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Safety model for chest drainage in pandemic by COVID-19

Modelo de segurança para realização de drenagem torácica na pandemia pela COVID-19

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ABSTRACT

Over one million cases of the SARS-CoV-2 virus have been confirmed worldwide, with the death toll exceeding 50,000 people. An important issue to be addressed concerns the exposure of health professionals to this new virus. The first reports from Wuhan province, China, described infection rates of up to 29% among healthcare professionals before the use of personal protective equipment (PPE) was fully regulated. There are several protocols on the correct use of PPE during aerosol-generating procedures. However, there is no specific guidance on how to proceed in cases of need for chest tubes in patients with positive COVID-19 active air leak. The objective of this work is to assist surgeons of the most diverse specialties during the chest drainage of a patient with COVID-19 and to avoid a risk of contamination to the professional and the environment.

Keywords: Severe Acute Respiratory Syndrome. Thoracostomy. Thoracic Surgery. Coronavirus.

INTRODUCTION

Over one million cases of the SARS-CoV-2 virus have been confirmed worldwide, the death toll exceeding 50,000 people[1]. The exposure of health professionals to this new virus is an important issue. The first reports from Wuhan province, China, described infection rates of up to 29% among healthcare professionals before the use of personal protective equipment (PPE) was fully regulated[2]. There are several protocols on the correct use of PPE during aerosol-generating procedures. However, there is no specific guidance on how to proceed in cases requiring chest drainage with active air leak in positive, suspected and even asymptomatic COVID-19 patients, the latter corresponding to about 80% of patients[3]. Since we are facing a pandemic of a previously unknown disease and there are not enough diagnostic tests for mass testing in Brazil, every precaution must be considered when approaching any patient.

The SARS-CoV-2 virus, which causes the COVID-19 disease, has been shown to be viable in aerosol form and is transmitted by droplets[4]. During the pandemic, there are patients who need chest drainage, whether in wards or intensive care units. Although drains may be inserted with less risk of viral spread for simple pleural effusions, there is concern that there may be a high risk of aerosol production in cases of pneumothorax with active air leakage, whether these are primary, secondary, spontaneous or iatrogenic.

Traditional chest drainage water-seal collectors have an outlet that allows the coupling of a negative pressure system. If it is not connected to suction, the outlet is opened to the atmosphere. When the air escapes into a chest drainage collector, it causes the inner liquid to bubble. Given the aerosolization that is likely to occur inside the drain collector, it escapes through this outlet and this can be an important way of environment contamination and viral transmission[5].

TECHNICAL REPORT

This proposal aims to serve as a tool and to assist surgeons in the treatment of conditions that require

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thoracic drainage during the COVID-19 pandemic. It is based on review of the literature published so far, in the opinion of individuals specialized in the thoracic surgery field, and not necessarily on evidence-based instructions. We recognize that management strategies are dynamic and must be determined individually, depending on the equipment and tools available at each institution.

Ideally, one should use closed digital drainage systems regularized in Brazil and marketed by the industry. As this is not the reality of most hospitals, we propose all steps of a safe and viable alternative, aiming to reduce the contamination of the environment and the exposure of the assistant team.

The main mechanism for preventing the spread of particles would be the use of the High Efficiency Particulate Arrestance (HEPA) filter. The HEPA filter was developed in 1940 to hinder the spread of cancerous contaminants through the air in the Manhattan Project, responsible for the production of the first atomic bombs in history[6].

Made of fiberglass, HEPA filters are designed to retain much smaller particles and impurities than ordinary filters. The diameter of the fibers, the speed of the particles and the thickness of the filter are considerable factors when analyzing the HEPA filters. They work in three ways: interception, impact and diffusion. The particles adhere to the fiber after following the air flow and being impacted by the fibers, which causes them to stick to the filter[7,8].

Common filters cannot keep viruses and bacteria, while the HEPA is able to capture 99.97% of air impurities. The filtering capacity that justifies this percentage is that the HEPA filter can filter particles up to 0.3 micrometers (μm)[6,7], which can be an important defense against aerosolization. The aerosol particles are smaller than five micrometers[4], so the HEPA filter would be an important barrier against the dispersion of aerosols in the environment.

