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A Sonographer's Step-by-Step Approach for Preventing Transmission of COVID-19

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Abstract

The 2019 novel coronavirus, known as COVID-19, has greatly affected the way sonographers care for their patients. Sonography can be a useful imaging tool for surveillance and diagnosis of various conditions associated with COVID-19 patients or patients under investigation (PUIs). Currently, there are limited resources and protocols for preventing the transmission of COVID-19 from ultrasound equipment. Our institution has created a detailed protocol for scanning COVID-19 patients or PUIs to address this important issue.

Keywords

clinical protocol, patient care management, COVID-19

The novel coronavirus (known as COVID-19) is a disease that is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was first recognized in China in December 2019 after a spike in acute respiratory symptoms, specifically pneumonia.^{1,2} Since then, the virus has rapidly spread, and the World Health Organization declared a global pandemic in March 2020.³ COVID-19 is a highly infectious virus, which is easily transmitted through human contact.¹ Furthermore, COVID-19 has fundamentally changed the way health care workers provide care for patients.⁴ Health care organizations have quickly compiled policies and procedures to minimize exposure for patients and their workers from COVID positive (COVID-19+) and patients under investigation (PUIs).⁵ Diagnostic medical sonography is a safe and effective tool that has been used in this patient population to monitor and assess COVID-19 complications.⁶ However, conventional methods for conducting sonography can increase the risk of transmitting the virus from patient to sonographer and potentially to an unaffected patient. Therefore, a systematic protocol designed to limit transmission and maximize the advantages of this imaging modality should be required.^{6,7} This includes appropriate protection for sonographer, ultrasound equipment, and minimizing patient contact by shortening the examination time. The authors share their

experience in creating a detailed disinfectant protocol that their workplace uses for COVID-19+ patients and PUIs.

Sonography is an imaging modality that has unique benefits due to its portability, safety, and cost-effectiveness. These advantages make sonography an effective portable diagnostic tool to evaluate COVID-19+ patients but can lead to an unintended transmission.^{6–10} In 2019, Westerway et al.¹¹ found a lack of knowledge among clinicians concerning proper disinfection and hygiene practices with ultrasound equipment. This raises concerns, especially when performing bedside ultrasonography for COVID-19+ patients. The global COVID-19 pandemic lays bare the problem of limited detailed protocols and disinfection processes in sonography departments.

The authors implemented a process for sonographers to create imaging protocols under the supervision of the

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division director and manager. Hence, two experienced (American Registry for Diagnostic Medical Sonography [ARDMS] credentialed) sonographers created this COVID-19 disinfectant and equipment management protocol. Appendix A details the protocol that provides a thorough explanation of the process of disinfecting the ultrasound equipment when scanning a COVID-19+ patient or PUI. This protocol describes the preparation of the ultrasound equipment before leaving the department, as well as the steps for disinfecting the equipment inside and outside the patient room. It also details the cleaning process for the equipment and transducer upon returning to the department, after the examination.

In addition to this COVID-19 disinfectant and equipment management protocol, the institution has created specific protocols for COVID-19+ patients or PUIs. These protocols were shortened to limit exposure to the sonographer and target images that answer the clinical question. Sonographers should acquire specific clinical information needed for the appropriate treatment. One example of specific imaging is visualizing thrombus in the common femoral vein and continuing into the external iliac vein. This triggers treatment for deep vein thrombus (DVT) in the common femoral and femoral veins, which may differ from the iliac veins. Additional imaging of the iliac veins with magnetic resonance imaging (MRI) or computed tomography (CT) can be avoided. In addition, for some COVID-19 protocols, the department has shortened the examination to one side (the symptomatic side) and replaced the number of static images with video clips to reduce staff's exposure time. Appendices B, C, and D highlight the COVID-19 protocols for renal, upper extremity, and lower extremity, respectively.

The authors' experience has underscored the need for sonographers to fully prepare the ultrasound equipment and transducers, in the department, before performing a bedside examination on a COVID-19+ patient or PUI. Proposed guidelines have suggested having dedicated ultrasound equipment(s) for COVID-19+ patients or PUIs.⁷ In addition, it would be important to remove any unnecessary items from the equipment except for those transducers that are necessary for the examination.⁷ Ultrasound equipment(s) should be disinfected with low-level disinfectant (LLD) wipes (the brand of wipes would be specified under each institution's guidelines).⁷ A single large equipment cover that protects the entire ultrasound machine needs to be used. The cover minimizes contaminating small crevices (e.g., small spaces between the keys on the keyboard) and cooling fans that are designed to prevent overheating (e.g., in the machine and perhaps in monitors). Transducer covers should also be used to effectively implement this protocol. At the authors' institution, sterile transducer covers are used, similar to the biopsy covers. These covers extend the cord

