Comparison of Dexamethasone 4 mg and 8 mg as an Adjuvant to 0.5% Bupivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgeries- A Randomised Clinical Study

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ABSTRACT

BACKGROUND

Dexamethasone as an adjuvant to local anaesthetics improves the quality and duration of peripheral nerve blocks. The effect of different doses of dexamethasone on the block characteristics remains inconclusive. The present study aimed to evaluate the effects of 4 mg versus 8 mg of dexamethasone with 0.5% bupivacaine in supraclavicular brachial plexus block.

METHODS

Sixty American Society of Anaesthesiologist's (ASA) grade I - II patients aged 18-70 years scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were enrolled prospectively. Ultrasound guided supraclavicular brachial plexus block was performed with 4 mg or 8 mg dexamethasone as adjuvant to 18 ml of 0.5% bupivacaine depending on randomization. The primary outcome assessed was duration of post-operative analgesia. The secondary outcomes were onset of sensory and motor blockade, duration of sensory and motor blockade and complications. Data was analysed using Chi-square and student's t test and $p<0.05$ was considered as statistically significant.

RESULTS

There was no significant difference in onset of sensory and motor blocks. Sensory and motor block duration was significantly higher in Group 2 ($p<0.001$). The mean duration of postoperative analgesia in group 1 was 604.33 ± 48.96 and 1074.0 ± 94.01 minutes in group 2 which was significantly higher ($p<0.001$).

CONCLUSIONS

Dexamethasone 8 mg as an adjuvant to 0.5% bupivacaine in supraclavicular brachial plexus block significantly prolongs the duration of sensory and motor blockade and post-operative analgesia compared to 4 mg dexamethasone. There is no difference between groups in onset of sensory and motor block.

KEY WORDS

Dexamethasone, Supraclavicular Brachial Plexus, Ultrasound

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BACKGROUND

Acute postoperative pain causes patient discomfort and also impedes the recovery. Peripheral nerve block minimizes the stress response, avoids polypharmacy and beneficial for the patients with various cardiopulmonary comorbidities.[1] In addition peripheral nerve blocks effectively controls postoperative pain with decreased opioid consumption[2,3] but, the analgesic effect of single-shot injection of local anaesthetics is time limited. Different adjuvant like epinephrine, clonidine, dexmedetomidine, opioids, and neostigmine[4,5] are added to local anaesthetics to achieve dense block and longer duration of analgesia but the results are inconclusive and associated with undesirable side effects such as sedation, respiratory depression, hypotension and bradycardia.[1,6]

Dexamethasone is a potent glucocorticoid with anti-inflammatory and analgesic property. As an adjuvant with local anaesthetic it is reported to influence the onset, duration of sensory and motor blockade and duration of analgesia. It acts by blocking nociceptive C fibers and suppresses ectopic neuronal discharge.[1]

Supraclavicular approach of brachial plexus block is most consistent and widely employed regional nerve block technique for surgical anaesthesia and postoperative analgesia for upper extremity surgery.**[1]** Most of the studies with dexamethasone as an adjuvant to local anaesthetic mixture in supraclavicular brachial plexus block have reported variable effects on onset and duration of sensory and motor blockade and duration of post- operative analgesia with the emphasis on the need for further studies to determine the adequate dose. The present study aimed to compare the effects of two doses of dexamethasone 4 mg versus 8 mg with bupivacaine in supraclavicular brachial plexus block with duration of postoperative analgesia as primary objective and onset of sensory and motor blockade, duration of sensory and motor blockade as secondary objectives.

METHODS

After obtaining approval from the Institutional ethics committee (KIMS/IEC/A21-2018) and written informed consent, 60 patients with American Society of Anesthesiologist's physical status (ASA) grades 1 and 2, aged 18-75 years, undergoing elective upper limb surgery below shoulder joint were enrolled in this prospective randomised study. Patients with local anaesthetic allergy, coagulation disorder, severe respiratory disorder, diabetes mellitus, hepatic and renal failure and pregnant women were excluded from study.

After shifting the patient to operation theatre, standard monitors were attached such as ECG, non-invasive blood pressure (NIBP) and pulse oximeter (SpO_2). Baseline parameters were recorded before block administration. Intravenous cannula was secured, and oxygen supplementation was given via face mask. All patients received injection midazolam 0.03 mg/kg intravenously after procedure.

Patients were randomly allocated in to two groups with each group consisting of 30 patients. The allocation sequence was generated using online randomisation chart (http://www.randomization.com). Randomization assignments were stored in sealed, sequentially numbered opaque envelopes. The anaesthesiologist, who was not involved in the study, opened the envelope in Operation Theatre and prepared the drug accordingly. Observations were done by the anaesthesiologist who was blinded to the study group. All blocks were performed by anaesthesiologist skilled in performing supraclavicular brachial plexus block under ultrasound guidance.

Ultrasound guided supraclavicular brachial plexus block was performed depending on group allocated-

- **Group 1–** 18 ml of 0.5% bupivacaine +1 ml (4 mg) dexamethasone +1 ml of normal saline
- **Group 2–** 18 ml of 0.5% bupivacaine +2 ml (8 mg) dexamethasone was used.

