Ultrasound guided femoral nerve block and lateral femoral cutaneous nerve block for postoperative pain control after primary hip arthroplasty: a retrospective study

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Abstract: Purpose: The purpose of this study was to evaluate the use of an ultrasound guided femoral nerve (FN) block together with an ultrasound guided lateral femoral cutaneous nerve (LFCN) block in addition to a patient controlled intravenous analgesia (PCIA) pump with piritramide as a strategy for postoperative pain-management after primary hip arthroplasty.

Methods: In a retrospective study, data recorded from 32 patients undergoing primary hip arthroplasty in 2008, before peripheral blocks were used, were compared with data from 38 patients undergoing primary hip arthroplasty in 2011, when an ultrasound guided single shot FN and LFCN block was used. As primary endpoint the total piritramide consumption after 48 hours was analyzed. A score on a visual analog pain scale at rest and during movement was included as a secondary outcome.

Results: Patients receiving the peripheral nerve blocks used significantly less piritramide in comparison to the patients who received no peripheral nerve blocks (p < 0.01). Moreover, pain scores at rest and during movement were significantly lower in the group with the peripheral nerve block (p-values respectively < 0.01 and < 0.05).

Conclusions: This retrospective study indicates that a FN block in combination with a LFCN block as supplementary postoperative analgesia after primary hip arthroplasty, can reduce the piritramide consumption. Furthermore, patients receiving the peripheral nerve block report lower pain scores at rest and during movement compared with the patients who did not receive a peripheral block. However, as this is a retrospective study, conclusions have to be drawn cautiously.

Keywords: hip arthroplasty; postoperative pain; ultrasound guided; peripheral nerve block; lateral femoral cutaneous nerve; femoral nerve.

Introduction

In 2007, approximately 21500 people underwent primary hip arthroplasty in Belgium and numbers are still increasing (1). Pain after hip surgery consists of pain located at the site of the incision, the femoral shaft and pain due to a reflexogenic contracture of the quadriceps musculature (2). Patients characterize their pain as moderate to intense during the first days after surgery. In addition, this postoperative pain induces fear of movement and consequently delays mobilization (3). Providing more adequate analgesia not only enhances the effective participation in early physiotherapy that is critical to accelerate the immediate functional recovery but also to minimize complications (4, 5).

After hip surgery, there are several options to provide postoperative pain relief, roughly divided into general and regional techniques. General postoperative analgesia consists of parenteral admission of paracetamol, NSAID’s, tramadol or patient controlled intravenous opioids. Regional strategies include neuraxial analgesia or peripheral nerve blockade. These regional analgesia techniques have been shown to reduce postoperative pain, morphine consumption and nausea and vomiting, as compared to general anaesthesia (6).

Parenteral paracetamol and NSAID’s as sole postoperative analgesic technique for hip surgery is likely to be insufficient. Moreover, due to important side effects (e.g. gastric, renal and liver problems) a large increase in dose is not possible. Postoperative opioids provide efficient pain relief but are associated with some serious side effects including respiratory depression, nausea, pruritus, constipation, bladder dysfunction, sedation and hallucina-
Peripheral nerve blockade avoids some of the unwanted adverse effects of neuraxial analgesia and allows for targeted analgesia of the operated limb (9, 6). Motor impairment is more restricted to a smaller group of muscles, facilitates early mobilization and physiotherapy. Among patients recovering from knee arthroplasty, a femoral nerve (FN) block significantly lowers morphine use after 24 hours (10). However, the hip joint is innervated by several nerves, including the femoral nerve, the obturator nerve, the sciatic nerve and the superior gluteal nerve, making peripheral nerve blockades more complex than in knee surgery (11, 12). Moreover, the lateral part of the proximal thigh, where the surgical incision is located in case of a lateral surgical approach, is innervated by yet another nerve, namely the lateral femoral cutaneous nerve (LFCN).

In patients undergoing hip arthroplasty, continuous peripheral nerve blockade, such as a posterior lumbar plexus block or a FN block, has been demonstrated to improve pain scores and reduce morphine consumption (6, 13). Although posterior lumbar plexus blocks are more effective than the FN blocks (9, 14, 15), their use is limited because they have a potential for more serious complications such as epidural spread, total spinal anesthesia, renal puncture, systemic toxicity and intraperitoneal injection (16, 17). Another peripheral analgesia technique is the fascia iliaca compartment block, which targets not only the FN but also the LFCN with a single injection of an anesthetic solution between the fascia iliaca and the iliacus muscle at the inguinal crease. In this way, more effective analgesia may be obtained than with a sole FN block. Stevens et al. demonstrated that the use of a fascia iliaca compartment block as an additional postoperative analgesia technique resulted in a significant morphine-sparing effect (18). However, due to the highly variable anatomical course of the LFCN (19), clinical success rates of this block when performed blindly using traditional landmark techniques are variable (20). Ultrasound guided techniques can increase success rates and reduce volumes of local anaesthetic required (21, 22).

