Utilizing Vasopressors: Critical Care Advances in the Emergency Department

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Disclosure

• I have no actual or potential conflict of interest in relation to this program/presentation.

• I have no relevant financial or nonfinancial relationships in the products or services described, reviewed, evaluated or compared in this presentation.

• I do not endorse specifically any test, treatment, or procedure mentioned on this presentation.
Objectives

• Review and recognize the types of shock and their presentations
• Discuss and understand the mechanisms of the commonly used vasopressors
• Identify when to use vasopressors to improve perfusion and oxygenation in the Emergency Department
Shock
Shock

• The PUMP
  • Oxygen delivery and utilization
    • Ventilation
    • Blood transfusions
    • Dobutamine
Shock

• The TANK
  • Volume status
    • IVF’s
      • 30 ml/kg in sepsis
Shock

• The PIPES
  • Vascular resistance, MAP
    • Norepinephrine
    • Epinephrine
    • phenylephedrine
Shock

• Shock causes cellular injury by:
  • Impairing tissue perfusion
  • Cellular hypoxia
  • Metabolic derangements

• Persistent hypoperfusion leads to irreversible tissue damage, progressive organ dysfunction, and can progress to death.
Shock may be caused by

• Primary decrease in CO (cardiogenic-obstructive shock)
• Low circulating blood volume (hypovolemic shock)
• Vasodilatation (distributive shock)
**Obstructive Shock**

- Myocardium contracts against high afterload.
- Back pressure leads to venous congestion.
- Despite normal BP, organs are poorly perfused due to a reduction in blood flow.
- Sympathetic over activity leads to vasoconstriction in order to maintain BP.

**Hypovolaemic Shock**

- Inadequate myocardial contractility.
- Despite normal BP, organs are poorly perfused due to a reduction in blood flow.
- Sympathetic over activity leads to vasoconstriction in order to maintain BP.

**Distributive Shock**

- With adequate fluid therapy, the heart usually compensates by increase rate and contractility, although this might not be enough.
- Vessels dilate causing relative hypovolaemia and a reduction in SVR.
- Changes above lead to a reduction in BP and organ perfusion.
- Capillary leak worsens hypovolaemia and causes oedema (including pulmonary).

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FEMC
Florida Emergency Medicine Clerkship
Shock

• Cardiogenic shock can be defined by
  • Intrinsic dysfunction
    • Myopathies, Infarction, Acute valvular dysfunction, or Arrhythmias
  • Extrinsic dysfunction caused by obstructive disorders
    • Pulmonary embolism, Constrictive pericarditis, Pericardial tamponade, or Tension pneumothorax
Shock

- Cardiogenic shock
  - Treating may require multiple agents
  - But despite appropriate inotropic and vasopressor support,
  - Mechanical assistance, intra-aortic balloon pump, or even cardiac transplant may be required.

Shock

• Hypovolemic shock can be defined as
  • Decreased circulating blood volume or total body volume resulting in a decreased preload that alters stroke volume and leads to a decreased CO.

• Hypovolemic shock can be caused by
  • Hemorrhage from trauma, aneurysm rupture, or gastrointestinal bleeding
  • Basic fluid loss caused by diarrhea, burns, or “third spacing.”

Shock

• Hypovolemic shock
  • Treated with volume resuscitation using isotonic crystalloid.
  • If hemorrhage was the cause of volume loss, give blood transfusion
  • If the blood pressure is dangerously low, it is reasonable to use vasopressors
  • Vasopressors are no substitute for adequate fluid resuscitation

Shock

• Distributive or vasodilatory shock
  • Results from vascular changes that lead to a decrease in vasomotor tone (vasodilation) and a loss of peripheral vascular resistance.
  • There are multiple causes of distributive shock
    • Septic shock
    • Anaphylaxis
    • Neurologic shock
Shock

- Septic shock
  - Most commonly seen in the ED.
  - Inflammatory mediators released by the body in response to an infection may have multiple deleterious effects that can lead to maldistribution of perfusion
    - Inappropriate vasoconstriction and vasodilation
    - Increased vascular permeability
    - Impaired cardiac contractility

Shock

- Septic shock
  - Volume resuscitation is the initial therapy in the resuscitation of patients with septic shock.
  - The inciting infection should be identified, with the early administration of antibiotics chosen according to expected pathogens.
  - Surgical removal of infected tissue may be necessary for localized infections. Inotropic and vasopressor support is often necessary.

