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Comparison of Techniques Combined of Blockades Peripheral Devices for Pain Management in Total Knee Replacement (TKR)

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ABSTRACT

Introduction: Patients undergoing TKR frequently experience severe pain in the immediate postoperative period. Peripheral nerve blocks, in the context of multimodal analgesia, have been used to mitigate pain, provide comfort and accelerate the functional recovery of the patients. This research compares IPACK, ACB and PAI blocks as techniques to provide adequate analgesia avoiding muscle weakness.

Materials and Methods: Experimental, prospective, randomized double-blind study. 100 patients undergoing TKR were studied during the period 2020 to 2022, divided into two groups of 50 patients each. Group 1: ACB plus IPACK and group 2: ACB plus PAI. The visual analog scale (VAS) was used to assess pain. Opioid rescues, degree of satisfaction, range of motion and distance traveled postoperatively were quantified.

Results: Both groups were homogeneous in demographic data and duration of surgery ($p>0.05$). Group 1 patients required fewer opioid rescues ($p=0.02$) and had a shorter hospital stay ($p=0.04$). The time factor showed statistical differences in the perception of pain ($p=0.001$), but not the group factor ($p>0.05$). No statistically significant differences were obtained in terms of general satisfaction with the applied techniques, distance traveled or range of movement evaluated between 24 and 48 hours of the postoperative.

Conclusions: The combination of ACB block plus IPACK showed better clinical and functional results for the approach of postoperative analgesia in TKR.

Keywords: Knee, Arthroplasty, Regional Anesthesia, Postoperative Pain

Introduction

The replacement total of knee (RTR) is a of the surgeries orthopedic with elderly nociceptive impact in the postoperative period. One of the main limitations in the postoperative recovery of these patients is the deficient management of pain [1]. Various studies they have demonstrated that the presence of pain severe in the replacements Pain in large joints is associated with non-compliance with rehabilitation plans, prolonged hospital stays, and increased healthcare costs [2]. Multiple analgesic strategies have been described for intervention, but there is no consensus on a single scheme that proves superior [3]. Multimodal analgesia and peripheral blocks allow for rapid functional recovery and reduced hospital stays, in the context of enhanced recovery from surgery (ERAS) [4,5].

Ultrasound-guided adductor canal block (ACB), first described in 2009 by Manickam and col. is used in patients subjected to RTR due to his opioid - sparing and motor function-preserving effect [6,7].

Periarticular infiltration (PAI), a technique described in 2008 by Kerr and Kohan, has achieved great popularity between the traumatologists already that has demonstrated effects analgesics comparable to various regional anesthesia techniques and the benefit of preserving quadriceps motor function [6-11].

The IPACK blockade, first described in 2014, provides analgesia for the portion later of the knee, maintaining intact the function articulates and avoiding the Steppage, which would be detrimental to early post-surgical mobilization and kinesiotherapy, with the consequent risk of falls [12-15].

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The aim of this work is to determine whether or not there is an advantage in the combination of IPACK+ACB and take as cluster control the infiltration periarticular knee, whose benefits are well demonstrated.

Materials and Methods

This was a prospective, randomized, double-blind, experimental study. The study was approved by the institution's Bioethics Committee, and all patients provided written informed consent for participation during their pre-anesthetic visit.

One hundred patients undergoing renal replacement therapy (RRT) between June 2020 and June 2022 were studied, randomly divided into two groups of 50 patients each, at the Sanatorio Adventista del Plata, Libertador San Martín, Entre Ríos, Argentina. Group 1 received IPACK+ACB blockade, and Group 2 received ACB+PAI blockade.

Criteria inclusion

- Patients subjected to arthroplasty total of knee unilateral primary.
- Ages included between 45 and 75 years
- Classification ASA I–III
- Weight equal both elderly to 60 kg

Criteria Exclusion

- Fibromyalgia
- Consumption chronic of opioids (further of 3 months previous to surgery)
- Consumption of gabapentinoids previous to the surgery (inside of the month previous to surgery)
- Allergies known to anesthetics locals either medication employees in the protocol
- Insufficiency renal I liver
- Coagulopathies
- Neuropathies peripherals
- Diabetes evil controlled
- Background of ulcers gastroduodenal either hemorrhage digestive high
- Disorders psychiatric of base that make it difficult he analysis of the variables analyzed

Anesthetic Protocol

All patients received spinal anesthesia in the sitting position with 2 ml of hyperbaric 0.5% bupivacaine (10 mg) plus 20 micrograms of fentanyl, administered at the L3-L4 intervertebral space using a 27G Whitacre needle, under aseptic technique. Immediately afterward, the patient was placed in the supine position and the corresponding blocks were performed.

