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Original Research

Local Infiltration Anesthesia in Total Hip Arthroplasty: A Randomized Controlled Trial

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ABSTRACT

Background: Total hip arthroplasty (THA) is a cost-effective solution for osteoarthritis, but it is often associated with postoperative pain that hinders early mobilization and rehabilitation. Local infiltration analgesia (LIA) has emerged as a potential strategy to reduce pain and speed recovery in THA patients. However, the efficacy of LIA in THA remains controversial, with conflicting evidence regarding its impact on pain management, length of hospital stays, and other outcomes. The aim of this study was to evaluate the efficacy of LIA in pain management after THA.
Methods: A blinded randomized controlled trial was conducted in 108 patients undergoing THA at a single center. Patients were randomized to receive either LIA or non-LIA during surgery according to an accepted protocol. Surgical procedures were standardized, and outcomes including pain, blood loss, length of hospital stay, functional outcomes, and patient satisfaction were assessed.
Results: No significant differences were observed between the LIA group and the control group in pain scores at 24 and 48 hours postoperatively, blood loss, length of hospital stay, or functional outcomes at 3 and 6 months. Patient satisfaction was similar between groups. There were no major complications.
Conclusions: The use of LIA did not improve pain management, hospital stay, blood loss, functional outcomes at 3 and 6 months postoperatively or patient satisfaction at 3 and 12 months after primary THA.

Introduction

Total hip arthroplasty (THA) proves to be a cost-effective solution for osteoarthritis by effectively reducing pain and enhancing overall quality of life [1]. This surgery may cause severe postoperative pain, which hampers early mobilization and delays rehabilitation start [2-6]. Effective pain management after THA has been linked to a measurable reduction in complications such as deep vein thrombosis, pulmonary embolism, and delayed recovery. Additionally, it facilitates early postoperative mobilization, which is critical for improving functional outcomes and reducing the risk of joint stiffness or muscle atrophy. [7,8] In the pursuit of minimizing the impact of pain and promoting recovery, various protocols have been established, resulting in improvements in postoperative rehabilitation [9-11].

In recent years, successful implementation of multimodal analgesia regimens incorporating local infiltration analgesia (LIA) has been observed in fast-track (FT) programs. These programs have demonstrated efficacy in decreasing hospital stay (LOS), as well as morbidity and mortality, without raising readmission rates or jeopardizing patient safety [4,12]. The evolution of FT programs in orthopaedic surgery has involved the refinement of

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postoperative analgesic strategies, aiming for optimal pain control and facilitating early mobilization.

LIA was introduced in the early 2000 in Sydney, Australia, [9,10] to enhance the start of mobilization and postoperative pain. This technique is based in local intra-articular and periarticular anesthesia infiltration in a high-volume solution, combined with adrenaline. LIA is becoming popular in orthopaedic surgery, specifically in FT programs, because it allows quick limb movement and is effective, simple, and safe [3,13].

LIA is widely used in THA. However, while the procedure has been accepted for total knee arthroplasty, there is a lack of evidence that LIA improves postoperative management in THA [14,15]. The results of recent studies are controversial, with some studies such as *Nassar et al.* [16] and *Xiao et al.* [17] supporting its use and other ones finding no benefit [3,18].

This study aims to evaluate the efficacy of LIA, by using the protocol outlined by Kerr [9] in the evaluation of pain after THA. Our hypothesis was that the use of LIA would not provide any benefit in reducing postoperative pain.

Material and methods

This was a superiority, blinded randomized controlled trial study performed on a single center.

The study took place at Parc Taulí Hospital (Sabadell, Barcelona, Spain) from March 2021 to May 2022. The hospital covered a population of 503,458 citizens at the time of the present study.

This study adheres to the guidelines set by the Consolidated Standards of Reporting Trials [19]. The study was approved by the research ethics board of our institution and was conducted in accordance with the Declaration of Helsinki.

Patients

We recruited patients from the waiting list of THA at our institution; all of them signed informed consent to participate in the study, and randomized to group 1, for treatment group, and group 2 for control group.