Necessary material:

- 3 KITS of personal protective equipment (PPE): hat, N95 mask, 2 pairs of long-sleeved gloves, waterproof apron / cloak, goggles, face shield;
- Chest drain of the desired size and collector;
- Orotracheal tube number 7 or 8;
- HEPA filter;
- Device to close the collector's communication with the environment if it does not have its own mechanism;
- 1 sterile hemostatic forceps;
- Sterile drapes;
- Lidocaine 1%;
- 10 mL syringe;
- 40x12 and 25x8 mm needles;
- Scalpel blade number 15;
- Small surgery kit;
- Surgical suture Vicryl® 1 and Nylon® 2.0 (or sutures of choice in the service);
- Dressing material: gauze and micropore bandage.

The procedure should be performed using the PPE recommended by the regulations of each service for contact with COVID-19 positive patients and other care during the pandemic. Our recommendations are use of personal protective equipment (PPE) for aerosolization, such as N95 mask, cap, goggles, and face shield, disposable waterproof apron and long-barreled gloves; foot protectors may also be recommended in some services.

- Prior preparing of the drainage system in a sterile manner, with the use of a collection bottle with a 5 cm water column (Figure 1);
- Use of the tracheal tube connector in the drain outlet that has a latex tip (Figure 2);
- Occlude the other outlet with a preferred device to ensure a seal, such as 1 mL syringe plunger; some drains already have their own sealing mechanism (Figure 3);
- Connect the HEPA filter to it (Figure 4);
- Measure how many of the drain length in centimeters should m be inserted, and occlude it with a straight hemostat;
- Connect the drain to the system (Figure 5);
- Position the patient in the usual way, in the supine position, headboard at 30° and the ipsilateral arm elevated;
- Perform wide antisepsis with degerming and alcoholic chlorhexidine;
- Place the sterile drapes;
- Carry out the local anesthesia;
- Proceed with incision in the 5th intercostal space in the posterior axillary line;

