Isolated Acute Exertional Compartment Syndrome (AECS) of the Extensor Carpi Ulnaris

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What to Learn from this Article?

The extensor carpi ulnaris is especially prone to develop the AECS syndrome and these need to be taken under consideration when individuals load their forearm repeatedly during heavy labor or sports.

Abstract

Introduction: Only two cases of an isolated compartment syndrome of the extensor carpi ulnaris have been described previously [1,2]. In both cases, the onset was acute. In the first case, histological examination revealed no necrosis. The second case was regarded to be due to a previously unknown anatomic variation and no necrotic tissue was recognized upon gross examination. This case report describes a third case of an isolated acute exertional compartment syndrome (AECS) of the extensor carpi ulnaris muscle with focal areas of necrotic tissue.

Case Report: We report the third case of an isolated AECS of the extensor carpi ulnaris muscle. A 35 year-old left-handed man, a motor mechanic by profession, presented to the emergency department with excruciating pain at the ulnar side of the left dorsal forearm. The previous day, he had repetitively used a sliding hammer with his left arm. Since then he had experienced severe pain despite the use of over-the-counter non-steroidal anti-inflammatory drugs. Here, in contrast to the previously reported cases, the histological examination revealed focal areas of necrotic tissue. No anatomic variations were found during surgical decompression. Postoperatively, the patient had complete pain relief and return of function.

Conclusion: This report again indicates that the extensor carpi ulnaris is especially prone to develop the AECS syndrome and raises the question whether involvement of the other extensor muscles may rather be secondary to the excessive swelling of the extensor carpi ulnaris and not to strenuous exercise. This should be taken into consideration when humans load their forearm repeatedly during heavy labor or sports. In addition, we are showing that even with histologically confirmed areas of partial muscle necrosis the patient can return to normal muscle function.

Key Words: Acute Exertional Compartment Syndrome, AECS, Extensor Carpi Ulnaris, Isolated, Compartment Syndrome.

Introduction

Only two cases of an isolated compartment syndrome of the extensor carpi ulnaris have been described previously [1,2]. In both cases, the onset was acute. In the first case, histological examination revealed no necrosis. The second case was regarded to be due to a previously unknown anatomic variation and no necrotic tissue was recognized upon gross examination. Despite a lack of unequivocal evidence for an inciting event, the latter case was considered an acute compartment syndrome in an avid competitive weight lifter.

We report the third case of an isolated AECS of the extensor carpi ulnaris muscle. In contrast to the above-mentioned cases, histological examination revealed focal areas of necrotic tissue. No anatomic

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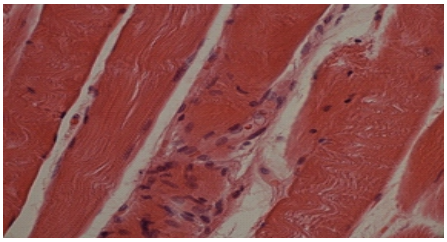

Figure 1: Histological sample of the extensor carpi ulnaris affected by the AECS (first operation; paraffin embedding). Skeletal muscle fibers show focal areas of necrosis and partially intense edema. Original magnification x40

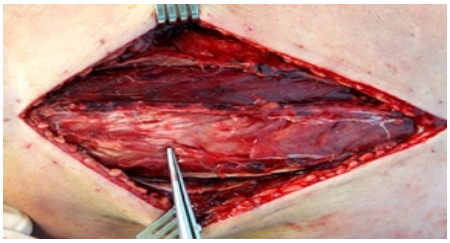

Figure 2: In situ aspect of the extensor carpi ulnaris during the second operation. In contrast to the surrounding, normal-appearing muscles, the isolated extensor carpi ulnaris of the left forearm appeared grey-white with a firm, partially edematous structure

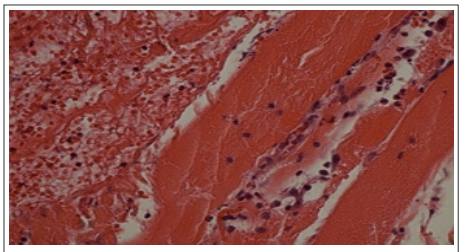

Figure 3: Histological sample of the extensor carpi ulnaris affected by the AECS (second operation; paraffin embedding). Advanced tissue changes, such as skeletal muscle fibers with larger focal areas of necrosis and reactive inflammatory changes can be recognized. Original magnification x40

variations were found during surgical decompression. Postoperatively, the patient had a complete relief of pain and full return of function.

