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Amany Mohamed Badr Ali Badr
Department of Anesthesiology, Surgical Intensive, Care and Pain Medicine, Faculty of Medicine - Tanta University, Egypt

Nadia Hassan Fattoh
Department of Anesthesiology, Surgical Intensive, Care and Pain Medicine, Faculty of Medicine - Tanta University, Egypt

Rabab Mohammed Mohammed
Department of Anesthesiology, Surgical Intensive, Care and Pain Medicine, Faculty of Medicine - Tanta University, Egypt

Mohammed Shebl Abdelghany
Department of Anesthesiology, Surgical Intensive, Care and Pain Medicine, Faculty of Medicine - Tanta University, Egypt

Corresponding Author:
Amany Mohamed Badr Ali Badr
Department of Anesthesiology, Surgical Intensive, Care and Pain Medicine, Faculty of Medicine - Tanta University, Egypt

Comparison of adductor canal block, peri–articular injection or infiltration between popliteal artery and posterior knee capsule with adductor canal block in total knee arthroplasty

Amany Mohamed Badr Ali Badr, Nadia Hassan Fattoh, Rabab Mohammed Mohammed and Mohammed Shebl Abdelghany

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Abstract
Background: Moderate to severe postoperative pain is experienced by patients after total knee arthroplasty (TKA), which has an impact on postoperative rehabilitation, patient satisfaction, and overall results.
Aim: Patients receiving total knee arthroplasty under general anesthesia were evaluated to see how well the combined adductor canal block and infiltration of the interspace between popliteal artery and the capsule of posterior knee block (IPACK) reduced post-operative discomfort. These treatments were compared to adductor canal block (ACB) and peri-articular injections alone (PAIs).
Patients and methods: 60 patients were randomly allocated into three groups (20 in each). All that Group I patients got was an adductor block. Patients in Group II only received the periarticular injection. The IPACK (interspace between popliteal artery and posterior knee capsule) block and adductor block procedures were performed on patients in Group III. The Numeric Rating Scale (NRS) was used to measure post-operative pain as the primary endpoint both during physical therapy and when the patient was at rest. Mobilization was assisted by the Timed Up-and-Go (TUG) and MRC tests, and the second objective was postoperative analgesia, which was assessed by the total number of analgesics used and the time it took until the first rescue analgesic was delivered.
Results: The total amount of morphine consumed in IQR amongst the three study groups was statistically different (p-value 0.005). Total postoperative morphine consumption in groups II and III was statistically significantly lower than in groups I (p-value 0.005), and there was also a significant difference between groups II and III (p-value 0.005), indicating that group II had significantly less total morphine consumption than the other two groups.
Conclusion: In contrast to combination IPACK-ACB and ACB alone, we came to the conclusion that adding PAIs to the pain management regimen for patients having TKA enhances analgesia quality and reduces opioid intake. Even though the combined IPACK-ACB block was less successful than PAIs, it nevertheless showed superior pain scores at rest and during physiotherapy and required less opioid consumption than ACB alone, making it a viable option to PAIs in situations where this technique is not practical.

Keywords: Total knee arthroplasty, adductor canal block; peri–articular injection, posterior knee capsule, IPACK

Introduction
The articular surfaces of the knee joint are replaced with smooth metal and highly cross-linked polyethylene plastic during total knee arthroplasty, also known as complete knee replacement. TKA aims to improve function and quality of life for those with advanced osteoarthritis by reducing pain [1]. It has been demonstrated that peri-articular injections (PAIs) are a useful addition to multimodal pain management regimens. Although there is a considerable deal of variation in the locations of injections and the components used in peri-articular cocktails, there is minimal standardization among surgeons' injection methods [2]. A different type of analgesia commonly utilized in TKA is peripheral nerve blocks (PNB). The sensory innervation of the knee is provided by the sciatic nerve's anterior femoral nerve and posterior cutaneous nerve of the thigh. Additionally, the saphenous nerve and the lateral femoral cutaneous nerve, respectively, have differing effects on the sensory innervation of the medial and lateral sides of the knee. [3].

