Point-of-care ultrasound

COVID-19

March 24, 2020
3:00 pm

https://zoom.us/j/4899792292
Point-of-care Ultrasound in COVID-19

Nilam J. Soni, MD, MS
Professor of Medicine
South Texas Veterans Health Care System
University of Texas Health San Antonio
Welcome!

Diverse Group of Participants…

• Specialties
• Geographically
• Settings
• POCUS skills

WE are all in this together
GOAL

Become familiar with the use of point-of-care ultrasound in COVID-19.
Objectives


2. Describe other high-yield POCUS applications in a closed COVID-19 unit.

Reminders

• Enter question in “chat” box at bottom

• Mute your microphone while not speaking

• All slides and recording will be posted – open access for all
Lung Ultrasound & COVID-19
Lung Ultrasound in COVID-19

I. What are the lung ultrasound patterns in COVID-19?

II. How can lung ultrasound be used in the diagnosis and management of patients with COVID-19?
Incubation Period: 2 – 14 days

- PCR Positive

- 98% symptomatic by 11 days
- Case Severity (Wu et al. 2020)
  - Mild – 81%
  - Severe – 14%
  - Critical – 5%

Limitation of PCR for COVID-19

- **Limited availability of testing**
  - 97% of U.S. land area; 60 million people live in rural settings\(^1\)
  - 200 of 254 counties of TX don’t have access to testing on 3/23/20

- Diminishing supply of viral swabs

- Errors in sample collection

- Delays up to 7 days for results

- False negatives of PCR (20-30% initially - low viral loads)

- Local Testing & New Tests – accuracy?

---

Conclusions:

1. Sensitivity of chest CT vs. PCR (98% vs 71%, p<.001)
2. Use chest CT for screening for COVID-19, especially if PCR negative

Tao Ai MD, PhD¹*, Zhenlu Yang MD, PhD¹*, Hongyan Hou, MD², Chenao Zhan MD¹, Chong Chen MD¹, Wenzhi Lv³, Qian Tao, PhD⁴, Ziyong Sun MD², Liming Xia MD, PhD¹
Correlation of CT & PCR Testing

- Retrospective study of 1014 suspected patients
- All pts had CT chest and serial PCR testing

Conclusions
1. CT chest positive in 93% while initial PCR was negative
2. Mean delay in initial negative to positive PCR 5.1 days
3. CT chest had 97% sensitivity and 25% specificity

Ai, et al. Radiology, February 26, 2020
https://pubs.rsna.org/doi/full/10.1148/radiol.2020200642
PCR Positive: 93% (subgroup with negative initial PCR)

CT Sensitivity:
- Days 0-5 = 84%
- Days 6-11 = 99%

(Wang et al, Radiology 2020)
CT Chest Findings in COVID-19

- **Bilateral** findings (88-90%)
- **Peripheral** distribution (72%)
- Ground glass opacities alone (34-46%)
- Ground glass opacities + Consolidation (50-60%)

Ai et al. Radiology February 26, 2020; Bernheim et al, Radiology Feb 20, 2020
CT Chest Findings Based on Time Course

Bernheim et al. Radiology February 20, 2020
March 11, 2020

ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection
ACR Recommendations

UPDATED MARCH 22, 2020

As COVID-19 spreads in the U.S., there is growing interest in the role and appropriateness of chest radiographs (CXR) and computed tomography (CT) for the screening, diagnosis and management of patients with suspected or known COVID-19 infection. Contributing to this interest are limited availability of viral testing kits to date, concern for test sensitivity from earlier reports in China, and the growing number of publications describing the CXR and CT appearance in the setting of known or suspected COVID-19 infection.

To date, most of the radiologic data comes from China. Some studies suggest that chest CT in particular may be positive in the setting of a negative test. We want to emphasize that knowledge of this new condition is rapidly evolving, and not all of the published and publicly available information is complete or up-to-date.

The Centers for Disease Control (CDC) does not currently recommend CXR or CT to diagnose COVID-19. Viral testing remains the only specific method of diagnosis. Confirmation with the viral test is required, even if radiologic findings are suggestive of COVID-19 on CXR or CT.
Hmmm......
ACR Recommendations

(Updated March 22, 2020) As an interim measure, until more widespread COVID-19 testing is available, some medical practices are requesting chest CT to inform decisions on whether to test a patient for COVID-19, admit a patient or provide other treatment. The ACR strongly urges caution in taking this approach. A normal chest CT does not mean a person does not have COVID-19 infection - and an abnormal CT is not specific for COVID-19 diagnosis. A normal CT should not dissuade a patient from being quarantined or provided other clinically indicated treatment when otherwise medically appropriate. Clearly, locally constrained resources may be a factor in such decision making.

Updated March 23, 2020

The health and safety of radiologists, allied professionals, patients and health care workers are of primary importance.

