JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (CPG)

Burn Care (CPG ID: 12)

Addresses burn injury assessment, resuscitation, wound care, and specific scenarios including chemical and electrical injuries. Reviews considerations for the definitive care of local national patients, including pediatric patients, who are unable to be evacuated from theater.

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TABLE OF CONTENTS

INTRODUCTION

The goal of this CPG is to provide practical, evidence-based recommendations for optimal care of burn casualties in the deployed or austere setting who generally fall into one of two categories: military casualties who can be evacuated out of theater for definitive care and local national patients, often children, who are presented for care at military medical facilities with no possibility of definitive care beyond that provided in theater.

> ***NOTE:*** *If caring for a burn casualty, contact the U.S. Army Institute of Surgical Research (USAISR) Burn Center as soon as possible. Early consultation will facilitate coordination of care to include possible activation of the Burn Flight Team to assist with movement back to Continental U.S. (CONUS). Inability to contact the Burn Center should not delay the evacuation process. Contact the Joint Patient Movement Requirements Center (JPMRC) as soon as possible to coordinate aeromedical evacuation.*
>
> ***Burn Center***
>
> - *DSN 312-429-2876 (429-BURN)*
> - *Commercial (210) 916-2876 or (210) 222-2876*
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Optimal treatment of burn patients can consume enormous personnel and logistical resources. Despite the best efforts of providers at each level of care, the mortality for burn casualties who cannot be evacuated out of theater is significantly higher than that experienced in CONUS facilities. These and other factors must be considered in the deployed environment. Review of *Chapter 26: Burn Trauma in the 2013 Emergency War Surgery* manual is also recommended.[1]

POINT OF INJURY

1. In the field, ***INTERRUPT THE BURNING PROCESS*** and address any life threatening bleeding, airway compromise, or tension pneumothorax as directed by Tactical Combat Casualty Care guidelines. Burn casualties may have additional traumatic injuries which may be more life threatening and require immediate attention.

2. Address any life threatening bleeding, airway compromise, or tension pneumothorax per tactical combat casualty care guidelines.

3. Rinse off dirt and any contaminating chemicals, including hydrocarbon fuels, with clean water. Dry chemicals should be brushed off before irrigation. Once a survey of injuries is performed, cover the patient with blankets to prevent hypothermia.

4. Evacuate the casualty as soon as possible. Tactical considerations and distance may precipitate prolonged field care in which resuscitation is begun under pre-hospital conditions.

INITIAL BURN SURVEY

1. Perform primary and secondary surveys for any trauma patient. Acute injuries found in the primary and secondary survey should be addressed as per standard trauma protocols. Avoid becoming distracted by the appearance of burned tissues.

2. Assess and protect the airway, if needed. Immediate intubation may not be necessary in less severely burned casualties, thereby allowing time to complete the primary survey and prepare for controlled intubation.

3. Indications for endotracheal intubation include a comatose patient, symptomatic inhalation injury, deep facial burns, and burns over 40% Total Body Surface Area (TBSA).

NOTE: *Edema after burn injury causes most Supraglottic airway devices such as laryngeal mask airways (LMAs) to be inadequate.*

4. Use a large-bore endotracheal tube (ETT), especially if inhalation injury is suspected. Size 8 ETT or larger is preferred for adults. The larger ETT tube facilitates subsequent bronchoscopy and pulmonary toilet, and decreases the risk of later airway occlusion due to casts comprised of blood, mucus and debris.

5. Secure ETT with cotton umbilical ties which can be adjusted as edema develops during resuscitation; standard adhesive ETT holders do not work around burned skin. Consider securing ETT with stainless steel wire secured around a pre-molar tooth prior to long-range transport, particularly in patients with extensive facial burns. Frequently reassess position of the ETT during the acute resuscitation period as edema waxes and wanes.

6. Keep the patient warm. Burns increase insensible heat loss. Burn casualties with injuries >20% TBSA are at high risk of hypothermia.

NOTE: *Do not debride blisters until the patient has reached a facility with surgical capability. Cover burns with loose, dry gauze wraps or a clean sheet.*

ACUTE RESUSCITATION

1. Calculate the patient's initial burn size using the Rule of Nines (Appendix A). When wounds are cleaned, re-calculate using the Lund-Browder charts (Appendix B and Appendix C). Superficial (1st degree) burn is NOT included in the estimation of TBSA used for fluid resuscitation.

2. Superficial burns (1st degree) appear red, do not blister, and blanch readily. Partial thickness burns (2nd degree) are moist and sensate, blister, and blanch. Full thickness burns (3rd degree) appear leathery, dry, non-blanching, are insensate, and often contain thrombosed vessels.

3. If TBSA is 20% or greater, patients typically require acute fluid resuscitation for the next 24 to 48 hours with close observation until hour 72 post-burn.

4. Place a Foley catheter with calibrated urometer chamber. Burns to the penis are not a contraindication to urinary catheter placement. Suprapubic bladder catheter placement is rarely, if ever, required in burn patients and should be avoided in the presence of abdominal burns.

5. If available, for patients weighing 40 kg or more, use the Burn Navigator, a burn resuscitation decision support fluid calculator.[2] At the top of every hour, follow the prompts and enter the intake and urine output (UOP) values. The device will provide isotonic fluid rate recommendations for the next hour. For guidance, see the Burn Navigator Training and Resources.

6. The device uses feedback algorithms and the principles listed below to make fluid rate recommendations. The goal is to achieve an hourly target UOP of 30-50mL/hr.

7. Intake and output tables and graphs display how much fluid a patient received. Graph colors change as the patient approaches over-resuscitation danger zones of >200mL/kg and then >250mL/kg.

8. The system seeks to encourage communication between physicians and bedside nurse by displaying an assessment checklist, alert, and minimum and maximum rate recommendations.

9. Each Burn Navigator device allows resuscitation of only one patient at a time.

   CAUTION: *The Burn Navigator is NOT intended to be used for electrical burn injuries resulting in rhabdomyolysis with pigmenturia (red-brown urine). Resuscitation fluid needs in these patients often outpace the system's recommendations. Use clinical judgment and consider the entire scenario when interpreting recommendations, especially when patients have conditions that artificially alter UOP.*

10. For adults, if the Burn Navigator system is not available, initiate manual intravenous (IV) fluid resuscitation using the Rule of 10s (10 mL/hr x %TBSA)[3] Use the Burn Resuscitation Worksheet (Appendix D) [4] to assist initiation of fluid resuscitation.

11. For patients weighing more than 80 kg, add 100 mL/hr to IV fluid rate for each 10 kg >80 kg.

12. For children, 3 x TBSA x body weight in kg gives the volume for the first 24 hrs. One half is programmed for delivery during the first 8 hours. Further guidance for pediatric management is provided below.

13. Lactated Ringer's (LR), PlasmaLyte A (Baxter International, Deerfield, Il) or other isotonic solution is the preferred resuscitation fluid; other solutions (normal saline) should be used with caution as electrolyte imbalances may result. In the absence of overt hypotension (MAP <55), avoid fluid boluses as additional volume contributes to edema. Instead, increase the rate of IV fluids to maintain adequate organ perfusion, as reflected by urine output (UOP).[3]

14. The use of blood products in major burn resuscitation due to coagulopathy, anemia, and bleeding from escharotomy sites or other traumatic injuries is common. Refer to the Joint Trauma System Damage Control CPG for transfusion guidelines and resuscitation of patients with other significant injuries.

15. Monitor UOP closely and decrease or increase the isotonic fluid rate by approximately 20-25% per hour to maintain a UOP of 30-50 mL/hour in adults, or 0.5 to 1 ml/kg /hr in children. Every attempt should be made to minimize fluid administration while maintaining organ perfusion. If UOP> 50 mL/hr, then decrease the fluid rate by 20% for two consecutive hours and reassess. Increase rate of LR by 20% if UOP is less than 30 mL/hr (adults) or pediatric target UOP for 2 consecutive hours. Over-resuscitation can lead to many life threatening complications in the burn patient - so close monitoring of UOP and end organ perfusion is imperative.

16. Both under- and over-resuscitation can result in serious morbidity and even mortality; patients who receive over 250 mL/kg in the first 24 hours are at increased risk for severe complications including acute respiratory distress syndrome and both abdominal and extremity compartment syndromes.

17. Hour-to-hour fluid management is critical, particularly during the first 24 hours. Use the Burn Resuscitation Flow Sheet (Appendix D) to record both fluid intake and UOP.

18. At 8-12 hours post-burn, if the hourly IV fluid rate exceeds 1500 mL/hr or if the projected 24 hr total fluid volume approaches 250 mL/kg, initiate 5% albumin infusion using Table 1 (Adults only); for children, infuse 4-7 mL/kg at the rate of 0.5 mL per minute. Continue the 5% albumin infusion until the 48-hour mark. Fresh frozen plasma may be substituted. In children, consider colloid infusion at calculated maintenance rate, reducing the calculated isotonic infusion by at equal volume.

Table 1: Hourly infusion rates for 5% albumin for adults

5% Albumin Infusion (ml/hr)	30-49%TBSA	50-69% TBSA	70-100% TBSA
<70 kg	30	70	110
70-90 kg	40	80	140
>90 kg	50	90	160

19. If possible, measure bladder pressures every 4 hours in intubated patients with >20% TBSA burns.[5] Ensure the patient is in the supine position and follow the manufacturer's instructions for commercial kits; otherwise, use between 25 and 50 ml, being consistent in whatever volume is used, for serial measurements using a transducer located at the level of the symphysis pubis. Sustained bladder pressure >12 mmHg indicates early intra-abdominal hypertension and adjuncts such as colloid fluid should be considered. If the measured pressure is >20mmHg, the patient should be paralyzed and the measurement repeated. Persistent bladder pressures >20mmHg may indicate abdominal compartment syndrome (See Abdominal Compartment Syndrome below).

20. Combat casualties with burns often present with multi-system injury, to include inhalation injury, hemorrhage, and soft tissue trauma. Associated injuries may increase fluid needs above and beyond standard burn resuscitation formulas.

