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Comparison of two Local Anesthetics in Femoral and Sciatic Anesthetic Block by Neurostimulation

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RESUMEN

Introducción: El bloqueo de nervios periféricos produce una alta calidad analgésica en cirugía de rodilla. Los anestésicos locales se utilizan en base a su eficacia y toxicidad, por lo que decidimos evaluar la analgesia postoperatoria mediante la comparación de ropivacaína con bupivacaína para bloqueo femoral y ciático en reconstrucción de ligamento cruzado anterior (LCA). **Métodos:** Estudio prospectivo de cohorte, aleatorizado y comparativo. Se estudiaron pacientes sometidos a cirugía de LCA. dividiéndose en dos grupos: R (ropivacaína), B (bupivacaína). Se aplicó bloqueo femoral y ciático postoperatorio, el anestésico local se utilizó en concentración del 0.25%, volumen total de 40 mL para cada nervio. Se evaluó EVA a las 6, 12, 18 y 24 horas en reposo y movimiento, tiempo de analgesia (TDA) y tiempo de bloqueo motor (TBM). **Resultados:** En las variables demográficas no se encontraron diferencias. La EVA en reposo y movimiento, para ambos grupos, fue similar hasta las 18 horas, donde se diferenció significativamente para el grupo R. El TDA fue mayor en ropivacaína, así como el TBM fue mayor con bupivacaína. **Conclusiones:** Aunque ambos anestésicos locales otorgaron adecuada analgesia, ropivacaína es un anestésico local más eficaz para el bloqueo de nervios femoral y ciático.

Palabras clave: Bloqueo femoral, bloqueo ciático, ropivacaína, bupivacaína, analgesia en ligamento cruzado anterior, neuroestimulación.

SUMMARY

Introduction: *The peripheral nerve blockade produces high analgesic quality in knee surgery. Local anesthetics are used upon the base of its effectiveness and toxicity, so we decided to evaluate the postoperative analgesia through the comparison of ropivacaine (R) against bupivacaine (B) for femoral and sciatic blockade in the arthroscopic reconstruction of the anterior crossed ligament (ALC) repair.* ***Methods:*** *Study of cohort, randomized and comparative. There were studied patients submitted to ALC. Surgery being divided in two groups: R and B. Blockade was applied femoral and sciatic postoperative, the anesthetic place use in concentration of 0.25%, total volume of 40 mL for every nerve. VAS was evaluated at 6, 12, 18, 24 hours at rest and movement, analgesia time (ADT) and motor blockade time (MBT).* ***Result:*** *There were no differences in the demographic variables. The VAS, at rest and movement, was similar for both groups until 18 hours, when it significantly differed for the group R. The ADT was major in ropivacaine as well as the MBT was major with bupivacaine.* ***Conclusions:*** *Though both anesthetic places granted adapted analgesic; ropivacaine is the most effective local anesthetic for the blockade of femoral and sciatic nerves.*

Key words: *Femoral nerve blockade, sciatic nerve blockade, ropivacaine, bupivacaine, analgesic in anterior crossed ligament, neurostimulation.*

INTRODUCTION

Advances in knee surgery deserve effective and modern anesthetic techniques providing analgesia during and after the surgical procedure[1,2]. The most operated patients don't receive adequate analgesia, being the main discomfort in the perioperative period, since the knee surgery is associated with severe pain[3,4]. Pain management is a matter of utmost importance for early mobilization, being the crucial factor for proper rehabilitation[4-8].

The pain can be managed by numerous techniques such as intravenous technique, patient-controlled analgesia (PCA), epidural analgesia and peripheral nerve block[4].

In December 1992, femoral nerve block began to be administered for postoperative analgesia after arthroscopy for ACL reconstruction. The used technique was a variation of the three-in-one block[8,9] first described by Winnie et al[10]. As part of a multimodal analgesia, the sciatic and femoral block provides pain control during the first 24 postoperative hours[3]. Edkin et al[11] have described that block increases the likelihood of 23 hours period without postoperative pain in patients with semitendinosus ACL and bone-tendon-bone (BTB)[12].

The peripheral nerve block may provide a high quality anesthetic and analgesic after a unilateral lower limb surgery, particularly in patients in whom an central lock is inadequate[13,14].

In 2000 it was observed that the femoral nerve block by itself is never appropriate for lower extremity surgery, it is always necessary to lock the other major peripheral nerves. Frost et al[15] found intense pain in the distribution of the sciatic nerve after this surgery, for this reason they suggest to associate the sciatic nerve block, noting that this relationship provides a sufficient analgesia[4]. Because it reduces up to 80% the consumption of parenteral opioids[8].

