PAEDIATRIC ACUTE CARE GUIDELINE	
Electrical Injuries	
Scope (Staff):	All Emergency Department Clinicians
Scope (Area):	Emergency Department

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http://kidshealthwa.com/about/disclaimer/

Electrical Injuries

Background

General

- Electrocution occurs when current passes through a person and disrupts normal electrical function of cells
- Most electrical injuries occur in the home, usually associated with electrical cords (60-70%) and wall outlets (10-15%)
- If a healthy child is exposed to common household electric current, is asymptomatic and no evidence of arrhythmia/ cardiac arrest, they can be discharged safely

The extent of damage done is determined by:
Amount of electrical current flow: • High voltage (>1000V) vs low (<1000V)
Type of current (AC v DC): • AC (most common in Australian homes), is more dangerous, causes tetanic muscle contraction and 'lock-on' effect • DC is less dangerous, patient tends to be thrown away from source

Current path: • Trans-thoracic (hand to hand), has a high mortality (>60%) due to increased spinal cord and myocardial damage • Vertical (hand to foot), mortality >20% due to cardiac arrhythmias • Straddle (foot to foot) low mortality <5%
Which tissues did it flow through? • Moist tissue (mouth) or wet skin increases conduction and therefore results in a more severe injury • Thin skin increases susceptibility to severe injuries
Duration: • Prolonged contact increases severity of injury

Three Main Electrical Injury Patterns:

- Direct trauma from electric current (direct tissue damage, e.g. cardiac ischaemia/ arrhythmia, compartment syndromes, rhabdomyolysis, peripheral nerve injury)
- Trauma from conversion of electrical energy to thermal energy (burns)
- Mechanical effects of electric current (violent muscle contraction which may lead to fractures/dislocations, falls resulting in possible trauma)

Lightning Injuries:

- Results in an instantaneous massive unidirectional current (DC) and thus a different pattern of injury to electrical injury
- Rarely causes burns/soft tissue destruction as it is too quick and no 'lock on'
- Likely to cause asystolic cardiac arrest (depolarised entire myocardium) or respiratory arrest (thoracic muscle spasm/ central respiratory depression)
- Relatively high (up to 50% chance of survival) if CPR commenced early and continued
- Asystole may spontaneously recover therefore management of apnoea and respiratory arrest is imperative
- Cardiac:
    - VF likely secondary to hypoxia not lightning shock induced
- Neurologic:
    - Immediate transient (LOC, confusion, anterograde amnesia, weakness, paraesthesia)
    - Immediate persistent (hypoxic encephalopathy, intracranial haemorrhage)
    - Delayed (motor neuron disease, movement disorders)
- Traumatic: fall resulting in spinal cord injury, epidural or subdural haematoma
- Autonomic instability:
    - Keraunoparalysis (transient paralysis and appearance of acute arterial

insufficiency of limb)

Assessment

History

- Electrical source, voltage, duration of contact, environmental factors at scene, resuscitative measures already provided
- Previous medical history (especially cardiac)
- Tetanus immunisation status

Examination

General:
Consider whether critically unwell or not, if so take ABCDE approach, in particular: • Airway- burns or soft tissue swelling to mouth, face, anterior neck (children may have oral burns from chewing electric cord) • Cervical spine- consider need for immobilisation if thrown from source • Circulation- VF commonest arrhythmia in arrested patients. Asystole common in high voltage and lightning strikes. Other arrhythmias are also possible.
Specific:
Skin: • Size, location of burns: • Entry and exit wounds- may be deceptively small, with extensive underlying soft tissue damage • Wound location give information about the pathway of the current through the body, if far apart increase tissues exposed for internal injuries to have occurred • Low voltage – small, well-demarcated contact burns at entry and exit sites • High voltage – serious burns, painless, yellow-grey charred craters with central necrosis, or skin sparing with damage to underlying soft tissue and bone • Kissing burn – occurs at flexor crease when current arcs across both flexor surfaces, associated with extensive underlying tissue damage
Neurological exam: • Most common CNS symptom is loss of consciousness • Other CNS symptoms may include acute peripheral neuropathy, transient paralysis/paraesthesia • Incidence of spinal cord damage is 2-27% following high voltage injury when the current travels arm to arm or arm to leg • May resemble lower motor neuron disease, amyotrophic lateral sclerosis or transverse myelitis

Eyes: • Visual acuity and fundoscopy due to risk of direct trauma and cataract
Ears: • Hearing and examination of tympanic membrane as risk of tympanic membrane rupture
Limbs: • Check range of movement and for bony tenderness • Neurovascular obs to extremities to assess for vascular damage/ delayed onset compartment syndrome

Investigations

Initial ECG for all: • Looking for arrhythmia or cardiac ischaemia • Incidence of arrhythmias is 4-17% • Low volt AC is more likely to cause cardiac consequences • Delayed arrhythmias are rare, only in those with arrhythmia on presentation (hence screening ECG on arrival)
Further investigation is only required for significant electrical injuries such as:
Urinalysis • For myoglobinuria to exclude rhabdomyolysis
Bloods • In those at risk for conductive electrical injury (patients with entry/exit wounds or cardiac arrhythmia and patients with high voltage injury), CK, FBC, U & E's, LFTs & Lipase (if intra-abdominal injury is suspected • Patients may have a high potassium, low calcium, high phosphate or metabolic acidosis
Radiology • Consider as clinically indicated

Management

Initial management

- Resuscitate as required according to advanced life support, specifically consider whether airway involvement will cause airway issues
- Cardiac monitoring if evidence of ischaemia or arrhythmia on ECG, loss of consciousness or high voltage injury
- Remove jewellery/constricting objects early to reduce risk of oedema
- Cool burns
- If patient appears well following a low voltage injury, they are likely well

Further management

- Supportive care:
    - Consider IV fluid to maintain urine output of 1-1.5ml/kg/hour (Burns Parkland formula not applicable for fluid calculation)
    - Discuss with Paediatric Burns Team early

Medications

- Ensure tetanus immunisation up to date

Admission criteria

- History of loss of consciousness, documented dysrhythmia or evidence of cardiac ischaemia- admit for cardiac monitoring
- Evidence of significant burns- admit under Paediatric Burns Team
- Evidence of significant trauma- admit under Paediatric Surgical, Orthopaedic, or Burns Team dependent on injury
- Evidence of rhabdomyolosis- admit under Paediatric Burns Team or other Team depending on other injuries

Discharge criteria

- Normal ECG
- No history of loss of consciousness
- No burn/trauma injury requiring admission

Tags

ac, asystole, burn, burns, current, dc, electrical, electrical injuries, electrothermal, injury, lightning, power, shock, vf, voltage

References

PMH ED Guidelines: Electrical Injuries – Last Updated 25/08/14
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