

Pain Relief by Dexamethasone as an Adjuvant to Local Anaesthetics in Supraclavicular Brachial Plexus Block

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ABSTRACT

Background: Local anaesthetics alone for Supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. Perineural injection of steroids is known to influence postoperative analgesia.

Patients and Methods: 60 adult patients undergoing various orthopaedic surgeries on forearm and around the elbow under supraclavicular brachial plexus block were selected and randomly divided into 2 groups of 30 each. In group-A (control) patients received 35ml of mixture of lignocaine 2%, bupivacaine 0.5% and 1:200000 adrenaline, while in group-B (dexamethasone) patients received the same amount of local anaesthetics with dexamethasone (8mg). The onset of action, peak effect and duration of analgesia in the 2 groups were compared and any complications were observed. Statistical analysis was done using student's unpaired 't' test.

Results: The two groups were comparable in demographic data. The mean onset time of sensory and motor block was 275.66 ± 30.32 sec and 326.66 ± 27.70 sec in control group (group-A) and 196.33 ± 26.45 sec and 225.66 ± 26.86 sec in dexamethasone group (group-B) respectively. The mean peak effect time of sensory and motor block was 708.33 ± 50.58 sec and 767.33 ± 47.26 sec in group - A and 544.33 ± 47.68 sec and 651.33 ± 38.75 sec in group - B respectively. The difference was statistically significant ($P < 0.05$). There was markedly prolonged duration of analgesia in group-B (12-18 hours) compared to group-A (4-6 hours). The results were statistically highly significant ($P < 0.001$).

Conclusion: Addition of dexamethasone as an adjuvant to local anaesthetics in brachial plexus block results in significantly early onset and markedly prolonged duration of analgesia without any unwanted effects.

KEY WORDS: Supraclavicular block, Analgesia, Local Anaesthetics, Dexamethasone.

Supraclavicular brachial plexus block is the most consistent block for upper limb surgeries. Local anaesthetics alone provides analgesia for not more than 4-8 hrs. so various additives like opioids¹, clonidine², hylase etc. were added to local anaesthetics, but the results are either inconclusive or associated with side effects.

Steroids when used intrathecally are reported to cause arachnoiditis but there is no evidence suggesting any neuritis when steroids are used in low concentration in peripheral nerve blocks. Steroids have powerful anti-inflammatory as well as analgesic property. Perineural injection of steroids is reported to influence post operative analgesia. They relieve pain by reducing inflammation and blocking transmission of nociceptive C-fibres and by suppressing ectopic neural discharge.³

With this background data we carried out this study to evaluate the efficacy of dexamethasone as an adjuvant to mixture of local anaesthetics in supraclavicular brachial plexus block. Onset time, peak effect and duration of post-

operative analgesia were observed.

PATIENTS AND METHODS

After institutional ethical committee approval and obtaining written informed consent from the patients, 60 ASA physical status I or II patients of either sex, aged 18-60 yrs scheduled for elective or emergency orthopaedic surgeries of upper limb under supraclavicular brachial plexus block were included in this study. Patients with history of uncontrolled diabetes, renal and liver diseases, circulatory instability, pregnant women, peptic ulcer disease, those with allergy to local anaesthetics and on long term steroid therapy were excluded from the study.

Patients were randomly allocated into 2 groups of 30 each. In group-A (control) patients received 15ml of lignocaine 2%, 15ml of bupivacaine 0.5% and 5mcg ml⁻¹ of 1:200000 adrenaline, while in group-B (dexamethasone) patients received Inj.dexamethasone 2ml (8mg) in addition to the above mixture. Total volume was made to 35 ml by

adding distilled water in both the groups.

On arrival to the operating room, multi-para monitor was attached and the initial pulse, BP, respiratory rate, SpO₂ were recorded as pre-block values. A 20 gauge IV cannula was inserted in a peripheral vein in the contralateral arm and Inj. glycopyrrolate 0.2 mg was given intravenously as pre-medication.

After appropriate patient positioning and strict aseptic and antiseptic precautions midclavicular point, external jugular vein and subclavian artery pulsation were identified. About 2cm above the midclavicular point just lateral to subclavian artery pulsation, a 24 gauge 1.5 inch needle was introduced and directed caudad and medially until paraesthesia was encountered, when 35 ml of local anaesthetics with or without dexamethasone was injected in this area.