21. After approximately 24-72 hours, completion of resuscitation is marked by stabilizing hemodynamic parameters and reduction of IV fluid rate to a maintenance level. A well-resuscitated adult burn patient should follow commands, be hemodynamically stable, be tachycardic in the range of 110-130 beats per minute, and have UOP between 30-50 mL/hr. Acid-base balance should normalize, hematocrit should reveal a dilutional anemia, and pulses should be present in all extremities.

MANAGEMENT OF PERSISTENT OLIGURIA AND HYPOTENSION

Clinically significant hypotension must be correlated with UOP. Adequate end organ perfusion as estimated by UOP 30-50 mL/hr generally requires a MAP >55mm Hg. Persistent oliguria and hypotension should trigger an assessment of the patient's hemodynamic status and intravascular volume. Reassess for a possible missed injury or ongoing bleeding. Monitor intravascular fluid status using all available technologies. Consider early use of 5% albumin as discussed above as an adjunct.

When available, monitor central venous pressure (CVP); goal CVP is 6-8 mmHg. If CVP is low, increase IV fluid rate. If CVP is at goal but hypotension (Mean Arterial Pressure, MAP < 55mmHg) persists, use vasopressin 0.04 Units/min (do not titrate) followed by norepinephrine (titrate 2-20mcg/min) if needed. Epinephrine and phenylephrine may be used as additional vasopressors in severe shock proven to be non-hemorrhagic. If intravascular volume appears adequate (CVP at goal), STOP increasing IV fluid rate even if oliguria persists. Consider this patient hemodynamically optimized and that the oliguria likely results from an established renal insult. Expect and tolerate some degree of renal dysfunction in large burns. Continued increases in IV fluid administration, despite optimal hemodynamic parameters, will only result in "resuscitation morbidity," that is often times more detrimental than renal failure.

If the patient exhibits catecholamine-resistant shock, consider the following diagnoses:

- Missed injury and/or on-going blood loss.

- Acidemia. If pH < 7.20, adjust ventilator settings to target PCO2 30-35 mm Hg. If, despite optimal ventilation, patient still has a pH < 7.2, consider administration of sodium bicarbonate or THAM (tris-hydroxymethyl aminomethane).
- Adrenal insufficiency. If suspected start hydrocortisone 100 mg IV every 8 hours. Use of etomidate during rapid sequence intubation may increase risk of adrenal insufficiency.[6]
- Hypocalcemia. Consider empirically administering calcium chloride (8-16mg/kg IV) for refractory hypotension, especially in patients who have received a blood transfusion. If able to measure levels, maintain ionized calcium > 1.1 mmol/L.

SPECIAL CONSIDERATIONS

ANTIMICROBIAL PROPHYLAXIS

1. Prophylactic IV antibiotics are not indicated for burn injury in the absence of infection. Penetrating wounds or open fractures should be treated with antibiotics according to current guidelines. See Wound Care section for discussion of topical antimicrobials.

2. Administer tetanus prophylaxis as for any trauma patient.

3. If wound infection is diagnosed clinically, direct empiric therapy against gram positive and gram negative bacteria based on known geographic susceptibilities. If this data is unavailable, a good starting point is broad coverage with vancomycin for gram positive organisms and a carbapenem or 4th generation cephalosporin for gram negative organisms.

INHALATION INJURY

NOTE: *Refer to the JTS Inhalation Injury and Toxic Industrial Chemical Exposure CPG for additional information* [4]

1. Inhalation injury occurs secondary to smoke exposure and is exacerbated by retained carbonaceous particles (soot) and chemicals. Clinical signs include progressive voice changes, soot about the mouth and nares, hypoxia, and shortness of breath (See Initial Burn Survey for airway management recommendations). If available, use bronchoscopic lavage to remove debris. Be judicious, as excessive irrigation may transport irritants to uninjured lung. Serial bronchoscopy may be required to remove large debris or casts. Patients diagnosed with inhalation injury should receive aerosolized unfractionated heparin 5000 units per ETT every 4 hours; mix heparin with albuterol, as heparin can induce bronchospasm.

2. Populations at risk for carbon monoxide (CO) toxicity include those exposed in enclosed spaces to fires, engines, and cooking stoves. Symptoms of CO toxicity include confusion, stupor, coma, seizures, and cardiac ischemia. Administer 100% oxygen and measure CO-hemoglobin levels via co-oximetry if available. Hyperbaric oxygen therapy may further reduce the CO-hemoglobin half-life but this therapy is cumbersome and not available while deployed.

3. Cyanide is encountered in fires and industrial processes. Early effects include dizziness, headache, nausea, and anxiety. High dose exposure causes rapid onset of coma, seizure, respiratory depression, hypotension, and tachycardia. Lactic acidosis > 8 mmol/L is common. Administer 100% oxygen via mechanical ventilation. Hydroxocobalamin is the preferred antidote; infuse 5 grams IV over 7 minutes. It may be infused over 2-5 minutes in cases of cardiac arrest or severe hypotension, and may be repeated

if no clinical improvement.[4] Cyanokit™ should be available at every Role 3 hospital and Role 2 hospitals as well if there is a high risk of managing burn casualties.

4. Hydrogen fluoride (HF) is a byproduct of standard fire suppression systems. Exposure to HF may result in rapidly progressive or fatal respiratory failure despite minimal external evidence of injury. Symptoms include shortness of breath, cough, or hypoxia; there must be a high level of suspicion for HF inhalation.[9] Treatment is supportive. If hypocalcemia is present, administer nebulized calcium gluconate (1.5 ml of 10% calcium gluconate in 4.5 ml water) q4hr until normalization of serum calcium levels. In the absence of significant burns, consider steroids if symptoms do not improve. Bronchopneumonia can develop within a week.

OPHTHALMIC INJURY

NOTE: *Refer to the JTS Eye Trauma: Initial Care CPG for additional information.*[4]

1. Every patient with facial burns should have a thorough eye exam. If available, consult an ophthalmologist for all patients with facial burns or corneal injury verified by Wood's lamp exam. Eye exams should be done early, before facial edema sets in.

2. If no injury exists, lubricate the eyes of intubated patients every 2 hours with lacrilube.

3. If a corneal injury is identified, use a Fox shield to cover the eyes and apply ophthalmic erythromycin ointment at least every 2 hours.

4. If there is suspicion of an open globe injury, no drops or ointment should be applied, place a Fox eye shield and refer to an ophthalmologist as soon as possible. For further details, please refer to the Joint Trauma System Ocular Trauma CPG.[4]

LINES AND TUBES

1. Sew and/or staple all venous and arterial catheters in place as tape does not adhere to burned skin. Do not circumferentially tape lines around extremities; this may further impede circulation and cause limb ischemia as extremities swell during resuscitation.

2. Use umbilical ties to secure endotracheal, orogastric, nasogastric and Dobhoff tubes.

GASTROINTESTINAL PROPHYLAXIS

1. Burn patients, regardless of age, are prone to nausea and vomiting as well as stress ulceration.

2. Place orogastric or nasogastric tube in all intubated patients for gastric decompression during resuscitation and later for enteral nutrition.

3. Administer IV proton pump inhibitor or similar agent to all patients with >20% TBSA burn injury.

CIRCUMFERENTIAL BURNS, ESCHAROTOMY, AND EXTREMITY COMPARTMENT SYNDROME

1. Escharotomy is normally performed in the setting of a circumferential full thickness burn. If the burn is superficial or not circumferential and pulses are absent, first rule out hypovolemia, hypotension, or occult bleeding. Escharotomy incises the skin but not the fascia, and is usually sufficient for

compartment syndrome caused by burns unless there is underlying muscle damage or over resuscitation. Refer to the Escharotomy Chart in Appendix E.

2. The requirement for escharotomy or fasciotomy usually presents in the first 6-24 hours following injury. If the need for either procedure has not been identified within the first 24-48 hours, then circulation is likely to remain adequate without surgical intervention. Elevation of the burned extremities 30-45° is required to decrease edema. A patient who required escharotomy or fasciotomy at a lower echelon of care should always have their extremity compartments reassessed upon arrival at the next echelon of care. Extension of the incision(s) may be required to restore circulation. This situation can occur if large IV fluid volumes are given during transport, compounding tissue edema. The threshold for escharotomy should be low in patients requiring transportation, but must take into account the ability to transfuse the patient after the procedure.

3. For any circumferential extremity (including fingers) burn, hourly monitoring is essential. The extremity should be elevated as high as feasible, especially during transport. Palpable radial pulses do not exclude digital compartment syndrome and digital pulses must be checked by using the Doppler to assess the palmar arch and digital arteries for hand and digit burns. In general, palpable pulses of the radial, dorsalis pedis and posterior tibialis is sufficient as long as there are no burns distal to these pulses. Absent Doppler signals or pulses that are diminishing on hourly exams should prompt immediate consultation with a burn surgeon and strong consideration of surgical decompression with escharotomies.

4. Repeat the vascular exam at least every hour. If available, use handheld Doppler ultrasound to assess the palmar arch, dorsalis pedis, and posterior tibialis. A triphasic signal in the above vessels is considered normal. Consider performing escharotomy early, based upon the vascular exam. Consider fasciotomy in the operating room if pulses remain undetectable even after escharotomy. Continue hourly pulse checks to ensure adequate perfusion following surgical decompression.

5. Escharotomy is performed by incising full thickness burns into the subcutaneous fat. Patients will require analgesia, sedation, and usually intubation. Because escharotomy can be associated with significant blood loss, at times it may be more prudent to rapidly evacuate the patient to a higher echelon of care rather than initiate the procedure in an austere environment. This is a judgment call based upon assessment of local resources and transportation time and availability.

6. Using electrocautery to perform escharotomy reduces bleeding compared to a scalpel. Extend escharotomy incisions the entire length of the circumferential portion of full-thickness burn. The depth of the incision should be through the dermis to the level of subcutaneous fat; it is not necessary to carry the incision to the level of fascia. Carry incisions across involved joints. Although full thickness burn is insensate, patients will require IV narcotics and benzodiazepines during this procedure. On completion of the escharotomy, reassess perfusion. If circulation is restored, bleeding should be controlled with electrocautery and the extremity dressed and elevated at a 30-45° angle. Assess pulses hourly for at least 12-24 hours.

