Original Article

Efficacy of Dexamethasone Adjuvant in Brachial plexus Block – A Comparison with Fentanyl Adjuvant

Moinul Hossain Chowdhury[1] ,Taneem Mohammad[2],Mamunur Rashid[3],Rabeya Begum[4],Md. Nurul Islam[5], Mohammad Mohosin[6], Atiqul Islam[7]

[1]Anaesthesiologist, Dept. of Anaesthesia, Analgesia Palliative and Intensive Care Medicine, DMCH, Dhaka, [2]Jr. Consultant, Dept. of Anaesthesia, Analgesia Palliative and Intensive Care Medicine, DMCH, Dhaka, [3]Anaesthesiologist, Dept. of Anaesthesia, Analgesia Palliative and Intensive Care Medicine, DMCH, Dhaka, [4] Professor, National Institute of Diseases of the Chest & Hospital, Mohakhali, Dhaka, [4]Asst.Professor, Dept. of Anaesthesia, Analgesia Palliative and Intensive Care Medicine, DMCH, Dhaka, [6]Jr. Consultant, Dept. of Anaesthesia, Analgesia Palliative and Intensive Care Medicine, DMCH, Dhaka, [7]Associate Professor, Department of Anaesthesiology, Sheikh Hasina National Institute of Burn and Plastic Surgery, Dhaka

Abstract

Background: *In supraclavicular brachial plexus block, local anaesthetics provide good operative conditions but have shorter duration of post-operative analgesia. Now-a-days different drugs have been used as an adjuvant with local anaesthetic in brachial plexus block to achieve quick, dense and prolonged block. Fentanyl is commonly used but this is associated with side effects like nausea, vomiting,sedation, respiratory depression and pruritus. So adjuvant drugs with minimal side effects but produce good surgical anaesthesia are always looked for.The benefit of adjuvant dexamethasone has recently been the focus of investigation as clinical reports suggest improved block characteristics.*

Objectives:*To compare the quality of anaesthesia & the duration of analgesia period between dexamethasone-bupivacaine combination and fentanyl-bupivacaine combination in supraclavicular brachial plexus block.*

Methods:*60 adult patients of either sex, aged 18 – 60 years,ASA physical status I or II,posted for elective surgeries of elbow, forearm and hand under supraclavicular brachial plexus block wereenrolled in the study. Patients were randomly allocated to one of the two groups - group A and group B. Group A (n=30) –received 38 mL 0.25% bupivacaine and 2 mL dexamethasone (10 mg). Group B (n=30) –received 38 mL 0.25% bupivacaine and 2 mL fentanyl (100mcg). Data were analyzed by Student's t test and Unpaired t-test as appropriate.*

Result:*Onset of sensory and motor block were significantly higher in group-B than in group-A (P = 0.000) and sensory and motor block were quite prolonged in group-A than group-B (p =0.000). Duration ofeffective analgesia (time from supraclavicular block to first analgesic demand) in study group-A hadsignificantly longer mean duration than that produced by control group-B (825.59 ± 13.44vs 667.40 ± 23.64 minutes).*

Conclusion:*Dexamethasone and bupivacaine combination is a better alternative to fentanyl and bupivacaine inrespect of quality of anaesthesia and duration of analgesia.*

Key words: *Supraclavicular brachial plexus block, adjuvant in brachial plexus block.*

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Introduction:

The brachial plexus block consists of injecting local analgesic drugs in the fascial spaces surrounding the nerve plexus, thereby blocking the autonomic, sensory and motor fibers supplying the upper extremity. It is a simple, safe and effective technique of anesthesia having distinct advantages over general and intravenous regional anesthesia. A regional technique should always be considered whenever general condition of the patient is poor, or in the presence of associated conditions like uncontrolled diabetes, cardiovascular or respiratory diseases. It is also useful when the patient prefers to retain his consciousness during surgery and when it is important for the patient to remain ambulatory.[1]

Regional nerve block minimizes the stress response and using minimal anesthetic drugs is always beneficial for the patients with various cardio-respiratory comorbidities.[3] Local anesthetics alone for Supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. So various adjuvant like opioids, clonidine, neostigmine, midazolam, dexmedetomidine etc. were added to local anesthetics in brachial plexus block to achieve quick, dense and prolonged block, but the results are either inconclusive or associated with side effects.[4]

