

Deadly Medication Mistakes

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 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 opioid overdoses.
 - 4) Convert doses of epinephrine between the various concentration formulations.
 - 5) Identify the two most critical pieces of information needed on syringes labeled in the ED.
- 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, Resuscitation 2012](#))
 - An easy acronym to remember high-risk medications: PINCH. P - Potassium, I - Insulin, N - Narcotics, C - Chemotherapy, H - Heparin
 - 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, J Biol Chem 1992](#))
 - The right insulin dose
 - 5 unit boluses up to 20 unit/hr infusions have been used ([Am J Med 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 only lasts about an hour.
 - Overall incidence of hypoglycemia appears to be ~10%, but could be higher ([Kidney Int 1990](#); [J Hosp Med 2012](#); [Apel, Clin Kidney J 2014](#))
 - Risk factors for developing hypoglycemia ([Apel, Clin Kidney J 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, Nutrition 2011](#))
- Higher insulin dose ([LaRue, Pharmacother 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, Clin Kidney J 2014](#))
- The Institute for Safe Medication Practices (ISMP) highlighted this issue in a [February 2018 Safety Alert](#)

- 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 10 mg of morphine seems like a lot to us, yet 2 mg of hydromorphone 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 mg in the prehospital setting, a dose much too high for patients chronically taking opioids. This dose will 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 HK, J Med Toxicol 2016](#))
 - Here is a great [trick-of-the-trade](#) for preparing the naloxone to give these smaller doses

- Heparin is also fraught with errors ([Grissinger, Jt Comm J Qual Patient Saf 2010](#))

- Alteplase (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

- 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](#))
- 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, J Emerg Med 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, Crit Care Clin 2006](#); [Skinhoj, Acta Med Scand Suppl 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, Clin Pharmacol Ther 1980](#))
 - Severe hypotension and complications associated with birth. ([Obstet Gynecol 2011](#); [Magee, BMJ 2003](#))
 - Profound hypotension in critically ill. ([Kane-Gill, Crit Care Med 2014](#))
 - Bottom line: start low, go slow (or consider alternative agents)
 - Further reading from [EM PharmD blog](#)
- 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, Br J Anaesth 2013](#))
 - Further reading from [Academic Life in EM](#)
- 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.