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A comparative study of 0.2% ropivacaine alone and 0.2% ropivacaine with low dose dexmeditomidine as adjuvant for intravenous regional anesthesia in upper limb surgeries

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Abstract

Background: Intravenous Regional Anaesthesia (IVRA) is techniqally simple and reliable mode of anaesthesia for distal upperlimb procedures and has success rate of 94% - 98% Ropivacaine for IVRA provides prolonged analgesia over lignocaine. Ropivacaine has less cardiotoxic profile and high sensorimotor differentiation compared with bupivacaine and seems to be effective choice. To reduce the amount of local anaesthetic used and to improve the quality of the block, adjuvants like Dexmeditomidine are added. Due to lack of adequate literature supporting efficacy of dexmeditomidine as adjunct to Ropivacaine for IVRA the following study has been conducted.

Aim: To study and compare the onset of sensory blockade ; efficacy in terms of duration of block; incidence of intraop-post tourniqet pain ; post operative analgesia between 0.2% ropivacaine and by addition of low dose of dexmeditomidine 0.5mcg/kg as adjuvant to 0.2% ropivacaine for IVRA.

Material and methods: After obtaining institutional ethical committee approval and informed written consent from the subjects A total of 50 patients undergoing upperlimb surgery of ASA 1,2 both males and females with age group 25-50 yrs, study was done over a period of 3 months. These patients were randomised to receive IVRA with

Group 1 - 40ml of 0.2% ropivacaine (25)

Group 2 - 40 ml of 0.2% ropivacaine + dexmeditomidine 0.5mcg/kg (25)

Injection atracurium 5mg was added to both the groups in the IVRA solution along with the local anesthetic as adjunct to provide adequate relaxation for surgery.

Anaesthetic efficacy regarding onset of sensory blockade ; duration of blockade ; post torniquet pain ; post operative analgesia were noted and compared stastically.

Results: The meantime of duration of surgery and tourniquet duration of both groups showed statistically no significant difference. In this study, the mean time of onset of sensory block was quicker in Group 2 (3.0 ± 0.2 min) when compared to Group 1 (4.0 ± 0.3 min) and this difference was extremely statistically significant. No side effect was reported in the intraoperative period in either of the groups except that tourniquet pain was reported in 4 patients in Group 1 and none in Group 2. None of the patients had significant bradycardia or hypotension to require any intervention.

Conclusion: Dexmedetomidine when added to Ropivacaine for IVRA significantly facilitates Early onset and prolongs the recovery of sensory as well as motor block as compared to Ropivacaine alone. α2 adrenergic agonists decrease the pain associated with the inflation of pneumatic tourniquet, without any associated haemodynamic instability or other significant side effects. Block quality, duration of post- operative analgesia and patient satisfaction were better with dexmedetomidine.

Introduction

Intravenous regional anesthesia (IVRA) was first described in 1908 by A.G. Bier; hence, the procedure is named Bier's block.[1]IVRA involves the intravenous administration of a local anesthetic into a tourniquet occluded limb. The local anesthetic diffuses from the peripheral vascular bed to nonvascular tissue such as axons and nerve endings.IVRA is a simple, effective method of providing anesthesia for short duration surgical procedures on the extremities.[2] Limitation of this block include anesthetic toxicity, slow onset, poor muscle relaxation, tourniquet pain, and minimal post-operative pain relief.[3] Various drugs such as procaine, prilocaine, lignocaine, and bupivacaine have been used in IVRA. Among these, lignocaine is the drug commonly used, and it does not have post-tourniquet analgesia.[4] Bupivacaine provides post-tourniquet analgesia, but cardiovascular (CV) collapse reported after its use in IVRA. Ropivacaine is an amide local anesthetic that is structurally related to bupivacaine with duration of anesthesia almost as long as that of bupivacaine, however, with less CV toxicity presumably because it is pure S-enantiomer.[5] An ideal drug for intravenous regional anesthesia should have features such as rapid onset of action, reduced dose of local anesthetic, prolonged post tourniquet release analgesia and wider margin of safety.Ropivacaine is a newly amide local anesthetic that is structurally related to

