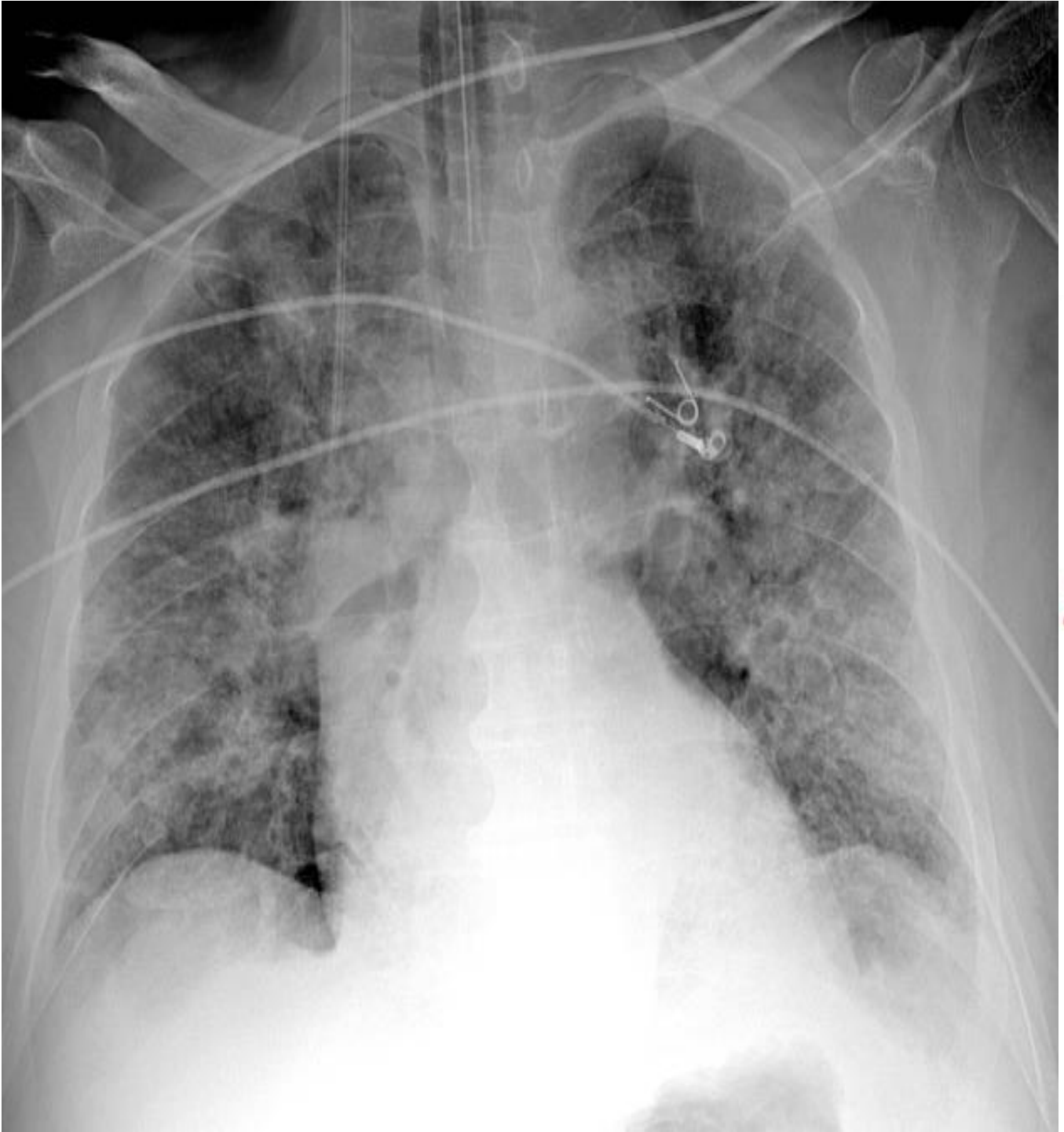
