


**Objectives**

**At the conclusion of this presentation the participant will be able to:**

- Identify types of burn injury
- Describe assessment of the burn patient
- Evaluate treatment options
- Identify patients requiring transfer to a burn center



The objectives for this presentation include:

- Identify the different types of burn injury including mechanism of injury and the varying degrees of burn depth.
- Describe the assessment priorities of the burn patient during initial management.
- Evaluate and initiate treatment and identify when burn patients need to be transferred to a burn center.

Instructor note: picture of burn dressing to the leg.

## Epidemiology

In the United States:

- > 1 million burns per year
- Roughly half receive medical treatment
  - 70% male
  - Average age: 32 years
  - 18% are Children <5 years
  - 12% are Elderly >60 years





- Over 1 million burn injuries occur per year.
- About 450,000 burns per year receive medical treatment
- Nearly 70 % are men with a mean age of 32 years old
- Children under age 5 account for 18% of the total and patients over 60 account for 12% of the cases.

*Source: American Burn Association, 2011 National Burn Repository – Report of Data from 2001-2010*

*Instructor note: care and support for the burn patient*

## Epidemiology

- Majority are <10% total body surface area (TBSA)
  - Mortality rate ~4%
  - Deaths increase with age, TBSA and inhalation injury
  - Most post burn morbidity and mortality due to infection



- Majority of burns are less than 10% TBSA (70%) and have a low mortality rate (0.6%)
- Mortality rate for all cases is roughly 3.9%. Deaths from burn injury increase with advancing age, burn size and inhalation injury.
- Cause of most post burn morbidity and mortality continues to be infection.

*Source: American Burn Association, 2011 National Burn Repository – Report of Data from 2001-2010*

*Instructor note: tar burn to the left hand. Tar burns special consideration emulsify tar with mineral oil product.*

## Length of Stay

Percentage Body Surface Area Burned	Length of Stay (Days)	Number of Patients
<20	6-17	1295
20-39	17-45	187
40-89	38-94	104
>90	129-237	12



