

Burn Care in EMS

By
Scott DeBoer, RN, MSN, CEN, CCRN, CFRN, EMT-B;
Craig Felty, RN, BSN, NREMT-P;
& Michael Seaver, RB, BA, EMT-P

The authors would like to thank Ann Marie O'Connor, RN, BSN, clinical nurse associate for the University of Chicago Hospitals Burn Center; and Kathy Supple, RN, MSN, nurse practitioner / case manager for Loyola University Medical Center Burn Center; for their invaluable assistance in the preparation of this article.

*"If all that changes slowly is explained by life –
All that changes quickly is explained by fire!"*
G. Bachelard (1884-1962)¹

When you ask EMS providers and ED nurses what patients they most fear, the response typically involves burn victims. This article provides an overview of initial burn assessment and treatment priorities in the field.

Airway Management

In the realm of EMS, from basic First Responder or EMT classes, we are taught about the "ABC's" (airway, breathing and circulation). When confronted with a burn patient, the priorities are no different. Why is "A" such a big issue? If you don't have "A", don't worry about assessing "b and C" because the patient probably won't be alive very long!

When assessing a burn patient, we need to be especially mindful of how the burn occurred, i.e. the mechanism of injury. In many cases, such as explosions or "enclosed space" fires, if the patient is burned on the outside (especially if there are burns to the face), it is likely he may be burned on the inside (upper airways) as well (*see Figure 1*). More important, if the patient is swollen on the "outside", he may also be swollen on the "inside".

Figure 1: EMS Inhalation Injury Findings

- Singed eyebrows or nasal hairs
- Black nasal / oral discharge
- Grossly swollen lips
- Hoarse voice
- Carbonaceous "soot" in back of the throat or sputum
- Facial burns
- Abnormal oxygenation
- History of enclosure in a smoke filled location

Adapted from: Russel T. The Management of Burns. In Ferrera P, et al., (eds): Trauma Management: An Emergency Medicine Approach, pp. 549-565. St. Louis, MO: Mosby, 2001.

Think of how a victim of a house fire must be breathing. Anxiety, fear and hypoxia all lead to rapid breathing of inhaled smoke, with carbon monoxide and various other toxic gases that accompany the superheated temperatures. Airway tissue edema from the heat injury or from chemical burns can quickly lead to a life-threatening airway emergency. This is a crucial consideration, especially with children, who have proportionately smaller airways, as a little edema goes a long way.²

Not all burn patients present with airway emergencies that require intubation, especially in the prehospital environment. An alert and oriented patient with no respiratory distress and no visible airway injury is highly unlikely to need urgent intubation. But when there are concerns about airway edema, patients, especially children, should be intubated quickly, before the airway becomes compromised.³

“How long does it take an airway to swell, and how much will it swell?” The answer to these two questions is essentially, “We don’t know.” It might help to think about what happens when a finger is slammed in a car door. The finger swells immediately, but more important, it continues to swell for hours after the initial injury. The same idea applies to a burned airway. Burn center clinical educators teach the following: “We can always take the tube out.... We can’t always put the tube in!”⁴ If the opportunity for endotracheal intubation is missed, invasive airways, such as needle (children or adults) or surgical cricothyroidotomy (adults), can be done. But these techniques are challenging in most adult patients, and are significantly more difficult to perform in children.²

The decision to intubate a burned patient at the scene is dependent upon EMS protocols and assessment of the victim. If the patient is in arrest or unconscious without a gag reflex, EMS providers should immediately provide bag-valve-mask ventilation and strongly consider intubation within established protocols. If the patient is unconscious (but still has a gag reflex), or remains conscious with severe facial burns, intubation in the EMS environment using rapid sequence intubation (RSI) techniques should be considered. If RSI is not an option, then 100% oxygen via face mask should be administered until the airway is definitively secured in the ED.^{2,3}