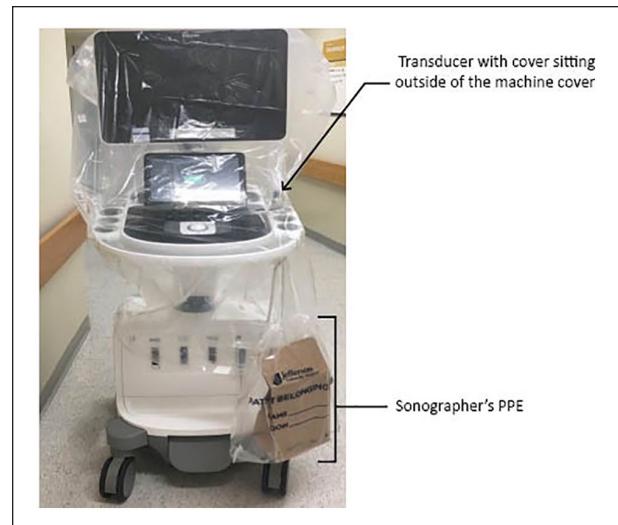


Figure 1. Demonstration of an ultrasound machine setup for coronavirus disease 2019 (COVID-19) patients or patients under investigation (PUIs). This setup is performed within the department before going to the designated COVID-19+ patient unit. The plastic bag connected to the ultrasound machine contains the sonographer's personal protective equipment, which is put on just before entering the patient's room.

length to minimize contamination. After the covers are placed on the transducer(s), they should sit on the outside of the machine cover in the designated equipment holder. In addition, sonographers should prepare for the examination by using single-use disposal gel packets, if available. If single gel packets are not available, use only one gel bottle, and discard it after the examination.⁷ The single gel packets or gel bottle should be placed on the outside of the machine cover in its designated equipment holder. Figure 1 illustrates an example of proper equipment preparation, in the department, prior to scanning a COVID-19+ patient.

When sonographers arrive to perform a sonogram on a COVID-19+ patient or PUI, they must protect themselves with proper personal protective equipment (PPE). The type or brand of PPE will depend on the specific institution's recommendations and guidelines, as well as availability. Before entering the patient's room, the sonographer should put on a N95 mask, powered air-purifying respirator (PAPR), or face shield; gown; and two sets of gloves. The outer pair of gloves is used to scan the patient. Keep one hand dedicated to manipulating the transducer and the other for the equipment. At the authors' institution, it is mandatory to wear a face shield with a N95 mask or PAPR with a N95 mask (in case of PAPR failure) when scanning COVID-19+ patients or PUIs.

After completing the sonogram, the machine should be moved away from the patient, so that there is at least

a 6-foot distancing. Achieving this physical distancing may be harder in some patient rooms, and this is based on room size and presence of other equipment. The outer pair of gloves, equipment cover, transducer covers, and gel should be removed and discarded at the completion of the sonogram. Before the sonographer exits the patient's room, the inner pair of gloves is used to disinfect the ultrasound equipment and transducers. When the sonographer is leaving the patient's room, they should remove their gown and gloves and wash their hands for 20 seconds. When the sonographer is outside of the patient's room (with the ultrasound equipment), they should put on a clean pair of gloves, remove their remaining PPE, and wash their hands again. While still outside of the patient's room, the sonographer should disinfect the ultrasound equipment and all parts of the transducer with LLD wipes. Finally, they should remove the gloves and wash their hands for another 20 seconds. In addition, some institutions report incorporating a "clean sonographer" and a "dirty sonographer" system to assist in the disinfectant process. The "dirty sonographer" would take off the equipment and transducer covers while in the patient's room, clean the equipment, and then push the machine outside the room. The "clean sonographer" would wait outside the patient's room for the machine and disinfect equipment in the hallway.

Upon returning to the department after a COVID-19 examination, the machine(s) should be disinfected again with LLD wipes. Transducers are wiped down with LLD wipes and placed in a Trophon machine (Nanosonics, Inc., Indianapolis, IN) for an additional layer of disinfection. When the dedicated ultrasound machine(s) and transducer (s) are not being used, they should be stored in a designated examination room with appropriate signage. By leaving the dedicated ultrasound machine(s) in one examination room, an additional layer of isolation is provided, and the sonographers know where the COVID-19 ultrasound machine(s) are at all times.

The intent of this article is to inform the broader sonographer community about this COVID-19 disinfectant and equipment management protocol as it is useful and easy to understand. This example protocol should not replace any existing COVID-19 standards. Instead, it should act as an adjunct to an already approved hospital protocol. The current situation is in flux, and providing care during this pandemic is evolving as more information is provided. Sonographers are on the frontline providing care for COVID-19+ patients and PUIs and cannot distance themselves, given the nature of the work.¹² It is important to continue providing safe and quality care to patients, while keeping sonographers safe. This article and the associated protocols are designed to aid in that process.

