provide a quick examination to determine whether pneumothorax or increasing pleural effusion is present. Bedside puncture can be performed on the basis of the lung ultrasound. Ultrasound also can demonstrate whether there is an increase of lung edema and, combined with the parameters of oxygenation, can direct whether mechanical ventilation and other treatments are needed. Fourth, lung evaluation findings, combined with parameters of oxygenation, hemodynamics, and ventilation, can be used to determine the timing of implementation of extracorporeal membrane oxygenation. Fifth, for critically ill patients who have been treated with mechanical ventilation or extracorporeal membrane oxygenation, we can evaluate the condition of the lungs dynamically, further clarifying the prognosis. Sixth, the evaluation of the inferior vena cava and heart by ultrasound provides great value for the differential diagnosis when the patient's condition changes rapidly. Finally, it is easy to acquire and transmit images of the ultrasound, which are essential for remote diagnosis and treatment.

There are also limitations of lung ultrasound. When there are pathologic changes in the deep part of lung field and no pathologic changes of the pleural, its advantages are reduced significantly. However, in order to decrease the probability of transmission, to better perform dynamic diagnosis of the novel coronavirus pneumonia, and to provide better protection of medical workers and patients, lung ultrasound should be used to the fullest.

Conflict of Interest

None.

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Zhongheng Zhang, MD*
Binbin Ren, MD†
Haozhe Fan, MD‡
Kun Chen, MD‡
Lin Chen, MD‡

*Department of Emergency Medicine, Sir Run Run Shaw Hospital, Zhejiang University School of Medicine, Hangzhou, China
†Department of Infectious Disease, Jinhua Hospital of Zhejiang University, JinHua, China
‡Department of Intensive Care Unit, Jinhua Hospital of Zhejiang University, JinHua, China

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POCUS to Guide Fluid Therapy in COVID-19

To the Editor:

PROVIDING ADEQUATE care to the large number of patients critically ill with coronavirus disease 2019 (COVID-19) with severe acute respiratory distress syndrome (ARDS) is a resource-intensive task. Reducing duration of mechanical ventilation may assist in decompressing intensive care units (ICUs). Standard of care in managing ARDS includes lung-protective ventilation and appropriate diuresis.[1,2] Recent literature regarding using portable ultrasonography at the bedside (point-of-care ultrasound or POCUS) on critically ill patients suggested current use in modern ICUs.[3] We propose that a focused lung and heart ultrasound may help follow progression of pneumonia and pulmonary edema and characterize volume status.

As anesthesiologists are being tasked to provide critical care, it is necessary to take the lessons of judicious fluid use from our operating rooms to the ICUs. Indeed, daily weights and fluid balance help guide diuretic and fluid therapy. However, the inflammatory state in COVID-19 patients may contribute to vascular permeability and intravascular depletion despite increased total body water. Periodic vasoplegia, high positive end-expiratory pressure, and cardiac dysfunction also confuse typical hemodynamic estimations of total body water such as blood pressure and central venous pressure.[4] Using an apical 4-chamber view and a parasternal short-axis view, we can obtain a quick estimation of left and right ventricular function and fluid status (Fig 1). These findings could then be

Fig 1. Apical 4-chamber view demonstrating an enlarged right ventricle consistent with elevated intravascular volume.

