

Radiology and the Pandemic: What's Changed ?

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A banner for a virtual course. On the left, there is a logo with a stethoscope and the number "72". The text reads "Annual Refresher Course for Family Physicians" and "Symposium annuel pour les omnipraticiens". In the center, there is a red heart with a white cross. To the right, it says "3-DAY VIRTUAL COURSE" and "Nov 29 - Dec 1".

Annual Refresher Course
for Family Physicians
Symposium annuel
pour les omnipraticiens

3-DAY VIRTUAL COURSE

Nov 29 - Dec 1



- No Disclosures



Objectives

- Understand how radiology departments have modified their practice due to COVID
- Review some of the radiological manifestations of COVID
- Understand some of the remaining challenges in radiology

Disclaimers

- How things are done in a Community Hospital-based Radiology department
- Do not have green and red equipment
- Diagnostic Radiology only
 - No IR procedures (Gastostomies etc)

Radiology and Covid

- Introduction
- How Covid has Impacted Medical Imaging
- Radiological Features of Covid
- Future Challenges

Introduction

- Covid-19 (coronavirus disease-2019) is an infectious disease caused by **S**evere **A**cute **R**espiratory **S**yndrome **C**orona**V**irus 2 (SARS-CoV-2)
- Wuhan, China 2019
- Pandemic by WHO in March 2020
- Oct 2021:
 - 230 million cases and at least 4.8 million deaths
 - Case fatality 2,3%
 - 6 billion vaccine doses administered

Nucleic Acid Amplification Tests (NAAT)

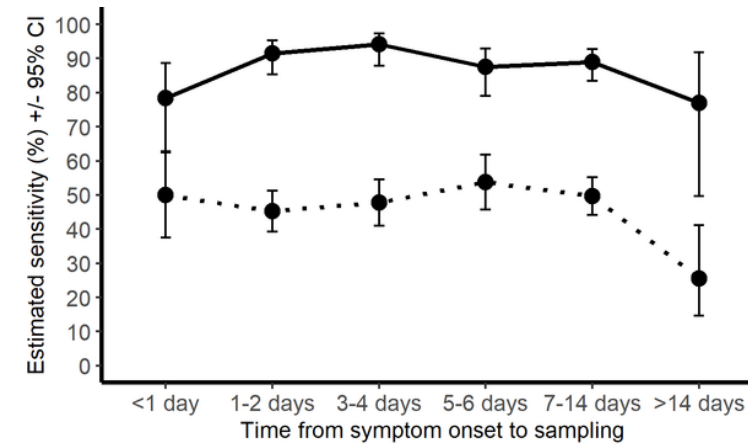
- Real Time Polymerase Chain Reaction (RT-PCR)
- Antigen detection tests
- Detection of viral nucleic acid or protein
 - Searches for specific sequences from the viral genome
 - Does not detect between viable and nonviable virus
- symptomatic patients
 - Positive agreement 96,7%
 - Negative test agreement 100%

Diagnostic Performance of an Antigen Test with RT-PCR for the Detection of SARS-CoV-2 in a Hospital Setting - Los Angeles County, California, June-August 2020

Auguste Brihn, Jamie Chang, Kelsey OYong, Sharon Balter, Dawn Terashita, Zach Rubin, Nava Yeganeh

NAAT: Definitive Diagnosis

- Highly specific, greater than 99.5%
- Variable sensitivity
 - 60-95%
 - FN rate based on time exposure
 - 100% on Day 1
 - 67% on Day 4
 - FN lowest 3 days after symptoms
- FN are a real clinical problem



— COVID-19 Laboratory confirmed only
• • COVID-19 Laboratory confirmed and High suspicion

Kortela E, Kirjavainen V, Ahava MJ, Jokiranta ST, But A, et al. (2021) Real-life clinical sensitivity of SARS-CoV-2 RT-PCR test in symptomatic patients. PLOS ONE 16(5): e0251661. <https://doi.org/10.1371/journal.pone.0251661>
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0251661>

<https://www.publichealthontario.ca/-/media/documents/lab/covid-19-lab-testing-faq.pdf?la=en>

Clinical Signs and Symptoms

Common

- fever (85-90%)
- cough (65-70%)
- anosmia (and other taste and/or smell disturbances) (40-50%)
- fatigue (35-40%)
- sputum production (30-35%)
- shortness of breath (15-20%)

Uncommon

- myalgia /arthralgia (10-15%)
- headaches (10-36%)
- sore throat (10-15%)
- chills (10-12%)
- pleuritic pain
- diarrhea (3-34%)
- splenomegaly

Complications

- Acute respiratory distress syndrome (ARDS)
 - ~22.5% (range 17-29%)
- Acute thromboembolic disease
 - pulmonary embolism
 - deep vein thrombosis (DVT)
- Acute cardiac injury: up to 30% of COVID-19 cases that have been hospitalized, with rates exceeding 50% in those with a prior cardiac history
 - myocardial ischemia
 - myocarditis
 - arrhythmias
 - cardiomyopathy
 - cardiogenic shock
 - cardiac arrest
 - heart failure

Complications

- Hepatobiliary: the liver is the most frequently affected organ after the lungs, although serious sequelae uncommon
 - fulminant liver failure is rare
 - portal vein thrombosis
 - hepatic vein thrombosis
 - acute cholecystitis : biliary stasis
- Acute pancreatitis
- Gastrointestinal
 - gastritis
 - enteritis and/or colitis
 - intestinal ischemia
 - small and large bowel perforation

Complications

- CNS
 - Delirium(15%)
 - Viral encephalitis
 - Diffuse leukoencephalopathy
 - Microhemorrhage
 - juxtacortical white matter and corpus callosum
 - cryptogenic/ischemic
 - higher mortality and greater severity of stroke in
 - Guillain-Barre syndrome (GBS)
- Secondary infections,
 - e.g. bacterial pneumonia, mucocSepsis
- Renal
 - Acute kidney injury (AKI)
 - 20-40% of hospitalized patients
 - Interstitial and/or hemorrhagic cystitis
- Coagulopathy

Hospital Entrance

- Checks at entrances
 - Fever? Cough? Recent contact with COVID positive person?
- Limit visitors to reduce possible exposure
- All patients **MUST** wear surgical masks

Radiology Clerks and Receptionists

- Stagger patient appointment times
 - to maintain social distancing
 - to provide time for air exchange and cleaning between exams
- Checks upon giving appointments
 - Fever? Cough? Recent contact with COVID positive person?

