Titrating Critical Care Medications

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Learning Objectives

The participant will be able to:

1. Determine when vasoactive medications are indicated.
2. Describe parameters and titration of critical care medications.
3. Define titration, vasopressor, inotropes, catecholamine, and adrenergic.
4. Identify vasoactive drugs, infusion rates, and other medications used to treat the critically ill patient.
5. Describe how to safely administer medications requiring titration.
Definitions

- **Titration**: increasing or decreasing a vasoactive drug or other critical infusion for therapeutic effect.

- **Vasopressor**: a class of drugs that induce arteriole vasoconstriction and thereby elevate blood pressure.

- **Inotropes**: drugs that affect the strength of contraction of heart muscle (myocardial contractility); negative inotropes (beta-blockers, diltiazem, and verapamil) decrease cardiac workload and blood pressure, positive inotropes (dopamine, dobutamine, epinephrine and norepinephrine) increase cardiac workload and blood pressure.

- **Catecholamine**: any of a class of aromatic amines that includes a number of neurotransmitters which cause sympathomimetic action (epinephrine, norepinephrine, dopamine, dobutamine).

- **Adrenergic**: having characteristics of secreting epinephrine or substances with similar activity (epinephrine and norepinephrine).
Indications

- Systolic blood Pressure (SBP) has a decrease of > 30 mm Hg from the baseline or a mean arteriole pressure (MAP) less than 65 mm Hg and when either condition results in end-organ dysfunction due to hypoperfusion.
- Pump: problem with the heart (MI, arrhythmia).
- Volume: circulating volume (hypovolemic shock).
- Squeeze: how tight or constricted the arterial system is (septic shock).
## Receptors

<table>
<thead>
<tr>
<th>Receptors</th>
<th>Location</th>
<th>Action</th>
</tr>
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<tbody>
<tr>
<td><strong>Alpha adrenergic:</strong></td>
<td></td>
<td></td>
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<tr>
<td>• Alpha-1</td>
<td>Vascular walls (arteries) Heart</td>
<td>Vasoconstriction Increase the duration of contraction without increasing chronotropy (heart rate)</td>
</tr>
<tr>
<td><strong>Beta adrenergic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Beta-1</td>
<td>Heart</td>
<td>Increase inotropy (force of contraction) and chronotropy (heart rate) with minimal vasoconstriction</td>
</tr>
<tr>
<td>• Beta-2</td>
<td>Blood vessels in the lungs</td>
<td>Vasodilation and brochodilation</td>
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## Dopamine

<table>
<thead>
<tr>
<th>Dose Range</th>
<th>Effect</th>
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<tbody>
<tr>
<td>1 to 2 mcg per kg per minute</td>
<td>Dopamine stimulates dopaminergic receptors in the renal bed, dilates renal arteries, and increases renal blood flow and increases urine production.</td>
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<tr>
<td>5 to 10 mcg per kg per minute</td>
<td>Dopamine stimulates beta-1 receptors in the heart. This increases in contractility and heart rate (which in turn will increase CO and usually blood pressure). At this dose the medication acts more as a positive inotrope.</td>
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<tr>
<td>Greater than 10 mcg per kg per minute</td>
<td>Dopamine stimulates alpha receptors in the peripheral vasculature, causing vasoconstriction and an increase in SVR, thus increasing blood pressure.</td>
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</table>

*The dose-dependent effects of dopamine mean that increasing the dose of the medication is similar to switching vasopressors.*
Dopamine

- The usual dosage range for dopamine is 2 to 20 mcg per kg per minute by continuous IV infusion, onset occurs within 5 minutes, peak time is unknown, and duration of its action lasts about 10 minutes after discontinuation.

- American Heart Association (AHA, 2015) guidelines recommend dopamine as the second drug of choice after atropine to treat symptomatic bradycardia.