We defined inclusion and exclusion criteria as listed:

Inclusion criteria

1. Adult population (>18 years of age)
2. Patients diagnosed with coxarthrosis (stages 2 and 3), confirmed by X-ray, following Tonnis' classification [20]
3. Disposition to undergo follow-up for up to 12 months
4. Patients with the ability to understand the study and provide informed consent

Exclusion criteria

1. Difficulty in understanding and following the study procedure
2. Patients with previous surgery on the same hip (osteotomy, osteosynthesis, fasciotomy, tendon repair, arthroscopy, debridement, epiphysiodesis, forage, allo-autograft)
3. Patients with a diagnosis outside the inclusion criteria (eg, acute femoral fracture requiring THA)
4. Patients presenting any contraindication for the use of LIA (allergy to local anesthetics, infection at the injection site, severe bleeding disorders, systemic infections, significant liver or kidney dysfunction, neuromuscular diseases)

During the presurgical visit, participation was proposed to patients who met all the criteria. For those who agreed to participate, demographic variables, medical history, and preoperative baseline variables were collected after signing the informed consent. Figure 1 shows the flowchart of patients through the study.

Randomization and blinding

On the day of the intervention and prior to it, the patients were allocated to one of the two groups using a sealed envelope method, which the surgeon opened just before the surgery. The patient was blinded to the received intervention.

Intervention

All surgeries were performed by the Hip Unit. Surgeries were performed under intradural or general anesthesia. Intravenous antibiotic therapy with 1500 mg of cefuroxime or 600 mg of clindamycin was administered in case of allergy.

With the patient in the lateral decubitus position, a modified anterolateral hip approach (Hardinge type) [21] was performed, including tenotomy of the gluteus medius and minimus T-capsulotomy preparation of the femoral component, preparation of the acetabular component, trial reduction, and subsequent placement of definitive components. We selected uncemented implants: LCU stem/Mobilelink cup (Waldemar Link GmbH & Co. KG) and Furlong stem/ACE cup (JRI Orthopaedics Limited) and Corail stem/Pinnacle cup (DePuy Synthes) choosing the best match stem prosthesis offset and cervical-diaphyseal angle. Fluoroscopic control was conducted.

We infiltrated levobupivacaine 2.5 mg/ml + epinephrine 5 mcg/ml in 80 ml of 0.9% saline, using a 19G or 20G spinal needle. The first injections were made after the implantation of acetabular and femoral components, before reducing the prosthesis, and the final one immediately before the skin was sutured. The first injections were made into the tissues around the rim of the acetabulum, capsule, gluteal and abductor muscles, peritrochanteric bursa and iliotibial band. The last injection was made into the subcutaneous tissue under the wound. Those injections were made to patients assigned in group 1 (surgery with the use of LIA). After that, we did not place any catheter (as in the Kerr paper) [9]. We closed layers without administration of the treatment in group 2 (surgery without the use of LIA).

Outcomes

According to the FT protocol, the goal is to discharge the patients within 2 days of hospitalization. However, some leave earlier or later depending on social or family needs. We registered pain by visual analog scale (VAS) at 24 and 48 hours during the hospitalization process.

Blood loss was recorded during surgery, according to anesthesiologist criteria (gauzes' counting and aspirative drainage).

Both groups followed the same rehabilitation treatment consisting of a 10-day home physiotherapy program.

Before surgery and at the 3-, 6-, and 12-postoperative month follow-up, pain, functionality, and quality of life were evaluated with the Harris Hip Score. At the 3- and 12-month follow-up, data regarding the satisfaction of the patient were collected according to a 5-point classification (1, highly satisfied; 2, satisfied; 3, barely satisfied; 4, poorly satisfied; 5, unsatisfied).

Throughout the follow-up, data on complications were collected.

Statistical analysis

Data were analyzed through the RStudio 2023.03.0 program, with R version 4.3.0 (2023-04-21 ucrt). To identify differences between the groups, the Student's *t*-test was used for numerical variables and a chi-square test for categorical variables. We determined statistical significance at $P < .05$.

Results

We included 108 patients in the study; 52 assigned to group 1 and 56 to group 2.

We lost two patients allocated in the no LIA group—one was lost during allocation, due to cancellation of the surgery, while the other was lost during the follow-up—leaving a total of 52 patients in the LIA group and 54 patients in the no LIA group.

