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OUTCOMES RESEARCH IN ORTHOPEDICS (O AYENI, SECTION EDITOR)

Postoperative Pain Management Strategies in Hip Arthroscopy

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Abstract

Purpose of Review Hip arthroscopy is a rapidly growing field due to its significant diagnostic and therapeutic value in the management of numerous hip disorders. Adequate control of postoperative pain in patients undergoing hip arthroscopy continues to be a challenging and evolving area in orthopedics. In the absence of standardized protocols for pain management in these patients, a variety of different approaches have been utilized in an effort to find a regimen that is effective at reducing postoperative pain, narcotic consumption, and cost to the patient and healthcare system. The purpose of this article, therefore, is to provide a comprehensive review of current literature regarding postoperative pain management techniques in patients undergoing hip arthroscopy.

Recent Findings Recent literature demonstrates the importance of a multimodal approach to treat postoperative pain in patients undergoing hip arthroscopy. When a peripheral nerve block or intraoperative anesthetic is used in combination with a pre- and postoperative analgesic medication regimen, patients report less pain and postoperative narcotic consumption. Patient-reported pain scores and postoperative opioid use were similar between the different modalities, however, postoperative complications appear to be less in groups receiving intra-articular (IA) injection or local anesthetic infiltration (LAI) compared to peripheral nerve blocks.

Summary In summary, we present evidence that intraoperative techniques, such as IA injection or LAI, in conjunction with pre- and postoperative pain medications, offers an effective multimodal strategy for treating postoperative pain following hip arthroscopy. This topic is of increasing importance due to the need for cost-effective strategies of managing pain and decreasing opioid consumption following hip arthroscopy.

Keywords Hip arthroscopy · Pain management · Peripheral nerve block · Intra-articular injection · Local anesthetic infiltration

Introduction

Hip arthroscopy is a rapidly growing field due to its significant diagnostic and therapeutic value in the management of numerous hip disorders. After failure of conservative treatments, hip conditions commonly treated with arthroscopy include femoroacetabular impingement (FAI), labral pathology, gluteus tendon tears, chondral lesions, loose body removal, synovial disorders, instability, septic arthritis, and snapping hip. As a result of the increasing popularity and relevance of hip arthroscopy, postoperative pain management in these patients has become an important area of research.

There is a lack of standardized protocols for postoperative pain management in the current literature. In addition to the patient's perception of pain, increased postoperative narcotic consumption due to ineffective pain management further complicates treatment of these patients [1]. The most common causes of failure to discharge outpatient surgical patients include inadequate control of postoperative pain, nausea, vomiting, and excessive sedation due to narcotic use [2]. Reducing postoperative pain could decrease narcotic consumption, resulting in less opioid-related side effects, earlier ambulation, quicker discharge, reduced readmissions for postoperative pain control, increased patient satisfaction, and increased cost-effectiveness of hip arthroscopy [2].

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Pain control is important not only to the patient but to the healthcare system and physician as well. A study conducted by Mistry et al. [3] demonstrated that the patient's perception of pain contributes significantly towards their satisfaction with the orthopedic surgeon and surgical facility. As a result, the patient's pain can have a direct impact on patient satisfaction survey scores and hospital/physician reimbursement in some countries [3–4]. Thus, it is imperative to identify techniques that will optimize postoperative pain management for the patient while minimizing costs to the healthcare system. Therefore, the purpose of this article is to provide a comprehensive review of current literature regarding perioperative pain management techniques in patients undergoing hip arthroscopy.

Oral Medication

Celecoxib has proven to be an efficacious oral analgesic and nonsteroidal anti-inflammatory (NSAID) in hip arthroscopy due to its high oral bioavailability, rapid absorption, and selective COX-2 inhibition. Selectivity of COX-2 inhibition reduces gastrointestinal side effects observed with non-selective NSAIDs [5•]. The COX-2 selectivity also provides the ability for higher anti-inflammatory dosing, especially in patients with gastrointestinal conditions that would otherwise prevent them from taking a NSAID medication. In addition to the anti-inflammatory and analgesic profile of celecoxib, it may also reduce the incidence of heterotopic ossification that can result from hip arthroscopy [6].

