ATV Case

- Two young men burned and dead on an ATV on abandoned hospital property
- Storm night before had downed power lines
- First impression is that a downed power line caused fire

What are the questions you should anticipate?
What should you do?
ATV Case
ATV Case
ATV Case
ATV Case

- Pain and Suffering State
  - So how long survival after electrical incident
- Pathway to ground
- Voltage
- Over load protection
- Cause of death
Electrocution

- Term invented by Alvah Edison, American Inventor
- Contraction of Electros (Greek for Amber) and Execution (For Judicial Death)
- Emphasized the dangers of Alternating Current
Electrocution

Tennessee Electric Chair
Electrocution

- Currently No State in the USA uses the electric chair to kill persons.
- Nebraska was the last state to have mandatory use of the electric chair
- They quit in February 2008
Electrical Investigations

- To properly investigate a possible electrical death or injury requires
  - Knowledge of electricity
  - Knowledge of how electricity causes death and injury
Electrical Investigations

- Electrical physics
  - Ohm’s law
  - Power formulae
  - Alternating vs. direct current
  - Power delivery systems
Electrical Investigations

- Electrical physics
  - Ohm’s law

$\text{I} = \frac{\text{E}}{\text{R}}$
Amps = volts/resistance

Generally voltage is known being 120, 240 or 7620
Resistance of persons can be estimated
Thus the amount of current can be estimated
Electrical Investigations

- Electrical physics
  - Ohm’s law
  - Power formulae

- Power = $\text{amps} \times \text{volts}$
- $\text{Amps} = \frac{\text{volt}}{\text{ohms}}$
- $\text{Power} = \frac{\text{volt}}{\text{ohms}} \times \text{volts}$
- $\text{Power} = \text{volts} \times \frac{\text{volts}}{\text{ohms}}$
Electrical Investigations

- Electrical physics
  - Ohm’s law
  - Power formulae

USA 117 Volts and 136 ohms

- Power = volts x amps
- 100 watts = 117v x .85 amp
- 100 watts = 117v x 117v / 136 ohms
Electrical Investigations

- Electrical physics
  - Ohm’s law
  - Power formulae

Rest of World 220 Volts and 136 ohms

- Power = volts x amps
- ? = 220v x 1.62 amp
- 355 watts = 220v x 220v / 136 ohms
Electrical Investigations

- Electrical physics
  - Ohm’s law
- Power formulae

For 7620 Volts and 136 ohms

- Power = volts $\times$ amps
- $? = 7620v \times 56$ amps
- 426,944 watts $= 7620v \times \frac{7620v}{136}$ ohms
Electrical Investigations

- Electrical physics
  - Ohm’s law
  - Power formulae

- POWER GOES UP AT THE SQUARE OF THE VOLTAGE

At 136 ohms resistance

- 117 volts = 100 watts
- 220 volts = 355 watts
- 7,620 volts = 426,944 watts
Electrical Investigations

- Electrical physics
- Ohm’s law
- Power formulae
- Alternating vs direct current
- No difference from 50 to 60 Hz
Electrical Investigations

- Electrical Physics
  - Ohm’s Law
  - Power formulae
  - AC v DC
  - Power delivery Systems
Overload protectors

Transformer 7280-120 volts

Telecommunications 40 volt DC

7280 volts line to ground

120 volt
Electrical Investigations

- Electrical Physiology
  - Normal cellular function nerves and muscle
  - Effect of electrical stimulation
Electrical Investigations

- Electrical Physiology
  - Normal cellular function nerves and muscle

Resting Cells have a 90 milivolt potential. If it is disturbed it reacts...
Electrical Investigations

- Electrical Physiology
  - Effect of electrical stimulation

Depolarized cell will contract or send neural signal
Electrical Investigations

- Effect of electrical current on persons
  - 0.0005-0.0015 amps Perception of current (females much more perceptive)
  - 0.017 amp mean “let-go” current
  - 0.050 amp complete paralysis in tetani
  - 0.100 amp ventricular fibrillation
  - 2.000 amp ventricular de-fibrillation
Electrical Investigations

- Effect of electrical current on persons
  - 0.5-1.5 milliamp tingle
  - 17 milliamp mean “let-go” current
  - 50 milliamp complete paralysis in tetani
  - 100 milliamp ventricular fibrillation
  - 2.000 amp ventricular de-fibrillation
  - 15 amp common household fuse/breaker
Electrical Investigations

- Breakers and Fuses, known as overload protectors do not protect persons
- To protect a person you need a Ground Fault Interrupter or GFI
Electrical Investigations

- Resistance of Persons to electricity
  - 100,000 ohms dry callused skin (I=E/R = 0.0022 amps cannot feel a tingle)
  - 1,000 ohms moist thin skin (I=E/R = 0.220 amps ventricular fibrillation)
Electrical Investigations

- Electrical Pathophysiology and Thanotology
  - Depolarization
  - Heating
  - Fenestration
Electrical Investigations

