Original Research Article

Evaluation of pain relief and rehabilitation provided by per operative periarticular injection of ropivacaine among patients undergoing total knee replacement arthroplasty

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Abstract

Background and Objective: Total knee arthroplasty is a frequently performed procedure that ensures improvement in quality of life. The incidence is expected to increase to upto 3.48 million procedures annually by 2030 because of the increase in geriatric population due to improved medical care. This study was undertaken to assess the efficacy of per operative periarticular injection of Ropivacaine on post-operative pain and compare the post operative outcome measures between the two groups. **Material and Methods:** This study was conducted in the Department Of Orthopaedics, Vivekananda Polyclinic & Institute of Medical Sciences, Lucknow (Uttar Pradesh). Fifty patients undergoing unilateral Total Knee replacement were enrolled. Ethical clearance was obtained from the institutional ethical committee and written informed consent was taken from all participating patients. **Results:** The mean age of Group A and Group B were 61.40 ± 1.45 years and 62.52 ± 1.76 years respectively. Tukey test showed significantly ($p<0.001$) different and lower VAS score in Group B as compared to Group A at all periods. Periarticular injection of ropivacaine has shown reduced requirement of urinary catheterization and thus helps in reducing morbidity and complications.**Conclusion:** Per operative periarticular injection of ropivacaine has been shown to be very successful, safe and cost effective protocol for alleviating post operative pain in patients undergoing total knee arthroplasty and also leading to early rehabilitation.

Keywords: Arthroplasty,Knee,VAS score,pain.

Introduction

In patients with advanced knee arthritis, total knee replacement (TKR) has been found to be the most successful surgical procedure. However, early postoperative pain control is pivotal in reducing the hospital stay, increasing patient satisfaction, and for better rehabilitation. It also reduces the potential for postoperative complications such as pneumonia or deep vein thrombosis. [1] Severe postoperative pain is experienced in approximately 60% of the patients and moderate pain in approximately 30% of patients undergoing TKR.[2]Different authors in their previous studies with intra-articular ropivacaine, fentanyl, dexmedetomidine, magnesium, levobupivacaine, ketorolac , bupivacaine and morphine had proved their efficacy in providing post-operative analgesia in total knee arthroplasty.[3-8] In our controlled study an attempt has been made to study the efficacy of ropivacaine 0.2%, via periarticular route intra operatively on post operative pain and recovery following total knee replacement arthroplasty. Ropivacaine is an amino-amide local anaesthetic, pure S enantiomer that blocks the peripheral afferents nerves by reversible blockade of impulse generation acting on voltage-dependent Na^+ channels. It is a long-acting local anaesthetic with half life of 1.4 hr after intravenous route and 4 hour after epidural route.

It is metabolized in liver mainly by aromatic hydration and excreted in urine. At lower concentration ropivacaine blocks sensory impulses more than motor. Ropivacaine is relatively safe drug with common side effects include hypotension, nausea , parasthesia, headache, bradycardia, tachycardia, hypertension, vomiting, urinary retention, increased body temperature and rigors.

However, it is recognized that ropivacaine has less cardio toxicity than other drugs such as bupivacaine and, therefore, it would seem to be an acceptable choice of local anaesthetic for the purposes of high-dose, high-volume local infiltration analgesia.[9] The goal of this prospective randomized controlled study design is to evaluate the pain relief and rehabilitation provided by a peri-articular injection of ropivacaine in patients undergoing total knee replacement arthroplasty by evaluating VAS score, amount of rescue analgesia required in post operative period, timing of full weight bearing mobilization, reduce rate of urinary catheterization (reduce source of infection) and duration of hospital stay required.

Material and Methods

The prospective randomized controlled study design was carried out amongst patients with osteoarthritis (primary or secondary) undergoing unilateral Total Knee Replacement in the Department of Orthopedics, Vivekananda Polyclinic & Institute of Medical Sciences, Lucknow (Uttar Pradesh) from October 2015 to November 2016. Subjects were divided in two groups, containing 25 patients each. A power analysis based on a previous study with the same inclusion criteria indicated that a sample size of 45 patients would

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provide a power of 90% to identify a five-point difference in the outcome.[10] The study has been done after taking ethical clearances from the institutional ethical committee and written informed consent from all participating patients undergoing elective total knee replacement arthroplasty.