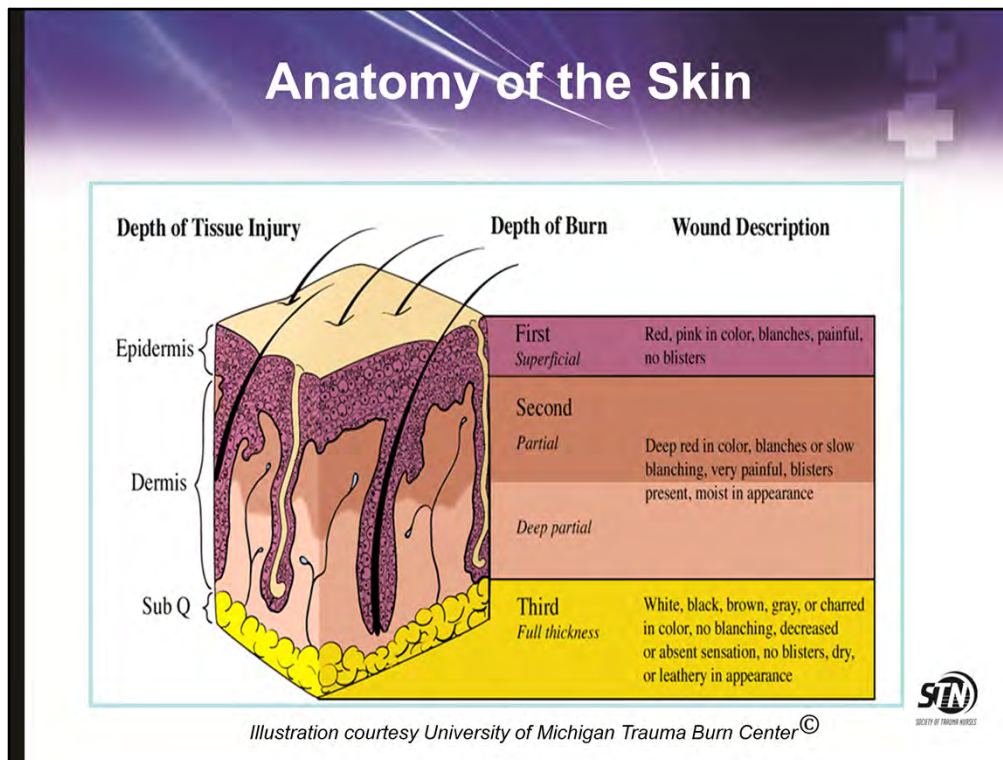
<b>Mortality Rate by Age Group And Burn Size</b> (expressed as the number of deaths over the total number of patients in that group)											
Age Group	Burn Size (% TBSA)										Total
	0.1-9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	>=90	
<b>birth -1.9</b>	<b>0.0%</b>	<b>0.3%</b>	<b>2.1%</b>	<b>3.6%</b>	<b>12.9%</b>	<b>20.9%</b>	<b>41.4%</b>	<b>57.1%</b>	<b>66.7%</b>	<b>66.7%</b>	<b>1.2%</b>
<i>Pct row</i>	2/4282	4/1450	7/327	5/139	11/85	9/43	12/29	12/21	8/12	6/9	76/6397
<b>2 - 4.9</b>	<b>0.3%</b>	<b>0.4%</b>	<b>3.8%</b>	<b>5.5%</b>	<b>5.1%</b>	<b>10.9%</b>	<b>30.8%</b>	<b>28.1%</b>	<b>65.0%</b>	<b>78.3%</b>	<b>2.3%</b>
<i>Pct row</i>	7/2225	3/784	11/293	7/128	4/78	6/55	8/26	9/32	13/20	18/23	86/3664
<b>5 - 19.9</b>	<b>0.2%</b>	<b>0.2%</b>	<b>1.4%</b>	<b>2.7%</b>	<b>8.7%</b>	<b>9.9%</b>	<b>17.7%</b>	<b>37.3%</b>	<b>40.4%</b>	<b>63.9%</b>	<b>2.0%</b>
<i>Pct row</i>	9/4792	4/1737	10/690	9/331	18/208	14/142	17/96	22/59	23/57	39/61	165/8173
<b>20-29.9</b>	<b>0.3%</b>	<b>0.6%</b>	<b>2.7%</b>	<b>3.5%</b>	<b>9.0%</b>	<b>14.5%</b>	<b>32.4%</b>	<b>37.0%</b>	<b>60.0%</b>	<b>84.6%</b>	<b>2.8%</b>
<i>Pct row</i>	10/3823	9/1445	15/558	9/257	16/177	17/117	23/71	17/46	27/45	44/52	187/6591
<b>30-30.9</b>	<b>0.1%</b>	<b>0.6%</b>	<b>3.6%</b>	<b>6.9%</b>	<b>15.1%</b>	<b>28.5%</b>	<b>39.8%</b>	<b>51.4%</b>	<b>66.7%</b>	<b>75.9%</b>	<b>3.6%</b>
<i>Pct row</i>	6/4334	10/1647	22/616	25/361	25/166	39/137	33/83	37/72	32/48	41/54	270/7518
<b>40-40.9</b>	<b>0.5%</b>	<b>1.3%</b>	<b>5.0%</b>	<b>17.3%</b>	<b>25.7%</b>	<b>32.4%</b>	<b>43.8%</b>	<b>58.5%</b>	<b>79.1%</b>	<b>85.2%</b>	<b>5.6%</b>
<i>Pct row</i>	17/3331	15/1186	26/520	43/248	46/179	33/102	35/80	31/53	34/43	46/54	326/5796
<b>50-50.9</b>	<b>1.3%</b>	<b>3.6%</b>	<b>10.8%</b>	<b>23.0%</b>	<b>41.3%</b>	<b>51.9%</b>	<b>62.2%</b>	<b>87.5%</b>	<b>78.3%</b>	<b>82.6%</b>	<b>9.1%</b>
<i>Pct row</i>	26/1967	26/730	35/325	41/178	43/104	42/81	23/37	28/32	18/23	38/46	320/3523
<b>60-60.9</b>	<b>2.1%</b>	<b>8.8%</b>	<b>17.1%</b>	<b>39.4%</b>	<b>63.0%</b>	<b>74.5%</b>	<b>75.7%</b>	<b>92.6%</b>	<b>87.0%</b>	<b>80.0%</b>	<b>15.4%</b>
<i>Pct row</i>	23/1099	43/486	42/245	41/104	46/73	41/55	28/37	25/27	20/23	28/35	337/2184
<b>&gt;=70</b>	<b>7.3%</b>	<b>26.5%</b>	<b>53.3%</b>	<b>72.7%</b>	<b>79.8%</b>	<b>90.1%</b>	<b>95.5%</b>	<b>89.1%</b>	<b>91.7%</b>	<b>91.4%</b>	<b>31.3%</b>
<i>Pct row</i>	102/1403	195/735	162/304	149/205	87/109	91/101	63/66	49/55	22/24	32/35	952/3037
<b>Total</b>	<b>0.7%</b>	<b>3.0%</b>	<b>8.5%</b>	<b>16.9%</b>	<b>25.1%</b>	<b>35.1%</b>	<b>46.1%</b>	<b>57.9%</b>	<b>66.8%</b>	<b>79.1%</b>	<b>5.8%</b>
<i>Pct row</i>	202/27256	309/10200	330/3878	329/1951	296/1179	292/833	242/525	230/397	197/295	292/369	2719/46883

- Over the past several decades tremendous advances in the medical and surgical management of burn injuries.
- Injuries uniformly fatal as recently as 25-30 years ago are now typically survivable.

*Palmieri TL, Klein MB. Burn research state of the science: Introduction. Journal of Burn Care & Research. 2007; 28 (4): 544-545.*

- This chart shows the significance of age, total body surface area burned and mortality rates.
- Children less than two and the elderly > age 60 are compromised.
- A 30% burn in a 60 year old patient is associated with a 40% mortality rate.

*Source: American Burn Association, 2011 National Burn Repository – Report of Data from 2001-2010*



- The skin is the body's largest organ.
- Bilayer, consisting of the epidermis and the dermis and ranges in thickness from .04 inches (1 mm) to .2 inches (6 mm) on the palms or soles of the feet.
- The epidermis is the outer non-vascular layer that consists of mostly keratinocytes.
  - Acts as barrier against the hazards of the environment.
  - Damage to the epidermal layer is considered a first degree (or superficial) burn. The skin is pink to red in color, painful and blanches; there are no blisters present. A sunburn is an example of a first degree burn.
- The next layer is the dermis.
  - Thickest part of the skin and houses the structures necessary for survival- sweat and sebaceous glands, hair follicles, capillaries, and nerve endings.
  - Damage to the epidermis into the dermis results in a second degree burn (partial or deep partial) injury.
  - Wound is painful, moist in appearance and blisters are present.
- The subcutaneous tissue lies between the dermis and the muscles
  - Made up of connective tissue and fat.
  - Damage through the epidermal and dermal layer to the subcutaneous tissue is a third degree or full thickness burn.
  - Tissue is dry and leathery in appearance and often white in color.

