e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(10); 680-685

Original Research Article

Comparison of Ropivacaine 0.25% Versus Ropivacaine 0.50% in Adductor Canal Block for Postoperative Pain Relief in Knee Surgeries

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Received: 25-07-2023 / Revised: 28-08-2023 / Accepted: 30-09-2023
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Conflict of interest: Nil

Abstract:

Objective: We have done this research to compare the onset, peak and duration of postoperative pain relief after adductor canal block among two different concentrations of Ropivacaine in knee surgeries.

Method: Patients were divided into two groups at random and underwent ultrasound-guided adductor canal blocks using two different Ropivacaine doses. Observations were recorded using different pain scales.

Results: We have seen the efficacy of adductor canal block having 2 different concentrations of ropivacaine in terms of pain control and have observed excellent results.

Conclusion: Both the concentration of drug used i.e. 0.5% and 0.25% Ropivacaine is equally effective to provide postoperative analgesia for about 8-10 hours.

Keywords: Adductor canal block, Pain relief, Knee surgeries, USG-guided, Palliative care.

Introduction

Pain is frustrating and debilitating. It can interfere with work, sleep, quality time, and activities. Pain management provides relief, but the therapy is complicated and may lead to adverse impacts if not efficiently administered as well as monitored. Therefore, Consequently, pain treatment may necessitate the participation of an anesthesiologist specializing in pain medicine [1]. Surgery is frequently needed if knee pain caused by structural damage or other disorders does not respond to other forms of pain management. During the procedure, the anesthesiologist will keep you pain-free. Anesthesiologists, who specialize in pain management, will also be crucial to the treatment of pain and the healing process following surgery. For physical therapy and rehabilitation to be effective after surgery, postoperative pain management is essential [2]. The FNB (Femoral Nerve Block) was long regarded as primary peripheral nerve block utilized to lessen pain after knee surgery. ACB (Adductor Canal Block) is a postoperative pain reliever for knee operations that was developed recently as a pure sensory nerve block [3,4]. The saphenous nerve and a portion of obturator nerve going via adductor canal of thigh are sensory nerves, which justifies the adductor canal block. By obstructing these nerves, a local anesthetic injected into the canal will offer sufficient analgesia [5]. An increasing body of research on the effectiveness of ACB and available data show that ACB is effective as FNB at delivering postoperative analgesia. Additionally, adductor canal block has the benefit of maintaining or barely impacting the quadriceps' strength [6], [7].

Maintaining quadriceps strength will enable early post-operative recovery. With the use of an ultrasound, a relatively straightforward ACB procedure is carried out [8].

Materials & Methods

This research was done in the Dept. of Anaesthesia, of a "tertiary care center of North India" from January 2021 - October 2022 on patients who were posted for knee surgeries. Total of 40 patients undergoing knee surgery, 20 patients for group A (0.5% ropivacaine) and 20 patients for group B (0.25% ropivacaine) were selected randomly for our study.

Inclusion Criteria

Informed written consent for participation in study, Age 18 to 70 years, ASA ("American Society of Anesthesiologists") physical status I -II, Unilateral knee surgery.

Exclusion Criteria

Patient's refusal, Neurovascular injury, Allergy to local anesthetics, Bilateral knee surgeries, Contraindication for spinal anesthesia, ASA physical status III -V.

Methods

Preoperative preparation

A detailed pre-anesthetic checkup was done. All subjects received Tab. Ranitidine and Tab. Alprazolam one tablet each, a night before surgery.

Intraoperative preparation

After taking the informed written consent, the patients were taken inside the operation theatre and large bore cannula was inserted and preloaded with 1000 ml Ringer's lactate or NaCl solution, as appropriate. Standard monitors i.e. Pulse oximeter, NIBP, temperature, and ECG were applied. With strict aseptic technique, spinal anesthesia was given in sitting position in L2-3 or L3-4 interspace. The drug used for spinal anesthesia: bupivacain heavy,
Dose given for spinal anesthesia:0.3mg/kg body weight Patients were randomly allotted to 1 of 2 groups using a computer-generated random number table:

Group A: patients received 0.5% ropivacaine in adductor canal after surgery.
Group B: patients received 0.25% ropivacaine in adductor canal after surgery.

Adductor Canal Block

The catheter Insertion Procedure includes identifying the adductor canal using a high-frequency linear array ultrasound transducer (5-10MHz) (SonoSite EDGE). The mid-thigh area was chosen for the placement of the transducer (half of the distance between patella and inguinal crease). The superficial femoral artery was situated on short axis dorsal/lateral to sartorius muscle. At this level, the artery's anterior/lateral hyperechoic structure was recognized as target catheter location in adductor canal. An 18G Tuohy needle will be positioned into adductor canal, laterally to superficial femoral artery. Sterile normal saline, 0.9 percent, up to 10 mL, will be administered for hydro-dissection into the adductor canal and needle advancement to check correct needle tip location.A flexible open-tip 20G epidural-type catheter will be inserted 1 - 2 cm in adductor canal. After the needle is taken out, continuous catheter will be secured and dressed in transparent occlusive dressing. Manual distribution of the medication has been used.

