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Operative Techniques in

Sports Medicine

Perioperative Pain and Swelling Control in Anterior Cruciate Ligament Reconstruction

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Anterior cruciate ligament reconstruction (ACLR) remains one of the most common sports medicine procedures performed in the young, athletic patient population. Over the past 2 decades, advances in surgical technique as well as improvements in perioperative pain control modalities have enabled the vast majority of patients undergoing ACLR to have the procedure performed in the outpatient setting. Multimodal pain control is paramount to the success of outpatient ACLR and incorporates various combinations of general-epidural-regional anesthetics, perioperative peri-incisional local anesthetics, oral analgesics, electrostimulation, compressive cryotherapy, and early physical therapy. This article provides a concise summary of evidence-based guidelines for perioperative pain and swelling management following ACLR, with an emphasis on oral agents and postoperative modalities.

KEYWORDS Anterior cruciate ligament, ACL, pain control, swelling, pain management

Introduction

Technical innovations and the expansion of outpatient surgery centers have enabled fast recovery and early discharge after arthroscopic anterior cruciate ligament reconstruction (ACLR). The option of outpatient surgery allows post-ACLR patients to return more quickly to their activities of daily living. Williams et al[1] have also shown that outpatient ACLR affords significant financial benefits, as an unexpected hospital admission after the ACLR increases hospital costs by 11%.

Perioperative management of pain and swelling has been instrumental in facilitating the transition from inpatient to outpatient ACLR. Lefèvre et al[2] recently showed no difference in postoperative discomfort between inpatients and outpatients and fewer sleep disturbances and more frequent walking on postoperative day 1 in the outpatient group. Numerous analgesic protocols and multimodal approaches have been developed over the past 25 years. This article presents literature from both the orthopaedic and the anesthesiology communities on various approaches to combat pain and swelling after the ACLR (Table).

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Physiology of Pain after ACLR

Myriad cytokines and pain mediators are released after any operation. Prostaglandins constitute part of the immediate inflammatory response. Increased levels of cyclooxygenase-2 (COX-2), which produces Prostaglandin E2 (PGE_2), have been found both locally at the surgical site and centrally in the cerebrospinal fluid.[3] Increased levels of COX-2 in the cerebrospinal fluid suggest humoral signals arising from the site of surgical inflammation.[4,5] Dye et al further elucidated intra-articular sources of knee pain through conscious neurosensory mapping. The lead author underwent bilateral conscious knee arthroscopies with only local anesthesia at the portal sites and experienced the most severe pain with probing of the anterior synovium, fat pad, and joint capsule. The authors concluded that failure of soft tissue reconstructions of the knee may be attributable to a lack of neurosensory restoration, and the anterior fat pad may be critical in this function.[6]

Oral Analgesics

Most pharmacological approaches to perioperative pain management for ACLR consist of a combination of nonsteroidal anti-inflammatories (NSAIDs) and acetaminophen with or without an antinociceptive agent such as gabapentin or pregabalin. Selective COX-2 inhibitors have not been shown

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Table Strategies to Reduce Pain and Swelling After ACLR

Oral Analgesics
COX-2 inhibitors (eg, celecoxib)
Acetaminophen
Opioids (eg, hydrocodone and oxycodone)
Tramadol
Antiepileptics (eg, gabapentin and pregabalin)
Peripheral Nerve Blocks
3-in-1 femoral nerve block (femoral, obturator, and lateral femoral cutaneous nerves)
Fascia iliaca block (femoral and lateral femoral cutaneous nerves)
Adductor canal block (obturator and saphenous nerves)
Intraoperative Anesthesia
General endotracheal
Spinal
Epidural
Avoid hypothermia
Intra-Articular or Periarticular Injections or Both
Bupivacaine or ropivacaine
Morphine
Sufentanil
Nonsteroidal anti-inflammatory drugs (eg, xefocam and tenoxicam)
OMS103HP (combination ketoprofen, amitriptyline, and oxymetazoline)
Targeted hamstring donor site injections
Other Pharmacologic Agents
Ketorolac
Zolpidem
Homeopathic agents
Electrostimulation
Dynamic intermittent compression cryotherapy