Methodology

All patients were randomly allocated by computer generated random table to one of the two groups comprising 25 patients each.All patients undergone a detailed pre anaesthetic checkup along with investigations required as per age, general condition and associated diseases. Pre operative evaluation include thorough clinical assessment, oxford knee score, MRSA screening, scanogram of lower limb.All patient preparation was standardized in both the groups. Nasal application of ointment Mupirocin, mouth wash with chlorhexidine and gut preparation was started five days prior to surgery. Tab etoricoxib 90 mg & injection ranitidine given stat 4 hrs prior to surgery. Transdermal Fentanyl patch (50 mcg) was applied on opposite arm & injection paracetamol 1000 mg given intravenous stat two hrs prior to surgery. The anaesthetic techniques were standardized to all patients. Spinal anaesthesia was given as per patient's age, height and weight. Antibiotic (injection cefazolin 2 gm) and injection tranexamic acid 1 gm IV was given before tourniquet inflation.

Post operative protocol is standardized for all the patients in both groups. Injection Paracetamol 1 gram was given IV 6 hourly, Fentanyl patch was removed on post op day 2. Rescue analgesia (Injection Tramadol 50 mg in 100 ml NS IV) is given as per requirement according to Visual Analogue Scale score (VAS Score >4).Outcome measures were recorded at 4 hr, 6 hr, 12 hr and 24 hr. Outcome variables measured were

1. Visual Analogue Scale (VAS) score
2. Blood pressure
3. Pulse rate
4. Rescue analgesia required (if any)
5. Urinary catheterization requirement
6. Timing of weight bearing
7. Discharge time post operatively

VAS is a measure of pain intensity. For pain intensity, the scale is most commonly anchored by "no pain" (score of 0) and "pain as bad as it could be" or "worst imaginable pain" (score of 10 on 10-cm scale) . 100-mm VAS ratings of 0 to 4 mm can be considered no pain; 5 to 44 mm, mild pain; 45 to 74 mm, moderate pain; and 75 to 100 mm, severe pain40. Its simplicity, reliability, and validity, as well as its ratio scale properties, make the VAS the optimal tool for describing pain severity or intensity. The visual analog scale was developed for assessing chronic pain but it is often used in studies of post operative pain.[11,12]

Statistical Analysis

Continuous data were summarized as Mean ± SE (standard error of the mean) while discrete (categorical) in number and percentage. Continuous groups were compared by independent Student's t test. Continuous groups were also compared by repeated measures two factor analysis of variance (ANOVA) and the significance of mean difference between the groups was done by Tukey's HSD (honestly significant difference) post hoc test using general linear models (GLM) after ascertaining normality by Shapiro-Wilk's test and homogeneity of variance by Levene's test. Categorical groups were compared by chi-square ($\chi 2$) test. P value less than 0.05 ($p<0.05$) was considered statistically significant. Analyses were performed on SPSS software (Windows version 17.0).

Results

Total 50 patients either sex was recruited and randomized equally into two groups and treated without periarticular injection of ropivacaine (Group A) or with periarticular injection of 0.2% ropivacaine (Group B). The age of Group A and Group B ranged from 46-75 yrs and 47-79 yrs respectively with mean (± SE) 61.40 ± 1.45 yrs and 62.52 ± 1.76 yrs respectively.Further, in Group A, there were 22 (88.0%) females and 3 males (12.0%) while in Group B, it were 17 (68.0%) and 8 (32.0%) respectively. Further, mean height, weight and BMI of Group A and Group B were 23.81-36.40 kg/m2 and 20.78-38.05 kg/m2 respectively with mean (± SE) 155.12 ± 1.17 cm and 156.80 ± 1.94 cm, 66.12 ± 1.36 kg and 67.64 ± 1.90 kg, and 27.53 ± 0.62 kg/m2 and 27.62 ± 0.83 kg/m2 respectively. Oxford knee score between the two groups also not differ significantly. (table 1)

