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Shifting Paradigms In Prehospital Vasoactive Therapy: A Case For Push Dose Vasopressors in Prehospital

Protocols

By Andrew C. Spruce, BS, NR-P | 7.9.20

The current prehospital paramedic medication administration paradigm follows a call-and-response standard, giving a protocolized, measured amount of medication to patients. The exception to this is dopamine, which instead is dosed atypically to the prehospital paramedic paradigm, with the paramedic expected to titrate the medication to effect, minute-by-minute. Titration is a common practice for intensive and critical care units, emergency departments, critical care and specialty care transport, while utilizing intravenous pumps. However, this practice is not commonplace for the prehospital paramedic and can be especially dangerous without the use of intravenous pumps.

Alameda County EMS of California studied and published the use of push dose epinephrine for EMS in the *JEMS* article, *A Push for Push Dose Epinephrine*. The protocol used by Alameda County is for management of hypotension in shock (hypovolemia, sepsis, and cardiogenic). After initial fluid resuscitation (maximum of 500ml), the protocol calls for push dose epinephrine to maintain SBP >90, in 5mcg increments using a 10 mcg/mL epinephrine mixture, every three minutes as needed. Alameda County found a positive response both in patient outcomes and speed of administration by paramedics.

Use of push dose vasopressor therapy falls perfectly in-line with the call-and-response nature of all resuscitation environments and is especially well-suited for the prehospital model of care. Additionally, push dose vasopressor therapy is exponentially safer than drip vasopressor therapy in the absence of an intravenous pump. Push doses can be measured absolutely, given exactly, and the response recorded precisely. While the gold standard for the treatment of shock is still an intravenous vasoactive drip on pump

technology, push dose provides a quality alternative for the short term prehospital environment.

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An Anomalous Paradigm

Shock patients are encountered by prehospital providers on a regular basis. These patients, regardless of etiology, can require rapid, life-sustaining intervention. The prehospital model of treatment for hypotension in shock has largely rested with copious amounts of isotonic, crystalloid fluid therapy, with vasoactive therapies as a latent thought. This paradigm persists today in 2020 – for a few understandable but unacceptable reasons. One reason is that emergency medicine as a specialty has struggled with determining its own limits of fluid therapy. Even today, the benefits of large fluid resuscitation in septic shock is debated.[10]

Another common reason is logistics, with many 911 systems having not predicted the need and invested in technology and training that would make the use of prehospital vasoactive drips a safer and more commonplace practice. Many agencies are hesitant to invest the tens of thousands of dollars needed for intravenous pump technology for medications that may be administered to a fraction of their patients. Additionally, few EMS agencies prioritize high-fidelity training in the use of vasoactive drips and how to titrate safely, quickly and effectively. Even if these agencies were to prioritize this training, prehospital paramedics overall still do not receive the necessary exposure to feel truly competent and secure in their titration skills.

We must view this problem as a gap to adopting good clinical practice to the prehospital model of care. Medication administration paradigms of the hospital intensive care unit do not readily work in the prehospital environment, specifically due to the nature of the environment. Prehospital paramedics are the extension of resuscitationists, not intensivists. As such, we must shift the vasoactive medication administration paradigm

to a model fit for the environment: push dose vasopressor therapy. This therapy lines up perfectly with the call-and-response nature of all resuscitation environments and is especially well-suited for the prehospital model of care. Additionally, push dose vasopressor therapy is exponentially safer than drip vasopressor therapy in the absence of an intravenous pump. Push doses can be measured absolutely, given exactly, and the response recorded precisely.

Prehospital Theorem – Medication Administration

Typically, the practice of paramedicine subscribes to a call-and-response paradigm predicated on giving a protocolized, measured amount of medication, whether it be standard- or weight-based dosage. When faced with a suspected opioid overdose, the paramedic pushes narcan. When faced with a hypoglycemic patient, the paramedic pushes dextrose. When faced with a cardiac arrest, the paramedic pushes nearly all ACLS resuscitation medications, (i.e. sodium bicarbonate, calcium chloride, atropine or epinephrine).

Even medications that are given by drip have a measured, finite dose; whether it is amiodarone HCl, magnesium sulfate, or diltiazem HCl. The only medication within the scope of the non-SCT, prehospital paramedic that does not have a measured, finite dose is dopamine HCl. Dopamine instead is dosed atypically to the paramedic prehospital medication paradigm, with the paramedic expected to titrate the medication to effect, minute-by-minute.

