ORIGINAL ARTICLE

High dose dexamethasone offers better postoperative analgesia than dexmedetomidine when added to intra articular ropivacaine following knee arthroscopic surgery

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ABSTRACT

Objective: Adequate pain relief after knee arthroscopy reduces surgical stress response and postoperative morbidity and improves recovery and rehabilitation. The objective of our study was to compare the duration of postoperative analgesia produced by high dose with that of low dose dexamethasone when added to dexmedetomidine and ropivacaine for intra-articular injection following knee arthroscopy.

Methodology: Prospective multicenter double blind study of 60 patients undergoing arthroscopic knee surgery from January 2015- May 2015, randomly assigned into 3 groups- Group I (20 ml 0.2% ropivacaine), Group II (16 ml of 0.2% ropivacaine + dexmedetomidine- 1μg/kg diluted to 4 ml) and Group III (dexamethasone 300 μg/kg diluted with 0.2% ropivacaine upto 20 ml).The duration of analgesia (VAS Score less than 4) and time to first postoperative analgesic request, total analgesic used during first 24 hours were recorded. Clinical incidences of nausea, vomiting, bradycardia, hypotension or other side-effects requiring intervention were observed in all the groups. The numerical data were expressed as mean ± standard deviation (SD). Student's t-test was employed to calculate the statistical differences in continuous variables between the groups, categorical variables were compared with chi-square test or Fisher's exact test as applicable. A P-value of < 0.05 was considered to be statistically significant.

Results: Group III had significantly low pain scores for first twenty hours as compared to Group II and Group I. Time to first postoperative analgesia request was longest in Group III (1356.2 ± 193.10 min) as compared to the Group II (433.2 ± 54.3 min) and Group I (311.8 ± 61.56 min)($p<0.01$). Mean total analgesic consumption in first 24 hrs was least in Group III (38.2 ± 27.83 mg) followed by Group I (221.25 ± 56.93 mg) and Group II (153.75 ± 51.5 mg) ($p<0.01$). No significant side-effects were noted.

Conclusion: Dexamethasone 300 μg/kg is as safe and free from side effects, but offers a prolonged postoperative analgesia as compared to dexmedetomidine when added to intra articular ropivacaine following arthroscopic knee surgeries.

Key words: Knee, Arthroscopy; Pain; Local anesthesia; Dexamethasone; Dexmedetomidine; Ropivacaine

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INTRODUCTION

Bhattacharjee DP et al[1] has described the use of intra-articular dexamethasone (8 mg) for good postoperative analgesia for 10-12 hours but the duration of analgesia with a higher dose of dexamethasone in cases of knee arthroscopy has not been evaluated. We studied the effects and side-effects of high dose intraarticular dexamethasone in a double blind, randomized study to evaluate the duration of postoperative analgesia and rescue analgesic requirement.

Postoperative pain is a very distressing symptom after any surgical procedure. Arthroscopic surgery is one of the most common orthopedic procedures, that usually does not require patients to be hospitalized before or after surgery.[2] However, it can produce severe pain caused by irritation of free nerve endings of synovial tissue, anterior fat pad and joint capsule during surgical excision and resection which at times can be unbearable.[3,4] Postoperative pain has a high negative impact on patient's early mobilization, rehabilitation, and his psyche which may lead to prolonged hospital stay.[5] Adequate pain relief reduces surgical stress response, so reduces patient's morbidity and improves postoperative recovery and rehabilitation.

Dexamethasone is a 9α-derivative synthetic, highly potent and highly selective glucocorticoid with minimal mineralocorticoid effects. It blocks the nociceptive impulse transmission along the myelinated C fibers.[6] Studies have shown that dexamethasone increases the duration of regional blocks, when combined with local anesthetics[7] and provides postoperative analgesia of 10-12 hours with its intraarticular use.

We hypothesized that if a high dose dexamethasone is injected in intraarticular space following knee arthroscopic surgery, a longer duration of postoperative analgesia can be achieved compared to dexmedetomidine, provided this dose remains free from relative side effects.

METHODOLOGY

The study protocol was approved by institutional ethics committee and informed consent was obtained from all of the enrolled patients. This multicentre prospective double blind trial was conducted between January 2015 to May 2015 at Hi-Tech Medical College & Hospital as well as Sparsh Hospital & Critical Care (Pvt) Ltd.

Sixty ASA I-II patients of either sex, aged 15-60 years, undergoing elective knee arthroscopy under spinal anesthesia were randomly assigned to one of the three groups using computer-generated random numbers comprising of 20 patients each. Patients who refused to involve in the study, or patients with any known allergy or contraindication to study drugs, pregnancy, lactating mothers and children, systemic disease, alcoholism, long-term analgesic therapy, spinal cord deformities, bleeding diathesis, local skin site infections, hypertension treated with a-methyldopa, clonidine or b-adrenergic blockers, or if they had used opioid or non-opioid analgesics within the previous 24 h, were excluded from the study.