For primary hip arthroplasty, the PROSPECT (Procedure-Specific Postoperative Pain Management) working group recommends general anaesthesia combined with a continuous femoral nerve block for postoperative pain relief. Furthermore a supplementary LFCN block may be required (15). A continuous peripheral nerve block is recommended over single-shot approach because it provides an extended proximal spread of effect and a greater duration of analgesia. However, placement of catheters poses the potential risk for infection and nerve injury (23). The prolonged motor blockade might also increase the risk of falls, although this risk remains controversial and depends strongly on the concentration of local anesthetic and the rate of infusion (24, 25). Due to the importance of early mobilization (within the first 24 hours after surgery), surgeons and physiotherapists in our hospital prefer a single shot peripheral block.

According to the PROSPECT-guidelines, anaesthetists at the Sint-Augustinus Hospital in Antwerp started in 2010 with an ultrasound guided single shot nerve block of the FN in combination with an ultrasound guided nerve block of the LFCN to provide postoperative analgesia following primary hip arthroplasty. A decrease in total piritramide (a synthetic opioid with a potency of 0.65-0.75 times that of morphine) usage and consequently fewer opioids-dependent side-effects and a faster rehabilitation are expected. However, this technique has not yet been evaluated clinically as a method of providing postoperative analgesia following primary hip arthroplasty. The aim of this study was to examine retrospectively whether or not piritramide consumption decreased since the introduction of this method. Secondary, differences in pain scores at rest and during movement were analyzed.

**Methods**

**Patients**

The patient population consists of patients undergoing primary hip arthroplasty, all performed by the same surgeon at the Sint-Augustinus Hospital in Antwerp, whose data were recorded in 2008 and 2011. In 2008 no peripheral nerve blocks were used, in contrary to the recordings in 2011 when an ultrasound guided single shot LFCN and a FN block were applied before surgery. Based on this information two groups of patients were formed. Properties of each group are listed in table 1. Three types of hip arthroplasty were included in this study: total hip replacement (THR), big
ball total hip replacement (Big ball) and total hip resurfacing (Mc Minn).

Procedure

Approximately 1 hour prior to surgery all patients received 1 mg PO lorazepam. In the peripheral nerve block group a single shot LFCN and FN block was administered to the awake patient in the surgery preparation room before starting surgery. The nerve blocks were performed under ultrasound guidance with a 22G insulated needle and “in plane” visualization of the needle. In addition to the ultrasound imaging, the correct position of the needle was confirmed with nerve stimulation. The optimal position close to the FN was verified by a brisk quadriceps contraction with a current output of 0.4 mA, frequency of 2 Hz, and pulse width of 0.1 ms. The location of the LFCN was verified by asking the patient to report when they experienced paresthesia at the lateral thigh with a current output of 0.4-0.7 mA, frequency of 2 Hz, and pulse width of 1 ms. After the stimulating needle was properly positioned 20 cc of levobupivacaine 0.25% with adrenaline 1:200000 was injected for the FN block and 10 cc of the same anesthetic solution for the LFCN. Adrenaline was added to the mixture of local anesthetic as a marker for early detection of inadvertent intravenous injection. Surgery itself was performed under general anesthesia by administering propofol 2 mg/kg, sufentanil 0.15 µg/kg and atracurium 0.5 mg/kg intravenously. Maintenance was obtained with inhalation of sevofuran. The first 48 hours postoperative all patients received a patient controlled intravenous analgesia pump (PCIA pump) with piritramide (Dipidolor®) at a concentration of 2 mg/ml and dehydrobenzperidol at a concentration of 100 µg/ml. The PCIA pump delivered an incremental bolus dose of 0.02 mg/kg with a lockout of 10 minutes and a maximal dose of 9.6 mg/hour. 30 minutes before the end of surgery all patients were given 2 g paracetamol intravenously. Afterwards patients received an additional 4 x 1 g of paracetamol a day the first 48 hours.

Data and analysis

48 hours after surgery, the following values were recorded: the total amount of intravenous piritramide delivered to the patient and a pain score on a visual analogue score (VAS) (with 0 indicating no pain and 10, the worst imaginable pain) at rest and during movement. The total piritramide consumption was considered as the primary variable, VAS-scores as secondary variables. Differences in total amount of piritramide consumption were compared between the two groups using a Mann-Whitney U test, which was chosen due to a rather skewed than normal distribution of the data in the nerve block group (the Kolmogorov-Smirnov statistic with a Lilliefors significance level was used for testing normality; group without peripheral nerve block: D = 0.13, p > 0.20, group with peripheral nerve block: D = 0.16, p < 0.05). The pain score at rest and during movement was compared with a student t-test, equal variances assumed (Levene’s test: p > 0.05). A possible effect of type of surgery on total piritramide consumption for type was analyzed with a Scheffé’s test for all pairwise combinations. All statistical analyses were calculated with Statistica 10.0 (StatSoft, Inc. Tulsa, OK, USA).

