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ORIGINAL STUDY

The influence of local infiltration analgesia after total hip replacement. A randomized clinical trial

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To determine whether local infiltration analgesia by catheter infusion was superior to conventional analgesia in terms of postoperative pain control after THR. A randomized double-blind clinical trial was performed. There were four groups based on catheter placement and the infusion constituents : 1) Intraarticular catheter + anesthetics ; 2) Intraarticular catheter +placebo ; 3) Subfascial catheter + anesthetics ; 4) Subfascial catheter + placebo. The anesthetic infusion contained bupivacaine (bolus + continuous perfusion up to 36 hours). The placebo solution was physiological serum. The same conventional analgesic schedule was prescribed to all patients. Pain was evaluated by means of PCA shots and the VAS. Side effects, time to start rehabilitation and time to discharge were also analyzed.

100 patients (25 for group). Mean age was 67 years old (SD 12 y/o) and 53% were male. Mean PCA shots was 27 [range 2-87] and mean VAS was 1 [range 0-7]. No differences were found (p>0.05) when these variables were compared between the groups. The use of LIA with bupivacaine using a catheter infusion does not provide better pain control after THR.

Keywords : Pain control ; local infiltration analgesia ; hip replacement.

INTRODUCTION

Total hip arthroplasties (THA) ease pain and improve the long-term quality of life for patients with osteoarthritis of the hip *(15)*. However, the management of pain during the first days after surgery is still an unsolved issue. Good control of postoperative pain after total hip arthroplasty is important in order to start rehabilitation early, improve the initial functionality of the patient and shorten the hospital stay. It is important to choose an analgesic that provides adequate pain control with minimal side effects. A number of recommendations for postoperative pain control have been described. They are intravenous analgesia with opioids, peripheral nerve blocks, epidural infusions with an anesthetic and synthetic opioids or combinations thereof *(6)*. However, these techniques are not

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without side effects such as hypotension, pruritus or urinary retention *(5)*.

Bianconi et al. *(3)* and Andersen et al. (1) has described Local infiltration analgesia (LIA) with promising results. However, it was not described until 2007 by Kerr and Kelan *(9)*. The technique is based on the systemic infiltration of a mixture of ropivacaine, ketorolac and adrenaline around all of the structures in the surgical field in primary arthroplasty surgery. It is followed by a further bolus and a final injection through a catheter at 20 hours after surgery. However, other authors have reported, that there are no differences in pain control in randomized studies between patients with or without LIA *(2,12,16)*. In addition, there is insufficient evidence relative to the proper placement of the catheter (intra-articular or extra-articular). Is it best to give it in the form of a bolus or a continuous infusion? Which injection composition is the most appropriate *(13)*? Accordingly, there are still several issues to be resolved so that this technique can be included in the general recommendations for pain control in THA *(8)*.

The aim of this study was to determine whether the local infiltration analgesia by means of a catheter improves the control of postoperative pain in total hip arthroplasty. The secondary objective was to determine whether LIA decreases opioid consumption and its adverse effects. The initial hypothesis was that the introduction of LIA reduces pain after THA.

MATERIAL AND METHODS

It is a double blind randomized clinical trial in patients undergoing primary total hip arthroplasty in a single center study over the period 2013-2014. The study was approved by the ethics committee of our hospital (CEIC 2013/5138/I) and was entered in the registry of clinical trials (NCT02630160). All patients were informed, agreed to participate in the study and signed informed consent. The inclusion criterion was primary total hip arthroplasty scheduled due to hip osteoarthritis. The exclusion criteria were patients with an intolerance or allergy to any of the study drugs, those that had had any intraoperative complication (periprosthetic fracture) or hemodynamic instability in the immediate postoperative period that would limit doing the appropriate follow-up in the first succeeding hours.

All patients were operated on by a senior member of the hip unit with the same Hardinge anterolateral approach. The use of a cemented or uncemented prosthesis was decided on according to the age and bone quality of each patient. All of the patients were operated on while under spinal anesthesia (12,8 mg bupivacaine).

As for the variables of the study, the study had two sides. One was focused on the composition of the infiltrate and the other was based on catheter placement. Thus, four groups were formed for comparison. They were Group I with an intraarticular catheter and anesthetic infusion, Group II with an intraarticular catheter and placebo infusion, Group III with a perifascial catheter and anesthetic infusion and Group IV with a perifascial catheter and placebo infusion. The assignment of patients to one of the four groups was done randomly by computer by the Pharmacy Service of the center, which prepared each analgesic solution to administer to preserve study blinding.

