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Original Research Article

Study of USG Guided Adductor Canal Block and IPACK Block for Postoperative Analgesia in Knee Surgeries

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Conflict of interest: Nil

Abstract

Background and Aim: Targeting postoperative pain relief in major knee surgery is a real challenge for the new advancements in technology and knowledge. The development of ultrasound guidance to block acute and chronic pain has gained more and more trust in the last decade. The aim of the study was to evaluate the effect of USG guided Adductor Canal Block and IPACK block for postoperative analgesia in elective knee surgeries.

Material and Methods: Sixty adult patients of ASA grade I and II, aged between 18 and 70 yrs posted for elective knee surgeries were selected and all the patients were operated under spinal anaesthesia using 0.5% 3 ml heavy Bupivacaine. Patients were divided into 2 groups at the end of surgery. Group R+D (Ropivacaine+Dexamethasone): USG guided 0.2% Ropivacaine 19 ml + Dexamethasone 1 ml (4 mg) for each block ie.ACB and IPACK block (Total 40 ml) Group C (Control): Patients received no block, however, postoperative pain was relieved by giving rescue analgesic Inj Tramadol. (1 mg/kg) when VAS≥4. Vital parameters like Heart Rate (HR), Blood Pressure (BP), Respiratory Rate (RR), Oxygen saturation (SpO_2) at room air were noted. Patients were observed for VAS Scale and any complications and toxicity of the drugs injected.

Results: There was no significant difference in both groups in terms of demographic variables. The difference in VAS score among both the groups during 4 to 7 hours was statistically significant. Vitals were comparable between both groups. Total Consumption of Analgesic Drug (Inj Tramadol) in 24 Hours was 75±25.42 mg in Group R+D, whereas it was 195±15.26 mg in Group C, which was statistically significant.

Conclusion: The ultrasound-guided ACB+IPACK block could relieve pain during the first 24-hour postoperative period, decrease the total postoperative analgesic consumption in 24 hours and significantly prolong the time for first rescue analgesic requirement after knee surgeries like Total knee arthroplasty and Arthroscopic knee surgeries.

Keywords: Arthroscopic knee surgeries, Dexamethasone, Ropivacaine, Total knee arthroplasty

Introduction

Postoperative pain is an essential consequence of knee surgeries that can affect early ambulation, range of motion, and hospital stay. Advanced surgical techniques like arthroscopies and early mobilisation after surgery have made knee surgeries more patients friendly. Inadequate pain control can lead to secondary medical sequels, such as venous thromboembolic and cardiac events [1].

Extensive tissue damage in major operations of the knee causes immediate changes in the endocrine system and central, peripheral, and sympathetic nervous systems. It stimulates catabolic hormone release including cortisol, growth hormone, glucagon, and catecholamine resulting in compromised immunity, increased oxygen demand, and higher strain on the cardiovascular system. Immobilisation caused by pain increases the risk of decreased pulmonary function, gastrointestinal complications such as ileus, and deep vein thrombosis related to surgical stress.[2]

Adequate control of pain is, therefore paramount to a successful outcome and patient satisfaction. Adequate analgesia with motor preservation has become the prime goal after orthopaedic surgeries to enable shorter hospital stay, early physiotherapy, and faster recovery [2].

Although opioids are considered a potent analgesic, they are associated with a number of unwanted side effects notably nausea, vomiting, sedation, constipation, confusion, pruritus, urinary retention, respiratory depression, delay ambulation, and overall increased length and cost of hospitalisation. In knee surgeries, epidural analgesia faces a relatively high failure rate and can produce adverse effects such as hemodynamic instability, bladder and bowel dysfunction, unintended motor blockade; it makes the patient confined to the bed, pruritus, and risk of respiratory depression, because of these effects its routine use is slowly declining. The most commonly used drugs for periarticular injections include local anaesthetics such as Bupivacaine, Ropivacaine, Morphine, Ketorolac, Clonidine, and Steroids [3].

