Comparing Continuous Adductor Canal Block Alone, with Combined Continuous Adductor Canal Block with iPACK in Terms of Early Recovery and Ambulation in Patients Undergoing Unilateral Total Knee Replacement- A Prospective Randomized Double Blinded Study

Manasa Vijay[1]

[1]Assistant Professor, Department of Anaesthesia, Sri Balaji Institute of Surgery, Research and Rehabilitation for Disabled Hospital, TTD (BIRRD), Andhra Pradesh.

ABSTRACT

BACKGROUND

Adductor canal block which blocks saphenous nerve which is purely sensory preserves motor functions and hence patients can be mobilized early decreasing complications and enabling early discharge. However, it does not relieve posterior knee pain. iPACK has shown promising results in providing significant posterior knee analgesia without affecting the motor nerves. Our aim was to make patients mobile on the same day of surgery and decrease the hospital stay, aiming for early discharge that is on second post-operative day.

METHODS

100 patients of ASA grade 1 and 2 posted for unilateral knee replacement were randomly selected. Group A received ACB + iPACK and group B patients received ACB alone. Post-operative ambulation score, muscle control score, knee flexion in degrees was checked on day 0, 1 and 2. VAS sore was checked at 6, 12 and 24 hrs.

RESULTS

Patients with combined iPACK with adductor canal block were completely painless after surgery. Whereas patients who received only adductor canal block (continuous) had mild pain on day 0. On day 1 patients in both the groups were absolutely pain free and required no additional dose of analgesics. But patients from both groups of patients were able to walk on the day of surgery comfortably and discharged on day 2.

CONCLUSIONS

iPACK with adductor canal block is the best mode in multimodal analgesia in treating post-operative pain after total knee replacement leading to decreased post-operative complications (due to quadriceps weakness), decreased nosocomial complications, early patient discharge and better patient satisfaction.

KEYWORDS

Adductor Canal, Bupivacaine, iPACK

Corresponding Author:
Dr. Manasa Vijay,
#308, B- Block,
Chenzi Plaza, Kt Road,
Bhavani Nagar,
Opp. To SBI Bank,
Tirupati, Andhra Pradesh.
E-mail: vijaymanasa168@gmail.com
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BACKGROUND

Adductor canal block has attracted extensive attention due to its lower complication of reducing quadriceps strength and reduced opioid consumption, better pain management, and early ambulation when compared with femoral nerve block.[1,2] But adductor canal nerve block blocks only saphenous nerve which supplies the medial part of leg up to great toe. Along with the saphenous nerve knee joint is supplied by sciatic nerve in the posterior part. This posterior pain may be decreased by addition of iPACK block (interspace between the popliteal artery and the capsule of the knee). Pain after TKR is a particularly serious problem.[3] Extensive tissue damage in TKR, cause immediate changes in the endocrine system and central, peripheral, and sympathetic nervous systems, and stimulate catabolic hormone release including cortisol, glucagon, growth hormone, and catecholamine, resulting in compromised immunity, increased oxygen demand, and higher strain on the cardiovascular system.[4] If postoperative pain is not managed properly the surgery-induced responses can be exacerbated, posing a serious danger to patients including ischemic cardiac events and myocardial insufficiency that result from increased stress on the cardiovascular system.[5] In addition, immobilization caused by pain may increase the risk of DVT, pulmonary embolism,[6] gastrointestinal complications such as ileus,[7] and thrombus formation that are related to surgical stress. Multimodal pain management approaches is currently recommended for postoperative pain control in TKA.[3] adductor canal block with iPACK blocks only the sensory nerves hence mobility is not affected leading to early discharge and decreased complications.

Aim

Aim of this study was to compare effect of combined block of adductor canal block with iPACK (Interspace between the Popliteal Artery and the Capsule of the posterior Knee) and adductor canal block alone with a catheter secured in patients undergoing unilateral Total knee replacement in immediate postoperative rehabilitation. It has been postulated that 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 Centre in Hartford, Conn. It is an ultrasound-guided infiltration of the interspace between the popliteal artery and the capsule of the knee with a local anaesthetic solution.

