Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Comparative Study of Bupivacaine 0.125% with Ropivacaine 0.15% for Post-operative Patient Controlled Epidural Analgesia in Unilateral Total Knee Replacement Surgery in a Prospective, Randomized, Double blinded Study

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Abstract

Background: This study compares a post-operative analgesic efficacy and motor blockade using patient controlled epidural analgesia (PCEA) with either bupivacaine (0.125%) or ropivacaine (0.15%) in unilateral total knee replacement (TKR) surgery by a prospective, randomized, double blinded study in tertiary referral center.

Materials and Methods: Total 60 patients aged 50 years and above, of either sex having ASA Grade I to III, undergone elective unilateral TKR surgery were studied and equally divided into two groups as per randomization. Combined spinal and epidural anesthesia were given at lumbar (L3-4)/(L2-L3) space with 3.1 ml mixture of 0.5% bupivacaine(H) 2.8 ml and 0.3 ml buprenorphine (90 ug) intrathecally. Group A received 0.125% bupivacaine and Group B received 0.15% ropivacaine using a patient controlled analgesia pump epidurally, started ½ h after surgery. Both the groups received these analgesic 5 ml/h for 24 h with initial bolus of 5 ml and demand dose of 5 ml with lock out period of 1 h. Postoperatively, patients were monitored for pain score, sedation score, motor power, and side effect for 24 h.

Results: Pain control is better with Group A (0.125% Bupivacaine). There was statistically significant difference in the mean visual analog scale score and verbal rating scale score in both groups, also requirement of rescue analgesia and additional boluses is more in Group B (0.15% Ropivacaine). There was no statically significant difference in the motor power, sedation score, and side effect.

Conclusion: Epidural 0.125% bupivacaine is superior to 0.15% ropivacaine for post-operative PCEA and comparable in terms of post-operative motor block, sedation score, and side effect.

Key words: Bupivacaine, Patient controlled epidural analgesia, Ropivacaine, Total knee replacement surgery

INTRODUCTION

Joint replacement surgeries are major orthopedic surgeries after spine in the present era. It is not intended to increase quantity of life but to improves mobility and quality of life.[1] Severe post-operative pain is a major complaint in patients who have undergone total knee replacement surgery (TKR). Post-TKR pain directly impacts post-operative physiotherapy and mobilization, which can result in stiffness and poor joint function.[2,3] Effective post-operative pain control is important, especially with the initiation of physiotherapy and early ambulation, which hastens recovery and reduces hospital stay.[4,5] The risk of post-operative complications, such as venous thromboembolism and nosocomial infections,[6] has also been shown to decrease with early mobilization. TKR surgery can be performed under general anesthesia, spinal anesthesia, epidural anesthesia or combined spinal

Access this article online

www.ijss-sn.com

Month of Submission : 11-2020
Month of Peer Review : 11-2020
Month of Acceptance : 12-2020
Month of Publishing : 01-2021

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epidural (CSE) anesthesia, and under peripheral nerve block.

CSE anesthesia provides not only perioperative surgical anesthesia but extends as post-operative analgesic. Continuous epidural analgesia is becoming popular as an effective method of providing post-operative analgesia. Continuous epidural is more effective and reliable than intermittent injection.[7] The utilization of patient controlled analgesia (PCA) allows patients to complement the analgesia if necessary.[8,9] This innovation, enabling patients to control their own analgesia, improves confidence and reducing the need for nursing care.[10] In this study, only local anesthetic agent either bupivacaine 0.125% or ropivacaine 0.15% is used with PCA pump for post-operative patient controlled epidural analgesia (PCEA) following unilateral TKR surgery in randomized, prospective, and double-blinded clinical study. We are avoiding use of epidural opioids because of their side effect so as to find out the efficacy of local anesthetic agent as well as side effect.

