

Comparison Intraarticular Ropivacaine and Ropivacaine Plus Dexmedetomidine for Post Operative Analgesia in Arthroscopic Knee Surgery

Chirag Patel¹, Anup Chandnani², Amit Sharma³

¹Assistant Professor, ²Assistant Professor, ³Resident Doctor, Department of Anesthesiology, BJ Medical College, Ahmedabad, Gujarat 380016, India.

Abstract

Arthroscopic knee surgery is routinely performed these days for various indications none the less with pain in post operative period requiring analgesic cover. Pain is mediated through Opiate receptors in intraarticular tissue. Dexmedetomidine, a alpha (α) 2 adrenergic agonist whose administration Intra articularly along with Inj. Ropivacaine (local anesthetic) does helps in providing good analgesia postoperatively. With this background this comparative we planned study between inj. ropivacaine and ropivacaine with dexmedetomidine deposited intra articularly for post operative analgesia in arthroscopic knee surgery. Duration of analgesia, efficacy of drugs and any side effects between both groups were compared. Fifty patients undergoing elective arthroscopy surgery of knee joint of ASA grade II & III; 18-65 years of age of either sex were included and after the surgery was over, they were randomly divided in two groups of 25; Group A (n=25) to receive Inj. Ropivacaine 0.25% and Group B (n=25) to receive Inj. Ropivacaine (0.25%) + Inj. Dexmedetomidine (1 μ g/kg) making final volume 20 ml pushed intra-articularly under aseptic precautions by the operating surgeon. Patients were observed postoperatively for Pulse, RR, Temp, BP, Sedation using Modified Wilson Score and Pain assesment at rest using VAS every 2 hourly for first postoperative day. Rescue analgesic using Inj. Diclofenac sodium 75 mg IV was given at VAS score was ≥ 4 . The duration (in hours) for first dose of analgesic was considerably more in group B [2.68 ± 0.48] than group A [1.88 ± 0.34]. There were no significant postoperative complications in both groups. So mixing of Intraarticular Dexmedetomidine with Ropivacaine provides longer duration of analgesia and reduced pain scores as compared to Intraarticular Ropivacaine alone safely.

Keywords: Ropivacaine; Dexmedetomidine; Post Operative Analgesia; Arthroscopy; VAS (Visual Analogue Scale).

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Introduction

Effective postoperative pain control is an essential component of the care of the surgical patient. Inadequate pain control may result in increased morbidity or mortality. Postoperative pain definitely indicates about some abnormal activity from recently damaged tissue being relayed

to Central nervous system, the intensity depending on type of tissue damage, the healing process and patient factors.

Arthroscopic procedures for knee is routinely performed surgery. Patients have moderate to severe post operative pain after knee arthroscopy. Pain affects patient's activity level, discharge and has negative impact on psychology which

Corresponding Author: Anup Chandnani, Assistant Professor, Department of Anesthesiology, BJ Medical college, Ahmedabad, Gujarat 380016, India.

E-mail: anupchandnani29@gmail.com

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causes discomfort and early ambulation is not achieved. These all factors advocate for use of an ideal analgesic with quicker onset, minimal side effects and help in early mobilization, recovery and discharge.

Various studies evaluated different factors and drugs which influence post arthroscopy pain such as-Type of surgery, tourniquet used or not; its duration and timing with drug administration, Anaesthesia technique-GA or RA, Volume injected, adjuvant, Preoperative pain threshold, Gender of the patients, Residual effects of peri operative analgesia, amount of surgical trauma.

Pain is sensed by Opiate receptors and free nerve endings. To achieve postoperative pain relief many techniques have been tried e.g. nerve blocks, intra articular administration of various drugs [3,4,13,14] and systemic drugs to control post arthroscopic pain.

Various combinations of local anaesthetics (lidocaine, bupivacaine), opioids (morphine), α -2 adrenoceptor agonists (clonidine and magnesium sulphate) have been tried intra articularly for post operative analgesia. Dexmedetomidine is alpha (α) 2 adrenergic agonist. Its intravenous administration before regional anesthesia does provide postoperative analgesia but with some adverse hemodynamic effects and respiratory depression. Use of S (-) enantiomer, amide local anaesthetic 150 mg Ropivacaine 0.75% intraarticularly helps in providing good sensory and motor block with minimal side effects and cardiac stability than bupivacaine.

