Management of Shock

Educational Reinforcement Material

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Pre-Test Questions

1) Why is the initial blood pressure goal >65 mm Hg?
    a. Because it is a nice round number
    b. Dogs overall did better in a study
    c. A large study showed that patients had significant renal and myocardial injury when higher than 65 mm Hg
    d. A large study showed that it is more harmful to the kidney and cardiac muscle when higher than 70 mm Hg
2) What is the main goal in treating septic shock?
    a. To get the MAP greater than 65 mm Hg
    b. To perfuse the brain, and cardiac muscle
    c. To allow / facilitate with antibiotic circulation
    d. To have a balance between perfusing organs and cellular death
3) Why is lactate produced during shock?
    a. Purely due to anaerobic metabolism of pyruvate to lactate from cell hypoxia
    b. Combination of anaerobic metabolism and epinephrine cause glycolysis
    c. Krebs cycle malfunction due to ischemia
    d. Mitochondrial increased demand from glycogen to glucose and glycolysis from beta 2 stimulation
4) What is the equation for cardiac output?
    a. Heart rate x Stroke Volume
    b. (Preload – after load) X contractility
    c. Stroke volume – peripheral vascular resistance
    d. LOVT area X LVOT velocity
5) What is the calculation of oxygen delivery?
    a. Heart rate x stroke volume x (1/ hematocrit)
    b. [(1.32 x hemoglobin x SaO_2) x cardiac output] + (0.003 X PaO_2)
    c. [cardiac output x (1/ hematocrit) X (SVR)] - (0.003 X PaO_2)
    d. [(1.5 x hemoglobin x SaO_2) x heart rate x (PVR-SVR)] + (0.03 X PaO_2)
6) What are signs of poor perfusion?
    a. Mental status change, increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time
    b. Mental status change, increase in lactic acid, increase in urine output, decreased capillary refill time, hemoconcentration
    c. Decrease in urine output, decreased capillary refill time, mottled extremities
    d. Mottled extremities increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time
7) Which medications are pure vasopressors?
    a. Phenylephrine, vasopressin
    b. Norepinephrine, vasopressin, epinephrine
    c. Epinephrine, phenylephrine
    d. Norepinephrine, and epinephrine
8) What does inotropic mean?
    a. Increase heart rate
    b. Increase diastolic filling time
    c. Increase contractility
    d. Increase conduction velocity
9) What does chronotropic mean?
    a. Increase heart rate
    b. Increase diastolic filling time
    c. Increase contractility
    d. Increase conduction velocity
10) What does inopressor mean?
    a. increases heart rate and causes arterial vasoconstriction
    b. increases cardiac contractility and induces vasoconstriction

c. induces venous vasoconstriction and arterial vasodilation
d. increases cardiac contractility and induces vasodilation

11) Which medications are inopressors?
a. Phenylephrine, vasopressin
b. Norepinephrine, dobutamine, epinephrine
c. Epinephrine, dopamine
d. Norepinephrine, epinephrine, dopamine

12) What does inodilator mean?
a. increases heart rate and causes arterial vasoconstriction
b. increases cardiac contractility and induces vasoconstriction
c. induces venous vasoconstriction and arterial vasodilation
d. increases cardiac contractility and induces vasodilation

13) Which medications are inodilators?
a. Dobutamine, milrinone, dopamine
b. Milrinone, dobutamine, epinephrine
c. Epinephrine, dopamine, milrinone
d. isoproterenol, dobutamine, milrinone

14) Vasopressin works on which receptors?
a. V1 only
b. V1 at low doses and then V2>V1 at high doses
c. V2 at low doses and then V1>V2 at high doses
d. V1 and V2
e. V2 only

15) What receptor causes free water reabsorption in the kidney?
a. V1
b. V2
c. V1 and V2

16) Which receptor causes smooth muscle vasoconstriction?
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

17) Which receptor causes increased chronotropy and inotropy?
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

18) Which receptor causes bronchodilation?
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

19) What is vasopressin?
a. A catecholamine
b. A combination of a catecholamine and hormone
c. A hormone

20) What receptor(s) are activated by norepinephrine?
    a. Alpha 1
    b. Beta 1
    c. Alpha 1 + Beta 1
    d. Alpha 1 + Beta 2
    e. Beta 1 + Beta 2
21) Activation of this/these receptor(s) by norepinephrine can cause arrythmias?
    a. Alpha 1
    b. Beta 1
    c. Alpha 1 + Beta 1
    d. Alpha 1 + Beta 2
    e. Beta 1 + Beta 2
22) Activation of this receptor is important in septic and obstructive shock by norepinephrine due to increased _____?
    a. Alpha 1 – vasoconstriction
    b. Beta 1- increased inotropy
    c. Beta 2- bronchodilation
    d. Alpha 2- vasodilation
23) Which is better for cardiogenic shock: norepinephrine vs dopamine?
    a. Norepinephrine
    b. Dopamine
24) At low doses, what receptor(s) are activated by epinephrine?
    a. Alpha 1
    b. Beta 1
    c. Alpha 1 + Beta 1
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25) What was the major unwanted effect by epinephrine in the SOAP II trial?
    a. Tachycardia
    b. Ischemia
    c. Hyperglycemia
    d. Hyperthermia
26) Which drug is best in pediatric septic shock?
    a. Vasopressin
    b. Epinephrine
    c. Norepinephrine
    d. Phenylephrine
27) Which drug is best with anaphylactic shock?
    a. Vasopressin
    b. Epinephrine
    c. Norepinephrine
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28) At 1 mg dose or greater, what receptor is more activated by epinephrine (alpha or beta) and which is more harmful?
    a. Alpha 1 > Beta 1; Alpha 1
    b. Alpha 1 > Beta 1; Beta 1
    c. Alpha 1 < Beta 1; Alpha 1
    d. Alpha 1 < Beta 1; Beta 1
29) Which pressor is more known to be the most arrhythmogenic?
    a. Dopamine
    b. Epinephrine
    c. Norepinephrine
    d. Phenylephrine
    e. Dobutamine

