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COVID-19

Point-of-Care Ultrasound Guide

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P29241-01

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Introduction

COVID-19 is overwhelming our healthcare system and the number of patients being diagnosed with COVID-19 is staggering. Point-of-care ultrasound (POCUS) is emerging as an important tool to support healthcare providers diagnose and manage COVID-19 lung and cardiac complications.

This document has been designed to assist healthcare professionals on how to best utilize point-of-care ultrasound technology to support the diagnosis of complications stemming from COVID-19 and management of patients with COVID-19. Specifically, clinicians can use the information in this document to:

- Confirm that their selection of transducer, ultrasound system, exam type, and scan settings are appropriate for performing COVID-19-related lung and cardiac ultrasound examinations;
- Follow recommended protocols to properly place an ultrasound transducer on the patient in order to obtain optimal quality images;
- Correctly interpret ultrasound images to diagnose the most typical COVID-19 findings relating to lung and cardiac conditions; and
- Review additional resources for healthcare professionals to learn of the most current COVID-19 information.

COVID-19 Lung Complications

COVID-19 primarily attacks the lung in the initial stages of the disease, so being able to recognize lung complications using point-of-care ultrasound is crucial to the early detection and management of COVID-19 patients[1,2]. This section provides guidance on how to use FUJIFILM Sonosite point-of-care ultrasound to identify the pulmonary manifestations of COVID-19.

Ultrasound use for lung exams in COVID-19 patients

FUJIFILM Sonosite ultrasound systems can assist with the following aspects of diagnosis and management of pulmonary issues, which are prevalent in COVID-19 patients:

- Triage and diagnose suspected pulmonary issues which may be linked to COVID-19
- Serial examination of COVID-19 patients to limit X-ray and CT scan use
- Evaluate for lung improvement or worsening of COVID-19 diagnosed patients
- Evaluate need for advanced airway or mechanical ventilation
- Assist with ventilator and weaning strategies
- Evaluate lung complications in Covid-19 patients that are in prone position

Selecting a FUJIFILM Sonosite system and transducer for lung ultrasound

Use the following table to identify the various combinations of FUJIFILM Sonosite ultrasound transducer types and systems that can be used to scan COVID-19 patients' lungs. The relative merits of the different types of transducers when used to scan lungs is also summarized.

Table 1. FUJIFILM Sonosite ultrasound transducer types, their relative merits when used to examine lungs, and supporting Sonosite ultrasound systems

Transducer type	Pros	Cons	Sonosite ultrasound systems
Curvilinear	• Ideal probe for lung ultrasound • Good combination of resolution and depth • Large field of view to see multiple rib spaces	• Large footprint can make it difficult to visualize through a single rib space • Need to switch to a phased array if doing cardiac imaging	• Sonosite PX • Sonosite X-Porte • Sonosite SII • Sonosite Edge II • Sonosite iViz • Sonosite M-Turbo
Phased Array (Sector)	• Deep penetration • Small footprint to examine between single intercostal space	• Difficult to get precise definition of pleural line • Near field resolution not as optimal as curvilinear	• Sonosite PX • Sonosite X-Porte • Sonosite SII • Sonosite Edge II

	• Useful when also doing cardiac exam • Widely available on most machines		• Sonosite iViz • Sonosite M-Turbo
Linear	• High frequency probe • High resolution, resulting in precise definition of pleural line in the near field. Great for evaluating pleural line and subpleural consolidations	• Due to the higher frequency, linear transducers are not ideal for visualizing structures past 6 cm • Might miss pleural effusions and deep consolidations	• Sonosite PX • Sonosite X-Porte • Sonosite SII • Sonosite Edge II • Sonosite iViz • Sonosite M-Turbo
Microconvex	• Great for lung imaging • High resolution • Great for evaluating pleural line and subpleural consolidations • Can penetrate more deeply than linear probe	• Not available on all systems • Cannot penetrate as deeply as curvilinear or phased array to evaluate for pleural effusions or deep consolidation	• Sonosite X-Porte • Sonosite SII • Sonosite Edge II • Sonosite iViz • Sonosite M-Turbo

More information For a listing of the specific models of transducers that are compatible with your FUJIFILM Sonosite ultrasound system and information about which exam types can be selected for examining lungs or heart, refer to your system user guide or visit the company's transducer listing at https://www.sonosite.com/node/13576.

Application presets for lung ultrasound

All of the FUJIFILM Sonosite ultrasound systems listed in Table 1 support lung examination through a variety of preset exam types. The available combinations of transducer and exam types varies with the specific ultrasound system (see Figure 1). For example, some systems might require selecting the Abdomen exam type instead of Lung when using a curvilinear transducer.

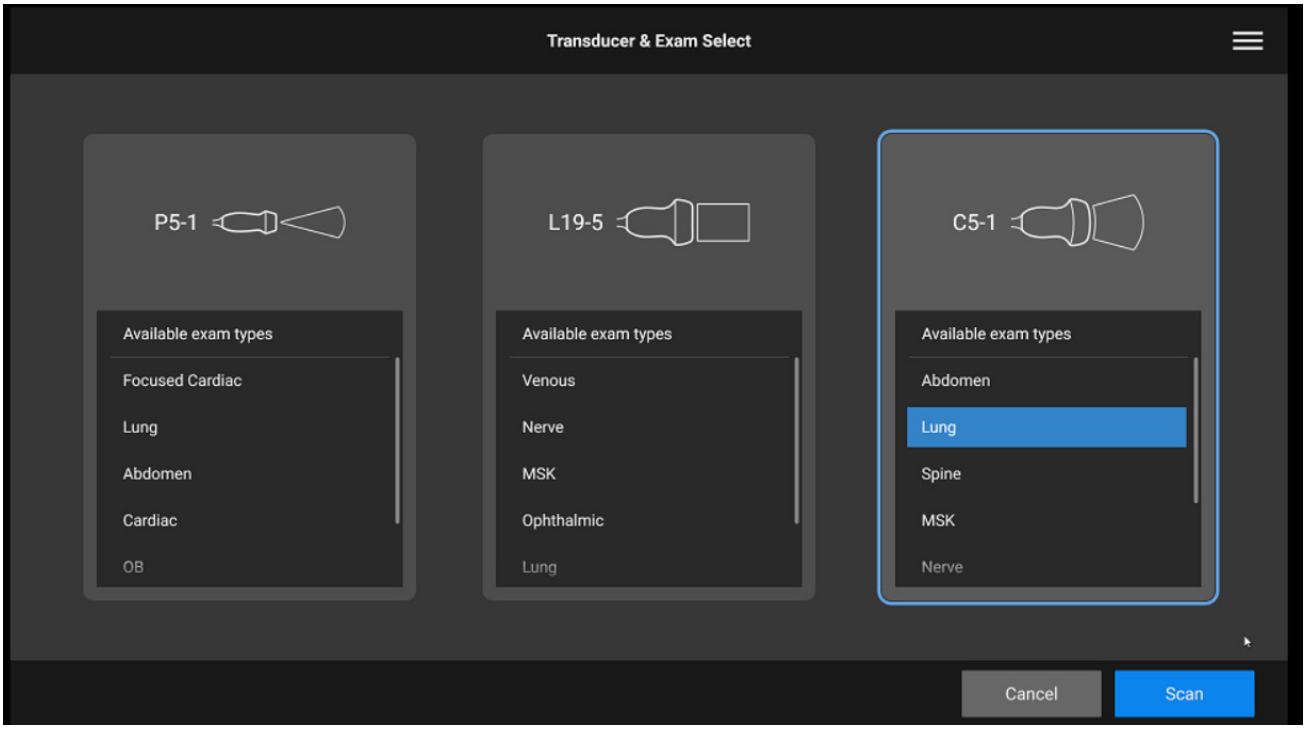

Figure 1. Selecting the appropriate transducer and exam type for scanning a lung.

More information For step-by-step instructions on how to configure your Sonosite ultrasound system for a lung exam with the appropriate transducer and initial depth setting, see your ultrasound system's user guide. Alternatively, you can visit the online Sonosite Document Library at https://www.sonosite.com/support/documents.

The 12-point lung exam protocol

As illustrated in Figure 2, COVID-19 can affect the lungs in a patchy or multilobar distribution[3,4].

