

iPACK Versus Local Infiltration Analgesia for Post Operative Pain Management in Total Knee Replacement

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Abstract

Background: This prospective randomised study was done to compare iPACK (local anesthetic infiltration in the interspace between Popliteal Artery and Capsule of Knee) versus LIA (Local Infiltration Analgesia), in combination with ACB (Adductor canal block) for post-operative pain management in patients undergoing TKR (Total Knee Replacement) surgeries. **Methods:** 120 patients in the age group of 50 to 70 yrs belonging to ASA I & II posted for TKR were divided into two equal Groups and studied. Both the groups received subarachnoid block as the anesthetic technique followed by Adductor canal block. Group A received iPACK and Group B received LIA. Post-operatively parameters like VAS (Visual Analogue Scale), distance walked and opioid consumption were studied. **Results:** Demographic profile was comparable in both the groups. Both the groups had optimal post-operative analgesia which was evident with respect to VAS, distance walked and opioid consumption. The mean VAS scores at 24 hrs was 2.85 ± 1.45 and 3.14 ± 1.12 in Group A and Group B respectively. The mean VAS scores at 48 hrs was 3.22 ± 2.32 and 3.8 ± 2.91 in Group A and Group B respectively. The distance walked and opioid consumption were comparable in both the Groups. **Conclusion:** It is concluded that both iPACK and LIA, in combination with Adductor canal block were equally effective in providing post-operative analgesia in TKR patients.

Keywords: Adductor canal block; iPACK; LIA (Local Infiltration Analgesia); TKR (Total Knee Replacement), VAS (Visual Analogue Scale).

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Introduction

A Total Knee Replacement (TKR) also known as Total Knee Arthroplasty (TKA) relies on a mechanical implant to replace the actual knee. Most people who undergo a knee replacement are between the ages of 50 and 80. The average age is about 70. About 60 percent of the recipients are women. The procedure has a high success rate and is considered relatively safe and effective.

TKA is associated with severe post-operative pain especially during the first 48 hrs after surgery¹ But the post-operative pain management remains a major challenge even to this day. Though the pain management has evolved tremendously in the past few decades, still it needs to go a way. Post-operative pain management is essential for faster recovery, rehabilitation and for desired outcome.^{2,3}

Various methods described for pain management after TKR are epidural anesthesia, femoral nerve

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block, adductor canal block, intra-articular cocktail, iPACK (local anesthetic infiltration in the interspace between popliteal artery and capsule of knee), intra-articular epidural catheter (Caledonion protocol) along with intravenous analgesics and combinations of these modalities.^{4,5}

The Adductor Canal Block (ACB) is a technique that was first described by Van Der W *et al.*⁶ as a highly successful approach to the saphenous nerve and was initially performed at the level of the distal thigh, distal to the quadriceps motor branches. It is frequently used to provide anesthesia and analgesia of medial calf and ankle. A randomized trial have demonstrated superior analgesia after Total Knee Arthroplasty (TKA) in patients receiving ACB compared with parenteral opioids.⁷⁻⁹

Ultrasound-guided local anesthetic infiltration of the Interspace between the Popliteal Artery and the Capsule of the posterior Knee (iPACK) provides posterior knee analgesia and the iPACK would spare the main trunk of the tibial and peroneal nerves and block only the terminal branches innervating the posterior knee joint. iPACK was proposed by research team at St. Francis Hospital and Medical Center in Hartford, Conn. headed by Dr Sanjay Sinha. It is an ultrasound-guided infiltration of the interspace between the popliteal artery and the capsule of the knee with a local anesthetic solution that provides an alternative analgesic when combined with a femoral nerve block.¹⁰

Local Infiltration Analgesia (LIA) has been introduced recently as a promising step forward in reducing post-operative pain and side effects from analgesics after knee arthroplasty. Multiple injections of local anesthesia in joint structures during the procedure with or without adjuncts like ketorolac, tramadol, dexmedetomidine, epinephrine, etc is referred to as LIA.¹¹

In this study, we have compared the combination of ACB plus LIA versus ACB plus iPACK in TKR patients for post-operative pain management.

Materials and Methods

This study was conducted at Sanjay Gandhi Institute of Trauma and Orthopedics and Specialist Hospital, Bangalore between *May 2018 to December 2018*. After approval of institutional ethical committee and written informed consent from patients were obtained, 120 patients of ASA (American Society of Anesthesiology) I and II aged between 50 and 70 years who were scheduled to undergo TKR were included in the study.

