

COVID AND IMAGING

Dr. Ajay Chaurasia

Prof & Head

Dr. Parag Bawaskar

Assist Prof

Department of Cardiology

TNMC & BYL Nair Hospital




Fleischer Society consensus statement

- Imaging is **not indicated** in patients with suspected COVID-19 and mild clinical features.
- Imaging is indicated in a patient with COVID-19 and **worsening respiratory status**.
- In a resource-constrained environment, imaging is indicated for **medical triage** of patients with suspected COVID-19 with moderate-severe clinical features and a high pretest probability of disease.

Standard Operating Procedure

- Standard care involves handwashing or hand sanitization and use of gloves.
- Droplet precautions include gown, gloves, headcover, facemask and eye shield.
- Airborne precautions add special masks (e.g. N-95 or N-99 respirator masks), and shoe covers.

- **Social distancing** —minimum six feet (1.8 meters) between individuals in waiting rooms and work spaces.
- **Encourage sick employees to stay home.** Personnel who develop respiratory symptoms (e.g., cough, shortness of breath) or unexplained fever should be instructed not to report to work.
- Ensure **sick leave policies** are flexible and consistent with public health guidance and that employees are aware of these policies.
- **Screen patients and visitors for symptoms of acute respiratory illness** (e.g., fever, cough, difficulty breathing) or gastrointestinal symptoms and coronavirus exposure in the last 2 weeks before entering one's healthcare facility .

- 
- Ensure technologist **hand hygiene practices**. If soap and water are not readily available, use of a hand sanitizer that contains at least 60% alcohol.
 - Increase **scheduling intervals or appointment times** to allow adequate time to clean equipment as needed.
 - Leverage **telemedicine** technologies and isolated workstations for reading and interpretation

Chest Radiograph(CXR)

- CXR widely available
- Cost effective imaging tool for thoracic abnormalities
- CXR can be done bedside and repeated as and when necessary

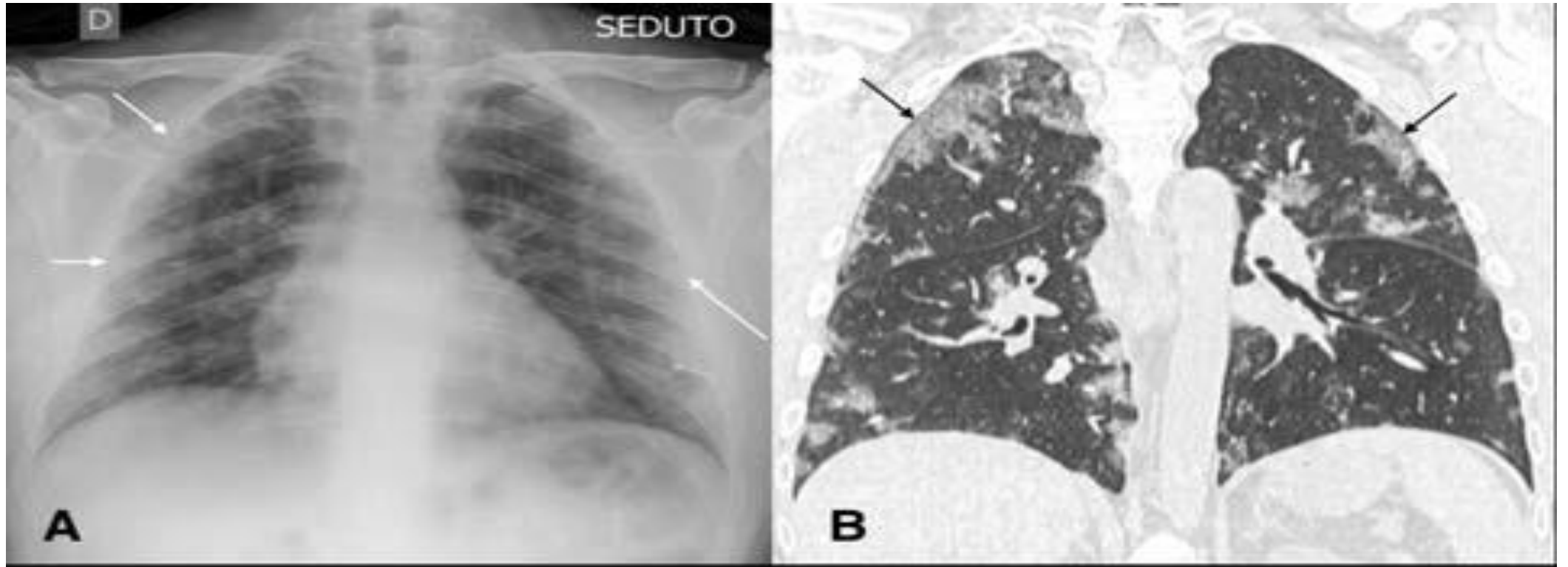
CXR

- Although less sensitive than chest CT, CXR is **the first-line imaging modality** used for suspected COVID-19 patients.
- Portable radiography units are preferred for ease of decontamination.
- **Chest radiographs may be normal in early or mild disease.**
- Of patients with COVID-19 requiring hospitalization, 69% had an abnormal CXR at the time of admission, and 80% had radiographic abnormalities sometime during hospitalization .
- Findings are most extensive about 10-12 days after symptom onset .