*Instructor note: skin diagram showing layers of skin and depth of injury.*



## Functions of the Skin

- Prevention of infection
- Conserve body fluids
- Temperature regulation
- Cosmetic appearance
- Sensation and touch





Functions of the skin include:

- Prevention from infection (i.e. the job of the epidermis)
- Conservation of body fluids and temperature maintenance.
- High risk for hypothermia once the skin is damaged. It is important to keep them warm and dry.
- Lifelong- damage to the integument system can involve scarring and contractures.
- Areas of third degree burn can lead to impaired sensation and touch due to damaged nerve endings.

## Burn Pathophysiology


- Inflammatory mediators
  - Shock
  - Hypovolemia
  - Increased pulmonary and vascular resistance
  - Myocardial depression




- Burn injury causes release of inflammatory mediators at the cellular level. This has a systemic effect. Inflammatory mediators affect the heart, large vessels and lungs.
- Shock ensues as a result of increased vascular permeability; fluid leaks from the intravascular space to the interstitial space.
- Increases in pulmonary and systemic vascular resistance and myocardial depression occur.
- Edema formation occurs from fluid and protein translocation into both burned and non-burned tissues.
- Increased hematocrit occurs soon after the injury due to plasma volume deficit.

## Etiology

- Thermal
- Frostbite
- Inhalation





Three categories of burn mechanism of injury:

- **Thermal injury** is the most common type of etiology and involves contact with heat sources such as fire, steam, hot liquids or objects.
  - Majority of admissions are due to thermal injury.
- **Frostbite** causes extracellular and intracellular ice to form leading to cell dehydration and shrinkage.
  - Treatment regimens can be different than thermal injuries.
- **Inhalation injury** can be divided into injuries above the glottis and below the glottis and is associated with high mortality.
  - Above the glottis involves thermal injury to the nose, throat and mouth. Swelling can occur within minutes to hours of injury and requires prompt intubation due to possible airway obstruction.
  - Below the glottis is often due to inhaled chemicals and smoke particles.
  - Current standard for diagnosis of burn inhalation injury is fiberoptic bronchoscopy. Chest x-rays often appear normal early on.

*Instructor note: top picture thermal injury to the legs. Bottom picture frostbite.*

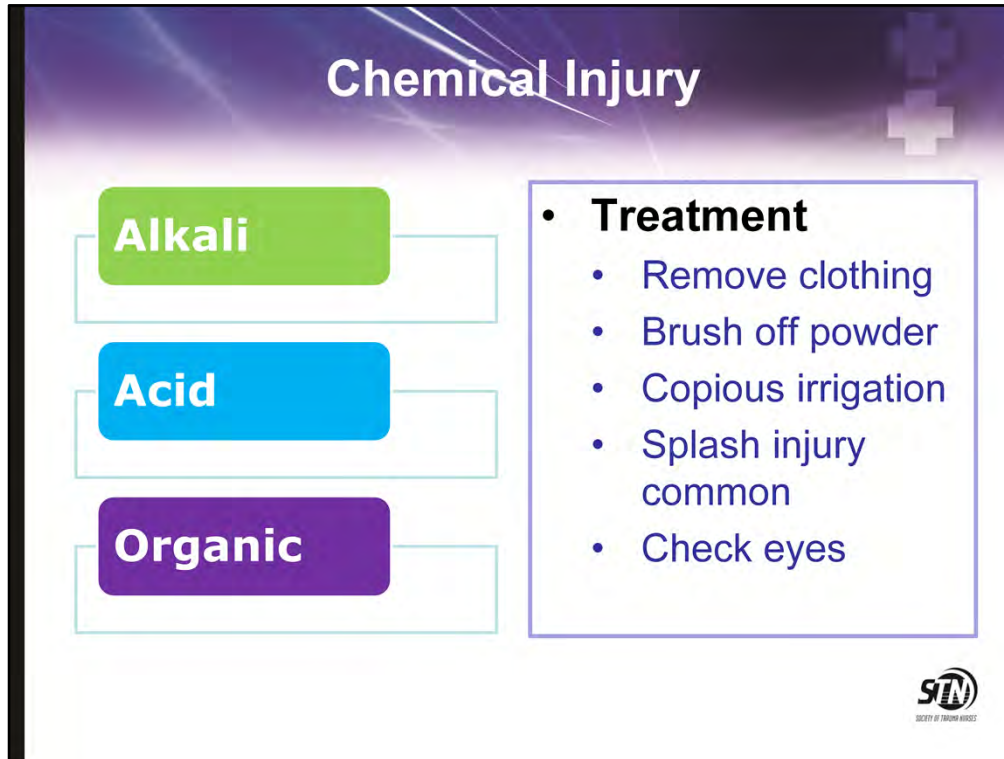
## Mechanism of Injury

- Types of burn injury
  - Scald
  - Electrical
  - Chemical



- Next, let's review the various types of injury more in depth.

