

Accepted Manuscript

Medication errors with push dose pressors in the emergency department and intensive care units

Nicole M. Acquisto, Ryan P. Bodkin, Christine Johnstone

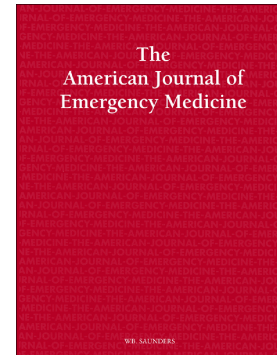
PII: S0735-6757(17)30452-7
DOI: doi: [10.1016/j.ajem.2017.06.013](https://doi.org/10.1016/j.ajem.2017.06.013)
Reference: YAJEM 56741

To appear in:

Received date: 6 February 2017
Revised date: 2 June 2017
Accepted date: 5 June 2017

Please cite this article as: Nicole M. Acquisto, Ryan P. Bodkin, Christine Johnstone , Medication errors with push dose pressors in the emergency department and intensive care units, (2017), doi: [10.1016/j.ajem.2017.06.013](https://doi.org/10.1016/j.ajem.2017.06.013)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Dear Reader,

Utilization of push dose pressors (PDP, low doses of phenylephrine or epinephrine administered IV push) during care of emergency medicine (EM) patients is increasingly popular in EM free open access medical education (FOAMed) [1,2] with resultant increased use in emergency department (ED) and intensive care unit (ICU) settings for peri-/post-intubation hypotension [3]. Due to prominence of this topic in FOAMed, indications are expanding to include bridge to continuous infusion vasopressors, medication related hypotension during procedural sedation and anaphylaxis.

This indication creep has potential detrimental effects, which are rarely discussed.

Concerns we have identified are:

1. Differences in patient populations regarding cause of hypotension
2. Decreased considerations for usual management of disease, hypotension and expected medication related adverse effects
3. PDP preparation during acute patient management and dose errors

We report PDP errors with phenylephrine and epinephrine at our institution. The first case, a post surgical patient with known blood loss/hypovolemic shock, developed hypotension during transport. Optimization of medications the patient was receiving (midazolam, fentanyl, hydromorphone) along with fluid resuscitation was not implemented initially. Phenylephrine PDP and propofol were used instead to treat hypotension and resultant hypertension. At presentation to ICU, phenylephrine “50” was ordered and 50 mg (50 mg/5 mL vials available in ICU for continuous infusion admixing)

was administered instead of intended 50 mcg. The second case, a post-laminectomy patient recently receiving norepinephrine continuous infusion for hemodynamic support, developed atrial fibrillation with rapid ventricular rate and was treated with diltiazem IV boluses/continuous infusion. The patient developed asymptomatic hypotension and phenylephrine PDP was ordered instead of fluid resuscitation/restarting norepinephrine (still at bedside) resulting in the entire phenylephrine pre-mixed syringe being administered by a physician, 1000 mcg [1000 mcg/10 mL], instead of intended 100 mcg. Epinephrine errors occurred with 0.3 and 1 mg administered IV for angioedema/allergic reaction (neither patient received intramuscular epinephrine) and 0.1 (100 mcg), 0.3, 0.5, and 1 mg IV administered to patients for hypotension instead of intended 5-20 mcg. Adverse effects in phenylephrine and epinephrine cases were transient blood pressure elevations (> 300 mm Hg), ST depressions, and QTc prolongation. These cases highlight our concerns using PDP in ED/ICU settings. In the phenylephrine cases, it appears that PDP were the first resuscitation measure instead of fluid/blood administration. Also, better understanding of pharmacokinetics, adverse effects, and optimization of other medications the patient was receiving may have changed decision-making and prevented PDP administration.

FOAMed videos describe preparation of epinephrine PDP using cardiac arrest epinephrine syringes [1], however in acute stressful situations there is confusion regarding preparation and dose [4]. Since recent FOAMed discussions and recommendations for IV epinephrine for anaphylaxis [2] there are more errors related to this indication at our institution. Other near miss errors that we have encountered are

physicians asking for epinephrine mixed to 100 mcg/mL concentration (misinterpretation of the 5-20 mcg dose vs. phenylephrine 100 mcg) and nurses asking to give 0.3 mg doses IV since the patient has IV access. It seems that first line therapy with IM epinephrine for anaphylaxis and initiation of fluids/norepinephrine for hypotension is not being considered.

Furthermore, EM/ICU physicians are not traditionally trained in medication manipulation. Phenylephrine (available 1 mg/mL) and epinephrine (available 1 mg/mL, 0.1 mg/mL) causes confusion regarding the number of dilutions to achieve the recommended mcg/mL concentration and dose. A proposed benefit of PDP is availability at bedside, but we feel the time taken to manipulate these concentrations to provide small doses of vasopressor actually take the same amount of time as admixing and initiating continuous infusion vasopressor. In some situations (e.g. peri-intubation period) hypotension can be anticipated and having continuous infusion vasopressor ready at bedside would be a safer alternative due to increased familiarity. Some may argue that having pre-mixed PDP syringes available may alleviate this confusion, however in one case we describe a ten-fold medication error with pre-mixed phenylephrine syringes.

