ELECTRICAL INJURIES, ATMOSPHERIC LIGHTENING, EXPLOSION INJURIES
Electrical injuries

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Depends on:

- **Nature of current**

  *In India, the domestic supply is 220-240 volts AC at 50 Hz*

- **Amperage vs voltage**

- **Amount of current**

  \[ A = \frac{V}{R} \]
# Effect of various amounts of AC & DC on body

<table>
<thead>
<tr>
<th>mA (AC)</th>
<th>mA (DC)</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Threshold of sensation</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Tremor and spasm</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>May involuntarily let go of electric line</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>Painful muscular contractions (tetany)</td>
</tr>
<tr>
<td>25</td>
<td>25–80</td>
<td>No permanent harm</td>
</tr>
<tr>
<td>25–80</td>
<td>80–300</td>
<td>LOC, arrhythmias, respiratory spasms</td>
</tr>
<tr>
<td>80–100</td>
<td>&gt;300</td>
<td>Irreversible ventricular fibrillation, death</td>
</tr>
</tbody>
</table>

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• Path of current
• **Duration of current**

\[ Q = I^2 \times R \times X \times t \]
Cause of death

- Low voltage (household) current
  - Ventricular fibrillation
- High voltage (industrial) current
  - Paralysis of respiratory center
  - Electro thermal injury
Post Mortem findings

- **External**
  - **Electric entry mark**
    - a. **Contact burn**
    - b. **Joule burn**
  
  ✓ produced in low voltage currents
  ✓ Appearance:
    - **Crater**, 1-3 cm in diameter with a ridge around circumference
    - **Charring**
    - **Metallization** -- **Acro reaction Test**

Absence does not rule out electrocution.

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✓ Histology:
  - **Micro blisters**
  - *Electric channels* – cells separated in the form of sharp slits
  - *Palisading and streaming of nuclei*
  - *Collagen* stains blue in ordinary H&E stain

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Palisading of nuclei

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c. **Flash/spark burn**

✓ Produced in high voltage currents, when sparking occurs between conductor and victim

❖ *Crocodile skin* – High temperatures causes keratin of skin to melt over multiple areas

❖ *Arc eye* – superficial and painful keratitis

d. **Electric splits**

✓ Point of entry shows laceration

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Crocodile skin

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- **Exit mark**
  - Where the body was earthed
  - More damage than entry
- **Internal**
  - Congestion of all organs
  - Petechial hemorrhages along the line of passage of current
  - Brain – irregular tears and fissures
  - *Zenker’s degeneration*
  - *Bone pearls*
Medicolegal Aspect

- **Manner of Death**
  - Accidental
  - Suicidal
  - Homicidal
- **Judicial electrocution**
- **Pregnancy and Electric Shock**
- **TASER**

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Lightening

Atmospheric discharge of electricity

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Electrical discharge is between a negatively charged cloud and a positively charged object on earth - negative lightening.

5% of lightening flashes are from positively charged clouds - positive lightening.

Temperature – about 50,000°C

Amperage – 12,000 to 200,000 Amperes

Voltage – equivalent to 1 million volts DC
Post Mortem appearance

- **External**
  1. Clothes
     - Torn, burnt, may be stripped off
     - Melting belt knuckles and zippers
     - Objects in pocket
Keraunopathology

2. **Burns**

- *Endogenous burns* – due to heat generated within the body.
  - Linear Burn
  - Punctate Burn
- **Tip toe sign** - small, circular, full thickness burns involving the sides of the soles of the feet and the tips of toes.
Arborescent burns – irregular, superficial, thin, tortuous markings on skin resembling the pattern of a fern or tree
- Seen in 20% to 33% cases
- Not associated with burning
- No pathological changes
- Disappear in 1-2 days in survivors

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- **Exogenous burns**

*Surface Burns*

3. **Mechanical lesions**
- **Internal**
  - Brain – congestion, edema, hemorrhages
  - Lungs – congested, patchy hemorrhages
  - Muscles – necrosis
  - Spinal cord – damage
  - Eyes & Ears – cataracts, corneal edema, tympanic membrane perforation
Explosions

- Natural
- Chemical
- Nuclear
- Electrical
- Magnetic
- Mechanical
Incendiary Bombs

- **Napalm Bombs** - is an incendiary mixture of a gelling agent and a volatile petrochemical.
  Was used in flamethrowers, bombs and tanks in World War II

- **Molotov Cocktail** - Petrol Bomb
  Consists of a glass bottle partly filled with gasoline with a rag put inside to serve as a wick
Letter Bombs – explosive device sent via post with the intention to injure or kill the recipient
EFFECT OF BLAST

A. In the Air
B. In the Water
C. Mechanical Explosion
IN THE AIR

- Most frequently seen
- Causes sudden displacement of air
- Produces
  - Blast wave injury
  - Scorching by flame or hot gases
  - Injury by flying missiles
  - Effect of anoxia
Injuries due to bombs

Primary Blast Injuries

- *Due to direct pressure effects of blast waves*
- Organs which contain air most likely to get damaged
- Most sensitive organ $\rightarrow$ Ear
- Classic injury $\rightarrow$ TM rupture,
- Blast Lung
Secondary Blast Injuries

- Produced by flying missiles
- Marshalls Triad

Tertiary Blast Injuries

- Victim lifted and thrown away
- Heavy piece of masonry falls upon
Burns

- Quaternary injuries
- Flash burns

Fumes

Explosive Injury

- Dust tattooing

Complete disruption
IN THE WATER

- Occurs in explosion under water, mines torpedoes
- More marked in viscera containing air
- Most common organ suffering damage - Intestines
- Retroperitoneal hemorrhage, injury of intra abdominal organs, rupture of bowel walls commonly observed

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Steam or gas boiler bursts due to increased pressure
The best way to predict the future is to create it.

- Peter Drucker

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