ISMP CANADA

Vasopressor stewardship: A case report and lessons shared

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Abstract

A case report, focused on vasopressor use and presented in this article, is likely to resonate with many critical care nurses. In this article the authors describe opportunities to enhance safety with vasopressor therapy. Specifically, the goal of improving communication among physicians, nurses, and pharmacists around desired endpoints for vasopressor therapy, triggers for reassessment of the therapeutic strategy and cause of the patient's shock was identified as an area for improvement. A form piloted within an organization for use during multidisciplinary rounds and key findings is shared. Vasopressors constitute the mainstay of therapy for nearly every hemodynamically unstable patient in critical care. It is hoped that the lessons and information shared help empower critical care nurses to facilitate vasopressor stewardship within their facilities and, ultimately, enhance patient safety.

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Case report

You are a nurse working a 12-hour night shift in the intensive care unit (ICU) of a tertiary care hospital. You receive a new admission, a 75-year-old male with acute respiratory distress syndrome (ARDS) transferred from a community hospital. He had been admitted to hospital one week prior for community-acquired pneumonia, but his condition had deteriorated despite treatment with broad spectrum intravenous (IV) antibiotics. He arrives intubated and mechanically ventilated, but his respiratory rate is rapid, irregular and poorly coordinated with the respirator. He requires deep sedation and neuromuscular blockade, which results in profound hypotension. You administer IV fluids and initiate vasopressors. The prescription is for a norepinephrine as a continuous infusion and states that the medication should be titrated to maintain a mean arterial pressure (MAP) of at least 65 mmHg. The intensivist eventually leaves the hospital with the impression that the patient's condition is improving.

Over the course of the night, you inform the resident on call that you are not able to obtain the target MAP prescribed, despite increasing doses of norepinephrine. The resident prescribes vasopressin and epinephrine IV infusions. By the end of your shift, the patient is profoundly malperfused with multiorgan failure despite a MAP that is on target, and even above, for most of the night. When the intensivist arrives in the morning, he is upset and feels he should have been notified of the situation earlier. Urgent continuous renal replacement to palliate the severe lactic acidosis that had worsened overnight is insufficient. Despite continuing resuscitation efforts, the patient dies a few hours later from refractory shock. No autopsy was performed.

This is a true case and, in its aftermath, discussions among the intensivist, his colleagues, house staff, nursing staff and pharmacists raised questions about vasopressor use and how to improve patient safety when administering these potent medications. This learning experience resulted in local efforts to enhance vasopressor safety, which are shared here to prevent a similar episode from occurring elsewhere. We believe this case reflects a common situation and that vasopressor stewardship may promote safer care of critically ill patients.

Background: Shock and vasopressors

Shock denotes multiorgan hypoperfusion and is associated with a high mortality. While shock and hypotension often co-exist and are sometimes mistakenly considered as the same thing, they are not synonymous. For example, a low blood pressure can be normal (and even healthy) in some individuals. On the other hand, tissue hypoperfusion can still occur with a normal blood pressure. Extremely low blood pressure values, however, invariably result in shock (Walley, 2005).

Vasopressors are medications that induce arterial (and sometimes venous) vasoconstriction, thereby increasing blood pressure. Some vasopressors also induce stronger and faster heart contractions. While vasopressors can be lifesaving, they

Table 1: Key components of piloted vasopressor form

Date:_____ Chart #:_____ Usual weight:_____kg

Intensive care unit*:

X site* Y site*

1. Which agent(s)?

Norepinephrine	Dopamine	Vasopressin
Epinephrine	Phenylephrine	Other: _____

2. Which indication?

Septic shock	Hypovolemic shock	Unknown cause shock
Cardiogenic shock	Obstructive shock	Other: _____

3. What is the target blood pressure and the tolerated range?

	Numerical value	Tolerated range		
MAP (mmHg):	_____	MIN: _____	MAX: _____	N/A: _____
SBP (mmHg):	_____	MIN: _____	MAX: _____	N/A: _____
DBP (mmHg):	_____	MIN: _____	MAX: _____	N/A: _____