- **Nursing implications:**
  - Before administering, correct hypovolemia and establish goal blood pressure.
  - Monitor blood pressure, heart rate and rhythm every five minutes during titration.
  - Monitor for tachyarrhythmias.
  - Infuse by central line if possible; if peripheral, monitor IV site routinely for extravasation. Treat suspected infiltrations with phentolamine.
  - Consider alternate medication if at about 20 mcg per kg per minute goal blood pressure is not reached.
Phentolamine for Extravasation

- **Uses:**
  - Medication of choice in to control blood pressure and sweating caused by *pheochromocytoma*, an epinephrine-secreting tumor that can arise from the adrenal medulla.
  - Treat the extravasation of vasopressors into peripheral tissues (e.g., dobutamine, dopamine, epinephrine, norepinephrine, phenylephrine, and vasopressin).

- **Dose:**
  - 5 mg is diluted in 10 mL normal saline and administered S/C into the infiltrated area as soon as possible following the extravasation (within 12-hours).
  - If dose effective, normal skin colour should return to the blanched area within one hour.
  - Elevate affected limb for 24 to 48-hours.
  - Apply local warming therapy for 15 to 20 minutes, every 4-hours for 24 to 48-hours.
Phentolamine Policy

1. PURPOSE
To describe the proper utilization of phentolamine (Rogitine®) in an effort to prevent tissue extravasation associated with the infiltration of alpha-adrenergic agents.

2. POLICY STATEMENT
Phentolamine is indicated for suspected or known extravasation of any of the following medications:
- Dobutamine
- Dopamine
- Epinephrine
- Norepinephrine
- Phenylephrine
- Vasopressin

3. SCOPE
Registered nurses (RNs) in the Emergency Department, Critical Care (ICU), Post Anaesthetic Recovery Unit (PACU), Neurosurgery, and 2C Medical may administer phentolamine for the treatment of vasoactive extravasation.

4. DEFINITIONS
Extravasation: passage or escape into tissue of vasoactive medications. Manifestations may be sudden onset of localized pain at an injection site, sudden redness or extreme pallor at an injection site or loss of blood return in an intravenous needle. Tissue slough and necrosis may occur if the condition is severe.

5. PROCEDURE
Precautions:
- Phentolamine must be administered as soon as possible within 12 hours of extravasation.
- The use of the drug in children has not been well documented and should not be given to premature infants due to the potential for excessive vasodilatation.
- Do not inject into areas of infection.

Equipment:
- Phentolamine 5 mg/mL
- 3 mL syringe x 1
- 25 gauge ½ inch needles (varies depending on total number of injections required)
- Clean gloves
- Supplies to discontinue IV catheter
- Normal saline 10 mL vial x 1
- Chlorhexidine/70% alcohol (Solu-IV) antimicrobial swab x 1
- Assess and document pulse and circulation distal to extravasated area.
- Prepare phentolamine 5 mg diluted in 9 mL of normal saline to a total volume of 10 mL.
- Replace needle used for mixing with 25 gauge ½ inch needle.
- Explain procedure to the patient and family/partner-in-care.
- Cleanse skin with 2% chlorhexidine/70% alcohol (Solu-IV) antimicrobial swab for 30 seconds. Allow dry time.
- Phentolamine is injected subcutaneously encircling the infiltrated site. Divide total dose (5 mg) to be given among number of injections. Change needle for each injection.
- If dose is effective, normal skin colour should return to the blanched area within one hour.
- Elevate affected limb for 24 to 48 hours.
- Apply local warming therapy (e.g., warm blanket) for 15 to 20 minutes, every 4 hours, for 24 to 48 hours.
- Monitor patient for adverse effects of phentolamine including acute hypotension, tachycardia, dysrhythmias, anginal pain, gastrointestinal distress, weakness, dizziness or flushing.
- Document procedure, condition of area immediately after phentolamine administration, and distal circulation checks.
- Subsequent assessment and documentation of the affected area should be noted for 12 to 24 hours.

6. DOCUMENTATION
- Medication administration record (MAR)
- PCS: IV Assessment Intervention / Flowsheet
- PCS: Circulatory Sensory Motor Assessment (CSM)
- Interdisciplinary Progress Record (CS-053)
- Administration of Phentolamine (Rogitine®) Medical Directive (PCS-MD-02)

7. REFERENCES


Norepinephrine

- Affects alpha receptors causing peripheral vasoconstriction, increased blood pressure, and increased SVR.

- The dosage is 0.01 to 0.3 mcg per kg per minute by continuous IV infusion, onset and peak time are immediate with 1 to 2 minute duration of effect when infusion is turned off.

