APPROACH TO CIRCULATORY SHOCK IN THE ICU

Hypotension with normal or high stroke volume*

- Vasodilatory shock

1. Sepsis
2. SIR
3. Anaphylaxis

Treatment: IVF and vasopressors
Hypotension with low stroke volume* and low CVP

- Hypovolemic shock

Treatment: IVF
Hypotension with low stroke volume* and high CVP

- Cardiogenic shock

Treatment: Inopressors (norepinephrine, epinephrine, dopamine) and or inodilators (dobutamine, milrinone)

- Obstructive shock

1. PE
2. Pneumothorax
3. Cardiac tamponade

*Normal stroke volume: 1 ml/Kg/beat
*Normal stroke Volume Index: 33-47 mL/m2 /beat

APPROACH TO OLIGURIA IN THE ICU

Oliguria is most commonly defined as a urine output <0.5 ml/kg/h over a period of 6 h although different time periods have been described varying between 1 and 24 h.

Whether or not to give fluids and or vasopressors to an oliguric patient requires a careful integration of several elements, including the patient's history, hemodynamic parameters, fluid responsiveness, signs of hypovolemia or fluid overload, information on fluid losses and fluids balances and duration of oliguria.

Etiology of acute oliguria:

1. Stress Response: Neuro-hormonal response to stress with increased release of antidiuretic hormone unrelated to kidney perfusion or damage and with maintained glomerular filtration rate (GFR). Usually transient, commonly seen in the post-operative period.
2. Functional oliguria: Reversible renal hypoperfusion due to low cardiac output (hypovolemia or myocardial dysfunction) or due to vasoplegic hypotension (vasodilatory shock). The decrease in urine output is an adaptive response, in attempts to conserve volume. In this scenario, hemodynamic manipulation (increased MAP or cardiac output) could improve renal perfusion and increase the urine output.
3. Structural Oliguria: Established/ongoing renal damage resulting from ischemia and or inflammation. Further hemodynamic manipulation (increased MAP or cardiac output) won't help. In fact, giving more fluid may accelerate the development of volume overload and hasten the need for hemodialysis.
4.

Based on the above the potential interventions include:

- Do nothing and wait for the patient to improve.
- Perform a fluid challenge, see if this improves stroke volume and urine output.
- Perform a vasopressor challenge (e.g. raise the MAP, see if this improves urine output).
- Perform an inotrope challenge (e.g. administer dobutamine, see if this improves urine output).
- Perform a furosemide stress test.
- Kidney imaging studies to rule out obstruction and urinalysis (urine casts and proteinuria may indicate renal causes on oliguria).

Step wise approach

Step 1: Hemodynamic stabilization

Fluid challenge to assess fluid-responsiveness. A positive fluid responsiveness is defined when the administration of fluids will lead to a relevant increase of stroke volume >10% and if the kidney is also still fluid-responsive (urine output improvement indicating reversible hypoperfusion).

- If positive fluid responsiveness, give IVF

- If negative fluid responsiveness, consider vasopressor and or inotrope challenge depending on signs of vasoplegia or low cardiac output.

Step 2: Response to diuretics - furosemide stress test

If oliguria persists despite adequate blood pressure after resuscitation with IVF and inopressors if needed and no evidence of urinary tract obstruction, proceed with furosemide stress test.
Furosemide stress test is used when approaching a patient with oliguria to determine whether underlying renal function is intact. The test consists simply of administering a bolus of 1 mg/kg furosemide (if the patient is furosemide naive) or 1.5 mg/kg furosemide otherwise.

- If >200 ml urine is produced over the next two hours, then the patient has "passed" the furosemide stress test
- If <200 ml urine is produced, then the patient has "failed" the furosemide stress test – this predicts ongoing renal dysfunction which may require dialysis.

If the patient pass, indicates that tubular function is intact and short-term renal recovery is likely. In this situation, ongoing hemodynamic manipulation to improve renal perfusion and maintain urine output with IVF and vasopressors if needed, are likely beneficial.

If the patient fails, this predicts ongoing renal dysfunction and further attempts to improve the urine output are likely to be futile and potentially harmful. In this situation renal recovery may occur, but it will likely take days and patient may require dialysis. Basic hemodynamic support must be continued, but aggressive efforts to elicit increased urine output should be curtailed.