Target blood pressure rationale (optional): _____

_____

4. What is the threshold dose that should trigger physician reassessment? (see suggestions below)
(Maximum dose should be prescribed in mcg/min and calculated using patient's usual weight)

Norepinephrine or epinephrine	> 0.2 mcg/kg/min
Dopamine	> 20 mcg/kg/min
Vasopressin	> 0.04 unit/min
Phenylephrine	> 0.75 mcg/kg/min

Example of vasopressor prescription:
Norepinephrine 8 mg in 250 mL of NS for IV infusion to maintain MAP of 65 mmHg (60–70 mmHg).
Call MD if the dose reaches 0.2 mcg/kg/min.

**Original piloted form specifies sites.*
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are also associated with numerous, often overlooked, harmful systemic effects, including increased myocardial oxygen consumption, gut and limb ischemia, modulation of the immune response against infection, and hyperglycemia (Farand, Hamel, Lauzier, Plante, & Lesur, 2006; Singer, 2007). Furthermore, in masking hypotension, vasopressors may delay clinicians' recognition that a patient's condition is deteriorating. Moreover, vasopressors are not curative. They are used to support the patient while definitive therapy takes effect.

Different forms of shock require different therapies, but intravenous fluids and vasopressors are used to support patients suffering from the most common forms of shock (Hollenberg, 2011). However, the optimal endpoints for resuscitation are unclear and blood pressure values that ensure adequate tissue perfusion without requiring excessive doses of vasopressors are unknown. Compelled to draw on expert opinion, current guidelines issued by the Surviving Sepsis Campaign recommend a minimum MAP of 65 mmHg for patients in septic shock (Dellinger et al., 2013; Hollenberg et al., 2004). To address this important gap in current knowledge, randomized controlled trials were recently completed (NCT01149278 Clinical Trial, 2010) or are currently under way (NCT01800877 Clinical Trial, 2013) to specifically address the question of optimal blood pressure targets for vasopressor dosing in shock. Until the results from these studies become available, the case described provides an impetus to explore opportunities to make vasopressors safer by enhancing communication processes around vasopressor use.

Internal audit of vasopressor use

A multidisciplinary team of ICU clinicians (i.e., nurses, intensivists and pharmacists) audited vasopressor use for three consecutive weeks in the three ICUs of the hospital. This resulted in the design of a one-page form that the ICU team completed daily during morning rounds for every patient receiving vasopressors (Table 1). The form, approved by the hospital's medication safety committee and piloted internally, had three objectives: 1) to provide explicit targets for vasopressor dosing so that every member of the treating team interprets them similarly (distinguishing between target range and minimal threshold), 2) to prompt daily reassessments of the indication for vasopressors, and 3) to identify an easy to recognize trigger for notifying the most responsible physician.

Table 2: Indication for vasopressor use identified

Indication at the start of vasopressor therapy	Indication as reassessed over the course of vasopressor therapy
post sedation	septic shock
hemorrhagic shock	septic shock
dialysis-induced	septic shock
septic shock	anasarca in need of diuresis
post-cardiopulmonary bypass	cardiogenic shock

The team collected completed data forms for 29 consecutive patients treated with vasopressors. The duration of vasopressor use ranged from one to five days. Indications varied with each unit's specific case mix. For example, septic shock was the most common indication in the mixed medical surgical units, whereas post cardiopulmonary bypass surgery was the dominant indication in the cardiovascular unit. For 5 of the 29 patients (17%), the indication for vasopressor use changed over the course of treatment (Table 2).

Forty-eight clinicians (30 nurses, eight residents, four intensivists, six pharmacists) used the form and assessed its usefulness. The perception that prescriptions of vasopressors were clear increased from 33% before implementation of the form during morning rounds to 98% afterwards. Respondents stated that the most common sources of ambiguity were the definition of acceptable blood pressure values and the maximum tolerable dose of vasopressors.