- First-choice vasopressor for sepsis (Surviving Sepsis Campaign, 2016).

Nursing implications:
- Before administering, correct hypovolemia and establish goal blood pressure.
- Monitor blood pressure, heart rate, and rhythm every five minutes during titration.
- Infuse by central line if possible; if peripheral, monitor IV site routinely for extravasation. Treat suspected infiltrations with phentolamine.
- Do not mix with NS. Do not mix with alkaline agents (those with a pH greater than 6.0, such as sodium bicarbonate, lidocaine and aminophylline).
- Monitor for headache, nausea, and vomiting, bradycardia, chest pain, and hypertension.
- Higher doses may be needed if receptors are down-regulated, as in sepsis.
- Very effective in low-SVR; less effect on heart rate than dopamine; preferred in presence of tachyarrhythmia.
Phenylephrine

- Often used for cardiac patients because of its pure alpha-receptor activity: it is less likely to cause tachyarrhythmias and will increase SVR, with a resultant increase in mean arterial pressure (MAP). The dosage is 0.5 to 5 mcg per kg per minute by continuous IV infusion, IV onset is immediate, peak time is unknown, and duration is 15 to 20 minutes duration of effect when infusion is turned off.

- Phenylephrine may also be given in intermittent IV bolus doses to support blood pressure. Dilute phenylephrine 10 mg in 100 mL of NS for a final concentration of 100 mcg/mL.

- Nursing implications:
  - Before administering, correct hypovolemia and establish goal blood pressure.
  - Monitor blood pressure, heart rate, and rhythm every five minutes during titration.
  - Infuse by central line if possible; if peripheral, monitor IV site routinely for extravasation. Treat suspected infiltrations with phentolamine.
  - Adverse effects may include bradycardia, hypertension, anxiety, tremor and arrhythmia.
  - Phenylephrine is not a first-line pressor for treating septic shock (Surviving Sepsis Campaign, 2016).
Vasopressin

- a.k.a. antidiuretic hormone = retain water in the body and constrict blood vessels (stimulation of V1 receptors causes vasoconstriction).

- Add to norepinephrine in patients with sepsis to achieve hemodynamic parameters.


- Onset of action in the presence of septic shock is within 15 minutes. Data are not available regarding the duration of action and peak effects when used in septic shock.

- **Nursing implications:**
  - Establish goal blood pressure and monitor vital signs every 15 minutes the first hour, then at least hourly.
  - Monitor serum sodium for the development of hyponatremia.
  - Water retention is an innate characteristic of the drug and can cause decreased levels of consciousness and seizures caused by cerebral swelling if sodium levels are not maintained.
General Recommendations

- Vasoactive medications should be titrated to clinical endpoints (parameters) that are appropriate to the specific medication. Parameters for vasopressor medications include blood pressure (MAP), signs of adequate tissue perfusion (urinary output, mental status, skin perfusion, SvO₂, lactate levels) and/or related hemodynamic data (CO, SVR, CVP, pulmonary capillary wedge pressure), if accessible.

- Increase the dose until the clinical effect is achieved (usually effects are seen within minutes) – use the peak effect of the medication to aid in increasing and decreasing infusion as tolerated.

- Notify the physician of potentially serious side effects or complications and titrate downward or discontinue the medication, if warranted.
### Strategies for Safe Administration

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Hang a bag of NS with tubing on an infusion pump; set at a fixed rate.</td>
<td></td>
</tr>
<tr>
<td>Use the shortest IV tubing and connect the IV line to the lowest port on the flush line.</td>
<td></td>
</tr>
<tr>
<td>Always have a “medication line” in case of emergency.</td>
<td></td>
</tr>
<tr>
<td>Clinical parameters (i.e., MAP, heart rate, etc.).</td>
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</tr>
<tr>
<td>Label IV lines</td>
<td></td>
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<tr>
<td>Check infusions at the start of each shift</td>
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<tr>
<td>Monitor the patient carefully.</td>
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<tr>
<td>Become familiar with length of the catheter and IV tubing</td>
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<tr>
<td>Attempt to wean infusions slowly.</td>
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</tbody>
</table>
Questions?