

# ELECTRICAL INJURIES

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# INCIDENCE

- 5000 ED VISITS ANNUALLY FROM ELECTRICAL INJURIES
- 1000 DEATHS ANNUALLY
- REPRESENT 2 TO 7 % BURN UNIT ADMISSIONS
- WIDE SPECTRUM OF CLINICAL PRESENTATIONS
- 50% ARE WORK RELATED

# PATHOPHYSIOLOGY

- ELECTRICITY IS THE FLOW OF ELECTRONS OVER A POTENTIAL DIFFERENCE
- OHMS LAW :  $I = V / R$
- VOLTAGE (V) - POTENTIAL DIFFERENCE
- CURRENT (I) – AMPERES
- RESISTANCE (R) – OHMS
- CURRENT IS DIRECTLY PROPORTIONAL TO VOLTAGE AND INVERSELY PROPORTIONAL TO RESISTANCE

# PREDICTORS OF TISSUE INJURY

- VOLTAGE
- TISSUE RESISTANCE
- CURRENT STRENGTH
- TYPE OF CURRENT : AC / DC
- CURRENT PATHWAY
- DURATION OF CONTACT

# PHYSIOLOGIC EFFECTS WITH CURRENT

CURRENT STRENGTH mA	PHYSIOLOGIC EFFECT
0.2 – 2 mA	TINGLING SENSATION
3 – 5 mA	LET-GO FOR CHILD
6 – 9 mA	LET-GO FOR ADULT
10 – 20 mA	TETANY : CAN'T LET GO
20 – 50 mA	RESPIRATORY ARREST
50 – 100 mA	V FIB

# TISSUE RESISTANCE

- LEAST : WET SKIN
- DRY SKIN
- NERVE / BLOOD VESSELS
- MUSCLE
- MOST : BONE AND TENDON
- > RESISTANCE = > HEAT RELEASE
- DEEPER TISSUES CAN HAVE FAR GREATER DAMAGE THAN EXTERNAL INDICATIONS

# ELECTRICAL PHYSIOLOGY

- VOLTAGE IS THE MOST COMMONLY USED MEASURE OF A PATIENT'S ELECTRICAL EXPOSURE
- INJURIES ARE ARBITRARILY DIVIDED INTO HIGH VOLTAGE (  $> 1000\text{ V}$  ) AND LOW VOLTAGE
- US HOUSEHOLD CIRCUITS =  $120\text{ V}$

# COMPARISON OF HIGH AND LOW VOLTAGE INJURIES

Characteristic	High Voltage	Low Voltage
Voltage	> 1000 V	< 1000 V
Current	AC	AC / DC
Contact Duration	Brief	Prolonged
Cardiac Arrest	Asystole	V Fib
Burns	Deep	Superficial
Rhabdo	More	Less
Blunt Injury	Common	Rare
Muscle	Tetany – AC	Tetany

# AC / DC

- AC USED IN HOMES AND OFFICES
- DC USED IN BATTERIES, CAR ELECTRICAL SYSTEMS, HIGH-VOLTAGE POWER LINES
- DC CONTRACTION – SINGLE CONTRACTION, VICTIM THROWN FROM ELECTRICAL SOURCE
- AC – TETANY CAUSES PROLONGED CONTACT AND POTENTIALLY MORE DAMAGE

# CLINICAL PRESENTATIONS

- DIRECT TRAUMA FROM ELECTRICAL CURRENT PASSING THROUGH BODY
- TRAUMA FROM CONVERSION OF ELECTRICAL ENERGY TO HEAT
- MECHANICAL EFFECTS : VIOLENT MUSCLE CONTRACTIONS, FALLS

# SYSTEMIC PRESENTATIONS

SKIN	CUTANEOUS BURNS
CARDIAC	ARRHYTHMIAS / ARREST
RESPIRATORY	ARREST
VASCULAR	TISSUE ISCHEMIA
NEUROLOGIC	LOC / TRANSIENT PARALYSIS / CORD INJURY
MUSCULOSKELETAL	FRACTURES / DISLOCATIONS

# SYSTEMIC PRESENTATIONS

RENAL

MYOGLOBINURIA / RENAL  
FAILURE

OTHER

CATARACTS /  
NEUROPSYCHIATRIC  
SEQUELLAE

# ED EVALUATION

- ABCs
- SPINE IMMOBILIZATION
- COMPLETE SECONDARY SURVEY
- LABS : LYTES, CPK, BUN, CR, URINE MYOGLOBIN
- EKG
- FLUID REPLACEMENT : 20 – 40 mL/Kg over 1<sup>st</sup> HOUR

# SPECIFIC INJURIES

- CARDIAC ARREST IS PRIMARY CAUSE OF DEATH
- SPINAL CORD INJURIES AND SPINAL FRACTURES
- PERIPHERAL NERVE INJURIES
- CUTANEOUS BURNS
- COMPARTMENT SYNDROME
- EXTREMITY FRACTURES
- BLAST INJURIES

# SPECIFIC INJURIES

- ORAL BURNS – DELAYED LABIAL ARTERY BLEED IN CHILDREN
- TISSUE NECROSIS – DIC
- PREGNANCY – MONITOR ALL PREGNANT FEMALES > 20 WEEKS, US, 24 HOUR MONITORING IF LOC, EKG CHANGES
- CONCERN FOR DELAYED FETAL DEMISE

# DISPOSITION

ADMIT :

- > 600 V INJURY
- CHEST PAIN, ABNORMAL EKG
- ELEVATED CPK , URINE MYOGLOBIN
- CNS CHANGES
- RESPIRATORY SYMPTOMS
- ABDOMINAL PAIN
- VASCULAR OR TISSUE DAMAGE

# DISPOSITION

## DISCHARGE:

- HOUSEHOLD VOLTAGE INJURY WITH NORMAL EKG, NORMAL EXAM, MINIMAL RISK OF DELAYED ARRHYTHMIAS
- CHILD WITH HAND WOUND FROM OUTLET AND NO EVIDENCE OF COMPLICATION

# CLINICAL PATHWAY

ABCs, HISTORY AND PHYSICAL EXAM

LOW VOLTAGE

EKG, TELEMETRY, LABS, O2

HIGH VOLTAGE

# LOW VOLTAGE

- EKG NORMAL, NO LOC, NO ARRHYTHMIA, NO COMPLICATING INJURY
- DISCHARGE
- ISCHEMIA ON EKG, LOC, COMPLICATING INJURY
- ADMIT

# HIGH VOLTAGE

- TRANSFER TO BURN CENTER
- APPROPRIATE CONSULTANTS : CARDIO, NEURO, ORTHOPEDICS, PLASTICS, RENAL, TRAUMA
- ADMIT



QUESTIONS ?