METHODS

After taking approval from institutional ethical committee, 100 patients of ASA grade I and grade II of either sex, age between 45 to 75 years posted for unilateral total knee replacements were selected. Patients who were contraindicated for regional anaesthesia and patients who refused to give consent for the study were excluded from the study. Sealed opaque envelopes were made based upon random numbers generated by computer. These envelopes were only accessible to the anaesthesiologist who provided the Block. Injection material for each participant patient and the data collection team were blinded. The anaesthesiologist who prepared the treatment solution was aware of the allocation, surgeon was not aware of the treatment and both were not involved in data collection or data analysis. Randomization was not stratified by surgeon. The anaesthesiologist also informed the scrub nurse of the group allocation, to prepare the appropriate solution. Post-operatively, patients and the Data collection team were blinded to the treatment administered in operation theatre. Group A patients received ACB + iPACK and group B patients received ACB alone on the OT table once spinal anaesthesia was given at L3 and L4 space with 25 number Quincke needle. Catheter was secured in adductor canal about 10 cms above the femoral condyle in both the group of patients. Inj. bupivacaine 0.25% 20 ml in adductor canal with 0.25% of bupivacaine 10 ml was given into the posterior capsule for group A patients. For group B patients only 20 ml of 0.25% was given into the adductor canal. Injection diclofenac 75 mg intramuscular was given 12th hrly. and injection paracetamol 1 gm was given 6th hrly. for both the groups. Inj. 0.25% of bupivacaine 20 ml was given 6th hrly. for both the groups on day 0. On day 1, 0.25% of bupivacaine 10 ml 6th hrly. was given. VAS score was examined at 6th, 12th and 24th hr. Ambulation score, muscle power score and knee flexion was checked on day 0, 1 and 2. On the 2nd day drain was removed and if the patients is pain free and ambulating well patient will be discharged on the 2nd day.

Technique for iPACK

The knee was bent in 90 degree flexion and needle was inserted from medial aspect. With the Ultrasonography the popliteal vessels were identified and and needle was inserted in the space between the vessels and the posterior capsule (Picture 1). 10 ml of 0.25% bupivacaine was given along the entire space and simultaneously the needle is withdrawn while the local anaesthesia is still being given).

Figure 1 and 2

Technique for Adductor Canal Block

In supine, frog leg position under aseptic precautions with a linear probe of frequency of 6 to 10 hz, 10 cm s above the femoral condyle sartorius muscle, femoral artery is identified and needle is passed and 0.25% 20 ml of drug is injected anterior to the artery (Figure 2) as the drug is injected artery will be pushed inferiorly and posteriorly.

RESULTS

Sl. No.		Group A (n=30)	Group B (n=30)	t-value / χ2 (p-Value)
1.	**Age Group (Yr.)**			
(a)	<50 Years	1 (2.0)	4 (8.0)	χ2=8.582* (p=0.035) df= 3
(b)	51 - 60 Years	10 (20.0)	20 (40.0)	
(c)	61 - 70 Years	31 (62.0)	18 (36.0)	
(d)	>70 Years	8 (16.0)	8 (16.0)	
	Total	**50 (100.0)**	**50 (100.0)**	
2.	**Mean Age &S.D. (yr.)**	64.42± 5.75	62.12 ± 7.16	t = 1.770@; p=0.133
3.	**Range**	49 - 75	46-78	
4.	**Sex**			
(a)	Male	30 (60.0)	25 (50.0)	χ2=1.010@ (p=0.315) df= 1
(b)	Female	20 (40.0)	25 (50.0)	
	Total	**50 (100.0)**	**50 (100.0)**	