The American College of Radiology® (ACR®) is closely monitoring guidance from the Centers for Disease Control and Prevention (CDC), World Health Organization (WHO) and other reliable sources regarding the Coronavirus (COVID-19).
Current Dilemma

• CT chest is not feasible in every suspected COVID-19 case

• Rationale for not CT scanning every patient
  – Disinfection of CT scanner
  – Risk to other patients, staff, and radiologists
  – Radiology overload

• Radiology suites (and echo labs) want to minimize exposure to these pts
Everyone in China got a CT Chest!

China built two 1,000-bed hospitals in 10 days!

Lung Ultrasound

Diagnostic accuracy of lung ultrasound is superior to chest x-ray and similar to CT scans for common lung pathologies when performed by a trained provider.
Disposable Stethoscopes
A preliminary study on the ultrasonic manifestations of peripulmonary lesions of non-critical novel coronavirus pneumonia (COVID-19)

Yi Huang¹, Sihan Wang¹, Yue Liu¹, Yaohui Zhang¹, Chuyun Zheng¹, Yu Zheng², Chaoyang Zhang³, Weili Min⁴, Huihui Zhou⁵, Ming Yu⁵, Mingjun Hu¹
LETTER

Findings of lung ultrasonography of novel corona virus pneumonia during the 2019–2020 epidemic

Qian-Yi Peng¹, Xiao-Ting Wang²*, Li-Na Zhang¹* and Chinese Critical Care Ultrasound Study Group (CCUSG)
Point-of-Care Lung Ultrasound findings in novel coronavirus disease-19 pneumoniae: a case report and potential applications during COVID-19 outbreak

D. BUONSENDO¹,², A. PIANO³, F. RAFFAELI²,⁴, N. BONADIA³, K. DE GAETANO DONATI⁴, F. FRANCESCHI³
Lung US Findings in COVID-19

- Thickened, **irregular pleural line**
- **B-lines** (focal, multifocal, confluent)
- Small, multifocal **subpleural consolidations**
- **Posterior** lung fields (75% of pts)
- Absence of pleural effusion

NORMAL Lung Ultrasound

1. Lung Sliding

AND

2. A-lines
Pleural Evaluation

Phased-array

Linear

Chest wall

Rib

Pleural line

Rib
Thick, Irregular Pleural Line
B-lines

Few (<3)  Multiple (≥3)  Confluent
Confluent B-lines in COVID-19

Courtesy of Gigi Liu, MD
Absence of Pleural Effusion

Mirror Image

Curtain Sign
## Classic Sonographic Signs

<table>
<thead>
<tr>
<th></th>
<th>Pleural Effusion PRESENT</th>
<th>Pleural Effusion ABSENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curtain Sign</td>
<td>—</td>
<td>+</td>
</tr>
<tr>
<td>Mirror Image</td>
<td>—</td>
<td>+</td>
</tr>
<tr>
<td>Spine Sign</td>
<td>+</td>
<td>—</td>
</tr>
</tbody>
</table>
Pleural Effusion PRESENT

Spine Sign
COVID +
Day 11
Left lower posterior lung
Different Lung Ultrasound Protocols…

Label your images!
4-Point Lung Ultrasound Exam

1

2

3

4
Proposed Lung Ultrasound Scoring

0 = Normal
1 = $\geq 3$ discrete, well spaced B-lines
2 = $\geq 3$ confluent, fused B-lines
3 = Subpleural consolidations
4 = Lobar consolidation
VA POCUS Template

- **DIAGNOSTIC**
  - Cardiac
  - Pulmonary
  - Lung
  - Abdomen
  - Pelvis
  - Abdominal aorta
  - Carotid artery
  - Renal/Bladder
  - Ocular
  - Musculoskeletal/Soft Tissue
  - Other

- **PROCEDURES**
  - Core biopsy
  - Ultrasound needle insertion
  - Ultrasound-guided pericardial aspiration
  - Ultrasound-guided aspiration of fluid collections
  - Ultrasound-guided aspiration of masses
  - Ultrasound-guided aspiration of cysts

- **ULTRASOUND USED FOR**
  - Pre-procedure evaluation
  - Site marking for needle insertion
  - Real-time needle insertion
  - Post-procedure evaluation

- Please see separate procedure note for further detail of the procedure itself.
## Proposed Triage of PUI’s

<table>
<thead>
<tr>
<th>RISK</th>
<th>LUNG ULTRASOUND</th>
<th>DISPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Age&gt;60; CVD; D-dimer, CRP, LDH, Lymph)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Normal</td>
<td>Home Observation</td>
</tr>
<tr>
<td>Low</td>
<td>Abnormal</td>
<td>Home vs. Hospital Observation</td>
</tr>
<tr>
<td>Intermediate / High</td>
<td>Normal</td>
<td>Hospital Wards</td>
</tr>
<tr>
<td>Intermediate / High</td>
<td>Abnormal</td>
<td>Intensive Care Unit</td>
</tr>
</tbody>
</table>
POCUS Applications in COVID-19

1. Goal-directed Echocardiography

2. Confirmation of endotracheal tube placement
Cardiomyopathy in COVID-19

- Seattle experience: 33% of elderly pts in ICU (Arentz et al. JAMA 2020)

- Goal-directed Echocardiography
  - Standard 5 views
  - Minimum 2 views
    - Parasternal long-axis
    - Subcostal or apical 4-chamber view
Cardiac Dysfunction in COVID-19

Recommendation:
For adults with COVID-19 and shock with evidence of cardiac dysfunction and persistent hypoperfusion despite fluid resuscitation and norepinephrine, we suggest adding dobutamine, over increasing norepinephrine dose (weak recommendation, very low quality evidence).

