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CASE REPORT

Contralateral compartment syndrome inoculated by invasive group A streptococcus

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Compartment syndrome is a rare but a well-documented complication in patients with trauma-induced group A streptococcus infection. Here, we present a case of a male who developed compartment syndrome on the left lower extremity after an injury inoculated by group A streptococcus on the right lower extremity. The patient was resuscitated with antibiotics, urgent fasciotomy, and immunoglobulin. The patient was eventually transferred to a burn center for further care.

Keywords: *group A streptococcus*; *toxic shock syndrome*; *acute compartment syndrome*; *multi-organ failure*

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The incidence of invasive group A streptococcal (GAS) infection leading to toxic shock syndrome has been well described in the literature, with typical cases being associated with deep soft tissue infection secondary to trauma. Toxic shock syndrome is almost always associated with poor outcomes and complications including acute respiratory distress syndrome, multi-organ failure, and necrotizing fasciitis. There have been some cases of compartment syndrome secondary to toxic shock syndrome reported, but the incidence is far less common. We present an unusual case of lower extremity compartment syndrome due to GAS initiated by contralateral limb trauma.

Case description

A 50-year-old African-American male with a history of moderate alcohol use and non-insulin-dependent diabetes mellitus presented to the emergency department for worsening right foot pain for 2 months after a heavy object landed on his right foot. He reported intense swelling of the foot with associated weeping of the skin on the right calf but denied paresthesias. Vitals were blood pressure 141/67 mmHg, heart rate 83 bpm, temperature 97.8°F, and 22 respirations per minute. Physical examination showed darkening of the skin on the dorsum of the right foot, bullous formation on the right calf, and tenderness to palpation at right calf (Fig. 1). The left calf also had darkening of the skin, but no muscle tenderness or rigidity on examination (Fig. 2). Pulses were present bilaterally. A basic metabolic panel showed sodium 121 mEq/L (135–145 mEq/L), potassium 3.8 mEq/L (3.5–5.0 mEq/L), chloride 91 mEq/L (95–105 mEq/L), bicarbonate 14 mEq/L (22–29 mEq/L), blood urea nitrogen (BUN) 27 mg/dL (6–20 mg/dL), and creatinine 3.75 mg/dL (0.6–1.3 mg/dL). A complete blood count (CBC) showed a white blood cell count (WBC) of 7.6×10^9/L ($3.5–10.5 \times 10^9$/L), hemoglobin 9.6×10^9/L (13.5–17.5 g/dL), and platelets 93×10^9/L ($150–450 \times 10^9$/L). Labs were significant for a lactate of 4.5 mmol/L (0.5–2.2 mmol/L) and aspartate aminotransferase (AST) 142 U/L (8–48 U/L). Clinical

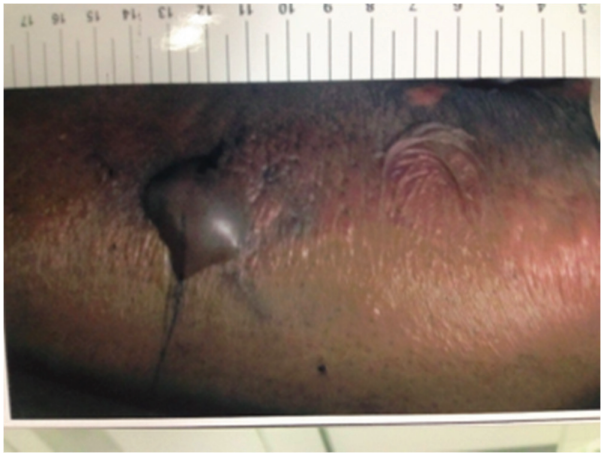

Fig. 1. Right calf with bullous formation.