The median age at the time of surgery (and randomization) was 65 years in both groups. The groups were comparable in terms of gender distribution (sex), with 26 males (50%) and 26 females (50%) in the LIA group and 22 males (39%) and 34 females (61%) in the control group ($P = .355$). Homogeneity was observed in both groups for the Harris Hip Score before surgery, with a mean of 50 (±15) in the LIA group and 55 (±21) in the control group ($P = .103$) (Table 1).

Pain scores at 24 hours and 48 hours showed no significant variation between groups, with mean scores of 4.7 (±1.9) in the LIA group and 5.1 (±2.2) in the non-LIA group at 24 hours ($P = .361$). At 48 hours after surgery, the VAS in the LIA group was 4.2 (±2.1) and in the control group was 4.4 (±2.1), with no significant differences between the two groups ($P = .628$).

Blood loss values were comparable with 310 (±180) in the LIA group and 250 (±180) in the control group, with no significant difference ($P = .127$). There was no significant difference in the length of hospital stay between the LIA group (2.5 ± 1.8) and the 184 in the control group (2.3 ± 1.0) ($P = .519$).

There were no significant differences in the mean Harris Hip Score at 3 months between the two groups. The LIA group had a mean score of 76 (±23), while the control group had a mean score of 77 (±16) ($P = .898$). Similarly, the Harris Hip Score at 6 months showed no significant difference between the LIA and control groups. The LIA group had a mean score of 80 (±23), while the control group had a mean score of 83 (±14) ($P = .486$) (Table 2).

Regarding satisfaction at the 3- and 12-postoperative month follow-up, the distribution of satisfaction levels did not show significant differences between the LIA and control groups ($P = .645$ at 3 months, $P = .975$ at 12 months). Both groups had similar distributions in the different satisfaction categories, with close percentages at each level.

