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MEDICAL CENTER

Protocol: Adult Burn Fluid Resuscitation

Category Approval Date Due for review

Clinical Practice 12/17/19 (CMT) 1/2022

	Applicable to		
⊠ VUH □ Children's □ DOT	VMG Off-site locations VMG	VPH Other	
	Team Members Performing		
 □ All faculty & ⊠ Faculty & staff staff providing direct patient care or contact 	⊠ MD ⊠ House Staff ⊠ APRN/P	A 🛛 RN 🗆 LPN	
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I. Population:

Adult burn patients with burn injuries

II. Indications:

Patients requiring fluid resuscitation and/or those that require critical care will be admitted to the BICU. The goal of fluid resuscitation after a severe burn injury is to prevent burn shock by matching a continuous fluid infusion with the patient's needs which are proportional to the size of the patient and the size of the burn. Please use the following guidelines to determine appropriate disposition and resuscitation:

Appropriate Unit		
<10% TBSA	Admit to: burn step down	
	Resuscitation: Oral	
10-19% TBSA	Admit to: burn step down	
	Resuscitation: Oral + MIVF	
≥20% TBSA	Admit to: BICU	
	Resuscitation: Resuscitation Protocol	

III. Definitions:

Depth of Burn

Estimated percent of total body surface area (%TBSA) of partial and full thickness burns is needed to calculate fluid requirements. Superficial burns (1st degree) are not included in this calculation.

Depth of Burn		
Superficial (1st Degree)	Erythema; skin intact ("sunburn")	
Partial Thickness (2 nd Degree)	Wet, weepy, blisters, pink, blanching	
Full thickness (3 rd Degree)	White, brown, red, black, leathery, dry	

Calculating TBSA

There are various methods used to estimate TBSA. The Rule of Nines¹ and/or the Palmar Method² are the easiest and fastest way to estimate burn size. As humans grow and their body proportions change, there are some slight changes to the Rule of Nines. The adult diagram is below. If the burn does not encompass the entire area referenced in the rule, the %TBSA is counted as a proportion of the size noted in the diagram. For example, if half of the posterior torso is burned that is 9% TBSA, not 18%. The palmar method is 1% TBSA= the palm of the patient from wrist crease to tip of longest finger.



IV. Assessment:

A. Urine Output

- While crude, urine output is the best and least invasive endpoint of resuscitation at our disposal. Urine output should be strictly monitored in all patients. Foley catheters will be placed in those patients requiring fluid resuscitation. For those patients not undergoing fluid resuscitation, consideration should be given to bladder scanning, possible Foley placement, and alternative fluid management if the patient is unable to spontaneously void ≥ 4 consecutive hours during the acute phase. See the Fluid Management Algorithm for TBSA <20%.
- 2. Fluid boluses are **not** indicated for the management of oliguria in the hemodynamically normal patient. Hourly titrations of resuscitation volume typically correct the issue.

B. Hypotension

- 1. Parameters for treating hypotension and threshold of minimum blood pressure must be individualized. Administration of vasopressors during the resuscitation phase is discouraged as most vasopressors cause cutaneous vasoconstriction and can extend the depth of the burn injury and the primary issue for the burn patient in burn shock is hypovolemia.
- 2. Isotonic crystalloid fluid boluses (500mL), administered rapidly, are the preferred method of management for hypotension in the resuscitation phase. The BICU fellow and/or attending should be notified if a patient is given a bolus. If hypotension persists after 2 boluses, bedside echo should be performed with the fellow or attending to determine if the patient is experiencing cardiac failure.
- 3. The fluid resuscitation rate should be increased at the same time as the bolus is being given. If the patient is experiencing hypotension, it should be assumed that the current rate is not appropriately preventing burn shock. Giving a bolus without increasing the continuous rate will not prevent additional hypotension.
- 4. Hypotension in a burn patient requires a comprehensive clinical evaluation to assess all possible etiologies. Noninvasive blood pressure measurements may also be inaccurate when tissue edema or thick, leathery burns are present. Consideration should be given to arterial line placement. Additional causes of persistent hypotension that may be missed include compartment syndrome (extremity or abdominal), cyanide poisoning, incorrect estimation of burn size.