RSI, or using medications to sedate and briefly chemically paralyze patients, has become an airway management technique of choice in the ED, operating rooms and many EMS systems.^{3,6} Succinylcholine (Anectine) is a neuromuscular blocking agent with a short duration (8-10 minutes in most patients) and is very commonly used with RSI. Though unlikely to be an issue in the initial few hours after the burn (i.e., in the EMS or ED settings), succinylcholine should be used with extreme caution in burn patients and those with neuromuscular diseases, such as muscular dystrophy, as severe hyperkalemia (increased

potassium) or malignant hyperthermia (life-threatening temperature elevation) may result.^{7,8,16}

Doctors at the University of Chicago Hospitals’ departments of pediatric critical care and anesthesia teach the “one day to one year” rule regarding succinylcholine and burns. This rule states “Succinylcholine is safe on the day of the burn and one year after the burn, but never between the two.” This will avoid unnecessary life-threatening complications that may result from hyperkalemia or hyperthermia.⁷⁻⁹

Longer-acting “paralytics”, such as Norcuron (vecuronium), Pavulon (pancuronium), Zemuron (rocuronium) and Nimbec (cisatracurium) may be used to assist with intubation or for muscle relaxation after intubation has been accomplished. Though these medications do not cause the increased potassium levels associated with succinylcholine, the duration of these medications (20-60 minutes) can be worrisome if intubation attempts are not immediately successful.⁷ As more and more EMS systems are using RSI, EMS practitioners must remember that paralytics, whether short- or long-acting, do not provide analgesia or sedation. Administration of these drugs should be accompanied by adequate amounts of intravenous analgesics and sedatives.^{5,7}

Once an appropriate-sized endotracheal tube (ETT) has been placed in pediatric (little fingernail rule, 16+age/4, Broselow-Luten tape) or adult patients (7.5mm for females and 8.0 for males), securing the tube can be quite difficult.^{2,10} Traditional methods of taping, ETTs simply do not work in patients with facial burns, as tape doesn’t stick to burned tissue. Either umbilical/twill tape or a commercially prepared ETT fixation device should be used.²

Fluid Resuscitation

Intravenous fluids are administered to replenish circulating fluid volume that is lost as a result of not only the burn, but also the massive fluid shifts and edema that accompany most significant burns. As challenging as it is to establish and secure an intravenous (IV) line on a healthy person in the back of an ambulance, imagine how it is with a burn patient.

The first concern with starting an IV in a burn patient is “Where”? Non-burned areas and large veins are the IV site of choice, but what if the patient seems to be burned everywhere? Can an IV be placed in burned tissue? Absolutely. IV fluids are critically important. A second concern is how best to secure the IV. In an ambulance or on scene, simply wrap a roll of gauze snugly around the IV site to hold it in place. When the patient arrives at the ED, stitches can be placed to help prevent dislodgement.²

Another concern is infection. How does one adequately clean and prepare the IV site on a burned patient? Just the same as

you would with an IV site for any other patient. And do so without hesitation. If an infection should set in, it can later be addressed. Out of concern for later infections, some burn centers routinely replace IV lines that were started by EMS.⁴ If the patient doesn't get enough fluids, especially in the first several hours after the burn, what will happen? He or she is going to die. Therefore, as per protocol, start the IV wherever you can.

What about intraosseous lines? Can one be placed through burned tissue? The answer is, absolutely. It may be your best bet, especially in children, but also adults. If you add shock, burns and fat, you have really bad combination when it comes finding the IV site. Even though it seems that these patients may not have accessible veins, they always have bones. For intraosseous cannulation, a standard bone-marrow aspiration needle or the "Bone Gun" (WaisMed, Caesarea, Israel), can be used in children's arms, legs, or pelvises. In adults, IOs may be placed in the sternum as well (F.A.S.T.1, Pyng Technologies, Richmond, BC).^{2,3,11} Since infection is always an issue, placing intravenous or intraosseous lines in burned areas should be avoided unless there is no alternative.^{2,3,12,14}

The American Burn Association criteria for placement of IV lines in the prehospital arena include:

"Bad burns" (>20% burn with an EMS transport time of over 60 minutes)

Hypovolemic shock from associated injuries

Management of life-threatening ventricular dysrhythmias

Potential exists for life-threatening airway obstruction or cardiac arrest.¹⁴

Lactated Ringer's (LR) or normal saline (NS) solution may be administered, depending on burn center preference and EMS protocols. Both are isotonic fluids that allow the maximum amount of fluids to fill up and remain in the "tank" (intravascular space).

