Electrothermal Ring Burn From a Car Battery

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abstract

Despite prevention efforts, burn injuries among auto mechanics are described in the literature. Electrothermal ring burns from car batteries occur by short-circuiting through the ring when it touches the open terminal or metal housing.

This article describes a 34-year-old male auto mechanic who was holding a wrench when his gold ring touched the positive terminal of a 12-volt car battery and the wrench touched both his ring and the negative terminal. He felt instant pain and had a deep partial-thickness circumferential burn at the base of his ring finger. No other soft tissues were injured. He was initially managed conservatively, but after minimal healing at 3 weeks, he underwent a full-thickness skin graft. The graft incorporated well and healed by 4 weeks postoperatively. He had full range of motion.

The cause of ring burns has been controversial, but based on reports similar to the current patient's mechanism, they are most likely electrothermal burns. Gold, a metal with high thermal conductivity, can heat up to its melting point in a matter of seconds. Many treatments have been described, including local wound care to split- and full-thickness skin grafts. Because most burns are preventable, staff should be warned and trained about the potential risks of contact burns. All jewelry should be removed, and the live battery terminal should be covered while working in the vicinity of the battery.

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Despite occupational prevention efforts, burn injuries among auto mechanics, although rare, are described in the literature. ElectrotHERMAL ring burns from car batteries occur by short-circuiting through the ring when it touches the open terminal or metal housing. Treatment ranges from conservative management to skin grafting, with most burns responding well to conservative management.

CASE REPORT

A 34-year-old male auto mechanic sustained a circumferential, deep partial-thickness contact burn to his left proximal ring finger. He was holding a stainless steel wrench in his left hand when it touched the negative terminal to the 12-volt car battery. Subsequently, his gold ring touched the positive terminal, short-circuiting through the ring. He felt immediate sharp pain at the base of his ring finger. He also felt some pain at the base of his long finger. He was able to remove the ring seconds after the incident.

A week after his injury, he was seen in the work health clinic. He had normal distal sensation and brisk capillary refill. Examination revealed mild ring finger edema with a localized, sharp-bordered circumferential third degree burn with areas of anesthesia evident. No tendon or bone involvement was observed. He had near full range of motion that was limited only by pain. He had a superficial contact burn on the ulnar side of the base of his long finger from touching the ring at the time of the injury.

His wound was monitored conservatively with local wound care. At 3 weeks after the injury, minimal granulation tissue was evident, and the patient was beginning to lack a few degrees of full metacarpophalangeal joint extension, along with continued pain (Figure 1). No signs of infection were observed. The decision was made to take a full-thickness skin graft from the left medial upper arm to cover the defect that measured 8 cm in circumference. After debridement of the wound bed, an 8 × 1.5-cm defect was seen. An 8 × 2-cm full-thickness skin graft was harvested from the medial upper arm and placed over the defect after appropriate preparation (Figure 2). A tie-down bolster dressing was placed on top of the skin graft, and an aluminum finger splint was used to prevent shear forces. The patient was examined in the office 14 days postoperatively. Four weeks postoperatively, his skin graft healed, and he regained full range of motion (Figure 3).

DISCUSSION

Burn injuries from rings are rare but have been cited in the literature. Often seen in auto mechanics, these cases usually consist of the mechanic’s metal ring touching the battery terminal or metal housing while another metal object (eg, a stainless steel wrench) also touches a metal object under the hood. Because metals are good conductors of heat, the ring can heat up to 1000°C (the melting point of gold) in 1 to 2 seconds after being hooked up to a car battery. The energy produced can cause a local burn, and rapid melting of the metal may occur.

A gold ring conducts heat and electricity more than a platinum ring because gold has higher thermal conductivity but lower resistance.

The authors define this type of burn as not strictly thermal or electrical, but rather a contact burn resulting from electrical energy transferred to the ring. Fisher and Dvoretzky reported a wrist burn from a watch and concluded that it was electrical. However, Attalia et al and Nisanci et al reported cases in which the ring burn was thermal. Regan and Moss reported 2 similar cases, 1 of which was due to a contact burn. Based on the mechanism described in the latter 3 articles, which were similar to that of the current patient, he sustained a burn when the current passed from the positive pole of the battery, through the ring, then through the wrench to the negative terminal, completing the circuit. The current did not arc or pass through the patient’s hand because no other tissues were injured in the hand, and the proximal long finger was superficially burned by simply touching his heated ring.

This type of injury resembles ring avulsion injuries described by Urbaniak et
Metal ring burns cause injuries similar to types I and IIA avulsion injuries. Type I occurs when adequate circulation exists and treatment is based on soft tissue management. Type IIA occurs when no bone, nerve, or tendon involvement exists but inadequate circulation requires vessel repair. In severe forms, even microvascular repair may be indicated. The digital neurovascular bundles are more protected in hand burns because the burn generally affects the volar or dorsal surface; however, in circumferential ring burns, one must be aware of arterial or venous insufficiency. Fortunately, the current patient had intact digital circulation, and operative treatment with a skin graft sufficed.

Treatments documented in the literature for this injury range from conservative treatment to escharotomy to split- and full-thickness skin grafts. The majority heal with conservative treatment; however, patients should be aware of the potential complications of scarring, loss of hair follicles and sweat glands, and permanent skin hyperpigmentation. This type of occupational burn is not rare, and it needs to be recognized by both professional and amateur mechanics because many are unaware of the possibility of this injury. Most jewelry-related work injuries are due to rings or watches becoming caught in machinery, but burns should also be included in the workplace discussion. Because most burns are preventable, staff should be warned about the potential risks of contact burns and trained to keep the cover over the live battery terminal while working in the vicinity of the battery. Clearer warnings may be necessary to guard individuals against wearing any metal conductors while working.

REFERENCES