High Risk Medication Errors - Part 1

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 two-part talk is to introduce several high-risk medications and provide practical pearls to help avoid common, potentially serious mistakes.

Objectives
1) List the five high-risk medications/medication classes that make up the PINCH acronym.
2) When treating a hyperkalemic patient with insulin, design a dextrose regimen to avoid hypoglycemia.
3) Utilize a low-dose naloxone dosing scheme for select opioid overdoses.
4) Identify 3 factors that make heparin a high-alert medication.
5) Identify the two most critical pieces of information needed on syringes labeled in the ED

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

Potassium

- Concentrated potassium formulations are not stocked on most patient care units, but errors still occur (ISMP 2007)
- Most institutions have detailed guidelines for IV potassium administration, including maximum concentrations and infusion dose limits
- 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 is fraught with errors (Grissinger 2010)
  - So many factors are in play when utilizing heparin, such as:
    - 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

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

- We frequently draw up medications for administration, but most IV meds are clear liquids. How can we tell the difference between a BP med and a neuromuscular blocker? What if a syringe has a dose written on it, but someone gives half and puts the syringe back down? How will the next person know how much is actually in there?
- 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