*Instructor note: second degree burn with blisters*



### 3 categories of chemicals Alkali, Acid and Organic.

- Alkali (NaOH, KOH, Ammonium ;found in cement and fertilizers)
- Acids are commonly found in bathroom cleaners
- Organic chemicals are often phenol, petroleum based products.
- Chemical injuries are insidious and continue to burn the tissue until the chemical is removed.
- Many of these areas can be full thickness.
- Splash injuries common
- Severity of injury depends on: amount of chemical, concentration of chemical, duration of contact with chemical

### Treatment:

It is important to remove clothing and brush off any powders prior to irrigation or the chemical may intensify.

- Copious irrigation is the treatment of choice after removing clothing.
- The eyes should be flushed and checked for corneal abrasions.
- Hydrofluoric acid burns cause hypocalcemia as fluoride binds free serum calcium. Treat with topical calcium gluconate gel as it leaches calcium from the cells.

**Reminder:** Always remember universal precautions to protect yourself and the rest of the staff.




Chemical burns often have areas of full thickness centrally surrounded by areas of partial thickness on the periphery.

*Instructor note: picture of chemical injury*

## Electrical Injury

- Often work related
- Extent difficult to determine
- Cardiac monitoring
- Observe for:
  - hemoglobinuria  
(port wine) color urine
  - compartment syndrome
- Fluid resuscitation with goal of 75-100 cc/urine/hour



- Electrical injuries are often work related.
- The skin is the most resistant organ in the body. Once this resistance is overcome, electricity travels the path of least resistance; along the bone surface through blood vessels and nerves generating heat and causing damage to muscles.
- The extent of the injury is difficult to ascertain, what you see is not what you get, as much of the damage lies under the surface.
- Many electrical injuries have an entrance and exit site depending on the voltage involved.
- High voltage exit wounds produce “blow out” injury or may cause loss of an extremity.


**Assessment:**

- Assess the patient for hemoglobinuria (port wine colored urine) due to the breakdown of muscle tissue. If present, patients require fluid resuscitation with a goal of 75-100 cc of urine output per hour.
- Patients may have cardiac dysrhythmias and require monitoring.
- Monitor extremities for compartment syndrome; fasciotomy may be required.

*Instructor note: top picture of electrical injury to hand. Bottom picture hemoglobinuria – dark port wine colored urine*

## Severity of Injury

- **Depth**
  - first, second and third degree
- **Extent of burn**
  - Rule of 9's, palm equals 1%
- **Age**
  - <2 and >60 at increased risk
- **Past Medical History (PMH)**
- **Location of burn**





- Severity of injury is determined by the extent of burn, depth of burn, age of the patient, previous health status and location of the burn.
- Patients less than 2 and greater than 60 are at increased risk due to immature immune system and comorbidities respectively.
- Burns to the perineum are at increased risk of infection.



## Depth: First Degree Burn

- Pink in color
- Damage to epidermis
- Do not count in TBSA calculation
- *No resuscitation fluid necessary*
- Heals on its own



### **First Degree Burn:**

- Damage to the epidermal layer is considered a first degree (or superficial) burn.
- The skin is pink to red in color, painful and blanches; there are no blisters present.
- A sunburn is an example of a first degree burn.
- First degree burns are not included in the fluid resuscitation calculation and will heal on its own.

*Instructor note: sunburn, first degree burn. Will heal without operative intervention.*

## Depth: Second Degree Burn

- Partial thickness injury
- Damage to epidermis & part of the dermis
- Superficial Second Degree: Pink to red, wet appearance, painful, will heal on its own
- Deep Second Degree: Mottled red/white with slow blanching. May convert to full thickness. May require operative intervention




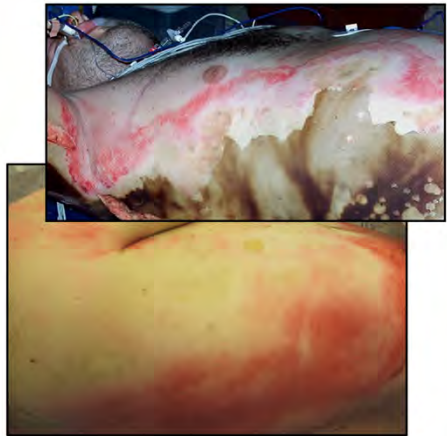
### **Second Degree Burn / Partial Thickness:**

- Involves damage through the epidermis into the dermal layer.
- A partial thickness burn can be divided into a superficial second degree burn and a deep second degree burn.
- The difference is the depth of tissue necrosis into the dermis.
- A superficial second degree is red/pink in color and shiny due to blister fluid.
- Capillary refill is normal and the wound is very painful. Superficial second degree will heal on its own.
- Deep second degree is red/white and mottled in appearance.
- It has slower capillary refill and potentially can convert to third degree.
- Deep second may or may not require operative intervention.

*Instructor note: top picture of second degree burn – pink /red shiny we appearance. Bottom picture deep second degree burn – more mottled in appearance.*

## Depth: Third Degree Burn

- Third degree or full thickness.
- White, black, brown in color, dry, leathery in appearance.
- Burn skin non-pliable
- Circumferential third degree may require escharotomy.
- Skin grafting required.



