INTRA-ARTICULAR BUPIVACAINE OR BUPIVACAINE AND MORPHINE AFTER ACL RECONSTRUCTION

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ABSTRACT

Objective: Reconstructive surgery of the ACL is one of the most commonly performed surgeries today and the control of postoperative pain is part of the priorities of the surgeon. Within the arsenal of analgesia we have the intra-articular application of drugs, and the most studied one is bupivacaine with or without morphine. This study compared the application of bupivacaine with or without morphine with a control group after ACL reconstruction with flexor tendon graft. Methods: Forty-five patients were randomized into three groups: in group I, 20 ml of saline were applied intra-articularly at the end of the surgery; in group II, 20 ml of bupivacaine 0.25%; and in group III, bupivacaine 0.25% associated with 1 mg of morphine. The groups were assessed for degree of pain by the Visual Analog Scale at 6, 24 and 48 hours postoperatively. Results: Group III had less pain at all times, but the pain was not as intense in all groups to the point of needing extra medications beyond the established protocol. Conclusion: The intra-articular application of these medications after ACL reconstruction with flexor tendon graft when performed under spinal anesthesia is not useful enough to use regularly. ***Level of Evidence II, Lesser quality RCT.***

Keywords: Anterior cruciate ligament/surgery. Anesthesia & analgesia. Bupivacaine. Morphine. Pain measurement.

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INTRODUCTION

Videoarthroscopy-assisted ACL (anterior cruciate ligament) reconstruction surgery in the knee is one of the most common types of surgery performed today by orthopedists and pain control in the postoperative period is one of the concerns facing surgeons. With adequate control of postoperative pain patients can begin their physiotherapeutic rehabilitation sooner, enabling early hospital discharge and reducing hospitalization costs.[1] It is also believed that poorly managed acute pain is one of the causes of chronic pain.[2] Pain relief and the reduction of neuroendocrine responses to stress can be obtained by several methods. Thus many surveys address the best form of analgesia for this surgery and how to use fewer drugs for this purpose, decreasing the side effects.[3] When peripheral opioid receptors were evidenced mainly in the swollen tissues, this opened up the possibility of using peripheral opioid administration in an attempt to tap into the high analgesic power of these medications, at the same time avoiding their undesirable central effects. Within this arsenal we have the intra-articular application of drugs, of which the most common are bupivacaine and morphine.[1,4] However, most surveys using such drugs are with patients submitted to general anesthesia, which is not the most widely used technique in our field. Therefore the aim of this study is to prove that in patients undergoing videoarthroscopy for ACL reconstruction under spinal anesthesia, the use of intra-articular bupivacaine and morphine at the end of the surgery reduces postoperative pain and the use of extra medication for pain control.

METHODS

After approval by the Institutional Review Board, we selected 45 patients of both sexes, aged between 15 and 55 years, physical status ASA I and II, coming from the private clinic or from the outpatient clinic of the Unified Health System (S.U.S.) of the main author, who were supposed to undergo videoarthroscopy-assisted anterior cruciate ligament reconstruction between June 2007 and September 2008. They all signed the Consent Form and agreed to take part in this survey. As exclusion criteria we selected the patients who did not agree to take part in the study, who had lesions in other ligaments that required a surgical procedure, who needed a change in the medication protocol or who did not hand in the completed pain scale form upon their first return visit.

The patients were monitored with a cardioscope, pulse oximeter

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and apparatus for non-invasive arterial pressure monitoring device. The anesthesia was always performed by the same group of anesthetists, and consisted of spinal block with 15mg of bupivacaine, 0.5% without vasoconstrictor, in association with extra analgesia with ketorolac 30mg and dipyrone 2ml applied intravenously, after anesthetic block. All the patients then underwent videoarthroscopy-assisted ACL reconstruction, performed by the same surgeon, with a flexor tendon graft secured by a titanium transfixing screw in the femur and a titanium interference screw in the tibia. Associated meniscal and chondral lesions were treated and noted down.

The 45 patients were divided into 3 groups by drawing a sealed envelope (double-blind method) at the time of the surgery performed by the operating room technician, who also prepared the medications without the knowledge of the surgeon or of the patient. In group I, 20ml of 0.9% saline were used at the end of the surgery. In group II, we used 20ml of 0.25% bupivacaine with vasoconstrictor, while group III received 20ml of 0.25% bupivacaine with vasoconstrictor and 1mg of morphine. The medications were applied at the end of the surgery after the closing of the incisions, followed by the application of a compressive dressing and release of the tourniquet.

IV (Intravenous) dipyrone 2ml was prescribed every 6 hours, with IV tenoxicam 20mg every 12 hours, and if the patient still complained about pain after using these medications, IV tramadol 50mg could be used every 6 hours. Icepack use for 20 minutes every 4 hours, metoclopramide in case of nausea or vomiting and bladder relief catheterization in case of urine retention were also associated.

