

Effect of Addition of Dexamethasone to Ropivacaine in Supraclavicular brachial plexus block.

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Abstract: Background and Objectives: We evaluated the effect of adding dexamethasone to ropivacaine for supraclavicular brachial plexus blockade. The primary endpoints were the onset and total duration of sensory and motor block, quality of analgesia and duration of analgesia.

Methods: Eighty patients of age group 20-50 years, scheduled for various elective orthopaedic surgeries on forearm and around the elbow under supraclavicular brachial block were divided into 2 equal groups in a randomized, double-blinded fashion. In group R (n=40), 30ml (150 mg) of 0.5% ropivacaine +2ml saline and in group RD (n=40), 30ml (150 mg) of 0.5% ropivacaine +2ml dexamethasone (8mg) were given. Motor and sensory block onset times, block durations, quality of intraoperative analgesia and duration of analgesia were recorded.

Results: Demographic data and surgical characteristics were similar in both groups. The sensory and motor block onset time was earlier in group RD as compared to group R (P<0.05). Sensory and motor blockade duration were longer in group RD than in group R (P<0.001). Duration of analgesia was longer in group RD than in group R (P<0.001). The 24 hour Visual Analog Scale was more in group R as compared to group RD. The quality of anaesthesia was excellent in both the groups. Mean arterial blood pressure levels in groups at 5, 10, 15, 30, 45, 60, 90, 120 and 150 minutes were statistically insignificant between the two groups (P>0.05). The mean pulse rate at different time intervals were statistically insignificant between the groups (P>0.05).

Conclusions: Dexamethasone added to ropivacaine for supraclavicular brachial plexus block prolongs the duration of the block and the duration of postoperative analgesia.

Keywords: Dexamethasone, Ropivacaine, Supraclavicular Brachial Plexus Block

I. Introduction

Ropivacaine is structurally closely related to bupivacaine. Compared to racemic bupivacaine, ropivacaine has lower central nervous system toxicity and cardiotoxicity⁽¹⁻³⁾, and it is better tolerated than bupivacaine^(4,5). Based on its profile, ropivacaine may be preferable to bupivacaine. Controversy exists regarding the potency of ropivacaine : in some areas it is clearly less potent, whereas in other areas this is less obvious. However ropivacaine alone provide analgesia for not more than 4-8 hours in peripheral nerve blocks. Increasing the duration of local anaesthetic action is often desirable because it prolongs surgical anaesthesia and analgesia. Different additives have been used to prolong regional blockade. Additives like opioids, clonidine, verapamil etc were added to local anaesthetics, but the results are either inconclusive or associated with side effects⁽⁶⁻⁸⁾. Steroids have powerful anti-inflammatory as well as analgesic property. Perineural injection of steroids is reported to influence post operative analgesia. Dexamethasone microspheres have been found to prolong the block duration in animal and human studies and adding methyl prednisolone to local anaesthetic increases the duration of axillary brachial block⁽⁹⁻¹²⁾. With this background, this study was carried out to evaluate the efficacy of dexamethasone as an adjuvant to ropivacaine in supraclavicular brachial block. Dexamethasone with ropivacaine use in axillary blocks has not been described. In this study, we investigated the effect of adding dexamethasone to ropivacaine for supraclavicular brachial plexus blocks. Our primary endpoints were the onset time, duration of motor and sensory blocks, and quality of intraoperative analgesia.

II. Methods

After ethical committee approval and informed consent, 80 ASA physical grades I–II patients of either sex, aged 20-50 years scheduled for elective orthopaedic surgeries of upper limb under supraclavicular brachial plexus block were included in this study. Patients were not premedicated before the block. After insertion of a 20-gauge IV cannula in the nonoperated arm, a 5 ml/kg/h infusion of 0.9% NaCl solution was started. After standard anaesthesia monitoring, baseline measurements of heart rate (HR), non-invasive arterial blood pressure, peripheral oxygen saturation (Spo2), and respiratory rate were recorded before the block was performed. After appropriate patient positioning and strict aseptic and antiseptic precautions midclavicular point, external jugular vein and subclavian artery pulsation were identified. About 2 cm above the midclavicular point just lateral to subclavian artery pulsation, a 24 gauge 1.5 inch needle was introduced and directed caudal and medially until