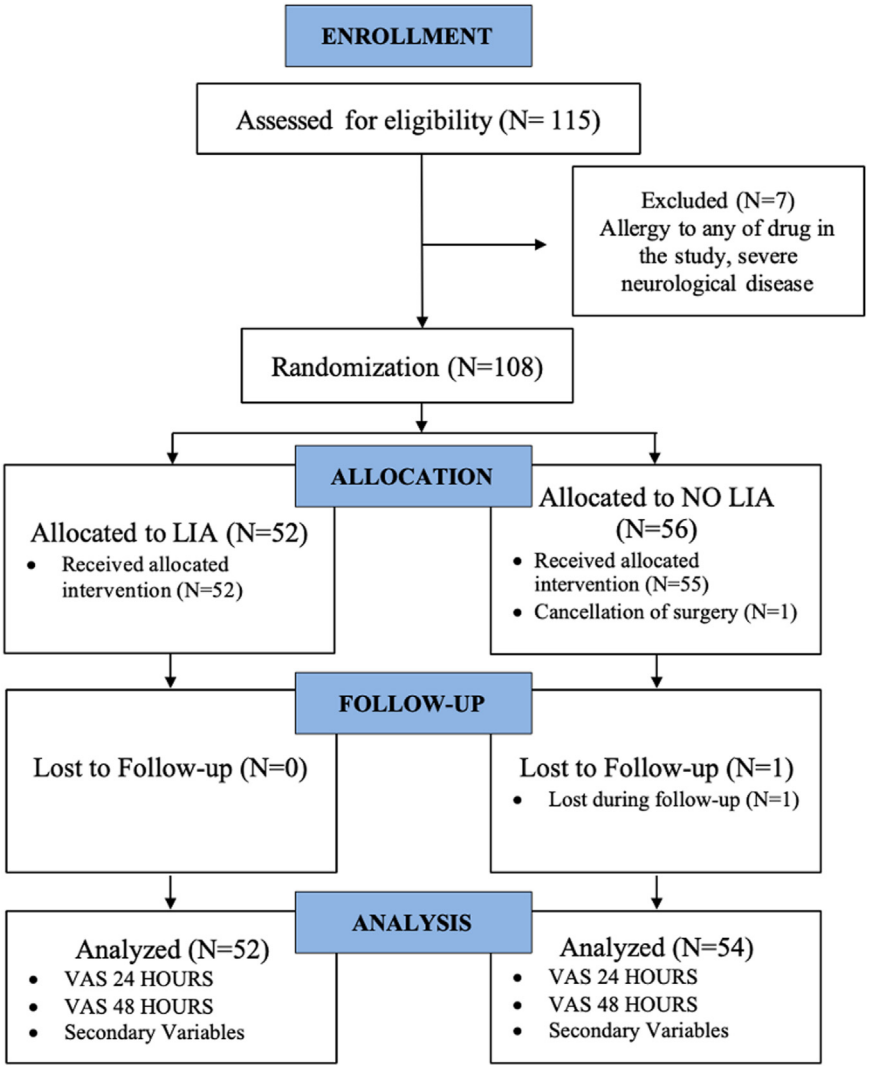

Figure 1. A CONSORT flowchart describing patient selection. CONSORT, Consolidated Standards of Reporting Trials.

Table 1
Demographic variables for patients included in the study.

Variables	LIA (N = 52)	Non-LIA (N = 56)	*P* value
Age	65	66	
Sex			
Women	26	34	.355
Men	26	22	
HHS PRE			
Mean (SD)	50 (±15)	55 (±21)	.103

HHS PRE, Harris Hip Score previous to surgery; SD, standard deviation.

In our study, there were 2 losses in the no LIA group—one patient did not undergo surgery and another patient was lost to follow-up. In terms of complications, four greater trochanter fractures and one femoral fracture were documented during surgery. In addition, one two-stage revision for an infection was done, however, equally placed in the two study groups.

Discussion

In this blinded randomized controlled trial, we tried to evaluate the effectiveness of the use of the LIA described by Kerr [9]. Our results show no differences in the pain assessment at 24 and 48 hours after surgery.

The overarching goal of multimodal pain management is to incorporate different approaches to pain management that target different pain pathways. This approach includes the use of oral analgesics such as nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids, together with complementary techniques such as LIA [8,9,22-26]. Acetaminophen, NSAIDs, and opioids are associated with well-documented side effects, which complicate their routine use and may hinder the prompt rehabilitation of patients [17].

Multimodal analgesia regimens have played a key role in the development of FT programs. Within these regimens, high-volume LIA has been proposed as a potential replacement for conventional measures [3,9,11,27]. Despite an increasing number of studies reporting positive results in total knee arthroplasty [28-32], the efficacy of LIA in THA remains controversial [3,15,18,33,34].

Table 2
Outcome measurements for patients included in the study.

Variables	LIA (N = 52)	Non-LIA (N = 56)	*P* value
VAS 24H			
Mean (SD)	4.7 (±1.9)	5.1 (±2.2)	.361
VAS 48H			
Mean (SD)	4.2 (±2.1)	4 4 (±2.1)	.628
Blood loss			
Mean (SD)	310 (±180)	250 (±180)	.127
Hospitalization days			
Mean (SD)	2.5 (±1.8)	2.3 (±1.0)	.519
HHS 3M			
Mean (SD)	76 (±23)	77 (±16)	.898
HHS 6M			
Mean (SD)	80 (±23)	83 (±14)	.486
Satisfaction 3 months			
1	30 (58%)	37 (66%)	.645
2	9 (17%)	11 (20%)	
3	8 (15%)	7 (12%)	
4	3 (6%)	1 (2%)	
5	0 (0%)	2 (3.8%)	
Satisfaction 12 months			
1	35 (62%)	34 (65%)	.975
2	11 (20%)	8 (15%)	
3	7 (12%)	5 (10%)	
4	2 (4%)	2 (4%)	
5	1 (2%)	1 (2%)	

HHS, Harris Hip Score; SD, standard deviation.

It is important to note that studies using LIA often use different analgesic solutions mixed together and administered at different time points, making it difficult to explain the results. As described by Kerr [9], in our study, we used 150-200 mL of an injectant mixture of ropivacaine HCl, ketorolac tromethamine, and adrenaline. The mixture was occasionally diluted with normal saline for volumes exceeding 150 mL to limit the total dose of ropivacaine to a maximum of 300 mg. The total dose was reduced to 250 mg in specific cases, such as unusually small patients, very elderly individuals, those with health issues, or a history of intolerance to analgesics or anesthetic agents. In patients with contraindications to NSAIDs, ketorolac was omitted, and alternative analgesics were used [9].

