

MEDICAL CENTER

Protocol: Adult Burn Fluid Resuscitation

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|-----------------|-------------------|
| Category | Clinical Practice |
| Protocol Number | BC-A-01 |
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| Applicable to | |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> VUH | <input type="checkbox"/> Children's <input type="checkbox"/> DOT <input type="checkbox"/> VMG Off-site locations <input type="checkbox"/> VMG <input type="checkbox"/> VPH <input type="checkbox"/> Other |
| Team Members Performing | |
| <input type="checkbox"/> All faculty & staff | <input checked="" type="checkbox"/> Faculty & staff providing direct patient care or contact |
| <input type="checkbox"/> Other: | <input checked="" type="checkbox"/> MD <input checked="" type="checkbox"/> House Staff <input checked="" type="checkbox"/> APRN/PA <input checked="" type="checkbox"/> RN <input type="checkbox"/> LPN |
| Content Experts | |
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I. Population:

Adult burn patients requiring fluid resuscitation

II. Indications:

All critical patients and those requiring fluid resuscitation will be assigned to the BICU. Frequency of interventions is also taken into consideration when assigning floor destination. Stable patients with interventions or assessments ordered more frequent than q4 require an ICU bed for nursing acuity. For those patients not requiring critical care, use the following guidelines to assign patients:

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

III. Definitions:

TBSA

Depth of Burn

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

| Depth of Burn | |
|--------------------------------------------|-----------------------|
| Superficial (1st Degree) | Erythema; skin intact |
| Partial Thickness (2 nd Degree) | Wet, weepy, blisters |
| Full thickness (3 rd Degree) | White, leathery, dry |

Calculating TBSA

There are various methods used to estimate TBSA. For burn patients requiring resuscitation, the Lund and Browder chart is the preferred method to estimate TBSA. For pediatric patients >15% TBSA, defer to Pediatric Burn Fluid Resuscitation protocol.

| Modified Lund and Browder ¹ | | | | | | |
|----------------------------------------|-----------|--------|--------|----------|-------|-------|
| Area | Birth-1yr | 1-4yrs | 5-9yrs | 10-14yrs | 15yrs | Adult |
| Head | 19 | 17 | 13 | 11 | 9 | 7 |
| Neck | 2 | 2 | 2 | 2 | 2 | 2 |
| Anterior trunk | 13 | 13 | 13 | 13 | 13 | 13 |
| Posterior trunk | 13 | 13 | 13 | 13 | 13 | 13 |
| R buttock | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| L buttock | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Genitalia | 1 | 1 | 1 | 1 | 1 | 1 |
| R upper arm | 4 | 4 | 4 | 4 | 4 | 4 |
| L upper arm | 4 | 4 | 4 | 4 | 4 | 4 |
| R lower arm | 3 | 3 | 3 | 3 | 3 | 3 |
| L lower arm | 3 | 3 | 3 | 3 | 3 | 3 |
| R hand | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| L hand | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| R thigh | 5.5 | 6.5 | 8 | 8.5 | 9 | 9.5 |
| L thigh | 5.5 | 6.5 | 8 | 8.5 | 9 | 9.5 |
| R leg | 5 | 5 | 5.5 | 6 | 6.5 | 7 |
| L leg | 5 | 5 | 5.5 | 6 | 6.5 | 7 |
| R foot | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| L foot | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |

To calculate TBSA using the Lund and Browder chart, measure the affected surfaces for each body part. For example, if a 10 year old presented with a burn to half of the left upper arm, the TBSA of burn would be 2%.

IV. Assessment:

A. Output

1. Output should be strictly monitored in all patients. Foley catheters will be placed in those patients requiring fluid resuscitation with hourly titrations. 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 $<20\%$.

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.
2. Isotonic crystalloid fluid boluses (usually 1 liter), administered rapidly, are the preferred method of management for hypotension in the resuscitation phase. If hypotension persists after 1 bolus, bedside echo is performed with the fellow or attending. Continued increase in IVF with heart failure must be avoided.
3. *Note: Fluid boluses are not calculated in resuscitation totals that determine hourly volumes.*
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 is present. Consideration should be given to arterial line placement. Fluid boluses are **not** recommended for the management of low UOP in the hemodynamically stable patient. Hourly titrations of resuscitation volume typically correct this finding.

