



A Comparative study between supraclavicular brachial plexus block with Bupivacaine plus dexamethasone and supraclavicular brachial plexus block with Bupivacaine alone

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Introduction

Pain is an extraordinary complex sensation which is difficult to define and equally difficult to measure in accurate objective manner. The International Association for the Study of Pain defines pain as ‘**an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage**’.¹

Many millions of patients worldwide undergo surgery every year and effective pain control is essential for optimal care of such patients. Truly the central axis of anesthesia is predicated on interruption of pain.

“**Regional anaesthesia**” is the term first used by **Harvey Cushing** in 1901 to describe pain relief by nerve block.² Regional nerve blocks are based on the concept that pain is conveyed by nerve fibers, which are amenable to interruption anywhere along their pathway.³

Peripheral nerve block avoids the unwanted effects of anesthetic drugs used during general anesthesia and the stress of laryngoscopy and tracheal intubation.⁴ It decreases the pain as analysed by VAS score post operatively. It also decreases the need of post operative analgesics,

decreases incidence of PONV, shortens the post anesthesia care unit time and increases the patient satisfaction.⁵

Regional anesthesia traces its origin to **Dr. Carl Koller** who in 1884 employed a solution of cocaine for topical corneal anesthesia in patients undergoing eye surgery.⁶ This marked the start of a new era in medicine namely the use of regional anesthetics for prevention of pain associated with surgery.

Brachial plexus block is a popular and widely employed regional nerve block technique for perioperative anesthesia and analgesia for surgery of the upper extremity. **William Halsted** (1852–1922) performed the first brachial plexus block.^{7,8} Using a surgical approach in the neck, Halsted applied cocaine to the brachial plexus. The first percutaneous supraclavicular block was performed in 1911 by German surgeon **Diedrich Kulenkampff** (1880–1967).⁹ There are various approaches which has been described for brachial plexus blocks viz. Supraclavicular, Interscalene, Infraclavicular, Axillary. Supraclavicular approach is the easiest and most consistent method for surgery below the shoulder joint.¹⁰

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, 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.¹¹

Steroids have powerful anti-inflammatory as well as analgesic property. They suppress inflammation through inhibition of Phospholipase A₂. Perineural injection of glucocorticoid along with local anesthetics is reported to influence the onset and duration of sensory and motor block.^{11,12,13}

Dexamethasone is a very potent and highly selective glucocorticoid. Various studies have been done using dexamethasone 8 mg 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.^{5,11,12,14,15,16,17,18,19}

In this context the present study has been undertaken to evaluate the effect of Dexamethasone 8 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 post operative rescue analgesic requirement.

Aim of Study

The aim of this study is to compare and evaluate supraclavicular brachial plexus block with bupivacaine plus dexamethasone and supraclavicular brachial plexus block with bupivacaine alone.

Objectives of the Study

- a) To study the onset time of sensory and motor blockade.
- b) To study the duration of sensory and motor blockade.
- c) To study the postoperative rescue analgesic requirement.

Material and Methods

The study was conducted at Department of Anaesthesiology and Critical Care, Bokaro General Hospital, Bokaro Steel City following the due approval of hospital ethics and scientific committee and after obtaining informed consent of patient to be inducted as subject of study.

Study Location

The study has been carried out in the Department of Anaesthesiology and Critical Care, Bokaro General Hospital, Bokaro Steel City, Jharkhand.

Study Population

The patients posted for upper limb orthopaedic surgeries under supraclavicular block during study period are referred to as population group. A rough estimate of the strength of this group was made by forward regression of previous year data of annual upper limb orthopaedic surgeries under supraclavicular block.

Study Design

- It is prospective, randomized, double blinded study.
- Duly approved by hospital ethical & scientific committee.

Sixty consecutive adult patients undergoing upper limb orthopaedic surgeries under supraclavicular block were studied. The patients were drafted in the study after obtaining written informed consent from them.

Study Time Frame

June 2018 to May 2019

Sample Size

Sample size for this study has been calculated using the prolongation of duration of sensory analgesia as the main criterion. Hickey R et al. in year 1992 showed that 40 ml 0.25% bupivacaine in supraclavicular brachial plexus block produced a mean duration of analgesia of 11.6 hrs with standard deviation of 3.2(11.6±3.2). To demonstrate that the addition of 8mg

dexamethasone to 38 ml of 0.25% bupivacaine would prolong the duration of analgesia (sensory block) by 20%, we calculated 30 patients per group were required to detect a statistically significant difference between groups with $\alpha=0.05$ and 80% power.

The sample size calculation was done using formula:-

$$n(\text{Sample Size}) = (r + 1)(Z_{\alpha/2} + Z_{1-\beta})^2 \sigma^2 / rd^2$$

$$r = n_1/n_2 = 1$$

n_1 – sample size of group 1

n_2 – sample size of group 2

Z – critical z value for a given α and β

α – probability of type 1 error (usually 0.05)

β – probability of type 2 error (usually 0.2)

σ – variance of mean

d – absolute difference between two means

$$n(\text{Sample Size}) = (1 + 1)(1.96 + 0.84)^2 3.2^2 / 1 \times 2.32^2$$

$$= 29.83 = 30$$

Thus the total sample size is 60.

Randomization

A random number table was used to randomly assign all the selected patients into 2 groups. The random number table was generated online (<https://www.random.org/integers>) with total 60 entries. Consecutive patients were assigned as under:

Group A ($n=30$) – supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml (8mg) dexamethasone

Group B ($n=30$) – supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml 0.9% normal saline.

The patients underwent assessment for onset of sensory block, onset of motor block, percentage failure of block, duration of analgesia and complications of block.

Group Allocation

Sample group: This study was conducted on 60 patients between 18 – 60 yrs of age.

Study group:

Group A ($n = 30$)-supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml (8mg) dexamethasone

Group B ($n = 30$)-supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml 0.9% normal saline.

Blinding of Study

As the study is double blinded prospective trial, both the study subject and investigator has been blinded to:

1. The group into which the patients were placed prior to completion of study.
2. The type of drugs added to 38ml of 0.25% bupivacaine i.e. one group will receive 38 ml of 0.25% of bupivacaine and 2 ml(8 mg) of dexamethasone and another group will receive 38 ml of 0.25% of bupivacaine and 2 ml of 0.9% NaCl.

This has been achieved in the following manner

1. All the selected patients were told the same thing regarding study i.e. a new drug will be added to the preparation of local anesthetic which would improve the quality of block with respect to better pain relief and prolonged duration of action.
2. The computer generated randomized list of two groups had been generated but it has not been given to the investigator until the study was completed.
3. An assistant had loaded the syringe with 38 ml of 0.25% bupivacaine and 2ml of dexamethasone or 2 ml of 0.9% NaCl based on group designation of the patients on the randomization list and handed over to investigator.
4. The list was available only with the assistant.
5. This assistant having the randomization list had not participate in the observation of the cases.
6. The study parameters was observed and recorded by the investigator.

Inclusion Criteria

- Adult patients of either sex, aged 18 – 60 yrs
- ASA physical status I and II
- Patients posted for elective orthopaedic surgeries of elbow, forearm and hand under supraclavicular brachial plexus block.
- Patient giving willful informed consent.

Exclusion Criteria

- Patients who have not given consent for the study
- Patients having age less than 18 and more than 60 yrs.
- ASA physical status III and more.
- Patients with history of peptic ulcer, T2DM, hepatic or renal failure.
- Patients with history of significant neurological, psychiatric, neuromuscular and cardiovascular diseases.
- Pregnancy.
- Patients receiving psychotropic drugs, chronic analgesic therapy.
- Known hypersensitive to any of the given drugs.

Methodology**Preoperative assessment**

On the day before surgery, patients were attended and examined properly for a preoperative counseling and repeat anesthetic check-up. Written informed consent was taken from all the willing participants after proper explanation of the study procedure and expected outcome in their own language.

History

A detailed history was obtained from every patient regarding any symptoms of breathlessness, asthmatic attack, bleeding disorder, drug allergy, previous history of surgery and anaesthesia, unconsciousness, seizures, hereditary neurological disorder, addiction and prolonged drug treatment, hospitalization.

Physical Examination

Patients were assessed for any evidence of pallor, icterus, cyanosis, clubbing. Blood pressure, pulse rate, respiratory rate and temperature were also noted. Airway was assessed. The body weight and height of each patient were also recorded.

Systemic Examination

Thorough examination of the cardiovascular, respiratory system and neurological system was done in all patients.

Investigations

Routine investigations were carried out preoperatively in all patients. These included:

- Hemoglobin percentage.
- Total and differential WBC counts and platelet count.
- Routine urine analysis.
- Estimation of blood urea, creatinine, electrolytes.
- Fasting and postprandial blood glucose level.
- Liver function test.
- HB_s Ag, HIV I & II, anti HCV Antibody.
- ECG (in patients above 40 years of age or with specific complaints).
- Chest X- ray (PA view).

Study equipments

- Written informed consent form.
- I.V cannula, transfusion set, IV fluid, 20 cc disposable syringe.
- Drugs- Bupivacaine 0.25%, Inj. Dexamethasone sodium phosphate (4 mg/mL), Inj. Diclofenac sodium (rescue analgesic) and other drugs for cardio pulmonary resuscitation.
- Weighing machine and measuring tape.
- Surface electrode.
- Peripheral nerve stimulator
- Visual analogue scale.
- Multichannel monitor for monitoring of electrocardiography (ECG), heart rate, respiratory rate, noninvasive blood

pressure (NIBP) and peripheral oxygen saturation (SpO₂).