Radiology Technicians and Porters

Personal Protective Equipment (PPE)

- Droplet-like precautions
 - Medical mask, gown, gloves and eye protection

Negative Pressure Rooms

Radiology Equipment:

- High-efficiency particulate air (HEPA) filtration
- Allow time for multiple air exchanges between patient exams via air circulation

1. Airborne Contaminant Removal

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *

ACH ♯	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6*	46	69
8	35	52
10*	28	41
12*	23	35
15*	18	28
20	14	21
50	6	8

Key Points

- Number of outpatients performed per shift decreased
- Need to protect equipment and human resources
- Hospital based Medical imaging department workers are **FRONTLINE**

When to Image?

Threshold for imaging varies widely globally due to local guidelines, local resources and culture

Xrays

- First line Imaging
- Portable Units
- Machines should be cleaned after examinations
 - Causative organisms can survive up to 72 hours
- 2 technicians in attendance

Xrays

- Normal in early-mild disease
- In COVID-19 cases requiring hospitalization,
 - 69% had an abnormal chest radiograph at the initial time of admission
 - 80% had radiographic abnormalities sometime during hospitalization
 - Findings are most extensive about 10-12 days after symptom onset

Xray Findings

airspace opacities

ground glass opacities
(GGO)

consolidation

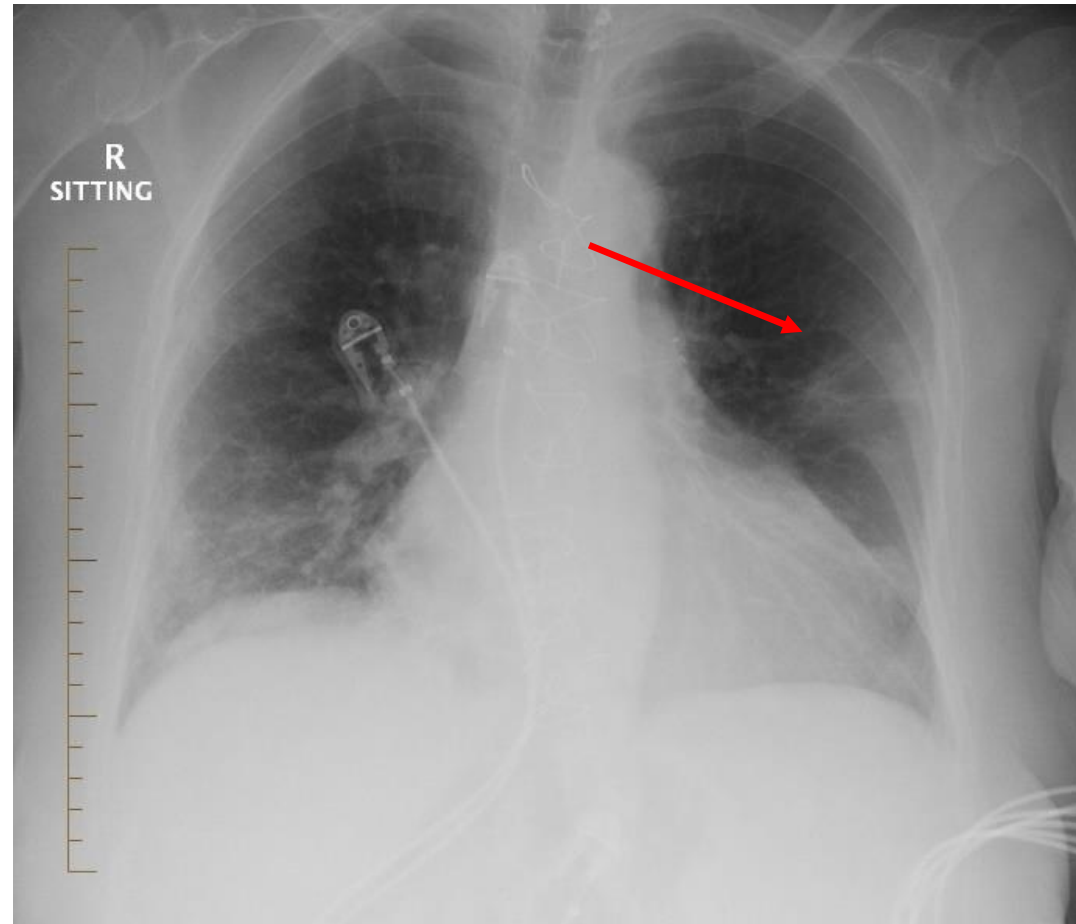
distribution

bilateral

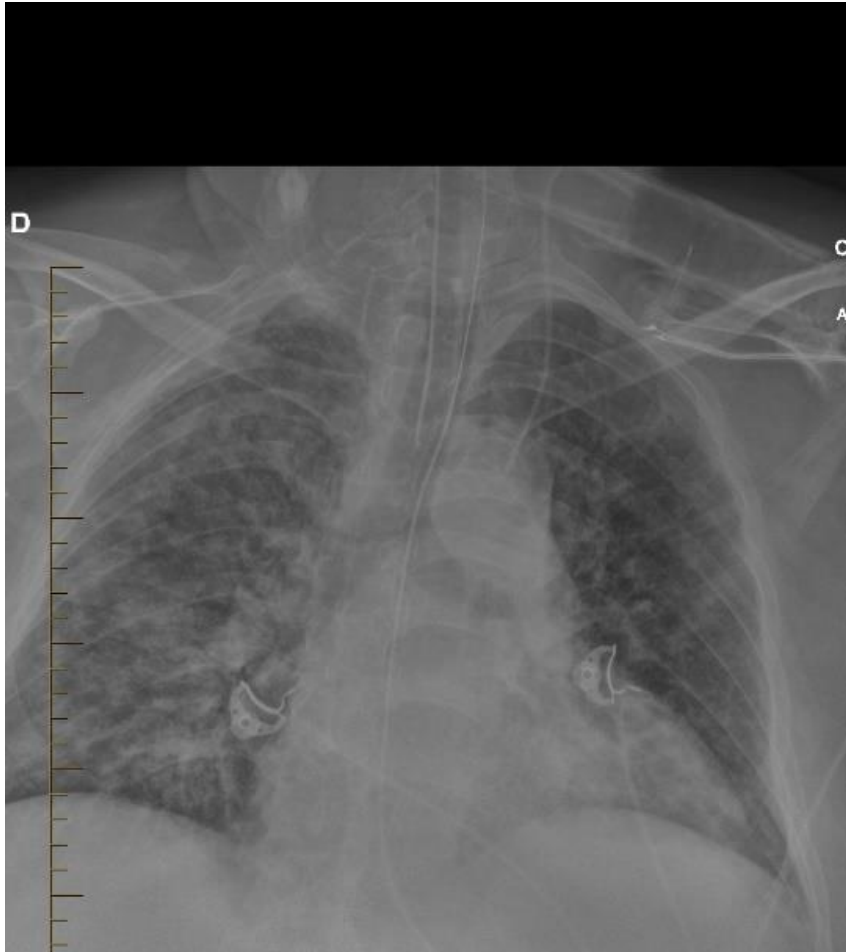
peripheral

lower lobes

pleural effusion is rare

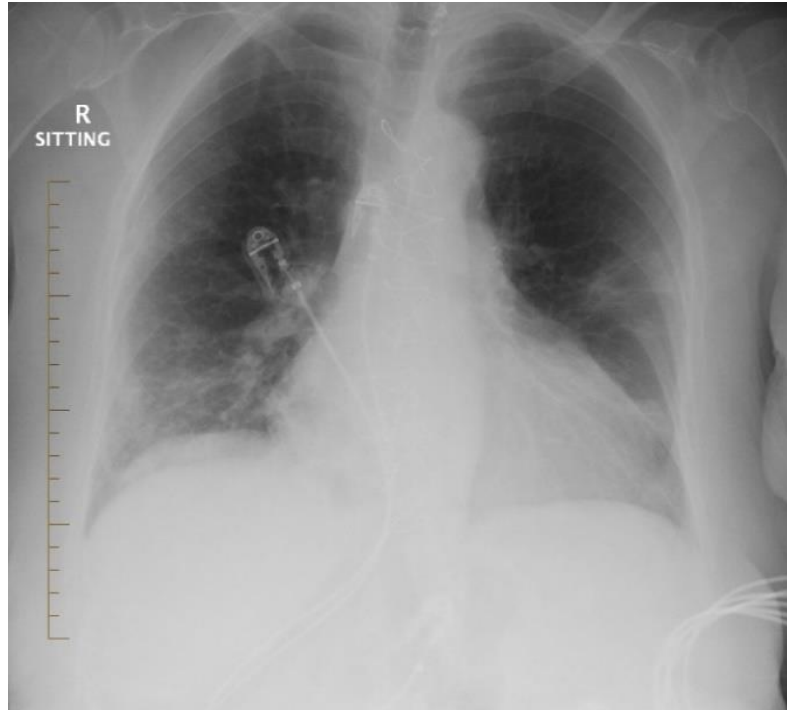


Xray Findings: Portable CXR

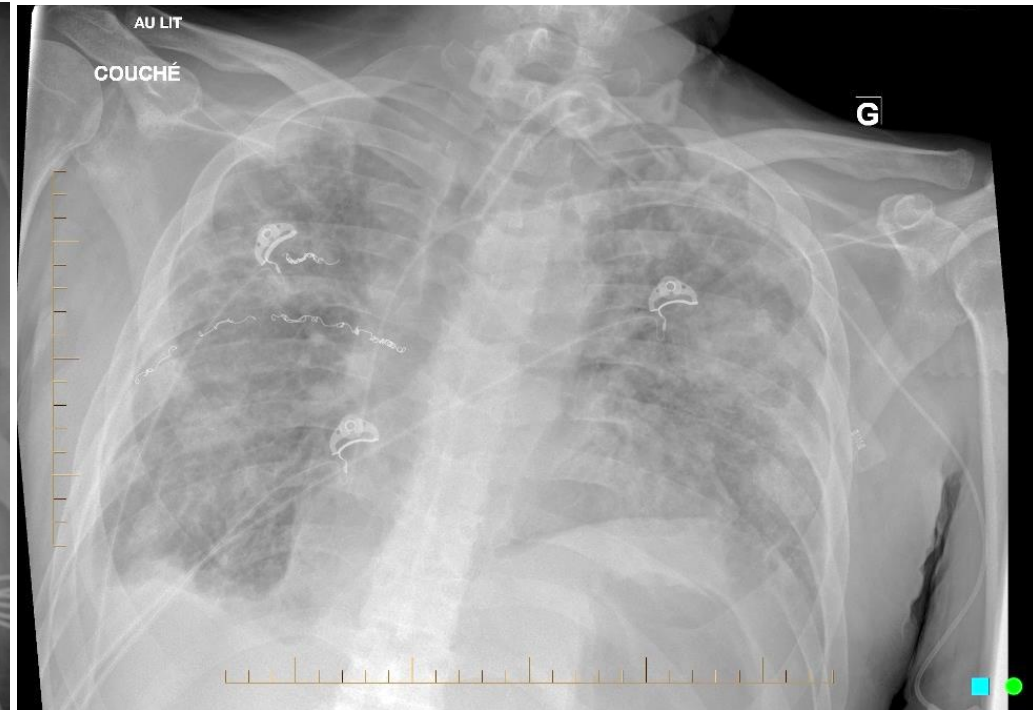


- Often poor quality
- Limited patient cooperation

78yo female



60yo male ARDS



CT as a Diagnostic Test

- CT should not be relied on as a screening tool for Covid
- In low prevalence (<10%) countries, the positive predictive value of RT-PCR was ten-fold that of CT chest

