UAB MEDICINE

BURN FLUID RESUSCITATION

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PURPOSE

The purpose of this guideline is to standardize crystalloid and colloid resuscitation in the early resuscitation phase of large burns (>20% for thermal or >10% for high-voltage electrical). This guideline is based on Version 1 with the following major changes.

- The formal resuscitation will be completed over the first 24 hours post-injury.
- Post-excision resuscitation will be performed for 12 hours following the initial excision procedure.
- Usage of Fresh Frozen Plasma is standardized
- Crystalloid titration is moderated when UOP is low and de-escalation is accelerated when UOP adequate
- Burn and trauma attendings are notified about standardized clinical events
- Failed/over-resuscitation will be predicted and mitigated in a standardized fashion
- Ongoing maintenance fluid rate is defined and provides a minimum hourly fluid administration

BURN ADMISSION CHECKLIST

Patients with >20% TBSA should receive rapid initiation of resuscitation and expedited admission to the TBICU. A **Burn Admission Checklist** and **Resuscitation Sheet** should be started upon arrival.

IMMEDIATELY START CRYSTALLOID

Immediately upon arrival, Lactated Ringers should be started at a minimum rate of 300mL/hr.

PERFORM INITIAL BURN MAPPING AND START FORMAL RESUSCITATION

Initial burn mapping should be performed immediately upon arrival by the trauma chief/attending and documented in the Lund and Browder chart on the resuscitation sheet. This should be **performed prior to formal debridement,** which should be performed in the TBICU or OR for burns >20%. Initial fluid resuscitation rate should be calculated as below and started **within 30 minutes of ED arrival.**

CALCULATE THE INITIAL FLUID RESUSCITATION RATE

THERMAL BURNS

Initial fluid resuscitation rate should be based on the Modified Brooke formula per ABA consensus guidelines. The predicted 24-hr fluid administration is calculated by the formula (2 mL/kg/%TBSA) * (weight kg) * (%TBSA). The initial fluid rate is determined by dividing this number by 16.

ELECTRICAL BURNS

Surface mapping often underestimates the extent of high-voltage electrical burns. Start patients with high-voltage electrical burns with the above formula, substituting 3 mL/kg/%TBSA.

PEDIATRIC BURNS

Patients 16 and older will be cared for at UAB. Patients 16 and older will be resuscitated with the same formulas as adults.

START ENTERAL NUTRITION

For burns >30%, a post-pyloric Dobhoff tube should be placed and tube feeds should be initiated at a goal rate of 30 kCal/kg/24hr. If post-pyloric Dobhoff cannot be obtained, feed through a gastric NG or OG. See full nutrition protocol for more details.

PERFORM INITIAL DEBRIDEMENT

Initial burn debridement should be performed rapidly. The priorities for initial debridement are 1) limit exposure time (<30 minutes) and 2) remove blisters and soot. Patients with temperature <37^{0}C should not be debrided until warmed above this temperature. Unless directed otherwise by the burn attending, dress initial burns with polysporin and cuticerin.

ADJUST FLUID RESUSCITATION RATE

Monitor hourly urine output (UOP) and adjust fluids according to a UOP goal of 30-50 mL/hr (75-100 mL/hr for electrical injuries). Every attempt should be made to minimize fluid administration while maintaining organ perfusion. UOP may take more than 1 hour to respond to a new fluid rate. If UOP trends in the right direction 1 hour after a fluid change, consider holding for another hour.

UOP < 15 mL/hr	***Increase IVF by 20%***
UOP 15-29 mL/hr	***Increase IVF by 10%***
UOP 30 mL/hr	***No change***
UOP 31-40 mL/hr	***Decrease IVF by 10%***
UOP 41-49 mL/hr	***Decrease IVF by 20%***

UOP > 50 mL/hr

- ***Assess for osmotic diuresis***
  - ***Decrease IVF by 20%***
  - ***Check UOP in 30 min***
- ***If UOP @ 30 minutes >=30 mL, decrease an additional 10%, if UOP @ 30 minutes <30 mL, leave fluids the same and continue hourly titration***

CALCULATE PREDICTED FLUIDS AT 24HR

After hour 8, each time fluids are increased, calculate predicted 24hr fluids and record on the burn resuscitation sheet. Calculate predicted 24hr fluids with the following formulas.

$$24hr\ predicted\ fluids\ (ml) = (Current\ total\ fluids) + (Current\ fluid\ rate * \#\ hours\ remaining\ in\ 24hr\ resus)$$

$$\text{24hr predicted resuscitation (mL/kg/\%TBSA)} = \frac{24hr\ predicted\ total\ fluids}{weight\ (kg) * \%TBSA}$$