Common peripheral nerve blocks called adductor canal blocks have been demonstrated to have no effect on quadriceps function while greatly reducing discomfort and narcotic usage [4]. Although ACB eases moderate to severe posterior knee pain, it does not completely eradicate pain in the peri-patellar and intra-articular regions of the knee joint [5]. The Infiltration between Popliteal Artery and the Capsule of the Knee (IPACK) block was created in 2012 to provide an alternative method of treating posterior knee pain following total knee replacement. In contrast to the sciatic nerve block, which effectively treats posterior knee pain, the IPACK delays the discovery of a surgical damage to the common peroneal nerve. Additionally, it avoids postoperative sole numbness and plantar flexion weakness [6]. We anticipated that IPACK block plus adductor canal block would lead to a more comfortable recovery than ACB alone. The purpose of the study was to evaluate the post-operative analgesic effects of peri-articular injections (PAIs) to ACB alone and infiltration of the region between the popliteal artery and the capsule of posterior knee block in patients undergoing total knee arthroplasty (IPACK)

Patients and Methods

After receiving approval from Tanta University's faculty of medicine's ethics committee (33748/3/20), this prospective, randomized trial was carried out in the anaesthesia department of Tanta University Hospitals between June 2020 and July 2021, and it was registered in clinical-trail.gov (NCT04396652) Following institutional ethics committee permission, each patient's informed consent was obtained.

Inclusion criteria

The study included adult patients with severe knee osteoarthritis, ASA classes I–III, and scheduled for elective total knee arthroplasty.

Exclusion criteria

Patients with a history of allergies to local anaesthetics, local infection at the block site, bleeding and coagulation disorders, advanced renal, hepatic, and cardiac diseases, lower extremity neurological abnormalities, neuropathy, and comprehension problems are among those who reject regional anaesthesia.

Grouping and Allocation

In this study, 60 patients were included. They were divided into three equal groups at random (20 patients each). Computer generated numbers were used for randomization, which was kept secret inside sealed, opaque envelopes. The envelope number for the study's excluded participants was read by the blind nurse. The same anesthesiologist who is skilled in using the procedure performed all of the regional anaesthetic blocks without playing any other roles in the research.

The primary outcome of the study was to assess post-operative pain by Numeric Rating Scale pain score (NRS). The secondary outcome was the post-operative analgesic consumption, time of first rescue analgesia, the quadriceps muscle power which was assessed by Medical Research Council scale (MRC) and mobilization ability which was assisted by Timed Up-and-Go test (TUG). Which was measured by a physician who had no subsequent role in the study.

All patients underwent a physical examination, a discussion of their medical history, typical laboratory testing, and familiarization with the NRS score as part of the preoperative evaluation. All common monitors were put on the patient as soon as they entered the operation room. Two intravenous lines were also inserted, lactated Ringer's solution (10 ml/kg/h) was administered intraoperatively, and all patients received oxygen (4 L/min) through a face mask the entire time. A 25G Quinke needle was used for all patients' midline approach spinal anaesthesia, along with 2.5–3 ml of 0.5% (15 mg) hyperbaric bupivacaine and 25g of fentanyl at the L3–4 interspaces. Following the surgical procedure, the following regional anaesthesia approach was used: There was only one adductor canal block given to Group I. (ACB). Group A received a single peri-articular injection (PAI) (II). Group (III): Infiltration of the region between the popliteal artery and capsule and adductor canal block (ACB) (IPACK)

Technique of adductor canal block (ACB)

ACB was given to patients in groups I and III.

Following the procedure, the knee was gently bent, the operated leg was externally rotated, and the thigh was cleaned with an antiseptic solution. The femoral artery and saphenous nerve in the adductor canal could be seen in the process using a high frequency ultrasound linear probe with a short axis view. It was transversely located in the middle of the thigh, between the anterior superior iliac spine and the patella. The femoral artery, which was discovered beneath the sartorius muscle, is superior to and lateral to the saphenous nerve and vein. A 100 mm 22G block needle was inserted into the sartorius muscle using the in-plane approach until the tip was just lateral to the artery. Then, 20 ml of 0.25% levobupivacaine was administered laterally. [Figure 1].