Sensory and motor blockade of radial, median, musculocutaneous and ulnar nerves were recorded at regular intervals (0,2,4,6,8,10,12,15 and 20 min) after drug injection. Sensory blockade of each nerve was assessed by pin prick and compared with the same stimulation on the contralateral hand. Sensory blockade was graded as

Grade-0: no sensation felt,

Grade-1: dull sensation felt,

Grade-2: sharp pain felt.

Onset time was defined as dull sensation along any of the nerve distribution.

Peak effect time as complete loss of sensation along all the nerve distribution.

Motor blockade was evaluated by thumb abduction (radial nerve), thumb adduction (ulnar nerve), flexion of elbow (musculocutaneous nerve) and thumb apposition (median nerve), the blockade was graded as

Grade-0: complete paralysis,

Grade-1: paresis,

Grade-2: normal muscle force.

Onset time was considered when patient felt heaviness on abduction of arm at shoulder. Peak effect time was considered when patient was unable to perform any of the maneuvers as defined above for each individual nerve.

Block was considered complete, when all the segments supplied by the nerves had anaesthesia. Incomplete when any of the segments supplied by the nerves did not had analgesia or anaesthesia even after 20 minutes of drug injection and failure when more than one nerve remained unaffected. Inj. midazolam 1mg was given intravenously 20 minutes after the procedure when assessment of block was complete. In case of failed block, patient was given general anaesthesia. Intra-operatively patients were monitored for vital parameters like pulse, BP, respiratory rate and SpO₂ at regular intervals. Assessment

of blood loss was done and crystalloids and colloids were administered accordingly.

At the end of surgery vital parameters, consciousness, response to verbal commands and duration of surgery were noted. Patients were observed for side effects in intra and post-operative period. Post-operatively vital parameters, were monitored every 3 hourly and analgesia was assessed using Visual Analogue Scale score.

Duration of analgesia was defined as the time from injection of drug in brachial plexus to VAS=5, when rescue analgesia was given in the form of Inj.diclofenac sodium 1.5mg kg⁻¹ intramuscularly.

Statistical analysis was performed in Pentium III version with SPSS programme. The data was analyzed with Chi-square test for qualitative data and student's unpaired 't' test for quantitative data. The results were considered significant if P value is < 0.05 and highly significant if P value is <0.001.

RESULTS

The demographic data and duration of surgery were comparable in both the groups (Table-1). In both the groups there was male predominance, but the difference was not statistically significant on inter-group comparison.

The mean onset time of sensory and motor block was 275.66 ± 30.32 sec and 326.66 ± 27.70 sec in group-A and 196.33±26.45 sec and 225.66 ± 26.86 sec in group-B respectively. The mean peak effect time of sensory and motor block was 708.33 ± 50.58 sec and 767.33 ± 47.26 sec in group-A and 544.33 ± 47.68 sec and 651.33 ± 38.75 sec in group-B respectively. The difference was statistically significant (P<0.05) (Tables 2). There was no significant change in vital parameters in both the groups on intra and inter group comparison.

The mean VAS score (Figure-1) was 5.9 ± 0.8 at the end of 6 hours in group-A and 5.7 ± 1.86 at the end of 15 hours in group-B. The difference was statistically highly significant. (P<0.001). Thus in group-B, patients had significantly longer duration of analgesia of 12-18 hours while in group-A patients had analgesia of only 4-6 hours. There was no failure of block in our study. Except for nausea

Table 1
Demographic Data

| Parameter | Group-A | Group-B | P value |
|-------------------------|--------------------|--------------------|---------|
| Number of patients | 30 | 30 | |
| Age (years) (mean ± SD) | 30.43± 8.93 | 32.66±7.50 | >0.05 |
| Sex (M:F) | 19:11 (64%:36%) | 20:10 (66%:34%) | >0.05 |
| Weight (KGs) | 58.46 ± 6.41 | 58.10±6.03 | >0.05 |
| ASA status | I 18 (60%) | 17 (57%) | >0.05 |
| | II 12 (40%) | 13 (43%) | >0.05 |

Table 2
Onset & Peak Effect Time of Sensory and Motor block

| | | Group – A | Group – B | P value |
|---|---------|---------------|--------------|---------|
| Onset time [Mean ± SD] (seconds) | Sensory | 275.66 ±30.02 | 196.33±26.45 | < 0.05 |
| | Motor | 326.66±27.70 | 225.66±26.86 | < 0.05 |
| Peak effect [Mean ± SD] (seconds) | Sensory | 708.33±50.58 | 544.33±47.68 | < 0.05 |
| | Motor | 767.33±47.26 | 651.33±38.75 | < 0.05 |

