Achieving a popliteal venous access for renal replacement therapy in critically ill COVID-19 patient in prone position

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ABSTRACT

This patient is a 67-year-old man who initially presented to our facility with acute respiratory failure secondary to COVID-19. Soon after arrival at our facility, the patient decompensated, developing severe acute respiratory distress syndrome requiring intubation and prone positioning to maintain adequate oxygenation. During the next few days, acute kidney injury with oliguria and severe volume overload developed. The vascular surgery service was consulted to obtain central venous access for emergent continuous renal replacement therapy. On examination, the patient was sedated and paralyzed in a rotating prone-positioning bed. He could not be positioned supine without immediately becoming hypoxic and decompensating. A 50-cm Permcath (Medtronic, Santa Rosa, Calif) was inserted through the left popliteal vein. This case report outlines a possible challenging scenario that the vascular interventionist may encounter in dealing with COVID-19 patients with respiratory compromise in the prone position. (J Vasc Surg Cases and Innovative Techniques 2020;6:266-8.)

Keywords: COVID-19; Renal; Replacement; Popliteal; Prone; Patient

At the time of this writing, the novel coronavirus COVID-19 is widely spreading as a once-in-a-century pandemic[1] with significant health implications, and it is responsible for more than a million infections worldwide.[2-4] At least 5% of those infected have become critically ill, developing acute respiratory distress syndrome (ARDS) complicated by acute kidney injury and multiorgan failure.[5,6] Many of these patients require central venous access for renal replacement therapy (RRT). Obtaining access, however, can be complicated by the prone positioning that is often employed for the management of severe ARDS. Here we present a case such as this and propose a novel solution to this complex access scenario. The patient's consent to publish this case report along with the technique and pictures was obtained before submission.

CASE REPORT

This patient is a 67-year-old man who initially presented to our facility with acute respiratory failure secondary to COVID-19. Soon after arrival at our facility, the patient decompensated, developing severe ARDS requiring intubation and prone positioning to maintain adequate oxygenation. During the next few days, acute kidney injury with oliguria and severe volume overload developed. The vascular surgery service was consulted to obtain central venous access for emergent continuous RRT (CRRT). On examination, the patient was sedated and paralyzed in a rotating prone-positioning bed. He could not be positioned supine without immediately becoming hypoxic and decompensating.

Considerations. In general, our first choice for access in critically ill patients requiring RRT is the internal jugular vein. If the internal jugular veins are not available, our second and third choices for access are the common femoral veins and subclavian veins, respectively. This patient, like many others with severe ARDS from COVID-19, had a number of barriers to obtaining access for RRT in the acute setting. First, prone positioning eliminates access to the common femoral veins and subclavian veins and makes obtaining internal jugular venous access significantly more challenging, elevating the risk of iatrogenic pneumothorax. Second, the proximity of the internal jugular veins to the patient's airway jeopardizes the dialysis nurses and ancillary staff by increasing their exposure to airway secretions and aerosolized particles, resulting in a heightened risk of viral transmission. Finally, many patients with COVID-19 have required prolonged treatment in the intensive care unit setting, worsening the development of long-term central venous stenosis with internal jugular or subclavian dialysis catheters.

Technique. In light of these considerations, we elected to place a 50-cm dialysis catheter in this patient's left popliteal vein. Under ultrasound guidance (Fig 1), the left popliteal vein was accessed in the popliteal fossa using a micropuncture technique. We prefer to examine the popliteal vein in both cross-sectional and longitudinal access to avoid any

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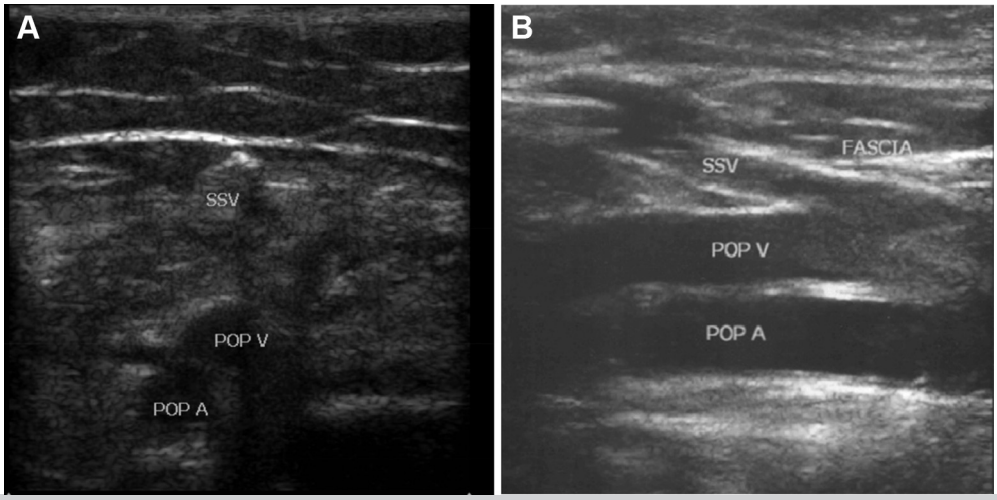

