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Dangerous 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.