

Toxemic Shock, Hematuria, Hypokalemia, and Hypoproteinemia in a Case of Cutaneous Anthrax

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Abstract

A 20-year-old woman who had daily contact with domestic herbivores presented with a painless and pruritic lesion in her neck; the lesion ulcerated to a black necrotic eschar from which *Bacillus anthracis* grew. Rapidly expanding edema at the site of the ulcer was followed by shock, hematuria, hypokalemia, and hypoproteinemia. The latter symptoms — unusual for cutaneous anthrax — responded to intravenous penicillin therapy.

Key Words: Anthrax, hypokalemia, hypoproteinemia, isolated hematuria, toxemic shock.

Introduction

ANTHRAX IS A WORLDWIDE infectious disease of domestic and wild herbivores; humans may become infected too when exposed to the infected animals or their products (1–6). *Bacillus anthracis* exotoxins mediate most of the symptomatology, causing extensive edema in cutaneous anthrax, and a clinical syndrome reminiscent of septic shock in the visceral form (7, 8). Cutaneous anthrax may be associated with a mortality of 10–20% (4), but there is only one prior case report in which it was associated with toxemic shock (9). To the best of my knowledge, this is the second reported case in which toxemic shock was present, and the first in which the patient developed hematuria, hypokalemia and hypoproteinemia.

Case Report

A 20-year-old Iranian village-woman who had daily contact with sheep and goats presented with a pruritic and painless lesion on the right side of her neck. In two days the lesion ulcerated and evolved into a black necrotic eschar. Progressive edema, starting from the site of the ulcer, extended rapidly to the face, neck,

shoulders, chest, and breasts. Due to increasing shortness of breath, she was referred to the Nemazee Hospital of Shiraz University of Medical Sciences, where she was found to be disoriented. Her systolic blood pressure was 30 mm Hg, her pulse rate 120 /minute, her respiration rate 27/minute, and her rectal temperature normal. Visible on the right side of her neck was a round ulcer measuring 2 cm, with black necrotic center, raised borders and small satellite vesicles around it, along with massive, non-pitting brawny edema of face, neck, shoulders, and upper part of the chest wall. An arterial blood gas analysis showed pH of 7.20, CO₂ of 12 mEq/L, P_{CO2} of 24 mm Hg, and P_{O2} of 100 mm Hg. A chest X-ray was normal and electrocardiogram disclosed sinus tachycardia. Central venous pressure (CVP) was 1 cm saline. Intravenous penicillin G (4 million units every 6 hours) and intravenous fluids were started. After 2 L of intravenous normal saline, her blood pressure increased to 60–80 mm Hg and her CVP to 2–3 cm saline, and she became oriented to time, person and place. Thereafter, intravenous fluid therapy was administered at a rate to keep CVP about 3 cm saline.

A large, encapsulated gram-positive rod consistent with *Bacillus anthracis* was demonstrated in scrapings taken from necrotic tissue. Admission laboratory test results were: hemoglobin (Hb) 18.4 g/dL, white blood cell (WBC) count 27,500 mm³ (80% polymorphonuclear cells, 17% lymphocytes, and 3% bands), and platelet count 113,000 mm³. Liver function tests were: total serum protein 4.6 g/dL, albumin 1.8 g/dL, AST 38 U/L, ALT 23 U/L, total

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bilirubin 1.1 mg/dL, and alkaline phosphatase 170 U/L. Coagulation profile disclosed the following results: prothrombin time 21 seconds with control of 13 seconds, activated partial prothrombin time 49 seconds (normal 32–46 seconds), fibrinogen level 37.5 mg/dL (normal 200–400 mg/dL), and fibrin degradation product (FDP) 30 mg/dL (normal 5–9 mg/dL). Blood urea nitrogen (BUN) was 40 mg/dL (normal 10–20 mg/dL), with concomitant serum creatinine of 0.9 mg/dL. Serum sodium was 137 mEq/L and serum potassium was 4.6 mEq/L.