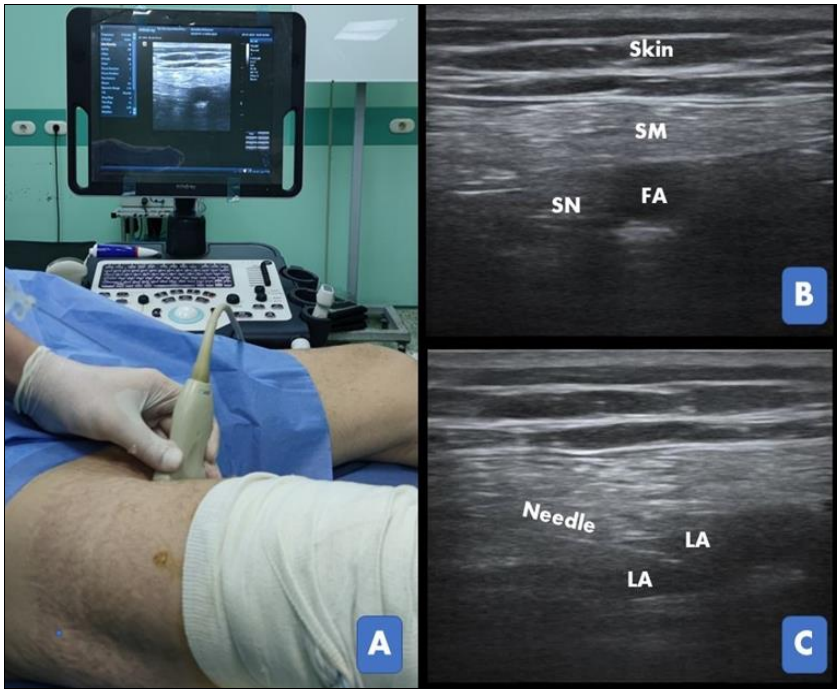

Fig 1: Showing the technique of Adductor canal block, A- Position of ultrasound probe in mid-thigh, B- cross sectional view showing saphenous nerve in the adductor canal deep to the Sartorius muscle, C- The injectionof the local anesthesic spread. SN: saphenous nerve, FA: femoral artery, LA: local anesthesia

Technique of infiltration of the interspace between popliteal artery and the capsule of posterior knee block (IPACK)

A curvilinear ultrasound probe was used during the procedure, which was carried out with the patient in a lateral position. The ultrasonic probe was introduced into the popliteal crease and held there until the femoral condyles could be seen after the popliteal fossa had been cleaned with an antiseptic solution. The femur shaft was then visible after the probe was moved proximally until the condyles were no longer visible. Then, using the in-plane technique, a needle was inserted into the medial thigh up to 1-2 cm beyond the lateral limit of the popliteal artery. Then, 15 ml of Levobupivacaine 0.25% was administered. [Figure 2].

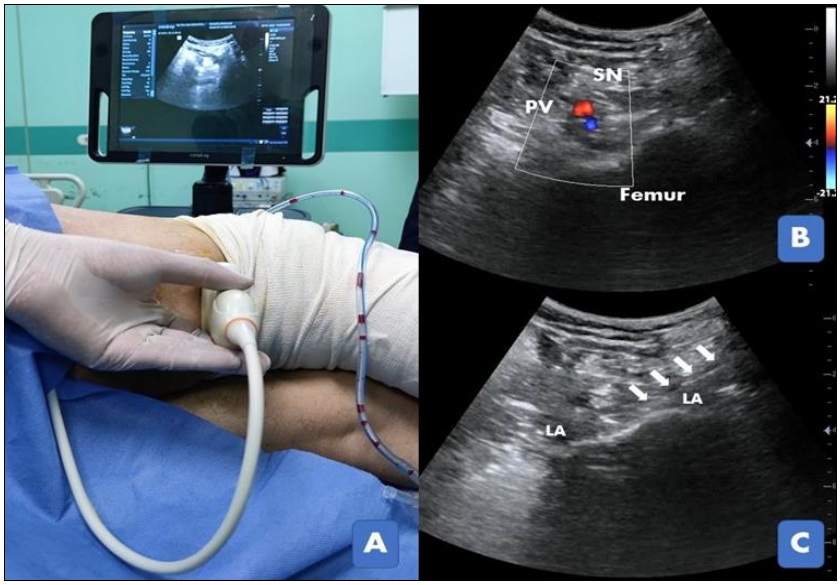

Fig 2: Showing the technique of the IPACK Block; A-position of the probe in the popliteal crease, B- Cross section showing popliteal artery, vein and the femoral shaft; C- The needle position between popliteal artery and the femur and loacal anesthesic spread

Peri-articular injection (PAIs)

