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LUMBAR PLEXUS BLOCK BY SHAMROCK METHOD ASSOCIATED WITH SPINAL ANESTHESIA FOR HIP SURGERY: A COMPARISON WITH INTRATHECAL MORPHINE

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Abstract: Justification: Postoperative pain is significant in hip surgeries and the literature is controversial. Therefore, a method of better analgesic control is sought. This research seeks to compare the analgesic action of the lumbar plexus block (BPL) with intrathecal morphine (MIT); to verify the influence of the techniques on the consumption of opioids and their side effects, and to evaluate the influence of BMI and waist circumference (CA) in the difficulty of carrying out the BPL. **Method**: Ensaio clínico randomizado e cego, incluindo 18 pacientes distribuídos em: Grupo Controle: MIT com 17,5mg de bupivacaína isobárica e 100mcg of morphine; Case Group: MIT with 17.5mg of bupivacaína isobárica and BPL with 20mL of 0.5% ropivacaine. The parameters of interest were evaluated at different times after anesthesia. **Results**: Pain scores were higher in the case group, except at 24 hours after anesthesia(p=0,039). Opioid consumption was equivalent. Nausea and vomiting were more frequent in the control group (p=0.068). Respiratory rate was similar, but SaO2 was lower in the control group at 24 hours (p=0.007). Difficulty in carrying out the BPL proved to be increasing as the IMC and CA increase. **Conclusions**: Postoperative analgesia through lumbar plexus block by the shamrock method was not more effective than that provided by intrathecal morphine early. However, the effects of the opioid on the neuraxis were evidenced through the decrease in SaO2 in 24 hours post-anesthesia and a tendency to a higher incidence of nausea/vomiting. It was also possible to identify a direct proportion behavior between IMC and CA in relation to the difficulty of carrying out the BPL.

Keywords: Conduction anesthesia. Nerve block. Hip arthroplasty. Hip fractures. Lumbosacral Plexus.

INTRODUCTION

Hip fractures represent a major public health impact in all countries. It is estimated that by the year 2050, there will be about 6.5 million hip fractures worldwide. [1]. Most of these fractures occur in the elderly population. Therefore, with the aging of the population, hip diseases will become increasingly prevalent, increasing the mortality and morbidity of these patients, in addition to increasing socioeconomic costs.[2]

For the anesthesiologist, dealing with this type of patient becomes a challenge due to the comorbidities associated with the elderly population, the need for early mobilization, functional rehabilitation and shorter hospital stay3,4. In addition, unlike most orthopedic surgeries of the lower limbs, which are classified as having a mild to moderate level of pain, knee and hip replacement surgeries are classified as having severe pain in the postoperative period.[5]

Spinal anesthesia or epidural anesthesia associated with an opioid has been widely used to perform this type of surgery in recent times.[5]

Unlike the brachial plexus, the peripheral nerves of the lower extremity are not anatomically grouped and are not superficial6. However, with the advent of nerve stimulators, specific needles for peripheral nerve blocks and ultrasound, the visualization of nerve structures has improved, as well as the success rates of blocks[7]. Recent applications focus on improving postoperative analgesia for better patient comfort, rehabilitation assistance and early hospital discharge.[8]

The lumbar plexus is formed by the anterior divisions of the first four lumbar spinal nerves. The plexus is located in front of the transverse processes of the lumbar vertebrae and is contained within the psoas muscle9 and is constituted by the following nerves: iliohypogastric, ilioinguinal,

genitofemoral, lateral femoral cutaneous, obturator and femoral nerves[10].

This study aims to compare the performance of spinal anesthesia with opioid and spinal anesthesia without opioid associated with lumbar plexus block for hip surgeries, in order to clarify whether it is possible to reduce postoperative pain, consumption of opioids and decrease adverse symptoms related to the use of opioids in patients undergoing lumbar plexus block technique. The objective was also to correlate the difficulty of executing this block with the IMC and patient's waist circumference.

METHOD

The research project was evaluated by the local Research Ethics Committee, with Opinion Number 3,082,968 and Certificate of Presentation of Ethical Appreciation (CAAE) of number 97634918.0.0000.0120. The code of the Brazilian Clinical Trials Registry (ReBEC) is RBR-2h39fm9. The privacy of patients was respected and data recording was only performed after signing the Free and Informed Consent Form by the patient.