Surviving Sepsis Campaign: Guidelines on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19) by Society of Critical Care Medicine
https://www.sccm.org/disaster
Cardiomyopathy in COVID-19

Courtesy of Gigi Liu, MD
Confirmation of ETT Placement

Courtesy of Jeremy Boyd, MD
Confirmation of ETT Placement

Trachea

Esophagus

Courtesy of Jeremy Boyd, MD
From foot of bed
Confirm Bilateral Lung Sliding Post-ETT Placement

Normal

Absent Lung Sliding
Disinfection of Ultrasound Machine

https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
Disinfection of Ultrasound Machine

• Active Ingredients
  – Sodium hypochlorite
  – Hydrogen peroxide
  – Quaternary ammonium
Disinfection of Ultrasound Machine

Cavicide, CaviWipes 1, Caviwipes Bleach
3 minutes

Clorox Disinfecting Wipes, Clorox Healthcare Bleach Germicidal Wipes
4 minutes
Sani-Cloth Germicidal Wipes

EPA Registration Number 9480

3 minutes
2 min (Super)
1 min (Bleach)
Cleaning the US Machine

- Remove supplies from basket
- Wipe down entire machine
  - Before entering pt room
  - Before leaving pt room
  - After leaving pt room
- Required wet time: >2-3 min
How long does COVID-19 live on surfaces?

<table>
<thead>
<tr>
<th>SURFACE</th>
<th>LIFESPAN OF COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>3 hours</td>
</tr>
<tr>
<td>Copper</td>
<td>4 hours</td>
</tr>
<tr>
<td>Cardboard</td>
<td>24 hours</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>2–3 days</td>
</tr>
<tr>
<td>Polypropylene plastic</td>
<td>3 days</td>
</tr>
</tbody>
</table>

*At 68°F to 73.4°F (21 to 23°C) and 40% relative humidity
Source: New England Journal of Medicine

Resources

https://lsom.uthscsa.edu/pulmonary-diseases/covid-19-resources/
"Alone we can do so little, together we can do so much." --Helen Keller
Guest Speaker

Mangala Narasimhan, DO
Director, Critical Care Unit
Northwell Healthcare
Long Island Jewish / Northshore
New York

https://www.youtube.com/watch?v=9CegCk3FwvQ&amp=&feature=youtu.be
"Coming together is a beginning. Keeping together is progress. Working together is success." --Henry Ford
COVID-19 with hypoxia

Indication for endotracheal intubation?

Tolerating supplemental oxygen?

HFNC = high-flow nasal cannula
NIPPV = noninvasive positive-pressure ventilation
SPO₂ = peripheral capillary oxygen saturation

Note: N-95/FFP-2 are facial masks

https://www.sccm.org/disaster
**COVID-19 with mild ARDS**

- **DO:** Vt 4-8 ml/kg and $P_{plut} < 30 \text{ cm H}_2\text{O}$
- **DO:** Investigate for bacterial infection
- **DO:** Target SPO2 92% - 96%

**CONSIDER:**
- Conservative fluid strategy
- Empiric antibiotics

**UNCERTAIN:**
- Systematic corticosteroids

**COVID-19 with Mod to Severe ARDS**

- **CONSIDER:** Higher PEEP
- **CONSIDER:** NMBA boluses to facilitate ventilation targets
- **CONSIDER:** If PEEP responsive
- **CONSIDER:** NMBA infusion for 24 h
- **CONSIDER:** Prone ventilation 12 - 16 h
- **CONSIDER:** If proning, high $P_{plut}$ asynchrony
- **CONSIDER:** A trial of inhaled Nitric Oxide
- **CONSIDER:** V-V ECMO or referral to ECMO center

**DON'T DO:** Staircase Recruitment maneuvers

**CONSIDER:** Short course of systematic corticosteroids

**UNCERTAIN:**
- Antivirals, chloroquine, anti-IL6

**Rescue/Adjunctive therapy**

- **UNCERTAIN:** Antivirals, chloroquine, anti-IL6
- **CONSIDER:** If forcing, high $P_{plut}$ asynchrony
- **CONSIDER:** NMBA infusion for 24 h
- **CONSIDER:** Prone ventilation 12 - 16 h
- **CONSIDER:** A trial of inhaled Nitric Oxide
- **CONSIDER:** V-V ECMO or referral to ECMO center

**Mod = moderate**
**ARDS = adult respiratory distress syndrome**
**$P_{plut} = plateau pressure**
**SPO2 = peripheral capillary oxygen saturation**
**PEEP = positive end-expiratory pressure**
**NMBA = neuromuscular blocking agents**
**ECMO = extracorporeal membrane oxygenation**

https://www.sccm.org/disaster
Godspeed... Be Safe