The same surgeon used the peri-articular (cocktail) injection method during surgery. An method called medial parapatellar arthrotomy was used during the procedure. The peri-articular cocktail injection contained 110 ml in total, divided as follows: 90 ml of normal saline, 17.5 ml of 0.5% levobupivacaine, 2 ml of ketorolac (30 mg), and 0.5 mg (0.5 ml) of epinephrine (4.5 ugm/ml). With a 21-gauge needle, the infiltration was injected prior to implant placement, dividing the volume amongst the quadrants, and the remaining local anaesthetic was injected into skin and subcutaneous tissue at the conclusion of surgery. [Figure 3]

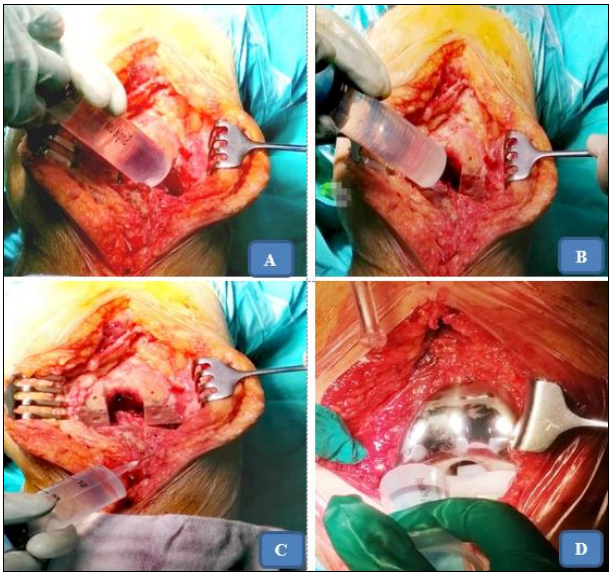

Fig 3: peri-articular injection intraoperatively in the following regions: A-Medial compartment; B- Posterior capsule C- Anterior compartment; D- Lateral compartment

The cocktail was injected in the following regions

- **Medial compartment:** including Medial retinaculum, Medial collateral ligament and medial meniscus capsular attachment. (Figure 3 A)
- **Posterior capsule:** (Figure 3 B)
- **Anterior compartment:** including Patellar tendon and fat pad, Cut ends of quadriceps muscle and tendon and subcutaneous tissue. (Figure 3 C)
- **Lateral compartment:** including Lateral retinaculum, Lateral collateral ligament and lateral meniscus capsular attachment. (Figure 3 D)

After the local anaesthetic approach was employed, all patients remained in the PACU room for around 30 minutes while being watched over. All patients in all groups had the same postoperative analgesic regimen, which included giving paracetamol 1 gm intravenously every 8 hours and giving ketorolac 30 mg every 12 hours. When the NRS was greater than 3, rescue analgesia in the form of 0.05 mg/kg of morphine was infused intravenously, and the morphine dose was repeated as required. The entire morphine dosage was consumed.

Measurements

The primary outcome: Post-operative pain by Numeric Rating Scale pain score (NRS).

The secondary outcome: The post-operative analgesic consumption, time of first rescue analgesia, the quadriceps muscle power which was assisted by Medical Research Council scale (MRC) and mobilization ability which was assisted by Timed Up-and-Go test (TUG).

Statistical Analysis

The statistical software application Minitab, version 16, created by Pennsylvania State University in the United States, was used to calculate the sample size. According to the findings of earlier studies [7], which showed that the mean and standard deviation of the pain score (NRS) with ambulation at 24 hours was 1.7 and 1.6 points, each group needed 18 patients in order to achieve a power of 95% and confidence interval of 95 and detect a difference of 2 points in the pain score. It was chosen to include at least 20 patients in each group to account for any dropouts. Once the data had been gathered, SPSS V.22 was used to organise, tabulate, present, and analyse the data (USA). The assumption of normality was checked using the Shapiro-Wilk test and histogram. Examples of quantitative parametric data having a normal distribution that were expressed as mean and standard deviation include age, weight, the first time an analgesic was required, and the total amount of postoperative medication ingested (SD). The three groups in this quantitative data were compared using analysis of variance (ANOVA) tests (F.test). Quantitative non-parametric data, like NRS, were presented together with their median and range. The Kruskall Wallis test was used to compare NRS among the three groups, while the Wilcoxon test was used to compare NRS within the same group.

