**BACKGROUND**

- COVID-19-related acute respiratory failure leads to silent but severe hypoxemia; underlying mechanism is uncertain
- Intrapulmonary bronchopulmonary anastomoses (IBAs) bypass alveolar capillary beds by utilizing the bronchial circulation to direct blood from pulmonary arteries to pulmonary veins: a unique right-to-left intrapulmonary vascular shunt
- Transcranial bubble ultrasound and 3D histologic image reconstruction in COVID-infected patients shows right-to-left intrapulmonary shunt: possibly due to IBAs

**CASE PRESENTATION**

- 17-year-old female with obesity presents with acute shortness of breath and chest pain after one week of upper respiratory symptoms, fever, nausea, and emesis
- Intubated shortly after admission due to increasing hypoxia
- Imaging showed nodularity of the lungs consistent with superimposed pneumonia and/or thromboemboli; echo and EKG negative for significant heart dysfunction
- Tested positive for SARS-CoV2; concern for hyperinflammation
- Treatments: intubation, proning, Remdesivir, steroids, antibiotics, tocilizumab and anakinra
- Progressed to acute respiratory distress syndrome (ARDS) and had 24 hours of pressor-refractory hypotension with tachycardia
- Death 16 days after presentation; autopsy requested

**METHODS**

- Standard autopsy sampling + 20 lung tissue blocks for extensive studies, culture
- Cannulation of main pulmonary vessels and injection with tissue ink, PA: blue ink, PV: orange ink, with serial sections
- State-of-the-art imaging of tissue blocks: synchrotron-based phase-contrast imaging, followed by 3D image reconstruction
- Art imaging of tissue blocks: synchrotron imaging of same tissue block (Fig. 2) with connection to bronchial microvessels (Br:bronchiole )

**RESULTS**

- IBAs demonstrated by all modalities: histology via ink injection (Fig. 1), and synchrotron imaging of same tissue block (Fig. 2)
- Extensive acute and focally-organizing thrombi within all sizes of pulmonary arteries, with associated hemorrhagic necrosis (Fig. 3)
- Preventing hyaline membrane disease (Fig. 4)
- Bronchial fibrin plugs/casts (Fig. 5)

**CONCLUSION**

- IBAs are present in COVID-related respiratory failure
- Ink injection studies show open anastomotic connections between pulmonary artery and bronchial vasculature
- Synchrotron based 3D image reconstruction confirms this relationship
- Other histopathologic findings in line with prior COVID literature: striking ARDS and extensive vascular insult (numerous pulmonary artery fibrin thrombi, focal vasculitis)
- Novel finding: Bronchial fibrin plugs and casts

**SPECULATION**

Precapillary right-to-left shunt via IBAs plays a key role in COVID-related silent hypoxemia and respiratory failure

**REFERENCES**