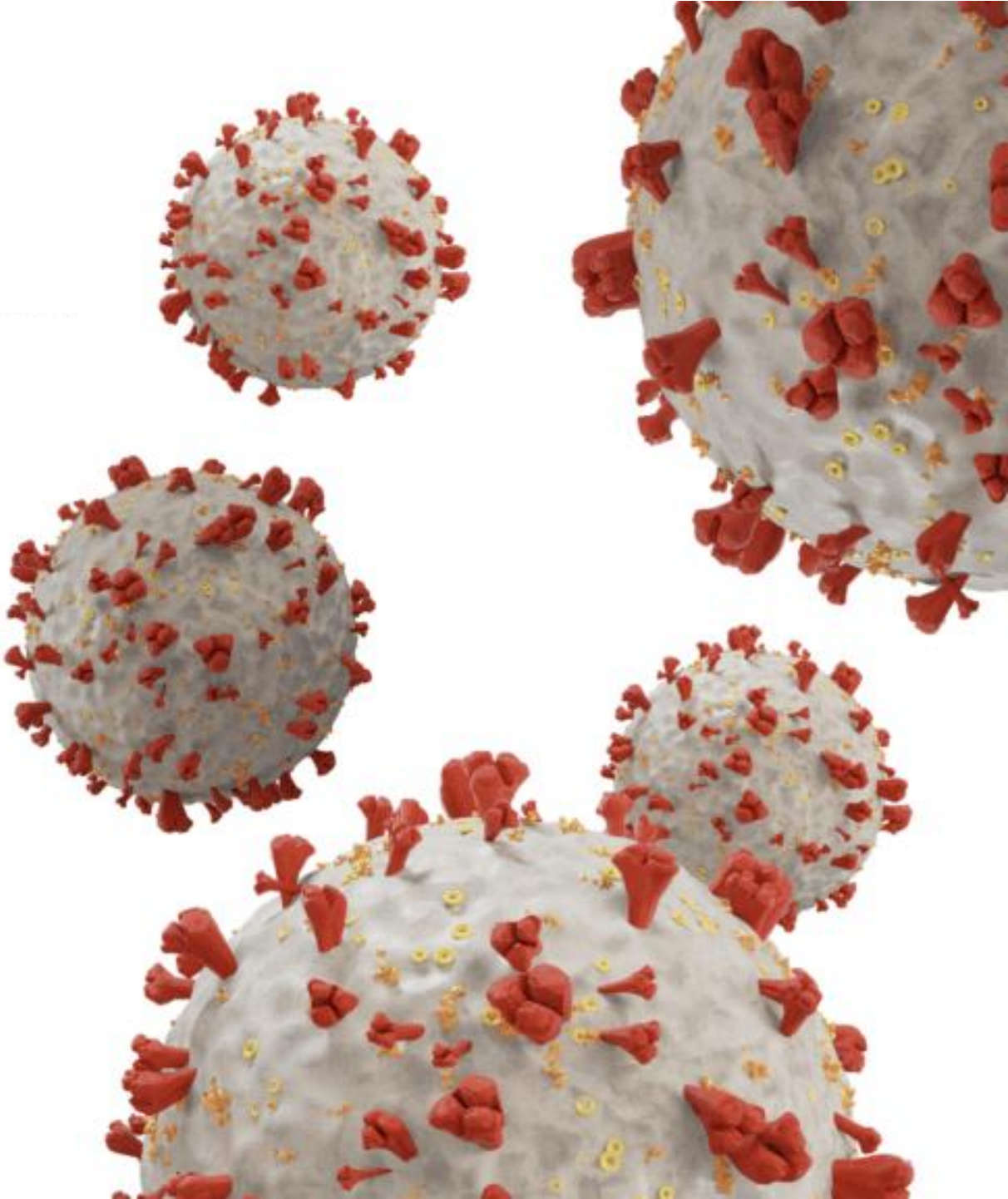
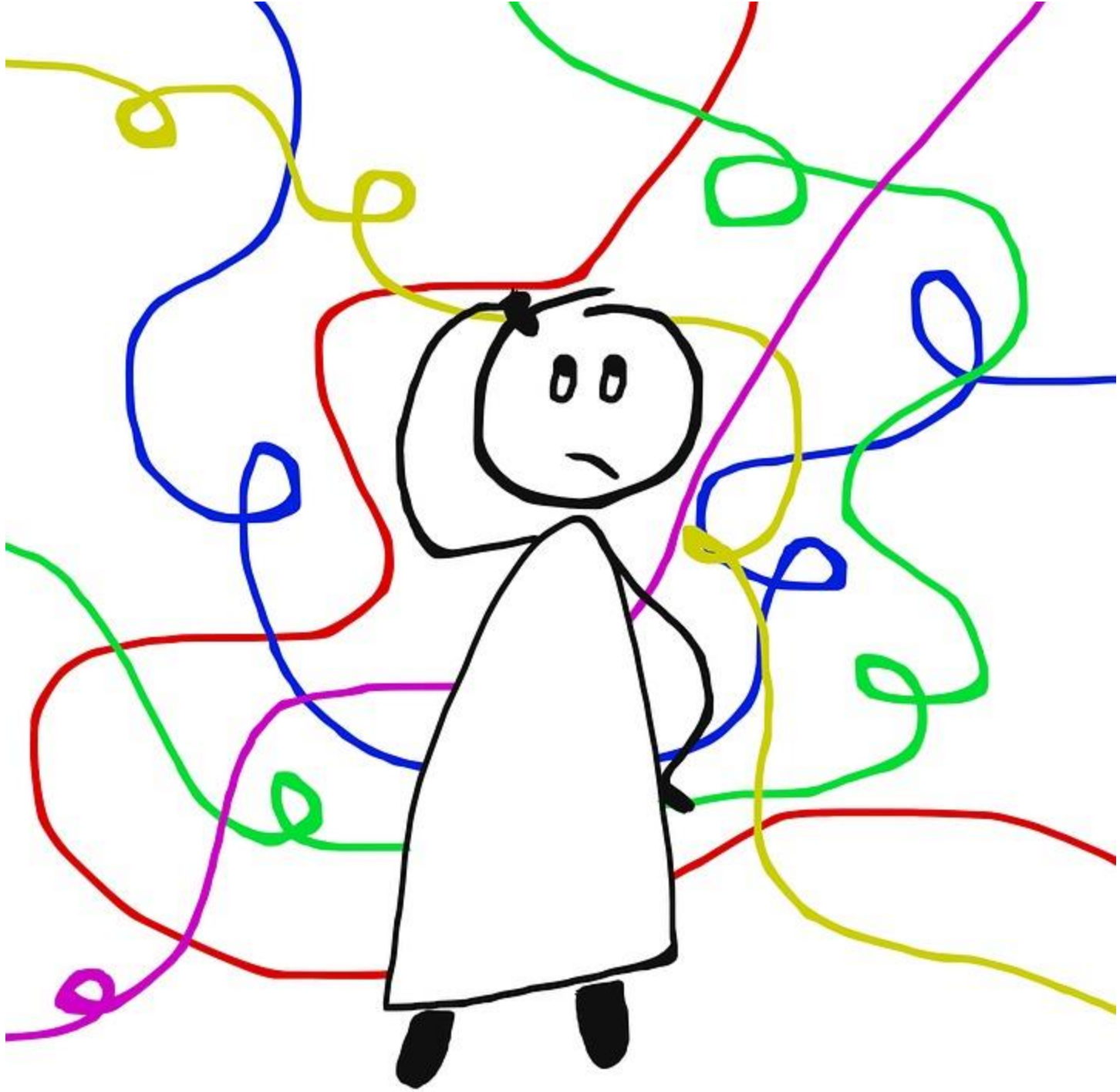
