Periarticular Local Anesthesia does not Improve Pain or Mobility after THA

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Received: 20 July 2011 / Accepted: 3 January 2012 / Published online: 24 January 2012
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Abstract

Background Periarticular infiltration of local anesthetic, NSAIDs, and adrenaline have been reported to reduce postoperative pain, improve mobility, and reduce hospital stay for patients having THAs, but available studies have not determined whether local anesthetic infiltration alone achieves similar improvements.

Questions We therefore asked whether periarticular injection of a local anesthetic during THA reduced postoperative pain and opioid requirements and improved postoperative mobility.

Methods We randomized 96 patients to either treatment (n = 50) or control groups (n = 46). Before wound closure,

the treatment group received local infiltration of 160 mL of levobupivacaine with adrenaline. The control group received no local infiltration. We assessed postoperative morphine consumption and pain during the 24 hours after surgery. Mobilization was assessed 24 hours postoperatively with supine-to-sit and sit-to-stand transfers, timed 10-m walk test, and timed stair ascent and descent. Patients and assessing physiotherapists were blind to study status.

Result We observed no differences in postoperative morphine consumption, time to ascend and descend stairs, or ability to transfer between treatment and control groups. The treatment group reported more pain 7 to 12 hours postoperatively, but there were no differences in pain scores between groups at all other postoperative intervals. The treatment group showed increased postoperative walking speed greater than 6 m, but not greater than 10 m, compared with the control group.

Conclusions Periarticular infiltration of local anesthetic during THA did not reduce postoperative pain or length of hospital stay and did not improve early postoperative mobilization.

Level of Evidence Level I, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

Orthopaedic surgeries are among the most painful based on questionnaire responses, with 41% of patients reporting moderate to severe pain within 48 hours of surgery [21]. Pain after joint arthroplasty can substantially impair activities of daily life [23, 24], and patients usually have considerable concern regarding pain during the recovery period after joint arthroplasty; greater than 1/2 of patients

reportedly receive suboptimal pain control postoperatively [13]. THA can produce postoperative pain that could prolong hospitalization and delay discharge until relief is achieved [9].

A local anesthetic infiltrated into the surgical wound is an inexpensive and simple technique to effect postoperative analgesia. Periarticular infiltration of a local anesthetic, by blocking pain at its origin, does not inhibit muscle action and does not preclude early mobilization. Although local anesthetic infiltration of the surgical wound after minor surgical procedures, such as herniotomy, reduces postoperative pain [17], its benefit after major surgery is not clear [17]. Local infiltration analgesia, as developed by Kerr and Kohan [14], involves infiltrating a combination of local anesthetic, NSAID, and adrenaline and has been reported to reduce postoperative pain and analgesia requirements [3], shorten hospital stay [2], and improve postoperative walking ability [2]. However, available studies [2, 3, 7, 8] have not determined whether local anesthetic infiltration alone achieves similar improvements.

We investigated if periarticular injection of a local anesthetic during THA (1) reduced postoperative pain and opioid requirements, (2) improved postoperative mobility, and (3) reduced length of hospital stay.

Patients and Methods

We prospectively recruited 96 patients with degenerative or rheumatoid arthritis undergoing primary THA between October 2006 and February 2007. During the study period we performed a total of 208 primary THAs. We excluded 112 patients, the majority of whom were excluded because they were not treated by the study anesthetist (JMM); eight were excluded because they were older than 85 years. None was excluded owing to cognitive impairment, history of allergy to the study medications, severe inflammatory polyarthritis, or American Society of Anesthesiologists (ASA) Class 4 or 5 physical status [1]. We recruited 50 patients for the treatment arm and 46 for the control arm (Table 1). In the treatment group, we excluded two patients who received a 150-mL infiltration and two who received a 120-mL infiltration of local anesthetic (Fig. 1). Morphine

use data were not available for one patient from the control group, and data for ambulation time, stair ascent/descent, and length of stay were not available for one patient from the control group. These four exclusions left 46 patients from each group available for analysis. The Office for Research Ethics Committees Northern Ireland (ORECNI) granted ethical approval (REC reference no: 06/NIR01/51).

Calculation of sample size was based on an expected difference in VAS score of 65% of the SD of this score between groups. This equates to a 1-cm difference in the VAS score using data from a previous large-scale study in this unit of patients having THAs for whom VAS scores were measured during the first 24 hours postoperatively [18]. Sample size estimation indicated that 50 patients in each group were required at a 5% significance level with a power of 90%.