CXR findings in COVID-19

- **Typical findings**

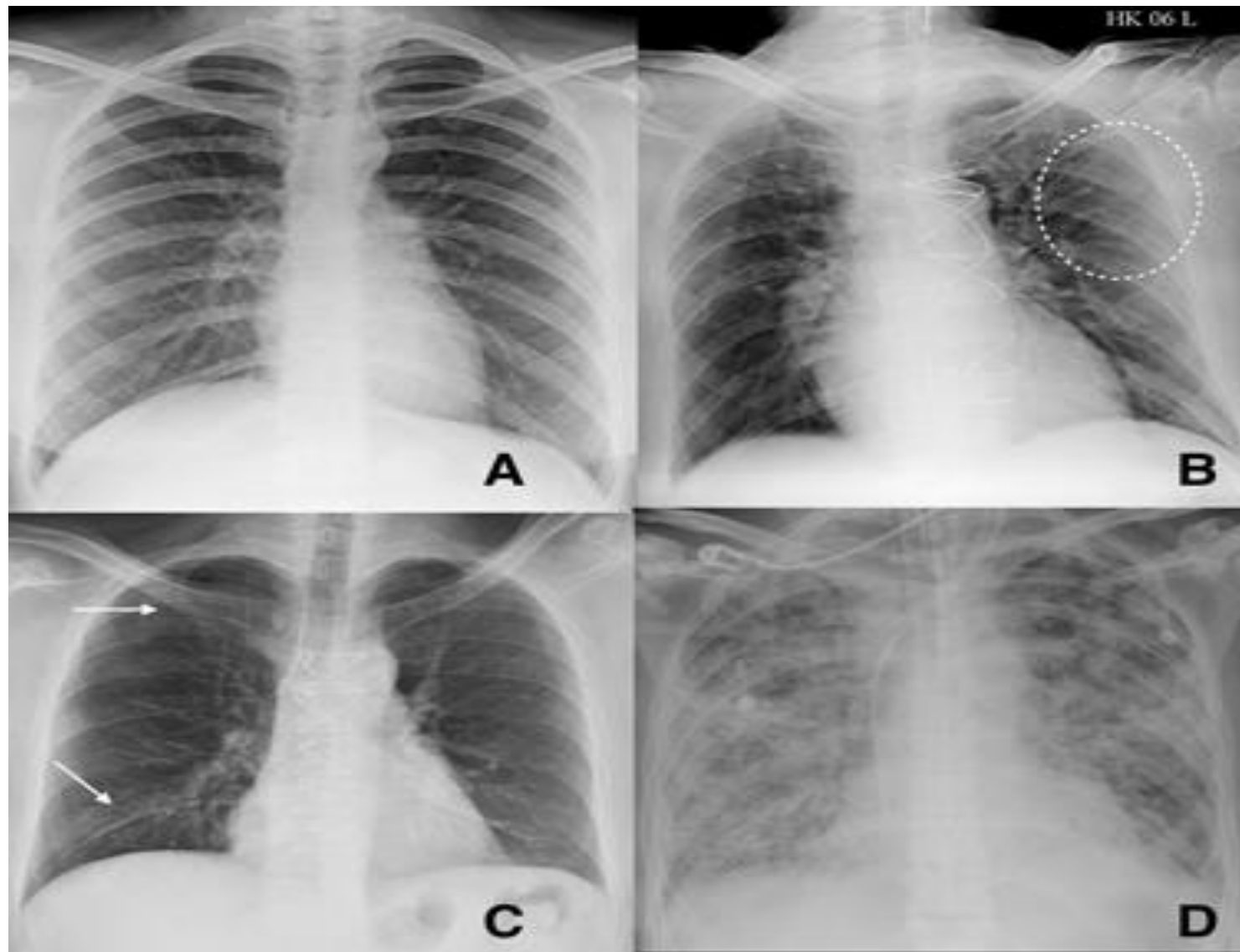
1. Ground glass opacities-areas of increased lung opacities
2. Consolidation-areas of homogenous opacities
3. Classic distribution-Bilateral and peripheral location with lower lobe predominance



CXR(A) shows bilateral peripheral ground glass opacities with corresponding CT image(B)



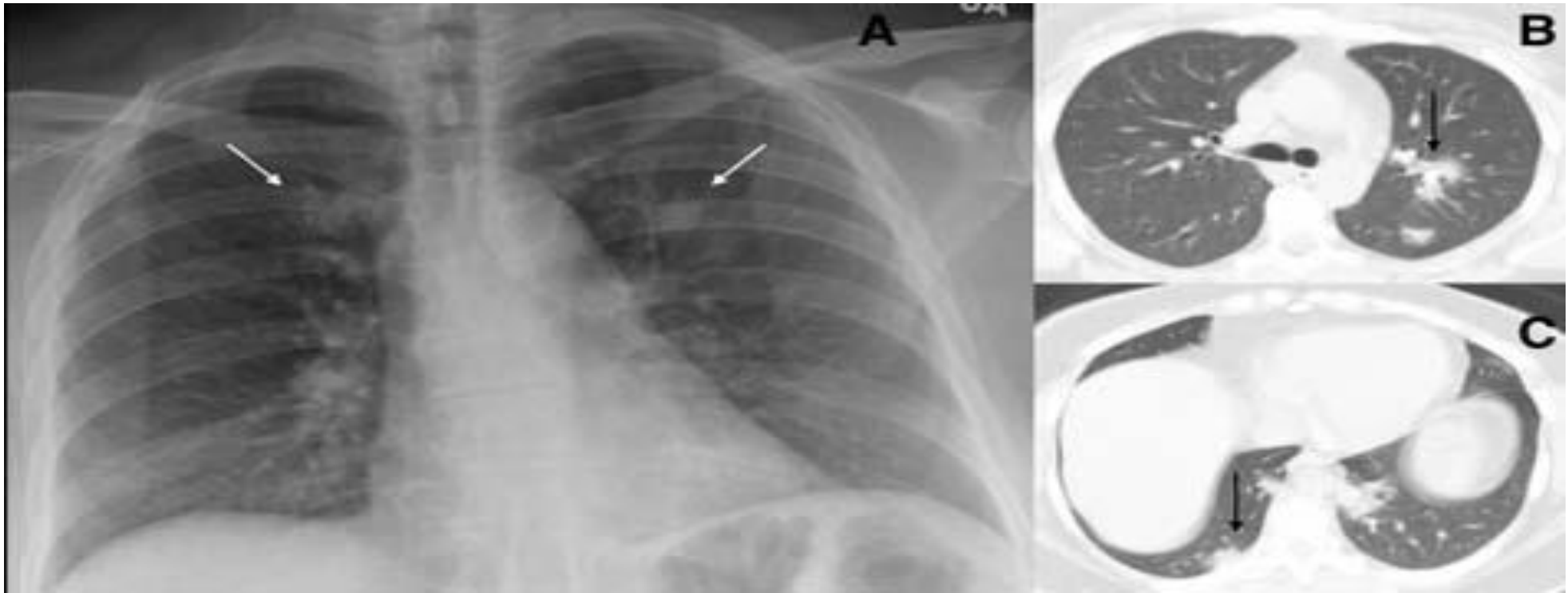
CXR shows bilateral peripheral areas of consolidation