Preoperative Instructions

Fasting Guidelines

All patients were instructed not to consume solid food after midnight on the day before surgery but clear fluids were permitted till two hours prior to scheduled time of operation.

Visual Analogue Scale

It is a sensitive scale for measuring pain intensity. It consists of a 100 mm line scale anchored at one end with 'no pain' and at the other end with 'worst pain imaginable'. All the patients were counseled and demonstrated when and how to express the pain intensity at the preanesthetic visit and on the day before surgery. They were asked to move the marker present over the scale to a point which represents their pain intensity best.

Premedication

Tablet ranitidine 150 mg was given at night for acid suppression. Tablet Clonazepam 0.5 mg was also given to ensure good night sleep. In the morning of operation tablet ranitidine 150mg and metoclopramide 10 mg were given orally two hours before surgery.

Monitoring

After the patient's arrival at the operation theatre, multichannel monitor was attached for monitoring of ECG, heart rate, respiratory rate, noninvasive blood pressure (NIBP), peripheral oxygen saturation (SpO₂). Baseline heart rate, blood pressure and peripheral oxygen saturation were recorded.

Intravenous infusion of Ringers' lactate and oxygen at the rate of 4-6 liters/minute via face mask were initiated. Patients were administered intravenous midazolam 0.03 to 0.04 mg/kg before brachial plexus block.

Supraclavicular brachial plexus block was performed with 38 mL of 0.25% bupivacaine plus 2 mL dexamethasone (8 mg) in group A and with 38 mL of 0.25% bupivacaine plus 2 mL 0.9% normal saline in group B. All local anesthetic solutions and adjuvant drug were prepared by an

anesthesiologist not involved in the performance of brachial plexus block or data collection. Both patient and observer were also blinded to the group allocation.

Technique of supraclavicular brachial plexus block

All patients were explained about the procedure first. Position of the patient was supine with head rotated to the contralateral side. The upper limb to be anesthetized was adducted and extended along the side toward the ipsilateral knee as far as possible. Antiseptic dressing and draping of the site was done. 5 mL of 2 % lignocaine with 1:200000 adrenaline was infiltrated around the skin to be punctured prior to block. Peripheral nerve stimulator was switched on, its one wire was connected to disposable silver chloride electrode attached on patient's forearm and the other wire was connected to insulated needle (22 G × 5 cm). Anterior scalene muscle, middle scalene muscle and midpoint of the clavicle were identified and marked. The posterior border of sternocleidomastoid muscle was palpated easily when the patient raised the head slightly. The palpating fingers then rolled over the belly of anterior scalene muscle into the interscalene groove, where a mark was made approximately 1.5 to 2.0 cm posterior to the midpoint of clavicle. The mark was the needle entry point. Palpation of the subclavian artery at this site confirmed the landmark.

After development of a skin wheal at that mark, the anesthesiologist stood at the side of the patient. The stimulation frequency was set at 1 Hz⁵⁰ and the intensity of the stimulating current was initially set to deliver 2 mA and was then gradually decreased. The 22-gauge 5 cm, insulated needle was then inserted at that marked point and advanced in a caudad, slightly medial and posterior direction until a slight distal motor response was elicited or the first rib was encountered. The position of the needle was considered to be acceptable when an output current < 0.5 mA⁵⁰ still elicited a slight distal motor response in forearm and hand.

In case, the first rib was encountered without elicitation of distal motor response the needle was systematically walked anteriorly and posteriorly along the rib until the plexus was located. The needle was withdrawn if subclavian artery was punctured and reinserted in a more posterolateral direction. On localization of the brachial plexus, aspiration for blood was performed before incremental injections of a total volume of 40 ml solution (38 ml 0.25% bupivacaine + 2 ml dexamethasone or normal saline).

The intercostobrachial nerve (T2) was blocked with 5 mL of 2 % lignocaine with 1:200000 adrenaline to avoid tourniquet pain.

Assessment of Sensory and Motor Blockade

Sensory blockade of radial, median, musculocutaneous, medial cutaneous nerve of arm and forearm, and ulnar nerves (C5-T1 dermatomes) and motor blockade of radial, median, musculocutaneous, and ulnar nerves were assessed every 2 minute after completion of local anesthetic (bupivacaine ± dexamethasone) injection till 30 minutes and then every 30 min after the end of surgery till first 12 hrs, thereafter hourly until the block had completely worn off.

Sensory blockade of each nerve was assessed by pinprick and evaluated using a 3-point scale: 2 = normal sensation, 1 = loss of sensation to pinprick, and 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 was measured using a 3- point scale where 2 = normal movement, 1 = paresis, and 0 = absent movement.

Loss of sensation to pinprick and muscle paresis in each of the radial, ulnar, median, and musculocutaneous nerve distributions, achieved within 30 minutes of local anesthetic injection, were considered as criteria for successful block. Patients with unsuccessful block were excluded from the study.

After 30 minutes, if the block was considered to be adequate, surgery commenced.

Each patient was observed for complications which may be caused by local anesthetic itself or block technique such as

- Seizure
- Hypotension
- Bradycardia
- Dysrhythmia
- Horner's syndrome
- Clinically significant pneumothorax.

Postoperative Care

After the end of surgery patients were sent to Post Anesthesia Care Unit under the observation of a blinded resident. Occurrences of any complication like bradycardia, hypotension, Horner's syndrome, and clinically significant pneumothorax were noted. The time of occurrence of first postoperative pain and the time of complete recovery of motor functions of the forearm and hand were recorded in every patient. Injection diclofenac sodium (rescue analgesic) 75 mg was given intramuscularly when Visual analogue scale score for pain was ≥ 30 mm. Number of injection diclofenac given to each patient during first 24 hours of postoperative period was recorded.

Parameters to be studied

1 Demographic Parameters – age, sex, height, weight, ASA status of patients.

2 Duration of surgery.

3 Block characteristics:

- Onset time of sensory block.
Onset time of sensory block was defined as the time interval between the end of local anesthetic injection and loss of sensation to pinprick in all of the nerve distributions.
- Onset time of motor block.
Onset time of motor blockade was defined as the time interval between the end of local anesthetic injection and paresis

(motor score = 1) in all of the nerve distributions.

- Duration of sensory block.

The duration of sensory block was defined as the time interval between the onset of sensory block and the first postoperative pain.

- Duration of motor block.

The duration of motor block was defined as the time interval between the onset of motor block and complete recovery of motor functions.

4. Post-operative rescue analgesic requirement (No. of intramuscular diclofenac sodium injection) in first 24 hours.

5. Incidence of any complication like seizure, bradycardia (heart rate < 60 beats /min), hypotension (fall in Mean Arterial Pressure > 20% of the baseline), dysrhythmia, Horner's syndrome, clinically significant pneumothorax etc.

Statistical Methods

After completion of assessment, data were selected randomly and tabulated and then analysed with Statistical software package SPSS16 for windows, version 16.0.

Mean, median, standard deviation and variance were calculated and following statistical significance tests were applied

1. Numerical variables have been compared between groups by Independent Samples t-test.
2. Independent samples t-test will be used to find out significance between two samples. Data will be reported as Mean value \pm S.D.
3. Categorical variables like ASA status, Age, Sex, Postoperative analgesic requirement and adverse effects have been compared between groups by Chi-square test.
4. All analysis has been Two Tailed and $P < 0.05$ has been taken to be statistically significant

Observations & Analysis

A total of 80 patients were assessed initially for eligibility from January 2010 to July 2011 for inclusion into the study, out of which 60 patients received study drugs after randomization. Twenty patients were not included in this study on account of patient's refusal, change in the plan of surgery or anesthesia. Six patients were considered dropouts after initial randomization and therefore not subjected to statistical analysis (unsuccessful brachial plexus block in 5 patients, data not retrieved completely in 1 patients). Therefore data of remaining 54 patients were assessed for final analysis.

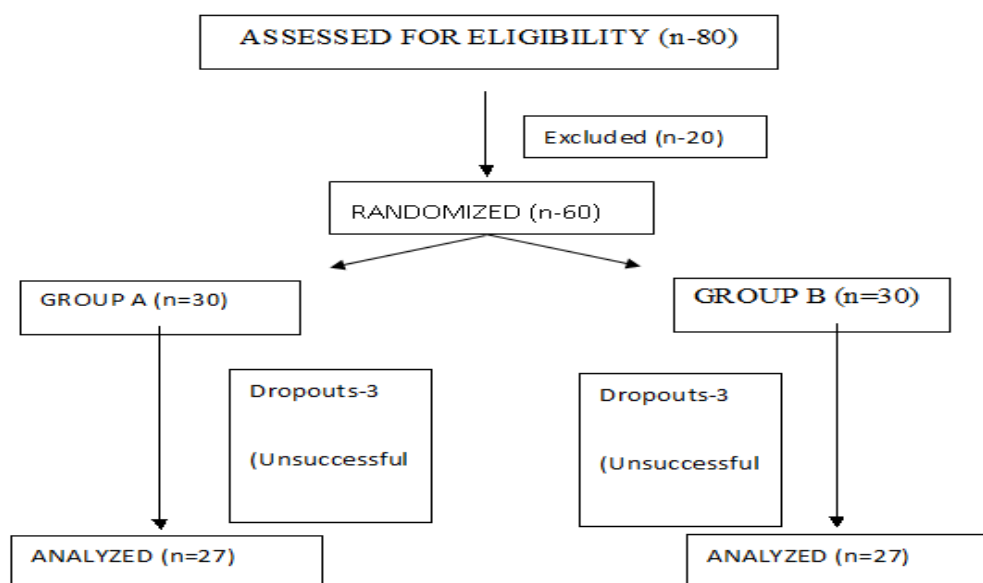


Figure 6- Consort diagram of the study

Mean Age

The patients who were accepted for the study were in age group 16-60 years. Both the groups were compared for significance in difference of age distribution.