The Consensus, Parkland and Brooke formulas are commonly used as guidelines for initial fluid resuscitation.^{12,14,14} It is important to remember that fluid resuscitation formulas are a guide, not the law. Some patients need more fluids than the formulas recommend, and certainly some need less. These formulas calculate the amount of fluid to be given in the first 24 hours after the burn (not after presentation to EMS for treatment). The formulas are summarized by: "2-4cc x weight in kg x % of body burned." The "% burn" is commonly estimated by using the "Rule of 9s" or its pediatric variation.¹²

Imagine a previously healthy 220-lb. (100-kg), 20-year-old patient with a 60% total body surface area burn. Based on the formulas, he would receive 12,000-24,000cc in 24 hours, and 6,000-12,000cc or 6-12 liters of fluids in the first eight hours after the burn. That works out of the rate of 750cc-1500cc per

hour for the first eight hours.^{13,26}

It can be challenging for EMS providers to use the above formulas, because in the prehospital arena accurate weights are a rarity and IV infusion pumps are frequently not available. It may be easier just to give these patients a bolus of fluid in the prehospital environment. For children, a 20cc/kg fluid bolus should be administered, as with any pediatric trauma patient. In many cases by the time the bolus is infused, the patient will be at the ED.² The Prehospital Advanced Burn Life Support (ABLS) course simply recommends:

- 150cc/hr for patients under five years of age
- 250cc/hr for patients from five to 15 years of age
- 500cc per hour for those over 15 years of age.¹⁴

Some burn centers recommend EMS personnel simply administer fluids at a "wide-open" rate, as it is difficult to give the severely burned adult patient enough, let alone too much, fluid in the prehospital setting.^{4,9,13} In areas with prolonged prehospital transport times, these guidelines must certainly be adapted. Regardless of how the prehospital fluid delivery is calculated, an accurate estimate of the volume of fluid given during EMS transport is important. This amount of fluid will be figured into the total sum of fluids that the burn patient should receive according to the chosen fluid resuscitation formula.^{3,12,30}

Dressings

Burned clothing can initially be moistened to extinguish heat and then removed. This can be done with the privacy of an ambulance while en route to the hospital. If clothing adheres to the burned body parts, do not attempt to pull it off. Simply leave it in place; any remaining clothing will be removed with the burned tissue during debridement.¹³

While not specifically related to hypothermia tissues, it is a good idea to remove jewelry with any significant burn injury. If the patient offers resistance to removing jewelry, explain that the earlier it is removed, the less chance it will have to be cut off later. There is the distinct possibility of the jewelry becoming a tourniquet of sorts as the surrounding tissues become edematous. Another important reason the early removal is that jewelry can retain heat and continue to burn. Even in non-burned areas, patients may later exhibit significant generalized swelling.¹⁵

Burn victims can easily and quickly become hypothermic. This is due not only to the physical loss of skin (and its thermoregulatory properties), but also from environmental factors such as wet clothing and the ambulance's or ED cool ambient temperatures. In addition to maintaining a warm environment, remember that wet skin cools many times faster than dry skin.^{2,16} Hypothermia may result in prolonged blood clotting times, hemodynamic instability and even apnea in infants and children.

Infants and small children lose significant amounts of heat from their large heads, so a hat or a towel can be applied to the head in an attempt to minimize heat loss. In the hospital setting, use intravenous fluids administered with a fluid warmer, since infusing large amounts of room-temperature fluids (68°F/20°C) can quickly result in disastrous hypothermia. Other interventions, such as turning up the heat in the ambulance or ED and later using convection forced air warmer, such as the Bair Hugger from Arizant Healthcare in Eden Prairie, MN, or warming blankets, can also help to prevent heat loss in these patients.^{2,16}

Dressings: Dry vs. Wet vs. ...

