

MMC BURN RESUSCITATION PROTOCOL

Acute burn resuscitation protocol

Adults with TBSA \geq 20%, children with TBSA \geq 15%

Standard crystalloid resuscitation

First 24 hours

Hours 0-6

- Administer IV LR; initial estimate is 3ml/kg/percent burn, with half administered over first 8 hours post-injury
- Goals: urine output 30ml/hr (adults), mean arterial pressure (MAP): 60 mmHg
- Children (< 30 kg): add maintenance fluid, using D5 LR
- Children (< 30 kg) urine output goal: 0.5mL/kg/hr, systolic blood pressure (SBP) goal: age-appropriate minimum (by Broselow chart)
- Reduce LR rate by 10% every hour that resuscitation goals are met
- If uo 20-29 ml in past hour, increase LR rate by 10%
- If uo 10-19 ml in past hour, increase LR rate by 20% and call attending
- If uo <10 ml in past hour, increase LR rate by 30% and call attending

Identification of patients with difficult resuscitation (hours 6-12)

- LR infusion rate increased twice (or more) in hours 6-12 of resuscitation
- Ongoing crystalloid requirement for 1st 8 hours expected to exceed 150% of predicted volume
- By the 12th hour post-injury: Hourly LR infusion rate exceeds 80% of the rate predicted for 1st 8 hours

For every hour that resuscitation goals not met during hours 8-24, increase LR rate by 10% and:

Second 24 hours

Resuscitation parameters

- Reduce crystalloid infusion by 10% every hour that resuscitation goals are met
- Target maintenance infusion: 1500 ml/m² estimated BSA over 24 hours
- Urine output and MAP goals: same as first 24 hours
- **For every hour that resuscitation goals not met**

Adjuncts to resuscitation

First 24 hours

Down Titration of IV fluids

- Goal UOP for adults is 25cc -35cc during acute phase
- For sustained (more than 2hrs) UO > 45cc/hr, Decrease LR rate by 10%
- If UO > 60cc/hr for past 2 hours, decrease LR rate by 20% and call attending
- If UO > 85cc/hr for last hour, decrease LR rate by 30% and call attending to discuss more aggressive down titration of fluids

Notify Attending MD

- Consider OR/SCU excision +/- Plasma exchange
- Vitamin C infusion
- If Oliguria present x 2 hours (<15cc/hr), Start CVVH

Colloid rescue

Administer 250 ml of 5% albumin over 1hour, may repeat dose once for maximum of 500ml of 5% albumin. If goals still not met, notify attending MD - may consider Colloid or FFP only resuscitation after hour 10.

Second 24 hours

Colloid supplementation

Administer 250 ml of 5% albumin over 1hour, may repeat dose once for maximum of 500ml of 5% albumin. Notify Attending MD if resuscitation goals still not met.

Acute burn resuscitation protocol

Adults with TBSA \geq 20%, children with TBSA \geq 15%

TRAUMATIC INJURY WITH BURN $>15\%$ TBSA: Patients who sustain non-burn injuries may require combined or alternate resuscitation strategy. Attending discretion advised.

Type of crystalloid: LR (and maintenance fluid in children < 30 kg) is the initial crystalloid resuscitation fluid.

Crystalloid bolus infusion: A 500 ml LR bolus is a recommended treatment in a patient with a systolic blood pressure (SBP) < 90 mmHg and MAP < 60 mmHg, confirmed on repeat measurement. Along with bolus infusion, hourly LR infusion is increased by 10% of current rate. For children < 30 kg, the bolus is 10 ml/kg of LR.

Colloid infusion: Colloid infusion protocol is detailed in flow chart. No colloid administration outside of the protocol should be administered.

Vasopressor use: Vasopressin 0.03 U/min is first line vasopressor treatment for low mean arterial pressure (<60 mmHg). Vasopressor initiation needs attending physician authorization.

