Guidelines for Burn Care and Resuscitation

Purpose:
Provide a framework to the delivery of care to burn patients. This includes the resuscitation strategy to optimize adequate resuscitation while avoiding morbidity associated with over-resuscitation.

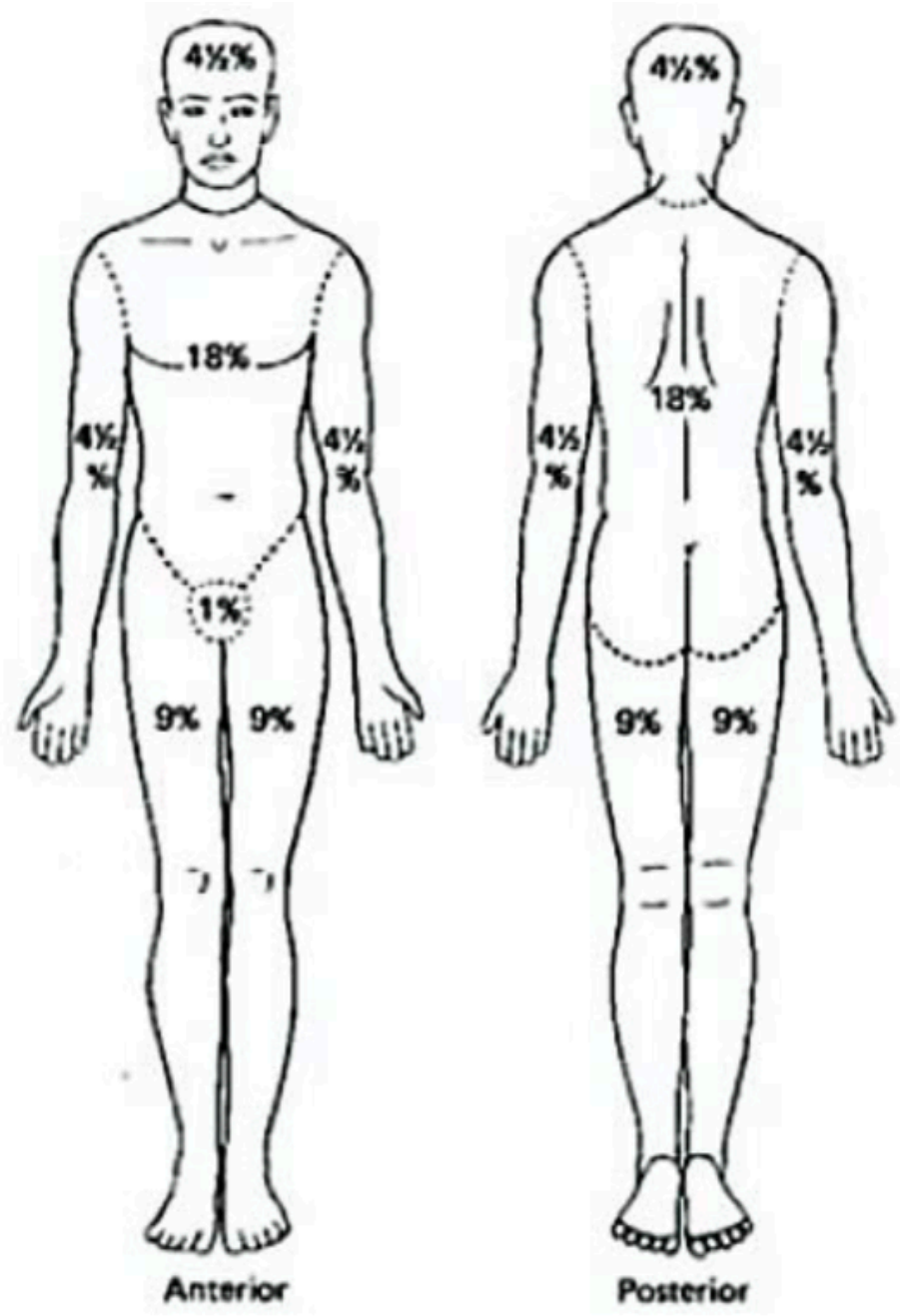
Objectives:
Proved practical, evidence-based recommendations for optimal care of burn patients