Results

The review included sixty patients. Six patients neglected to meet the incorporation models (1 had a skin contamination, 1 was extremely chubby, 2 were ongoing pain relieving clients, 1 had ASA IV, and 1 had coagulopathy) and three wouldn't take an interest subsequent to having their qualification for not entirely set in stone. The leftover 60 patients were separated into three gatherings at irregular (20 in each). All patients were checked and measurably evaluated. FIGURE 4: The Partner outline. Age, weight, orientation, and ASA classification among all gatherings were genuinely immaterial. Table 1

As to varieties very still and during physiotherapy in the three gatherings under study, they were genuinely unimportant at 0 and 2 hours with p upsides of 0.815 and 0.415, separately, very still. Furthermore, at 4, 6, and 12 hours, there was a genuinely tremendous distinction between the three gatherings under study, with a P worth of 0.005. (it was lower in bunch II contrasted with bunch I and III). Figs. 5, 6 There was genuinely fundamentally decreased morphine consumption in bunch II contrasted with bunches I and III, as well as in bunch III contrasted with bunch I, with a P worth of 0.005. This was valid for both the aggregate sum of morphine consumed and the planning of the main salvage absense of pain. Furthermore, bunch II had a considerably longer first salvage absense of pain period than bunch I and gathering III (P 0.05).

Furthermore, it was remarkably longer in bunch III than bunch I (P-esteem 0.05) also. Table 2 shows that bunch II and III showed genuinely critical upgrades as far as engine versatility when contrasted with bunch I (P esteem 0.05). In any case, the distinction between bunches II and III was not genuinely critical (P esteem >0.05). At 12 and 24 hours, the MRC score showed genuinely massive contrasts between the three gatherings under study (P esteem 0.05). Table 2

Discussion

In contrast to the ACB group and the combination ACB + IPACK group, our research demonstrated that peri-articular injections significantly lower opioid use in TKA patients, delay the onset of the first rescue analgesic, and result in lower NRS scores at 4, 6, and 12 hours at rest and during physical therapy. The TUG and MRC ratings also show a significant difference favoring the PAI group. This may be due to levobupivacain's temporary blockade of the sensory afferent neurons feeding the knee joint for 6–12 hours.

Additionally, we thought that the sensory coverage of IPACK block and PAIs combined with ACB, which is limited to the antero-medial region of the knee, was the main factor contributing to their stronger analgesic effects when compared to ACB alone. Patients with ACB may thus continue to experience posterior knee pain. The IPACK block is better to ACB because ACB primarily blocks the saphenous nerve and the vastus medialis nerve [8].

IPACK block prevents the popliteal plexus and the terminal sections of the genicular nerves from innervating the back of the knee joint, preserving the main tibial and normal peroneal nerve trunks [9, 10]. In TKA patients who recently had ACB, the back knee's postoperative pain may persist [11]. The improvement of a knee's range of motion and postoperative numeric rating scale (NRS) ratings is primarily achieved by expanding an IPACK block, and ambulation distances when contrasted with the ACB alone [12]. In a review contrasting IPACK and PAIs block and ACB alone after all out knee arthroplasty, Korkusuz *et al*. [13], partitioned the members into three gatherings: the ACB-just gathering, the (IPACK + ACB) bunch, and the (PAI + ACB) bunch. Pretreatment NRS very still and during development didn't fundamentally vary between the gatherings. At the point when IPACK and PAI were joined with ACB, the 48th-h NRS score of the patients very still and while moving was fundamentally lower than it was for the gathering that got just ACB. Furthermore, contrasted with the PAI + ACB bunch, the IPACK + ACB bunch had fundamentally lower 48th-h NRS scores, narcotic ingestion, hospitalization, and assembly times. The three review bunches didn't vary considerably as far as preoperative scope of movement and Pull values, but the IPACK + ACB and PAI + ACB bunches altogether beat the ACB bunch as far as postoperative second day ROM values and first and second day Pull test results.

