Acute heart failure from electrical shock: a case report

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ABSTRACT

A report of a 13-year-old female with respiratory distress following an electrical shock at home and the management undertaken at the hospital in Yei; including implications for South Sudan.

Key words: electrical shock, heart failure, respiratory distress, South Sudan

CASE REPORT

A 13-year-old female was brought to our hospital in distress after sustaining a shock when she placed her left hand on wire coming from the wall socket. Initial assessment showed T 37.1°C, pulse 133/minute, BP 118/42, O_2 saturation 66% on room air, as assessed by pulse oximetry. The patient had marked breathlessness. There were crackles throughout the chest. Heart examination revealed tachycardia without murmurs or gallop rhythm. Her spleen was palpable 4cms below the left subcostal margin. The liver was not palpable. There were multiple blisters, mild swelling and marked pain in so she was unable to fully open or close her left hand (Figure 1a).

She was given O_2 supplementation via nasal cannulae and IM diclofenac 75 mg for severe pain. On O_2 2 Lpm, her O_2 saturations increased to 84%. She was given dexamethasone 16 mg IV and then frusemide 40 mg IV and her respiratory status improved substantially over one hour Her O_2 saturations increased to 94%, still on 2 Lpm via nasal cannulae. We put Silva-sulphadiazine cream on the burns of her hand with using a sling sheet to minimize the oedema. The oxygen saturations continued to improve. Because of concerns about myoglobinaemia

Figure 1a. This picture shows the hand at presentation. The palm was discoloured. There was induration and the patient was unable to close or open the palm. There were blisters that were assumed to be the primary points of contact with the electrical wire. (Credit: Ann Mutunga)

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Figure 1b. The hand one week later, showing resolution of the induration and normal function of the fingers. The blisters were superficial and not inflamed. (Credit: Ann Mutunga)

Figure 1c. Another view of the hand in recovery. Other than the blisters, there was no evidence of injury. (Credit: Aaron Osman)

leading to obstruction of renal tubules and balanced against the concerns for her heart, we gave a slow infusion of normal saline, 3 L over 18 hours. Ultrasound of the heart showed tachycardia, but normal contractility and size of the ventricles.

The next morning, she had O_2 saturations of 96% on room air. The swelling in the hand was substantially reduced. We treated her empirically for malaria because of the splenomegaly.

One week later, the patient had blisters without evidence of infection on the left hand (Figures 1b and c). The swelling had reduced and normal function had returned. Her BP was 118/50 and pulse 88 / minute. O_2 saturation on room air was 99%. T 36.1°C. The remainder of her examination was normal.

DISCUSSION

The severity of electrical shock varies greatly, from mild discomfort to death. Cardiac complications include dysrhythmias, asystole, and direct injury to the

