



Original Research Article

Efficacy of dexamethasone vs dexmedetomidine as an adjuvant for brachial plexus block- A randomised control trial

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ABSTRACT

Background: The brachial plexus block is an easy and relatively safe procedure for upper limb surgeries though there are different approaches to it, it is a block of roots, divisions and cords of the brachial plexus, out of which supraclavicular approach is most widely used method for anaesthesia and preoperative pain management in surgery below shoulder joint. It is performed at the trunk level where the plexus is presented most compactly. Another advantage is that it can be performed with the patient's arm in any position to provide excellent anaesthesia for elbow, forearm and hand surgery.

Various local anaesthetic agents are used for Brachial Plexus Block but most commonly used drugs are; Bupivacaine, and Lignocaine. Bupivacaine is long acting whereas Lignocaine is short acting drug. Novel adjuncts studied to date include butorphanol, buprenorphine, dexamethasone, Clonidine, Neostigmine, Tramadol, Midazolam, Dexmedetomidine etc.

Dexmedetomidine is an anxiolytic sedative and analgesic agent, it is a selective α_2 – adrenoreceptor agonist and is approximately 8 times more potent than clonidine. It was superior to clonidine also in quality for anesthesia in tourniquet tolerance, and postoperative analgesia and it is notable for its ability to provide sedation without risk of respiratory depression and can provide cooperative or semi arousable sedation.

The mechanism by which α_2 adrenergic receptor agonists produce analgesia is likely to be multifactorial. Peripherally α_2 adrenergic agonists produce analgesia by reducing the release of norepinephrine and α_2 receptor independent inhibitory effect on nerve fibre action potential.

Recent pre-clinical and clinical studies show that the glucocorticoid dexamethasone appears to be effective as adjuvant to local anesthetics since it possesses anti-inflammatory and analgesic properties. In addition, perineural injection of steroid does influence post operative analgesia. This study was done to compare the adjuvant effect of dexamethasone and dexmedetomidine, when added with local anesthetics in Supraclavicular brachial plexus block.

Materials and Methods: It was a prospective randomized control trial conducted for 18 months in LLR hospital Kanpur. 90 patients of ASA grade 1 and 2 aged more than 18 yrs of either sex were included and Thirty patients were randomly divided in each of the three groups and observations were made regarding hemodynamic changes such as HR, MAP, SPO2 and onset of sensory, motor block and duration of motor, sensory effect. Student t test and analysis of variance were the methods used for analysis.

Result: Additions of injection dexamethasone and injection dexmedetomidine with lignocaine markedly prolonged duration of sensory and motor block however duration of injection dexmedetomidine was found to be longer as compared to dexamethasone.

Conclusion: Dexmedetomidine has longer duration of motor and sensory effect when used as an adjuvant as compared to dexamethasone.

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1. Introduction

Peripheral nerve block is a suitable alternative to general anesthesia in certain patients. The peripheral nerve block may be used for surgical anesthesia alone or, in conjunction with general anesthesia and for acute and chronic pain management.

Brachial plexus block is an easy, safe method for upper limb surgeries it is block of roots, divisions and cords of brachial plexus, out of which supraclavicular approach is widely used method for anaesthesia and preoperative pain management in upper limb surgeries. It is performed at the trunk level where the plexus are most compact. Another advantage is that it can be performed with the patient's arm in any position to provide excellent anaesthesia for elbow, forearm and hand surgery.

Most commonly used drugs are; Bupivacaine, and Lignocaine. Bupivacaine is longer acting than Lignocaine. Novel adjuncts studied to date include Butorphanol, buprenorphine, dexamethasone, alpha 2 adrenergic agonist, Neostigmine, Tramadol, Midazolam, Dexmedetomidine etc.

Dexmedetomidine is an anxiolytic sedative and analgesic agent. It is a selective α_2 – adrenoceptor agonist and is approximately 8 times more potent than clonidine. It is superior to clonidine also in quality for anesthesia in tourniquet tolerance, and postoperative analgesia and Dexmedetomidine is notable for its ability to provide sedation without risk of respiratory depression and can provide conscious sedation.