The patients were discharged 18 to 20 hours after surgery, instructed to take 50mg of diclofenac sodium orally every 8 hours in case of pain.

The pain assessment was carried out with the visual analogue scale (VAS) that consists of a 10cm horizontal line where zero (far left side) corresponds to the absence of pain and 10 (far right side) to maximum pain, where the patient makes a mark at the point corresponding to the level of pain they are experiencing, and this point is transformed into a number in centimeters. The scale was applied 6, 24 and 48 hours after the surgery, whereas at 6 hours it was applied with the patient still in hospital, with the guidance of the surgeon in charge and at 24 and 48 hours the patient noted down the results at home and brought them in on their first return visit 7 days after surgery. The surgeon only discovered the drug that was used 3 days after the surgery.

The sample size was estimated with a basis on the visual analogue scale of pain as main variable.

The results were tabulated and submitted to statistical analysis. The age distribution was analyzed by the Kruskal-Wallis nonparametric test and the pain assessment between the groups and at the different times was executed using the nonparametric analysis of variance technique for the model of repeated measures in independent groups, supplemented by Dunn's method for multiple comparisons between groups and assessment times. All the tests were carried out at the 5% significance level.

RESULTS

All the patients delivered the VASs completed properly, so that none of the cases had to be excluded.

The groups had similar distribution in terms of age, side operated and associated procedures. Male patients predominated (there were only two female patients - 1 in group II and 1 in group III).

The results are presented in Tables 1, 2, 3 and 4. At 6 hours after surgery the groups were similar in relation to the result of the VAS values. At 24 and 48 hours group III (bupivacaine and morphine) obtained the lowest values ($p=0.05$). In the control group the pain was more intense, with higher values of VAS at 24 and 48 hours after surgery. In group II (bupivacaine) the lowest values were obtained at 24 hours after surgery ($p<0.05$) and in group III the pain was similar in all the periods. (Figure 1)

Three patients from the control group required rescue medication (tramadol), one 6 hours after surgery, another at 7 hours and thirty minutes, and the last at 9 hours and forty minutes after surgery. One patient required metoclopramide due to nausea and vomiting 5 hours after surgery.

One patient from group II (bupivacaine) presented post-spinal anesthesia headache controlled with medications. And one patient from group III required bladder relief catheterization due to urine retention 11 hours after surgery.

As regards the presentation of associated lesions, we had 60% of the patients from group I (9 patients), 66.66% from group II (10 patients) and 100% from group III, which was significantly larger. The associated lesions were always of the same pattern (meniscal or chondral lesions and sulcoplasty).

DISCUSSION

We observed that in our cases there was a better result with the association of bupivacaine and morphine at all the study times (figure 1), with the best results, when compared with the other groups, at 24 hours after surgery, which is compatible with the results presented in the literature.[4,5-10] However, we also noted that pain was well controlled even in the patients that received only bupivacaine or in the control group, with VAS values below the mean values found in literature.[2,11] This may be due to the preemptive analgesic factor of the spinal anesthesia.

Table 1. *Age, VAS, associated lesions and rescue medication in the control group (Group I).*

Case	Age	6h	24h	48h	Associated Lesions	Other medications	Side	Sex
2	53	0.3	8.7	1.6	Bucket-handle tear of MM		R	M
4	26	1	8	6	Radial tear of LM (small)		L	M
5	44	2.5	2.7	2.4		tramal 1amp 7h30po + plasil 1amp 5hpo	R	M
7	32	0.1	0	0	Bucket-handle tear of MM		L	M
9	45	0	0.8	0.9	Bucket-handle tear of MM + notchplasty		R	M
12	27	1.2	2.1	1.8			L	M
15	19	2	5.1	2.8	Anterior horn LM		R	M
19	29	6.7	3.2	1.6	LM + notchplasty	tramal 1amp 9h40mpo	L	M
22	46	0	0	0	MM (Post horn)		R	M
24	42	0.1	0.2	0	Femoral chondral lesion		R	M
30	44	0	0	0	Bucket-handle tear of MM + notchplasty		R	M
34	27	0.2	0.2	0.4			R	M
37	24	6.6	6.8	4.7		tramal 1amp 6hpo	L	M
38	20	0.8	0.9	0.3			L	M
30	27	0.4	0.4	0.4			L	M

Table 2. *Age, VAS, associated lesions and rescue medication in the bupivacaine group (Group II).*