Fig 1. **A** and **B,** Venous duplex ultrasound B-mode images, axial and sagittal views. *POP A,* Popliteal artery; *POP V,* popliteal vein; *SSV,* small saphenous vein.

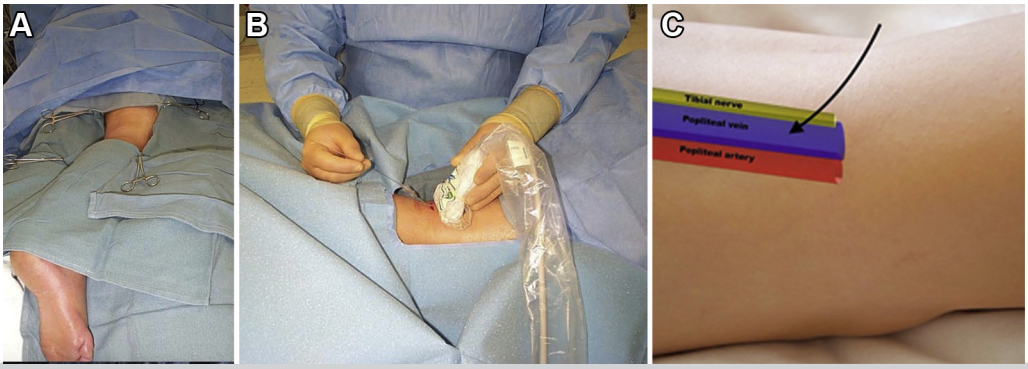

Fig 2. **A-C,** Accessing the popliteal vein in the popliteal fossa.

Fig 3. A 50-cm Permcath.

valve, with care taken not to injure the tibial nerve, which is located superficially, or the popliteal artery, which is the deepest structure in the popliteal fossa. A 4F micropuncture sheath was placed, and a stiff 0.035-inch wire was advanced without resistance. A skin nick was made over the wire, and the vein was dilated (Fig 2). The 50-cm dialysis catheter (Fig 3) was fully advanced. The catheter was then sutured in place, and both ports were flushed easily. At this point, CRRT was immediately initiated without difficulty. The patient ultimately recovered and was transferred out of the intensive care unit several days later.

DISCUSSION

The advantages of using popliteal venous access for RRT in critically ill COVID-19 patients are substantial. First, the popliteal vein is easily accessible in patients requiring prone positioning in the setting of severe ARDS, whereas the internal jugular, femoral, and subclavian veins are not. Second, using the popliteal vein for access physically distances medical personnel from the patient's upper airway, reducing transmission of the virus. Finally, using lower extremity access for RRT limits the development of catheter-induced superior vena cava and upper extremity central venous stenosis, which is known to cause long-term arteriovenous access failure.

There may be disadvantages to using popliteal venous access for RRT as well. First, this method of access is highly operator dependent, requiring familiarity with the anatomy of the popliteal fossa and comfort using ultrasound. Second, there is a risk of provoking lower

extremity deep venous thrombosis with this method, although the risk is presumably similar to that of developing upper extremity or internal jugular catheter-associated deep venous thrombosis. Finally, this method requires the use of a longer dialysis catheter to reach the deep central veins, which may limit high flow rates during RRT. In our limited experience, however, we have not found these problems to be significant.

CONCLUSIONS

This report details the first case of a critically ill COVID-19 patient who could not be positioned supine and required access for urgent CRRT. We achieved access through a 50-cm dialysis catheter placed in the left popliteal vein. To our knowledge, this technique has not been previously described in the vascular surgical literature. This unorthodox choice of access was beneficial to both the patient and the staff members involved in his care. He ultimately recovered renal function and was discharged without the need for long-term dialysis access. We propose that the popliteal veins can and should be considered for access in all critically ill COVID-19 patients requiring prone positioning and RRT.

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