Case Report

A 35 year-old left-handed man, a motor mechanic by profession, presented to the emergency room at 10:00 a.m. with excruciating pain at the ulnar side of the left dorsal forearm. The previous day he had repetitively used a sliding hammer with his left arm. Since then he had experienced severe pain despite the use of over-the-counter non-steroidal anti-inflammatory drugs.

Upon admission, the patient denied any history of recent trauma, fever or chills, and the medical history was inconspicuous. He denied the use of intravenous drugs, anabolic steroids, anticoagulants or other medications, and stated to consume 4 cups of coffee with caffeine per day, as well as nicotine and alcohol occasionally.

The initial evaluation (approx. 18 hours after the onset of pain) showed an afebrile patient with stable vital signs and an unremarkable routine whole body exam without any tattoos or changes of the integument. There was marked swelling with extreme tightness to palpation at the left dorsal forearm, but full range of motion of the left shoulder and elbow with only limited pain at supination/pronation. Severe pain was elicited by passive flexion/extension or ulnar/radial deviation of the wrist. The radial pulse was palpable and the capillary refill in all fingertips was physiological. The left dorsal forearm showed diminished sensation in form of a hypesthesia, paresthesia and altered ability to discriminate between two points while testing with pinprick, light touch and two-point discrimination. The hand was neurologically intact to motor and sensory testing. Radiographs in two planes of the left elbow, forearm, and wrist did not show any bony abnormalities. Complete blood cell count and electrolytes were normal including a C-reactive protein of 1.9 mg/l (normal 0 – 5.0mg/l), and an erythrocyte sedimentation rate of 1 mm/h (normal 1 – 15 mm/h). The serum creatinine kinase was considerably elevated at 9.01 µmol/l (normal 0 – 3.15 µmol/l). Duplex-ultrasound examination of the arteries and veins of the left arm also remained inconspicuous. Despite immediate treatment with diazepam and opioid-derivates the patient continued to have severe pain. Therefore, an emergency decompressive fasciotomy centered over the extensor carpi ulnaris, was performed in the operating room. Upon release, the muscle bulged, displayed demarcation by grey-brown color (however, less intense than on the intraoperative macroscopic figure) without gross signs of necrosis, and appeared less contractile than the surrounding musculature, which in turn displayed a normal color, texture, and ability to contract. Histological examination of 2 specimens of the grey-brown tissue (together measuring 12 x 9 x 4 mm) showed skeletal muscle fibers with focal areas of necrosis and partially intense edema. Malignancy was excluded (Fig. 1).

After irrigation, the skin was loosely approximated and the wound temporarily closed by stapling the edges of the skin with Epigard TM (synthetic skin substitute consisting of polyurethane-foam). A sterile dressing was placed over the open aspect of the wound and a well-padded volar forearm orthosis was applied. Three days later, the patient was returned to the operating room for wound closure. At this time, the entire extensor carpi ulnaris appeared grey-white to dark brown (Fig. 2), with a firm texture and diminished contraction. Histological examination of multiple tissue fragments (together measuring 14 x 10 x 5 mm) revealed skeletal muscle fibers with larger focal areas of necrosis and reactive inflammatory changes. Again, malignancy was excluded (Fig . 3).

Following irrigation, the skin incision was sutured and covered by a sterile dressing and a well-padded volar forearm orthosis. An orthotic immobilization followed for one week, and his activities were increased progressively. The patient showed an uneventful recovery with complete relief of pain. Two months after the second intervention, left arm and hand were neurologically intact to motor and sensory testing and functionally comparable to the contralateral side.