Table 1 Mean Age

GROUP	N	MEAN	S.D	P value	INFERENCE
A	27	30.30	10.37	0.796	NS
B	27	31.04	10.56		

S : Significant ; NS : Not Significant

Mean Weight

Both the groups were compared for distribution of body weight. The apparent difference was not found to be significant in both groups.

Table 2 Mean Weight

GROUP	N	MEAN	S.D	P value	INFERENCE
A	27	61.19	5.12	0.719	NS
B	27	60.60	5.41		

S : Significant ; NS : Not Significant

Mean Height

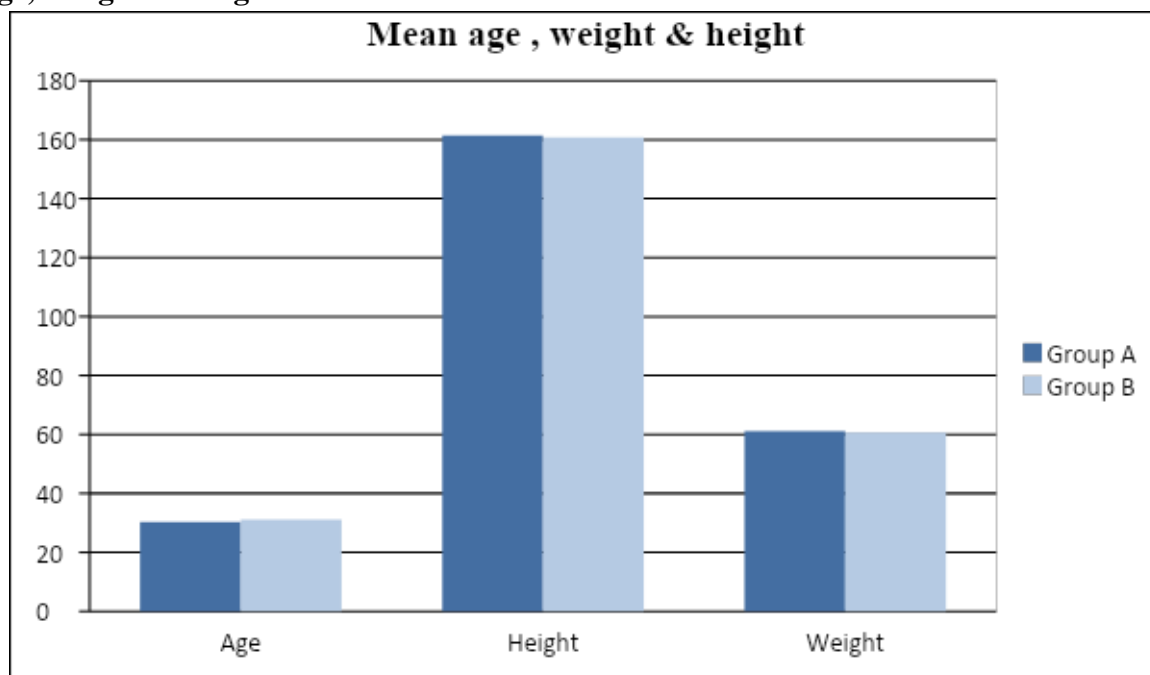
Both the groups were compared for distribution of body height. The apparent difference was not found to be significant in both groups.

Table 2 – Mean Height

GROUP	N	MEAN	S.D	P value	INFERENCE
A	27	161.48	5.56	0.611	NS
B	27	160.70	5.59		

S : Significant ; NS : Not Significant

Mean Age, Weight & Height



Gender

Both the groups were compared for sex distribution. The apparent difference was not found to be significant in both groups.

Gender

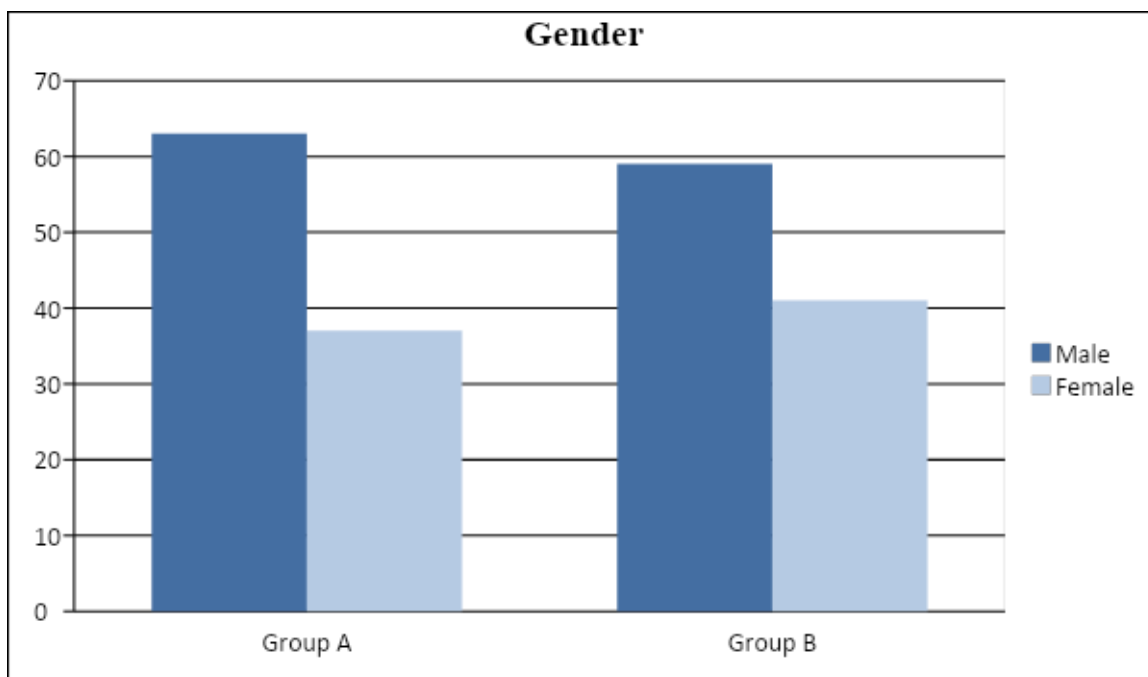
Gender	Group A		Group B	
	Number	Percent	Number	Percent
Male	17	63.00	16	59.00
Female	10	37.00	11	41.00
Total	27	100.0	27	100.0

P-Value : 0.780

S : Significant ; NS : Not Significant

Table 3 shows that there are no statistically significant difference between the groups in respect to patients' gender (Chi-square test $p > 0.05$).

Gender



ASA Grade

Both the groups were compared for ASA Grade. The apparent difference was not found to be significant in both groups.

ASA Grade

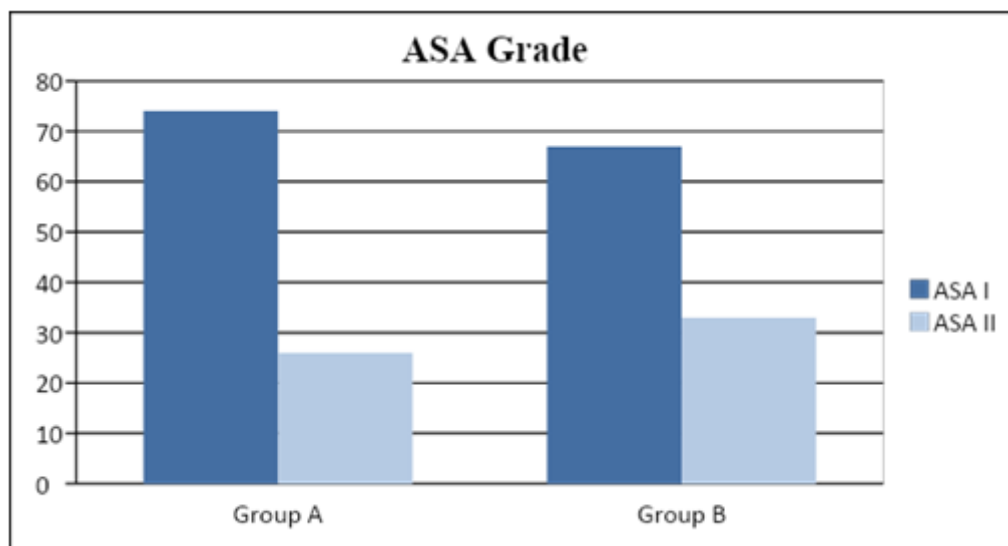
ASA grade	Group A		Group B	
	Number	Percent	Number	Percent
I	20	74	18	67
II	7	26	9	33
Total	27	100.0	27	100.0

P-Value : 0.551

S: Significant ; NS : Not Significant

Table 3 shows that there are no statistically significant difference between the groups in respect to patients' ASA physical status (Chi-square test $p > 0.05$).