Our results show that there is no additional pain reduction with the protocol of LIA administration described by Kerr [9] in primary THA, as measured by the VAS of pain at 24 and 48 hours after surgery. These results are similar to those of other studies like *Bernaus et al.* [3], *Demeulenaere et al.* [26], *Affas et al.* [35], *Cuenca-Llavall et al.* [18], *Tan et al.* [36] or *Hofstad et al.* [14]. However, our study has a larger sample size (N). Studies by *Parvataneni et al.* [37] and *Andersen et al.* [15] report reduced opioid consumption in patients undergoing LIA during THA. This observation may be an indication of lower VAS scores in the immediate postoperative period. *Kuchálik et al* [33] showed that LIA significantly reduced pain intensity and rescued analgesic consumption during early mobilization compared with femoral nerve block. Overall, the efficacy of LIA in immediate postoperative pain management for THA remains controversial. Some studies suggest benefits in specific contexts, for instance, Chen et al. [38] demonstrated that intra-articular injection of bupivacaine after THA led to a reduction in pain and meperidine usage during the initial 12 hours postsurgery.

We did not find any relationship between postoperative pain and blood loss. Furthermore, there are no relevant studies in literature, and it is a point to be studied in the future.

When analyzing the length of hospital stay, we found no statistically significant differences between the treatment and control groups. The average length of hospital stay was 2 days in both groups in our study. However, in the Nassar et al. study [16], patients receiving LIA had an average hospital stay of 2 days, whereas the national Australian average is 5 days. This may have suggested an association between the use of LIA and a reduction in hospital stay. One possible explanation for these differences is the use of registries, which can result in heterogeneity in protocols between hospitals. Chen et al. [38] also observed a decrease in hospital days in the group that received LIA, but the average length of hospital stay was longer in both groups compared to our study.

The differences observed in our study may be explained by the implementation of the FT protocol in our hospital, which facilitates process standardization, optimizes recovery, and promotes early discharge. However, the patient ultimately has the final say regarding discharge timing, with individual recovery, comfort, and safety remaining the top priorities.

While the majority of studies assess pain control, only a limited number have looked at the benefits of LIA in terms of patient satisfaction [17,33,36]. In our study, we found no differences between the two groups at the 3- and 12-month follow-up. This result was easily explained by the lack of more effective pain control in the LIA group that did not lead to an earlier start of mobilization and recovery.

One of the strengths of this study is that it was conducted at a single center and by the same group of expert hip surgeons, ensuring the use of similar surgical techniques, implants, and the same type of anesthesia in each case, which facilitates procedural uniformity and reduces the risk of bias. However, our study has several limitations. An important limitation is that although the

intervention was randomized, the surgeons, anesthetists, and operating theatre nurses were aware of whether the patient received the intervention or not, which could have influenced the final results. Another limitation of this study is the utilization of VAS as a method to evaluate pain while the majority of studies use opioid consumption.

Conclusions

Our results suggest that LIA according to the Kerr protocol has no impact on pain management and provides no benefit in terms of hospital stay length, blood loss, functional outcomes at 3, 6, and 12 hours, or patient satisfaction in primary THA. Further research is essential to determine the optimal multimodal analgesia regimen after THA.

CRediT authorship contribution statement

Arnau Verdaguer-Figuerola: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Vito Andriola:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Albert Soler-Cano:** Writing – review & editing, Validation, Supervision, Investigation. **Anna Alavedra-Massana:** Validation, Investigation, Data curation. **Alejandro Carballo:** Supervision. **Marc Tey-Pons:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis.

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Conflicts of Interest

The authors declare there are no conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2025.101692.