7. Thoracic escharotomy incisions should extend from the neck, across the mid-clavicle, and down the anterior axillary line. Connect each side with an incision across the upper abdomen.

8. In the upper extremities, place the hand in the anatomic position (palm facing forward) and make an incision in the mid radial or mid ulnar line, carrying the incision up the arm. Ulnar incisions should stay anterior (volar) of the elbow joint to avoid the ulnar nerve, which is superficial at the level of the elbow. If both hand and arm are burned, continue the incision across the mid ulnar or mid radial wrist and onto the hand. If circulation is not restored, perform a second incision on the opposite side of the extremity.

9. If finger escharotomies are required, avoid functional surfaces (radial surface of the index finger and ulnar surface of the little finger). Place the fingers in a clenched position and note the finger creases at DIP and PIP joints. Escharotomy incisions should be just dorsal to a line drawn between the tops of these creases.

10. Lower extremity escharotomy incisions are placed in the mid-lateral and/or mid-medial line extending from the ankle to the hip. If circulation is not restored, perform a second incision on the opposite side of the extremity.

11. If bilateral extremity escharotomy incisions do not restore circulation, re-evaluate the adequacy of the patient's overall hemodynamic status. Re-assess for a possible missed injury or ongoing bleeding.

12. Consider fasciotomy in the operating room (OR) if pulses remain undetectable after escharotomy. Continue hourly exams to ensure adequate perfusion following interventions. Optimal fluid resuscitation and prompt escharotomy usually mitigates the need for fasciotomy. Due to the frequency of extremity injuries seen among combat casualties, fasciotomies on burned extremities may be required for those with delayed revascularization, hemorrhage requiring massive resuscitation, and crush injuries. For further details, see the JTS Acute Extremity Compartment Syndrome and the Role of Fasciotomy in Extremity War Wounds CPG.[4]

13. High altitude aeromedical evacuation is not, in and of itself, a contributor to the development of compartment syndrome in a burned extremity. Escharotomy/fasciotomy for thermal burns should only be performed for the clinical diagnosis of compartment syndrome, and if available, confirmed by measurement of compartment pressures.

14. Following escharotomy or fasciotomy, late bleeding may occur as circulation is restored. Examine the surgical site every few minutes for up to 30 minutes for signs of new bleeding, which is usually easily controlled with electrocautery.

ABDOMINAL COMPARTMENT SYNDROME

Massive fluid replacement (> 250 mL/kg within 24 hours) is a risk factor for abdominal compartment syndrome, a clinical diagnosis which includes increased bladder pressure, increased airway pressures, oliguria, and hypotension.[7,8] Bladder pressure > 20 mm Hg in the setting of this syndrome warrants early consideration of therapeutic paracentesis which may provide partial relief of elevated intra-abdominal pressure related to sequestration of resuscitation fluid in burn patients.

The decision to pursue decompressive laparotomy must factor in the significant risk of morbidity and mortality from the procedure in patients with extensive burns or burns to the abdominal wall.[7] If the patient requires a decompressive laparotomy, perform a standard celiotomy followed by a temporary abdominal closure. If the abdominal wall skin is burned, adhesive drapes for negative pressure wound dressings (NPWD) will not adhere to the skin edges. Use of a Bogotá bag or similar sterile plastic material sewn to the skin edges is preferred.

CHEMICAL BURNS

NOTE: *Refer to the JTS Inhalation Injury and Toxic Industrial Chemical Exposure CPG for additional information*[4]

1. Expose body surfaces, brush off dry chemicals, and copiously irrigate with clean water. Large volume (>20L) serial irrigations may be needed to thoroughly cleanse the skin of residual agents. Do not attempt to neutralize any chemicals on the skin. Use personal protective equipment to minimize

exposure of medical personnel to chemical agents. Resuscitation strategy and goals for patients with chemical burns are the same as for thermal injuries.

2. White phosphorous fragments ignite when exposed to air. Clothing may contain white phosphorous residue and should be removed. Fragments embedded in the skin and soft tissue should be irrigated out if possible or kept covered with soaking wet saline dressings or hydrogels. Urgently retrieve deeply embedded fragments in the OR. Monitor calcium levels closely and treat hypocalcemia with IV replacement.

3. Contact the Army Burn Center DSN 312-429-2876 (BURN) or (210) 916-2876 or (210) 222-2876 or Email to usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil.

ELECTRICAL INJURY

1. First responders should remove the patient from the electricity source while avoiding injury themselves.

2. In cases of cardiac arrest due to arrhythmia after electrical injury, follow advanced cardiac life support (ACLS) protocol and provide hemodynamic monitoring if spontaneous circulation returns.

3. Small skin contact points (cutaneous burns) can hide extensive soft tissue damage. Observe the patient closely for clinical signs of compartment syndrome (refer to the Circumferential Burns section above, and the Extremity Compartment Syndrome CPG3 for discussion of escharotomy/fasciotomy). Tissue that is obviously necrotic must be surgically debrided. Note that escharotomy, which relieves the tourniquet effect of circumferential burns, will not necessarily relieve elevated muscle compartment pressure due to myonecrosis associated with electrical injury; therefore fasciotomy is usually required.

4. Compartment syndrome and muscle injury may lead to rhabdomyolysis, causing pigmenturia and renal injury. Pigmenturia typically presents as red-brown urine. In patients with pigmenturia, fluid resuscitation requirements are much higher than those predicted for a similar-sized thermal burn. Isotonic fluid infusion should be adjusted to maintain UOP 75-100 mL/hr in adult patients with pigmenturia. If the pigmenturia does not clear after several hours of resuscitation consider IV infusion of mannitol, 12.5 g per liter of lactated Ringer's solution, and/or sodium bicarbonate (150 mEq/L in D5W). These infusions may be given empirically; it is not necessary to monitor urinary pH. In patients receiving mannitol (an osmotic diuretic), close monitoring of intravascular status via CVP and other parameters is required.

WOUND CARE

Significant personnel and supply resources are required for wound care of major burns. Consideration should be given to rapidly transferring a patient to a higher echelon of care utilizing dry dressings and hypothermia protection at the Role 1 or Role 2 levels. Bear in mind that any dressings will likely be immediately removed upon arrival at the next echelon of care to facilitate patient evaluation.

Whenever possible, debride (remove sloughed skin and blisters) burn wounds in the operating room (OR), thereby providing a clean, warm environment to both examine the wounds and place sterile dressings. Use chlorhexidine gluconate or similar antiseptic cleanser. Debridement may be facilitated by scrub brushes and/or gauze sponges. Definitive removal of burn eschar (sharp/surgical excision) will be performed after stabilization and transport to the USAISR Burn Center.

1. Shave and debride the face, covering wounds with topical antibiotic ointment QID. Ear burns are prone to chondritis; apply mafenide acetate (Sulfamylon®) cream twice a day if available. Avoid pressure from endotracheal tube ties.

   If mafenide acetate (Sulfamylon) is not available prior to or during transport, thoroughly clean twice a day and utilize silver sulfadiazine cream or any other topical antimicrobial ointment. Examine frequently for cellulitis advancing beyond the ear or for evidence of necrosis of the cartilage. This requires surgical debridement.

2. Wrap burns on the scalp, trunk, neck, and extremities in sterile gauze soaked with a 5% solution of Sulfamylon. Apply the solution QID and as needed to keep dressings lightly moist, but not so wet as to cause maceration.

3. Alternatively, burns may be dressed with silver-impregnated nylon, covered with sterile gauze and moistened with sterile water. One of the advantages of this type of burn dressing is the ability to leave the dressing in place for extended periods of time (up to 7 days) which is advantageous during delayed or long-distance evacuations.

4. Avoid over-wetting dressings to avoid maceration of tissues. Frequent assessment of the patient's temperature is necessary to prevent hypothermia secondary to wet dressings, especially during air evacuation.

5. In patients who cannot be safely evacuated for burn excision, consider using silver sulfadiazine cream alternated BID with mafenide acetate (Sulfamylon) cream to provide antimicrobial penetration of thick burn eschar as a bridge to surgical care.

GUIDELINES FOR PATIENTS WHO CANNOT BE EVACUATED FROM THEATER

Care provided in theater is not envisioned to be definitive care. Definitive care for US service members is provided at the USAISR Burn Center in San Antonio, Texas. Coalition forces progress along the evacuation chain in order to return to their home nation health care facilities. Unfortunately, the care available to local national patients may fail to compare to the definitive care available for US and coalition forces. Care decisions are to be made in the context of the available continuum of care for the patient in their nations of origin.

1. Calculate burn size using a Lund and Browder chart (Appendix B and Appendix C.) Triage of local national casualties to an expectant category may be required if their burns exceed the host nation's ability to treat and rehabilitate (e.g. full thickness burns >50% TBSA). If caring for expectant casualties, provide adequate comfort care measures. Take into consideration inhalation injury, medical co-morbidities, and extremes of age, which can increase mortality.

2. For patients with combined partial and full thickness burns of 50% TBSA or greater, with less than half of the burn being full thickness, initiate resuscitation and allow the partial thickness component to declare itself as it is sometimes difficult to determine the full extent of the full thickness burn at the time of initial presentation. After approximately 48-72 hours, reassess the patient to estimate the percentage of full thickness burn more accurately.

3. Consider inhalation injury in relationship to the TBSA burned when deciding whether to classify the patient as expectant; a patient with a 40% TBSA burn and inhalation injury will likely not do as well as a patient with a 40% TBSA burn without inhalation injury.

4. Burn injuries may initially appear survivable, but skin graft loss, infections, or conversion of donor site(s) to full thickness wounds themselves may transform a potentially survivable injury into a fatal one. Be aware of this possibility and the potential change to an expectant category.

5. The transition from aggressive care to comfort care is a difficult decision, especially when the care team has worked exhaustively to maximize survival. The attending surgeon should elicit objective input from medical colleagues, nurses, and facility leadership in making the decision to transition to comfort care as it will solidify the process and assist with closure, especially for those engaged in the care of the patient for extended periods.