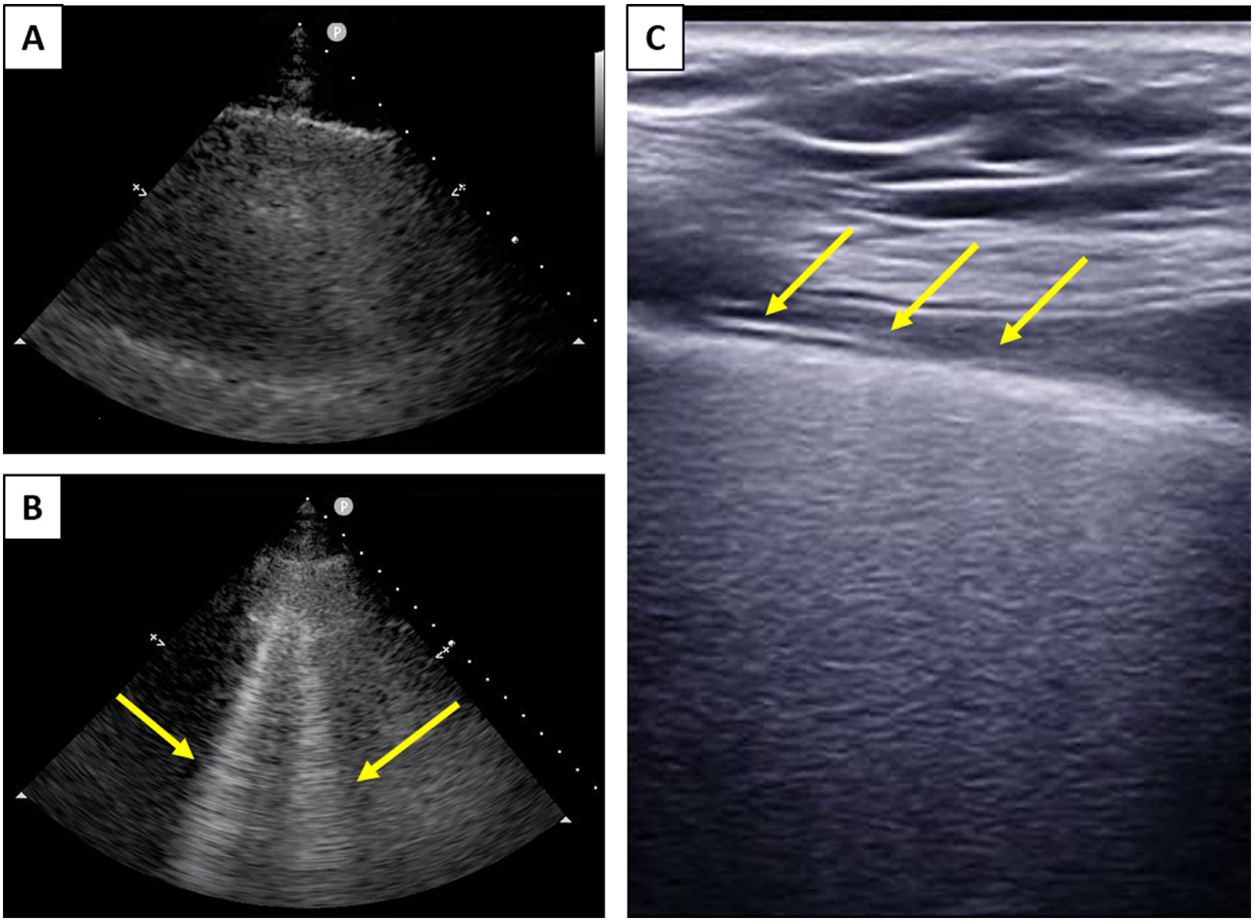

Fig 2. (A) Lung ultrasound demonstrates area of consolidation prior to placing the patient in the prone position. Consolidation in a nonaerated lung, which results in a significant shunt. (B) Lung ultrasound after placing the patient in the prone position demonstrates significant "B lines" (arrows) consistent with acute respiratory distress syndrome, however, with improved aeration. Clinically, the patient's oxygenation improved as well after proning. (C) Linear probe demonstrates a thickened pleural line (arrows).

interpreted in the context of hemodynamics and fluid balance to guide treatment.

Lung ultrasound can help characterize normal and abnormal lung regions. In addition to ventilatory settings, partial pressure of oxygen, and pulse oximetry, a scoring of diseased- to- normal lung regions may add to patient assessment. Placing patients with severe ARDS in the prone position is used as high settings or limits of mechanical ventilation are reached.[5] Posterior lung ultrasound, if identifying significant areas of normal lung parenchyma, may identify patients in whom early proning may reduce precipitous increases in ventilator settings, escalation of vasopressors, and need for neuromuscular paralysis. We depict a COVID-19 patient pre- and post-proning demonstrating improved lung aeration and reduced consolidation (Fig 2).

In a time when there is an increase in telemedicine, limited physical examinations, and limited provider-patient direct contact, it is difficult to recommend the use of personnel and personal protective equipment to perform specialized and technical tasks. However, the potential benefit of possible reduced end-stage lung failure, reduced ventilator days, and reduced critical care resource use needs to be carefully weighed. As noncritical care−trained physicians are called to provide critical care, the utility of a curriculum of very focused POCUS may also assist in patient management.

Conflict of Interest

No conflicts of interest for any authors reported.

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Richard Thalappillil, MD*
Robert S. White, MD*
Christopher W. Tam, MD†
*Department of Anesthesiology, Division of Cardiac Anesthesiology, Weill Cornell Medical Center, New York, NY
†Department of Anesthesiology, Division of Cardiac Anesthesiology and Critical Care, Weill Cornell Medical Center, New York, NY

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One-Lung Ventilation: A Simple Technique to Reduce Air Contamination During the Coronavirus Disease 2019 (COVID-19) Pandemic

To the Editor:

We would like to present a simple and efficacious technique to reduce contamination in the operating room (OR) while performing one-lung ventilation (OLV) during the coronavirus disease 2019 (COVID-19) pandemic.

