

# Acute Limb Ischemic Events Post Pressor Support in the ICU Setting: Identifying a nurse driven protocol for identification and prevention

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## Abstract

Vasopressor support has become the therapeutic cornerstone in treating shock and maintaining perfusion in critically ill patients in the ICU setting. However, like any treatments there are adverse effects. Vasopressors allow patients experiencing hypotension related to hypovolemic or distributive shock to maintain perfusion of vital organs and preserve cardiac and neurological functioning, however, due to contractility of vessels they can cause a host of downstream problems. Acute limb ischemia is associated with vasopressor support, especially long-term support as well as hypercoagulable states often associated with pathologies seen in the ICU. The paradigm within the medical community has been “life over limb”, positing that perfusion trumps all. While perfusion of vital organs is undoubtedly the most important piece of the clinical picture, we present a paradigm shift to “life and limb”, implementing a nurse driven protocol for vascular checks, dependent padding of limbs as well as unit wide education on the ability to preserve vascular function through early intervention.

## Background

Common side effects for vasopressor usage include ischemia/infection, hyperglycemia, tachycardia and tachyarrhythmias (Russell, 2021). Vasopressors cause vasoconstriction, which increases the workload of the heart. In prolonged applications there can be cardiac contractility problems, as well as downstream issues with perfusion. In this review we focus on the downstream implications of vasoconstriction and associated complications with ischemia and infarct on soft tissue. Distal ischemia related to vasopressor support is further complicated by hypercoagulable states often seen in critically ill patients that can further reduce perfusion to distal extremities (Putko, 2021) Furthermore, if not promptly treated, soft tissue infections can lead to further shock as the body copes with another infection. While limb ischemia is a rare side effect of pressor support, further support for patients prior to experiencing any sort of necrosis is necessary to decrease the likelihood of complicating their hospital course.

## Objectives

- Identify patients at risk for acute limb ischemia based on pressor support > 2.6 days
  - Delineate patients in a risk metric based on amount of pressor support, as well as factors that would predispose patients to ischemic events, including hypercoagulable pathologies, preexisting distal occlusions, and social determinants such as smoking, hypertension, etc.
- For those patients deemed to be at significant risk of experiencing an ischemic event implement a nurse driven protocol within EPIC including q2h vascular checks, dependent padding of limbs and serum biomarker trends.
- Notify provider immediately if limbs appear dusky and/or pulses are not palpable; discuss consult to vascular and/or wound care at this time.
- Initiate a CNL driven education initiative on the unit on the signs of impending acute limb ischemia.

## Implications for Practice

The CNL is uniquely poised to contribute to positive outcomes based on closer surveillance of distal extremities to prevent acute limb ischemia through education on the unit, a nurse driven protocol for early detection and intervention as well as lateral integration with subspecialties such as wound care and vascular.

- Education: CNL's will provide unit wide education on acute limb ischemia as well as proposed plans for early detection and intervention
- Implementation: CNL's will work with administration to design a flow sheet within EPIC that allows for a nurse driven protocol to identify patients at high risk for ALI. By identifying high risk patients and carefully monitoring them throughout the course of their stay we are able to intervene appropriately and, where appropriate, prevent and treat distal limb necrosis. This flowsheet will populate as an order set after physicians initiate a pressor and allow for a nurse driven protocol of surveillance and intervention, including q2H vascular checks, dependent padding of limbs and orders that can be released at nursing discretion for trending of serum biomarkers such as aminotransferase, which can be an early marker of skeletal muscle breakdown and/or hypoxic livers.
- Lateral Integration: CNL's will integrate vascular and wound care teams into rounding to treat patients deemed at risk for ALI.

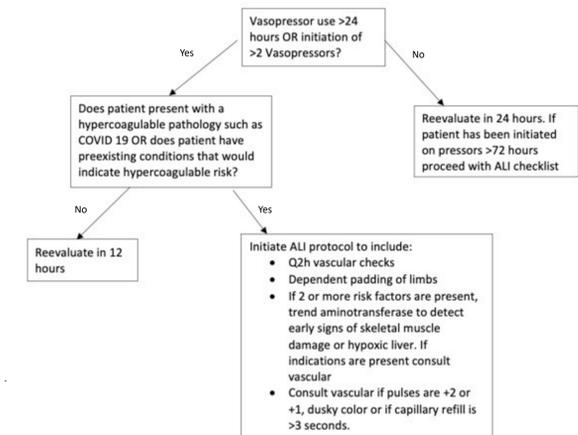
## Evidence Summary

Vasopressor initiation maintains perfusion in patients during periods of extreme hypotension and preserves function of vital organs, but occasionally to the detriment of distal extremities which experience necrosis thanks to the contractility of small vasculature. Warkentin et. al established a correlation between what they termed as “liver shock”, or a hypoxic liver and increased incidences of acute limb ischemia. In their retrospective case study, they identified patients with higher levels of serum aminotransferase as being particularly at risk for acute limb ischemia (Warkentin, 2015). Additionally, these patients often showed signs of hypoxic liver between 1 and 3 days before acute limb ischemia was discovered, indicating that increased levels of serum aminotransferase can be used to initiate an early protocol of q2 vascular checks, as well as a vascular protocol to preserve limb perfusion. Elevated levels of serum aminotransferase can also be indicative of skeletal muscle breakdown, potentially indicating distal necrosis. While this prospective case study does not provide solid evidence in human trials, a study done on mice indicated a link between “shock liver” and large vessel occlusion by thrombus (Safdar, 2013). Synthesizing these studies and analyzing them through the lens of acute limb ischemia post pressor support can lead to a new protocol for prevention of the latter. An additional element that presented during the research phase was the confounding issue of hypercoagulability within patients who are critically ill. In a study of COVID patients, Putko et al identified the hypercoagulability that critically ill patients experience as leading to issues of thrombus in the extremities, further complicating the issue of vasopressor induced limb ischemia. It is clear that an algorithm should be developed for patients who may present as a higher risk for thrombus. Deldar et. al presented a surgical algorithm used in their hospital for determination of limb saving procedures which was furthered by Newbury et al in their medical management of limb ischemia. Synthesizing these two into a clear protocol can lead to nurse driven identification of patients in need of closer scrutiny and ischemic limb protocols.

Authors, Years	Results	Level of Evidence	Quality
Livesey, 2020	Early recognition of distal ischemia during and post pressor support in the critical care setting leads to significantly significant less morbidity and mortality	IV	B
Newbury, 2020	Patients who experienced ALI had significantly higher pressor needs; they received on average 2.6 pressors as compared to 1.3 in the control group. Patients with ALI also were on pressors for significantly longer than patients who did not experience ALI (8.5 days vs 1.6 days).	IV	B
Putko, 2021	Hypercoagulability within the realm of SARS CO-V 2 infection can lead to increased issues with thrombosis and limb ischemia.	VI	B
Warkentin, 2016	Close monitoring of aminotransferase levels can indicate whether a patient should be on a more stringent vascular protocol (i.e., q2 vascular checks)	IV	B
Chanan, 2020	Provides treatment protocol for patients experiencing acute limb ischemia; important take aways are that serum biomarkers should be trended that indicate skeletal muscle breakdown	IV	B

## Implications for Practice, cont.

Example of flowsheet for nurse driven protocol:



## References



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