Results

We recorded only the total intravenous piritramide consumption after 48 hours. This recordings indicate that patients who received the dual peripheral nerve block used significantly less piritramide than patients who did not receive a peripheral nerve block. As shown in figure 1, the median total piritramide consumption without a peripheral nerve block was 25.4 mg (25%-75% interquartile range = [10.2; 38.2]).
facing hip surgery (mean = 19.78 mg, 95%-confidence interval [14.43 ; 25.12]) and the lowest use in THR (mean = 14.95, 95%-confidence interval [8.17 ; 21.72]), piritramide consumption after big ball surgery is situated in between (mean = 18.31, 95%-confidence interval [11.19 ; 25.43]) (Table 2).

However, the Scheffé pairwise comparisons showed no significant differences for type of hip arthroplasty.

**DISCUSSION**

Many approaches exist for managing postoperative pain after hip arthroplasty. The aims of each remain the same: to minimize pain while avoiding the side effects of excess administration.

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<td>Total dipidolor use and results of the Scheffé’s test for the different types of surgery.</td>
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<td>Total dipidolor use (mg) (mean ± SD)</td>
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<td>THR : Scheffé p-value</td>
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<td>Big ball : Scheffé p-value</td>
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SD = Standard Deviation; THR = total hip replacement; Mc Minn = total hip resurfacing; Big ball = big ball total hip replacement.
of analgesics and not delaying the rehabilitation. This study shows possible benefits of adding an ultrasound guided single shot FN and LFCN block to the former pain management strategy for hip arthroplasty. Consistent with previous findings, significantly less piritramide was used by patients who received the peripheral nerve blocks (9, 13, 18). Thus, by means of adding an ultrasound guided FN and a LFCN block to the standard protocol, the opioid use can be decreased thereby lowering the risk of important side-effects. Moreover, with the use of ultrasound guidance, the site of injection can be precisely determined and the amount of anesthetic solution can be reduced, which also decreases the risk of possible systemic toxicity. Despite PROSPECT recommendations of using a continuous block rather than a single shot approach, this study shows that a single shot FN block combined with a single shot LFCN block can be a reasonably good alternative and avoids the use of catheters and possible falls during early rehabilitation (15).

The analgesic effect of single shot peripheral nerve blocks lasts approximately 4 to 24 hours depending on the amount and type of analgesic solution used. Surprisingly, when asked 48 hours after the infusion, patients who received the peripheral nerve block still rated their pain score at rest and during movement lower than did the patients who did not get a peripheral nerve block. Although the effect was weaker during movement than at rest, it was still marginally significant. These lower VAS scores, largely after the postulated end of the block, could be associated with a possible preemptive effect. Further research is needed to clarify these findings. However, VAS scores should be interpreted cautiously, as they tend to be very subjective and might be influenced by a lot of factors.

Different types of hip arthroplasty are included in this study, this might be a confounding variable. However, no influence on total piritramide consumption was seen for the different types of surgery. Thus, the somewhat different distribution of types of surgery in the two groups cannot explain the differences found in total piritramide consumption between these groups.

As this study is retrospective, it has some important limitations. First, data recording has not been done on a standardized manner. Some patients had to be excluded from the study because data were lacking. Second, there’s a gap of 3 years between the data included in this study, data for the group without a peripheral nerve block was recorded in 2008 and data for the group with a peripheral nerve block was recorded in 2011. In the period in between 2008 and 2011, the peripheral nerve block technique wasn’t used consistently, thus data recorded in this period couldn’t be used in the study. Third, although the surgeon is very experienced, his technique could have improved between 2008 and 2011, explaining the differences in postoperative piritramide usage and pain-scores. Fourth, no deductions can be made about the effect of the LFCN block or the FN block separately since every patient received either both or no blocks.

It is noteworthy that the interquartile range and the 95% confidence interval in the group without peripheral nerve block are relatively large; possible explanations are an important difference between the patients’ susceptibility to pain or piritramide, differences during surgery (e.g. length of the operation, size of the scar …) and/or errors made during data-recording. The group that did receive a peripheral nerve block contains two outliers concerning total piritramide consumption. This might be due to a failed peripheral block. Unfortunately, information about the efficacy of the peripheral nerve blocks was lacking in the data recordings.

In conclusion, since the FN and the LFCN block were added to the standard protocol for postoperative pain relief after primary hip arthroplasty in the Sint-Augustinus hospital in Antwerp, patients required less piritramide and reported lower pain scores. However, to fully understand the magnitude of the effect and to objectify other benefits of this new strategy, further examination with a double blind randomized controlled trial is needed.

References