A study by DR. Anil. K. Paswan and DR. Shashi Prakash et al. [2] on Effect of intra-articular adjuvants like dexmedetomidine and opioids on postoperative analgesia for arthroscopic knee surgery concluded that post operative use of rescue analgesia was duly prolonged.

A similar study by S paul, D P Bhattacharjee, S Ghosh et al. (2010) [1] about efficacy of intraarticular ropivacaine with or without α -2 adrenergic agonist for postoperative analgesia in knee surgeries were of conclusion that Dexmedetomidine and as an addition to ropivacaine improves the quality and duration of postoperative analgesia without any adverse effects.

Henceforth this study comparing ropivacaine with and without dexmedetomidine for post-operative analgesia in arthroscopic knee surgery was done to:-

- Assess and compare post-operative pain free period.

- Demand of rescue analgesia.
- Efficacy of drugs and any associated complications.

Methodology

After approval of ethics committee this prospective randomized double blind comparative study was done at civil hospital, BJ Medical College, Ahmedabad between intraarticular ropivacaine with and without dexmedetomidine for post-operative analgesia in knee surgery done arthroscopically involving 50 patients.

ASA II and III patients within age between 18-65 years of either sex were taken in this study. Patients with history of infection, cardiac disease, coagulopathy, hepatic or kidney disease were not a part of this study. After a detailed preoperative check up with all relevant investigations done, explanation of the procedure, type of anesthesia and participation in evaluation of post operative analgesia, patients were subjected to arthroscopy. A proper understanding of Visual Analogue Scale was made to the patients.

Tab diazepam 5 mg orally a night before operation was given to all patients. Preoperative monitoring of the basic vital parameters, preloading with Inj. Ringer Lactate and Inj. Ondansetron 75-100 mcg/kg IV was given prior to anesthesia. Spinal anaesthesia was given in sitting position using inj. bupivacaine 0.5% (heavy) 12-15 mg using a 23-gauge Quincke needle in L₂-L₃ or L₃-L₄ inter vertebral space under strict aseptic and antiseptic precautions. Onset and level of sensory was to be achieved maximum between T8 to T10 segment and motor block was recorded after making the patient supine immediately after giving spinal anesthesia. A thigh tourniquet [14] was applied on the operative limb with a pressure 250-350 mm Hg continuously during surgery. Per operative monitoring of Pulse, BP, heart rate and SpO₂, EtCO₂, ECG, RR was done at every 15 minutes throughout the surgery.

After the surgery was over, patients were randomly categorised in two groups to receive 20 ml of drug preparation; Group A (n=25): received Inj. Ropivacaine 0.25% and Group B (n=25): received Inj. Ropivacaine (0.25%) + Inj. Dexmedetomidine (1 μ g/kg) which was given intra-articularly under aseptic care by the operating surgeon. Till then the tourniquet was kept inflated and was deflated after 10 minutes of intraarticular injection of drug in both groups.

Patients were monitored postoperatively for the vital parameters, Sedation (by Modified Wilson Score 1-5) (Table 1) and Pain assesment at rest using VAS (Table 2) (0= No Pain, 10 = Worst Possible Pain) upto 24 hr at interval of 2 hours. Rescue analgesia of inj. Diclofenac sodium 75 mg IV was given when VAS was ≥ 4 . Total duration of analgesia was taken as the duration from intra-articular deposition of the drug to the requirement of first analgesic. Improvement in VAS score, duration of analgesia and total number of rescue analgesics during 24 hrs. in post-operative period decided the efficacy of the drug used. Time for regression of the spinal effect was also noted.

The patients were monitored for any undue complications in the post operative period. These observations were made by an observer who had no clue about the patient's group.

Unpaired Student's t-test was used to compare both groups statistically. 'p' value < 0.05 was considered significant. Mean and standard deviation were calculated and p value derived.

Results

Table 3 shows comparable date under both groups in terms of age and weight.

Table 4 shows the comparative duration of anesthesia and surgery in the both the groups, statistically comparable, group B (170 ± 29.64) and (152.6 ± 30.76) as compared to group A (156.48 ± 39.04) and (137.56 ± 38.06), ($p > 0.05$) respectively.