V. Intervention/Treatment:

Labs

CBC, BMP, Magnesium, Phosphorous, Calcium, and Lactic Acid should be drawn upon admission. BMP, Mg, Phos, Ca should be drawn q6hrs during resuscitation. In patients who are undergoing an uneventful resuscitation, a daily CBC is sufficient.

FLUID MANAGEMENT TBSA <20%



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FLUID MANGEMENT TBSA ≥20%

Fluid Requirements

STEP One: Calculate the starting rate

The ABLS consensus formula³ is used during resuscitation. Lactated Ringer's is used as the resuscitation fluid. Resuscitation starts at 2ml/kg/%TBSA. Filling out the table below at the start of resuscitation will give you all of the values that you will need throughout the resuscitation. At VUMC, our fluid titration during resuscitation is nurse-driven and the resident is responsible for knowing how the resuscitation is progressing and communicating with the BICU attending.

Necessary Calculations				
Starting Rate	Typical starting rate of resuscitation			
	2ml xkg x %TBSA=ml/16=ml/hr.			
Albumin	Consider starting albumin per protocol when resuscitation is ≥ this rate			
Start	4ml xkg x %TBSA=ml/16=ml/hr.			
Albumin	Discontinue albumin protocol when fluids return to this rate			
Stop	3ml xkg x %TBSA=ml/16=ml/hr.			
MIVF Rate	4-2-1 Rule			
	For 0-10kg: +4ml/Kg/hr., For 10-20kg: +2ml/kg/hr., For >20kg: +1ml/kg/hr.			

STEP Two: Titrate Resuscitation Volume Hourly

Resuscitation volume is titrated \uparrow or \downarrow hourly by 10-20% based on UOP if the heart rate is <140 and MAP >60. See table below for guidance:

Standard Titration of Resuscitation					
UOP	≤19	20-29	30-39	40-49	≥50
LR ml/hr.	个20%	个10%	-	↓10%	↓20%

Vital Sign Monitoring & Interventions for Hemodynamic Abnormalities

Heart rate and blood pressure are monitored throughout the resuscitation. If the patient develops a sustained heartrate of >140 bpm, please contact the BICU attending. **Tachycardia** is frequently multifactorial; pain and anxiety should be addressed first. Intoxication should be considered if UOP is adequate and pain/anxiety have been addressed. If tachycardia is accompanied by **hypotension**, the most likely diagnosis is inadequacy of resuscitation and the patient should receive a bolus of 500 mL of LR along with a simultaneous increase in the hourly infusion of LR by 20%. Hypotension is defined as a MAP of <60, for hypotension, a bolus as described above should be given. If a bolus is given, the BICU fellow or attending must be notified. Hypotension without oliguria is unusual, discuss with BICU attending before giving a bolus.

Albumin Start

Albumin is used in patients who are failing resuscitation, requiring increasing volumes of resuscitation with persistent oliguria. Patients may require albumin if they have reached a rate of double the starting fluid rate or they have developed complications related to edema. Use of albumin in the first 8 hours after injury is discouraged as the capillary leak is highest in that time frame. Albumin infusion is the preferred method of administration, but boluses may occasionally be used if deemed appropriate. If given, a bolus of albumin should be 250ml of 5% albumin. Often one or two boluses are enough to resolve oliguria and allow downward titration of crystalloid. If this proves unsuccessful or at the preference of the BICU attending, you should proceed with 5% albumin infusion at 1/3 the current hourly rate while continuing LR at 2/3rds of the current rate⁴. Titration of both the albumin and LR should follow the standard titration guidelines by UOP as listed above. Discussion with the BICU attending is required prior to starting albumin.

