Medication Utilization in the Rural Emergency Setting

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The Disclosure Slide

• Nothing to disclose today

Today’s Objectives

• Identify medications utilized in emergent situations
• Highlight dosing strategies for priority medications
• Distinguish agent specific administration considerations
Hypothetical Case...

- 65 yo M on warfarin presents to Small Town Hospital in Rural, KS. BRBPR, coffee ground emesis everywhere, GCS 8. INR 7
- Vitals
  - BP: 60/40, HR 52, O2 sat 82%
- Referral Center:
  - Intubate now, start fentanyl drip, norepinephrine drip, give vitamin K 10 mg IV, FFP or PCC, transfer ASAP

Is your hospital ready to execute these orders quickly and efficiently?

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Life Happens...People Falter

- Incorrect Preparation
- Wrong Administration Technique
- Prescribing Errors
- Mislabeling
- Wrong Dose

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Medications for Today

- Sepsis
  - Epinephrine
  - Norepinephrine
  - Phenylephrine
  - Vasopressin
- Cardiac
  - Epinephrine
  - Amiodarone
  - Adenosine
  - Milrinone
- Sedation
  - Propofol
  - Fentanyl
  - Midazolam
- Other
  - Alteplase
  - Insulin
  - Procainamide
  - Streptokinase

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SEPSIS MEDICATIONS

**Vasopressors**
- Sepsis = medical emergency
- Septic shock → adrenergic support imperative

<table>
<thead>
<tr>
<th>Receptor Type</th>
<th>Location</th>
<th>Stimulation</th>
<th>Hemodynamic Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-1 (α1)</td>
<td>Smooth muscle</td>
<td>Vasconstriction</td>
<td>↑ SVR, MAP</td>
</tr>
<tr>
<td>Beta-1 (β1)</td>
<td>Myocardium</td>
<td>↑ Heart Rate</td>
<td>↑ CO</td>
</tr>
<tr>
<td>D1, D2</td>
<td>Kidney</td>
<td>↑ Heart Rate</td>
<td>Vasodilation</td>
</tr>
<tr>
<td>V1-V2</td>
<td>Smooth muscle</td>
<td>↑ water reabsorption</td>
<td>↑ SVR, MAP</td>
</tr>
</tbody>
</table>

Receptor Type: α = α1, β = β1, D = D1, D2, V = V1-V2
Location: Smooth muscle, Myocardium, Kidney
Stimulation: Vasconstriction, Vasodilation
Hemodynamic Effect: ↑ SVR, MAP, ↑ CO

**Vasopressors – Dosing & Titration**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Receptor Binding Affinity</th>
<th>Dosing Range</th>
<th>Titration Increment Every 5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>++++ ++++ N/A</td>
<td>Non-WB: 1-10 mcg/min</td>
<td>0.5-5 mcg/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WB: 0.05-2 mcg/kg/min</td>
<td>0.05-0.1 mcg/kg/min</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>++++ +++ N/A</td>
<td>Non-WB: 5-80 mcg/min</td>
<td>0.5-5 mcg/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WB: 0.1-3 mcg/kg/min</td>
<td>0.05-0.1 mcg/kg/min</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>++++ O N/A</td>
<td>Non-WB: 50-200 mcg/min</td>
<td>25-50 mcg/min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WB: 0.5-9 mcg/kg/min</td>
<td>2 mcg/kg/min</td>
</tr>
<tr>
<td>Dopamine</td>
<td>++++ ++++ ++++</td>
<td>2.5-20 mcg/kg/min</td>
<td>2.5-5 mcg/kg/min</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>N/A N/A</td>
<td>0.25-0.04 units/min</td>
<td>0.01 units/min</td>
</tr>
</tbody>
</table>

Note: WB = weight-based, Non-WB = non-weight-based

Overgaard, C.B., Dzavik, V. Circulation. 2008;118:1047-1056
Lexicomp Online. Accessed 28 July 2017
Put Your Hands Up!  
(For Audience Participation)  
• How many present are employed by institutions that utilize “smart” pumps (e.g., Alaris)?

Vasopressors: Preparation
• American Society of Health-Systems Pharmacists (ASHP) Standardize 4 Safety  
  1. Phase I – Adult continuous infusions  
  2. Phase II – Pediatric continuous infusions  
  3. Phase III-IV: Intermittent, PCA/epidurals

• To be completed 2017-2018

Vasopressors: Preparation

<table>
<thead>
<tr>
<th>Vasopressor</th>
<th>Concentration</th>
<th>Dosing Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>20 mcg/mL, 50 mcg/mL</td>
<td>0.0-20 mcg/kg/min</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>50 mcg/mL, 100 mcg/mL</td>
<td>0.05-20 mcg/kg/min</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>80 mcg/mL, 400 mcg/mL</td>
<td>0.4-10 mcg/kg/min</td>
</tr>
<tr>
<td>Dopamine</td>
<td>1600 mcg/mL, 3200 mcg/kg/min</td>
<td>0-100 mcg/kg/min</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>0.2 unit/mL, 1 unit/mL</td>
<td>0.0-10 units/kg/min</td>
</tr>
</tbody>
</table>

ED Pearls: Medication Utilization in Rural Emergency Setting

CARDIAC MEDICATIONS

Epinephrine
Adenosine
Diltiazem
Nicardipine

Epinephrine

• Dosing
  – Cardiac arrest: 1 mg IV q 3-5 minutes
  – Post-ROSC: 0.1-0.5 mcg/kg/min

• Not immune to drug shortages...