Patients of Group A were given 20 ml of 0.5 percent ropivacaine, while those in Group B were given 20 ml of 0.25 percent ropivacaine. Following Pain scores were recorded:

- Numerical pain intensity scale at 1hr, 4hr, 6hr, 8hr, 10hr, 12hr
- Wong-Bakers faces pain scale at 1hr, 4hr, 6hr, 8hr, 10hr, 12hr.

This study was double-blinded since neither the patients nor the observer who observed the patients or gathered the data knew what kind of intervention each one had received.

Observation & Results

The range of age of patients in both groups was 18 to 70 years, mean age of patients was 40.8±16.28 years. The difference in mean age of patients of Group A (39.6±14.3 years) was lower than that of Group II (42±18.33 years). Most of the patients were of age of 18 to 30 years old. [Table 1].

Table 1: Comparison Of Age (Years) Between Group A And B

Age (years)	Group A (n=20)	Group B(n=20)	Total	P value
18-30	8 (40%)	7 (35%)	15 (37.50%)	0.744†
31-40	2 (10%)	4 (20%)	6 (15%)	0.661*
41-50	6 (30%)	2 (10%)	8 (20%)	0.235*
51-60	2 (10%)	2 (10%)	4 (10%)	1*
61-70	2 (10%)	5 (25%)	7 (17.50%)	0.407*
Mean ± SD	39.6 ± 14.3	42 ± 18.33	40.8 ± 16.28	0.647‡
Median (25th-75th percentile)	41.5 (27.75-46.25)	38 (26.75-57.25)	40 (27-53)	
Range	20-68	18-70	18-70	

‡ Independent t test, * Fisher's exact test, † Chi square test

According to pain intensity scale, at 1st-hour mean pain intensity scale was 0 ± 0 for both group A and group B. At 4th-hour mean pain intensity scale was 1.1±1.92 for Group A and 0.1±0.45 for Group B. At 8th-hour mean pain intensity scale was 3.6±1.81 and 4.3±0.99 for Group A and Group B respectively. At 10th-hour mean pain intensity scale was 6.35±1.63 and 6.8±0.95 for Group A and Group B respectively. At 12th hour all patients in both groups complained of pain. The pain intensity scale showed that pain gradually increased with respect to time after the block and less difference was noted.

No pain at 1st hour with {median (interquartile range)} {0(0-0)} for both the groups with p=1. At 4th hour majority of patients experienced no pain in both groups, {median (interquartile range)} with {0(0-2)} & {0(0-0)} for groups A and B resp. with p=0.009 and mean was 1.1±1.92 and 0.1±0.45 for groups A and B. At 8th hour, group B significantly experienced more pain with {median (interquartile range)} {3(3-4)} and {4(4-4.25)} for group A and group B respectively with p= 0.02, mean was 3.6±1.81 and 4.3±0.99 for group A and B respectively. At 10th hour, both groups experienced pain but the pain intensity was more in group B with {median (interquartile range)} {6(5-7)} and {6.5(6-7.25)} and mean of 6.35 ± 1.63 and 6.8 ± 0.95 for group A and B respectively. [Table 2]. By using WONG-BAKERS PAIN SCALE differences in level of pain of patients of Group A and B were not found to be significant at baseline and 1 hour. At 4th hour 70% (n=14) of patients had no hurt in Group A and 100% (n=20) of patients had no hurt in Group B. 25% (n=5) had hurt little bit state in Group A. 1 patient (5%) had hurt whole lot state pain in Group A. At 8th hour 45% (n=9) of patients had hurt little bit pain in Group A and 5% (n=1) had hurt little bit pain in Group B. 45% (n=9) and 70% (n=14) had hurt little more pain in Group A and B respectively. Hurt even more pain was complained by "1 patient (5%) in Group A whereas 4 patients (20%) in Group B". 5% (n=1) and 5% (n=1) had hurt whole lot pain in Group A and B respectively. At 10th hour 20% (n=4) of patients had hurt little more pain in Group A. 65% (n=13) had hurt even more pain in Group A.

1 patient (5%) and 18 patients (90%) showed hurt whole lot in group A and B. Hurt worst pain has been complained by 2 patients (10%) in Group A & 10% (n=2) in Group B. At 12th hour all patients had worst possible pain. [Table 3].