Effective pain control after knee surgeries is challenging, as the operative procedure often affects 2 main innervations to the knee (1)the femoral nerve, which innervates the anterior and to a lesser degree, the medial aspects of the knee and (2)the sciatic nerve through its tibial and common peroneal branches which innervates the posterior aspects of the knee. However, a continuous femoral nerve catheter block has been reported to provide excellent postoperative analgesia and to decrease opioid consumption. Patients who receive the femoral nerve catheter block often encounter a significant degree of quadriceps weakness that limits their participation in early physical rehabilitation [4]. Adductor block is one such method of peripheral nerve blockade that has the unique advantage of providing localised analgesia to peripatellar and interarticular aspects of the knee joint without significant quadriceps weakness.

Targeting postoperative pain relief in major knee surgery is a real challenge for the new advancements in technology and knowledge. The development of ultrasound guidance to block acute and chronic pain has gained more and more trust in the last decade. Among some of the most commonly used techniques for major knee surgery pain postoperatively are the Adductor canal and IPACK block [5].

IPACK block is a relatively new block with little available data. So, we have selected an Adductor canal block with an IPACK block in our study. The aim of the study was to evaluate the effect of USG guided Adductor Canal Block and IPACK block for postoperative analgesia in elective knee surgeries.

Material and Methods

After approval from the Institutional Review Board, we conducted this observational study of 60 patients between May 2018 to May 2021. Sixty adult patients of ASA grade I and II, aged between 18 and 70 yrs posted for elective knee surgeries were selected and all the patients were operated under spinal anaesthesia using 0.5% 3 ml heavy Bupivacaine.

Exclusion Criteria

- Patient's refusal
- Body Mass Index (BMI)>40
- Allergy to local anaesthetic
- Patient on anticoagulant/bleeding disorders
- Local Infection
- Failed cases

Pre-Study Evaluation

All patients were evaluated thoroughly during the pre-operative visit. A detailed history was taken, the general and systemic examination was done. Vital parameters like Heart Rate (HR), Blood Pressure (BP), Respiratory Rate (RR), Oxygen saturation (Spo_2) at room air were noted. Routine laboratory investigations like Complete blood count(CBC), Renal function test(RFT), Liver function test(LFT), Serum electrolytes, Urine examination, Random blood sugar(RBS), Chest x-Ray, and Electrocardiogram(ECG) were done in all cases. Specific investigations were done as per the requirement of the individual case. After explaining the procedure in their native language, written informed consent was taken from all patients. Each patient was explained in detail regarding the 0-10 point VISUAL ANALOGUE SCALE (VAS) on a sheet of paper, where score 0 is labelled as no pain and 10 as worst pain. Quality of postoperative analgesia was assessed using patient's interpretation of pain from Visual Analogue Scale [6,7].

All patients for elective surgery fasted overnight. All patients received their scheduled morning doses of medication for the systemic illness. Anaesthesia machine was checked and prepared. Emergency drug tray was kept ready. On entering the operation theatre, baseline vital parameters were noted. A peripheral i.v access was secured on non-dominant hand with 18 G cannula and i.v fluid ringer lactate solution was started. Except in diabetic patients, Normal Saline was used.

Patients were divided into 2 groups at the end of surgery.

Group R+D (Ropivacaine+Dexamethasone): USG guided 0.2% Ropivacaine 19 ml + Dexamethasone 1 ml (4 mg) for each block ie.ACB and IPACK block (Total 40 ml)

Group C (Control): Patients received no block, however, postoperative pain was relieved by giving rescue analgesic Inj Tramadol. (1 mg/kg) when VAS≥4.