Graph – 3: ASA Grade



Onset time of sensory and motor block

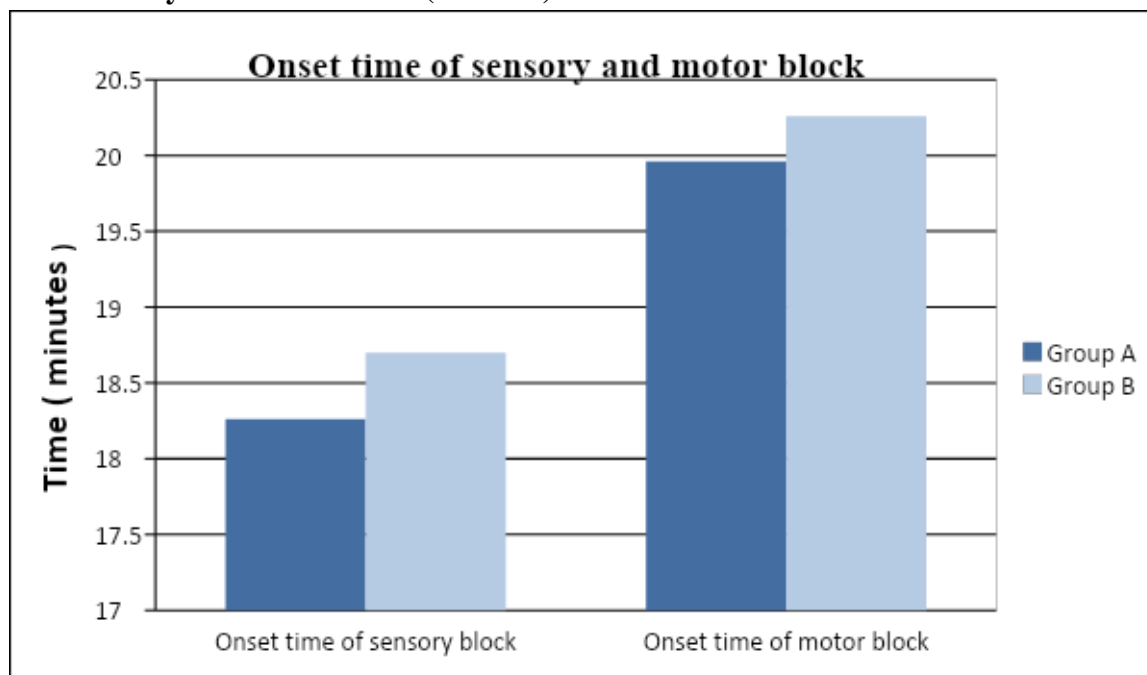
Onset time	Group A (mean ± SD)	Group B (mean ± SD)	P value
Onset time of sensory block (minute)	18.26 ± 1.25	18.70 ± 1.26	0.201
Onset time of motor block (minute)	19.96 ± 1.28	20.26 ± 1.28	0.402

Test done: Independent samples t-test.

Table 2 shows that there is no statistically significant difference between the groups in respect to onset time of sensory block (p value = 0.201). It also shows that there is no statistically

significant difference between the groups in respect to onset time of motor block (p value = 0.402). So the onset times of sensory and motor block were similar in the two groups.

Onset time of sensory and motor block (minutes)



Duration of sensory and motor block

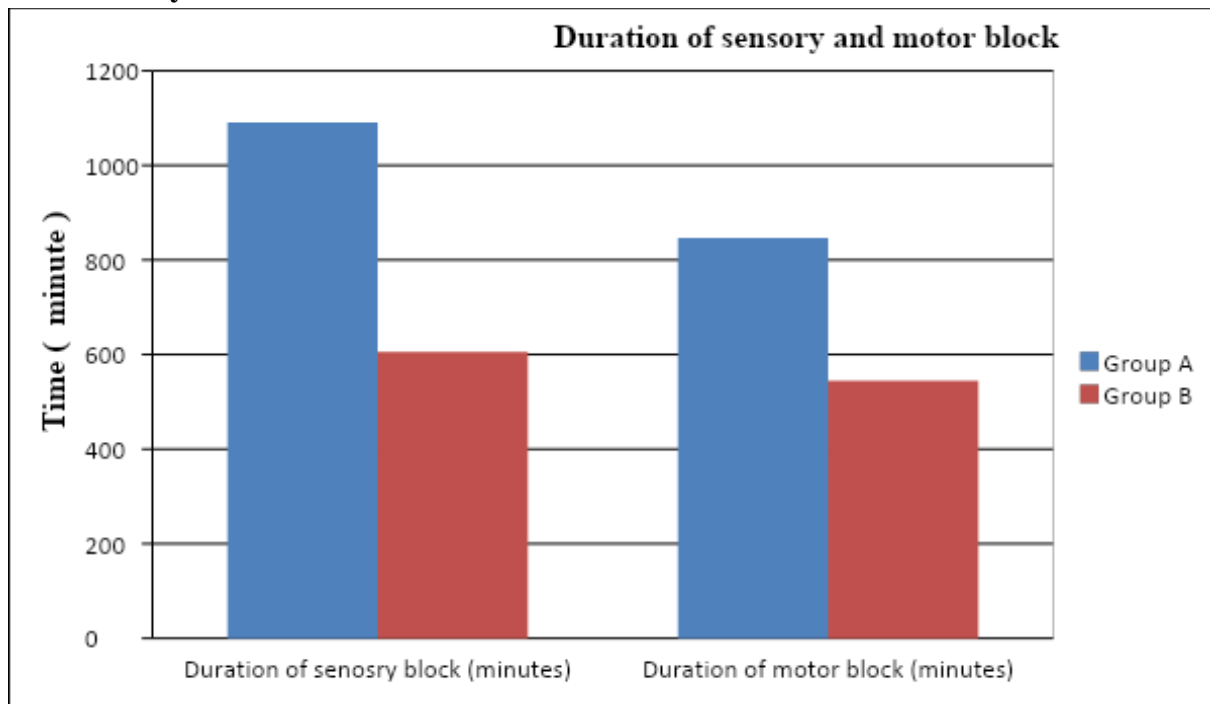
Duration of block	Group A (mean ± SD)	Group B (mean ± SD)	P value
Duration of sensory block (minute)	1091.11± 107.42	605.37 ± 58.60	0.000
Duration of motor block (minute)	846.67 ± 102.09	544.07 ± 55.40	0.000

Test done: Independent samples t-test.

Table 3 shows that the duration of sensory and motor blockade were significantly longer in the group A (dexamethasone group) than in the group

B (control group). The difference in block durations between the two groups is statistically highly significant (p value < 0.001).

Duration of sensory and motor block



Post-operative rescue analgesic requirement (Number of intramuscular diclofenac sodium injection) in first 24 hours

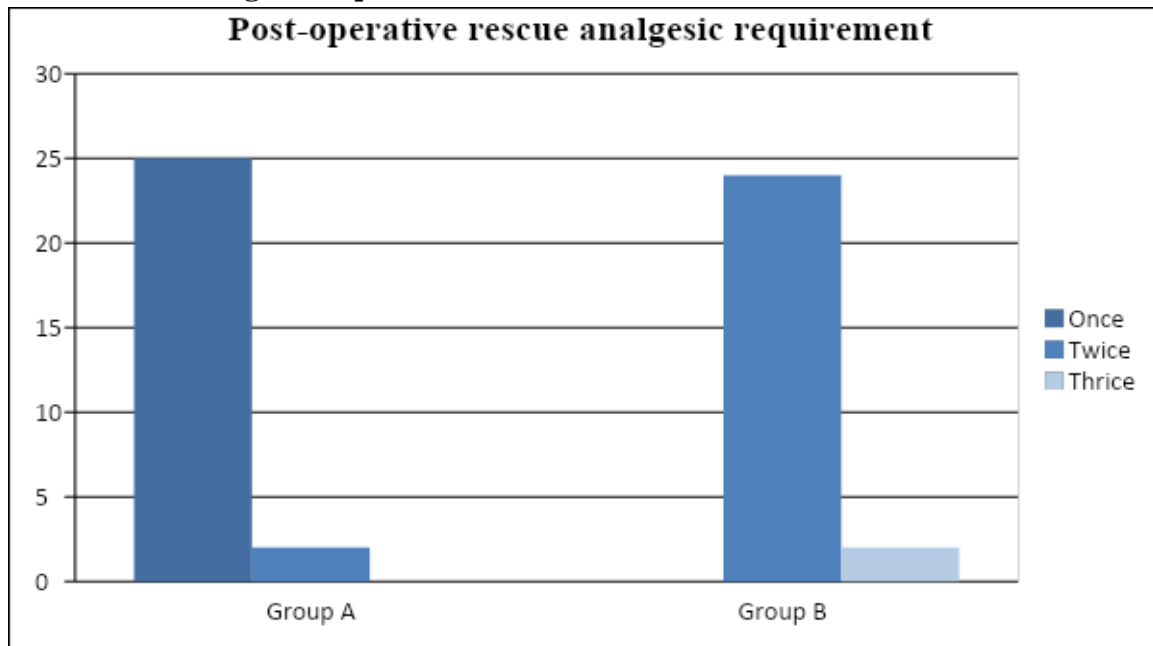
Group	No. of injection diclofenac in first 24 hours of postoperative period			p value
	1	2	3	
Group A	25	2	0	0.000
Group B	0	24	3	

Test done: Chi- square test.

Table 4 depicts the post-operative rescue analgesic requirement in both the groups. Patients in group A (dexamethasone group) required less number of diclofenac sodium injection than patients in group

B (control group) in first 24 hours of postoperative period, and the difference is statistically highly significant (p value < 0.001).