MATERIALS AND METHODS

This study was conducted over a period of 2 years in a tertiary care institute after obtaining approval from the hospital ethical committee and informed consent from all participants. A randomized, prospective, double-blinded clinical study of patients undergoing elective unilateral TKR surgeries receiving continuous epidural infusion of either ropivacaine 0.15% or bupivacaine 0.125% after completion of surgery was undertaken. Sample size was taken as 60 patients, by consecutive type of non-probability sampling method used in selecting study subject during the period of study. All the eligible subject fulfilling the criteria of inclusion/exclusion were taken in study group after prior informed consent. Subjects were divided into two Groups A and B of 30 each by randomization table taken from www.randomization.com. Group A to receive of 0.125% bupivacaine and Group B 0.15% ropivacaine with PCA pump (CADD-LEGANCY® PCA PUMP 6300, Smiths Medical International Ltd, USA, Figures 1 and 2) for post-operative epidural analgesia.

We included adult patients aged 50 years and above of both sexes with ASA Grade I/II/III for the study. All patients were of average height (160–170 cm) and weight (65–75 kg). After pre anesthetic check-up (PAC), patients were kept fasting for past 8 h and premeditated with tablet ranitidine 150 mg and tablet alprazolam 0.25 mg.

Unwilling person, dementia, other mental or psychiatric symptom, hypersensitivity to any of the study drug, anatomical deformity of spine or local infection, patients who need to be converted to general anesthesia and extension of anesthetic duration by giving epidural top ups were excluded from the study.

Patients were explained for pain assessment using visual analog scale (VAS) score and verbal rating scale (VRS) score during pre-operative evaluation. After arrival in OT patient was reassessed and preloaded with IV Ringer's lactate fluid preferably 10 ml/kg body weight. Baseline pulse rate, SpO_2, heart rate, non-invasive blood pressure (NIBP), eletrocardiograph (ECG), and respiratory rate (RR) were noted. Patient was given sitting position, Lignocaine 2% was used for local skin infiltration followed by insertion of 8-cm 18-G Tough epidural needle (Portex, Portex Ltd., Ketn, UK) at lumbar (L3-4)/(L2-L3) interspinous space, under all aseptic precautions. With the help of loss of resistance to air technique, epidural space was located and catheter was inserted 4

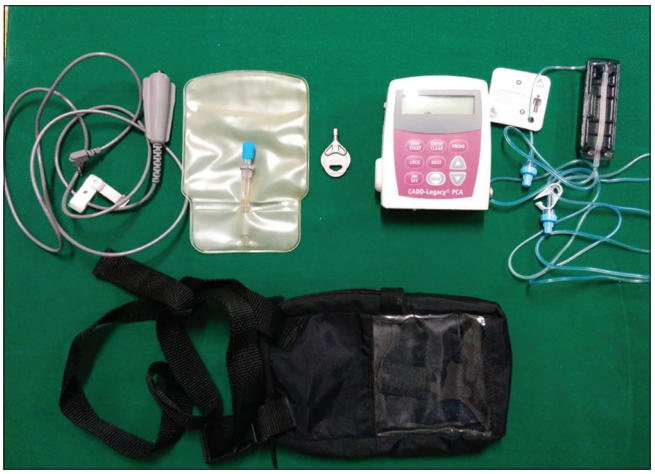

Figure 1: Computerized Ambulatory Drug Delivery [CADD] patient controlled analgesia pump

Figure 2: Patient controlled analgesia pump attached to patients epidural catheter in SICU

cm, confirmed with free flow of fluid. 27G spinal needle was used to give spinal anesthesia with 0.5% bupivacaine heavy (2.8 ml) with 0.3 ml buprenorphine (90 ug). Spinal level was assessed for loss of pinprick sensation to 20 G needle in mid-axillary line. Intraoperatively patients were monitored throughout (Pulse, SpO_2, Heart Rate, NIBP, ECG, Respiratory rate) at 5 min intervals. Any intraoperative complications were assessed and treated accordingly. Duration of tourniquet application was noted.