Shock

• Anaphylaxis
  • Caused by an immediate-type hypersensitivity response to an allergen, provoking a severe, systemic inflammatory response.
  • This response leads to increased vascular permeability, with intravascular volume loss, decreased SVR, and impaired myocardial contractility.
  • Bronchospasm with increased resistance to airflow is common in anaphylaxis.
Shock

• Anaphylaxis

  • Epinephrine is the drug of choice in the treatment of anaphylactic shock due to its potent inotropic and vasopressor effects, as well as the ability to decrease bronchospasm.
Shock

- Neurogenic shock
  - Form of distributive shock, normally arises from injuries or damage to the cervical spinal cord.
  - A unique feature of neurogenic shock is that tachycardia in response to hypotension is uncommon.
Shock

• Neurogenic shock
  • Intravenous fluid is the first-line in therapy for neurogenic shock.
  • Vasopressor support may be required.
  • If bradycardia is present, dopamine or another vasopressor that will provide chronotropic (heart rate) stimulation as well as increased vascular resistance may be preferred.

Shock

• Vasoconstriction in the peripheral circulation is the normal response to conditions in which the arterial pressure is too low for adequate tissue perfusion, such as acute hemorrhagic or cardiogenic shock.

• In other conditions, hypotension occurs as a result of failure of the vascular smooth muscle to constrict.
Shock

• It is also important to note that vasodilatory shock is the final common pathway of prolonged and severe shock of any cause.

• Such so-called vasodilatory shock is characterized not only by hypotension due to peripheral vasodilatation but also by a poor response to therapy with vasopressor drugs.

### Table 1. Causes of Vasodilatory Shock.*

<table>
<thead>
<tr>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
</tr>
<tr>
<td>Inadequate tissue oxygenation</td>
</tr>
<tr>
<td>Nitrogen intoxication (hypoxic lactic acidosis)</td>
</tr>
<tr>
<td>Carbon monoxide intoxication</td>
</tr>
<tr>
<td>Prolonged and severe hypotension</td>
</tr>
<tr>
<td>Hemorrhagic shock</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
</tr>
<tr>
<td>Cardiopulmonary bypass</td>
</tr>
<tr>
<td>Shock with probable vasodilatation</td>
</tr>
<tr>
<td>Metformin intoxication</td>
</tr>
<tr>
<td>Some mitochondrial diseases</td>
</tr>
<tr>
<td>Cyanide poisoning</td>
</tr>
<tr>
<td>Cardiac arrest with pulseless electrical activity</td>
</tr>
</tbody>
</table>

*Anaphylaxis, liver failure, and glucocorticoid deficiency are sometimes listed among the causes of vasodilatory shock, but the data are inconclusive.
Shock

• MAP is derived from the product of systemic vascular resistance (SVR) and CO.

• SVR is governed by blood viscosity, vessel length, and the inverse of vessel diameter.

• SVR and CO are important clinical concepts that distinguish the different forms of shock.
Shock

• Consequently, any basic approach to hypotension should begin with an assessment of the patient’s volume status and CO.

  • Low CO states are clinically linked to a narrowed pulse pressure, a rising shock index, and a delayed capillary refill with cool peripheral extremities.

  • Widened pulse pressures with low diastolic pressures, bounding pulses, warm extremities, and normal capillary refill can be seen with increased CO states.

Shock

- Conditions that cause high output and low resistance are classically linked to inflammatory states.
  - Septic shock
  - Severe pancreatitis
  - Anaphylaxis
  - Burns
  - Liver failure
Shock

• Conditions with suspected hypoperfusion and clinical evidence of low CO, an assessment of cardiac volumes and global intravascular volume must be reassessed.
  • Hemorrhage (trauma, GI bleed)
  • Volume loss (diarrhea, vomiting)
<table>
<thead>
<tr>
<th>Shock Type</th>
<th>HR</th>
<th>SVR</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemic</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Distributive</td>
<td>↑</td>
<td>↓</td>
<td>↑ early; ↓ late</td>
</tr>
<tr>
<td>Cardiogenic</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Obstructive</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>
Management of shock

• The management of shock consists in correcting physiologic irregularity, perfusion deficits, and oxygen delivery
  • First focuses on identifying the underlying cause
  • Applying some combination of
    • Fluid resuscitation
    • Vasoconstrictors
    • Inotropic agents
    • Potentially vasodilators

Management of shock

• Clinically, this is achieved by improving
  • Blood pressure and CO through the optimization of preload
  • Augmentation of SVR
  • The increase of cardiac contractility.

