Placement of a Peripherally Inserted Central Catheter in a Prone Patient With COVID-19

Feasibility and Case Report

Linda Kelly, DNP, CNP, NCMP • Denise Dreher, RN, CRNI®, VA-BC • Georgia Kim, RN, CRNI® • Timothy Hughes, BSN, RN • A. Sassan Sabouri, MD

ABSTRACT

The emergence of the coronavirus disease 2019 (COVID-19) virus has increased in patients with acute respiratory distress syndrome (ARDS). The use of prone positioning during COVID-19–associated ARDS has led to improved oxygenation and decreased mortality. Extended hours of proning may delay or prevent traditional approaches to central vascular access, such as jugular, subclavian, or femoral cannulation. A peripherally inserted central catheter (PICC) is a viable option for prone patients. This article presents a PICC placement in a 56-year-old man with COVID-19 ARDS who required 20- to 24-hour prone positioning during his care in the intensive care unit. Insertion of a PICC while the patient is prone expedites lifesaving medications and infusions without waiting for the patient to be stable enough to be turned to the supine position.

Key words: acute respiratory distress syndrome, catheterization, central venous, coronavirus, peripherally inserted central catheter, prone position, SARS

The prone position has been used as an adjuvant therapy since the 1970s to treat severe hypoxia in patients with acute respiratory distress syndrome (ARDS).[1,2] Proning a patient allows for improved gas exchange in the lungs. The tidal volume stabilizes, in part, by reversing pleural pressure, which becomes more negative in the dorsal sections of the lungs. The prone position also improves resting lung volume in the dorsocaudal regions by reducing the superimposed pressure of both the heart and the abdomen.[3]

Infection with severe acute respiratory coronavirus 2 (SARS-CoV-2) or coronavirus disease 2019 (COVID-19) infection can cause an uncommon but critical ARDS. Management of ARDS attributed to this virus requires a multistep method including periodic prone positioning of the patient.[4,5] In a typical ARDS prone position, the patient is lying on their abdomen face down. Their head is turned toward the ventilator with the arm on the side of the ventilator raised above their head. The arm on the side opposite the ventilator is adducted (Figure 1).

Although central vascular access is a critical step in managing patients with ARDS, prone positioning may be critical. In patients with SARS-CoV-2–induced ARDS, proning may be used for a minimum of 12 hours per day.[5,6] Ultrasound-guided central vascular access device (CVAD) placement can be done in atypical patient positions, including prone

Author Affiliations: *Massachusetts General Hospital, Boston, Massachusetts (Drs Kelly and Sabouri, Mss Dreher and Kim, and Mr Hughes).*

Linda Kelly, DNP, CNP, NCMP, *is a doctoral-prepared nurse. She has worked at Massachusetts General Hospital for 38 years and is currently the nursing director for the vascular access nursing team. In her role she promotes patient-centered care and advancing vascular access. Dr Kelly also practices as a certified nurse practitioner.* **Denise Dreher, RN, CRNI®, VA-BC,** *has worked at Massachusetts General Hospital for 46 years, 39 of those on the vascular access nursing team. Ms Dreher is a clinical scholar and a subject matter expert in vascular access nursing.* **Georgia Kim, RN, CRNI®,** *has worked on the vascular access nursing team at Massachusetts General Hospital for 15 years. In her role, she has championed the use of ultrasound guidance in peripheral intravenous catheter placements.* **Timothy Hughes, BSN, RN,** *has worked at Massachusetts General Hospital for 15 years and on the vascular access nursing team for the past 6 years. In his role, Mr Hughes is one of the primary resource nurses for the vascular access nursing team.* **A. Sassan Sabouri, MD,** *holds a dual appointment at Massachusetts General Hospital, as the medical director of the vascular access nursing team for 5 years and as an anesthesiologist for the Department of Anesthesia, Critical Care, and Pain Medicine for 10 years. He is an assistant professor of anesthesia at Harvard Medical School and has 29 years of experience in anesthesia and critical care medicine.*

The authors of this article have no conflicts of interest to disclose.

Corresponding Author: *Linda Kelly, DNP, CNP, NCMP, Massachusetts General Hospital, 55 Fruit St, MGH Bigelow 1034, Boston, MA 02114 (lkelly2@partners.org).*

DOI: 10.1097/NAN.0000000000000430

Copyright © 2021 Infusion Nurses Society. Unauthorized reproduction of this article is prohibited.