School-age children are taught that “Stop, drop, & roll” is the first thing to do if they catch fire. Why? Because one has to “stop the burning process”. Not only is it important to extinguish the flame, but one should “cool the burn, not the patient”.^{2,20-22} Is it OK to briefly run a burned hand under cool water? Absolutely. Small burns (e.g., a burn to the hand) can be covered initially with gauze and saline. Wet, cool dressings feel better, and there is very little likelihood of developing hypothermia from a burn to an isolated area. However, for transport purposes, the general rule is that once the burning process is stopped, serious or “bad burns” should be covered loosely with dry dressings. This can be accomplished by simply putting clean, dry sheets (sterile if available, but not mandatory) under and over the patient, with a blanket on top to prevent heat loss (even in summer). The rationale for “dry dressings” is that they cover the burn but do not add to potentially life-threatening hypothermia. As a rule, burn centers teach “dry dressings for everyone”.^{4,17,18}

The exception to the loose, dry dressing rule is availability of a product like Water-Jel from Water-Jel Technologies in Carlstadt, NJ. Especially applicable for EMS, this product makes the patient feel better (like a wet dressing would) but *doesn't* cause hypothermia. Industrial EMS providers have been using this product for several years, and more recently, the U.S. military and the countries of England, Ireland and Germany have begun to use this product almost exclusively for prehospital burn dressings.¹⁹ Water-Jel gelatinous dressings are composed of sterile water and tea-tree oil. The dressing pulls heat from the burn into the dressing (helping to prevent further burn injury) without adding to the potential for hypothermia, as with wet saline dressings.²⁰⁻²² Once the patient is in the burn center, the prehospital dressings are easily removed (they don't stick to the burn) and debridements begun after rinsing away any residual Water-Jel with saline.¹⁹ As with other issues in EMS burn care, the type of burn dressing used should be guided by local protocols and burn center guidelines.

An additional benefit of this type of dressing, especially for BLS providers who cannot administer IV morphine, is the pain

relief that is frequently associated with its use. In a prehospital burn patient study, more than 70% of patients indicated a significant reduction in pain, while 7% verbalized “total pain relief” solely with application of the burn dressing.²⁰ For ALS providers who may administer morphine or similar analgesics, studies have shown that after Water-Jel dressing placement, less intravenous medication needs to be administered.²⁰ In addition to the analgesic effects of the dressing, the other active ingredient is tea-tree oil, which is a naturally occurring antibacterial from Australia that can help prevent further infection.^{20,22-24}

Silver sulfadiazine (Silvadene), or “burn goop”, though commonly used for burns in the outpatient and inpatient hospital settings, should not be placed on the burn by EMS or transferring hospitals, as the receiving staff will have to remove dressings and the Silvadene to assess the burn.^{3,13}

What about blisters? From the EMS perspective, their care is simple: Cover them with a sterile dressing.¹⁸ Once in the hospital setting, there are three schools of thought regarding burn blisters. One group contends that the blisters should be left intact, as the top layer of the blisters acts as a barrier to infection. Another group adopts the “middle-of-the-road” approach of aspirating blisters fluid with a syringe (the fluid is thought to impair white blood cell activity), but leaving the blisters covering intact. The third school of thought advocates complete removal of all blisters fluid and the outer blister covering, due to concerns about impaired wound healing.^{3,13}

Pain Management

“The wise person looks not for pleasure, but merely freedom from pain”. Aristotle 384-322 B.C.²⁵

“Disease can destroy the body, but pain can destroy the soul” E. Lisson, 1989²⁶

At home or in the ED, pain associated with minor, superficial burns can be treated with topical anesthetics (Solarcaine, aloe very) and/or oral medications such as acetaminophen, with or without codeine, or ibuprofen. Caution is advised when using topical anesthetics on children, because absorption of large quantities of the anesthetic may cause seizures. Pain associated with significant partial-thickness or second-degree burns is unlike any other pain and can require what most medical professional would consider “unbelievable and unsafe” amounts of analgesia.²⁷