Postoperatively, patients were observed in recovery room for 30 min and shifted to surgical intensive care unit. Group A received infusion of bupivacaine 0.125% and Group B received infusion of ropivacaine 0.15% with PCA pump epidurally, started 30 min after surgery in anticipation of spinal anesthesia getting worn off. Both the groups received basal continuous epidural infusion at the rate of 5 ml/h for 24 h with initial bolus of 5 ml at the starting of PCA pump. Demand dose is set at 5 ml and taken by patients when feels the breakthrough pain. In between the demand dose, lock-out period of 1 h is kept in which time, though the patient presses demand dose switch, at that time, no drug is delivered. Lock-out period is mainly for patient safety by avoiding excess of drug. Patients were monitored for PR, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), RR, SpO_2, sensory level, motor power, sedation score, and side effects every 30 min for first 4 h, thereafter every 4 h till 24 h. Post-operative pain was observed by VAS as subjective score and VRS as objective score. Any fall in SpO_2 below 94% was taken as a respiratory depression. The analgesic solution was prepared by an individual who was not involved in post-operative evaluation. The patients and observer both were blinded for the study. Any post-operative nausea and vomiting were treated with inj Ondansetron 4 mg IV stat. If there was a drop in SpO_2 below 94% for more than 1 min, supplemental oxygen by facemask was administered.

VAS was shown to patients with scale of 0–100 mm, 0 being no pain, and 100 mm being most severe pain. If VAS was above 30 mm then rescue analgesia in the form of injection Diclofenac 75 mg IM was given. VRS was also explained; 0 – no pain, 1 – mild pain, 2 – moderate pain, 3 – severe pain, and 4 – worst. Sedation score assessed as; 1 – awake patients, 2 – mildly sedated easy to wake up (responds to voice), 3 – moderately sedated (responds to tactile stimuli), and 4 – deeply sedated; difficult to wake even to shaking and loud voice. Motor power was assessed by modified BROMAGE scale.

Score	Criteria
1	Complete block (unable to move feet or knees)
2	Almost complete block (able to move feet only)
3	Partial block (just able to move knees)
4	Detectable weakness of hip flexion while supine (full flexion of knees)
5	No detectable weakness of hip flexion while supine
6	Able to perform partial knee bend

Patients were monitored for intraoperative events such as hypotension, bradycardia, respiratory depression, shivering, nausea, and vomiting and followed-up for 24 h for any post-operative complications and appropriately treated.

Other clinical variable noted during study include duration of surgery, total (continuous and PCEA mode) dose of analgesic infused in mg, No. of attempts to take bolus during lockout period, need for supplemental analgesic drugs, level of motor block, and any post-operative complication.

After data collection, data entry was done in Excel. Data analysis is performed with the help of SPSS Software ver 15 and Sigmaplot Ver 11. Quantitative data are presented with the help of Mean, Standard deviation, Median, and comparison among study group is done with the help of Unpaired *t*-test or Mann–Whitney test per results of normality test. Qualitative data are presented with the help of frequency and percentage table, association among study group is assessed with the help of Chi-square test. $P < 0.05$ is taken as significant level.

RESULTS

Both the groups were comparable for demographic variables such as age, gender, height, weight, ASA grading, and duration of surgery [Table 1] so that a random distribution of patients was confirmed to both groups and there were no confounding factors.

There is no statistically significant difference in PR, SBP, DBP, MAP, RR, SpO_2, and sedation score at various time intervals in two groups ($P > 0.05$).

