



Burns

Air Methods Corporation Community Based Services



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Objectives

- List burns by the type of causative factors (chemicals, exposures, electrical, etc.)
- Identify treatment modalities, including airway management, pain control, and fluid resuscitation
- Calculate burn percentages, and size estimation
- List transport modalities and level of care

Burns-Introduction

- Epidemiology
- Initial management
- Treatment
- Associated Injuries



<https://www.gettyimages.com/detail/stock-photo/141141141-141141141-the-almost-instant-death-of-the-origins-of-the-particle-city-1971-1971>

Epidemiology

0.13 facts from American Burn Association:
 Burn injuries account for an estimated 450,000 annual emergency department (ED) visits per year
 45,000 require hospitalization
 Approximately 60% of these patients are hospitalized at one of the 125 specialized burn treatment centers in the United States

Epidemiology

3400 deaths per year are related to fire/burn/and smoke inhalation (nation wide).
 Nebraska has St Elizabeth burn center that is accredited by the American Burn Center.
 96.6% of admissions to burn centers from 2003-2012 survive.

Epidemiology

With temps > 120 degrees Fahrenheit, it takes only 3 seconds to burn a child's skin severely enough to require surgery



<http://www.docuimagequality.com/burns/148/gradesburnedface.cofee-144629/>

Mechanics and Causative Factors

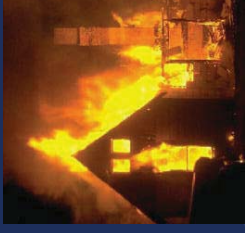
- Thermal
 - Flame
 - Scald
 - Flash
 - Contact
- Chemical
- Radiation
- Electricity
- Lightning
- Frostbite



<http://www.docuimagequality.com/burns/148/gradesburnedtop.cofee-144629/>

Thermal: Flame

Most Common



<http://threewordmedicare.com/2011/12/01/when-the-house-burns-down/>

Thermal Scald

Second most common burn
Highest in the pediatric population
Immersion burns involve deeper tissue structures
Consider abuse



http://www.medic.com/qa/qa/qa/qa/vol_11/tem_38re_kv131b171.htm

Flash Burns



http://burnsurgery.blogspot.com/2010/10/flash-burns-thermal-cracker_18.html



<http://www.amsworld.com/article/0639933/burn-care>

Contact Burns

Liquid
Semi-liquid, (Tar, solvents, water, etc.)
Objects



http://burnsurgery.blogspot.com/chemical_burns.htm



<http://www.burnviews.com/injured.html>

Electrical Burns

Damage is related
Amount of tissue conducting the
current

- Amperage (flow of current)
 - Voltage (amount of current)
 - Resistance or conductivity of fluids and tissue
- AC (Alternating current) has a higher incidence of myocardial fibrillation than DC (Direct current)



<https://www.stanfordchildrens.org/en/topic/default?id=electrical-burns-980933>

<http://www.dominion.edu.uk/avoidingburns/multimedia/electricalburns/>

Electrical Burns

Entrance Wound

High resistance of skin transforms electrical energy into heat, which produces burns around the entrance point (dark spot in center of wound)



<http://burnsurgery.blogspot.com/2013/10/electrical-contact-burns-signs-exposed.html>

Alternating Current (AC)

Low voltage AC electrocution

- three times more dangerous than DC current at the same voltage

With AC electrocution

- continuous muscle contractions may occur
- since the muscle fibers are stimulated at between 40 to 110 times per second.



Alternating Current (AC)

Voltage and type of current

- United States and Canada is 110V & some 220V
- Larger household, industrial applications such as shops, manufacturing plants, etc., and center pivot irrigation systems may have as high as 440 V



Alternating Current (AC)

- Power lines and electrical transformers constitute high-voltage energies and involve over 600 volts
- By definition, high-tension injuries involve currents of greater than 1000 volts



Example of AC Current

Contact electrical burns,

- 120-V alternating current.

The right knee was the energized side, and the left was ground.

- These are contact burns and are difficult to distinguish from thermal burns.



https://www.cchh.org/31C/ab08/condition/electrical_injury/electrical_injury_examples.htm

Internal Injuries: Same Hand

Same hand a few days later, when massive subcutaneous tissue damage had caused severe swelling (swelling usually peaks 24-72 hours after electrical shock)



https://www.dhs.gov/317C/ocohs/construction/electrical_injuries/burn_earrings.html

Involuntary Muscle Contraction

This worker fell and grabbed a power line to catch himself.