Major burns require a unique approach to pain management, EMS and ED personnel should serve as patient advocates in assuring adequate pain relief.²⁸ If the patient is in shock, as many are in the subsequent hours post-burn, blood is preferentially shunted to the heart, lungs and brain, and away from the “butt and the gut”. Administration of intramuscular or oral medications is not advisable in these patients.²⁹

With partial-thickness burns, plenty of intravenous analgesia is certainly appropriate. Though true that the actual tissue involved in full-thickness or third-degree burns doesn't hurt, extensive burns that are only third-degree are not the norm. More commonly, third-degree burns are surrounded by second-degree burns, which are exquisitely painful.¹⁸ Intravenous morphine or fentanyl can be used for systemic analgesia on conjunction with aggressive fluid resuscitation.^{13,16,27-29} Sufficient medication should be given to keep the patient calm but conscious, or at least easily awakened. For pediatric patients, this might mean 0.1 mg/kg of IV morphine every 5-10 minutes. For adults, 5-10 mg of IV morphine every 5 minutes may be necessary to obtain adequate pain relief.^{3,29} These amounts are in stark contrast to the 1-2 mg of morphine that is cautiously administered to adult patients with chest pain.

If necessary, Narcan (naloxone) can be used to reverse opiate-induced respiratory depression. A bag-valve-mask device with oxygen and an appropriately sized mask should always be kept at the bedside in case of severe respiratory depression. Small repeated doses (0.1 mg/kg in children under 12 months of age and 1.0 mg in older children and adults) of intravenous naloxone administered for respiratory depression or apnea should arouse the patient sufficiently.³⁰

With any burn, regardless of severity, the importance of parental or family support and adequate analgesia (from dressings and/or intravenous medications) cannot be underestimated.¹⁶

Conclusion

When we focus on the mechanism of the burn injury and assess any associated trauma, establish and maintain a patent airway and initiate fluid resuscitation, our patients stand a good chance of surviving. EMS providers also need to include good burn wound management and aggressive pain management as part of their care.

