

Thrombosis of the Right Internal Jugular Vein is Not a Contraindication to Ambulatory Veno-Venous Extracorporeal Membrane Oxygenation with a Bicaval Dual-Lumen, Single Cannula System

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ABSTRACT

Background: Veno-venous extracorporeal membrane oxygenation (VV-ECMO) is an ever-emerging method of managing respiratory failure in patients who are refractory to conventional mechanical ventilatory support. An increasingly common method of cannulation involves placement of a bicaval dual-lumen, single cannula via the right internal jugular (IJ) vein. Thrombus in this vein has been considered a contraindication for cannula placement.

Case report: A 45-year-old Hispanic male presented with bleomycin-induced respiratory failure resulting in acute respiratory distress syndrome (ARDS). Ambulatory VV-ECMO support was initiated, and during surgical cannula placement an occlusive thrombus was noted in the right IJ vein. A tract was dilated and the cannula was placed without any thromboembolic complications.

Conclusion: This case demonstrates that cannulation for ambulatory VV-ECMO in the setting of an occlusive IJ thrombus can be safe and feasible.

INTRODUCTION

For patients suffering from respiratory failure, treatment with veno-venous extracorporeal membrane oxygenation (VV-ECMO) is a viable option to support gas exchange [Peek 2009]. Conventional cannulation with VV-ECMO often requires two cannulas with femoral access, which commonly necessitates immobilization. This significantly limits physical mobility and often leads to further deconditioning of the patient. However, placement of a single right internal jugular (RIJ) cannula allows for ease of ambulation. Thrombosis of the IJ vein has been considered a contraindication to implementation of this cannulation strategy. We present a case of ambulatory VV-ECMO using a bicaval dual-lumen, single cannula system for a patient with severe respiratory failure

secondary to bleomycin-induced pulmonary toxicity, with pre-cannulation thrombosis of the RIJ vein.

CASE REPORT

A 45-year-old male with testicular cancer requiring chemotherapy developed acute respiratory distress syndrome (ARDS) secondary to bleomycin toxicity. He was initially treated with ventilatory support and high-dose steroids, but his ARDS continued to worsen with increasing peak pressures and FiO₂. On hospital day (HD) 15, due to his worsening clinical condition, the decision was made to support this patient with ambulatory ECMO.

The patient was brought to the operating room, and the RIJ vein was located under ultrasound guidance. This showed flow at the distal aspect of the vein, but complete occlusion of the proximal vein with no flow was detected. A 5-French micropuncture set (Cook Medical, Bloomington, IN, USA) was used to gain access to the right IJ vein under sonographic guidance. A venogram was obtained, confirming occlusion of the right IJ vein near the base of the neck with a patent superior vena cava (SVC). With the aid of a hydrophilic guidewire, a 5-French Kumpe (Cook Medical, Bloomington, IN, USA) catheter was advanced past the thrombus down to the inferior vena cava (IVC). The hydrophilic wire was exchanged for a stiff guidewire. After sequential dilation of the venous access site and occluded segment of the right IJ over the guidewire, a 31-French Avalon cannula (Avalon Laboratories, Rancho Dominguez, CA, USA) was inserted appropriately with the distal hole at the hepatic vein confluence and proximal hole at the opening of the right atrium, facing the direction of the tricuspid valve. Excellent flow with good oxygenation, ventilation, and carbon dioxide levels was observed. The patient tolerated the procedure well and had no apparent complications. While on ECMO, the patient was heparinized with an activated clotting time goal of 160 to 180 seconds, and after decannulation was bridged to warfarin. A CT angiogram obtained for further diagnostic work-up also showed the absence of any pulmonary emboli. The patient was decannulated on HD 31 and successfully discharged from the hospital on warfarin without antiplatelet therapy. An upper extremity duplex four months later showed chronic occlusive venous disease of the RIJ.