Appendix A

COVID-19 Ultrasound Protocol^{7,13–24}

Equipment management and disinfection plan

Purpose. This plan provides guidance on portable ultrasound equipment cleaning and disinfection within the context of COVID-19+ patients, including PUIs, for COVID-19.

Disinfection

All LLD wipes used to disinfect the ultrasound machine and transducers must undergo the proper "wet time" to allow for proper disinfection. The type of LLD wipes used will depend on the hospital's approved disinfectant wipes.

Wet time for disinfectant wipes at the authors' institution:

- Nonbleach AF3 wipes—wet time is 3 minutes
- Bleach wipes—wet time is 4 minutes

Prior to Examination

- Limit the number of ultrasound machines used.
 - Have one to two ultrasound machines dedicated specifically for COVID-19 cases.
- Remove all unnecessary items from the machine.
 - Reduce the number of transducers connected to the machine by only taking transducers that are needed for the sonographic examination.
 - Place cover over unit.
- Use single-use gel packets and transducer covers.
 - If single-use gel packets are not available, use one gel bottle.
 - If gel bottle is used, discard immediately after examination (see below).
 - Use transducer covers for every examination, if possible.
- Clean equipment.
 - Disinfect the machine with LLD wipes.
 - Wipe down all parts of the equipment, including the keyboard, console, transducers, transducer cord, and so on, with LLD wipes and allow for proper "wet time."

During Examination

- Wear two sets of gloves and refer to the guidelines for proper PPE equipment.
 - See below for an explanation on the use of a "double-glove" method, which is preferred, when performing portable sonograms.
 - Scanning should, as much as possible, be performed with one hand on the transducer

and the other hand in contact with the keyboard and machine controls. Since aerosols and particulate matter may adhere to crevices in keyboards, the hand in contact with the machine should be considered semi-clean, unless there is a machine cover. Gel application would be with the semi-clean hand, dispensing clean gel.

After Examination: Inside the Patient Room

- Remove and discard transducer cover(s), gel packets, or gel bottle.
- Clean the machine and all parts of the transducer (including cord and connector) with LLD wipes.
 - This step should be performed when exiting the room with the door open, using the optimum approach so as to stand 6 feet away from the patient.
 - Before disinfection, remove and discard only the outer pair of gloves.
 - Keeping mask, face shield, gown, and gloves on—disinfect the machine and transducers with LLD wipes.
 - Remove and discard gown and gloves, and wash hands for 20 seconds.
 - Exit the room with the ultrasound machine.

After Examination: Outside the Patient Room

- Remove remaining PPE and disinfect the ultrasound equipment outside the room.
 - Put on a new pair of gloves, remove PPE worn while scanning (face shield, N95, PAPR etc.), remove gloves again, wash hands, and place surgical mask back on.
 - Put on a new pair of gloves, and disinfect the machine and all parts of the transducer with LLD wipes, allowing for proper wet time.
 - Remove gloves and wash hands again before returning to department.

After Examination: In the Imaging Department

- Return disinfected machine to an examination room dedicated to COVID-19.
 - Disinfect the machine and all parts of the transducers again with LLD wipes.
 - After proper cleaning and disinfection, all transducers that were taken and/or used for examination should be placed into the Trophon (or other facility disinfection system) for further disinfection.

Further Explanation

- Extra precautions
 - This is a list of actions from the plan that the authors (as a department) decided required extra precautions:
 - Transducer covers
 - Trophon/disinfection system
 - Cleaning the machines and transducers inside the room, outside the room, and again in the department
 - Keeping the machine in a specific room
- Cleaning of equipment inside and outside the patient room
 - Cleaning the machines inside the room and outside the room is the authors' hospital recommendation.
 - For the subheadings (After Examination: Inside Patient Room/After Examination: Outside Patient Room), not one primary source was used for a reference as a step-by-step process for cleaning an ultrasound machine inside or outside the room while still wearing PPE. So, the advice was combined from four separate sources^{15,16,20,25}; this was done to provide the safest plan for sonographers.
 - Two sets of gloves (mentioned as the "double-glove" method)
 - By wearing two sets of gloves, the sonographer can remove the "outer" contaminated pair before cleaning the machine inside the room.

Appendix B

COVID-19+ Rapid Renal Sonography Protocol

Please note: Renal sonogram will contain videos to speed acquisition.

Make sure the study is indicated and no recent sonogram, abdominal CT, or chest CT were recently performed that includes substantial portions of the kidneys. Sonographers should speak to the radiologist to confirm that the study is indicated. Indications for sonograms are in flux as guidelines are being solidified. Radiologists generally need to speak to clinical service to confirm the study is indicated.

