Commentary on “Successful Use of Pulmonary Cryotherapy for Tracheobronchial Thrombus Extraction and Recanalization of the Tracheobronchial Tree During a Pediatric Venovenous Extracorporeal Membrane Oxygenation Run”

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IN THE MARCH 2019 ISSUE, Engelhardt and colleagues report the application of a technique to solve a unique problem in a child on venovenous extracorporeal membrane oxygenation (V-V ECMO) with a complex constellation of problems.¹ Successful clearance of organized thrombi within the airway can be extremely challenging, particularly when surrounded by friable mucosa or granulation tissue, when located in the more distal airways, in children where the size of the flexible scopes dramatically limit or prohibit effective suctioning, and in patients who are anticoagulated. Using a team with multiple and complementary skill sets, with a combination of techniques (including cryoextraction), through rigid and flexible bronchoscopy, access to both proximal and distal airway obstruction is possible.

Those of us who manage ECMO patients are very familiar with the constant challenge of balancing anticoagulation and bleeding and frequently deal with the presence of hemorrhage and thrombus in a variety of situations, including the airway. Despite these challenges, ECMO provides an excellent environment for the management of a variety of complex airway issues by providing extracorporeal gas exchange, thus converting a potential immediate life-threatening crisis into a controlled situation where a strategy can be developed and executed. And although that does not simplify the underlying problem, it does buy extremely valuable time. We recognize the importance of a multidiscipline approach to handling these complex patients, and rather than comment on how the authors applied the technique of cryoextraction, we think it is valuable to discuss (and laud) how they approached the problem.

Developing a clinical plan to deal with unusual challenges is too often hampered by our inability, or at least difficulty, in admitting at times that we are in fact “stumped”; and then being willing to seek help, advice, and guidance from colleagues rather than calling it quits. This is often most difficult in seeking assistance outside of our home institutions or our particular specialty. But what En-

gelhardt and colleagues did exemplifies what we should all consider when faced with a particularly vexing clinical situation. First, they looked outside their specialty. As pediatric providers we recognize the unique problems and needs of pediatric patients, but in doing so, perhaps overlook the fact that many techniques commonly used in adults can be applied to our smaller patients, as exemplified in this case.

Second, they looked outside their institution. And although some pediatric intensivists may seek clinical guidance from the literature, and even call other pediatric intensive care colleagues at other institutions when faced with a particularly challenging problem, how often do they test the waters in the adult intensive care unit (ICU) looking for new ideas and solutions? The extra steps of the authors to seek out a new technique, discover an adult approach that might be successfully applied to their pediatric patient, and then arrange the logistics to bring that expertise to their patient, define extraordinary care and effort.

As surgeons, we have each had experiences of finding techniques or instruments outside of our primary area of practice that have solved a unique problem or filled a specific need. The same type of effort can be applied in medicine and critical care, as with multidiscipline conferences and case discussions, along with expanding the search for solutions outside of the usual boundaries, into other specialties, other institutions, and different patient populations and age groups. With some reflection we can recognize limits that we have, often unconsciously, placed on ourselves, which define our planning and actions. Once those limits and boundaries are recognized, it becomes easy to venture beyond them. So, kudos to the authors and their team.

Finally, in the spirit of considering new approaches, we will make a brief comment on the authors’ reports of their challenges with their patient’s bleeding. They describe three different approaches to managing the patient’s heparin anticoagulation, all commonly used methods, and all without success. We believe the reason for failure may be in placing

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the entire focus on heparin management based on a common, but false, assumption that heparin causes bleeding.

Heparin does not cause bleeding, it only prevents clotting, or in the case of the usual range of anticoagulation for ECMO, simply slows clotting. So why do we see so much blood loss and transfusion with procedures on ECMO? Both exposure of the blood to the foreign surfaces of the ECMO circuit, as well as any incision or interruption of tissues during surgical procedures stimulate fibrinolysis, making it more difficult to maintain “stable” clots that prevent periprocedural bleeding. Once clots lyse, the ongoing heparin anticoagulation makes establishing new clots more difficult and a cycle of bleeding is created.

By balancing and controlling clot formation using heparin management to protect the ECMO circuit from thrombosis, along with inhibiting lysis with antifibrinolytics and thromboelastography monitoring, (along with a number of modifications of surgical techniques) we have learned how to successfully perform almost any operation or procedure with minimal or very “manageable” bleeding and usually limited transfusion (some exceptions and remaining challenges include craniotomies, burn excisions, and retroperitoneal hematoma explorations). And although we are comfortable with this approach, others have reported success with minimal to no heparin anticoagulation, keeping ECMO flows high and recognizing and preparing for the real risk of sudden circuit failure from thrombosis.

Most likely there are always other successful approaches available to discover if you are not having success with

those with which you are familiar. The boundaries of possibilities are not the ICU walls, or the hospital property, or even what you can find with a quick search on the Internet, but rather the entirety of current medical knowledge and experience. We just have to remember to look that far.

Author Disclosure Statement

Drs. Hines, Adolph, Carter, and Varghese have no conflicts of interest or financial ties to disclose.

Reference

1. Engelhardt K, Piroli T, Raman L, et al. Successful use of pulmonary cryotherapy for tracheobronchial thrombus extraction and recanalization of the tracheobronchial tree during a pediatric venovenous extracorporeal membrane oxygenation run. *Pediatr Allergy Immunol Pulmonol* 2019; 32:28–30.

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