

Acute Compartment Syndrome Following Fulkerson Surgical Technique in Patellofemoral Instability

Nancy A Bergquist*, Alexandria S Bledig and Bailey A Weidner

Global Neuroscience Initiative Foundation, University of Colorado-Colorado Springs, USA.

Abstract

Patellofemoral instability affects mostly young and active people. Patients present with Episodes of mechanical instability of the patella and anterior knee pain. Surgery can address both bony and soft-tissue components; however, no gold standard exists in the literature for surgical treatment. Fulkerson osteotomy technique for surgical repair was employed in this case, which resulted in immediate acute compartment syndrome for this patient. Acute compartment syndrome is an emergent condition requiring immediate surgical attention. This article assesses a case of acute compartment syndrome following Fulkerson osteotomy for anteromedial tibial tubercle transfer surgery in Patellofemoral syndrome involving a 19-year-old female. Resultant compartment syndrome following a Fulkerson technique surgery is rare in literature. This is a case of protracted pain, paresthesia, and paralysis through multiple surgical interventions and rehabilitation designed to preserve her lower limb due to the resultant acute compartment syndrome. This patient's history is significantly unique in the literature and is reported here for study regarding occurrence and in preventing future potential surgical complications in similar patients.

Keywords: Acute; Compartment syndrome; Fulkerson; Surgery

Introduction

Over one hundred different surgical techniques exist in the treatment of patellar instability yet no gold standard has emerged in the literature [1]. Fulkerson osteotomy technique was designed to restore abnormal force vectors on the patella and decrease pressure on involved cartilage [2]. A case of Fulkerson surgical technique resulting in acute compartment syndrome could not be located in the literature for comparison with this case. Compartment syndrome occurring in the lower leg is classified as either acute or chronic with chronic sometimes referred to as chronic exertional, and is defined as a condition in a closed compartment with increased pressure to the extent that microcirculation of the tissue is decreased [3]. Compartment syndrome has been reported due to many various offending reasons, and in locations such as the shoulder, arm, hand, gluteal region, thigh, and foot, but most commonly in the anterior compartment of the lower leg [4]. There are four compartments involving the lower legs that are separated by fascia and contain muscle from the knee to the ankle: anterior, lateral, superficial posterior and deep posterior compartment. The anterior compartment is the most commonly involved in the lower leg.

Acute Compartment Syndrome (ACS) develops when intracompartmental pressure (ICP) exceeds venous capillary pressure resulting in arteriolar compression in that compartment [5]. Neuropathy and lack of distal pulse in the limb are noted as ACS progresses, with muscle necrosis and permanent nerve damage as likely outcomes if surgical intervention is not rapidly employed. An important prognostic factor for outcome in these cases is the time of development of ACS, to the time of diagnosis, to the time of surgical intervention [6].

Chronic Compartment Syndrome (CCS)/Chronic Exertional Compartment Syndrome (CECS) typically occur in repetitive type physical activities, usually in young people and Athletes. The hallmark symptomatology for CCS/CECS is sharp pain during activity that requires rest to alleviate the pain, usually within minutes. Measured increase in ICP can require either abstention from the offending activity or fasciotomy surgery repair though the procedure can be less invasive than in the case of ACS.

Case presentation

Routine, outpatient, left-sided Fulkerson's technique surgical procedure for anteromedial tibial tubercle transfer was performed on

November 16, 2011 to alleviate Patellofemoral syndrome in this patient. The surgery was documented as successful with no complications and the patient was subsequently released the same day at approximately 3:30 pm with a follow up visit scheduled for 10:30 am the following morning.