30) At 5-10 mcg/kg/min, what receptor(s) are primarily activated by dopamine?
    a. Alpha 1
    b. Beta 1
    c. Alpha 1 + Beta 1
    d. Alpha 1 + Beta 2
    e. Beta 1 + Beta 2
31) At >10 mcg/kg/min, what receptor(s) are more activated by dopamine?
    a. Alpha 1 = Beta 1
    b. Alpha 1 > Beta 1
    c. Alpha 1 < Beta 2
    d. Beta 1 > Beta 2
    e. Beta 1 < Beta 2
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    b. Beta 1
    c. Alpha 1 + Beta 1
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33) In which situation would phenylephrine be harmful to the patient?
    a. Adult septic shock
    b. Pediatric septic shock
    c. Hemorrhagic shock
    d. Cardiogenic shock
34) Why is phenylephrine harmful in right heart failure?
    a. Increased pulmonary vascular resistance
    b. Increased cardiac preload due to venous vasoconstriction
    c. Reflex bradycardia
    d. All of the above
    e. None of the above
35) What is the dosage of push dose phenylephrine that should be administered to a patient?
    a. 100-300 mcg every 5-10 minutes
    b. 100-200 mcg every 5-10 minutes
    c. 80-200 mcg every 2- 4 minutes
    d. 150-200 mcg every 2-4 minutes
36) What is the onset of push dose phenylephrine?
    a. 30 seconds
    b. 2 minutes
    c. 10 seconds
    d. 1 minute
37) What is the dosage of push dose epinephrine that should be administered to a patient?
    a. 5-10 mcg every 5-10 minutes
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38) What is the duration of push dose epinephrine?
    a. 5-10 minutes
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    d. 1-2 minute
39) Where does dobutamine work?
    a. Alpha 1
    b. Beta 1
    c. Alpha 1 + Beta 1
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    e. Beta 1 + Beta 2
40) Where do you mainly want dobutamine to work in cardiogenic shock?

a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2

41) Can you use dobutamine a as first line agent in septic shock?
a. Yes
b. No

42) Which medication is a phosphodiesterase 3 inhibitor?
a. Dobutamine
b. Norepinephrine
c. Milrinone
d. Selepressin

43) What is lusitropy?
a. Increased ventricular filling
b. Contraction of the ventricles
c. Increased heart rate
d. Diastolic relaxation

44) Are arrhythmias common with milrinone?
a. Yes
b. No

45) Why is milrinone good in obstructive shock?
a. Decrease preload
b. Decreased pulmonary vascular resistance
c. Bronchodilator
d. Decreased afterload

46) Which drug is a hormone?
a. Milrinone
b. Dobutamine
c. Norepinephrine
d. Vasopressin

47) How does vasopressin cause vasodilation?
a. Inhibits nitric oxide production
b. Activates beta 2
c. Inhibits alpha 1
d. Activates alpha 1

48) How does vasopressin help a patient with a pulmonary embolism?
a. Decrease preload, decrease cardiac afterload
b. Restore mean arterial blood pressure, decrease pulmonary vascular resistance
c. Decrease cardiac afterload, decrease pulmonary vascular resistance
d. Decrease preload, restore mean arterial blood pressure

49) What is a feature of vasopressin?
a. Increases sensitivity to catecholamines
b. Increases sensitivity to endogenous vasopressin
c. Doesn't work very much on V2 receptors in the kidney during shock
d. Tolerated better than norepinephrine in liver patients

Manuel with Blanks

Mean Arterial Blood Pressure

Why a mean arterial blood pressure of 65 mm Hg?

- After MAP <65 start to have an increase in _____ and _____

Save the Map-

- CNS: Stroke, cord injury, paralysis
- CVS: MI, ischemic extremities
- Respiratory: ARDS, pulmonary edema
- Renal: Acute kidney Injury, acute tubular necrosis
- Metabolic: Acidosis, lactate production
- Hepatic: Coagulopathy, platelet dysfunction, hypoalbuminemia
- GI: Pancreatitis, ischemic bowel, bacterial translocation, acalculous cholecystitis

Goals of Shock

The goal of shock is to _____. How to determine this at the microcirculation level is the question? At this time all we can do is provide optimal MAP.

Organs have critical perfusion pressures:

- Cerebral perfusion pressure 50-70 mm Hg
- Coronary perfusion pressure _____ mm Hg
- Renal Perfusion Pressure 65-70 mm Hg

Optimize hemodynamics: _____= stroke volume X heart rate

- Stroke volume is determined by: _____, _____, and _____

Balance perfusion to vital organs and prevent ischemia to non-vital organs (i.e. gut ischemia)

Signs of poor perfusion

- Mental status
- Capillary refill
- Urine output
- Mottles extremities
- Lactate?

Epidemiology of Shock (SOAP II)

- Obstructive shock (2%)
- Hypovolemic shock (16%)
- Cardiogenic shock (16%)
- Distributive shock (66%)
  - Septic (62%) – most common shock in the ICU
  - Non-septic (4%)

Warm shock

Distributive shock

- Septic 62%
- Non-septic: 4%of shock

Cold shock

1. Obstructive Shock 2%
2. Hypovolemic Shock 16%
3. Cardiogenic Shock 16%

Terminology 0657

Vasopressor:

- Induce _____
- Phenylephrine, Vasopressin, Angiotensin II, Selepresin

Inotrope:

- Increase _____

Inopressor:

- Induce _____ and increase _____
- Norepinephrine, Dopamine, Epinephrine

Inodilator:

- Increase _____ and cause _____
- Dubutamine, Milrinone, Levosimendan, isoproterenol

Receptors 09:09

Alpha 1: _____

Beta 1: Chronotropy = _____ and Inotropy = _____

Beta 2: _____ and _____

V2: (+) ADH in the kidney and _____ free water absorption

Angiotensin II: (+) aldosterone and _____

Norepinephrine

- Mechanism of action
  - _____vasoconstriction

- _____: increase heart rate (chronotropic) + increase contractility (Ionotropic) = Small BUT significant
  - beta 1 effect possibly causing arrhythmias
- increased _____
- _____: improve venous return

× Uses
- Septic shock, forms of obstructive shock, cardiogenic shock

× Doses
- Starting: _____ mcg/kg/min
- Range: 0.05mcg/kg/min – 1 mcg/kg/min

Epinephrine

× Mechanism of action
- _____: vasoconstriction
- _____: increase heart rate (chronotropic) + increase contractility (Ionotropic)
- _____: Bronchodilation and vasodilation
- Metabolizes _____to lactate via non-aerobic pathway
- insulin resistance and _____

× Uses
- Pediatric septic shock
- Adult septic shock
- Cardiogenic shock (especially with bradycardia)
- Anaphylactic shock
- Cardiac arrest

× Doses
- High doses (1 mg)=> want _____ effects; _____ harmful
- <0.2 mcg/kg/min → primarily _____ effects (inotrope)
  - e.g. hypotension related to bradycardia, cardiogenic shock
- >0.2 mcg/kg/min → 05:49 _____ > _____ (vasoconstriction + iontrope)

Dopamine

× Mechanism of action
- _____: vasoconstriction
- _____: increase heart rate (chronotropic) + increase contractility (Ionotropic)

× Uses
- Cardiogenic shock: especially with bradycardia
- Previously used in pediatric septic shock (now epinephrine is preferred)