The anesthetic solution to study consisted of a bolus of 40mL of 0,25% bupivacaine in the surgical field during the intraoperative period and then a continuous infusion of the same anesthetic, administered via catheter with a CPP (Continuous perfusion pump) over 36 hours after surgery at a rate of 10ml/h. The placebo solution consisted of the same dose in a 0,9% saline bolus with a CPP over 36 hours after surgery. Additionally, all patients received the same analgesic dose consisting of : IV paracetamol 1g/8h, IV dexketoprofen 50mg/2ml every 12h and a PCA pump without continuous infusion (0,025mg/kg morphine and 0,01mg/kg droperidol. The bolus time was between 10 minutes and up to a maximum 6 bolus/h) where the patient could self-administer a bolus of 1ml if pain presented (VAS>3). Moreover, rescue IV Tramadol 50mg could be administered if the pain was poorly controlled.

The demographics of patients (sex, age, laterality) were collected. To assess pain, the VAS every 8 hours during the first 32 hours and the number of doses requested and administered by the PCA pump

and the number of tramadol doses administered were taken into account. Adverse effects (nausea, vomiting, drowsiness, urinary retention ...), the time from surgery to starting sitting (hours), time to start walking (hours) and hospital stay (days) were also collected.

Statistical analysis

Prior to the start of the study, an analysis of the sample size was carried out. It concluded that 25 patients were needed in each group to have a power of 80% with an alpha error of less than 0,05. With the results obtained, a descriptive analysis of the sample was performed. Categorical variables are presented as frequencies and percentages and quantitative variables are presented using the median and the first and third quartiles. Subsequently, a bivariate analysis comparing all outcome variables in each of the randomization groups to which each patient belongs was performed using the Chi-square test for categorical variables. For quantitative variables, a Kruskal-Wallis test was performed. They were considered statistically significant at p values of less than 0.05 in all the analyses. The SPSS15.0 (IBM Corp.) was used

RESULTS

One hundred patients were included and each of the four study groups consisted of 25 patients. The mean age was 67 years (31-90), 53% of patients were male and 43% of the prostheses were on the left side.

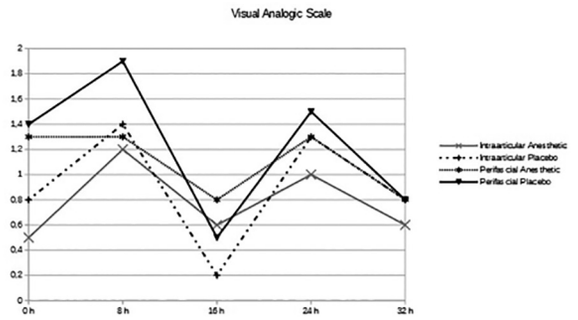

Figure 1. — Pain Distribution over time measured with VAS in all groups

Table I. — Relevant results in all patients

Main variables (n=100)	Median (range)
VAS	1 (0 – 2.4)
VAS at Discharge	0.58 (0 - 5)
PCA requested	60.46 (2 - 741)
PCA administered	29.43 (2 - 87)
Time to starting to sit (hours)	42.4 (24 - 72)
Time to start ambulation (hours)	50.2 (24 - 72)
Average stay (days)	5.1 (3 - 8)

Table I shows the results for pain, the rehabilitation start time and hospital stay for all the patients.

Upon comparing each of the groups, no significant differences (n.s.) in terms of pain control were seen as shown in Table II. Pain measured by VAS presented a similar distribution over time in

Table II. — Postoperative pain control variables. VAS and rescue

	Intraarticular anesthesia	Intraarticular placebo	Perifascial anesthesia	Perifascial placebo	p
Mean VAS	0.78 (0.61)	0.88 (0.3)	1.11 (0.80)	1.81 (0.72)	0,287
PCA requested	55.6 (57.5)	53.6 (49.0)	36.62 (19.3)	99 (197.3)	0,917
PCA administered	31.7 (18.9)	33.2 (21.4)	25.15 (12.2)	26.4 (22.2)	0,704
Tramadol	4 (26.7%)	3 (20%)	3 (20%)	5 (33.3%)	0,783

* Values represented as medians and standard deviation in parentheses for quantitative variables with number of cases and percentage in brackets for qualitative variables, p value after the Kruskal-Wallis.

Table III. — Variables for start of rehabilitation and hospital stay

	Intraarticular anesthesia	Intraarticular placebo	Perifascial anesthesia	Perifascial placebo	p
Sitting up(hours)	39 (11.87)	45 (10.11)	45 (10.76)	39 (11.35)	0,095
Ambulation (hours)	48 (7.12)	51 (8.14)	51 (8.11)	50 (5.94)	0,671
Hospital stay (days)	4.9 (0.83)	5.3 (1.22)	5 (1.06)	5.2 (1.16)	0,361

*Values represented in media and standard deviation in parentheses, p value after the Kruskal-Wallis.

all groups (Figure 1). No differences (n.s.) between groups were found at the beginning of rehabilitation or hospitalization, as shown in Table III.