Pain management consisted of a pre-surgical femoral nerve block at approximately 7:30 the morning of the surgery and one 5 mg acetaminophen oxycodone combination (Percocet) at 1:30 am on November 17, 2011 while at home. At that time, she was experiencing throbbing knee pain and paralysis of her left lower leg, foot, and toes which led her to call the anesthesiologist on duty. Recommendation was made for two additional Percocet, 5 mg each. Thirty minutes later, around 2:30 am, the pain and paralysis were not improving so she contacted the orthopedic surgeon on duty. Recommendation was made for more pain medication (unknown type and dose) and to either go to the local hospital's Emergency Department or wait for the original surgeon's clinic to open at 8:00 am. She waited for his clinic to open and was immediately seen by her surgeon. Utilizing a pressure transducer and a recording device the surgeon measured a slightly elevated ICP in the anterior compartment of her left lower leg but not high enough to diagnose ACS. She was sent to the original surgery center to have another femoral nerve block in an attempt to reduce her pain.

Upon arrival at the surgical center she was started on high dose intravenous (IV) morphine for pain. The patient remembers screaming from the high pain level she was experiencing. Her surgeon repeated the ICP test, which had increased to 31 mmHg and was now slightly over the 30 mmHg standard level that suggests fasciotomy intervention to alleviate the pressure. She was transported by ambulance to the local

***Corresponding author:** Nancy A Bergquist, Global Neuroscience Initiative Foundation, University of Colorado-Colorado Springs, USA, Tel: 719-255-8227; E-mail: dmb81@gmail.com

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hospital for further evaluation. A full left leg ultrasound was performed to rule out deep vein thrombosis (DVT) and was ruled negative. She was rushed to surgery where a lateral fasciotomy was performed on the left lower leg to release all four compartments. A small hematoma in the left anteromedial proximal tibia area of her prior knee surgery was also discovered at that time and was evacuated. When the ICP measured 32 mmHg, both her original sports medicine orthopedic surgeon and an orthopedic surgeon specializing in the ankle proceeded with lateral fasciotomy. The fascia was released producing immediate bulging of the muscle tissue, which was edematous but normal in color. She was then admitted to the hospital with a left lower leg wound measuring 17 cm by 9 cm with tissue extruding approximately 1 cm. Her symptoms of paresthesia and paralysis in her ankle joint continued despite the fasciotomy. 2 mg/hour hydromorphone (Dilaudid) IV drip was used but the pain remained debilitating for her and she was unable to ambulate, requiring observation for DVT threat. Her wound was dressed but left surgically unclosed.

Surgical closure was attempted two days later on November 19, 2011. The extruding muscle was noted to be bright red with some bleeding, indicating successful blood flow to the tissues. Musculature in the posterior, deep posterior and lateral compartment was normal in appearance and contractile to Bovie type stimulation. The anterior compartment showed hemorrhagic changes particularly in the most proximal portion of the tibialis anterior without liquefaction or obvious malodorous component and the distal portion of the muscle was contractile to stimulation. The wound was cleansed with antibiotic irrigation, debrided, and redressed as closure was not possible at that time.

Surgical closure was again attempted two days later on November 21, 2011 with concurrent plastic surgery consultation. There was hemorrhagic muscle in the proximal anterior compartment and the mid portion of the deep posterior compartment without drainage, liquefaction, or odor. The wound was irrigated again with a mixture of antibiotic and saline solution and fitted with a negative pressure wound therapy unit (V.A.C.) to help promote granulation and draw the wound edges together.

The patient was discharged another two days later on November 23, 2011 and was placed in a passive motion machine at home to prevent locking of her left knee following the Fulkerson knee surgery. Due to continued pain intensity, 1-20 mg oxycodone (OxyContin) was prescribed twice daily (BID), 2-5 mg oxycodone every four hours (Q 4 hrs) for pain control, 3-300 mg pregabalin (Lyrica) three times daily (TID) as an anticonvulsant, 1-10 mg cyclobenzaprine (Flexeril) three times daily (TID) as a muscle relaxant, as well as an antibiotic three times daily (TID). Pain remained at an intense level in spite of the medications. She was bedridden and used a walker with no weight bearing for bathroom trips. Home nurse visits occurred every other day to remove and reapply new dressing. The dressing changes were painful with some debridement occurring with each change.