Patient was positioned supine with the head turned to the opposite side to be blocked and arms placed by the side of the patient. The ultrasound machine (GE Logiq e Healthcare) was placed on the opposite side to achieve proper ergonomics. Under sterile aseptic precaution ultrasound guided supraclavicular brachial plexus block was performed, with high frequency (13-6 MHz) linear probe. The probe was placed transversely in the supraclavicular fossa, the subclavian artery and cluster of hypoechoic nodules of brachial plexus anterolateral to the artery was identified. An in-plane approach was used, from lateral to medial direction with 22 gauge stimulating needle. The real time spread of local anaesthetic around the brachial plexus at the time of injection was noted.

The primary objective of the study was the duration of postoperative analgesia. The secondary objectives were sensory and motor block onset time, duration of sensory and motor blockade and any complications. After completion of local anaesthetic injection, in different dermatomes and myotomes of the upper limb onset of sensory and motor blockade assessed every 5 minutes till 30 minutes and then every hour until the block had completely worn off. Pinprick test used to assess sensory blockade and 3-point scale is used to evaluate: 0= loss of sensation to light touch, 1= loss of sensation to pinprick, and 2= normal sensation. Flexion of the elbow in supination (musculocutaneous), thumb adduction and ulnar deviation of the hand (ulnar nerve) thumb abduction and wrist extension (radial nerve), thumb opposition and wrist flexion (median nerve)were used to assess motor blockade and evaluated using a 3-point scale where, 0= absent movement, 1= paresis, 2= normal movement

Sensory block onset time was defined as the time interval between the end of block administration and loss of sensation to pinprick in the desired dermatomes (sensory score= 1). Motor block onset time was defined the time interval between the end block administration and paresis (motor score= 1) in desired myotomes. Surgery was started after adequate sensory and motor blockade was achieved. If there is failure to achieve adequate surgical anaesthesia even after 30 minutes of block administration, it was considered as block failure, converted to general anaesthesia and excluded from study. Duration of sensory block was defined as the time

interval between onset of complete sensory blockade to return of normal sensation to pinprick. The duration of motor block was defined as the time interval between the onset of motor block and complete recovery of motor functions.

After shifting the patient to post anaesthesia care unit pain intensity was evaluated using 10 cm visual analog scale (VAS) where 0 represents no pain and 10 represents worst possible pain. Rescue analgesia with intravenous tramadol injection 1 mg/kg was given when VAS score was ≥3. VAS score was recorded postoperatively every 30 minutes. Duration of analgesia was defined as the time interval between the onset of complete sensory block to the postoperative VAS score ≥3 or the time for request for first rescue analgesic.

Statistical Analysis

Sample size was calculated based on the study by Dheeraj et al.[12] Considering 80% power of the study and alpha error of 5%, the estimated sample size was 30 in each group. Data was tabulated in Microsoft excel sheet and analysed using an SPSS 16 version. Quantitative data have been compared between groups by unpaired student t-test. Qualitative variables have been compared between groups by Chi-square test and Fischer exact test. Analysis has been considered significant if $p < 0.05$.

RESULTS

Parameters	Group 1 (N=30)	Group 2 (N=30)	p Value
Age (years)	40 (±16.75)	41.73 (±16.79)	0.690
Weight (kg)	71.43 (±8.66)	74.50 (±8.69)	0.177
Duration of surgery (minutes)	108 (±20.57)	108.33 (±18.77)	0.948
Gender(Female/Male)	8/22	5/25	

Table 1. Patient Characteristics

Parameters	Group 1 (N=30)	Group 2 (N=30)	p Value
Sensory block onset (minutes)	8.0 (±1.66)	8.07 (±1.93)	0.886
Motor block onset (minutes)	10.67 (±2.06)	11.60 (±1.69)	0.060
Duration of sensory block(minutes)	512.0 (±36.89)	635.0 (±38.66)	< 0.0001
Duration of motor block (minutes)	457.0 (±34.05)	588.0 (±33.05)	< 0.0001
Duration of analgesia(minutes)	604.33 (±48.96)	1074.0 (±94.01)	< 0.0001

Table 2. Block Characteristics

Duration expressed as Mean (±SD)

A total of 60 patients were enrolled in the study with 30 patients in each group. All patients underwent surgery under supraclavicular brachial plexus block and there were no dropouts. The demographic profile (table 1) were comparable between the two groups. The mean sensory block onset time was 8.0 ± 1.66 minutes in group 1 and 8.07±1.93 minutes in group 2. The mean motor block onset was 10.67±2.06 minutes in group 1 and 11.60 ± 1.69 minutes in group 2. There was no significant difference in onset of sensory and motor blocks among both groups.