References

[1] Gaffney CJ, Pelt CE, Gililland JM, Peters CL. Perioperative pain management in hip and knee arthroplasty. Orthop Clin North Am 2017;48:407–19.
[2] Strassels SA, Chen C, Carr DB. Postoperative analgesia: economics, resource use, and patient satisfaction in an urban teaching hospital. Anesth Analg 2002;94:130–7.
[3] Bernaus M, Novellas M, Bartra A, Núñez JH, Anglès F. Local infiltration analgesia does not have benefits in fast-track hip arthroplasty programmes: a double-blind, randomised, placebo-controlled, clinical trial. HIP Int 2022;32:711–6.
[4] Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg 2008;248:189–98.
[5] Filos KS, Lehmann KA. Current concepts and practice in postoperative pain management:need for a change? Eur Surg Res 1999;31:97–107.
[6] Skinner HB. Multimodal acute pain management. Am J Orthop Belle Mead NJ 2004;33(5 Suppl):5–9.
[7] Ibrahim MS, Khan MA, Nizam I, Haddad FS. Peri-operative interventions producing better functional outcomes and enhanced recovery following total hip and knee arthroplasty: an evidence-based review. BMC Med 2013;11:37.
[8] Lin DY, Brown B, Morrison C, Fraser NS, Chooi CSL, Cehic MG, et al. The Pericapsular Nerve Group (PENG) block combined with Local Infiltration Analgesia (LIA) compared to placebo and LIA in hip arthroplasty surgery: a multi-center double- blinded randomized-controlled trial. BMC Anesthesiol 2022;22:252.
[9] Kerr DR, Kohan L. Local infiltration analgesia: a technique for the control of acute postoperative pain following knee and hip surgery: a case study of 325 patients. Acta Orthop 2008;79:174–83.
[10] Mayr HO, Prall WC, Haasters F, Baumbach SF, Hube R, Stoehr A. Pain relieve without impairing muscle function after local infiltration anaesthesia in primary knee arthroplasty: a prospective randomized study. Arch Orthop Trauma Surg 2019;314:1007–13.
[11] Liu P, Wu Y, Liang Z, Deng Y, Meng Q. Comparing the efficacy of pain managements after total hip arthroplasty: a network meta-analysis. J Cell Biochem 2019;317:4342–54.
[12] Kehlet H. Fast-track hip and knee arthroplasty. Lancet 2013;381:1600–2.
[13] Yin JB, Cui GB, Mi MS, Du YX, Wu SX, Li YQ, et al. Local infiltration analgesia for postoperative pain after hip arthroplasty: a systematic review and meta- 322 analysis. J Pain 2014;15:781–99.
[14] Hofstad JK, Winther SB, Rian T, Foss OA, Husby OS, Wik TS. Perioperative local infiltration anesthesia with ropivacaine has no effect on postoperative pain after total hip arthroplasty: a randomized, double-blind, placebo-controlled trial with 116 patients. Acta Orthop 2015;86:654–8.
[15] Andersen LØ, Kehlet H. Analgesic efficacy of local infiltration analgesia in hip and knee arthroplasty: a systematic review. Br J Anaesth 2014;113:360–74.
[16] Nassar I, Fahey J, Mitchell D. Rapid recovery following hip and knee arthroplasty using local infiltration analgesia: length of stay, rehabilitation protocol and cost savings. ANZ J Surg 2020;90:355–9.
[17] Xiao Q, Xu B, Wang H, Luo Z, Yuan M, Zhou Z, et al. Analgesic effect of single-shot ropivacaine at different layers of the surgical site in primary total hip arthroplasty: a randomised, controlled, observer-blinded study. J Orthop Surg 2021;16:81.
[18] Cuenca-Llavall M, Pérez-Prieto D, Santiveri FJ, Garcia AL, Marqués F. The influence of local infiltration analgesia after total hip replacement. A randomized clinical trial. Acta Orthop Belg 2020;86:33–7.
[19] Calvert M, Blazeby J, Altman DG, Revicki DA, Moher D, Brundage MD, et al. Reporting of patient-reported outcomes in randomized trials: the CONSORT 340 PRO extension. JAMA 2013;309:814.
[20] Valera M, Ibañez N, Sancho R, Tey M. Reliability of Tönnis classification in early hip arthritis: a useless reference for hip-preserving surgery. Arch Orthop Trauma 343 Surg 2016;136:27–33.
[21] Hardinge K. The direct lateral approach to the hip. J Bone Joint Surg Br 1982;345:17–9.
