Successful Use of Limited Transthoracic Echocardiography to Guide Veno-venous Extracorporeal Membrane Oxygenator Placement in a Patient With Coronavirus Disease 2019

To the Editor:

ACCORDING TO THE American Society of Echocardiography (ASE), the 2019 novel coronavirus Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) can be easily spread during echocardiographic studies, with transesophageal echo (TEE) carrying a heightened risk because it can provoke aerosolization of the virus. Therefore, it is recommended that TEE be avoided in suspected or confirmed coronavirus disease−2019 (COVID-19) patients if an alternative imaging modality, such as transthoracic echo (TTE), can provide equivalent information. The ASE further recommends that such studies be as focused as possible while providing the appropriate information to guide clinical care.[1] The World Health Organization and the Surviving Sepsis Campaign recommend considering the use of extracorporeal membrane oxygenation (ECMO) for severe acute respiratory distress syndrome (ARDS) with refractory hypoxemia despite medical management.[2,3]

The authors' anesthesiology perioperative echocardiography service recently performed periprocedural imaging during veno-venous extracorporeal membrane oxygenator (VV ECMO) placement in a patient with COVID-19 and severe ARDS. TTE, instead of TEE, was used to minimize contact with and aerosolization of infectious particles. Imaging these critically ill patients has unique considerations. Prone patients must be positioned supine for cannula placement, which may be detrimental to oxygenation and ventilation. High positive end-expiratory pressure and respiratory rates may create challenges for transthoracic imaging, including limited windows and poor image quality. Imaging should be as efficient as possible to minimize procedural time and thus hypoxemia and exposure for the imager. VA ECMO may be necessary in some cases because as many as 22% of critically ill patients with COVID-19 will have cardiac dysfunction.[4] Given these considerations, the goal should be to safely and expeditiously achieve images that are adequate to support the procedure, rather than images of the absolute highest quality.

To that end, our echocardiography team has decided to forego our previously described approach to TEE imaging of VV ECMO in favor of a TTE approach in COVID-19 patients, as detailed in Figure 1.[5] Before prepping and draping the patient, the imager should assess gross cardiac function to assess the last-minute consideration of VA ECMO. Evaluation should include global biventricular systolic function, gross valvular abnormalities, extremes of volume status, and presence of pericardial effusion. During this initial survey, the determination of whether parasternal, apical, or subcostal views will provide adequate image quality to guide the procedure can be made. At this point it is reasonable to consider transitioning to TEE imaging if it is clear that surface images will not be adequate. In our experience with TTE-guided cannulation, the subcostal views provide the most relevant information for procedural guidance and can often be obtained in supine ventilated patients.

In our recent case, the patient's gross biventricular systolic function was normal; therefore, VV ECMO placement continued as planned. Focused cardiac imaging was performed to guide placement and positioning of a crescent jugular dual-lumen catheter (MC3, Medtronic, Minneapolis, MN) (Videos 1 and 2). Subcostal images initially demonstrated guidewire advancement into the hepatic vein, which required subsequent repositioning into the inferior vena cava (IVC). Subcostal views were also used to guide the ECMO cannula tip into the IVC to visualize venous drainage via the inflow ports within the IVC and to ensure proper positioning of the outflow jet across the tricuspid valve. Parasternal RV inflow and apical

- **Pre-procedural Images**: *Assess gross cardiac function and determine adequacy of windows*
  - Parasternal long axis: LV size and function, AV & MV function
  - Parasternal RV inflow (PRVI): Feasibility of visualizing cannula outflow
  - Parasternal LV short axis: Global LV function
  - Apical 4 Chamber (A4): Biventricular size & function, MV & TV function
  - Subcostal 4 Chamber (SC4): Biventricular size & function, MV & TV function, pericardial effusion, feasibility of visualizing cannula outflow
  - Subcostal IVC (SCIVC): Feasibility of guiding wire and cannula
- **Procedural Images**: *Guide wire & cannula into IVC, ensure outflow through TV, rule out pericardial effusion*
  - SCIVC: guide wire and cannula into IVC, measure cannula tip to RA/IVC junction
  - SC4/A4/PRVI: identify cannula outflow jet, ensure flow across TV into RV
  - SC4: evaluate for new pericardial effusion
  - Reassess cannula position and outflow orientation after cannula secured

Fig 1. Imaging sequence and goals of preprocedural and intraprocedural transthoracic echocardiography for guiding veno-venous extracorporeal membrane oxygenator cannulation.

Fig 2. Compact ultrasound machine prepared for coronavirus disease−2019 veno-venous extracorporeal membrane oxygenator cannulation. All extraneous cords removed with a single-phased array probe connected.

4-chamber views also provided excellent visualization of the outflow jet (Video 3).