× Doses
- 0.5-5 mcg/kg/min→ D1/D2 receptors (coronary, cerebral, renal and splanchnic vasodilation)
- 5-10 mcg/kg/min → primary Beta 1 (ionotropic)
- >10 mcg/kg/min → Alpha > Beta (vasoconstriction + ionotropic)

× _____

Phenylephrine

× Mechanism of action
- _____: vasoconstriction ONLY

× Possible reflex bradycardia

× Uses
- Sepsis, Refractory vasoplegia
- Note: can increase both systemic and pulmonary vascular resistance = BAD w/ cardiogenic shock +/- right heart failure

- Dose
  - 50 mcg/min to 300 mcg/min

Push Dose Pressors

Phenylephrine

- Pre-made syringe where each ml contains 100 mcg of phenylephrine
- Vial Contains 10 mg/ml→
  - Draw up 1 ml (10 mg) of phenylephrine from the vial and inject 1 ml into a 100 ml bag of normal saline so each 1 ml =100 mcg
  - Draw up 2 ml (20 mg) of phenylephrine from the vial and inject 2 ml into a 250 ml bag of normal saline so each 1 ml =80 mcg
- Pharmacokinetics
  - Onset: 1 minute
  - Duration: 10-20 minutes
  - Push Dose: 1-2 ml (80-200 mcg) every 2-4 minutes

Epinephrine

- Both alpha and beta= _____
- NEVER give 1 mg of epinephrine to someone with a pulse
- Ampule contains 100 mcg/ml
  - Take a 10 ml syringe of normal saline and get rid of 1 ml => 9 ml of normal saline + draw up 1 ml of epinephrine so each ml = 10 mcg
- Pharmacokinetics
  - Onset: 1 minute
  - Duration: 5-10 minutes
  - Push Dose: 1-2 ml (10-20 mcg) every 2-5 minutes

Dobutamine

- Mechanism of Action
  - _____: increase heart rate (chronotropic) + increase contractility (Ionotropic)
  - _____: bronchodilation
- Uses
  - Cardiogenic Shock- mainly want the _____ effect for contractility
  - Septic Shock- not primary agent, but 2nd or 3rd agent where they need cardiogenic support
  - Obstructive shock (RV failure in the setting of a massive PE)
- Doses: 2.5-20 mcg/kg/min
- Caution: _____

Milrinone

- Mechanism of Action
  - _____ (prevents degradation of cAMP
  - Increases lusitropy (diastolic relaxation)
    - Allows for a larger filling volume
  - Increases _____
  - Can increase _____
    - which means arrhythmias are possible, but are much less common
  - _____- decreases systemic vascular resistance and peripheral vascular resistance
- Uses

- Cardiogenic shock
- Obstructive shock (RV failure in the setting of massive PE)
- Cardiac surgery

× Doses
- 0.25 – 0.75 mcg/kg/min (renally cleared)

Vasopressin

× Mechanism of action
- _____: Vasoconstriction
  - Good for refractory vasoplegia
  - Works by inhibiting nitric oxide production (potent vasodilator)
- _____: Free water reabsorption
  - Can lead to pulmonary edema

× Non-catecholamine, and can increase _____ to catecholamine

× _____ : not pH sensitivity in the setting of acidemia

× Uses
- Septic Shock
- Pulmonary Embolism
  - _____: Restore mean arterial blood pressure
  - _____ pulmonary vascular resistance

× Doses
- 0.03 units/min

Post Test Questions

1) Why is the initial blood pressure goal >65 mm Hg?
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   a. Heart rate x Stroke Volume
   b. (Preload – after load) X contractility
   c. Stroke volume – peripheral vascular resistance
   d. LOVT area X LVOT velocity
5) What is the calculation of oxygen delivery?
   a. Heart rate x stroke volume x (1/ hematocrit)
   b. [(1.32 x hemoglobin x SaO_2) x cardiac output] + (0.003 X PaO_2)
   c. [cardiac output x (1/ hematocrit) X (SVR)] - (0.003 X PaO_2)
   d. [(1.5 x hemoglobin x SaO_2) x heart rate x (PVR-SVR)] + (0.03 X PaO_2)
6) What are signs of poor perfusion? I-0442
   a. Mental status change, increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time
   b. Mental status change, increase in lactic acid, increase in urine output, decreased capillary refill time, hemoconcentration
   c. Decrease in urine output, decreased capillary refill time, mottled extremities
   d. Mottled extremities increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time
7) Which medications are pure vasopressors? I-0657
   a. Phenylephrine, vasopressin
   b. Norepinephrine, vasopressin, epinephrine
   c. Epinephrine, phenylephrine
   d. Norepinephrine, and epinephrine
8) What does inotropic mean? I-0657
   a. Increase heart rate
   b. Increase diastolic filling time
   c. Increase contractility
   d. Increase conduction velocity
9) What does chronotropic mean? I-0657
   a. Increase heart rate
   b. Increase diastolic filling time
   c. Increase contractility
   d. Increase conduction velocity
10) What does inopressor mean? I-0657
   a. increases heart rate and causes arterial vasoconstriction
   b. increases cardiac contractility and induces vasoconstriction

c. induces venous vasoconstriction and arterial vasodilation
d. increases cardiac contractility and induces vasodilation

11) Which medications are inopressors? I-0657
a. Phenylephrine, vasopressin
b. Norepinephrine, dobutamine, epinephrine
c. Epinephrine, dopamine
d. Norepinephrine, epinephrine, dopamine

12) What does inodilator mean? I-0657
a. increases heart rate and causes arterial vasoconstriction
b. increases cardiac contractility and induces vasoconstriction
c. induces venous vasoconstriction and arterial vasodilation
d. increases cardiac contractility and induces vasodilation

13) Which medications are inodilators? I-0657
a. Dobutamine, milrinone, dopamine
b. Milrinone, dobutamine, epinephrine
c. Epinephrine, dopamine, milrinone
d. isoproterenol, dobutamine, milrinone

14) Vasopressin works on which receptors? I-0909
a. V1 only
b. V1 at low doses and then V2>V1 at high doses
c. V2 at low doses and then V1>V2 at high doses
d. V1 and V2
e. V2 only

15) What receptor causes free water reabsorption in the kidney? I-0909
a. V1
b. V2
c. V1 and V2

16) Which receptor causes smooth muscle vasoconstriction? I-0909
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

17) Which receptor causes increased chronotropy and inotropy? I-0909
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

18) Which receptor causes bronchodilation? I-0909
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
e. D1

19) What is vasopressin? I-0909
a. A catecholamine
b. A combination of a catecholamine and hormone
c. A hormone

20) What receptor(s) are activated by norepinephrine? IIa- 0101
a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