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bupivacaine with duration of anesthesia almost as long as that of bupivacaine, however, with less CNS and CVS toxicity presumably because it is pure S-enuntiomer.[6]Bupivacaine has been used for intravenous regional anesthesia and provides sustained analgesia after tourniquet release; however, reports of seizures and cardiac arrest after intravascular absorption have resulted in eventual discontinuation of bupivacaine for IVRA.[7] The clinical use of ropivacaine is well established in epidural anesthesia and peripheral nerve blocks.[13] Therefore the use of a local anesthetic that would provide longer lasting post tourniquet release analgesia and with least incidence of toxic effects prompted us to study the effectiveness of ropivacaine in intra-venous regional anesthesia.To reduce the amount of local anesthetic required or to improve the quality of the block or both, various additives such as opioids, muscle relaxants, alpha-2 agonists have been tried in IVRA with various results. Among this Dexmeditomidine selective α2 receptor agonist is used in this study along with Ropivacaine.Dexmedetomidine, a potent α2 receptor agonist, is approximately 8 times more selective toward α2 receptors than clonidine.[8] In the present study, wehave evaluated and compared the effects of adding dexmedetomidine to Ropivacaine for IVRA in upper limb orthopaedic surgeries.In the present study, we have evaluated and compared anesthetic efficacy and post-tourniquet analgesia during IVRA using ropivacaine alone and ropivacaine with dexmeditomidine for upper limb elective surgeries.Atracurium as an adjuvant in IVRA is used as it acts on muscle spindle; it reduces central input from these structures, which results in loss of muscle tone and control of voluntary movements with a decrease in nervous inputs to the brain[9] . Atracurium has also shown to alleviate muscle spasms and reduce pain both during and after surgery[9]

Materials and methods

This study was a randomized, prospective controlled double-blinded study. It was done at Gandhi Government Medical College from April 2018 to June 2018 after approval from the Medical Ethics Committee. 50 patients of American Society of Anesthesiologists physical status I and II of either sex, between the ages of 18 and 55 years undergoing upper limb below elbow surgery were assigned into two groups each containing 25 patients. Group 1: Patients in this group received 40 ml of 0.2% ropivacaine Group 2: Patients in this group received 40 ml of 0.2% ropivacaine with dexmeditomidine0.5mcg/kg. Pre-operative evaluation included history, general physical examination, and routine investigations. The procedure and the visual analog scale scoring system (VAS) were explained to the patient preoperatively, and a written informed consent was obtained. In VAS, the patient was asked to grade his/her pain on a numeric scale of 0-10 (0 = no pain and 10 = the worst pain).Patients with a history of any CVS, Respiratory, or Central nervous system disorders were excluded from the study. Patients with hematological disorders such as sickle cell anemia and thalassemia,and peripheral vascular diseases. patients with known hypersensitivity to ropivacaine, patients with difficult airway, were also excluded from the study. The patients were shifted into the operation theatre. No premedication was given. The pulse oximeter, non-invasive blood pressure monitor, and electrocardiographic monitor were connected to the patient. The vital parameters were recorded. A separate intravenous line was started in the non-operated limb.A vein in the dorsum of the hand of the operated limb was cannulated with 22G intravenous cannula. If the dorsum of the hand was involved in the surgery, a vein higher up in the forearm was chosen. It was firmly fixed, flushed with normal saline and stopper applied. Exsanguination was accomplished by Esmarch bandage (active) from fingertip to arm. In subjects where the application of Esmarch bandage was not feasible, emptying of veins was facilitated with compression of axillary artery with the limb elevated.(Passive). At the proximal end of the Esmarch bandage, the first tourniquet was applied around the upper part of the arm over cotton wool padding. Proximal tourniquet was inflated to 50-100 mmHg above the patient's systolic blood pressure. The absence of radial artery pulsations and failure of pulse oximetry tracing in ipsilateral index finger was confirmed. Then 40 ml of local anesthesia solution was injected through the cannula at a rate of 1 ml/s by an anesthesiologist who was blinded to the study drug. The sensory block was assessed by pinprick with a 23G hypodermic needle. Patient response was evaluated in dermatomal sensory distribution of medial cutaneous, lateral cutaneous, median, radial, and ulnar nerves.6 Sensory block onset time was noted as time interval after completion of injection of study drug to sensory block achieved in all dermatomes. Motor function was assessed by asking the patient to flex and extend the wrist and fingers, and motor block onset time was noted when no voluntary movement was possible following Injection of study drug.After ensuring complete analgesia below the first tourniquet, the second tourniquet was applied distal to the first tourniquet and inflated to 50-100 mmHg above the patient's systolic blood pressure. The first tourniquet was then removed. The patients were observed for any toxic manifestations of local anesthetics after release of the first tourniquet. The surgery was started only after sensory block was achieved. If a patient had no sensory or motor block, it was considered a failure of block and the patient was administered general anesthesia.Intraoperative tourniquet pain, if perceived ,Tourniquet was deflated following a minimum of 30 min after inflation and was not inflated for more than 90 min. The tourniquet was deflated by cyclic deflation technique at 10 s intervals. At the end of surgery, post-tourniquet analgesia time was noted as time elapsed from tourniquet deflation to recovery of pain (VAS >5) in all dermatomes of the operated limb. Side effects after tourniquet release if any was noted.Duration of sensory block was taken as the time interval from cessation of pinprick sensation to all dermatomes until the return of