The mechanism of action alpha 2 adrenergic agonist is multifactorial. Peripherally α_2 adrenergic produce analgesia by reducing the release of norepinephrine and α_2 receptor independent inhibitory effect on nerve fibre action potential.

Recent clinical studies show that the dexamethasone appears to be effective as adjuvant to local anesthetics. This study was done to study the adjuvant effect of dexamethasone when added with local anesthetics in Supraclavicular brachial plexus block. Dexamethasone is very potent and highly selective glucocorticoid. Basically it is used as anti-inflammatory as well as analgesic properties. 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.

2. Materials and Methods

This was a prospective randomized double blinded study conducted for 18 months in LLR hospital Kanpur after obtaining approval from institutional ethical committee. Informed consent was taken from all the patients. 90 patients of age above 18 yrs, of female sex and ASA grade I & II

were selected. 30 patients each were randomly divided into each of the following 3 groups.

Group A (n=30): lignocaine (1.5%) with adrenaline (1:200000) (24ml)

Group B (n=30): lignocaine (1.5%) with adrenaline (1:200000) + dexmedetomidine $1\mu\text{g}/\text{kg}$ (24ml)

Group C (n=30): lignocaine (1.5%) with adrenaline (1:200000) + dexamethasone (4mg) (24ml)

2.1. Inclusion criteria

1. Age >18 yrs
2. Patients in ASA I & ASA II
3. Patients undergoing elective lower arm, forearm and hand surgeries.

2.2. Exclusion criteria

1. Patients not giving consent
2. Patient having HIV, HbsAg & HCV infection
3. Patients with Hb < 7% g/l
4. Patients having any bleeding disorders
5. Infection at anatomical site of needle insertion

2.3. Investigations

1. Complete hemogram
2. Blood coagulation profile
3. Renal functional test
4. Liver functional test
5. ECG
6. Serum electrolyte
7. Random blood sugar

2.4. Statistics

Sample size was calculated using power of the study. Based on means and standard deviations of similar studies the power of the study was calculated. With power of 95% & α error of 0.05% the sample size was 25.

Statistical significant difference in the means between the groups was calculated. Statistical tests applied: Student unpaired t test & Anova test

2.5. Comparison of mean arterial pressure (mmHg)

In Group A preoperative Mean Arterial Pressure 5 minute after block, 30 min, 1hr, 2hr and 4hr was 117.78 ± 8.81 , 115.39 ± 7.07 , 114.04 ± 8.03 , 114.71 ± 6.21 and 113.46 ± 5.48 respectively. Similarly, in Group B and Group C Mean Arterial Pressure were 120.48 ± 6.11 , 112.18 ± 3.59 , 110.92 ± 3.78 , 109.77 ± 3.47 , 112.81 ± 2.63 and 119.14 ± 5.08 , 118.75 ± 4 , 118.07 ± 3.42 118.71 ± 3.32 , 118.39 ± 2.72 .

T test showed the difference in mean arterial pressure in different groups as compared with the preoperative value was found to be statistically insignificant ($p > 0.05$).

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Table 1: Blood pressure (mmHg)