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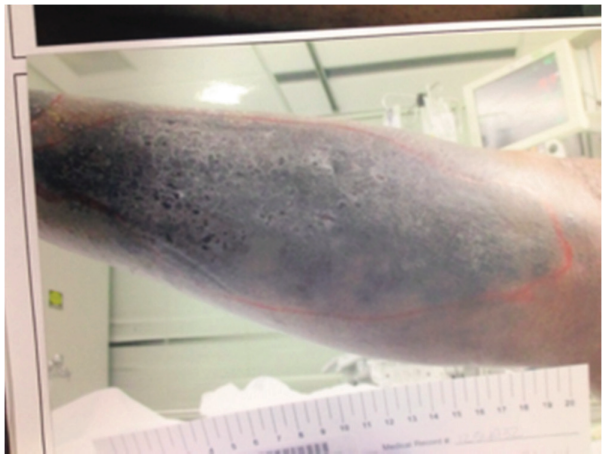

Fig. 2. Left calf.

presentation was suggestive of severe sepsis secondary to the right calf infection. Blood cultures were drawn. Afterward, he was given vancomycin and piperacillin/tazobactam and was taken for surgical debridement of the wound. A tissue sample from the right leg was taken. Exploration of the wound revealed suppurative fluid in the right lower extremity on the medial and lateral sides as well as dead subcutaneous soft tissue. Fascia below was viable and found healthy. After the procedure, he was transferred to ICU due to hemodynamic instability.

His medical condition worsened. The morning of his second hospital day (post-operative day 1 from right leg debridement), his WBC was 22.4×10^9/L, lactate 11.4 mmol/L, troponin 1.34 ng/mL (<0.05 ng/mL), creatine kinase- MB (CK-MB) 16,887 (30–200 IU/L). Dark brown urine was noted in the Foley bag. Urine analysis showed blood, but urine microscopy lacked RBCs. He temporarily began renal replacement therapy for worsening renal failure and was given a blood transfusion for coagulopathy in the setting of liver failure. Due to lack of improvement with medical intervention, the patient was taken to the operating room for right leg fasciotomy. The anterior, medial, and superficial posterior compartment muscle groups showed gross tissue swelling without necrosis. Post-operatively, the CK-MB decreased to 16,134 IU/L.

The patient's WBC raised to 29.9×10^9/L following the surgery and his creatine phosphokinase (CPK) decreased from 16,134 to 14,461 U/L after his right leg fasciotomy, the following day. CT scan, without contrast, of the lower extremities showed diffuse soft tissue edema bilaterally but no gas/abscess under the muscle groups (Fig. 3). Due to lack of clear clinical improvement from his first two surgeries, increased tissue tension in the left lower extremity, the decision was made to perform an exploratory fasciotomy on the contralateral leg. Surgery revealed bulging muscles of the anterior and medial compartments under pressure. All tissues were viable on clinical examination intraoperatively. After the left leg fasciotomy, the

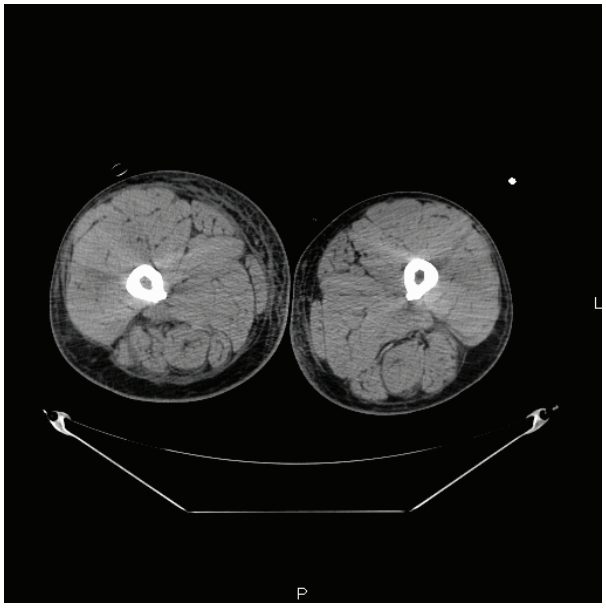

Fig. 3. CT scan without contrast. Diffuse soft tissue swelling seen bilaterally without gas or abscess.

patient's CPK levels decreased sharply in the following hours from 14,461 to 7,009 U/L. On post-operative day 1, from the left leg fasciotomy, the CPK fell to 5,301 U/L. Blood cultures were negative. Tissue sample from the right leg debridement showed group A beta hemolytic streptococcus. Clindamycin with intravenous immunoglobulin was added to the treatment plan. His clinical picture gradually improved until the patient was awake and was able to follow commands. He was transferred to the burn unit for further management.