This study is configured as a clinical trial with two groups of patients randomly randomized with simple blinding, carried out in a single center. Randomization was performed by drawing lots by authors who did not participate in the postoperative data collection. The other authors, in turn, were not aware of which intervention was performed. Patients were already aware of which study group they participated in.

Included in this study were patients undergoing elective or urgent surgery to correct a hip fracture or to insert a hip prosthesis; over 18 years old; score of 15 on the Glasgow Coma Scale; and with the ability to correctly answer the questionnaire applied by the researcher. The surgeries considered for inclusion in the research were those for correction of transtrochanteric, subtrochanteric, femoral neck, femoral head and acetabulum fractures, in addition to surgeries for insertion of partial or total hip prosthesis or revision of hip prostheses.

Patients undergoing emergency surgery were excluded from this study; who reported allergy to local anesthetics; who had a local skin infection where both spinal anesthesia and lumbar plexus block must be punctured; who had severe clotting disorder or use of anticoagulants not paused for the appropriate time; who had pathologies that prevented positioning to perform the lumbar plexus block or spinal anesthesia; who had neurological symptoms present at the site of innervation referring to the lumbar plexus; who had hemodynamic instability, defined in the study as systolic blood pressure lower than 90 mmHg, heart rate higher than 110 beats per minute or need for vasoactive drugs; who had intracranial hypertension or who were in the presence of sepsis.

The sample was defined by convenience, totaling 18 patients who were distributed as follows: control group: submitted to spinal anesthesia with isobaric bupivacaine and morphine; case group: submitted to spinal anesthesia with isobaric bupivacaine alone associated with lumbar plexus block with 0.5% ropivacaine guided by ultrasound and nerve stimulator.

Variables such as weight, sex, age, IMC and abdominal circumference were collected prior to anesthesia and sedation was administered with 0,5 a 1,5 μk/kg de fentanil e 0 a 2 mg of midazolam. For anesthetic administration, the patient was positioned in lateral decubitus contralateral to the lesion. The lumbar plexus block method used was shamrock and the puncture site was scanned using an ultrasound device with a 3 to 5 MHz curvilinear transducer in the

flank region, corresponding to the height of the L4-L5 vertebrae. A Stimuplex A100 needle was connected to a nerve stimulator and puncture was performed with the needle parallel to the transducer (in-plane approach), 3 to 5 cm away from the midline. The nerve stimulator with a frequency of 1 Hz was activated at a square pulsatile current of 1 mA until adequate stimulation of the ipsilateral quadriceps femoris was found and then reduced to 0.3 mA, waiting for the absence of stimulation. After negative blood aspiration, patients randomized to the block group received 20 mL of 0.5% ropivacaine

[Figure 1]. The control group was not submitted to the previously described technique.

For spinal anesthesia, patients also remained in lateral decubitus. The puncture was performed at the level of L3-L4 with injection of 17.5 mg of isobaric bupivacaine and 100 mcg of morphine or only 17.5 mg of isobaric bupivacaine (according to randomization) with a Quincke needle size 26G or 27G.

The performer of the lumbar plexus block technique in the case group filled out a form of difficulty in performing the block soon after its performance, whose classification followed as shown in Table 1.

Patient pain scores were assessed 1h after surgery and 6h, 12h, and 24h after anesthesia. Pain was quantified by the analogue pain intensity scale.

Patients had access to the administration of opioids for rescue analgesia, upon medical demand and prescription, both in the anesthetic recovery room and in the ward. The total dose after 24 hours of anesthesia was recorded. The number of episodes of nausea and vomiting, respiratory rate and oxygen saturation at all evaluation times were also collected.