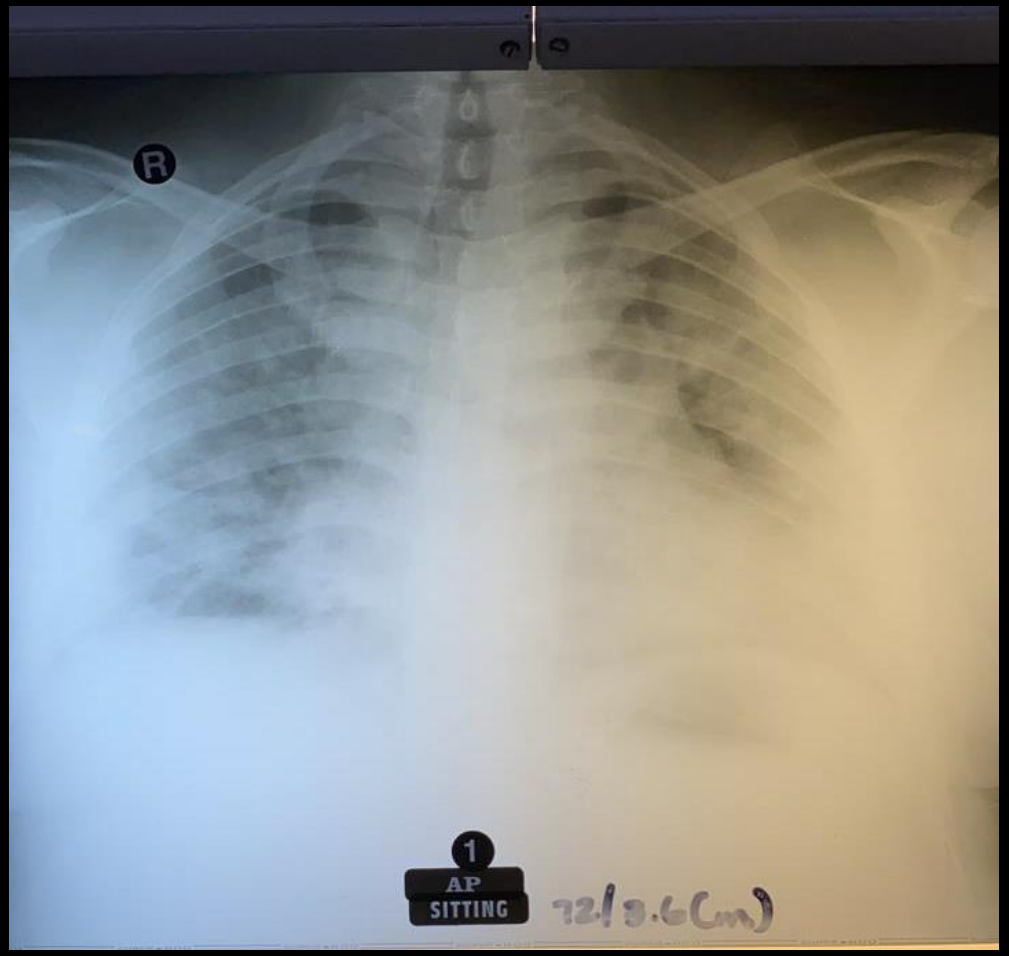