This could be made sense of by the engine saving impact of IPACK over ACB, which influences strong strength [13]. In expansion, Elliot *et al*. [14] announced no distinctions between patients who went through IPACK and FNB (Femoral nerve block) after absolute knee arthroplasty and the people who got IPACK and ACB with regards to NRS appraisals or narcotic use. The emergency clinic stay was likewise more limited for the main gathering. Besides, a concentrate by Patterson *et al*. distributed in 2015 [15] that took a gander at what the IPACK block meant for torment after essential TKA exhibited that the blend of IPACK and ACB diminished postoperative agony. However, they tracked down no significant contrasts in the utilization of pain relievers, the outcome of exercise based recuperation, or length of clinic stay. The aftereffects of Kertkiatkachorn *et al*. [16] showed that the Pull test, knee scope of movement, and quadriceps strength test didn't considerably vary between bunches among pattern and any time point. Shockingly, on Case 0 at both 0 and 45 levels of the knee joint, the quadriceps strength of the ACB+ IPACK bunch was fundamentally lower than that of the ACB+ PAI bunch. Also, in the concentrate by Jung *et al*. [17], neither gathering in the system experienced any postoperative confusions connected with the activity, like summed up pruritus, discombobulation, hypotension, hematoma, or contamination. Our review's shortcoming is that all patients were released and not circled back to following 72 hours, consequently we couldn't assess their drawn out visualization inferable from postponed torment beginning and constant agony that impeded scope of movement and ambulation. Another downside is that we didn't evaluate every patient's degree of blockage or the area of their knee distress (front and back). Additionally, the failure rate was not noted.

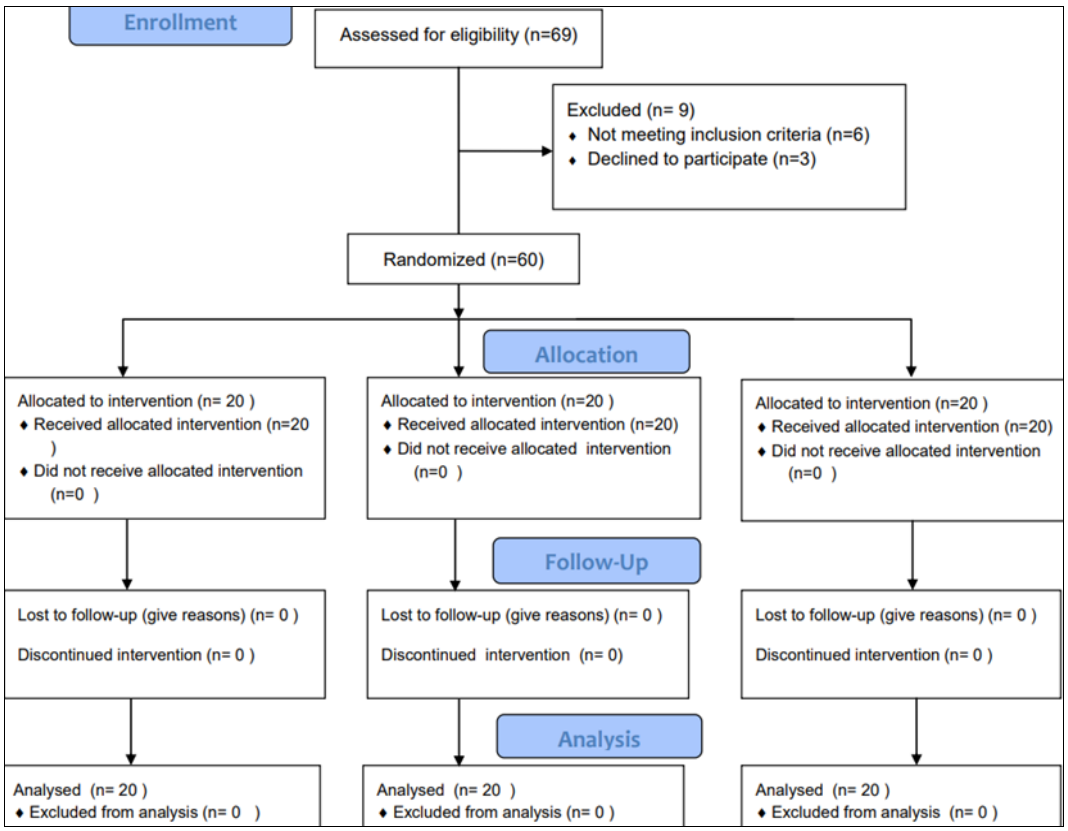

Fig 4: Consort flow chart of Participants through each stage of the randomized trial