The results obtained in the study were expressed as means and standard deviations (quantitative variables) or as frequencies and

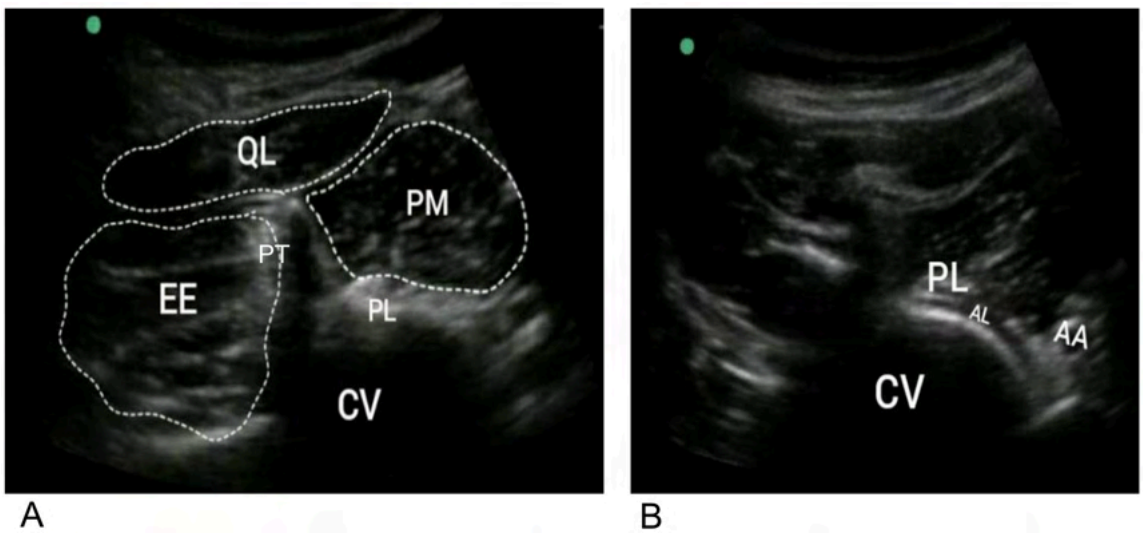

Figure 1 Visualization of the Lumbar Plexus by Ultrasonography. (A) Figure demonstrating the characteristic trefoil (shamrock) appearance of the musculature around the transverse process of L3. (B) When performing the tilt movement on the transducer, the visualization of the transverse process is lost, which allows the visualization of the needle in plane. QL-Square Lumbar Muscle; EE-Eretor Spine Muscle; PM–Psoas Major Muscle; PT- Transverse Process; CV–Vertebral Body; PL–Lumbar Plexus; AL–Lumbar Artery; AA – Abdominal Aorta Artery.

percentages (qualitative variables). When comparing two groups in terms of quantitative variables, Student's t test was used for independent samples. If the variable did not have a normal distribution, a nonparametric test was applied. Values of $p<0.05$ indicated statistical significance. Data were organized in Excel 2016 MSO version 1807 spreadsheet.

RESULTS

Of the 18 research participants, nine were randomized to the case group and nine to the control group. The age of the case group was 59.9 ± 8.12, most were male (55.5%), mean weight of 75.9 ± 14.9 kg, mean height of 1.69 ± 0.05 m, BMI of 26.3 ± 4.7 and waist circumference of 97.5 ± 14.9 cm. The median level of difficulty in performing the lumbar plexus block was 2, with most being classified as level 1 (44.4%) and only one classified as level 4 (11.1%).

In the control group, age was 46.8 ± 14.1, most women (55.5%), mean weight of 76.9 ± 14.6 kg, height of 1.63 ± 0.10 m, BMI of 29 ± 5.9 and abdominal circumference of 92.9 ± 18.02 cm. The profile of the participants of both groups can be analyzed in full in Table 2. In the first postoperative hour (T1), 44.4% of both groups had already suffered loss of spinal anesthesia motor block. The number of episodes of nausea and vomiting (NVPO) in the case and control groups was, respectively, 0.1 ± 0.33 vs 0.5 ± 1.07 (p=0.176). The respiratory rate was 13.8 ± 2.05 rpm vs 13 ± 2.07 rpm (p=0.225). Measured oxygen saturation was 94.8 ± 2.22 vs 95.4 ± 3.02 (p=0.327) and pain intensity was 0.9 ± 1.3 vs 0.8 ± 1.5 (p=0.438).

At T2 (six hours after anesthesia), all patients in both groups were already without the motor block provided by spinal anesthesia. NVPO between cases and controls was, respectively, 0.4 ± 0.72 vs 0.3 ± 0.5 (p=0.356). The respiratory rate was 14.6 ± 2.3 vs 14.9 ± 2.15 (p=0.377), oxygen saturation, 95.3 ± 1.80 vs 95.2 ± 1.86 (p=0.450) and pain intensity was 1.8 ± 1.73 vs 1.4 ± 2.23 (p=0.343).

