European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 03, 2022

ORIGINAL RESEARCH

Intravenous Regional Anaesthesia: Comparison of Ropivacaine and Ropivacaine Dexamethasone Combination

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ABSTRACT

Background: Intravenous regional anaesthaesia(IVRA), also known as Biers Block is a technique of producing surgical anaesthesia by intravenous injection of a local anesthetic into a limb whose circulation has been interrupted by a tourniquet.Ropivacaine is a safer alternative among available local anaesthetics with analgesic duration 4-8 hrs. Dexamethasone is a long-acting synthetic corticosteroid and is beneficial anti-inflammatory agent for the management of acute surgical pain.This study was done with the aim to comparethe effectiveness as well the onset and duration of sensory block, motor block and analgesia between ropivacaine alone and ropivacaine-dexamethasone in regional anaesthesia.

Methods: 50 adult patients of ASA grade I & II in the age group of 20-50 years were randomized into two groups of 25 patients, scheduled for ambulatory hand surgery andwere administered intravenous(IV)Ropivacaine (0.2%) 40 ml and IV Ropivacaine(0.2%)40ml plus 8mg Dexamethasone after inflating the proximal cuff of tourniquet and assessment was done with pin prick and visual analogue scale (VAS)score.

Results:This study showed, the duration as well as the recovery of sensory block was prolonged on adding dexamethasone. In group receiving dexamethasone as an adjuvant to ropivacaine the duration of analgesia was prolongedas well as the total analgesic consumption was reduced. Conclusion: IVRA is a safer technique and addition of dexamethasone to ropivacaine increases the analgesic efficacy as well the duration of sensory block which decreases pain scores and attributes to early recovery as well as short hospital stay.

Keywords: Intravenous Regional Anaesthesia, Ropivacaine, Ropivacaine DexamethasoneCombination.

INTRODUCTION

Intravenous regional anaesthesia has rapid onsetandwith a low incidence of side effects.[1]The mechanism of action is not clear and factors like ischemia, acidosis, hypothermia, and asphyxia play a vital role.[2] The ideal drug for IVRA should have rapid onset of action, reduced dose, prolonged analgesia after removal of tourniquet and wide safety margin.Local anesthetics are used commonly in this method; also, adjuvant drugs are used to increase the quality of the block .[3]Ropivacaine is a newamide local anestheticwith less central nervous system (CNS) and cardiovascular system (CVS) toxicity being a pure S-enantiomer.[4] Dexamethasone is a potentlong acting synthetic corticosteroid which can reduce acute inflammation induced by tissue injury causingsurgical pain.

AIMS AND OBJECTIVES

- To study the effectiveness of ropivacaine alone versus ropivacaine-dexamethasone in intravenous regional anaesthesia.
- To compare the onset and duration of sensory block, motor block and analgesia between ropivacaine alone and ropivacaine-dexamethasone in regional anaesthesia.

MATERIALS AND METHODS

The study was approved by the ethical committee of the Sher-e- Kashmir institute of medical sciences, Soura. A written consent was obtained from the entire subject included in the study.A total number of 50 patients of ASA physical status I and II aged 20 to 50 years undergoingambulatory hand surgery were taken.The patients were randomly divided into two groups of 25 each. The allocation sequence was generated by systematic random sampling. Group A (control): Patientsreceived 40 ml of 0.2% ropivacaine. Group B (study): Patients in this group received 40 ml of 0.2% ropivacaine and 8mg dexamethasone. The patients were evaluated clinically, and investigations were done before surgery.In the operation theatre,all the equipment and drugs needed for resuscitation were kept available before administration of intravenous regional anaesthesia and the tourniquet was checked for any leaks before application. On receiving the patient in the operating room, all standard monitoring including non-invasive blood pressure, electrocardiogram and peripheral oxygen saturation monitoring were started and intravenous access was established using 18-gaugecannula in the non-surgical arm.An intravenous infusion of ringer lactate was started, and 1 mg midazolam was given intravenously as premedication. A 22-gauge cannula was inserted in the operative arm as distally as possible. The operative arm was elevated for 2 minutes and then exsanguinated using an Esmarch bandage. Two tourniquets were applied on the arm with generous layers of padding, ensuring that no wrinkles were formed, and the tourniquet edges did not touch the skin. The proximal cuff was inflated to 50mmHg above systolic arterial pressure. After confirming the absence of a palpable radial pulse, the solution was injected slowly over 90 seconds.After onset of sensory and motor block, the distal cuff was inflated to 250mmHg and the proximal cuff was released. Time at inflation of tourniquet and drug administration was noted. The tourniquet was not deflated before 30 minutes and was not inflated for more than 90 minutes. Sensory block was assessed by pinprick test using 22-gauge sterile hypodermic needle every minute after injection of drug and after tourniquet deflation. Onset of sensory block was taken as time from injection of drug until sensory block was achieved in all dermatomes.Motor block was assessed by asking the patient to flex and extend the wrist and fingers every minute after administration of drug and alter deflation of tourniquet. Complete motor block was taken when no voluntary movement were possible. Onset of motor block was taken as time from injection of drug till complete motor block was achieved. Duration of sensory block was taken as the time interval from cessation of pinprick sensation in all dermatomes until the return of 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 in all dermatomes determined by pinprick test) and recovery time of motor block (time from tourniquet deflation to the movement of fingers) were to be noted. Pain was assessed intraoperatively and for 2 hours postoperatively using the visual analogue scale (VAS) where a score of 0 was given for no pain and 10 for worst pain imaginable. Time to the request for first analgesic after tourniquet deflation and total analgesic consumption in 24 hours were noted in all patients. Number of patients requiring rescue medication (diclofenac 50mg) was recorded in both groups.