Zhang et al. examined whether celecoxib 200 mg administered 1 h before hip arthroscopy would reduce postoperative hip pain [7]. Fifty-three patients were randomized to receive either 200 mg celecoxib or 200 mg placebo. They found no significant difference in visual analog scale (VAS) scores and SF-12 scores immediately following surgery. The celecoxib group, however, had clinically significant lower VAS pain scores at 12 and 24 h post-op compared to placebo [8•]. Postoperative opioid consumption was also significantly less in the celecoxib group compared to the placebo group (2.56 pills vs 4.35 pills, $p < 0.05$) [7].

Another randomized controlled trial conducted by Kahlenberg et al. [5] studied whether 400 mg of celecoxib administered 1 h before hip arthroscopy would reduce pain, postoperative opioid consumption, and time to discharge compared to placebo. Fifty patients were randomized to celecoxib group versus 40 patients in the placebo group. Patients in the celecoxib group had statistically significant lower VAS pain scores 1 h postoperatively compared to the placebo group (4.6 vs 5.3, $p < 0.03$). Additionally, patients who received celecoxib preoperatively spent significantly less time in PACU compared to patients receiving placebo (152.9 vs 172.9 min, $p = 0.04$).

In addition to celecoxib, oral medications such as gabapentin, acetaminophen, and cyclobenzaprine have also proven to be efficacious in the management of postoperative pain. In a meta-analysis of randomized controlled trials conducted by Han et al., gabapentin significantly reduced postoperative opioid consumption by 6.06 morphine milligram equivalents compared to placebo in patients who underwent total hip arthroplasty ($p = 0.007$). Gabapentin also reduced the 48-h postoperative VAS pain score by a mean of 2.63 compared to placebo in these patients ($p = 0.004$) [9]. Schug et al. performed a randomized controlled trial to determine the effect of acetaminophen vs placebo as an adjuvant to morphine during patient-controlled analgesia following major orthopedic surgery. They found that the acetaminophen group had significantly lower pain scores on postoperative day 1 (2.1 vs 3.3, $p = 0.03$), shorter duration of patient-controlled analgesia (35.6 vs 45.5 h, $p = 0.03$), and greater patient satisfaction than the placebo group (8.7 vs 7.9, $p = 0.04$) [10]. Lastly, cyclobenzaprine is an anti-spasmodic agent that is often included in multimodal pain regimens in hip arthroscopy patients. Current literature investigating its efficacy in hip arthroscopy is lacking, however, this medication is FDA approved for relief of spasms and pain in patients with acute musculoskeletal conditions, which can result in improved mobility and comfort to the patient [11].

Peripheral Nerve Blocks

Lumbar Plexus Block

The hip joint is extensively innervated by branches of the lumbar plexus, including the femoral, obturator, and lateral femoral cutaneous nerves [12]. The femoral and obturator nerves innervate the anterior and anterolateral capsule, while the lateral femoral cutaneous nerve provides cutaneous innervation to the region of common portal placement during hip arthroscopy [12–13]. Lumbar plexus block (LPB) involves injection of anesthetic directly onto these nerves at their origin in the lumbar plexus. This provides complete proximal blockade of major nerve innervation to the hip, without the need for multiple individual blocks [14]. Therefore, a LPB can decrease the failure rate and complications associated with performing multiple blocks [15]. However, a potential complication of a LPB is anesthetic medication entering into the epidural space, which can result in postoperative falls and urinary retention [16].

Schroeder et al. [17] performed a retrospective matched cohort study to examine the efficacy of a LPB compared to no regional anesthesia in patients undergoing hip arthroscopy. One hundred and eighteen patients received a preoperative LPB, and were compared with 118 patients who did not

receive any regional anesthesia. They found a statistically, but not clinically, significant difference in postoperative pain levels using the VAS in the postoperative care unit (5.0 in the LBP group vs 5.3 in the control group). Patients who received a LPB also required less postoperative narcotic, anti-emetics, and ketorolac than the control group. Interestingly, while there were less postoperative medications required by the LPB group, their total postoperative hospital time prior to discharge was longer (240 vs 217 min) and pain levels 1 day following surgery were similar between groups [17–18].