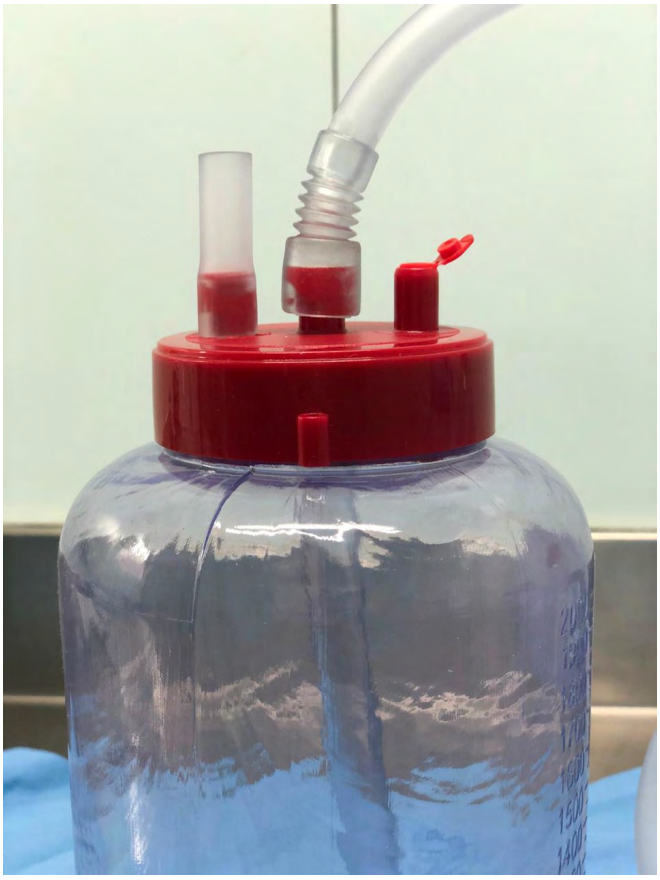

Figure 1. *Common thoracic drain collector with two open air holes.*

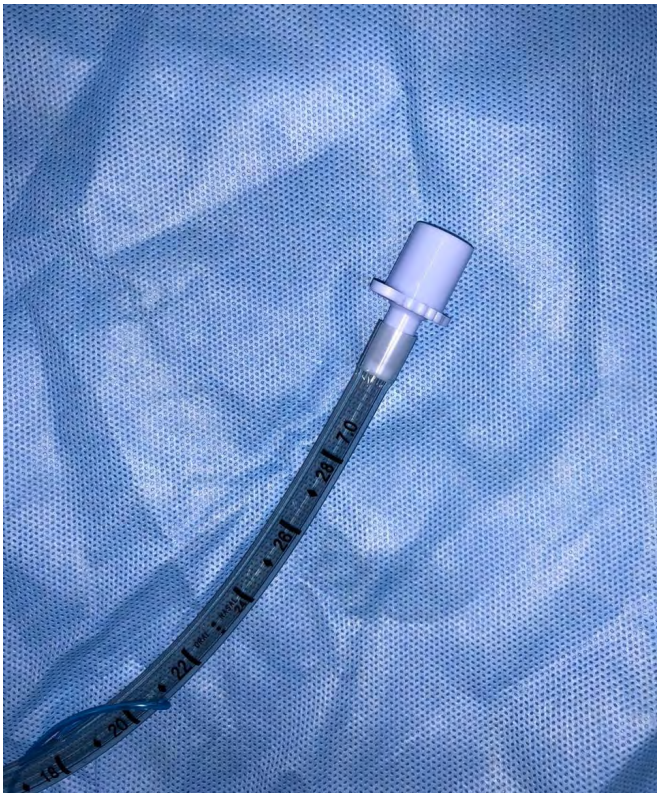

Figure 2. *Orotracheal tube to be used as a collector.*

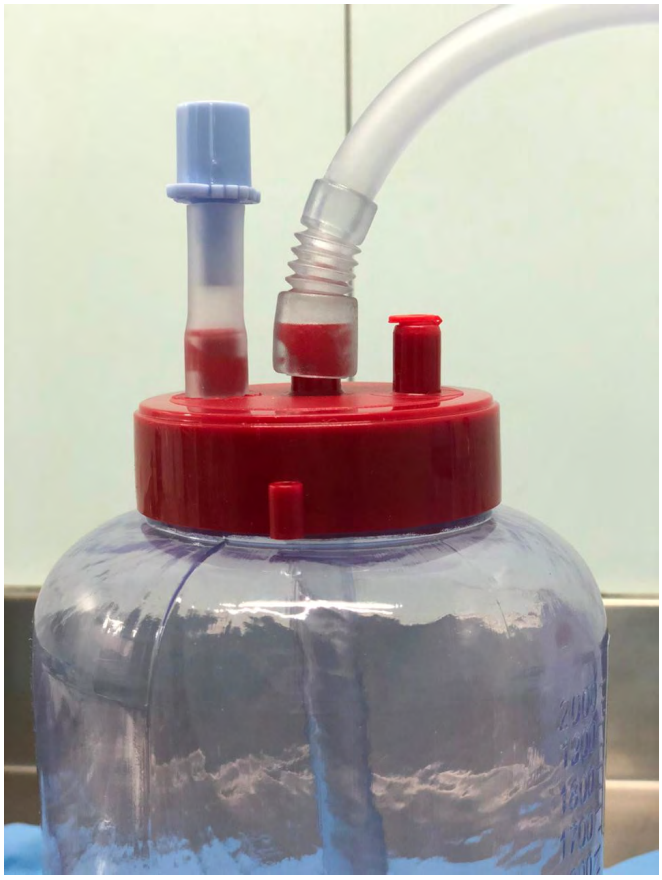

Figure 3. *Tube connector coupled to the collector and the hole communicating with the closed environment.*