### **Third degree burn / Full thickness burn:**

- Destroys the epidermis and dermis.
- White, brown or charred in appearance and dry and leathery.
- The necrotic tissue is known as burn eschar.
- Skin grafting is required.
- The wound is not painful as the nerve endings are destroyed and there is no blanching present.


### **Assessment:**

- Careful ongoing assessment of circumferential third degree burn is necessary as patients may need an escharotomy.

*Instructor note: top picture of third degree burns to chest an abdomen. White dray leathery appearance. Will require grafting. Bottom picture again white dry leathery appearance – third degree burns to back, side and arm.*

## Extent of Burn: Rule of 9's

- TBSA calculation
  - Rule of 9's
  - Peds vs. adults
  - Palm is equal to 1%



### Body Surface Area Calculation

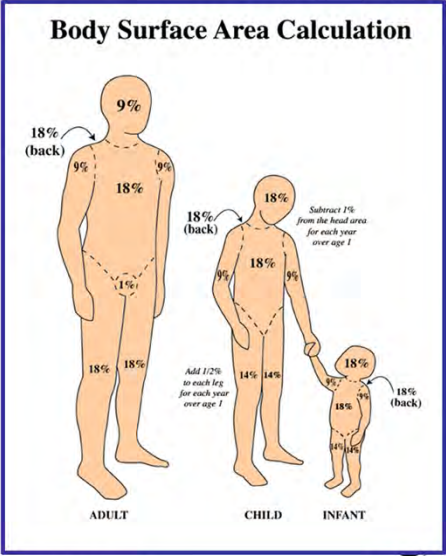


Illustration courtesy University of Michigan Trauma Burn Center ©



### Estimating burn size: Percent Total Body Surface Area (TBSA)

#### RULE OF NINES

- Divides each body region into a percentage.
- Note: the difference between adults and children.
  - The child's head is larger in relation to the rest of their body; the head increases in percentage and the percentage decreases in the legs.
  - In the adult, the head (circumferential) is 9% and each arm is 9%, each leg is 18% and the posterior and anterior torso are each 18%.
- The palmar surface of the patient's hand from base of palm to finger tips is roughly 1% TBSA. This is helpful when estimating scattered burns.

## Initial Management

- Stop the burning
- Airway and breathing
- Circulation
  - Extent of burn
  - Depth of burn
  - Begin resuscitation
  - Limb threat injuries
- Transfer to burn center



**Initial management priorities:**

- Stop the burning process- remove all clothing and jewelry.
- Assess ABC's
  - Determine if the patient can maintain their airway.
  - Is breathing adequate?
  - Begin fluid resuscitation.
  - Assess whether the patient should be transferred to a burn center.
- **What are your guidelines for transferring to a burn center?**

*Instructor note: picture of burn to left hand, several days post injury.*

## Inhalation Injury (Airway)

- Assessment
  - History
  - Singed hair
  - Carbonaceous sputum
  - Hypoxia, SOB
  - Stridor, hoarseness
  - Oropharyngeal erythema
- Treat with 100% Oxygen
- 20% of burns involve inhalation injury



### **Incidence:**

- Smoke inhalation is present in approximately 10-20% of all reported cases
- Identified in 60-70% of patients who die in burn centers (American Burn Association: Advanced Burn Life Support Course).
- The most recent report from the National Burn Repository reported incidence of 18%.
- A inhalation injury increases the ICU length of stay, hospital length of stay, and mortality rate.
- Mortality increases 7 fold with an associated inhalation injury.
- Inhalation injuries are more common and more severe with age.

### **Assessment:**

- History of event: Closed space fire (house fires, car fires, etc)
- Singed facial or nasal hair
- Carbonaceous sputum
- Stridor, hoarseness
- Shortness of breath or difficulty breathing


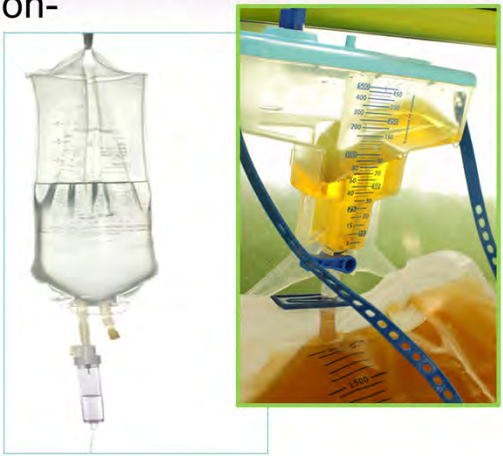
### **Treatment:**

- 100 % oxygen
- Early intubation

For patients **suspected of having an inhalation injury do not wait to intubate** as with ongoing fluid resuscitation swelling will increase and it will be difficult to pass an endotracheal tube. Stridor or hoarseness is a late sign!

## Resuscitation (Circulation)

- Initial Fluid Resuscitation- Burns >20-25% TBSA
- LR infusion
- Monitor urine output
  - Adults 30ml/hour
  - Pediatric <30kg: 1 ml/kg/hour
- Complications:
  - Shock
  - Acute renal failure





### Circulation:

- **Place 2 large bore IV's** in non burned tissue if at all possible.
- Burn resuscitation formula determines an **estimate** of fluid needs over the first 24 hours and is recommended for burn patients with TBSA >20%.
- Most commonly used formula is the Burn Consensus formula by the American Burn Association.
- In the early phases of care, pre-hospital and early hospital setting prior to calculating the TBSA start fluids using the following recommendations:
- Initial fluid resuscitation – starting point. Prior to figuring the TBSA.
  - ≤ 5 y/o – LR – 125 ml per hour**
  - 6-13 y/o – LR - 250 ml per hour**
  - ≥ 14 y/o - LR – 500 ml per hour**
- Use the rule of 9's to determine the TBSA.
- **Resuscitation Formula: (explained on next slide)**
- Monitor urine output to determine effectiveness of resuscitation.
- Adequate urine output: Adults 30ml/hr; children 1mL/kg/hr for children < 30kg
- Shock and acute renal failure are consequences of hypovolemia.