Case	Age	6h	24h	48h	Associated lesions	Other medications	Side	Sex
10	30	1.5	5.8	0.8			R	M
11	45	0.4	0.5	0.6	MM flap + med and lat chondral		R	M
16	29	2.2	5.5	3.1	MM flap + LM degen		R	M
17	42	2.6	5	4.4			L	M
18	35	4.6	6.6	3.7	Radial tear of LM		L	M
20	22	1.1	2.3	4.3			L	M
21	19	3.1	1.8	0.9	LM PH	Post-spinal anesthesia headache	L	F
23	21	0.1	0.2	0.3	MM PH		R	M
26	23	0	0.3	0.2	MM Flap + notchplasty		R	M
28	22	0.8	9.5	9.5			L	M
29	22	0.2	1.8	0.3	Bucket-handle tear of MM + notchplasty		R	M
33	29	7.1	6.8	7.9	MM + notchplasty		R	M
36	38	0	0.5	1.2	MM+notchpl+troch chondral defect		L	M
40	28	1.2	1.4	1.3	MM+LM+notchpl		L	M
43	29	0.4	0.5	0.5			R	M

Table 3. *Age, VAS, associated lesions and rescue medication in the bupivacaine group + morphine (Group III).*

Case	Age	6h	24h	48h	Associated lesions	Other medications	Side	Sex
1	18	2	0	0	LM + notchpl	SVA 11h post-op.	R	M
3	41	0.5	0.4	1.6	MM + notchpl		L	M
6	29	0	1.4	1.6	MM		L	M
13	16	0	0	0	LM + notchpl		R	F
14	34	0	0.1	0.2	Free chondral body		L	M
25	22	0.2	0.3	0.2	LM		L	M
27	40	0.2	0.5	0.3	Bucket-handle tear of LM + MM flap +notchpl		R	M
31	36	3.3	1	0.2	Troch chondral defect		L	M
32	21	4.7	5.8	2.4	Bucket-handle tear of LM		R	M
35	39	0	0	0	MM + LM		R	M
8	28	0.3	0.9	1.1	MM flap + notchpl		R	M
41	38	3.8	5.2	2	Notchpl		L	M
42	40	0	0	0	Notchpl		L	M
44	38	0.2	0.3	0.4	Bucket-handle tear of LM+free body +notchpl		R	M
45	40	3	0.7	0.8	Notchpl		R	M

Table 4. *Median and minimum and maximum values of pain intensity according to group and evaluation time.*

Group	6h	24h	48h
saline	0.4(0.00-6.70)	0.9(0.00-8.70)	0.9(0.00-6.00)
Bupi	1.1(0.00-7.10)	1.8(0.20-9.50)	1.2(0.20-9.50)
bupi+morphine	0.2(0.00-4.70)	0.4(0.00-5.80)	0.3(0.00-2.40)

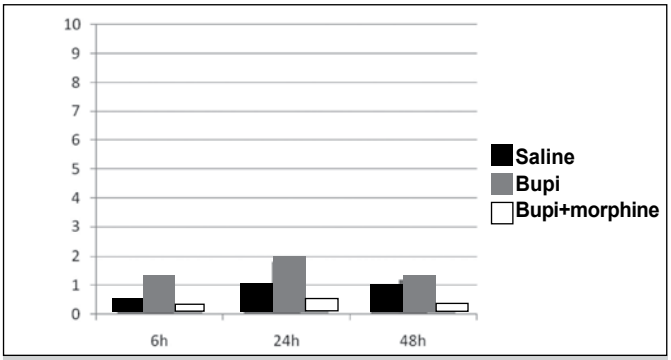

Figure 1. *Mean values of VAS according to time in the 3 groups.*

The groups presented a similar pain pattern 48 hours after surgery, which suggests that the effect both of the drugs applied and of the preemptive analgesia has already passed, compatible with the time described in literature.[1]

The control group had greater use of rescue medication (three cases), while no other group required such use, similar to other published studies[3,6,10] suggesting that even the use of bupivacaine alone, associated with this type of anesthesia, has a good effect on pain control.

Our rate of complications in relation to the anesthetic procedure was very low, with only one case that required bladder relief catheterization in group III, while one case from group II presented post-spinal anesthesia headache controlled by analgesic medication and rest, and one case in group I had nausea and vomiting controlled with intravenous metoclopramide. Among these complications only nausea and vomiting are more frequent, representing complications inherent to the type of anesthesia used (spinal block).[3] Eroglu *et al.,*[11] in a similar survey using spinal anesthesia and applying bupivacaine, morphine or saline solution, obtained similar complications, and a patient from the group that used morphine also evolved with urine retention.