Various types of arthroscopic assisted surgeries were included in the study as shown in (Table 5).

Table 1: Modified Wilson Sedation Scale:

Score	Description
1	Oriented, eyes may be closed but can respond to Questions 'Can you tell me your name?' 'Can you tell me where you are right now?'
2	Drowsy; eyes may be closed, arousable only to command: (Name), please open your eyes.
3	Arousable to mild physical stimulation (earlobe tug)
4	Unarousable to mild physical stimulation

Table 2: Visual Analogue Score (with or without Movement)

	0	1	2	3	4	5	6	7	8	9	10
No pain											Worse pain

Table 3: Demographic data (Mean \pm SD)

Demographic data	Group A	Group B	p value
Age (years)	29.92 \pm 9.12	30.92 \pm 10.64	0.72
Weight (kg)	65 \pm 6.79	60.48 \pm 7.64	0.32
Male: Female	20:5	20:5	-

(p value < 0.05 is considered significant.)

Table 4: Duration of anaesthesia and surgery for two groups (minutes)

	Group A	Group B	p Value
Duration of anaesthesia	156.48 \pm 39.04	170 \pm 29.64	0.16
Duration of surgery	137.56 \pm 38.06	152.6 \pm 30.76	0.13

(p value < 0.05 is considered significant.)

Table 5: Type of surgery in both groups

Type of Surgeries	Group A	Group B
Arthroscopic Acl Repair	15	15
Arthroscopic Pcl Repair	2	1
Arthroscopic Meniscal Repair	5	5
Arthroscopic Knee Release	-	2
Arthroscopic Rim Reconstruction	-	1
Arthroscopic Synovectomy	1	-
Arthroscopic Debridement	-	1
Diagnostic Arthroscopy	2	-
Total	25	25

In the post operative period the changes in the pulse rate was statistically insignificant when compared between intra groups and inter group (Graph 1).

Graph 2 shows the comparative post-operative systolic blood pressure changes in both groups at different time intervals which were statistically comparable, except after 20 hours.

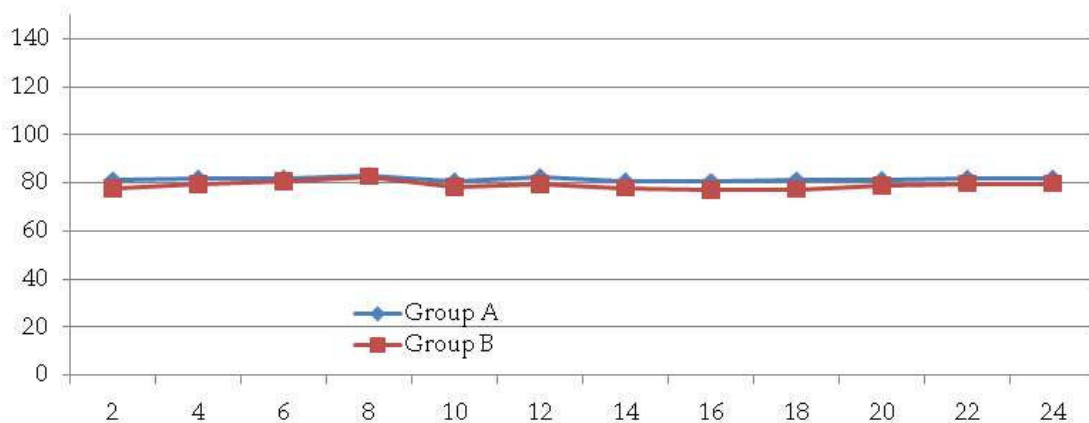
Table 6 and Graph 3 show none of the patient in both groups complained of pain initially for two hours. At 6 hrs patients in Group A had VAS score of 3.04 ± 0.98 whereas in group B it 1.76 ± 0.44 , which is statistically significant (p value < 0.05). Later at 2, 6 and 8-hour VAS score in Group A was 1.68 ± 0.8 , 2.48 ± 0.77 , 3.04 ± 0.98 respectively as compared to group B where it was 0.99 ± 0.42 , 1.049 ± 0.2 and 1.76 ± 0.44 respectively. These changes were statistically significant ($p=0.0001$, $p=0.0001$, $p=0.0013$).

