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Evaluation of the Efficacy of Postoperative Analgesia of Ropivacaine with and Without the Addition of Adjuvant Dexamethasone in Brachial Plexus Block

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Abstract
Use of an interscalene block as the primary anesthetic modality enhances the number of patients that are fit for orthopedic surgery and reduces the immediate postoperative pain. In spite of all the above said, the enhanced post operative analgesia is short lived and the use of the brachial plexus block has not been shown to improve pain scores beyond 24 hours postoperatively. The study was conducted on 60 patients undergoing upper limb surgeries under brachial plexus block. Patients were randomly divided into two groups. Group RD (n=30) was given block with 30ml of 0.5% Ropivacaine +2ml dexamethasone (8mg). Group R (n=30) was given block with 30ml of 0.5% Ropivacaine +2ml Saline. The mean time for Onset of the motor block was 6.66±1.26 minutes in group-RD and 6.88± 0.84 minutes in group-R (P >0.05) and thus statistically not significant. The total duration of Post-Operativeerative analgesia was 21.2 ±3.23 hrs in group RD and 10.24±1.57hrs. In group R, the p value being < 0.001. Thus total duration of post operative analgesia was significantly longer in group RD patients compared to group R patients.

INTRODUCTION

The post operative pain following the orthopedic surgery can be severe 1and, managing this type of pain following shoulder procedures is a challenge to both anesthetists and the orthopedicians. In an attempt to offer better post operative analgesia and smooth the post operative progress of patient in terms of mobilization, regional anesthesia by way of the brachial plexus is frequently used either as an addition to general anesthesia or as the primary anesthetic modality[1].

The brachial plexus of nerves arises from the ventral rami of C5 to T1 (with variable contributions from C4 and T2) and travels between the anterior and middle scalene muscles, ultimately providing sensory and motor innervation to the shoulder, arm, and hand. The upper elements of the plexus (innervating the shoulder and part of the arm) are more superficial and are readily accessible for deposition of local anesthetic in the interscalene area[2].

Use of an interscalene block as the primary anesthetic modality enhances the number of patients that are fit for orthopedic surgery and reduces the immediate postoperative pain. In spite of all the above said, the enhanced post operative analgesia is short lived and the use of the brachial plexus block has not been shown to improve pain scores beyond 24 hours postoperatively. Numerous studies have evaluated the role of perineural catheters as a way to offer continuous brachial plexus pain relief. Such catheters are placed in the perioperative period and then left in place for several days to provide a continuous supply of local anesthetic to the nerves but secondary block failure can occur as a result of disconnection, and equipment troubleshooting. Furthermore, outpatient use of indwelling peripheral nerve catheters is potentially associated with infectious complications and unrecognized local anesthetic toxicity, although neither concern has yet been substantiated. Patients undergoing shoulder procedures with single-injection interscalene blocks are frequently hospitalized overnight due to inadequate pain relief after resolution of their blocks[3].

For 0.5% ropivacaine or bupivacaine, the usual local anesthetics, previous studies report an average analgesic duration of 11 hours without epinephrine and approximately 12 hours with epinephrine. Newer local anaesthetics with minimal cardiovascular effects and longer duration of action have been developed[4]. Consequently, a method of prolonging analgesia from a brachial plexus block without the extra cost and logistical difficulties of indwelling catheters would benefit both patients and their caregivers. One promising approach is use of adjuvant drugs that prolong block duration when added to the local anesthetic. Many drugs have been studied as adjuvants for single-injection regional anesthetic techniques[5].

Dexamethasone is very potent and highly selective glucocorticoid. Basically it is used as anti-inflammatory and immunosuppressant. Its potency is about 40 times that of hydrocortisone. Clinical Uses of Dexamethasone are for treatment of many inflammatory and autoimmune conditions but Glucocorticoid are also used to treat patients suffering from neuropathic pain and complex regional pain syndromes (CRPS). So, steroids have anti-inflammatory as well as analgesic effects[6]. There are very few studies that have compared Dexamethasone with efficacy of ropivacaine 0.5%, compared to ropivacaine 0.5% and Dexamethasone(8mg) for brachial plexus block is routinely administered for upper limb surgery.