Steroids have powerful anti-inflammatory as well as analgesic property. They suppress inflammation through inhibition of phospholipase A2. Local application of methylprednisolone has been found to block transmission in nociceptive C-fibers but not in myelinated A-beta fibers.[5] The effect was reversible, suggesting a direct membrane action of steroids.[5] Corticosteroids also suppress ectopic neuronal discharge.[6]Perineural injection of glucocorticoid along with local anesthetics is reported to influence the onset and duration of sensory and motor block.[4,7,8]Dexamethasone is a very potent and highly selective glucocorticoid. 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[3,4,7,9,10-15] and motor block.[3,11,12,15]

Several studies have indi-cated that fentanyl increases the quality of peripheral blockade and improved the duration of postoperative analgesia.[16,17] Opioids are frequently used in regional anesthesia as an adjuvant agent. The introduction discovery of opioid receptors in the peripheral nervous system has led to research into opioid use as an adjuvant in peripheral blockade applications such as brachial plexus block-ade. Gobeaux et al.[16] added 100 mcg of fentanyl to adrenalinizedlidocaine for brachial plexus block and reported that when fentanyl was added this enhancement of intensity and duration of sensory and motor nerve blocks allowed a reduction in the amount of li-docaine required and shortened the delay between in-jection and complete blockade.[16] They suggested that this result might be related to the peripheral effects of opioids. The lipid solubility of fentanyl is thought to have had a perineural effect. Since opioids are associated with side effects like heavy sedation, respiratory depression and psychomimmetic effects, drugs with minimal of these side effects are always looked for.

Recently, dexamethasone has been studied as an adjuvant to local anesthetic in peripheral nerve block.[9,11] Although the exact mechanism of dexamethasone's action is unknown, preliminary studies suggest its addition can impressively prolong the duration of analgesia with minimal adverse effects. It has been suggested that dexamethasone may prolong block duration by increasing the activity of inhibitory potassium channels on nociceptive C fibers [5] or by causing vasoconstriction via glucocorticoid receptor mediated nuclear transcription modulation.[21] Dexamethasone's suppression of inflammatory mediators, including prostaglandins (PGE_2), may also play a role. It has been reported about dexamethasone that it causes prolong duration of action of local anesthetics and develops no respiratory depression. Thus, dexamethasone has selected as an adjuvant to bupivacaine to compare with fentanyl as an adjuvant to local bupivacaine in brachial plexus block in this study.

In this context the present study has been undertaken to evaluate the effect of dexamethasone 10 mg, used as an adjuvant to 0.25 % bupivacaine in supraclavicular brachial plexus block, on the onset time and duration of sensory as well as motor block and compared with fentanyl 100 mcg used as an adjuvant to 0.25 % bupivacaine.

Materials & Methods:

After admission in Orthopedic ward, in Dhaka Medical College Hospital, total 60 orthopedic patients of either sex aged 18-60 years, ASA status I or II, who will be undergoing for elective orthopedic surgeries of elbow, forearm and hand under supraclavicular brachial plexus block by taking history, thorough general and systemic examination and appropriate investigations fulfilling inclusion and exclusion criteria. Study was conducted in Orthopedics surgery operation theatre and in post-operative ward in Dhaka Medical College Hospital. Sequence of study were pretesting of questionnaire, finalization of

questionnaire, consent talking, detailed history, physical examination, investigation was done .The complication which were developed during the procedure was noted and managed accordingly. All the data collected and checked properly .and finally inserted in to the computer.

After obtaining informed consent, patients were instructed pre-operatively in the use of visual analogue scale (VAS) for pain assessment, pin prick method for sensory block and movement of hand and fingers for motor block.They were advised overnight fasting and premedicated with oral pantoprazole 40 mg in the morning of the surgery.

In the operation room, after attaching routine monitors (Electrocardiogram, noninvasive blood pressure, pulse oximeter), intravenous access will be secured.

Patients were randomized to one of the two groups. Group A, patients no. 30, getting injection of > 0.25% Bupivacaine (38 ml)+ Dexamethasone (2 ml/ 10 mg) and Group B, total patients no. 30, getting injection of > 0.25% Bupivacaine (38 ml) + Fentanyl (2 ml/ 100 mcg)

After proper explanation of technique, block were performed in supine position with head rotated to the contralateral side and upper limb to be anesthetized were adducted and extended along the side toward the ipsilateral knee as far as possible. Interscalene groove were indentified& landmark were confirmed by palpation of the subclavian artery. The skin of landmark area was blocked by 2% lignocaine. On negative aspiration for blood, a total volume of 40 ml solution (38 ml 0.25% bupivacaine + 2 ml dexamethasone/10mg or 2 ml fentanyl/100mcg) were injected slowly.