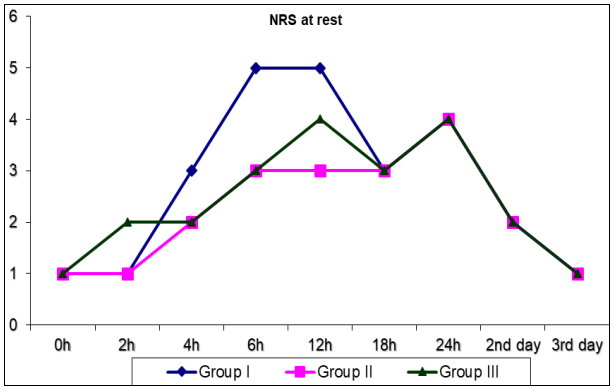

Fig 5: NRS score at rest in the three studied groups

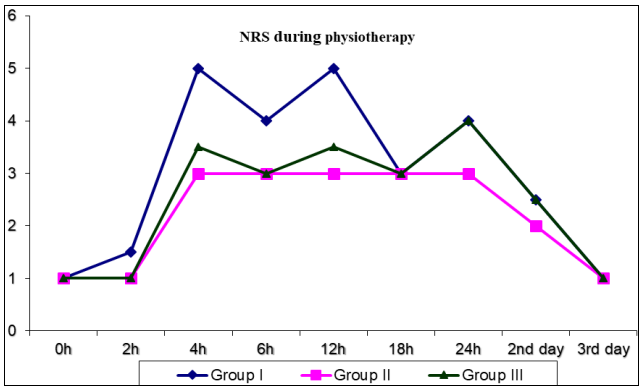

Fig 6: NRS score during physiotherapy in the three studied groups

Table 1: Demographic data between the three studied groups

		Group I	Group II	Group III	p. value
Age (Year)					0.748
	Mean ± S.D	53.80 ± 7.71	52.25 ± 5.77	52.85 ±5.73	
Gender (M/F)	Male (%)	9 (45%)	9 (45%)	10 (50%)	0.935
	Female (%)	11 (55%)	11 (55%)	10 (50%)	
Weight (Kg)	Mean ± S.D	86.45 ± 8.13	86.40 ± 8.67	86.50 ±9.10	0.999
ASA score	I (%)	5 (25%)	4 (20%)	3 (15%)	0.949
	II (%)	8 (40%)	9 (45%)	10 (50%)	
	III (%)	7 (35%)	7 (35%)	7 (35%)	

*Data presented as mean and SD

Table 2: Amount of total post-operative morphine consumption, first rescue analgesia, TUG score and MRC at 12hrs and 24 hrs in the three studied groups

		Median	IQR		p. value			
Total morphine consumption (mg)	Group I	12	9	–	12	0.001*	P1	0.001*
	Group II	3	3	–	6		P2	0.001*
	Group III	6	3.7	–	9		P3	0.018*
Time of 1st rescue analgesia (hour)	Group I	4	4	–	6	0.001*	P1	0.001*
	Group II	15	11.25	–	18.75		P2	0.003*
	Group III	6.5	4	–	12.75		P3	0.012*
TUG score	Group I	0	0	–	0	0.001*	P1	0.001*
	Group II	1	1	–	1		P2	0.030*
	Group III	0.5	0	–	1		P3	0.060
MRC at12h	Group I	0	0	–	1	0.001*	P1	0.001*
	Group II	4	3.25	–	4		P2	0.001*
	Group III	2	1	–	3		P3	0.001*
MRC at24h	Group I	1.5	1	–	3	0.001*	P1	0.001*
	Group II	5	5	–	5		P2	0.001*
	Group III	3.5	3	–	4		P3	0.001*

*Data presented as median, IQR, *Denote significant change (p<0.05), P1: P value between group I and group II, P2: P value between group I and group III, P3: P value between group II and group III

Conclusion

We concluded that PAIs in patients undergoing TKA lower pain score, decrease opoid consumption compared to combined IPACK+ACB and ACB alone. Although combined IPACK+ACB was less effective than PAIs, but it still shows less pain score and opoid consumption at rest and during physiotherapy when compared to ACB alone.