Titration is a common practice in intensive and critical care units across the country, including emergency departments. Vasoactive titration is an important skill set of any critical care or emergency provider who cares for shock patients for an extended, post-resuscitation period. In critical care and specialty care transport medicine, titration is again a commonly used skill for the transport team nurse or paramedic. These providers, who are regularly titrating vasoactive medications most affirmatively, have access to

intravenous pumps that are capable of not only providing accurate amounts of medication minute-to-minute, but programed to safeguard the patient from medication error, using standardized concentration and dosing range guardrails. No reasonable critical care provider would attempt titration of a vasoactive medication by gravity, least of all without having the attention bandwidth to only focus on the drip and response.

This of course begs the question of why is this expected of prehospital paramedics, most of whom have little to no practical experience titrating medications. Few state EMS systems have mandated prehospital EMS agencies to invest in intravenous pump technology, and government funding is often readily available. Nonetheless, in 2020, with the portable, and user-friendly technology readily available, there is no valid reason to continue current practice with respect to vasoactive medications. This practice can be dangerous to the patient and can place the provider and agency in a grave amount of liability.

Fortunately, there is a cost effective and safer solution to temporize these patients until arrival at the hospital which falls within the current prehospital paramedic paradigm: push dose vasopressors. For example, epinephrine as a push dose vasopressor would allow for a known medication with a known response to be used for the hypotensive shock patient. Using a measured, finite dose of push dose epinephrine would fit well in the 'call-and-response' paradigm referenced earlier, with a set of measurable parameters for when to administer, how much to administer, and what goal is to be achieved.

Evidence and Recommendations

The latest evidence points to a more conservative fluid resuscitation in the hypotensive shock patient.[9] Even in septic shock, the prevailing treatment modalities favor the early administration of vasoactives over fluid therapy in excess of 30ml/kg.[3] There is no evidence that crystalloid fluids remain in the vascular space for any significant period,

so if the patient is not responsive to an initial one to two liters of therapy, there is no evidence of benefit in administering additional fluid therapy for the correction of hypotension. Instead, most recent protocols recommend starting low dose norepinephrine IV, or epinephrine as an alternative, to provide alpha receptor stimulation and systemic vasoconstriction to maintain an appropriate MAP.[2]

Dopamine is increasingly considered a less than adequate vasopressor for most forms of shock. Increased risk of cardiac arrhythmia, adverse events, and increased mortality rates have been documented.[1,7] While norepinephrine IV infusion has been a trending alternative to dopamine,[7] this paper recommends push dose epinephrine as an alternative in any system lacking intravenous pumps, and for all EMS systems as a rapid temporizing option. Epinephrine is the most abundant and effective medication for push dose vasopressor in the prehospital environment.

Epinephrine provides alpha-1 adrenergic and beta-1 stimulation, which would provide chronotropic and inotropic response.[7] While norepinephrine is mostly alpha-1, and phenylephrine is a sole alpha-1, these medications are not often stocked by EMS agencies, nor familiar to the prehospital paramedics who would be administering it. Utilization of these medications would prove to be much more logistically and operationally taxing as opposed to the use of epinephrine. After a push dose protocol has been implemented and become a more common practice prehospital action, it would be reasonable to consider utilizing push dose norepinephrine or phenylephrine at the discretion of the EMS agencies.

Jurisdictions in Use

California – Alameda County EMS[6]

Alameda County EMS is the developing agency and location of the push dose EMS study in the JEMS article *A Push for Push Dose Epinephrine* (2019). The protocol used by Alameda County is for management of hypotension in shock (hypovolemia, sepsis, and cardiogenic). After initial fluid resuscitation (maximum of 500ml), the protocol calls for push dose epinephrine to maintain a SBP >90, in 5mcg increments using a 10 mcg/mL

epinephrine mixture, every 3 minutes.

Pennsylvania – Statewide[5]

The State of Pennsylvania has adopted a push dose protocol for ALS providers statewide. Push dose can be found in all sections that address hypotension and shock. The protocol allows for a maximum dose of 20mcg per 1 to 2 minutes, using a standard 10mcg/ml

concentration. The goal of the protocol is directed by systolic blood pressure. Pennsylvania uses this as a bridge to vasoactive drip.