21) Activation of this/these receptor(s) by norepinephrine can cause arrythmias? IIa-0230

a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

22) Activation of this receptor is important in septic and obstructive shock by norepinephrine due to increased _____? IIa-0230
a. Alpha 1 – vasoconstriction
b. Beta 1- increased inotropy
c. Beta 2- bronchodilation
d. Alpha 2- vasodilation

23) Which is better for cardiogenic shock: norepinephrine vs dopamine? IIa-0351; IIa-1005
a. Norepinephrine
b. Dopamine

24) At low doses, what receptor(s) are activated by epinephrine? IIa-05:21
a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

25) What was the major unwanted effect by epinephrine in the SOAP II trial? IIa-0843
a. Tachycardia
b. Ischemia
c. Hyperglycemia
d. Hyperthermia

26) Which drug is best in pediatric septic shock? IIa-0806
a. Vasopressin
b. Epinephrine
c. Norepinephrine
d. Phenylephrine

27) Which drug is best with anaphylactic shock? IIa-0706
a. Vasopressin
b. Epinephrine
c. Norepinephrine
d. Phenylephrine

28) At 1 mg dose or greater, what receptor is more activated by epinephrine (alpha or beta) and which is more harmful? IIa-0732
a. Alpha 1 > Beta 1; Alpha 1
b. Alpha 1 > Beta 1; Beta 1
c. Alpha 1 < Beta 1; Alpha 1
d. Alpha 1 < Beta 1; Beta 1

29) Which pressor is more known to be the most arrhythmogenic? IIa-1005
a. Dopamine
b. Epinephrine
c. Norepinephrine
d. Phenylephrine
e. Dobutamine

30) At 5-10 mcg/kg/min, what receptor(s) are primarily activated by dopamine? IIa-0910
a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

31) At >10 mcg/kg/min, what receptor(s) are more activated by dopamine? IIa-0925
a. Alpha 1 = Beta 1
b. Alpha 1 > Beta 1

c. Alpha 1 < Beta 2
d. Beta 1 > Beta 2
e. Beta 1 < Beta 2

32) What receptor(s) are activated by phenylephrine? IIa-1115
a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

33) In which situation would phenylephrine be harmful to the patient? IIa-1215
a. Adult septic shock
b. Pediatric septic shock
c. Hemorrhagic shock
d. Cardiogenic shock

34) Why is phenylephrine harmful in right heart failure? IIa-1215
a. Increased pulmonary vascular resistance
b. Increased cardiac preload due to venous vasoconstriction
c. Reflex bradycardia
d. All of the above
e. None of the above

35) What is the dosage of push dose phenylephrine that should be administered to a patient? IIa-1228
a. 100-300 mcg every 5-10 minutes
b. 100-200 mcg every 5-10 minutes
c. 80-200 mcg every 2- 4 minutes
d. 150-200 mcg every 2-4 minutes

36) What is the onset of push dose phenylephrine? IIa-1228
a. 30 seconds
b. 2 minutes
c. 10 seconds
d. 1 minute

37) What is the dosage of push dose epinephrine that should be administered to a patient? IIa-1440
a. 5-10 mcg every 5-10 minutes
b. 15-20 mcg every 5-10 minutes
c. 8-20 mcg every 2- 5 minutes
d. 10-20 mcg every 2-5 minutes

38) What is the duration of push dose epinephrine? IIa-1440
a. 5-10 minutes
b. <30 seconds
c. 10-20 minutes
d. 1-2 minute

39) Where does dobutamine work? IIb-0115
a. Alpha 1
b. Beta 1
c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
e. Beta 1 + Beta 2

40) Where do you mainly want dobutamine to work in cardiogenic shock? IIb-0146, 0215
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2

41) Can you use dobutamine a as first line agent in septic shock? IIb-0157
a. Yes
b. No

42) Which medication is a phosphodiesterase 3 inhibitor? IIb-0337

a. Dobutamine
b. Norepinephrine
c. Milrinone
d. Selepressin

43) What is lusitropy? IIb-0445
a. Increased ventricular filling
b. Contraction of the ventricles
c. Increased heart rate
d. Diastolic relaxation

44) Are arrhythmias common with milrinone? IIb-0400
a. Yes
b. No

45) Why is milrinone good in obstructive shock? IIb-0514
a. Decrease preload
b. Decreased pulmonary vascular resistance
c. Bronchodilator
d. Decreased afterload

46) Which drug is a hormone? IIb-0635
a. Milrinone
b. Dobutamine
c. Norepinephrine
d. Vasopressin

47) How does vasopressin cause vasodilation? IIb-0805
a. Inhibits nitric oxide production
b. Activates beta 2
c. Inhibits alpha 1
d. Activates alpha 1

48) How does vasopressin help a patient with a pulmonary embolism? IIb-0812
a. Decrease preload, decrease cardiac afterload
b. Restore mean arterial blood pressure, decrease pulmonary vascular resistance
c. Decrease cardiac afterload, decrease pulmonary vascular resistance
d. Decrease preload, restore mean arterial blood pressure

49) What is a feature of vasopressin? IIb-0850
a. Increases sensitivity to catecholamines
b. Increases sensitivity to endogenous vasopressin
c. Doesn't work very much on V2 receptors in the kidney during shock
d. Tolerated better than norepinephrine in liver patients

Post Test Questions and Answers

1) Why is the initial blood pressure goal >65 mm Hg? I-0239
   a. Because it is a nice round number
   b. Dogs overall did better in a study
   c. A large study showed that patients had significant renal and myocardial injury when higher than 65 mm Hg
   d. A large study showed that it is more harmful to the kidney and cardiac muscle when higher than 70 mm Hg
2) Which receptor causes smooth muscle vasoconstriction? I-0909
   a. Alpha 1
   b. Alpha 2
   c. Beta 1
   d. Beta 2
   e. D1
3) How does vasopressin help a patient with a pulmonary embolism? IIb-0812
   a. Decrease preload, decrease cardiac afterload
   b. Restore mean arterial blood pressure, decrease pulmonary vascular resistance
   c. Decrease cardiac afterload, decrease pulmonary vascular resistance
   d. Decrease preload, restore mean arterial blood pressure
4) What was the major unwanted effect by epinephrine in the SOAP II trial? IIa-0843
   a. Tachycardia
   b. Ischemia
   c. Hyperglycemia
   d. Hyperthermia
5) Can you use dobutamine a as first line agent in septic shock? IIb-0157
   a. Yes
   b. No
6) What is the calculation of oxygen delivery?
   a. Heart rate x stroke volume x (1/ hematocrit)
   b. [(1.32 x hemoglobin x SaO_2) x cardiac output] + (0.003 X PaO_2)
   c. [cardiac output x (1/ hematocrit) X (SVR)] - (0.003 X PaO_2)
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   b. Epinephrine
   c. Norepinephrine
   d. Phenylephrine
9) Which medications are pure vasopressors? I-0657
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11) What does inotropic mean? I-0657
   a. Increase heart rate
   b. Increase diastolic filling time

c. Increase contractility
d. Increase conduction velocity

12) Which receptor causes increased chronotropy and inotropy? I-0909
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
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c. Epinephrine, dopamine
d. Norepinephrine, epinephrine, dopamine