Local anesthetics are used based on setup time, duration of action, efficacy and toxicity, in addition to the specific requirements in postoperative analgesia[16,17]. The volume of local anesthetic solution as well as the dosage are a critical factor affecting the success in obtaining a desired clinical effect[17]. In this regard, researches found that bupivacaine and ropivacaine are effective -at equivalent doses, as well as at similar volumes and concentrations- to block peripheral nerves[5,6,16,17]. This study was undertaken to compare the analgesia provided by two local anesthetics (bupivacaine and ropivacaine), at the same volumes and concentrations for blocking the femoral and sciatic nerve in ACL arthroscopic surgery.

MATERIAL AND METHODS

Prospective, randomized study involving a comparative cohort of patients from the National Institute of Rehabilitation who underwent arthroscopic surgery for anterior cruciate ligament (ACL) in the period from April to November 2006.

Prior informed consent and approval from Ethics Committee, patients were divided into two groups: R (Ropivacaine), and B (bupivacaine). All patients were received 12.5 mg bupivacaine through # 25 Quincke needle for surgical spinal block.

Once finished the surgical procedure, femoral and sciatic block were applied via anterior approach by using peripheral nerve locator (Stimuplex® Dig RC B-Braun) and 150 mm short bevel needle for plexus anesthesia (Stimuplex® A 150 B-Braun) with an current intensity of 2 Hz and by applying in both a final 0.50 mA current, until obtaining a grade II response in the assessment scale of motor response (ASMR) and patellar motor response (ASPMR)[18], using the bupivacaine or ropivacaine anesthetics at 0.25% concentration with a total volume of 40 mL for each nerve to be blocked.

Pain intensity was estimated by visual analogue scale (VAS) of 11 points (from 0 to 10), which was assessed at 6, 12, 18 and 24 hours at rest and movement. The time of analgesia (TOA) and time of motor block (TMB) were assessed also in hours by starting at time 0 when leaving the operating room. The sensory and motor block was assessed by the scale of the four "P's" as described by Thompson and Brown[19], which assesses the block of the four major nerves of the lower extremity and consists of the following:

1) Pull: Inability of plantar flexion, it suggests the sciatic nerve block.
2) Pull: The anesthesiologist in the patient causes resistance by the leg adduction in the medial region; the weakness states obturator nerve conduction block.
3) Pinch: The inability to detect a puncture in the thigh on the side shows anesthesia in the distribution of lateral femorocutaneous nerve.
4) Punt: While the anesthesiologist raises his/her knee of the patient, he/she requests to the patient to extend his/her knee provoking resistance. The inability to elevate the leg indicates femoral nerve block.

In case of pain assessed with a VAS greater than 5, the application of non-steroidal anti-inflammatory (ketorolac at 1mg/kg body weight) was considered.

Statistical analysis: Descriptive statistics and measures of central tendency were applied, by applying Student's t-test for independent variables, Kolmogorov-Smir-

mov (KS, p) to observe the normality of age and weight distributions.

Spearman Rho Coefficient for non-parametric variables and Pearson Coefficient for parametric variables were applied. For repeated measures, General Linear Model (ANOVA) and Covariance Analysis were used. p-values <0.05 were considered as significant. SPSS Program, Version 12.0.

RESULTS

The study included 73 patients divided into two groups, with the following features in the preoperative state: group B: 36 patients, of whom 28 (77.8%) were males, mean age 28.4 (± 5.6), mean weight 74.1 (± 7.7); group R: 37 patients, of whom 25 (67.7%) were males, mean age 26.7 (± 6.5), mean weight 77.5 (± 13.6). Both groups were subdivided in turn into two categories by weight and sex, as these parameters were significant each other with a p = 0.0001. In the Group B: 20 patients (55.6%) were underwent BTB surgery and 16 (44.4%) were underwent semitendinosus surgery and the Group R the respective percentages were 54.1% and 45.9% (p = 0.54).