6. For patients with a less than 50% TBSA burn, proceed with resuscitation and plan for early excision and grafting within a week to maximize chance of survival.

7. Skin substitutes such as allograft (deceased donor skin) and biologic dressings such as xenograft (pig skin) are not readily available outside CONUS. The extent of burn excision should be guided by the amount of autograft (split thickness donor skin) available. Do not excise wounds if autograft is not available. Tangential excision should be employed, if possible, to preserve viable dermis and subcutaneous fat. The non-viable dermis is excised to healthy, punctate bleeding dermis. Fascial excision is reserved for subdermal burns that extend well into the subcutaneous tissue, and for those burns which are heavily colonized or infected.

8. If patients arrive with open burn wounds, surgically excise to a healthy wound bed and apply negative pressure wound dressing (NPWD) until granulation tissue is noted. If NPWD is not available, apply gauze dressings moistened with an antimicrobial solution such as 5% mafenide acetate (Sulfamylon) until further surgical debridement can occur.

9. Meshing of split thickness skin grafts will maximize available donor skin. Rarely is there a need to mesh skin wider than 2:1; meshing wider than 3:1 is not recommended due to poor outcomes without comprehensive long term rehabilitation outside of a burn center.

10. Utilize dilute epinephrine solution (1:1,000,000 concentration) to infiltrate subcutaneous tissue by clysis prior to harvesting of donor skin with dermatome. This process will minimize blood loss at the donor site(s). Likewise, dilute epinephrine solution provides topical hemostasis during excision of burns. To control raw surface area bleeding apply a non-adherent dressing (e.g., Telfa), followed by a lap pad soaked in the dilute epinephrine solution.

11. Take the patient to the OR for staged excisions and grafting of the full thickness burns with a goal of complete excision within one week of injury. Consider using a NPWD over fresh autograft with intervening non-adherent layer (e.g. Dermanet or negative pressure Silverlon). If NPWD is not available, sew a bulky bolster dressing over the graft site using a non-adherent layer or silver nylon against the split thickness graft. Leave the post-operative dressing in place for 3-5 days.

12. Following NPWD removal, use Sulfamylon moistened gauze dressings for approximately 5-7 days. When graft interstices are closed transition to a topical agent such as Bacitracin or polymicrobial ointment.

13. Whenever resources are available, perform extensive dressing changes in the OR (not ICU or ward), especially early in the treatment process when wounds remain open. This allows for optimal pain control (with airway protection as needed), improves inspection of wounds, and provides a clean and warm environment.

14. Gram negative bacterial and fungal colonization followed by infection is associated with a high rate of graft loss and increases mortality. Liberal use of dilute Dakin's solution (1/4 strength or 0.125% sodium

hypochlorite) to cleanse colonized burn wounds is recommended. Delay grafting procedures until colonization and infection are controlled.

15. Once the grafts are healed, continue to keep patient clean, using showers when available.

16. Early ambulation and physical therapy, is critical to the long-term functional outcome in burn patients. Once post-operative dressings are removed, perform range of motion of all affected joints.

17. Early and continuous nutrition is vital to wound healing. Even patients who are able to eat may need supplementation to meet calorie goals. Provide approximately 35kcal/kg/day to burned adults. Consult a nutritionist when available. Use a nasoenteric feeding tube to provide a high protein, low fat enteral formula and administer a daily multivitamin.

ADDITIONAL CONSIDERATIONS FOR PEDIATRIC BURN PATIENTS

Deployed surgical teams frequently provide initial care for injured local national children. Burn care for children generally follows adult recommendations, with a few modifications as itemized below.[9] See Appendix C: Pediatric Lund Browder Burn Estimate and Diagram.

Airway patency can be lost early in small children with facial or extensive burns as modest mucosal edema can quickly compromise their small airway; carefully securing the ETT with umbilical tie and adequate sedation is important to prevent unplanned extubation.

Peripheral or intraosseous vascular access may suffice initially, but central venous access is more reliable during formal burn resuscitation; catheters should be sewn in place.

Children with burns under 15% TBSA usually do not need a calculated resuscitation. They can be given 1.5x calculated maintenance rate (see 4-2-1 Rule below[9]) and have diapers weighed for urine output. If they can eat, they should be allowed access to bottle feeds. Some of these children can be supported enterally, with nasoenteric infusions of World Health Organization (WHO) resuscitation formula (1L clean water, 8 tsp sugar, ½ tsp salt, and ½ tsp baking soda).[10]

1. Children with acute burns over 15% of the body surface usually require a calculated resuscitation. Place a bladder catheter (size 6 Fr for infants and 8 Fr for most small children). The Modified Brooke formula (3 mL/kg/%TBSA LR or other isotonic fluid divided over 24 hours, with one-half given during the first 8 hours) is a reasonable starting point. This only provides a starting point for resuscitation, which must be adjusted based on UOP and other indicators of organ perfusion. Goal UOP for children is 0.5-1mL/kg/hr. Decrease or increase the isotonic fluid rate by approximately 20-25% per hour to maintain UOP at 0.5-1mL/kg/hr.

2. Very young children do not have adequate glycogen stores to sustain themselves during resuscitation. Administer a maintenance rate of D5LR to children weighing < 20 kg. Utilize the 4-2-1 rule: 4ml/kg for the first 10kg + 2ml/kg 2nd 10kg + 1ml/kg over 20kg. This maintenance rate is in addition to the isotonic infusion calculated for burn resuscitation and is not titrated.

3. In children with burns > 30% TBSA, early administration of may reduce overall resuscitation volume. If needed, initiate 5% albumin at the child's calculated maintenance rate (use the 4-2-1 rule) and subtract this from the isotonic fluid rate; the albumin rate is maintained while the isotonic fluid is adjusted based on UOP.

4. Monitor resuscitation in children, like adults, based on physical examination, input and output measurements, and analysis of laboratory data. The well-resuscitated child should have alert sensorium,

palpable pulses, and warm distal extremities; urine should be glucose-negative. Monitor electrolytes every 8 hours during the first 72 hours to pick up hypo- and hypernatremia and hypocalcemia. If available, monitor calcium levels and replete to maintain iCa >1.1.

5. Cellulitis is the most common infectious complication and usually presents within 5 days of injury. Prophylactic antibiotics do not diminish this risk and should not be used unless other injuries require them. Most anti-streptococcal antibiotics such as penicillin are successful in eradicating infection. Initial parenteral administration is advised for most children presenting with fever or systemic toxicity.

6. Nutrition is critical for pediatric burn patients. Nasogastric feeding may be started immediately at a low rate in hemodynamically stable patients and tolerance monitored. Start with a standard pediatric enteral formula (e.g. Pediasure) targeting 30-35 kcal/kg/day and 2g/kg/day of protein.

7. Children may rapidly develop tolerance to analgesics and sedatives; dose escalation is commonly required. Ketamine and propofol are useful procedural adjuncts.

When burned at a young age, many children will develop disabling contractures. These are often very amenable to correction which may be performed in theater with adequate staff and resources. Seek early consultation from the USAISR Burn Center (DSN 312-429-2876 (BURN); Commercial (210) 916-2876 or (210) 222-2876; email usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil).

Opportunities for pediatric surgical care provided by Non-Governmental Organizations (NGOs) may be the best option but require the coordinated efforts of the military, host nation, and NGOs.

Pediatric specific questions can be asked through the Burn consult hotline (ask to coordinate with the pediatric intensivist).

PERFORMANCE IMPROVEMENT (PI) MONITORING

POPULATION OF INTEREST

All burn casualties (as identified by diagnosis code).

INTENT (EXPECTED OUTCOMES)

1. All burn patients with GCS < 8, symptomatic inhalation injury, deep facial burns, or burns ≥ 40% receive a definitive airway (endotracheal tube, cricothyroidotomy, or tracheostomy) prior to interfacility transfer (Role 2-Role 3 or Role 3-Role 4).
2. All patients with burns ≥ 20% TBSA receive formal fluid resuscitation documented on burn flow sheet.
3. Escharotomy is performed for circumferential full thickness burns.

PERFORMANCE/ADHERENCE METRICS

1. Number and percentage of patients in the population of interest with burn ≥ 40% TBSA or GCS < 8 or inhalation injury with AIS severity code > 1 or facial burns with face AIS >2 who receive a definitive airway (endotracheal tube, cricothyroidotomy, or tracheostomy) at first surgical capability.

2. Number and percentage of patients with burn ≥ 20% TBSA who have burn flow sheet completed.

3. Number and percentage of patients with circumferential burn who receive escharotomy.

DATA SOURCE

- Patient Record
- Department of Defense Trauma Registry (DoDTR)
- Burn Navigator data

SYSTEM REPORTING & FREQUENCY

The above constitutes the minimum criteria for PI monitoring of this CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the Joint Trauma System (JTS) Chief and the JTS PI Branch.

RESPONSIBILITIES

It is the trauma team leader's responsibility to ensure familiarity, appropriate compliance, and PI monitoring at the local level with this CPG. It is the responsibility of the nurse assigned to the trauma patient to ensure the Burn Navigator or Burn Flow Sheet (Appendix D) is initiated and completed.