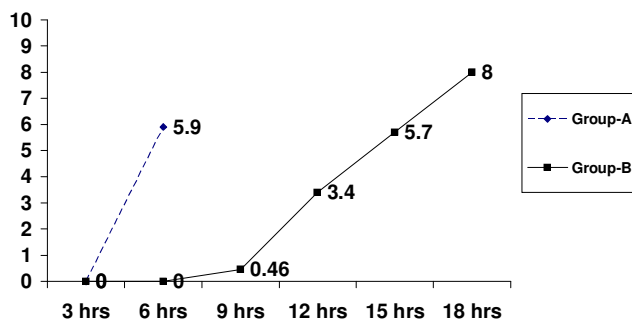


Figure 1
Duration of Post-operative Analgesia

and vomiting in 2 patients in group-A, no other significant complications were observed during our study.

DISCUSSION

Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. A combination of lignocaine and bupivacaine provided better operating conditions but the duration of analgesia is rarely maintained for more than 4-6 hours.

Steroids are very potent anti-inflammatory and immunosuppressive agents. Perineural injection of steroid is reported to influence post-operative analgesia. Epidural steroids were used for treatment of back pain and sciatica.³ Various steroids have been used for this purpose, but dexamethasone a 9 α -derivative synthetic glucocorticoid is preferred because of its highly potent anti-inflammatory property, about 25-30 times as potent as hydrocortisone and without any mineralocorticoid activity thus was found to be safer and devoid of potential side effects.

Epidural Dexamethasone may influence intraspinal prostaglandin production. Acute noxious stimulation of peripheral tissues leads to sensitization of dorsal horn neurons of spinal cord by the release of excitatory amino acids such as glutamate and aspartate. These amino acids activate N-Methyl-D-Aspartate receptors resulting in calcium ion influx which leads to activation of phospholipase A₂, which converts membrane phospholipids to Arachidonic acid. Corticosteroids are capable of reducing prostaglandin synthesis by inhibiting phospholipase A₂ through the

production of calcium dependent phospholipid binding proteins called Annexins and by the inhibition of cyclooxygenase-2 during inflammation⁴.

Pre-operative administration of dexamethasone by oral and intravenous routes has been shown to reduce overall pain scores and analgesic requirements in the post-operative period without any adverse effects in various oral and general surgical procedures.^{5,6} Dexamethasone is also known to reduce post-operative nausea and vomiting.⁹ The possible mechanism of analgesic and antiemetic actions are due to anti-inflammatory property of Dexamethasone.⁷

Preliminary works demonstrated that addition of corticosteroid microspheres to local anaesthetics prolonged the duration of blockade of peripheral nerves.⁸ It has been reported that intercostal injection of dexamethasone containing bupivacaine microcapsules produces prolonged duration of anaesthesia and analgesia in healthy human volunteers.⁸ These authors believed that there is a causative relationship between the suppression of inflammation and the remarkably longer duration action.

Few preliminary studies reported that steroids significantly prolongs the duration of analgesia in extremity nerve blocks.^{9,10,11} A study in axillary block suggest that dexamethasone when added to lignocaine significantly prolonged duration of analgesia without any change in onset time.⁹ Another study in supraclavicular block reported that dexamethasone when added as adjuvant to mixture of local anaesthetics resulted in significantly early onset and longer duration of analgesia.^{10,11}

In our study we noticed significantly early onset of sensory and motor block in group-B compared to group-A (P<0.05). The early onset of action might be due to synergistic action with local anaesthetics on blockage of nerve fibres. The duration of pain relief (postoperative analgesia) was markedly prolonged in group-B (12-18 hours), while it was only 4-6 hours in group-A. Our results are in comparison with study of Shrestha BR, et al. who reported onset of action of 10-30 min (mean 18.15±4.25 min) in local anaesthetic group and 10-20 min (mean 14.15±2.10 min) in local anaesthetic + steroid group, while duration of analgesia was 2.30-4 hours (mean 3.16±0.48) in local anaesthetic group and 8-24 hours (mean 12.75±5.33) in local anaesthetic+ steroid group.