All local anesthetic solutions and adjuvant drugs were prepared by an anesthesiologist not involved in the performance of supraclavicular brachial plexus block, patient care or data collection.

The onset and duration of sensory blockade were assessed by using pinprick test every 2 minutes interval till score 0. (it was evaluated using a 3-point scale: 2 = normal sensation, 1 = loss of sensation to pinprick, and 0 = loss of sensation to light touch).Time of 0 point of pinprick test was noted

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) every 2 minutes interval till score 0. (it was measured using a 3- point scale where 2 = normal movement, 1 = paresis, and 0 = absent movement. Time for onset of grade 0 motor blockade was noted.

During operation, patient complaint of pain, limb movement and surgeon satisfaction were noted.

Post-operative pain measurement was done using visual analogue scale (VAS). Postoperatively, in patients witha visual analogue scale (VAS) score of '3', intramuscular ketorolac (30 mg) was administered as rescue analgesic and the duration of analgesia was noted.

Patients were watched for any peri-operative complications like bradycardia, hypotension, sedation, nausea, vomiting, pruritus & respiratory depression and managed accordingly.

If inadequate block occurs or pneumothorax develops or a large haematoma forms before injection of drugs, then our plan was that the operation will be continued under General anaesthesia and result of my study will be concluded by statistical analysis. But no patient developed such conditions.

After giving supraclavicular brachial plexus block, giving time was noted at data collection sheet. Sensory block was examined by Pin prick method upto loss of sensation of light touch and the time was noted. Time of onset of motor block was examined by 3 point scale where 2= normal movement, 1= paresis & 0= absent movement. For motor function of radial nerve examination, patient was requested for thumb abduction & wrist extension and the time of absent movement was recorded. For motor function of ulnar nerve examination, patient was requested for thumb adduction & ulnar deviation of hand and the time of absent movement was recorded. For motor function of median nerve examination, patient was requested for thumb opposition & wrist flexion and the time of absent movement was recorded. For motor function of musculocutaneous nerve examination, patient was requested for flexion of

the elbow in supination and the time of absent movement was recorded.

After confirmation of sensory and motor block, surgeons were allowed to start operation and starting time of operation was recorded. After operation started, patients were observed for any unusual movement of operating hand. Surgeon satisfaction during operation was also noted.

After operation completed, patient was transferred to post operative ward and observed for any complication and monitored for pulse, BP, SpO_2& respiratory movement.

In post operative ward, patient was assessed for reversal of sensory and motor block by pin prick method 3 point scale respectively.

For sensory block, when in pin prick method scale 2 was observed then the time was noted. For motor blockade, when 3 point scale scored 2 then the time was noted. When pain scored 3 in visual analogue scale, patient was given Inj. ketorolac (30 mg) I/V and time was recorded. Patient was observed for developing complication like nausea, vomiting, pruritus, respiratory depression etc. 2 patients of group B developed nausea. They were managed inj. Ondensetron (8mg) immediately.

All collected questionnaire checked very carefully to identify the error in the data.

Results:

Table-1 *Demographic characteristics of group A and Group B*

Demographic Variables	Group A	Group B
Age (year)		
≤ 30	10 (33.3%)	12 (40%)
> 30	20 (66.7%)	18 (60%)
Mean ± SD	38.53 ± 14.45	38.93 ± 13.73
Sex		
Male	14 (46.7%)	20 (66.7%)
Female	16 (53.3%)	10 (33.3%)
Weight (kg)		
Mean ± SD	60.2 ±7.07	58.87 ± 8.08
Height (cm)		
Mean ± SD	146.27 ± 20.05	151.93 ± 18.95

NB: percentages in the parenthesis are calculated column wise.

There were no significant difference between the Group - A and Group - B regarding age, sex, weight and height of the patient.

Table-II

Comparison of timing of anaesthesia events between Group A and Group B

Timing of anaesthesia	Group A	Group B	P-value
Onset of sensory block (minutes)	18.33 ± 1.77	20.47 ± 1.89	.000
Duration of sensory block (minutes)	818.93 ± 13.62	649 ± 21.18	.000
Onset of Motor block (minutes)	21.13 ± 2.65	26 ± 1.97	.000
Duration of motor block (minutes)	698.73 ± 15.17	575 ± 22.74	.000

Data were analyzed using Student's T test and were presented as mean ± SD. Onset of sensory and motor block were significantly higher in Group B than Group A. Persistence of sensory and motor block were significantly higher in Group A than Group B.