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APPENDIX A: PHYSICIAN'S ORDER

1. **Diagnosis**: _____
2. **Condition**: VSI SI NSI Category: Nation/Service (e.g., US/USA, HN/IA)
3. **Allergies**: Unknown NKDA Other
4. **Monitoring**
   - 4.1. Vital signs: Q _____ hrs
   - 4.2. Urine output: Q _____ hrs
   - 4.3. Transduce bladder pressure Q _____ hrs
   - 4.4. Neurovascular/Doppler pulse checks Q _____ hrs
   - 4.5. Transduce: _____CVP _____A-line _____Ventriculostomy
   - 4.6. Neuro checks: Q _____ hrs
   - 4.7. Cardiac monitor: Yes / No
5. **Activity**
   - 5.1. _____Bedrest _____Chair Q shift _____ Ad lib _____ Roll Q 2 hrs
   - 5.2. _____Passive ROM to UE and LE Q shift
   - 5.3. Spine precautions: _____C-Collar /C-Spine _____TLS Spine
6. **Wound Care**
   - 6.1. _____NS wet to dry BID to: _____
   - 6.2. _____Dakin's wet to dry BID to: _____
   - 6.3. _____VAC dressing to _____75 mm Hg _____125 mm Hg
   - 6.4. _____Abdominal closure drains to LWS
   - 6.5. _____Other: _____
7. **Tubes/Drains**
   - 7.1. _____NGT to LCWS or _____ OGT to LCWS
   - 7.2. _____Place DHT _____Nasal _____Oral and confirm via KUB
   - 7.3. _____Foley to gravity
   - 7.4. _____Flush feeding tube Q shift with 30 mL water
   - 7.5. _____JP(s) to bulb suction; strip tubing Q 4 hrs and PRN
   - 7.6. _____Chest tube to: _____20 cm H_2O suction (circle: R L Both) or _____Water seal: (circle: R L Both)
8. **Nursing**
   - 8.1. Strict I & O and document on the JTTS Burn Resuscitation Flow Sheet Q 1 hr for burn > 20% TBSA
   - 8.2. _____Clear dressing to Art Line/CVC, change Q 7D and prn
   - 8.3. _____Bair Hugger until temperature > 36° C
   - 8.4. _____Lacrilube OU Q 6 hrs while sedated
   - 8.5. _____Oral care Q 4 hrs; with toothbrush Q 12 hrs
   - 8.6. _____Maintain HOB elevated 45°
   - 8.7. _____Fingerstick glucose Q _____ hrs
   - 8.8. _____Routine ostomy care
   - 8.9. _____Ext fix pin site care
   - 8.10. _____Trach site care Q shift
   - 8.11. _____Incentive spirometry Q 1 hrs while awake; cough & deep breath Q 1 hr while awake
9. **Diet**
   - 9.1. _____NPO
   - 9.2. _____PO diet
   - 9.3. _____TPN per Nutrition orders
   - 9.4. _____Tube Feeding: _____@ _____mL/hr OR _____Advance per protocol

10. Burn Resuscitation (%TBSA > 20%)

10.1. If available, initiate Burn Navigator computer decision support system and follow prompts on screen. System will provide recommendations for burn fluid resuscitation, provider should use clinical judgment and consider entire clinical scenario when interpreting recommendations.

10.2. Start initial infusion of Lactated Ringers (LR) at _____ml/hr IV (10 x % TBSA >40 kg <80 kg) (Add 100 ml/hr for every 10 kg > 80 Kg)

10.3. Titrate resuscitation IVF as follows to maintain target UOP (Adult: 30-50 mL/hr; Children: 1.0 mL/kg/hr)

- Decrease rate of LR by 20% if UOP is greater than 50 mL/hr for 2 consecutive hrs
- Increase rate of LR by 20% if UOP is less than 30 mL/hr (adults) or pediatric target UOP for 2 consecutive hrs

10.4. If CVP > 10 cm H_2O and patient still hypotensive (SBP < 90 mm Hg), begin vasopressin gtt at 0.02 – 0.04 Units/min

10.5. Post burn day #2 (Check all that apply)

_____Continue LR at _____ mL/hr IV

_____Begin _____@ _____mL/hr IV for insensible losses

_____Start Albumin 5% at _____ mL/hr IV ((0.3 – 0.5 x %TBSA x wt in kg) / 24) for 24 hrs

11. IVF (% TBSA ≤ 20%): ____LR ____NS ____D5NS ____D5LR ____D5 .45NS ____+ KCl 20 meq/L @ ____mL/hr

12. Laboratory Studies & Radiology

12.1. _____CBC, Chem-7, Ca/Mg/Phos: _____ ON ADMIT _____DAILY @ 0300

12.2. _____PT/INR _____TEG _____Lactate: _____ ON ADMIT _____DAILY @ 0300

12.3. _____LFTs _____Amylase _____Lipase: _____ ON ADMIT _____DAILY @ 0300

12.4. _____ABG: _____ON ADMIT _____ 30 mins after ventilator change _____Q AM (while on ventilator)

12.5. _____Triglyceride levels after 48 hours on Propofol

12.6. _____Portable AP CXR on admission

12.7. _____Portable AP CXR Q AM

13. Prophylaxis

13.1. _____Protonix 40 mg IV Q day

13.2. _____Lovenox 30 mg SQ BID OR _____Heparin 5000 U SQ TID starting_____

13.3. _____Pneumatic compression boots

14. Ventilator Settings

14.1. Mode: _____ SIMV _____CMV _____AC _____CPAP

14.2. FiO_2: _____%

14.3. Rate: _____

14.4. Tidal Volume: _____ cc

14.5. PEEP: _____

14.6. Pressure Support: _____

14.7. Insp Pressure: _____

14.8. I/E Ratio: _____

14.9. _____ APRV: Phi_____ Plow_____ Thi_____ Tlow_____ FiO_2: _____%

14.10. _____Maintain patient in soft restraints while on ventilator

14.11. _____Wean FiO_2 to keep SpO_2 > 90-96% or PaO_2 >60-100 mmHg[1]

14.12. _____nebulizer/MDIs: _____Albuterol _____Atrovent _____Xopenex Unit Dose Q 4 hrs

15. Analgesia/Sedation/PRN Medications

15.1. Analgesia/sedation goal is Richmond Agitation Sedation Scale (RASS), scale below, of 0 (alert and calm) to -3 (moderate sedation). Hold continuous infusion for RASS of -4 (deep sedation) or higher.

15.2. _____Propofol gtt at _____ mcg/kg/min, titrate up to 50 mcg/kg/min.

15.3. _____Fentanyl gtt at _____mcg/hr titrate up to 250 mcg/hr; for analgesia may give 25-100 mcg IVP Q 15 minutes for acute pain or burn wound care.

15.4. _____Morphine gtt at _____mg/hr, titrate up to 10 mg/hr, for analgesia may give 2-10 mg IVP Q 15 minutes for pain or burn wound care.

15.5. _____Versed gtt at _____ mg/hr, titrate up to 10 mg/hr ; may give 2-5 mg IVP Q 15 minutes for acute agitation or burn wound care.

15.6. _____Ativan gtt at _____mg/hr, titrate up to 10 mg/hr; may give 1-4 mg IVP Q 2-4 hours for acute agitation.

15.7. Important: Hold continuous IV analgesia/sedation at 0600 hrs for a RASS of -4 or -5. If further analgesia/sedation is indicated, start medications at ½ of previous dose and titrate for target RASS.

15.8. _____Morphine 1-5 mg IV Q 15 minutes prn pain

15.9. _____Fentanyl 25-100 mcg IV Q 15 minutes prn pain

15.10. _____Ativan 1-5 mg IV Q 2-4 hrs prn agitation

15.11. _____Percocet 1-2 tablets po Q 4 hrs prn pain

15.12. _____Tylenol _____ mg / Gm PO / NGT / PR Q _____ hrs PRN for fever or pain

15.13. _____Morphine PCA; Program (circle one): 1 2 3 4

15.14. _____Zofran 4-8 mg IVP Q 4 hrs PRN for nausea/vomiting

15.15. _____Dulcolax 5 mg PO / PR Q day PRN for constipation

16. Specific Burn Wound Care

16.1. Cleanse and debride facial burn wounds with Sterile Water or (0.9% NaCl) Normal Saline Q 12 hrs, use a washcloth or 4x4s to remove drainage/eschar

16.2. Cleanse and debride trunk and extremities with chlorhexidine gluconate 4% solution (Hibiclens) and Sterile Water or Normal Saline, before prescribed dressing changes

16.3. Change fasciotomy dressings and outer gauze dressings daily and as needed; moisten with sterile water Q 6 hours and as needed to keep damp, not soaking wet.

Face & Ears

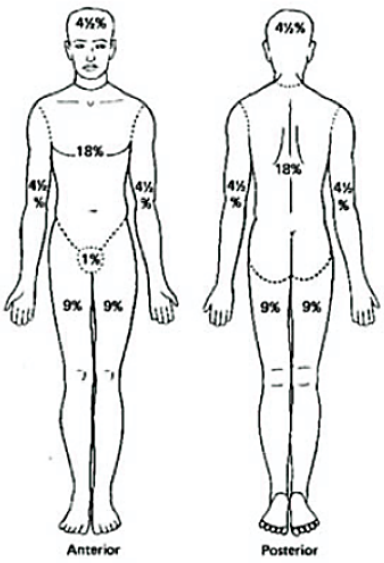
_____Bacitracin ointment BID &PRN
_____Sulfamylon cream to ears BID & PRN
_____5% Sulfamylon solution dressing changes Q AM and moisten every 6 hrs
_____Bacitracin ophth ointment: apply OU Q 6 hrs

BUEs & Hands, BLEs, Chest, Abdomen & Perineum

_____Silvadine cream Q AM & PRN (*deep partial & full thickness*)
_____Sulfamylon cream Q PM & PRN (*deep partial & full thickness*)
_____5% Sulfamylon solution – change Q AM & moisten Q 6 hrs (*superficial burns)*
_____Silver nylon dressing and moisten with sterile water approximately every 6 hrs PRN; dressings may be left in place for 72 hrs)

Back

_____Silvadine cream Q AM & PRN (*deep partial & full thickness burns*)
_____Sulfamylon cream Q PM & PRN (*deep partial & full thickness burns*)
_____5% Sulfamylon solution dressings changed Q AM and moisten Q 6 hrs
_____ Silver nylon dressing and moisten with sterile water approximately every 6 hrs PRN; dressings may be left in place for 72 hrs)



Rule of Nines to calculate initial burn size

17. Other Orders

17.1. _____

17.2. _____

18. Notify Physician if: SBP < _____, MAP < _____, HR <_____ or > _____, SaO_2 < _____%, T > _____, UOP < 30 mL/hour for 2 consecutive hours

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RICHMOND AGITATION SEDATION SCALE (RASS)