I. 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 tissue.
2. Assess and protect the airway, if needed. Indications for endotracheal intubation include a comatose patient, symptomatic inhalation injury, deep facial burns, and burns over 40% Total Body Surface Area (TBSA) with clinical suspicion of pending respiratory failure.
3. Use a large-bore endotracheal tube (ETT), especially if inhalation is suspected. Size 8 ETT or larger is preferred to facilitate bronchoscopy and pulmonary toilet.
4. Secure ETT with cotton umbilical ties which can be adjusted as edema develops during resuscitation. Frequently reassess position of the ETT during the acute resuscitation period as edema waxes and wanes.
5. Keep the patient warm. Burns increase insensible heat loss. Burn patients with injuries >20% TBSA are at high risk of hypothermia

II. Acute Resuscitation:

1. Calculate the patient's initial burn size using the Rule of Nines (Image 1)
2. Include only 2nd and 3rd degree burns



Rule of Nines to calculate initial burn size

Image 1: Rule on Nines

3. Once wounds debrided and cleaned, recalculate TBSA using the Lund-Browder chart (Image 2). Superficial (1st degree) burn is NOT included in the estimation of TBSA for fluid resuscitation.

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

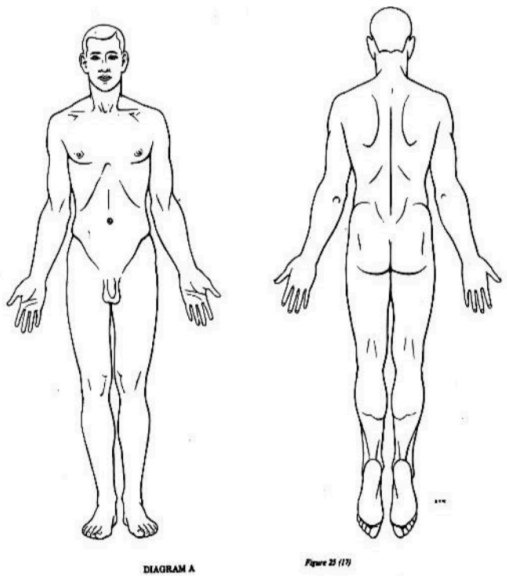


DIAGRAM A

Image 2. Lund-Browder Chart

4. If TBSA is 20% or greater, patients typically require acute fluid resuscitation for the next 24-48 hours with close observation until hour 72 post-burn.
5. Place a foley catheter with a calibrated urometer chamber. Burns to the penis are not a contraindication to catheter placement.
6. Initiate IV fluid resuscitation with Lactated Ringers using the **Rule of 10s**:

   10ml/hr X % TBSA for initiation of fluid resuscitation

   Note: For patients weighing more than 80kg, add 100ml/hr to initial IV fluid rate for each 10 kg >80

   Examples of Initial Fluid Calculation:
   1. 70 kg male with 40% TBSA
      Initial Fluid Rate= 10ml/hr X 40%= 400ml/hr
   2. 100 kg male with 40% TBSA
      Initial Fluid Rate = 10ml/hr x 40%=400ml/hr + 200ml/hr= 600ml/hr

7. Avoid fluid boluses. Instead, titrate the rate of IV fluids to maintain adequate organ perfusion as reflected by UOP.
8. **Monitor UOP hourly** and decrease or increase the isotonic fluid rate by approximately 20-25% to maintain UOP of **30-50cc/hr**. Every attempt should be made to minimize fluid administration while maintaining organ perfusion.
   a. If UOP is **<30cc/hr** then **increase** IVF 20-25%
   b. If UOP is **30-50cc/hr** then **continue** current fluid rate
   c. If UOP is **>50cc/**hr then **decrease** IVF 20-25%
9. Both under- and over-resuscitation can result in serious morbidity and even mortality; patients who receive over **250ml/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.
10. At **8-12 hours post-burn**, if the hourly IV fluid rate exceeds **1000ml/hr** or if the projected **24 hr total fluid volume approaches 250ml/kg**, initiate 5% albumin infusion using Table 1

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

Table 1: Hourly infusion rates for 5% albumin

11. Continue albumin at the rate indicated in Table 1 for 24 hours. Note: 24 hours of albumin infusing, not 24 hours from burn injury. At the completion of 24 hrs of albumin

infusion discontinue the albumin drip. Note: Discuss with attending whether to completely stop albumin drip after 24th hour or titrate down to off.