Procedure For Adductor Canal Block [8,9]

Position patient supine with the knee slightly flexed and leg externally rotated (frog-leg position). Clean area with 0.5% Chlorhexidine solution. The ultrasound machine was kept on the opposite side of the limb of the patient to be blocked. High-frequency ultrasound probe was placed on the anterior aspect of the patient's thigh, approximately mid-point between the inguinal crease and medial condyle. The femur was identified and the probe was moved medially until the trapezoid/boat-

shaped Sartorius muscle is visualized. The femoral artery lies just under this muscle within the adductor canal. Note the Saphenous nerve is almost always too small to be reliably imaged and the aim of the technique is, therefore, to deposit local anaesthetic under Sartorius and around the femoral artery. The image was optimized, depth was adjusted, and gain and frequency settings were adjusted.

The appropriate probe position is just proximal to where femoral artery dives posteriorly and the probe was positioned perpendicular to the artery. At this point, the femoral artery should start to pass deeper to form the popliteal artery. The needle was advanced into the adductor canal. This can be achieved by traversing Sartorius or vastus medialis. Then, a test dose of 1 ml of the local anaesthetic solution was injected after negative aspiration of blood.

The local anaesthetic spread was observed to ensure the needle tip is definitely within the adductor canal. The remaining local anaesthetic drug was injected in 5 ml aliquots after negative aspiration of blood each time. Total 20 ml of the drug (0.2% Ropivacaine and Dexona) was used. The IPACK block was applied scanning the popliteal fossa with a curved low-frequency transducer until femoral condyles were visualised at a depth of approximately 3.5 to 4.5 cm. The transducer was advanced cephalad until the condyles were out of view and the femoral axis came into view. At this point, stimuplex needle was inserted in-plane from anteromedial to posteromedial between the popliteal artery and the femur, until the tip of the needle was 1 to 2 cm from the lateral edge of the popliteal artery. IPACK block was given using19 ml of 0.2% Ropivacaine with 1 ml(4mg) of Dexamethasone under direct Ultrasound visualisation in 5 ml aliquots after negative aspiration of blood each time.

During the conduct of block and thereafter, the patients were continuously monitored for HR, BP, RR and SpO_2. Patients were observed for VAS Scale and any complications and toxicity of the drugs injected.

Haemodynamic vitals (HR, Systolic blood pressure (SBP), Diastolic blood pressure (DBP), RR, SPO2 were recorded post block every 1 hourly till 24hours At the end of the procedure, patients were shifted to the postoperative ward where monitoring was continued. Recovery from the motor block was assessed by asking the patients to move their knee and feet and to raise extended leg.

