Treatment of Atypical Compartment Syndrome Due to *Proteus* Infection

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**abstract**

Compartment syndrome is an orthopedic emergency with a multitude of etiologies. Although it is most commonly associated with trauma to the extremity, hematoma and infection are 2 rare etiologies of insidious compartment syndrome. *Proteus mirabilis* is an opportunistic gram-negative species that can infect the respiratory tract, urinary tract, and open wounds. The authors present the case of a 69-year-old woman who developed tissue necrosis and compartment syndrome secondary to an untreated hematoma infected by *P mirabilis*. This case involves an atypical presentation caused by an untreated infected hematoma, emphasizing the need for a high index of suspicion. Current literature supports immediate surgical intervention in the clinical scenario of fulminant compartment syndrome, regardless of compartment pressure findings. The probability of compartment syndrome in the patient presenting with pain, paresthesias, paresis, and pain with passive stretch, all of which were positive findings in this patient, has been reported to be 98%. Thus, Doppler evaluation and intercompartmental pressures were considered but forgone to expedite operative treatment. Emergent 4-compartment fasciotomies, with excision and debridement of nonviable tissue, are potentially limb-saving procedures, intended to limit loss of function and obviate the need for lower extremity amputation. The decision was made to perform a dual-incision fasciotomy to avoid contamination of the uninvolved compartments with a standard single-incision approach. To date, this represents the first report in the English literature of the insidious onset of tissue necrosis secondary to a *Proteus*-infected hematoma, highlighting a unique etiology of atypical compartment syndrome. [Orthopedics. 2017; 40(1):e176-e178.]

Compartment syndrome is an orthopedic emergency, frequently associated with traumatic injuries to the extremities, requiring immediate surgical evaluation and management.† Hematoma and infection are 2 rare etiologies of insidious compartment syndrome that warrant a high index of suspicion.**2-4 Proteus mirabilis** is a gram-negative species and an opportunistic pathogen that can infect the respiratory tract, the urinary tract, and open wounds.**5** To date, a *Proteus*-infected hematoma causing tissue necrosis and insidious compartment syndrome has not been reported in the English literature. Emergent compartment fasciotomies with excision of nonviable infected tissue are potentially limb-saving procedures, preserving lower extremity function, limiting disability, and obviating the need for lower extremity amputation. This case highlights the insidious nature of an atypical compartment syndrome caused by an untreated infected hematoma and the need for immediate surgical intervention.

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for a high index of suspicion with immediate surgical intervention.

**CASE REPORT**

A 69-year-old woman with a significant history of atrial fibrillation taking anticoagulation medication presented to the emergency department with a 3-day history of progressive pain and ecchymosis over the lateral aspect of her right leg, after sustaining a mechanical fall. At the time of injury, she reported no acute pain or significant ambulatory limitation. Plain radiographs of the lower extremity showed no evidence of acute osseous injury or malalignment. The emergency department personnel subsequently discharged the patient home with recommendations of ice, anti-inflammatory medications, and elevation.

Forty-eight hours later, the patient returned to the emergency department reporting increased pain, swelling, and weakness of the lower extremity. On examination, she exhibited a fluctuant and draining hematoma with a necrotic eschar at the previous contusion site (Figure 1A). Physical examination revealed a tense and painful anterior and lateral compartment, decreased sensation over the deep peroneal nerve distribution, and foot drop with pain with passive range of motion. Dorsalis pedis pulses were decreased but palpable.

Emergent right leg compartment fasciotomies, excision of the necrotic eschar, and irrigation and debridement of the infected hematoma and surrounding infected tissue were clinically indicated for the patient. A 2-incision fasciotomy, used to release all 4 compartments, was performed by the senior author (M.L.W.). The infected necrotic eschar and hematoma were promptly cultured. All nonviable tissue was sharply debrided and removed (Figure 1B). Negative pressure dressings were applied to the wounds, with intermittent suction at 75 mm Hg. Intraoperative cultures revealed pan-sensitive *P. mirabilis*. Based on recommendations from the infectious disease team, antibiotic therapy consisting of metronidazole, levofloxacin, and vancomycin was initiated. The patient underwent 2 additional debridements prior to definitive closure of the medial wound (Figure 2A) and wet to dry dressing changes to the lateral wound (Figure 2B).