Improving vasopressor safety

Important knowledge gaps exist regarding vasopressor requirements in shock, and results of clinical trials in progress will be instrumental in improving care. Meanwhile, the case highlighted here suggests that communication gaps exist among clinicians. This suggests other opportunities exist to further improve safety of vasopressor use.

First, vasopressor prescriptions that are written and provide a target blood pressure range instead of a single value better communicate when vasopressors should be reduced and may limit unnecessary exposure to these medications. Reports from published studies suggest that actual blood pressure values tend to be higher than intended per protocol (Rivers et al., 2001). In the presented case, the intensivist expected vasopressor doses to be kept as low as possible, but the prescription only stated a target MAP of "65 mmHg or greater". Prescribing blood pressure targets as a range avoids this type of misunderstanding.

Second, frequent reassessments of indications by the ICU multidisciplinary team are important in order to identify situations where vasopressors are unnecessary or where specific agents must be avoided. For example, the internal audit revealed a situation where vasopressors initially started for suspected post cardiopulmonary bypass vasoplegia were no longer required once it became clear that the hypotensive episode was caused by cardiogenic shock.

Third, empowering every member of the multidisciplinary ICU team to communicate concerns regarding the effect of vasopressors may facilitate early recognition of complications. Specific triggers warranting urgent communication with the physician responsible for the patient are one way to do this. During the clinical audit, nurses expressed their discomfort with unclear definitions for vasopressor efficacy and treatment failure. The physician involved might have communicated more clearly to the residents and nurses his wish to be called if parameters deteriorated. This, of course, implies expressing what a deteriorating clinical status means. Vasopressor doses constitute useful, straightforward triggers. While it is not necessarily wrong to administer high doses, patients who deteriorate invariably

become resistant to vasopressors, and rapidly increasing doses could constitute a sensitive marker of deterioration. Moreover, focusing on vasopressor dose, instead of blood pressure alone, helps to prevent a situation where worsening hypotension goes unnoticed because vasopressors are masking the event. Using these triggers, early recognition of common problems leading to shock that have specific therapies other than vasopressors (e.g., pulmonary embolism, hypovolemia, hemorrhage, myocardial infarction, and cardiogenic shock) would be expected to lead to more favourable patient outcomes.

These suggestions focus on better communication of vasopressor prescriptions and more careful monitoring of their usefulness. They constitute steps towards better vasopressor stewardship. Other measures like standardized paper or electronic orders may facilitate the system-level implementation of vasopressor stewardship. In other centres, this approach has improved compliance with thromboprophylaxis compliance and reduced prescription errors related to chemotherapy and total parenteral nutrition (Mitchell, Jones, Meguid, & Curtas, 1990; O'Connor, Adhikari, DeCaire, & Friedrich, 2009; Sano, Waddell, Solimando, Doulaveris, & Myhand, 2005). Most importantly, many clinicians play a role in administering vasopressors and improving patient care demands a multidisciplinary approach, engaging nurses, physicians, and pharmacists.

Conclusion

Ultimately, more important than "how" to promote vasopressor stewardship is the simple recognition that there is an opportunity to enhance safety with this class of medications. Given that they constitute the mainstay of therapy for nearly every hemodynamically unstable patient, given their potency and systemic effect profile, and given that patients who receive vasopressors are invariably among the most vulnerable patients in the health care system, clinicians have no margin of error. The risk of suboptimal vasopressor use is greater mortality and morbidity. But the opportunity to get it right is to save lives and reduce patient harm.

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ISMP Canada is an independent national not-for-profit organization committed to the advancement of medication safety in all health care settings. ISMP Canada maintains a national voluntary medication incident and 'near miss' reporting program founded for the purpose of sharing the learning experiences from medication errors. Our collaborative goal is implementation of preventive strategies and system safeguards to decrease the risk for error-induced injury.

ISMP Canada is a key partner in the Canadian Medication Incident Reporting and Prevention System (CMIRPS). Medication Incidents (including near misses) can be reported to ISMP Canada:

(i) through the website ***http://www.ismp-canada.org/err_report.htm*** *or*

(ii) by phone: 416-733-3131 or toll free: 1-866-544-7672.

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