to interfere with normal hemostasis and thus can be taken in the days before and after surgery. Celecoxib is contraindicated in patients with allergies to aspirin or sulfonamides, and its dose should be halved for patients older than 70 years or with borderline renal failure.[5] Use of a tourniquet does not impede systemic NSAIDs from suppressing local prostaglandin production.[7] Multiple randomized controlled trials (RCTs) have demonstrated the efficacy of preoperative COX-2 inhibitors for ACLR.[8-11] Reuben et al compared celecoxib 400 mg with a placebo administered 1-2 hours before surgery and reported 30%-35% less postanesthesia care unit opioid consumption in the treatment group. Patients continued to take celecoxib or placebo every 12 hours for 14 days, and the celecoxib group had lower pain scores at rest and during movement and consumed less rescue oxycodone at all time intervals. These authors demonstrated sustained benefits of celecoxib in a separate report of 6-month follow-up.[9] The celecoxib group had fewer patellofemoral complications, flexion contractures, revision debridements, and returned to a higher level of athletic activity. NSAIDs, however, can interfere with tendon-to-bone healing, and Dimmen et al showed in a rat model that indomethacin and parecoxib reduced pullout strength of tendons fixed through a bone tunnel.[12] The exact duration of NSAID use at which human ACLR healing is compromised is not understood, so NSAIDs may not be recommended beyond a 2-3-week perioperative window.

Acetaminophen or paracetamol, has analgesic and antipyretic properties. It functions as a central rather than a peripheral prostaglandin inhibitor, and recent data suggest that it may also act via the serotonergic pathway.[13] Peak serum concentrations are achieved within 2 hours, and dosing should not exceed 4 g/d.[14] Propacetamol is an intravenous (IV) formulation that reduces postoperative opioid consumption by 35% following major orthopaedic surgery.[15] Oral acetaminophen was also used in conjunction with celecoxib and placebos in most of the aforementioned RCTs. Dahl et al[16] compared acetaminophen to ibuprofen in patients undergoing arthroscopic ACLR and found that ibuprofen reduced pain to a significantly greater degree than did acetaminophen in the first 24 hours postoperatively. Nevertheless, acetaminophen has a lower incidence of adverse events than NSAIDs and is often used in conjunction with NSAIDs for additive, and possibly synergistic, analgesia.

Most surgeons provide patients with prescriptions for a rescue opioid medication. Hydrocodone and oxycodone with or without acetaminophen are frequently used for the first 1-2 weeks postoperatively. Tramadol is another nonscheduled drug with a lower risk of abuse and respiratory depression. It binds to central μ-opioid receptors and inhibits reuptake of norepinephrine and serotonin. It is a safer alternative to traditional narcotics and is an option for older patients with more comorbidities or apprehension or both toward narcotic drug use.

Gabapentin and pregabalin are 2 anticonvulsant medications that are also effective in treating neuropathic pain. They bind to the α_2-δ subunit of voltage-gated calcium channels to prevent the release of nociceptive neurotransmitters. Ménigaux et al[17] reported that, compared to a placebo, 1 dose of gabapentin 1200 mg 1-2 hours before surgery significantly reduced preoperative anxiety and postoperative pain and improved early motion at 24 and 48 hours. Mardani-Kivi et al[18] used half that dose (600 mg) and found reduced pain intensity and opioid consumption immediately after arthroscopic meniscectomy and ACLR. Pregabalin has not had such consistently positive outcomes for the ACLR. Nimmaanrat et al[19] compared pregabalin 75 mg before and 12 hours after surgery to a placebo and showed no difference in pain severity or analgesic use postoperatively. The most common side effects of gabapentin and pregabalin are dizziness, somnolence, and peripheral edema,[20] so it is important to use additional modalities to control postsurgical swelling.

Peripheral Nerve Blocks

Peripheral nerve blockade provides regional anesthesia to avoid the side effects of systemic analgesia. The femoral nerve is most commonly targeted with or without the assistance of neurostimulation or ultrasound or both. Stimulation of the femoral nerve produces a snap of the patella, and a high-frequency linear ultrasound probe may help locate the femoral nerve lateral to its corresponding artery. Typically 20 mL of