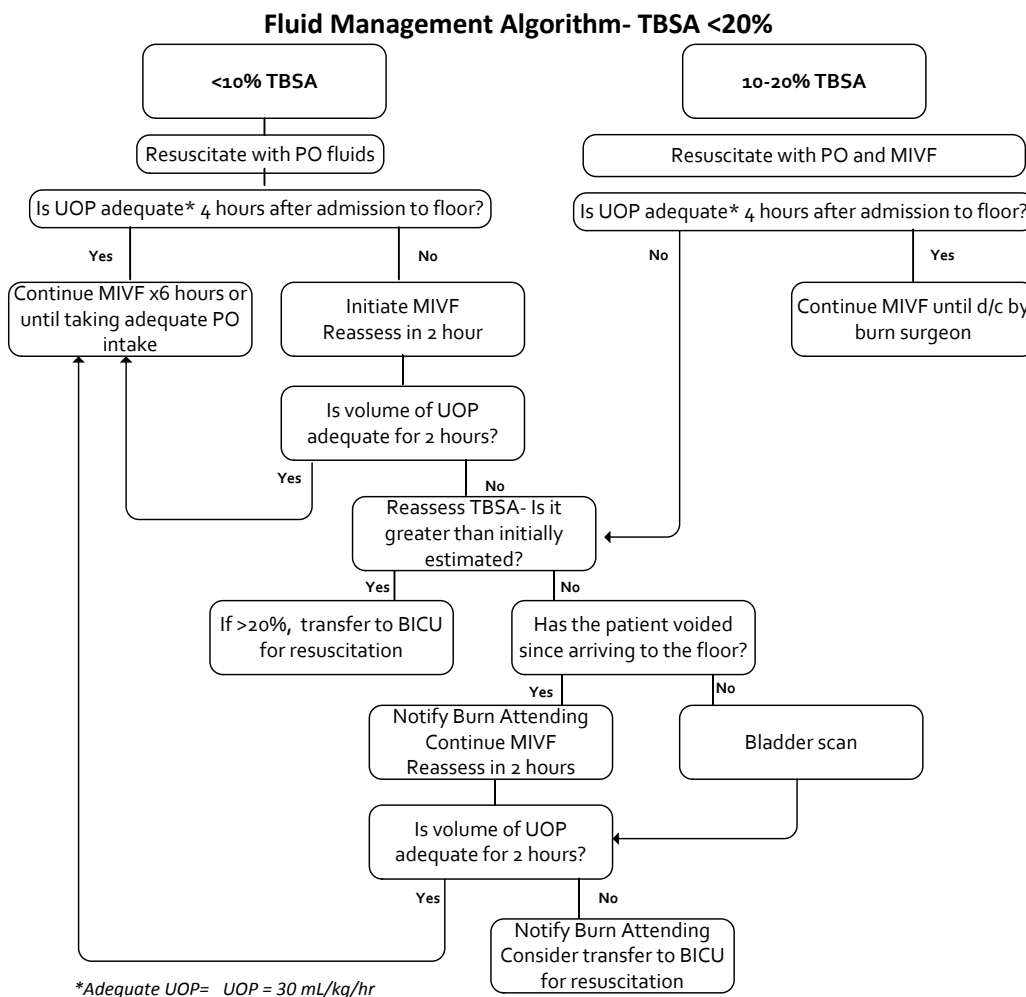
V. Intervention/Treatment:

Labs

CBC, BMP, and Lactic Acid should be drawn upon admission and then q6 hours until fluid resuscitation has ended.

FLUID RESUSCITATION

TBSA <20%



TBSA >20%

Fluid Requirements

| | | |
|-------------------------------------------------------------------------------------|------------|----------------|
| Resuscitation Fluid | LR | Titrate hourly |
| Dextrose Source <i>Consider discontinuing when enteral feedings are at goal.</i> | D10 | 20ml/hr |

STEP One: Calculate the starting rate

A modified version of the Parkland formula is used during resuscitation. Resuscitation starting rate typically begins at a Parkland 3 (see formula below) and is titrated hourly based on UOP.

| Necessary Calculations | |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Parkland 3 | Typical starting rate of resuscitation volume $3\text{ml} \times \text{___ kg} \times \text{___ TBSA} = \frac{\text{ml}}{16\text{hr}} = \text{___ ml/hr}$ |
| Parkland 6 | Consider initiating albumin protocol when resuscitation volumes \geq this rate. $6\text{ml} \times \text{___ kg} \times \text{___ TBSA} = \frac{\text{ml}}{16\text{hr}} = \text{___ ml/hr}$ |
| Parkland 4 | Discontinue albumin protocol when fluids return to this rate. $4\text{ml} \times \text{___ kg} \times \text{___ TBSA} = \frac{\text{ml}}{16\text{hr}} = \text{___ ml/hr}$ |

STEP Two: Titrate Resuscitation Volume Hourly

Resuscitation volume is titrated \uparrow or \downarrow hourly by 10-20% based on UOP.

| Standard Titration (LR Only) | | | | | |
|------------------------------|-----------------|-----------------|-------|-------------------|-------------------|
| UOP | ≤ 19 | 20-29 | 30-39 | 40-49 | ≥ 50 |
| LR ml/hr | $\uparrow 20\%$ | $\uparrow 10\%$ | - | $\downarrow 10\%$ | $\downarrow 20\%$ |

Albumin Start

Albumin infusion is the preferred method of administration but boluses may be used if deemed appropriate. A bolus of 250ml of 5% albumin should be given. Often one or two boluses are enough to increase urine output and allow downward titration of crystalloid. If this proves unsuccessful then further consideration should be given to an albumin infusion using one of the following methods:

| Albumin Infusion Options | | |
|------------------------------|-----------|-----------------------------------|
| Baseline Rate | 5% or 25% | Rate determined by provider |
| Proportion of hourly volumes | 5% | 1/3 of total resuscitation volume |

If the decision is made to administer albumin as a proportion of the hourly resuscitation volume, resuscitation fluid totals are 2/3 crystalloid and 1/3 5% albumin. These proportions of 2/3 crystalloid and 1/3 albumin are maintained when titrating hourly volumes.