Management of shock

- Vasopressor agents largely improve perfusion pressure and preserve regional distribution of CO through an increase in MAP above autoregulatory thresholds.
- Vasopressor agents may also improve cardiac preload and increase CO by decreasing venous compliance and augmenting venous return.
- Inotropes improve oxygen delivery and CO through an increase in rate and contractility.

Vasoactive drugs

• Vasoactive drug therapy is used to manipulate the relative distribution of blood flow and restore tissue perfusion.

• These agents are classically subdivided, based on their predominant pathway of activity, into two separate class types:
  • Vasopressors and inotropes.
Vasoactive drugs

• Vasopressors modulate vasoconstriction and thereby increase blood pressure
  • norepinephrine, vasopressin, metaraminol, vasopressin, methylene blue

• Inotropes increase cardiac performance and thereby improve cardiac output (CO).
  • milrinone, levosimendan
Vasoactive drugs

• Vasopressor and inotropic agents function primarily through stimulation of adrenergic receptors or through the induction of intracellular processes that mimic sympathetic end points (increased cAMP).

• Many of the drugs in use have varied effects because of their mixed receptor activity.
Vasoactive drugs

• Most of these act directly or indirectly on the sympathetic nervous system with effects that vary according to the strength of sympathetic receptor stimulus and affinity.
  • Direct-acting drugs operate by stimulating the sympathetic nervous system receptor
  • Indirect-acting drugs cause the release of norepinephrine, which produces the effect.
Vasoactive drugs

• Inodilators are agents with inotropic effects that also cause vasodilation leading to decreased systemic and/or pulmonary vascular resistance (SVR, PVR)
  • milrinone, levosimendan

• Some agents don’t fit these categories easily!
  • dopamine

• No inotropic agents have been shown to have superiority over any others in good quality trials.
# Vasoactive Medication Receptor Activity and Clinical Effects

<table>
<thead>
<tr>
<th>Drug</th>
<th>Alpha-1</th>
<th>Beta-1</th>
<th>Beta-2</th>
<th>Dopaminergic</th>
<th>Predominant Clinical Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Neosynephrine) Phenylephrine</td>
<td>***</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>SVR ↑ ↑, CO ↔/↑</td>
</tr>
<tr>
<td>(Levophed) Norepinephrine</td>
<td>***</td>
<td>**</td>
<td>0</td>
<td>0</td>
<td>SVR ↑ ↑, CO ↔/↑</td>
</tr>
<tr>
<td>(Adrenalin) Epinephrine</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>0</td>
<td>CO ↑ ↑, SVR ↓ (low dose) SVR/↑ (higher dose)</td>
</tr>
</tbody>
</table>

**Dopamine (mcg/kg/min)**

<table>
<thead>
<tr>
<th>Dose</th>
<th>Alpha-1</th>
<th>Beta-1</th>
<th>Beta-2</th>
<th>Dopaminergic</th>
<th>Predominant Clinical Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to 2</td>
<td>0</td>
<td>*</td>
<td>0</td>
<td>**</td>
<td>CO</td>
</tr>
<tr>
<td>5 to 10</td>
<td>*</td>
<td>**</td>
<td>0</td>
<td>**</td>
<td>CO ↑, SVR ↑</td>
</tr>
<tr>
<td>10 to 20</td>
<td>**</td>
<td>**</td>
<td>0</td>
<td>**</td>
<td>SVR ↑ ↑</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug</th>
<th>Alpha-1</th>
<th>Beta-1</th>
<th>Beta-2</th>
<th>Dopaminergic</th>
<th>Predominant Clinical Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobutamine</td>
<td>0/*</td>
<td>***</td>
<td>**</td>
<td>0</td>
<td>CO ↑, SVR ↓</td>
</tr>
<tr>
<td>Isoproterenol</td>
<td>0</td>
<td>***</td>
<td>***</td>
<td>0</td>
<td>CO ↑, SVR ↓</td>
</tr>
</tbody>
</table>

*** Very Strong Effect, ** Moderate effect, * Weak effect, 0 No effect.
<table>
<thead>
<tr>
<th>Agent</th>
<th>Receptor Agonist Activity*</th>
<th>Initial Dose</th>
<th>Onset</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>α</td>
<td>β₁</td>
<td>β₂</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>+++</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>+++</td>
<td>+++</td>
<td>−</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Dopamine</td>
<td>++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dobutamine</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isoproterenol</td>
<td>−</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