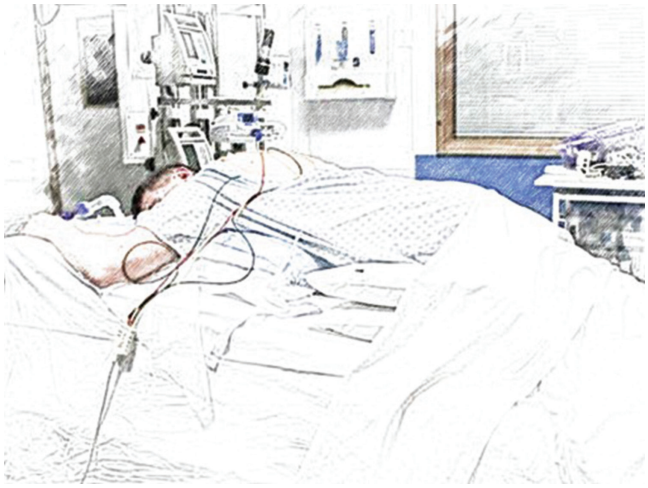

Figure1 Image of a typical prone positing in the ICU and placement of 3 ECG leads. © A. Sassan Sabouri, MD. *Abbreviations: ECG, electrocardiogram; ICU, intensive care unit.*

position.[7-9] However, prone positioning may cause challenges for the placement of a CVAD. Even with using real-time ultrasound visualization of related anatomic structures, this positioning might be challenging and may increase the risks of complications. Real-time ultrasound provides the operator the benefit of visualizing the target vein and surrounding anatomic structures, such as arteries and nerve bundles.[7] Hereby, a successful peripherally inserted central catheter (PICC) insertion in a patient with SARS-CoV-2 ARDS as an alternative to CVAD placement via the chest or neck is presented. Objectives for presenting this case are to: (1) discuss the rationale for placing a PICC rather than a CVAD in a prone patient with ARDS, (2) describe the technical considerations when establishing a PICC in a prone patient, and (3) compare the PICC confirmation methods used in a prone patient with a standard method of care, which is PICC placement in a supine patient.

CASE REPORT

The patient was a 56-year-old man with a height of 5'6" and a weight of 182 pounds, resulting in a body mass index (BMI) of 29.53. The patient was admitted to a 1000-bed, level I trauma center in a major quaternary medical center in Boston, Massachusetts, in April 2020. The patient had a 12-day history of fever, congestion, and shortness of breath. His condition was coupled with multiple comorbidities, including diabetes, hypertension, chronic kidney disease, and status postrenal transplant in 2017. The day after admission, laboratory tests revealed the patient was positive for COVID-19 via the real-time reverse transcription-polymerase chain reaction (RT-PCR). The patient's condition deteriorated rapidly from the initial presentation over the next couple of days, manifesting itself in acute respiratory distress, hypoxia, and increased inflammatory markers, including absolute neutrophil count (ANC), ferritin, procalcitonin (PCT), and C-reactive protein (CRP). He also had an elevated D-dimer. Transfer to the intensive care unit (ICU) was warranted, where a triple lumen left internal jugular (IJ) CVAD was inserted. Consideration had to be given to the prolonged proning schedule, increasing vasopressor requirements, and the need to start parenteral nutrition (PN).

The vascular access nursing team (VANT) was consulted to place an urgent PICC while the patient was in the prone position. The PICC insertion could not wait until the patient was supine, which would have been in the middle of the night. The tenuous combined factors of respiratory and hemodynamic instability would not allow early repositioning to supine. Clinicians on the ICU care team believed that insertion of a right IJ CVAD would be more challenging than a PICC placement in the current clinical situation with the patient prone.

Prone PICC Placement Description

Informed consent for the procedure was included in the ICU-bundled documents.[10] Prone positioning prohibited a visual assessment of the chest area to check for devices such as pacemakers, defibrillators, and implanted ports. A thorough medical chart review, including past medical and surgical history, radiology reports, blood work, and allergies, was completed.[10] A discussion with the ICU care team was also completed. A review of daily chest radiographs showed approximate superior vena cava (SVC) length and the absence of any implanted devices. Inspection of the axilla and shoulder areas revealed no scars from prior shoulder or axillary lymph node surgeries.

An arteriovenous fistula (AVF) was located on the left forearm; thus, the right upper arm was assessed using ultrasound. The need for vein preservation in patients with chronic kidney disease was recognized,[10] but a Nephrology Service consult was deferred by the ICU care team due to the acuity of the patient's clinical condition. The probe was held at the normal 90° angle to the arm during scanning. A brachial vein was chosen because of its greater vessel occupancy ratio as compared with the patient's basilic vein, and the targeted insertion site was marked with a surgical pen.[10] The decision was made to place a 5-French (FR) triple lumen power-injectable polyurethane PICC. This would allow for 2 additional lumens for medications; the third lumen (nonpower-injectable) would be labeled as *dedicated* for PN.[10]

The external catheter measurement was approximately 45 cm for PICC length. The electrocardiogram (ECG) electrode leads were placed on the patient's dorsal surface, with the black lead just below the right shoulder and the red lead applied just medial to the left hip. Lead placement for a supine approach would be the same right shoulder and left hip but placed on the ventral surface. The tip positioning system (TPS) device was placed between his scapulae.