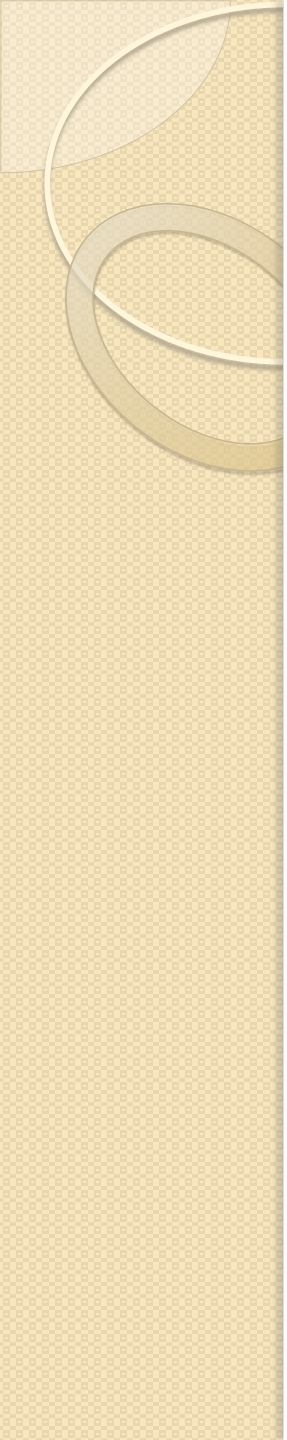
CXR A-normal, B-ill-defined hazy opacity in left UZ, C-multiple peripheral opacities
D- extensive parenchymal infiltrates

CXR findings in COVID-19

- **Atypical findings**
 1. Pleural involvement
 2. Pneumothorax
 3. Nodular lesions



Atypical presentation -CXR (A) inform of nodules with corresponding CT images(B and C)

- 
- CXR abnormality can precede RT-PCR positivity
 - Repeat RT-PCR should be obtained in presence of high clinical suspicion of COVID 19

Radiographic scoring system

- Simplistic scoring system was used by Wong et al
- Each lung was graded 0-4 based on severity
 - 0-no involvement
 - 1-upto 25%
 - 2-25-50%
 - 3-50-75%
 - 4-more than 75%

Limitations

- CXR can be normal or near normal in early stages of COVID 19
- 20% patient do not have any abnormality on CXR at any given point of illness
- Sensitivity of CXR was 69 % as compared to RT-PCR
- Radiological abnormalities may lag behind clinical improvement
- Findings of CXR are non specific and can be seen in other viral pneumonia

CHEST CT

- More sensitive than CXR
- No findings can completely rule out or rule in diagnosis of COVID 19
- American college of radiology recommends not using chest CT for screening or diagnosis of COVID 19

CHEST CT


Typical findings

- Ground-glass opacities (GGO) bilateral, subpleural, peripheral.
- Crazy paving appearance (GGOs and inter/intra-lobular septal thickening)
- Air space consolidation.
- Bronchovascular thickening in the lesion.
- Traction bronchiectasis.

CHEST CT

Atypical findings

- Mediastinal lymphadenopathy
- Pleural effusions
- Multiple tiny pulmonary nodules (unlike many other types of viral pneumonia)
- Tree-in-bud
- Pneumothorax
- Cavitation


- 
- The use of CT as a primary screening tool was discouraged with a recent (April 2020) meta-analysis reporting a pooled sensitivity of 94% and specificity 37% .
 - In low prevalence (<10%) countries, the positive predictive value of RT-PCR was ten-fold that of CT chest.