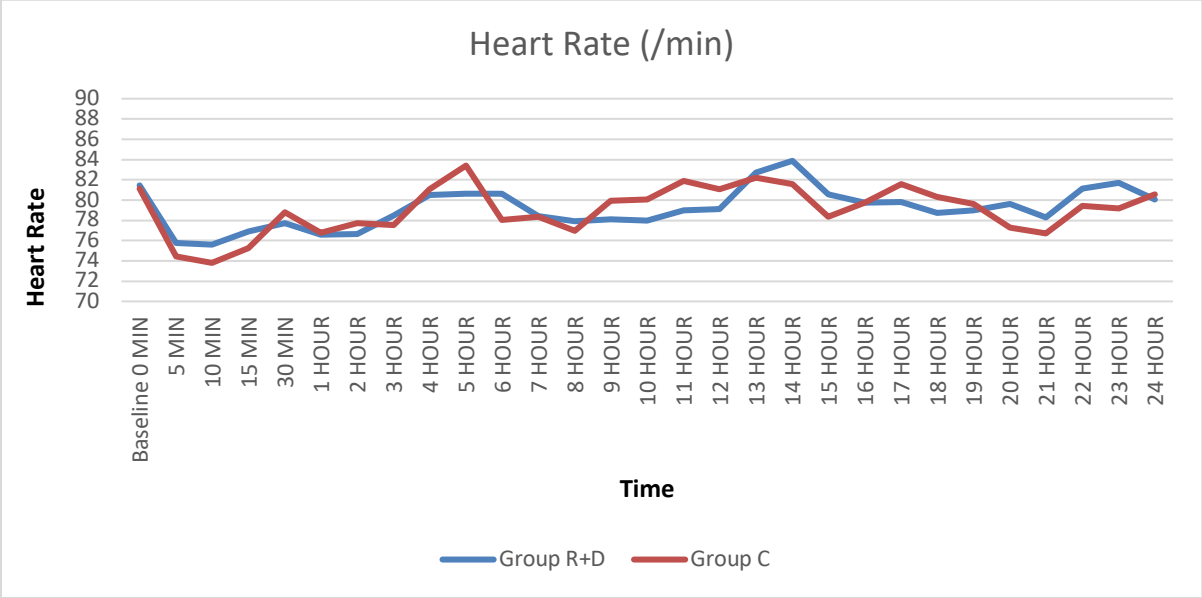
Results

Table 1: Demographic Variables

Variables	Group R + D (Mean±Sd)		Group C (Mean±Sd)		P-Value
Age(Years)	44.4±15.8		43.1±14.60		0.74
BMI(kg/M^2)	22.6±1		23.4±1.3		0.0098
Duration of surgery(min)	139.5±19.5		138.7±34.3		0.912
Sex	N	%	N	%	P-Value
Male	17	56.67	17	56.67	0.99
Female	13	43.33	13	43.33	0.98
ASA Grade 1	19	63.33%	20	66.67%	0.78
2	11	36.67%	10	33.33%	0.78

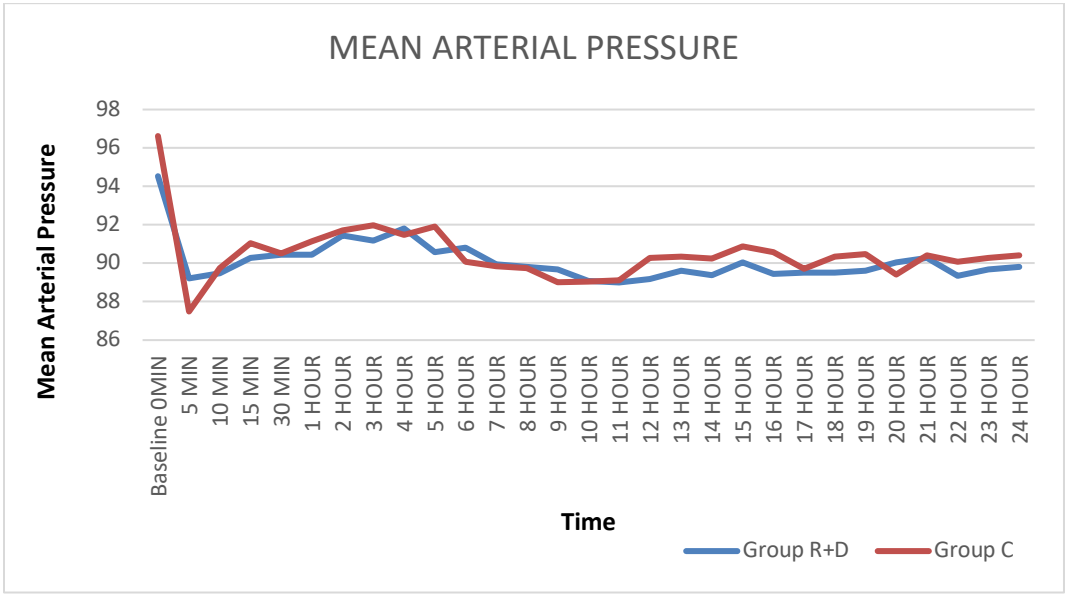
Statistically significance at $p \leq 0.05$

There was no significant difference in both groups in terms of demographic variables. The mean age in years was 44.4±15.8 in Group R+D, while 43.1±14.6 in Group C with p-value 0.74 which was not significant. Mean BMI in (kg/M^2) was 22.6±1 in Group R+D while 23.4±1.3 in Group C with p-value 0.0098 which was also not significant. Both groups had equal sex ratio with 17 males and 13 females. The ASA physical status I: II ratio was 19:11 in Group R+D and 20:10 in Group C.