Time	Group A		Group B		Group C		A vs C		A vs B		B vs C	
	Mean 1	SD 1	Mean 3	SD 3	Mean 2	SD 2	T	P	T	P	T	P
Baseline	117.51	11.41	122.03	6.11	119.64	5.88	0.87	>0.05	1.84	0.05	1.47	>0.05
5 min	117.78	8.81	120.48	5.32	119.14	5.08	0.7	>0.05	1.38	>0.05	0.95	>0.05
10 min	116.42	8.45	115.03	4.51	119.28	4.75	1.56	>0.05	0.76	>0.05	3.4	<0.01
30 min	115.39	7.07	112.88	3.59	118.75	4	2.18	<0.05	1.66	>0.05	5.73	<0.001
60 min	114.07	8.03	110.92	3.78	118.07	3.42	2.42	<0.05	1.87	>0.05	7.34	<0.001
90 min	113.1	7.14	109.74	3.78	118.5	4.13	3.46	<0.01	2.19	<0.05	8.21	<0.001
2 hr	114.71	6.21	109.77	3.47	118.71	3.32	3	<0.01	3.65	<0.01	9.75	<0.001
3 hr	113.67	6.11	110.63	2.2	118.53	3.85	3.56	<0.01	2.47	<0.05	9.38	<0.001
4 hr	113.46	5.48	112.81	2.63	118.39	3.1	4.14	<0.01	0.56	>0.05	7.2	<0.001
6 hr	112.85	5.96	114.59	2.93	117.82	3.33	3.85	<0.01	1.38	>0.05	3.82	<0.01
8 hr	112.42	5.2	117.25	2.04	118.39	2.72	5.38	<0.001	4.56	<0.001	1.76	>0.05
12 hr	113.32	4.24	118.55	1.71	118.89	3.32	5.47	<0.001	6.03	<0.001	0.47	>0.05

Table 2: Heart rate (bpm)

	Group A		Group B		Group C		A vs C		A vs B		B vs C	
	Mean 1	SD 1	Mean 3	SD 3	Mean 2	SD 2	T	P	T	P	T	P
Baseline	90.1	10.49	92.81	7.42	85.14	7.37	2.04	<0.05	1.1	>0.05	3.84	<0.01
5 min	89.42	8.49	91.81	5.82	86.28	7.2	1.49	>0.05	1.22	>0.05	3.13	<0.01
10 min	86.53	6.1	86.14	5.67	86.53	7.07	0	>0.05	0.24	>0.05	0.22	>0.05
30 min	85.82	7.25	83	5.94	84.5	6.65	0.7	>0.05	1.58	>0.05	0.88	>0.05
60 min	85.14	5.8	80.81	5.68	84.6	6.98	0.31	>0.05	2.79	<0.05	2.21	<0.05
90 min	82.85	6.26	80.44	5.41	84.85	6.85	1.14	>0.05	1.52	>0.05	2.65	<0.05
2 hr	82.75	5.94	81.55	5.62	84.78	7.58	1.11	>0.05	0.76	>0.05	1.79	>0.05
3 hr	84.46	6.77	83.22	5.23	85.14	7.37	0.35	>0.05	0.76	>0.05	1.11	>0.05
4 hr	83.25	5.99	85.44	4.76	84.96	6.95	0.98	>0.05	1.5	>0.05	0.29	>0.05
6 hr	83.42	5.71	88.07	4.83	84.92	7.29	0.85	>0.05	3.26	<0.01	1.89	>0.05
8 hr	84.5	7.29	90.81	3.41	85.5	7.23	0.51	>0.05	4.13	<0.001	3.5	<0.001
12 hr	84	5.95	93	4.54	85.57	6.93	0.9	>0.05	6.32	<0.001	4.71	<0.001

2.5.1. Effect on heart rate (bpm)

In Group A preoperative Mean Heart Rate 5 minute after block, 30 min, 1hr, 2hr and 4hr is 89.42 ± 8.94 , 85.82 ± 7.25 , 85.14 ± 5.8 , 83.27 ± 5.99 respectively. Similarly in group B and group C Heart Rate were 91.81 ± 5.82 , 83 ± 5.94 , 80.81 ± 5.68 , 81.55 ± 5.62 respectively and 86.28 ± 7.2 , 84.5 ± 6.65 , 84.6 ± 6.98 , 84.75 ± 5.95 , 83.25 ± 5.99 respectively Paired T TEST SHOWED the difference in Mean Heart Rate in different groups as compared with the preoperative value was found to be statistically insignificant.

