Heart involvement in COVID-19:

What is the risk of long-term consequences?

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Cardiovascular effects of COVID-19
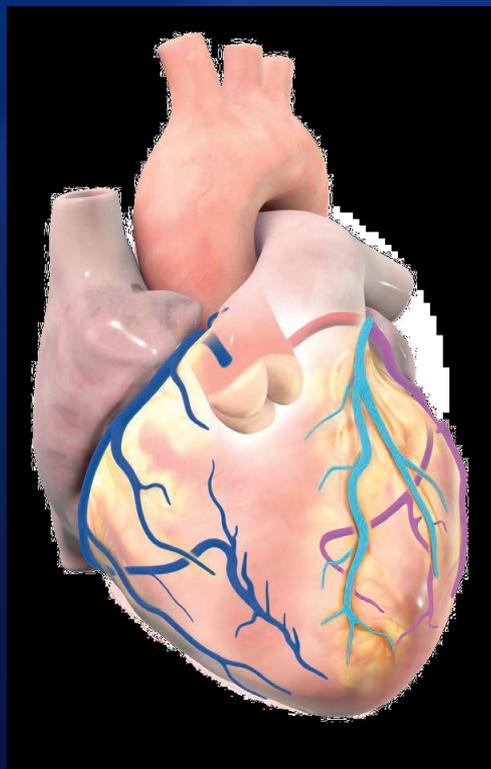
- 187 hospitalized patients in Wuhan[1]

- Elevated troponin levels in 28%

- In hospital mortality:
  7.6% without underlying CVD & normal TnT
  13.3% with CVD and normal TnT
  37.5% without CVD but ↑ TnT
  69.4% for CVD and ↑ TnTs

[1] Guo T, JAMA Cardiol 2020

Mechanisms of cardiac injury – RV involvement

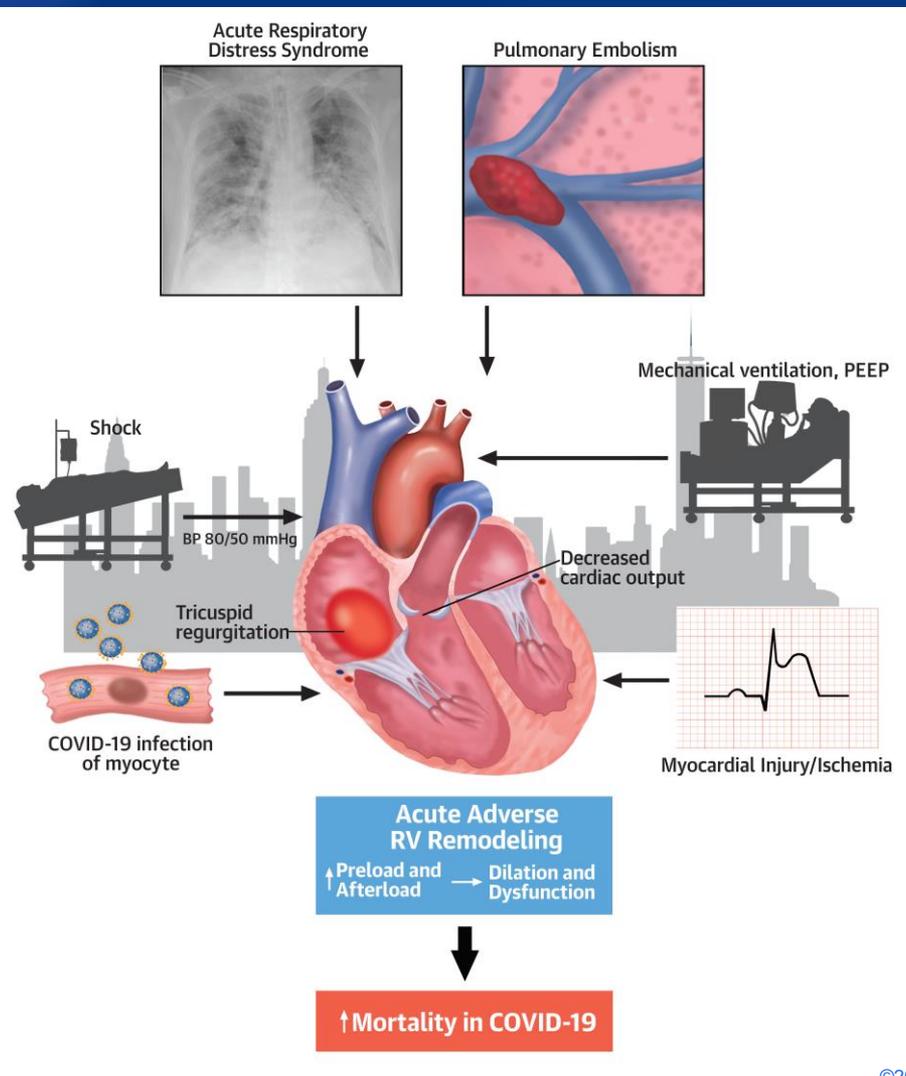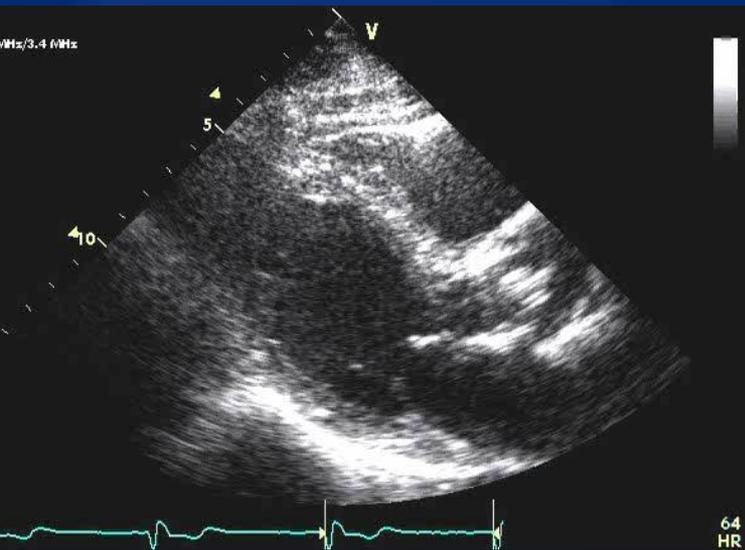Hypoxemia (ARDS, pulmonary embolism)