At twelve hours after anesthesia (T3), the respective NVPO of the case and control groups was 0.7 ± 1.32 vs 2.1 ± 2.93 (p=0.103), respiratory rate was 15.1 ± 2.57 rpm vs 14 ± 3.57 rpm (p=0.230), oxygen saturation was 93.7 ± 2.6 vs 95.7 ± 1.32 (p=0.031) and pain intensity was 3.8 ± 2, 23 vs 2.8 ± 3.53 (p=0.243).

Twenty-four hours after anesthesia (T4), the respective PONV of cases and controls was 0.7 ± 1.32 vs 3.1 ± 4.31 (p=0.068), respiratory rate of 14.2 ± 1.56 rpm vs 14.8 ± 2.68 rpm (p=0.300), oxygen saturation of 94.4 ± 2.19 vs 96.9 ± 1.45 (p=0.007) and pain intensity of 1.3 ± 1, 43 vs 3.3 ± 2.86 (p=0.039). The mean cumulative dose of tramadol at all assessment times was the same in both groups (77.8 mg), ranging from 0-200 mg in the first group (SD 97.18) and 0-300 mg in the second (SD 97.18). 120.19). In addition, none of the patients submitted to the block presented any type of complication secondary to this technique. Data collected during the survey at all observation times are available in Table 3.

Another data identified in the research was a behavior of direct proportion between BMI and waist circumference in relation to the level of difficulty in performing the lumbar plexus block: the level increased with every 2.2 units increase in BMI and with every increase of 9 cm in the abdominal circumference (Graph 2).

DISCUSSION

Pain scores evaluated at all times were higher in the case group, except at T4, in which there was a statistically significant difference between the two groups (p=0.039), as shown in Graph 1.

This means that, in a later evaluation, it is possible to verify benefits in the use of lumbar

plexus block over intrathecal morphine regarding postoperative analgesia, although the earlier result tends to be less effective. This data is in agreement with the literature review presented, which demonstrates that the duration of action of peripheral nerve block can reach up to 24 hours.[11], while intrathecal morphine shows an action time of approximately 18 hours12. On the other hand, another study that aimed to compare the analgesia provided by the lumbar plexus block using the 3-in-1 technique, also with intrathecal morphine, showed a better analgesic effect of the block in earlier periods, despite using a dose as a comparison. 50% lower morphine than used in this study[13].

The slightly inferior early analgesic result of this block in relation to spinal anesthesia may reflect the participation of sacral plexus branches in the innervation of the posterior portion of the hip joint capsule, as well as the integument in the gluteal region14,15,16. Possibly, the association of lumbar plexus block with superior cluneal nerve block would be a solution to this negative outcome.[17], presenting the advantage demonstrated late.

It can also be observed that total opioid consumption in the first 24 hours was the same in both categories, with a smaller dose variation in the case group. In other words: with the use of the block, more patients needed opioids for pain relief, but the doses needed to achieve this relief were lower. It may be questioned whether this finding could be a result of the hyperalgesia effect intrinsic to opioids.

When analyzing possible adverse effects of the use of opioids in the neuraxis, NVPO episodes were found in greater quantity in the control group in all periods, except at T2, although this difference was not statistically significant at any time of evaluation. This makes lumbar plexus block an interesting analgesic alternative for those patients at very high risk of developing postoperative nausea and/or vomiting, although this benefit is not yet well defined.

The respiratory rate was similar in both groups, but the oxygen saturation value by pulse oximetry was significantly lower in the control group in the T4 period (p=0.007). These results show the ventilatory depressant effects of the use of morphine, especially late[12]. This data can be taken into account in those patients who are at greater risk of respiratory depression or hypoxia in the postoperative period, such as the extreme elderly9, obese and physical status on the ASA scale greater than 2[18].