We used a standardized anesthetic protocol for all patients that comprised intrathecal isobaric bupivacaine 0.5% (0.1–0.2 mg/kg), intravenous (IV) propofol, or midazolam to allow sedation to an appropriate depth, granisetron (1 mg) as prophylaxis against perioperative nausea and vomiting, and supplemental oxygen at 4 L per minute. All patients received prophylactic IV antibiotics 15 to 30 minutes before the start of surgery and two additional doses 8 and 16 hours postoperatively. We prescribed morphine (10 mg as required, every 4–6 hours) IV for all patients after surgery. Patients in both groups received 1 g acetaminophen IV every 6 hours for 36 hours. After 36 hours, we discontinued acetaminophen and patients received a combination oral analgesia (tramadol 100 mg, every 4–6 hours as required, and co-codamol 30/500 mg, every 4–6 hours as required).

All operations were performed by or under the direct supervision of the senior author (DEB) via a standard posterior approach in the same operating room complex. All anesthesia was administered by the same senior anesthetist (JMM). All patients received identical Corail[®] femoral stems (DePuy International, Leeds, UK) and Pinnacle[®] acetabular cup components (DePuy International). The femoral head was either a metal or ceramic Articul/eze[®] bearing (DePuy International) and the acetabular liner was either an UHMWPE or ceramic-bearing.

Randomization was done using computer-generated block randomization with the randomization sequence based on permuted blocks of four. We randomized patients to either the treatment or control group. We used sealed envelopes, opened the morning before surgery, to allocate patients to the treatment or control group. An independent statistician generated the allocation sequence. Patients were enrolled by the senior author's surgical team or a research nurse and theater coordinators assigned patients to their group. The surgical team consisted of the senior author and two arthroplasty fellows. Before wound closure, the treatment group received local wound infiltration to the

Table 1. Patient details

Variable	Treatment group (n = 50)	Control group (n = 46)
Mean age (years)	67.1 (9.7)	69.6 (8.0)
Gender (male:female)	31:19	22:24
Body mass index (kg/m ²)	27.9 (5.3)	27.9 (4.9)

Standard deviations in parentheses.

Fig. 1 The flow diagram of patients through our study is shown.

operative site consisting of 1 mg levobupivacaine with adrenaline in 200 mL of saline, giving a final concentration of 0.125% levobupivacaine in 1:200000 adrenaline per milliliter. A total of 160 mL of this mixture was infiltrated into soft tissues as follows: 20 mL anteriorly to the lateral cutaneous nerve, 30 mL to the split fibers of the gluteus maximus, 20 mL to the capsule and piriformis, 30 mL inferiorly to the tensor fascia lata, 30 mL to the anterior subcutaneous border, and 30 mL to the posterior subcutaneous border. Patients in the control group received no local infiltration.

Patients experienced identical postoperative physiotherapy protocols. Patients began mobilizing with full weightbearing on the first postoperative day and a functional assessment was done 2 days postoperatively, unless the patient was medically unwell.

We did a pilot study of the functional assessment protocol for 2 weeks before the study to allow physiotherapists to become familiar with the procedures and to standardize

assessment. Patients, physiotherapists, and nursing staff were blind regarding whether patients received the periarthicular local anesthesia injection. The primary outcome measures were VAS measured hourly for 24 hours postoperatively, morphine consumption, walking velocity measured during a 10-m walking test, and stair ascent and descent times. Secondary outcome measures included ability to mobilize with a walking aid, supine-to-sit transfer and sit-to-stand transfer, mobilization day (the first postoperative day on which mobilization was achieved), and length of hospital stay. Pain was reported up to 24 hours postoperatively as intraarticular catheters, which extend the period of analgesia [3], were not used in this study. We measured postoperative time to home readiness as the time from the end of surgery until the patient was fit to go home. The length of stay was the number of days between the surgery and the patient actually leaving the hospital, which often was longer than the time to home-readiness owing to preparation of care arrangements and social service

packages. We based functional assessment on the Iowa Level of Assistance scale [22] which, during the acute phase of rehabilitation after THA and TKA, reportedly has interobserver reliability of kappa = 0.48–0.78 and intra-observer reliability of kappa = 0.79–0.90.