12. Measure bladder pressures q4hrs in intubated patients with >20% TBSA. Sustained bladder pressure >12 mmHg indicates early intra-abdominal hypertension and adjuncts such as colloid should be considered. Persistent bladder pressures >20% may indicate abdominal compartment syndrome.
13. 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 burn patient should follow commands, be hemodynamically stable with a tachycardia in the range of 110-130 bpm 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.

III. MANAGEMENT OF PERSISTENT OLIGURIA AND HYPOTENSION

1. Clinically significant hypotension must be correlated with UOP. Adequate end organ perfusion as estimated by UOP 30-50 mL/hr generally requires a MAP>55 mmHg. Persistent oliguria and hypotension should trigger an assessment of the patients hemodynamic status and intravascular volume. **Reassess for possible missed injury or ongoing bleeding.**
2. Monitor intravascular volume status using all available technologies
3. Consider early use of 5% albumin as discussed above.
4. The key assessment is determining intravascular fluid status. In this example we use CVP as a reflection of volume status with low CVP (<6) indicating hypovolemia and CVP of 6-8 reflecting adequate volume status. CVP is an imperfect assessment of volume and additional tools such as PA Catheter, continuous SVV, bedside U/S are all adjuncts to be considered for assessing volume status.
    a. If CVP is low (<6) titrate up IVF rate 20-25%
    b. If CVP is at goal (6-8) but hypotension (MAP<55 mmHg) persists, use norepinephrine as first line agent. Use vasopressin 0.04 Units/min as second line agent.
    c. If intravascular volume appears adequate (CVP, SVV, U/S), **STOP** increasing IVF rate even if oliguria persists. Consider patient hemodynamically optimized and accept established renal insult. Continued increases in IV fluid will result in "resuscitation morbidity" that is often more detrimental than renal failure.
5. If patient demonstrates catecholamine-resistant shock, consider the following diagnoses:
    a. Missed injury and/or ongoing blood loss
    b. Acidemia
    c. Adrenal insufficiency. If suspected start hydrocortisone 100 mg IV q8 hours.
    d. Hypocalcemia. Maintain ionized calcium >1.1 mmol/L

IV. INHALATION INJURY

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. Use bronchoscopic lavage to remove debris but be judicious as excessive irrigation may transport irritants to uninjured lung. 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.

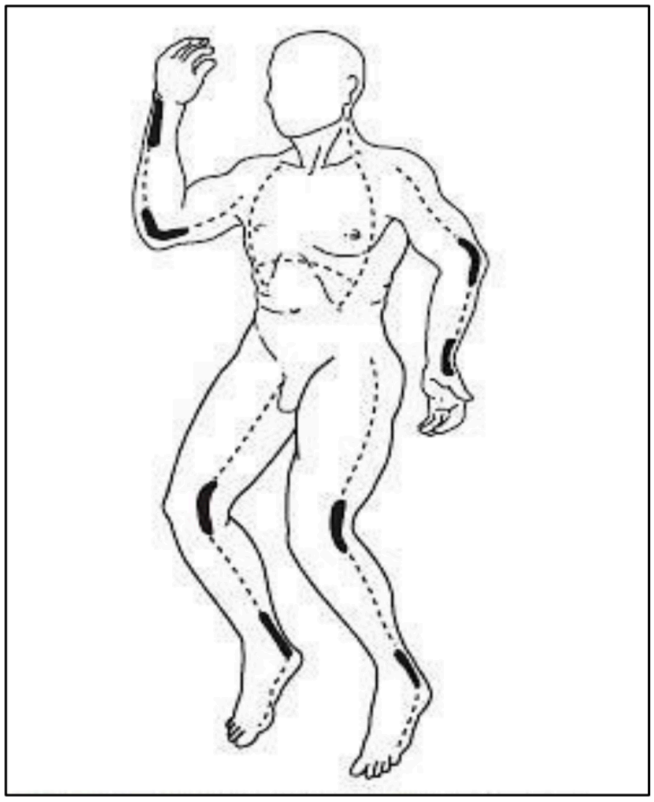
2. Patients at risk for carbon monoxid (CO) toxicity include those exposed in enclosed spaces to fires, engines and cooking stoves. Symptoms of CO toxicity include confusion, stupor, coma, seizures, and cardiac ischemia. Administer 100% oxygen and measure CO-hemoglobin levels.
3. Cyanide is encountered 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.