* Receptor activity may be dose dependent
<table>
<thead>
<tr>
<th>Receptor</th>
<th>Location</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alpha-1 Adrenergic</strong></td>
<td>Vascular wall</td>
<td>Vasoconstriction</td>
</tr>
<tr>
<td></td>
<td>Heart</td>
<td>Increase duration of contraction without</td>
</tr>
<tr>
<td></td>
<td></td>
<td>increased chronotropy</td>
</tr>
<tr>
<td><strong>Beta Adrenergic</strong></td>
<td><strong>Beta-1</strong></td>
<td>Heart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑Inotropy and chronotropy</td>
</tr>
<tr>
<td></td>
<td><strong>Beta-2</strong></td>
<td>Blood vessels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vasodilation</td>
</tr>
<tr>
<td><strong>Dopamine</strong></td>
<td>Renal</td>
<td>Vasodilation</td>
</tr>
<tr>
<td></td>
<td>Splanchnic (mesenteric)</td>
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</tr>
<tr>
<td></td>
<td>Coronary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cerebral</td>
<td></td>
</tr>
<tr>
<td><strong>Subtype</strong></td>
<td></td>
<td>Vasoconstriction</td>
</tr>
</tbody>
</table>
Effect on Blood Pressure

PE  NE  Dopa  Epi  Dobut  Dopex  Iso

Effect on cardiac output

α

β

Hollenberg Crit Care Clin 2009
Figure 1. Algorithm For The Assessment and Treatment Of Hypotension

Hypotensive patient defined as: Systolic BP 90 mm Hg, MAP 80 mm Hg, or decrease in baseline BP (MAP) > 20% or 40 mm Hg.

Signs and symptoms of impaired tissue perfusion (no physical exam, diagnostic testing, or invasive blood pressure monitoring) means shock, and aggressive treatment is necessary.

Initial evaluation of the patient includes: device support if necessary, immediate measurement of obvious causes of hypotension (e.g., blood loss, bleeding trauma, etc. and ACS protocol for electrolytes or ABG). Otherwise, some key physical exam findings (e.g., JVD and lung sounds) can help direct further diagnosis and management of hypotension in the patient.

Diagnosis to Rule Out Hypovolemia: Distribution shock:
- Sepsis
- Acute kidney injury
- Myocardial infarction

Initial treatment of non-cardiogenic hypotension is FLUID RESUSCITATION.

Administer at least 20-60 mL/kg (typical 0.5-1.0 L) of crystalloid solution as a first line challenge. “Maintenance” rates are not adequate. Crystalloid solution is equal to or below in terms of outcome and significantly less expensive.

Monitor for adequate CVP (right atrial pressure) at least 8-12 cm H2O, to a sign of adequate fluid resuscitation. JVD observation, hexobarbital or direct central venous pressure monitoring may be utilized. (Class I)

If CVP is adequate, use premon as indicated by underlying pathology.

If CVP is inadequate, continue to administer IV crystalloid to an adequate CVP. Consider use of pressors to “bridge the gap” until full fluid resuscitation is achieved.

In a bleeding patient, consider early administration of packed red blood cells along with aggressive limited use of crystalloid solution to avoid potential tissue hypoxia and overexpansion.

Step One: Is JVD and/or evidence of increased CVP present?

Vasopressor support may be acceptable for sepsis/hypovolemia. Administration of these drugs, in concert with various methods to improve systemic oxygenation (e.g., respiratory support) may improve systemic oxygenation. Doppler ultrasonography can improve vascular access and reduce patient discomfort with smaller (Class I)

Non-pharmacologic B-12 IV Epo 5 mg over 30 minutes and titrate to desired. BP can be titrated to a 3-4 mm Hg increase when BP goal achieved. (Class IIa)

Desmopressin 10-20 mg/kg and titrate to 0.5-10 mg/kg/min. (Class IIa) Consider more severely dehydrated and morbid obese patients due to lower “max dose” receptor activity than non-pharmacologic. “Bentimul” dopamine (i.e., vasoactive renal function) is no longer recommended (Class IIa)

Early goal-directed therapy:
- Endotetrazolim
- Consider if/pharmacologic vasopressors: Norepinephrine (Class A)

Vasoactive drugs (norepinephrine) should be continued to maintain urine output (Class B)

Vasopressors (10-50 mcg/min) may allow other vasopressors agents to be titrated down. (Class B)

In septic patient: STEEL Hypotension

= Endotetrazolim

Treatment for decreased cardiac function (may occur in later stages of other types of shock)

Consider OBSTRUCTIVE etiology and treat accordingly, the use of bedside echocardiography is particularly useful in diagnosis.