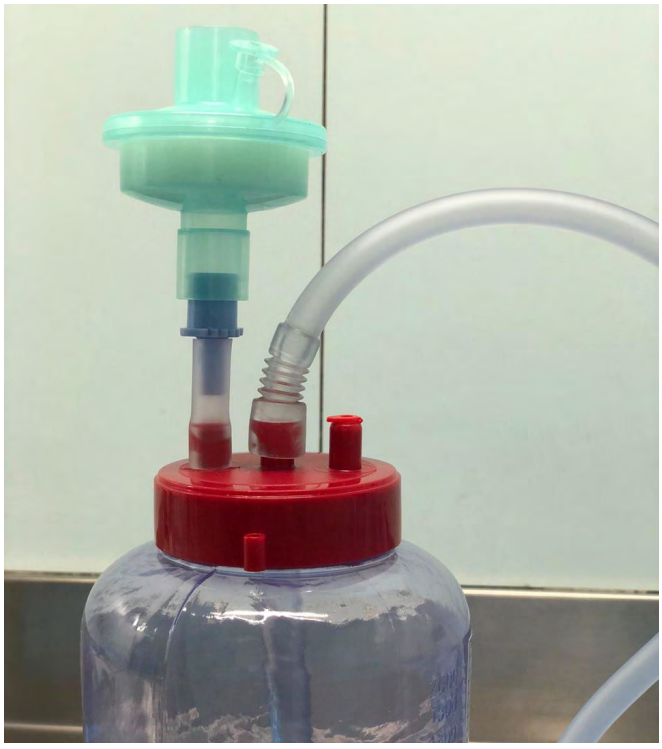

Figure 4. *The collector with the HEPA filter connected to the connector of the orotracheal tube which was previously coupled and the other closed hole to avoid aerosols.*

Figure 5. *Closed draining system which is ready for the procedure, complying with safety recommendations.*

• Dissect by planes, until the pleural cavity. If the patient is on mechanical ventilation, interrupt ventilation at that time;

• Insert the occluded drain, and with the intermediate connector attached to the collection bottle, fix it with 1 Vicryl® suture. Perform suture to the skin to obtain hermetic closure of the orifice;

• Unclamp the hemostat;

• Apply a U stich with 2.0 Nylon® suture and cover with the dressing.

CONCLUSIONS

Aerosolization by chest tube insertion is still an unknown phenomenon, but we should consider avoiding any possible means of contamination. The use of the entire closed circuit, occluded by a clamp and already connected to the collection bottle, is part of the arsenal for the safety of the care team.

We should consider as limiting the work the fact that the HEPA filter intercepts particles as small as 0.3 µm. A droplet is 0.5 µm. However, the size of the virus varies between 0.07 and 0.09 µm[9]. Considering that the microorganism needs a vehicle to be carried to the environment and that it would be aerosolization, the HEPA filter would be effective. However, the effectiveness of this adaptation needs to be studied, and the benefits, proven through evidence-based medicine. However, given the current pandemic, any method of reducing viral spread should be considered.

R E S U M O

Mais de um milhão de casos do vírus SARS-CoV-2 foram confirmados em todo o mundo, com o número de mortos ultrapassando 50.000 pessoas. Uma questão importante a ser abordada diz respeito à exposição dos profissionais de saúde à esse novo vírus. Os primeiros relatórios da província de Wuhan, na China, descreveram taxas de infecção de até 29% entre os profissionais de saúde antes que o uso de equipamentos de proteção pessoal (EPI) fosse totalmente regulamentado. Existem vários protocolos sobre o uso correto de EPI durante os procedimentos geradores de aerossóis. No entanto, não há orientação específica sobre como proceder em casos de necessidade de drenos torácicos em pacientes com vazamento de ar ativo COVID-19 positivos. O objetivo desse trabalho é auxiliar os cirurgiões das mais diversas especialidades durante a drenagem torácica de um paciente com COVID-19 e evitar um risco de contaminação ao profissional e no ambiente.

Palavras chave: *Síndrome Respiratória Aguda Grave. Toracostomia. Cirurgia Torácica. Coronavirus.*

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