The mean duration of sensory block was 512.0±36.89 minutes in group 1 and 635.0 ± 38.66 minutes in group 2. The mean duration of motor block was 457.0±34.05 minutes in group 1 and 588.0±33.05 minutes in group 2. There was statistically significant higher duration of both sensory and motor block in Group 2 compared to group 1. The mean duration of postoperative analgesia in group 1 was 604.33 ± 48.96 minutes and 1074.0±94.01 minutes in group 2, which was significantly higher in group 2. (table 2) Intraoperative and post-operative haemodynamic parameters recorded at regular intervals of all the patients were stable. There were no complications noted in both the groups.

DISCUSSION

Postoperative pain consistently marks the highest concern in majority of surgical patients, highlighting the necessity for prolonged postoperative analgesia.[7,8] The effects of single-injection of local anaesthetics in peripheral nerve blocks is time limited and after few hours it unmasks the moderate-to-severe pain of the surgical insult. Post-operative patient comfort can be increased by interventions that increase the duration of local anaesthetic action. Strategies to prolong brachial plexus block analgesia of the local anaesthetic used include, co-administration of adjuvants or placement of indwelling perineural catheters to allow prolonged infusion that goes beyond the pharmacological duration. Technical challenges with indwelling catheter placement like, failure rate, catheter migration, anaesthetic leakage or pump malfunction, or rarely infection.[9,10] reduce the efficacy of providing analgesia for several days.

Albrecht E et al.[11] systematically reviewed the safety and efficacy of perineural dexamethasone as an adjunct for peripheral nerve blockade in 29 controlled trials with 1695 participants and found that addition of perineural dexamethasone as adjuvant to short, medium and long-duration action local anaesthetics prolonged the postoperative analgesia and motor blockade beyond the pharmacological action of sole local anaesthetics. But, the evaluation of the relationship between the different doses of dexamethasone and duration of analgesia remained inconclusive.

The present study clearly displayed the benefits of co-administration dexamethasone 8 mg with 0.5% bupivacaine in supraclavicular brachial plexus block. It significantly improved the duration of sensory and motor block and postoperative analgesia compared to dexamethasone 4 mg with 0.5% bupivacaine. Dheeraj et al.[12] in their study comparing two doses of dexamethasone as adjuvant in supraclavicular brachial plexus block concluded 8 mg dexamethasone is more efficacious than 4 mg but, combination of 15 ml 2% lignocaine and 15 ml 0.5% bupivacaine was used as compared to 18 ml 0.5% bupivacaine in the present study. Tandoc MN et al.[13] and Vieira PA et al.[14] reported that the addition of dexamethasone to a bupivacaine in interscalene block prolongs sensory block and reduces opioid use.

Shrestha BR et al.[15] and Prashanth A Biradar et al.[16] compared the analgesic efficacy of local aesthetic with and without dexamethasone in supraclavicular brachial plexus block and concluded addition of dexamethasone for brachial plexus block significantly prolongs the duration of analgesia without any complications. They used 30-40 ml of local anaesthetic with dexamethasone as adjuvant. The present

study demonstrated effective postoperative analgesia with low volume 0.5% bupivacaine and dexamethasone.

Dexamethasone is one of the most promising drugs to increase the efficacy of peripheral regional anaesthesia, and meta-analyses suggest there may be a benefit.[11,17,18] These meta-analysis is limited by heterogeneity in study design like anaesthetic technique employed for nerve block, local anaesthetic volume used, use of epinephrine and the absence of standard definitions for certain endpoints, such as duration of analgesia, duration of sensory blockade and time to first analgesic request which are used as surrogate markers of patient perception of a pain-free period after surgery.

The onset time of sensory and motor block was similar in the two groups with no statistical difference (p value= 0.886). These findings were similar with the studies conducted by Parrington SJ and Movafegh with dexamethasone as adjuvant in brachial plexus block.[19,20] Few studies[15,21] found significantly earlier onset of sensory and motor block in the local anaesthetic plus dexamethasone group than in the control group. This discrepancy may be due to differences in study methodology such as use of varying methods of assessment of sensory and motor block and higher dose of local anaesthetic.

In the present literature, there are no reports of dexamethasone-induced neuronal damage. At the sensory nerve level, Williams and colleagues[22] demonstrated that ropivacaine and dexamethasone, in clinically relevant concentrations, did not result in neurotoxicity. Corcoran T et al.[23] In the post hoc analysis of the ENIGMA-II trial evaluated, the effect of dexamethasone administration to high-risk non-cardiac surgical patients with 30 day follow-up and concluded that dexamethasone did not increase the risk of postoperative wound infection or other adverse events and appears to be safe in patients either with or without diabetes mellitus. In the present study no complications were recorded in both the groups.

We acknowledge small sample size as the limitation of our study and thus further randomized trials with well-defined anaesthetic technique and outcomes are required to define optimal dose of perineural dexamethasone as an adjuvant to local anaesthetic in peripheral nerve blocks.

CONCLUSIONS

Dexamethasone 8 mg as an adjuvant to 0.5% bupivacaine in supraclavicular brachial plexus block significantly prolongs duration of sensory and motor blockade and post-operative analgesia compared to 4 mg dexamethasone. There is no difference between groups in onset of sensory and motor block.

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