- Tension pneumothorax (Class IIb)
- Massive pulmonary emboli (Class III)
- Cardiac tamponade (Class I)
- Massive hilar or right ventricular infarct (Class I)

Post-infarction hypotension due to high intracranial pressure and decreased cardiac return

Doppler

Doppler

Doppler
<table>
<thead>
<tr>
<th>Pressor</th>
<th>Indications</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Dopamine   | • Dopamine is FDA indicated for all forms of shock and for treatment of decreased cardiac output  
• Poor cardiac function with poor perfusion  
• Post arrest hypotension/myocardial stunning | • Effective at multiple receptors  
• Graded, dose-dependent receptor activity (not all or nothing)  
• Titrated to patient specific responses and hemodynamic monitoring | • “Dopaminergic” doses may improve urine output but do not improve renal function and generally are not helpful in addressing hypotension  
• May be arrhythmogenic at higher “alpha” doses  
• High doses may compromise urine output (consider use with dobutamine) |
| Norepinephrine | • Septic shock due to low SVR  
• Can be used in anaphylactic shock | Excellent at increasing systemic vascular resistance (SVR) | Increased risk of dysrhythmias and myocardial ischemia; increased oxygen consumption; may decrease intestinal perfusion and increase lactate levels |
| Phenylephrine | FDA indicated for use in hypotension | Good choice if tachycardia/arrhythmia limiting use | No effect on cardiac output |
| Dobutamine | • FDA indicated for decreased cardiac output and CHF  
• Best if used when there are signs/symptoms of shock without severe hypotension (< 90 mmHg) | • Inotropic agent: increases cardiac output  
• Good for congestive heart failure without hypotension | Can decrease SVR; may provoke hypotension. Potential solution: add dopamine or epinephrine to increase SVR OR consider switching to another class of inotropic agents, such as phosphodiesterase inhibitor (e.g., milrinone and amrinone) |
| Epinephrine | • FDA indicated for use in anaphylactic shock  
• Intravenous form is FDA indicated for cardiac arrest | Does not require volume resuscitation prior to use (for the purely anaphylactic cause of shock) | Increased risk of dysrhythmias and myocardial ischemia. |
| Vasopressin | Consider in septic shock refractory to volume expansion and first line catecholamines | May decrease amount of other vasopressors needed | • Not a first line agent  
• Delayed onset of action  
• Its use in septic shock and for cardiac arrest are off-label |
<table>
<thead>
<tr>
<th>Clinical Application</th>
<th>1st Line Agent</th>
<th>2nd Line Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Shock</td>
<td>Norepinephrine (Levophed)</td>
<td>Vasopressin</td>
</tr>
<tr>
<td></td>
<td>Phenylephrine (Neosynephrine)</td>
<td>Epinephrine (Adrenalin)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>Dobutamine</td>
<td>Milrinone</td>
</tr>
<tr>
<td>Cardiogenic Shock</td>
<td>Norepinephrine (Levophed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dobutamine</td>
<td></td>
</tr>
<tr>
<td>Anaphylactic Shock</td>
<td>Epinephrine (Adrenalin)</td>
<td>Vasopressin</td>
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<tr>
<td>Neurogenic Shock</td>
<td>Dopamine</td>
<td>Phenylephrine (Neosynephrine)</td>
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<tr>
<td>Hypotension</td>
<td>Anesthesia-induced</td>
<td></td>
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<tr>
<td></td>
<td>Phenylephrine (Neosynephrine)</td>
<td></td>
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<tr>
<td>Following CABG</td>
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</tr>
<tr>
<td></td>
<td>Epinephrine (Adrenalin)</td>
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</tr>
</tbody>
</table>
Case 1

- 72 year-old woman with DM type II, hypertension and Stage II CKD is transferred from a Skilled Nursing Facility for altered mental status. Her vitals upon arrival are as follows: Temp 101F, BP 70/45, Hr 140, RR 20, O2 Sat 95% RA. Pertinent lab findings: WBC 21, Cr 3.5, Lactic Acid 3.4, Positive UA.

- After adequate IVF resuscitation, pt continues to remain hypotensive BP 60-70s/30-40s and tachycardic Hr 130s. What is the most appropriate 1st line vasopressor/inotropic agent?