3. Discussion

Yadav RK et al (2008) studied that ninety patients were randomized in three groups and received 24 ml of study drugs. The group A [Lignocaine with adrenaline (1.5%)], group B [Lignocaine with adrenaline (1.5%)] +500 microg Neostigmine, and group C (Lignocaine with adrenaline (1.5%) +4 mg Dexamethasone) for brachial plexus block through supraclavicular approach. The observed parameters were onset of analgesia, completion of sensory and motor blockade, Duration of analgesia, Surgeon's score, side effects, number of supplemental analgesics doses and Visual analogue scale (VAS) score for pain in 12 hour of post-operative period. The weight of the patient in the present study ranged from 48 to 75 kgs. All

Table 3: Onset of sensory block

Group	A			C			t	P
	N	Mean (Min)	SD	N	Mean (Min)	SD		
A vs C	28	15.55	0.64	27	11.89	1.26	13.5	<0.001
A vs B	28	15.55	0.64	28	11.65	1.05	16.78	<0.001
C vs B	27	11.89	1.26	28	11.65	1.05	0.76	>0.05

The Mean & Standard deviation of onset of sensory block the group A vs C and A vs B is statistically significant ($p < 0.001$)

Table 4: Onset of motor block

Group	A			C			t	P
	N	Mean (Min)	SD	N	Mean (Min)	SD		
A vs C	28	18.11	0.81	27	14.65	1.56	10.26	<0.001
A vs B	28	18.11	0.81	28	14.18	0.92	60.13	<0.001
C vs B	27	14.65	1.56	28	14.18	0.92	30.17	<0.001

The mean & Standard deviation of onset of motor block the group A vs C, A vs B C vs B is statistically significant ($p < 0.001$)

Table 5: Duration of sensory block

Group	A			C			t	P
	N	Mean (Min)	SD	N	Mean (Min)	SD		
A vs C	28	166.17	14.69	27	352.59	32.11	51.43	<0.001
A vs B	28	166.17	14.69	28	321.25	13.59	41	<0.001
C vs B	27	352.59	12.11	28	211.25	13.59	9.03	<0.001

The mean & Standard deviation of duration of sensory block the group A vs C, A vs B and C vs B is statistically significant ($p < 0.001$)

Table 6: Duration of motor block

Group	A			C			t	P
	N	Mean (Min)	SD	N	Mean (Min)	SD		
A vs C	28	137.17	15.31	27	276.48	16.18	32.77	<0.001
A vs B	28	137.17	15.31	28	285.35	22.35	28.94	<0.001
C vs B	27	276.48	16.18	28	285.35	22.35	1.69	>0.05

The mean & Standard deviation of duration of motor block the group A vs c and A vs b is statistically significant ($p < 0.001$).

the patients were weight wise evenly distributed in all the three groups. Though patients were selected randomly it was observed that out of 90 patients, 70 patients (77.77%) were males as compared to 20 patients (22.22%) who were females. It is again evident that males are more prone to accidents in comparison to females. In the present study we have used 1.5% lignocaine with adrenaline (1:200000) 24 ml as a fixed dose for the patients. Identical amount of drug used in study done by Yadav RK, Sah BP, Kumar P, Singh SN, 2008. We have limited the volume 24 ml because this amount was sufficient clinical effect and less chance of achieving toxic blood level.¹

The Pulse rate, mean arterial pressure and saturation were recorded perioperative period. Any episode of hypotension (20% decrease in mean arterial pressure in relation to baseline values), bradycardia (<50 beat/min) and hypoxemia (<90%). The pulse rate and mean arterial pressure was lower in Group B compared with Group A and Group C. however, no episode of hypotension and bradycardia was reported. Esmaoglu et al reported that the addition of 100ug dexmedetomidine to 0.5% levobupivacaine caused bradycardia in 7 of 30 patients. In the present study, no

episode of bradycardia was noted. This may be because we used a smaller dose of dexmedetomidine. Similarly, other studies using a similar dose of dexmedetomidine found no episode of hypotension or bradycardia in patients receiving dexmedetomidine.¹

Schnabel et al (2018) in a meta-analysis demonstrated that Dexmedetomidine in combination with local anaesthetics increases postoperative analgesia for around 5 h. However, there are higher risks of intraoperative hypotension and bradycardia. Findings on side effects are associated with high uncertainty. Initial evidence suggests no difference in the duration of analgesia associated with systemic or perineural Dexmedetomidine.²