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Not available

Author's Contribution

Not available

Conflict of Interest

Not available

Financial Support

Not available

References

1. Feng JE, Novikov D, Anoushiravani AA. Total knee arthroplsty: improving outcomes with a multi-disciplinary approach. J Multidiscip Healthc. 2018;11:63-73.
2. Ross JA, Greenwood AC, Sasser P, *et al*. Periarticular Injections in Knee and Hip Arthroplasty: Where and What to Inject. J Arthroplasty. 2017;32(9s):S77-S80.
3. Chung AS, Spangehl MJ. Peripheral Nerve Blocks vs Periarticular Injections in Total Knee Arthroplasty. J Arthroplasty. 2018;33(11):3383-8.
4. Li D, Ma GG. Analgesic efficacy and quadriceps strength of adductor canal block versus femoral nerve block following total knee arthroplasty. Knee Surgery,

Sports Traumatology, Arthroscopy. 2016 Aug;24(8):2614-9.
5. Ilfeld BM, McCartney CJ. Searching for the optimal pain management technique after knee arthroplasty: analgesia is just the tip of the iceberg. Anesthesiology. 2017;126(5):768-770.
6. Sinha SK, Clement A, Surette A-M. Infiltration between the Popliteal Artery and Capsule of the Knee (iPACK): Essential Anatomy, Technique, and Literature Review. Current Anesthesiology Reports. 2019;9(4):474-8.
7. Kim DH, Beathe JC, Lin Y, YaDeau JT, Maalouf DB, Goytizolo E, *et al*. Addition of infiltration between the popliteal artery and the capsule of the posterior knee and adductor canal block to peri articular injection enhances postoperative pain control in total knee arthroplasty: A randomized controlled trial. Anesthesia &Analgesia. 2019Aug1;129(2):526-35.)
8. Jenstrup MT, Jaeger P, Lund J. Effects of adductor-canal-blockade on pain and ambulation after total knee arthroplasty: a randomized study. Acta Anaesthesiol, 2012;56:357-64.
9. Tran J, Peng PWH, Lam K, *et al*. Anatomical study of the innervation of anterior knee joint capsule: Implication for image-guided intervention. Reg Anesth Pain Med. 2018;43(4):407-14.
10. Kampitak W, Tansatit T, Tanavalee A, *et al*. Optimal location of local anesthetic injection in the interspace between the popliteal artery and posterior capsule of the knee (iPACK) for posterior knee pain after total knee arthroplasty: an anatomical and clinical study. Korean J Anesthesiol. 2019;72:486-94.
11. Kuang MJ, Ma JX, Fu L, *et al*. Is adductor canal block better than femoral nerve block in primary total knee arthroplasty? A GRADE analysis of the evidence through a systematic review and meta-analysis. J Arthroplasty. 2017;32:3238-48.
12. Niesen AD, Harris DJ, Johnson CS, *et al*. Interspace between popliteal artery and posterior capsule of the knee (IPACK) injectate spread: a cadaver study. J Ultrasound Kampitak W, Tansatit T, Tanavalee A, *et al*. Optimal location of local anesthetic injection in the interspace between the popliteal artery and posterior capsule of the knee (iPACK) for posterior knee pain after total knee arthroplasty: an anatomical and clinical study. Korean J Anesthesiol 2019;72:486–94. Med. 2019;38:741–5.
13. Korkusuz Et T, Basaran M, Yarımoğlu B. Comparison of iPACK and periarticular block with adductor block alone after total knee arthroplasty: a randomized clinical trial. Journal of Anesthesia. 2022 Feb;14:1-1.
14. Elliott CE, Myers TJ, Soberon JR. The adductor canal block combined with iPACK improves physical therapy performance and reduces hospital length of stay (Abstract 197). Presented at the 40th Annual Regional Anesthesiology and Acute Pain Medicine Meeting (ASRA), in Lavages, Nevada; c2015 p. 14-16
15. Patterson ME, Vitter Y, Bland K. The effect of the IPACK block on pain after primary TKA: a double-blinded, prospective. Randomized Trial J Arthroplasty. 2020;35:173-7.
16. Kertkiatkachorn W, Kampitak W, Tanavalee A. Adductor canal block combined with ipack (interspace between the popliteal artery and the capsule of the posterior knee) block vs periarticular injection for analgesia after total knee arthroplasty: a randomized noninferiority trial. The Journal of Arthroplasty. 2021 Jan 1;36(1):122-9.
17. Jung DW, Shon WY, Seo SS. Comparison of the postoperative analgesic effect for infiltration between the popliteal artery and the capsule of the posterior knee and that of periarticular multimodal drug injection in total knee arthroplasty: retrospective study in the immediate postoperative period. Knee Surgery & Related Research. 2020 Dec;32(1):1-9.

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