Exclusion criteria included patients with history of cardiorespiratory disorders, hepatic and renal diseases, convulsions and neurological deficits, psychiatric diseases, ASA Grade III and above. Patients were divided into two equal groups by computer generated random tables. Patients in both the groups received Subarachnoid block with Inj. Bupivacaine 0.5% (hyperbaric) as the primary anesthetic technique and Adductor canal block with 20 ml of 0.2% ropivacaine. Patients in Group A received iPACK (30 ml 0.2% Ropivacaine for iPACK) immediately after adductor canal block. Patients in Group B received LIA (a cocktail mixture of 100 ml of 0.2% Ropivacaine + 30 mg ketorolac + 0.5 mg of adrenaline) administered by the surgeon intra-operatively. Adrenaline was added in LIA mixture so that the absorption of ropivacaine into the systemic circulation is reduced thereby the systemic toxic levels of the drugs are not attained. All the patients underwent surgery with tourniquet applied about 100 mm Hg above the systolic blood pressure. No compression bandage was used in any of the patients. All the patients received Injection Dexamethasone 8 mg I.V. pre-operatively and Inj. Paracetamol 1 gram I.V. intra-operatively.

Technique

Adductor Canal Block

With the patient lying supine and limb positioned slightly abducted and externally rotated. A high frequency linear probe is placed in transverse orientation on the anteromedial aspect of the mid thigh, femoral artery is identified deep to the sartorius muscle. At this level, an in plane approach is used passing the needle from lateral to medial side. The needle tip is advanced into the adductor canal and 20 ml of 0.2% Ropivacaine is injected around the lateral aspect of the artery and the saphenous nerve.

iPACK

Patient lying supine, the knee is bent in 90 degree flexion. A high frequency linear probe was used to identify the popliteal vessels and posterior aspect of femur at the level of knee. The needle was inserted from medial aspect in the space between the popliteal vessels and posterior capsule and 30 ml of 0.2% ropivacaine is given along the entire space.

LIA

LIA is performed by the operating surgeon intra-operatively. Following skin incision, 25 ml of

cocktail mixture is injected proximally as a block of the inter mediate and medial cutaneous nerves of the thigh, and in areas of fat deep to the deep fascia using a "moving needle" technique. Following bony resections and prior to cementing the implants, the posterior aspect of the joint is exposed by bending the knee to 90° and opening the interval with a laminar spreader; 50 ml of the injection mixture is injected into the posterior capsule on each side. The needle is pointed along the posterior aspect on the distal femur to avoid injecting the common peroneal nerve on the lateral side. Following cementing of the implants, a further 25 ml of injection mixture is injected into the synovium, medial and lateral retinaculum, anterior capsule and quadriceps.¹²

In the recovery room pain was assessed by the visual analogue scale. Pain score was evaluated in PACU and at 8th, 16th, 24th and 48th hr. Distance walked on day 0 and the opioid consumption on day 0, 1 and 2 were recorded. Injection Morphine was given intravenously as the rescue analgesic.

Statistical Analysis

SPSS 22 program for microsoft windows was used for statistical analysis. All continuous data were expressed as mean (SD) while the categorical data were expressed as percentages. A p value of < 0.05 was considered statistically significant.

Observations and Results

A total of 120 patients of either sex were randomly selected for the study. Statistical data was analyzed using student t test. The patients in the two Groups were comparable with respect to age, gender, Body Mass Index (BMI) and Visual Analog Scale (VAS) at rest and movement, shows in (Table 1 & 2).

Table 1: Demographics of the Groups

Parameter	Group A (n = 60)	Group B (n = 60)	p - value
Age (yr)	60.40 ± 6.50	61.32 ± 7.2	0.46
Male	28 (46)	23 (38)	0.51
Female	32 (54)	37 (62)	0.63
Body mass index (kg/m ²)	26.75 ± 3.72	27.21 ± 4.64	0.55
VAS at rest	3.2 ± 2.1	3.6 ± 2.0	0.28
VAS at movement	7.4 ± 2.4	7.5 ± 2.5	0.82

Table 2: VAS (Visual Analogue Scale), distance walked (in number of steps) and opioid consumption (morphine equivalents) in post-operative period

