

ICU Fluid Resuscitation and Monitoring for Adult Patients with Severe Burns

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Monitoring	General Management	Initial Goals
<input type="checkbox"/> Intravascular arterial blood pressure	<input type="checkbox"/> HOB $\geq 30^\circ$	<input type="checkbox"/> Urine output minimum 30ml/h maximum 50ml/h
<input type="checkbox"/> CVC (preferably supradiaphragmatic)	<input type="checkbox"/> Gastric prophylaxis	<input type="checkbox"/> Temperature $\geq 37^\circ\text{C}$
<input type="checkbox"/> ScvO ₂ q3h X 24h then R/A	<input type="checkbox"/> DVT prophylaxis	<input type="checkbox"/> MAP $\geq 65\text{mmHg}$
<input type="checkbox"/> CVP as per ICU protocols	<input type="checkbox"/> Burn dressings as per Plastic Surgery	<input type="checkbox"/> ScvO ₂ $\geq 70\%$
<input type="checkbox"/> Lactate q3h X 24-72h	<input type="checkbox"/> Elevate all burned body parts when possible	<input type="checkbox"/> Lactate $\leq 4\text{mmol/L}$
<input type="checkbox"/> ABGs as per ICU protocols	<input type="checkbox"/> Start uninterrupted enteric feeds as early as possible (as per Dietitian) unless legitimate concern of splanchnic hypoperfusion or abdominal compartment syndrome	<input type="checkbox"/> Hgb $\geq 70\text{g/L}$
<input type="checkbox"/> Bladder pressures q6h from 12-72h post burn		<input type="checkbox"/> Plt ≥ 50 (Actively bleeding or imminently going to OR)
<input type="checkbox"/> Increase frequency if pressures $\geq 15\text{mmHg}$	<input type="checkbox"/> Fecal containment system for perineal burns as directed by ICU or Burn physician	<input type="checkbox"/> INR ≤ 1.5 (Actively bleeding or imminently going to OR)
<input type="checkbox"/> For facial burns or inhalational injury: - Consult Ophthalmology - Consider Bronchoscopy (if suspicion of inhalational injury)	<input type="checkbox"/> Attempt to minimize opioid infusion administration and utilize prn opioids as soon as feasible	
Initial Fluid Resuscitation		Recommendations for Hypotension
STEP 1	Calculate initial 24h resuscitation fluid requirements = (3ml of Ringers Lactate)(kg) (% TBSA from Plastics consult) / 24h. ½ of this IVF is administered in the first 8 hours (post burn) and the second ½ is delivered in the remaining 16 hours.	True hypotension MUST BE correlated with urine output. If MAP is consistently $\leq 65\text{mmHg}$ and there is evidence of poor end-organ perfusion (urine output $\leq 30\text{ml/hr}$, lactate $\geq 4\text{mmol/L}$, ScvO ₂ $\leq 70\%$) the following steps are recommended:
STEP 2	Determine the administered pre-hospital IVF volume, subtract this from your above calculation, and adjust your treatment appropriately.	I) Volume Status: If CVP $\leq 5\text{mmHg}$ or pulse pressure variation $\geq 15\text{mmHg}$ and patient is not breathing spontaneously, administer a fluid bolus of 0.5-1L RL in attempt to improve MAP (it is UNCOMMON to achieve CVP goals of 10-12mmHg in severe burn patients).
STEP 3	Monitor urine output hourly and decrease or increase the RL infusion by 20% to maintain urine output between 30-50ml/hr (50-100ml/hr for high-voltage electrical burns). Avoid boluses if possible. NOTE: Hour to hour fluid resuscitation is critical, particularly during first 24 hours. OVER-RESUSCITATION IS AS HARMFUL AS UNDER-RESUSCITATION.	II) Vasopressors: If MAP is persistently $\leq 65\text{mmHg}$ initiate Levophed at 1-20 ug/min to maintain MAP $\geq 65\text{mmHg}$ (massive burn patients commonly require Levophed 1-5 ug/min due to extensive vasodilatory shock secondary to the massive systemic inflammatory response associated with severe burns).
STEP 4	If urine output is $\leq 15\text{ml/hr}$ for two or more consecutive hours despite increasing fluid rate OR patient requires twice current calculated rate for more than two hours: CALL ICU FELLOW OR ATTENDING, flush urinary catheter, assess breath sounds and bladder pressure. Consider initiating 5% albumin infusion at 1/3 of current resuscitation rate and make up the remainder of rate with RL. Titrate rate as above based on urine output.	III) MAP Goal: If persistently requiring levophed (1-5ug/min) consider a MAP goal of $\geq 55\text{mmHg}$ as long as urine output $\geq 30\text{ml/hr}$, ScvO ₂ $\geq 70\%$ and lactate $\leq 4\text{mmol/L}$.
STEP 5	At 8 hours post burn, calculate the PROJECTED 24 hour resuscitation total if fluid rates are kept constant. If it exceeds 6 mL/kg % TBSA burn or 350 ml/kg total, the following steps are recommended. (Refer to the 8 hour assessment form)	IV) Ca ²⁺ and Cortisol (discuss with ICU fellow/attending before initiation of treatment) If patient exhibits catecholamine-resistant shock (defined as SBP $\leq 90\text{mmHg}$ after 1 hour of aggressive IVF and vasopressor administration), consider adrenal insufficiency (check a random cortisol and start hydrocortisone 100mg IV q8h) or hypocalcaemia (maintain ionized calcium $\geq 1.1\text{ mmol/L}$). (1-5)
	I) Initiate 5% albumin infusion at 1/3 of current resuscitation rate and make up the remainder of rate with RL. Titrate infusion to urine output as described above. After 24 hours post burn, titrate infusion down to maintenance and continue albumin until 48 hours post burn.	1. Azzopardi EA, McWilliams B, Iyer S, Whitaker IS. Fluid resuscitation in adults with severe burns at risk of secondary abdominal compartment syndrome—An evidence based systematic review. Burns. 2009 Nov 1;35(7):911-20.
	II) Watch for signs of Intra-Abdominal Hypertension (bladder pressure $\geq 15\text{mmHg}$, increased airway pressures, decreased urine output, hypotension) and extremity compartment syndromes (absent doppler signal or pulses that are diminishing on serial exams q30-60 minutes should prompt consideration of escharotomy)	2. Ennis JL, Chung KK, Renz EM, Barillo DJ, Albrecht MC, Jones JA, et al. Joint Theater Trauma System implementation of burn resuscitation guidelines improves outcomes in severely burned military casualties. J Trauma. 2008 Feb 1;64(2 Suppl):S146-51; discussion S51-2.
		3. Latenser BA. Critical care of the burn patient: the first 48 hours. Critical Care Medicine. 2009 Oct 1;37(10):2819-26.
		4. Saffle JIL. The phenomenon of “fluid creep” in acute burn resuscitation. J Burn Care Res. 2007 Jan 1;28(3):382-95.
		5. Cartotto R, Zhou A. Fluid creep: the pendulum hasn't swung back yet! J Burn Care Res. 2010 Jan 1;31(4):551-8.