Case Reports

Two Cases of Glenohumeral Chondrolysis after Intraarticular Pain Pumps

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Abstract

Background Acute idiopathic chondrolysis in young adults is rare. The etiology often is unknown and outcomes can be devastating owing to rapid development of painful secondary osteoarthritis. There have been some recent reports of chondrolysis after arthroscopic shoulder procedures. Animal and laboratory data suggest chondrolysis is related to the use of intraarticular pain pumps, although there is no conclusive evidence that this is causative in patients.

Case description We present two cases of young adults with chondrolysis of the humeral head after intraarticular pain pump use with humeral head resurfacing and biologic glenoid resurfacing.

Literature review Several authors report glenohumeral chondrolysis after shoulder arthroscopy involving the use of bupivacaine pain pumps. In addition, experimental animal studies have confirmed the presence of chondrolysis after bupivacaine infusion.

Purposes and clinical relevance These cases provide additional evidence of an important association between

postarthroscopic chondrolysis of the glenohumeral joint and the use of bupivacaine pain pumps.

Introduction

Chondrolysis is defined as the disappearance of articular cartilage as the result of lysis or dissolution of the cartilage matrix and cells. Although the incidence of idiopathic chondrolysis remains to be elucidated, secondary chondrolysis with diseases, including slipped capital femoral epiphysis, is well documented [19, 20, 29]. The idiopathic and secondary varieties are rare [30]. Idiopathic chondrolysis is well-defined clinically, usually having its onset early in the second decade of life, with a marked female preponderance. An autoimmune etiology has been proposed [7, 30] but not confirmed. Postarthroscopic glenohumeral chondrolysis has been reported among secondary causes [22, 24]. Although these cases are reported temporally after arthroscopy, the actual cause of this process is unknown and the consequences are devastating. This condition currently has no effective treatment and most affected patients ultimately must consider some type of glenohumeral arthroplasty and/or biologic resurfacing [24]. Although the etiology remains unclear, some studies report patients had glenohumeral chondrolysis after arthroscopic shoulder surgery associated with bupivacaine pain pumps [9, 12]. Given the popularity and success of regional anesthesia and with the effectiveness of intraarticular pain pumps in controlling postoperative pain [23, 26], this finding poses a concern for patients who receive bupivacaine pain pumps after shoulder procedures.

We report two patients who had chondrolysis develop after arthroscopy with use of bupivacaine pain pumps. All

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Each author certifies that his or her institution approved the reporting of this case report, that all investigations were conducted in conformity with ethical principles of research.

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information documented was obtained from the respective patients' medical records.

Case Reports

Patient 1

A 19-year-old National Collegiate Athletic Association (NCAA) Division I gymnast was seen at another hospital for right shoulder pain, subluxation, and instability. Based on her history and presentation, a diagnosis of anterior shoulder instability was made. An arthroscopic capsular plication of her right shoulder was performed. Intraoperative findings revealed intact glenoid and humeral head articular cartilage. According to the operative report, her superior, anterior, posterior, and inferior labrum was intact. A positive anterior drive-through sign was noted. An anterior capsular plication was performed. A bupivacaine pain pump was placed intraarticularly and her incisions were closed. The record contained no information on the flow rate.

She continued to have pain after her index capsular plication without a pain-free period. Additionally, she experienced substantial shoulder stiffness that did not resolve after surgery despite physical therapy and abstinence from gymnastics. Her pain was continuous, severe, and present at rest preventing her from sleeping at night and interfering with her academic work. She was seen at our institution approximately 1 year after her initial surgery. On presentation, she had substantial pain with all shoulder motion and was unable to participate in gymnastics. She had no gross instability but had restricted shoulder motion. Specifically, she had painful forward flexion to 95°, abduction to 50°, external rotation to 30°, and internal rotation to the lumbar region. Her Penn shoulder score [17] was 13 of 100.

