CON ED
October 18, 2010
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The wet smoke still drifted skyward – blending in with the pre-dawn grey winter sky. The 2 story Cape Cod-style home, now reduced to smoldering rubble, had been consumed quickly by the fire. Scott Jeffers had returned to the scene after transporting to the ED the only survivor. Jeffers, a 19-year veteran of Oak County EMS, in all his years had never before experienced a call as gut-wrenching and grisly as this.

The family of 6 was now reduced to one—fighting for her life in the Burn Unit at Clayton Memorial Medical Center, 60 miles away. Jeffers, stood staring-- as if hypnotized by the charred remains of the home.

The fire engine and two additional tankers had responded, but the blaze had virtually engulfed the house by the time they had arrived. The searing flames and thick smoke had impeded efforts to gain entrance and the rescue team had prepared for the worst.

All the victims were upstairs. Three young children had died in their beds. One child and the two parents were lying in the hallway. All victims were severely burned, including the mother who was still alive.

Jeffers had carried her out and the EMS team was ready. She was still barely breathing, and had a pulse. An ambu bag was applied for assisted ventilations as the EMTs struggled to find a vein for IV access. Her face was charred and swollen. Jeffers knew that intubation would be difficult, if not impossible. The skin on her arms blistered in some areas, and whitish in others.

"Let me take a quick look," Jeffers said. The EMT removed the face mask and Jeffers inserted the laryngoscope blade. The tongue and pharynx was swollen. Carbonaceous material had accumulated in the throat.

"Give me some suction," Jeffers barked.

"I can't see a damn thing, continue to bag her and grab the King Airway."

The paramedics rushed her to the local community hospital 5 miles away. The emergency physician, a semi-retired moonlighter, was unable to access a central vein.

One of the nurses had accessed a foot vein and Ringer's Lactate was initiated. The patient's oxygen saturation was reasonable with the King Airway, so the physician decided not to remove it and attempt a difficult intubation. The helicopter had been activated prior to EMS arrival and ETA was 10 minutes. When the flight crew arrived, the patient was hypotensive, tachycardic and the oxygen saturation was drifting downward.

BURN INJURIES

Perhaps one of the most devastating and complex of all emergencies, severe burn injuries continue to be a major cause of human suffering and disability. Although deaths from burn injuries have declined in the past two decades, approximately *1.4 million persons in the United States suffer from burn injuries yearly*. Of these, approximately 180.000 are hospitalized and 5% of hospitalized patients die as a result of their burn injuries. In structural fires, one half of burn victims die of smoke inhalation or carbon monoxide poisoning before reaching the hospital.

There are several burn categories, including chemical, electrical, scalds and fire. Serious burn injuries occur most often in young adult males, followed by children younger than 9 years old. For children under 2 years old, liquid scalds and hot surface burns account for nearly all serious burn injuries.

Burn injuries are extremely complex and invoke metabolic, anatomic, and physiologic changes involving virtually *all major organ systems*. In addition, for victims of structural fires, there are compounding and **complicating factors**, *including traumatic injury* (jumping from a window, falling down the stairs, etc), *carbon monoxide poisoning*, *cyanide toxicity*, *smoke inhalation*, and *substance abuse*. Knowledge of these physiologic and complicating factors will improve the emergency team's ability to provide timely and effective intervention.

Severity of burn injury depends on the extent and location of the burn, age of the patient, presence of inhalation injury, pre-existing medical conditions, and presence of intoxicants such as alcohol.

Depth of burn injury can be described based upon classification by degree. *First degree burns* (superficial) cause minor damage to the epidermal skin layer. Clinical signs include redness, tenderness and pain. Sensation is intact and no blistering occurs. An example of a first degree burn injury is sunburn.


first degree (superficial) burn

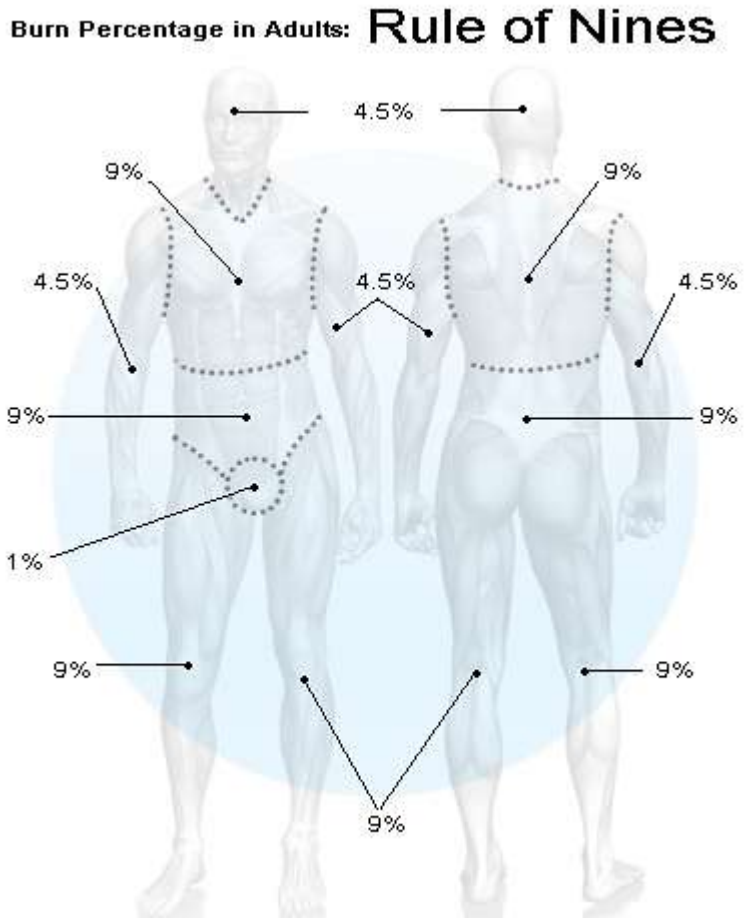
Second degree burns involve the epidermal and the dermal layers. Blisters are common. These burns are tender and if they involve the deeper dermal layer, sensation can be impaired and scarring can occur.