ACR Recommendations for the Use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection." American College of Radiology, 11 Mar. 2020, [ACR](#) [accessed 16 March 2020]

"RCR position on the role of CT in patients suspected with COVID-19 infection | The Royal College of Radiologists". Rcr.ac.uk, 2020. [Link](#).

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Fang Y, Zhang H, Xie J et-al. Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR. (2020) Radiology. [doi:10.1148/radiol.2020200432](https://doi.org/10.1148/radiol.2020200432) - [Pubmed](#)

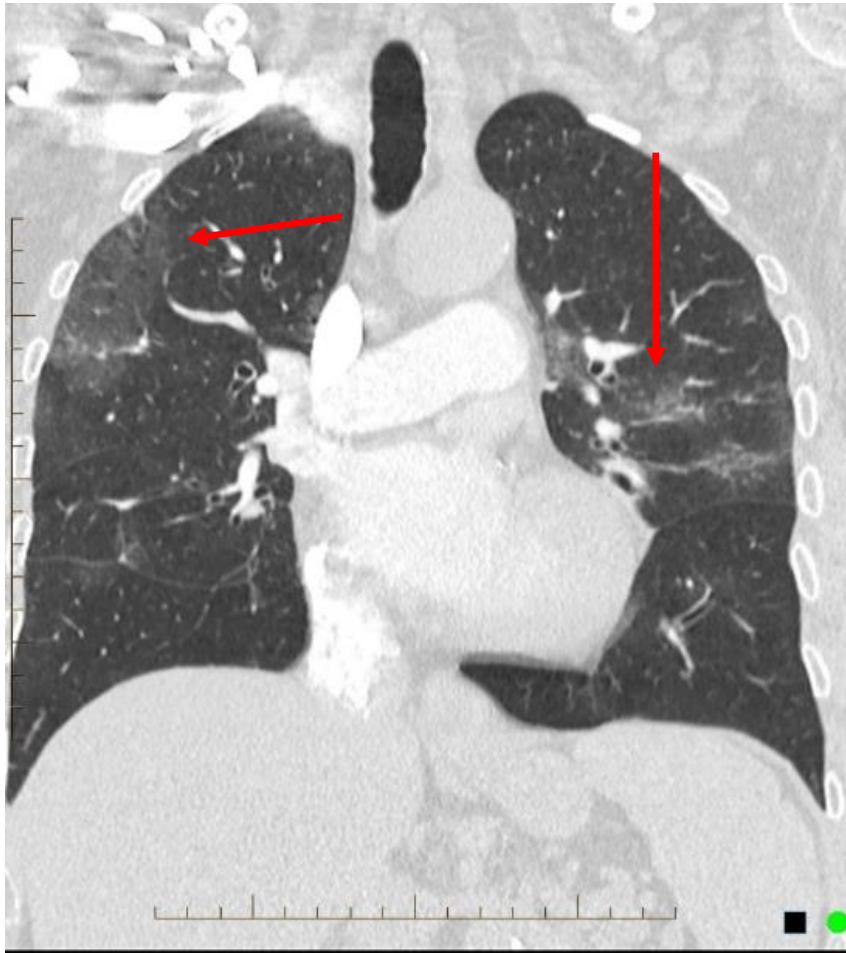
2020 Fleischner Society

- Imaging is NOT indicated in patients with suspected COVID-19 and mild clinical features unless they are at risk for disease progression
 - depletion of finite resources (PPE)
 - increased risk of transmission to staff and patients
 - COVID-19 positive and negative patients come into close proximity in the radiology department
 - additional ionizing radiation

2020 Fleischner Society

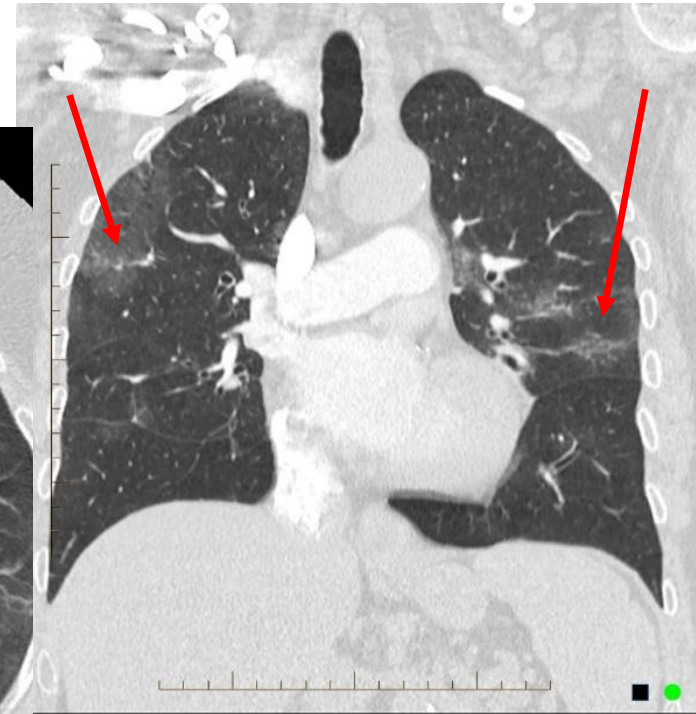
- Imaging is indicated in a patient with COVID-19 and worsening respiratory status
- Imaging is indicated for medical triage of patients with high pretest probability of COVID-19 who present with moderate-severe clinical features