• Ratio strengths phasing out since May 2016

Amiodarone – Class III antiarrhythmic

VFib/Vtach

• Dosing
  – First Dose = 300 mg
  – Subsequent doses = 150 mg
  – Continuous infusion
    • 1 mg/min x 6 hours, followed by 0.5 mg/min x 18 hours

• Maximum total loading dose?

• PRICY ~ $40.60 per pre-mix

• Less expensive
  • $1.5-5 per vial


Dager WE, Sanočki CA, Wiggins BS, Tisdale JE. Pharmacotherapy. 2006;26(12):1703-1729
**Adenosine**

**Dosing**
- Stable Narrow or Wide Tachycardia
  - 6 mg/hr push, may repeat with up to two doses of 12 mg
  - Halve dose when given through central lines
- Distinctive Administration
  - Very short half-life (10 seconds), must give FAST!
- Unique Side Effects
  - Short-lived but intense sensations

**Nicardipine – Calcium Channel Blocker**

**Hypertension**
- Dosing
  - Initiate 5 mg/hr, titrate to parameter up to 15 mg/hr
- Many Preparations
  - Pre-mix 0.1 & 0.2 mg/mL = $114.228 per bag
  - 25 mg/10 mL vial = $24.17
- PEARLS
  - Pharmacokinetic considerations
    - 0.5 mg/mL concentration for CENTRAL lines only
    - Necessary for small hospitals?

**Diltiazem – Calcium Channel Blocker**

- Indications: Atrial fibrillation/flutter with rapid ventricular response
- Dosing: 0.25 mg/kg ABW IV push, may redose 0.35 mg/kg IV push
  - Follow with infusion of 2.5 – 15 mg/hr
- Multiple preparations available
  - 25 mg/5 mL vials = $2.62 per vial
  - 125 mg/25 mL vials = $11.13 per vial
  - 250 mg/250 mL pre-mix bags = $45.58
ED Pearls: Medication Utilization in Rural Emergency Setting

SEDATION MEDICATIONS

**Propofol – GABA<sub>A</sub> Agonist**

- Quick procedures, post-intubation sedation
- Dosing – varies widely
  - 5-20 mcg/kg/min initially, increase 5-10 mcg/kg/min every 5 minutes
- All products = 10 mg/mL
- Forewarned is forearmed
  - Dose-dependent hypotension, respiratory depression
  - PRIS (long term infusions)
  - Egg, soy hypersensitivity

**Fentanyl – Mu opioid agonist**

- Dosing
  - 25-100 mcg/hr, increase 25-50 mcg/hr every 5-10 minutes
- PEARLS
  - 100 mcg = 10 mg morphine (100x)
  - Avoid in unknown ingestions (serotonergic)
  - Hypotension possible
- Inexpensive, no pre-made products
  - 10-50 mcg/mL concentration
  - Check 503b compounding centers (e.g., PharMedium)
**Midazolam – GABA\(_A\) Agonist**

- **Dosing:** 0.01-0.05 mg/kg/hr initially, titrate up every 10-15 minutes to desired level of sedation
- **PEARLS**
  - Dose dependent hypotension
  - Active metabolites: caution in renal, hepatic injury
  - ↑ dose requirements: Alcoholic, status epilepticus
  - Maximum dose?
- **Inexpensive, no premade products**
  - 50 mg/50 mL or 100 mg/100 mL

**Alteplase – tissue Plasminogen Activator (tPA)**

- **Indication:** Ischemic stroke, pulmonary embolism (PE)
  - Stroke: 0.09 mg/kg over 1 minute, followed by 0.81 mg/kg over 60 minutes
  - PE: 100 mg over 2 hours
- **Genentech manufactures**
  - 50 mg/50 mL, 100 mg/100 mL
  - $$$

**MISCELLANEOUS MEDICATIONS**

- Alteplase
- Insulin
- Vitamin K

ONE DOES NOT SIMPLY

MIX OF TPA WITHOUT CAREFUL ASSESSMENT.
Alteplase – continued

- Errors have occurred with administration
  - Establish a system to ensure consistent process
- Waste (unused medication) will need to be addressed
- At SRHC – drug mixed, waste removed, vial hung with exact dose, administered, line flushed with NS
  - Other methods exist (not removing waste from vial)

Insulin

- Many uses in the ED
- Hyperkalemia cocktail - shifts potassium to intracellular compartment
  - Multiple variations, also many errors
  - 10 units regular IV push, give 25-50 g 50% dextrose before to prevent hypoglycemia
  - Consider 0.1 mg/kg in small, old, insulin naïve

Final Polling Question

How does your nursing staff prepare and administer IV push insulin regular?

A. Withdraw via insulin syringe, dilute in saline flush syringe
B. Withdraw via insulin syringe, dilute in empty syringe with 0.9% NaCl vial
C. Other
D. We don’t give it IV push, only sub-Q
**Vitamin K**

Reversal of vitamin K antagonist therapy (warfarin) in acute major bleeding

1-10 mg IVPB or PO

IV push, IM, and subcutaneous administration?

Tablets now very expensive ($70/tablet), ok to use IV product for PO route

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**Case Conclusion**

- Patient intubated in ED
- Fentanyl, norepinephrine vials removed from pharmacy ADC, compounded by nurse in glove box to pre-specified concentration
- Medications started per protocol doses
- Titration instructions communicated to EMS
- FFP, vitamin K IVPB given
- Patient transferred lights & sirens

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**In Summary**

- Emergent situations include a broad array of patient presentations
- Emergent medications often require careful manipulation and administration to avoid harm
- Agent specific considerations should be identified to optimize clinical and financial outcomes