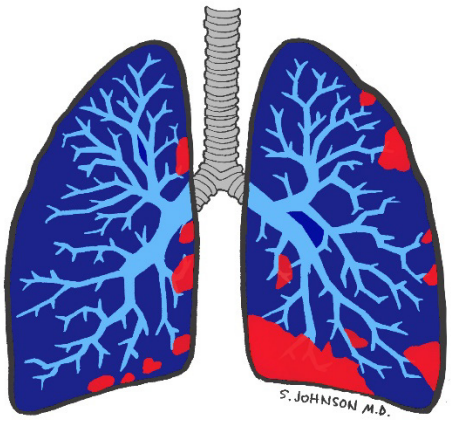

Figure 2. Illustration of a COVID-19 patient's lungs that display characteristic patchy areas.[3]

To increase the sensitivity of detecting COVID-19 lung findings, FUJIFILM Sonosite recommends performing a 12-point lung ultrasound exam (6 points on each lung) when possible[1,5,6]. The positioning of the transducer onto the patient for each of the 6 points on each lung is illustrated in Figure 3 and described in Table 2 below.

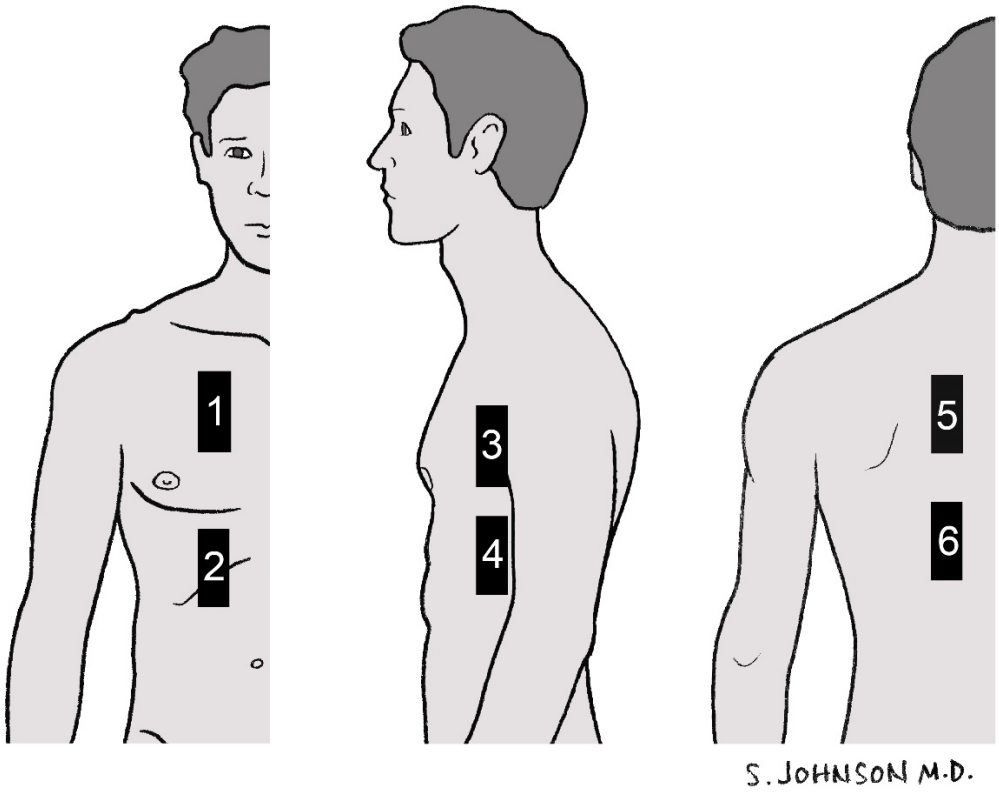

Figure 3. The 12-point lung exam is comprised of 6 discrete transducer scan points on each lung.

Table 2. Description of the six recommended transducer locations on each lung

Transducer Location	Lung Field
1	Anterior Superior
2	Anterior Inferior
3	Lateral Superior
4	Lateral Inferior
5	Posterior Superior
6	Posterior Inferior

Alternative lung exam protocols

In situations where scanning all 12 points on the lungs is not possible due to patient positioning or condition, Table 3 summarizes the recommended subset of transducer locations for alternate patient positions.

Table 3. Transducer positions available for patients in various positions

Patient Position	Available Transducer Locations (for each lung)
Upright	1-6
Supine	1, 2, 3, 4
Prone	3, 4, 5, 6

Transducer indicator and orientation marker positioning

For each point, place the indicator bump on the transducer towards the patient's head, and the orientation marker on the screen should be on the left side (see Figure 4). In addition, make sure you are between two rib spaces to clearly identify the pleural line.

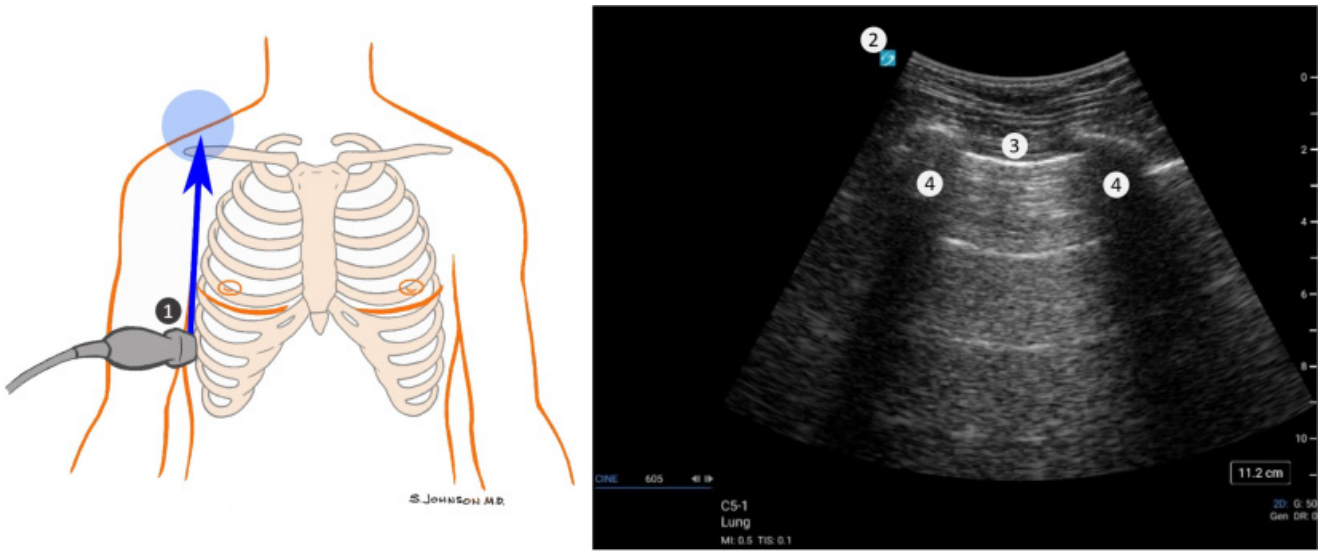

Figure 4. Proper transducer positioning on the patient, and lung ultrasound image with orientation marker on the left side.

1. Transducer probe bump pointing up toward patient's head
2. Orientation marker (on left side)
3. Pleural line
4. Rib shadow

Using ultrasound to identify deterioration of lungs in COVID-19 patients

As the severity of COVID-19 worsens in the lungs, it develops a predictable set of ultrasound patterns that correlate with the severity of lung disease (see Figure 5)[1,7,8,9]. This section describes how to use point-of-care ultrasound to identify the pulmonary manifestations of COVID-19, and then use the characteristic patterns to gauge the severity of lung complications in your patients.

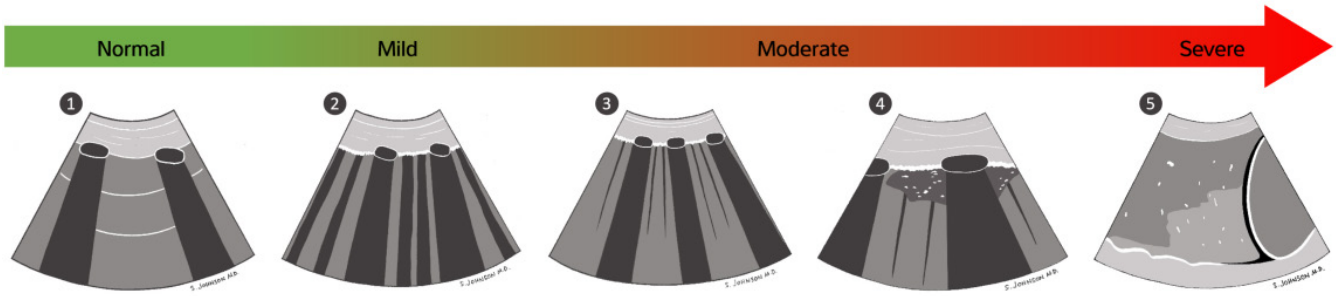

Figure 5. Characteristic lung ultrasound findings that appear in normal lungs, and in COVID-19 patients as the disease progresses from mild to severe.