Discussion

This case illustrates a unique case of trauma-induced invasive GAS leading to toxic shock syndrome and contralateral compartment syndrome. GAS is commonly found in the pharynx, on the skin, or in vaginal area. When it is found in other parts of the body, it is usually associated with higher virulence. The review of literature reveals cases of trauma-induced GAS compartment syndrome causing either ipsilateral upper limb compartment syndrome (1) or lower limb unilateral compartment syndrome (2). Cases of lower bilateral compartment syndrome from GAS were more commonly reported as having a non-traumatic origin (3, 4). The non-traumatic etiology commonly involved an upper respiratory tract infection/vaginal infection or pharyngitis (3). In our case, the etiology was from trauma which introduced the GAS into the right foot. The etiology was established as GAS based on the positive tissue culture from his first operation. The development of coagulopathy, multi-organ failure, and distributive shock, requiring pressor

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medications, was diagnostic for toxic shock syndrome (5). The patient presented with right lower limb mild trauma subsequently complicated by toxic shock syndrome. While supportive care was provided to him, he developed compartment syndrome on the contralateral side of the infection site. Necrotizing fasciitis, which is a rare but well-described complication of GAS, was initially suspected in the patient, but debridement and fasciotomy showed only mild necrotic soft tissue and no necrosis of the fascia. However, the lack of clinical improvement with abnormal physical examination prompted a search for additional pathology. Although compartment syndrome is usually diagnosed by measuring compartment pressure, our diagnosis was made clinically through the perioperative finding of bulging tissue swelling due to elevated compartment pressure. After the left leg fasciotomy, the rapid downtrending of the CPK level further supported the diagnosis of compartment syndrome. The accumulated medical literature shows that GAS can cause compartment syndrome distant from its initial source and our case is another example in that pattern.

There are two possible mechanisms that could have led to the compartment syndrome. The first is possibly from the streptococcal toxic shock syndrome itself. The syndrome is due to exotoxins A and B. These exotoxins act as superantigens which bind major histocompatibility complex class II molecule and T-cell receptor on antigen-presenting cells (6). This leads to overactivation of T cells and antigen-presenting cells, followed by secretion of inflammatory mediators such as IL-1, IL-6, and Tumor necrosis factor-α (TNF) (7). This cascade leads to shock and tissue injury (8). A cytokine storm from the toxic streptococcal syndrome superantigens, especially exotoxins A and B, could have led to tissue edema and subsequently compartment syndrome thus precipitating rhabdomyolysis (4).

Alternatively, the direct effect of the bacteria itself may have played a role by means of hematogenous spread. A case review series of patients with rhabdomyolysis found that patients with GAS had muscle biopsy, a confirmed evidence of the bacteria (9). The authors suggested that direct invasion caused decreased oxidative and glycolytic enzyme activity of the skeletal muscle, along with increased lysosomal enzyme activation (9). Another case review series of patients with compartment syndrome from GAS found that the majority had had positive blood cultures and tissue cultures (3). Our patient probably had transient bacteremia which led to the seeding of the bacteria to the contralateral leg and thus caused the bilateral compartment syndrome. Although the two blood cultures revealed no growth, this does not exclude bacteremia. Two blood cultures can detect 80–90% of bacteremia. More than four blood cultures are needed to have a sensitivity of 99% (10, 11). The direct role of toxin on muscle tissue is less likely as studies have demonstrated toxins from GAS, namely streptolysin O and streptolysin S only cause polymorphonuclear leukocyte or keratinocyte injury (12). In contrast, toxin-induced muscle damage is likely the mechanism of *Legionella* (9) and possibly streptococcal group C (13). In addition, septic shock likely contributed to muscle ischemia which increased his susceptibility for rhabdomyolysis (14). In either pathophysiological scenario, the biopsy finding, the surgical finding of bulging tissue, and rapid clinical improvement with downtrending CPK level after bilateral fasciotomy indicated that patient had compartment syndrome secondary to GAS.

Conclusion

Invasive GAS can lead to toxic shock syndrome by either traumatic or non-traumatic entry. A rare complication from trauma-induced GAS infection is compartment syndrome and even rarer is the contralateral lower limb compartment syndrome. GAS infection may be associated with protean manifestation. Lack of improvement after initial treatment should prompt a search for pathology distant from the original injury site.

Conflict of interest and funding

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