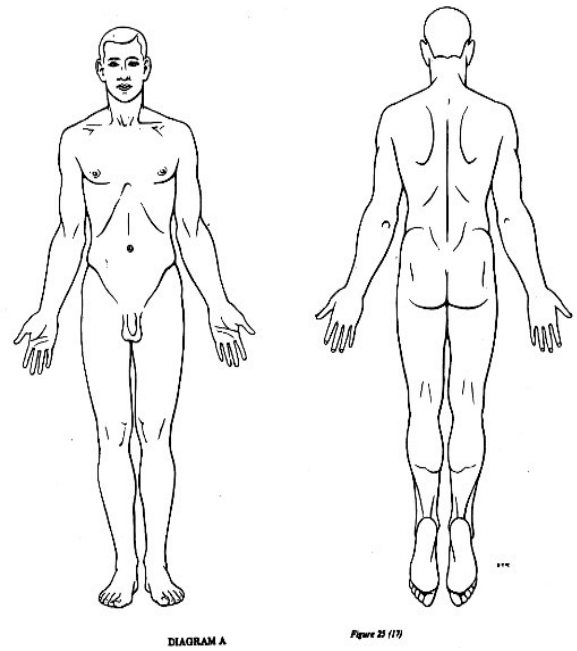
Score	Term	Description
+4	Combative	Overtly combative or violent; immediate danger to staff
+3	Very agitated	Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff
+2	Agitated	Frequent nonpurposeful movement or patient–ventilator
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	Spontaneously pays attention to caregiver
-1	Drowsy	Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice
-2	Light sedation	Briefly (less than 10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, but any movement to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

APPENDIX B: ADULT LUND BROWDER BURN ESTIMATE & DIAGRAM

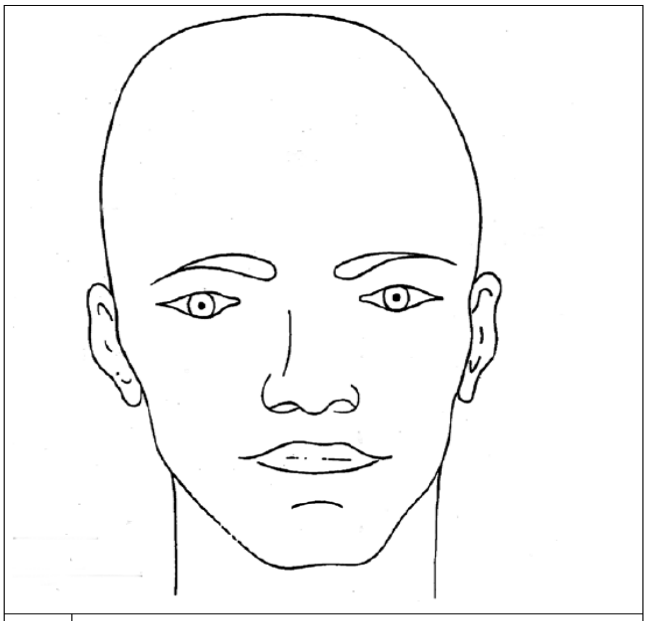
Total Area front/back (circumferential)		one side--anterior	one side--posterior	Do not include in total TBSA			
	Adult	adult	adult	1st ○	2nd ○	3rd ○	TBSA
Head	7	3.5	3.5				0
Neck	2	1	1				0
Anterior trunk*	13	13	0				0
Posterior trunk*	13	0	13				0
Right buttock	2.5	na	2.5				0
Left buttock	2.5	na	2.5				0
Genitalia	1	1	na				0
Right upper arm	4	2	2				0
Left upper arm	4	2	2				0
Right lower arm	3	1.5	1.5				0
Left lower arm	3	1.5	1.5				0
Right hand	2.5	1.25	1.25				0
Left hand	2.5	1.25	1.25				0
Right thigh	9.5	4.75	4.75				0
Left thigh	9.5	4.75	4.75				0
Right leg	7	3.5	3.5				0
Left leg	7	3.5	3.5				0
Right foot	3.5	1.75	1.75				0
Left foot	3.5	1.75	1.75				0
	100	48	52	0	0	0	0

Age:	
Sex:	
Weight:	

Patient Identification

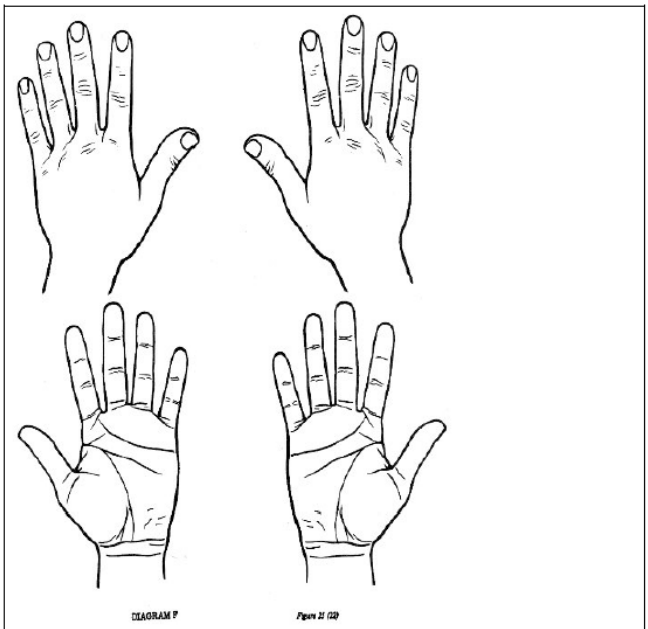


ADULT BURN DIAGRAM: HEAD



Date:	
Name:	

ADULT BURN DIAGRAM: HANDS

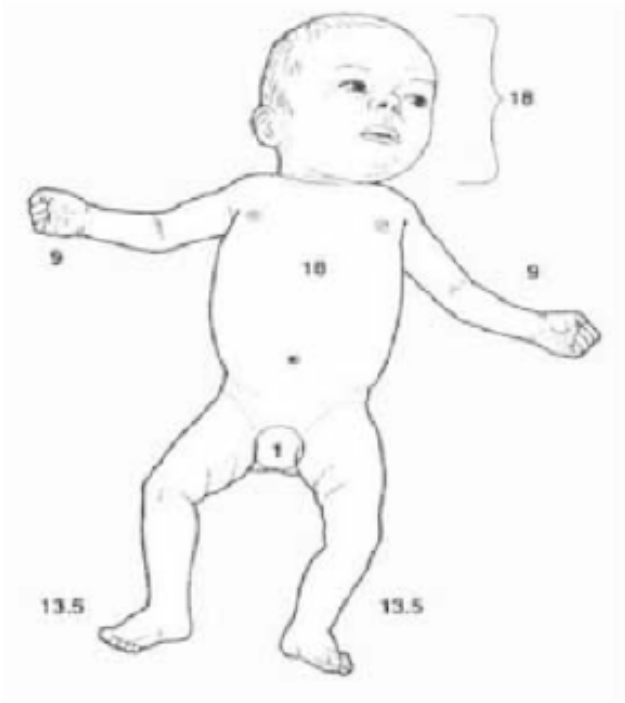


Date:	
2nd:	
3rd:	
Total:	

APPENDIX C: PEDIATRIC LUND BROWDER BURN ESTIMATE & DIAGRAM

INFANT BURN ESTIMATE AND DIAGRAM

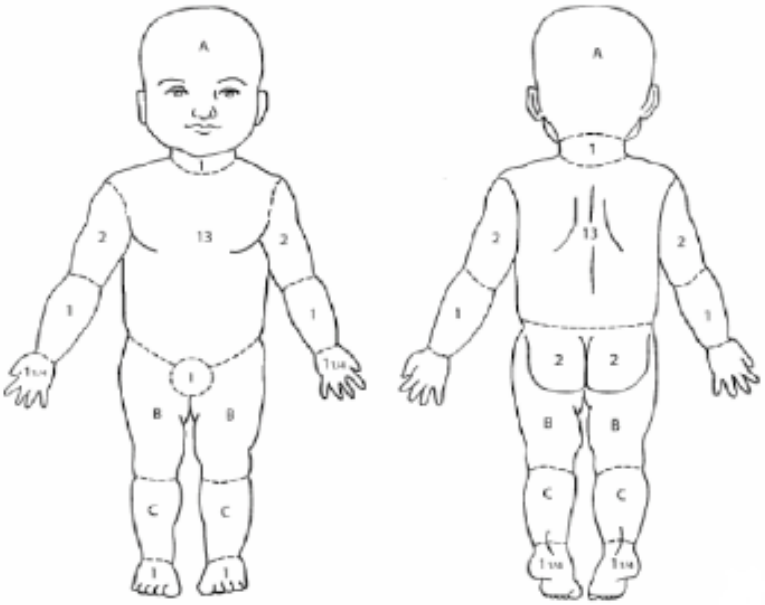
Total Area front/back (circumferential)	Birth to 1 year	Do not include in total TBSA 1st	2nd °	3rd °	TBSA
Head	19				0
Neck	2				0
Anterior trunk*	13				0
Posterior trunk*	13				0
Right buttock	2.5				0
Left buttock	2.5				0
Genitalia	1				0
Right upper arm	4				0
Left upper arm	4				0
Right lower arm	3				0
Left lower arm	3				0
Right hand	2.5				0
Left hand	2.5				0
Right thigh	5.5				0
Left thigh	5.5				0
Right leg	5				0
Left leg	5				0
Right foot	3.5				0
Left foot	3.5				0



CHILD BURN ESTIMATE AND DIAGRAM

Total Area front/back (circumferential)	1 to 4 years	5 to 9 years	10 to 14 years	15 years	Do not include in total TBSA 1st	2nd °	3rd °	TBSA
Head	17	13	11	9				0
Neck	2	2	2	2				0
Anterior trunk*	13	13	13	13				0
Posterior trunk*	13	13	13	13				0
Right buttock	2.5	2.5	2.5	2.5				0
Left buttock	2.5	2.5	2.5	2.5				0
Genitalia	1	1	1	1				0
Right upper arm	4	4	4	4				0
Left upper arm	4	4	4	4				0
Right lower arm	3	3	3	3				0
Left lower arm	3	3	3	3				0
Right hand	2.5	2.5	2.5	2.5				0
Left hand	2.5	2.5	2.5	2.5				0
Right thigh	6.5	8	8.5	9				0
Left thigh	6.5	8	8.5	9				0
Right leg	5	5.5	6	6.5				0
Left leg	5	5.5	6	6.5				0
Right foot	3.5	3.5	3.5	3.5				0
Left foot	3.5	3.5	3.5	3.5				0

1	
2	
3	



APPENDIX D: JTS BURN RESUSCITATION PROTOCOL, WORKSHEET & FLOW SHEET

THE BURN RESUSCITATION PROTOCOL

The JTS Burn Resuscitation Flow Sheet provides clinicians with a tool to track burn resuscitation over a 72-hour period. Conceptually, the flow sheet creates a continuum between clinicians during the resuscitation phase. This format allows clinicians to accurately trend intake and output, hemodynamics and vasoactive medications, and promotes optimal outcomes through precise patient management.

