



## Essential Learning

### Electrical Injury

- **Determinants of electrical injury severity**

- Factors that determine the severity of electrical injuries include: voltage, current (amperage), duration of current flow (time patient is in contact with the electrical source), resistance of the tissues, and direction of current flow.
  - Traditionally, electrical injuries are divided into high-voltage (>1000 V) or low-voltage (<1000 V), but the risk for serious or fatal injury increases appreciably at >600 V.
    - U.S. residential power lines: 7,620 V (AC)
    - Subway rails: >600 V (AC or DC)
    - Washer/dryer outlets: 240 V (AC)
    - Standard household outlets: 120 V (AC)
    - Telephone lines: 65 V
  - Alternating current (AC) is postulated to be approximately 3 times more dangerous than direct current (DC) at a given voltage. AC can produce tetany, and since the extremity flexors are stronger than the extensors, a patient with tetanic muscle contractions will not be able to let go of the contact point. Skeletal muscle tetany occurs at 6–22 mA, thoracic muscle tetany (respiratory arrest) at 18–30 mA, ventricular fibrillation at 60–4000 mA, and cardiac standstill (asystole) at >2000 mA. With DC injuries, there is a single intense discharge of electrical potential, and victims are often thrown from the source, sustaining blunt traumatic injuries, including dislocations/fractures. There is also an increased risk of asystole with DC injuries (think of defibrillation).
  - High-resistance tissues (tendon, fat, bone) will dissipate electrical current as heat, causing thermal damage with resultant deep tissue thermal burns. Low-resistance tissues (nerves, mucous membranes, muscle) will conduct the current and sustain both electricity-induced damage (electroporation, i.e. direct cell membrane disruption) and thermal injury.

- **Indications for admitting electrical injuries**

- Patients with low-voltage injuries (historically defined as <1000 V, but for practical purposes low-voltage is <400–600 V) who are asymptomatic and have a normal ECG upon presentation to the ED may be discharged without further testing or cardiac monitoring.
- Indications to admit a patient for 12–24 hours of cardiac monitoring: loss of consciousness, cardiac arrest in the field, new ECG abnormalities on presentation, history of dysrhythmia in the field (e.g. during EMS transport), history of cardiac disease (or history of multiple cardiac disease risk factors), chest pain, or exam findings suggesting conductive injury (i.e. passage of current across the thorax).

- **Attributions**

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