CT Findings

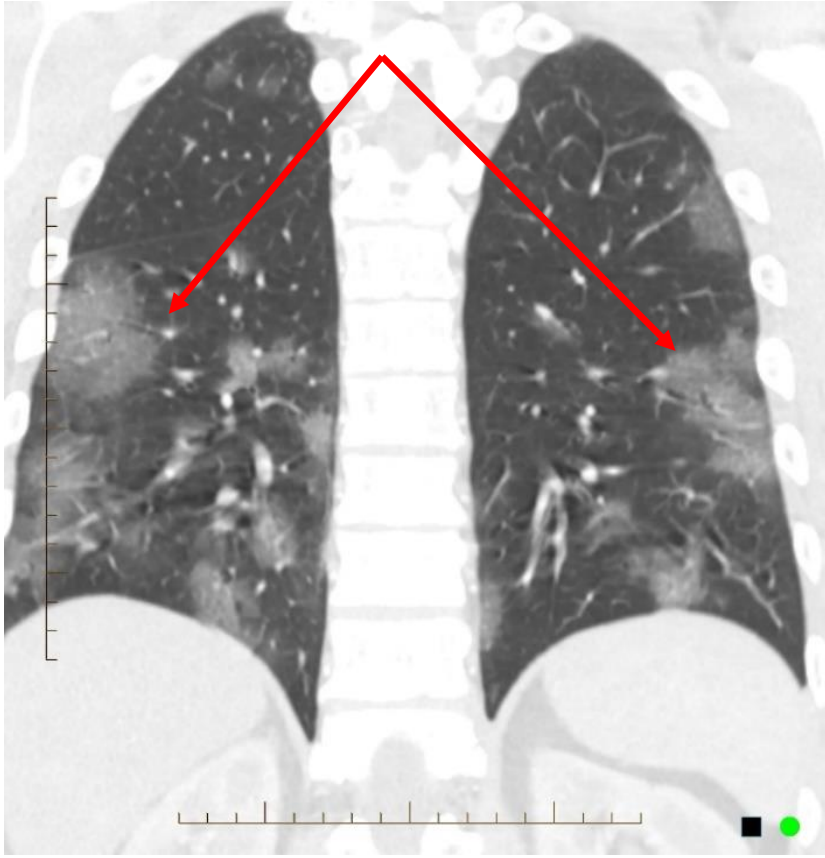


- **GGO**
 - bilateral, subpleural, peripheral
- **crazy paving**
 - GGO and septal thickening
- **air space consolidation**
 - bilateral, peripheral, and basal distribution

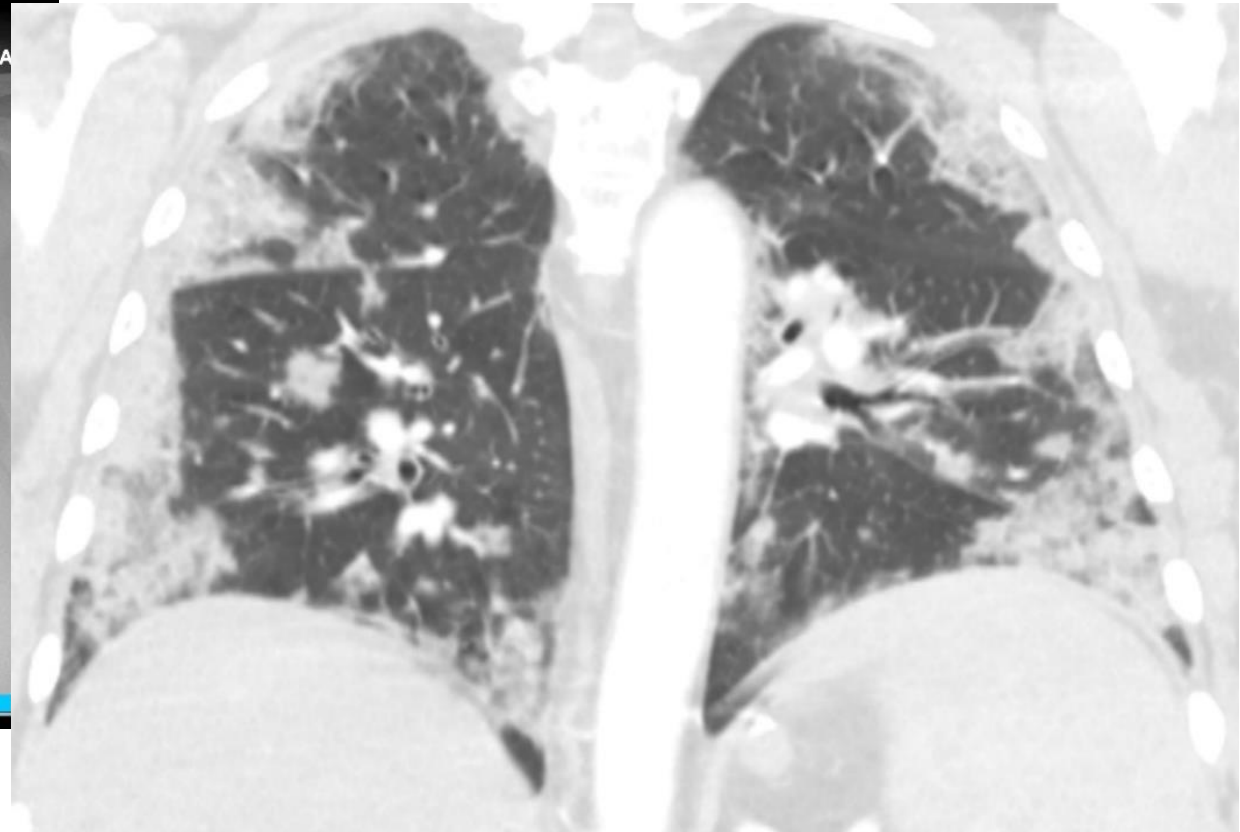
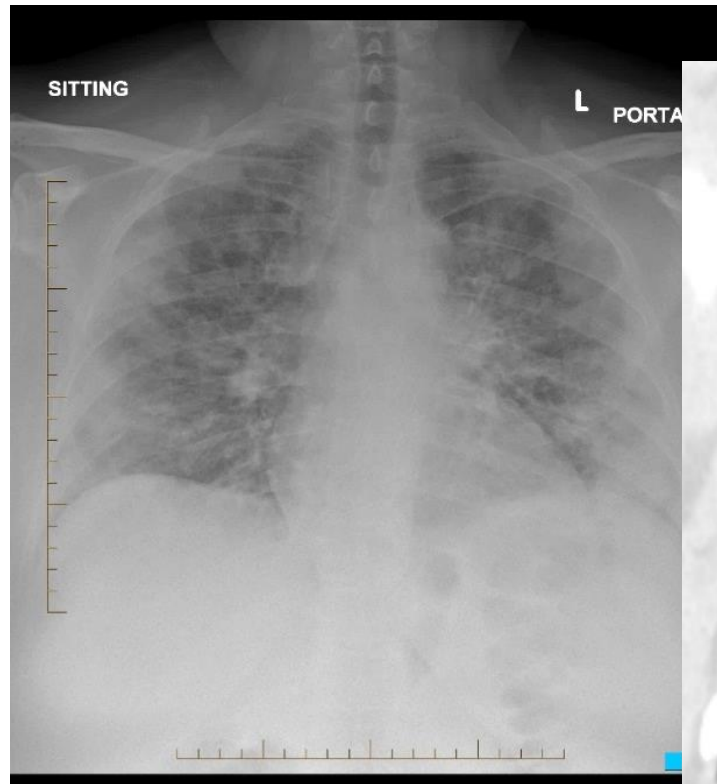
78 year old female