References

- Bachelard, G. *The Psychoanalysis of Fire*. Translated by Ross A. Boston, MA: Beacon Press, 1968
- Purdue G, Hunt J, Burris, A. Pediatric burn care. *Clinical Pediatric Emergency Medicine* 3(1):76-82, 2002
- Russel T. The Management of Burns. In Ferrera P, et al. (eds). *Trauma Management: An Emergency Medicine Approach*, pp. 549-565. St. Louis, MO: Mosby, 2001.
- O'Connor A (2003, September) University of Chicago Hospitals Burn Center. Personal communication.
- Wang H, O'Connor R., Domeier R. (2000) Prehospital rapid-sequence intubation. Position paper: National Association of EMS Physicians.
- Idris A., Gabrielli A. Advances in airway management. *Emerg Med Clin North Am* 20(4):843-858, 2002
- O'Connor R, Levine B. Airway Management in the Trauma Setting. In Ferrera P, et al (eds): *Trauma Management: An Emergency Medicine Approach*, pp. 52-74, St. Louis, MO: Mosby, 2001
- Schow A, Lubarsky D, Olson R, Gan T. Can succinylcholine be used safely in hyperkalemic patients? *Anesthesia & Analgesia* 95(1):119-122, 2002
- Kabana M. (2003, September) University of Chicago Hospitals: Departments of Pediatric Critical Care and Anaesthesia. Personal communication.
- Emergency Nurses Association. Editor. Pediatric considerations: Respiratory interventions & diagnostic procedures. In: *ENPC Provider Manual*, 2nd Ed., pp. 113-130. Emergency Nurses Association: Park Ridge, IL, 1998.
- DeBoer S, Zeglin D. Pediatric rapid-sequence intubation: Intraosseous style. *Air-Med* 5(5):11-12, 1999
- American Burn Association. Shock & fluid resuscitation, pp.22-29. Advanced Burn Life Support Provider Course. American Burn Association: Chicago, IL, 2001.
- Talbot-Stern J. Burns. In Harwood-Nuss A, et al (eds). *The Clinical Practice of Emergency Medicine*, 3rd Ed., pp. 624-629. Philadelphia, PA: Lippincott, Williams, and Wilkins, 2001
- American Burn Association. Stabilization & transport from the pre-hospital scene. *Advanced Burn Life Support Pre-Hospital Manual*, pp. 44-45. American Burn Association: Chicago, IL, 2001.
- McDonald L, Knowlton C. The ABC's of emergency burn management. *Nursing Spectrum* 2003 Emergency Nurses Specialty Edition. CE 142C, 68-73, Sept. 2003.
- Szyfelbein S, Martyn J, Sheridan R, Cote C. Anesthesia for Children With Burn Injuries. In Cote C., et al, (eds). *A Practice of Anesthesia for Infants and Children*, 3rd ed., pp. 522-543, Philadelphia, PA: W.B. Saunders, 2001
- American Burn Association. Burn wound management, pp. 30-36. Advanced Burn Life Support Provider Course. American Burn Association: Chicago, IL, 2001.
- McSwain N, Frame S, Paturas J, eds. Thermal Trauma: Injuries produced by heat and cold. In: *PHTLS: Basic & Advanced Prehospital Trauma Life Support*, 4th Edition, pp. 263-277, Mosby: St. Louis, MO: Mosby, 1999.
- Bourke, P. (2003, September) Water-Jel Industries: Europe. Personal communication.
- Castner T, Harz C, Schlor J. Cooling: Out of the bag: Water-Jel burn dressings. *AGAN-Product Test. Rettungsdienst* 5(25):32-35, 2002.
- Castner T. Monitoring of temperature while cooling burn injuries. *Rettungsdienst* 1(23):28-31, 2000.
- Mertz P, Davis S, Cazzanica A, Eaglstein W. Burn study: To assess second-degree burn wound treatment with Water-Jel. Department of Dermatology & Cutaneous Surgery: University of Miami School of Medicine. Unpublished study. Oct. 12, 1990.
- Doleck R, Torsova V. Water-Jel in the treatment of burns: A bacteriological study. *Journal of Burn Care and Rehabilitation* 11(2):135-141, 1990.
- Torsova V, Chmelarova E. Evaluation of the effects of a new Water-Jel system on specific bacterial & yeast strains in laboratory conditions. *Burns* 21(1):47-56, 1995.
- Aristotle. (384-332 B.C.). "The wise person looks not for pleasure, but merely freedom from pain." www.utm.edu/research/iep/e/stoicism.htm.
- Lisson E. (1989). "Disease can destroy the body, but pain can destroy the soul." www.nhho.org/nhpci/dimensions.html.
- Hedderich R, Ness T. Perspectives in pain management: Analgesia for trauma and burns. *Critical Care Clinics* 15(1):167-184, 1999.
- Flynn M. Burn Injuries. In McQuillan K. et al (eds). *Trauma Nursing: From Resuscitation Through Rehabilitation*, 3rd Ed, pp. 788-809. Philadelphia, PA: W.B. Saunders, 2002.
- American Burn Association. Stabilization, transfer, and transport. Advanced Burn Life Support Provider Course, pp. 54-58. Chicago, IL; American Burn Association, 2001.
- Krauss B, Shannon M, Damian F, Fleisher G. *Guidelines for Pediatric Procedural Sedation*, 2nd Ed, p. 37. Irving, TX: American College of Emergency Physicians, 1998.

Scott DeBoer RN, MSN, CEN, CCRN, CFRN, EMT-B, is a flight nurse with Classic LifeGuard, Page, AZ, and founder of Peds-R-Us Medical Education, Dyer, IN.

Craig Felty RN, BSN, NREMT-P, is assistant chief flight nurse with UCAN, University of Chicago Hospitals, Chicago, IL.

Michael Seaver, RN, BA, EMT-P, is president of EMSCON, Ltd. in Merrillville, IN.