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Chest Tube Drainage in the Age of COVID-19



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KEYWORDS

- COVID-19 • SARS-CoV-2 • Chest tube • Tube thoracostomy • Pneumothorax
- Barotrauma • Pleural effusion

KEY POINTS

- Chest tubes are commonly placed at the bedside for the treatment of pneumothorax and/or pleural effusion for the COVID-19 patient.
- Barotrauma caused by mechanical ventilation can manifest as a pneumothorax, which is commonly treated with tube thoracostomy.
- Pleural air released by tube thoracostomy is a potential source of airborne infection owing to aerosolization of the severe acute respiratory syndrome coronavirus 2 virus.
- Various strategies are emerging to reduce the risk of infection associated with exposure to pleural air.

INTRODUCTION

Chest tube thoracostomy in patients with airborne precautions requires special consideration, as air leaks are a potential source of airborne infection. Although no definitive guidance exists regarding the potential aerosolization of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2),¹ chest tube insertion, management, and removal are all potentially aerosol-generating procedures and may create a risk of exposure for health care personnel.

COVID-19 is a respiratory syndrome whose clinical manifestations range from asymptomatic to severe interstitial pneumonia and acute respiratory distress syndrome (ARDS).² A metaanalysis of 19 observational studies showed that about one-third of hospitalized COVID-19 patients develop ARDS (32.8% [95% confidence interval 13.7–51.8]).³ Pneumothorax appears to be a frequent complication of ARDS in general, with 1 study demonstrating the incidence to be 48.8%.⁴ The proportion of mechanically ventilated COVID-19 patients with ARDS who suffer pneumothorax

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because of barotrauma is anticipated to be similar, but is not yet known.^{4,5} The development of pneumothorax in ARDS has been associated with as much as 20% higher mortality compared with those without pneumothorax.⁶ Thus, prompt recognition and treatment of pneumothorax in any mechanically ventilated patient, and particularly in patients with ARDS and COVID-19-related ARDS, can prevent further respiratory and hemodynamic deterioration.

The following risk mitigation strategies have been proposed and are under review at the authors' institution to minimize exposure to pleural air during chest tube placement in the COVID-19 patient. These modifications of the standard insertion technique were developed in parallel and in correspondence with members of the American Association for the Surgery of Trauma (AAST) Acute Care Surgery and Critical Care Committee. Please refer to their guidelines for further details.⁷

CHEST TUBE INSERTION IN THE COVID-19 PATIENT

Triaging

- Elective insertion should be postponed until COVID-19 testing can be performed if possible.
- In patients with unknown COVID-19 status when chest tube placement is required on an urgent or emergent basis or in a patient with confirmed COVID-19-positive status, the procedure should be performed in a negative-pressure airborne precaution isolation room.

Preparation

- Use appropriate personal protective equipment for aerosol-generating procedures.
- Bring only essential equipment into the room.
- Leave backup equipment outside of the room with an assistant positioned outside.
- Set up equipment outside of the room as much as possible, including the chest tube drainage system.
- The procedure should be performed by an experienced practitioner, with minimal nonessential personnel present. The AAST guidelines recommend establishment of a dedicated thoracic procedure team.⁷

Mechanically Ventilated Patients

- If the patient is mechanically ventilated, consider the use of neuromuscular blockade to prevent coughing and to facilitate holding respirations while entering the pleural space and until placement of tube. Both coughing and respirations could expel potentially infectious pleural air.

Insertion

- Fully drape the entire patient instead of the half drape commonly used for this procedure.
- When possible, use a small-diameter pigtail catheter (eg, 14F) with percutaneous Seldinger technique. If a large-bore tube is required, use a smaller incision and a tunneled approach to reduce the amount of potentially infectious air leak.
- Clamp the tube before insertion to prevent pleural air escaping via the newly inserted chest tube.
- Attach the tube to the previously prepared chest tube management system tubing for egress of air from the thoracic cavity.
- Close the skin incision around the tube to prevent air leakage around the tube.