Modified Albumin Titration

When albumin is initiated as an infusion, either as a baseline rate or as a proportion of hourly volumes, fluids are titrated as followed:

- After initiating an albumin infusion, the rate of resuscitation volume does not decrease for two hours.
- The following two hours, $\downarrow 10\%$ if UOP warrants decrease in fluid volume.

- May return standard titration, $\uparrow\downarrow$ by 10%-20%, the following hour.

| Modified Albumin Titration (LR + albumin) | | | | | |
|-------------------------------------------|-----------------|-----------------|-------|-------------------|-------------------|
| UOP | ≤ 19 | 20-29 | 30-39 | 40-49 | ≥ 50 |
| Hour 1 | $\uparrow 20\%$ | $\uparrow 10\%$ | - | - | - |
| Hour 2 | $\uparrow 20\%$ | $\uparrow 10\%$ | - | - | - |
| Hour 3 | $\uparrow 20\%$ | $\uparrow 10\%$ | - | $\downarrow 10\%$ | $\downarrow 10\%$ |
| Hour 4 | $\uparrow 20\%$ | $\uparrow 10\%$ | - | $\downarrow 10\%$ | $\downarrow 10\%$ |
| Hour 5 | $\uparrow 20\%$ | $\uparrow 10\%$ | - | $\downarrow 10\%$ | $\downarrow 20\%$ |

Note: Albumin use during the first 8 hours of burn resuscitation is rarely necessary.

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 4ml/kg/hr, albumin administration should be discontinued. Albumin should continue ideally no longer than 24 hours after from the initial burn injury. When albumin is discontinued, the volume is replaced with crystalloid fluid and continues to be titrated to UOP.

Example:

- Current resuscitation volume= 150ml/hr.

$$\begin{array}{r} 100\text{ml LR (2/3 crystalloid)} \\ +50\text{ml albumin (1/3 colloid)} \\ \hline 150\text{ml (total resuscitation volume)} \end{array}$$
- Stop albumin and decrease resuscitation by 10%

$$\begin{array}{r} 150\text{ ml (Current total volume)} \\ - 15\text{ml (10\% of current volume)} \\ \hline 135\text{ml (Next hour fluid rate of LR)} \end{array}$$

Resuscitation End Points

Once resuscitation volume is at calculated weight based MIVF rate for 4 consecutive hours, the burn fluid resuscitation has ended. MIVF are continued until oral or enteral intake is sufficient to maintain adequate UOP.

VI. Complications:

Difficulty Resuscitating

If resuscitation volume is at rate of Parkland 6 and UOP is not $\geq 30\text{ml/hr}$, notify the burn attending after reassessing the following:

- Is the TBSA greater than initially estimated?
- Does the patient have an inhalation injury?
 - Inhalation injuries may require greater volumes than those predicted with the parkland formula. In these circumstances, crystalloid volumes as high as a Parkland 8 may be attempted prior to starting albumin.

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° | <ul style="list-style-type: none"> • Heat Lamps • Plastic Covering • Thermal Surgical Cap • Fluid Warmer |
| 35-36° | <ul style="list-style-type: none"> • Heat Lamps • Plastic Covering |
| >36° | <ul style="list-style-type: none"> • Continuous Monitoring |

Stress Ulcers

Patients with >20% TBSA are at risk for stress ulcers and should receive routine prophylaxis beginning at admission.⁴ 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 abdominal and extremity compartment syndrome. If there is suspicion of compartment syndrome, notify burn attending immediately. All patients with circumferential burns present should receive hourly neurovascular assessments until discontinued by the burn surgeon.

VII. References:

1. Lund CC, Browder NC. The estimation of areas of burns. *Surg Gynecol Obstet.* 1944;79:352-358.
2. American Burn Association. (2011). *Advanced burn life support providers manual.* Chicago, IL.
3. Sharma, R. K., & Parashar, A. (2010). Special considerations in pediatric burn patients. *Indian Journal Of Plastic Surgery: Official Publication Of The Association Of Plastic Surgeons Of India*, 43(Suppl), S43-S50
4. Choi, Y. H., Lee, J. H., Shin, J. J., & Cho, Y. S. (2015). A revised risk analysis of stress ulcers in burn patients receiving ulcer prophylaxis. *Clinical and Experimental Emergency Medicine*, 2(4), 250–255.