraclavicular brachial plexus block, JAFMC Bangladesh, 7(1): p. 11-14.
17. Shrestha BR, Maharjan SK, Shrestha S, Gautam B, Thapa C, Thapa PB (2007), Comparative study between tramadol and dexamethasone as an admixture to bupivacaine in supraclavicular brachial plexus block, JNMA J Nepal Med Assoc., 46(168):158–64.
18. Kumar AN (2014, November 3), Comparative study between 0.25% Bupivacaine with 8 M.G Dexamethasone and 0.25% Bupivacaine with 50µg Dexmedetomidine as an adjuvant for interscalene brachial plexus Block: prospective clinical study, Journal of Evolution of Medical and Dental Sciences, Vol. 3, Issue 58,; Page: 13111-13119, DOI: 10.14260/jemds/2014/3743
19. Tandoc MN, Fan L, Kolesnikov S, Kruglov A, Nader N (2011, October), Adjuvant dexamethasone with bupivacaine prolongs the duration of interscalene block: a prospective randomized trial, J Anesth., 25(5): p. 704-9.