- Electrical Pathophysiology and Thanotology
  - Classification is usually
    - Low Voltage <600 volts
    - High Voltage >600 volts
Electrical Investigations

- Electrical Pathophysiology and Thanotology
  - Low voltage circuits kill by ventricular fibrillation. The heart tries to beat 5,000/minute as 50 Hz AC is – 2,500 times per minute and + 2,500
  - Low voltage may kill by asphyxiation
Figure 12 – Occurrence of the vulnerable period of ventricles during the cardiac cycle. The numbers designate the subsequent stages of propagation of the excitation.
Figure 13 - Triggering of ventricular fibrillation in the vulnerable period. Effects on electrocardiogram (ECG) and blood-pressure.
Electrical Investigations

- Ventricular fibrillation (same as sudden heart natural death) is mechanism of death in low voltage deaths
- There is 13-18 seconds of consciousness after v-fib
Electrical Investigations

- Electrical Pathophysiology and Thanotology
  - High Voltage kills by asphyxiation by heat denaturation of the brain
  - Ventricular fibrillation is extremely rare
  - Asphyxiation with pulmonary edema foam is the common finding
Electrical Investigations

- Asphyxiation with pulmonary edema foam is the common finding in high voltage
Electrical Investigations

- When should an electrical investigation be commenced?
  - In all deaths where there is a possibility that there is a circuit with the person in it
  - A circuit requires a source of electricity and a pathway to ground
  - Generally, pathway to ground is most difficult to achieve
Electrical Investigations

- The lack of electrical burns is not diagnostic of lack of electrocution
- The presence of electrical burns is not diagnostic of electrocution
- Both findings are not 100% diagnostic
Electrical Investigations

- To have electrical injury or death requires that a person be in a circuit
- With alternating current there is no entrance or exit there is an energized and a grounded side
- Unlike gunshot wounds the energized and grounded side cannot be distinguished
Electrical Investigations

- Electrical Burns
  - Low Voltage
  - High Voltage
- arc
- contact
Electrical Investigations

- Electrical Burns
  - Low Voltage
Electrical Investigations

- Electrical Burns
  - High Voltage
- Arc
Electrical Investigations

- Electrical Burns
  - High Voltage
- Contact
Electrical Investigations

- Electrical Burns
  - High Voltage
- Contact
  Central charring then pallor and then reddening
Electrical Investigations

- Scene Investigation is extremely important
- Equipment Low-voltage
  - Camera with macro lens and zoom
  - Volt-ohm meter
  - Tape Measure
- Equipment Hi-Voltage
  - Add a hard hat
  - A bucket truck is handy
Electrical Investigations

- Other investigatory leads
  - Differential Rigor Mortis
    - Forms very rapidly if circuit is prolonged
  - Creatine Kinase
    - May be helpful postmortem
    - Certainly mandatory in non-fatal cases
Electrical Investigations

- Volt-Ohm Meter
  - used mostly for measuring resistance, although may be useful for measuring voltage
Electrical Investigations

● Steps
  – Establish pathway to ground
    ● hot or cold water pipes (if copper or galvanized) and equipment connected to them
  ● grounded appliances (ones with three-prong male plugs and metal cases e.g. refrigerator or range)
Electrical Investigations

- Establish pathway to ground
  - Concrete floor
  - Conduit (metal pipes protecting electric wire)
  - Ground (as in dirt)
  - Any Metal touching the above
Electrical Investigations

- Establish source of energy [NOTE THIS CAN BE DANGEROUS]
- Best done power off with demonstration of low resistance pathway from energized prong to exposed metal or wire or equivalent
- Can give false negatives
Electrical Investigations

● Steps
  – Generally DO NOT TOUCH BEFORE PHOTOGRAPHING
  – Generally DO NOT DISMANTLE BEFORE X-RAYING
Electrical Investigations

Steps

- Document Source of Power, at least 1 step back toward power company
- If end user, photograph transformer(s), electric meter, breaker-fuse boxes
- If high voltage, photograph transformer(s), fuses, re-closures
Electrical Investigations

- Cases Northern IL.
Electrical Investigations

- Cases Northern IL.

This is a downed 7280 wire
Electrical Investigations

- Cases Northern IL.

- Downed 7,280 volt wire
- Deceased last seen here
- Deceased ended here
Electrical Investigations

- Cases Northern IL.
- Wire parted without a load
- He was crouched when wire hit his back
- Flipped him up 6 feet and back 30 feet
- Probably fibrillated him (low amperage, poor ground through truck)
Electrical Investigations

Summary
– Always consider electrical as cause of death
– Thorough scene investigation is extremely vital
– Complete autopsy with photographs and toxicology should be done
ATV Case

- Pain and Suffering State
  - So how long survival after electrical incident Ans. Some Seconds
- Pathway to ground Ans. Ground
- Voltage Ans. 7,280
- Over load protection Ans. 30 amps
- Cause of death Ans. Conflagration
Electrical Investigations

● Summary

– Always consider electrical as a possible cause of death
– Thorough scene investigation is extremely vital
– Complete autopsy with photographs and toxicology should be done