

Case Reports

Dermabond as a Novel Solution for Needle-Hole Repair in Arterial Cannula while on Extracorporeal Membrane Oxygenation Therapy

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Abstract: The annual incidence of extracorporeal membrane oxygenation (ECMO) for adult patients is increasing. Indications may vary from acute lung injury, ECMO-assisted cardiopulmonary resuscitation, to cardiac failure with an inability to wean from cardiopulmonary bypass. Complications may happen to the ECMO circuit, including cannula leaks from holes, cracks, or other damage, during the support period. Here, we present a novel solution for repairing a bleeding structural leak in the side of an arterial cannula. Dermabond was used to seal a small leak in the cannula likely caused by an earlier accidental needle puncture. Dermabond was applied to the area of damage, then allowed to

cure, and wrapped with Ioban for increased stability. The patient was weaned from ECMO 2 days later without any complications from the repair of the cannula. The cannula was unable to be exchanged because of the small thoracotomy used to gain access for cannulation, so a repair was attempted. Moving the cannula to the femoral vessel was ruled out because of continued hypoxia and fear of creating a mixing cloud. Although less invasive incisions are becoming more common in cardiac surgery, these incisions for ECMO may be problematic if issues related to cannulas arise. **Keywords:** ECMO, needle hole, circuit repair, Dermabond. *J Extra Corpor Technol. 2019;51:160–2*

OVERVIEW

The annual incidence of extracorporeal membrane oxygenation (ECMO) for adult patients is increasing. Indications may vary from acute lung injury, ECMO-assisted cardiopulmonary resuscitation (CPR), to cardiac failure with an inability to wean from cardiopulmonary bypass. Complications may happen to the ECMO circuit, including cannula leaks from holes, cracks, or other damage, during the support period. The moments in which these failures happen are stressful, and quick decisive action by clinicians is warranted. These responses are best served with the background of literature and evidence-based practice to guide the clinicians. To broaden the base of knowledge, here, we present a novel solution for repairing a bleeding structural leak in the side of an arterial cannula.

Dermabond was used to seal a small leak in the cannula likely caused by an earlier accidental needle puncture. Another consideration to take into account with ECMO cannulation approaches the way in which surgical site issues are able to be addressed. The adaption of minimally invasive surgical approaches used in cardiac surgery may not transfer well into the area of ECMO because of limited exposure and, therefore, limited ability to maneuver in the surgical incision.

DESCRIPTION

The patient was a 53-year-old man who presented to an outside hospital after an out-of-hospital cardiac arrest episode. On arrival at the emergency department (ED), he was found to be in ventricular tachycardia. In addition, the patient had a brief period of hypoxic pulseless electrical activity arrest with CPR. He had return of spontaneous circulation in the ED. The electrocardiogram demonstrated ST elevation throughout the anterolateral leads, and he was taken to the catheterization laboratory where an intra-aortic balloon pump and drug-eluting stents were

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placed. After reperfusion of the myocardium, the patient continued to be in cardiogenic shock, with worsening pulmonary edema and hypoxia. He was then taken to the operating room (OR) and placed on venoarterial ECMO using a Cardiohelp circuit (Getinge, Rastatt, Germany). Cannulation access was gained via a mini-right anterior thoracotomy because of concerns for hypoxia and left ventricular (LV) distention (1). In addition, the thought was that this mini-incision would have less bleeding risk than a traditional full sternotomy.

To cannulate via a minimally invasive route, an incision was made in the 3rd intercostal space and the 4th rib was divided (2). The pericardial fat pad was removed to maximize visibility, and approximately 3 cm of a 22-Fr. EOPA (Medtronic, Dublin, Ireland) arterial cannula was placed in the ascending aorta. Venous cannulation was used via the right atrial appendage with a 36-Fr. single-stage cannula (Medtronic), and a 20-Fr. LV vent (Liva-Nova, London, England) was placed via the right superior pulmonary vein into the left ventricle.

The patient was transferred to our institution on hospital day 3. The patient remained on ECMO because of ongoing pulmonary complications, including hemoptysis from trauma due to the original CPR and with further prolonged hemoptysis due to low-dose anticoagulation with heparin for circuit maintenance. The patient also developed lung consolidation. The patient would become hypoxic if flows were lowered in the intensive care unit (ICU). The a prothrombin time (PTT) was being maintained at a point in the high 40 seconds to low 50 seconds. There had been attempts to gain better control over the hemoptysis with cessation of anticoagulation but with no improvement on intra-lung bleeding into the endotracheal tube. The patient was maintained on ECMO for 18 days before a weaning off process was attempted in the OR, which failed because of hypoxia. Chest tube drainage had been minimal over the previous 10 days. During that afternoon, after arriving back from the OR, the patient had increased chest tube output in the ICU, so the patient was brought back to the OR for exploration of bleeding. At this time, a small needle-hole defect in the arterial cannula was noted about 2.5 cm proximal to the cannulation site of the ascending aorta. This was the source of the bleeding. An attempt was made

to wean off from ECMO, but the saturations decreased into the lower 80 seconds with maximum ventilation support. Unfortunately, because of the location of the needle hole, traditional options would have been either to replace the cannula or, if weanable from ECMO, to decannulate. However, given the need for ongoing ECMO support for respiratory failure in the presence of myocardial recovery, and poor visibility through the thoracotomy for recannulation, neither option was favorable.