A. Epinephrine (Adrenalin)
B. Dobutamine
C. Norepinephrine (Levophed)
D. Dopamine
Pathophysiology

• Septic Shock: results in a ↓ SVR and a systemic inflammatory response syndrome with diffuse capillary leak

• Cardiac Output: typically elevated, but may be depressed in some cases
Treatment

• Vital Signs: inadequate endpoints in determining a response to resuscitation efforts in sepsis
• Lactate Measurements: serial will guide ongoing resuscitation efforts
Treatment

• Epinephrine in Septic Shock:
  • Comparison Between Epinephrine and Norepinephrine: prospective, double blinded, randomized trial of 280 patients in shock compared epinephrine and norepinephrine for the ability to reach MABP goals
  • No Difference: in ability to reach MABP goals or 28-day or 90-day mortality between groups

Intensive Care Med 2008 34:2226-2234
Treatment

• Epinephrine in Septic Shock:
  • Comparison Between Epinephrine alone versus Norepinephrine and Dobutamine: prospective, multicenter, double blinded, randomized trial of 330 patients in septic shock compared epinephrine and norepinephrine for efficacy and safety
  • No Difference: in 28-day all cause mortality, no difference in time to hemodynamic success or time to vasopressor withdrawal

Lancet 2007 370:676-684
• No Difference: Currently EBM supports Norepinephrine over Dopamine; and equivalent to Epinephrine

• Assess Volume: Utilize Ultrasound, arterial wave form analysis or pulse pressure variation to determine intravascular volume

• Dobutamine Care: vasodilator properties of Dobutamine may reduce MABP
Case 2

- 64 year-old man with PMH significant for CAD s/p MI and PCI (2004; drug-eluting stents), ischemic cardiomyopathy (EF 20-25%) with AICD (2007), who presents to ED with 1 week history of progressively worsening shortness of breath, orthopnea and bilateral lower extremity edema, and chest pain after running out of all medications about 10 days ago.

- In ED, vitals: Temp 99F, BP 75/48, Hr 75, RR 25, O2 Sat 91% on RA. CXR reveals vascular congestion and bilateral pleural effusion. Bedside ultrasound reveals significantly diminished EF. EKG reveals new Q waves in leads v1-v5.

- What is the most appropriate 1st line vasopressor/inotropic agent?

  A. Epinephrine (Adrenalin)
  B. Dobutamine
  C. Norepinephrine (Levophed)
  D. Dopamine
Pathophysiology

- Primary Pump Failure
  - Decreased Contractility: acute coronary syndrome related ischemia
- Limited Cardiac Output
- Reduced Coronary Perfusion pressure with reduced MABP
- Increased Heart Rate corresponds to raised myocardial oxygen demand
Treatment

• First Line Therapy: Dobutamine with or without Norepinephrine
• Dopamine and Epinephrine: are 2nd and 3rd line agents
• Phosphodiesterase Inhibitors: have long half lives that limits their utility in acute settings (milrinone)
• Phenylephrine: offers pure alpha stimulation that can cause ↑afterload without improved contractility, resulting in reflex bradycardia
Case 3

56 year-old obese man with PMH significant for COPD and OSA, who was initially admitted to the medicine floor for acute COPD exacerbation secondary to community-acquired pneumonia, was found to be in acute respiratory failure.

Versed and Succinylcholine were given for emergent intubation. Vitals after intubation are as follows: Temp 99.8F, BP 74/48, Hr 74. What is the most appropriate 1st line vasopressor/inotropic agent?

A. Phenylephrine (Neosynephrine)
B. Dobutamine
C. Norepinephrine (Levophed)
D. Dopamine
Case 4

• A 19 y/o man has sustained a high c-spine injury at C-2 due to a trampoline accident. His neurological injury is complete at the C-2 / C-3 level and he is intubated.

• Vital Signs: Temp 97.8F, BP 78/50, HR 62, RR 18

• He has been given 4 L of NS and his BP has not responded.

• What are the options for vaso-active agents in the treatment of spinal shock?
  a. Milrinone  
  b. Dobutamine  
  c. Phenylephrine  
  d. Dopamine
Pathophysiology

• Hypotension of Spinal Shock: due to the loss of sympathetic tone of the heart and vasculature.
• Resultant Bradycardia & ↓ SVR: may further exacerbate cord injury—the penumbra is at risk.
Treatment

• Maximizing MABP with fluids and Dopamine offers the best choice for improvement in neurological outcome without adverse events.

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In Summary......

• We reviewed the types of shock and their pathophysiology
• We identified the mechanisms that the different vasopressors can help us in treating shock
• Now, we can choose what will be the better vasopressor depending the type of shock
Questions?