*Pham TN, Cancio LC, Gibran NS, American Burn Association Practice Guidelines Burn Shock Resuscitation. J Burn Care Research. Volume 29 (1); 257-266.*

## Burn Resuscitation Formula

- Adult and Chemical Burns:
  - **2 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**
- Pediatric (14 years and under and less than 40kgs):
  - **3 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**
- Adult High Voltage Electric Injuries:
  - **4 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**
- Pediatric High Voltage Electric Injuries



New guidelines from the ABA from ABLIS 2010 - breakdown the fluid resuscitation formula and age:

Research indicated that resuscitation based upon using higher starting points commonly result in excessive edema formation and over-resuscitation. Fluid rates have been adjusted according to this information as follows:

Adult and Chemical Burns:

**2 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**

Pediatric (14 years and under and less than 40kgs):

**3 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**

Adult High Voltage Electric Injuries:

**4 ml LR X kg X %TBSA (2<sup>nd</sup> & 3<sup>rd</sup> degree)**

Pediatric High Voltage Electric Injuries:

**Consult a burn center**

Example on next page:

Instructor note: picture of a severely burn injured patient in the ICU



## Example Resuscitation Formula

- 50 % TBSA (2<sup>nd</sup> and 3<sup>rd</sup> degree burns only)
- Age 28
- Mechanism explosion
- 70 kg patient
- **2 ml X 70kg X 50 %  
TBSA = 7,000 cc**
- Give 3,500 ml over the 1<sup>st</sup> 8 hours
- Give the other 3,500 ml over the next 16 hours




Example of fluid resuscitation calculation.

- Determine the total body surface area using the rule of 9's; only include second and third degree burns (not first degree).
- We calculate 50% TBSA and 70 kg for weight.
- $2\text{ml} \times 70\text{ kg} \times 50\%$  equals 7,000 ml/kg/% TBSA of Lactated Ringers.
- Divide this in half and give the first half over 8 hours and the next half over 16 hours.

## Escharotomy

- Circumferential injury
- Third degree
- Check pulses often



- Limb threatening complications can result when a full thickness circumferential injury is present.
- Assessment of pulses is paramount (particularly in the digits with hand burns).
- If necessary an escharotomy must be performed to release the burn eschar which is encumbering blood flow to the distal extremities.
- If the burn is deep and extends to muscle, a fasciotomy may need to be performed.
- Escharotomies of the chest wall may also be necessary with a circumferential burn.
  - Signs will include peak pressures on the ventilator and decreasing tidal volumes.

## Special Considerations Trauma Combined with Burn Injury

- Assess ABC's, administer fluid resuscitation
- Don't be distracted by burn
- Treat life threatening injuries first
- 2-3 fold increase in inhalation injury, increased mortality



### Trauma and burn injury combination:

- Assess airway, breathing, circulation first and attend to any life threatening injuries.
- It is easy to be distracted by burn injuries.
- Treat as a trauma first, administer fluid resuscitation as calculated by consensus formula, do not spare if patient has head injury.
- Burns combined with Trauma presents a rare injury pattern that has a synergistic effect on mortality.
  - 2-3 fold increase in the incidence of inhalation injury in this population and increased mortality despite similar TBSA burned when compared with patients with burn as the sole mechanism;
  - ISS appears to be an independent predictor of mortality in this combined injury pattern.

*Santaniello, JM, Luchette FA, Esposito TJ, et al. Ten Year Experience of Burn, Trauma and Combined Burn/Trauma Injuries Comparing Outcomes. Journal of Trauma. 2004;57(4);696-701.*

## Special Considerations: Pediatric Burns

- Psychosocial issues
  - Abuse, neglect
  - Pattern of injury
- Airway
  - Airway size and shape
- Breathing
  - Chest wall more compliant
- Circulation
  - Children < 10kg should have D5LR for resuscitation



### Pediatric Burns

- Special patient population with notable differences.
- Majority of scald injuries occur in children <2 years of age.
- Children's injuries are often the result of abuse or neglect.
  - Important to listen to the history and compare the pattern of injury to determine if the story is accurate.
  - Involve social work and/or child protective services if there is any doubt.

Pediatric ABC's have their own characteristics:

- Peds airway is funnel shaped and angled, more cephalad, making intubation more challenging.
- Can gauge tube size by the diameter of the small finger.
- Peds have compliant chest walls and will not tolerate restriction by a circumferential torso burn, may need escharotomies.
- May require more fluid resuscitation.

Circulation:

Children less than 10 kilograms should have their resuscitation with D5LR.

## Special Considerations: Pediatric Burns



### Circulation

- Larger surface area
- Increased volume needs
- Hypothermia risk
- Thinner skin depth



## Special Considerations: Geriatric Burns

- Pre-injury health status- pre-existing conditions
- Abuse or neglect
- Skin is thin, burn can be deep
- Decreased reserves to stress response
- May need additional monitoring to guide resuscitation.