The notable adverse events were dizziness (15.6%), drowsiness (7.3%), nausea and vomiting (6.3%) and hypotension (2.1%). In total, 31.3% of the patients had some adverse effect. No differences in adverse effects were found between the study groups (n.s.) in the statistical analysis.

As for complications, there were 5 cases of acute infection that required surgical debridement and the replacement of moving parts and 2 cases of neuroapraxia of the external popliteal sciatic nerve which resolved spontaneously.

DISCUSSION

The results of our study refute the hypothesis that LIA with a catheter improves postoperative pain control in total hip arthroplasty. Secondly, it has been shown that LIA does not decrease opioid consumption or adverse effects in comparison to the placebo.

The intra-articular injection of analgesics has been shown effective in total knee arthroplasty *(7,14)*. With respect to total hip arthroplasty, this technique has been described with promising results by Andersen et al, among others *(3,9)*. This study compared continuous epidural infusion with local infusion and posterior intraarticular bolus at 8 hours after surgery. It showed a reduction in pain as well as decreased opioid consumption and shorter hospital stays *(1)*. However, works that do not find the previously described improvements have been published in the last three years. For example, Specht et al. *(16)* compares two groups in their work that combines intraoperative local infiltration of ropivacaine 200mg and 30mg ketorolac and a postoperative bolus of the same composition or a placebo in the other group. They conclude that the postoperative bolus provides no additional benefit to intraoperative LIA. Another interesting study, by Andersen in 2011 *(2)*, emphasizes that there are no differences in terms of pain control with local analgesia infiltration when compared to a placebo. In this study, patients undergoing bilateral total hip arthroplasty are compared. In one, LIA is administered and the placebo in the other. Besides not finding differences, they introduce the concept of multimodal analgesia use for good pain control. Postoperative pain is caused by an overstimulation of nociceptive pathways with a great release of neuropeptides, neurotransmitters and prostaglandins that are able to maintain the stimulation of peripheral and central nociceptors. They also create reflex muscle contractions and sympathetic vasomotor disturbances. The multimodal treatment of pain is the combining of two or more drugs and/or analgesic methods in order to enhance analgesia and decrease side effects *(10)*. The latest revisions conclude that LIA is superior to a placebo for pain control even though it is not shown to be superior to other types of analgesia. They also assert that the use of multimodal analgesia is an important factor in arriving at early rehabilitation after surgery for total hip arthroplasty *(13)*. The results of our trial are consistent with those obtained by other authors *(2,16)* and we agree with it because all those studies added a dose of multimodal analgesia. Thus, LIA was unable to provide an improvement in pain control.

The adverse effects from opioids like nausea (15-43%), cognitive disorders such as drowsiness (34%), pruritus (15-43%), hypotension (30%), urinary retention (60%) and even respiratory depression (2%) are recognized *(4)*. LIA has been shown to be effective in decreasing opioid consumption when compared to a placebo *(13)*. But, as has been observed in our study, LIA does not reduce opioid consumption when patients receive multimodal analgesia postoperatively *(12,13)*. With regard to complications, five cases of deep wound infection requiring surgical debridement were observed. In all the cases, a culture of the catheter tip was performed without finding contamination or anything directly related to the observed infections. Bianconi et al. *(3)* also cultured the catheter tip at 55h after surgery and did not obtain any positive results. Infection rates are disparate in the literature, highlighting 37.5% in some series *(4)* or 0.7% and 1.2% in other series *(10)*. McCarthy et al. *(13)* ended up concluding that existing studies that use LIA are small and are not designed with the intention of detecting complications such as infection or local anesthetic toxicity.

Our study has some limitations that might lead to systematic biases. We believe that the lack of uniformity in the prostheses used, the hospital rehabilitation protocol and hospital stay may be limiting factors. Rehabilitation and hospital stay were not very dependent on patients' pain as sitting and walking started at about the same time in all patients, regardless of the pain presented.

CONCLUSIONS

Local postoperative analgesic infiltration with a catheter does not improve pain control in total hip arthroplasty when a multimodal analgesia is administered postoperatively. LIA does not diminish opioid consumption or its adverse effects when compared to a placebo. The use of multimodal analgesia in total hip arthroplasty appears effective in maintaining good control of postoperative pain. Therefore, we do not recommend the systematic use of LIA in the postoperative hip. It should be reserved for patients with an intolerance, contraindications or allergies to the drugs used in multimodal analgesia.

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