Electrical Injuries

Aliases

Electrical burns, electrocution

Patient Care Goals

1. Prevent additional harm to patient.
2. Identify life threatening issues such as dysrhythmias and cardiac arrest.
3. Identify characteristics of electrical source to communicate to receiving facility (voltage, amperage, alternating current [AC] versus direct current [DC]).
4. Understand that deep tissue injury can be far greater than external appearance.
5. Have high index of suspicion for associated trauma due to patient being thrown.
6. Determine most appropriate disposition for the patient as many will require burn center care and some may require trauma center care.

Patient Presentation

Inclusion Criteria

Exposure to electrical current (AC or DC).

Exclusion Criteria

None

Patient Management

Assessment

1. Verify scene is secure. The electrical source must be disabled prior to assessment by rescuers who are properly trained and equipped.
2. Conduct primary survey with specific focus on dysrhythmias or cardiac arrest. Apply a ECG cardiac monitor
3. Identify all sites of burn injury. If the patient became part of the circuit, there will be an additional site near the contact with ground; electrical burns are often full thickness and involve significant deep tissue damage.
4. Assess for potential associated trauma and note if the patient was thrown from contact point. If patient has altered mental status, assume trauma was involved and treat accordingly.
5. Assess for potential compartment syndrome from significant extremity tissue damage.
6. Determine characteristics of source, if possible: AC or DC, voltage, amperage, and also time of injury.

Treatment and Interventions

1. Identify dysrhythmias or cardiac arrest—even patients who appear dead (particularly dilated pupils) may have good outcomes with prompt intervention [see appropriate guideline for additional information and patient assessment/treatment].
2. Immobilize if associated trauma suspected [see Trauma section guidelines].
3. Apply dry dressing to any wounds.
4. Remove constricting clothing and jewelry since additional swelling is possible.
5. Consider isotonic IV/IO fluid bolus 20 ml/kg ***[AEMT]***
6. Remember that external appearance will underestimate the degree of tissue injury.
7. Treat pain per Pain Management guideline; electrical injuries may be associated with significant pain.
8. See Burn Protocol for additional information on treatment of Electrical Burn
9. Take electrical injury patients to a burn center whenever possible, since these injuries can involve considerable tissue damage.
10. Prioritize treatment of trauma when there is significant associated trauma and if local trauma

resources and burn resources are not in the same facility.

Patient Safety Considerations

1. Verify no additional threat to patient
2. Shut off electrical power
3. Move patient to shelter if electrical storm activity still in area

Notes and Educational Pearls Key Considerations

- Electrical current causes injury through three main mechanisms:
    - Direct tissue damage, altering cell membrane resting potential, and eliciting tetany in skeletal and/or cardiac muscles
    - Conversion of electrical energy into thermal energy, causing massive tissue destruction and coagulative necrosis
    - Mechanical injury with direct trauma resulting from falls or violent muscle contraction
- Anticipate atrial and/or ventricular dysrhythmias as well as cardiac arrest.
- The mortality related to electrical injuries is impacted by the following:
    - Route current takes through the body (current traversing the heart has higher mortality)
    - Type of current—AC vs. DC
        - AC is more likely to cause cardiac dysrhythmias while DC is more likely to cause deep tissue burns; however, either type of current can cause any injury.
        - DC typically causes one muscle contraction while AC can cause repeated contractions.
        - Both types of current can cause involuntary muscle contractions that do not allow the victim to let go of the electrical source
        - AC is more likely to cause ventricular fibrillation while DC is more likely to cause asystole
    - The amount of current impacts mortality more than the voltage

Current level (Milliamperes)	**Probable Effect on Human Body of 120 V, 60 Hz AC for 1 second**
1 mA	Perception level; slight tingling sensation; still dangerous if wet conditions
5mA	Slight shock felt; not painful but disturbing; average individual can let go; however, strong involuntary

	reactions to shocks in this range may lead to injuries
6mA–16mA	Painful shock; begin to lose muscular control; commonly referred to as the freezing current or "let-go" range
17mA–99mA	Extreme pain, respiratory arrest, severe muscular contractions; individual cannot let go; death is possible
100mA–2000mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart); muscular contraction and nerve damage begins to occur; death is likely
> **2,000mA**	Cardiac arrest, internal organ damage, and severe burns; death is probable

Source: https://www.osha.gov/SLTC/etools/construction/electrical_incidents/eleccurrent.html

Pertinent Assessment Findings

1. Identification of potential trauma concomitant with electrical injury
2. Presence of cardiac dysrhythmias

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

9914095—Injury - Electrical Injuries

Key Documentation Elements

- Characteristics of electrical current
- Downtime if found in cardiac arrest
- Positioning of the patient with respect to the electrical source
- Accurate description of external injuries
- Presence or absence of associated trauma

Performance Measures

- Confirmation of scene safety
- Documentation of electrical source and voltage if known
- Documentation of ECG cardiac monitoring
- Documentation of appropriate care of associated traumatic injuries
- ***EMS Compass® Measures*** *(for additional information, see www.emscompass.org)*
    - *Trauma-01: Pain assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain
    - *Trauma-02: Pain re-assessment of injured patients.* Recognizing that pain is undertreated in injured patients, it is important to assess whether a patient is experiencing pain
    - *Trauma-04: Trauma patients transported to trauma center.* Trauma patients meeting Step 1 or 2* or 3** of the *CDC Guidelines for Field Triage of Injured Patients* are transported to a trauma center
    - Any value documented in NEMSIS eInjury.03 - Trauma Center Criteria
    - * 8 of 14 values under eInjury.04 - Vehicular, Pedestrian, or Other Injury Risk Factor match Step 3, the remaining 6 value options match Step 4

References

1. Electrical Injuries. Emedicince.medscape.com. http://emedicine.medscape.com/article/433682-overview. Updated February 8, 2017. Accessed August 29, 2017.
2. Pham TN, Gibran NS. Thermal and electrical injuries. *Surg Clin North Am.* 2007;87(1):185- 206.
3. Price TG, Cooper MA. Electrical and lightning injuries. In Hockenberger R, ed. *Rosen's Emergency Medicine, 7th Edition.* 2009.