[22] Kardash KJ, Sarrazin F, Tessler MJ, Velly AM. Single-dose dexamethasone reduces dynamic pain after total hip arthroplasty. Anesth Analg 2008;348:1253–7.
[23] Toms L, McQuay HJ, Derry S, Moore RA. Single dose oral paracetamol (acetaminophen) for postoperative pain in adults. Cochrane Pain, Palliative and Supportiv Care Group. Cochrane Database Syst Rev 2019;2015:CD008659. https://doi.org/10.1002/14651858.CD004602.pub2.
[24] Fredheim O, Borchgrevink P, Kvarstein G. Behandling av postoperative smerte i sykehus. Tidsskr Den Nor Legeforening 2011;131:1772–6.
[25] Maund E, McDaid C, Rice S, Wright K, Jenkins B, Woolacott N. Paracetamol and selective and non-selective non-steroidal anti-inflammatory drugs for the reduction in morphine-related side-effects after major surgery: a systematic review. Br J Anaesth 2011;106:292–7.
[26] Demeulenaere M, Janssens GPL, Van Beek N, Cannaerts N, Tengrootenhuysen MMF. Optimizing rapid recovery after anterior hip arthroplasty surgery: a comparative study of fascia iliaca compartment block and local infiltration analgesia. J Arthroplasty 2022;37:1338–47.
[27] Højer Karlsen AP, Geisler A, Petersen PL, Mathiesen O, Dahl JB. Postoperative pain treatment after total hip arthroplasty: a systematic review. Pain 2015;365:8–30.
[28] Hu B, Lin T, Yan SG, Tong SL, Yu JH, Xu JJ, et al. Local infiltration analgesia versus regional blockade for postoperative analgesia in total knee arthroplasty: a meta-analysis of randomized controlled trials. Pain Physician 2016;369:205–14.
[29] Yoo JD, Huh MH, Lee SH, D'Lima DD, Shin YS. A network meta- analysis of randomized controlled trials assessing intraoperative anesthetic therapies for analgesic efficacy and morphine consumption following total knee arthroplasty. J Arthroplasty 2023;39:1361–73.
[30] Fan L, Zhu C, Zan P, Yu X, Liu J, Sun Q, et al. The comparison of local infiltration analgesia with peripheral nerve block following total knee arthroplasty (TKA): a systematic review with meta-analysis. J Arthroplasty 2015;30:1664–71.
[31] Dysart SH, Barrington JW, Del Gaizo DJ, Sodhi N, Mont MA. Local infiltration analgesia with liposomal bupivacaine improves early outcomes after total knee arthroplasty: 24-hour data from the PILLAR study. J Arthroplasty 2019;34:882–886.e1.
[32] Essving P, Axelsson K, Åberg E, Spännar H, Gupta A, Lundin A. Local infiltration analgesia versus intrathecal morphine for postoperative pain management after total knee arthroplasty: a randomized controlled trial. Anesth Analg 2011;113:926.
[33] Kuchálik J, Magnuson A, Lundin A, Gupta A. Local infiltration analgesia or femoral nerve block for postoperative pain management in patients undergoing total hip arthroplasty. A randomized, double-blind study. Scand J Pain 2017;16:223–30.
[34] Lunn TH, Husted H, Solgaard S, Kristensen BB, Otte KS, Kjersgaard AG, et al. Intraoperative local infiltration analgesia for early analgesia after total hip arthroplasty: a randomized, double-blind, placebo-controlled trial. Reg Anesth Pain Med 2011;36:424–9.
[35] Affas F. Local infiltration analgesia in knee and hip arthroplasty efficacy and safety. Scand J Pain 2016;13:59–66.
[36] Tan NL, Gotmaker R, Barrington MJ. Impact of local infiltration analgesia on the quality of recovery after anterior total hip arthroplasty: a randomized, triple-blind, placebo-controlled trial. Anesth Analg 2019;129:1715–22.
[37] Parvataneni HK, Shah VP, Howard H, Cole N, Ranawat AS, Ranawat CS. Controlling pain after total hip and knee arthroplasty using a multimodal protocol with local periarticular injections: a prospective randomized study. J Arthroplasty 2007;22(6 Suppl 2):33–8.
[38] Chen DW, Hu CC, Chang YH, Lee MS, Chang CJ, Hsieh PH. Intra articular bupivacaine reduces postoperative pain and meperidine use after total hip arthroplasty: a randomized, double-blind study. J Arthroplasty 2014;29:2457–61.