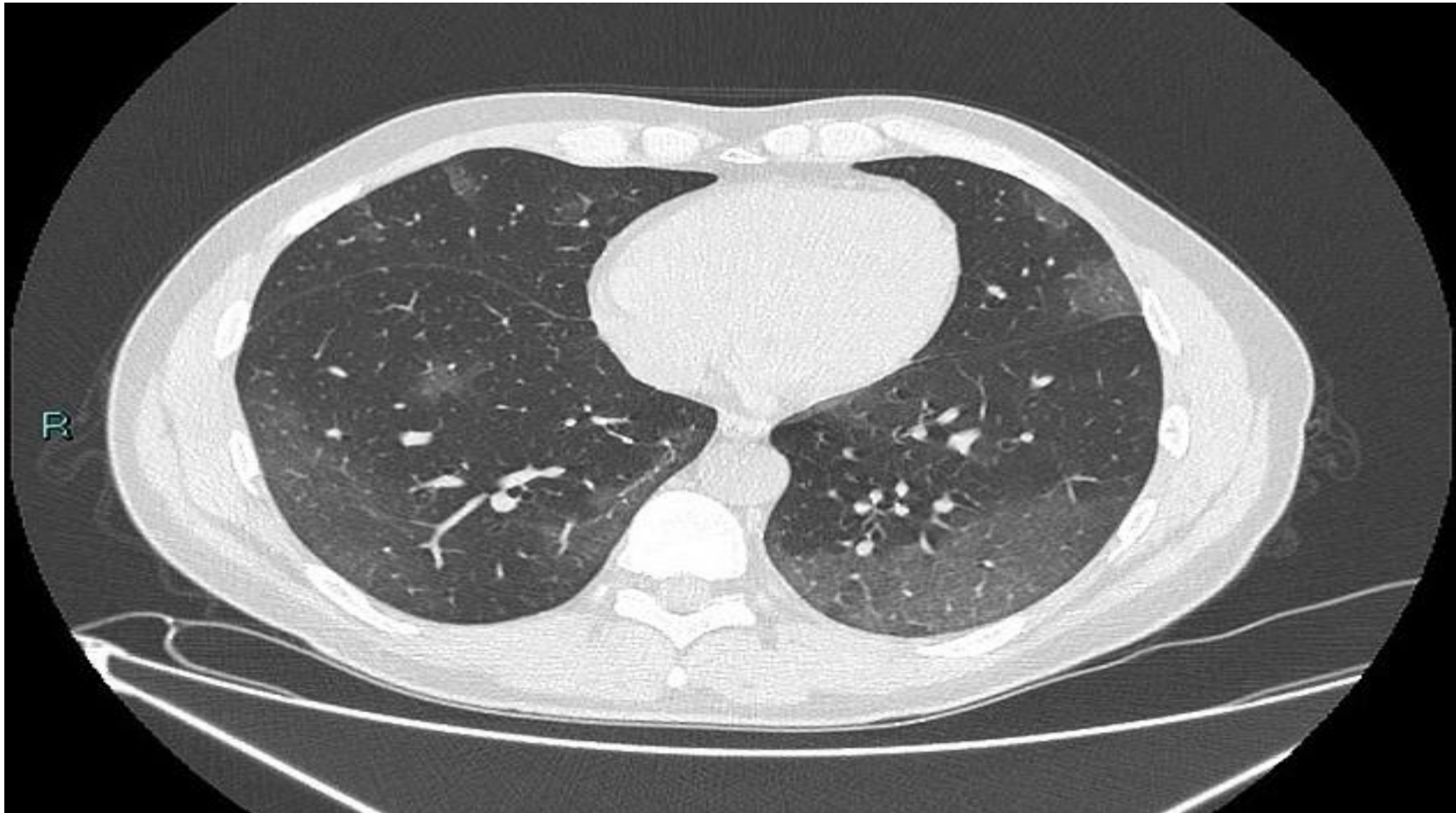
Four stages on CT

- Early/initial stage (0-4 days): normal CT or GGO only
 - up to half of patients have normal CT scans within two days of symptom onset
- Progressive stage (5-8 days): increased GGO and crazy paving appearance
- Peak stage (9-13 days): consolidation
- Absorption stage (>14 days): with an improvement in the disease course, "fibrous stripes" appear and the abnormalities resolve at one month and beyond

CO-RADS

- Dutch Association for Radiology proposed a CT scoring system for COVID-19.
- CO-RADS (COVID-19 Reporting and Data System) to ensure CT reporting is uniform and replicable. This assigns a score of CO-RADS 1 to 5, dependent on the CT findings.

- 
- Chest CT had sensitivity of 97% and specificity of 25% (Wuhan study)
 - Chest CT may be normal soon after symptom onset
 - However, Chest CT abnormalities have also been documented prior to development of symptoms and RT-PCR positivity



There are large bilateral pure ground-glass opacities in the upper and lower lobes prevalent in the dorsal region



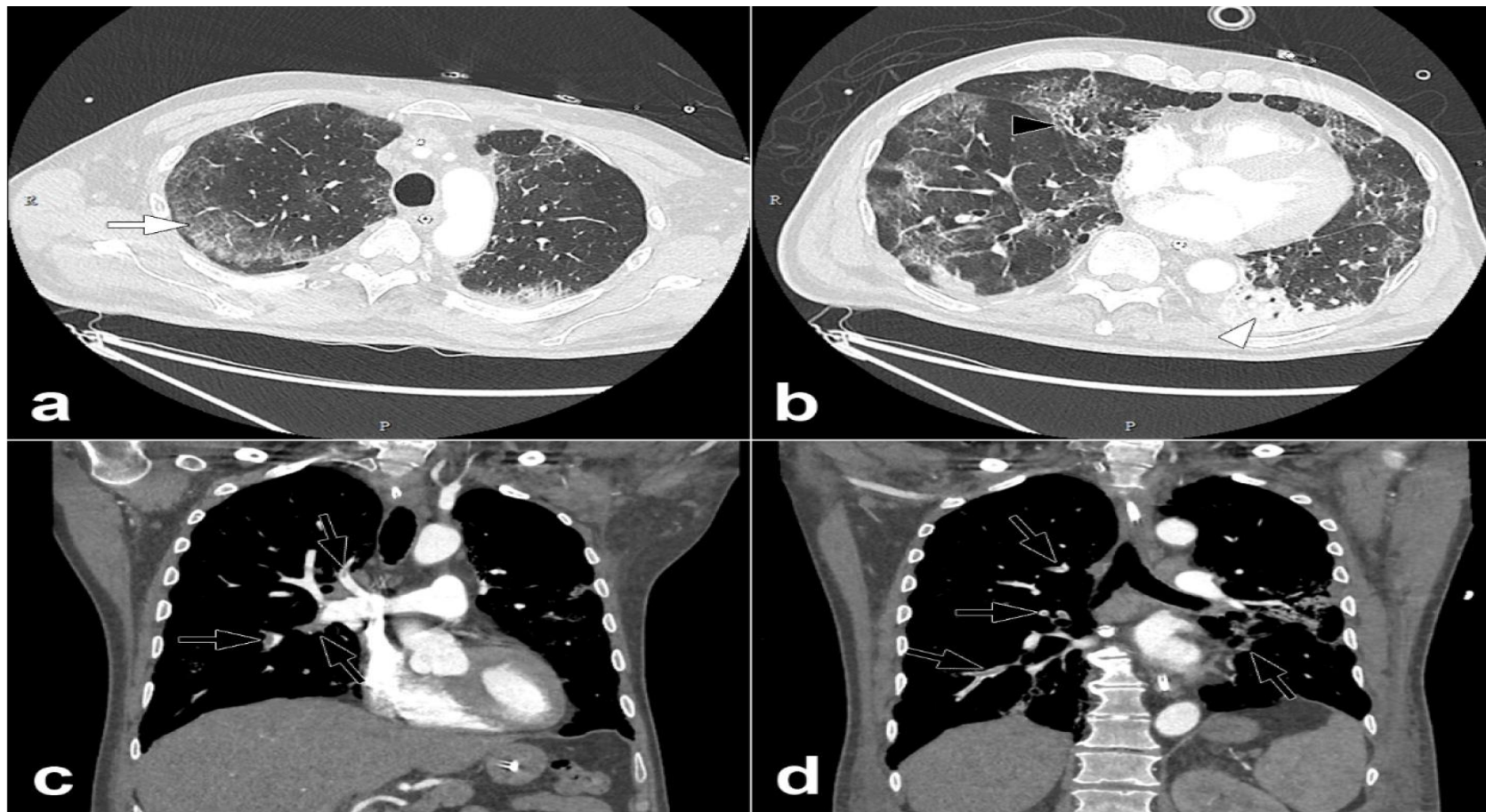
Multifocal regions of consolidation and ground-glass opacifications.