### Geriatric burns:

- Increased mortality rate
- Affected by pre-injury health status, pre-existing conditions, **and current medication**
- Stress response to burns not easily tolerated
- Assess for signs of abuse and/or neglect
- Skin is often thin with decreased vascularity → more susceptible to deep burns when exposed to similar mechanism of injury
- May require increased monitoring to guide fluid resuscitation such as Pulmonary Artery catheter

## Initial Management



- Monitor urine output and adequacy of resuscitation
- Keep patient warm and dry
- Wound care
- Pain med
- Consider need for transfer



- Continue to monitor urine output and adequacy of resuscitation.
- Keep the patient warm and dry.
- Cover the wounds with a clean sheet.
  - It is not recommended to place antimicrobial creams on the wound as the burn center will wash, debride and dress the wound.
  - Additionally some creams may interfere with biotechnology dressings.
- Give morphine IV for pain. (small doses titrate to affect)
  - Avoid IM injections due to malabsorption.
- Consider transfer to a burn center.

## ABA Burn Center Referral Criteria

- Partial thickness burns >10%
- Burns to face, hands, feet, genitalia, perineum, or major joints
- 3<sup>rd</sup> degree burns any age
- Electrical burns
- Chemical burns
- Inhalation injury
- Patients with pre-existing medical conditions
- Patients with burns & concomitant trauma
- Pediatric burns
- Patients who will require special social, emotional, or long-term rehab intervention



- Some burns have special considerations that should be treated at a burn center.
- The American Burn Association has developed general guidelines for burn center transfer.
- Some burn centers treat adults only, pediatric only or both adults and pediatrics.
- All pediatric burns, inhalation injuries, third degree burns and burns to areas of function (i.e. the face, hands, feet, major joints) must be transferred.

*Source: American College of Surgeons Committee on Trauma, Resources for the Optimal Care of the Injured Patient: 2006*



## US Burn Centers

- Only 55% of US burns admitted to burn centers
  - Burn Center's average 200 admits per year
  - Non burn acute care hospitals average <3 per year
- Specialized nursing and medical team including OT, PT, Social Work and more...



- About 55% of the estimated 45,000 United States acute hospitalizations for burn injury are admitted to 125 hospitals with specialized facilities for burn care.
- Percentage admitted to burn centers has increased steadily in recent decades, with growing recognition of the special needs of burn patients and continuing advances in the technical resources and skills of those who refer, transport and treat them.
- Burn centers now average 200 annual admissions, while the other 4,700 U.S. acute care hospitals average less than 3.
- Specialized burn nursing is an important component of burn center expertise and contributes to improved patient outcomes.
- Education is key to cultivating and maintaining burn nursing competency.
- Burn Centers offer functional and cosmetic outcomes as well as a specialized team that includes, OT, PT and social work.

Burn Incidence and Treatment in the United State: 2011 Fact Sheet.  
[www.ameriburn.org](http://www.ameriburn.org); accessed 6-15-11.

## Skin Grafting

- Split Thickness Skin Graft (STSG)
- Third degree burns
- Donor site must be flat surface
- Partial thickness into dermis
- Increase risk of infection





Skin graft: STSG – split thickness skin graft

- Required for third degree burns, sometimes used for deep partial second degree burns due to issues with scarring and cosmetic outcomes.
- Donor site: Partial thickness donor contains viable dermis; taken from a non-burned area of the body.
- Donor site must be flat area (not all areas of body are suitable for donor site which can be an issue with very large burns)
- Be mindful of total body percent affected and increase risk of infection with addition of donor sites.
- Clarification of terms: Autograft (from the patient – permanent placement) versus homograft (cadaver skin, used as temporary placement until autografts available or to prep site for autograft application).



- Picture of harvesting donor site in the OR with a dermatome (long blade, needs flat surface area)
- Harvested skin is put through a skin mesher in order to poke holes in the skin (mesh size is varied depending on how much donor site a patient has available)
  - Meshed skin can cover more surface area, allows for draining of exudate
  - Will heal looking “bumpy” (like a waffle iron), not cosmetically appealing
- Sheet grafts are autografts not run through the mesher
  - Used for areas that will be seen more readily- face, hands etc.
  - Much better cosmetic outcome
  - Patient must have plenty of donor site (large burns often can not afford to use that much skin)
- Skin grafting over joints require specialized OT/PT care, often placed in splints for a period of time

## Donor Sites

- Painful
- Heal on their own
- STSG donor sites maybe re-harvested

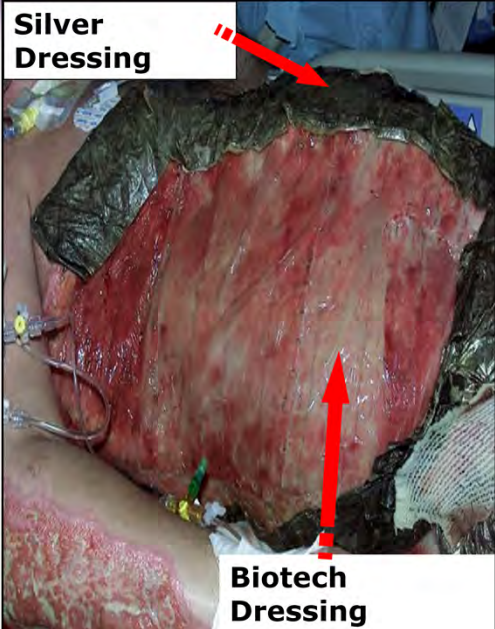


Donor sites:

