# Electric shock injuries from a domestic appliance

Commentary by **GORDIAN FULDE** MB BS, FRACS, FRCS(Ed), FRCS/RCP(A&E)Ed, FACEM

## What injuries are likely to result from an electric shock from an oven?

## Case scenario

Beatrice, a 50-year-old woman, presented five days after she had received an electric shock. She had inserted a paper clip in beside a faulty oven button that would not stay depressed. The shock had initially jolted her backwards and she had experienced several hours of tingling in her right hand and aching pain in her right forearm. She had also developed an almost instantaneous headache but she had not lost consciousness or suffered any memory loss. Beatrice was concerned because her headache had persisted now for five days and she had also felt a bit 'off balance' since the shock. The day before she presented she had also had a brief episode of chest tightness and tingling in her left hand. She had previously been well.

On examination, she had no burn injury and her cardiovascular system appeared normal. In particular, she was in normal sinus rhythm with no sign of any congestive heart failure (CHF). She was still quite upset about the whole incident.

Is it possible for an electric shock that does not cause any major immediate effects to have long-term neurological or cardiac sequelae?

## Commentary

It is possible that this patient may suffer long-term sequelae after her electric shock, even though the immediate effects were not major, as up to 70% of patients who have had a significant electrocution will suffer physical and psychological sequelae. These delayed complications are wide ranging, as can be seen from the Table.[1]

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### Electrical injuries

Most domestic current electrical injuries are occupational accidents, predominantly in men aged 20 to 50 years. With all electrical injuries, first aiders should ensure their own safety first – that is, making sure the power is off or disconnected before attending to the casualty.

The electric shock patient can 'mimic' a dead patient by having no response, no pulse, no reflexes and no respiration. These patients can be saved with immediate cardiopulmonary resuscitation (CPR), with potentially a good functional outcome.

To make sense of any electrical injury, a basic knowledge of electricity and physiology and a focused history of the actual shock are required.[2] The nature of the current source will give the likely type (AC or DC), potential difference (voltage, V) and amount (amperage, A) of the current involved, the time the individual was in contact with the source will give an indication of the amount of current that actually passed through the person's body, and the path of the current through the body will indicate the probable pattern of injury. This will allow a fairly accurate prediction of the severity of injuries. The severity of injury is determined primarily by the voltage.

#### Amount and type of current

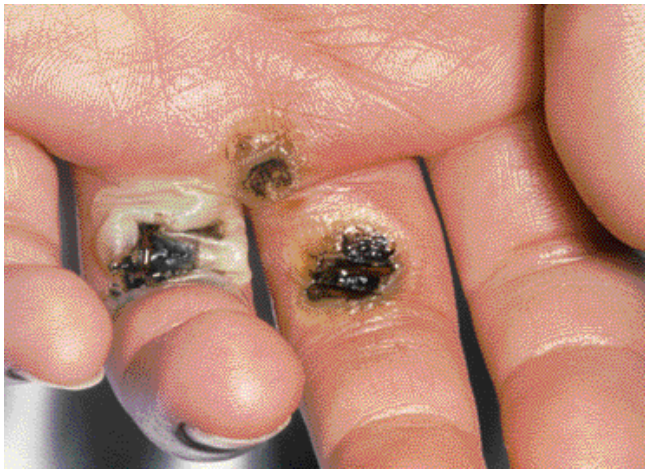
The domestic electricity supply is 240 volts, 50 Hz AC, but most household appliances operate at low voltages. Examples of the currents involved in various household electrical items are:

- lights and light switches – 8 A
- power points – 10 A
- ovens and some ducted air conditioners – 16 A.

**Table. Delayed complications of electrical injury**

| | |
|---|---|
| Pulmonary contusion | Ileus |
| Pleural effusion, pneumonitis | Growth disturbance |
| Cardiac dysrhythmias | Peptic ulcer |
| Peripheral neuropathy | Intestinal perforation |
| Cognitive impairment | Splenic rupture |
| Optic atrophy | Pancreatitis |
| Seizures | Gallbladder necrosis |
| Spinal syndromes | Cholelithiasis |
| Cerebral oedema | Gastrointestinal haemorrhage |
| Cataracts | Acute renal failure |
| Psychiatric illness | Fetal death |
| Myocardial infarction | Sepsis |

**continued**



PHOTOLIBRARY

Figure. Blistering caused by electrical burns on the hand.

### Time in contact

A person may have an extended or a very brief contact with a current source. He or she may be:

- 'frozen' to the circuit – when a very significant amount of current passes through the body and serious injuries are likely to occur (the person is unable to let go because of muscle tetany), or
- 'thrown' back – when probably less actual current passes through the body but traumatic injuries may occur from the action of being thrown and falling to the ground.

When a current source 'blows up', as in a short-circuit, often in a power board, little current passes through the body but burns and eye damage often occur.

### Path of current

The seriousness and pattern of injury from an electric shock can be predicted by the path of the current through the body. High voltage tends to take a direct path through the tissues, whereas low voltage tends to follow the path of least resistance (i.e. nerves and blood vessels). Wet or thin skin has a low electrical resistance and the current passes through, causing little or no skin damage but severely burning internal organs and tissues. Dry or thick skin has a high resistance and the current tends to produce severe skin burns but not enter the body (Figure).

Possible paths the current may take through a body are:

- local – entry and exit close to each other, usually in an extremity, often a deep burn with potential of damage to local structures (nerves, blood vessels, muscle), compartment syndrome may be a complication
- hand to hand (transthoracic) – potentially critical (up to 60% mortality) as can cause heart arrhythmias besides the above injuries to the limbs
- head to toe – associated with a significant mortality (up to 20% mortality) and morbidity, especially from damage to neurological tissue and the heart.

### Managing Beatrice

Beatrice may have had a hand-to-hand pattern (initial right hand and arm symptoms, later tingling left hand). Fortunately, she was 'jolted backwards' by the shock and therefore it is unlikely she endured a large current flow. Although the heating components of ovens involve high currents, the control switches operate at lower currents.

Patients who walk in to the GP's surgery complaining of an electric shock with no obvious burn marks and a normal examination do not require hospitalisation. In this case, I would do an ECG to see if there was any ECG pattern of injury or underlying heart issues as the patient's episode of chest tightness a day earlier might have been cardiac ischaemia. I would also seriously consider doing cardiac markers (troponin) to exclude ischaemia.

Regarding this patient's persistent headache and feeling 'off balance', if her neurological examination was normal, I would suggest a period of observation and ask her to contact me (or go to the Emergency Department if after hours) if the symptoms worsen.

## Prevention

The risk of serious electrical shocks from the domestic electricity supply can be reduced by the use of earth leakage (ECL) circuit breakers, also known as residual current devices (RCDs), on the various circuits around the home. All new houses are required to have these safety switches on power point and lighting circuits, and older houses should have them fitted if they are not already in place. Fixed high current appliances such as ovens and air conditioners may be excluded from this requirement. It should be noted, however, that appliances with two-pronged plugs (such as hair dryers) may not trigger these life-saving devices because these plugs do not have an earth connection.

Advise patients to have a chat with an electrician, because accidents do happen. MT

## References

1. Fulde GWO, Singletary EM. Electrical injuries. In: Aghababian RV, editor-in-chief. Emergency medicine: the core curriculum. Philadelphia: Lippincott-Raven Publishers; 1998. p. 244-249.
2. Fulde GWO. Electrical injuries. In: Fulde GWO, ed. Emergency medicine: the principles of practice. 4th ed. Sydney: Elsevier Australia; 2004. p. 333-339.

**DECLARATION OF INTEREST: None.**