	Group A	Group B	p value
VAS at PACU	0.88 ± 0.13	0.87 ± 0.12	0.69
VAS at 8 hrs	1.22 ± 0.67	1.24 ± 0.72	0.88

VAS at 16 hrs	2.24 ± 1.75	2.55 ± 1.18	0.30
VAS at 24 hrs	2.85 ± 1.45	3.14 ± 1.12	0.26
VAS at 48 hrs	3.22 ± 2.32	3.8 ± 2.91	0.27
Distance walked on D0	10.34 ± 1.23	10.64 ± 1.46	0.22
Opioid consumption D0	6.5 ± 7.3	7.2 ± 7.8	0.61
Opioid consumption D1	15.1 ± 13.4	16.8 ± 14.1	0.49
Opioid consumption D2	12.3 ± 10.8	12.9 ± 11.1	0.76

It may be noted from the above Table that there is not much difference in VAS scores, distance walked in number of steps and opioid consumption on post-operative day 0, 1 and 2 between the two Groups.

Discussion

Multimodal analgesia has become the norm for post-operative pain management in TKR patients. Though there are multiple options, the best analgesic technique still remains elusive. There are multiple studies on LIA, ACB and iPACK individually, but very few studies on combination of these modalities. The results have been very variable. Hence in our study, we compared iPACK versus LIA, in combination with Adductor Canal Block.

ACB + iPACK

Sankineani *et al.*¹³ conducted a study comparing ACB + iPACK versus ACB alone in TKR patients. They concluded that ACB + iPACK provided better range of motion and ambulation than ACB alone. Motor functions was preserved and better pain management achieved with ACB + iPACK group.

Zhou *et al.*¹⁴ in their study used ACB in combination with posterior capsular infiltration (iPACK) and compared it with ACB and LIA alone. They concluded that ACB and iPACK provided more ideal analgesia and patient satisfaction in first 24 hrs after surgery.

ACB + LIA

Wirarinaree *et al.*¹⁵ did a study and found that combined ACB + LIA enhanced early ambulation with reduced and delayed rescue analgesia when compared to ACB alone after TKR. Nader *et al.*¹⁶ in their study concluded that ACB with LIA decreased pain and opioid requirement in post-operative period when compared to LIA alone after TKR.

ACB + LIA versus ACB + iPACK

Brandon *et al.*¹⁷ compared adductor canal catheters and LIA patients with adductor canal catheters and iPACK for TKR surgeries. They concluded in their

study that addition of iPACK blocks decreased lowest pain scores on post-operative day 0 (POD 0). Other outcomes like opioid consumption, ambulation distance, length of stay and adverse events were similar between the groups.

In our study

Our study was conducted to compare iPACK versus LIA, in combination with Adductor canal block as the post-operative analgesic technique. We used 20 ml of 0.2% ropivacaine, 30 ml of 0.2% ropivacaine and 100 ml of 0.2% ropivacaine for ACB, iPACK and LIA respectively. The total dose of 0.2% ropivacaine never exceeded 120 ml (240 mg). This dose was less than the dose used in the study conducted by Brydone *et al.*¹⁸ About 400 mg of ropivacaine was used in their study and they noted that the toxic levels of free venous ropivacaine was not reached and hence considered safe.

In our study, we noted that VAS scores, distance walked and opioid consumption were comparable in both groups. This is in concurrence with the study conducted by Brandon *et al.* Both combination of ACB + iPACK and ACB + LIA are equally efficacious in post-operative pain management in TKR patients. ACB + LIA may be used when the surgeons are co-operative and who are willing to actively get involved in pain management. The advantages of LIA are simplicity of the technique, limited time taken to perform and avoidance of motor block. But certain surgeons are not comfortable with LIA as it is given intra-operatively after the insertion of implants. In such cases ACB + iPACK may be a suitable alternative technique as it is given pre-operatively. The advantage of iPACK being it provides excellent analgesia by reducing the pain in the posterior aspect of the knee and also avoids motor block. The disadvantage of ACB + iPACK may be that it requires expertise and time consuming. Hence, it is advisable to go with a combined multimodal approach of pain management for TKR patients either ACB + iPACK or ACB + LIA.

Conclusion

We conclude that both iPACK and LIA, in combination with Adductor canal block are equally good and effective as a multimodal analgesic technique for post-operative pain management in total knee replacement patients.

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