- Very painful
- Heal on their own
- With STSG donor sites maybe re-harvested for future skin grafting. (Used in large burns)
- Many different types of dressings for donor sites, burn community still struggling to find “the best donor dressing”

## Wound Care

- Cleanse wound with antibacterial agent
- Major advancement in burns
- Topical antimicrobial creams
- Biotechnology dressings
- Silver dressings
- Wound biopsy guides therapy





### Wound care:

- Clean burn wound with antibacterial agent (soap and water)
- Major advancements in the last 10- 15 years (biotech and silver dressings), has changed burn care
- Continue to use topical antimicrobial creams
  - Choose topical based on effectiveness against different types of infection
  - Silver sulfadiazene is mainstay and often stocked in most ER's
- Biotechnology
  - Skin substitutes
  - Come in a variety of forms such as acellular matrices or bilayer laminates (a popular skin substitute uses shark glycosaminoglycans and bovine tendon collagen matrix to provide coverage and closure for very large TBSA burns)
  - Technology continues to advance.
- Silver dressings
  - Very broad spectrum
  - Variety of forms: non stick dressings, foams, absorbent materials, sponges
  - Able to leave silver dressing in place for extended period of time (some 5-7 days).
  - Decreased number of dressings for patients (used to be BID with topical creams) and associated pain.
  - Decreased nurse staffing necessary for dressing changes.
  - Easier to care for at home
- Wound tissue biopsy guides choice of dressing or topical based on type of infection present

## Complications

- Inadequate resuscitation
  - Renal Failure
- Over resuscitation
  - Abdominal compartment syndrome
- And controversy....
  - Continue to debate resuscitation endpoints



- Aim of resuscitation is to support vital organ perfusion with the minimum amount of fluid necessary.
- Resuscitation is a balancing act with under resuscitation causing renal failure and over resuscitation potentially causing abdominal compartment syndrome, pleural effusions and/or increased edema in non-burned areas.
- Controversy continues about exact composition and timing of “ideal” resuscitation as well as resuscitation endpoints (there is a lack of class 1 evidence to guide therapies).
- Traditional resuscitation often fails to normalize lactic acid and base deficit and may be associated with over resuscitation when used as goal directed therapy.
- Increase in preload and cardiac index via aggressive resuscitation guided by Central venous catheters and PA catheters did not show any benefits. Therefore a preload driven strategy for burn resuscitation is not advisable. Invasive monitoring with a CVC or PA catheter is however, indicated in special circumstances such as elderly burns or patients with inadequate response to standard treatment.
- Initial literature from military experience and some US burn centers detail use of nurse driven protocols to diminish variations along with early use of albumin.

*Jeng JC, Lee K, Jablonski K, Jordan MH. Serum lactate and base deficit suggest inadequate resuscitation of patients with burn injuries: application of a point-of-care laboratory instrument. J Burn Care Rehabil. 1997; 18:402-5.*

*Pham TN, Cancio LC, Gibran NS, American Burn Association Practice Guidelines Burn Shock Resuscitation. J Burn Care Research. Volume 29 (1); 257-266.*

## Controversies


- Lack of evidence based practice
  - Small number of large burns
  - Burn centers geographically isolated
  - Lack of standards for training
  - Perpetuates apprenticeship mindset
  - Few rigorous multi-center trials
  - Opposing techniques/philosophies
- Burn State of the Science
  - Develop national research agenda




- Even though there have been amazing advances in the management of burns over the last few decades, there continue to be incongruities throughout the care continuum.
- The majority of evidence is class 2 and class 3.
- The reason for this is there are only a small number of burns each year and few rigorous multicenter trials.
- Burn centers are geographically isolated and there is an apprentice mindset when it comes to training.
- Many centers have opposing techniques and philosophies.
- In response to the variation in burn center practices, a Burn State of the Science conference was convened in 2007 with the goal to develop a comprehensive national research agenda covering all aspects of burn care from the acute phase through the rehabilitative phase.

*Palmieri TL, Klein MB. Burn research state of the science: Introduction. Journal of Burn Care & Research. 2007; 28 (4): 544-545.*

## Future Considerations



- Biotechnology
- Dermal replacement
- Stem cells
- Resuscitation endpoints
- Methods to stop capillary leak



Future considerations include:

- Continuous advances in biotechnological dressings
- Current skin substitute coverage lacks an adequate dermal layer. Research continues to find a dermal layer that will hold up over time. Ultimate goals include ability to grow hair follicles, sweat and sebaceous glands and nerve endings.
- Research to find stem cells to augment epithelialization and attenuate systemic inflammatory response.
- Resuscitation endpoints remain elusive.
- Research focus on methods to stop the capillary leak during burn shock.



## Summary

- Initial burn management priorities include
  - Maintain adequate airway
  - Adequate fluid resuscitation
    - Calculate TBSA and use the Burn Consensus Formula
  - Transfer patient to a burn center if necessary
- Special considerations when caring for pediatric or elderly
- A national burn research agenda is needed to develop standards of care & evidence based practice