In Group A, up to 8 hr there was requirement of rescue analgesia in 24/25 whereas in group B

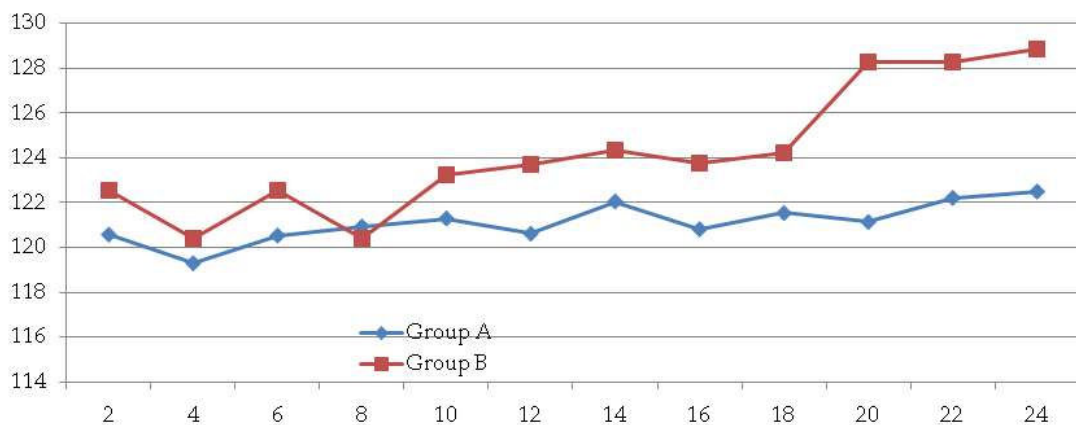
none of patients required rescue analgesics till 8 hours. Noting more specifically, the requirement of rescue analgesics was in 13/25 patients at 6 hr, 9/25 patients at 14 hr in Group A and in Group B 14/25 patients at 12 hr, 10/25 patients at 20 and 22 hr. These have been shown in table 7.

Table 8 & Graph 4 show the duration of analgesia, which was significantly more in Group B (11.42 ± 1.25 hr) as compared to Group A (6.4 ± 1.29 hr). (p Value < 0.0001). The number of doses of rescue analgesics was less in Group B (1.88 ± 0.34) as compared to Group A (2.68 ± 0.48). (p Value < 0.0001).

The known and anticipated complications like nausea, vomiting, respiratory depression or convulsions post operatively were not seen in any patients of both the groups. Hypotension was seen in one patient from Group A and two patients from Group B which was treated with IV fluids. Bradycardia was noted in two patients of group B.



Graph 1: Comparison of post operative heart rate between two groups

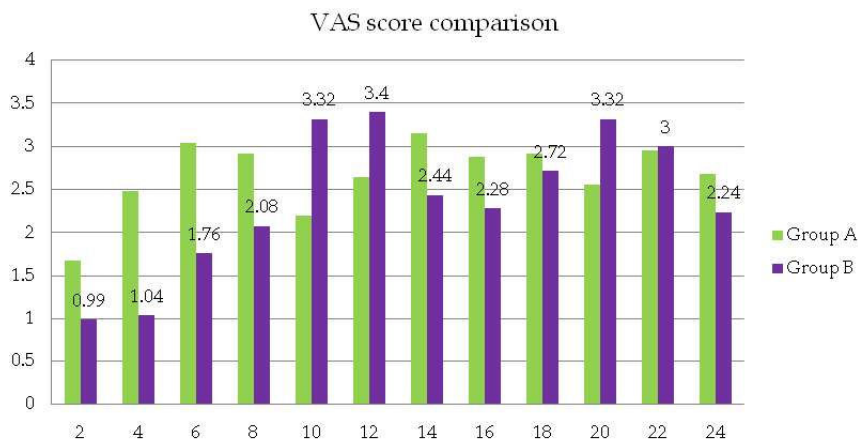


Graph 2: post operative systolic blood pressure changes

Table 6: VAS score between two groups (Mean ± SD) (At rest)