Mean VAS scores in Group A at 1 h, 2 h, 2.5 h, 4 h, 8 h, 12 h, and 20 h were 1.17±0.65, 1.80±1.12, 1.82±1.10, 1.80±0.92,

Table 1: Demographic variable and duration of surgery

Study parameter	Group A	Group B	*P* value
Mean age	63.63±7.81	62.60±6.49	0.453
Sex M/F	14/16	10/20	0.292
Mean height	163.87	160.58	0.093
Mean weight	66.00	68.83	0.173
ASA grading I/II/III	5/18/7	11/13/6	0.209
Mean duration of surgery	80.33	82.23	0.502

2.30±1.51, 2.10±1.03, and 2.07±0.08, respectively. Mean VAS scores in Group B at 1 h, 2 h, 2.5 h, 4 h, 8 h, 12 h, and 20 h were 1.60±0.72, 2.13±0.63, 2.83±1.32, 2.32±1.33, 3.43±1.07, 3.00±0.91, and 2.97±1.22, respectively. VAS score was statistically significant in both groups over 24 h at the above time interval with *P* value for above time intervals respectively are ($P = 0.039$), ($P = 0.015$), ($P = 0.005$), ($P = 0.036$), ($P = 0.013$), ($P = 0.003$), and ($P = 0.001$) [Table 2]. Mean VAS score in Group A at many of the time interval was lower than Mean VAS score in group B, mean pain control is better in Group A than Group B over a period of 24 h.

Mean VRS scores in Group A and Group B at 1 h, 1.5 h, and 2.5 h were 0.87±0.35, 0.97±0.41, 0.93±0.45 and 1.00±0.00, 0.98±0.48, 1.27±0.45, respectively. In our study, VRS scores were statistically significant at many of the time intervals in both groups over 24 h with *P* value at the above time interval are ($P = 0.040$), ($P = 0.049$), and ($P = 0.007$) [Table 3]. It means that pain control is better in Group A than Group B over a period of 24 h.

Motor function in both the groups was statistically significant only a few intervals of time. In Group A mean modified Bromage scale at 1.5 h, 2 h, and 4 h was 1.00±0.00, 1.17±0.38, and 3.67±1.21, respectively. In Group B mean modified Bromage scale at 1.5 h, 2 h, and 4 h was 1.30±0.47, 1.47±0.51, and 4.33±0.66, respectively. *P* value for above time intervals are ($P = 0.040$), ($P = 0.49$), and ($P = 0.007$), respectively [Table 4]. Rest of the time there was no significant difference in motor function in both the groups mostly after 4 h.

Statistically significant difference exists in both groups in terms of total doses of epidural analgesic required (continuous and PCEA mode) (mg) ($P < 0.05$), total

Table 2: Comparison of vas score between bupivacaine group (Group A) and ropivacaine group (Group B)

VAS	Group A			Group B			Mann–Whitney U	P value
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median		
VAS 0 min (h)	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.000
0.5	0.30	0.53	0.00	0.40	0.56	0.00	−0.793	0.428
1	1.17	0.65	1.00	1.60	0.72	1.00	−2.064	0.039
1.5	1.57	1.1	1.4	1.77	1.22	1.50	−1.296	0.195
2	1.80	1.21	2.00	2.13	0.63	2.00	−1.954	0.015
2.5	1.82	1.10	2.00	2.83	1.32	3.00	−2.820	0.005
3	2.00	1.05	2.00	2.47	1.50	2.00	−1.111	0.266
3.5	2.27	0.91	2.00	2.27	0.45	2.00	−0.526	0.599
4	1.80	0.92	2.00	2.37	1.33	2.00	−2.092	0.036
8	2.30	1.51	2.00	3.43	1.07	3.00	−3.705	0.013
12	2.10	1.03	2.00	3.00	0.91	3.00	−3.740	0.003
16	2.03	1.00	2.00	2.47	0.73	2.00	−1.852	0.064
20r	2.07	0.87	2.00	2.97	1.22	3.00	−3.187	0.001
VAS 24	1.90	0.80	2.00	2.20	0.89	2.00	−1.151	0.250

"Yellow *P* value denotes statistically significant value." Normality Test (Shapiro–Wilk) failed (*P*<0.05), thus Mann–Whitney rank sum test applied

Table 3: Comparison of verbal rating scale score between bupivacaine group (Group A) and ropivacaine group (Group B)