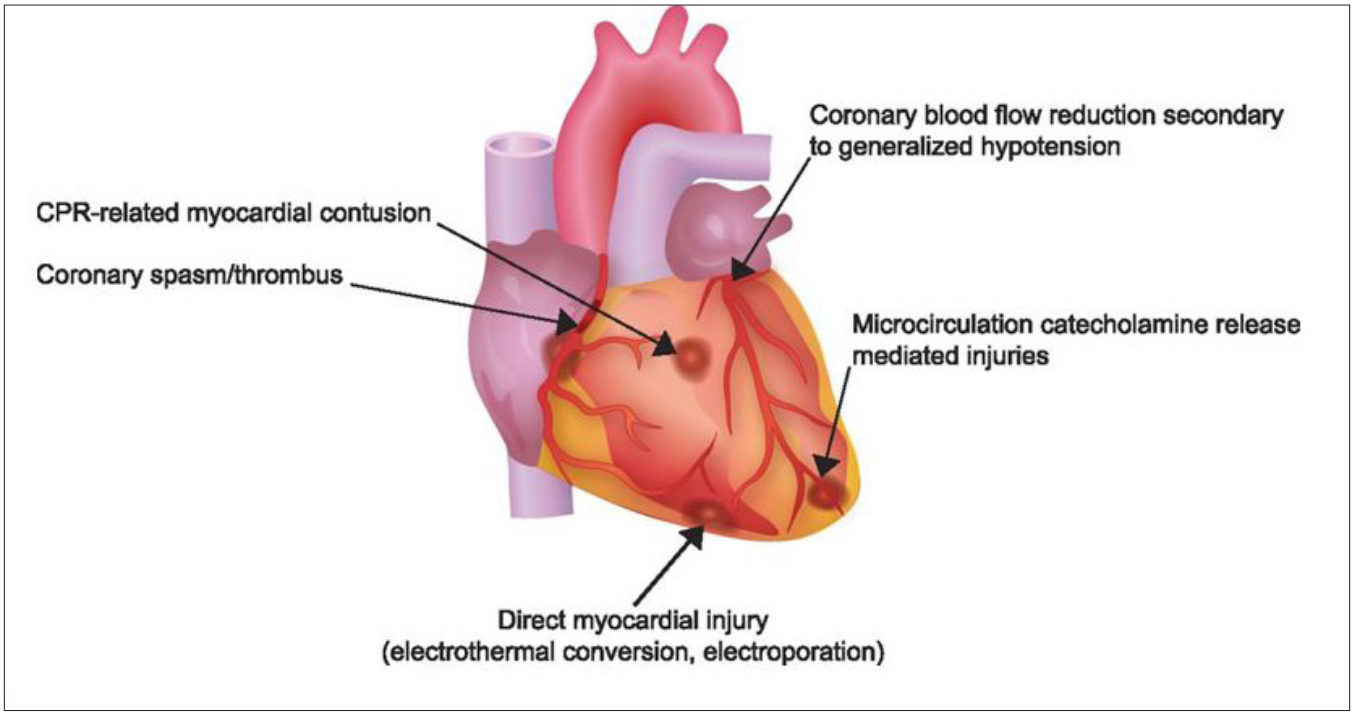

Figure 2. This diagram shows potential means of injury to the heart following an electrical injury, ranging from direct myocardial injury to dysrhythmias to physical injury if CPR was required. (Published with permission from Electrical cardiac injuries: current concepts and management. European Heart Journal 2018;39(16))

Table 1. Power sources and their electrical potential for causing injury (published with permission[1])

Current Intensity (I)	Effect
1 mA	Tingling, barely perceptible
16 mA	Maximum current a person can grasp and 'let go'
20 mA	Muscle tetanization
20–50 mA	Paralysis of respiratory muscles, respiratory arrest
50–100 mA	Ventricular fibrillation threshold
2 A	Cardiac standstill and internal organ damage
15–30 A	Common household circuit breakers

A = Ampere

myocardium.[1] Figure 2. We had no facility to measure cardiac troponins which would reflect myocardial damage. It is uncertain whether there was some myocardial injury in our patient, but her rapid recovery suggests that any damage was minimal. Dilated cardiomyopathy has been described, but that was excluded by ultrasound. Ideally a prolonged period of cardiac monitoring and follow-up is recommended,[1] but our hospital does not have that capacity. However, pulse oximetry is widely available and was invaluable in monitoring our patient.

The young age of our patient may have contributed to her rapid recovery. The frusemide may have been a factor if indeed the pulmonary crackles were a sign of pulmonary oedema. The steroid dexamethasone may have had a role in her recovery, as it is well documented that electrical injury results in damage to cell membranes of muscle and other organs, and may have played a role in protecting against severe myocardial damage. Guidance for the use of corticosteroids is limited. There are reports of late onset dysrhythmias.[1] Finally, renal damage from tubular obstruction secondary to myoglobin released from injured muscle has been reported.[2] The careful administration of fluids was necessary to balance between stressing the compromised heart and the theoretical concern regarding the risk of myoglobinaemia, but we concluded that careful administration of fluids was also important. One reference suggested 0.5 to 1 ml/kg/hour for renal protection[3] although we utilized a slightly higher rate.

Electrical damage can cause significant swelling of the tissues in the hand, potentially resulting in a compartmental syndrome, much like a snake bite.[3] We employed the same techniques we use for snake bites, namely elevation to reduce the risk. Since the tissue has been compromised, it is important to use a loose, non-binding wrap and keep the hand elevated above the level of the shoulder and heart.

SUMMARY

Electrical power is becoming more common in South Sudan, but building codes are frequently ignored. Direct current (from batteries) is generally felt to be less potentially serious than alternating current as from the municipal grid Our patient sustained a significant, potentially fatal, injury from direct current. Table 1 lists the potential amperes from various sources, which makes this patient's injury all the more surprising.

In the United States, there are approximately 4,400 serious electrical injuries annually, with about 400 deaths. About 10% are from lightening.[1] High voltage in industry and heavy equipment accounts for the majority of the rest, but electrical injuries, including fatalities, do occur at home.[1] The suggested monitoring of electrically injured patients is extensive[3] but impractical for most South Sudanese hospitals. We think our management of this patient provides a reasonable template for South Sudanese medical providers faced with similar electrical injuries. Further reports of experiences would be collectively valuable.

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