We used independent samples t-tests to test for differences in continuous variables (VAS, morphine use, walking velocity, timed stair ascent and descent, time to discharge, and length of stay) between groups. We used chi-square tests to test for differences in dichotomous data (mobilization day and level of assistance) between groups. We used principal component analysis with varimax rotation to determine an appropriate means to analyze the repeated measures of hourly VAS pain scores collected 24 hours postoperatively. Post hoc principal component analysis of the VAS pain scores suggested that VAS scores from 1 to 6 hours, 7 to 12 hours, 13 to 18 hours, and 19 to 24 hours be used as summary pain scores. This enabled four independent sample t-tests and reduced the impact of multiple testing and the likelihood of Type 1 error. For statistical analysis of functional tasks, we grouped the moderate, maximal, and dependent levels of assistance together owing to the small number of patients in each of these groups. Statistical analysis was performed using SPSS version 13.0, PASW Version 18 (SPSS Inc, Chicago, IL, USA), and Excel 2007 (Microsoft, Redmond, WA, USA).

Results

The treatment group reported more pain between 7 and 13 hours postoperatively. There were no differences in pain

scores between the groups at other postoperative intervals (Table 2). There was no difference in morphine use between the treatment and control groups during the first 36 hours postoperatively (Table 2).

The treatment group showed increased postoperative walking speed (0.36 m/second) measured over 6 m compared with the control group (0.30 m/second). There was no difference in the walking speed between the groups measured over 10 m (Table 2). There were no differences in the time to ascend or descend stairs between groups (Table 2). The majority of patients were able to mobilize on the first postoperative day, with 41 of 46 patients in the treatment group and 40 of 46 patients in the control group able to mobilize (Table 3). There was no difference in the ability to mobilize 1 day postoperatively ($p = 0.50$) or on the mobilization day ($p = 0.40$) between the groups. Fifty-eight of 92 patients completed the functional assessment within 48 hours of surgery, with an additional 19 patients completing the assessment by 72 hours (Table 4). We found no difference ($p = 0.44$) between groups regarding the level of assistance required to perform functional tasks. Of the 10 patients unable to mobilize on the first postoperative day, three were hypotensive (one in the treatment group, two in the control group), three had chest pain

Table 3. Ability of patients to mobilize 1 day postoperatively

Group	Unable to mobilize on Day 1	Able to mobilize on Day 1	Total
Treatment	5	41	46
Control	6	40	46

Table 2. Mean postoperative outcome measure

Parameter	Treatment group	Control group	Mean difference	95% confidence interval of difference		p value
				Lower	Upper	
Mean VAS (mm)						
1–6 hours	0.96	1.19	−0.23	−0.71	0.26	0.36
7–12 hours	1.55	0.91	0.64	0.06	1.22	0.03
13–18 hours	0.53	0.73	−0.20	−0.51	0.12	0.21
19–24 hours	0.68	0.98	−0.30	−0.67	0.07	0.11
Mean IV morphine use (mg) (36 hours postoperative)	13.0	15.1	−2.1	−7.2	2.6	0.43
Mean walking speed (m/second)						
Over 6 meters	0.36	0.30	0.06	0.0005	0.12	0.048
Over 10 meters	0.35	0.30	0.05	−0.014	0.116	0.12
Mean time for stair activities (seconds)						
Ascent	11.6	12.5	−0.83	−2.68	1.02	0.38
Descent	12.2	12.9	−0.66	−2.63	1.30	0.50

VAS = visual analog scale; IV = intravenous.

Table 4. Number of patients completing postoperative functional assessment

Group	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Unable*	Total
Treatment	4	27	8	6	0	1	0	46
Control	3	24	11	5	1	1	1	46
Total	7 (8%)	51 (55%)	19 (21%)	11 (12%)	1 (1%)	2 (2%)	1 (1%)	92 (100%)

* Unable to complete the functional assessment owing to a postoperative myocardial infarction.

(two in the treatment group, one in the control group), one had atrial fibrillation (control group), one had a dural leak (treatment group), and one had a myocardial infarction (control group). For one patient in the treatment group, the reason for delay in mobilization was unknown.

There was also no difference ($p = 0.39$) between the length of hospital stay between the treatment (mean, 3.5 days) and control (mean, 3.9 days) groups. There was no difference ($p = 0.61$) in postoperative time to home-readiness between the treatment (mean, 2.4 days) and control (mean, 2.5 days) groups.

Discussion

Reduced pain and analgesia use, improved and earlier mobilization, and reduced length of hospital stay have been reported for patients receiving local anesthetic infiltration during and after TKA [5, 6, 10, 11, 25, 27]. However, there are few studies of periarticular infiltration after THA, and these consider combinations of local anesthetic and NSAIDs [7, 8] and involve periarticular injections during surgery and intraarticular infiltration using catheters after surgery [2, 3]. We assessed if local anesthetic infiltration of the surgical wound during THA reduced postoperative VAS pain scores and opioid requirements. We also assessed if local anesthetic infiltration improved postoperative mobilization and reduced length of hospital stay.