Verbal rating score (h)	Group A			Group B			Mann–Whitney U	*P* value
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median		
0	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.000
0.5	0.27	0.45	0.00	0.37	0.49	0.00	−0.826	0.409
1	0.87	0.35	1.00	1.00	0.00	1.00	−2.053	0.040
1.5	0.90	0.41	1.00	0.98	0.48	1.00	−1.966	0.049
2	0.97	0.41	1.00	1.00	0.00	1.00	−0.463	0.644
2.5	0.93	0.45	1.00	1.27	0.45	1.00	−2.685	0.007
3	0.93	0.37	1.00	1.10	0.40	1.00	−1.656	0.098
3.5	1.03	0.18	1.00	1.00	0.00	1.00	−1.000	0.317
4	0.97	0.41	1.00	1.13	0.35	1.00	−1.644	0.100
8	1.07	0.45	1.00	1.27	0.45	1.00	−1.648	0.099
12	1.07	0.37	1.00	1.13	0.35	1.00	−0.702	0.483
16	0.93	0.37	1.00	1.07	0.25	1.00	−1.619	0.105
20	1.10	0.31	1.00	1.23	0.43	1.00	−1.374	0.169
24	0.97	0.18	1.00	1.03	0.18	1.00	−1.402	0.161

"Yellow *P*value denotes statistically significant value." Normality Test (Shapiro–Wilk) failed (*P*<0.05), thus Mann–Whitney rank sum t applied

dosage of diclofenac required ($P < 0.05$), and no of bolus attempted ($P < 0.05$) [Table 5].

DISCUSSION

TKR is a common orthopedic surgery generally performed in elderly patients to relieve morbidity associated with osteoarthritis and other related joint disorders. After surgery, pain relief is essential to enable ambulation and initiate physiotherapy, but post-operative pain management can be influenced at an institutional level by factors such as local experience, skills (particularly for regional techniques) and practice.

CSE anesthesia is safer in the elderly unless absolutely contraindicated and remains a useful anesthetic technique for lower limb arthroplasty. It combines the advantages of both spinal and epidural technique by initially providing an intense blockade of rapid onset, later post-operative pain relief. So the technique of CSE anesthesia was chosen.[11,12]

In our study, continuous epidural infusion was used using PCEA for post-operative pain and provides superior pain control, allows the patient to undertake physiotherapy thus adding the better outcome of surgery with shorter recovery time. Continuous epidural is specifically suited for TKR as patient is not ambulated after wearing off anesthesia 24 h postoperatively.[13] This stage of immobility if associated with severe pain can cause significant morbidity in the form of venous thromboembolism. During PCEA, patient controls the administration of analgesic according to severity of pain. PCEA system allows on-demand bolus injections with the option of a background infusion. Over dosage is avoided by limiting the size of the bolus and setting a lock-out interval between two doses.

Epidural infusion of local anesthetics is one of the most effective ways of post-operative pain relief,[14,15] also promote reconvalescence by blunting autonomic and somatic reflexes to pain.[16,17] We used the local anesthetic in the lower concentration without opioids to know their analgesic efficacy, as a new tool in the postoperative pain management. As well, we could not find many references of study of 0.15% ropivacaine concentration for post-operative analgesia.

In our study with respect to demographic variables as age, gender, height, weight, ASA grading, and mean duration of surgery, both the groups were comparable and statistically not significant so it does not alter and keeps the uniformity in post-operative analgesia management.