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pinprick sensation.Duration of motor block was taken as the time interval from cessation of finger and wrist movements until the return of these movements.Recovery time of sensory block (time from tourniquet deflation to the recovery of pain at incision site.Recovery time of motor block (time from tourniquet deflation to the movement of fingers) was noted.Data are expressed as mean ± standard deviation. Independent samples t-test was used for evaluation of demographic data, duration of surgery and tourniquet, onset of sensory Block, and duration of post-tourniquet analgesia. $P < 0.05$ was considered statistically significant. All analyses were done using SPSS version 16.0 statistical software.

Results

Demographic variables such as age, weight, and sex were comparable between the two groups (Table 1). The difference between both groups was statistically not significant ($P > 0.05$). The meantime of duration of surgery and tourniquet duration of both groups showed statistically no significant difference ($P > 0.05$).

Table 1: Demographic variables, duration of surgery and tourniquet

Sl. No	Variables	Group 1	Group 2	P Value
1	Age	37±12	34±12	
2	Weight	56±14	58±10	
3	Duration Of Surgery(Minutes)	70±5	72±4	
4	Duration Of Torniquet(Minutes)	78±5	79±4	

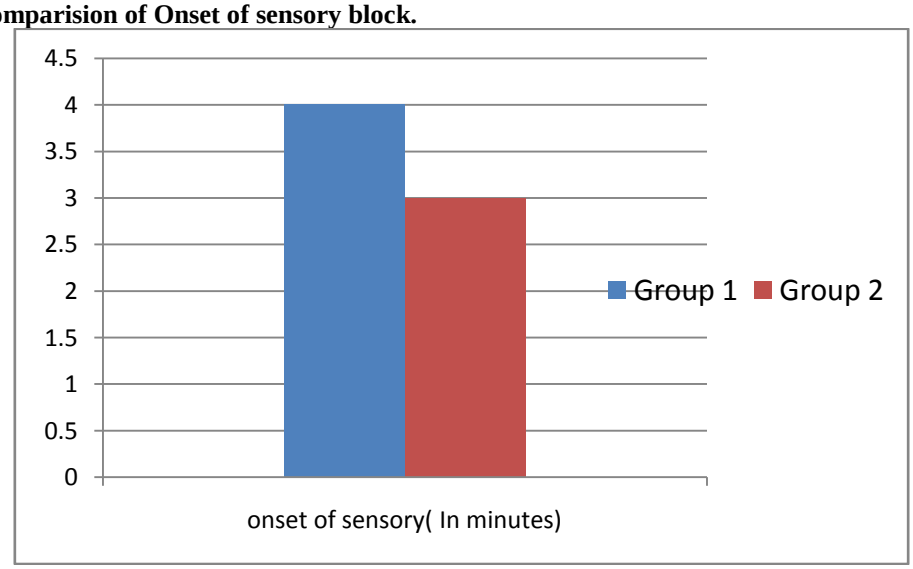
In this study, the mean time of onset of sensory block was quicker in Group 2 (3.0 ± 0.2 min) when compared to Group 1 (4.0 ± 0.3 min) (Table 2) and this difference was extremely statistically significant ($P = 0.0005$). The mean duration of Sensory block was higher in Ropivacaine plus Dexmeditomidine group (8+0.5 hrs)when compared to Ropivacaine group (5+0.2hrs).and this difference was statistically significan. (Table 2)The mean duration of post-tourniquet analgesia was higher in ropivacaine plus Dexmeditomidine group (7 ± 0.3hrs) when compared to ropivacaine group (4 ± 0.2hrs) and this difference was statistically significant ($P = 0.011$). (Table 2)