The use of corticosteroids as an adjuvant to local anaesthetics for peripheral nerve blocks has rarely been described, the mechanism of action is not clearly understood. The exact dose of dexamethasone to be used in peripheral nerve blocks has not been described. In all the previous studies dexamethasone was used in dose of 4-8mg and was found to be safe without any adverse effects. The mechanism of blockade prolonging effect of

Dexamethasone is not clearly understood. The block prolonging effect may be due to its local action on nerve fibres and not a systemic one.⁸ The effect might be mediated via glucocorticoid receptors. When steroids alone were used in regional blocks the blockade is not produced. Steroids might bring about this effect by altering the function of potassium channels in excitable cells.¹³

Corticosteroids cause skin vasoconstriction on topical application.¹⁴ The vasoconstriction effects of topical steroids are mediated by the occupancy of classical glucocorticoid receptors rather than by non-specific pharmacological mechanisms. According to traditional theory of steroid action, steroids bind to intracellular receptors and modulate nuclear transcription. In our study Dexamethasone produced a relatively rapid onset which cannot be explained by the above mechanism of action. Therefore vasoconstriction the presumed mechanism of action of epinephrine adjuvant effect on local anaesthetics is probably not responsible for block prolonging effect of Dexamethasone.

Some authors also believe that analgesic properties of corticosteroids are the result of their systemic effect.¹⁵

In conclusion, the addition of dexamethasone (8mg) as an adjuvant to mixture of local anaesthetics in supraclavicular brachial plexus block results in significantly early onset and peak effect of sensory and motor block and markedly prolonged duration of post-operative analgesia. Further studies are needed to evaluate the optimal dose of dexamethasone to be used in brachial plexus block as well as the mechanism of its prolonged analgesic effect.

REFERENCES

1. Kapral S, Goolann G, Wait B, et.al: Tramadol added to mepivacaine prolongs the duration of an axillary brachial plexus blockade. *Anesth Analg* 1999;88:853-6.
2. Iohom, Gabriella FCARCSI; Machmachi, Adnane; Diarra, Desire-Pascal; Khatouf, Mohammed et.al: The effects of clonidine added to mepivacaine for paronychia surgery under axillary brachial plexus block. *Anesth Analg* 2005;100(4):1179-1183.
3. Honorio T. Benzon, Epidural steroids. In P.Prithvi Raj. *Pain medicine, a comprehensive review*. Mosby publications 1999 Page 259-263.
4. Wang YL, Tan PP, Yang CH: Epidural dexamethasone reduces the incidence of back ache after lumbar epidural anaesthesia *Anaesth. Analg* 1997; 84; 376-78.
5. Elhakim M, Ali NM, Rashed I et.al: Dexamethasone reduces post-operative vomiting and pain after paediatric tonsillectomy. *Can.J.Anaesth* 2003; 50; 392-97.
6. Bisgaard T, Klarskov B et.al: Pre-operative dexamethasone improves surgical outcome after laproscopic cholecystectomy. A randomized double blind placebo controlled trial. *Ann Surg* 2003; 238; 651-60.
7. Liu K, Hsu CC, Chia YY: Effect of dexamethasone on post-operative pain and emesis. *Br J Anaesth* 1998; 80; 85-86.
8. Kopacz DJ, Locouture PG, et.al: The dose response and effects of dexamethasone on bupivacaine microcapsules for intercoastal blockade (T9 to T11) in healthy volunteers. *Anesth Analg* 2003; 96; 576-82.
9. Ali movafegh, Mehran Razazian, Fatemeh H: Dexamethasone added to lidocaine prolongs Axillary brachial plexus blockade *Anesth Analg* 2006; 102; 263-267.
10. Shrestha BR, Maharjan SK, Tabedar S: Supraclavicular brachial plexus block with and without dexamethasone - A comparative study *KUMJ* 2003; 1 (3): 158-160.
11. Shrestha BR, Maharjan SK, Gautam B, Joshi MR: Comparative study between tramadol and dexamethasone as an admixture to bupivacaine in supraclavicular brachial plexus block. *JNMA J Nepal Med Assoc.* 2007; 46(168): 158-64.
12. Stan T, Goodman E, Cardida B, Curtis RH: Adding methylprednisolone to local anaesthetic increases the duration of axillary block. *Reg Anaesth Pain Med* 2004; 29; 380-381.
13. Attardi B, Takimoto K, Gealy R et.al: Glucocorticoid induced upregulation of a pituitary K⁺ channel mRNA in vitro and in vivo. *Receptors channels* 1: 287-93; 1993.
14. Marks R, Barlow JW, Funder JW: Steroid induced vasoconstriction: Glucocorticoid antagonist studies. *J.Clin.Endo.Meta* 1982; 54; 1075-77.
15. Baxendale BR, Vater M, Lavery KM: Dexamethasone reduces pain and swelling following extraction of third molar teeth. *Anaesthesia* 1993; 48; 961-964.