MATERIALS AND METHODS

Study Design: Double blinded randomized controlled trial

Sample Size: The study was conducted on 60 patients undergoing upper limb surgeries under brachial plexus block. Patients were randomly divided into two groups.

Group RD: (n=30) was given block with 30ml of 0.5% Ropivacaine +2ml dexamethasone (8mg).

Group R: (n=30) was given block with 30ml of 0.5% Ropivacaine +2ml Saline.

Inclusion Criteria:

- Patients with ASA class I and II
- Patients aged between 18 to 65 years
- Patients undergoing both elective and emergency upper limb surgery
- Patients with normal sensory and motor function in affected limb
- Patients who give a valid informed written consent

Exclusion Criteria:

- Patient refusal or inability to cooperate
- Allergy to local anaesthetics
- Coagulopathy disorders
- Patients with ASA class III and IV
- Patients with neurological disorders, nerve palsy and neuromuscular disorders
- Patients requiring conversion to GA
- Those who had incomplete block were excluded

The actual study was started after taken permission from the institutional ethics committee. A predesigned and pre-tested questionnaire was used.

- All the study drugs used were preservative free
- 30ml solution for ‘single shot’ supraclavicular brachial plexus blockade would be administered.

- Pre-anaesthetic check-up would be done and informed about the procedure
- Patients were fasted over night
- IV line secured and patients would be connected to monitors to record pulse, O2 saturation, NIBP and ECG
- Premedication with inj. Midazolam 0.05mg/kg body weight before the procedure. Drug solutions are prepared
- Patient lies supine, arms by the side and head turned to other side

RESULTS AND DISCUSSIONS

The mean time for Onset of the sensory block was 4.3±1.53 minutes in group- RD and 4.57±1.41 minutes in group-R (P>0.05). Thus, Group-RD patients and group R onset times were not significant.

The mean time for peak effect of sensory blockade was 9.3±2.2 minutes in Group RD and 9.07± 1.07 minutes in Group R (P>0.05). Group RD patients had same peak effect of sensory blockade as compared to Group R patients.

The total duration of sensory block was 10.17± 1.13 hrs in group RD and 6.5±1.5 hours. in group R, the p < 0.001. Thus the total duration of sensory block was significantly prolonged in Group RD.

The mean time for Onset of the motor block was 6.66±1.26 minutes in group-RD and 6.88± 0.84 minutes in group-R (P >0.05) and thus statistically not significant.

The mean time for peak effect of motor blockade was 12.9±1.4 minutes in Group RD and 13.1± 1.52 minutes in Group R (P>0.05) and thus statistically not significant.

The mean duration of motor block was 8.35 ± 0.81 hours. in group RD and 7.42± 0.78hrs. in group R the p value being < 0.001. Thus the total duration of motor block was significantly prolonged in group RD compared to group R.

The total duration of post-operativeerative analgesia was 21.2 ±3.23 hrs in group RD and 10.24±1.57hours. In group R, the p value being < 0.001. Thus total duration of post operative analgesia was significantly longer in group RD patients compared to group R patients.

In group RD, 33.3% of patients did not require any analgesic in 24 hours post- op duration, 60% patients required one dose of rescue analgesia and the rest 6.7% required 2 doses of analgesia within 24 hours post-operatively. Whereas in group R, 40% patients required 3 doses of analgesia and the rest 60% required 2 doses of analgesia in 24 hours post-operative duration. Thus, group RD patients had significantly longer duration of post-operative analgesia and the requirement of additional analgesics was significantly reduced.

The mean time for onset of sensory blockade was 4.3± 1.53 minutes in group- RD and 4.57±1.41 minutes in group-R and was thus statistically not significant.

The mean time for peak effect of sensory blockade was9.3 ±2.2 minutes in group-RD and 9.07±1.07 minutes in group-R and was thus statistically not significant.

Thus in group-RD (Dexamethasone group) patients had same onset and peak effect of sensory blockade compared to group-R.

Total duration of sensory block in group RD was 10.17 ±1.13 hours and in group R was 6.5 ±0.6 hours and was statistically highly significant.