Table 2: Analgesia characteristics

Sl. No	Charecteristics	Group 1	Group 2	P Value
1	Onset Of Sensory Block(minutes)	4±0.3	3±0.2	
2	Duration Of Sensory Block(hours)	5±0.2	8±0.5	
3	Duration Of Post Tourniquet Analgesia	4±0.2	7±0.3	

No side effect was reported in the intraoperative period in either of the groups except that tourniquet pain was reported in 4 patients in Group 1 and none in Group 2. None of the patients had significant bradycardia or hypotension to require any intervention.

Graph 1: Comparision of Onset of sensory block.



Graph 2: Comparision of duration of sensory block.

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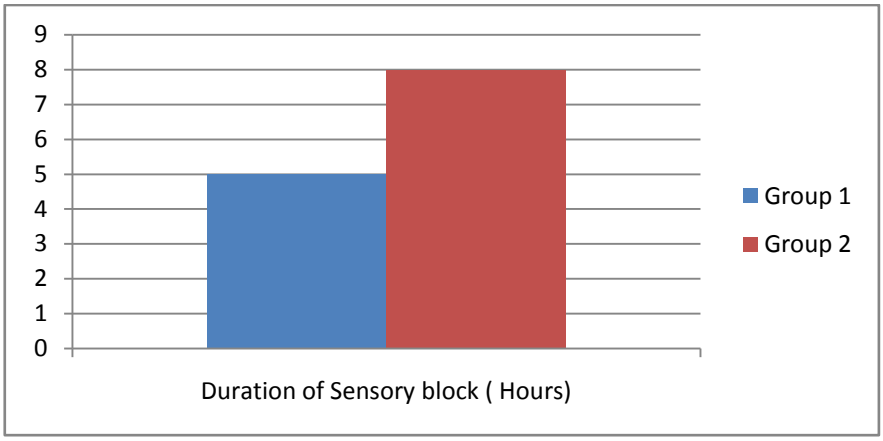
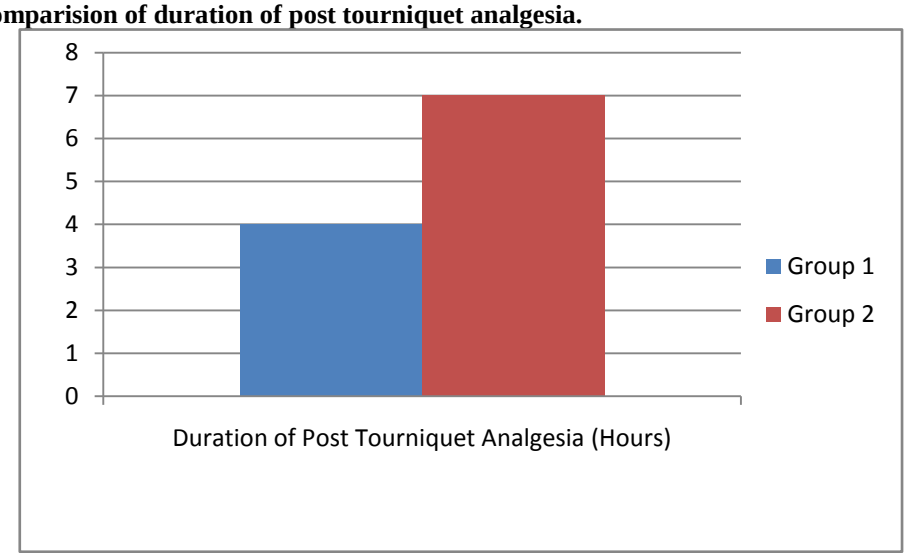