Table 1. Age, Weight, Sex Distribution

@ Not significant; *significant at 0.05 level

	Group	N	Mean	S.D.	S.E.
Day 0	Group A	50	100.00	.000[a]	.000
	Group B	50	100.00	.000[a]	.000
Day 1	Group A	50	100.00	.000[a]	.000
	Group B	50	100.00	.000[a]	.000
Additional Dose of Tramadol	Group A	0[b]	.	.	.
	Group B	15	100.00	.000	.000

Table 2. Flexion in Degree

	Group	N	Mean	S.D	S.E.
Day 0	Group A	50	6.00	.000a	.000
	Group B	50	6.00	.000a	.000
Day 1	Group A	50	8.00	.000a	.000
	Group B	50	8.00	.000a	.000
Day 2	Group A	50	8.00	.000a	.000
	Group B	50	8.00	.000a	.000

Table 3. Ambulation Score

	Group	N	Mean	Std. Deviation	Std. Error Mean
Day 0	Group A	50	3.00	.000a	.000
	Group B	50	3.00	.000a	.000
Day 1	Group A	50	3.00	.000a	.000
	Group B	50	3.00	.000a	.000
Day 2	Group A	50	3.00	.000a	.000
	Group B	50	3.00	.000a	.000

Table 4. Muscular Control Score

	Group	N	Mean	Std. Deviation	S.E.	t-Value	Sig
6 hrs	Group A	50	.00	.000	.000	19.858**	0.000
	Group B	50	1.30	.463	.065		
12 hrs	Group A	50	.00	.000a	.000	-	-
	Group B	50	.00	.000a	.000		
24 hrs	Group A	50	.00	.000a	.000	-	-
	Group B	50	.00	.000a	.000		

Table 5. VAS Scores

It was noted that the mean value of group B patients was 1.30 ± 0.463 compared to group A nil. Since t value is 19.858 and sig=0.000 which is less than 0.001 which indicates that it is highly significant

There was no significant difference between two groups in terms of ambulation score and muscle power score. both the group of patients were able to walk with no pain on day 0. But few patients (15 among 50) in group B required additional tramadol at 6 hrs. after the surgery. It was observed that group A patients had 0 VAS score at 6, 12, 24 hrs. Whereas group B patients had VAS score of 2, 1 that is very mild pain at 6 hrs. After the surgery which dint affect there ambulation and on day 1 and day 2 both the group of patients were pain free and dint require any additional dose of analgesics. Both the group of patients were discharged on the 2nd day after the surgery. No untoward effects were observed in both the groups.

DISCUSSION

Adductor canal block gives relief from pain of knee joint medially[8] but it doesn't cover the posterior capsule as the deep small genicular nerves are not covered by adductor canal block alone. Posterior knee pain is mediated by articular branches that originate primarily from the tibial component of the sciatic nerve with contributions from the obturator nerve (Figure 3).[9,10] Posterior knee pain can be controlled by sciatic nerve block, but might lead to foot drop and delay diagnosis of surgically induced common peroneal nerve injury.[11] A selective tibial nerve block in the popliteal fossa is an alternative to sciatic nerve block and can provide analgesia without causing a foot drop, but it decreases sensory perception in the sole of the foot and causes weakness of plantar flexion.[11] The benefit of adding iPACK is the entire posterior space between capsule and popliteal vessels adds up to the pain relief of the posterior capsule significantly and spares the main trunk of the tibial and peroneal nerves and block only the terminal branches innervating the posterior knee joint and hence preserving the sensory motor function of leg and foot.[11] Studies have shown that continuous adductor canal block was superior to single shot.[12] Studies have shown that iPACK with adductor canal block showed better post op VAS score and better range of knee motion.[13] in our study we placed a catheter in adductor canal to give 0.25% of bupivacaine 20 ml 6th hry on day 0 and 0.25% 10 ml 6th hry on day 1 for all patients.

