

MIDLINE CATHETERS ARE THE OPTIMAL VASCULAR ACCESS DEVICE FOR MANAGING SEPTIC SHOCK IN THE EMERGENCY DEPARTMENT

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Intravenous (IV) access is essential for the management of any critically ill patient. Since early goal-directed therapy in 2001, it has been dogma that central venous catheters are necessary for the “sepsis bundle” management of septic shock and administration of vasopressors.¹ This notion was born of the concern for medication extravasation leading to tissue necrosis and limb ischemia when vasoactive medications are administered via peripheral IV; however, these fears are based primarily on older case reports. Central venous catheter insertion is an invasive procedure commonly performed in the emergency department (ED). This procedure carries a risk of major mechanical complications and exposes patients to the potential for central line-associated blood infections (CLABSI).^{2,3} Recently, peripheral administration of vasopressors has gained acceptance as new evidence demonstrating that extravasation events with peripherally administered vasopressors are rare and unlikely to result in limb ischemia or necrosis.⁴⁻⁸ However, peripheral IVs are known to have limited capacity to provide reliable vascular access, often becoming displaced rapidly after insertion.^{9,10} Midline catheters represent a third option. Midline catheters have longer dwell times than peripheral IVs and fewer risks of major complications than central venous catheters, making them the superior choice for the management of septic shock in the ED setting.^{5,8,9-16}

Midline catheters have advantages over peripheral IVs for the management of septic shock in the ED setting for several reasons. Midline catheters are a heterogeneous group of vascular access devices that may be single or dual lumen, may feature fixed or trimmable catheters, and can be placed rapidly with techniques familiar to emergency physicians or nurses trained in advanced vascular access (eg, accelerated or classical Seldinger technique, similar vasculature to peripheral IVs). Despite the heterogeneity, midline catheters are categorically more reliable than peripheral IVs with reported average dwell times of 16.3 days for midline

catheters versus 4.8 days for peripheral IVs.⁹⁻¹¹ Furthermore, midline catheters can serve as reliable long-term vascular access with a study demonstrating that 68% of patients who underwent midline catheter placement never required additional IV insertion through the remainder of their hospitalization.⁵ This is a significant advantage over peripheral IVs, which have been demonstrated to have a failure rate of as high as 46% in the first 24 hours.^{9,10} Additionally, unlike peripheral IVs, some midline catheters are capable of providing multiple ports of access at a single site, which is often necessary to infuse several medications simultaneously as is common in the management of septic shock patients. Some midline catheters may simultaneously infuse incompatible medications depending on the proximity of the exit ports to one another. This allows vascular access device selection to be tailored to the clinical scenario without sacrificing reliable venous access. For example, a single-lumen, accelerated Seldinger technique device might be chosen for a reliable means of administering vasoactive agents during an active resuscitation, where a dual-lumen, classic Seldinger technique device might be selected when multiple ports of access are necessary.

Midline catheters also appear to be significantly less prone to the major complications associated with central venous catheters. One study demonstrated an overall major mechanical complication of central venous catheter placement of 1.4%, including 17 (0.6%) iatrogenic pneumothoraces.³ While the rates of major mechanical complications related to midline catheter placement have been reported as high as 3.3%, they are arguably less severe than those associated with central venous catheter insertion (eg, catheter occlusion, displacement, leakage, and infiltration versus pneumothorax, hematoma, and arterial injury).¹² Several studies performed in the acute care setting report even lower midline catheter-associated complication rates.^{5,8} Midline catheters also appear to result in fewer blood stream infections compared to central venous catheters. In a systematic review, midline catheters were found to have a blood stream infection rate of 0.2/1,000 catheter days compared with 2.7/1,000 catheter days for central venous catheter.¹³ One prospective study performed over the course of 2 years found no infections associated with midline catheters in 5,430 catheter days.¹⁴ Importantly, while midline catheter can cause blood stream infection, they cannot cause CLABSI by definition. While the impact of a midline catheter-associated blood stream infection is unknown, CLABSI has been associated with significant increases in cost, intensive care unit length of stay, and overall hospital length of stay.² Additionally, midline catheters likely have lower rates of symptomatic deep vein

thrombosis when compared to central venous catheters (0.2% to 3.97% vs 5% to 18%, respectively).^{8,15,16} Finally, it is conceivable that alert patients may prefer cannulation of an upper extremity vessel with a midline catheter rather than the sensitive areas necessary for most central venous cannulation (eg, neck or groin vessels) and without the discomfort of being underneath sterile drapes common to central venous catheters insertion. Moreover, central venous catheters are secured with sutures, which is a known source of discomfort, while midline catheters are typically secured with non-invasive skin adhesive devices.¹⁷ Importantly, the potential benefits of patient comfort and preference are speculative. Thus, midline catheters are capable of providing a safe means of providing venous access for vasopressor administration without the risk of CLABSI, which is beneficial to patient outcomes, hospital operations, and reimbursement.

Midline catheters as a class of vascular access devices are ideal for the treatment of septic shock. These catheters have the advantage of providing the rapid venous access of peripheral IVs with increased dwell time and fewer complications than central venous catheter insertion while featuring insertion techniques already familiar to emergency physicians.^{3,5,8,11-13} Furthermore, since they do not enter central circulation they cannot cause CLABSI, potentially improving patient outcomes, expediting hospital operations, and enhancing reimbursement.² For most septic shock patients, the versatility, reliability, and high safety profile makes midline catheters the optimal choice for vascular access in the management of patients with septic shock in the ED. Just as the management of septic shock has evolved beyond the Rivers protocol, so too must we evolve beyond the outdated one-size-fits-all bundle approach of the central venous catheter and with more nuance than a standard peripheral IV.

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