IDENTIFY MARKERS FOR FAILING RESUSCITATION

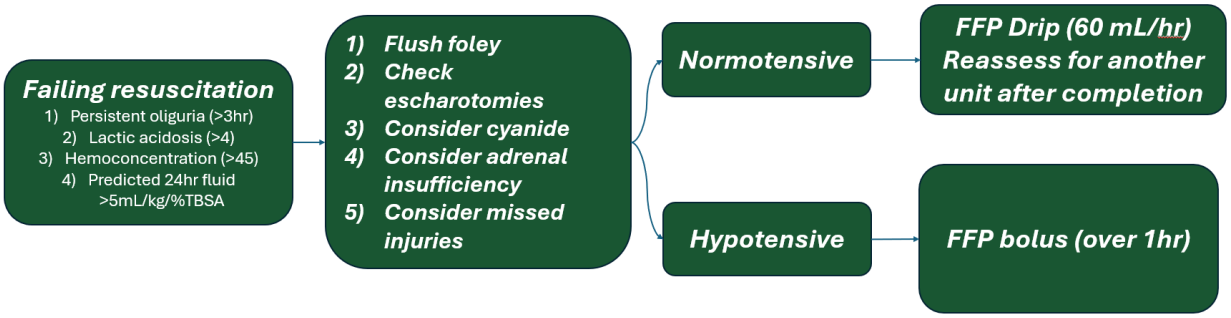
- Persistent oliguria – UOP <30 mL/hr despite two consecutive increases in fluids
- Increasing or persistent lactic acidosis (>4)
- Elevated hematocrit (>45)
- Predicted 24hr fluid administration >5mL/kg/%TBSA

MITIGATE FAILING RESUSCITATION

Patients who have markers of failed resuscitation should be assessed for the following:

1) Patent foley – flush and consider bladder scan
2) Incomplete escharotomies – extremity and torso
3) Cyanide toxicity
4) Adrenal insufficiency
5) Missed injuries

After addressing these common causes of failed resuscitation, the following maneuvers should be employed.



FRESH FROZEN PLASMA INFUSION

Fresh frozen plasma (FFP) infusion should be administered at 60 mL/hr.

FRESH FROZEN PLASMA BOLUS

Patients with hypotension and persistent oliguria may benefit from colloid bolus using FFP. 1 unit FFP bolus should be administered over 1 hour.

Patients with hematocrit above 45 should receive a 1 unit FFP and recheck in 6 hours with standard labs.

VASOPRESSOR USAGE

Vasopressors should only be used for refractory hypotension. Vasopressors should be titrated to a goal MAP >60. Fluid rate should continue to be titrated towards goal urine output. **Trauma and Burn attending should be notified at initiation of vasopressors**.

FAILED RESUSCITATION, INITIATING EARLY CRRT, ULTRA-EARLY EXCISION

DETERMINING FAILED RESUSCITATION

The following clinical events should trigger an escalation to trauma and burn attendings to determine failed resuscitation and further management.

- Predicted 24-hr resuscitation >5mL/kg/%TBSA for 4 consecutive hours
- Remains oliguric or anuric for 4 consecutive hours despite standard maneuvers for failed resuscitation

ULTRA-EARLY EXCISION

Select patients should be taken to the OR for level 1 excision upon determining failed resuscitation at the discretion of the Burn attending

INITIATION OF EARLY CRRT AND FLUID MANAGEMENT AFTER EARLY CRRT

Select patients will undergo earl CRRT at trauma and burn attending's shared discretion in consultation with nephrology.

After initiating CRRT, over the next 4 hours, reduce crystalloid rate to initial fluid rate (based on 2 mL/kg/%TBSA). Fluids may continue to be titrated based on volume status at trauma and burn attending's shared discretion.

COMPLETION OF RESUSCITATION AND ONGOING MAINTENANCE RATE

At 24hr, total fluid should be calculated in mL/kg/%TBSA and documented on the resuscitation sheet.

After the first 24hr resuscitation, burn patients have ongoing insensible losses and require a higher. Total fluids (tube feeds + free water + drips + crystalloid) should not be decreased below the maintenance rate.

POST-EXCISION RESUSCITATION

After first burn excision, formal resuscitation will be resumed for 12 hours. Initial fluid rate will be determined by the operating burn surgeon, and urine output may be titrated based on the above titration protocol.