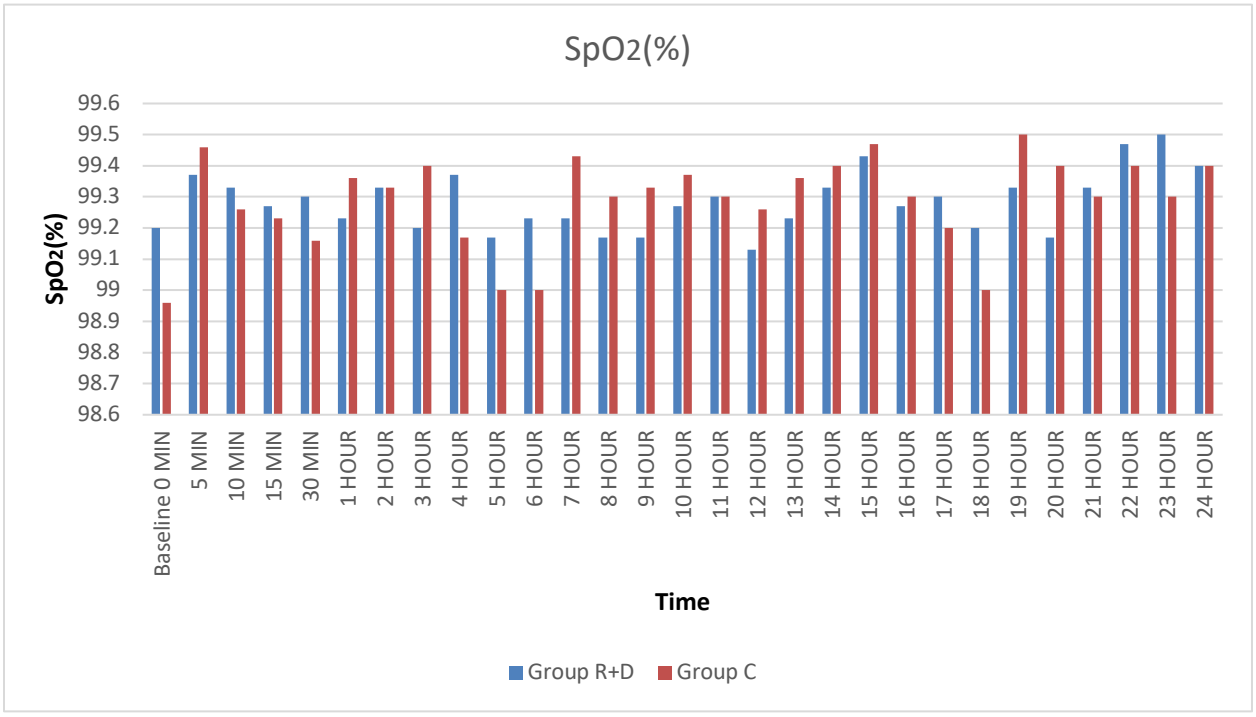
Graph 1

Both the groups had Mean Heart Rate comparable at all the stages till 24th hour postoperatively and the p-value was not significant. (Graph 1)