1. Normal lung displaying A-lines
2. A few B-lines with thickening or irregularity of the pleural line
3. Confluent B-lines
4. Subpleural consolidation
5. Moderate-to-large consolidation with pleural effusions (rare)

These stages are described in more detail in the following sections.

Normal lung: A-lines with lung sliding

Before identifying diseased lung, it is important to be able to recognize how a normal lung ultrasound appears, as shown in Figure 6. Normal lungs will have “A-lines,” which are a reverberation artifact of ultrasound, signifying that the lung is aerated (normal). When viewed in real time, normal lungs will also exhibit “lung sliding” that signifies apposition of the visceral and parietal pleura.

More information To watch a video clip of lung sliding, visit https://www.youtube.com/watch?v=p3g6bW2XzAo&list=PL2AGI6-lzXJQt3LGH0Fqc5rjln_hwmfhZ&index=11

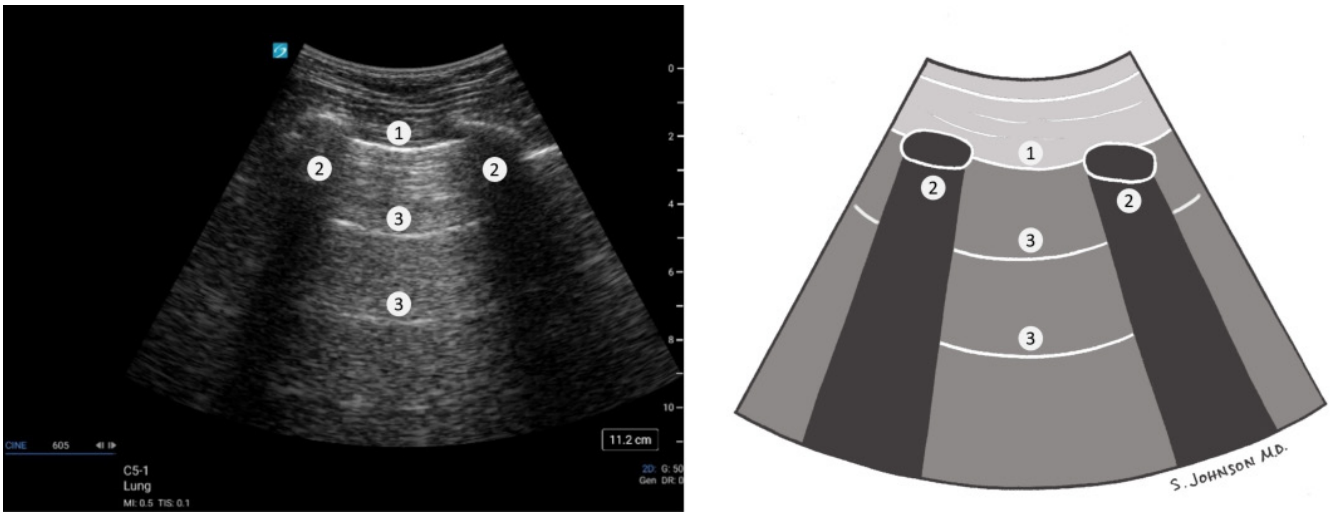

Figure 6. An ultrasound scan and matching illustration of a normal lung.

1. Pleural line
2. “Bat wing” sign, created from two rib shadows
3. A-lines

B-lines with pleural thickening

As COVID-19 first starts to attack the lungs, it causes inflammation and fluid to build up at the pleural line. This will result in the ultrasound findings of B-lines as identified in Figure 7.

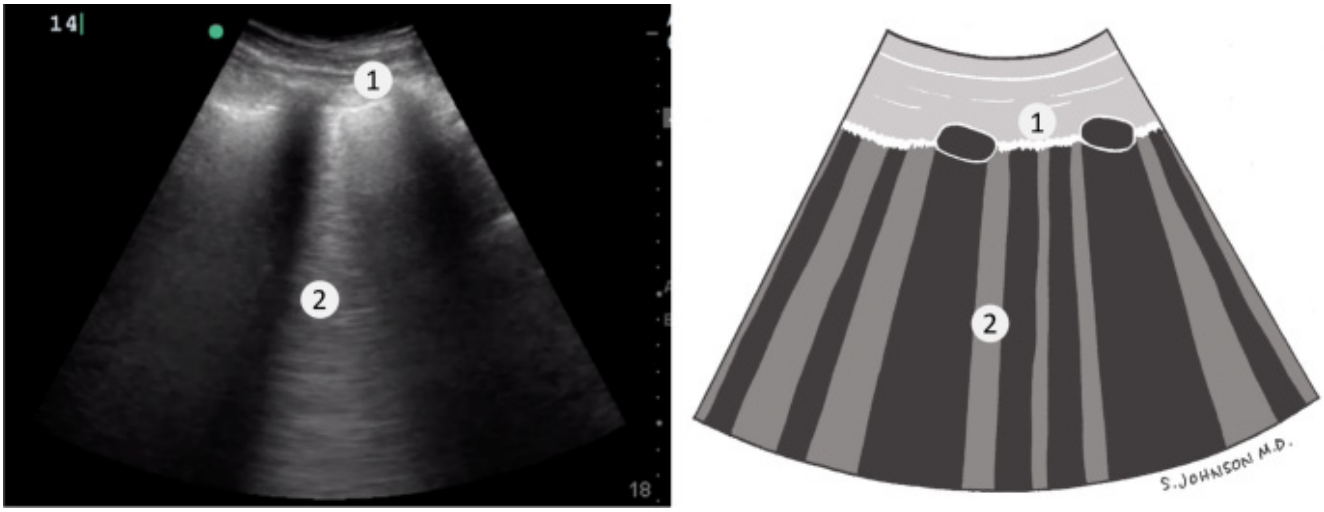

Figure 7. An ultrasound scan and matching illustration of a lung with B-lines and irregular/thickened pleural line.

1. Irregular and thickened pleural line
2. B-lines, which are hyperechoic vertical lines that indicate interstitial edema in diseases such as pneumonias or acute respiratory distress syndrome

Confluent B-lines

As COVID-19 disease worsens in the lung, there will be a dramatic increase in the amount of interstitial thickening and fluid[7]. This results in an increased number of B-lines on the ultrasound image. The number will reach a threshold where it becomes difficult to differentiate between individual B-lines. This will give rise to confluent B-lines, as shown in Figure 8.

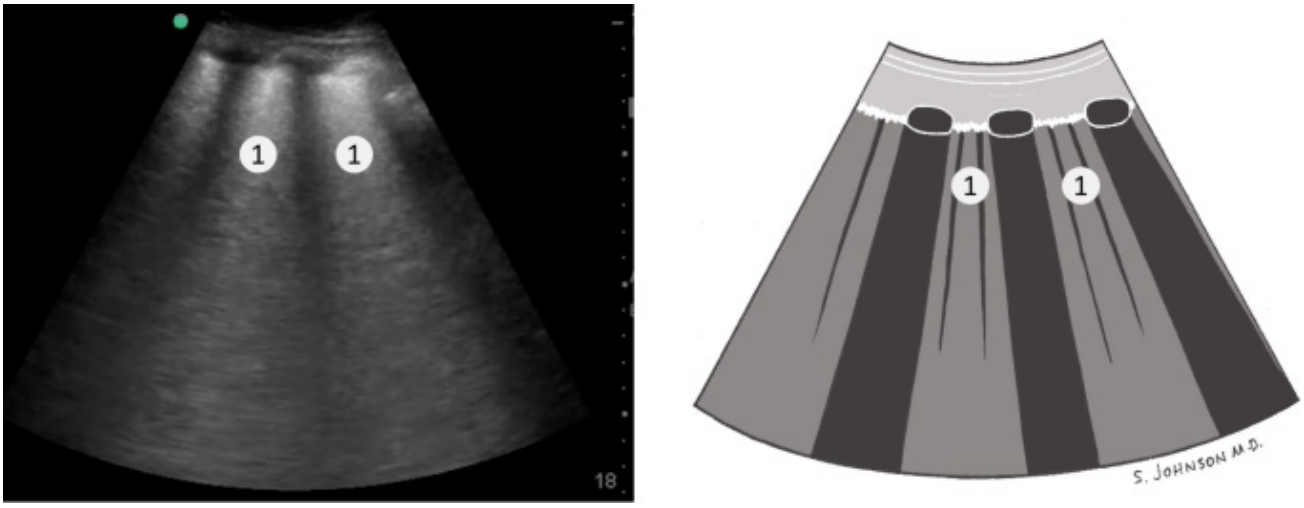

Figure 8. An ultrasound scan and matching illustration of a lung with confluent B-lines.