The direct proportion found between BMI and abdominal circumference with the level of difficulty in performing the lumbar plexus block is consistent with the difficulty found in the practice of performing the block in patients with a greater amount of abdominal fat, making it difficult to visualize the structures and the needle. during the procedure. This is probably due to the greater thickness of the wall to be overcome by the ultrasound waves, requiring an increase in the transducer reach depth and making it difficult to align the needle parallel to the transducer wave beam[19]

In view of this result, one must question the efficiency of the lumbar plexus block technique in morbidly obese patients, while at the same time questioning its benefit due to the absence of ventilatory depressant action in the postoperative period.

The absence of complications in the sample of patients submitted to the block technique shows a good level of safety of the method if safety measures are followed, such as the use of ultrasound and peripheral nerve stimulator. Another source in the literature also suggests an acceptable level of safety, with no neurological sequelae, signs of anesthetic toxicity and complications related

to puncture (hematoma, infection) using ultrasound and nerve stimulator[20].

Despite the numerous variables that could be analyzed in this study, providing several data with exploratory potential in the scientific environment, the results are still insufficient for generalization in larger populations, since the study sample is small, randomized for convenience, and does not cover characteristics extreme conditions such as morbid obesity.

Another limitation of the study is based on the subjectivity in defining the difficulty of the puncture to perform the lumbar plexus block. Although a structure was created in an attempt to provide greater objectivity to this data, the ultrasound-assisted block technique is operator dependent and the results may vary according to the expertise of the professional performing it.

In addition, blinding patients and performing a placebo block in the control group would also improve the quality of results, if performed.

CONCLUSION

Postoperative analgesia through lumbar plexus block using the shamrock method proved to be more effective than the analgesia provided by intrathecal morphine in a late manner (after 24 hours of anesthesia), although there is no evidence of this benefit early on.

The ventilatory depressant effects of morphine on the neuraxis were present through the decrease in the pulse oximetry value in practically all evaluation times, being more expressive 24 hours after anesthesia, but there were no evident changes in respiratory rate. There was also a tendency towards a greater amount of nausea and/or vomiting due to the use of opioids compared to the blockade.

Another data identified was the behavior of direct proportion between BMI and waist circumference in relation to the level of difficulty in performing the lumbar plexus block. The level of blockade difficulty must be taken into account before deciding to do it through the amount of abdominal fat measured by BMI and waist circumference.

More concrete data on the benefits of morphine blockade on neuraxis must still be sought with a larger study population, as well as the complementation of the technique through superior cluneal nerve block must still be investigated.

OTHER TOPICS

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TABLE AND FIGURE

Difficulty level	Definition
Level 1	Good visualization of plexus and needle on US during block
Level 2	Good visualization of the plexus and regular visualization of the needle during the block
Level 3	Poor visualization of the plexus and regular visualization of the needle during the block
Level 4	Poor visualization of the plexus and needle during the block

Table 1- Stratification of difficulty in performing plexus block.