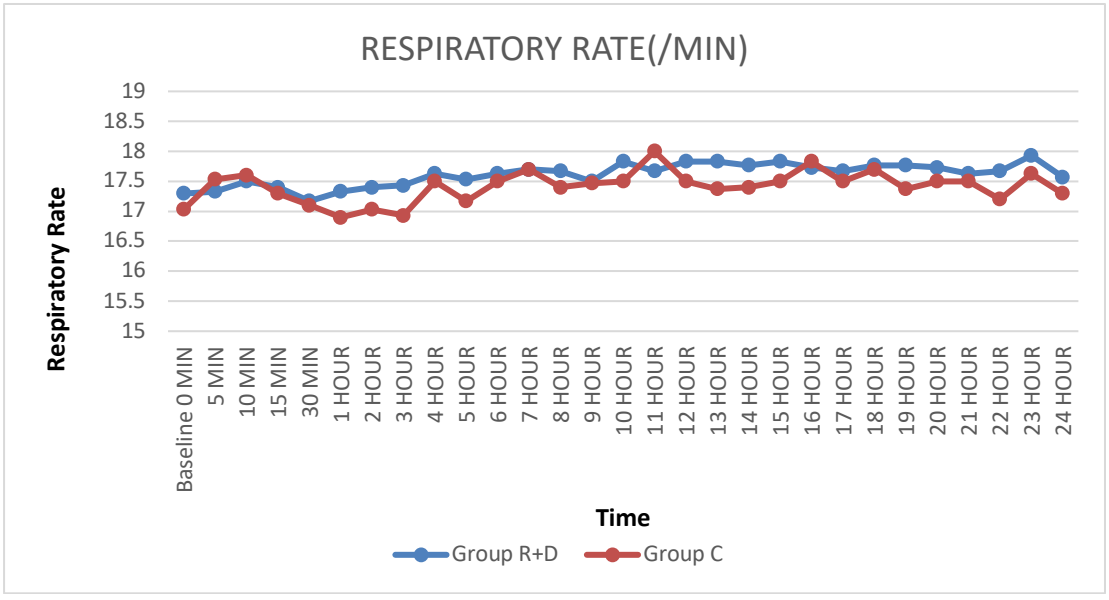
Graph 2

Both the groups had MAP comparable at all the stages till 24th hour postoperatively and the p-value was not significant. (Graph 2)



Graph 3

Both the groups had Mean SpO_2 comparable at all the stages till 24th hour postoperatively and the p-value was not significant. (Graph 3)



Both the groups had Mean Respiratory Rate comparable at all the stages till 24th hour postoperatively and the p-value was not significant. (Graph 4)

Table 2: Comparison of VAS score between both groups

VAS SCORE	GROUP R+D MEAN±SD	Group C MEAN±SD	P-value
2 HOUR	0.63±0.49	0.83±0.37	0.0714
3 HOUR	0.80±0.40	0.96±0.18	0.0504
4 HOUR	1±0	4.3±0.80	<0.0001
5 HOUR	1±0	3.4±0.93	<0.0001
6 HOUR	1±0	2.53±0.50	<0.0001
7 HOUR	1±0	1.7±0.46	<0.0001
8 HOUR	2.03±0.36	2.23±0.56	0.1053
9 HOUR	2.92±0.50	3.05±0.35	0.2481
10 HOUR	2.98±0.44	4.06±0.86	0.001
11 HOUR	3.12±0.21	3.0±0.32	0.0913
12 HOUR	3.10±0.24	3.0±0.29	0.1510
13 HOUR	4.20±0.84	2.43±0.50	0.0001
14 HOUR	3.10±1.12	2.66±0.47	0.0520
15 HOUR	2.63±0.49	2.8±0.40	0.1464
16 HOUR	1.67±0.71	4±0.90	0.0001
17 HOUR	1.73±0.69	2.2±1.42	0.1084
18 HOUR	1.67±0.47	1.76±0.62	0.5288
19 HOUR	2.07±0.25	1.86±0.57	0.0697
20 HOUR	2.43±0.50	2.6±0.49	0.1887
21 HOUR	3.05±0.15	3.08±0.29	0.6167
22 HOUR	4.03±0.88	4.06±0.78	0.8894
23 HOUR	3.17±0.98	3.36±0.85	0.4257
24 HOUR	2.30±0.46	2.5±0.50	0.1123

Statistically significance at p≤0.05

As a requirement of the first dose of rescue analgesic in form of Tramadol (1 mg/kg) was at 13 hours in group R+D, VAS was seen decreasing in subsequent hours due to effect of Tramadol and again VAS increased thereafter. So, the second requirement of rescue analgesic was around 22 hours in group R+D. (Table 2)

While in group C first rescue analgesic injection Tramadol (1 mg/kg) was given at 4 hours postoperatively as VAS≥4 then, VAS was seen decreasing due to effect of Tramadol. Thereafter pain was taken care of subsequently by inj. Tramadol. Likewise, the 24-hour dose requirement was around 10, 16 and 22 hours postoperatively in group C.