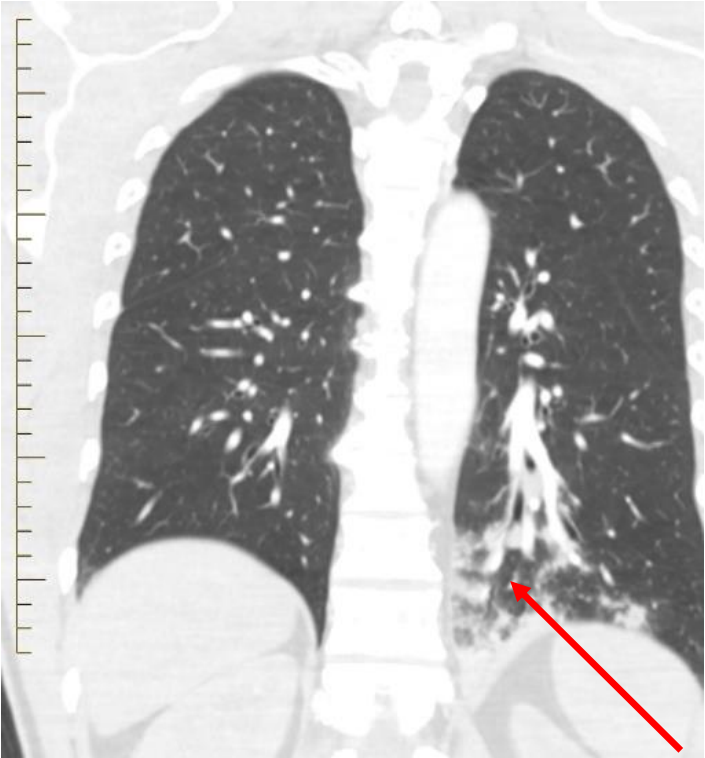
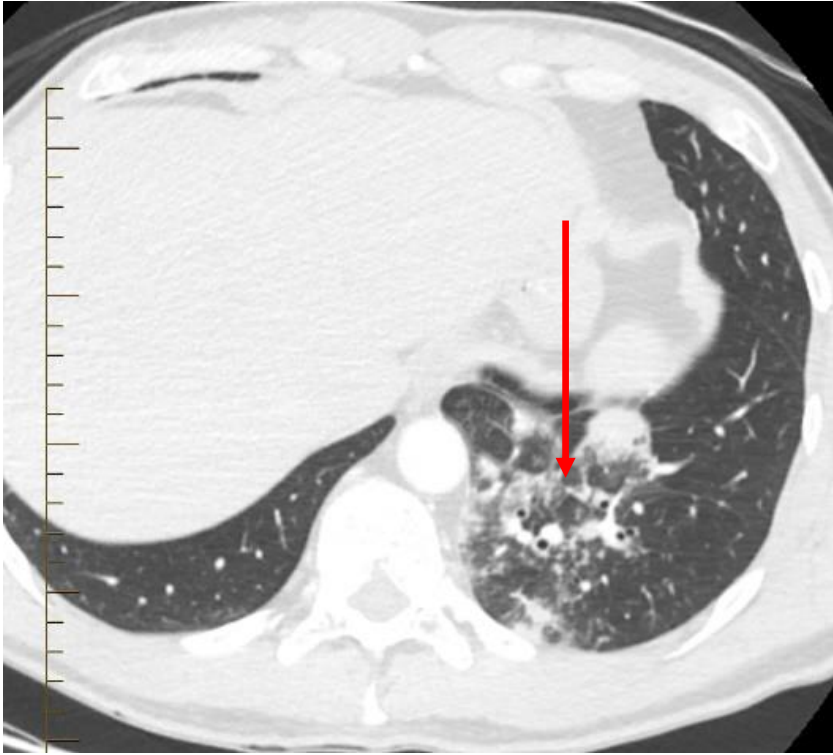
41 year old male