Our results are in consonance with Pathak et al. 2012, Ali Movafegh et al. 2006, But Shrestha BR (2004) has noted early onset of sensory block.

The mean time for the onset of motor blockade was 6.66±1.26 min in group- RD and 6.88 ±0.84 minutes in group-R and was thus statistically not significant.

The mean time for peak motor blockade was 12.9± 1.4 min in group-RD and 13.1 ±1.52 min in group-R and was thus statistically not significant.

Thus in group-RD (Dexamethasone group) patients had same onset and peak effect of motor blockade compared to group-R patients.

Total duration of motor block in group RD 8.35 ±0.81 hours and in group R was 7.42 ±0.78 hours and was statistically highly significant.

Our results are in consonance with the studies of K.C. Cummings, D.E. Naperowski, A. Kurz-2011, Pathak et al. 2012, Ali Movafegh et al. 2006, who reported no change in onset and peak effect of motor block and prolongation of motor block[7].

Tsing Hua *et al*. 2000 reported that in Axillary block there was no significant change in the onset time and peak effect of sensory and motor blockade, but in supraclavicular and interscalene blocks there was significantly early onset and peak effect on sensory and motor blockade.

The early onset of action of Dexamethasone may be due to its synergistic action with Local anaesthetics on blockade of nerve fibres.

Adequacy of block: 30 patients in group RD and 30 patients in group R had complete blockade and 2 patients in group R had failure of block those were excluded from the study. Patients in either of the groups had less failure of block as we have used nerve stimulator in our study. Thus addition of Dexamethasone did not make any significant difference on the quality of block[8].

The reference studies reported very minimal failure or incomplete block, this could be because all the studies used peripheral nerve locator and ultrasound in their studies.

The surgery was allowed to start only after final assessment of block at 20 minutes by which time block was complete in both the groups in majority of cases.

Table 1: Onset Time of Sensory Block

Onset Time (in minutes)	Group RD (no. of patients)	Group R (no. of patients)	p-value
1-2	7	3	
2-4	3	8	
4-6	18	18	
6-8	2	1	
8-10	0	0	
10-12	0	0	
12-14	0	0	
14-16	0	0	
Mean ± SD	4.3±1.53	4.57±1.41	p>0.05

Table 2: Peak Effect Time of Sensory Block

Time (in minutes)	Group RD (no. of patients)	Group R (no. of patients)	p-value
4-6	0	0	
6-8	0	8	
8-10	2	19	
10-12	13	3	
12-14	10	0	
14-16	5	0	
Mean ± SD	9.3±2.2	9.07±1.07	p>0.05

Table 3: Total Duration of Sensory Block

Time in hours	Group RD (no. of patients)	Group R (no. of patients)	p-value
4-6	0	10	
6-8	0	15	
8-10	18	5	
10-12	10	0	
12-14	2	0	
Mean ± SD	10.17±1.13	6.5±0.6	<0.001

Table 4: Onset Time of Motor Block

Time of Motor Block (in minutes)	Group RD (no. of patients)	Group R (no. of patients)	p-value
2-4	1	2	
4-6	10	9	
6-8	18	18	
8-10	1	1	
10-12	0	0	
Mean ± SD	6.66±1.26	6.88±0.84	P >0.05

Table 5: Peak Effect Time for Motor Block

Time (in minutes)	Group RD (no. of patients)	Group R (no. of patients)	p-value
6-8	0	1	
8-10	2	2	
10-12	11	9	
12-14	12	14	
14-16	6	4	
Mean ± SD	12.9±1.4	13.1±1.52	>0.05

Table 6: Total Duration of Motor Block

Time in hours	Group RD (no. of patients)	Group R (no. of patients)	P-value
2-4	0	0	
4-6	0	4	
6-7	2	7	
7-8	11	18	
8-9	9	1	
9-10	8	0	
10-11	0	0	
Mean ± SD	8.35±0.81	7.42±0.78	<0.001

Table 7: Total Duration of Postoperative Analgesia

Time in Hours	Group RD (no. of patients)	Group R (no. of patients)	p-value
6-8	0	2	
8-10	0	15	
10-12	0	10	
12-14	0	3	
14-16	0	0	
16-18	2	0	
18-20	06	0	
20-22	05	0	
22-24	17	0	
Mean ± SD	21.2±3.23	10.24±1.57	<0.001

Table 8: Rescue Analgesic Requirement in 24 Hours

No. of Doses	Group RD (no of pts)	Group R (no of pts)
0	10 (33.3%)	0
1	18(60.0%)	0
2	2(6.7%)	18 (60%)
3	0	12(40%)

None of the patients required supplementation with full general anaesthesia.