Statistical Methods: The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were expressed as frequencies and percentages. Graphically the data was presented by bar diagrams. Student's independent t-test was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

RESULTS

In this study, the two groups showed no statistically significant difference in age with a p-value 0.714. The gender distribution in between the two groups was 56% males and 44% females in study group whereas in control group the gender distribution was 60% males and 40% females with a preponderance of males in both groups.**Table 1** shows the age distribution of the group.

The mean duration of surgery in both the groups was comparable as evident from **Table 2**and the tourniquet was kept inflated for 54.4 min in study group and 53.3 min in control group.

Table 1: Age distribution of the group

Age (years)	Study Group		Control Group		P-value
	No.	%age	No.	%age	
20-34	9	36	8	32	0.714
35-49	11	44	10	40	
≥ 50	5	20	7	28	
Total	25	100	25	100	
Mean ± SD (Range)	38.5±10.83 (20-56)		39.7±11.37 (20-60)		

Table 2: Showing duration of surgery (min) between two groups

Group	Mean	SD	Std. Error	Range	P-value
Study	46.9	11.32	2.26	28-65	0.605
Control	45.3	9.78	1.96	25-60	

The comparison based on the onset of sensory block and onset of motor block asshown in tablewas insignificant however while comparing duration of sensory block and motor block it was seen that the duration of sensory block was prolonged on adding dexamethasone to Ropivacaine in IVRA.The mean onset of sensory block in study group was 3.0(minutes) and 3.3(minutes) in control group which was comparable. The difference was statistically insignificant (P value 0.240).The mean duration of onset of motor block in study group was 4.1(minutes) and 4.5(minutes) in control group (Table 5). The difference was statistically insignificant (P value 0.262).According to the study the mean duration of sensory block in study group was 60.5 (minutes) and that in control group was 52.6 (minutes) which was statistically **significant** (P value 0.009). The mean duration of motor block was 53.7

(minutes) in study group and 52.4 (minutes) in control group which was also statistically insignificant (P value 0.642).

Most important that themean recovery time of sensory block in study group was 5.6 (minutes) and 4.1 (minutes) in control group which was statistically **significant** (P value 0.009) as shown in **Table3**.

Table 3: Showing recovery time of sensory block (min) between two groups

Group	Mean	SD	Std. Error	Range	P-value
Study	5.6	1.36	0.30	3-9	0.009*
Control	4.1	1.87	0.37	0-8	

*Statistically Significant Difference (P-value<0.05)

Whereas from **Table4** the mean recovery time of motor block in study group was 4.4 (minutes) and 4.7 (minutes) in control group which was statistically insignificant (P value 0.734).

Table 4: Showing recovery time of motor block (min) between two groups

Group	Mean	SD	Std. Error	Range	P-value
Study	4.4	2.35	0.47	0-9	0.734
Control	4.7	2.61	0.52	0-7	

Table 5: Showing total analgesic requirement in 24 hrs between two groups(50mg DiclofenacSodiumIV)

The mean of total analgesic requirement in 24 hrs was 83.0(milligrams) in study group and 208.0(milligrams) in control group as shown in **Table 5**was statistically **significant** (P value <0.001) and isimportant finding.

Table 5: Showing total analgesic requirement in 24 hrs between two groups (50mg Diclofenac Sodium IV)

Group	Mean	SD	Std. Error	Range	P-value
Study	83.0	64.29	12.86	0-250	<0.001*
Control	208.0	92.06	18.41	50-350	

*Statistically Significant Difference (P-value<0.05)

In our study the recovery time of motor block showed no significant difference between the two groups.The patients receiving dexamethasone as an adjuvant had longer periods of subjective comfort thereby requesting for first dose of analgesia later than those in whom dexamethasone was not added hence showing a statistically significant difference with a p-value of 0.036 as evident from the **Table 6.**

Table 6: Showing time to request for first analgesic (min) between two groups.