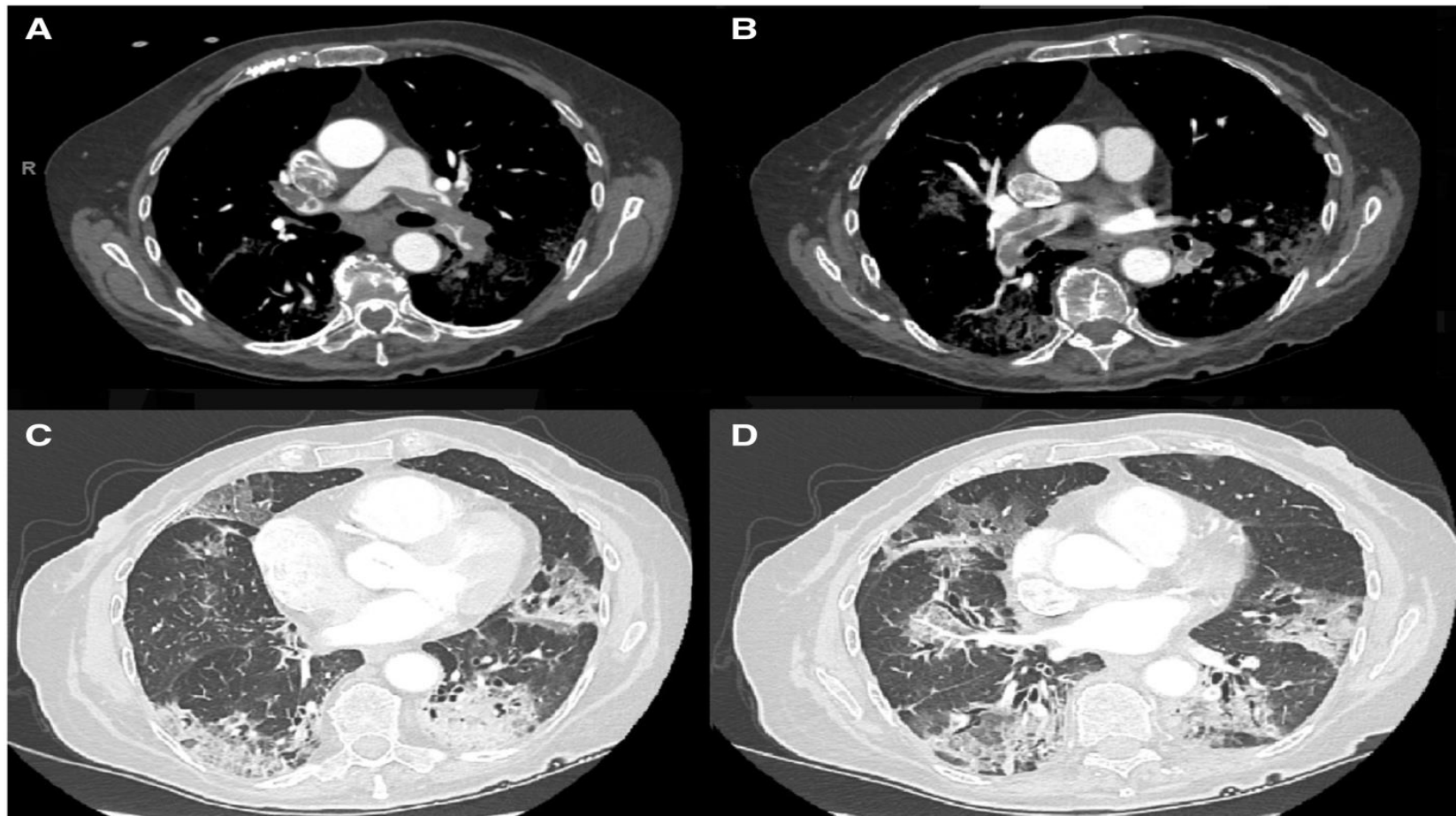
CT images show multiple patchy, peripheral and basal, bilateral areas of ground-glass opacity. No mediastinal lymphadenopathy has been seen.

Pulmonary Embolism in COVID 19

- In a retrospective study of 100 patients with severe clinical features of COVID-19 infection, the proportion of patients with acute pulmonary embolus was 23% (95% CI: 15%, 33%) on pulmonary CT angiography.