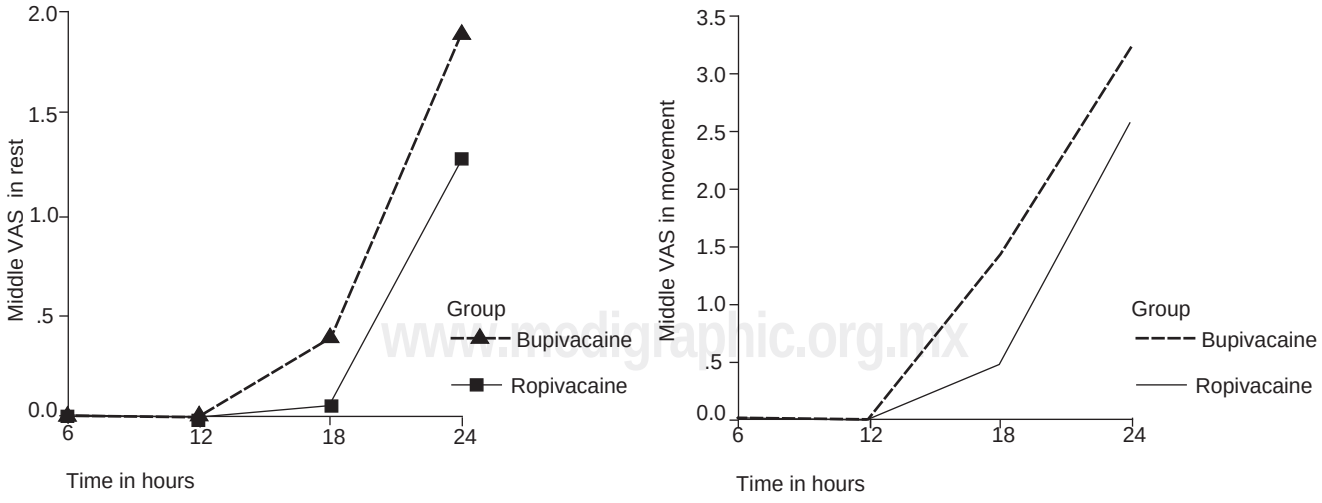
TOA in group B was 19.7 hours (± 2.3), and the group R was 21.8 hours (± 2.0) with p = 0.0001. The TMB in group B was 19.8 hours (± 1.7) and in group R was 16.5 hours (± 1.4) with p = 0.001.

VAS at rest and movement for both groups was similar until 18 hours, in this time point there was a significant difference in group R with a p <0.05, subsequently the VAS parameter maintained continuous in this group until 24 hours (Figure 1).

Correlations among weight, TOA, TMB and sex were performed in the two groups, statistical significance was found in TOA, and in the group B and group R in female patients with a p = 0.009; moreover statistical significance was found in TMB and between female patients of the groups A and R, with a p = 0.0001. The weight, TMB and TOA parameters of male patients in the groups B and R had p = 0.015, p = 0.0009, p = 0.0001, respectively. Single parameter similar among women was weight, this can be observed in the Table I. TOA was higher with ropivacaine in both women and men, and TMB was higher with bupivacaine also in both women and men. On the other hand, the motor block-analgesia times only correlate significantly with bupivacaine in both sexes, but they are much more intense in women (Rho = 0.77).

Weight correlates with the time of analgesia, but only in the case of ropivacaine and in both sexes (more weight to shorter analgesia (Figure 2). TMB and weight parameters correlate significantly only in the case of males treated with bupivacaine, i.e. more weight to shorter motor block time (Figure 3).

When the linear and curvilinear correlations were performed, no significant correlation between weight and motor block time was observed in women, in both treatment group and in the other. In men treated with ropivacaine, curvilinear regression at quadratic level improved substantially the linear correlation (Figure 4). While in bupivacaine group, motor block time tends to decrease with increasing the weight of patients, especially after the 70 kg in the rop-



*VAS: Visual analogous scale.
Figure 1. VAS* in rest and movement.

ivacaine group the same situation presents up to 90 kg where the situation is reversed.

The type of surgery determined different times of analgesia and motor block, as in both groups the TOA was greater in the semitendinosus surgery as compared to BTB (p = 0.0001); moreover, the TMB also was greater in the semitendinosus surgery, especially when bupivacaine was used (p = 0.05).

No administration of NSAIDs and was required in this study, as VAS was not above 5.

During this work there was no complication in any of the treated groups.

Table I. Correlations between weight, time of anelgesia and time of motor block by sex and group.