A prospective, blinded controlled trial conducted by Yadeau et al. [16] included 82 patients randomized to receive a LPB or control block prior to hip arthroscopy. In the postoperative care unit, the LPB group had significantly lower pain compared to control group at rest. However, they found no statistically significant differences between pain with movement, analgesic use, or patient satisfaction. The investigators reported 1 hospital readmission due to urinary retention and 2 postoperative falls in the LPB group [16, 18].

Femoral Nerve Block

The articular branches of the femoral nerve are known to be important contributors to innervation of the hip joint. Thus, it is believed that the femoral nerve is a significant contributor to postoperative pain following hip arthroscopy [19]. Femoral nerve block (FNB) is achieved by locating the femoral nerve, located lateral to the femoral artery and superficial to the iliopsoas muscle, and injecting anesthetic circumferentially around the nerve. Blockade of the articular branches of the femoral nerve provides extensive anesthesia to the anterior portion of the hip capsule. As with LPB, however, FNB can result in postoperative falls due to quadriceps inhibition [20].

In a retrospective chart review performed by Dold et al. [19], 96 consecutive patients receiving either a preoperative FNB with general anesthesia ($n = 54$) or general anesthesia alone ($n = 40$) were analyzed. The femoral nerve block group required lower doses of total intraoperative morphine-equivalent medications compared to the general anesthesia only group (2.72 vs 8.05, $p < 0.0001$). Patients in the FNB group reported lower mean pain scores within the first hour following surgery, however, the FNB group spent more time in PACU (85.9 vs 81.5 min). Importantly, two patients in the control group had to be admitted overnight due to inadequate pain control, while no patients from FNB group were admitted due to complications or inadequate pain control.

In a blinded controlled trial of 50 patients undergoing hip arthroscopy by Xing et al. [20], patients received either a preoperative ultrasound-guided FNB ($n = 27$) or normal saline ($n = 23$). All patients also received a preoperative analgesic regimen of 1000 mg acetaminophen and 400 mg celecoxib 1 h prior to surgery, followed by a 3-week course of celecoxib and oxycodone following surgery. Postoperative pain and average opioid use were lower in the FNB group, although time spent in recovery and patient satisfaction with pain control were similar between groups [20]. Notably, there was a higher risk of falls in patients receiving FNB in the first 24 h after surgery. Six of 27 patients (22.2%) in the FNB group fell within the first 24 h following surgery, while no patients (0%) in the control group reported a fall.

Ward et al. [21] investigated the use of a postoperative FNB versus routine IV narcotics for postoperative pain control in 40 patients following hip arthroscopy with inadequate pain control, defined as pain scores of 7 or greater. Patient satisfaction with pain control was significantly higher in the FNB group compared to those that received IV morphine (90% vs 25%, $p < 0.0001$). Additionally, time to discharge from PACU was significantly longer in patients who received morphine compared to those that received FNB (177 vs 216 min, $p < 0.0001$). This study supports femoral nerve block as a valuable alternative to narcotic pain medications for patients with inadequate pain control in the early postoperative period. However, based on the prior study by Xing et al. which demonstrated a significantly higher risk of falls in patients receiving FNB, fall precautions should be observed.

Fascia Iliaca Block

Fascia iliaca nerve block (FIB) is an attractive technique for perioperative pain management due to its ability to provide extensive block of sensory nerves around the hip joint, without the postoperative motor deficits observed with other techniques, such as femoral nerve block [22]. Fascia iliaca block has shown high efficacy for pain relief and decreased opioid consumption following total hip arthroplasty and operative fixation of femur fractures, however, its utilization in hip arthroscopy has not been as well established [23–25].