ACB: Ultrasound-guided saphenous nerve block at the level of the adductor canal. With the patient in the supine position, with the limb in slight external rotation (leg position) of frog), preview asepsis of the fur, HE place fields sterile and using a A linear probe (Sonosite M-Turbo) with a sterile cover was placed transversely on the anteromedial aspect of the thigh, in the middle third. Color Doppler was used to identify the femoral artery beneath the sartorius muscle. A proximal scan was performed. and distal for identify he vertex of the triangle femoral. A time identified In the same, 15ml of isobaric bupivacaine 0.25%

was injected distally to this vertex, where start he channel the adductors, but proximal to his end, identified by the The femoral vessels exited through the adductor hiatus. A 21G 100mm Braun Stimuplex® needle was used, employing a flat technique with a lateral-to-medial orientation toward the anterolateral aspect of the artery. Once the needle tip was positioned close to the artery, careful aspiration was performed, and the solution was injected. Its dispersion around the artery was observed.

IPACK: infiltration in the interspace between the artery popliteal and the diaphysis femoral distal injection with 20 ml of 0.25% isobaric bupivacaine, under ultrasound guidance. With the patient in the supine position. supine and with the knee semi-flexed, preview disinfection of the fur, placement of fields sterile and using a probe convex (Sonosite M-Turbo) with deck sterile, we place it transversely on the medial side of the knee, approximately 2 to 3 cm above the patella, sliding the transducer in a proximal/distal direction to identify the distal femoral diaphysis and the popliteal artery. Color Doppler was used to identify the artery. The needle (the same one used in ACB) was inserted in flat, from the face anteromedial of the knee, in address toward he spaces between the popliteal artery and the femur, at a steep angle to remain near the femur and avoid the neurovascular injury. Once reached interspace the local anesthetic was injected and its distribution along the axis of the femur was observed.

PAI: periarticular infiltration of the knee with 50 ml of solution composed of isobaric bupivacaine 0.5% 20 ml + ketorolac 30 mg + epinephrine 0.5 mg (10 ug/ml) + physiological solution 30 ml according to consulted bibliographic citations [16-18]. Of the 50 ml of said solution, 20 ml HE they used for infiltrate the capsule later previous to the placement of the prosthesis and the rest of the infiltration is periarticular, over the deep region of the lateral collateral ligaments and medial, pes anserinus, around the tissues adjacent to the prosthesis and subcutaneously below the surgical wound (30ml). This infiltration is carried out by the surgeon in charge.

Analgesia Multimodal Intraoperatively

- Ketorolac 60 mg house
- Dexamethasone 8 mg ev
- Paracetamol 1 g house

Coadjuvants Used he the Intraoperative

- Ranitidine 50 mg house
- Metoclopramide 10 mg IV
- Cefazolin 2 g ev
- Acid Tranexamic 1 g ev

Plan Analgesic Postoperative

- Paracetamol 1 g grandmother each 8 hs.
- Ketorolac 30 mg ev every 8 hs.
- Dexamethasone 4 mg ev each 12 hs. (2 dose postoperative and suspend)
- Rescue pain with Tramadol ev 1 mg/kg Yeah analogous scale visual (EVE) ≥ 4 .

Adjuvants Used in the Postoperative Period

- Metoclopramide 10 mg ev (SOS)
- Ranitidine 50 mg ev every 8 hours.

The age, sex, weight, height, body mass index (BMI), duration of the surgical procedure, and hospital stay were recorded.

HE evaluated he pain acute, both in repose as in motion, with the scale EVE, to 6 o'clock 12, 24 and 48 hs postoperative. HE quantified the administration of analgesics opioids of rescue, degree of satisfaction of the plan analgesic provided (0-3 dissatisfied, 4-5 Not very satisfied, 6-7 Satisfied, 8-10 very satisfied), range of joint movement measured in degrees at 48 hours post-surgery, distance in meters traveled at 48 hs and adverse effects.

Analysis Statistical

Qualitative variables are described using absolute frequencies and percentages. Quantitative variables are described using means and standard deviations. The chi-square test was used to analyze the relationship between qualitative variables and groups. Pearson's correlation coefficient was used for quantitative variables, and the independent samples t-test was used for quantitative variables. Pain assessment by group over time was performed using repeated measures ANOVA. Significance statistics HE fixed in alpha equal to 0.05. He can statistical reached was 82 %.

Results

The patients of both groups were homogeneous in age, sex, BMI and duration of surgery. The patients of the cluster 1 received less rescues of opioids ($X^2=5.0$; $df=1$; $p=0.02$) (Figure 1) and had a shorter hospital stay ($X^2=4.0$; $df=1$; $p=0.04$) (Figure 2).

