The Journal of Emergency Medicine, Vol. ■, No. ■, pp. 1–7, 2017

0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2017.09.007

Brief Report

COMPLICATIONS FROM ADMINISTRATION OF VASOPRESSORS THROUGH PERIPHERAL VENOUS CATHETERS: AN OBSERVATIONAL STUDY

Kamal Medlej, MD,* Amin Antoine Kazzi, MD,† Ahel El Hajj Chehade, MD,† Mothana Saad Eldine, MD,† Ali Chami, MD,† Rana Bachir, MPH,† Dina Zebian, PHD,† and Gilbert Abou Dagher, MD†

*Department of Emergency Medicine, Massachusetts General Hospital, Boston, Massachusetts and †Department of Emergency Medicine, American University of Beirut Medical Center, Beirut, Lebanon

Reprint Address: Gilbert Abou Dagher, MD, Department of Emergency Medicine, American University of Beirut Medical Center, P.O. Box 11-0236, Riad El Solh 110 72020, Beirut, Lebanon

□ **Abstract—Background: The placement of a central venous catheter for the administration of vasopressors is still recommended and required by many institutions because of concern about complications associated with peripheral administration of vasopressors. Objective: Our aim was to determine the incidence of complications from the administration of vasopressors through peripheral venous catheters (PVC) in patients with circulatory shock, and to identify the factors associated with these complications. Methods: This was a prospective, observational study conducted in the emergency department (ED) of a tertiary care medical center. Patients presenting to the ED with circulatory shock and in whom a vasopressor was started through a PVC were included. Research fellows examined the i.v. access site for complications twice daily during the period of peripheral vasopressor administration, then daily up to 48 h after treatment discontinuation or until the patient expired. Results: Of the 55 patients that were recruited, 3 (5.45% overall, 6% of patients receiving norepinephrine) developed complications; none were major. Two developed local extravasation and one developed local thrombophlebitis. All three complications occurred during the vasopressor infusion, none in the 48 h after discontinuation, and none required any medical or surgical intervention. Two of the three complications occurred in the hand, and all occurred in patients receiving norepinephrine and with 20-gauge catheters. Conclusions: The incidence of complications from the administration of vasopressors through a PVC is small and did not result in significant morbidity in this study. Larger prospective studies are needed to better determine the factors that are associated with these complications, and identify patients in whom this practice is safe.** © **2017 Published by Elsevier Inc.**

□ **Keywords—complications; critical care; peripheral venous catheters; sepsis; septic shock; vasopressors**

INTRODUCTION

Circulatory shock is frequently encountered in the emergency department (ED) and is a life-threatening condition if not addressed promptly (1). The early initiation of vasoactive agents in certain distributive shock states like septic shock has been associated with improved survival (2–4). The early goal-directed therapy (EGDT) trial by Rivers et al. emphasized early aggressive i.v. fluid administration, vasopressor initiation in cases of refractory hypotension, and placement of a central venous catheter (CVC) to measure central venous pressure (CVP) and central venous oxygen saturation ($ScvO_2$) (5,6). Since the introduction of EGDT, the need for placement of a CVC in sepsis has come under increasing scrutiny. Alternative means of monitoring fluid responsiveness and adequacy of resuscitation that do not rely on central venous access

Received: 19 May 2017; Final submission received: 22 August 2017;
Accepted: 14 September 2017

have been described (7–14). The placement of a CVC has also been identified as a barrier to the implementation of EGDT, as it is a time-consuming procedure that cannot always be easily or safely performed in the ED (15,16). However, the placement of a CVC for the administration of vasopressors is still recommended and required by many institutions, given the concern for complications associated with peripheral administration of vasopressors. A literature search for the nature and incidence of complications associated with administration of vasopressors through a PVC yielded a number of case series and case reports describing skin necrosis after the administration of norepinephrine (17–19). One study dating back to 1956 described two cases of tissue necrosis in 55 patients who received the drug (3.6% complication rate) (19). These complications were also described with vasopressin and dopamine (20–23). It must be noted, however, that the placement of a CVC can have complication rates as high as 22% (24–28).

While administration of vasopressors through a PVC is usually avoided, it is difficult to properly assess the risk of such practice without further studies. We are unaware of any large prospective studies looking at the incidence of complications from the peripheral administration of vasopressors. The rate of extravasation, rate of complications, infusion sites most likely to lead to complications, and concentrations of vasopressors most likely to lead to complications remain unknown.

This prospective observational study was conducted in the ED of a tertiary care academic center that routinely administers vasopressors through a PVC. We hope it will help determine the true incidence of complications associated with peripheral administrations of vasopressors, as well as identify factors associated with complications, and situations in which this practice may be safe.

MATERIALS AND METHODS

This study was submitted to and approved by the Institutional Review Board (IRB). Between May 2013 and April 2015, we identified all patients presenting to the ED of a tertiary care academic center who were started on vasopressors through a PVC (of note, infusion of vasopressors through ultrasound-guided peripheral lines is infrequent, but not expressly forbidden at our institution). The patients, or their next of kin if the patients did not have capacity to understand or sign the consent forms, were approached by research fellows and the purpose of the study was explained. Fifty-five patients were enrolled in the study after signing an informed consent form that was approved by the IRB. Of note, prospective research in the emergency setting in our patient population is, unfortunately, not common, and potential subjects are sometimes reluctant to enroll in academic studies, given the high-pressure context. In our study, 13 patients refused to sign consent and could not be recruited. Once enrolled, patients were followed by research fellows (recently graduated MDs choosing to work as post-doctoral research fellows for 1–2 years before starting their residency) who physically examined the i.v. access sites twice daily during the period of peripheral vasopressor administration, then daily up to 48 h after treatment discontinuation, or until the patient expired. The period of 48 h was chosen because some studies have reported a delayed presentation of complications up to 48 h after the discontinuation of the peripheral infusion of vasopressors (17,19). The different types of circulatory shock were prospectively assessed for each patient by the research fellows in consultation with the principal investigator. The research fellows were physicians that had been educated to identify the complications of interest, which were divided into minor complications (drug extravasation, thrombophlebitis, and localized cellulitis) and major complications (tissue necrosis and limb ischemia). The role of the research fellows was entirely observational and they did not influence decisions made by the medical teams caring for the patients.

Data on the duration of peripheral vasopressor treatment, type of vasopressor used, dilution of the vasopressor, maximal infusion rate (norepinephrine i.v. infusion is dosed in μg/min and dopamine infusion is dosed in μg/kg/min), and PVC location were collected. In addition, we also recorded the gauge of the catheter used; reason for treatment discontinuation; duration of vasopressor use through the peripheral line post recognition of a complication; and complication type, site, and timing (complications were prospectively classified as major and minor, with major complications defined as resulting in long-term morbidity and mortality). We further documented the location of inpatient transfer (regular floor or intensive care unit [ICU]), the duration of hospital stay, and the date the patient expired, when applicable.

Categorical variables were tabulated and analyzed using frequency and percentage, whereas the continuous variables were summarized as mean $\pm$ standard deviation. All analyses were conducted using the Statistical Package for Social Science, version 22.0.

RESULTS

Patient Demographics

Fifty-five patients were enrolled in this study, 34 (61.8%) males and 21 (38.2%) females, with a combined mean age of 70 years. Two-thirds of the patients had a history of hypertension (67.3%) and about half had diabetes