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c. Epinephrine, dopamine, milrinone
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16) Vasopressin works on which receptors? I-0909
a. V1 only
b. V1 at low doses and then V2>V1 at high doses
c. V2 at low doses and then V1>V2 at high doses
d. V1 and V2
e. V2 only

17) What receptor causes free water reabsorption in the kidney? I-0909
a. V1
b. V2
c. V1 and V2

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a. Mental status change, increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time
b. Mental status change, increase in lactic acid, increase in urine output, decreased capillary refill time, hemoconcentration
c. Decrease in urine output, decreased capillary refill time, mottled extremities
d. Mottled extremities increase in heart rate, increase in lactic acid, decrease in urine output, increased capillary refill time

19) Which receptor causes bronchodilation? I-0909
a. Alpha 1
b. Alpha 2
c. Beta 1
d. Beta 2
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20) What is vasopressin? I-0909
a. A catecholamine
b. A combination of a catecholamine and hormone
c. A hormone

21) At 1 mg dose or greater, what receptor is more activated by epinephrine (alpha or beta) and which is more harmful? IIa-0732
e. Alpha 1 > Beta 1; Alpha 1
f. Alpha 1 > Beta 1; Beta 1
g. Alpha 1 < Beta 1; Alpha 1

h. Alpha 1 < Beta 1; Beta 1

22) What is the main goal in treating septic shock? I-0305
   a. To get the MAP greater than 65 mm Hg
   b. To perfuse the brain, and cardiac muscle
   c. To allow / facilitate with antibiotic circulation
   d. To have a balance between perfusing organs and cellular death

23) Activation of this/these receptor(s) by norepinephrine can cause arrythmias? IIa-0230
   a. Alpha 1
   b. Beta 1
   c. Alpha 1 + Beta 1
   d. Alpha 1 + Beta 2
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24) Activation of this receptor is important in septic and obstructive shock by norepinephrine due to increased _____? IIa-0230
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   b. Beta 1- increased inotropy
   c. Beta 2- bronchodilation
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25) At low doses, what receptor(s) are activated by epinephrine? IIa-05:21
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   b. Beta 1
   c. Alpha 1 + Beta 1
   d. Alpha 1 + Beta 2
   e. Beta 1 + Beta 2

26) What is the equation for cardiac output? I-0305
   a. Heart rate x Stroke Volume
   b. (Preload – after load) X contractility
   c. Stroke volume – peripheral vascular resistance
   d. LOVT area X LVOT velocity

27) Which drug is best with anaphylactic shock? IIa-0706
   a. Vasopressin
   b. Epinephrine
   c. Norepinephrine
   d. Phenylephrine

28) Which pressor is more known to be the most arrhythmogenic? IIa-1005
   a. Dopamine
   b. Epinephrine
   c. Norepinephrine
   d. Phenylephrine
   e. Dobutamine

29) At 5-10 mcg/kg/min, what receptor(s) are primarily activated by dopamine? IIa-0910
   a. Alpha 1
   b. Beta 1
   c. Alpha 1 + Beta 1
   d. Alpha 1 + Beta 2
   e. Beta 1 + Beta 2

30) What does chronotropic mean? I-0657
   a. Increase heart rate
   b. Increase diastolic filling time
   c. Increase contractility
   d. Increase conduction velocity

31) At >10 mcg/kg/min, what receptor(s) are more activated by dopamine? IIa-0925
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   b. Alpha 1 > Beta 1
   c. Alpha 1 < Beta 2
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32) In which situation would phenylephrine be harmful to the patient? IIa-1215
   a. Adult septic shock
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   a. 5-10 minutes
   b. <30 seconds
   c. 10-20 minutes
   d. 1-2 minute

37) Where does dobutamine work? IIb-0115
   a. Alpha 1
   b. Beta 1
   c. Alpha 1 + Beta 1
   d. Alpha 1 + Beta 2
   e. Beta 1 + Beta 2

38) Why is lactate produced during shock? I-0305
   a. Purely due to anaerobic metabolism of pyruvate to lactate from cell hypoxia
   b. Combination of anaerobic metabolism and epinephrine cause glycolysis
   c. Krebs cycle malfunction due to ischemia
   d. Mitochondrial increased demand from glycogen to glucose and glycolysis from beta 2 stimulation

39) Where do you mainly want dobutamine to work in cardiogenic shock? IIb-0146, 0215
   a. Alpha 1
   b. Alpha 2
   c. Beta 1
   d. Beta 2

40) Which medication is a phosphodiesterase 3 inhibitor? IIb-0337
   a. Dobutamine
   b. Norepinephrine
   c. Milrinone
   d. Selepressin

41) What is lusitropy? IIb-0445
   a. Increased ventricular filling
   b. Contraction of the ventricles
   c. Increased heart rate
   d. Diastolic relaxation

42) Are arrhythmias common with milrinone? IIb-0400
   a. Yes

b. No

43) What receptor(s) are activated by phenylephrine? IIa-1115
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c. Alpha 1 + Beta 1
d. Alpha 1 + Beta 2
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44) Why is milrinone good in obstructive shock? IIb-0514
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b. Decreased pulmonary vascular resistance
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45) Which drug is a hormone? IIb-0635
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c. Norepinephrine
d. Vasopressin

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b. Increases sensitivity to endogenous vasopressin
c. Doesn't work very much on V2 receptors in the kidney during shock
d. Tolerated better than norepinephrine in liver patients

Reinforcement Game: Bingo

Mgmt of Shock					
Metabolizes glucose to lactate	Range 0.05 mcg/kg/min-1 mcg/kg/min	Phosphodiesterase 3 inhibitor	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Cardiac output	Arrhythmogenic
Dose: 0.3 units/min	Decrease pulmonary vascular resistance	Beta 2	Vasopressor	Phenylephrine	Epinephrine
Hormone	> 10 mcg/kg/min Alpha 1 >Beta 1	Venoconstriction	Perfusion pressures	5-10 mcg/kg/min = Beta 1	Milrinone
Can have reflex hypotension	Low dose coronary + cerebral + renal and splanchnic vasodilation	Acidemia	**Shock** **Free Space**	Inodilator	Norepinephrine
Prevents degradation of cAMP	Push does: 10-20 mcg every 2-5 minutes	Caution as first line if patient is hypotensive	Starting dose: 0.05 mcg/kg/min	Vasopressin	May decrease heart rate
Small but significant Beta 1 effects	Cardiogenic Shock	Good for refractory vasoplegia	DO NOT USE with Right Heart Failure	Alpha 1 only	Inopressor

