Informed consent was provided by the patient for this report. The patient was a 30-year-old female with a history of depression, hypothyroidism, intravenous drug abuse, and hepatitis C, G2P0010 at 33 weeks’ gestation. She presented to her local hospital with shortness of breath and chest discomfort and plausible contact with verified cases of coronavirus disease 2019 (COVID-19). She required increasing levels of oxygen and was intubated. Computed tomography of the chest ruled out pulmonary embolism but revealed diffuse ground-glass opacities (Figure 1). FilmArray Respiratory Panel (BioFire Diagnostics, Salt Lake City, Utah) and gram stain were both negative and, having failed conventional therapies and inhaled nitric oxide, she was transferred in full airborne precautions for initiation of mechanical support. She arrived profoundly hypoxic with oxygen saturation of 74% and ratio of arterial oxygen partial pressure to fractional inspired oxygen of 56 despite 100% fraction of inspired oxygen and 20 cmH2O of positive end-expiratory pressure. She received a multidisciplinary evaluation, and we initiated veno-venous extracorporeal membrane oxygenation (ECMO) support, using a 20-F FemFlex II (Edwards Lifesciences, Irvine, Calif) cannula via the right internal jugular vein and a 25-F Bio-Medicus Multistage (Medtronic, Minneapolis, Minn) cannula via the right femoral vein. The patient was tilted leftward to alleviate pressure on the inferior vena cava. The neonate in breech presentation was delivered safely by cesarean delivery immediately postcannulation in the intensive care unit within 90 minutes of the patient’s arrival. Apgar score was 9. Anticoagulation, although administered during initiation of ECMO, was held during the delivery. The patient was extubated on day 2, tested negative for COVID-19, was able to nurse her baby on day 3, was decannulated on day 6, and was discharged day 7. Further history revealed that, although not a “smoker,” she had been an active “vaper” until the day of her hospitalization. It was most plausible that she had sustained E-cigarette or vaping product use–associated lung injury (EVALI).

DISCUSSION

In a single year, 2 novel physiological entities have expanded indications for extracorporeal support.1,3 In this report, we describe the management of a 30-year-old expectant mother who presented in her third trimester with severe acute hypoxic respiratory failure secondary to EVALI. She tested negative for influenza A and B. However, by presenting during the severe acute respiratory syndrome coronavirus 2 pandemic in a high-risk geographic area, suspicion was heightened, and she was transferred from with the presumptive diagnosis of COVID-19.

Dual corollaries warrant consideration in the acute setting. First, there is growing evidence that vaping impairs
lung and host immunity. As such, healthy young adults who may not otherwise experience severe respiratory symptoms to seasonal flu or novel viral outbreaks are now likely to become a new “at-risk” group. Vaping status should consequently be routinely entered into the medical record and an effort to should be taken to distinguish EVALI from other respiratory illness in the history by eliciting signs of fever, sore throat, and/or exposure. Second, current opinion regarding safety of vaping during pregnancy remains mixed. Emerging evidence suggests that, like smoking, it poses significant risk to the developing fetus. This is due, in part, to the well-known adverse effects of maternal nicotine exposure on fetal outcomes and postnatal development. A single e-cigarette pod (for a JUUL, Sorin, or similar rechargeable device), or disposable e-cigarette stick, can deliver the nicotine equivalent of 4 packs of cigarettes (ie, 20-90 mg nicotine); the ill effects of nicotine exposure to the unborn child are thus cause for great concern. Even in the absence of nicotine, in utero exposure to vaping (without nicotine) may also induce vascular impairment and dysfunction in offspring after birth. As such, vaping during pregnancy may have a profound impact on vascular health and function and should not be considered “safe” or “risk-free.”