During the procedure following complications were noted

1. Catheter migration: catheter was misplaced from the nerve sheath and we could not administer drug to the patient. 5% of group A patients (n=1) and 5% of group B patients (n=1) were noted with this complication.
2. Drug was administrated to the patient under ultrasound guidance but could not place catheter in them. This was seen in 5% of group A patients (n=1).
3. Rest of the patients experienced no complications during and after the procedure.

Due to complications noted during the procedure, some patients experienced more pain than other patients of the same group. (Table-4).

Table 2: Comparison of pain intensity scale between group A and B

Pain intensity scale	Group A (n=20)	Group B (n=20)	Total	P value
At 1st hour				
Mean ± SD	0 ± 0	0 ± 0	0 ± 0	1§
Median (25th-75th percentile)	0(0-0)	0(0-0)	0(0-0)	
Range	0-0	0-0	0-0	
At 4th hour				
Mean ± SD	1.1 ± 1.92	0.1 ± 0.45	0.6 ± 1.46	0.009§
Median (25th-75th percentile)	0(0-2)	0(0-0)	0(0-0)	
Range	0-8	0-2	0-8	
At 8th hour				
Mean ± SD	3.65 ± 1.81	4.35 ± 0.99	4 ± 1.48	0.002§
Median (25th-75th percentile)	3(3-4)	4(4-4.25)	4(3-4)	
Range	2-9	3-8	2-9	
At 10th hour				
Mean ± SD	6.35 ± 1.63	6.8 ± 0.95	6.58 ± 1.34	0.089§
Median (25th-75th percentile)	6(5-7)	6.5(6-7.25)	6(6-7)	
Range	5-10	6-9	5-10	
At 12th hour				
Mean ± SD	10 ± 0	10 ± 0	10 ± 0	1§
Median (25th-75th percentile)	10(10-10)	10(10-10)	10(10-10)	
Range	10-10	10-10	10-10	

§ Mann Whitney test

Table 3: Comparison of Wong- Bakers Faces Pain Raising Scale Between Group A and B

WONG- bakers FACES pain raising scale	Group A(n=20)	Group B(n=20)	Total	P value
At 1st hour				
No hurt	20 (100%)	20 (100%)	40 (100%)	NA
At 4th hour				
No hurt	14 (70%)	20 (100%)	34 (85%)	0.02*
Hurts little bit	5 (25%)	0 (0%)	5 (12.50%)	0.047*
Hurt whole lot	1 (5%)	0 (0%)	1 (2.50%)	1*
At 8th hour				
Hurts little bit	9 (45%)	1 (5%)	10 (25%)	0.008*
Hurt little more	9 (45%)	14 (70%)	23 (57.50%)	0.11†
Hurt even more	1 (5%)	4 (20%)	5 (12.50%)	0.342*
Hurt whole lot	1 (5%)	1 (5%)	2 (5%)	1*
At 10th hour				
Hurt little more	4 (20%)	0 (0%)	4 (10%)	0.106*
Hurt even more	13 (65%)	0 (0%)	13 (32.50%)	<.0001*
Hurt whole lot	1 (5%)	18 (90%)	19 (47.50%)	<.0001*
Hurt worst	2 (10%)	2 (10%)	4 (10%)	1*
At 12th hour				
Hurt worst	20 (100%)	20 (100%)	40 (100%)	NA

* Fisher's exact test, † Chi-square test

Table 4: Comparison of complications between group A and B

Complication	Group A(n=20)	Group B(n=20)	Total	P value
No complication	18 (90%)	19 (95%)	37(92.50%)	1*
Catheter migration	1 (5%)	1 (5%)	2 (5%)	1*
Couldn't place catheter, single shot of drug was given	1 (5%)	0 (0%)	1 (2.50%)	1*
Total	20 (100%)	20 (100%)	40 (100%)	-

Discussion

This research was done to compare the effectiveness of local infiltration of two different concentrations of ropivacaine in adductor canal block which is 0.25% and 0.5%. The primary objective was to see pain control by two different pain scoring methods. Knee surgeries are done in increasing numbers yearly because of high incidence of osteoarthritis in elderly population and trauma in young people. Patients usually avoid these operations because of the apprehension of severe postoperative pain and delayed functional recovery. Major advantage of postoperative pain management is that it not only helps in treating pain during rest but also helps in early functional recovery in activities such as walking, climbing stairs, and knee flexion and extension. Achieving adequate postoperative analgesia with minimal side effects is the most important objective for anesthetists. Therefore, many techniques have been used for controlling pain in postoperative period. Systemic opioid such as morphine can also be used but it causes undesirable impacts like vomiting, nausea, drowsiness, urinary retention, and respiratory depression. ACB is an interfascial block performed in thigh. The adductor canal involves vastus medialis nerve, additional to saphenous nerve that innervates anterior, medial, and lateral aspects of knee. In Adductor canal block, superficial femoral artery has been found below Sartorius muscle in adductor canal using linear probe of ultrasound, and ropivacaine was infiltrated in hypoechoic structure anterior/lateral to superficial femoral artery. This study included patients undergoing unilateral knee surgery under spinal anesthesia aged 18 -70 years belong to ASA grade I –ll, giving written informed consent Govil N et al (2022) [9] studied two volumes of ropivacaine in adductor canal. 10ml of 0.5 percent ropivacaine with 20 ml of 0.5 percent ropivacaine. Quadriceps muscle strength at various timelines shows a significant variation ($P < 0.025$). No significant variations between pain scores & knee flexion at different time points.