paraesthesia was encountered, when local anaesthetics with or without dexamethasone was injected in this area. Patients were randomly allocated using a sealed envelope technique to receive either 30ml of 0.5% ropivacaine with 2ml of isotonic sodium chloride solution (group R, n=40), or 30ml of 0.5% ropivacaine with 2ml (8mg) of dexamethasone (group RD, n=40) in a double-blind fashion. The drug solutions were prepared by an anaesthesiologist not involved in the study. Sensory block was assessed by pinprick test using a 3-point scale: 0 = normal sensation, 1 = loss of sensation of pinprick (analgesia), 2 = loss of sensation of touch anaesthesia). Motor block was evaluated by Modified Bromage Scale (4=Full power in relevant muscle group, 3 =Reduced power but ability to move muscle group against resistance, 2=Ability to move relevant muscle group against gravity but inability to move against resistance, 1=Flicker of movement in relevant muscle group, 0=No movement in relevant group). Sensory and motor blocks were evaluated every 3 minutes up to 30 minutes after injection, and then every 30 minutes after surgery, until they had resolved. Sensory onset time was defined as the time interval between the end of total local anesthetic administration and complete sensory block (score 2). Duration of sensory block was defined as the time interval between the end of local anaesthetic administration and the complete resolution of sensory block (normal sensation or score 0). Motor block was defined as no movement in relevant group (Modified Bromage Scale 0). Duration of motor block was defined as the time interval between the end of local anaesthetic administration and the recovery of full power in relevant muscle group (Modified Bromage Scale 4). The quality of intraoperative analgesia was judged by the investigator at the end of surgery as excellent (no discomfort or pain), good (mild pain or discomfort, no need for additional analgesics), fair (pain that required additional analgesics), or poor (moderate or severe pain that needed more than fentanyl 100µg or general anaesthesia). HR, systolic arterial blood pressure (SAP), and diastolic arterial blood pressure (DAP) were recorded at 0 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 45 minutes, 60 minutes, 90 minutes, 120 minutes and 150 minutes. Adverse events comprised hypotension (a 20% decrease in relation to the baseline value), bradycardia (HR <50 beats per minute), hypoxemia (SpO₂<90%), or nausea and vomiting. Pain was assessed using the Visual Analog Scale (0–10) every 60 minutes during first 24 hours. Nursing staff administered IM diclofenac 75mg when the Visual Analog Scale >4. The time between the end of local anesthetic administration and the first analgesic request was recorded as the duration of the analgesia. Data were entered and analyzed with the Graph Pad.com (version 5, 2010). Statistical tests used for comparison is unpaired t-test and fisher's exact test. Results are presented as mean (SD) and number (%) of cases as appropriate. The level of significance was set at P < 0.05, and 95% confidence intervals were calculated for the main outcome measures.

III. Results

The demographic data and surgical characteristics were similar in each group (Table 1).

	Group R	Group DR	P value
Age (years)	30±8	31±9	0.6009
Sex (M/F)	34/6	35/5	1.0000
Weight (kg)	68±10	65±12	0.2282
Height (cm)	172±6	174±8	0.2097
Surgical duration (min)	93±36	98±42	0.5692
BMI (kg/m ²)	22.7±3.1	23.6±4.0	0.2641
Values are expressed as mean ± SD			

Sensory and motor block onset time was earlier in group RD as compared group R (Table 2; P < 0.05). Sensory and motor blockade durations were longer in group RD than in group R (Figure 1; P< 0.001).

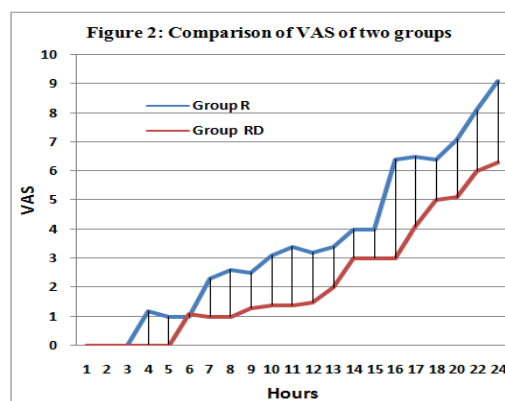
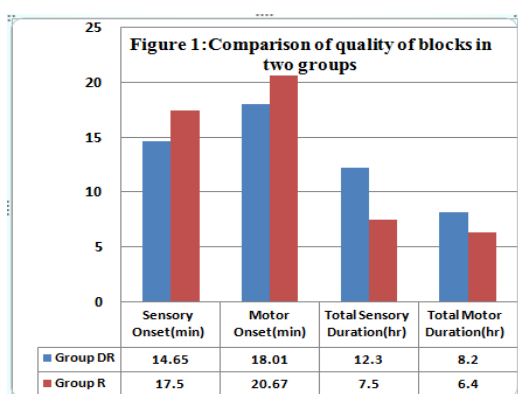
	Group R	Group RD	P value
Onset time of sensory block (min)	17.5±4.2	14.65±3.31	0.0124
Onset time of motor block (min)	20.67±3.03	18.01±4.51	0.0210
Total duration of sensory block (hr)	7.5±0.55	12.3±0.40	<0.0001
Total duration of motor block (hr)	6.4±0.30	8.2±0.50	<0.0001
Values are expressed as mean ± SD			

Duration of analgesia was significantly longer in group RD than in group R (Table 3; P<0.001). The intraoperative quality of analgesia was excellent and similar in both groups (Table 3). However two patients in

group R and one patient in group RD complain mild pain and discomfort but no additional analgesic required. It was statistically insignificant between the two groups (p value>0.05). None of the patients in both the groups had poor quality of analgesia (Table 3).