There were no radiographic studies available that postdated her index arthroscopic surgery. Plane radiographs obtained at our institution revealed early arthritic changes. An MR arthrogram of her shoulder revealed articular cartilage loss and subchondral cyst formation in the glenoid and humeral head (Fig. 1). To further evaluate the extent of chondral damage, she underwent a diagnostic arthroscopy of her shoulder. The humeral head (Fig. 2A) and glenoid surface (Fig. 2B) had focal cartilage defects in the central load-bearing area. Arthroscopic synovial biopsies showed no evidence of infection.

Based on clinical presentation and radiographic and arthroscopic findings, she was treated with a hemicap right humeral resurfacing implant with a graft jacket interposition of the glenoid [8, 16]. At last followup, 18 months after reconstructive surgery, she had minimal pain at rest.

Fig. 1 (A) Coronal and (B) axial MR images of the left shoulder show chondrolysis with erosive changes of the glenoid and humeral head articular surfaces.

On clinical examination, she had forward flexion to 130°, abduction to 100°, external rotation to 50°, and internal rotation to her thoracic level. Her Penn shoulder score was 66, and visual analog scale score for pain was 25 of 100. Her SF-36 [14, 28] physical functioning score was 85 of 100, general health average 80 of 100, and pain score 68 of 100 (100 being no pain). She had returned to competition in NCAA Division I gymnastics during her final year of college without difficulty.

Patient 2

A 26-year-old female childcare worker with a history of neurofibromatosis sustained a posterior glenoid labrum tear of her left shoulder while lifting some chairs at work. She was seen at an outside hospital and underwent a posterior glenoid labrum repair. A bupivacaine pain pump was placed for postoperative pain relief. Postoperatively, she had substantial shoulder pain and stiffness. The surgeon who performed her index surgery thought that her symptoms were related to postoperative adhesive capsulitis and therefore she underwent an arthroscopic débridement and capsular release. A bupivacaine pain pump again was placed after this second surgery. The record contained no information on the flow rate. She had no improvement in her symptoms and noted severe, constant pain in her shoulder at rest and with motion.

Fig. 2 Arthroscopic views from the posterior portal show chondral defects of the (A) humeral head and (B) glenoid.

Twelve months after her initial surgery, she was seen at another tertiary center where an arthroscopic capsular release of her shoulder was planned. The treating surgeon documented advanced chondrolysis of the glenoid and humeral head articular surfaces and for this reason aborted the capsular release. Instead, this surgeon recommended reconstructive shoulder surgery as a more definitive treatment.

We saw the patient 1.5 years after her index surgery. On examination, she had limited active forward elevation to 90° with substantial pain. Abduction in the scapular plane was limited to 40°. She had external rotation to only 30° and internal rotation was limited to the sacrum. Her MR and arthroscopic images revealed chondrolysis of the humeral head and glenoid articular surfaces (Fig. 3). Given her young age and advanced arthritis, we performed a humeral head resurfacing and interposition arthroplasty of the glenoid with a graft jacket.

Sixteen months after shoulder arthroplasty, she had no pain at rest. She had passive forward flexion to 130°,

Fig. 3 A chondral defect can be seen on the surface of the humeral head.

passive abduction in the scapular plane to 80°, and passive neutral external rotation to 40°. She had good strength with internal and external rotation. She had returned to work full-time as a childcare provider, however she had difficulty reaching over shoulder height and had pain at the limits of her motion. Her Penn shoulder score was 38 of 100.

Discussion

The cause of chondrolysis is unknown, with various theories regarding its etiology. Some joints appear more prone to development of articular chondrolysis than others: chondrolysis is relatively common in the hip as compared with in smaller joints such as the shoulder or ankle [2]. Postarthroscopic chondrolysis has been reported in not only the shoulder but also the knee [6, 15, 27] and ankle [2].

van Huyssteen and Brace [27] and Douw et al. [6] reported acute chondrolysis of the knee after arthroscopy involving accidental use of chlorhexidine. Douw et al. described three patients (four knees) who underwent knee arthroscopy; all their knees were accidentally irrigated with 1% aqueous chlorhexidine instead of plain saline. All three patients had chondrolysis of the knees and presented with increased knee pain and stiffness an average of 2.3 months after the index surgery [6].