Table 1: Demographic characteristics (Mean ± SE) of two groups

Demographic characteristics	Group A (n=25) (%)	Group B (n=25) (%)	t/$\chi 2$ value	P value
Age (years)	61.40 ± 1.45	62.52 ± 1.76	0.49	0.625
Sex:				
Female	22 (88.0)	17 (68.0)	2.91	0.088
Male	3 (12.0)	8 (32.0)		
Height (cm)	155.12 ± 1.17	156.80 ± 1.94	0.74	0.462
Weight (kg)	66.12 ± 1.36	67.64 ± 1.90	0.65	0.519
BMI (kg/m2)	27.53 ± 0.62	27.62 ± 0.83	0.09	0.931
Oxford knee score	13.32 ± 0.81	13.16 ± 0.98	0.13	0.900

The post operative VAS (score) of two groups over the periods (time) is summarized in Table 2. At all periods, the mean VAS was comparatively lower in Group B as compared to Group A. For each period, comparing the mean difference in VAS score between the groups, Tukey test showed significantly ($p<0.001$) different and lower VAS score in Group B as compared to Group A at all periods.(table 2)

Table 2: Post operative VAS score (Mean ± SE, n=25) of two groups over the periods

Period	Group A	Group B	Mean difference	p value
4 hr	5.32 ± 0.22	3.20 ± 0.18	2.12 ± 0.29	<0.001
6 hr	5.20 ± 0.24	3.44 ± 0.25	1.76 ± 0.35	<0.001
12 hr	4.88 ± 0.30	3.40 ± 0.18	1.48 ± 0.35	<0.001
24 hr	4.96 ± 0.30	3.00 ± 0.16	1.96 ± 0.34	<0.001

The post operativehemodynamic parametersof two groups over the periods (time) is summarized in Table 3.Tukey test showed ($p>0.05$) SBP& DBP between the two groups at all periods i.e. did not differ significantly. In pulse rate between the groups, Tukey test showed significantly ($p<0.05$) different and lower pulse rate in Group B as compared to Group A at 4 hr, however, at other period it did not differ significantly.(table 3)

Table 3: Post operativehemodynamic parameters (Mean ± SE, n=25) of two groups over the periods

Period (Hours)	SBP(mmHg)		DBP(mmHg)		Pulse rate (beats/min)	
	Group A	Group B	Group A	Group B	Group A	Group B
4	137.60 ± 2.17	131.24 ± 1.61	83.12 ± 2.00	81.44 ± 1.64	91.68 ± 2.06*	85.36 ± 1.37*
6	138.80 ± 2.61	131.84 ± 1.75	83.12 ± 1.61	79.68 ± 1.47	90.16 ± 1.74	86.24 ± 1.33
12	136.28 ± 2.17	132.56 ± 1.26	81.52 ± 1.54	80.24 ± 1.66	88.80 ± 1.61	83.48 ± 0.83
24	137.28 ± 2.40	130.40 ± 1.46	81.60 ± 1.54	79.52 ± 1.50	86.00 ± 1.46	83.40 ± 0.74

*statistically significant

The post operative discharge time (days) andweight bearing time (hours) of two groups is summarized in Table 4. The mean post operative discharge time and weight bearing time of Group B lower comparatively than Group A. Comparing the mean post operative discharge time and weight bearing time of two groups, showed significantly different.(table 4)

Table 4: Post operative discharge and weight bearing time (Mean±SE, n=25) of two groups

Time	Group A	Group B	t value	p value
Discharge time (days)	3.96 ± 0.23	3.16 ± 0.27	2.24	0.030
Weight bearing time (Hours)	29.20 ± 2.38	15.84 ± 2.83	3.62	0.001

The distribution of post operative time rescue analgesia requirement of two groups over the periods (time) is summarized in Table 5. For each period, comparing the post operative rescue analgesia requirement of two groups, $\chi 2$ test showed significantly ($p<0.01$ or $p<0.001$) different and lower rescue analgesia requirement in Group B as compared to Group A at all periods.(table 5)

Table 5: Distribution of post operative rescue analgesia requirement of two groups over the periods

Period (Hours)	Rescue analgesia requirement	Group A (n=25) (%)	Group B (n=25) (%)	$\chi 2$ value	P value
4	Yes	25 (100.0)	7 (28.0)	28.13	<0.001
	No	0 (0.0)	18 (72.0)		
6	Yes	23 (92.0)	1 (4.0)	38.78	<0.001
	No	2 (8.0)	24 (96.0)		
12	Yes	16 (64.0)	0 (0.0)	23.53	<0.001
	No	9 (36.0)	25 (100.)		
24	Yes	7 (28.0)	0 (0.0)	8.14	0.004
	No	18 (72.0)	25 (100.0)		

