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Common Dangerous Medication Errors

Session Overview

The Emergency Department is a fast-paced environment in which important treatment decisions are sometimes made with limited time. Medication mistakes, particularly those with high-risk drugs, can increase morbidity and mortality. The goal of this talk is to introduce several high-risk medications and provide practical pearls to help avoid common, potentially serious mistakes.

Objectives

1) List high-risk medication errors in emergency patients
2) Identify strategies to prevent high-risk medication errors

Background

- Medication errors are common. In one academic medical center's evaluation of medical resuscitations, 1 out of 2 doses was administered in error. 14% were considered at least moderate in severity. 46% were prescribing errors, 28% administration technique, 14% mislabeling, 10% preparation, and 2% improper doses. (Gokham 2012)
- The Institute for Safe Medication Practices (ISMP) defines high-alert medications as "drugs that bear a heightened risk of causing significant patient harm when they are used in error."
    - ISMP maintains a comprehensive, updated list of high-alert medications
- Peth 2003

Variables associated with medication errors in the emergency department

Undifferentiated and unfamiliar patients 24-hour nature of services
Dispensing and administering medications without pharmacist double checks
Outpatient medication dispensing without pharmacist double checks
Critical and emergent nature of care provided
Overcrowding
Reliance on verbal orders
Understaffing of personnel
Absence of standardized handoff communication
Lack of independent double checks of nurse-prepared medications

- An easy acronym to remember high-risk medications: PINCH. P - Potassium, I - Insulin, N - Narcotics, C - Chemotherapy, H - Heparin

Potassium

- Treating Hyperkalemia with Insulin
    - How insulin works
        - Temporarily shifts potassium intracellularly through a complex process of activating Na+-K+ ATPase and by recruitment of intracellular pump components

into the plasma membrane. Insulin binding to specific membrane receptors results in extrusion of Na+ and cellular uptake of K+. (Hundal 1992)

- The right insulin dose
  - 5 unit boluses up to 20 unit/hr infusions have been used (Blumberg 1988). Most common dose is 10 units IV regular insulin bolus (lowers K+ ~ 0.5-1 mEq/L).
- Preventing hypoglycemia
  - Incidence of hypoglycemia
    - A 10 unit dose of IV regular insulin has an onset of action ~5-10 minutes, peaks at 25-30 minutes, and lasts 2-3 hours. IV dextrose lasts < 1 hour.
    - Overall incidence of hypoglycemia appears to be ~10%, but could be higher (Allon 1990; Schafers 2012; Apel 2014, Scott 2019)
  - Risk factors for developing hypoglycemia (Apel 2014)
    - No prior diagnosis of diabetes
    - No use of diabetes medication prior to admission
    - Lower pretreatment glucose (104 mg/dL vs 162 mg/dL, P = 0.04)
    - Renal dysfunction (insulin may be partially renally metabolized) (Dickerson 2011)
    - Higher insulin dose (LaRue 2017)
  - Strategies for avoiding hypoglycemia
    - Here is a suggested strategy for administering enough dextrose to counter the initial insulin bolus of 10 or 20 units. It is loosely based on the Rush University protocol. (Apel 2014)
- ISMP highlighted this issue in a February 2018 Safety Alert

Insulin

- Insulin has been on the ISMP High Alert list for decades. There are multiple products, each with different kinetic profiles, that can cause confusion.
- Most insulin products are 100 units/mL; some are 200, 300, and 500 units/mL (Kalra 2018)
- In addition, we are now using insulin for non-diabetic treatments, such as calcium channel blocker poisoning. Doses of IV insulin can be up to **10** units/kg/hr. This presents unique challenges in that we potentially need non-standard concentrations of IV insulin infusions to avoid volume overload with the standard 1 unit/mL infusion used for most purposes.
- ISMP published guidelines in 2017 for Optimizing Safe Subcutaneous Insulin Use in Adults

Narcotics

Opioids are a frequent cause of litigation in ED cases, particularly hydromorphone

- Some EDs are becoming 'opioid free,' and instead utilizing acetaminophen, NSAIDs, and even ketamine and lidocaine for acute pain control.
- Hydromorphone 1 mg IV = Morphine 7 mg IV
  - It seems odd that morphine 10 mg seems like a lot to us, yet hydromorphone 2 mg is prescribed with little concern
  - An appropriate starting dose of morphine is 0.1 mg/kg, assuming normal kidney function and age < 65 years

