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Thoracic Duct Chylous Fistula Following Severe Electric Injury Combined with Sulfuric Acid Burns: A Case Report

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Male, 32
Final Diagnosis: Thoracic duct chylous fistula
Symptoms: Fistula
Medication: —
Clinical Procedure: A boneless muscle flap transplantatio
Specialty: —

Objective: Rare disease





Background: As patients with thoracic duct injuries often suffer from severe local soft tissue defects, integrated surgical treatment is needed to achieve damage repair and wound closure. However, thoracic duct chylous fistula is rare in burn patients, although it typically involves severe soft tissue damage in the neck or chest.

Case Report: A 32-year-old male patient fell after accidentally contacting an electric current (380 V) and knocked over a barrel of sulfuric acid. The sulfuric acid continuously poured onto his left neck and chest, causing combined electrical and sulfuric acid burn injuries to his anterior and posterior torso, and various parts of his limbs (25% of his total body surface area). During treatment, chylous fistula developed in the left clavicular region, which we diagnosed as thoracic duct chylous fistula. We used diet control, intravenous nutritional support, and continuous somatostatin to reduce the chylous fistula output, and hydrophilic silver ion-containing dressings for wound coverage. A boneless muscle flap was used to seal the left clavicular cavity, and, integrated, these led to resolution of the chylous fistula.

Conclusions: Patients with severe electric or chemical burns in the neck or chest may be complicated with thoracic duct injuries. Although conservative treatment can control chylous fistula, wound cavity filling using a muscle flap is an effective approach for wound healing.

MeSH Keywords: Burns • Fistula • Thoracic Duct

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Background

Thoracic duct chylous fistula is a rare complication that typically occurs in patients who are undergoing neck or chest surgeries [1]. However, this fistula increases the risk of infection, bleeding, hypovolemia, electrolyte imbalance, and malnutrition, and also results in delayed wound healing. In severe cases, thoracic duct chylous fistula can progress to chylothorax and mediastinal chylous fistula, which increases the risk of mortality [2]. In this report, we describe a burn patient with combined electrical and sulfuric acid burn injuries who was diagnosed with thoracic duct chylous fistula. He was successfully treated via integrated conservative and surgical treatments.

Case Report

The patient was a 32-year-old male chemical factory worker without any notable medical history. While servicing a machine, the patient contacted a 380 V electric current through his left arm and subsequently fell unconscious. During his fall, he knocked over a barrel filled with sulfuric acid. The 98% sulfuric acid continuously poured over the left side of his neck and chest, and caused combined electrical and sulfuric acid burn injuries (25% of his total body surface area). However, the residual sulfuric acid was not removed until he was brought to the local hospital 32 min later.

At 11 h after the injury, he was transferred to our hospital. His arterial blood gas analysis revealed a pH of 7.15, a PO_2 of 297 mmHg, a PCO_2 of 32 mmHg, HCO_3^- levels of 11.4 mmol/L, and a -17 base excess in the extracellular fluid compartment. The pH of his wound exudates was 5. Our examination revealed that numerous portions of the left neck and chest muscles were necrotic. The left clavicle was also clearly exposed and necrotic, and a cavity was present above the left supraclavicular fossa (Figure 1). The majority of the left forearm muscle group was necrotic, which had resulted in total loss of the left arm's sensory and motor functions. Our diagnoses were burns (both electrical and concentrated sulfuric acid) to 25% of his total body surface area, with third-degree (18%) and fourth-degree (7%) burns to his head, torso, and limbs.

On the second day of admission, escharotomy was performed on the patient's torso and left arm. The left subclavian vein was found to be embolized and fractured. In addition, the left brachial plexus had necrotized, whereas the left subclavian artery was still pulsing (Figure 2). Therefore, we ligated the left subclavian artery and vein. The wound was filled with hydrophilic silver ion-containing dressings (AquacelAg®, ConvaTec, US) to facilitate wound drainage. Three days after the surgery, the patient started consuming some fluid food (milk). We subsequently observed that a high volume of milky exudate was

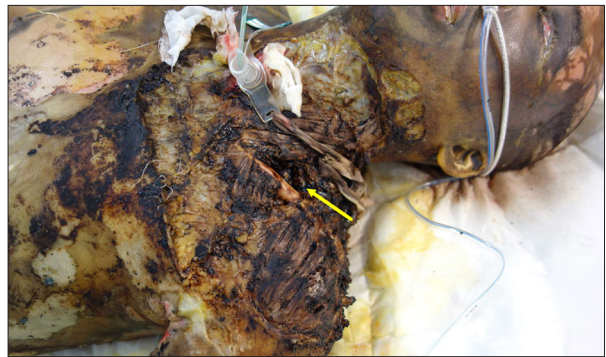


Figure 1. A cavity above the left supraclavicular fossa (arrow).

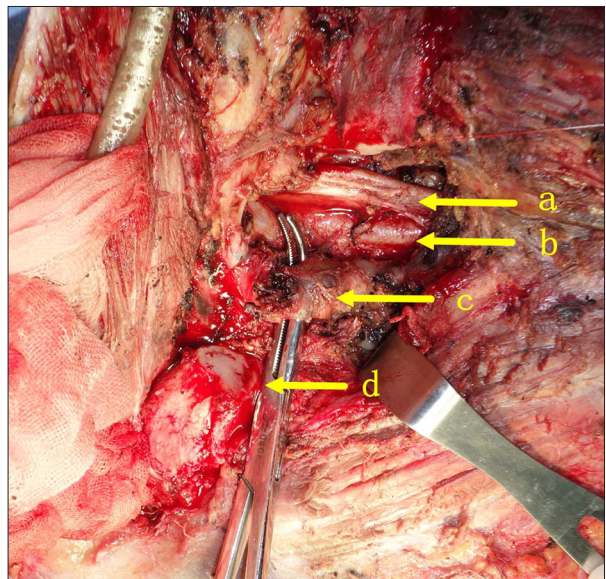


Figure 2. Necrotized left brachial plexus, fractured left subclavian vein, and a pulsing left subclavian artery. The cavity above the left supraclavicular fossa exposed the left brachial plexus (a), subclavian artery (b), and subclavian vein (c) after removing the middle portion of the left clavicle (d).

secreting from the wound near the left clavicle (Figure 3). After we verified that the milky exudate was chyle, we subsequently diagnosed the patient with thoracic duct chylous fistula.