Hand hygiene was performed, and full personal protective equipment (PPE) was donned, including sterile gown and gloves, face shield, hair cover, and N95 mask. Cutaneous

Copyright © 2021 Infusion Nurses Society. Unauthorized reproduction of this article is prohibited.

skin antisepsis was done utilizing 2% chlorhexidine gluconate, and maximal sterile barrier drapes were used. A second person's assistance was required to reposition the patient's arm by abduction and rotation, being mindful of the natural range of motion of the shoulder. This repositioning allowed more optimal access to the targeted site. The assistant also needed to retract the patient's upper arm skin folds (due to increased patient BMI) for needle insertion ease. The assistant was also a monitor to ensure that sterile technique was maintained throughout the procedure.[10] The large drape was placed over the left arm and covered the patient and bed so that the fenestrated opening would be positioned over the right arm PICC insertion site. A sterile probe cover was placed on the ultrasound probe, and the marked intended insertion site was validated again after patient repositioning. An intradermal dose of 2 to 3 mL of lidocaine 1% was given to provide local anesthesia for venipuncture and dermatotomy. The VANT then proceeded with a standard PICC insertion as if the patient was in the supine position, including catheter tip terminal placement using the ECG tip confirmation system.[11] ECG changes seen on this prone PICC insertion were the same as those seen on a supine insertion. A postinsertion chest radiograph was also done to verify tip location and validate ECG tip confirmation reliability in prone patients.[11] Extra care was taken not to dislodge the endotracheal tube when the x-ray plate was placed and then removed from under the patient. The radiograph confirmed the PICC tip at the cavoatrial junction, and the patient tolerated the procedure well without evidence of any immediate complications.

The PICC remained intact for >1 month as the patient was cared for in the ICU. The PICC was removed after an upper extremity ultrasound revealed a partially occlusive acute thrombus in the right brachial vein.

DISCUSSION

The worldwide COVID-19 pandemic has created one of the most significant public health challenges in the last century and has severely taxed health care institutions. The increase in numbers of critically ill patients with multisystem failure has been a greater part of this challenge. These patients are at higher risk for lengthy admissions in ICUs, many with life-threatening conditions. PICC insertion has been recommended for vascular access in patients with COVID-19.[12] The advantages of PICCs in patients with COVID-19 include compatibility with periodic proning and easy accessibility.[13] When compared with CVAD insertion, PICCs are generally easier to place and are more reliable, have a better safety profile, and provide long-term intravenous access.[14] PICCs are also traditionally placed with the patient in the supine position. In an atypical position, such as a prone patient, PICC placement is feasible with preplanning and team collaboration.

The VANT was proactive by anticipating a predicted COVID-19 first surge in March 2020, focusing on prone PICC placement feasibility. Four members of the VANT visited one of the ICUs to observe prone patients and received a detailed explanation of the proning process from the clinical nurse specialist in the unit. Baseline data were collected on inpatients with indwelling PICCs placed while in the traditional supine position. Exterior measurements were then taken on those patients when turned prone to assess for a correlation of measurements. Consistent similar measurements were obtained for each patient when turned supine. With a right upper arm approach, measurements were taken on patients in the prone position from their proposed insertion site to the axilla, then directly across to the medial edge of the right scapula. A left-sided approach was measured from the proposed insertion site to the axilla, then to the medial edge of the left scapula. Two centimeters were added to the measurement to compensate for the additional anatomic length, when approaching from the left side. The VANT believed the scapulae on a prone patient were comparable to using the clavicles as an anatomic landmark when measuring a supine patient.

CASE SUMMARY

This case represents a successful PICC placement in a prone patient. The thoughtful prework and discussion by the VANT of potential challenges that may occur were necessary to anticipate potential complications and ensure prone PICC placement could be a viable option in patients susceptible to SARS-CoV-2 ARDS. The discussions allowed the team to anticipate potential difficulties and possible thought-provoking variables they may encounter in the prone position. This includes the possibility of PICC-associated thrombus for patients in hypercoagulable states, which is common in patients with COVID-19–induced ARDS. Constructive ideas and possible solutions were shared. Potential preprocedural variables explored included measurement for catheter length, ECG lead placement, and arm position.