1. Confluent B-lines, signifying that the lungs are starting to be overwhelmed with inflammation and fluid from the virus. Confluent B-lines can signal that the patient's condition is heading toward a more severe viral pneumonia or acute respiratory distress syndrome (ARDS).

Subpleural consolidation

As even more fluid builds up in the lung from COVID-19 complications, parts of the lung can become completely filled with fluid and lead to consolidation of the lung. Viral pneumonias such as COVID-19 can lead initially to small subpleural consolidations with air bronchograms, as shown in Figure 9.

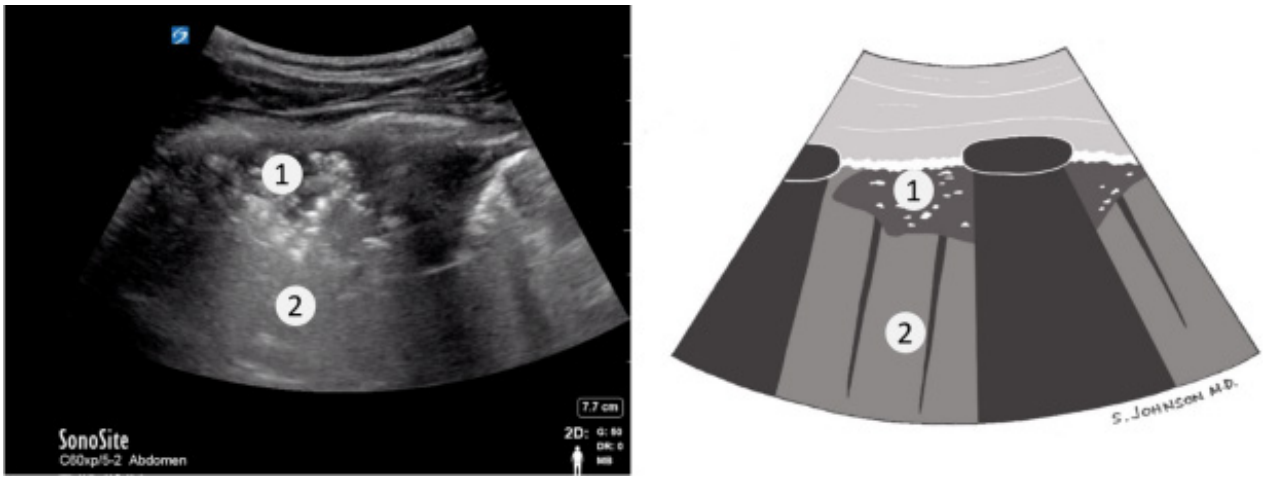

Figure 9. An ultrasound scan and matching illustration of a lung with a subpleural consolidation.

1. Subpleural consolidation with air bronchograms (white dots)
2. Confluent B-lines below the subpleural consolidation

Note Because subpleural consolidations are fairly small and can be less than a centimeter, FUJIFILM Sonosite recommends also using a linear or microconvex transducer to identify these lesions.

Consolidation and pleural effusion (rare)

With severe COVID-19 lung complications, fluid can fill entire lobes of the lungs, resulting in large consolidations and parapneumonic pleural effusions, as shown in Figure 10. These are more rare or atypical findings.

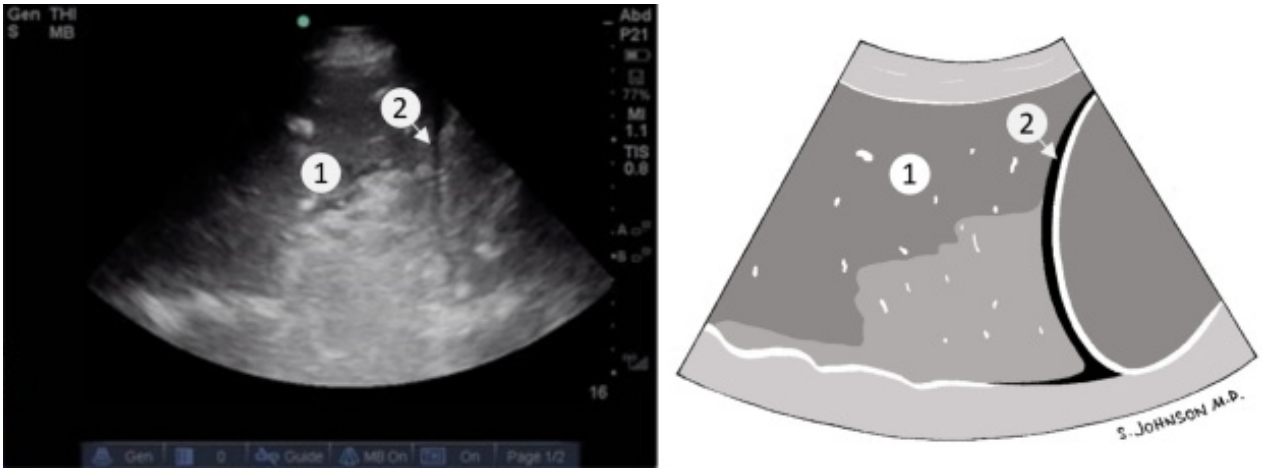

Figure 10. An ultrasound scan and matching illustration of a lung with consolidations and pleural effusion.

1. Lung consolidation
2. Small pleural effusion

Potential COVID-19 lung management using point-of-care ultrasound

It is important to note that these findings are sensitive to, but not specific for, COVID-19 infection. Many of the ultrasound findings described are common in other viral pneumonias. However, these findings can help you determine how severely COVID-19 has affected the lungs to decide on the next best steps in management.

FUJIFILM Sonosite recommends using these findings to help guide your clinical management and the progress of disease of your patients. Of course, it is important to combine these ultrasound findings with other diagnostic tests to build a more accurate overall clinical picture of the patient.

More information For more resources on the most up-to-date COVID-19 management recommendations, see the References section later in this document.

COVID-19 Cardiac Complications

COVID-19 is an interesting disease that affects not only the lungs, but it can also have significant cardiac manifestations in the later stages of the disease. Cardiac issues usually occur in patients with severe COVID-19 infection, so being able to diagnose and monitor cardiac complications is important to the safety and management of your patients[10,11].

Unlike the lungs that have a linear progression of severity, COVID-19 can attack different areas of the heart at independent time points. For example, COVID-19 can attack the heart muscle, causing myocarditis with depressed left ventricular function[12]. It can attack the pericardium, causing pericarditis with pericardial effusions. COVID-19 can even cause a combination of myocarditis and pericarditis leading to myopericarditis[13]. In some cases, it may also cause cardiac tamponade and myocardial infarction (heart attack)[2,6,14,15,16].

In addition to directly attacking the heart, there is increasing evidence that COVID-19 can significantly increase the risk for thromboembolic disease, causing deep vein thrombosis (DVT) and pulmonary embolism[17]. If the clot burden from a pulmonary embolism becomes significant enough, it can turn into a massive pulmonary embolism resulting in right heart strain and obstructive shock.

Unfortunately, COVID-19 patients may present with any of these cardiac findings at different time points in their disease process. This section describes how to evaluate for the most common cardiac complications of COVID-19 using point-of-care ultrasound: myocarditis, pericarditis, cardiac tamponade, and massive pulmonary embolism.

Ultrasound use for cardiac exams in COVID-19 patients

FUJIFILM Sonosite ultrasound systems can assist with the following aspects of diagnosis and management of cardiac issues in COVID-19 patients:

- Clinical symptoms including chest pain and shortness of breath
- Evaluation of COVID-19 patients who are unstable
- Elevation of cardiac enzymes
- Significant EKG changes
- Any significant change in vital signs

Selecting a FUJIFILM Sonosite system and transducer for cardiac ultrasound

The phased array transducer is the optimal type of transducer recommended for use in cardiac ultrasound imaging. Its low frequency can penetrate to image a deep structure, such as the heart. The small footprint of the phased array probe is also ideal, allowing it to go in between rib spaces for optimal cardiac images.

The following FUJIFILM Sonosite ultrasound systems support cardiac examination to scan COVID-19 patients' hearts:

- Sonosite PX
- Sonosite X-Porte
- Sonosite SII

- Sonosite Edge II
- Sonosite iViz
- Sonosite M-Turbo

Application presets for cardiac ultrasound

All of the FUJIFILM Sonosite ultrasound systems listed in the previous section offer a pre-set Cardiac exam type.