62 year old female



48-year-old double vaccinated male



CT Changes: Four Stages Over time

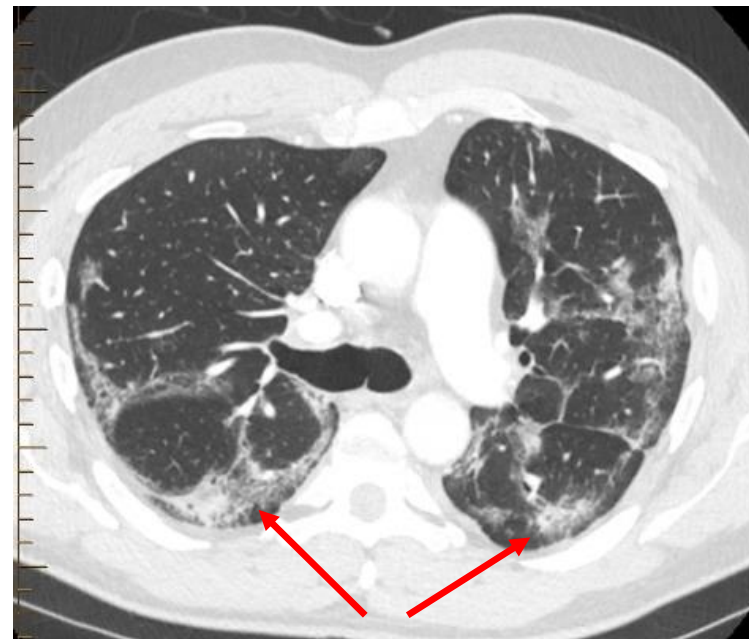
- early/initial stage (0-4 days):
 - normal or GGO only
 - 50% normal CT scans within two days of symptom onset
- progressive stage (5-8 days):
 - increased GGO and crazy paving
- peak stage (9-13 days):
 - consolidation
- absorption stage (>14 days):
 - with an improvement in the disease course,
 - "fibrous stripes" appear
 - abnormalities resolve at one month and beyond

51 year old male

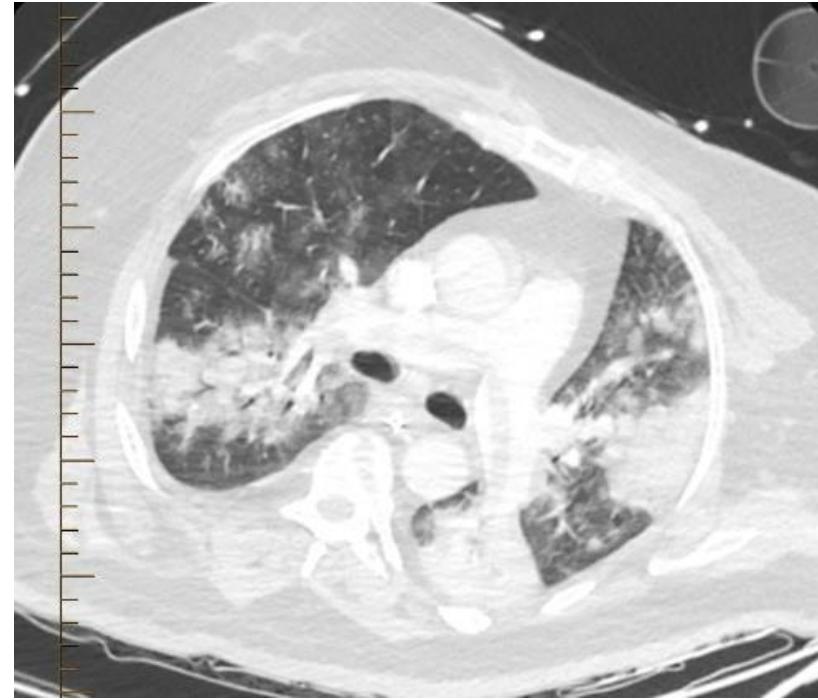
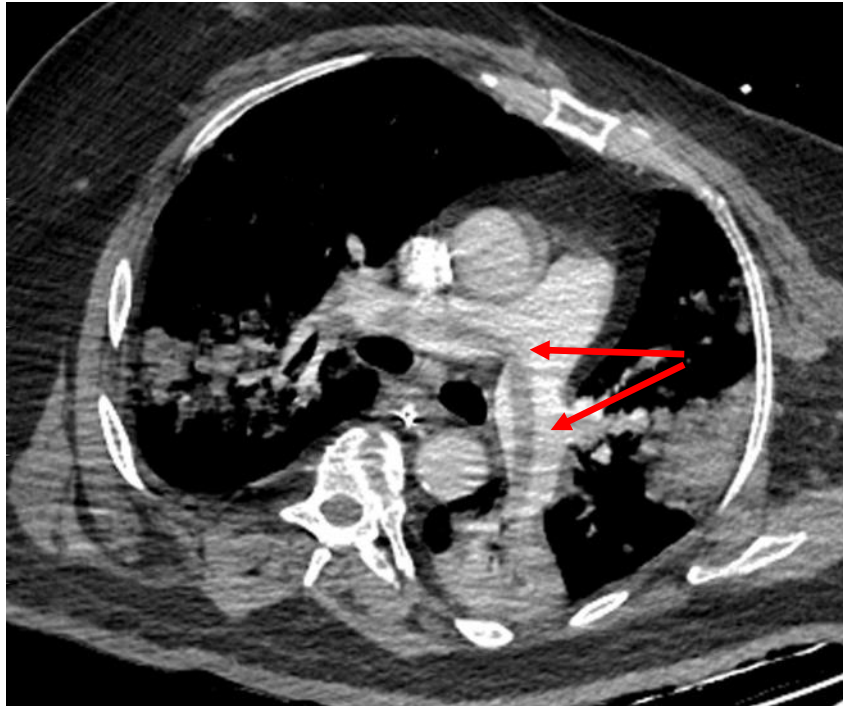
Sept 8, 2021