Although this is a prospective randomized trial, we note the following limitations of our study. First, the focus is on the early postoperative period, although longer-term followup after discharge would be unlikely to show new differences in the outcome measures tested as top-up analgesia via intraarticular catheter doses were not used, as in previous studies [2, 3], and single-dose local anesthetic infiltration of a surgical wound lasts only a few hours [17]. Second, the protocol required injections of local anesthetic and adrenaline at the surgical site at the time of surgery, but not any followup injections, as in other studies [2, 5, 6, 10, 11, 14, 25]. Kerr and Kohan [14] described their technique of injecting a mixture of ropivacaine, ketorolac, and adrenaline around the area of surgery and a subsequent injection via a fine catheter 20 hours postoperatively.

Followup infiltration might produce greater improvements in postoperative analgesia, but the use of intraarticular catheters introduces a potential infection risk. Essving et al. [11] asked whether an intraarticular catheter exposes the patient to infection, but believed the benefit of retaining the catheter to allow postoperative delivery of local anesthetic and NSAIDs outweighed the potential risk of infection. Third we used a single standardized dosing regimen of local anesthetic and larger doses might have been required to produce improvements in postoperative pain relief. Some suggest that pain relief provided by local anesthetic infiltration is limited by the ability to deliver the anesthetic to the correct site in sufficient amounts to provide long-lasting and clinically meaningful pain relief after major surgery [9]. However, as patients undergoing THA generally experience good recovery after surgery, it may be difficult to detect a difference in postoperative pain scores in patients receiving periarticular local anesthetic infiltration. In this study, for example, the pain scores at the end of the first postoperative day for the treatment and control groups were 0.65 and 0.98, respectively. Investigating increased patient numbers or using a longer-acting local anesthetic might have produced a difference in postoperative pain score improvement between the treatment and control groups. Finally, although pain scores were combined to reduce the effect of multiple comparisons, we did not perform post hoc analysis of outcome measures, which would have reduced the likelihood of Type I errors.

We found intraoperative local anesthetic infiltration in patients who had THAs produced no reduction in postoperative pain or postoperative opioid requirements. There were no differences in pain scores between the groups at the postoperative times tested, apart from the period between 7 and 12 hours, when the treatment group reported more pain (Table 2). Andersen et al. [3] reported less pain and less analgesia use in a randomized, double-blind study of patients who had THAs who received periarticular wound infiltration of a local anesthetic, NSAID, and adrenaline with subsequent intraarticular infiltration the next day. In a separate, nonblinded study, Andersen et al. [2] reported reduced narcotic consumption, improved mobilization, and reduced hospital stay for patients who had THAs who received periarticular infiltration of a local anesthetic, NSAID, and adrenaline at surgery, and

subsequent intraarticular infiltration 8 hours postoperatively. Reduced use of patient-controlled analgesia (morphine) during the first 24 hours postoperatively and reduced pain on activity after anesthetic care were observed for patients who received periarticular infiltration of a local anesthetic, NSAIDs, morphine, and adrenaline during THA [8]. However, studies combining local anesthetics with NSAIDs, adrenaline, and various other treatment modalities make interpretation of their results difficult, with few considering single components of the multimodal technique [9]. Peters et al. [19] reported improved pain scores and faster rehabilitation for patients who had THAs and TKAs and who received local wound infiltration. However, their study was retrospective and involved the use of COX-2 inhibitors. Essving et al. [10, 11] reported reduced opioid consumption and pain intensity for patients who had total and unicompartmental knee arthroplasties who received a combination of local anesthesia, NSAID, and adrenaline. We identified only two studies that specifically investigated the effect of local anesthetic infiltration during joint arthroplasty using a randomized, double-blind design, one in patients having TKAs [5] and the other in patients having THAs [15]. Andersen et al. [5] reported reduced pain up to 32 hours postoperatively for patients receiving local anesthesia and adrenaline infiltration during TKAs with postoperative injections at 8 hours and 24 hours via intraarticular catheter. The recent study by Lunn et al. [15] assessed postoperative pain after local anesthetic infiltration (ropivacaine 0.2% and adrenaline) in patients who had THAs and they reported no reduction in postoperative pain compared with the control patients. Lunn et al. used a “multimodal oral analgesic regimen” involving acetaminophen, celecoxib, and gabapentin. Oral celecoxib was used rather than incorporate an NSAID in the infiltration as they thought that an “NSAID provides analgesia whether administered locally or systemically, without important difference” [15]. In our study, we did not consider NSAIDs in any form to ensure a clear comparison with the local anesthetic element of intraoperative infiltration. We did not assess if infiltration of a combination of local anesthetic, NSAID, and adrenaline was effective in patients undergoing THA, as this had been reported previously [2, 3], but whether local anesthetic infiltration was effective in these patients. It appears that although the use of infiltrations involving local anesthetics, NSAIDs, and adrenaline reduced postoperative pain in patients undergoing THAs [2, 3], the use of a local anesthetic and adrenaline alone does not. The use of other analgesic adjuvants such as oral NSAIDs or gabapentin was not considered in our study. The study by Lunn et al. [15] involved five surgeons at two sites and two different implant types, with pain measured up to 8 hours postoperatively. Our study involves one

