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Review of Outcomes in Pediatric Patients Undergoing Anterior Cruciate Ligament Repairs With Regional Nerve Blocks

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Purpose This article compared the outcomes of pediatric patients undergoing ACL repairs receiving intravenous opioids versus regional nerve blocks for pain management. It was hypothesized that compared to intravenous opioids the use of regional nerve blocks would decrease pain, opioid consumption, and opioid-related side effects.

Method: A random retrospective chart review was conducted on a total of 93 pediatric patients who underwent ACL repairs either in 2004 prior to the implementation of regional nerve blocks for pain management [pre-protocol cohort, (n = 44)] or in 2009/2010, after the implementation of regional nerve block use [post-protocol cohort, (n = 49)].

Findings: The two cohorts were comparable in age, weight and gender. The post-protocol cohort had a significantly lower total opioid consumption ($p < 0.001$). A sensitivity analysis excluding patients who received patient controlled analgesia (PCA) further validated the findings of significantly lower total opioid consumption adjusted for body weight [mg/kg] ($p = 0.02$) and reduction in the highest numerical rating score (NRS) reported on post-operative day (POD) 1 ($p = 0.01$). The cohorts were not significantly different in incidence of common opioid-related side effects or median length of stay (LOS).

Conclusions: There was evidence that regional nerve blocks reduced opioid consumption and also impacted pain reduction on POD 1 but demonstrated no significant change on opioid-related side effects or readiness for discharge. In view of the retrospective nature of the study the potential benefits of regional nerve blocks suggested a clinical equipoise to conduct a controlled trial in children.

PAIN AND SWELLING after anterior cruciate ligament (ACL) reconstruction arthroscopic and open surgery are commonplace. The pain frequently subsides over time with tissue healing and with active physical therapy (Edkin, Spindler, & Flanagan 1995). The pain is aggravated by knee motion and if it is not effectively managed can result in delayed ambulation and discharge from the hospital.

This study aimed to determine whether regional nerve blocks provide better pain relief, reduce opioid consumption and associated side effects, and facilitate early discharge from the hospital compared with the standard intravenous opioid analgesics for pediatric patients undergoing ACL repair.

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In this study, patient medical records were reviewed randomly for the modalities of postoperative pain management after ACL repair to compare the benefits of regional nerve block to standard intravenous opioid analgesic regimen. Relevant topics in the National Library of Medicine's Medline database and the Cochrane Central Register of Controlled Trials from January 1, 1966 to December 30, 2012 were queried through the following search strategies: combining "postoperative pain" or "postoperative analgesia" and "anterior cruciate surgery." The search was further refined by combining "and" with "local anesthetics" or "regional anesthesia" or "patient controlled analgesia" or "opioids." The search included pediatric and adult ages. No language restriction was used.

Background

Anterior Cruciate Ligament

There are four primary ligaments of the knee that work together to provide overall stability to the knee joint. The lateral and medial collateral ligaments are located on the sides of the knee to provide stability against excessive lateral or medial motion. The cruciate ligaments are inside the knee joint and cross each other forming an "x" with the ACL in the front and posterior cruciate ligament in the back. The cruciate ligaments control the back and forth motion of the knee. Specifically, the ACL prevents the tibia from sliding out in front of the femur and provides rotational stability to the knee (American Academy of Orthopedic Surgeons 2009b).

ACL Injury

The ACL is the most commonly injured knee ligament affecting over 200,000 Americans each year. ACL injuries are recognized with greater frequency in children and adolescents both related to traumatic and non-traumatic sports injuries. The incidence of ACL injury among children and adolescents is on the rise. A study by Shea, Pfeiffer, Wang, Curtin, and Apel (2004) which examined insurance claims over a 5 year period for soccer players aged 5 to 18 years, noted that knee injuries accounted for 22% of all injuries with 31% of these injuries involving an ACL tear. An ACL injury occurs when the ligament is overstretched or torn. Injuries range from mild, such as a small tear, to severe, such as when the ligament tears completely or when the ligament and part of the bone separate from the rest of the bone (American Academy of Orthopedic Surgeons 2009a). Because of skeletal immaturity children and young adolescents tend to sustain partial ACL tears or tibial spine avulsions, instead of complete ACL tears because their skeletons are more flexible and apt to absorb force without damage. As children mature, the skeleton becomes more rigid and thus more prone to complete ACL tear injuries (Shea et al. 2004).

Injury to the ACL can result from rapidly changing direction, stopping suddenly, slowing down while running, or landing incorrectly from a jump. These kinds of motions on the knee make individuals prone to twisting or hyperextending the knee that can lead to ACL injury even without direct contact or collision. The addition of physical contact with these motions can further place the person at risk for straining the ACL to the point of tearing. ACL injuries are most commonly seen in sports such as soccer, football, basketball, volleyball and skiing because these sports incorporate these types of movements. Nearly half of all injuries to the ACL occur in conjunction with damage to other structures of the knee such as the articular cartilage, meniscus, and other ligaments or bones (American Academy of Orthopedic Surgeons, 2009a).

Special Considerations for Treatment of ACL Injuries in the Pediatric Population

Historically, surgical reconstruction of ACL injuries in skeletally immature children and adolescents has been controversial due to the concern for potential damage to the proximal tibial and distal femoral growth plates. The risk of growth disturbance is inversely proportional to the amount of remaining growth. Disruption of the growth plates has been shown to lead to premature growth arrest of the knee joint resulting in leg length discrepancy and/or angular joint deformity (Hudgens & Dahm 2012; Shea et al. 2004). Consequently, ACL surgery may be delayed until the child is closer to skeletal maturity or the surgeon may modify the surgical technique to decrease the risk of growth plate injury.

There are risks associated with conservative treatment. A literature review regarding non-operative management of ACL injuries in skeletally immature patients conducted by Hudgens and Dahm (2012) demonstrated that prolonged non-operative therapy for complete ACL tear places children and adolescents at risk of further damage to the knee joint and also found that this age group has difficulty adhering to stringent activity restrictions putting them at even more risk of recurrent instability episodes that will eventually necessitate surgical repair. Hudgens and Dahm found that the available literature substantially supported early operative intervention for complete ACL tears in this population. Similarly, a study conducted by Henry et al. (2009) compared two different strategies of management of ACL rupture in skeletally immature patients, reconstruction with an open physis versus delayed reconstruction at skeletal maturity, and found that patients who underwent a delayed repair had a higher rate of medial meniscal tears from the time of injury to repair in comparison with the group who had early reconstruction. This further supports early ACL reconstruction as the preferable option in treatment of ACL injury in the skeletally immature patient.

Multiple physeal sparing ACL surgical reconstructive approaches have been described in the literature as an appropriate surgical option for treating ACL injuries in