The difference in VAS score among both the groups during 4 to 7 hours was statistically significant.(p value<0.0001). This difference was also observed at 10 hours (p value=0.001), 13 hours (p value=0.0001) and 16 hours (p value=0.0001) as shown in above table.

Table 3: Total consumption of Rescue Analgesic (Inj Tramadol) in mg

Total Consumption of Inj Tramadol In Mg	Group R+D Mean±Sd	Group C Mean±Sd	P Value	Inference
	75±25.42	195±15.26	<0.0001	SS

Total Consumption of Analgesic Drug (Inj Tramadol) in 24 Hours was 75±25.42 mg in Group R+D, Whereas it was 195±15.26 mg in Group C, which was statistically significant. (Table 3)

Table 4: Duration of analgesia

Duration of Analgesia (In Hours)	Group R+D Mean±Sd	Group C Mean±Sd	P Value	Inference
	13.67±0.71	4.57±0.5	<0.0001	SS

The first dose of rescue analgesic (mean duration of analgesia) was given at 13.67±0.71hours in Group R+D and 4.57±0.5 hours in Group C, which was extremely significant.

Table 5: Complications among study participants

Complications	Group R+D	Group C
Vomiting	1(3.3%)	3(10%)
Nausea	2(6.6%)	5(16.6%)
Respiratory Depression	0	0
Pain at site of injection	1(3.3%)	0

In group R+D, 1 patient (3.3%)had vomiting while in group C 3 patients(10%) had vomiting and 2 patients(6.6%) had nausea while in group C there were 5 patients(16.6%). Out of thirty, 1 patient (3.3%) had pain at the site of injection postoperatively in Group R+D, which relieved after half an hour of the block.

Discussion

Adequate control of pain is therefore paramount to a successful outcome and to patient satisfaction. Adequate analgesia with motor preservation has become the prime goal after orthopaedic surgeries to enable shorter hospital stay, early physiotherapy and faster recovery. Adductor canal block (ACB) has the unique advantage of providing localized analgesia but it doesn't provide pain relief to the posterior capsule. It has been postulated that IPACK combined with ACB will provide better pain relief by covering analgesia of both anterior and posterior capsular regions of the knee with preservation of quadriceps muscle strength than ACB alone [9].

Sixty adult patients of ASA grade I and II, aged between 18 and 70 yrs posted for elective knee surgeries were selected and all the patients were operated under spinal anaesthesia using 0.5% 3 ml heavy Bupivacaine.

In our study, all the patients were from 18-70 years of age group and ASA grade I-II. In our study, there was no statistically significant difference between demographic data of the two groups in terms of age, sex, BMI and ASA physical status. A similar result was found in a study by Nagi Amer *et al* [5] who did a comparison of USG guided combined ACB + IPACK block versus Combined Adductor canal and periarticular Injection block, which showed no statistically significant difference concerning the demographic data among 246 patients aged 18-75 years undergoing ACL Reconstruction surgery.

R D Wang *et al* [12], derived that Ropivacaine is associated with less cardiovascular and CNS toxicity than Bupivacaine and provides a greater degree of

dissociation between sensory and motor effects producing less intense motor blockade and more rapid recovery to full patient mobilization. Ropivacaine has shorter elimination half-life (t1/2), with a lower potential for accumulation. Ropivacaine has less cardiovascular toxicity than bupivacaine with respect to direct myocardial depression, the success of resuscitation and arrhythmogenic potential when given in equal doses.