Standardized Concentration

To ensure that the 10mcg/ml concentration is mixed correctly each time, it is the recommendation of the authors that the mixture process be protocolized. The suggested method is:

- COLLECT ITEMS
  - 1 EPINEPHRINE 1:10,000 JET
  - 1 10ML NS FLUSH
  - 1 BLUNT TIP NEEDLE
- EXPEL AIR AND FLUID FROM 10ML NS FLUSH UNTIL 9ML REMAINS
- DRAW 1ML EPINEPHRINE 1:10,000
- FLUSH SHOULD BE BACK AT 10ML MARK
- SHAKE WELL FOR 5 SECONDS BEFORE USE
- PLACE "EPINEPHRINE 10MCG/ML" LABEL ON SYRINGE

Sample Protocol

- Indications
  - For hypotension in the non-fluid responsive shock patient. Criteria for administration is a SBP<90 in the presence of the following:
    - Altered mental status

- Altered Mental Status
  - Non-responsive to fluid therapy after 2 liters of Ringer's Lactate
- **OR** Altered Mental Status plus any of the following:
  - CRT >4 seconds
  - Fluid sensitive patient (pulmonary edema, heart failure, renal failure)
  - Neurogenic shock
  - Clinical judgement (peri-arrest state)

- Precautions
  - Quantities in excess of 50mcg/min can potentially cause end-organ damage[8]
- Push Dosage
  - Push dose is intended for the temporizing of hypotensive patients, unresponsive to fluid resuscitation, where vasopressor IV pump technology is not readily available. Remember: push dose is a short term bridge to IV drip and is not intended for prolonged use (notify the receiving facility as soon as possible of the use of push dose epinephrine).
    - Adults (standing order)[3]
      - For all hypotensive shock patients that are non-responsive to fluid resuscitation, or part of a fluid sensitive population, with a MAP<65 mm HG (NIBP must cycle every 2 minutes while using push dose epinephrine)
        - Mix push dose epinephrine with a normal saline flush for a concentration of 10mcg/ml
        - Administer 5-20mcg (0.5-2ml) IVP to maintain MAP≥65 and repeat as needed every 2-5 minutes
- Pediatric push dose[4]
  - For all hypotensive shock patients that are non-responsive to fluid resuscitation, or part of a fluid sensitive population, with a MAP at or above recommendation in age table below (NIBP must cycle every 2 minutes while using push dose epinephrine)

- Mix push dose epinephrine with a normal saline flush for a concentration of 10mcg/ml
- Administer 1mcg/kg to a maximum of 20mcg IVP to maintain age appropriate MAP and repeat as needed every 2 to 5 minutes

Conclusion

Push dose vasopressors is a measured, safe alternative for temporizing the hypotensive shock patient in the prehospital environment. The current prehospital titration-by-gravity vasopressor paradigm is poorly measured, inexact, and unfamiliar to the prehospital paramedic's everyday practice. Additionally, dopamine has fallen out of favor as a first-line vasopressor in the treatment of shock, with epinephrine as one recommended replacement.

Given the prehospital paramedic is already familiar with epinephrine, and it is ubiquitous in the drug boxes of all EMS agencies, utilizing epinephrine as a push dose vasopressor is cost effective and logistically advantageous. While the gold standard for the treatment of shock is still an intravenous vasoactive drip on pump technology, push dose provides a quality alternative for the short term prehospital environment.

Disclaimer: This paper reflects the views of the author and is not intended to supplant the protocol or standard of care currently in practice at any individual agency. Always follow your local protocol and medical direction when caring for patients. The author wrote this opinion from the prehospital environment perspective, not interfacility care.

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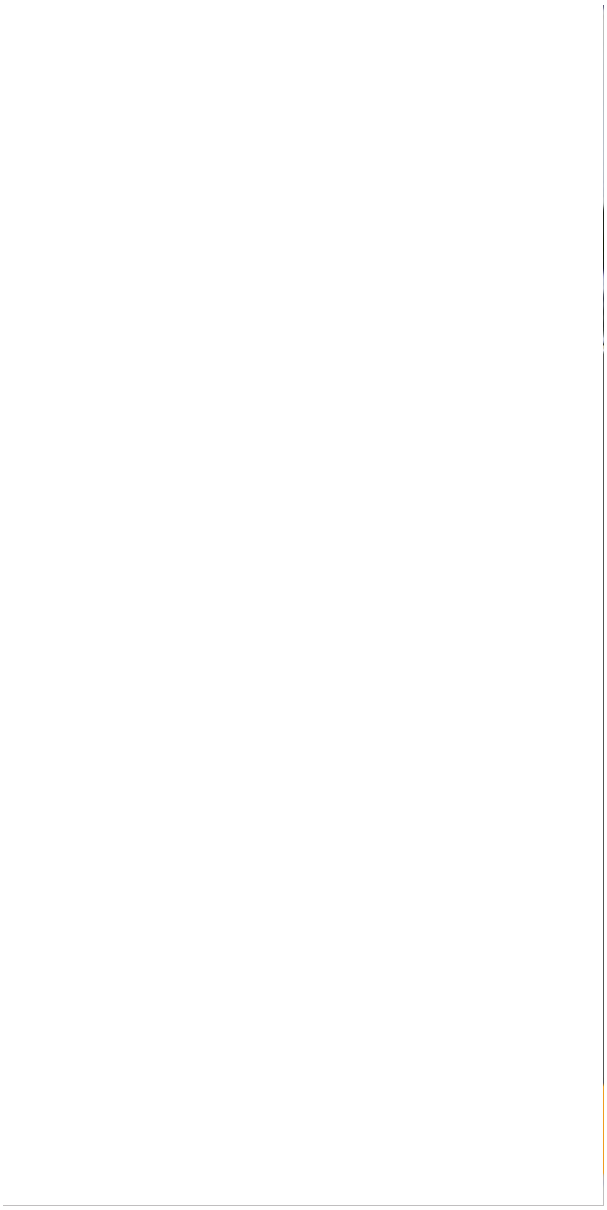

