**Transcript Details**
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What to Look for When Using Point-of-Care Ultrasound for COVID-19

Dr. Nelson:
So there's a lot of discussion about the use of point-of-care ultrasound in the setting of COVID, and this is coming up for a lot of different reasons. One is the concept of limited resources and what utility a handheld ultrasound device or a cart that can be pulled up to the bedside might have instead of using something like portable chest x-ray or sending a patient over to radiology for an x-ray or a CT scan. So, insofar as ultrasound can serve a diagnostic purpose, could it essentially replace or augment some of the other imaging that's happening is a really important question, so the availability of radiology at all, the availability of CT scan especially, and the fact that a lot of times the imaging that we're used to using or that we would like to use at the point of care isn't the same quality that we would normally get—in other words, we might be used to getting a chest x-ray done in radiology, getting a PA in lateral chest x-ray, and now we're getting portables, which has an image quality difference just by the nature of how it's performed, so maybe ultrasound can play a role in diagnosis and prognosis. I want to speak a little bit today about what we actually look for, and we're looking for the same kinds of things that we would look for with ultrasound in general in patients who are short of breath or in respiratory distress.

I'd like to start by going through a normal lung ultrasound image, and we can see here in this image that near the top of the screen there's skin and subcutaneous tissue. There are 2 ribs that are causing some shadowing, and those dark shadows extend towards the edge of the screen, and there's a bright white, crisp, horizontal line, and it's the brightest thing on the screen, and that's the pleura. If you look really closely at it, you can see that as the patient's breathing, it's just very faintly sliding from left to right, so this tells us a couple of things. Since there's a bright white line and it's horizontal and there are even some horizontal artifacts coming down from it that we call A lines, that is a lung that is dry, not wet. There is also… Because of the lung sliding, we know that there's no pneumothorax in that location—so 2 very important things, 2 things we can tell very quickly and 2 things that are very important when we assess COVID patients especially.

This next slide demonstrates pleura that's still sliding back and forth, so we know that there is no pneumothorax—but 2 important differences here. One is the crispness of the pleura is broken in 1 or 2 locations, more evident towards the left of the midline here, left of that rib shadow, and there's also some bright white reverberation artifact coming down from the pleura towards the bottom of the screen. So that bright white reverberation artifact is known as a B line, and that means that there is either consolidation or interstitial edema or fibrosis or some other process taking place in that area which is no longer air. It is liquid or solid in that region. So B lines are signs of either wet lungs or lungs that have some connective tissue process going on with them. And the interruptions in the pleural lines where it's not straight and crisp anymore also give you that same impression that there is not a nice, clean interface between the air-filled alveoli at the edge of the lung and the tissue beyond them, so something is interrupting the normal gas exchange in that area.

In the third example here, we can see some more evidence of bright white B lines coming down from the pleura, and even though the lung is moving so we can tell that there's no pneumothorax, there's these bright white, vertically oriented lines, which are signs of either lung consolidation, interstitial edema or some other wet process going on with the lungs.

So the classic COVID signs that have been described thus far coming out of places like China, Italy, and the United States where a lot of cases have been described by folks that are comfortable using lung ultrasound is this interruption in the pleura line, thickening of the pleura, B lines and consolidation, and you can see some consolidation here, for example. We see that pleura sliding back and forth. It's very shredded-looking, and sometimes this is referred to as a shred sign. There is not a nice, clean, bright white line, and there's even a little dark area just beneath the pleura where we should only see artifacts; we should only see reflections; and instead we see something that looks a little bit more like solid tissue. That's probably even better noticed on this image where we can see just beneath the bright white pleural line there's a darker area, and that dark area is a subpleural consolidation. So here we can not only see that there is an abnormality in the pleura itself, but we can see the actual pneumonia process happening within the lung.

We can use this especially in an environment where resources might be scarce or challenging to come by, or in cases where patients have a change in their status and you want to reassess them quickly, it's much easier to bring an ultrasound machine to the bedside than it is to get a chest x-ray or a repeat CAT scan.

So another thing that we can look at is looking at an example of pneumothorax. I mentioned before that there was a sign when the lung is sliding back and forth that there is no pneumothorax in that location, and we can see here on the top third of the screen there is subcutaneous tissue and intercostal muscles. On the right side of the screen, there's a bright white rib and a shadow coming down beneath it, and just below and to the left of that we can see pleura sliding back and forth, but if we follow that bright pleural line to the left of the screen, we can see that the left side of it isn't sliding. So the right side of it is sliding. That's normal lung. The visceral and parietal pleura are right up against each other. On the left side, there's pneumothorax. The appearance of the sliding is gone. So the behavior of the pleura on ultrasound is interestingly what tells us whether there's a pneumothorax or not.

If I took a still image at any point here, you wouldn't be able to tell visualizing it that there was a pneumothorax or not. You'd have to see the sliding to be able to tell whether it's present or not. This is actually not only a sign of a pneumothorax, but it's specifically a sign called the lung point. This is the exact spot where the pneumothorax edge is happening. On the right side of the pleura on this screen, the lung is sliding normally. There is no pneumothorax in that area; visceral and parietal pleura are touching. On the left side of the pleura, the lung is not visualized to be sliding because the visceral and parietal pleura have air in between them and they're not touching.

So, overall, we can use signs like this to help rapidly diagnose, potentially triage, and get some rough sense of prognosis on patients who are presenting with some respiratory distress in the setting of COVID. It's more concerning, I think, for most folks to see someone that has B lines on ultrasound, just like it would be to see that they had consolidation or ground glass appearance on their x-ray. And if a patient is on a ventilator and you're managing especially multiple patients on multiple vents and you need to rapidly assess if there's been a change—a patient suddenly becomes hypoxic or more short of breath or there's been some change in their plateau pressures on the vent—it might be helpful to quickly assess to see whether there's a pneumothorax because a lot of patients do require a fair amount of pressure to maintain their oxygenations in the setting of COVID.

Ultrasound essentially can perform a lot of the same functions that it normally would without COVID, but in the setting of COVID where it strains our resources and we're dealing with hypoxic patients who are ventilated, it might give us some opportunity to rapidly make diagnosis and treatment decisions at the bedside.