Table 4: Comparison of motor function between bupivacaine group (Group A) and ropivacaine group (Group B)

Motor function	Group A			Group B			Mann–Whitney U	*P* Value
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median		
Motor function 0 (h)	1.00	0.00	1.00	1.00	0.00	1.00	0.000	1.000
0.5	1.00	0.00	1.00	1.00	0.00	1.00	0.000	1.000
1	1.00	0.00	1.00	1.00	0.00	1.00	0.000	1.000
1.5	1.00	0.00	1.00	1.30	0.47	1.00	−3.227	0.001
2	1.17	0.38	1.00	1.47	0.51	1.00	−2.477	0.013
2.5	1.83	0.75	2.00	2.03	0.56	2.00	−1.234	0.217
3	2.53	1.25	2.50	2.77	0.68	3.00	−0.984	0.325
3.5	3.07	1.28	3.00	3.57	0.68	3.00	−1.682	0.093
4	3.67	1.21	4.00	4.33	0.66	4.00	−2.186	0.029
8	4.33	0.92	5.00	4.67	0.48	5.00	−1.204	0.228
12	4.73	0.58	5.00	4.83	0.38	5.00	−0.440	0.660
16	4.87	0.43	5.00	4.87	0.35	5.00	−0.345	0.730
20	4.97	0.18	5.00	5.00	0.00	5.00	−1.000	0.317
24	4.99	0.19	5.00	5.00	0.01	5.00	−1.000	0.318

"Yellow *P* value denotes statistically significant value." Normality test (Shapiro–Wilk) failed (*P*<0.05), thus Mann–Whitney rank sum test applied

Table 5: Comparison of drugs associated variable in two group

Study Parameter	Group A			Group B			Unpaired *t* test	*P* Value
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median		
Total mg of analgesia required* (continuous and PCEA)	168.88	42.59	178.63	226.75	11.60	225.00	−6.687	0.002
No of bolus attempted*	1.67	1.09	2.00	4.00	1.58	4.00	−5.408	0.03
Total dosage of diclofenac required*	0.67	0.80	0.50	1.67	0.84	1.00	−3.696	0.012

"yellow *P* value denotes statistically significant value." *P* value calculated for Unpaired T test except at "*." "*" Normality test (Shapiro-Wilk) Failed (*P*<0.050), thus *P* value calculated for Mann–Whitney rank sum test

PR, SBP, DBP, MAP, RR, SpO_2, and sedation score were comparable in both the groups at any of the time intervals over 24 h ($P > 0.05$). These findings were supported by study conducted by Hoka *et al.,* [18] in which patients undergoing ipsilateral leg orthopedic surgery with epidural or CSE anesthesia were randomly assigned to three groups: 0.1% ropivacaine; 0.2% ropivacaine; and 0.125% bupivacaine. At the end of surgery, continuous epidural infusion was started at a rate of 6 ml/h after a bolus epidural administration of 5 ml. Vital signs were stable at every measuring point in all the groups.

VAS Score was the primary outcome that was compared. Mean VAS scores in Group A and Group B at time interval of 1 h, 2 h, 2.5 h, 4 h, 8 h, 12 h, and 20 h were 1.17±0.65, 1.80±1.12, 1.82±1.10, 1.80±0.92, 2.30±1.51, 2.10±1.03, and 2.07±0.08 and 1.60±0.72, 2.13±0.63, 2.83±1.32, 2.32±1.33, 3.43±1.07, 3.00±0.91, and 2.97±1.22, respectively, in both group. Mean VAS was statistically significantly different at many of the time intervals in both the groups over 24 h with *P* value for above time intervals, respectively, are ($P = 0.039$), ($P = 0.015$), ($P = 0.005$), ($P = 0.036$), ($P = 0.01$), ($P = 0.003$), and ($P = 0.001$). Mean VAS score in Group A at many of the time intervals is lower than Mean VAS score in Group B; it means pain control is better in Group A.

In study conducted by Muldoon *et al.*,[19] compared the analgesia and motor block produced by extradural infusions of ropivacaine 0.2% or bupivacaine 0.2% after TKR in Fifty-two patients at 8 ml/h for 24 h after operation. Analgesia was assessed by post-operative VAS and morphine consumption. VAS score was more in ropivacaine group with more morphine consumption as compared to bupivacaine group.

In our study, pain score is lower in bupivacaine group (0.125%) than ropivacaine group (0.15%).