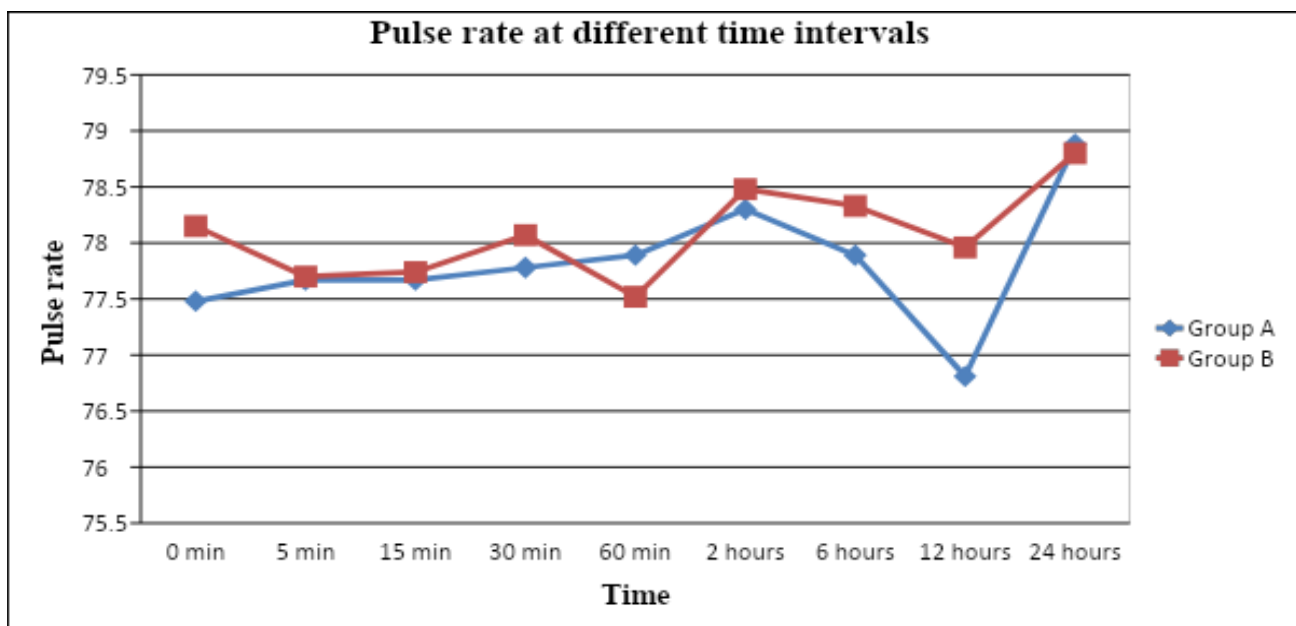
Post-operative rescue analgesic requirement



Pulse rate at different time intervals between the study groups

Pulse	Mean \pm SD		p value	Significance
	Group A	Group B		
0 min	77.48 \pm 5.78	78.15 \pm 6.59	0.69	NS
5 min	77.67 \pm 6.03	77.70 \pm 6.06	0.985	NS
15 min	77.67 \pm 6.03	77.74 \pm 6.01	0.966	NS
30 min	77.78 \pm 5.89	78.07 \pm 6.08	0.665	NS
60 min	77.89 \pm 6.03	77.52 \pm 5.92	0.821	NS
2 hours	78.30 \pm 6.13	78.48 \pm 5.97	0.913	NS
6 hours	77.89 \pm 6.06	78.33 \pm 6.29	0.795	NS
12 hours	76.81 \pm 5.99	77.96 \pm 5.93	0.482	NS
24 hours	78.88 \pm 5.83	78.81 \pm 6.21	0.771	NS

Pulse rate at different time intervals

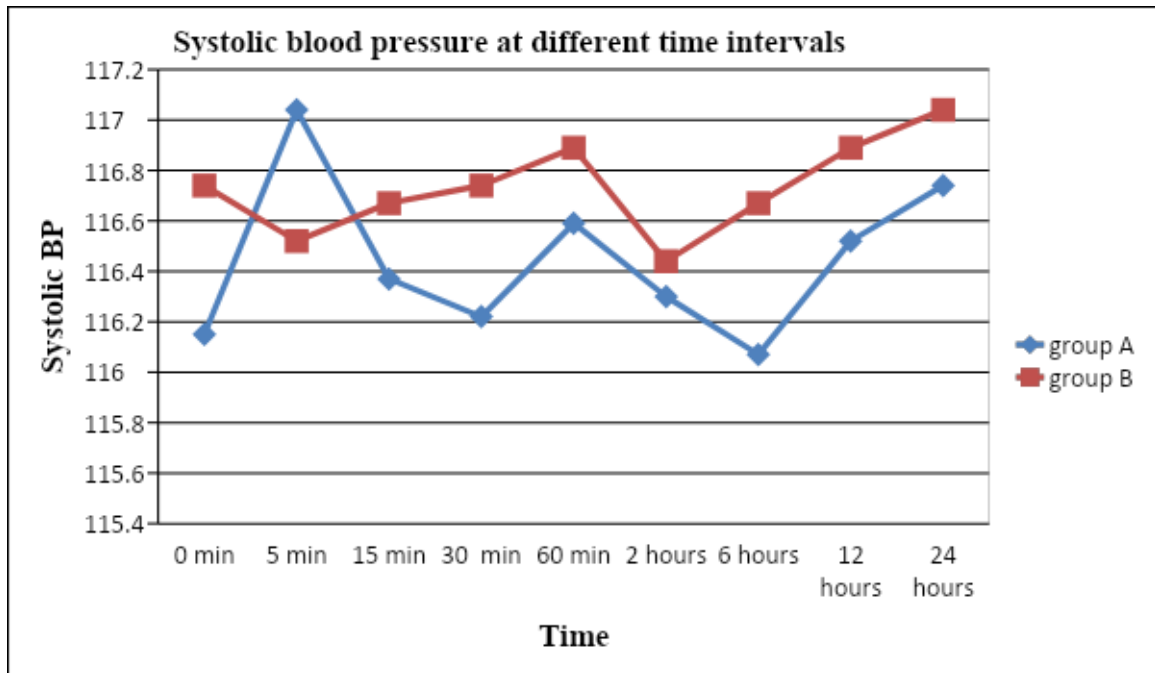


There was no statistically significant difference between Group A & Group B in Heart rate at different time intervals.

Systolic blood pressure at different time intervals between the treatment groups

Systolic blood pressure	Mean ± SD		p value	Significance
	Group A	Group B		
0 min	116.15±11.22	116.74±10.97	0.846	NS
5 min	117.04±10.35	116.52±10.56	0.848	NS
15 min	116.37±10.15	116.67±10.56	0.916	NS
30 min	116.22±10.34	116.74±10.83	0.815	NS
60 min	116.59±10.15	116.89±10.22	0.914	NS
2 hours	116.30±10.47	116.44±10.68	0.961	NS
6 hours	116.07±10.71	116.67±11.06	0.840	NS
12 hours	116.52±10.89	116.89±10.95	0.901	NS
24 hours	116.74±11.14	117.04±11.18	0.920	NS

Systolic blood pressure at different time intervals

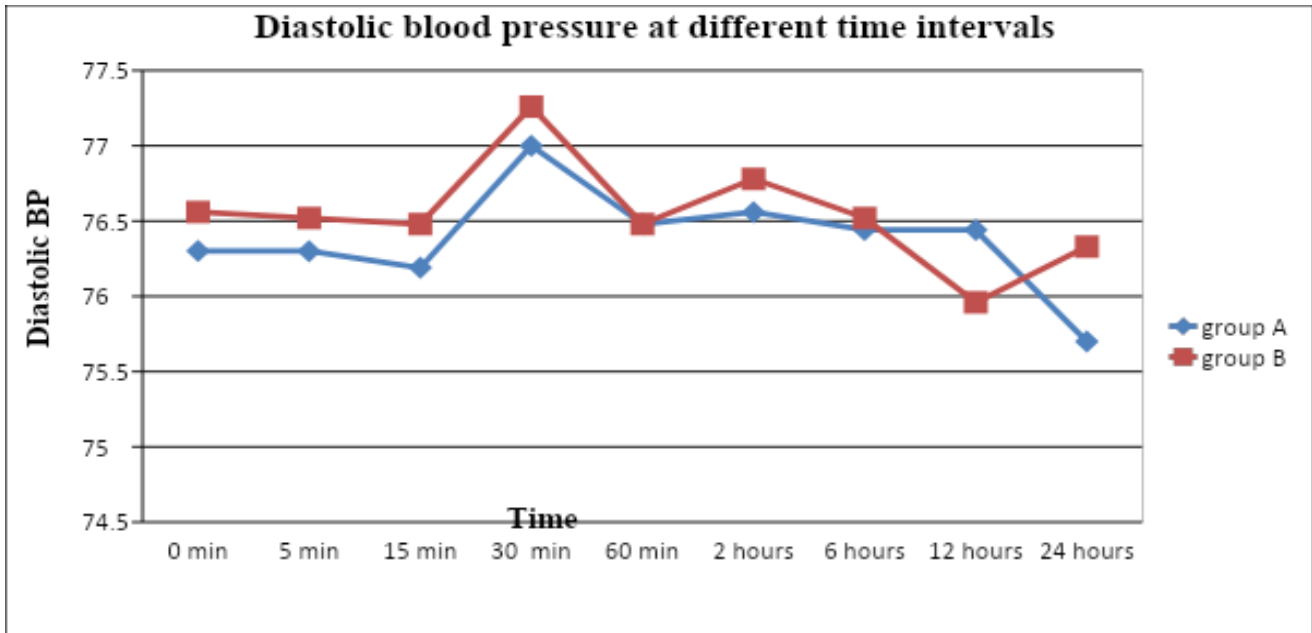


There was no statistically significant difference between Group A & Group B in systolic blood pressure at different time intervals.