- resulting electric shock mummified his first two fingers, which had to be removed.
- acute angle of the wrist was caused by burning of the tendons, which contracted, drawing the hand with them.



Lightning Injuries

Second most frequent cause of storm related deaths.

- Usually causes superficial burns, with deep tissue penetration from the current.
- May cause asystole or fibrillation.
- Short or long term hearing loss or changes.
- Vision changes or early cataracts.

Mechanisms of Injury

Lightning injury-5 basic mechanisms

- Direct strike
- Flash discharge (splash)
- Contact
- Ground current (step voltage)
- Blunt trauma



Direct Lightning Strikes

Outside, hiking, by a tall object, etc.

Carrying metal objects

Metal worm in the hair (hairpin)

- Increases the chances of a direct strike compared with a metal object worn lower on the body
- Associated with high morbidity because they frequently involve the head.
- May cause hearing loss, cataracts, arthritis, etc.

Flash Discharge

Struck by a flash discharge or side impact from another struck object

Splash injury also occurs from person to person when several people are standing close together

Pathophysiology

Lightning injury differs from commercial high-voltage electric injury

- Brief Duration
- Direct Current
- High temperature
- Sonic waves
- Flash burns
- Co-morbid trauma

Pathophysiology

As lightning follows the shortest route between contact points of the human body

- it may involve vital structures in its path.
- Almost every organ system is vulnerable.
- A wide variety of complications can result from damage to these organ systems.

Chemical Burns

Safety for you and your colleagues
Injury dependent on the concentration and the duration of the exposure

Acid or Alkali

- Irrigate strong acids or alkali exposures for at least 30-60 minutes
- Continuous irrigation if eye is exposed to chemicals



Chemical Burn- Alkali



<http://baschark.com/chemicalburns-in-eyes.htm>

Chemical Burn-Acid



<http://img.phila.de/vastar.com/ur/Theoretical-approach-alkali-burn-22818760>

Radiation

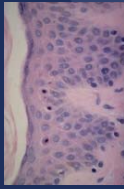
Sunburn

Radiation therapy



Sunburn Damage

Within 2 hours after UV exposure, damage to epidermal skin cells is seen.



Sun Protection

UV Index	0-2	3-5	6-7	8-10	11-12
Low	Minimal	Minimal to slight	Slight to moderate	Moderate to severe	Very severe
High	Minimal	Minimal to slight	Slight to moderate	Moderate to severe	Very severe
Very High	Minimal	Minimal to slight	Slight to moderate	Moderate to severe	Very severe
Extreme	Minimal	Minimal to slight	Slight to moderate	Moderate to severe	Very severe

http://www.weather.com/weather/Weather-809-Sun-also-Mean-Be-Sun-Smart-15481058

Frostbite

As the tissue cools, ice crystals form, cell dehydration follows with cell death
Rewarm with 40 degree C water
Do not rub or use any friction



Pathophysiology

Cardiovascular

Renal

Metabolism

Immune System

Gastrointestinal



https://www.interest.com/par/33415512482369563/

Scene/ER Safety



Primary Assessment

Early & aggressive airway management including c-spine protection if necessary



Breathing

Usually involves the upper airway above the glottis
 May have a delayed onset
 Chemical involvement may cause lower airway damage
 Carbon Monoxide



Circulation

2 large bore IVs with LR
 Consensus formula (formerly Parkland burn formula)
 Treat for all injuries
 Monitor UOP
 — Adults > 30-50 mls/hr
 — Pediatrics 1-2 mls/kg/hr