Today we know that the best form of postoperative pain control is multimodal analgesia that consists of the association of several methods and drugs to increase its effects and to decrease its doses, reducing the side effects.[1] One of the forms of analgesia that we have at our disposal is the application of intra-articular medication. Several medications have already been studied for the use of this form, including fentanyl,[1] meperidine,[1] ketorolac,[1] corticoid,[1] clonidine,[1,12] ketamine,[13] tenoxicam,[12] magnesium sulfate,[9] tramadol[14] and neostigmine[12]. However, the best results were obtained with the association of bupivacaine and morphine.[7,8] Bupivacaine is an anesthetic from the amide group with a prolonged duration of action and doses at 0.5% or less do not appear toxic to the articular cartilage.[1,15] Its intra-articular effect remains controversial and lasts an average 2 to 4 hours.[5,7,8,16] Its systemic side effects include the ability to alter the cardiac rhythm and the central nervous system, but these effects are dose dependent.[17] For this reason we associate bupivacaine with vasoconstrictor and apply the drug before releasing the tourniquet. There are reports of these complications with the intra-articular application of bupivacaine, yet in surgeries without these precautions.[17] However, Guler *et al.*[18] compared the use of intra-articular bupivacaine and morphine before and after releasing the tourniquet in anterior cruciate ligament reconstruction surgeries in patients submitted to general anesthesia and concluded that releasing the tourniquet before applying the medication afforded better pain relief results and reduced the postoperative consumption of opioids.

Morphine is an opioid with slow onset of action (it can take from 8 to 12 hours to start) and prolonged effect.[7,8] It is known that the peripheral tissues have opioid receptors and the opioids produce local analgesia in the presence of inflammation, but not in normal tissue.[1,5] Marchal *et al.*[19] proved that morphine has a better effect when more inflammatory response is present or is caused by surgery. The dose used for intra-articular application can range from 1 to 5mg, with inconclusive results concerning the best dosage.[17] Intra-articular medication can be used before the surgical procedure or at its end with greatly variable results in literature.[20] We opted for its use at the end as in our group of patients the chosen anesthesia was the spinal block.

Most surveys found in the literature were conducted with general anesthesia[4,6,9,12-14,16,19,20] and we know that spinal anesthesia has a prolonged preemptive analgesia effect of up to 48 hours, fulfilling the role of preventing the central sensibilization and pain amplification in the postoperative period, thus managing to reduce the use of medications in the postoperative period.[1] Heard *et al.*[21] conducted a study comparing video-assisted knee surgeries with general anesthesia and with spinal block anesthesia and concluded that the patients submitted to spinal block have less pain regardless of the type of analgesia employed in the postoperative period. The epidural anesthesia can decrease the effect of morphine by diminishing the neuroendocrine response to surgical trauma and reducing the release of inflammatory mediators.[1,3] Eroglu *et al.*[11] compared the effect of bupivacaine and of intra-articular morphine with placebo on patients submitted to knee arthroscopy under spinal anesthesia, yet excluding the patients selected to undergo ACL reconstruction, and obtained optimal pain control, but the VAS values were even higher than our results.

Our analgesia protocol in the postoperative period was as simple and inexpensive as possible so as to produce the least possible influence on the end result, with the least suffering for the patient. We therefore associated an analgesic (dipyrone) with a non-hormonal anti-inflammatory drug (tenoxicam) for intravenous use. We also prescribed icepacks, as it is known that ice, through a mechanism not fully explained, reduces inflammation, edema and bruising in the postoperative period, also reducing the nerve conduction velocity, producing an anesthetic effect on the pain nerve fibers, and can reduce muscular spasm.[1,5] We opted to use tramadol as an extra analgesic medication in case of failure in pain control, as this drug is widely available in our service at an accessible price and has an optimal analgesic effect with good duration, and few side effects in this dosage. Diclofenac was prescribed in case of pain after hospital discharge on account of its proven analgesic effect and low cost. This protocol is simpler than those found in US and European literature where the medications in use, such as hydrocodone and oxycodone, are more potent and expensive than those employed in Brazil, yet our results were similar, if not better than those found in literature, as the side effects were minimal and we had limited use of tramadol as a form of extra analgesia, with good pain control even in the control group. Pain analysis with VAS is widely employed despite the difficulty of its application in some people, yet its efficiency is scientifically proven.[2] The VAS values obtained were similar to literature, confirming the efficiency of our protocol when compared to others. This study presents some limitations. Firstly, the same surgeon who operated on the patients also applied and supervised the use of the VAS, yet this individual only discovered which drug was used three days after the surgery, when all the scales had been completed and the patient had already been discharged from hospital. The anesthetic block was performed by different anesthetists, yet they were all from the same team, with standard technique, drugs and dosage. The presence of associated lesions can create a pain sensation bias, yet even with Group III having associated lesions in all the cases, their pain level was lower than the other groups.

CONCLUSION

In view of the results presented here, we can conclude that the intra-articular application of the medications studied within the specified parameters did not have a strong enough analgesic effect to justify their frequent use in patients submitted to anterior cruciate ligament reconstruction with flexor tendon graft assisted by video under spinal anesthesia. In spite of the tendency to experience less pain, at all the times of group III (bupivacaine and morphine), the pain index in VAS was low in all the groups and at all the times, and was controlled with simple, low-cost medications.

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