More information For specific guidance on how to configure your Sonosite ultrasound system for a cardiac exam with a phased array transducer, see your ultrasound system's user guide. Alternatively, you can visit the online Sonosite Document Library at https://www.sonosite.com/support/documents.

Transducer indicator and orientation marker positioning

When you select the Cardiac exam type, the orientation marker should appear on the top right side of the screen, as shown in Figure 11.

Figure 11. A Cardiac exam displaying apical 4-chamber view with the transducer orientation marker at the top-right of the screen.

Cardiac ultrasound protocol

Cardiac views are normally obtained with the patient in a supine position. However, if you are having difficulty attaining quality images, consider placing the patient in the left lateral decubitus position to bring the heart away from the sternum.

Optimal interpretation of cardiac function is achieved by examining the heart from several different views. The initial transducer placement on the body, transducer indicator position, and key structures to examine are provided for each view below.

Parasternal long axis view

Beginning with a parasternal long axis view, place your transducer next to the sternum around the fourth intercostal space, with the transducer indicator positioned toward the patient's right shoulder, as shown in Figure 12.

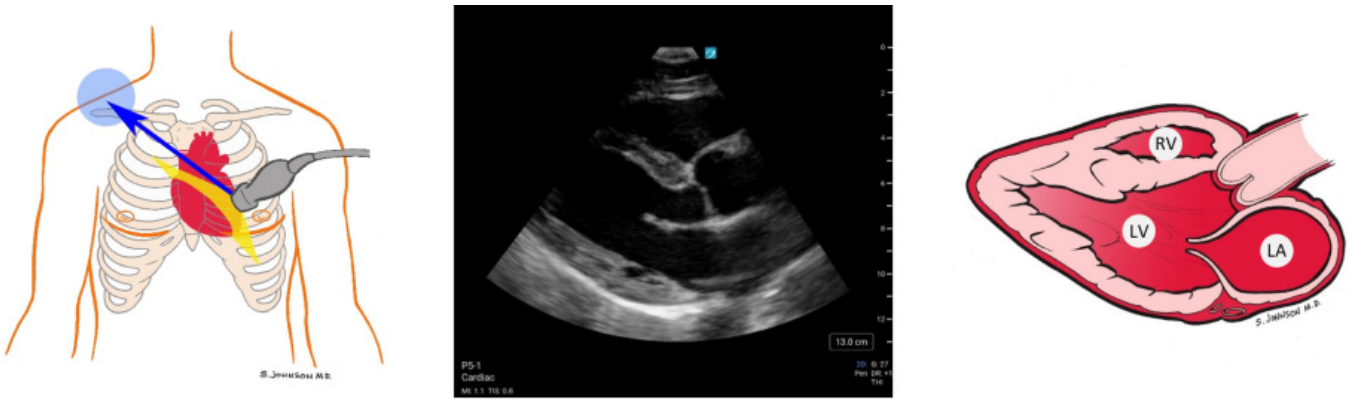

Figure 12. Parasternal long axis view.

Key structures to examine in this view include:

- LV = Left ventricle
- RV = Right ventricle
- LA = Left atrium

Parasternal short axis view

From the parasternal long axis view, rotate the transducer clockwise, 90 degrees to have the indicator point toward the left shoulder, as illustrated in Figure 13.

Figure 13. Parasternal short axis view.

Key structures to examine in this view include:

- RV = Right ventricle
- LV = Left ventricle

Apical four-chamber view

From the parasternal short axis view, slide the ultrasound probe down towards the apex while keeping the indicator towards the patient's left. Finally, tilt the tail of the ultrasound probe down toward the patient's feet, as illustrated in Figure 14.

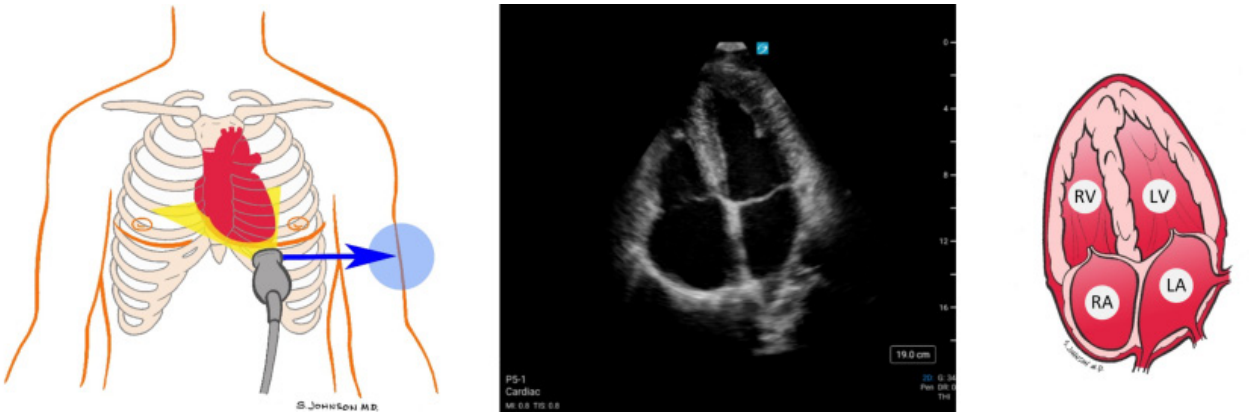

Figure 14. Apical four-chamber view.

Key structures to examine in this view include:

- LA = Left atrium
- LV = Left ventricle
- RA = Right atrium
- RV = Right ventricle

Subxiphoid view

Keep the indicator toward the patient's left side, and bring the ultrasound transducer to the epigastric area (just inferior to the xiphoid bone), as indicated in Figure 15. Tilt the probe towards the patient's feet. In most circumstances, you will need to lay the probe almost flat on the abdomen to get a proper subxiphoid view. Having the patient take a deep breath in may improve your view because it brings the heart closer to your probe.

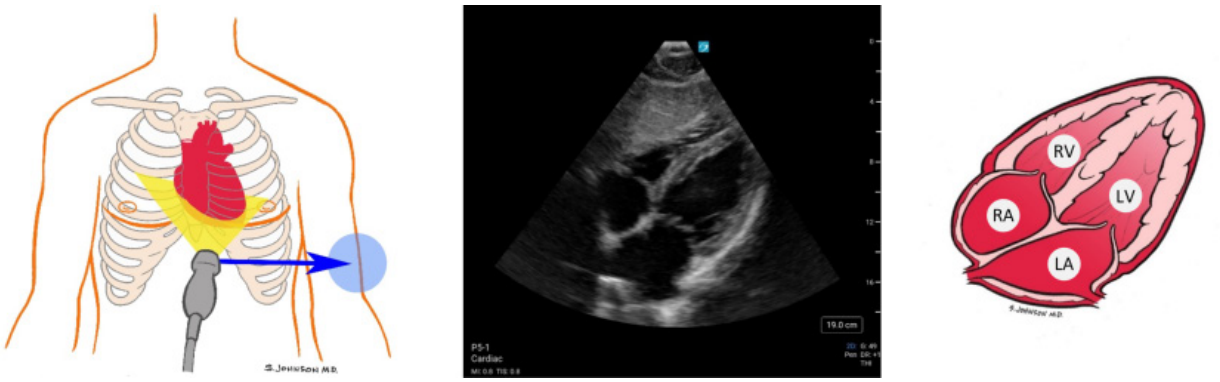

Figure 15. Subxiphoid view.

Key structures to examine in this view include:

- LA = Left atrium
- LV = Left ventricle
- RA = Right atrium
- RV = Right ventricle

Inferior vena cava (IVC) view

From the subxiphoid view, keep the right atrium in view and rotate the transducer clockwise to bring the indicator down toward the patient's feet, as indicated in Figure 16. The IVC should be seen in a longitudinal view entering the right atrium.