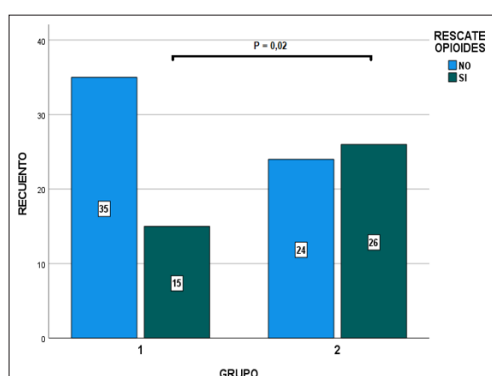


Figure 1: Graphic of bars grouped with difference of proportions of rescue of opioids between groups. Group 1 received a significantly lower number of rescues ($P=0.02$)

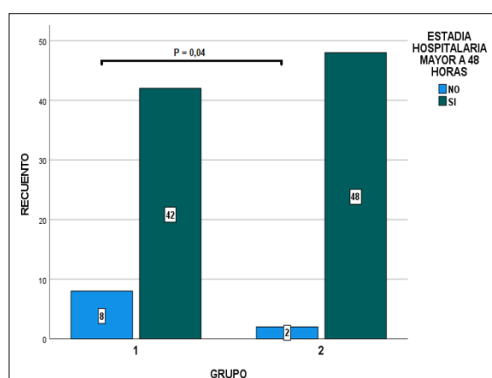


Figure 2: Graphic of bars grouped with difference of proportions of stay hospital stay between groups. Group 1 had a significantly shorter hospital stay ($P=0.04$)

No was differences statistically significant in the duration of the surgery, degree of satisfaction of the plan analgesic, range of mobilization neither distance tour registered at 48 hs. post-surgical (see table 1). The effects adverse registered in both groups either they showed differences significant (4 patients they said nausea for the group 1 versus 6 in group 2).

The time required to perform the blocks was counted immediately after spinal anesthesia was performed, being 7.4 ± 1.1 and 8.6 ± 1.4 minutes for group 1 and group 2 respectively, with no significant differences ($P=0.21$)

Table 1: Comparison of variables demographics, surgical and post-surgical according to groups

	CLUSTER 1 (N=50)	CLUSTER 2 (N=50)	WORTH P
AGE [years], average \pm OF	68.2 ± 6.8	66.7 ± 8.3	0.34 ¥
SEX FEMALE, N (%)	23 (46)	26 (52)	0.55 §
BMI, average \pm OF	29.8 ± 5.5	29.7 ± 6.3	0.91 ¥
DURATION OF SURGERY [minutes], average \pm OF	108.4 ± 25.8	106.9 ± 24.6	0.77 ¥
RESCUE OPIOIDS, N (%)	15 (30)	26 (52)	0.02 §
STADIUM HOSPITALARIA MAYOR A 48HS, N (%)	42 (84)	48 (96)	0.04 §
SATISFACTION OF THE ANALGESIC PLAN, mean \pm ED	8.4 ± 1.3	8.1 ± 1.5	0.23 yen
DISTANCE 48HS, average \pm FROM	28.0 ± 11.3	29.1 ± 12.5	0.66 ¥
RANKS 48-HOUR MOVEMENT, average \pm OF	85.1 ± 10.9	82.4 ± 14.6	0.31 ¥
EFFECTS ADVERSE, N (%)	4 (8)	6 (12)	0.55 §

OF: Detour Standard. ¥ Test T of samples independent. § Proof Chi Square of Pearson.

Regarding the assessment of pain over time between both groups, the results of the analysis statistical revealed that he factor within-subject (time) was significant in EVA at rest ($F=7.9$ $df=3$ $p=0.0001$) and in motion ($F=6.7$ $df=3$ $p=0.0001$), but the inter-subject factor analysis (groups) showed no differences either at rest ($F=1.0$ $df=1$ $p=0.32$) or in motion ($F=0.2$ $df=1$ $p=0.65$) (see Figures 3 and 4).

Discussion

Both techniques combined of blockades peripherals they showed be effective in he Multimodal management of acute postoperative pain in patients undergoing RTR, with the great advantage of preserving quadriceps muscle strength for early mobilization and kinesiotherapy, as well as mitigating the potential risks of falls that could occur if they presented muscle weakness as a result of the blocks performed, which would prevent a “fast-track” recovery 19-20 for major orthopedic surgery 21-25.