	Bupivacaine	Ropivacaine
Female		
(n = 8)		(n = 12)
Weight	68.6 (9.0)	67.5 (10.6)
TOA*[2]	19.3 (2.0)	22.5 (2.5)
TMB°[3]	19.7 (1.0)	16.1 (1.5)
Linear correlations:		
TOA* -TMB°	0.77 (p = 0.04)	0.37 (p = 0.23)
Weight-TOA*	0.57 (p = 0.13)	- 0.558 (p = 0.04)
Weight-TMB°	0.13 (p = 0.75)	- 0.26 (p = 0.40)
Male		
(n = 28)		(n = 25)
Weight[4]	75.6 (6.7)	82.4 (12.2)
TOA*[5]	19.8 (2.5)	21.4 (1.6)
TMB°[6]	19.8 (1.9)	16.7 (1.3)
Linear correlations:		
TOA*-TMB°	0.430 (p = 0.02	0.26 (p = 0.20)
Weight-TOA*	-0.30 (p = 0.87)	-0.556 (p = 0.004)
Weight-TMB°	-0.43 (p = 0.02)	-0.24 (p = 0.24)

1. p = 0.81, 2 p = 0.009, 3 p = 0.0001, 4 p = 0.015, 5 p = 0.009, 6 p = 0.0001
*TOA: Time of analgesia.
°TMB: Time of motor block.

DISCUSSION

The surgical operations in open procedures such as arthroscopic procedures are situations generating intense and disabling pain, and often inadequate pain control is provided, thus remains a challenge for any anesthesiologist, establishing effective analgesic techniques[3,4].

Postoperative management consists of treating pain, as well as of establishing and facilitating early rehabilitation programs[5-8]. The results of this study demonstrate that the utilization of techniques of peripheral nerve regional block provide adequate analgesia for this type of surgery and are comparable to those reported by Edkin[11], Frost[15], and Singelyn[20].

In our study, similar concentrations and volumes of both local anesthetics were used, like those reported by Fanelli[21], Marhofer[22], and Ganampatty [23], with adequate postoperative analgesia for 24 hours as reported in their works and also published by Edkin et al[11].

The reduction in pain at rest and in motion in both groups was obtained suitably, similarly to that described by Boezaart A[1], he suggests that peripheral nerve block produces adequate analgesia for this type of surgery[1, 4,16,17].

Our results in the consumption of analgesics (NSAIDs and opioids) are consistent with those described by Vloka et al[24] and Iskandat et al[25], who did not require use of analgesics.

Of the two used local anesthetics, ropivacaine showed a greater control of the pain, similarly to that described by Beaulieu et al[26].

In our study, motor block was assessed using the four "P's" of Thompson and Brown[19], unlike the study by Greengrass et al[27], when motor block was assessed by Bromage.

The weight of the patients was a significant covariate with respect to the TOA, weight and type of semitendinosus surgery, probably because in this surgery only soft tissue was a part of interest, but not in BTB. There are no reports in the literature about this finding found in our study.