Resuscitation goals:

Include an hourly urinary output of 30ml/hr and a MAP of 60mmHg. 30ml/hr UOP is the target regardless of patient weight or calculated Parkland fluid estimates. For patients whose pre-injury dry weight is less than 60kg, a urinary output of 0.5 ml/kg/hour is targeted. For Children (< 30 kg), the urine output goal is 0.5mL/kg/hr, the systolic blood pressure (SBP) goal is according to age-appropriate minimum (detailed in Broselow chart)

Coordination of plasma exchange:

The burn service is responsible for providing dialysis access prior to the start of the plasma exchange procedure. Requires discussion with Nephrology. Consider in cases of persistent burn shock despite early excision

Continuous veno-venous Hemofiltration (CVVH): In cases of difficult or failing resuscitations with persistent oliguria, CVVH should be started. Vascular access will be provided by the Burn/SCU team. Persistent Oliguria is defined as 2 or more hours with UOP <15 cc. IVF should be titrated down to a maintenance rate with Albumin or LR. Initial Goal CVVH fluid removal is 50-100cc hour. Goal MAP is 60mmHg.

Monitoring parameters:

Hemodynamic monitoring consists of continuous EKG, pulse oximetry, Q10min blood pressure monitoring and/or arterial line placement, and Foley catheter for urinary output and bladder pressure measurements. Urinary output is recorded hourly during the first 48 hours. **Analgesics and sedatives are provided with goal to keep an alert and calm patient.** Active ambient warming (heat shield, Bair hugger) of the patient and local environment is initiated to maintain a core body temperature of at least 37°C.

Acute burn resuscitation protocol

Adults with TBSA \geq 20%, children with TBSA \geq 15%

Nutrition:

Enteral nutrition should be started as soon as feasible after admission and at the latest by 6 hours. Since oral nutrition cannot achieve caloric goals in patients with challenging resuscitation, a feeding tube should be placed for gastric or postpyloric feeding and nutrition commenced.

Eye care:

All burn patients with $>$ 25% TBSA burns undergoing resuscitation should have ophthalmologic consultation.

Glucose control:

No intravenous dextrose is administered in adults the first 24 hours, except in patients with persistent serum glucose \leq 50 mg/dL. Treatment for hyperglycemia will be initiated for blood glucose \geq 180 mg/dL. Hyperglycemia is managed with continuous IV insulin infusion for a serum glucose goal $<$ 150 mg/dL.

Surgical management in first 24 hours:

Only surgical procedures approved by the attending physician should be permitted. These include establishment of a surgical airway, emergency amputations, decompression procedures for extremities and abdominal compartment syndromes, and long bone stabilization procedures. If feasible, surgical procedures should be performed at the bedside in order to avoid patient transport.

DIFFICULT AND FAILING RESUSCITATION MANEUVERS

Early Excision:

Historically, excision of burn wounds within 48 hours of injury was avoided. This was due to the risk of compounding burn shock with hemorrhagic shock. However, there are technical ways to avoid significant hemorrhage. The goal is to remove at least 50% of any full thickness burn wounds with the goal to remove as much as possible while avoiding position changes (i.e. proning). This procedure can be done in the ICU room, burn procedure room or the OR.

- **Subdermal Technique: A subdermal excision can be performed using a Bovie to quickly remove the full thickness of the skin without significant hemorrhage. The entire dissection is carried out in the subdermal plane.**

Acute burn resuscitation protocol
Adults with TBSA \geq 20%, children with TBSA \geq 15%

- **Tangential technique:** The Kline pump should be used to inject a mixture of 2mg epinephrine in 1L normosol or LR as tumescence in the subdermal plain to be excised. Using a Watson or Braithwaite knife, the burn wound can be excised with limited hemorrhage.
- **Hemostasis:** In both techniques epinephrine soaked telfas and laparotomy pads can be used. There will be almost no bleeding with the subdermal technique if care is taken to remain in the subdermal plane.
- **Coverage:** Cadaver allograft skin or porcine xenograft should be used to cover the excised wound beds to limit fluid loss and assist in temperature regulation. These can be secured with staples and/or Artiss (Fibrin sealant spray)

INHALATION INJURY

- Nebulized Heparin/Mucomyst (See pharmacy protocol)
- V-V ECMO