The CT scan was obtained 10 days after the onset of COVID-19 symptoms. Axial CT images (a,b) show peripheral ground-glass opacities (arrow) associated with areas of consolidation in dependent portions of the lung (arrowheads). Involvement of the lung volume was estimated to be between 25% and 50%. Coronal CT reformations (mediastinum windows) (c,d) show bilateral lobar and segmental pulmonary embolism (black arrows).



In a 75-year-old Covid-19-positive woman hospitalized for severe bilateral pneumonia, CT scan documented bilateral pulmonary embolism associated with extensive ground-glass opacifications involving both the lung parenchymas.

Eur Heart J, Volume 41, Issue 19, 14 May 2020, Page 1858, <https://doi.org/10.1093/eurheartj/ehaa254>

Echocardiography

ASE statement on COVID 19

- Determine which echo studies are “elective” and reschedule them, performing all others.
- Identify “non-elective” (urgent/emergent) indications and to defer all others.
- Echo should only be performed if expected to provide clinical benefit.

ASE statement

- Echocardiographic exams be planned ahead based on indications, clinical information, laboratory data and other imaging findings.
- Scan times should be minimized.
- Ensure rapid review and reporting of key findings in the patient's record and communicating them with the primary care team.

Echocardiography study in COVID

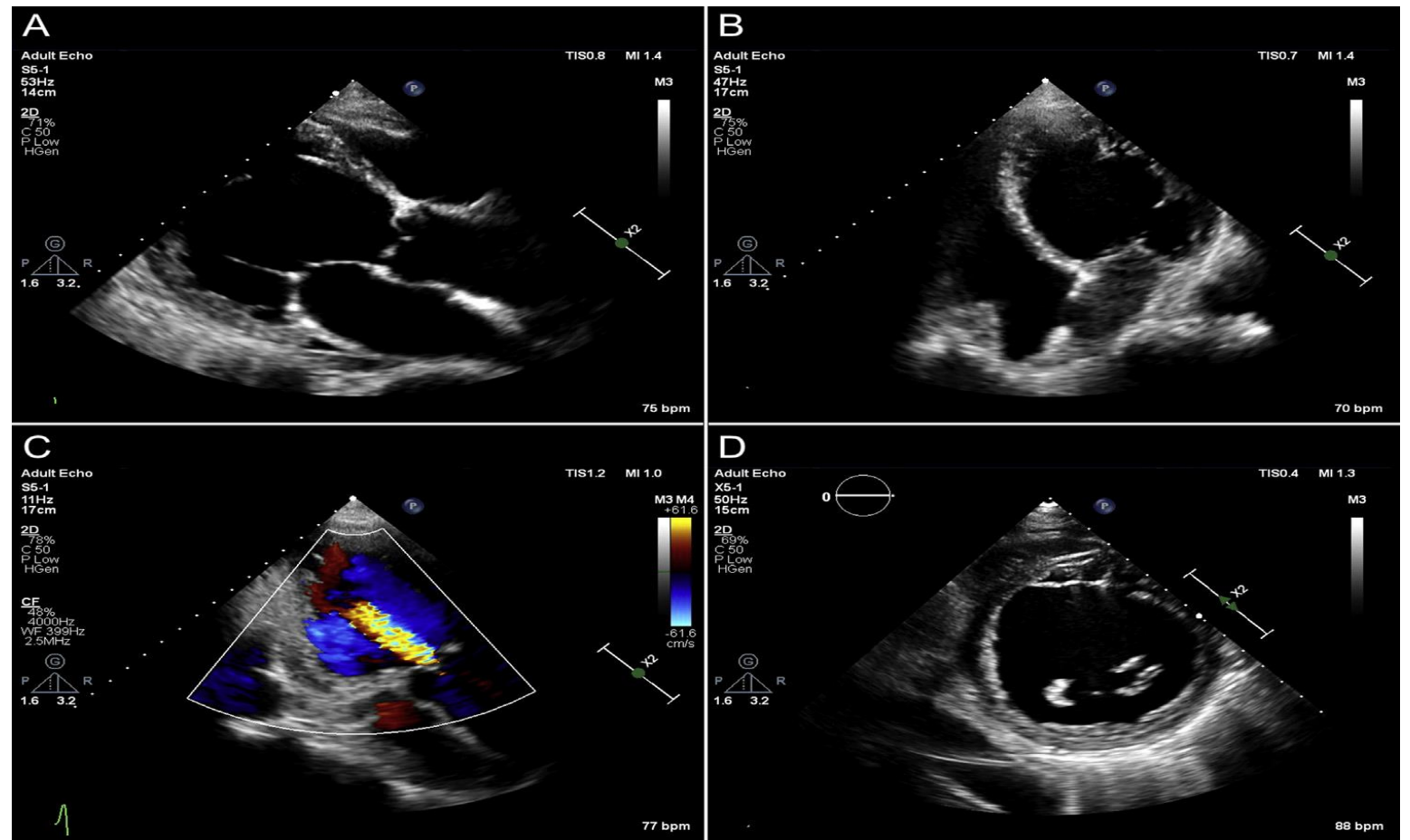
- 100 consecutive patients underwent echo study within 24 hrs of admission and a repeat echo was done in case of clinical deterioration
 1. Normal study-32%
 2. RV dilatation and dysfunction-39%
 3. LV diastolic dysfunction-16%
 4. LV systolic dysfunction-10%



What Are the Clinical Implications?