In the weeks preceding this admission, the ECMO team had conducted a series of preparedness drills and drafted a checklist for managing suspected COVID-19 (Appendix 1). The drills involved multidisciplinary providers, nurses, perfusionists, respiratory therapists, security, and housekeeping in high-fidelity scenarios using mock pumps and mannequins in simulating transport, cannulation, and containment (Figure 2). The drills allowed for a fluid and reproducible response. The patient remained in full airborne precautions until the patient was confirmed negative and volunteered the history of active vaping once extubated and communicative.

The repeated drills allowed us to identify commonly overlooked features delineated to follow:

- need for a pretransportation huddle to anticipate hurdles and barriers;
- need for environmental services crew to cordon off and disinfect hallways and elevators;

![FIGURE 1. Diffuse bilateral ground-glass infiltrates on coronal-section computed tomography.](image)

![FIGURE 2. The layout of the airborne-precaution room.](image)
• need for personal protective equipment for 2 sets of teams;
• need for receptacles for contaminated equipment and clothing;
• consideration of institutional review board exemption to permit compassionate use of trial drug, Remdesivir (Gilead Science, Foster City, Calif);
• use of a designated telephone (and/or whiteboard) from which the teams inside patient’s room may communicate without having to break the negative-pressure seal; and
• a cordoning off of main room door and the use of signage.

The concurrent novelty and mimicry proffered by EVALI is likely to render it a potential differential diagnosis in the midst of a COVID-19 pandemic, and the ensuing diagnostic dilemma will likely test the level of preparedness for dealing with this deadly virus.

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APPENDIX 1: COVID-19 ECMO CHECKLIST

- Activation with all teams aware and on standby
  - Activation phone call to alert all stakeholders (clinical and administrative)
  - Include “Incident Command” to the activation to alert transportation team by phone
  - Crowd control and allay anxiety
  - Smoke test performed before transfer to airborne protection room
  - Have team leader decide the personnel; on the transport team who will don PPE
    - Dedicate a wing of the ICU to COVID-19
    - No orientees or unnecessary trainees
- Transportation
  - Precautionary gear
  - Code transport
  - Use designated elevator
  - Hold and clean elevator
  - Clear the hallways ahead of time
- PAPR gear
  - HEPA filter for ventilator circuit
  - Instructor/Infection Control to help with face-shields and helmets
  - Gloves available inside and outside room
  - Infection Control representative at the room
  - Consider N95 masks as back-up
  - Materials should be made aware of need for more gear
  - Laundry bag to collect contaminated gear
  - Shoe covers
- ECMO considerations
  - Transport the patient with clean cover
  - Cannulation tray and cannulae (standard 20F Fem-flex and 25F Multistage)
  - Ultrasound probe in the room (draped and plugged in)
  - Primed pump
  - ECMO specialist and perfusionist present in room
  - Standard right internal jugular and right femoral configuration (avoid operating room, or cannula that requires simultaneous fluoroscopic, transesophageal echocardiographic imaging)
  - Select providers based on demographic and comorbidities
- Airborne Infection Isolation Room
  - Seal door once patient is inside
  - Use signage
  - Communicate by phone and/or white board
  - Extra pens
  - Disposable bronchoscopy in the room
  - Hand hygiene dispensers all refilled
  - Disposal point for protective gear
  - Phone to communicate outside the room
- Ventilator management
  - Intubation precautions with HEPA filter ventilator
  - Intubation by attending
  - Avoidance of BIPAP
  - Avoidance of operating room (positive pressure room)
  - Do not use PACU
- Clinical management/considerations
  - Infectious Diseases consult
  - Trial drug availability (compassionate use) emergently available, Remdesivir
  - Housekeeping to prepare room and increase cleaning frequency
  - Closed-suction systems
  - Disposable covers for all surfaces
  - PAPR personal protective equipment
  - Avoid unnecessary radiographs, cover the radiology equipment
  - Administrative personnel to provide on-call numbers
  - Prompt testing (influenza, BioFire, COVID-19)
- Miscellaneous notes
  - Use simplest mode of cannulations that does not require the OR
  - Control contacts and enforce visitation policy
  - Storage and supplies to be thoughtfully sequestered