Discussion

A compartment syndrome is caused by an elevated pressure within a closed fascial compartment, leading to a reduction in blood flow below the level necessary to maintain tissue viability and function. This pressure can either result from a decreased volume of the closed compartment, such as with constrictive casts/dressings or tight fascial closures. More commonly, it is due to an increased volume of the compartment contents on the basis of traumatic hemorrhage, coagulopathy, posttraumatic and postischemic edema, prolonged limb compression, intra-arterial catheterization and drug injection, thermal injuries, venous obstruction or strenuous exercise [3]. A compartment syndrome due to strenous exercise and/or repetitive loading is an exertional compartment syndrome and usually observed in competitive or collegiate athletes [6]. Depending on the stage at which the tissue is obtained, muscle necrosis, granulation, scar tissue, and calcification may all be present [4]. Eventually, the original tissue is replaced by dense, fibrous connective tissue with subsequent deformity and loss of function [4]. There are many reports of exertional compartment syndromes in the leg (acute and chronic), and in the forearm. The AECS is far less prevalent than the chronic exertional

compartment syndrome (CECS) [5]. CECS is defined as an intermittent and reversible pathologic elevation of the compartment pressure following exertion [3]. Among the reported cases of forearm CECS, the classic presentation is one of forearm pain, often associated with weakness during and shortly after forearm exertion [6]. Four AECS cases report on an involvement of the dorsal forearm [1,2,7,8], two of which [1,2] describe an isolated AECS of the extensor carpi ulnaris. In contrast to the CECS, there is no gradual resolution of pain after cessation of exercise [7], consistent with our report. Clinical signs include a swollen, tense and tender forearm with pain usually exceeding that expected from the causative factor, pain to passive stretch of involved musculature, sensory deficits, and motor weakness or paralysis [9] (the latter two as late findings). Ciacci *et al*. [10] reported an atypical case of an exercise-induced bilateral anterior tibial compartment syndrome of acute onset without pain and concluded that pain is not an obligatory symptom for early diagnosis. The authors did not suggest that the reported case constitutes a rule.

In this acute case in an emergency setting, the musculature was so tense that earliest decompression was absolutely mandatory. We felt that there was no time for pressure measurements or other diagnostic studies like Magnetic Resonance Imaging (MRI). These procedures would have led to a further delay of treatment with additional pain and risk of infection. From our point of view, this would have been a violation of the ethical code. In addition, we did not fully understand the diagnosis pre-operatively. We expected to be dealing with a typical acute exertional compartment syndrome of the forearm. Intra-operatively we surprisingly discovered an isolated AECS of the extensor carpi ulnaris, as indicated by the notably different colour of the muscle and the different reduced muscle response when pinging the muscle with the forceps. This was confirmed by subsequent histological analysis.

Our patient had presented at a stage, in which at least focal muscle necrosis had occurred accompanied by intense edema, but without reduction of transverse striations. This differs from the first described case of an isolated compartment syndrome of the extensor carpi ulnaris [2], which lacked histological signs of necrosis. Also the second case [1], likely to be due to a previously unknown intermuscular septum between extensor carpi ulnaris and extensor digitorum communis lacked necrotic tissue upon gross examination.

In yet another case regarding several muscles of the dorsal forearm [8], the extensor carpi ulnaris was markedly swollen and had a pale discoloration but appeared viable. The other muscles seemed less involved. This raises the question whether the extensor carpi ulnaris is especially prone to develop the syndrome and whether the involvement of the other extensor muscles may rather be secondary to the excessive swelling of the extensor carpi ulnaris and not to the strenuous exercise [8]. This hypothesis is further supported by the present report of an isolated AECS of the extensor carpi ulnaris. The underlying reason(s) of this disorder is (are) believed to be repetitive and/or strenuous exercise (present report) and possibly in selected cases, anatomic variations [1]. This report again indicates that the extensor carpi ulnaris is especially prone to develop the AECS syndrome and raises the question whether involvement of the other extensor muscles may rather be secondary to the excessive swelling of the extensor carpi ulnaris and not to the strenuous exercise. The consequence would be taking this into consideration when humans load their forearm repeatedly during heavy labor or sports. In addition, we are showing that even with histologically confirmed areas of partial muscle necrosis the patient can return to normal muscle function.

Conclusion

This report again indicates that the extensor carpi ulnaris is especially prone to develop the AECS syndrome and raises the question whether involvement of the other extensor muscles may rather be secondary to the excessive swelling of the extensor carpi ulnaris and not to the strenuous exercise. The consequence would be taking this into consideration when humans load their forearm repeatedly during heavy labor or sports. In addition, we are showing that even with histologically confirmed areas of partial muscle necrosis the patient can return to normal muscle function.

Clinical Message

The extensor carpi ulnaris is especially prone to develop the AECS syndrome. The consequence would be taking this into consideration when humans load their forearm repeatedly during heavy labor or sports.

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