Patients of Group I received intraarticular 20 ml (0.2%) ropivacaine hydrochloride [ROPIN™; Neon Laboratories Ltd. Andheri (East), Mumbai (India)]; Group II received ropivaicaine 0.2% 16 ml plus dexmedetomidine 1μg/kg diluted to 4 ml, and Group III received dexamethasone [DEXONA™-4mg/ml: ZYDUS®] (300 μg/kg) in ropivacaine 0.2% upto 20 ml.

On preoperative rounds, patients were explained regarding the procedure and were taught to interpret the visual analogue scale (VAS) (graded from 0=no pain to 10=maximum pain). On the night before the surgery all patients received alprazolam 0.25 mg orally as premedication, and were NPO 8 hrs before surgery. Before operation, baseline heart rate (HR), mean arterial pressure (MAP), and VAS score were recorded in each patient. On the operating table, routine monitoring (ECG, pulse oximetry, non-invasive blood pressure) were recorded. An intravenous line was secured. The anesthetic technique was standardized for all patients. After placement of routine monitors, all operations were performed under spinal anesthesia with inj. bupivacaine 15 mg. A thigh pneumatic tourniquet was applied during surgery and till 10 min after the intraarticular injection of the tested drug into the knee joint at the end of the procedure. Patients were randomly allocated using a computer-generated randomization list into three groups (n=20). Prefilled syringes containing drugs were prepared and kept in number coded sealed envelopes made sterile by Sterrad sterilization machine. The anesthesiologist and the surgeon were unaware of the nature of the drug in each syringe. At the end of surgery, test solution was injected intraarticularly by the orthopedic surgeon, 10 min later tourniquet was released and sterile compression bandage applied.

Patients were transferred to post anesthesia care unit (PACU) following surgery. Pain value was determined and recorded based on VAS (where 0 = no pain and 10 = the worst possible pain) and vital parameters like heart rate, mean arterial pressure

Table 1: Patient characteristics of 3 groups(n=20) Data are Mean(range) or Mean (SD)

Variables	Group I (n=20)	Group II (n=20)	Group III (n=20)	P
Age(Years)	30.8 ± 10.74	31.7 ± 13.40	32.3 ± 9.17	NS
Gender(M/F)	14 / 6	15 / 5	13 / 7	NS
Weight(Kgs)	63.6 ± 5.44	63.9 ± 11.60	66.3 ± 6.92	NS
Duration of Surgery(minutes)	93.0 ± 20.02	99.0 ± 33.48	98.0 ± 28.98	NS

Table 2: Types of Arthroscopic Procedures undergone by the 3 Groups

Surgical Procedure	Group I(n=20)	Group II(n=20)	Group III (n=20)
ACL Reconstruction	3	4	4
PCL Reconstruction	1	-	1
Medial Meniscectomy	2	2	3
Lateral Meniscectomy	1	2	1
ACL Reconstruction + Medial Meniscectomy	4	4	3
ACL Reconstruction + Lateral Meniscectomy	3	2	2
ACL Single Bundle Reconstruction	2	1	1
ACL+ PCL Reconstruction	-	1	-
ACL + Lateral and Medial Meniscectomy	1	1	1
PCL + Lateral Meniscectomy	-	-	1
Diagnostic Arthroscopy	2	3	2
ACL Bony Avulsion	-	-	1
PCL Bony Avulsion	1	-	-

Table 3: Analgesia Duration and total Analgesic Requirement In 24 Hours

	Group I	Group II	Group III	P
Mean Time to 1st Post Operative Analgesic requirement (mins)	311.8 ± 61.50	433.2 ± 54.3	1356.2 ± 193.10	0.004
Mean Total Analgesic (Diclofenac) consumption in 24 hours (mg)	221.25 ± 56.93	153.75 ± 51.5	38.2 ± 27.83	0.007

were recorded at 1, 3, 6, 12, 18 and 24 hrs after operation. Inj. diclofenac 75 mg intravenously was injected as a rescue analgesic if VAS score was ≥ 4 and was repeated every 8 h if required. The time to the first analgesic requirement and the total dose of inj. diclofenac use during the first 24 hr after operation were also recorded. Inj. tramadol 1 mg/kg was given IV if the VAS score was 4 even after administering inj. diclofenac. Side-effects such as nausea, vomiting, bradycardia (defined as hart rate < 45 beats/min), hypotension (defined as reduction of MAP ≥ 25% of baseline) and hypertension were recorded. All data were collected by an observer who was unaware of patients' group assignment.

Statistical Analysis: The primary outcome variable in the study was the duration of analgesia following the surgery and the secondary outcome variable was the total diclofenac consumption between the three groups.

The numerical data were expressed as mean ± standard deviation (SD). Student's t-test was employed to calculate the statistical differences in continuous variables between the groups, categorical variables were compared with chi-square test(or Fisher's exact test; as applicable). A "P" value of <0.05 was considered to be statistically significant. SSPS; version 16.0 (SPSS, Chicago, IL, USA) was used for analysis.

RESULTS

Out of 60 patients , male patients (42) dominated the groups. As regards the demographic characteristics (see Table 1), there was no significant differences in the mean age, weight of the patients and duration of surgery. No side-effects were reported during the first 24 hour after surgery. Mean Arterial pressure and heart rate did not change significantly.