1. The clinicians at the first medical facility where the patient receives treatment will initiate the JTTS Burn Resuscitation Flow Sheet. This treatment facility will be listed in the "Initial Treatment Facility" block. Clinicians at any level of care may initiate the flow sheet.
2. Record today's date in the "Date" block according to the current date where the recorder is located. (Do not adjust this date based on the patient's origin or destination; use the local date).
3. Record the patient's full name and social security number in the "Name" and "SSN" blocks. Document name and SSN on all three pages of the flow sheet.
4. Record the patient's weight in the "Pre-burn est. wt (kg)" block. In theater, record the estimated weight based on the patient's weight prior to injury or "dry weight." If a patient presents prior to initiating resuscitation and an accurate weight can be easily obtained without delaying care, providers are urged to weigh the patient and record the result.
5. Record the total body surface area burned in the "%TBSA" block (do not include superficial injury in this calculation). Clinicians will assess the burn size and use this value to determine fluid resuscitation requirements. Following the patient's transfer to another facility, the receiving clinicians are required to "re-map" the burn, considering that burn wound may "convert" (or become deeper) between assessments at one facility or during transport between two facilities.
6. Burn Fluid Resuscitation Calculations: Use the Rule of Tens to determine fluid requirements for the first 24 hours post-burn. (Rule of Tens: 10 x % TBSA > 40 kg and < 80 kg; if > 80 kg, add 100 ml/hr for every 10 kg > 80 kg). At 8-12 hours post-burn, reevaluate resuscitation efforts and assess for potential over resuscitation. If fluid resuscitation needs exceed 6 ml/kg/%TBSA in 24 hours, consider the guidelines established in the *Emergency War Surgery Handbook* and the addendum to the handbook, "Recommendations for Level IV Burn Care." *[LRMC specific: USAISR/BAMC Burn Unit Guidelines can also be found in the LRMC Burn Care Guide.]*
    a) Clinicians at the first medical facility to treat the patient will calculate the fluid requirements for the first 24 hours post-burn and record the amount in the block on page 1 labeled "Estimated fluid volume patients is administered,"
    b) Clinicians will record the "fluid volume ACTUALLY received" during the first 24 hours of resuscitation in the block labeled as such at the top of page 2. This amount will equal the actual volume delivered during the first 24 hours (as recorded on page 1).
    c) Clinicians will transcribe the 24-hour fluid volume totals recorded on pages 1 and 2 of the flow sheet onto page 3 in the block labeled "fluid volume ACTUALLY received." This allows clinicians to see the first 48-hour totals as the patient enters into the last 24 hours of the 72-hour period.
7. Record the local date and time that the patient was injured in the "Date & Time of Injury" block. This date and time IS NOT the time that the patient arrived at the medical facility, but rather the date and time of INJURY.

8. Record the facility name and/or treatment team in the "Tx Site/Team" block. The facility name/team name is the team of clinicians who managed the patient during each specified hour on the flow sheet. This team may reside within a facility, in which case the facility name is recorded, or be a transport team (e.g., MEDEVAC, CCATT, AEROVAC).
9. "Hr from burn" is defined as the number of hours after the burn injury occurred. If a patient does not arrive at a medical facility until 3 hours after the burn occurred, clinicians do not record hourly values for hours 1-3 but begin recording the row marked "4th" hour post-burn. To the extent possible, clinicians should confer with level I and II clinicians to determine fluid intake and urine output. These totals may be record in the 3rd hour row.
10. Record the current local time of the recorder in the "Local Time" block, be it Baghdad Time, Berlin Time, ZULU, or CST. As with date do not adjust time based on the patient's origin or destination; use the local time.
11. Record the total volume of crystalloids and colloids administered in the "crystalloid/colloid" column, not the specific fluids delivered. Clinicians should refer to the critical care flow sheet to determine the fluids types and volumes. This burn flow sheet is designed to track total volumes. Examples of crystalloid solutions are LR, 0.45% NS, 0.9% NS, D5W, and D5LR. Examples of colloids are Albumin (5% or 25%), blood products, and other volume expanders such as dextran, hespan, or hextend. The use of hydroxyl ethyl starch (hextend) as a resuscitation fluid is no longer recommended.
12. Document the name, dosage, and rate of vasoactive agents in the "Pressors" block. Patients who receive vasoactive agents may also have invasive pressure monitoring devices (e.g., arterial line, central venous line, pulmonary artery catheter), in which case significant values should be recorded in the "BP" and MAP (>55)/CVP" columns.
13. For additional burn resuscitation guidelines refer to the *Emergency War Surgery Handbook* and the *Recommendations for Level IV Burn Care*.

JTS BURN RESUSCITATION WORK SHEET

Initiate AFTER *completion of trauma assessment and interventions*
Adults only: *Refer to Additional Considerations for Pediatric Burn Patients in the Burn Care CPG.*

1. Contact USAISR Burn Center (DSN 312-429-2876) or email: usarmy.jbsa.medcom-aisr.list.armyburncenter@health.mil

Date/Time contact: _____POC:_____ by:_____

2. Estimated Pre-burn Weight (wt): _____kg (Average Service Members are 82 ± 15 kg)

3. Estimate Total Burn Surface Area (TBSA) using Rule of Nines (refine with Lund-Browder after wounds are cleansed)

Partial thickness (2nd)_____% + Full thickness (3rd)_____% = **TBSA_____%**

IF TBSA >40%: intubate (use ETT ≥ 7.5 fr to facilitate bronchoscopy)

IF TBSA <15%: formal resuscitation may not be required, provide maintenance and/or oral fluids

4. Standard Burn Resuscitation Fluid: Lactated Ringers (LR) or Plasmalyte

5. Calculate INITIAL Fluid Rate using Rule of 10 (adults):

- IF wt < 40kg: 2ml x %TBSA_____ x wt(kg)_____ ÷ 16 = _____ml/hr
- IF wt ≥ 40kg: %TBSA_____ x 10 = _____ml/hr
  - IF wt > 80kg: add 100ml/hr to initial rate for every 10 kg>80: adjusted initial fluid rate = _____ml/hr
  - (Example: 100kg patient with 50% TBSA burn = 50% x 10 = 500 ml + 200 ml = 700 ml for first hour)

6. If Inhalation Injury Present: administer aerosolized heparin in albuterol (5,000 units Q4 hours)

7. Titrate Resuscitation Fluid: maintain target **UOP 30-50ml/hr** (Q 1 hour)

- If rhabdomyolysis present: use target UOP 75-100 ml/hr (Contact USAISR Burn Center DSN 312-429-2876)
- Goals: UOP >30 but <50ml/hr; adequate tissue perfusion (normalized lactate/base deficit), MAP >55 mmHg
- Minimum fluid rate 125mL/hr LR
- * Avoid fluid boluses
- ** Too much fluid as dangerous as too little

High risk for over resuscitation/abdominal compartment syndrome:

- If hourly rate >1500mL/hr x 2 hrs OR
- If total 24 hr volume exceeds: wt(kg) x 250ml= _____ml (includes all infused fluids)
  - Contact USAISR Burn Center (DSN 312-429-2876)
  - Consider adjuncts (below)
  - Check bladder pressures Q4hrs (>20 mmHg notify physician)
  - Avoid surgical decompression (significant mortality risk in burns)

Adjuncts:

1. Colloids: 5% albumin/FFP (Use hextend only if others unavailable; Hextend, as a resuscitation fluid, is no longer recommended.)
   - * Colloids not preferred until hour 8-12; can consider earlier in difficult resuscitation
   - Infuse at ml/hr according to chart below based on adult patient weight and burn size
2. Vasopressors: Contact USAISR Burn Center (DSN 312-429-2876)

5% Albumin Infusion (ml/hr)	30-49%TBSA	50-69% TBSA	70-100% TBSA
<70 kg	30	70	110
70-90 kg	40	80	140
>90 kg	50	90	160

Ensure adequate volume (CVP trend 6-8 cm H_2O); **maintain MAP > 55 mmHg**

- Maintain ionized Ca >1.1 mmol/L
- Start with vasopressin 0.04 units/min. **DO NOT TITRATE**
- Second line pressor: norepinepherine 2-20mcg/min
- Refractory shock: consider epinephrine or phenylephrine infusion
- Refractory shock: consider adrenal insufficiency, give hydrocortisone 100mg IV Q8 hrs
- Manage acidemia (pH<7.2): use ventilator interventions first, then bicarbonate or THAM infusion
- Renal replacement therapy if available (Contact USAISR Burn Center DSN 312-429-2876)

Assessment/Interventions:

- Complete full secondary trauma exam
- Ensure thermoregulation; administer warmed fluids; cover with space blanket; elevate burned extremities
- Superficial burn (1st degree): Sunburn, no blister, blanch readily; NOT included in TBSA
- Partial thickness (2nd degree): Blanch, moist, blisters, sensate
- Full thickness (3rd degree): Leathery, white, non-blanching, dry, insensate, thrombosed vessels
- Protect eyes with moisture shields if corneas exposed or blink reflex slow; apply ophthalmic erythromycin ointment at least Q2hrs.
- **Prompt intubation for facial burns, suspected inhalation injury, TBSA >40%**
    - Anticipate induction-associated hypotension.
    - Secure ETT with cloth tie, not adhesive tape
    - Reassess ETT position at teeth Q1 hour as edema develops and resolves
    - Intubated patients require oro/naso-gastric tube for decompression.
    - Administer IV proton-pump inhibitor.
- Monitor bladder pressure at least Q4hrs for large burns or high volume resuscitations
    - Abdominal compartment syndrome: decreased UOP, increased pulmonary pressures, difficulty ventilating, bladder pressure remains > 20 mmHg
    - Avoid decompressive laparotomy; consider percutaneous peritoneal drainage
    - Reduce crystalloid volume using colloid or vasopressors
- Monitor pulses hourly: palmar arch, dorsalis pedis, posterior tibial with Doppler
    - Consider escharotomy if signal diminished; refer to Burn CPG for technique (Call USAISR Burn Center DSN 312-429-2876)
- Monitor extremity compartment pressures as clinically indicated
    - Elevate burned extremities at all times
    - Extremity compartment syndrome: pain, paresthesia, pallor, paralysis, pulselessness (late sign)
    - Fasciotomy may be required
- Wound care
    - Thoroughly cleanse burn wounds, preferably in Operating Room
    - Select topical antimicrobial in consultation with Burn Surgeon (Call USAISR Burn Center DSN 312-429-2876) based on product availability, expected transport time, etc.
    - Acceptable to cover burns with dry sheets or clean dressings for first 48 hours
- All definitive burn surgery done at USAISR Burn Center for US Service Members (DSN 312-429-2876)

JTS BURN RESUSCITATION FLOW SHEET (1 of 3)

Date		Initial Treatment Facility							
Name		SSN	Pre-burn estimated weight (kg)	%TBSA (Do not include superficial 1st degree burn)	Calculate Rule of Tens (if >40<80kg, %TBSA x 10 = starting rate for LR	Calculate max 24hr volume (250ml x kg) Avoid over-resuscitation, use adjuncts if necessary			
Date &Time of Injury				BAMC/ISR Burn Team DSN 312-429-2876: Yes No					

Tx Site/ Team	HR from burn	Local Time	Crystalloid* (LR) / Colloid	Total	UOP (Target 30-50ml/hr)	Base Deficit/ Lactate	Heart Rate	MAP (>55) / CVP (6-8 mmHg)	Pressors (Vasopressin 0.04 u/min) Bladder Pressure (Q4)
	1st								
	2nd								
	3rd								
	4th								
	5th								
	6th								
	7th								
	8th								
	9th								
	10th								
	11th								
	12th								
	13th								
	14th								
	15th								
	16th								
	17th								
	18th								
	19th								
	20th								
	21st								
	22nd								
	23rd								
	24th								
Total Fluids:					*Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion				

JTS BURN RESUSCITATION FLOW SHEET (2 of 3)

Date		Initial Treatment Facility				
Name		SSN	Pre-burn estimated weight (kg)	%TBSA (Do not include superficial 1st degree burn)	Calculate Rule of Tens (if >40<80kg, %TBSA x 10 = starting rate for LR	Calculate max 24hr volume (250ml x kg) Avoid over-resuscitation, use adjuncts if necessary
Date &Time of Injury				BAMC/ISR Burn Team DSN 312-429-2876: Yes No		

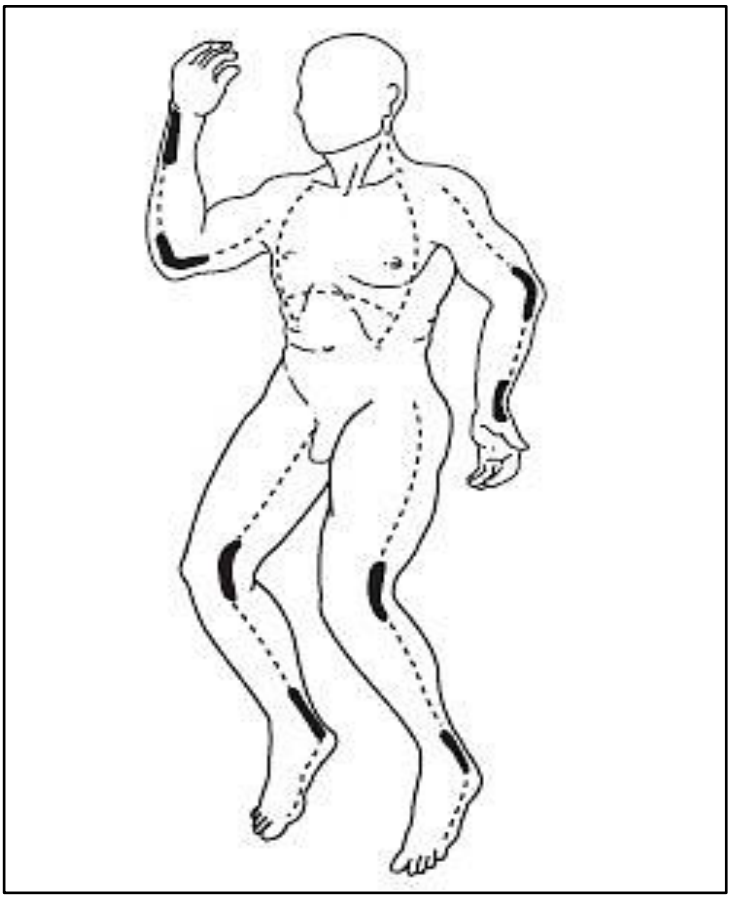
Tx Site/ Team	HR from burn	Local Time	Crystalloid* (LR) / Colloid	Total	UOP (Target 30-50ml/hr)	Base Deficit/ Lactate	Heart Rate	MAP (>55) / CVP (6-8 mmHg)	Pressors (Vasopressin 0.04 u/min) Bladder Pressure (Q4)
	25th								
	26th								
	27th								
	28th								
	29th								
	30th								
	31st								
	32nd								
	33rd								
	34th								
	35th								
	36th								
	37th								
	38th								
	39th								
	40th								
	41st								
	42nd								
	43rd								
	44th								
	45th								
	46th								
	47th								
	48th								
Total Fluids:					*Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion				

JTS BURN RESUSCITATION FLOW SHEET (3 of 3)

Date		Initial Treatment Facility				
Name		**SSN**	**Pre-burn estimated weight (kg)**	**%TBSA (Do not include superficial 1st degree burn)**	**Calculate Rule of Tens (if >40<80kg, %TBSA x 10 = starting rate for LR**	**Calculate max 24hr volume (250ml x kg) Avoid over-resuscitation, use adjuncts if necessary**
Date &Time of Injury				**BAMC/ISR Burn Team DSN 312-429-2876: Yes No**		

Tx Site/ Team	HR from burn	Local Time	Crystalloid* (LR) / Colloid	Total	UOP (Target 30-50ml/hr)	Base Deficit/ Lactate	Heart Rate	MAP (>55) / CVP (6-8 mmHg)	Pressors (Vasopressin 0.04 u/min) Bladder Pressure (Q4)
	49th								
	50th								
	51st								
	52nd								
	53rd								
	54th								
	55th								
	56th								
	57th								
	58th								
	59th								
	60th								
	61st								
	62nd								
	63rd								
	64th								
	65th								
	66th								
	67th								
	68th								
	69th								
	70th								
	71st								
	72nd								
Total Fluids:					***Titrate LR to maintain adequate UOP (30-50ml/hr) and perfusion**				

APPENDIX E: ESCHAROTOMY FIGURE



Dashed lines indicate the preferred sites for escharotomy incisions. **Bold lines** indicate the importance of extending the incision over involved major joints. Incisions are made through the burned skin into the underlying subcutaneous fat using a scalpel or electrocautery. For a thoracic escharotomy, begin incision in the midclavicular lines. Continue the incision along the anterior axillary lines down to the level of the costal margin. Extend the incision across the epigastrium as needed. For an extremity escharotomy, make the incision through the eschar along the midmedial or midlateral join line.

Figure 26.2-1 Emergency War Surgery; Fourth United States Revision; 2013 (page 379).

APPENDIX F: ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGS

PURPOSE

The purpose of this Appendix is to ensure an understanding of DoD policy and practice regarding inclusion in CPGs of "off-label" uses of U.S. Food and Drug Administration (FDA)–approved products. This applies to off-label uses with patients who are armed forces members.

BACKGROUND

Unapproved (i.e. "off-label") uses of FDA-approved products are extremely common in American medicine and are usually not subject to any special regulations. However, under Federal law, in some circumstances, unapproved uses of approved drugs are subject to FDA regulations governing "investigational new drugs." These circumstances include such uses as part of clinical trials, and in the military context, command required, unapproved uses. Some command requested unapproved uses may also be subject to special regulations.

ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGS

The inclusion in CPGs of off-label uses is not a clinical trial, nor is it a command request or requirement. Further, it does not imply that the Military Health System requires that use by DoD health care practitioners or considers it to be the "standard of care." Rather, the inclusion in CPGs of off-label uses is to inform the clinical judgment of the responsible health care practitioner by providing information regarding potential risks and benefits of treatment alternatives. The decision is for the clinical judgment of the responsible health care practitioner within the practitioner-patient relationship.

ADDITIONAL PROCEDURES

Balanced Discussion

Consistent with this purpose, CPG discussions of off-label uses specifically state that they are uses not approved by the FDA. Further, such discussions are balanced in the presentation of appropriate clinical study data, including any such data that suggest caution in the use of the product and specifically including any FDA-issued warnings.

Quality Assurance Monitoring

With respect to such off-label uses, DoD procedure is to maintain a regular system of quality assurance monitoring of outcomes and known potential adverse events. For this reason, the importance of accurate clinical records is underscored.

Information to Patients

Good clinical practice includes the provision of appropriate information to patients. Each CPG discussing an unusual off-label use will address the issue of information to patients. When practicable, consideration will be given to including in an appendix an appropriate information sheet for distribution to patients, whether before or after use of the product. Information to patients should address in plain language: a) that the use is not approved by the FDA; b) the reasons why a DoD health care practitioner would decide to use the product for this purpose; and c) the potential risks associated with such use.