Shock

Acute coronary syndrome

Myocarditis

Stress cardiomyopathy

Adverse right ventricular remodeling related to doubling in mortality (Kim JACC 2021)

Pellikka PA, Naqvi T : JACC 2021

Acute Respiratory Distress Syndrome

Pulmonary Embolism

Mechanical ventilation, PEEP

Shock

BP 80/50 mmHg

Decreased cardiac output

Tricuspid regurgitation

COVID-19 infection of myocyte

Myocardial Injury/Ischemia

Acute Adverse RV Remodeling
↑Preload and Afterload → Dilation and Dysfunction

↑Mortality in COVID-19

Cardiac Abnormalities in COVID-19 and Relationship to Outcome

- Clinically-indicated echo in 179 COVID-19 inpatients at 10 MC sites

- Age 60± 17 years; 60% men

- Events within 30 days in 70 (39%) patients including prolonged hospitalization in 43 (24%) & death in 27 (15%)

Krishna H, Pellikka PA, et al Mayo Clinic Proc 2021

Cardiac Abnormalities in COVID-19 and Relationship to Outcome

- Left ventricular ejection fraction < 50% in 29 (16%), regional wall motion abnormalities in 26 (15%), and right ventricular systolic pressure (RVSP) >35 mm Hg in 44%

- Myocardial injury (troponin elevation + new ventricular dysfunction or electrocardiographic abnormalities) in 13 (7%)

Myocardial injury: Mayo Clinic cohort

Non-ST elevation myocardial infarction: 6 pts

Stress cardiomyopathy: 3

Myocarditis: 2

Ischemic cardiomyopathy after cardiac arrest, prior CABG: 1

Stress cardiomyopathy/myocarditis: 1

77 yo woman with stress cardiomyopathy

Cardiac Abnormalities in COVID-19 and Relationship to Outcome

- Prior echo available in 36 (20%) : pre-existing abnormalities were seen in 28 (78%) of these

- In a multivariable age-adjusted model, AUC 0.81, prior cardiovascular disease, troponin, D-dimer, and RVSP were related to events at 30 days

305 pts NYC, Milan

- Troponin ↑ in 62%

- Any major echo abnormality: RWMA, global LV dyfunction, RV dysfunction, pericardial effusion, diastolic dysfunction, associated with ↑ in-hospital mortality

Picture placeholder

Central Illustration: Spectrum of echocardiographic abnormalities in patients with biomarker evidence of myocardial injury and coronavirus disease-2019.

Giustino G, et al. Characterization of Myocardial Injury in Patients With COVID-19
J Am Coll Cardiol. 2020 Nov 3;76(18):2043-2055

Prognostic impact of prior heart failure in pts hospitalized with COVID-19

Placeholder for Fig 3

Forest Plot of the Effect of a History of HF on Outcomes in Patients Admitted for COVID-19

After a multivariable logistic regression adjusting for age, sex, race, obesity, hypertension, diabetes, coronary artery disease, atrial fibrillation, chronic kidney disease, chronic obstructive pulmonary disease, previous treatment with renin-angiotensin-aldosterone inhibitors, systolic blood pressure, heart rate, oxygen saturation, white blood count, lymphocytes, creatinine, and albumin on admission, history of HF persisted as an independent risk factor for the need for intensive care unit (ICU) care, intubation and mechanical ventilation, and in-hospital mortality.