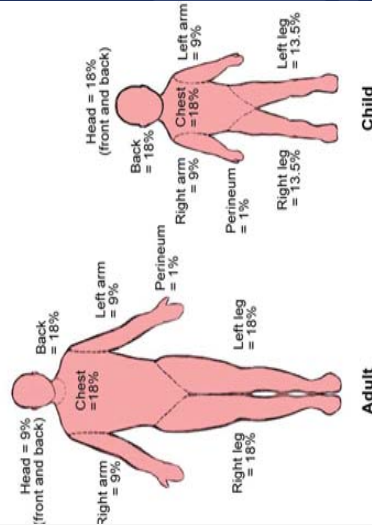


Lund and Browder Burn Chart

Area Burned	Age In Years		Percentage of Total Body Surface
	1 to 4	5 to 14	
Head	10	17	13
Neck	2	2	2
Anterior Trunk	13	13	13
Posterior Trunk	13	13	13
Right Arm	2.5	2.5	2.5
Right Forearm	1	1	1
Right Hand	1	1	1
Right Upper Arm	4	4	4
Left Upper Arm	4	4	4
Left Forearm	3	3	3
Left Hand	3	3	3
Left Lower Arm	3	3	3
Right Hand	2.5	2.5	2.5
Right Forearm	2.5	2.5	2.5
Right Upper Arm	2.5	2.5	2.5
Right Thigh	5.5	6.5	6.5
Right Lower Leg	5.5	6.5	6.5
Right Foot	5	5	5
Left Lower Leg	5	5	5
Left Foot	5	5	5
Right Foot	3.5	3.5	3.5
Left Foot	3.5	3.5	3.5

<http://img.medscape.com/urology/emergencymedicine/95148-1481683.jpg>

Lets Calculate a Percentage



http://study.dread.com/index.php?option=com_content&view=full&Itemid=511561

Fluid Calculation

According to Advanced Burn Life Support(2011)
 Consensus Formula:
 — 2 ml per kg X percentage of burn
 — Give the first half over the first 8 hours from onset of burn
 — Give the second half over the remaining 16 hours



Pediatric Calculation

9 month old, 10 kg patient brought to ER

- second and third degree burns:
 - to chest, abdomen, scrotal area, upper right arm and palm of right hand.



<http://www.doh.ny.gov/health/2007>

<http://medscape.com/viewarticle/93118>

Pediatric Fluid Calculation

Per Advanced Burn Life Support (ABLS):

- > Children: $2-4 \text{ ml LR} \times \text{kg body weight} \times \% \text{BSA burn}$
- > Half administered in the first 8 hours post burn.
- > The remaining half the next 16 hours



<http://www.healthcare.wa.gov/healthcare/abls.htm>

Pediatric Urinary Output

The fluid infusion rate should be increased or decreased by one-third

- > if the urinary output falls below or exceeds the desired level by more than one-third for two to three hours. (Children $<30 \text{ kg}$ UOP goal = 1 ml/kg/hr)



<http://abls.com/2011/01/01/abls-2011/>

Infant Fluid Calculation

Infants < 12 months and young children:
Fluid with 5% dextrose at a maintenance rate in addition to the resuscitation fluid noted above.



Pediatric Fluid Calculation (cont.)

2 ml per kg X % of burn.

Pt weight is 10kg.

$2 \text{ ml} \times 10 \times 20.5 = 420 \text{ ml}$ over 24 hours.

210 ml is given in the first 8 hours from the onset of burn (run at 26 ml/hr)

» ABLS 2011

Disability

Neuro assessment before and after sedation and paralytics.

Assess for circumferential burns. Monitor pulses, motor and sensation distal to the injury.

Monitor for compartment syndrome

Pain Management

Aggressively treat and manage pain
If the patient is not intubated, administer IV opioids in small boluses and titrate to effect.
Monitor closely for respiratory depression.
Anxiolytics such as Ativan may be necessary.
Consider intubation if pain control is inadequate.

Pain Management (cont.)



Exposure

After the burning process is stopped, remove wet clothes, blankets, etc
Cover with clean dry sheets or blankets (They do not need to be sterile). Avoid wet dressings as they can cause hypothermia.



Maintain temperature, avoid hypothermia

Secondary Survey

Check for associated trauma.
Estimate burn size
Pt's palm=approx. 1% of burned area



www.amboss.com/US/medical/trauma/burns

<http://www.cdc.gov/od/ocdc/pubs/ocdc.htm>

If in Doubt

CALL YOUR BURN CENTER



<http://www.jaistia.com/news/health/burn-center-jobs-stressful-rewarding-4660416-1600071620.html>

Special Considerations

Pediatric Population



<http://www.dailymail.co.uk/news/health/2389727/Three-month-old-baby-gets-safes-home/hq-burns-spontaneously-bursting-flames-burns-home.html>

Summary

- Stop the burning process
- Aggressive airway management
- Adequate fluid resuscitation
- Maintain warmth after exposure
- Analgesia
- Burns are distracting, look for other injuries

Questions?



References

www.GDC.com

Trauma Nursing Core Course, 7th edition, copyright 2014 by ENA

Wendling, P., *think plastic wrap as wound dressing for thermal burns*, ACEP News, Elsevier Global Medical News American Burn Association 2013

 Air Methods