Postoperative Time	Group A	Group B	p Value(between the groups)
0 hr	0.16 ± 0.37	0	Not applicable
2 hr	1.68 ± 0.80	0.99 ± 0.42	0.0040
4 hr	2.48 ± 0.77	1.04 ± 0.20	0.0001
6 hr	3.04 ± 0.98	1.76 ± 0.44	0.0010
8 hr	2.92 ± 0.91	2.08 ± 0.28	0.0001
10 hr	2.20 ± 0.58	3.32 ± 0.99	0.0001
12 hr	2.64 ± 0.76	3.40 ± 0.87	0.0019
14 hr	3.16 ± 0.90	2.44 ± 0.65	0.0020
16 hr	2.88 ± 0.88	2.28 ± 0.46	0.0040
18 hr	2.92 ± 1.08	2.72 ± 0.54	0.1
20 hr	2.56 ± 0.77	3.32 ± 0.85	0.0018
22 hr	2.96 ± 0.79	3.00 ± 0.91	0.80
24 hr	2.68 ± 0.80	2.24 ± 0.52	0.02

(p value<0.05 is considered significant.)



Graph 3: VAS score between two groups (At rest)

Table 7: Number of patients required rescue analgesic.

	2 Hours	4 Hours	6 Hours	8 Hours	10 Hours	12 Hours	14 Hours	16 Hours	18 Hours	20 Hours	22 Hours	24 Hours
Group A	0	3	13	8	1	4	9	7	5	4	6	6
Group B	0	0	0	0	9	14	2	0	1	10	10	1

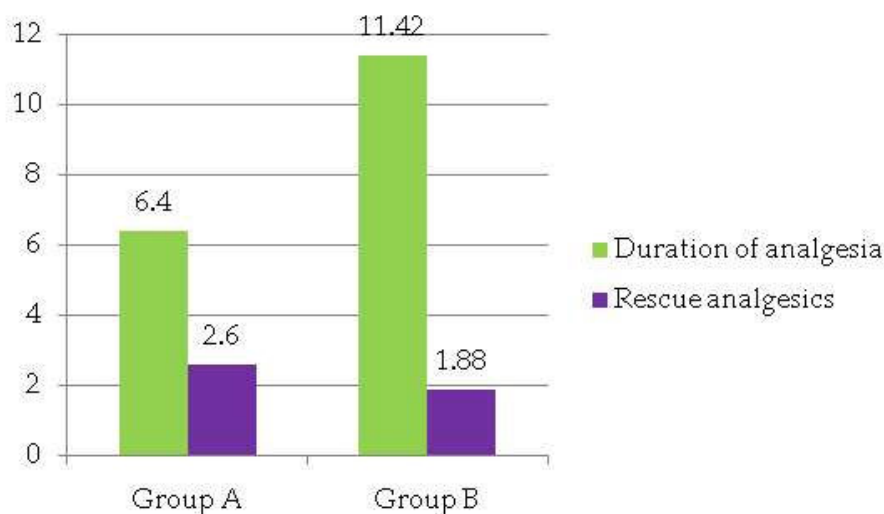
Table 8: Duration of analgesia and no. of doses of rescue analgesics between two groups

	Group A	Group B	p Value
Duration of Analgesia (hrs)	6.40 ± 1.29	11.42 ± 1.25	p<0.0001
No. of doses of Rescue analgesics	2.68 ± 0.48	1.88 ± 0.34	p<0.0001

(p value < 0.05 is considered significant.)

Table 9: Postoperative complications

Postoperative complications	Group A	Group B
Hypotension	1	2
Bradycardia	-	2
Convulsions	-	-
Respiratory depression	-	-
Nausea	-	-
Vomiting	-	-
Dizziness	-	-



Graph 4: Duration of analgesia and no. of doses of rescue analgesics between two groups

Discussion

Post operative pain contributes to patient dissatisfaction with their surgical experience. So a strategic programme during the recovery phase post operatively which covers the post operative pain management provides reduced sympathetic stress response, reduced postoperative pulmonary and cardiac complications becomes mandatory which also includes benefits like early physiotherapy, early mobilization and early discharge.

