The Heart Surgery Forum #2014-365
18 (1), 2015 [Epub February 2015]
doi: 10.1532/hsf.1225

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Insertion of the Avalon Cannula for Venovenous Extracorporeal Membrane Oxygenation in a Patient with an Implanted ASD Occlusion Device

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ABSTRACT

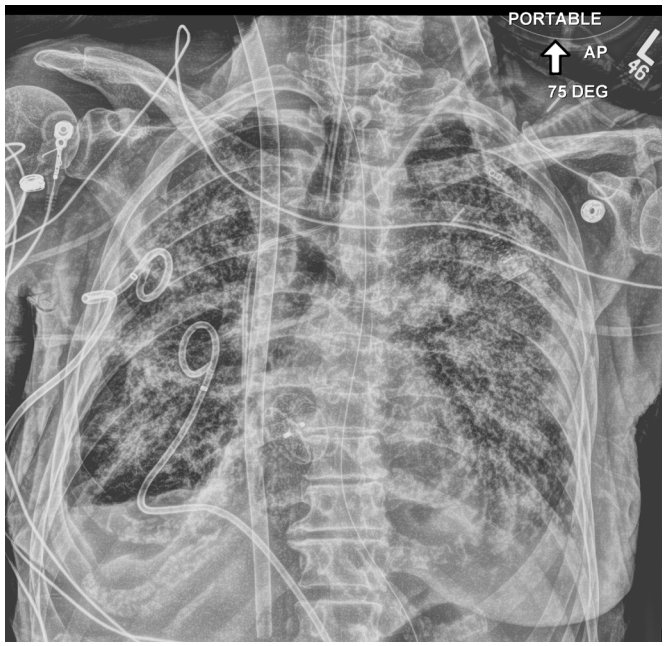
Use of the Avalon Elite bicaval dual lumen catheter (Maquet Cardiopulmonary AG, Rastatt, Germany) can be effective in patients requiring venovenous extracorporeal membrane oxygenation (VV-ECMO) for adult respiratory distress syndrome (ARDS). Proper placement of the cannula is important in providing adequate therapy and avoiding life-threatening complications. We report a case of successful cannulation in a patient with an implanted atrial septal defect (ASD) occlusion device who developed severe refractory ARDS.

INTRODUCTION

The Avalon Elite bicaval dual lumen catheter (Maquet Cardiopulmonary AG, Rastatt, Germany) can be used for venovenous extracorporeal membrane oxygenation (VV-ECMO) (Javidfar 2011; Bermudez 2010). This catheter offers advantages in decreasing the recirculation of oxygenated blood back within the ECMO circuit, thus maximizing the support VV-ECMO can offer patients with severe refractory adult respiratory distress syndrome (ARDS) (Javidfar 2011). Another benefit to the Avalon Elite is that it only requires one cannulation site; typically the right internal jugular vein. The catheter consists of two lumens. One lumen allows for adequate drainage of deoxygenated blood from the inferior vena cava (IVC) and the superior vena cava (SVC). The second lumen allows for oxygenated blood to return from the external oxygenator to the right atrium specifically directed at the tricuspid valve. Effective placement of this catheter can be safely performed at the bedside using the Seldinger technique and transesophageal echocardiography (TEE). It is imperative to have proper guide wire placement, SVC to IVC without coiling in the atrium, as visualized on TEE prior to advancement of the cannula, in order to avoid life-threatening complications such as right atrial or ventricle perforation (Hirose 2012). Using this technique, we describe successful cannulation of a patient with significant history for an atrial septal defect (ASD) occlusion device who developed severe refractory ARDS.

CASE REPORT

A 63-year-old female with significant past medical history for bipolar disease, hypothyroidism, hyperlipidemia, Graves' disease, and ASD repair with an occlusion device developed severe aspiration pneumonia status post attempted suicide. Patient initially presented to the emergency room at an outside hospital obtunded with severely depressed respiratory function. She was intubated and central line placement was attempted via the right subclavian. Post-procedure x-ray revealed a right-sided pneumothorax requiring chest tube placement. She subsequently developed septic shock, methicillin susceptible staphylococcus aureus (MSSA) pneumonia, and an empyema requiring 6 days of intubation.



Status post-venovenous cannulation via the right internal jugular vein.

Received May 18, 2014; received in revised form January 30, 2015; accepted February 12, 2015.

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Unfortunately, a persistent air leak remained from the chest tube; computed tomography scan showed it to be in the lung parenchyma. At this time she was transferred for possible surgical evaluation. The chest tube was removed with subsequent placement of two chest tubes for persistent pneumothorax. While awaiting potential surgical evaluation, the patient developed severe hypercapnic respiratory failure with profound hypoxemia that rapidly led to ARDS. Despite using ARDS protocol-driven ventilator management, inhaled nitric oxide, and neuromuscular blockade agents we were unable to achieve adequate ventilation. As a result, cannulation for VV-ECMO was planned. Using the Seldinger technique the right internal jugular vein was accessed. Under TEE guidance the guide wire was observed moving from the SVC down into the IVC without coiling or bending into the right atrium. In a step wise fashion the right internal jugular vein was dilated. After final dilatation, a bolus of 10,000 units intravenous heparin was given followed by advancement of a 27 French Avalon Elite catheter. Appropriate placement of the catheter was subsequently confirmed via TEE. No complications were observed. The ECMO flow could be started and maintained 3-4.5 liters/min the following days. The patient successfully tolerated the ECMO weaning trials during the following weeks.

DISCUSSION

Correct positioning of the Avalon cannula during insertion of VV-ECMO is of extreme importance to prevent complications and to provide effective oxygenation and CO2 elimination. We try to position the drainage port of the Avalon cannula in the IVC, optimizing removal of deoxygenated blood, with the infusion port in the mid right atrium, which should be directed toward the tricuspid valve. So we intend to have an optimized flow of blood from the outflow of the ECMO circuit toward the right ventricle and diseased lung. TEE can be used effectively to confirm proper positioning of the cannula. With the Avalon cannula in the right position the patient can ambulate and there is no need for a femoral cannula.

The insertion of the Avalon cannula can also include life-threatening complications. The guide wire may not be easily advanced into the IVC. In such a scenario, a looping of the wire and the cannula through the tricuspid valve and into the right ventricle can happen. A large Eustachian valve and/or extensive Chiari webs can cause the guide wire not to pass into the IVC. Fluoroscopic guidance can provide better confirmation of the right guide wire and cannula positioning in complicated cases. In our patient, the TEE guided placement could be done without any complications.

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