After the diagnosis was confirmed, conservative treatment was administered to reducing the amount of chylous fistula drainage, including fasting, dietary management, and application of somatostatin. The patient also underwent several rounds of debridement. However, the severity and size of the soft tissue defects in the left neck and chest area complicated not only the seal of orificium fistulae of thoracic duct, but also the repair of the wound surfaces. Local and free flaps could not be used in this patient, which forced us to utilize unconventional flaps. Considering the urgency of surgical coverage of the necrotic wound cavities, and the reality that the patient's left



Figure 3. Wound drainage near the left clavicle after milk consumption. Five days after the injury, significant drainage of chyle-like fluid was observed issuing from the left clavicle wound after the patient consumed milk.

forearm, limb salvage value was judged to be lost. After most of the necrotic tissues had been removed from the wound, the distal muscle necrosis on the left arm was amputated, the distal bone of the humeral neck was removed, and the residual left arm muscles formed a huge local boneless muscle flap that was used to fill and seal the wound cavity near the left clavicle, which completely survived. After 45 days of treatment, all of the patients' wounds were essentially sealed (Figure 4). The patient was followed-up for 1 year, and no recurrence was found.

Discussion

The thoracic duct is located in the deep tissues, and thoracic duct chylous fistula is relatively rare in burn patients. However, we believe that the thoracic duct chylous fistula in this case was likely a primary injury, rather than a secondary injury sustained during the surgery or dressings. This hypothesis is supported by 2 points. (1) Concentrated sulfuric acid and electric shock can both cause severe burns, and it is rare to encounter both injuries in the same patient. During the surgery, we identified a large number of carbonized blood



Figure 4. Healed wound surfaces.

deposits in the blood vessels of the neck and chest, as well as embolization and fracture of the left subclavian vein. Both of these findings are direct evidence of circulatory injury caused by an electric current. Furthermore, the sulfuric acid residuals were not immediately removed, and they continued to damage the left supraclavicular fossa region, which likely contributed to the deep tissue damage in that region. We believe that this damage led to the thoracic duct chylous fistula, as the patient continued to suffer from acidosis, despite receiving intravenous fluid support. Furthermore, his arterial blood pH was 7.15 and he had a -17 base excess in the extracellular fluid compartment, whereas the pH of his wound exudates was 5; this combination of findings is rare, even among patients with intensive burns. (2) Although there are many variations for the termination of the thoracic duct, the ligation positions for the patient's left subclavian vein and subclavian artery were under the middle portion of the left clavicle, which makes it unlikely that direct injury of thoracic duct occurred during the surgery. In addition, the left supraclavicular fossa was stuffed and drained using hydrophilic dressings. It

is also unlikely that this dressing procedure caused injury to the thoracic duct. Furthermore, the patient did not undergo any other operations between the surgery and the diagnosis of the thoracic duct chylous fistula, which precludes any surgical injury in the interim.

The diagnosis of thoracic duct chylous fistula relies primarily on the patient's medical history and symptoms. Furthermore, a high level of triglycerides (>100 mg/dL) in the drainage fluid would support a diagnosis of chyle leak [3]. However, thoracic duct chylous fistula can easily be missed in the early treatment of burn patients, as these patients are commonly fasted or given an oil-free fluid diet in the early treatment stage due to their injured condition and the need for surgery. Therefore, any wound drainage would not exhibit the typical milky appearance of chyle, and the high volume of drainage from burn wounds would also make detecting a chylous fistula difficult.

In this case, the patient likely experienced primary injuries to the thoracic duct, and the injury sites contained a considerable amount of necrotic tissues. Therefore, we could not perform a ligation procedure [4] or utilize biological glue to seal the chylous fistula site [5] due to the high risk of failure. As a result, we initially selected conservative treatment to reduce the amount of chylous fistula in the early treatment stage [4,6,7]. Large tissue flaps were needed to fill and seal the wound cavity near the left clavicle, and most of the muscle around the recipient injury sites

was necrotic and could not be used, such as omohyoid flap, which would always be used in other cases [8]. Furthermore, available free flaps could not be suitably attached to the recipient sites, as the important blood vessels were exposed and damaged, which further increased the risks of failed surgery and major bleeding. Therefore, because the patient's left forearm had major muscle necrosis and complete loss of function, we formed a boneless muscle flap to seal the wound in the left neck and chest area, and also to seal the orificium fistulae of thoracic duct, which resulted in a satisfactory treatment outcome.

Conclusions

Although it is rare in burn patients, the occurrence of thoracic duct chylous fistula should be taken into consideration, especially in patients with severe electric or chemical burns on the left neck or chest. We believe that a "milk experiment" may facilitate an early diagnosis for patients who are suspected of having chylous fistula. Once a diagnosis is confirmed, conservative treatment (e.g., diet control and somatostatin application) can rapidly and effectively reduce the amount of chylous fistula. However, wound coverage using skin flaps is often needed to seal the wound surfaces. In severely injured patients who require urgent wound coverage, and in whom it would be difficult to achieve sufficient coverage, the use of deboned muscle flaps from amputated limbs may be a viable option.

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