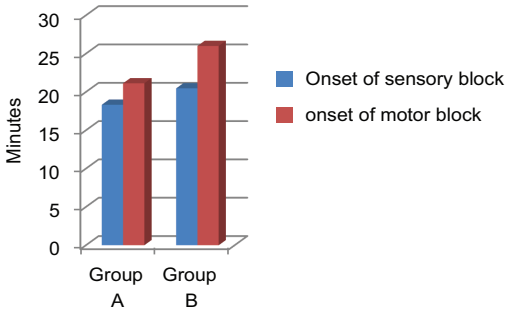

Fig 1 The comparison of onset of sensory and motor block between Group A&B.

Bar chart showing the comparison of onset of sensory& motor block between Group A & Group B.

Onset of sensory and motor block was significantly earlier in Group A (sensory18.33 ± 1.77 minutes, motor 21.13 ± 2.65 minutes) than Group B(sensory 20.47 ± 1.89 minutes, motor 26 ± 1.97 minutes)

Table III *Comparison of effective analgesia between groups –*

Group	Duration effective analgesia (minute)	
	Mean	SD
Group A	825.59	13.44
Group B	667.40	23.64

Data were analyzed using Unpaired t-Test and are presented as mean ± SD; Duration of effective analgesia (time from supraclavicular brachial plexus block to first analgesic demand). Study group-A had significantly longer mean duration of analgesia (825.59± 13.44 minutes) than that produced by control group-B (667.40 ± 23.64 minutes)

Duration of analgesic period: Duration of effective analgesia (time from supraclavicular block to first analgesic demand) in study group-A had significantly longer mean duration than that produced by control group-B (825.59 ± 13.44 vs 667.40 ± 23.64 minutes).

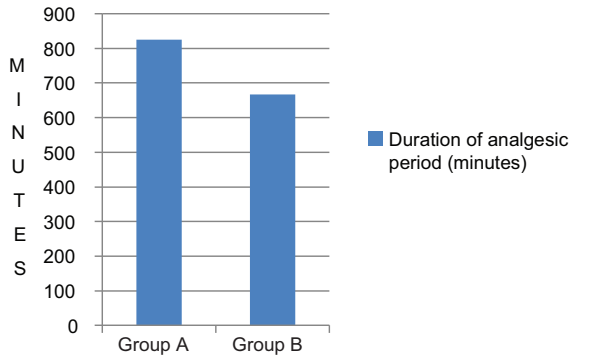

Fig 2 *Simple bar chart showing the duration of analgesic period of Group A and Group B*

Discussion:

In this study fentanyl or dexamethasone was used as adjuvant in bupivacaine. Onset as well as duration of sensory and motor block was recorded along with quality. Patient's characteristics in respect of age, sex, weight and height demographic characteristics and ASA status were similar amongst the groups. A total of 60 patients, 30 in each group, were evaluated. The study group A was given 0.25% Bupivacaine (38 ml) & Dexamethasone (2 ml/ 10 mg) and the control group Bwas given 0.25% Bupivacaine (38 ml) & Fentanyl (2 ml/ 100 mcg). All groups were comparable with respect to the demographic and operational factors. In Study group A majority of patients 20(66.7%) belongs to age 31 to 60 yrs and in Control group B of patients 18(60%) observed in 31 to 60 yrs of age group. Mean age of patients was 38.53±14.45 years for group A and 38.93±13.73 years for group B.

The data obtained in this study was analyzed using unpaired 't' test which gives p value to be applied as follows : - If p> 0.05, it means that there is no significant difference between the means of two groups studied. If p=0.05, it indicates that there is a significant difference at 5% level of significance. (i.e. out of 100, in 95 cases there is a significant difference). If p< 0.01, it indicates that the data is significant at 1% level of significance (i.e. out of 100, in 99 cases there is a significant difference). If p<0.001, it is highly significant).

In this study, onset of sensory block after giving supraclavicular brachial plexus block which is 18.33 ± 1.77 minutes for Group A and 20.47 ± 1.89 for Group B . P- value is .000 which is statistically highly significant.

Onset of motor block after giving supraclavicular brachial plexus block which was 21.13 ± 2.65 minutes for Group A and 26 ± 1.97 for Group B . P- value was .000 which is statistically highly significant.