Mgmt of Shock					
Arrhythmogenic	Monotherapy	Nitric Oxide	Obstructive Shock	Beta 2	> 0.2 mcg/kg/min Alpha 1 >Beta 1
Range 0.05 mcg/kg/min-1 mcg/kg/min	Inotropy- increased contractility	Phenylephrine	Inotropic	Lusitropy	Milrinone
Heart rate X stroke volume	Onset 1 minute	Dose: 0.3 units/min	Metabolizes glucose to lactate	Inodilator	Epinephrine
Septic shock	Phosphodiesterase 3 inhibitor	Soap II trial: norepinephrine vs dopamine	**Shock** **Free Space**	Alpha 2	Vasopressin
Alpha 1	Increase catecholamine sensitivity	Push dose: 80-200 mcg every 2-4 minutes	Push does: 10-20 mcg every 2-5 minutes	V2 receptors	Pulmonary Embolism
Inopressor	Norepinephrine	V1 & V2 activation	Cardiogenic Shock	Vasopressor	Perfusion pressures

Mgmt of Shock					
Nitric Oxide	Hormone	Milrinone	Increase catecholamine sensitivity	Lusitropy	Inopressor
Epinephrine	Venoconstriction	Phenylephrine	Starting dose: 0.05 mcg/kg/min	Dopamine	5-10 mcg/kg/min = Beta 1
Norepinephrine	Beta 1	> 10 mcg/kg/min Alpha 1 >Beta 1	Push dose: 80-200 mcg every 2-4 minutes	Obstructive Shock	Alpha 1
Only Beta 1 and Beta 2	Perfusion pressures	Metabolizes glucose to lactate	**Shock** **Free Space**	DO NOT USE with Right Heart Failure	Vasopressor
Prevents degradation of cAMP	Alpha 2	Septic shock	Inodilator	Arrhythmogenic	Acidemia
chronotropic	Caution as first line if patient is hypotensive	Decrease pulmonary vascular resistance	Range 0.05 mcg/kg/min-1 mcg/kg/min	MAP >65 mm Hg	Alpha 1 only

Mgmt of Shock					
Cardiogenic Shock	Norepinephrine	Lusitropy	Perfusion pressures	Acidemia	May decrease heart rate
5-10 mcg/kg/min = Beta 1	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Small but significant Beta 1 effects	Phenylephrine	Alpha 2	Beta 2
Obstructive Shock	Milrinone	Inotropy- increased contractility	Caution as first line if patient is hypotensive	Refractory vasoplegia	Venoconstriction
Improve venous return	Onset 1 minute	Heart rate X stroke volume	**Shock** **Free Space**	Metabolizes glucose to lactate	Monotherapy
Push dose: 80-200 mcg every 2-4 minutes	Range 0.05 mcg/kg/min-1 mcg/kg/min	Prevents degradation of cAMP	Good for refractory vasoplegia	Decrease systemic vascular resistance and peripheral vascular resistance	V1 & V2 activation
V1 receptors	Inopressor	Increase catecholamine sensitivity	MAP >65 mm Hg	Nitric Oxide	Pulmonary Embolism

Mgmt of Shock					
Phenylephrine	Push does: 10-20 mcg every 2-5 minutes	Caution as first line if patient is hypotensive	Chronotropy-increased heart rate	Lusitropy	Prevents degradation of cAMP
Increase catecholamine sensitivity	May decrease heart rate	Beta 2	Perfusion pressures	Inodilator	Cardiac output
Improve venous return	Decrease pulmonary vascular resistance	Preferred drug pediatric septic shock	Hormone	DO NOT USE with Right Heart Failure	Refractory vasoplegia
Small but significant Beta 1 effects	Push dose: 80-200 mcg every 2-4 minutes	Can have reflex hypotension	**Shock** **Free Space**	MAP >65 mm Hg	Anaphylactic Shock
V1 & V2 activation	Good for refractory vasoplegia	Phosphodiesterase 3 inhibitor	Pulmonary Embolism	V1 receptors	V2 receptors
Soap II trial: norepinephrine vs dopamine	Heart rate X stroke volume	Inotropic	Septic shock	Venoconstriction	Range 0.05 mcg/kg/min-1 mcg/kg/min

Mgmt of Shock					
Soap II trial: norepinephrine vs dopamine	Pulmonary Embolism	Can have reflex hypotension	Increase catecholamine sensitivity	Alpha 1	Monotherapy
Inodilator	Beta 1	Hormone	Obstructive Shock	Onset 1 minute	Lusitropy
MAP >65 mm Hg	Venoconstriction	Alpha 1 only	May decrease heart rate	Cardiogenic Shock	Preferred drug pediatric septic shock
Dose: 0.3 units/min	Only Beta 1 and Beta 2	Vasopressin	**Shock** **Free Space**	Inopressor	Alpha 2
Improve venous return	Metabolizes glucose to lactate	Phosphodiesterase 3 inhibitor	Vasopressor	Refractory vasoplegia	Arrhythmogenic
Decrease systemic vascular resistance and peripheral vascular resistance	Phenylephrine	Acidemia	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Nitric Oxide	Dose: 2.5-20 mcg/kg/min

Mgmt of Shock					
Increase catecholamine sensitivity	chronotropic	Alpha 2	Decrease pulmonary vascular resistance	Caution as first line if patient is hypotensive	Beta 1
Milrinone	Cardiogenic Shock	Anaphylactic Shock	Push does: 10-20 mcg every 2-5 minutes	5-10 mcg/kg/min = Beta 1	Vasopressor
Phosphodiesterase 3 inhibitor	Prevents degradation of cAMP	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Refractory vasoplegia	Decrease systemic vascular resistance and peripheral vascular resistance	V2 receptors
Monotherapy	Cardiac output	Hormone	**Shock** **Free Space**	Dobutamine	Chronotropy-increased heart rate
Dose: 0.3 units/min	Epinephrine	Vasopressin	Phenylephrine	Small but significant Beta 1 effects	Norepinephrine
Nitric Oxide	Heart rate X stroke volume	Inopressor	Perfusion pressures	Preferred drug pediatric septic shock	Inotropic

