Oklahoma State University Medical Center | Department of Emergency Medicine

Simulation-based training to improve knowledge of dosing and formulation of push dose vasopressors in the emergency department

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BACKGROUND

- Vasopressors phenylephrine and epinephrine are formulated into push dose pressors (PDPs), which are used to treat transient hypoperfusion through intermittent administration in small doses[3].
- PDP use is common in anesthesia medicine, but relatively new to emergency medicine[3].
- PDPs are particularly useful for managing hypotension in the peri-intubation and peri-arrest phases or as a bridge to continuous vasopressor infusions in critically ill patients[2].
- However, PDPs must be formulated at bedside, which may result in errors and adverse events[1].
- Hesitation to emergency department use arises from concerns for dosing and formulation errors[1].

OBJECTIVES

- Primary: Measure knowledge of PDP dosing, formulation, and adverse events prior to and following a simulation-based educational intervention among emergency medicine resident physicians.
- Secondary: Assess the efficacy of simulation-based training to improve safety and quality of healthcare in the emergency department setting.

METHODS

- Emergency medicine residents participated in a one-day simulation-based didactic session.
- Baseline knowledge was assessed with a quiz prior to any educational intervention.
- Participants were given two formal lectures encompassing the indications for use, formulation, and dosing of push-dose epinephrine and phenylephrine as well as hands-on demonstrations of formulation preparation..
- Residents next participated in four team-based simulation scenarios of critically ill patients in which PDP formulation and administration was required with debriefing after case conclusion.
- Immediately following the lectures and team-based simulation scenarios, the quiz was readministered and knowledge reassessed. A 3-month follow-up quiz will also be administered to assess knowledge retention.

RESULTS

Bedside Formulation Sheet
Bolus dose pressors

Epinephrine:
Alpha & beta effects: Increased HR, SVR, CO

Formulation instructions:
- Use a 10 ml syringe and fill with 9ml of normal saline
- Draw up 1 ml of epinephrine from cardiac amp (100mcg/ml)
- Formulation is 10 mcg/ml of Epinephrine

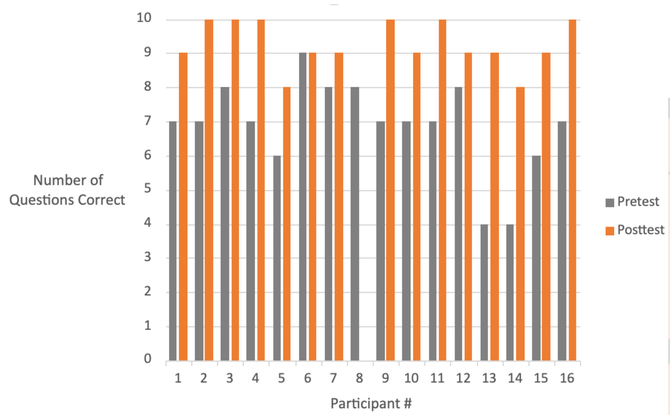
Onset: 1 minute
Duration: 5 to 10 minutes

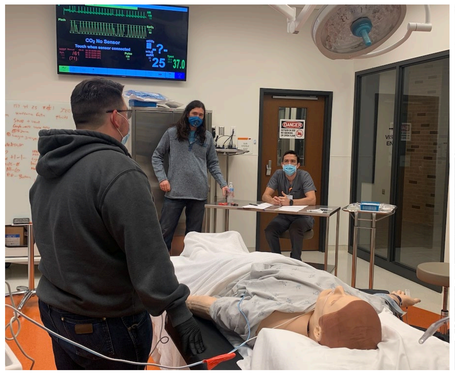
Phenylephrine:
Pure alpha effects: No change in HR, Increased SVR

Formulation instructions:
- Use a 3 ml syringe and draw up 1 ml phenylephrine (10mg/ml)
- Inject 1 ml phenylephrine into 100 ml bag of normal saline
- Formulation is 100 mcg/ml of Phenylephrine

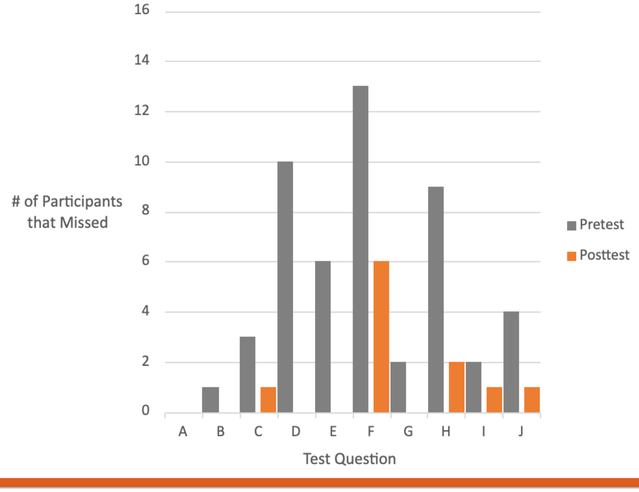
Onset: 1 minute
Duration: 10 to 20 minutes