A 68-year old man, with an American Society of Anesthesiologists score II (body mass index, 21.5 kg/m^2) and history of arterial hypertension, underwent left thoracotomy and subsequent left upper lobectomy, due to a positron emission tomography/computed tomography (PET/CT)−positive nodule in the left upper lobe. The patient was asymptomatic and negative in the preoperative nasopharyngeal test for COVID-19. However, in our department, every patient presenting in the OR is considered as a potential transmitter of the disease, taking into account that the upper respiratory swabs specimen exhibits a low but nevertheless potential false negative value.[1] Indeed, it is well-established that transmission may occur from asymptomatic patients.[2] Therefore, the personnel in the OR were provided a minimum of personal protective equipment (PPE), which included fitted respirator masks (FFP2 masks with 94% filtration efficiency, approximately equivalent to N95 respirator masks[3]), double gloves, safety goggles, and gown, and the patient was wearing a surgical mask at his arrival. Moreover, strict infection protocols are implemented to reduce cross-infection in the OR, despite the fact that in our institution there is only 1 negative- pressure OR dedicated to procedures for patients with confirmed COVID-19. Specifically, an anteroom for donning and doffing is available in every OR, a high air exchange cycle rate (≥25 cycles/h) is applied to reduce the viral load in the OR, and a minimum number of OR staff is present throughout the procedure.[4] Two high-efficiency particulate air (HEPA) filters are used in every patient, 1 between the patient and the breathing circuit and the other at the distal end of the expiratory limb. In addition, low-flow anesthesia is performed to keep the viral filtration efficiency of HEPA filters at acceptable levels, mitigating the viral transmission.[5]

After the insertion of a thoracic epidural catheter, rapid-sequence induction was performed, and the patient was intubated with a left double- lumen tube (DLT) 39 French (Fr) size (Portex, Smiths Medical Inc.). The correct position of the DLT was verified with chest auscultation immediately after intubation, in the final right lateral decubitus position, avoiding our common practice of using a flexible fiberoptic bronchoscope, to minimize aerosol-generating procedures (AGPs).

Before skin incision, OLV had already been implemented to allow adequate time for lung collapse. The access to the nonventilated lung was occluded to avoid dispersion of droplets or aerosol.[6] After the thorax was opened, the nondependent lung was not adequately deflated, rendering the operating field challenging for the thoracic surgeons, although ventilation was not delivered in the aforementioned lung. At that point, it was deemed essential for the patient's safety to make the upper lung deflate by opening the corresponding connector, thus allowing a communication of the patient's lower respiratory system with the environment of the OR. To decrease the amount of the aerosol contamination, a HEPA-pleated hydrophobic filter was used in the bronchial connector (Hydro-Guard Mini breathing filter, Intersurgical). Specifically, a disposable bronchial connector was used for the appropriate connection of the HEPA filter. The first step was to cut the bronchial connector obliquely (Fig 1, A). In that way, it acquired a suitable shape that enabled wedging in the bronchial (nonventilated) lumen of the DLT by advancing it with rotating moves, and subsequently the HEPA filter was connected to the tube connector (Fig 1, B). The last step was to open the bronchial lumen of the DLT and connect it with the improvised structure (Fig 2). The nondependent lung was then deflated, and the operation was completed uneventfully.

A previous attempt at using a tube connector of a single-lumen endotracheal tube (ETT) (incidentally size 8) had failed. Postoperatively, we examined the reason of this failure and concluded that solely the connectors of ETTs with internal diameter (ID) of 7.0 mm and 7.5 mm could fit on the bronchoscope entry point of an adult DLT (35-41 Fr). Connectors from smaller ETTs could not be wedged firmly, whereas connectors from larger ETTs could not fit at all (Fig 3).

A direct connection of the HEPA filter into the adapter on the bronchial lumen before the Y connector could be another simple and efficient option; however, it demands consecutive handling and discontinuation of the breathing circuit, increasing the possibility of droplet dispersion and subsequent OR contamination (Fig 4). It also increases tubing length and therefore resistance to airway deflation.

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus is oval or round, with an approximate diameter of 60 to 140 nm.[7] However, HEPA-pleated hydrophobic filters perform a filtration efficiency greater than 99% for aerosol-generating sodium chloride particles, with a count median diameter of 0.07 μm at a flow of 30 L/min.[8] Although appropriate viral filtration efficiency to prevent SARS-CoV-2