Prone-Positioned Patients

- Prone positioning is used to improve lung mechanics and gas exchange by enhancing lung recruitment.⁸ This technique is used as an adjunct in the management of ARDS patients, including mechanically ventilated COVID-19 patients.
- When prone-positioned patients require chest tube thoracostomy, place a rolled blanket to elevate the lateral chest and insert the chest tube as close to the mid-axillary line as possible within the “safe triangle” (Fig. 1) to avoid kinking of the tube.

CHEST DRAINAGE SYSTEM MANAGEMENT IN THE COVID-19 PATIENT

When possible, the drainage system should be placed on suction. In this setup, the suction canister and medical gas vacuum lines exhaust in a manner similar to a negative pressure room. When the system is placed on water seal and disconnected from wall suction, air leaking from the lung can flow into the drainage system and into the room. Thus, the use of a water seal should be avoided. Patients, however, might need to be transported for various reasons, and maintaining wall suction might not be feasible. Although neither 3-chamber nor digital chest drainage systems are equipped with viral filters, the 3-chamber system can be easily modified using the following options to offer potential viral protection to make water seal safe.

In-Line Viral Filters

Repurposed ventilator or smoke-evacuation viral in-line filters may be attached in between the 3-chamber device and the wall canister. Filters that have been proposed by other groups include the in-line BILF-150/200 filter (Buffalo Filter LLC) originally used in surgical smoke evacuation⁷ or a ventilator filter, such as the Air-Life 303EU bacterial/viral filter (Carefusion)⁹ or Filta-Guard (Intersurgical Ltd)¹ (Figs. 2 and 3).

- Consider adding dilute bleach in the water seal chamber with or without the filter in the 3-chamber chest drainage system.

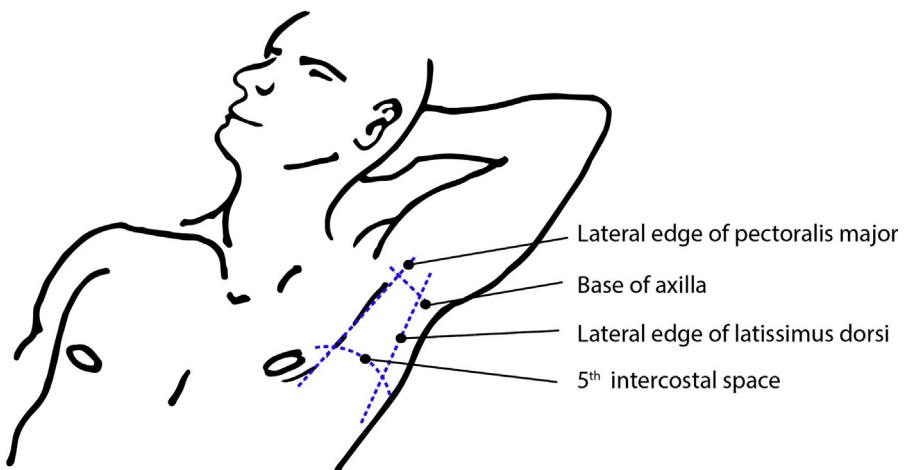


Fig. 1. Safe triangle.

BILF150 / BILF200

In-Line Filters

Designed to capture surgical smoke particulate before it enters wall suction systems

99.999% ULPA Media

Economical and easy to use



BILF150

Fig. 2. BILF150/BILF200 filter.



Fig. 3. Atrium Ocean with bacterial/viral filter.

CHEST TUBE REMOVAL

- Minimize staff in the room and use personal protective equipment appropriate for an aerosol-generating procedure.
- Place an occlusive dressing over the tube site, reinforced by pressure dressing.
- Carefully dispose of the chest tube and the drainage device and doubling the biohazard bag.

SUMMARY

Chest tube thoracostomy for patients with COVID-19 warrant special consideration given the mode of transmission of the SARS-CoV-2 virus and the aerosolizing nature of the procedure itself. Proper preparation, personal protective equipment, modified techniques, and drainage maintenance are critical to minimizing exposure to health care personnel.

DISCLOSURE

The authors have nothing to disclose.

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