The post operative urinary catheterization and Catheter removal time (Hours) of two groups is summarized in Table 6. Comparing the post operative urinary catheterization (Y/N) and Catheter removal time in hours of two groups, showed significantly ($p<0.05$) different and lower (28.0%) urinary catheterization in Group B as compared to Group A (44.0% vs. 16.0%, $\chi 2=4.67$, $p=0.031$). Comparing the post operative catheter removal time in hours of two groups, showed significantly different and higher (38.65) post operative catheter removal time of Group B as compared to Group A (29.45 ± 2.49 vs. 48.00 ± 9.80, $t=2.68$, $p=0.019$).(table 6)

Table 6: Distribution of post operative urinary catheterization and catheter removal time (Mean ± SE) of two groups

		Group A(n=25) (%)	Group B(n=25) (%)	$\chi 2$ value	P Value
Urinary catheterization	Yes	11 (44.0)	4 (16.0)	4.67	0.031
	No	14 (56.0)	21 (84.0)		
Catheter removal time (Hours)		29.45 ± 2.49 [11]	48.00 ± 9.80 [4]	2.68	0.019

box brackets indicate the number of patients

Discussion

In recent years, there has been an increasing interest in periarticular injections (PAI) to control post-operative pain after total knee arthroplasty. The present controlled study evaluates the efficacy of per operative periarticular ropivacaine injection on post operative pain and recovery following total knee arthroplasty. In our study, the age of patients in Group A and Group B ranged from 46-75 years and 47-79 years respectively. Our study has shown that females are affected more than males with a ratio of approx. 4:1. As per the AHRQ reports the average age of patients is approximately 75 years, very few were over 85 and about two third are females.[13]In our study, hemodynamic parameters had not shown any significant difference between the two groups. Although mean systolic blood pressure and mean diastolic blood pressure was slightly lower in group B in comparison to group A, but it was statistically insignificant ($p>0.05$).Mean pulse rate shows significant difference at 4 hours. So, in our study, periarticular injection of 2% ropivacaine has not shown any effect on hemodynamic parameters. Our findings are consistent with study of Joost R.C. Lameijer et al.[14] . In our study, Lower requirement of rescue analgesia in periarticular injection group is directly associated to lower incidence of pain in group B. our findings are consistent with Kenji Kurosaka et al. [15] Busch CA et al[16] also concluded that Intraoperative periarticular injection with multimodal drugs can significantly reduce the requirements for patient-controlled analgesia. In our study, the post operative discharge time of Group A and Group B ranged from 2-6 days and 1-6 days respectively. Post operative discharge time of Group B as compared to Group A was found significant. Early post operative discharge time is associated with low cost burden to the patient and feeling of general well being. Our findings are consistent with M. Antony et al[17] and Gómez-Cardero P et al[18] who also showed reduced hospital stay with a perioperative protocol of local anaesthesia and intra-articular ropivacaine respectively. Our study has clearly showed significantly earlier weight bearing time in group B and thus early mobilization, rehabilitation, and physiotherapy. These findings are consistent with study done by Gómez-Cardero P et al[18] In our study, at all periods, the mean Visual analogue scale score was significantly lower in Group B as compared to Group A . Therefore, patients receiving periarticular injection of ropivacaine suffered significantly low pain. Our findings are consistent with studies done by Gibbins et al, Antony et al[17] and Moo Ho Song et al.[19] In current study, on comparing the post operative urinary catheterization of two groups, showed significantlydifferent and lower (28.0%) urinary catheterization in Group B as compared to Group A. Urinary catheterization can directly attribute to urinary tract infection and thus increasing morbidity and complications.

Periarticular injection of ropivacaine has shown reduced requirement of urinary catheterization and thus helps in reducing morbidity and complications.

Conclusion

Per operative periarticular injection of ropivacaine has been shown to be very successful, safe and cost effective protocol for alleviating post operative pain in patients undergoing total knee arthroplasty and also leading to early rehabilitation.

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