    - A good strategy is start low, go slow (or consider opioid alternatives)
- Naloxone
    - Patients typically receive 2-4 mg in the prehospital setting, a dose often too high for patients chronically taking opioids. This dose can precipitate withdrawal. [The important caveat is that with fentanyl (and fentanyl derivatives) mixed with heroin, a high dose of naloxone (up to 10 mg) may be needed]
    - A more conservative strategy is to start with 0.04 mg and administer 0.04-0.08 mg increments to achieve desired respiratory rate (Kim 2016)
    - Here is a trick-of-the-trade for preparing naloxone to give these smaller doses

Heparin

- Heparin is fraught with errors (Grissinger 2010). Factors that may increase risk of error:
    - Indication (ACS, VTE/PE, etc)
    - Bolus vs. no-bolus vs. infusion
    - Dosing (weight-based vs. non-weight-based)
        - Dosing in obesity (actual vs adjusted)
    - Monitoring frequency
    - Prophylaxis vs. treatment
    - Utilization with other anticoagulants, antiplatelets, or blood-altering drugs (eg, tPA)
    - Multiple concentrations and vial/bag sizes
- Avoiding errors: EMR order sets, nurse-driven adjustments, double checks, barcode scanning, infusion pumps

IV Hydralazine

- Potent vasodilator. Onset of action: ~20 minutes, peak effects last 60 minutes, duration of action is unpredictable and can persist for up to 8 hours. (Powers 1998)
- Dangerous adverse effects
    - Stimulation of sympathetic nervous system, leading to exacerbation of oxygen consumption in a myocardium as well as an increase in heart rate.
    - Associated with increasing ICP. (Rhoney 2006; Skinhoj 1983)
    - Latent period of 5-15 minutes followed by progressive and often precipitous BP drop. (Schroeder HA. J Clin Invest 1951;30:672-3.) (Shepherd 1980)
    - Severe hypotension and complications associated with birth. (Obstet Gynecol 2011; Magee 2003)
    - Profound hypotension in critically ill. (Kane-Gill 2014)
- Inappropriate use (Campbell 2011)
    - Only 2% of all patients had documented evidence of hypertensive crisis.
    - Over 80% of all doses were associated with a reduction in systolic BP < 25%.
    - Of the 16 patients who experienced an adverse effect, most were related to hypotension, with six experiencing a decrease in systolic BP > 65 mmHg.
- Bottom line: start low, go slow (or consider alternative agents)
- Further reading from EM PharmD blog

Epinephrine

Epinephrine is one of the most problematic medications in the ED with regard to errors

- The ratio concentration labeling only increases the confusion. And, there are so many sizes/concentrations that may be available in EDs and code carts.
    - Cardiac arrest concentration: **1:10,000** = 1 gm/10,000 mL = 1,000 mg/10,000 mL = **0.1 mg/mL**
    - Pretty-much-everything-else concentration: **1:1,000** = 1 gm/1,000 mL = 1,000 mg/1,000 mL = **1 mg/mL**
    - **Fortunately, the epinephrine ratio labeling are going away starting in May 2016 (at least in the U.S.)!** (EMPharmD: No More Epinephrine Ratios; ISMP Canada: Changes in Expression of Strengths)
- Here are a few ways to reduce errors:
    - Limit the number of epinephrine sizes/concentrations in your ED
    - Consider stocking epinephrine auto injectors for anaphylaxis/asthma (EMPharmD: Epinephrine IM for Anaphylaxis; EMPharmD: Epinephrine Auto-Injectors for In Hospital Use)

Alteplase (tPA)

tPA, although actually easy to mix (tPA Mixing Tutorial), is prepared in high-pressure situations and can lead to dosing errors

- Make sure to have dosing sheets available on paper and in EMRs

Second Antibiotic Dose in Sepsis

- Most studies evaluating early antibiotic administration in sepsis patients focus on timing of the first dose. But, what about the second dose? We get it wrong, a lot. PharmERToxGuy.com highlights this issue and offers some potential solutions.

Syringe labeling in the ED

- The two critical pieces of information that must be on every syringe are: **drug name** and **concentration** (Kothari 2013)
- Further reading from Academic Life in EM

Medication Error-Prevention Strategies (Weant 2014)

- Medication-error analysis
- Computerized provider-order entry systems
- Automated dispensing cabinets
- Bar-coding systems
- Medication reconciliation
- Standardizing medication-use processes
- Education
- Emergency-medicine clinical pharmacists (ACMT 2018; ACEP 2015)