Group	Mean	SD	Std. Error	Range	P-value
Study	261.0	90.39	18.08	120-420	0.036*
Control	201.6	103.85	20.77	15-330	

*Statistically Significant Difference (P-value<0.05)

The total analgesic consumption in 24 hrs was also decreased by adding dexamethasone to Ropivacaine and the patients in study group consumedanalgesic 50mg of diclofenac less than control group which is 83.0mg and 208.0 mg in other groups respectively and the difference between the two was statistically significant(p value<0.001)

DISCUSSION

The concept behind regional anesthesia is that pain is conveyed by the nerve fibres which are amenable to interruption anywhere along their pathway. Intravenous regional anaesthesia is a safe, simple to administer and effective method of providing anaesthesia for surgery on

extremities. It is ideal for short procedures on an ambulatory basis. Lidocaine, the most often used local anaesthetic for IVRA has a relatively short duration of action which may affect the duration of intraoperative and post tourniquet release analgesia and tourniquet tolerance.[5]Theoretically it would be beneficial to use a long acting drug such as bupivacaine, but it is considered too risky for IVRA because it binds too tightly to myocardium sodium channels and may lead to irreversible cardiac arrest if it escapes into the systemic circulation.[16]Ropivacaine has a similar duration of action as that of bupivacaine, but with less depression of cardiac conduction presumably because it is a pure S-enantiomer.[5]

Many studies have shown that local steroid application can have an analgesic effect, although the results are not consistent.[7]Acute inflammation from tissue injury has an important role in the formation of surgical pain, and dexamethasone may be useful for its anti-inflammatory effect.[7]In our study, adding dexamethasone to ropivacaine for IVRA did not affect the time to onset of either sensory or motor block. The addition of dexamethasone however increased the duration of sensory block in study group, the findings in our study correlated well to those of Niranjan Kumar,Vermaand AshutoshRanjan, in 2016,and Prashant A Biradar et al, in 2017, who also found that duration of sensory block was prolonged on use of dexamethasone as an adjuvant.[8,9]After tourniquet release, however, motor and sensory block recovery times were longer in study group compared with the control group. The recovery time of sensory block was prolonged by adding dexamethasone and our findings were similar to what Amin Anka et al, in 2012, found use of dexamethasone as an adjuvant.[10] The duration of analgesia in patients receiving dexamethasone as adjuvant was prolonged compared to patients receiving ropivacaine alone as was assessed postoperatively using VAS scale. Addition of dexamethasone to intra venous regional anaesthesia also decreased the total analgesic consumption in 24 hrs postoperatively. This finding of ours can be attributed to the anti-inflammatory potential of dexamethasone which has been seen in theory to provide surgical analgesia. So, in conclusion, prolonged duration of sensory block, prolonged recovery of sensory block and prolonged duration of analgesia makes dexamethasone an effective adjuvant in intravenous regional anaesthesia.Dexamethasone is 25 times more potent than cortisol and has shown significant analgesic effect for extraction of third molarteeth,[11]haemorrhoidectomy,[12]tonsillectomy,[13]laparoscopiccholecystectomy,[14]lumbar laminectomy,[15]axillary brachial plexus block,[16]etc. Preoperative administration of dexamethasone has been reported to reduce overall pain scores and analgesic requirements in postoperative period through both oral and intravenous routes without any adverse effects while epidural steroids are effective in treatment of low back pain. Dexamethasone microspheres have been found to prolong the block duration in animal and human studies and adding methyl prednisolone to local anesthetic increases the duration of axillary brachial block.[17-20] The main analgesic effects are by peripheral inhibition of phospholipase enzyme thereby decreasing the activity of cyclooxygenase and lipoxygenase pathways in response to inflammation. Acute inflammation induced by tissue injury plays a significant role in the genesis of surgical pain, and dexamethasone should theoretically be beneficial in the management of acute surgical pain as a result of its potent anti-inflammatory effect.[7]Hereby it can be seen that IVRA is a safe technique that does not require anatomical landmarks and though the onset of action of dexamethasone may be a little longer but it has an instantaneous analgesic effect which can be attributed to a direct membrane action rather than an anti-inflammatory action.

CONCLUSION

1. Intravenous regional anaesthesia is effective for short procedures on distal extremities.
2. The duration of sensory block was prolonged on addition of dexamethasone to ropivacaine in IVRA

3. The recovery time of sensory block got prolonged with the use dexamethasone as an adjuvant to ropivacaine in IVRA
4. Time to request for first dose of analgesic was also prolonged on adding dexamethasone to ropivacaine as compared to the group in which ropivacaine alone was used.
5. Total analgesic consumption was less in study group in which dexamethasone was added to ropivacaine thereby indicating decreased episodes of pain in postoperative period.
6. Reintroduction of a safer block which was not used now.

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