An attempt was made to apply bone wax (Ethicon, Somerville, NJ) over the hole, but that approach did not stop the bleeding out of the side of the cannula. A repair attempt was made with Dermabond (Ethicon) as a reasonable alternative to an almost impossible cannula exchange. It was felt that adhesion and curing could not be completed with high arterial line pressures and ongoing flow in the circuit. This patient had an ECMO circuit internal pressure of 240 mmHg in the arterial line with a blood flow of 4.5 L/min. When the trial off from ECMO was performed, the bleeding from the needle hole stopped with the temporary cessation of circuit flow. Therefore, ECMO was temporarily turned off to establish a lower pressure and no flow in the arterial line to allow adhesion and curing of the glue before going back on ECMO (Figure 1). The cannula was dried and freed of debris before applying the Dermabond to the needle-hole area of the cannula. The Dermabond was allowed to cure for 60 seconds. The cannula was then circumferentially wrapped with Ioban (3M, St. Paul, MN) to provide additional support for the Dermabond. ECMO was resumed after 90 seconds of flow suspension.

The patient ultimately remained on ECMO for an additional 48 hours before decannulation, without complications related to the repaired needle-hole site in the arterial cannula. The hemoptysis and lung consolidations finally improved enough to allow for weaning and decannulation. His ventilation was successfully weaned over the next 3 days after ECMO decannulation; however, a computed tomography scan at that time demonstrated a massive right hemispheric brain infarction, with an 11-mm shift caused by associated brain swelling. Therefore, the family elected to withdraw care, and the patient expired shortly thereafter.



Figure 1. Simulation of steps performed for cannula repair. (A) Cleaning and removing debris from the cannula before applying Dermabond. (B) Applying Dermabond to the affected area of the cannula and allowing a cure time. (C) Wrapping Ioban around the cannula to provide additional support for the Dermabond.

COMMENTS

Over the past decade, the need for mechanical circulatory support has dramatically increased, with an increased breadth of indications for ECMO (3). Complications associated with ECMO include infection, air trapping, and cannula dislodgment, with bleeding being the most common at 33% (3). The incidence of mechanical complications due to ECMO is as high as 14.9% in the neonatal and adult population and increases with the duration of time on mechanical circulatory support (4,5). Needle damage or punctures to ECMO tubing can be managed by locally excising that segment of tubing and reconnecting the circuitry. A previous article described applying bone wax over the needle hole in an arterial cannula and buttressing with a cable tie; however, the needle hole may continue to leak (6). In our particular patient, this repair was initially partially attempted, but because of the location of the needle hole, a cable tie could not be placed and leaking occurred. With application of the Dermabond technique described previously, hemostasis was achieved and maintained. Other options were additionally considered, but because of the concern for creating a mixing cloud, moving cannulation to the femoral vessels was deemed not appropriate (1). In addition, although the cardiac function appeared reasonable on full-flow VA ECMO, because of a lack of being able to perform a true prolonged weaning trial, reconfiguring to a VV ECMO cannula technique was not considered at this point.

Dermabond is a strong fast-curing Food and Drug Administration (FDA)-approved medical adhesive of the cyanoacrylate family. Its structure is 2-octyl cyanoacrylate monomer, which after polymerization gives a strong bond. It is a less toxic, with less skin irritation, variety of instant glue similar to industrial "super glues." The setting time for this product is rated by the company at 95 seconds, with a chemical initiator at the tip of the dispenser (7). The use of cyanoacrylate glues has been reported in the literature in relation to being used to seal the skin area and insertion site of percutaneous ECMO cannulas or central line placements. This has been shown to reduce bleeding from around the insertion site between the skin and cannula area (8,9). An *in vitro* study demonstrating reduced bacterial growth in the area has also been reported as compared with more conventional dressing covers (8). Given this information, however, the application to repair a cannula would still be outside the intended instructions of use.

Searching the FDA Manufacturer and User Facility Device Experience database of device complications revealed numerous reports of arterial cannula failures during ECMO use from multiple manufacturers (10). Given that most cannulas used for ECMO are FDA 510(k) cleared for up to 6 hours of use, the reports of failures

would be expected but are still unsettling. Most of these cannula ruptures or cracks lead to massive blood loss and, in some reports, patient death (10). These reports should be of concern to ECMO centers. Although the incidence rate of failure is overall low, centers should be aware of the risk to allow for assessment of cannulas in ECMO patients. These risks are separate from the well-published complications of bleeding around a cannula insertion site (11).

In addition, minimally invasive techniques are fast emerging in cardiac surgery and have the potential to minimize the risks of bleeding (12). The visualization for an ECMO cannula exchange was suboptimal in this case report. The cannula could not be safely exchanged, leading the team to use Dermabond and Ioban repair. A careful discussion of risks and benefits for different surgical approaches should take place among the surgical team. Given our experiences, perhaps, in a VA ECMO patient likely to remain cannulated for an extended period of time, cannulation via sternotomy may provide the best access for troubleshooting over a thoracotomy.

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