Mgmt of Shock					
Onset 1 minute	chronotropic	Lusitropy	Phosphodiesterase 3 inhibitor	Acidemia	Inotropic
V2 receptors	Perfusion pressures	Nitric Oxide	Range 0.05 mcg/kg/min-1 mcg/kg/min	Starting dose: 0.05 mcg/kg/min	Soap II trial: norepinephrine vs dopamine
Monotherapy	Decrease pulmonary vascular resistance	Obstructive Shock	Refractory vasoplegia	Dose: 0.3 units/min	> 0.2 mcg/kg/min Alpha 1 >Beta 1
Milrinone	5-10 mcg/kg/min = Beta 1	Good for refractory vasoplegia	**Shock** **Free Space**	Hormone	Dopamine
Low dose coronary + cerebral + renal and splanchnic vasodilation	Decrease systemic vascular resistance and peripheral vascular resistance	Septic shock	Inotropy- increased contractility	Inodilator	Small but significant Beta 1 effects
V1 & V2 activation	Beta 2	Venoconstriction	Epinephrine	Inopressor	Heart rate X stroke volume

Mgmt of Shock					
Decrease pulmonary vascular resistance	Norepinephrine	Cardiogenic Shock	Monotherapy	Obstructive Shock	Low dose coronary + cerebral + renal and splanchnic vasodilation
Cardiac output	Chronotropy-increased heart rate	Phenylephrine	Hormone	May decrease heart rate	Inotropic
V1 receptors	Onset 1 minute	Preferred drug pediatric septic shock	Milrinone	Lusitropy	Perfusion pressures
Dopamine	Alpha 1	Push does: 10-20 mcg every 2-5 minutes	**Shock** **Free Space**	Acidemia	DO NOT USE with Right Heart Failure
Vasopressor	Dose: 0.3 units/min	Soap II trial: norepinephrine vs dopamine	Dobutamine	Alpha 1 only	Small but significant Beta 1 effects
MAP >65 mm Hg	Nitric Oxide	Pulmonary Embolism	chronotropic	Starting dose: 0.05 mcg/kg/min	Inotropy-increased contractility

Mgmt of Shock					
DO NOT USE with Right Heart Failure	Refractory vasoplegia	Metabolizes glucose to lactate	Range 0.05 mcg/kg/min-1 mcg/kg/min	V1 receptors	Obstructive Shock
Inopressor	Caution as first line if patient is hypotensive	Arrhythmogenic	Alpha 2	Good for refractory vasoplegia	Norepinephrine
Onset 1 minute	Alpha 1	Starting dose: 0.05 mcg/kg/min	Hormone	Beta 2	Vasopressor
Prevents degradation of cAMP	Small but significant Beta 1 effects	Only Beta 1 and Beta 2	**Shock** **Free Space**	Vasopressin	Venoconstriction
Push does: 10-20 mcg every 2-5 minutes	Cardiac output	Monotherapy	Epinephrine	> 10 mcg/kg/min Alpha 1 >Beta 1	Chronotropy- increased heart rate
Increase catecholamine sensitivity	V2 receptors	Dobutamine	Alpha 1 only	Nitric Oxide	> 0.2 mcg/kg/min Alpha 1 >Beta 1

Mgmt of Shock					
Decrease systemic vascular resistance and peripheral vascular resistance	Soap II trial: norepinephrine vs dopamine	MAP >65 mm Hg	Beta 1	Range 0.05 mcg/kg/min-1 mcg/kg/min	Alpha 1 only
Arrhythmogenic	Low dose coronary + cerebral + renal and splanchnic vasodilation	Vasopressor	Milrinone	Acidemia	Inotropic
Phosphodiesterase 3 inhibitor	Alpha 2	Vasopressin	Perfusion pressures	Phenylephrine	5-10 mcg/kg/min = Beta 1
Hormone	Dose: 0.3 units/min	> 10 mcg/kg/min Alpha 1 >Beta 1	**Shock** **Free Space**	Prevents degradation of cAMP	V1 receptors
Increase catecholamine sensitivity	Venoconstriction	DO NOT USE with Right Heart Failure	Dobutamine	V1 & V2 activation	Only Beta 1 and Beta 2
Decrease pulmonary vascular resistance	Nitric Oxide	Inodilator	Lusitropy	Cardiac output	Preferred drug pediatric septic shock

Mgmt of Shock					
Inotropy- increased contractility	Onset 1 minute	Obstructive Shock	Beta 1	Norepinephrine	Vasopressin
Acidemia	> 10 mcg/kg/min Alpha 1 >Beta 1	Soap II trial: norepinephrine vs dopamine	Septic shock	Monotherapy	Starting dose: 0.05 mcg/kg/min
Venoconstriction	Phenylephrine	Arrhythmogenic	Improve venous return	Push does: 10-20 mcg every 2-5 minutes	Metabolizes glucose to lactate
Dopamine	chronotropic	Dose: 2.5-20 mcg/kg/min	**Shock** **Free Space**	Inotropic	5-10 mcg/kg/min = Beta 1
Caution as first line if patient is hypotensive	MAP >65 mm Hg	Anaphylactic Shock	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Can have reflex hypotension	Increase catecholamine sensitivity
Preferred drug pediatric septic shock	V1 receptors	Perfusion pressures	Epinephrine	Inopressor	Decrease systemic vascular resistance and peripheral vascular resistance

Mgmt of Shock					
Decrease pulmonary vascular resistance	Increase catecholamine sensitivity	Cardiogenic Shock	Low dose coronary + cerebral + renal and splanchnic vasodilation	Chronotropy- increased heart rate	Acidemia
Small but significant Beta 1 effects	Prevents degradation of cAMP	Onset 1 minute	Range 0.05 mcg/kg/min-1 mcg/kg/min	Nitric Oxide	Monotherapy
Preferred drug pediatric septic shock	Cardiac output	Only Beta 1 and Beta 2	DO NOT USE with Right Heart Failure	May decrease heart rate	Beta 1
Venoconstriction	Metabolizes glucose to lactate	Good for refractory vasoplegia	**Shock** **Free Space**	Dopamine	Can have reflex hypotension
Push does: 10-20 mcg every 2-5 minutes	Dose: 2.5-20 mcg/kg/min	Lusitropy	Refractory vasoplegia	Alpha 1	Alpha 1 only
MAP >65 mm Hg	Perfusion pressures	Milrinone	V1 receptors	Anaphylactic Shock	Norepinephrine

Mgmt of Shock					
Pulmonary Embolism	Acidemia	May decrease heart rate	Refractory vasoplegia	Caution as first line if patient is hypotensive	Decrease systemic vascular resistance and peripheral vascular resistance
Good for refractory vasoplegia	V1 receptors	Epinephrine	Vasopressor	Dobutamine	Alpha 1
Septic shock	5-10 mcg/kg/min = Beta 1	Chronotropy- increased heart rate	Improve venous return	Low dose coronary + cerebral + renal and splanchnic vasodilation	> 10 mcg/kg/min Alpha 1 >Beta 1
Cardiac output	Inotropy- increased contractility	Starting dose: 0.05 mcg/kg/min	**Shock** **Free Space**	Heart rate X stroke volume	Arrhythmogenic
Only Beta 1 and Beta 2	Milrinone	Prevents degradation of cAMP	V1 & V2 activation	Perfusion pressures	Alpha 1 only
Dose: 2.5-20 mcg/kg/min	chronotropic	Onset 1 minute	Inotropic	Can have reflex hypotension	Dopamine