The operative arthroscopic procedures were comparable in the 3 groups (Table 2).

VAS scores in Group III at 3rd hr ($p<0.01$) and at 6th hr ($p<0.02$) and 12th hr ($p<0.05$) and 18th hr ($p<0.05$) was least as compared to Group I and II following surgery (Figure 1)

No clinical incidence of nausea, vomiting, bradycadia, hypotension or other side-effects requiring intervention was reported in the subjects.

Time to first postoperative analgesia(inj diclofenac 75 mg) request was longest in Group III (1356.2 ± 193.10 min)as compared to the Group II (433.2 ± 54.3 min) and Group I (311.8 ± 61.56 min) ($p<0.01$). Mean Total analgesic consumption in first 24 hrs was least in Group III (38.2 ± 27.83

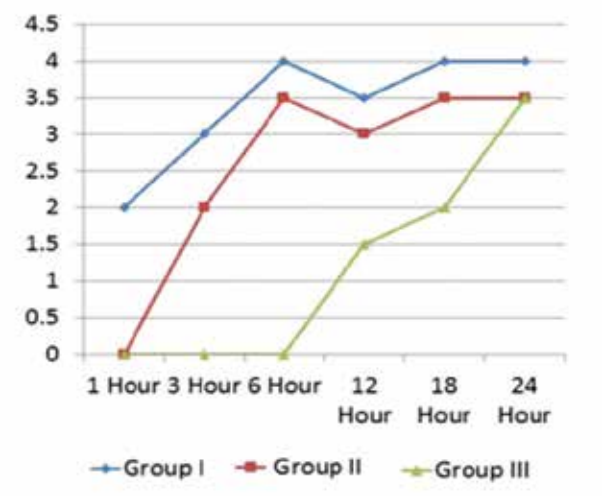

Figure 1: Change in Visual Analogue Scale in 3 Groups (n=20)

mg) followed by Group I (221.25 ± 56.93 mg) and Group II (153.75 ± 51.5 mg) ($p<0.01$) (Table 3).

None of patients in any group required inj tramadol.

DISCUSSION

Early successful rehabilitation after arthroscopic knee surgery requires the use of effective methods for adequate postoperative pain control and early mobilization. We performed a prospective double blinded study to study the effects of intrarticular high dose (300 μg/kg) dexamethasone in providing postoperative analgesia in knee arthroscopy and comparing it with routine intrarticular analgesics like dexmedetomedine and ropivacaine.

A high dose (300 μg/kg) of intrarticular dexamethasone enhanced the postoperative analgesia after arthroscopic knee surgery without any significant side effects. There was an increased time to first analgesic request and a decreased use of postoperative analgesia. Thus, dexamethsone (300 μg/kg) can safely and effectively be used in post-knee arthroscopic procedures.

Although intraarticular morphine[8], bupivacaine, fentanyl, dexmedotomidine[4,9], levobupivaicine and dexamethasone[1], intraarticular magnesium[10] have been used. Research has been directed towards new doses of these drugs for increased duration of postoperative analgesia. Studies have revealed a beneficial analgesic effect of intraarticular clonidine after arthroscopic surgery[11,12].

To date, no study has evaluated the analgesic effects of intra-articular dexamethasone in a dosage of 300 μg/kg in knee arthroscopic surgeries. Dexamethasone, a 9α-derivative synthetic glucocorticoid was selected because of its highly potent anti-inflammatory property with minimal mineralocorticoid activity, thus found to be safer and devoid of potential side effects. Steroids have block prolonging effect according to their anti-inflammatory potency[6]. Local anesthetic agents can provide analgesia for limited period of time when used as single injection. The dense and prolonged block in the dexamethasone group is due to the synergistic action with local anesthetic ropipivacaine on blockade of nerve fibres.

Recent studies reported a postoperative analgesia of 10.24 ± 2.8 hours with dexamethasone 8 mg (2 ml) with 18 ml of 0.25% levobupivacaine intraarticularly[1], 312.0 ± 120.7 min with intra-articular dexmedetomidine group in dose of 1 μg/kg[9] and 244.1 ± 20.1 min with dexmedetomidine (100 μg) and ropivaicaine[3]. We report a significant prolongation of analgesia and the time to first postoperative analgesic requirement (1356.2 ± 193.1 min, $p< 0.01$) and a significant reduction in consumption of analgesic (38.2 ± 27.83 mg, $p < 0.01$) in first 24 hours in the intra-articular dexamethasone group which are better as compared to the reported literature. We attribute these results to the high dosage of dexamethasone 300 μg/kg.

The limitations of the study were the small sample size and the variability of arthroscopic knee procedures.

CONCLUSION

High dose dexamethasone administered intra-articularly as an adjuvant to local anesthetic ropivacaine significantly improves the quality and duration of postoperative analgesia and reduces the consumption of diclofenac sodium in patients undergoing elective knee arthroscopy. So, we recommend the use of dexamethasone 300 μg/kg intrarticularly in knee arthroscopic surgeries.

Conflict of Interest: The authors declare that they have no conflict of interest.

Authors' contribution: All authors took part in the concept, conduct of study, preparation of the manuscript and data analysis.

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