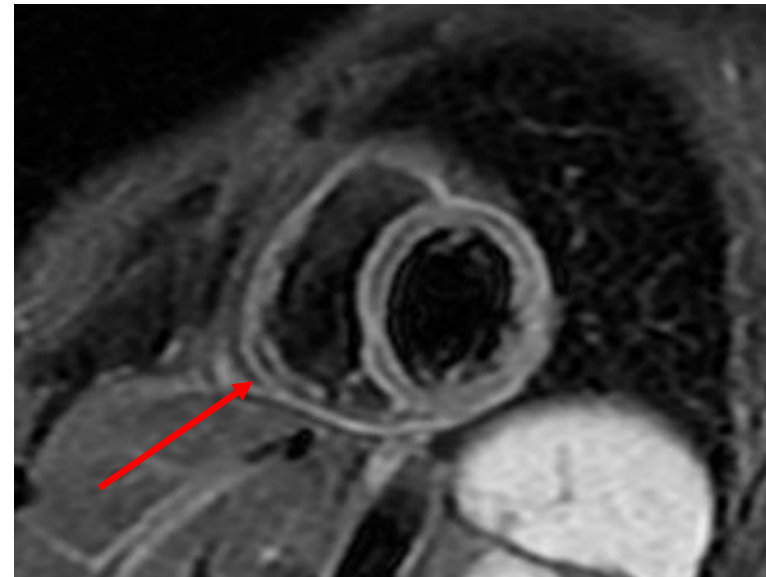
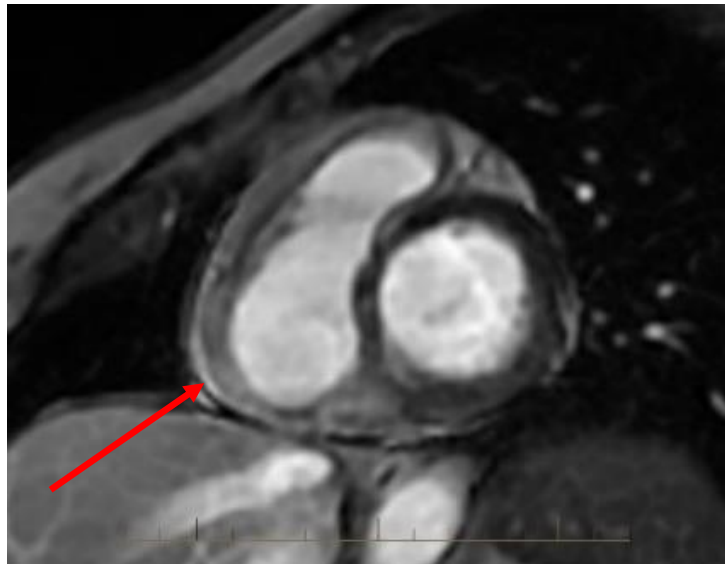
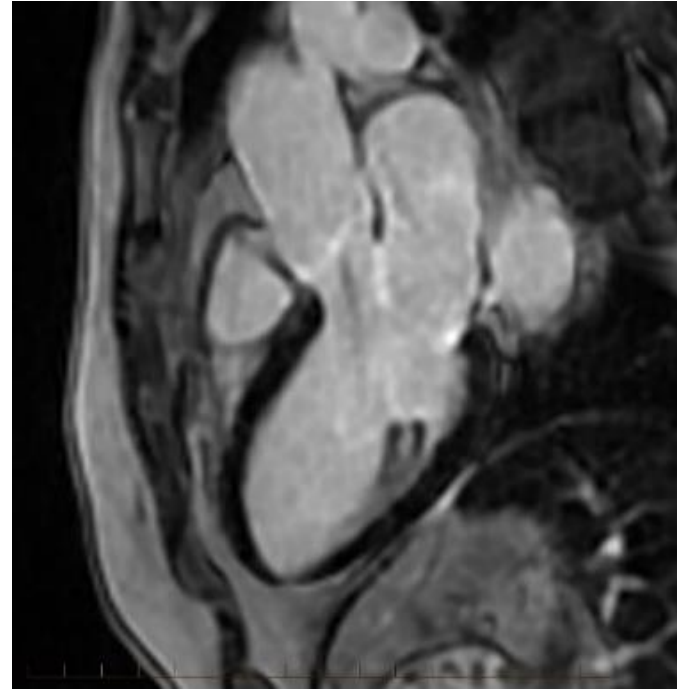
Sept 23 2021



Pulmonary Embolus



Myocarditis



Unanswered Questions

- Do classification systems of CT and chest radiographic findings sufficiently predict prognosis?
- Can imaging be used to reduce hospital admissions?
- What is the effect on cancer screening due to delays in imaging?

Unanswered Questions

- 45% of those with potential cancer symptoms did not contact their doctor during the UK's first wave of the pandemic (March–August 2020),
 - Fear
 - Avoid placing strain on system
- Re-deployment of staff towards critical care for the management of COVID-19 patients, triage of patients with COVID-19 infection, and the cessation of cancer screening in hospital
- Suspected cancer referrals fell by 350 000 compared with the same period in 2019.
- Interruptions in cancer screening programmes and delays in scans and diagnostics, a spike in late cancer presentations is anticipated, making some previously curable tumours more difficult to treat and further excess deaths unavoidable.

Unanswered Questions: Canada

- interruption of cancer screening programs since the onset of the COVID-19 disease include delayed diagnosis and marked increases in the numbers of avoidable cancer deaths.
- On account of delays in cancer diagnosis, including delays in imaging, approximately 5300 additional breast cancer deaths and 4500 additional deaths due to colorectal cancer
- Urgent policy interventions are needed to handle the backlog of routine diagnostic services to minimize the harmful effects of the COVID-19 pandemic on cancer patients.

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