Graph 3: Comparision of duration of post tourniquet analgesia.



Discussion

Ropivacaine use has increased in popularity because of its potential to offer prolonged and improved analgesia compared to lidocaine, but its onset of sensory and motor block is delayed compared to lignocaine. To improve the onset of the block and improve the post-operative analgesia dexmedetomidine was used as adjuvant in our study.The pharmacological properties of α2 agonists, which include sedation, analgesia, anxiolysis, peri- operative sympatholysis, cardiovascular stabilising effects, reduced anaesthetic requirements and preservation of respiratory function, have been extensively studied and clinically employed in regional anaesthesia.[5] Dexmedetomidine is 8–10 times more selective towardα2 adrenergic receptors and is 3.5 times more lipophilic than clonidine. It thus prolongs the duration of both sensory and motor blockade induced by local anaesthetics, irrespective of the route of administration.Kol et al. suggested that addition of 0.5 µg/kg dexmedetomidine had more potent effect, shortening sensory block onset time and prolonging sensory block ,recovery time more than lornoxicam in IVRA.[10] In this study, the onset of sensory as well as motor block was significantly shortened and recovery was prolonged by addition of dexmedetomidineThe duration of analgesia assessed by time for requirement of rescue analgesic It was significantly longer in the dexmedetomidine group.Peri- operative Dexmedetomidine administration decreases the requirements for opioid or non- opioid analgesics both intra- and post- operatively.[11] Intravenous Dexmedetomidine as a premedication was effective because it reduced patient anxiety, Sympathoadrenal responses and opioid analgesic requirements, but it did not reduce tourniquet pain.[12,13] In this study, the mean time of onset of sensory block was lesser in Ropivacaine plus dexmeditomidine group(3.0 ± 0.2 min) when compared to Group 1 Ropivacaine (4.0 ± 0.3 min). These values were consistent with the findings of Niemi et al.[14]In this study, the incidence of tourniquet pain is higher in ropivacaine group. Four patients in ropivacaine group perceived intraoperative tourniquet pain while this was nil in patients who received dexmeditomidine along with ropivacaine. The mean duration of Sensory block was higher in Ropivacaine plus Dexmeditomidine group (8+0.5 hrs)when compared to Ropivacaine group (5+0.2hrs).and this difference was statistically significant. The duration of post-tourniquet analgesia was higher in ropivacaine plus Dexmeditomidine group(7 ± 0.3hrs) when compared to ropivacaine group (4+0.2 hrs). The incidence of side effects was similar in both the groups. Patients who received dexmeditomine along with

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ropivacaine showed higher incidence of bradycardia when compared to ropivacaine group. The vital signs such as pulse rate and blood pressure were stable in all patients. There were no complications during and after the release of the tourniquet in all groups of patients.

Conclusion

We conclude that Ropivacaine 0.2% with Dexmeditomidine 0.5 µg/kg in IVRA has well anaesthetic efficacy, lengthened post-tourniquet analgesia and less incidence of intraoperative tourniquet pain with minimal side effects after tourniquet release when compared to Ropivacaine 0.2% alone.Dexmedetomidine when added to Ropivacaine for IVRA significantly facilitates Early onset and prolongs the recovery of sensory as well as motor block as compared to Ropivacaine alone.α2 adrenergic agonists decrease the pain associated with the inflation of pneumatic tourniquet, without any associated haemodynamic instability or other significant side effects. Block quality, duration of post‑ operative analgesia and patient satisfaction were better with dexmedetomidine.

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