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DISCUSSION

We describe a case of successful and safe cannulation of a thrombosed right IJ vein with a bicaval dual-lumen, single cannula for VV-ECMO support. In the modern era, percutaneous access of the RIJ vein and femoral vein has become the mainstay of VV-ECMO cannulation, drastically reducing the risk of complications seen with open surgical cannulation. However, ambulation with femoral cannulation remains problematic. With the advent of the single cannula system via the RIJ vein, ambulation on ECMO has been reported. This has been shown to allow patients to recover faster in-hospital and improve mobility after discharge [Peek 2009; Kon 2011; Lee 2015; Rubino 2014; Schweickert 2009].

Thrombus in the RIJ is generally regarded as a contraindication to employing bicaval dual-lumen, single venous cannulation. Although femoral-femoral VV-ECMO is an alternative, it further exacerbates the concern with patient ambulation. Furthermore, some have reported less efficient delivery of oxygenated blood to the right heart due to recirculation [Kuhl 2015]. Although single cannulation VV-ECMO is not a novel idea [Peek 2009], recannulation of a thrombosed RIJ vein with a bicaval dual-lumen, single cannula has not been previously reported. While alternate methods of single cannulation ECMO, such as a left subclavian approach, have been developed, comfort level with these alternatives are limited and center-specific [Shafii 2012].

Alternative options to this approach included local thrombolytic therapy or mechanical thrombectomy [Tajima 2004]. However, thrombolysis necessitates many hours of local therapy and was not practical given the patient's clinical condition. Furthermore, there was significant concern about hemorrhagic complications from recent thrombolytic therapy combined with anticoagulation required for ECMO. Alternatively, mechanical thrombectomy may have increased the risk of distal embolization to the pulmonary bed.

The strategy employed in this case does present an obvious risk of pulmonary embolism. Therefore, care was taken to ensure that the thrombus was not mobile. Furthermore, careful dilation under fluoroscopic and ultrasound guidance

was performed to ensure a tract was being dilated instead of breaking the clot loose.

Since chronic respiratory failure is one of the major risk factors for deep vein thrombosis, a high percentage of patients who require ECMO may have thrombus in the RIJ vein [Galanaud 2009]. This approach may allow for expanded use of ambulatory ECMO in this patient population.

REFERENCES

- Galanaud JP, Sevestre-Pietri MA, Bosson JL, et al. 2009. Comparative study on risk factors and early outcome of symptomatic distal versus proximal deep vein thrombosis: Results from the OPTIMEV study. *Thromb Haemost* 102:493-500.
- Kon ZN, Iacono A, Griffith BP, Garcia, JP. 2011. Ambulatory ECMO: a new approach for bridge-to-lung transplantation. *J Thorac Cardiovasc Surg* 142:755-61.
- Kuhl T, Michels G, Pfister R, Wendt S, Langebartels G, Wahlers T. 2015. Comparison of the avalon dual-lumen cannula with conventional cannulation technique for venovenous extracorporeal membrane oxygenation. *Thorac Cardiovasc Surg* 63:653-62.
- Lee JJ, Hwang SM, Ko JH, et al. 2015. Efficacy of veno-venous extracorporeal membrane oxygenation in severe acute respiratory failure. *Yonsei Med J* 56:212-19.
- Peek GJ, Mugford M, Tiruvoipati R, et al. 2009. Efficacy and economic assessment of conventional ventilator support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CAESAR): a multicentre randomized controlled trial. *Lancet* 374:1351-63.
- Rubino A, Vuylsteke A, Jenkins DP, Fowles JA, Hockings L, Valchanov K. 2014. Direct complications of the Avalon bicaval dual-lumen cannula in respiratory extracorporeal membrane oxygenation (ECMO): Single-center experience. *Int J Artif Organs* 37:741-7.
- Schweickert WD, Pohlman MC, Pohlman AS, et al. 2009. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomized controlled trial. *Lancet* 373:1874-82.
- Shafii AE, McCurry KR. 2012. Subclavian insertion of the bicaval dual lumen cannula for venovenous extracorporeal membrane oxygenation. *Ann Thorac Surg* 94:663-5.
- Tajima H, Murata S, Kumazaki T, Ichikawa K, Tajiri T, Yamamoto Y. 2004. Successful interventional treatment of acute internal jugular vein thrombosis. *Am J Roentgenology* 182:467-9.