 second degree (partial thickness) burn (blister)

Third degree (full thickness) burns totally destroy the epidermis and dermis, as well as the blood supply to the dermis. The skin is numb and has a leathery, whitish appearance.

 third degree (full thickness) burn

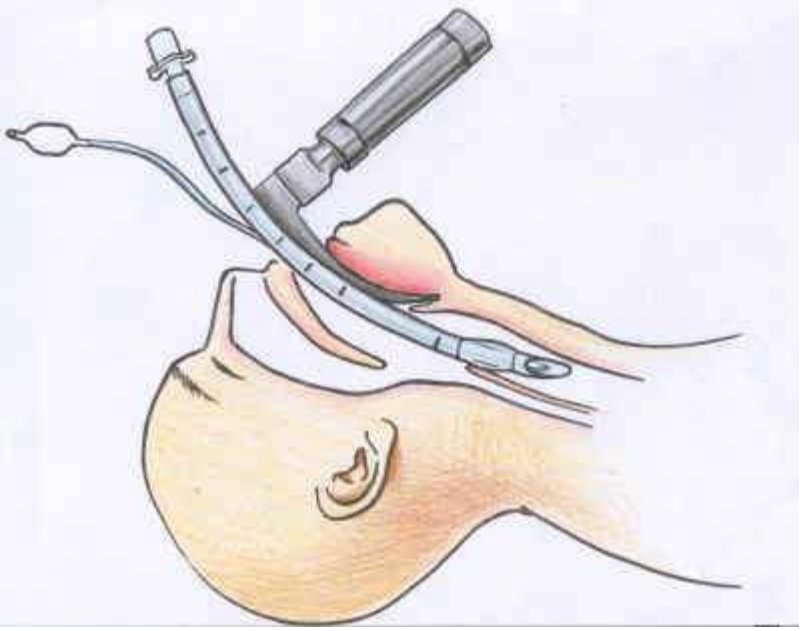
The **"rule of nines"** is the time-honored method of estimating extent of total body surface area (TBSA) of burns. For the adult, the rule allots 9% of TBSA to the head and neck, and to each upper extremity, 18% each to the anterior and posterior thorax, 18% to each lower extremity and 1% to the genitalia and perineum. The area of the patient's palm represents 1% of the total body surface area and can be used for estimation of burn size. The infant patient has a relatively larger head (18%) and proportionately smaller legs (14% each), compared to the adult.



Burns are further classified as Minor, Moderate, and Severe (Major). Major burn injury victims should be transported to a Burn Center. Major burns include:

- Full thickness (3rd degree) burns involving more than 10% of TBSA
- Partial thickness burns involving more than 25% of TBSA in adults or 20% in children
- Burns of the face, eyes, ears, hands or perineum (functional and/or cosmetic impairment)
- Burns associated with major trauma or smoke inhalation
- Burns in high risk patients

Field management of the burn victim necessitates that the EMT is aware of the clinical signs and symptoms of impending airway failure as well as the multitude of associated co-existing complications that often occur in conjunction with the burn. **Smoke inhalation** is a lethal condition that causes upper airway and lung damage. Signs of inhalation injury include carbonaceous sputum, singes nasal hairs, burns of the mouth and nose and shortness of breath. Patients who suffer from **airway injury** should receive *endotracheal intubation early*, before edema makes intubation difficult or impossible.



For those patients with stable airways, high-flow humidified oxygen should be provided via a nonrebreathing apparatus.

Hypovolemic shock ("Burn Shock") can occur due to loss of intravascular fluids into the tissues adjacent to the burn wound. The damaged skin can no longer retain water, and fluid losses can be large and devastating. Venous access in a burn victim can be quite difficult, even under the best of circumstances. Transfer of the burn victim should not be delayed by a prolonged search for IV sites. Fluid resuscitation is best

guided by achievement of normal urinary output (30 to 40 mls per hour in an adult and one ml per kg per hour in children younger than 2 years). The **Parkland formula** is a widely used guide for initial fluid administration. This formula recommends Ringer's Lactate at 4 ml/kg/% TBSA burned. One half of the fluid is given in the first 8 **hours from the time of the burn**, with the other half administered over the next 16 hours.

For pediatric fluid administration, the Galveston formula has been recommended, utilizing D5RL at 5000ml/m^2 of TBSA burned, plus 2000 ml/m^2 administered in the first 24 hours. One half is instilled in the first 8 hours, the other half given over the subsequent 16 hours. (Dextrose is provided in children because they have smaller glycogen stores than adults).

Morphine has been the traditional narcotic used to manage the burn victim's pain. The doses can be titrated upward as needed and there is little protein binding.