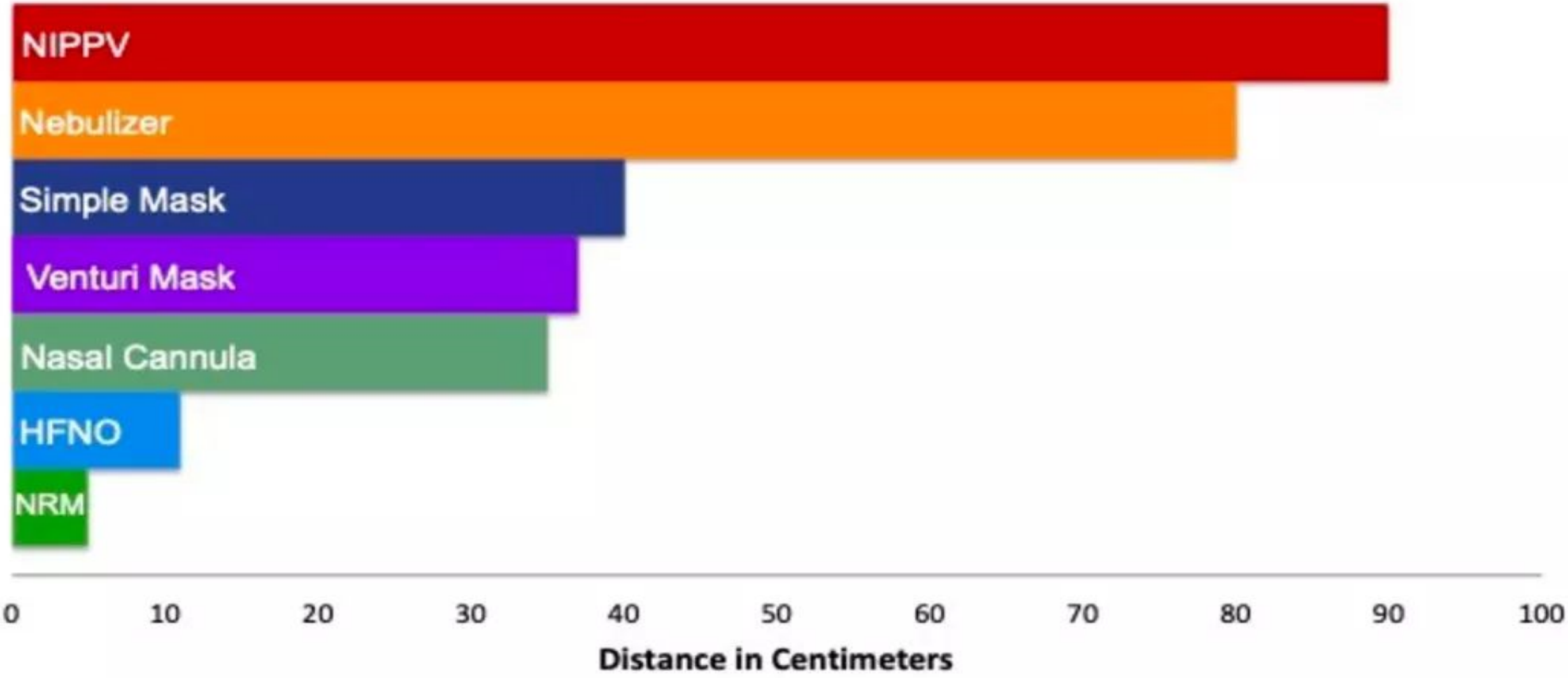

No plan survives first contact with the enemy. What matters is how quickly the leader is able to adapt.
~ Tim Harford
WISEFAMOUSQUOTES.COM