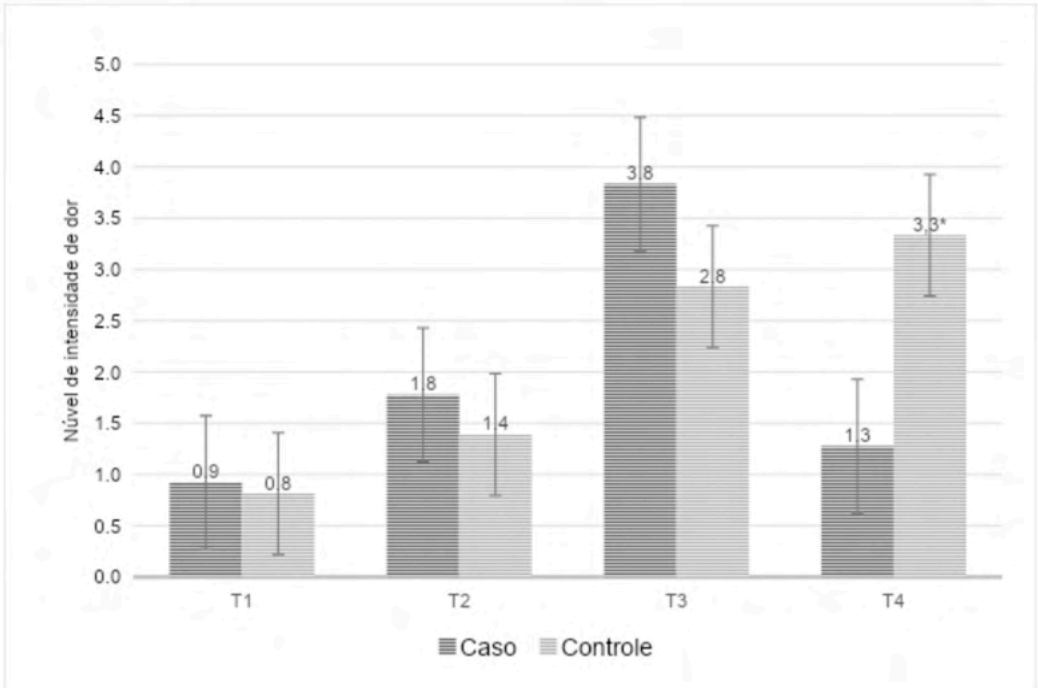
Variables		G1	G2	Total
n		9	9	18
Sex	Female	4 (44,4%)	5 (55,5%)	9 (50%)
	Male	5 (55,5%)	4 (44,4%)	9 (50%)
Age (average)		59,9 ± 8,12	46,8 ± 14,1	53,3 ± 13,1
	≤40	0 (0%)	3 (33,3%)	3 (16,6%)
	41-60	5 (55,5%)	6 (66,6%)	11 (61,1%)
	>60	4 (44,4%)	0 (0%)	4 (22,2%)
Weight (Kg)		75,9 ± 14,9	76,9 ± 14,6	76,4 ± 14,4
Height – m (average)		1,7 ± 0,05	1,6 ± 0,10	1,67 ± 0,09P
BMI (average)		26,3 ± 4,7	29 ± 5,9	27,7 ± 5,37
	≤25	4 (44,4%)	2 (22,2%)	6 (33,3%)
	25-30	4 (44,4%)	3 (33,3%)	7 (38,8%)
	≥30	1 (11,1%)	4 (44,4%)	5 (27,7%)
Abdominal circumference - average		97,5 ± 14,90	92,9 ± 18,02	95,0,6 ± 16,29
Blocking difficulty - median		2	NA	NA
	1	4 (44,4%)	NA	NA
	2	2 (22,2%)	NA	NA
	3	2 (22,2%)	NA	NA
	4	1 (11,1%)	NA	NA
Procedure	femoral neck fracture	2 (22,2%)	1 (11,1%)	3 (16,6%)
	Total hip arthroplasty	6 (66,6%)	6 (66,6%)	12 (66,6%)
	Acetabular fracture	0 (0%)	2 (22,2%)	12 (66,6%)
	partial hip arthroplasty	1 (11,1%)	0 (0%)	1 (5,55%)

Table 2 - Profile of research participants.