Li D et al (2016) [10] conducted the meta-analysis to estimate that ACB is superior to FNB in the management of pain and joint functional recovery after TKA. In comparison to FNB, the ACB shows significant reduction in VAS ("Visual Analogue Scale") score at rest for 8 hours & at 24 hours with $p<0.001$ after TKA. Additionally, quadriceps strength and mobility skills are improved by ACB ($p < 0.001$). The variation between 2 groups was not significant statistically for VAS score at rest for 48 hours, the VAS score with activity 2 days after

surgery, opioid use, patient satisfaction, tourniquet times hip, and adductor strength.

Vora MU et al (2016) [11] study noted that ACB shows equivalent analgesia to FNB in TKA surgery. ACB shows advantage for early ambulation, quadriceps weakness, and earlier discharge. This block can be utilized as rescue block in individuals having moderate to severe pain after arthroscopic knee surgeries. Midthigh technique using ultrasound with "0.2% ropivacaine or equivalent local anesthetic" in 15 to 30 mL volume looks like an optimum method.

Thus, in our study, we have seen the effectiveness of adductor canal block with two varied concentrations of ropivacaine in terms of pain control. The main goal of present research was to evaluate pain relief between ropivacaine 0.5% and ropivacaine 0.25% in "ultrasound-guided" adductor canal block based on different pain scores.

In pain intensity scale, patients in both the group experienced no pain at 1st hour with {median (interquartile range)} {0(0-0)} for both the groups with p=1. At 4th hour majority of patients experienced no pain in both groups, {median (interquartile range)} with {0(0-2)} & {0(0-0)} for groups A and B resp. with p= 0.009 and the mean was 1.1±1.92 and 0.1±0.45 for group A and B. At 8th hour, group B significantly experienced more pain with {median (interquartile range)} {3(3-4)} and {4(4-4.25)} for group A and B resp. with p= 0.02, mean was 3.6±1.81 and 4.3±0.99 for group A and B respectively.

At 10th hour, both the groups experienced pain but the pain intensity was more in group B with {median (interquartile range)} {6(5-7)} and {6.5(6-7.25)} and mean of 6.35 ± 1.63 and 6.8 ± 0.95 for group A and group B resp. Pain was significantly covered in group A.

In Wong Bakers Faces Scale, the patients of both groups were observed at 0,1,4,8,10,12 hours. At 0 and 1 hour, there was no discernible difference in the level of discomfort between the two groups. At 4th hour 70% (n=14) of patients had no hurt in Group A and 100% (n=20) of patients had no hurt in Group B. 25% (n=5) had hurt little bit state in Group A. 1 patient (5%) had hurt whole lot state pain in Group A. At 8th hour 45% (n=9) of patients had hurt little bit pain in Group A and 5 % (n=1) had hurt little bit pain in Group B. 45%(n=9) and 70% (n=14) had hurt little more pain in Group A and B respectively.

Hurt even more pain was complained by "1 patient (5%) in Group A while 4 patients (20%) in Group B". 5% (n=1) and 5% (n=1) had hurt whole lot pain in Group A and B respectively. At 10th hour 20% (n=4of patients had hurt little more pain in Group A. 65%(n=13) had hurt even more pain in Group A .1 patient (5%) and 18 patients (90%) showed hurt whole lot in Group A and B. Hurt worst pain has been complained by 2 patients (10%) in Group A & 10% (n=2) in B.

Limitation of Study

It was a single-centric study with small sample size which was not enough to represent population from which sample of study was obtained. A multicentric study is needed to verify the effects. Sometimes it was difficult to access pain scores in geriatric patients due to associated co-morbidities such as deafness, parkinsonism, dementia, etc. Our study was based on ultrasound guidance where technical expertise is required. Pain is a subjective variable and pain perception has led to subjective error.

Recommendations

1. Larger sample sizes, multicenter, age-specific, and gender-specific
   studies are needed to validate the findings.
2. Further analysis would be required to define the optimal injection site of ACB for knee surgeries.

Conclusion

In our study both the concentration of the drug users i.e. 0.5% and 0.25% Ropivacaine is equally effective in providing postoperative analgesia for about 8-10 hours in both groups.

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