Alvarez-Garcia J, et al. Prognostic Impact of Prior Heart Failure in Patients Hospitalized With COVID-19.
J Am Coll Cardiol. 2020 Nov 17;76(20):2334-2348.

- Pts with hx HF had longer length of stay: 8 vs 6 d

- More frequent mechanical ventilation: 23 vs 12%

- Higher mortality: 40 vs 25%

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Indirect consequences of the pandemic

Placeholder for Fig 1

Incidence of Hospitalization for Acute MI before and during the Covid-19 Pandemic in 2020 and during the Same Period in 2019, Relative to the Incidence of Hospitalization for Covid-19.

Data from 43,017,810 person-weeks from January 1 through April 14, 2020, were evaluated. The weekly rates of hospitalization for acute myocardial infarction decreased by up to 48% during the Covid-19 period. From January 1 through March 3, 2020, a total of 1051 hospitalization events occurred (incidence rate, 4.1 per 100,000 person-weeks), and from April 8 through April 14, 2020, a total of 61 hospitalization events occurred (incidence rate, 2.1 per 100,000 person-weeks) (incidence rate ratio, 0.52; 95% confidence interval [CI], 0.40 to 0.68; P<0.001)

Solomon MD, et al. The Covid-19 Pandemic and the Incidence of Acute Myocardial Infarction. N Engl J Med. 2020 Aug 13;383(7):691-693.

- Hospitals shut down or with limited access

- Late presentation of ACS

- Decline in elective and emergent cardiac surgery

- Massive impact on research trials – remote monitoring

Outcomes of Cardiovascular Magnetic Resonance Imaging in Pts Recently Recovered From COVID-19

- 100 pts recently recovered from severe COVID-19, University Hospital Frankfurt

- Mean age 49, median time from diagnosis to CMR 71 days (64-92)

- CMR abnormal in 78%, inflammation in 60%

Puntmann: JAMA Cardiol 2020

Follow up after COVID-19
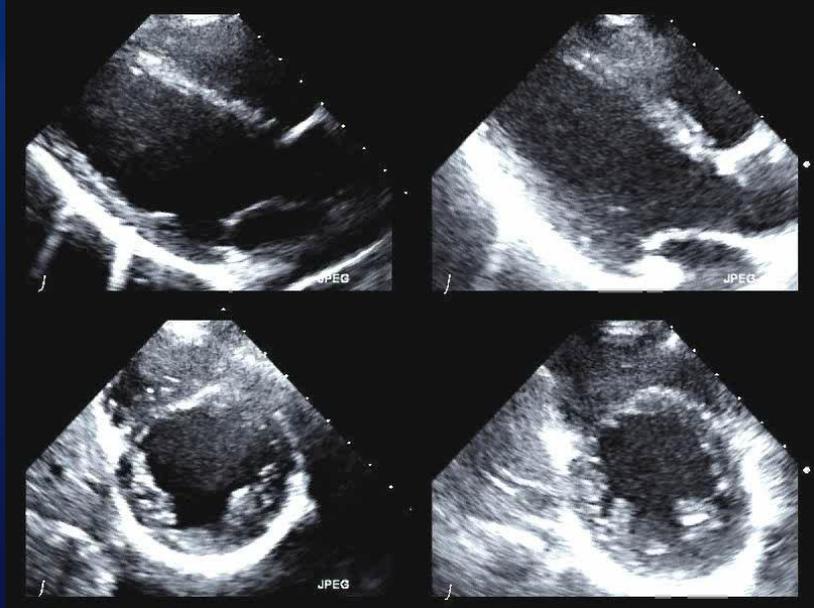
- Sequelae after moderate or severe COVID-19

- Perception of decline in exercise capacity, increased shortness of breath. Deconditioning vs damage (heart or lungs)?

- Heart failure with preserved ejection fraction? Similar cardiometabolic risk profile (DM, obesity, aging)

- Will there be long-term cardiac sequelae? Pulmonary hypertension, heart failure

- Role of advanced imaging (stress echo, strain, CMR)

- Can artificial intelligence (applied to ECG or echo) identify pts at risk of poor outcome?

Summary

- Cardiac involvement in COVID-19 is varied

- Right ventricular enlargement, dilatation and elevated pressures are associated with poor short-term outcomes

- Caution in attributing cardiac abnormalities to COVID-19; some pre-existing

- Further information is needed regarding long-term cardiac effects of COVID-19

Questions and Comments

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