Innovative Positioning for Peripherally Inserted Central Catheter Insertion on a Prone Patient

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Abstract

Our hospital, a 220-bed, level-1 trauma center, sees an increase in patients with acute respiratory distress syndrome (ARDS) during the winter months. To maximize an ARDS patient's lung capacity and improve mortality rates (which can be as high as 40%), it is common for a critically ill patient to remain intubated in a prone position until ventilation/perfusion rates improve. When central line access is needed, but the patient cannot tolerate staying supine for the procedure, it was hypothesized that a peripherally inserted central catheter (PICC) could be placed with the patient prone. Six patients received PICCs with a 100% success rate. The ability to place a PICC in any critically ill, prone patient can expedite the administration of fluids and drugs by the critical care team and assist them in providing optimal care.

Keywords: *PICC, prone patient*

Vascular access specialists have been trained to stand at the side of a bed during placement of a peripherally inserted central catheter (PICC). Meeting with a patient who is in a semi-Fowlers position facilitates the examination of a patient's arm(s) while utilizing an ultrasound probe to locate a viable basilic, brachial, or cephalic vein. Finding the presence of thrombi, scarring, a dialysis shunt, or an implanted port often eliminates that arm as a site for PICC placement. The patient's chest area can also be inspected for the presence of open sores, a pacemaker, a defibrillator, mastectomy scars, and signs of present and previous subclavian ports or other central venous catheters (CVCs). This assessment helps to determine whether one arm is more favorable for PICC insertion than the other. Measurement of the length from the elbow to the estimated area of the superior vena cava/right atrial junction can be done as well at this time. The prospective patient, when alert and oriented, can also sign an informed consent while in the supine position.[1]

Our facility is a 220-bed, level-1 trauma center with 5 intensive care units. The vascular access team places approximately 1000 PICCs and 400 midline catheters per year throughout the hospital. Occasionally, a team member is asked to place a PICC on a patient with acute respiratory distress syndrome (ARDS) who is receiving treatment in a prone position. This type of patient, seen more frequently during the fall and winter months, often cannot tolerate remaining supine long enough to place a PICC.

ARDS is characterized by pulmonary congestion, impaired oxygenation, or decreased lung compliance followed by a pulmonary insult such as sepsis, trauma, aspiration, pneumonia, or systemic injury.[2] The alveoli in the lungs have an increased capillary permeability and hyaline membrane formation, with a resulting edema. The accumulation of protein-rich fluid in the alveoli impairs oxygenation.[3] Patients with ARDS have a mortality rate as high as 40%.[4] As early as 1974, the prone position was recommended as a lung-protective strategy in patients with ARDS. Over the years, pronation therapy in patients with ARDS has been shown to improve regional ventilation, alveolar recruitment and oxygenation, redistribution of perfusion, recruitment of perfused tissue from dorsal regions that exceeds ventral derecruitment, and greater equality

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Figure 1. **This is how the patient looked upon entering his hospital room.**

of ventilation and perfusion ratios.[2,4,5] More importantly, the prone position in patients with severe ARDS has been used to improve the survival rate.[2,5-9]

It had been the custom of our vascular access team to ask a prone patient's intensive care (ICU) nurse to advise us of a window of opportunity for PICC placement. As soon as the patient built up stamina to tolerate supine positioning for an hour, our team would be notified to place the PICC. However, occasionally while in the midst of the procedure, an ICU nurse would run into the room and implore us to complete the procedure more quickly due to patient deterioration. This would cause the vascular access team member a significant amount of stress, especially because this type of patient often had poor venous access to begin with.

One of the authors was asked by an ICU physician to try placing a PICC while the acutely ill patient remained in a prone position. This presented the challenge of maintaining maximal barrier precautions while choosing the correct anatomic vessel for cannulation. The insertion process was successful and 5 subsequent PICC insertions were accomplished on prone patients over the past year by 2 of the authors.

Case Study of a Prone Patient Needing Central Line Access

Why wait until a prone patient is supine? The following case history will illustrate why prone placement can be an excellent choice. The case study has been approved by our institution's institutional review board.

The patient was a 48-year-old morbidly obese man who weighed 371 lb (168 kg), was 6-ft tall (183 cm), and had a body surface area of 2.77 m^2. He had just finished a course of oral antibiotics at home for community-acquired pneumonia, and was still feeling poorly. The ambulance personnel who arrived at his home found the patient ashen and hypoxic, and placed a nonrebreather oxygen mask on him running at 15 L/min. An 18-g peripheral intravenous line (PIV) was placed in his left antecubital fossa. His comorbidities included hypertension, type 2 diabetes, gout, chronic pain, and a previous ablation for atrial fibrillation.

He arrived at our hospital's emergency room at 10:00 PM and was diagnosed with severe hypoxic respiratory failure. Initially hypertensive at 160/100 mm Hg, he was in a sinus rhythm with unifocal premature ventricular contractions. He was afebrile at 97.0°F (36.1°C). At 11:00 PM he was sedated, intubated without incident, and placed on a ventilator. Another PIV was inserted into his right hand.

Intravenous medications administered through the patient's 2 PIVs over the next several hours included piperacillin-tazobactam, vancomycin, methylprednisolone, fentanyl citrate, propofol, hydromorphone, vecuronium, iopamidol (for a computerized axial tomography scan), etomidate,

Figure 2. **A view of the patient's left arm, with the patient prone.**