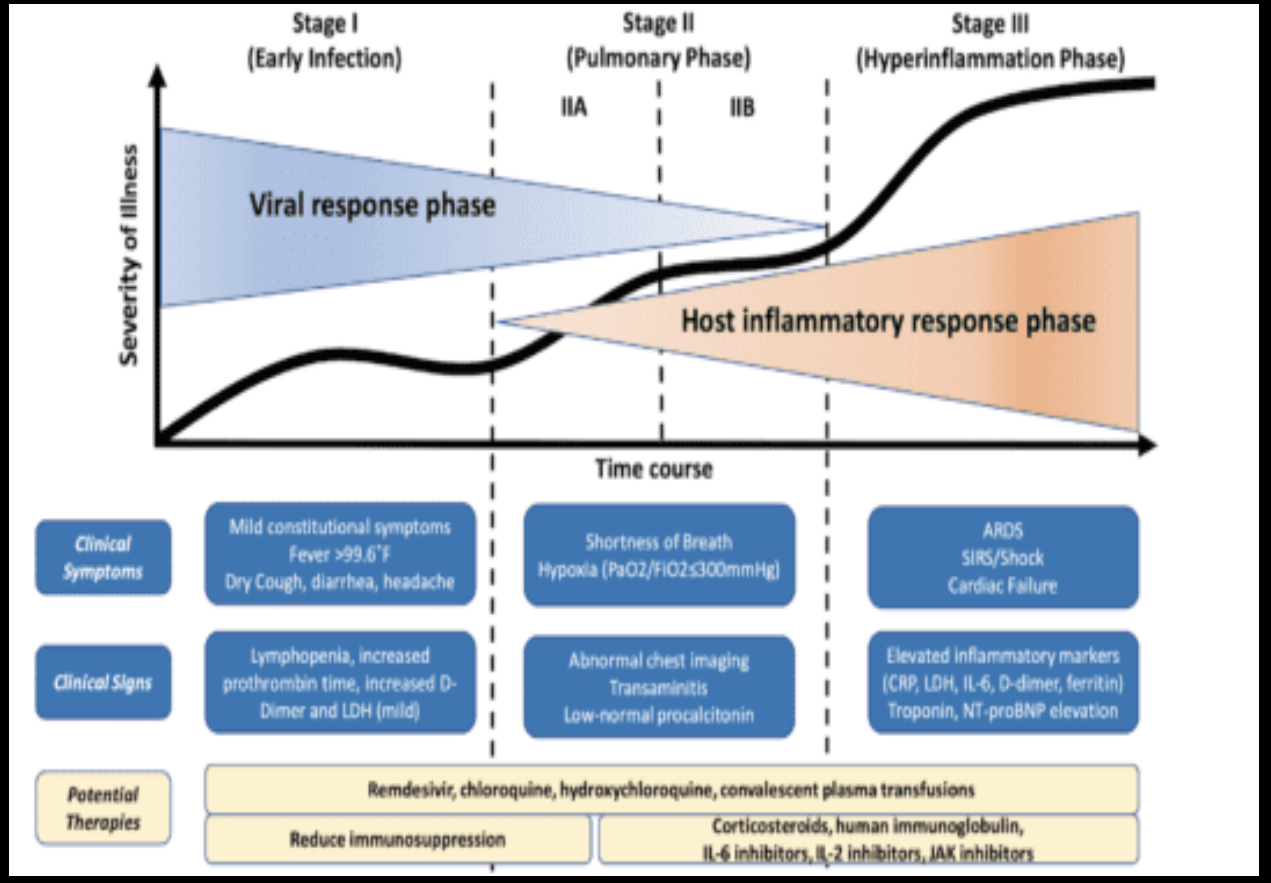



R
1
AP
SITTING
72/9.6(cm)


NIOSH
1860
N95
LOT B14300

Figure 1. Comparison of aerosol dispersion differences (cm) using various treatment modalities.




Stage I
(Early Infection)
Stage II
(Pulmonary Phase)
IIA
IIB
Stage III
(Hyperinflammation Phase)
Severity of Illness
Viral response phase
Host inflammatory response phase
Time course
Clinical Symptoms
Mild constitutional symptoms
Fever >99.6˚F
Dry Cough, diarrhea, headache
Shortness of Breath
Hypoxia (PaO2/FiO2≤300mmHg)
ARDS
SIRS/Shock
Cardiac Failure
Clinical Signs
Lymphopenia, increased prothrombin time, increased D-Dimer and LDH (mild)
Abnormal chest imaging
Transaminitis
Low-normal procalcitonin
Elevated inflammatory markers (CRP, LDH, IL-6, D-dimer, ferritin)
Troponin, NT-proBNP elevation
Potential Therapies
Remdesivir, chloroquine, hydroxychloroquine, convalescent plasma transfusions
Reduce immunosuppression
Corticosteroids, human immunoglobulin,
IL-6 inhibitors, IL-2 inhibitors, JAK inhibitors

#1: Risk stratification and disposition

- COVID is a humbling disease. Perhaps no aspect of the disease is more humbling than sorting out which patients require critical care versus less intensive care. Disposition is difficult for two main reasons:
- Patients commonly have a “silent hypoxemia” phenotype, which causes them to look far better than they actually are.
- COVID is a multi-phasic illness (including a viremic phase and a subsequent adaptive immunity phase). Patients are often clinically OK for several days during the viremic phase, before abruptly deteriorating.