Three weeks later on December 12, 2011, a plastic surgeon decided the defect had healed enough to accommodate wound closure surgery. A section of the tibialis anterior muscle was noted to be necrotic during surgery, it was debrided and the wound closed with 3-0 polyglactin (Vicryl) sutures to re-approximate the deep dermis and 4-0 poliglecaprone (Monocryl) suture to re-approximate the skin. A Jackson-Pratt type drain was placed to minimize risk of seroma or hematoma. The skin was not able to be pulled together to be completely closed so petrolatum impregnated gauze dressing with 3% bismuth tribromophenate gauze (Xeroform) was used over the incision and

changed daily to keep the wound moist and clean. The patient was transported to recovery and noted to have tolerated the procedure well.

Two weeks later on January 4, 2012, the patient was able to start physical therapy to rehabilitate both her knee and leg. She required a dorsiflexion assistive brace and crutches during ambulation. Toe touch weight bearing for one month was ordered while the wound completely healed. Physical therapy was focused on knee motions and stability. The patient experienced neuropathy pain in her foot with any touching contact. Two months of therapy allowed the patient to transition from crutches to walking with the brace only. She wore a special brace during rest and at night to force dorsiflexion in her ankle to prevent drop foot syndrome.

Four months after the wound closure, in April 2012, a bulbous accumulation of fluid was noted at the Fulkerson surgery site. Her orthopedic surgeon initiated antibiotic treatment and determined screws from the original knee surgery were infected and needed to be surgically removed. Forty-nine percent of patients in a study from 1999 to 2004, with 41 modified Fulkerson osteotomies performed in 34 athletes required removal of screws from the original surgical site [7]. Her plastic surgeon performed concurrent scar revision of the lateral fasciotomy incision site to provide a more cosmetically acceptable scar at this time as well. Physical therapy was reinitiated once the patient was cleared for weight bearing. During this time the patient removed herself from all medication against medical advice but continued with physical therapy.

The patient ran a five-kilometer race on the one-year anniversary of her original procedure and continues to be active with running, volleyball, and hiking. Currently, the patient has mild left anterior tibialis muscle weakness, cosmetic deformity of the lower leg from atrophy, an approximate 10 inch surgical scar on the lateral side of her lower left leg, and approximately 20 degrees reduction of left foot dorsiflexion compared to the right.

Discussion

Diagnosing ACS has historically been accomplished via a large bore needle device measuring intracompartmental pressures. CCS/CECS is diagnosed based on historical and physical exam findings combined with elevated intracompartmental pressures. Direct static testing with a large bore needle device is the most common instrument used for diagnosis but controversy exists regarding evidence of standardization of the procedure [8]. Standardized approaches using dynamic limb testing with transducer-tipped catheters and using radiographic techniques are under investigation. Sequential ICP monitoring is suggested in the literature to determine a patient's ICP trend versus waiting for the standard 30 mmHg minimum compartment pressure or clinical signs and symptoms before initiating surgery [9]. This approach has been shown to decrease the time to fasciotomy surgery and subsequent sequelae [10]. This case history displays a time to surgery based on ICP pressure while in the presence of near immediate clinical signs and symptoms of ACS after her knee surgery which supports the literature that relates a time lag of clinical signs and symptoms behind ICP changes [11].

Conclusion

ACS is a progressive limb threatening diagnosis that should be considered with patients with intractable pain and limb paralysis regardless of reaching a measured standard compartment pressure with ICP monitoring. Further research has already been recommended in the literature using large studies to better formulate standards and

protocols in both diagnosis and treatment procedures for ACS. Accurate and detailed understanding of limb neurology, physiology, and anatomy is crucial for successful procedural outcome of ACS. An awareness of the many causative reasons for compartment syndrome for improved case management should also be an important educational objective for broad spectrum health care professionals who may encounter compartment syndromes in practice.

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