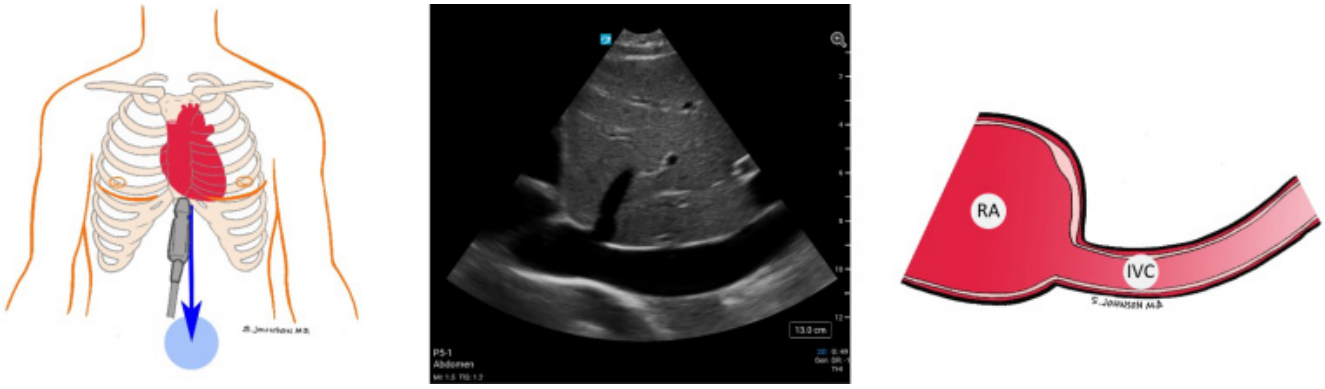

Figure 16. Inferior vena cava view.

Key structures to examine in this view include:

- IVC = Inferior vena cava
- RA = Right atrium

Diagnosing cardiac complications in COVID-19 patients

As the medical community gains a better understanding of the novel SARS-COV-2 virus, researchers are recognizing that it can attack the body in different phases. In the first 2 stages (typically the first 10 days)

patients may have constitutional symptoms and pulmonary symptoms. However, later in their disease stage (after approximately 10 days) they can develop hyperinflammation and increased thrombotic risks that can affect the heart (see Figure 17)[2].

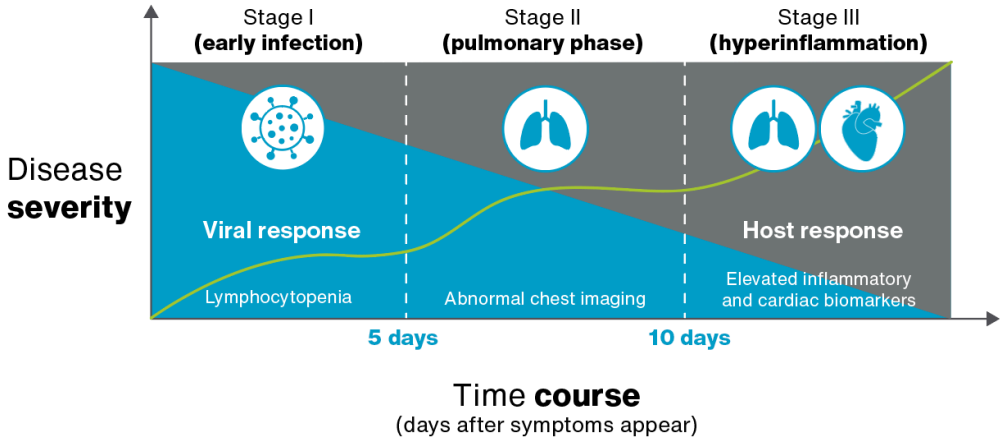

Figure 17. Phased progression of COVID-19 (adapted from Akhmerov 2020).

Therefore, it is important to always consider cardiac complications in your COVID-19 patients, but especially later in their disease course or after the patient has been admitted (since these cardiac findings may not be present on the initial evaluation).

Ultrasound can help evaluate COVID-19 patients with severe or worsening clinical symptoms for severe cardiac complications. This section lists the most common COVID-19 cardiac complications that are diagnosed by ultrasound exams, and provides representative imagery for each of the following:

- Myocarditis
- Pericarditis
- Cardiac tamponade
- Pulmonary embolism (with right heart failure)

Caution These cardiac findings can occur independently of each other. When evaluating severe COVID-19 patients, be sure to look for all of these complications.

Myocarditis

COVID-19 can attack the heart muscle, leading to myocarditis. The typical findings in myocarditis are global decrease in left ventricular ejection fraction (see Figure 18) with an elevation of troponin levels.

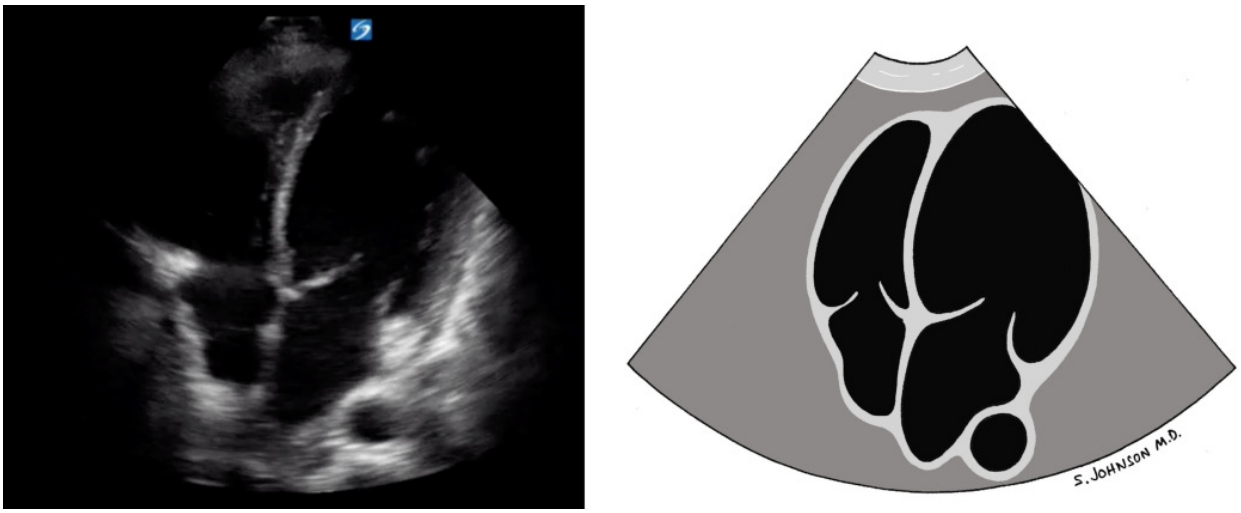

Figure 18. An ultrasound image and matching illustration of a heart with myocarditis and enlarged left ventricle.

Myocarditis findings on ultrasound:

- Decreased left ventricular ejection fraction (enlarged left ventricle)
- IVC dilated

Pericarditis

COVID-19 can also attack the pericardium of the heart, leading to pericardial inflammation and accumulation of pericardial effusion (see Figure 19). However, it is important to note that mild and early forms of pericarditis may have normal ultrasound findings.

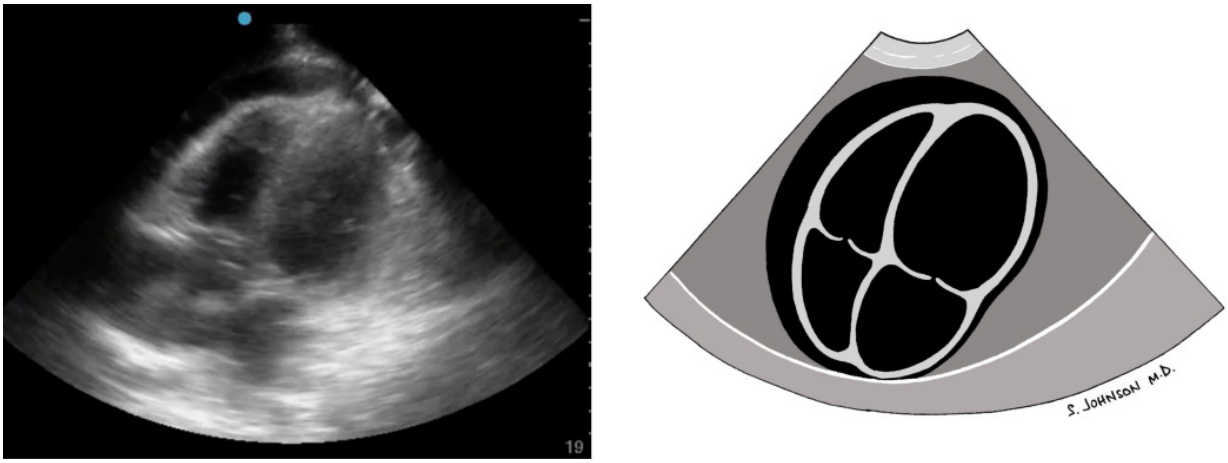

Figure 19. An ultrasound image and matching illustration of a heart with pericarditis and pericardial effusion.