Other Considerations When Starting Albumin

When albumin has been started then this should be an indicator that the patient is at risk for secondary complications from resuscitation including abdominal compartment syndrome. Consideration should be given to the following:

- Placement of central access if not already done
- Assessment of cardiac function by either non-invasive or invasive means
- Monitoring of abdominal compartment pressures q4 hours

Albumin Stop- when the total rate of hourly fluid administration returns to 3ml/kg/%TBSA, albumin administration should be discontinued. Albumin should continue ideally <u>no longer than 24 hours</u> <u>after</u> from the initial burn injury. When albumin is discontinued, the volume is replaced with crystalloid fluid and continues to be titrated to UOP.

Example: UOP=40cc/hr.

- Current resuscitation volume= 150ml/hr.
 - 100ml LR (2/3 crystalloid) <u>+50ml</u> albumin (1/3 colloid) 150ml (total resuscitation volume)
 - Stop albumin and decrease resuscitation by 10% 150 ml (Current total volume) <u>– 15ml</u> (10% of current volume) 135ml (Next hour fluid rate of LR)

Resuscitation End Points

Once resuscitation volume is at calculated weight based MIVF rate for 4 consecutive hours, the burn fluid resuscitation has ended. The crystalloid should be switched to D5NS + 20 KCl (unless there are contraindications, specifically electrolyte abnormalities) and continued at the maintenance rate until oral or enteral intake is enough to maintain adequate UOP. ***Use caution when discontinuing IV fluids in patients who still have the inflammatory drive and insensible losses of the burn injury.***

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VI. Complications:

Difficulty Resuscitating

If the resuscitation fluid has been increased for two consecutive hours and UOP is not \geq 30ml/hr., notify the burn attending and reassess the following:

- Is the TBSA greater than originally estimated?
- Does the patient have an unaddressed compartment syndrome (extremity or abdominal)?
- Does the patient have an inhalation injury?
 - Inhalation injuries may require greater volumes than those predicted with the original resuscitation formula

Hypothermia

Hypothermia is common in burn patients. If severe, it can cause alterations in oxygenation and electrolytes. Interventions to manage hypothermia are as followed:

Hypothermia Management	
<35°	Heat LampsPlastic Covering
	Thermal Surgical Cap
	Fluid Warmer
35-36°	Heat Lamps
	Plastic Covering
>36°	Continuous Monitoring

Stress Ulcers

Patients with >20% TBSA are at risk for stress ulcers and should receive routine prophylaxis beginning at admission.⁵ Early initiation of enteral feedings is also recommended. See Adult Burn Nutrition Protocol.

Compartment Syndrome

Those patients receiving high-volume resuscitations are at risk for developing ocular, abdominal, and extremity compartment syndrome. All patients undergoing IVF resuscitation who cannot communicate vision changes should have an ophthalmology consult to measure intraocular pressures and intervene if elevated. If there is suspicion of abdominal or extremity compartment syndrome, notify burn and BICU attendings immediately. All patients with circumferential full thickness burn on an extremity should receive hourly neurovascular assessments until discontinued by the burn surgeon.

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VII. References:

1 Moore, R. A., Waheed, A. & Burns, B. in *StatPearls* (StatPearls Publishing StatPearls Publishing LLC., 2019).

2 Kirby NG, B. G. Vol. 3rd Edition 85 (HMSO, London, 1981).

3 *ABLS-Advanced Burn Life Support Provider Manual*. (American Burn Association, 2018).

- 4 Cochran, A., Morris, S. E., Edelman, L. S. & Saffle, J. R. Burn patient characteristics and outcomes following resuscitation with albumin. *Burns : journal of the International Society for Burn Injuries* **33**, 25-30, doi:10.1016/j.burns.2006.10.005 (2007).
- 5 Choi, Y. H., Lee, J. H., Shin, J. J. & Cho, Y. S. A revised risk analysis of stress ulcers in burn patients receiving ulcer prophylaxis. *Clinical and experimental emergency medicine* **2**, 250-255, doi:10.15441/ceem.15.076 (2015).