Comparison and Participants Pre and Post Lecture Quiz Results





Pre and Post Lecture Quiz Results



Pre and Post Lecture Quiz

Circle: Pre-test or Post-test

Name:_____
Date:_____
Medical student year ___ or resident PGY ___
Email address for follow-up:_____

Pre and Post Lecture Quiz
Formulation, dosing, and safety of bolus dose epinephrine and phenylephrine

A. What are the indications of using bolus dose epinephrine or phenylephrine in the emergency department setting?
   a. During hypotension events that may lead to poor outcomes
   b. As a substitute for vasopressor infusion therapy
   c. As a substitute for intravenous fluid resuscitation
   d. During hypertensive emergencies

B. What is the correct formulation of push dose epinephrine?
   a. Draw up 1 mL of cardiac epinephrine from a 10 mg/mL vial into a 3 mL syringe and then Inject this into a 100 mL bag of normal saline.
   b. Draw up 9 mL of normal saline into a 10 ml syringe. In this syringe, draw up 1 mL cardiac epinephrine (100mcg/10ml).
   c. Draw up 10 mL of cardiac epinephrine and inject this into a 1000 mL bag of normal saline.
   d. Draw up 5 mL of normal saline into a 10 mL syringe. In this syringe, draw up 5 mL of cardiac epinephrine (500mcg/10mL).

C. What is the correct dose of push dose epinephrine?
   a. 100 mcg as a one-time dose
   b. Infusion rate: wide open
   c. 5 - 20 mcg q 2 - 5 mins
   d. 50-100 mcg q 5 mins

D. What is the correct formulation of push dose phenylephrine?
   a. Draw up 1 mL of phenylephrine from a 10 mg/mL vial into a 3 mL syringe and then Inject this into a 100 mL bag of normal saline (100 mcg/ml)
   b. Draw up 9 mL of normal saline into a 10 ml syringe. In this syringe, draw up 1 mL of phenylephrine (1000 mcg/1ml).
   c. Draw up 10 mL of phenylephrine and inject this into a 1000 mL bag of normal saline.
   d. Draw up 8 mL of normal saline into a 10 mL syringe. In this syringe, draw up 2 mL of phenylephrine (2000 mcg/1 mL).

E. What is the correct dose of push dose phenylephrine?
   a. 1 mg as a one-time dose
   b. Infusion rate: wide open
   c. 50 - 200 mcg q 2 - 5 mins
   d. 500 mcg q 5 mins

F. What is the most error prone step in preparing and administering push dose pressors?
   a. Drug incompatibility
   b. Storage of push dose
   c. Wrong bolus rate
   d. Medication reconstitution

G. Which aseptic technique is NOT required when creating or managing push dose pressors at the bedside?
   a. Hand hygiene before and after preparation/administration
   b. Disinfection of the medication access diaphragm on vial/neck of ampule
   c. Sterile glove and face mask use during preparation of medication
   d. Disinfection of IV access ports or vascular access device prior to administration

H. All of the following statements are safe administration and preparation of push dose pressors EXCEPT:
   a. It is appropriate not to label the syringe only if immediately administering the medication
   b. It is inappropriate to use a 10ml saline flush for dilutional preparation
   c. Vocalize the dose of push dose pressor given following administration
   d. Labelling should include at minimum the name of the medication and concentration

I. Proper labeling of 2 pressors prepared at bedside would be:
   a. Prepare one syringe, label it. Prepare second syringe, label it.
   b. Grab 2 prelabeled syringes and prepare according to the label.
   c. Label the first medication, as you know the second must be the other unlabeled mixture.
   d. Prepare both syringes and then label them prior to use.

J. Select the correctly paired push dose pressor with the adverse effect:
   a. Epinephrine: reflex bradycardia
   b. Phenylephrine: reflex bradycardia
   c. Phenylephrine: unopposed beta agonism
   d. Epinephrine: bronchoconstriction

CONCLUSIONS

- PDPs can be a useful tool for managing hypotension in the critically ill patient.
- However, adequate knowledge of dosing, formulation, and side effects for these medications is essential in limiting human error and adverse events.
- A lecture and simulation-based educational intervention can be an effective means to improve physician knowledge regarding proper dosing, formulation and side effects of PDPs.

FUTURE DIRECTIONS

- Obtain long term knowledge assessment with 3-month post lecture quiz
- Use of simulation lab to improve safety of healthcare in emergency department setting
- Platform to pursue further research studies in use of push dose vasopressors in the emergency department.

REFERENCES

1. Cole, J. B., Knack, S. K., Karl, E. R., Horton, G. B., Satpathy, R., & Driver, B. E. (2019). Human Errors and Adverse Hemodynamic Events Related to “Push Dose Pressors” in the Emergency Department. *Journal of Medical Toxicology,15*(4), 276-286. doi:10.1007/s13181-019-00716-z
2. Rotando, Andrew, et al. 2019. “Push dose pressors: Experience in critically ill patients outside of the operating room.” *The American Journal of Emergency Medicine* 37(3): 494-498.
3. Weingart, Scott. 2015. “Push-dose pressors for immediate blood pressure control.” *Clinical and Experimental Emergency Medicine* 2(2): 131-132.