The onset of sensory effect was assessed by pin prick test the mean onset time of sensory block was 15.55±0.64, 11.65±1.05 and 11.89±1.26 in group A, group B and group C respectively. Statistically A vs C and A vs B are highly significant ($p < 0.001$) and C vs B is non significant however, sensory onset is delayed in group C as compared to group B.²

Pani N et al (2017) reported that the onset of sensory and motor block was faster in normal saline group when

compared to dexamethasone group. The mean duration of sensory and motor block was significantly longer in Group D than Group S. They concluded that the addition of dexamethasone to levobupivacaine in SCBP blockade prolonged time for first rescue analgesia and reduced the requirement of rescue analgesics with faster onset and prolonged duration of sensory and motor block. Hamed MA et al (2018) stated that the onset time of sensory and motor blockade was shortened and the duration of the block was significantly prolonged in the D(dexmedetomidine) Group ($P < 0.001$) and F (fentanyl) Group ($P < 0.001$). The duration of postoperative analgesia was also longer in the D (dexmedetomidine) Group 13.5 h compared with the F Group 8.3 h and C Group 7.5 h. Hypotension and bradycardia were recorded in 2 patients in D Group, and nausea and vomiting were recorded in F Group.³

The mean duration of sensory block in group A, group B and group C were found to be 166.17+14.69, 321.25+13.59 and 352.59+12.11 minutes respectively statistically A vs C, A vs B and C vs B are highly significant ($p < 0.001$) however duration of sensory block is more in Group C as compared group B and group A as found in study of Hamed MA et al (2018) stated that the onset time of sensory and motor blockade was shortened and the duration of the block was significantly prolonged in the D Group ($P < 0.001$) and F Group ($P < 0.001$). The duration of postoperative analgesia was also longer in the D Group 13.5 h compared with the F Group 8.3 h and C Group 7.5 h. Hypotension and bradycardia were recorded in 2 patients in D Group, and nausea and vomiting were recorded in F Group. Pani N et al (2017) reported that Time for request of the first rescue analgesia was 396.13 ± 109.42 min in Group S and 705.80 ± 121.46 min in Group D ($P < 0.001$). The requirement for rescue analgesics was more in Group S (narmol saline) when compared to Group D(dexamethasone).³

Elzayyat NS et al (2014) showed that adding dexmedetomidine to intrathecal bupivacaine prolonged the sensory blockade duration by 38% compared with bupivacaine alone, although the sensory blockade duration was prolonged by 23% when adding dexamethasone to intrathecal bupivacaine. The cost effectiveness of dexmedetomidine versus dexamethasone is an issue of conflict, as tangible cost of dexmedetomidine is higher.⁴

Bharti et al 2015 concluded that addition of dexmedetomidine to ropivacaine –lidocaine prolonged the duration of brachial plexus block and improved postoperative analgesia.⁵

Faraj W Abdallah et al 2016 suggested that dexmedetomidine prolong the duration of analgesia when administered in conjunction with peripheral nerve block.⁶

Jithendra Chinappa et al 2017 concluded that perineural dexmedetomidine with ropivacaine provide prolonged analgesia, hastens the onset of sensory and motor block and prolongs the duration of brachial plexus block.⁷

4. Conclusion

1. Brachial plexus block via supraclavicular approach with 1.5% 24 ml Lignocaine provide ideal surgical condition and intense analgesia upto a period of three hours.
2. Addition of inj Dexamethasone and inj dexmedetomidine with lignocaine markedly prolonged duration of sensory and motor block. However, duration of inj dexmedetomidine is more prolonged as compared to inj dexamethasone.
3. Addition of inj Dexamethasone and inj dexmedetomidine with lignocaine markedly decreases the onset of sensory and motor block. However, onset of inj dexmedetomidine is before inj dexamethasone
4. Rescue analgesia required in plain lignocaine with adrenaline groups was between 2 to 3 hr, in dexamethasone group in between 5 to 6 hr and in dexmedetomidine groups in between 6 to 7 hr.
5. There was no hemodynamic instability in any patient in all three groups at any time interval.

5. Source of Funding

None.

6. Conflict of Interest

None.

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