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REVIEW

Integrative Pediatrics

A Review of Current Guidelines for the Treatment of Knee Hemarthrosis in Youth

Potpally Nikhil*

Rutgers – New Jersey Medical School, USA

Introduction

Among the pediatric age group, the most common cause of acute knee effusion occurs following acute trauma to the joint, often in sports [1]. The management of hemarthrosis has both immediate and long-term effects in an individual. In the short-term, blood exerts an intra-capsular pressure effect in the restricted joint space, leading to increased sensation of pain and limitation of range of motion [2]. Long-term, the risk of osteoarthritis is increased in both traumatic and nontraumatic causes of hemarthrosis [3]. Although degenerative changes may not be evident clinically or radiographically until decades later, the underlying pathogenesis of articular cartilage injury is believed to be initiated by the effects of blood and inflammatory mediators within the joint following an trauma. Through a series of biochemical reactions involving toxic metabolites, the articular cartilage eventually undergoes irreversible damage leading to degenerative changes of the joint over time [2,4].

The knee is the most commonly affected joint in both healthy, young patients and in those with hemophilia. Additionally, although the exact rates of hemarthrosis in patients with hemophilia are unknown, the majority of recurrent bleeds are known to occur within the knee joint [5]. Therefore, the incidence of knee hemarthrosis is not insignificant, requiring evaluation in the emergency department or outpatient office visits for acute management.

Removal of blood from a joint via aspiration of hemarthrosis would appear to be a standard practice, especially in the younger population. However, there is no guideline or consensus of managing this injury, despite the known effects of leaving blood in the joint. In this paper, we review the literature of hemarthrosis, current treatment recommendations, and present a rationale for joint aspiration to minimize harmful effects of blood, and potentially reduce the incidence of osteoarthritis following hemarthrosis.

Review of Literature

Studies have shown that a single exposure of cartilage to blood can result in negative effects to the various components of the joint [4]. Following a joint hemarthrosis, the breakdown of erythrocytes results in the release of heme- an iron-containing complex. The interaction of heme-derived iron with monocyte and macrophage-generated oxygen metabolites, namely hydrogen peroxide, generates the deleterious hydroxyl radical which has been shown to play a key role in the pathogenesis of chondrocyte apoptosis [4]. Remodeling of the extracellular cartilage matrix of the joint is also consequently impacted, even under low concentrations of blood exposure to articular cartilage, due to irreversible inhibition of proteoglycan synthesis [2,4]. Together, these processes lay the foundation for pro-inflammatory changes overwhelming the knee joint's reactive anti-inflammatory mechanisms.

Whereas the pathogenesis of blood upon articular cartilage on a molecular level is believed to be consistent among different age groups, the etiology of an acute hemarthrosis of the knee is varying. Post-traumatic hemarthrosis in adults is often caused by anterior cruciate ligament ruptures (70%), patellar dislocation injury (15%), meniscal tears (10%), osteochondral fragment fractures (2-5%), or other injury (5%) [6]. However in youth, studies have shown that the cause of knee hemarthrosis appears to be different. [7]. In younger adolescents with traumatic knee effusion, patellar dislocations are the most prevalent injury resulting in traumatic hemarthrosis, whereas in older adolescents, ACL tears have been identified as the primary injury [7,8].

There are additional mechanisms of joint damage that have been described to occur in hemophilic joints, which contribute to the eventual end-joint presentation of hemophilic arthropathy. Recurrent bleeds lead to intra-articular changes highlighted by proliferation of synovium and destruction of articular cartilage [5]. This accumulation of blood and

synovial proliferation leads to a relatively hypoxic environment in the joint, and in combination with pro-inflammatory factors, creates stimulus for angiogenesis to occur. This newly hypervascular and friable-vessel filled joint is now more susceptible to bleeding [6,9], and sets the stage for the ultimate development of hemophilic arthropathy.

Management of Hemarthrosis

The management of hemarthrosis in hemophilia is detailed in internationally recognized guidelines, and the treatment typically follows established protocols. Following the clinical evaluation of the affected joint, the patient is infused with factor concentrate and the joint is immobilized, elevated, and compressed [10]. Topical application of ice is recommended for pain relief, and rehabilitation is subsequently advised. Currently, aspiration of blood in a hemophilic joint is not indicated, unless the joint is painful, tense, and/or bleeding following 24 hours of conservative care [10].

In contrast, management of hemarthrosis in the traumatic knee has no current standard or guideline at this time. In general, following a history and physical examination, plain radiographs are routinely taken to rule out fractures. A rapid joint effusion following an injury is generally associated with pain. There may also be some degree of asymmetric warmth without erythema and a diminished range of motion. In youth, the initial goals of therapy consist of pain control and a thorough diagnostic evaluation [1]. For a first-time traumatic patellar dislocation, conservative nonoperative management is the suggested treatment [1]. This includes: ice, compression, immobilization and often limited weight-bearing with crutches. If there is suspicion for fracture, ligamentous, or meniscal damage, an MRI and orthopedic evaluation is usually recommended. Based upon the pathology noted on imaging and the physical exam findings, appropriate repair or reconstructive surgery is the next recommended step. If the diagnostic workup reveals no structural damage, follow up with an orthopedic surgeon is recommended, but the hemarthrosis is generally not aspirated unless there is significant swelling or suspicion of infection [1]. Physicians tend to let the hemarthrosis self-resolve and rely on the body's natural mechanisms of blood evacuation. Based on animal studies; however, it has been found that the resorption of blood from a joint space takes at least 4 days [9]. Aspiration of blood within two days following the inciting bleed has been suggested, in vitro, as a means of minimizing long term cartilage deterioration, which can potentially prevent evident damage later in life [2].

Arguments against universal aspiration of hemarthrosis include the potential need for anesthesia and risk of infection [11,12]. Especially within a pediatric population, sedation has been believed to be necessary prior to evacuation of blood from a joint [11]. However, this has never been validated in any study. With appropriate technique, the procedure can likely be done without using more than local anesthesic agents. The greatest concern related to the aspiration of a joint is the development of a septic joint by introducing outside bacteria. The estimated incidence of this complication appears to be close to 1 in 3,000 procedures [13], although with sterile technique and experienced physicians, the rate is felt to be much lower. In one study, the aspiration of a hemarthrosis in the emergency department following traumatic injury was shown to result in improved pain scores and greater sensitivity of physical examination maneuvers in diagnosing ligamentous injury [14]. An improved physical exam could allow for more accurate noninvasive diagnoses potentially reducing the need for further diagnostics such as arthroscopy in certain cases [14-17].

Aspiration of a hemarthrotic joint is not routinely recommended or performed in the current treatment in both hemophilic and non-hemophilic populations despite research detailing the toxic effects of blood to various joint structures occurring within days.

Conclusion

Considering the negative relationship between blood and the release of inflammatory mediators following an acute joint injury with hemarthrosis, there appears to be a scientific and clinical rationale in recommending aspiration of a hemarthrosis after injury in young patients. Unfortunately, at this time there are no established guidelines in the treatment of an acute hemarthrosis and essentially no specific recommendation for aspiration in spite of the known toxic effects of blood on chondrocytes causing early arthritis in this population. A prospective, controlled clinical trial should be conducted in order to assess the long-term risks and benefits of early intervention with aspiration of knee hemarthrosis in youth after an acute injury. This same study should be considered in the hemophilia population who suffer recurrent bleeds and are at known risk for early degenerative arthritis and joint replacement.

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Correspondence: Potpally Nikhil, Rutgers – New Jersey Medical School, USA. E-mail: np424@njms.rutgers.edu

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