The primary portals utilized in hip arthroscopy are located within areas innervated by the lateral femoral cutaneous nerve and anterior branches of the femoral nerve [13]. The femoral and obturator nerves innervate the anterior and anterolateral capsule, which is incised during hip arthroscopy [8]. Fascia iliaca blockade works to anesthetize the primary nerves emerging from the lumbar plexus including the femoral, lateral cutaneous femoral, and obturator nerves. The nerves affected by the surgical portals and capsulotomy during hip arthroscopy are within the distribution of the fascia iliaca, therefore, a fascia iliaca nerve block is aimed at providing extensive analgesia during these procedures [26].

Recently, Purcell et al. [27•] conducted a retrospective cohort study of patients undergoing hip arthroscopy with fascia iliaca blocks using a new formulation of bupivacaine that is contained within liposomal carrier molecules (Exparel). Their study aimed to determine the benefits of liposomal bupivacaine compared to standard bupivacaine in perioperative pain management following hip arthroscopy. Interestingly, at 1, 2, and 3 days postoperatively, patients in the liposomal bupivacaine group actually had higher pain scores than the control bupivacaine group. There was no statistically significant difference in overall PACU pain scores (3.68 vs 3.85), maximum PACU pain scores (5.59 vs 5.47), or mean pain scores in PACU at discharge (2.41 vs 2.88). Therefore, use of liposomal bupivacaine in regional nerve blocks may not be worth the significantly higher cost of the medication compared to plain bupivacaine.

Intra-articular Injection

Local anesthetic intra-articular (IA) injections have proven to be effective in pain control when injected into the hip joint. Childs et al. [28•] performed a retrospective review to compare the efficacy of intra-articular (IA) injection vs FNB in reduction of postoperative pain scores. The IA injection consisted of 300 mg ropivacaine (0.05%) with epinephrine, 30 mg ketorolac, and 5 mg morphine. Although patients in IA group reported higher pain scores on admission to PACU, at 1, 3, and 6 weeks postoperatively there were no significant differences in patient-reported pain scores between groups. Importantly, the occurrence of postoperative falls in the FNB group was significantly greater (19 vs 5, $p < 0.001$), as well as a higher rate of postoperative peripheral neuritis compared to the IA injection group (26 vs 2 $p < 0.001$). With similar pain scores and a significantly lower rate of complications, IA with local anesthetic offers a good alternative to FNBs for postoperative pain control.

Intra-articular injections utilizing other medications, such as morphine, have been utilized for years in knee arthroscopy. Their efficacy in hip arthroscopy, however, is only more recently being investigated. Cogan et al. [29•] conducted a retrospective review of 43 patients that underwent hip arthroscopy to determine the efficacy of an intra-articular morphine and clonidine injection on postoperative pain management.

All patients received preoperative celecoxib (400 mg) with acetaminophen (1000 mg), whereas 22 patients received an additional IA injection of morphine (10 mg) and clonidine (100 μg) at the conclusion of the procedure. They found that patients receiving an IA injection consumed significantly less opioid morphine equivalents in PACU compared to the control group ($p < 0.02$). Pain scores were similar between groups, and there was no significant difference in time to discharge [29•]. Therefore, an IA with clonidine and morphine may help reduce the amount of postoperative opioids consumed by patients undergoing hip arthroscopy, which could help mitigate associated complications such as respiratory depression and dependency.

Local Anesthetic Infiltration

Recently, local anesthetic infiltration (LAI) has gained interest among orthopedic surgeons as an efficacious alternative to more costly procedures such as femoral and fascia iliaca blocks. Like intra-articular injection, local anesthetic infiltration is performed during the surgical case and does not typically require ultrasound guidance or anesthesiologist involvement. Typically, the surgeon performs an LAI at the end of the procedure by injecting anesthetic medication within the soft tissues surrounding the hip capsule. Several studies have explored the use of local anesthetic infiltration on pain control in total knee and total hip arthroplasty, where LAI has been shown to decrease postoperative pain and narcotic consumption [30–34].