Dexmedetomidine [5,6,7] is a centrally acting highly selective α -2 agonist with pharmacodynamics including anxiolysis, sedation, sympatholysis, analgesia and anesthesia without respiratory depression. It acts on the alpha 2 adrenergic presynaptic receptor agonist for providing analgesia; Dexmedetomidine is highly selective alpha-2 adrenoceptor agonist making it more potent as compared to clonidine [3] and also acts synergistically with the local anesthetic agent potentiating its action. This property of it definitely helped in the post operative analgesia during its use intra articularly during knee surgery.

Ropivacaine [8,9,10] a local anesthetic blocks the action potential of the nerve conduction by its selective action on the sodium channels of the nerve. It was found to be more safe with no side effects when used intra articularly.

Demographically the patient data was comparable in relation to Age, Sex, Weight and ASA physical status.

50 patients posted for elective knee arthroscopy were anesthetized with spinal anesthesia with

bupivacaine heavy (15-20 mg). At the end of surgery they were divided into 2 groups; Group A (n=25) received Inj Ropivacaine (0.25%) (19 ml) and Inj.0.9% Normal saline (1 ml) while Group B (n=25) received Inj Ropivacaine (0.25%)(19 ml) and Inj. Dexmedetomidine (1 μ g/kg)(1 ml), total volume 20 ml intraarticularly at the end of arthroscopy.

Tourniquet was kept deflated after 10 minutes of intraarticular drug administration to facilitate increase intraarticular pressure thereby enhancing systemic absorption after the deflation.

R.R. AlMetwalli (2008) compared intraarticular and intravenous dexmedetomidine in 60 adult patients of ASA I-II, posted for arthroscopic partial meniscectomy under general anaesthesia for postoperative analgesia in a double blind randomized study. They concluded that the patients who had intra articular injection had quite low pain post operatively even upto 6 hours. Comparing the sedation after injection, it was found to be more in the intravenous group in their study. We used intraarticular dexmedetomidine in low dose (1 μ g/kg) with LA to prevent systemic side effects like sedation in our study. The post operative analgesia time for intra articular injection in our study was comparable to theirs.

The results in our study were comparable to the study done by S paul, D P Bhattacharjee, S Ghosh et al. (2010) [1] who concluded that adding dexmedetomidine to ropivacaine does give a good post operative pain free period cutting short the use of rescue analgesics.

In our study, patient stayed stable hemodynamically derived statistically in both groups.

Pain does stimulate sympathetic response but good analgesic cover helps to curtail this response which was seen in our study. The recovery time from spinal anesthesia was also similar in both groups with good analgesia cover in group B as compared to group A (where VAS was 2.48 ± 0.77 after four hours) which further increased to 3.04 ± 0.98 at end of 6 hours in post operative period.

It was observed that the mean duration of analgesia was longer in group B (11.42 ± 1.25 hr) as compared to group A (6.40 ± 1.29) ($p < 0.01$) as derived from the VAS values at end of 4, 6 and 8 hours (Graph 3) minimizing the use of rescue analgesics in group B. Using Dexmedetomidine in optimally low dose helped to keep the sedation score at bay with patients easily arousable. 1/25 patient (4%) in group A and 2/25 patients (8%), Group-B developed hypotension which were treated with IV fluids. 2/25 patients of group B developed bradycardia which were treated by iv inj atropine. None patients developed convulsions or respiratory depression.

The only limitation to our study was to not able to get the plasma concentration of dexmedetomidine.

Concluding that dose of (1 $\mu\text{g}/\text{kg}$) dexmedetomidine along with Inj. Ropivacaine (0.25%) 20 ml used in intra articular space is sufficient enough for providing adequate pain relief in the post operative period (sparing few side effects).

Conclusion

Use of Ropivacaine local anesthetic with and without Dexmedetomidine for arthroscopic knee surgeries in our study revealed that post operative pain free period was longer and use of systemic analgesics to relieve pain was much less in the study group (Ropivacaine with Dexmedetomidine). These were all derived by use of VAS, Modified Wilsons sedation score done by double blind technique with bare minimum hemodynamic and respiratory side effects.

Henceforth, it can be concluded that addition of Intraarticular Dexmedetomidine to Ropivacaine produces significant longer duration of analgesia, advocating less use of systemic analgesics and better patient compliance and satisfaction in the post operative period as compared to Intraarticular Ropivacaine alone without any significant side effect.

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