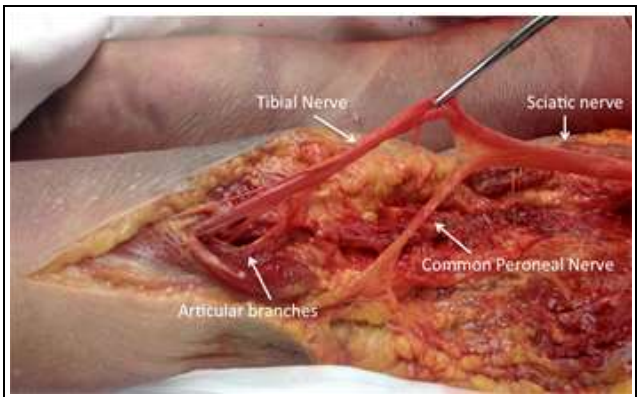

Figure 3. Dissection of Popliteal Fossa Showing Articular Branches to Posterior Knee Arising from Tibial Nerve[11]

Score Sheet for Ambulation Score[14]

For every completed activity the patient's ability to control the operated leg is assessed according to the following- A score of 3 is assigned if control with the operated leg is good. Good control means, that the patient can use the operated leg efficiently during ambulation. Muscular control is only slightly affected compared to the non-operated leg. A score of 2 is assigned if control with the operated leg is fair. Fair control means, that the patient can use the operated leg to some extent during ambulation, but muscular control is considerably affected compared to the non-operated leg. A score of 1 is assigned if control with the operated leg is poor. Poor control means, that the patient has difficulties using the operated leg during ambulation, and muscular control is

almost insufficient to perform the ambulation. A score of 0 is assigned if the patient cannot perform the first activity. If the test is terminated i.e. patient not able to walk, the reason(s) is stated according to the following:

- Pain.
- Nausea or vomiting.
- Dizziness or indisposition.
- Insufficient motor control to ambulate safely.
- Drainage from the surgical wound that preclude further ambulation.

Head of the bed elevated to 30 degrees. Legs to the operated side.

Ambulation	Muscular control
2 Performs independently (incl. assistive devices)	**3** Good control
1 Performs with personal physical support	**2** Fair control
0 Cannot perform step	**1** Poor control
	0 Cannot perform step
Activity 1. Ambulation to Sitting Position in Bed[8]	

Ambulation	Muscular Control (Only if Activity is Completed)
2 Performs independently (incl. assistive devices)	**3** Good control
1 Performs with personal physical support	**2** Fair control
0 Cannot perform step	**1** Poor control
Activity 2. Ambulation to Standing Position from Bed	

Ambulation	Muscular Control (Only if Activity is Completed)
2 Performs independently	**3** Good control
1 Performs with personal physical support	**2** Fair control
0 Cannot perform step	**1** Poor control
Activity 3. Walking with a High Walker on Wheels Walking at Least 10 m (33 ft).	

Ambulation	Muscular Control (Only if Activity is Completed)
2 Performs independently	**3** Good control
1 Performs with personal physical support	**2** Fair control
0 Cannot perform step	**1** Poor control
Activity 4. Walking with Elbow Crutches Walking at Least 10 m (33 ft).	

Reason for Termination

Check reasons for termination if test terminated before activity 4:

··Pain	· Dizziness or indisposition	· Drainage from the surgical wound
··Nausea or vomiting	· Insufficient muscular control	· Other reasons (note reasons)
Reason for Termination		

Pain During Ambulation

Worst knee related pain during ambulation-

No pain 0 1 2 3 4 5 6 7 8 9 10 Worst imaginable pain

The test produces two scores:

- An Ambulation Score (0-8): The sum of ambulation scores from the performed activities.
- Muscular Control Score (0-3) The median of muscular control scores from the completed activities. If first activity (ambulation to sitting position) cannot be performed the score is 0.

Pain in the operated side during ambulation on a 11-point numeric rating scale where 0 is no pain and 10 is the worst pain imaginable.

CONCLUSIONS

iPACK with adductor canal block is the best mode in multimodal analgesia in treating post-operative pain after total knee replacement leading to decreased post-operative complications (due to quadriceps weakness), decreased nosocomial complications, early patient discharge and better patient satisfaction.

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