	Group R	Group RD	P value
Excellent	38	37	>0.05
Good	2	2	
Fair	0	1	
Poor	0	0	
Time to First analgesic request (hr)	8.30±0.40	14.50±0.30	<0.0001
Postoperative analgesic consumption during the first 24 hours [n (%)]	30 (75%)	18 (45%)	0.0115
Values are expressed as mean ± SD , numbers or percentage (%)			

From the sixth hour, patients who received dexamethasone showed a significantly lower VAS than the patients received ropivacaine only (Figure 2). Mean arterial pressure and mean pulse rate in group R and group RD at 0,5,10, 15, 30, 45, 60, 90,120 and 150 minutes were statistically insignificant (P > 0.05). No side effects including nausea, vomiting, hypotension, and hypoxemia were reported in either group.



IV. Discussion

In this study, we demonstrated that in patients undergoing supraclavicular brachial plexus block, dexamethasone added to ropivacaine, shortens sensory and motor block onset time and extends block durations. Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. Ropivacaine provided better operating conditions but the duration of analgesia is rarely maintained for more than 4-8 hours. Addition of steroid to local anaesthetics effectively and significantly prolongs the duration of analgesia as well as producing earlier onset of action⁽¹³⁾. Steroids are very potent anti-inflammatory and immunosuppressive agents. Perineural injection of steroid is reported to influence postoperative analgesia. Epidural steroids were used for treatment of back pain and sciatica⁽¹⁴⁾. Various steroids has been used for this purpose, but dexamethasone, a derivative synthetic glucocorticoid is preferred because of its highly potent anti-inflammatory property, about 25-30 times as potent as hydrocortisone and without any mineralocorticoid activity. Thus was found to be safer and devoid of potential side effects. Pre-operative administration of dexamethasone by oral and intravenous routes has been shown to reduce overall pain scores and analgesic requirements in the postoperative period without any adverse effects in various oral and general surgical procedures⁽¹⁵⁾. Dexamethasone is also known to reduce post-operative nausea and vomiting. The possible mechanism of analgesic and antiemetic actions are due to anti-inflammatory property of dexamethasone^(16,17).

In reported study significantly early onset of sensory and motor block was noticed in group DR compared to group R (p<0.05). The early onset of action might be due to synergistic action of dexamethasone with local anaesthetics on blockage of nerve fibres. The duration of pain relief (postoperative analgesia) was markedly prolonged in group RD (14.5±0.3 hours), while it was only 8.3±0.4 hours in group R (p<0.001). A variety of animal studies have reported the analgesic effect of corticosteroids by adding to local anaesthetics for peripheral nerve blockade. Droger and colleagues have shown that dexamethasone incorporation into bupivacaine caused prolongation of the intercostals nerve blockade in sheep⁽¹⁸⁾. Castillo and co-workers reported that addition of

dexamethasone to bupivacaine resulted in prolongation of sciatic nerve blockade in rats⁽¹⁹⁾. These studies have attributed the prolongation of the block duration to the anti-inflammatory effect of steroids. In one study on human volunteers, addition of dexamethasone to bupivacaine microcapsules provided prolongation of the intercostals nerve blockade⁽²⁰⁾. Use of oral dexamethasone succeeded in reducing pain and swelling following tooth extraction⁽²¹⁾. Addition of dexamethasone to lidocaine⁽²²⁾ 1.5% solution for axillary brachial plexus block resulted in longer sensory and motor blockade duration (sensory blockade duration was 242±76 vs. 98±33 min for control and motor blockade duration was 310±81 vs. 130±31 min for control). In another study, 40mg methyl prednisolone was added to a mixture of local anaesthetic formed of 20ml bupivacaine + 20ml mepivacaine + 0.2ml epinephrine for axillary brachial plexus block⁽²³⁾. It resulted in longer analgesia (23 vs. 16 h for control) and longer motor blockade duration (19 vs. 13 h for control). Shrestha and co-workers⁽²⁴⁾ added 8 mg of dexamethasone to a mixture of lidocaine and bupivacaine for supraclavicular brachial plexus block. Dexamethasone provided a faster onset of action and longer duration of analgesia without any adverse effects. Parrington and colleagues⁽²⁵⁾ added 8mg of dexamethasone to 30ml mepivacaine 1.5% during supraclavicular brachial plexus blockade. The dexamethasone group showed a longer duration of analgesia: 332 (225-448 min) vs. 228 (207-263 min) min in the control group, whereas the onset times of sensory and motor blockade were similar in both groups. In another study⁽²⁶⁾, Cummings III and co-workers reported longer analgesia when using ropivacaine or bupivacaine for interscalene blocks, with the effect being more potent with ropivacaine. However, the block duration was more prolonged with bupivacaine than with ropivacaine.

V. Conclusion

Addition of dexamethasone to ropivacaine in supraclavicular brachial plexus block significantly prolongs the duration of analgesia and motor block in patients undergoing upper limb surgeries and is a remarkably safe and cost effective method of providing post operative analgesia.

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