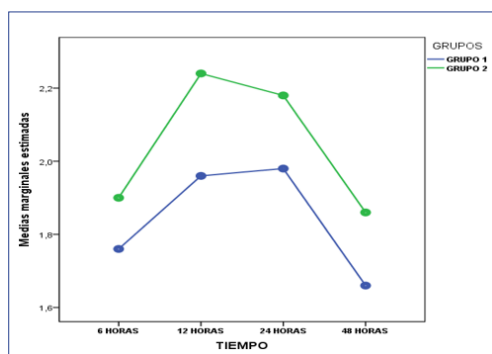


Figure 3: Profile graph of the within-subject factor (Time) according to the between-subject factor (Group) in assessment at rest. There were no significant differences in the assessment of pain at rest between groups ($p=0.32$)

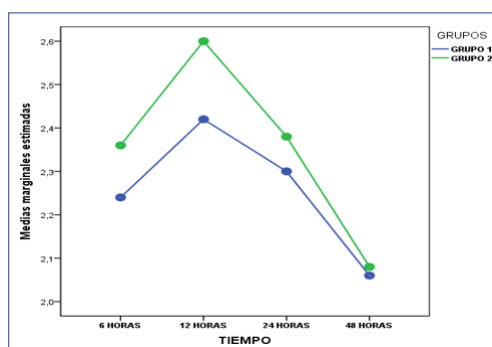


Figure 4: Profile graph of the within-subject factor (Time) according to the between-subject factor (Group) in motion assessment. There were no significant differences in pain assessment during movement between groups ($p=0.65$)

Yeah good in the clusters 1 (IPACK+ACB) HE noticed a EVE minor compared with the cluster

2, no statistically significant differences were found in the analysis provided by the repeated measures ANOVA, although this was reflected clinically in the minor consumption of opioids and the minor duration in the stay registered hospital in group 1. We believe that this effect may correspond to the greater number of Tramadol rescue doses in patients in group 2, which could have masked this effect in the pain evolution curve over time. Therefore, since these patients remained in the analysis, the statistical effect was not reflected, but the clinical results were. From a medical ethics perspective, the patients could not have been excluded. evolving a post-surgical without receive medication analgesic of rescue, if needed, for this reason it was not decided to exclude them from the analysis over time, since pain as 5th vital sign represents a standard of quality in Perioperative care. Periarticular infiltration of the knee, while an effective technique, has a number of characteristics that is necessarily know to the hour of use it as scheme analgesic:

- **Variability:** from that HE described, this technique has varied substantially not only in the way it is performed (some studies include the placement of a periarticular catheter) but also in the adjuvant drugs that are used.

- **Blind Technique:** injection without ultrasound control into the posterior capsule could cause migration of the anesthetic solution laterally and involve the peroneal nerve, with the consequent motor block.
- **Duration:** its effects vary mainly in the early postoperative period (first 24 hours).
- **Effects Analgesics:** they have been good proven in the context of a scheme of complementary multimodal analgesia, although they would be less effective during movement and/or physiotherapy compared to other techniques.
- **High Dose of Drugs:** Yeah, good exists great variability in the preparation Regarding infiltration, in the original article by Kerr and Kohan⁸ the technique is described by infiltrating up to 300-340 mg of 0.2% ropivacaine (although reductions of these doses were made in patients with risk factors for local anesthetic poisoning, the values allow us to assume that they were usually above the 3 mg/kg recommended for ropivacaine). Without embargo, No exists in such job a characterization to background of the studied population, which does not allow for accurate conclusions to be drawn.
- **Need for the Use of a Hemostatic Cuff:** although there are studies that demonstrate the usefulness of high dose local infiltrative anesthesia (HDLIA) in knee surgeries with and without a hemostatic cuff, the use of the same would represent a “safety element” against the risks of poisoning by local anesthetics for these patients, so its systematic use would be suggested.

Previous studies comparing PAI+ACB found that, while this combination reduced postoperative pain at rest, they failed to demonstrate a reduction upon mobilization on the first postoperative day, whereas the use of IPACK block allowed better control of the pain so much in repose as in movement in the first 24 hours, achieving early ambulation [20,21].

Sawhney and cabbage. they demonstrated that PAI in combination with ACB they achieve best results in the control of the pain that each technique employee by separate, according to it published in your article [23,24].

In contrast to our research, Kertkiatkachorn and col. found that the ACB + IPACK group was associated with higher opioid analgesic consumption and greater difficulty for wander in he 1st day postoperative. TO weigh of it, bliss the combination provided analgesia that was non-inferior to that observed in the ACB + PAI group both at rest and during movement in patients undergoing RTR [25,26].

On the other hand, IPACK and ultrasound-guided ACB block allow for adequate control of the injection site of the anesthetic solution, controlling the migration of local anesthetics in the posterior capsule of the knee and in the Hunter's canal, thus reducing doses and volumes and providing a better safety profile for the patient.

Conclusion

The combination of blockades IPACK further ACB obtained results further favorable for The approach to postoperative analgesia in total renal replacement therapy (TRRT) is clinically evident in both the evaluation and follow-up of patients, as well as in the reduction of hospital stay. hospital and he minor consumption of opioids postoperative. Of all However, further research will be needed to determine whether there is actually an advantage to using one analgesic regimen over the others.

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Note attached to Committee of Ethics institutional.



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