Mgmt of Shock					
Starting dose: 0.05 mcg/kg/min	Milrinone	Vasopressor	MAP >65 mm Hg	Cardiac output	Alpha 1
Push does: 10-20 mcg every 2-5 minutes	Dopamine	Metabolizes glucose to lactate	Decrease systemic vascular resistance and peripheral vascular resistance	> 0.2 mcg/kg/min Alpha 1 >Beta 1	Alpha 2
Epinephrine	Inopressor	Inodilator	Nitric Oxide	Onset 1 minute	Septic shock
Increase catecholamine sensitivity	Inotropy- increased contractility	Cardiogenic Shock	**Shock** **Free Space**	Arrhythmogenic	Beta 1
Dose: 2.5-20 mcg/kg/min	DO NOT USE with Right Heart Failure	> 10 mcg/kg/min Alpha 1 >Beta 1	Anaphylactic Shock	Norepinephrine	Push dose: 80-200 mcg every 2-4 minutes
chronotropic	Acidemia	Only Beta 1 and Beta 2	Alpha 1 only	Obstructive Shock	Good for refractory vasoplegia

Mgmt of Shock					
Pulmonary Embolism	Alpha 1 only	Onset 1 minute	Decrease systemic vascular resistance and peripheral vascular resistance	DO NOT USE with Right Heart Failure	Preferred drug pediatric septic shock
chronotropic	Phosphodiesterase 3 inhibitor	Starting dose: 0.05 mcg/kg/min	Caution as first line if patient is hypotensive	Metabolizes glucose to lactate	Push dose: 80-200 mcg every 2-4 minutes
Inotropic	Alpha 1	> 10 mcg/kg/min Alpha 1 >Beta 1	Nitric Oxide	Heart rate X stroke volume	Beta 2
Norepinephrine	Inodilator	Monotherapy	**Shock** **Free Space**	Inopressor	Epinephrine
Improve venous return	Chronotropy-increased heart rate	Cardiac output	Small but significant Beta 1 effects	Septic shock	Increase catecholamine sensitivity
May decrease heart rate	Perfusion pressures	Dobutamine	Lusitropy	MAP >65 mm Hg	Dose: 0.3 units/min

Mgmt of Shock					
Norepinephrine	Dose: 2.5-20 mcg/kg/min	Soap II trial: norepinephrine vs dopamine	Phosphodiesterase 3 inhibitor	Can have reflex hypotension	Acidemia
Push does: 10-20 mcg every 2-5 minutes	Vasopressin	Dopamine	Starting dose: 0.05 mcg/kg/min	Inopressor	Range 0.05 mcg/kg/min-1 mcg/kg/min
Inodilator	Decrease pulmonary vascular resistance	Cardiogenic Shock	Epinephrine	Low dose coronary + cerebral + renal and splanchnic vasodilation	Inotropy-increased contractility
Arrhythmogenic	Nitric Oxide	Beta 1	**Shock** **Free Space**	Vasopressor	Good for refractory vasoplegia
Dobutamine	Lusitropy	V1 receptors	Metabolizes glucose to lactate	Beta 2	Dose: 0.3 units/min
Venoconstriction	Decrease systemic vascular resistance and peripheral vascular resistance	> 10 mcg/kg/min Alpha 1 >Beta 1	V1 & V2 activation	Alpha 2	Only Beta 1 and Beta 2

Mgmt of Shock					
Inodilator	Metabolizes glucose to lactate	MAP >65 mm Hg	Preferred drug pediatric septic shock	Refractory vasoplegia	Acidemia
Lusitropy	Nitric Oxide	V1 receptors	Norepinephrine	Cardiogenic Shock	Starting dose: 0.05 mcg/kg/min
Heart rate X stroke volume	Prevents degradation of cAMP	Increase catecholamine sensitivity	Dobutamine	Decrease pulmonary vascular resistance	Phosphodiesterase 3 inhibitor
Inopressor	Alpha 2	Push dose: 80-200 mcg every 2-4 minutes	**Shock** **Free Space**	Onset 1 minute	Beta 2
Soap II trial: norepinephrine vs dopamine	Vasopressin	Push does: 10-20 mcg every 2-5 minutes	Good for refractory vasoplegia	DO NOT USE with Right Heart Failure	Septic shock
Decrease systemic vascular resistance and peripheral vascular resistance	Perfusion pressures	Phenylephrine	Hormone	Alpha 1 only	Cardiac output

Mgmt of Shock					
Lusitropy	Can have reflex hypotension	chronotropic	Caution as first line if patient is hypotensive	Chronotropy- increased heart rate	Inopressor
Push does: 10-20 mcg every 2-5 minutes	Vasopressin	5-10 mcg/kg/min = Beta 1	May decrease heart rate	Pulmonary Embolism	Acidemia
Dose: 2.5-20 mcg/kg/min	Anaphylactic Shock	Inotropic	Dopamine	Phenylephrine	Dose: 0.3 units/min
Septic shock	Alpha 1 only	Starting dose: 0.05 mcg/kg/min	**Shock** **Free Space**	Small but significant Beta 1 effects	Increase catecholamine sensitivity
DO NOT USE with Right Heart Failure	Refractory vasoplegia	Heart rate X stroke volume	Milrinone	Norepinephrine	MAP >65 mm Hg
Decrease systemic vascular resistance and peripheral vascular resistance	Only Beta 1 and Beta 2	Prevents degradation of cAMP	> 10 mcg/kg/min Alpha 1 >Beta 1	Beta 2	V2 receptors

Mgmt of Shock					
Inotropic	Inopressor	Dobutamine	Can have reflex hypotension	5-10 mcg/kg/min = Beta 1	Inodilator
Epinephrine	May decrease heart rate	Alpha 1 only	Cardiac output	Acidemia	Lusitropy
Prevents degradation of cAMP	Inotropy- increased contractility	MAP >65 mm Hg	Onset 1 minute	Heart rate X stroke volume	V1 receptors
Refractory vasoplegia	Septic shock	Pulmonary Embolism	**Shock** **Free Space**	Decrease systemic vascular resistance and peripheral vascular resistance	Push dose: 80-200 mcg every 2-4 minutes
chronotropic	Push does: 10-20 mcg every 2-5 minutes	Phenylephrine	Chronotropy- increased heart rate	Starting dose: 0.05 mcg/kg/min	Nitric Oxide
Beta 2	Beta 1	Hormone	Cardiogenic Shock	Caution as first line if patient is hypotensive	V2 receptors