In our study, there was no statistically significant difference between 2 groups, study group (ACB+IPACK) and control group in patient's haemodynamic characteristics like HR, MAP, RR and Spo2. Wang *et al* [13] who randomized participants into 2 groups: study and control group. Where, study group received ACB with 10ml 0.5% Ropivacaine + 8 mg Dexamethasone and control group received 10 ml 0.5% Ropivacaine +2 ml normal saline. Patients were assessed for the duration of analgesia using a numerical rating scale and requirement of opioid. In his study, there was no significant difference between the 2 groups with respect to haemodynamic parameters like MAP and HR.

In our study, the requirement of the first dose of rescue analgesic in form of Tramadol (1 mg/kg) was at 13 hours (VAS≥4) in group R+D, VAS was seen decreasing in subsequent hours due to effect of Tramadol and again VAS increased thereafter. So, the second requirement of rescue analgesic was around 22 hours in group R+D. While in group C first rescue analgesic injection Tramadol (1 mg/kg) was given at 4 hours postoperatively as VAS≥4 then, VAS was seen decreasing due to effect of Tramadol. Subsequently, the pain was taken care of by inj. Tramadol. Likewise, the 24-hour dose requirement was around 10, 16 and 22 hours postoperatively in group C. Shruti Ghodageri *et al* [14] studied the NRS static and dynamic scores among the patients of ACB group, which were significantly lower than the NRS static and dynamic scores among the patients of conventional analgesia (Tramadol) group at 1st, 2nd, 4th, 8th, 12th,20th and 24th hours postoperatively.

In our study, the time for the first rescue analgesic request was prolonged in the group R+D. The group R+D had the first analgesic request after 13.67±0.71 hours, which was prolonged as compared to the control group in which the mean duration of analgesia was 4.57±0.5 hours. G Jayaraman *et al*.[15], performed combined adductor canal block by giving 0.25% Bupivacaine 10 ml and IPACK block by giving 20 ml of 0.25% Bupivacaine in five patients undergoing unilateral anterior cruciate ligament (ACL) repair at the end of surgery. In his study, the time to first rescue analgesic was around 14-15 hours in all cases.

In our study mean dose of analgesic drug (Inj. Tramadol) consumption in 24 hours was 75±25.42mg in Group R+D and 195±15.26 mg in Group C, the difference being statistically highly significant($P<0.0001$). This observation of our study co-related very well with that of Nagi Amer *et al*. [5] study. Shruti Ghodageri *et al* [14] performed a study on 60 patients, who were allocated into 2 groups of 30 each. Group 1 with conventional analgesia (Tramadol) and group 2 was ACB group receiving 20 ml of 0.75% Ropivacaine. The postoperative 24 hr total Tramadol consumption in conventional group was 333.3±12.76 mg, which was significantly higher than the consumption in the ACB group, where it was 115.0±7.638 mg.

In our study In group R+D, 1 patient (3.3%) had vomiting while in group C 3 patients(10%) had vomiting. In groupR+D only 2 patients (6.6%) had nausea while in group C 5 patients had nausea (16.6%). While in Nagi Amer *et al* [13] study, the occurrence of postoperative nausea and vomiting was low in both groups with no

statistical difference. In the study done by Andres Fabricio *et al*.[16], none of the patients experienced side effects like nausea, vomiting. A similar result was found in the study done by El-Sayed M. El-Emam *et al* [17], who compared the analgesic effect of ACB with ACB+IPACK in patients who underwent TKA and reported no complications in both groups.

Conclusion

The ultrasound-guided ACB+IPACK block could relieve pain during the first 24-hour postoperative period, decrease the total postoperative analgesic consumption in 24 hours and significantly prolong the time for first rescue analgesic requirement after knee surgeries like Total knee arthroplasty and Arthroscopic knee surgeries. The possibility exists of less motor blockade with the combined use of ACB and IPACK preserving long term analgesic effect.

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