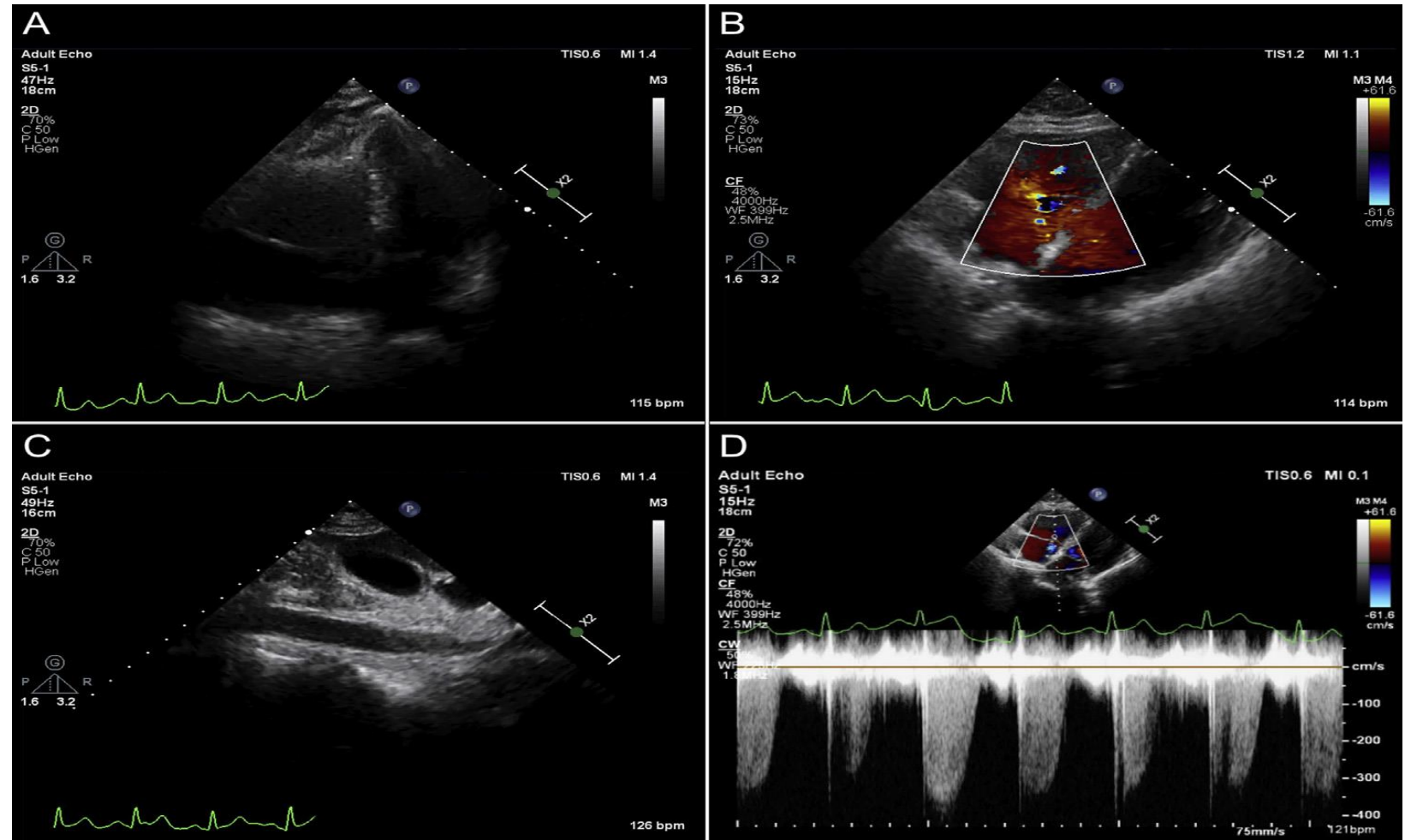
- In patients with clinical deterioration, echocardiography helps establishing the mechanism of cardiac injury with significant impact on patients' management.

73-yr-old male with fever,
dyspnea.
COVID positive.
BNP raised.



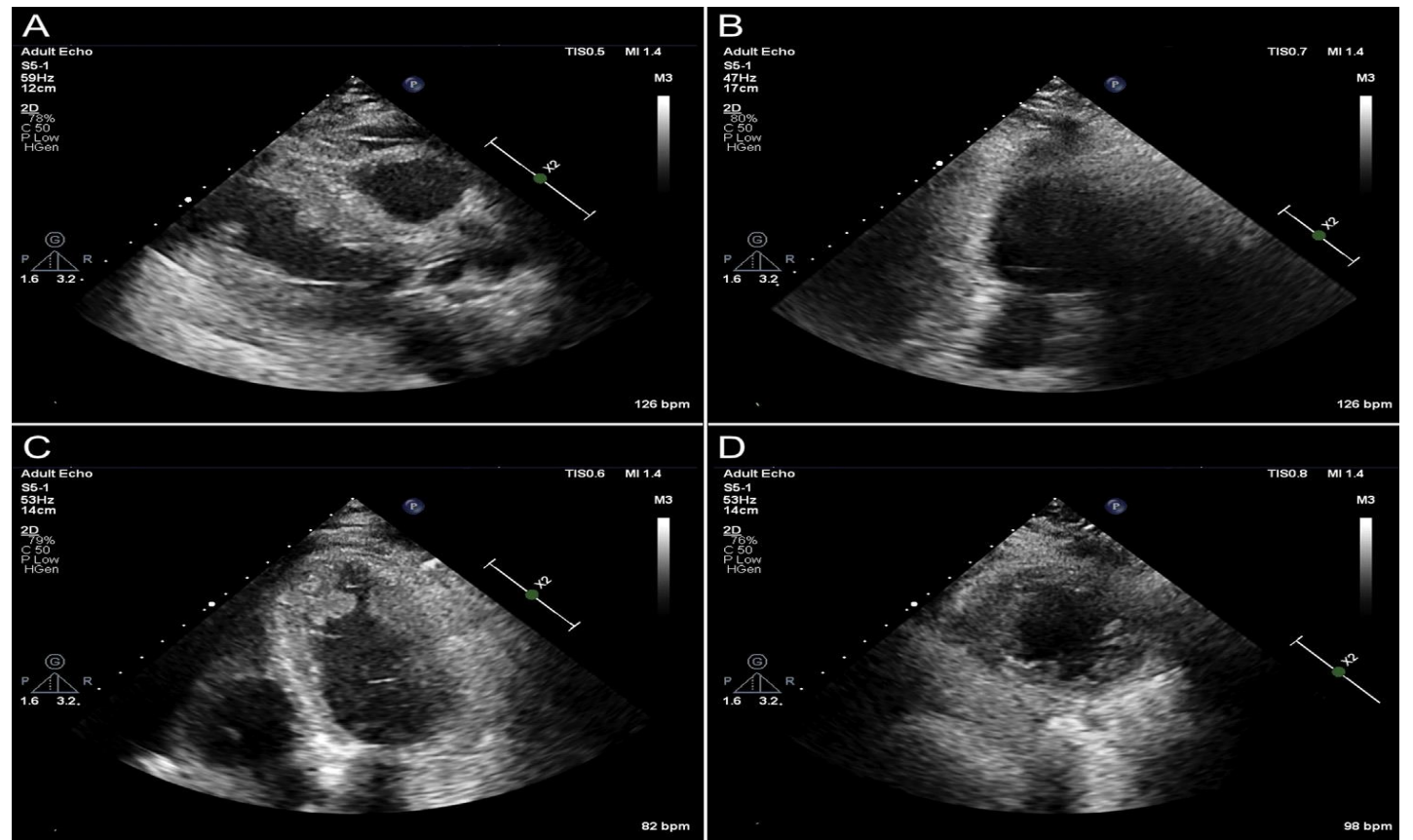
POCUS shows dilated LV with LVEF of 20% and moderate aortic regurgitation