Diastolic blood pressure at different time intervals between the treatment groups

Diastolic blood pressure	Mean ± SD		p value	Significance
	Group A	Group B		
0 min	76.30±6.99	76.56±7.16	0.893	NS
5 min	76.30±6.56	76.52±6.77	0.904	NS
15 min	76.19±6.49	76.48±6.57	0.871	NS
30 min	77.00±6.30	77.26±6.75	0.884	NS
60 min	76.48±6.47	76.48±6.63	0.870	NS
2 hours	76.56±6.62	76.78±6.69	0.904	NS
6 hours	76.44±6.92	76.52±6.93	0.966	NS
12 hours	75.70±6.07	75.96±6.23	0.877	NS
24 hours	76.22±6.24	76.33±6.36	0.949	NS

Diastolic blood pressure at different time intervals

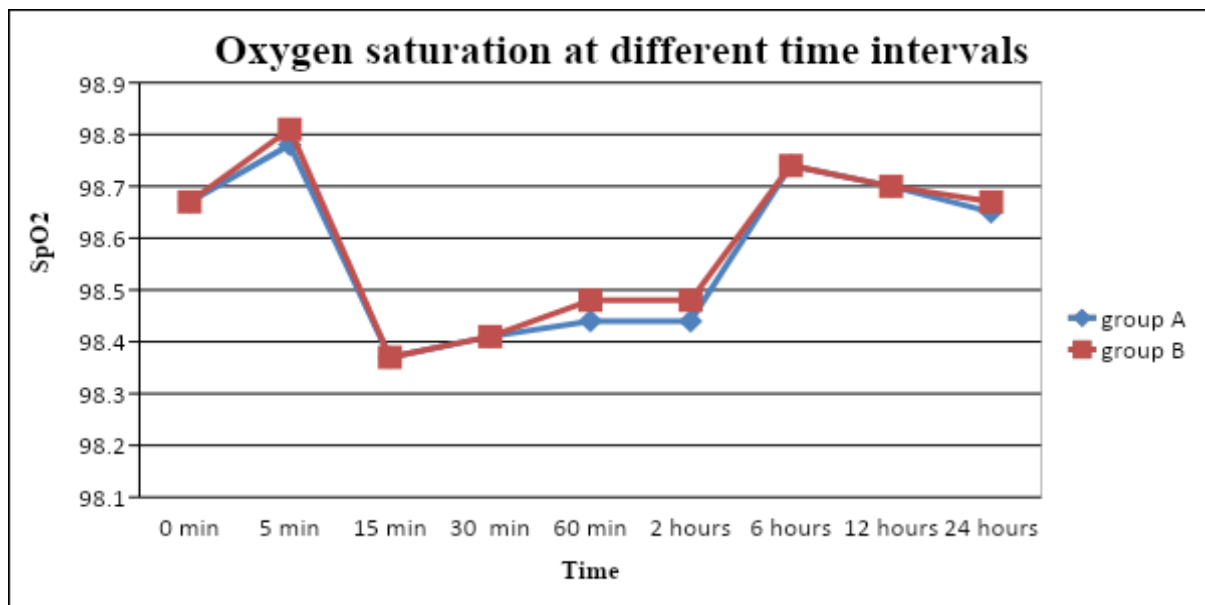


There was no statistically significant difference between Group A & Group B in systolic blood pressure at different time intervals.

Oxygen saturation at different time intervals between the treatment groups

SpO ₂	Mean ± SD		p value	Significance
	Group A	Group B		
0 min	98.67±0.48	98.67±0.48	1	NS
5 min	98.78±0.42	98.81±0.39	0.789	NS
15 min	98.37±0.49	98.37±0.492	1	NS
30 min	98.41±0.63	98.41±0.63	1	NS
60 min	98.44±0.50	98.48±0.50	0.773	NS
2 hours	98.44±0.50	98.48±0.50	0.773	NS
6 hours	98.74±0.44	98.74±0.44	1	NS
12 hours	98.70±0.46	98.70±0.46	1	NS
24 hours	98.65±0.49	98.67±0.49	1	NS

Oxygen saturation at different time intervals



Discussion

The present study was conducted in the Department of Anaesthesia and Critical care, Bokaro General Hospital, carried out during the study period from June 2018- May 2019, with principle aim to evaluate the effect of Dexamethasone added to Bupivacaine in supraclavicular brachial plexus block.

Regional nerve block can provide effective surgical anesthesia as well as postoperative analgesia. Moreover, regional nerve block avoids the unwanted effect of the anesthetic drugs used during general anesthesia and the stress of laryngoscopy and tracheal intubation. Supraclavicular brachial plexus block is a popular and widely employed regional nerve block technique for perioperative anesthesia and analgesia for surgery of the upper extremity. Local anesthetics alone for supraclavicular brachial plexus block provide good operative conditions but have shorter duration of postoperative analgesia. So various drugs like opioids, clonidine, neostigmine, Midazolam, etc. were used as adjuvant with local anesthetics in brachial plexus block to achieve quick, dense and prolonged block, but the results are either inconclusive or associated with side effects.

Glucocorticoids have powerful anti-inflammatory as well as analgesic property. Perineural injection of corticosteroid along with local anesthetics is reported to influence the onset and duration of sensory and motor block.

Study Characteristics

Sample Group

- A. A total of 60 patients fulfilling the inclusion criteria were selected who were undergoing surgery under supraclavicular block and were observed for the onset of sensory block, onset of motor block, duration of block, postoperative rescue analgesic requirement and the complications due to the block.
- B. 60 patients were randomly allocated to one of the group by computer generated

randomization table.

Group A(n = 30)-supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml (8mg) dexamethasone

Group B (n = 30)- supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml 0.9% normal saline.

Demographic Characteristics

Age Distribution

The patients who were accepted for the study were in age group 18-60 years. With reference to Table 1, there is no significant difference in age in Group A (30.30 ± 10.37) and Group B (31.04 ± 10.56).

Weight Distribution

Both the groups were compared for distribution of body weight. The apparent difference was not found to be significant in both groups with Group A (61.19 ± 5.12) and Group B (60.67 ± 5.41) referring to Table – 2.

Height Distribution

Both the groups were compared for distribution of height. The apparent difference was not found to be significant in both groups with Group A (161.48 ± 5.56) and Group B (160.70 ± 5.59) referring to Table 3.

Gender Distribution

Both the groups were found to be statistically similar. Group A, 63% patients were Male while 37% were Female and in Group B, 59% patients were Male and 41% patients were Female with reference to Table – 4. Apparent difference between the two patients group were found to be statistically insignificant.

ASA Grade

The apparent difference was not found to be significant in both groups. ($p = 0.551$) with reference to table – 5. 74% patients were ASA 1 and 26% patients were ASA 2 in Group A while 67% patients in group B were ASA 1 and 33% patients were ASA 2.

Duration of surgery

Both the groups were found to be statistically similar in view of duration of surgery. Duration of surgery was 118.67 ± 17.45 (minute) in group A and 119.56 ± 18.50 (minute) in group B with P value of 0.857.

Onset of Sensory Block

To determine the onset of sensory block we

performed our assessment at the sensory areas of the median, ulnar, radial and musculocutaneous nerves and found that the onset of sensory block was similar in two groups. According to table x onset time of sensory block was 18.26 ± 1.25 (minute) in dexamethasone group and it was 18.70 ± 1.26 minute in control group.

There is no significant difference clinically as well as statistically as the p value is 0.201

The above mentioned results were observed by following core studies which correlates with present study:

Study	Onset of Sensory Block (minutes)		P value	Inference
	A	B		
Parrington SJet al (2010) ⁹²	9 ± 5	10 ± 4	0.779	NS
Naveen Kumar et al(2014) ⁹⁵	6.46 ± 2.41	6.6 ± 3.40	0.79	NS
Shaheena Parveen et al (2015)	30.33 ± 5.31	28.20 ± 3.02	>0.05	NS

Movafegh et al in 2006 did a randomized double blind study for evaluating effect of dexamethasone on the onset and duration of action of lignocaine in axillary brachial plexus block and found the onset times of sensory and motor block were similar in the two groups.

Different from our study **Golwala M P et al, Yadav R K et al, Abu Nadeem et al, Nilesh Solanki et al** in their studies found earlier sensory block in local anesthetic plus dexamethasone group than in control group. This discrepancy may be due to differences in study methodology such

as use of varying methods of block assessment, higher dose of local anesthetic, higher concentration of local anesthetics and use of adjuncts like epinephrine.

Onset of motor Block

In our study as per Table – 7, the group A showed an onset time of 19.96 ± 1.28 min and Group B 20.26 ± 1.28 min.

There is no significant difference clinically as well as statistically as the p value is 0.402

The above mentioned results were observed by following core studies which correlates with present study

Study	Onset of motor block minute		P value	Inference
	A	B		
Parrington SJ et al (2010) ⁹²	8 ± 3	8 ± 3	0.846	NS
Shaheena Parveen et al (2015)	38.77 ± 4.26	38.70 ± 4.25	<0.05	NS

Different from our study **Golwala M P et al, Yadav R K et al, Abu Nadeem et al, Nilesh Solanki et al** in their studies found earlier motor block in local anesthetic plus dexamethasone group than in control group. This discrepancy may be due to differences in study methodology such as use of varying methods of block assessment, higher dose of local anesthetic, higher concentration of local anesthetics and use of adjuncts like epinephrine.