Pericarditis findings on ultrasound:

- Pericardial effusion
- Thickened pericardium (>2mm)

Note There have been COVID-19 cases described where patients will exhibit a combination of myocardial and pericardial complications leading to fulminate myopericarditis[13]. In these situations, you may see a combination of findings of myocarditis (decreased left ventricular function) and pericarditis (pericardial effusion) on your ultrasound images.

Cardiac tamponade

In severe cases of COVID-19 pericarditis where the volume of the pericardial effusion creates significant pericardial pressure that exceeds the pressure of the right atrium and/or right ventricle, the result will be cardiac tamponade (see Figure 20).

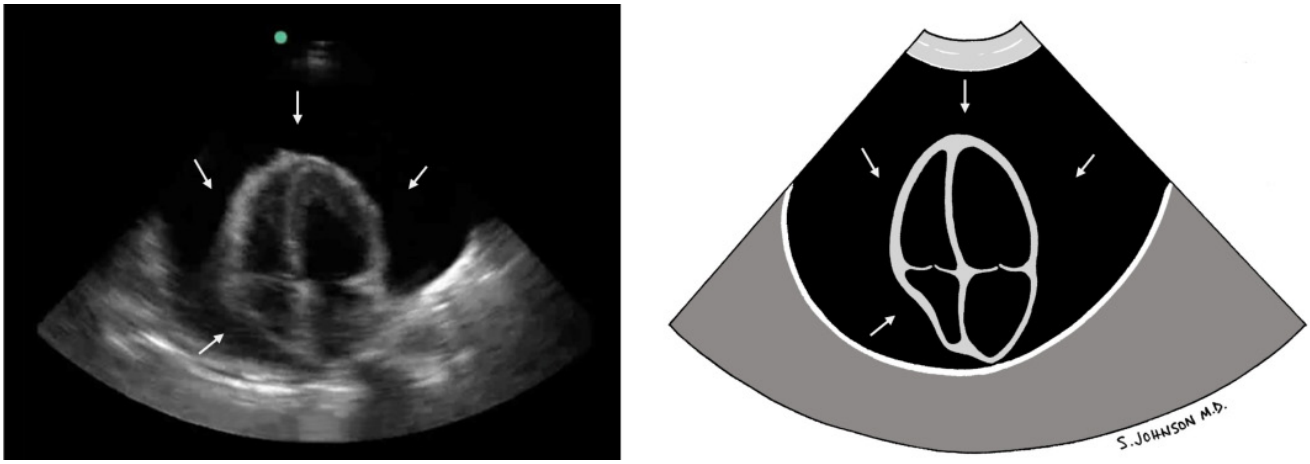

Figure 20. An ultrasound image and matching illustration of a heart with cardiac tamponade and right atrial systolic collapse.

Cardiac tamponade findings on ultrasound:

- Pericardial effusion (highlighted with arrows)
- Right atrial systolic collapse
- Right ventricular diastolic collapse
- IVC dilated

Pulmonary embolism

COVID-19 has been associated with significant thromboembolic disease. This can lead to significant pulmonary embolism with resulting right ventricular failure and hemodynamic collapse. Early on, there may be no significant ultrasound findings for small pulmonary embolisms, but as the clot burden increases, ultrasound can be used to evaluate for massive pulmonary embolism with findings of right ventricular dysfunction (see Figure 21).

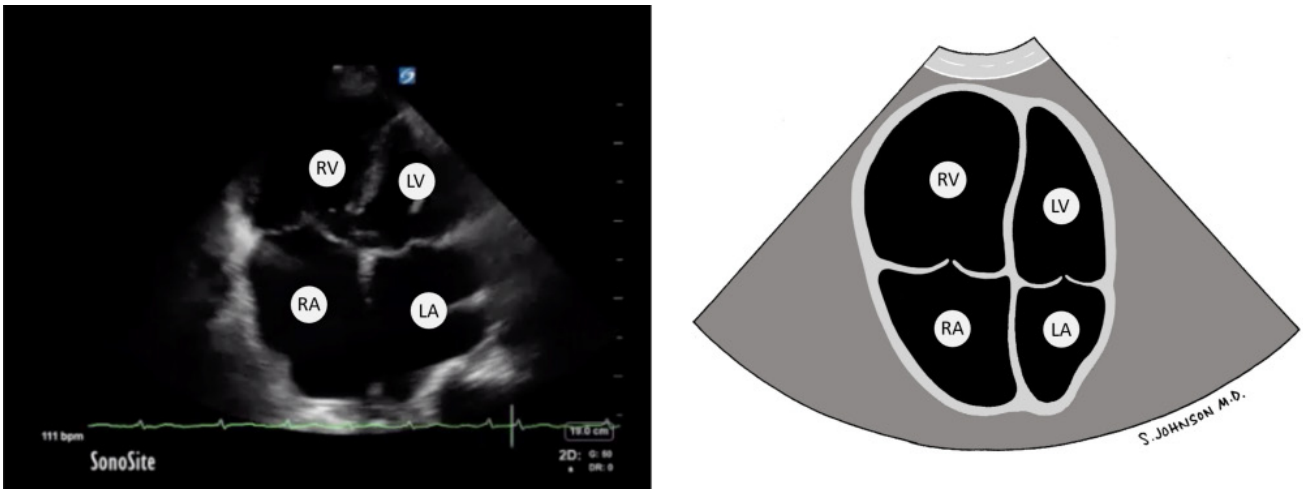

Figure 21. An ultrasound image and matching illustration of a heart with a massive pulmonary embolism and enlarged right ventricle.

- LA = Left atrium
- LV = Left ventricle
- RA = Right atrium
- RV = Right ventricle

Massive pulmonary embolism findings on ultrasound:

- Enlarged right ventricle (right ventricle to left ventricle ratio greater than 1.0)
- McConnell's Sign (hyperdynamic apex with hypodynamic right ventricle)
- D Sign (intraventricular septal flattening)
- IVC dilated

Note Many of the findings on ultrasound for massive pulmonary embolism suggest acute right ventricular strain. Keep in mind that other diseases can also cause right ventricular dysfunction in critical ill patients such as pulmonary arterial hypertension, ARDS, and severe tricuspid regurgitation[18].

Potential COVID-19 cardiac management using point-of-care ultrasound

SARS-COV-2 is a novel virus that we are continually learning new things about. Being able to recognize these cardiac complications on point-of-care ultrasound can help you quickly identify why a COVID-19 patient is clinically worsening. You can then use this critical information to initiate appropriate life-saving measures.

This list offers some examples of how cardiac ultrasound can help change the management of your COVID-19 patients who exhibit the following cardiac complications:

- **Findings of myocarditis and left ventricular dysfunction:** Consideration of starting appropriate vasopressor/ionotropic therapy, help guide fluid management, cardiology consult.
- **Findings of pericarditis/tamponade:** Consideration of emergent pericardiocentesis, formal echocardiography, cardiology consult, and frequent reevaluation.
- **Findings of thromboembolism:** Consideration of further confirmatory tests such as CT scan for pulmonary embolism and initiation of anticoagulation or thrombolytic therapy.

Note This is a summary of potential management of the most commonly described COVID-19 cardiac complications; it is not designed to be an exhaustive list. You should also be aware of other rarer COVID-19 cardiac complications, such as myocardial infarction[16] that are beyond the scope of this guide.

Cleaning and Disinfection

Use the FUJIFILM Sonosite recommendations in the respective product documentation when cleaning or disinfecting your ultrasound system, stand, transducer, and accessories. Use the cleaning recommendations in the peripheral manufacturer's instructions when cleaning or disinfecting your peripherals.

WARNING The system and transducers must be cleaned and disinfected after each exam. Detailed instructions are provided in the ultrasound system's user guide. It is important to follow these cleaning and disinfecting instructions without skipping any steps. For a complete list of approved cleaners and disinfectants, refer to the cleaners and disinfectants tool available at www.sonosite.com/sales-support/cleaners-disinfectants.

Caution The following steps are general cleanliness precautions that FUJIFILM Sonosite recommends to help reduce the potential spread of Sars-Cov-2 virus. Users must always consult with their healthcare facility to ensure their practice aligns with facility protocols. These are additional steps to consider.

Recommendations for reducing spread of the Sars-Cov-2 virus

Steps:

1. Prior to entering patient's room to performing an ultrasound exam, configure the system settings in order to be ready to scan as soon as you enter the patient's room. Ensure that you have Sonosite-approved cleaning wipes with you before entering the patient's room.
2. Cover yourself in personal protective equipment (PPE) as directed by your facility's policies.
3. Enter the patient's room and perform your ultrasound exam.
4. Before exiting the room and while you are still in your PPE, wipe the system with the approved cleaning wipes, carefully removing all gel and visible fluids or contaminants. Place the cleaned system aside at least six feet from the patient.
5. Remove safety gown and gloves, sanitize your hands, and put on new gloves. Face mask and eye shield should remain on.
6. Remove the ultrasound system from the room. Use approved cleaning wipes and follow approved and validated cleaning and disinfection protocols for the subject system as outlined in its user manual to clean and disinfect the system, transducer, and accessories such as the stand.
7. Remove PPE and sanitize your hands.
8. Allow the cleaned and sanitized ultrasound to dry. It is now ready for use by the next healthcare provider.