69-yr-old male
with fever,
Chest pain, pedal
edema.
Raised D-dimer



POCUS showed dilated RA, RV and IVC, moderate TR and Severe pulmonary hypertension.

45-yr-old woman with fever, chest pain.
Raised Troponin and BNP




POCUS showed thickened LV walls with moderate LV systolic dysfunction, LV apical thrombus and RWMA at apical segment

Cardiac CT (CCT)

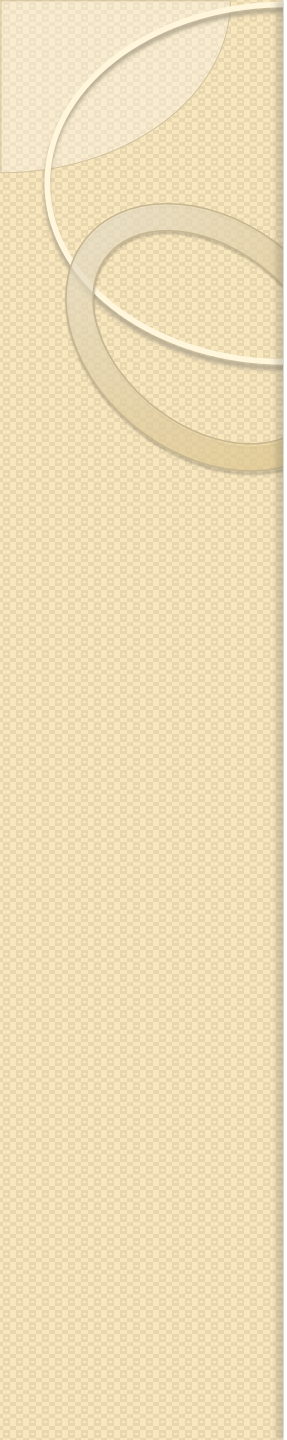
Guiding points to consider when deciding on the role and timing of CCT.

- Consider deferring CCT exams which can be safely postponed.
- CCT may be preferred to transesophageal echocardiography (TEE) in order to **rule-out left atrial appendage and intracardiac thrombus** prior to cardioversion in order to reduce coughing and aerosolization related to TEE.

- 
- The ability of CCT to decisively **exclude coronary disease or high risk anatomy** may prevent the need for inpatient admissions and resource use.
 - In elderly patients, those with co-morbidities with greater risk of morbidity / mortality from COVID-19, the benefit and risk of cardiac CT should be evaluated on a case by case basis.
 - In patients with confirmed COVID-19, the benefit of CCT in most clinical scenarios will likely be lower than the risk of exposure and infection to healthcare personnel.


CCTA for ACS

- Coronary CT Angiogram (CCTA) may be useful in carefully selected patients with elevated cardiac enzymes, inconclusive electrocardiogram, and symptoms of possible acute coronary syndrome (ACS) in order to exclude obstructive coronary artery disease.
- The use of coronary CTA should only be considered at centres with high-level of expertise in diagnostic imaging.
- CCTA is not recommended to evaluate patients with definitive ST elevation myocardial infarction. These should proceed directly to definitive therapy as per local institutional protocol.

- 
- The decision to proceed with coronary CTA versus invasive angiography should be made in collaboration with local clinical staff from the Heart Team, including cardiac catheterization laboratory.

Urgent indications for CCT

- Acute chest pain with sufficient clinical suspicion for CAD.
- Stable chest pain at high risk for events, or when there is concern for possible high-risk coronary anatomy.
- Evaluation of left atrial appendage in acute atrial arrhythmia prior to restoration of sinus rhythm.
- Acute inpatient cardiomyopathy in low to intermediate pretest probability of CAD, only if CCT would change management.

- 
- Acute symptomatic prosthetic heart valve dysfunction, endocarditis, perivalvular extension of endocarditis or possible valve abscess.
 - New cardiac masses which are suspected to be malignant, if necessary to plan biopsy or surgery.
 - Rule-out left ventricular thrombus following equivocal echocardiography when alternative diagnostic tests (e.g. MRI) are not feasible.



Thank You