The mean duration of surgery was 68.17±25.47 minutes in group-RD and 73.14± 27.32 minutes in group-R and was comparable in both the groups and was statistically insignificant.

Post-operative analgesia was judged on the basis of Visual Analogue Scale score. Patients were explained about this method and rescue analgesics were given when the VAS score was ≥4. The results of our study shows that at the end of 3hours none of the patients in both the groups experienced any pain.

By the end of 6th hour: 8 patients (26.66%) required rescue analgesia in group R while none of the patients required rescue analgesia in group RD.

By the end of 7th hour: 18 patients (60%) in group R required rescue analgesia none of the patients required rescue analgesia in group RD.

By the end of 12th hour: Total 30 patients (100%) in group R required rescue analgesia and none of the patients in group RD.

By the end of 20 hours: Only 8 patients (28.66%) required rescue analgesia in group RD. All patients in group R (100%) required rescue analgesia.

By the end of 24 hours: Only 20 patients (66.66%) required rescue analgesia in group RD. 10 patients did not require any rescue analgesia in first 24 hours.

Thus, rescue analgesia started from 6th hour post-operatively in group R and at the end of 12th hour all patients in group R had received their rescue analgesia.

While in group RD, rescue analgesia started from 18th hour post-operatively and even at the end of 24 hours only 20 patients required rescue analgesia. The rest 10 patients did not require any rescue analgesic in the first 24 hours post-operatively.

Thus, requirement of rescue analgesia was much earlier in group R as compared to group RD (p 0.001: highly significant).

Thus Dexamethasone produced significantly prolonged duration (16-24hours) of post-operative analgesia.

Our study is in consonance with the studies of K.C. Cummings, D.E.Naperowski,A.Kurz-2011,who reported 22 hours(median) of post operative analgesia.

Shrestha BR Maharjan SK, Tabedar S-2003, who reported duration of post- operative analgesia of 8-24 hours (Mean 12.75 ± 5.33 hours).

Chandramouli P, Iyer et al. 2007, who studied Ropivacaine with or without Dexamethasone in extremity nerve blocks (Interscalene and Femoral) reported analgesia time of 22.20 ± 5.9 hours in Interscalene block and 38.80 ± 11.6 hours in femoral block.

The mechanism of blockade prolonging effect of Dexamethasone is not clearly understood. The block prolonging effect may be due to its local action on nerve fibres and not a systemic one (Drager et al.). The effect might be mediated via glucocorticoid receptors. Blocking transmission in nociceptive c-fibres and suppressing ectopic neuronal discharge. Local application of Methylprednisolone has been found to block transmission in c-fibres but not in a and ß fibres. The effect was reversible, suggesting a direct membrane action of steroids[9].

Corticosteroids cause skin vasoconstrication on topical application (Marks R. et al.). The vasoconstriction effects of topical steroids are mediated by the occupancy of classical glucocorticoid receptors rather than by non-specific pharmacological mechanisms. According to traditional theory of steroid action, steroids bind to intracellular receptors and modulate nuclear transcription.

Thus the exact mechanism of prolonged duration of analgesia when Dexamethasone is used as an adjuvant to local anaesthetic mixture is uncertain. Proposed possible theories are attributed to anti-inflammatory property and its local action on nerve fibres[10].

Thus addition of Dexamethasone decreased the total number of rescue analgesic requirement in first 24 hours and prolonged the duration of analgesia.

CONCLUSION

Thus, Ropivacaine (0.5%) with Dexamethasone can be safely used in supraclavicular brachial plexus block and it has prolonged duration of anaesthesia as well as prolonged post-operative pain relief in comparison with Ropivacaine alone without any side effects.

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