Recently some authors have reported chondrolysis after bupivacaine administration via pain pump [12, 13, 24, 25]. In addition, various animal models and in vivo experiments have revealed acute chondrolysis after bupivacaine infusion [4, 9, 10]. Chu et al., using bovine knee models, compared articular cartilage damage after treatment with 0.5% bupivacaine compared with 0.9% saline [4]. Using flow cytometry to assess chondrocyte viability for 1 week, they found greater than 99% chondrocyte death after

bupivacaine treatment compared with 20% of cells treated with normal saline ($p < 0.05$) [4]. In another study Gomoll et al., using rabbit models, compared chondrocyte viability after infusion with bupivacaine with and without epinephrine compared with infusion with saline (all for 48 hours) [9]. They observed decreased chondrocyte viability in the samples treated with bupivacaine ($p = 0.08$) and bupivacaine with epinephrine ($p = 0.02$) compared with those treated with normal saline [9]. Gomoll et al. recently published their results of effects of bupivacaine on cartilage over a longer term than initial studies [10]. In this in vitro study, 36 rabbits were randomized in a control group (saline), bupivacaine group, or bupivacaine with epinephrine group. Their shoulders were infused with the respective solutions; they were sacrificed at 3 months. In contrast to previous studies, they did not note an increase in chondrocyte toxicity or cell death in the bupivacaine models after 3 months. In contrast, Gomoll et al. observed evidence of increased metabolism (proteoglycan synthesis) in the shoulders infused with bupivacaine; this increase was most notable in the bupivacaine with epinephrine group. They suggested the findings reflected a reparative process that occurs weeks after bupivacaine infusion [10]. More basic research is needed to provide more insight into these conflicting results.

Clinical reports of chondrolysis associated with pain pumps have been limited to the glenohumeral joint. Although commonly used in the treatment of knee disorders, there is no documented case of chondrolysis after use of pain pumps in the knees. Given most arthroscopic shoulder procedures using pain pumps are not complicated by chondrolysis [1, 3], other possible etiologies must be considered. Such possibilities include surgical and device placement techniques leading to chondral scuffing, use of intraarticular thermal devices, and a host predisposition for the development of chondrolysis, such as quality of native tissue, small size of the glenohumeral joint, and lack of joint fluid to dilute the bupivacaine or thinner shoulder articular cartilage compared with the knee [9].

Chondrolysis resulting after exposure to thermal and/or radiofrequency has been described [5, 11, 18, 21, 24]. Petty et al. [24] evaluated three cases of chondrolysis after shoulder arthroscopy, two of which involved the use of thermal energy. However, others have reported the occurrence of chondrolysis after arthroscopy without the use of thermal devices but with the use of pain pumps [12]. Hansen et al. [13] reported 10 patients (12 shoulders) who had chondrolysis develop received pain pumps for 48 hours; four of the patients had thermal devices used during the procedures. Neither of our patients had documentation of treatment with a thermal device.

For unclear reasons, chondrolysis associated with pain pumps and/or thermal device use tends to occur in younger

females. Good et al. [11] reported that of the eight patients who had chondrolysis develop after thermal capsulorrhaphy, six were females and two were males with a mean age of 23 years for all patients. In the study by Hansen et al. [13], the average age of the patients was 28.9 years. The patients in our study were 20 and 26 years old and both were female.

With only two cases we cannot presume a direct cause and effect relationship between pain pumps and chondrolysis, only a possible association in keeping with other reports. In addition, we cannot be certain that our second patient did not have other predisposing factors or variables. It is possible that her chondrolysis was attributable to initial overtightening of the capsule during the labral repair. Furthermore it could have been caused by overtightening in the presence of the bupivacaine pain pump (decreasing the effective joint space).

Our cases add to the evidence of an association between pain pumps and glenohumeral chondrolysis. Additional research is necessary to understand why certain patients have chondrolysis develop and others do not. However, at this time, we do not encourage the use of pain pumps for shoulder cases.

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