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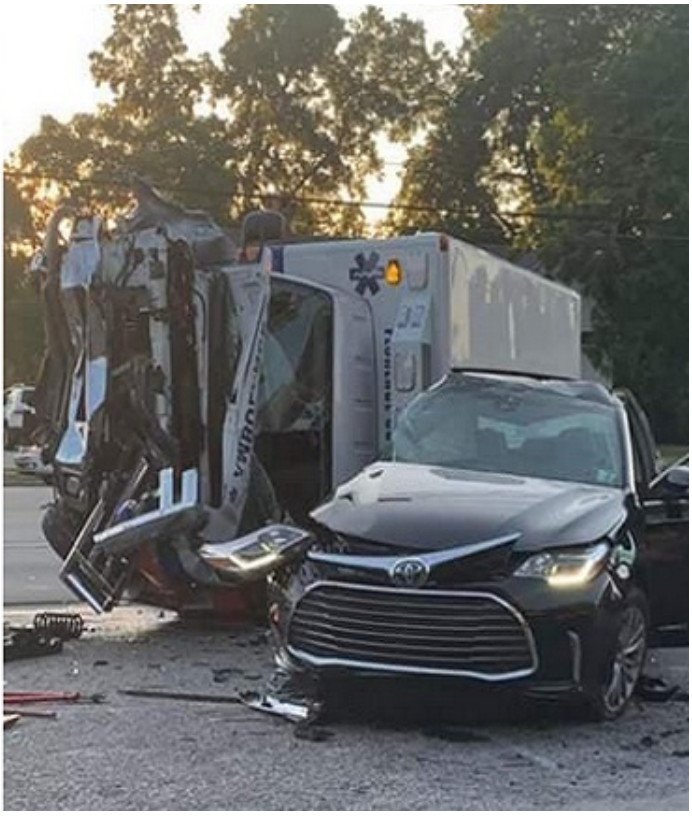

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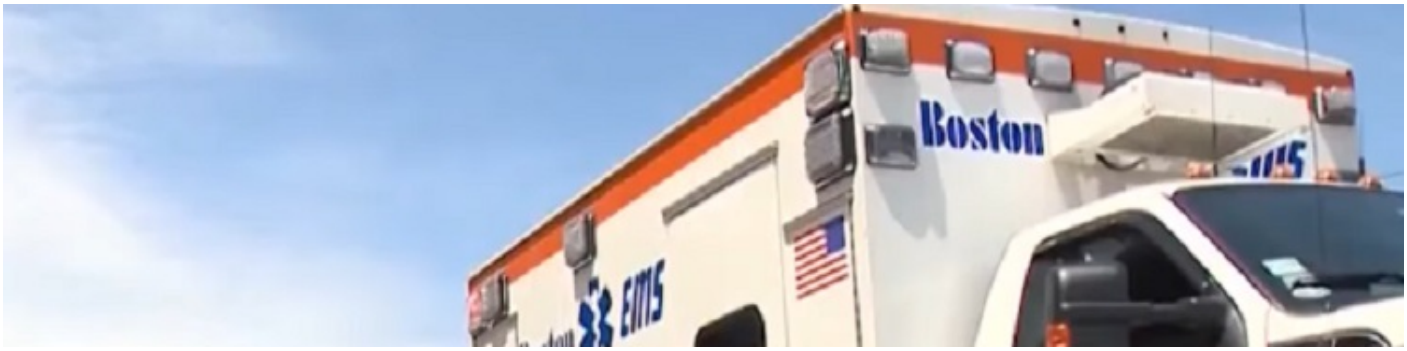

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