anaesthetist and one surgeon's team consisting of the senior author (DEB) and two arthroplasty fellows at one site using one implant type, reducing the number of potential confounding variables. Pain was measured up to 24 hours postoperatively which is important as the benefits of local anesthetic infiltration may be apparent only when the residual effect of preoperative analgesia and spinal anesthesia have dissipated [20].

Other studies have investigated the use of local anesthetics in combination with NSAIDs and other treatment modalities, which makes it difficult to assess each element's contribution to postoperative pain relief [2–4, 10, 11, 27]. Dahl and Moiniche [9] reported a need for randomized, double-blind trials addressing single components of the multimodal technique, particularly that of local anesthetic infusions, regarding their effect on recovery after orthopaedic surgery. We assessed, in a randomized, blinded trial, the use of periarticular infiltration of local anesthetic without the use of NSAIDs, either as part of the local infiltration or orally, in patients who had hip replacements.

Although pain management after THA has an important impact on early postoperative mobilization [12], we found no improvement in mobilization or stair climbing ability for patients who received a periarticular local anesthetic. The treatment group did have increased postoperative walking speed (0.36 m/second) measured over 6 m compared with the control group (0.30 m/second). The reason for this is unknown, but might be attributable to chance given the subject numbers, although it is unlikely attributable to any pain-relieving effect of local anesthetic infiltration as the treatment group did not report reduced pain at any postoperative time (Table 2). There was no difference in the walking speed between the groups at 10 m. We measured walking speed over 6 m and 10 m to assess the steady-state phase of gait, having corrected for the acceleration and deceleration phases at the beginning and end of the walkway [26]. This study examined four functional milestones (supine-to-sit transfer, sit-to-stand transfer, walking, and stair climbing) considered essential for safe and independent patient discharge from the hospital [28]. We believe the use of combined activities to assess functional ability provided a more objective measure of overall patient function than single activities [16].

Several studies have reported reduced length of hospital stay after the use of local anesthetic and NSAID infiltration in patients who had TKAs [11] and THAs [2]. Andersen et al. [3] reported that patients who underwent THA and received an infiltration of ropivacaine, ketorolac, and adrenaline were discharged from the hospital earlier (median, 2.6 days) than those who received no infiltration (median, 2.8 days). These results compare well with our mean values for postoperative time to home-readiness

(treatment group, 2.4 days; control group, 2.5 days). However, there were no differences in postoperative time to home-readiness or length of hospital stay between the treatment and control groups in this study.

Although the regimen of local anesthetic and NSAID infiltration during surgery and postoperatively via intraarticular catheter appears to reduce postoperative pain, opioid use, and length of hospital stay [2, 3], local anesthetic infusion during surgery alone did not produce any improvement in pain, analgesia use, or length of stay in patients undergoing THAs. Whether the addition of NSAIDs to our postoperative regimen would successfully reduce postoperative pain or analgesia in patients undergoing THA is unknown. Periarticular infiltration of a local anesthetic, as part of a multimodal analgesia protocol, is easily administered during THA. However, infiltration of a local anesthetic during THA did not reduce pain or morphine use postoperatively and did not reduce the length of hospital stay or improve early postoperative mobility, with no difference in stair ascent and descent and transfers between the treatment and control groups.

Acknowledgments We thank Sonia Derbyshire, RGN for assistance with patient recruitment and data collection. We also thank Mike Stevenson BSc, PGCHET, FSS, Centre for Medical Education, Queens University, Belfast, for statistical advice.

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