Clinical situations are flexible, and this may require adjustment as indications are developed. (Doppler is not needed currently, but some European clinical practices are doing resistive indices. If Doppler is ordered, have the physician or sonographer confirm what is needed with the ordering team.)

Renal sonogram for COVID-19 contains videos to capture information quickly.

Video. Two overlapping videos per kidney usually need to be taken: two for short axis and two for long axis. If one video per axis is possible, take one video, but make sure to go beyond the upper and lower pole of the kidney.

Right kidney

- Short axis from above kidney to below middle of kidney
- Short axis from above middle of kidney to below kidney
- Long axis from lateral to medial right kidney (may require two sweeps). Should start just outside kidney and end outside medial to kidney.

Repeat for left kidney.

Bladder. Video clip of the bladder, in the transverse plane and continuing through the entire bladder.

Jets only. If there is hydronephrosis, image the bladder for 15 seconds to detect jets. Take sonographic images if jets are visualized; otherwise, the study is at an end.

Appendix C

COVID-19+ Rapid Upper Extremity Venous Ultrasound Protocol

Please note: Generally unilateral. If bilateral symptoms, start with limb closest to the sonographer or the most symptomatic limb first. Complete the additional limb if first limb is normal.

- Central subclavian vein: gray-scale, color and spectral Doppler
 - If acute DVT: stop
- Peripheral subclavian vein: gray-scale without and with compression. Sweep color box medial-lateral for middle and peripheral subclavian vein.
 - If acute DVT: stop
- Axillary vein: gray-scale without and with compression and color Doppler
 - If acute DVT: stop
 - If normal:
 - Patient has peripheral line: continue scan to arm
- Do not scan arm if thrombus is seen in subclavian and axillary vein.
- If no thrombus is visualized in central veins, scan brachial, cephalic, and basilic veins in arms. Stop if thrombus is found.
- No internal jugular vein unless facial swelling or line
 - Long-axis color toward head and toward confluence of other central veins

- Compression if possible
- No forearm veins unless forearm symptoms and no thrombus above

Documentation

Central subclavian: long-axis gray-scale, color and spectral Doppler

- (If necessary) Innominate long-axis gray-scale and color Doppler

Mid-subclavian: long-axis color only

Peripheral subclavian: short axis without and with compression, long-axis color Doppler

Axillary: short axis without and with compression, long-axis color Doppler

- (If necessary) Peripheral veins short axis without and with compression (brachial, basilic, and cephalic veins)
 - If thrombus, consider long axis of thrombus

Internal jugular vein (if necessary): long-axis color

- Color angled centrally
- Color angled toward head
- Gray-scale without and with compression

Appendix D

COVID-19+ Rapid Lower Extremity Venous Ultrasound Protocol

“Clot than STOP.” Please note: Protocol minimizes contact with patient.

- No calf imaging (unless calf symptoms that referring physician wishes to evaluate)
- Unilateral scan unless both legs symptomatic
- Scan most affected leg first
- Stop when acute DVT and proximal extent are confirmed

Asymptomatic patient lower extremity ultrasound screening is not recommended.

Venous ultrasound for symptomatic patients with objective signs such as leg swelling, tenderness, increased warmth, increased circumference >2 cm

- Common femoral vein to popliteal vein (start at inguinal ligament, end at tibioperoneal trunk where posterior tibial vein and peroneal veins come together)

- No calf except for rare symptomatic calf that requires imaging (not swollen leg/calf only)—confirm with referring physician
- Scan entire vein compressing every 1 to 2 cm down leg
 - Common femoral vein without and with compression
 - Femoral vein without and with compression
 - Popliteal vein without and with compression
- Long-axis common femoral vein spectral Doppler image
- Document gray-scale without and with compression: common femoral vein, central femoral vein, mid femoral vein, peripheral femoral vein, and popliteal vein
- Once acute DVT is found: STOP scanning peripherally (keep scanning if indeterminate or chronic scar).
 - If top (end) of clot is seen, STOP.
 - If top of clot is not seen, such as in some common femoral vein DVT, document external iliac vein.
 - With curved array, take additional gray-scale and color Doppler images of external iliac vein above inguinal ligament and abdominal side wall.
- If common femoral vein waveform is absolutely flat, with no undulations or phasic variation, document external iliac vein.
 - With curved array, take additional gray-scale, color Doppler images and spectral Doppler images of external iliac vein above the inguinal ligament and abdominal side wall.
- Add color if visualization of vein is difficult only.
- Popliteal spectral Doppler for selected patients only
 - Add popliteal spectral Doppler if visualization limited (more than 3 cm of a vein is not visualized).
 - Add popliteal Doppler if common femoral vein spectral Doppler is not performed (e.g., overlying bandage or lines).

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