Covering the ultrasound system for additional protection

As illustrated in Figure 22, all FUJIFILM Sonosite ultrasound systems described in this document can be covered or bagged in clear, disposable plastic to enhance protection from contamination and ease cleaning and disinfection.

Figure 22. A Sonosite PX ultrasound system bagged in clear, disposable plastic.

Conclusions

The medical community's understanding of COVID-19 is evolving on a daily basis. Point-of-care lung and cardiac ultrasound images are key data points to help guide your clinical management and track the progress of the disease of your patients. However, proper management of your patients requires combining these ultrasound findings with other diagnostic tests to ensure you gain the most accurate overall clinical picture of the patient.

It is important to understand that the lung and cardiac ultrasound findings described in this document are based on the most current information available at the time of publication. For the most up-to-date clinical care recommendations for management of COVID-19 patients, visit the US Centers for Disease Control and Prevention's COVID-19 site at https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html. Additional resources are listed in the next section of this document.

References

[1] Smith, M.J., Hayward, S.A., Innes, S.M. and Miller, A.S.C. (2020), Point-of-care lung ultrasound in patients with COVID-19 – a narrative review. Anaesthesia.

[2] Akhmerov A, Marbán E. Covid-19 and the heart. Circulation Research. 2020;126:1443–1455.

[3] Hosseiny, M., Kooraki, S., Gholamrezanezhad, A., Reddy, S., Myers, L. (2020). Radiology Perspective of Coronavirus Disease 2019 (COVID-19): Lessons from Severe Acute Respiratory Syndrome and Middle East Respiratory Syndrome American Journal of Roentgenology.

[4] Soldati G, Smargiassi A, Inchingolo R, et al. Is there a role for lung ultrasound during the COVID-19 pandemic? J Ultrasound Med 2020; Mar 20.

[5] Soldati G, Smargiassi A et al. Proposal for International Standardization of the Use of Lung Ultrasound for Patients with COVID-19. J Ultrasound Med.

[6] Johri AM, Galen B, Kirkpatrick JN, Lanspa M, Mulvagh S, Thamman R, ASE Statement on Point-of-Care Ultrasound (POCUS) During the 2019 Novel Coronavirus Pandemic, Journal of the American Society of Echocardiography (2020).

[7] Peng QY, Wang XT, Zhang LN; Chinese Critical Care Ultrasound Study Group (CCUSG). Findings of lung ultrasonography of novel corona virus pneumonia during the 2019-2020 epidemic. Intensive Care Med. 2020;46(5):849-850.

[8] Buonsenso D, Piano A et al. Point-of-Care Lung Ultrasound findings in novel coronavirus disease-19 pnemoniae: a case report and potential applications during COVID-19 outbreak. Eur Rev Med Pharmacol Sci. 2020;24(5):2776-2780.

[9] Volpicelli, G., Gargani, L. Sonographic signs and patterns of COVID-19 pneumonia. Ultrasound J 12, 22 (2020).

[10] Drake, D., Bonis, M., Covella, M., Agricola, E., Zangrillo, A., Zimmerman, K., Cobey, F. (2020). Echo in Pandemic: Front Line Perspective, Expanding Role of Ultrasound and Ethics of Resource Allocation Journal of the American Society of Echocardiography https://dx.doi.org/10.1016/j.echo.2020.04.007

[11] Zhang L, Wang B, Zhou J, Kirkpatrick J, Xie M, Johri AM, Bedside Focused Cardiac Ultrasound in COVID-19 Infection From the Wuhan Epicenter: The Role of Cardiac Point of Care Ultrasound (POCUS), Limited Transthoracic Echocardiography and Critical Care Echocardiography Journal of the American Society of Echocardiography (2020).

[12] Hu, H., Ma, F., Wei, X., Fang, Y. (2020). Coronavirus fulminant myocarditis saved with glucocorticoid and human immunoglobulin European Heart Journal https://dx.doi.org/10.1093/eurheartj/ehaa190

[13] Inciardi, R., Lupi, L., Zaccone, G., Italia, L., Raffo, M., Tomasoni, D., Cani, D., Cerini, M., Farina, D., Gavazzi, E., Maroldi, R., Adamo, M., Ammirati, E., Sinagra, G., Lombardi, C., Metra, M. (2020). Cardiac Involvement in a Patient With Coronavirus Disease 2019 (COVID-19) JAMA Cardiology 5(7)https://dx.doi.org/10.1001/jamacardio.2020.1096

[14] Shi S, Qin M, Shen B, et al. Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China [published online ahead of print, 2020 Mar 25]. JAMA Cardiol. 2020;e200950.

[15] Alina Hua, Kevin O'Gallagher, Daniel Sado, Jonathan Byrne, Life threatening cardiac tamponade complicating myo-pericarditis in COVID-19, European Heart Journal, 2020: ehaa253.

[16] Stefanini, G., Montorfano, M., Trabattoni, D., Andreini, D., Ferrante, G., Ancona, M., Metra, M., Curello, S., Maffeo, D., Pero, G., Cacucci, M., Assanelli, E., Bellini, B., Russo, F., Ielasi, A., Tespili, M., Danzi, G., Vandoni, P., Bollati, M., Barbieri, L., Oreglia, J., Lettieri, C., Cremonesi, A., Carugo, S., Reimers, B., Condorelli, G., Chieffo, A. (2020). ST-Elevation Myocardial Infarction in Patients with COVID-19: Clinical and Angiographic Outcomes Circulation https://dx.doi.org/10.1161/circulationaha.120.047525

[17] Cui S, Chen S, Li X, Liu S, Wang F. Prevalence of venous thromboembolism in patients with severe novel coronavirus pneumonia [published online ahead of print, 2020 Apr 9]. J Thromb Haemost. 2020;10.1111/jth.14830.

[18] Rudski, L., Lai, W., Afilalo, J., Hua, L., Handschumacher, M., Chandrasekaran, K., Solomon, S., Louie, E., Schiller, N. (2010). Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. Journal of the American Society of Echocardiography : official publication of the American Society of Echocardiography 23(7), 685 - 713- quiz 786-8. https://dx.doi.org/10.1016/j.echo.2010.05.010

Additional resources

Government and healthcare agencies and organizations

- US Centers for Disease Control and Prevention Interim Clinical Guidance for Management of Patients with Confirmed Coronavirus Disease (COVID-19): https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html
- World Health Organization COVID-19 guidance for health workers: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/health-workers
- Association for Medical Ultrasound Guidelines for Cleaning and Preparing External- and Internal-Use Ultrasound Transducers and Equipment Between Patients as well as Safe Handling and Use of Ultrasound Coupling Gel: https://www.aium.org/officialStatements/57
- Association for Medical Ultrasound Quick Guide on COVID-19 Protections — Ultrasound Transducers, Equipment, and Gel: https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_UTEG.pdf
- American Society of Echocardiography Coronavirus (COVID-19) Resources: https://www.asecho.org/covid-19-resources/
- Society of Critical Care Medicine COVID-19 Guidelines: https://www.sccm.org/SurvivingSepsisCampaign/Guidelines/COVID-19
- American College of Emergency Physicians COVID-19 page: https://www.acep.org/corona/covid-19-Main/

- American College of Chest Physicians COVID-19 Updates and Resources: https://www.chestnet.org/Guidelines-and-Resources/COVID-19/Updates-and-Resources
- Canadian Internal Medicine Ultrasound (CIMUS) Recommendations Regarding Internal Medicine Point-of-Care Ultrasound (POCUS) use during Coronavirus (COVID-19) pandemic: https://cjgim.ca/index.php/csim/article/view/438/1063

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- Sonosite COVID-19 Ultrasound Resources site: https://secure.sonosite.com/covid-19
- Sonosite COVID-19 YouTube Playlist: https://www.youtube.com/playlist?list=PL2AGI6-lzXJQt3LGH0Fqc5rjln_hwmfhZ
- Document library: https://www.sonosite.com/support/documents
- Education: https://www.sonosite.com/education
- Point-of-care ultrasound systems, transducers, and accessories: https://www.sonosite.com/products

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