In a retrospective study, Philippi et al. [35•] sought to determine whether an extracapsular LAI of bupivacaine with epinephrine during hip arthroscopy would decrease the rate of elective postoperative femoral nerve blocks. In the PACU, patients were given standard pain medications as determined by a nursing staff, and a postoperative femoral nerve block was offered to the patient by the anesthesiology team if pain control was not adequate. Patients who received an LAI requested fewer femoral nerve blocks compared to non-LAI group (0.34 vs 0.56, $p = 0.027$). However, the difference in PACU opioid consumption was not statistically significant between groups ($p = 0.740$).

In a single-blinded randomized controlled trial, Garner et al. [36•] compared pain scores between 26 patients who received a femoral FIB and 20 patients who received a LAI with local anesthetic during hip arthroscopy. They found a clinically significant difference in postoperative pain scores between the two groups, with the LAI group having less pain following surgery. The average dose of morphine consumed by each patient was also twice as high in the FIB group, leading to considerably more nausea and vomiting in the FIB group within the first 24 h after surgery.

Baker et al. [37] conducted a randomized, double-blinded trial comparing LAI and IA injection. Patients were randomized to receive 10 mL of 0.25% bupivacaine either around the portal sites or injected into the joint space prior at the conclusion of the procedure. Immediately following surgery, patients in the LAI group required significantly more rescue medication compared to the intra-articular injection group (2.33 mg vs 0.57 mg, $p = 0.036$). However, VAS pain scores were not statistically different between groups at 1 and 2 h post-op (2.4 vs 2.7 at 1 h and 2.1 vs 2.3 at 2 h respectively).

In conclusion, LAI is an effective procedure that offers similar benefits to peripheral nerve blocks, without the increased risk of iatrogenic nerve injury, intravascular injection, postoperative falls, and higher cost to the hospital and patient. Local anesthetic medication is placed within the soft tissues surrounding the hip joint, including the portal sites and/or pericapsular space. Additionally, LAI is a quick procedure, does not require ultrasound guidance, and is conducted intraoperatively by the surgeon.

Conclusion

Adequate control of postoperative pain in patients undergoing hip arthroscopy continues to be a challenging and evolving area in orthopedics. In the absence of standardized protocols for pain management in these patients, a variety of different approaches have been utilized in an effort to find a regimen that is effective at reducing postoperative pain, narcotic consumption, and cost to both the patient and healthcare system.

Due to the wide variety of perioperative pain management strategies reported in the current literature, and paucity of comparative high-quality studies, it is difficult to determine the best strategy for pain management in these patients. The studies examined in this review highlight the importance of a multimodal approach to treating pain in patients undergoing hip arthroscopy.

When a form of preoperative block or intraoperative anesthetic was utilized in conjunction with a pre- and postoperative analgesic regimen, patients reported less pain and postoperative narcotic use than without the interventions. Patient-reported pain scores and postoperative opioid use were fairly similar between the different regimens, however, postoperative complications appear to be less in groups receiving an IA injection or LAI compared to peripheral nerve blocks. Nerve blocks include the potential for iatrogenic nerve injury, need for specialized equipment, highly trained anesthesiologists, and higher costs associated with the procedure. With the increasing demand for cost-effective strategies of managing pain and opioid consumption following hip arthroscopy, intraoperative techniques such as IA injection and LAI mixed with a pre- and postoperative pain medication regimen may be the optimal strategy.

Future studies are warranted to evaluate the efficacy of peripheral nerve blocks versus other methods of pain management, including intra-articular or periarticular injections. In addition, future studies should explore which multimodal pain regimen would benefit patients most based on demographics and patient-specific variables. The cost-effectiveness of each regimen also merits consideration as rising health care costs remain an important consideration.

Compliance with Ethical Standards

Conflict of Interest Collin LaPorte, Michael Rahl declare no conflicts of interest

Olufemi Ayeni is part of a speaker's bureau for Conmed, outside of the submitted work.

Travis Menge reports consulting fees from Smith & Nephew, and research support/grants from Stryker, DJO, and Smith & Nephew, outside of the submitted work.

Human and Animal Rights and Informed Consent This article does not involve studies with human or animal subjects performed by any of the authors.

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