V. SPECIAL CONSIDERATIONS

1. Prophylactic IV antibiotics are not indicated for burn injury in the absence of infection
2. Administer tetanus prophylaxis as for any trauma patient
3. Consult ophthalmology for all patients with facial burns
4. Administer IV PPI to all patients with >20% TBSA burn injury
5. Transition from Propofol to versed once patient has left the ED and has completed initial procedures

VI. CIRCUMFERENTIAL BURNS, ESCHAROTOMY, AND EXTREMITY COMPARTMENT SYNDROME

1. Escharotomy is normally performed in the setting of circumferential full thickness burns. 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.
2. Need for fasciotomy usually presents in the first 6-24 hours following injury.
3. Repeat vascular exam hourly in patients with circumferential full thickness burns



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).

VII. ELECTRICAL INJURY

1. Small skin contact points can hide extensive soft tissue damage
2. Observe extremities closely for signs of compartment syndrome
3. Muscle injury may lead to rhabdomyolysis causing myoglobinuria and renal injury. In patients with myoglobinuria, fluid resuscitation requirements are much higher than predicted by similar size thermal burns. IV fluid infusion should be adjusted to maintain UOP 75-100 mL/hr.

Burn Flow Sheet:

Pre-burn estimated wt (kg)	%TBSA (no 1st degree)	Rule of 10s (if 40-80kg) %TBSA x 10 for starting rate of LR (add 100ccs/hr for each 10kg >80kg)	Calculate max 24h volume (250ccs x kg)

Time	Hour from burn	Crystalloid	Colloid	Total Fluids	UOP (Target 30-50ccs/hr)	Base Deficit/Lactate	HR	CVP	MAP (>55)	Pressors/ q4h bladder pressure
	1									
	2									
	3									
	4									
	5									
	6									
	7									
	8		*							
	9		*							
	10		*							
	11		*							
	12		*							
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
TOTAL FLUIDS:										

- *Add **albumin** if projected 24h total fluids **at 8-12h** exceeds max or if IVF rate exceeds 1500ccs/hr

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

- **Persistent hypotension**: calculate **CVP** (goal 6-8mmHg) – if low inc IVF, if at goal use **levo** (can add **vaso 0.04** next)
- **Persistent oliguria**: If CVP is at goal stop increasing IVF (oliguria likely result of est renal insult)

Pre-burn estimated wt (kg)	%TBSA (no 1st degree)	Rule of 10s (if 40-80kg) %TBSA x 10 for starting rate of LR (add 100ccs/hr for each 10kg >80kg)	Calculate max 24h volume (250ccs x kg)

Time	Hour from burn	Crystalloid	Colloid	Total Fluids	UOP (Target 30-50ccs/hr)	Base Deficit/Lactate	HR	CVP	MAP (>55)	Pressors/ q4h bladder pressure
	25									
	26									
	27									
	28									
	29									
	30									
	31									
	32									
	33									
	34									
	35									
	36									
	37									
	38									
	39									
	40									
	41									
	42									
	43									
	44									
	45									
	46									
	47									
	48									
TOTAL FLUIDS:										

- *Add **albumin** if projected 24h total fluids **at 8-12h** exceeds max or if IVF rate exceeds 1500ccs/hr

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

- **Persistent hypotension**: calculate **CVP** (goal 6-8mmHg) – if low inc IVF, if at goal use **levo** (can add **vaso 0.04** next)
- **Persistent oliguria**: If CVP is at goal stop increasing IVF (oliguria likely result of est renal insult)