Mean VRS scores in Group A and Group B at 1 h, 1.5 h, and 2.5 h was 0.87±0.35, 0.97±0.41, and 0.93±0.45 and 1.00±0.00, 0.98±0.48, and 1.27±0.45, respectively, in both the group. VRS scores were statistically significant in Group A and Group B over 24 h with *P* value at the above time interval are ($P = 0.040$), ($P = 0.049$), and ($P = 0.007$), shown pain control is better in Group A.

Total doses of local anesthetic required (continuous and PCEA mode) (mg) in Group A and Group B were 168.88±42.59 mg and 226.75±11.60 mg, respectively, and statistically significant ($P = 0.002$).

Heid *et al.*[20] evaluated the analgesic efficacy of epidural ropivacaine 0.2% versus bupivacaine 0.125% after retropubic prostatectomy in 40 patients by patient-controlled lumbar epidural analgesia and shows ropivacaine consumption are 60% higher than that of bupivacaine ($P < 0.001$).

Intramuscular diclofenac is given to the patient as a supplementary analgesia if their VAS score exceeded >30 mm, maximum dose is limited to three doses of 75 mg of diclofenac in 24 h, two doses were kept at least 4 h apart. In our study group, requirement of diclofenac was statistically significant ($P = 0.012$) as it is 0.67±0.80 doses in Group A and 1.67±0.84 doses in Group B.

Muldoon *et al.*[19] showed that median morphine consumption was 30.7 mg in the ropivacaine group and 20.5 mg in the bupivacaine group. They used additional analgesia of morphine by iv PCA and in our study we used inj diclofenac 75 mg by im route. In both the studies, requirement is more with ropivacaine group.

Furthermore, in Group A mean number of attempted boluses was 1.67±1.09 and in Group B 4.00±1.58, significantly differ as $P = 0.03$. It shows that there is better analgesic control with bupivacaine rather than ropivacaine.

Thus, all above finding proving epidural bupivacaine 5 ml/h (6.25 mg/h) of 0.125% to be superior to epidural ropivacaine 5 ml/h (7.5 mg/h) of 0.15%.

The secondary objective compared is the motor function score for the two groups. Motor function in ropivacaine group was better in first 4 h, then both the groups were comparable and statistically not significant up to 24 h period ($P = 0.321$). Korula *et al.*[21] conducted study to compare the clinical efficacy of ropivacaine 0.2% and bupivacaine 0.125% for post-operative analgesia in patients undergoing bilateral mesh hernioplasty. Motor block achieved with bupivacaine was of greater intensity in the beginning but after 30 min, difference was not significant and duration of motor block was similar in two groups. This supports our finding.

In both the groups, incidence of hypotension, nausea, and vomiting was comparable and statistically not significant. Out of total 60 patients, only one patient had complained of pruritus in Group B which was statistically insignificant. Respiratory depression is always associated with deeper sedation which was not seen in any of the patient in our study. The changes in respiratory rate were also not statistically significant.

CONCLUSION

We concluded that epidural 0.125% bupivacaine (6.25 mg/h) is superior to 0.15% ropivacaine (7.5 mg/h)

for post-operative PCEA. Post-operative motor function was better in first 4 h in terms of Bromage score with ropivacaine following unilateral TKR surgery. None of the groups showed any hypotension and respiratory system related side effect at this low concentration.

Limitation

In our study, as the concentration used for ropivacaine was 0.15%, we did not get enough references for each and every parameter for comparison. Larger study need to be conducted to confirm these findings.

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How to cite this article: Wani PB, Varma N, Sahu DK, Sharma A, Parampill R. Comparative Study of Bupivacaine 0.125% with Ropivacaine 0.15% for Post-operative Patient Controlled Epidural Analgesia in Unilateral Total Knee Replacement Surgery in a Prospective, Randomized, Double blinded Study. Int J Sci Stud 2021;8(10):115-121.

Source of Support: Nil, **Conflicts of Interest:** None declared.