On the first hospital day, the patient passed 1.5 L of tea-colored urine which disclosed 3+ blood, and many normal-looking red blood cells/HPF with no protein or casts. Thereafter, repeated urinalysis disclosed hematuria, the severity of which gradually decreased. Eventually, the hematuria disappeared during the second week of hospitalization.

By the second hospital day, blood pressure had increased to 90 mm Hg and CVP had risen to 3 cm saline. On the 3rd day, a serum potassium level of 1.8 mEq/L was reported, while the concomitant urine potassium level was 29 mEq/L. Intravenous potassium chloride 20 mEq/hr was then started. This dose was reduced to 60 mEq/day when serum potassium concentration became normal, on the 4th day. At that time, the hemoglobin level and platelet count dropped to 9.4 g/dL and 50,000/mm³ respectively, but the WBC count increased to 37,500/mm³. Repeated throat, urine, stool and blood cultures were negative, but the wound cultures grew *Bacillus anthracis*. Complement (C3, C4, CH50) levels were normal. Antibodies for hepatitis B and C viruses, antinuclear antibody, VDRL, and ANCA were negative. Creatine phosphokinase and lactate dehydrogenase were normal (59 U/L and 170 U/L respectively). Ultrasonography and CT scan of abdomen and pelvis were normal. During 14 days of penicillin therapy, edema gradually disappeared and the neck ulcer evolved into a crusted black lesion. Four weeks after the patient's discharge from the hospital, her laboratory results were: platelet count 130,000/mm³, serum potassium 4 mEq/L, total serum protein 6.9 g/dL, albumin 3.7 g/dL, and normal urinalysis. Her physical examination, urinalyses, and abdominal and pelvic sonography have remained completely normal during one year of follow-up.

Discussion

In visceral anthrax, extensive edema, as a result of capillary wall dissolution and venous obstruction (induced by *Bacillus anthracis* tox-

ins), may lead to systemic shock and death (7, 8). In contrast, circulatory shock is very rare in cutaneous anthrax and has only been the subject of one case report (9). Coexistence of hemoconcentration, pre-renal azotemia (BUN/creatinine ratio > 20), and massive edema on admission, associated with repeated negative blood cultures, suggests that *Bacillus anthracis* toxin induced leakage of intravascular fluid into the interstitial space, causing severe volume depletion and circulatory shock.

To the best of my knowledge, hematuria has not been reported previously in patients with cutaneous anthrax. Hematuria was repeatedly found in this patient but disappeared gradually within two weeks. The patient had not been catheterized, and no other obvious cause for hematuria was discovered. It is possible that platelet thrombi induced by *Bacillus anthracis* resulted in renal vein thrombosis and/or hematuria of glomerular origin; but absence of proteinuria, dysmorphic red blood cells and red cell casts makes hematuria of glomerular origin very unlikely. However, the sequential occurrence and disappearance of hematuria following circulatory shock, along with low fibrinogen, high FDP, thrombocytopenia, and prolonged prothrombin time strongly suggests that disseminated intravascular coagulation was the underlying mechanism for the hematuria.

Hypoalbuminemia has been reported previously in a patient with cutaneous anthrax and toxic shock (9). This is the second reported case of cutaneous anthrax with hypoalbuminemia and the first one in which hypoproteinemia developed. The underlying mechanism(s) of hypoproteinemia in this case is not clear. There was no evidence of liver cirrhosis, chronic viral hepatitis, malnutrition, glomerulonephritis, generalized weeping skin disease, or protein-losing enteropathy. Coexistence of extensive non-pitting edema, severe hemoconcentration and pre-renal azotemia suggests that intravascular protein leaked through capillary endothelium damaged, apparently reversibly, by *Bacillus anthracis* toxins.

This is also apparently the first reported case of cutaneous anthrax in which severe hypokalemia developed. Given that the patient's urine potassium concentration was 29 mEq/L in the absence of massive diuresis, her hypokalemia cannot be attributed to renal potassium loss or low potassium dietary intake.

The present case emphasizes that patients with cutaneous anthrax can develop *Bacillus anthracis* toxin-induced circulatory shock that

may be associated with hematuria, hypokalemia and hypoproteinemia. Prompt recognition and treatment is essential.

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