Although the PICC was successfully placed in this patient while in the prone position, there are limited data specific to the technical challenges and the success rates of placing PICCs while the patient is prone. Case series and control trial studies may need to be performed to compare prone versus supine PICC placement success and complications.

CONCLUSION

This case report demonstrated that PICC insertion in a prone patient is a feasible option, should not be considered a deterrent in a critical patient situation, and may be applicable for patients with acute COVID-19–induced ARDS. Preplanning and collaborative team discussions about potential prone PICC placement have been essential in the decision-making process since facing COVID-19 multisurges. Since the onset of COVID-19, the VANT has received more

Copyright © 2021 Infusion Nurses Society. Unauthorized reproduction of this article is prohibited.

consults for PICC placement in prone patients; however, no additional PICCs have been placed in prone patients at the time of this writing, because clinically appropriate criteria were not met for these consults. This successful PICC placement opened a dialogue with clinicians about a nontraditional approach to PICC insertion in potentially critically ill prone patients.

REFERENCES

1. Drahnak DM, Custer N. Prone positioning of patients with acute respiratory distress syndrome. *Crit Care Nurse*. 2015;35(6):29-37. doi:10.4037/ccn2015753
2. Guérin C, Reignier J, Richard J-C, et al. Prone positioning in severe acute respiratory distress syndrome. *N Engl J Med*. 2013;368(23):2159-2168. doi:10.1056/NEJMoa1214103
3. Gattinoni L, Taccone P, Carlesso E, Marini JJ. Prone position in acute respiratory distress syndrome. rationale, indications, and limits. *Am J Respir Crit Care Med*. 2013;188(11):1286-1293. doi:10.1164/rccm.201308-1532CI
4. Ghelichkhani P, Esmaeili M. Prone position in management of COVID-19 patients: a commentary. *Arch Acad Emerg Med*. 2020;8(1):e48.
5. Barrasa H, Rello J, Tejada S, et al. SARS-CoV-2 in Spanish intensive care units: early experience with 15-day survival in Vitoria. *Anaesth Crit Care Pain Med*. 2020;39(5):553-561. doi:10.1016/j.accpm.2020.04.001
6. Garcia B, Cousin N, Bourel C, et al. Prone positioning under VV-ECMO in SARS- CoV-2-induced acute respiratory distress syndrome. *Crit Care*. 2020;24(1):428. doi:10.1186/s13054-020-03162-4
7. Sofi K, Arab S. Ultrasound-guided central venous catheterization in prone position. *Saudi J Anaesth*. 2010;4(1):28-30.doi:10.4103/1658-354X.62612
8. Lazzari A, Bini R, Bertucci R, Coletti A, Voghera P. Ultrasound-guided intravenous catheter insertion in a prone patient using a T probe in emergency setting. *J Vasc Access*. 2017;18(6):e95-e97. doi:10.5301/jva.5000754
9. Anagnostopoulos D, Saranteas T, Papadimos T, Kostroglou A, Kouki P. Ultrasound-guided internal jugular catheter insertion in prone position. *J Cardiothorac Vasc Anesth*. 2020;34(5):1388-1390. doi:10.1053/j.jvca.2019.10.008
10. Gorski LA, Hadaway L, Hagle ME, et al. Infusion therapy standards of practice. *J Infus Nurs.* 2021;44(suppl 1):S1-S224. doi:10.1097/NAN.0000000000000396
11. Dale M, Higgins A, Carolan-Rees G. Sherlock 3CG(®) tip confirmation system for placement of peripherally inserted central catheters: a NICE medical technology guidance. *Appl Health Econ Health Policy*. 2016;14(1):41-49. doi:10.1007/s40258-015-0192-3
12. Centers for Disease Control and Prevention. Evaluating and testing persons for coronavirus disease 2019 (COVID-19). Published 2020. Updated March 17, 2021. Accessed March 26, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-criteria.html
13. Scoppettuolo G, Biasucci DG, Pittiruti M. Vascular access in COVID-19 patients: smart decisions for maximal safety. *J Vasc Access*. 2020;21(4):408-410. doi:10.1177/1129729820923935
14. Duwadi S, Zhao Q, Budal BS. Peripherally inserted central catheters in critically ill patients: complications and its prevention-a review [published correction appears in *Int J Nurs Sci.* 2020 Dec 05;8(1):IV]. *Int J Nurs Sci*. 2018;6(1):99-105. doi:10.1016/j.ijnss.2018.12.007

Copyright © 2021 Infusion Nurses Society. Unauthorized reproduction of this article is prohibited.