Although a TTE approach will certainly not always be feasible, it serves to provide adequate information while minimizing aerosolization, provider exposure, and procedure duration. A compact and portable ultrasound machine, such as the Philips CX50, is easy to transport to the bedside, to cover with a plastic barrier, to fit within a limited space, and to clean (Fig 2). Removal of ECG and other attachments minimizes equipment contamination and cleaning. The machine can be positioned so that the echocardiographer can manipulate the probe and knobs while the screen is also visible to the surgeon. It is helpful to also have a linear probe for the surgeon to use during internal jugular vein access, and to have probe covers for both probes. It would be reasonable to consider using a smaller-platform hand-carried ultrasound device for this approach, and it is likely that our team will attempt this in the future.

In conclusion, the use of TTE, instead of TEE, to assess cardiac function and guide procedures, is especially relevant for COVID-19 patients and is in accordance with the recently published recommendations from the ASE.[1] Our team recommends a limited TTE approach to imaging (Fig 1) to minimize procedural time, patient hypoxemia, and provider exposure. Our team also recommends the use of a compact portable ultrasound machine, removal of ECG and other attachments, a clear plastic barrier to minimize machine contamination, and thorough cleaning of the machine and probes after imaging.

Conflict of Interest

None.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.jvca.2020.04.047.

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Brad Moore, MD*
Ned Morgan, MD*
Craig Selzman, MD†
Josh Zimmerman, MD, FASE*
*Division of Perioperative Echocardiography, University of Utah Department of Anesthesiology, Salt Lake City, UT
†Division of Cardiothoracic Surgery, University of Utah Department of Surgery, Salt Lake City, UT

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COVID-19 Outbreak in France: Setup and Activities of a Mobile Extracorporeal Membrane Oxygenation Team During the First 3 Weeks

To the Editor:

The severe acute respiratory syndrome coronavirus-2−related disease, coronavirus-2019 (COVID-19), mainly is characterized by respiratory manifestations, with approximately 15% to 30% of patients developing acute respiratory distress syndrome (ARDS).[1] The World Health Organization guidelines recommend to proceed to venovenous extracorporeal membrane oxygenation (ECMO) for eligible patients with COVID-19−related ARDS only in centers with "sufficient case volume to ensure clinical expertise."[2] The Amiens ECMO center received many calls from several hospitals in the region about refractory ARDS secondary to COVID-19 during the first weeks after COVID-19 was declared a pandemic. The decision was made rapidly to set up a mobile ECMO team in order to start on-site ECMO treatment.

Start of the Outbreak in Picardy

Located in the north of France, the Picardy region has a population of 1.925 million inhabitants living in a 19,399-km territory. A network of 29 general hospitals is located in this regional territory, with 128 intensive care unit (ICU) beds. The only ICU in Picardy with the ability to manage ECMO is the cardiac thoracic vascular and respiratory unit of Amiens University Medical Centre. The unit has performed about 60 ECMO treatments every year for more than 10 years (one-third of those have been venovenous ECMO treatments).

The COVID-19 outbreak occurred in Picardy at the end of February 2020, resulting in a rapid need for ICU beds. Calls from peripheral centers for ECMO services increased rapidly. In 1 month (March 2020), 676 patients were admitted to the region's hospitals for COVID-19−related disease. Among those patients, 156 required ICU admission (admission rate: 23.1%).[3]

Setting up the Mobile ECMO Team

Clustering infected patients requiring ECMO within an expert center was necessary to ensure adequate care and resource management. A unique phone number was publicized to all ICUs of the region to centralize the request for ECMO services. An on-call ECMO team member was able to give advice and evaluate the need for ECMO. All ECMO team members were educated on the management and eligibility criteria for ECMO initiation. The mobile ECMO team was composed of a specialized intensivist, thoracic surgeon, and trained perfusion nurse. A roster was started in order to make the team available 24 hours a day, 7 days a week. The decision to initiate ECMO treatment was always a multiconsultant decision. The ECMO team was able to reach any hospital in the region in less than 45 minutes (by road or by air, depending on the weather). On arrival to the site, the ECMO team decided whether to perform conventional ventilation or to initiate ECMO on site and transfer the patient on ECMO support. Patients on ECMO were admitted to a specialized ICU with trained staff. The Cardiohelp (Getinge, Gothenburg, Sweden) ECMO device was used for each transport because of its compact and light (10 kg) design.

Number of Calls and Patient Characteristics

During March 2020, 22 calls were received at our ECMO center. The ECMO team initiated 8 venovenous ECMO treatments on site and transferred 3 patients on conventional ventilation. For all patients, the drainage cannula (size 25 F) was inserted in the right femoral vein and the return cannula (size 19 F) was inserted in the right jugular vein. Heparin treatment was started after the procedure with continuous perfusion of unfractionated heparin