Findings of study group correlate with the studies of Shaikh M R et al,[25]Movafegh A et al[11] and Parrington SJ et al.[13] However, Golwala MP et al.[4] and Yadav RK et al.[10] in their studies, found significantly earlier onset of sensory (275.66 ± 30.32 sec) and motor block (326.66 ± 27.70 sec) in the local anesthetics plus dexamethasone group (35ml of mixture of lignocaine 2%, bupivacaine 0.5%,1:200000 adrenaline + dexamethasone 8mg) than in the control group (35ml of mixture of lignocaine 2%, bupivacaine 0.5% and 1:200000 adrenaline). This discrepancy may be due to differences in study methodology such as use of varying methods of block assessment, higher dose of local anesthetic and use of adjuncts like epinephrine.

Chavan S G et al,[22] stated that addition of Fentanyl to local anaesthetics causes a delayed onset of analgesia, although this may be accounted

for by the decreased P^H caused by Fentanyl. Nishikawa K et al [23], described that P^H of solution of local anaesthetics decreases after adding Fentanyl.Rajkhowa T. et al [24], showed their study results obtained that the addition of fentanyl to ropivacaine for supraclavicular brachial plexus blocks significantly prolonged delayed the sensory and motor block onset time.

Duration of sensory block after giving supraclavicular brachial plexus block which was 818.93 ± 13.62 minutes for Group A and 649 ± 21.18 minutes for Group B. P- value was .000 which is statistically highly significant. Duration of motor block after giving supraclavicular brachial plexus block which was 698.73 ± 15.17 minutes for Group A and 575 ± 22.74 minutes for Group B . P- value was .000 which is statistically highly significant. These findings lend support to the observations of various earlier studies by Movafegh A et al.[11], Shrestha BR et al.[9], Vieira PA et al.[12] and Tandoc MN et al.[15] Shaikh M R et al[25]

In control group the onset of sensory and motor block were significantly higher than that of study group but the duration of sensory and motor block were significantly higher in study group than that of control group. In this study, intra and postoperative pulse rate, systolic and diastolic BP, respiratory rate and SPO_2 did not vary throughout whole period of observation. There was no significant difference between two groups. The intensity of postoperative pain measured on VAS (visual analog scale). When pain assessment scored 3, patients were given analgesic drug (inj. Ketorolac 30 mg).

Duration of effective analgesia (time from supraclavicular brachial plexus block to first analgesic demand) Study group-A had significantly longer mean duration of analgesia (825.59± 13.44 minutes) than that produced by control group-B (667.40 ± 23.64 minutes)

Golwala M P et al (2009), [4] has done a study to compare the quality and duration of analgesia with adding dexamethasone in local anaesthetics. There was markedly prolonged duration of analgesia after using in local anaesthetics with dexamethasone (12–18 hours). Duration of analgesia in terms of hrs, was nearlymatched with our Study Group A. One such randomised prospective trial was done by Shrestha BR, Maharjan SK, Tabedar S[3]. In their study patients in-one group, a brachial plexus block was done with 40-50 ml of local anesthetic with 1:200,000 adrenaline and in the other group the block was performed with the same amount of local anesthetic with dexamethasone. The authors found that there was significant prolonged duration of anaesthesia and analgesia (12.75 ± 5.33 hours) in the dexamethasone group which nearly support our study.

In our study, regarding duration of analgesia between groups, 4 patients (13.3%) among 30 patients in control group required first analgesic dose within 10 hrs during post-operative period while none of the patients in study group required analgesic within the same period.

In our study, two patients (6%) subjects in group-B had developed nausea which was not observed in group-A. In the study of Pathak R G et al[1], Cumming et al[14] ,Golwala M P et al[4] and Shaikh M R et al[25]had not found any complication after using dexamethasone as adjuvant with local anaesthetics which is similar with this study. In the studies of Ahmed N U et al [2], Rajkhowa T et al [24] and Chavan S G et al [22] showed no complication occurred after using fentanyl as adjuvant with local anaesthetics but in our study, two patients control group (6.6%) developed nausea.This discrepancy may be not due to drugs but due to other factors like female patient, stress condition etc.

Conclusion:

The addition of dexamethasone (10 mg) as an adjuvant to local anaesthetic, bupivacaine in supraclavicular brachial plexus block results in significantly early onset effect of sensory and motor block and causes significantly prolonged duration of sensory block, motor block and post-operative analgesia than the addition of fentanyl (100 mcg) as an adjuvant to local anesthetic, bupivacaine. From the discussion so far, it is evident that dexamethasone-bupivacaine combination is more effective than fentanyl-bupivacaine in reducing intensity of postoperative pain.

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