Variables		G1	G2	Value of p+	Total
Evaluation at 1 h after surgery (T1)					
n		9	8		17
engine block	No	4 (44,4%)	4 (50%)		8 (47%)
	Yes	5 (55,5%)	4 (50%)		9 (52,9%)
NVPO – average of episodes		0,1 ± 0,33	0,5 ± 1,07	0,176	0,3 ± 0,77
Respiratory frequency (average)		13,8 ± 2,04	13 ± 2,07	0,225	13,4 ± 2,03
Sat. O2 (average)		94,8 ± 2,22	95,4 ± 3,02	0,327	95,1 ± 2,56
pain intensity (average)		0,9 ± 1,33	0,8 ± 1,51	0,438	0,87 ± 1,37
Evaluation at 6 hours after anesthesia (T2)					
n		9	9		18
engine block	No	9 (100%)	9 (100%)		18 (100%)
	Yes	0 (0%)	0 (0%)		0 (0%)
NVPO – average of episodes		0,4 ± 0,72	0,3 ± 0,5	0,356	0,39 ± 0,61
Respiratory frequency (average)		14,6 ± 2, 30	14,9 ± 2,15	0,377	14,72 ± 2,16
Sat. O2 (average)		95,3 ± 1,80	95,2 ± 1,86	0,450	95,3 ± 1,78
pain intensity (average)		1,8 ± 1,73	1,4 ± 2,23	0,343	1,6 ± 1,95
Assessment at 12 hours after anesthesia (T3)					
n		9	9		18
engine Block	Não	9 (100%)	9 (100%)		18 (100%)
	Sim	0 (0%)	0 (0%)		0 (0%)
NVPO – average of episodes		0,7 ± 1,32	2,1 ± 2,93	0,103	1,4 ± 2,33
Respiratory frequency (average)		15,1 ± 2,57	14 ± 3,57	0,23	14,56 ± 3,07
Sat. O2 (average)		93,7 ± 2,60	95,7± 1,32	0,031*	94,7 ± 2,25
pain intensity (average)		3,8 ± 2,24	2,8 ± 3,54	0,243	3,3 ± 2,92
Assessment at 24 hours after anesthesia (T4)					
n		9	9		18
engine block	No	9 (100%)	9 (100%)		18 (100%)
	Yes	0 (0%)	0 (0%)		0 (0%)
NVPO – average of episodes		0,7 ± 1,32	3,1 ± 4,31	0,068	1,9 ± 3,34
Respiratory frequency (average)		14,2 ± 1,56	14,8 ± 2,68	0,300	14,5 ± 2,15
Sat. O2 (average)		94,4 ± 2,19	96,9 ± 1,45	0,007*	95,7 ± 2,20
pain intensity (average)		1,3 ± 1,44	3,3 ± 2,86	0,039*	2,3 ± 2,44
cumulative dose of tramadol		77,8 ± 97,18	77,8 ± 120,19	0,5	77,8 ± 106,03

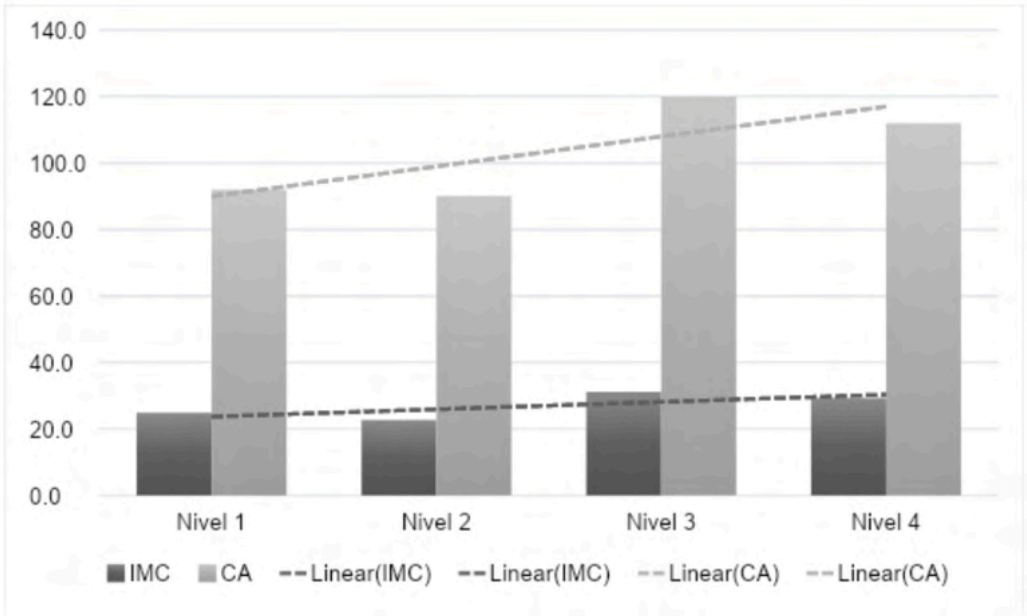
+: Test t of Student; * : value of p < 0,05;

Table 3 - Results of post-anesthetic follow-up.



*p<0,05. For this comparison, Student's t test was performed.

Graphic 1: Comparison between the average pain intensity level of the participants in the case groups (BLP) e control (intrathecal morphine) collected at the four time points defined by the study (T1, T2, T3 e T4).



AC: waist circumference

Graph 2: Direct proportion relationship between the level of difficulty of performing the lumbar plexus block and the patients' BMI and abdominal circumference. It is possible to raise the difficulty rating level for every 9 cm increase in waist circumference from a measurement of 81 cm, as well as every 2.2 units in the BMI measurement, from a BMI of 21.5.