There are limited data regarding PDP use and safety in the ED/ICU. An evaluation of phenylephrine PDP for peri-intubation hypotension in the ED found that use was not systematic and 70% of patients ultimately received continuous infusion vasopressors [3]. Author's conclude PDP are used as a "bridge to vasopressor infusion or aggressive fluid resuscitation" which we would argue should be first line treatment. They infer that non-

systematic use of phenylephrine may cause inadvertent negative effects for undifferentiated hypotension due to worsening shock secondary to inadequate fluid resuscitation. Although significant adverse effects were not seen in our patients past one hour, there are several reports of epinephrine IV errors ranging from 0.04 – 1 mg with significant adverse effects (intracerebral bleed, myocardial ischemia/infarction and dysrhythmias) [5-10]. There has been overwhelming positive support through FOAMed for PDP, but we believe it is important to present an opposing discussion regarding medication errors, patient safety, and potential risk.

REFERENCES

1. Weingart S. EMCrit Podcast 6 – Push-dose pressors. July 10, 2009. Available at: www.emcrit.org/podcasts/bolus-dose-pressors.
2. Emergency Medicine: Reviews and Perspectives (EMRAP). The Doc in the Bay: Underutilizing Epi in Anaphylaxis. December 2015;15 (12). Available at: www.emrap.org
3. Panchal AR, Satyanarayan A, Bahadir JD, Hays D, Mosier J. Efficacy of bolus-dose phenylephrine for peri-intubation hypotension. *J Emerg Med* 2015;49:488-94.
4. Emergency Medicine: Reviews and Perspectives (EMRAP). Strayerisms: Anaphylaxis Rebuttal. May 2016;16 (5). Available at: www.emrap.org
5. Kanwar M, Irvin CB, Frank JJ, Webber K, Rosman H. Confusion about epinephrine dosing leading to iatrogenic overdose: a life-threatening problem with a potential solution. *Ann Emerg Med* 2010;55:341-44.
6. Anchor J, Settipane RA. Appropriate use of epinephrine in anaphylaxis. *Am J Emerg Med* 2004;22:488-90.
7. Campbell RL, Bellolio F, Knutson BD, et al. Epinephrine in anaphylaxis: higher risk of cardiovascular complications and overdose after administration of intravenous bolus epinephrine compared with intramuscular epinephrine. *J Allergy Clin Immunol Pract* 2015;3:76-80.
8. Shaver KJ, Adams C, Weiss SJ. Acute myocardial infarction after administration of low-dose intravenous ephinephrine for anaphylaxis. *CEJM* 2006;8:289-94.

9. Park JS, Min JH, In YN. Acute myocardial infarction due to stent thrombosis after administration of intravenous epinephrine for anaphylaxis. *Chinese Medical Journal* 2015;128:2692-93.
10. Khoueiry G, Rafeh NA, Azab B, et al. Reverse takotsubo cardiomyopathy in the setting of anaphylaxis treated with high dose intravenous epinephrine. *J Emerg Med* 2013;44:96-99.

ACCEPTED MANUSCRIPT

TITLE PAGE**Title**

Medication errors with push dose pressors in the emergency department and intensive care units

Running Title

Medication Errors with Push Dose Pressors

Authors

Nicole M. Acquisto, Pharm.D.

Emergency Medicine Clinical Pharmacy Specialist, Department of Pharmacy

Assistant Professor, Department of Emergency Medicine

University of Rochester Medical Center

601 Elmwood Ave. Box 638

Rochester, NY 14642

Ryan P. Bodkin, MD, MBA

Assistant Professor, Department of Emergency Medicine

University of Rochester Medical Center

601 Elmwood Ave, Box 655

Rochester, NY 14642

Christine Johnstone, DO

Resident, Department of Emergency Medicine

Medication Errors with Push Dose Pressors

601 Elmwood Ave, Box 655
University of Rochester Medical Center
Rochester, NY 14642

Reprint Requests

Nicole M. Acquisto, Pharm.D.

Emergency Medicine Clinical Pharmacy Specialist, Department of Pharmacy

Assistant Professor, Department of Emergency Medicine

University of Rochester Medical Center

601 Elmwood Ave. Box 638

Rochester, NY 14642

Telephone: 585-275-6147

Email: nicole_acquisto@urmc.rochester.edu (e-mail address may be published)

Source of Support

None

Prior Presentations

None

Keywords

Push dose pressors, vasopressors, medication errors