

## SEPTIC SHOCK MANAGEMENT

### Sepsis backbone treatment:

- Appropriate and timely antimicrobial therapy
- Source control if indicated
- Fluid therapy with crystalloids – initial bolus of 30 mL/Kg followed by maintenance IVF with frequent reassessment
- Targeted vasopressors to keep MAP >65 mmHg and UO >0.5 mL/Kg/h

### IV Fluids:

Use balanced crystalloids LR or Plasmalyte-Normosol as maintenance IV fluids and boluses as needed to achieve MAP target 65 mm Hg and UO >0.5 mL/Kg/h

- Initial IV balanced crystalloids infusion at 125 -150 mL/h
- IV bolus at 30 mL/Kg if the patient becomes hypotensive (MAP <65 or SBP <90 mmHg)
  - In patients with large cumulative positive fluid balance consider albumin 5% 250 mL bolus as needed
  - In patients with large cumulative positive fluid balance AND peripheral edema-third spacing, consider albumin 25% 50 mL IV q6h

The target ordered volume must be ordered and initiated within the specified time frame if initial hypotension or septic shock is present per CMS mandate.

- An IV bolus less than 30 mL/kg of crystalloid IVF is acceptable for the target ordered volume if all of the following criteria were met:
  - There is a physician/APN/PA order for the lesser volume of crystalloid IVF as either a specific volume (e.g., 1500 mL) or a weight-based volume (e.g., 25 mL/kg).
  - The ordering physician/APN/PA documented within a single source (e.g., note or order) in the medical record all of the following:
    - The volume of fluids to be administered as either a specific volume (e.g., 1500 mL) or a weight-based volume (e.g., 25 mL/kg)
    - AND a reason for ordering a volume less than 30 mL/kg of crystalloid fluids.
      - Reasons for lesser IV volume include and are not limited to concern for:
        - Fluid overload
        - Heart failure
        - Renal failure
        - Blood pressure responded to lesser volume
- If a portion of the crystalloid IVF volume was administered as colloids, there must be an order and documentation that colloids were started or noted as given
- Physician/APN/PA can use ideal body weight (IBW) to determine the target ordered volume if all of the following conditions are met
  - Physician/APN/PA documents the patient is obese (defined as BMI >30)
  - Physician/APN/PA documents IBW is used to determine target ordered volume

### Vasopressors:

- Norepinephrine to titrate up to 35-90 µg/min to achieve MAP target 65 mm Hg
- Vasopressin 0.03 U/min if no response to norepinephrine at 30 µg/min. It can be increased to 0.04 U/min
- IV stress-dose steroids if no response to IVF and moderate to high-dose vasopressor therapy
  - IV hydrocortisone 200–300 mg/d as a continuous infusion or in divided doses or for 5–7 days with or without a taper
  - Fludrocortisone 50-µg enterally

- Epinephrine If MAP not at target as third agent up to 20-50 µg/min
- Phenylephrine If MAP not at target as fourth agent up to 200-300 µg/min
  - Usually not needed unless patient with atrial fibrillation

#### Miscellaneous:

- Consider femoral arterial line insertion
  - Radial arterial pressure waveforms often underestimate blood pressure in the context of severe hypovolemia and peripheral vasoconstriction.
- Consider lower the MAP target to 60 mmHg in patients older than 65 years especially if requiring high doses of multiple vasopressors

### REFRACTORY SHOCK

Refractory shock is defined as persistent organ dysfunction and evidence of tissue hypoperfusion (e.g., hyperlactatemia, metabolic acidosis, oliguria, delayed capillary refill) despite a normal or high central mixed venous O<sub>2</sub>Sat (ScvO<sub>2</sub>) and normal central venous-to-arterial carbon dioxide partial pressure (v-aPCO<sub>2</sub>).

- Normal ScvO<sub>2</sub> = 70-75%
- Normal v-aPCO<sub>2</sub> = 2-5 mmHg

Rationality for using the pCO<sub>2</sub> gap (v-aPCO<sub>2</sub>) as a marker of blood perfusion and mitochondrial dysfunction.

- CO<sub>2</sub> is the end product of aerobic metabolism
- pCO<sub>2</sub> in the venous blood reflects the global tissue blood flow relative to metabolic demand
- CO<sub>2</sub> is about 20 times more soluble than O<sub>2</sub> so diffuses more reliably out of ischemic tissues into the venous effluent making it a sensitive marker of hypoperfusion
- pCO<sub>2</sub> gap (v-aPCO<sub>2</sub>) >6 mmHg suggests a persistent shock state that may be amenable to fluid resuscitation +/- inotrope support

Refractory shock usually indicates a marked microcirculatory disorder and/or mitochondrial dysfunction poorly responsive to macrohemodynamic therapeutic manipulations. This situation is more commonly seen during septic shock.

- A v-aPCO<sub>2</sub> >6 mmHg identifies patients for whom an increase in CO may be beneficial in sustaining organ perfusion despite a ScvO<sub>2</sub>>70%.
- If the v-aPCO<sub>2</sub> is <6 mmHg it is unlikely that increasing CO would reverse organ hypoperfusion.

#### PCO<sub>2</sub> gap in different shock states (from Vallet et al (2013))

Shock type	Lactate	O <sub>2</sub> ER	ScvO <sub>2</sub>	cvaCO <sub>2</sub> gap
Cardiogenic or hypovolemic	HIGH	HIGH	LOW	HIGH
Anemic or hypoxemic	HIGH	HIGH	LOW	LOW
Distributive	HIGH	LOW	HIGH	HIGH
Cytopathic	HIGH	LOW	HIGH	LOW