Duration of Sensory Block

According to table X, the duration of sensory block was 1091.11 ± 107.42 (minute) in group A whereas it was 605.37 ± 58.60 minute in control group. Thus the duration of sensory block was significantly longer in the group A which received dexamethasone as adjuvant (p value < 0.001)

There is significant difference clinically as well as statistically as the p value is < 0.001

The above mentioned results were observed by following core studies which correlates with present study

Study	Duration of Sensory block minute		P value	Inference
	A	B		
Shreshta BR et al (2007)	1028.17	453.17	< 0.001	S
Tandoc et al (2011)	1512±114	798±60	<0.05	S
Shaheena Parveen et al (2015)	1085.73±234.23	322.37±138.37	<0.001	S
N M Solanki et al (2017)	636.4±26.12	262.04±17.6	<0.001	S

Duration of Motor Block

According to table X, the duration of motor block was 846.67±102.09 (minute) in group A whereas it was 544.07±55.40 minute in control group. Thus the duration of motor block was significantly

longer in the group A which received dexamethasone as adjuvant (p value < 0.001)

There is significant difference clinically as well as statistically as the p value is < 0.001

The above mentioned results were observed by following core studies which correlates with present study

Study	Duration of motor block minute		P value	Inference
	A	B		
Shreshta BR et al (2007)	393	202.9	< 0.001	S
Tandoc et al (2011)	2352±234	1476±198	<0.05	S
Shaheena Parveen et al (2015)	510.00±125.36	352.33±91.60	<0.001	S
N M Solanki et al (2017)	463.2±35.20	251.4±18.68	<0.001	S

From the above discussion we have observed that in our study mean duration of sensory block (analgesia) and motor block in the dexamethasone group were 18.18 hours (1091.11 min) and 14.1 hours (846.67 min) respectively. While mean duration of analgesia and motor block in the dexamethasone plus bupivacaine group were 25.2 hours and 39.2 hours respectively, in the study by Tandoc MN et al.¹³ The median duration of sensory and motor block in the dexamethasone plus bupivacaine group were 24.28 hours and 22.9 hours respectively, in the study by Vieira PA et al.¹⁰ Longer duration of sensory and motor block found in these studies may be due to use of higher concentration (0.5%) and dose of bupivacaine and use of adjuncts like epinephrine and clonidine (in the study of Vieira PA et al.¹⁰).

Postoperative rescue analgesia requirement

In our study, we have observed that patients of group A (received dexamethasone) required significantly less number of diclofenac sodium injection in first 24 hours of postoperative period than the patients of group B (control).

This finding correlates with the studies of **Vieira PA et al**¹⁰, and **Tandoc MN et al.**¹³ and **Abu Nadeem et al.**

Reduced requirement of rescue analgesic in the dexamethasone group during first 24 hours of postoperative period is because of prolonged duration of sensory block (analgesia).

Complications

In present study there was no neurological complication following peripheral nerve blocks i.e., post block neuralgia in any of the group. None of our patient in the study showed any clinical evidence of pneumothorax. Other side effects like hematoma, signs and symptoms for local anesthetic toxicity, nausea, bradycardia, and hypotension were not significant in between the study groups.

We have used 38 ml 0.25 % bupivacaine (total dose = 95 mg) because the maximum dose of bupivacaine is 2 mg/kg and 30 – 50 mL volume of 0.25% - 0.5% bupivacaine has been recommended for brachial plexus block in the text book.¹⁶

The 8 mg dose of dexamethasone was chosen because it has been used previously for perineural injection and is within the dose range used clinically for postoperative nausea.¹²

The mechanism of action of dexamethasone in prolonging peripheral neural blockade is not clearly understood. The block effect may be due to its local action and not a systemic one.⁴⁴ In brief, the prolongation of duration of sensory and motor blockade after perineural administration of dexamethasone may be secondary to its local action on nociceptive C fibers mediated via membrane associated glucocorticoid receptors 3 and the up-regulation of the function of potassium channels in excitable cells.^{37,38}

The safety of dexamethasone use in a nerve sheath may raise some concerns. However, the use of dexamethasone at doses between 4 and 12 mg via the intravenous, perineural, and epidural route is described in regional anesthesia and pain medicine text books.¹¹ Reports of corticosteroid mediated neurotoxicity seem to be related to the vehicle polyethylene glycol and the preservative benzyl alcohol in steroid preparations as well as the presence of insoluble steroid particulate matter in the injectate.⁵¹ Dexamethasone sodium phosphate is a nonparticulate steroid and does not contain either polyethylene glycol or benzyl alcohol.⁵¹ In vivo and in vitro animal studies have demonstrated that locally applied corticosteroid have no long term effect on the structure, electrical properties, or function of the peripheral nerves⁵² and that the extrafascicular and intrafascicular injection of dexamethasone in a rat sciatic nerve experimental model caused no or minimal peripheral nerve damage, respectively when compared with other steroids such as hydrocortisone or triamcinolone.⁴⁵

Finally the frequency of unsuccessful blockade (8.3 %) encountered in the present study is comparable to previous studies using nerve stimulator guided approaches to supraclavicular brachial plexus blockade.^{50,53}

Summary

The present study was conducted in the Department of Anesthesia and Critical care, Bokaro General Hospital, carried out during study period from June 2018 to May 2019, with principle aim to to compare between supraclavicular brachial plexus block with bupivacaine plus dexamethasone and supraclavicular brachial plexus block with bupivacaine alone with respect to following variables:

- A. Onset time of sensory and motor blockade.
- B. Duration of sensory and motor blockade.
- C. Postoperative rescue analgesic requirement

The study population was randomized via computer generated software into two groups as under:-

Group A: (n = 30)-Supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml(8mg) dexamethasone

Group B : (n = 30)-Supraclavicular brachial plexus block is performed with 38 ml 0.25% bupivacaine and 2 ml 0.9% normal saline.

The Results Obtained are-

1. No statistically significant difference in the demographic parameters and duration of surgery between the two groups was noted.
2. The onset time of sensory and motor block were similar in the two groups.
3. The duration of sensory block and motor block were significantly longer in the dexamethasone (8 mg) group than in the control group (p value < 0.001).
4. Patients in the dexamethasone (8 mg) group required significantly less number of diclofenac sodium injection in first 24 hours of postoperative period than the patients in control group (p value < 0.001).
5. There was no significant difference in the incidence of side effects like hypotension, bradycardia, pneumothorax, horners syndrome, seizures in both the groups.

Conclusion

Regional anesthesia has much to offer for the patients, surgeons and anesthesiologists because of its inherent simplicity, preservation of consciousness, avoidance of airway instrumentation, rapid recovery and significant postoperative analgesia.

The supraclavicular block is one of the several techniques used to accomplish anesthesia of the brachial plexus. The block is performed at the level of the brachial plexus trunks where the majority of sensory, motor and sympathetic innervations of the upper extremity is carried in just three nerve structures confined to a very small surface area. Consequently, typical features of this block include rapid onset, predictable and dense anesthesia.

Perineural injection of glucocorticoid along with local anesthetic is reported to influence the onset and duration of sensory and motor block.

We, therefore, conclude that addition of 8 mg dexamethasone to bupivacaine 0.25% solution in supraclavicular brachial plexus block

- 1) Prolongs the duration of sensory and motor blockade.
- 2) Reduces the requirement of rescue analgesic in postoperative period.
- 3) Has no effect on the onset time of sensory and motor blockade.

Limitations of the Study

- 1) Further studies are needed to evaluate the optimal dose of dexamethasone to be used for prolonged brachial plexus block as well as the exact mechanism of this effect.
- 2) Only surgeries under supraclavicular block were chosen for this study.
- 3) Our results failed to demonstrate a significant association between the type of local anesthetic injected and the neurological outcome
- 4) Only ASA I & II patients were included in study. So, to extrapolate the findings of my study on general population further studies and reviews are required.

- 5) Older age group (>60 years) have been excluded from the study so effect of drug on older age group was not studied.
- 6) More than two local anesthetic might have been included in the study design to give more comparative data.

Recommendation

This study recommends use of Dexamethasone (8 mg) as an adjuvant to Bupivacaine in supraclavicular brachial plexus block as

- 1) It prolongs the duration of both motor and sensory blockade in upper limb orthopaedic surgeries.
- 2) It reduces the requirement of rescue analgesics in the post operative period.

Bibliography

1. Merskey H, AlbeFessard D, Bonica JJ, Carmon A, Dubner R, Kerr FWL, Lindblom U, Mumford JM, Nathan PW, Noordenbos W, Pagni CA, Renner MJ, Sternbach RA, Sunderland S. Pain terms: a list with definitions and notes on usage. Recommended by the IASP subcommittee on taxonomy. PAIN 1979;6:249–52.
2. Atkinson RS, Rushwan GB, Lee AJ. Regional technique. 10th ed. Synopsis of Anaesthesia 1987;31:593-4.
3. Raj PP. Historical aspects of regional anaesthesia. 1st ed In: Text Book Of Regional Anaesthesia 2002;1: 3
4. Paul JE et al. Anesthesiology 2010;113: 1144.
5. Shrestha BR, Maharjan SK, Shrestha S, Gautam B, Thapa C, Thapa PB et al. Comparative study between tramadol and dexamethasone as an admixture to bupivacaine in supraclavicular brachial plexus block. J Nepal Med Assoc 2007; 46(168):158-64.
6. Koller C: On the use of cocaine for producing anaesthesia on the eye. Lancet 2:990-994, 1884

