Electrocution

Electrocution is death caused by an electric shock. It results in 0.54 deaths per 100,000 people per year, of which:

- More than 90% are by generated electricity
- Of the low voltage deaths, most are in the home or workplace
- Of the high voltage deaths most are in the workplace

Electrocution can occur from domestic or industrial electricity.
A Low voltage is one below 1000 volts. A High voltage is above this level.

The UK domestic supply is 240 V alternating current 50 Hz

The domestic electricity supply in the UK is about the most lethal combination that could have been devised. The voltage of around 240V is sufficient to cause muscle spasm and thus a 'hold-on' effect, so that a live conductor may not be able to be released. At the same time it is too low to cause a 'throw-off', which accounts for many of the survivors of shocks due to high-tension conductors.
The frequency of the cycle of alternating current is in the middle of the most lethal range for causing ventricular fibrillation.

Factors influencing the severity of electrical injury include

- Whether the current is alternating (AC) or direct (DC)
  Contact with alternating current may cause titanic contraction of skeletal muscle. This may prevent release from the source of electricity and may also cause respiratory arrest. It may also cause VF (analogous to R-on-T phenomenon). Asystole is more common after DC shock.
- Voltage
- Magnitude of energy delivered
  Current is expressed in amperes. High current (15-20mA) initiates muscle spasm
- Resistance to current flow
  Skin resistance is decreased by moisture, increasing the likelihood of injury. Nerves and blood vessels are good conductors. Increased resistance is offered by muscle, skin, tendon, fat and bone in that order. Axons become distorted, blood vessels sustain endothelial damage, while muscle swelling and necrosis may occur.
- Pathway of current through patient
  Transthoracic (hand to hand or opposite leg) is more likely to be fatal than a vertical (hand to foot) or straddle (foot to foot)
- Area and duration of contact

Management overleaf.

Management

- If necessary, resuscitate along ABC lines.
- Take accurate history asking about source of electricity, contact made, loss of consciousness, entry/exit wounds, any associated symptoms.
- Obtain an ECG
- Examine patient looking for entry/exit wounds. These are often full thickness burns and can help to assess the flow of the current through the body

Admission or discharge?

- Asymptomatic patients with a normal ECG who have sustained an electric shock from a domestic supply may go home.
- Arrange review of burns if necessary
- If abnormal ECG, history of loss of consciousness, soft tissue damage/large burns or symptomatic refer physicians for overnight ECG monitoring.

A shock to the system

Assessing people with electrical injuries

Electrical injuries caused by the action of an electric current on the human body can range from benign small skin burns to life-threatening internal organ damage. Most injuries are sustained through contact with low voltage domestic circuits, and will not need extensive treatment. However, cardiac monitoring is important in selected patients due to risk of cardiac arrhythmias.

1 Early management

Turn off electrical source (if safe to do so)

Perform basic life support if needed

Immobilise head and neck (in severe injury)

Intravenous hydration
May be needed to prevent renal failure

Resuscitation
A prolonged resuscitation attempt is warranted

2 Clinical assessment

Check clinical signs to assess effects of the electrical current on the patient's body

Extensive burns

Pregnant women

Loss of consciousness

Potential injuries

Cardiovascular
- Arrhythmias (most common)
- Heart muscle injury
- Bradycardia
- Clotting in blood vessels

Respiratory arrest
- Diaphragm paralysis
- Tetanic contraction
- Inhibition of control in brain

Skin burns
- Infection
- Dehydration

Neurological
- Loss of consciousness
- Impaired recall
- Spinal cord injury
- Paralysis
- Loss of sensations in limbs

Kidney failure
- Myoglobin tubular precipitation
- Generalized hypotension

Musculoskeletal
- Fractures/luxations
- Muscle damage
- Rhabdomyolysis
- Compartment syndrome

Determine path of current through body

Electricity usually flows from an electrical source, through the body to the ground. Locating entry and exit points can help to determine which organs could be damaged

Determine voltage of accident

Low voltage		High voltage	
Mines	960 V	High voltage line	45 000–400 000 V
Subway rails	750 V	Rail network	25 000 V
Workshops	380 V	Overhead line	1 500 V
Domestic	110 V (US) 220 V (EU)		

ECG and blood tests

ECG anomaly · Arrhythmias · Troponin rise

3 Discharge

If there is no cause for concern, consider prompt discharge

Admit to burns unit

Specialised surgical care, such as skin grafts

Admit to obstetrics

Fetal cardiac monitoring

Admit to hospital

Patients with initial loss of consciousness, cardiac anomalies, or high-voltage injury require continuous ECG monitoring

Manage organ failure

Echocardiography

With or without:

Cardiac MRI

Coronary angiography

Depending on clinical findings

Monitor ECG for at least 24 hours

Explain to patient the occasional risk of delayed cardiac arrhythmias (which can very rarely lead to sudden death)

Arrhythmia-free for at least 24 hours

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