Postoperatively, her motor deficits remained unchanged. The foot drop was treated with an ankle foot orthosis brace during recovery. Two weeks after the index procedure, a meshed split-thickness skin graft was applied to the lateral wound (Figure 2C), with negative pressure dressing with intermittent suction at 75 mm Hg to promote graft uptake. Four weeks later, the patient exhibited a mature graft and the lower extremity was viable and free of infection or wound breakdown (Figure 3).

**DISCUSSION**

Acute compartment syndrome is an orthopedic emergency requiring immediate surgical evaluation and treatment. Increased intercompartmental pressures result in the collapse of small vessels and decreased tissue perfusion, ultimately leading to global cell death and tissue necrosis within an anatomic compartment. Although commonly associated with high-energy traumatic insults, compartment syndrome may have more unexpected causes. Although rare, atypical etiologies of compartment syndrome, such as isolated hematomas and local infections, are precarious due to their
Case Report

Within the orthopedic and musculoskeletal literature, P mirabilis has been identified as the cause of osteomyelitis among immunocompromised patients.5 Within the orthopedic and musculoskeletal literature, P mirabilis has been identified as the cause of osteomyelitis among immunocompromised patients.5 The current patient was seen and evaluated by an infectious disease specialist who suspected seeding of the wound with P mirabilis by external contamination, although no skin breakdown over the wound was reported prior to presentation. Although this patient had no known immunodeficiencies, a high level of suspicion should be maintained surrounding Proteus wound infections.

Emergent compartment fasciotomies with excision of the nonviable infected tissue are potentially limb-saving procedures, preserving lower extremity function, limiting disability, and obviating lower extremity amputation.1 Acute compartment syndrome is a primary indication for fasciotomy. Although current diagnostic tools are effective, thorough clinical evaluation and judgment remain the first-line means of early identification of compartment syndrome. This patient presented with a full clinical spectrum of symptoms for compartment syndrome. A previous study on the diagnosis of compartment syndrome reported a probability of 98% for compartment syndrome in patients presenting with pain, paresthesias, pain with passive stretch, and paresis,10 all of which were found on examination of the current patient. Of note, pain with passive stretch has been documented as the most reliable sign of compartment syndrome.10 As a result, Doppler evaluation and intercompartmental pressures were considered in the current case but not applied to expedite operative treatment. Additionally, given this patient’s constellation of signs and symptoms, these modalities would not have changed the indication for emergent surgery. Both single-incision and dual-incision fasciotomy techniques have been presented in the literature for the treatment of acute compartment syndrome.6,7,11 Although reports of both techniques have focused on traumatic compartment syndrome in the setting of high-energy fractures, the outcomes have been uniformly equivocal. For the current patient, the decision was made to perform a dual-incision fasciotomy to avoid contamination of the uninjured compartments with a standard single-incision approach. Although negative outcomes, including chronic pain, sensory deficits, and persistent foot drop, have been noted with relative frequency, fasciotomy is also understood to be a limb-salvaging procedure if conducted prior to the onset of total myoneural ischemia.12-14 Previous studies have reported a decreased incidence of infection after vacuum-assisted wound closure15; with this in mind, the current authors elected to use a negative pressure dressing.

Conclusion

To date, a P mirabilis-infected hematoma causing tissue necrosis and insidious compartment syndrome has not been reported in the English literature. This case highlights the need for a high index of suspicion for insidious compartment syndrome resulting from an infected hematoma sustained from a low-energy injury. Current literature supports immediate surgical intervention in the clinical scenario of fulminant compartment syndrome, regardless of compartment pressure findings. Emergent 4-compartment fasciotomies with excision and debridement of nonviable tissue are potentially limb-saving procedures.

References