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Session Title: Medication Tips & Tricks for the Crashing Patient

Session overview

This talk is focused on medication updates in resuscitation. Topics covered include ventricular tachycardia/ventricular fibrillation, hypoglycemia during hyperkalemia treatment, naloxone dosing, alteplase dosing in cardiac arrest, ketamine and post-intubation hypotension, and sedation in COVID-19 patients.

Objectives

- Discuss the role of lidocaine and esmolol in ventricular tachycardia/ventricular fibrillation
- Utilize a low-dose naloxone dosing scheme for opioid overdoses
- State the cardiac arrest dosing of thrombolytics
- Choose an appropriate induction agent in patients who may become hypotensive

ACLS Updates

1) **Lidocaine or Amiodarone for Ventricular Fibrillation, Pulseless/Polymorphic Ventricular Tachycardia**. A 2018 AHA Focused Update re-introduced lidocaine as an equally weakly recommended alternative to amiodarone (Class IIb; Level of Evidence B-R) (Panchal 2018). This holds true in the 2020 full guidelines (Panchal 2020). The AHA continues to acknowledge that an antidysrhythmic medication is unlikely to cardiovert VF or pVT into normal sinus rhythm. Read more about the lidocaine and other medication-related updates in the focused guideline update. (PharmERToxGuy blog 2019)
2) **Highlights of the 2020 Guidelines**. Now that the AHA is releasing focused updates in the 5-year period between guidelines, I anticipate fewer major changes when the full guidelines are published. Here is a three-part summary of the medication-related guideline recommendations.
    a) Vasopressors and Non-Vasopressors in Cardiac Arrest
    b) Management of Specific Arrhythmias
    c) Toxicology
3) **Esmolol**. is an additional option to consider for refractory VF (PharmERToxGuy blog 2016). Here is an infographic from the blog.

Treating Hyperkalemia with Insulin (Lindner 2020)

- 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, Finder 2022). 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 10-20% (Allon 1990; Schafers 2012; Apel 2014, Scott 2019, Jacob 2017)
    - 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, Coca 2017, Pierce 2015)
        - 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, Harel 2016)
        - Consider starting with 5 units in most patients (LaRue 2017)
    - ISMP highlighted this issue in a February 2018 Safety Alert

Naloxone

- Patients typically receive 2 mg in the prehospital setting, a dose much too high for patients chronically taking opioids that can precipitate withdrawal. [Important caveat is that with fentanyl (and fentanyl derivatives) mixed with heroin, high-dose 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, Wong 2019)
- Here is a great trick-of-the-trade for preparing the naloxone to give these smaller doses

Cardiac Arrest Dosing of tPA

This is a tough question in the middle of a critical resuscitation. A full summary of the data is available on Academic Life in EM blog from 2013, last updated in 2016.

- The dose of tPA in cardiac arrest is somewhere between 50-100 mg given as a bolus +/- infusion.
    - We generally give 50 mg as an IV push and often repeat with the other 50 mg in 10-15 minutes, if indicated.
- According to the AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, “Ongoing CPR is not an absolute contraindication for fibrinolysis.”
- Some studies suggest allowing 15 minutes of CPR for drug to work (Konstantinides 2020).
- Evidence is ‘best’ for PE; data does NOT support for undifferentiated cardiac arrest.
- Anticoagulants, such as heparin, were used in most studies along with the fibrinolytic.

Sedation Guidance for Intubated COVID-19 Patients

Patients requiring intubation secondary to SARS-CoV-2 infection typically require more sedation than we use normally. Based on our experience in Boston, we provide a suggested strategy here with a corresponding infographic. Key points:

1) Consider initiating a norepinephrine infusion prior to intubation. These patients tend to drop blood pressure.
2) Consider adding an additional sedative agent along with induction (ketamine or etomidate). We use midazolam 4 mg.
3) At the initiation of an opioid (or midazolam) infusion and with rate changes, we must bolus too. The importance of boluses is discussed here.
4) Neuromuscular blockade may be needed, along with heavy sedation, to improve ventilator compliance.

Ketamine and Post-Intubation Hypotension

We traditionally think of ketamine as a hemodynamically-neutral induction agent. But, some reason data from the National Emergency Airway Registry (NEAR) registry suggests that ketamine may be about the same as etomidate in terms of its effect on blood pressure. A meta-analysis reached a similar conclusion (Sharda 2022). The bottom line is that higher-quality data is needed. For some more in-depth discussion on the new data, check out the PharmERToxGuy and Critical Care Now summaries.