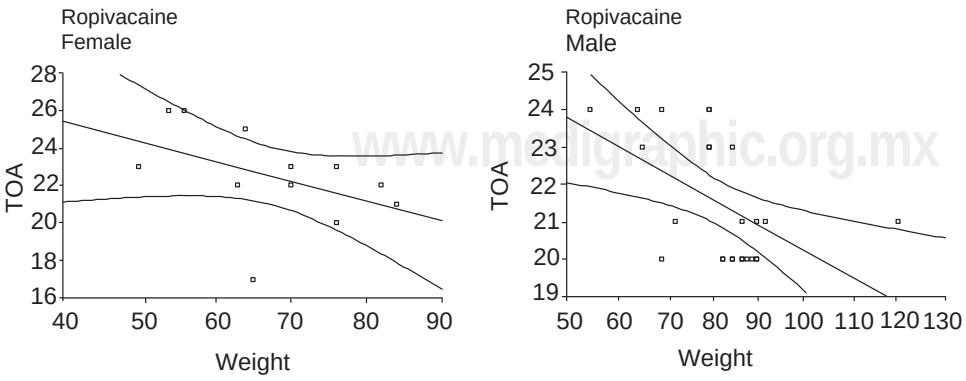


Figure 2. TOA: Time of analgesia by sex

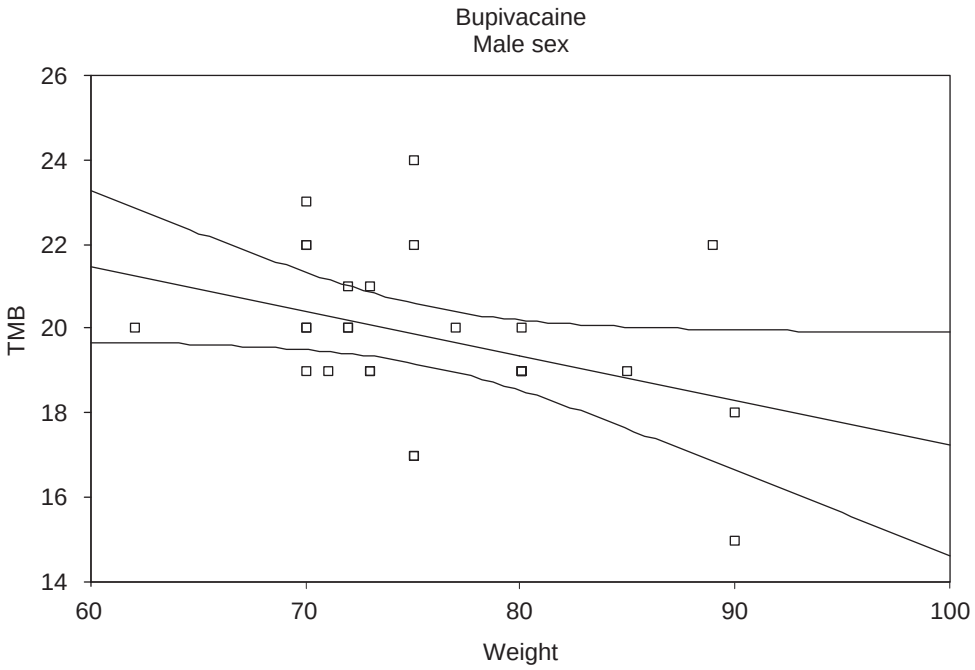
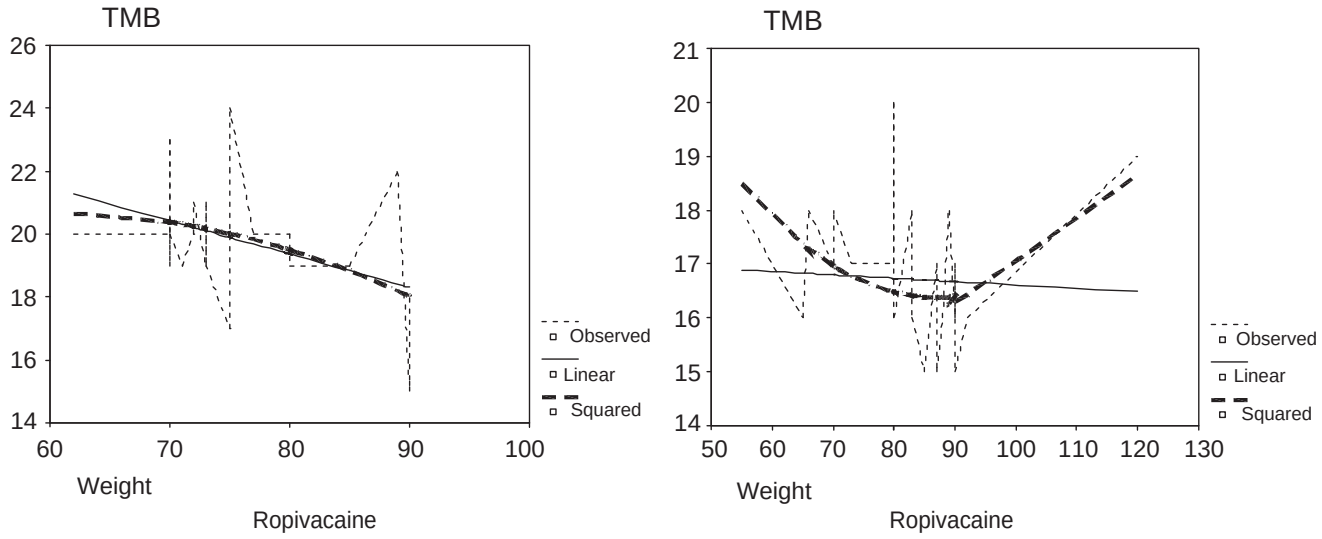


Figure 3. Time of motor block with bupivacaine in masculine sex



TMB: Time of motor block.
Figure 4. TBM of ropivacaine and bupivacaine in men.

CONCLUSIONS

Successful and sufficient analgesia was obtained with both local anesthetic during the first 24 hours after arthroscopic knee procedure.

The sciatic and femoral nerve block with both anesthetics is a suitable tool for pain management after ACL reconstruction (semitendinosus and bone-tendon-bone), as it decreases the consumption of NSAIDs and opioids, and facilitates an early rehabilitation.

Although in terms of effectiveness between the two local anesthetics, ropivacaine has a greater time of analgesia and lower VAS than bupivacaine, but ropivacaine don't have a greater time of motor block, so we concluded that ropivacaine is more effective for postoperative analgesia when it is used in femoral and sciatic block.

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