7. Practical comments on the use and abuse of cocaine; suggested by its invariably successful employment in more than a thousand minor surgical operations. *New York Medical Journal*. 42: 294–5.
8. Anesthesia of nerve roots with cocaine. *Cleveland Medical Journal*. 2: 355.
9. Zuranästhesierung des plexus brachialis [On anesthesia of the brachial plexus]. *Zentralblattfür Chirurgie* (in German). 38: 1337–40
10. Nguyen HC, Fath E, Wirtz S, Bey T. Transscalene brachial plexus block: A new posterolateral approach for brachial plexus block. *AnesthAnalg*. 2007;105:872–5..
11. Golwala MP, Swadia VN, Dhimar AA, Sridhar NV. Pain relief by dexamethasone as an adjuvant to local anaesthetics in supraclavicular brachial plexus block. *J Anaesth Clin Pharmacol* 2009; 25(3):285-8.
12. Castillo J, Curley J, Hotz J, Uezono M, Tigner J, Chasin M, et al. Glucocorticoids prolong rat sciatic nerve blockade in vivo from bupivacaine microspheres. *Anesthesiology* 1996; 85:1157–66.
13. Stan T, Goodman EJ, Bravo-Fernandez C, Holbrook CR. Adding methylprednisolone to local anesthetic increases the duration of axillary block. *RegAnesth Pain Med* 2004; 29(4):380-1.
14. Shrestha BR, Maharjan SK, Tabedar S. Supraclavicular brachial plexus block with and without dexamethasone - A comparative study. *Kathmandu University Medical Journal* 2003; 1:158- 60.
15. Yadav RK, Sah BP, Kumar P, Singh SN. Effectiveness of addition of neostigmine or dexamethasone to local anaesthetic in providing perioperative analgesia for brachial plexus block: A prospective, randomized, double blinded, controlled study. *Kathmandu University Medical Journal* 2008; 6(23):302-9.
16. Movafegh A, Razazian M, Hajimaohamadi F, Meysamie A. Dexamethasone added to lidocaine prolongs axillary brachial plexus blockade. *AnesthAnalg* 2006; 102:263–7.
17. Vieira PA, Pulai I, Tsao GC, Manikantan P, Keller B, Connelly NR. Dexamethasone with bupivacaine increases duration of analgesia in ultrasound-guided interscalene brachial plexus blockade. *Eur J Anaesthesiol* 2010; 27(3):285-8.
18. Parrington SJ, Donnell DO, Chan VWS, Shreves DB, Subramanyam R, Qu M, et al. Dexamethasone added to mepivacaine prolongs the duration of analgesia after supraclavicular brachial plexus blockade. *RegAnesth Pain Med* 2010; 35:422-6.
19. Cummings KC, Napierkowski DE, Parra-Sanchez I, Kurz A, Dalton JE, Brems JJ, et al. Effect of dexamethasone on the duration of interscalene nerve blocks with ropivacaine or bupivacaine. *Br J Anaesth* 2011; 107(3):446-53.
20. Tandoc MN, Fan L, Kolesnikov S, Kruglov A, Nader ND. Adjuvant dexamethasone with bupivacaine prolongs the duration of interscalene block: a prospective randomized trial. *J Anesth* 2011; 25(5):704-709.
21. Hickey R, Garland TA, Ramamurthy S. Subclavian Perivascular Block: Influence of location of paresthesia. *AnesthAnalg* 1989;68:767-71.
22. Kotani N, Kushikata T, Hashimoto H, Kimura F, Muraoka M, Yodono M, et al. Intrathecal methylprednisolone for intractable postherpetic neuralgia. *N Engl J Med*. 2000; 343(21):1514-9.
23. Naveen Kumar. “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 2014; Vol. 3, Issue 58, November 3; Page: 13111-13119.
24. Parveen S, Jan M, Taj A, Bhat AA. Effect of dexamethasone as an adjuvant with bupivacaine in ultrasound guided single shot supraclavicular brachial plexus block in upper extremity surgeries- a prospective randomized study. *International Journal Respiratory Medical Sciences* 2017;5:2139-43
25. Nadeem A, Varshney VK, Haleem S, Singh A. A Comparative Evaluation Of Dexamethasone As An Adjunct To Bupivacaine And Levobupivacaine For Supraclavicular Brachial Plexus Block Using Peripheral Nerve Stimulator. *Ann. Int. Med. Den. Res.* 2018; 4(1):AN01-AN06.
26. Solanki NM, Garg A, Kavadi SD, Rathod A. Comparative study of supraclavicular brachial plexus block with or without dexamethasone. *Indian Anaesth Forum* 2017;18:56-62
27. Collins VJ. *Principles of Anesthesiology. General and regional anesthesia.* 3rd ed. Philadelphia: Lea and Febiger; 1993. p. 1363-1383.
28. Reynolds F. Adverse effects of local anaesthetics. *Br. J. Anaesth* 1987; 59:78 – 95.
29. Berde CB, Strichartz GR. Local Anesthetics. In: Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL, editors. *Miller's Anesthesia.* 7th ed. Philadelphia: Churchill Livingstone Elsevier; 2010. p. 913-36.
30. Woolf CJ, Chong MS. Preemptive analgesia — treating postoperative pain by preventing the establishment of central sensitization. *Anesth Analg* 1993; 77:362–379.
31. Basbaum AI, Jessel TM. The perception of pain. In: Kandel ER, Schwartz JH, Jessel TM, eds. *Principles of Neural Science.* New York: McGraw-Hill; 2000. p. 472–491.
32. Dray A. Pharmacology of peripheral afferent nerve terminals. In: Yaksh TL, Lynch C, Zapol WM, et al, editors. *Anesthesia: Biologic Foundations.* Philadelphia: Lippincott-Raven; 1997. p. 543–556
33. Colin J. L. McCartney and Stephen Choi. *Analgesic Adjuvants in the Peripheral Nervous System ;Hadzić's Textbook Of Regional Anesthesia And Acute Pain Management* second edition; p.147-148.
34. Ekenstein B, Egner B, Patterson GN. Alkyl pyrrolidine and N-alkyl piperidine carboxylic acid amines. *Acta Chem Scand.* 1957; 2: 1183-6.
35. Telivuo LA. New long acting local anesthetic solution for pain relief after thoracotomy. *Ann. Chir. Gynaec. Fenn.* 1963; 52: 573-6.
36. Hollmen A, Axillary plexus block . A double blind study of 59 cases using mepivacaine and LA 43 (marcaine). *Acta Anaesth Scand .* 1966; 21: 54-8.
37. Klein SM, Greengrass RA, Steele SM, et al: A comparison of 0.5% bupivacaine, 0.5% ropivacaine, and 0.75% ropivacaine for interscalene brachial plexus block. *Anesth Analg* 1998; 87:1316-20.
38. Ghoneim MM, Pondya H: Plasma Protein binding of bupivacaine and its interaction with other drugs in man. *Br J Anaesth* 1974; 46: 435-8.
39. Clarkson CW, Hondeghem LM. Mechanism for bupivacaine depression of cardiac conduction: Fast block of sodium channels during the action potential with slow recovery from block during diastole. *Anesthesiology* 1985; 62:396-405.
40. Block A, Covino B: Effect of local anesthetic agents on cardiac conduction and contractility. *Reg Anesth* 1982; 6:55-9.

41. Chamberlain BK, Volpe P, Fleischer S: Inhibition of calcium-induced calcium release from purified cardiac sarcoplasmic reticulum vesicles. *J BiolChem* 1984; 259:7547-53.
42. De Jong RH, Ronfeld RA, DeRosa RA: Cardiovascular effects of convulsant and supraconvulsant doses of amide local anesthetics. *AnesthAnalg* 1982; 61:3-9.
43. Kotelko DM, Shnider SM, Dailey PA, et al: Bupivacaine-induced cardiac arrhythmias in sheep. *Anesthesiology* 1984; 60:10-18.
44. Morishima HO, Pedersen H, Finster M, et al. Bupivacaine toxicity in pregnant and nonpregnant ewes. *Anesthesiology* 1985; 63:134-9.
45. Rosen MA, Thigpen JW, Shnider SM, et al. Bupivacaine-induced cardiotoxicity in hypoxic and acidotic sheep. *AnesthAnalg* 1985; 64:1089-96.
46. Weinberg G: Lipid rescue resuscitation from local anaesthetic cardiotoxicity. *Toxicological Reviews* 2006; 25:139-45.
47. Schimmer BP, Parker KL. Adrenocorticotrophic hormone; Adrenocortical Steroids and their synthetic analogs and actions of Adrenocortical hormones. In: Brunton LL, Lazo JS, Parker KL, editors. *Goodman & Gilman's the Pharmacological basis of Therapeutics*. 11th ed. New York: McGraw-Hill; 2006.
48. Tasker JG, Di S, Malcher-Lopes R. Minireview: Rapid Glucocorticoid Signaling via Membrane-Associated Receptors. *Endocrinology* 2006; 147(12): 5549-56.
49. Norman AW, Mizwicki MT, Norman DP. Steroid-hormone rapid actions, membrane receptors, and a conformational ensemble model. *Nat Rev Drug Discov* 2004; 3:27-41.
50. Tripathi KD. *Essentials of Medical Pharmacology*. 6th ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2008. p. 275-87.
51. Johansson A, Hao J, Sjölund B. Local corticosteroid application blocks transmission in normal nociceptive C-fibres. *ActaAnaesthesiolScand* 1990; 34:335-8.
52. Devor MD, Gorvin-Lippmann R, Raber P. Corticosteroids suppress ectopic neural discharge originating in experimental neuromas. *Pain* 1985; 22:127-37.
53. Takimoto K, Levitan ES. Glucocorticoid induction of Kv1.5 K⁺ channel gene expression in ventricle of rat heart. *Circ Res* 1994; 75:1006-13.
54. Attardi B, Takimoto K, Gealy R, Severns C, Levitan ES. Glucocorticoid induced up-regulation of a pituitary K⁺ channel mRNA in vitro and in vivo. *Receptors Channels* 1993; 1:287-93.
55. Wang JJ, Ho ST, Tzeng JI, et al. The effect of timing of dexamethasone administration on its efficacy as a prophylactic antiemetic for postoperative nausea and vomiting. *AnesthAnalg* 2000; 91:136-9.
56. Elhakim M, Ali NM, Rashed I et al. Dexamethasone reduces post-operative vomiting and pain after pediatric tonsillectomy. *Can.J.Anaesth* 2003; 50; 392-97.
57. Haddox JD. Lumber and cervical epidural steroid therapy. *Anesth Clin North Am* 1992; 10:179-203.