Subtypes of COVID - 19

- Mild – flu like symptoms, anosmia – manage well as out patients
- Silent Hypoxemia (can cause iatrogenic injury when patients are intubated in this phase)
- Indolent- Fine then Not
- Hyperacute

COVID-19 + hypoxic vasoconstriction

mechanism to match perfusion to ventilation

constriction of small intrapulmonary arteries in response to alveolar hypoxia
(blood is diverted to better oxygenated lung)
global (e.g. high altitude pulmonary edema -HAPE)
or
focal (e.g. atelectasis, pneumonia)

why might hypoxic vasoconstriction explain COVID-19 “silent hypoxemia”

possible loss of lung perfusion regulation and hyperperfusion of gasless alveoli

what about HAPE treatments?

similarities exist as hypoxic vasoconstriction is one pathophysiologic basis for HAPE (although hypoxic vasoconstriction is present in other processes as well)
some have argued that treatments such as nifedipine, acetazolamide, and phosphodiesterase inhibitors warrant investigation but thus far, no trials and none registered on ClinicalTrials.gov.

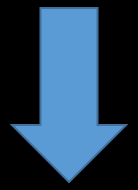
References:
Dunham-snary KJ. Chest. 2017;151(1):181-192.
SSolaimanzadeh. Cureus. 2020 Mar; 12(3): e7343.

@FOAMpodcast

COVID-19 underlying patho-physiology presentation of respiratory failure

COVID-19 appears to have several phases. Management should be guided by timing of the onset of symptoms to understand where in the trajectory of the disease the patient is.

- Early phase of respiratory failure primarily affects the vasculature. Pro-coagulation leading to micro-vascular pulmonary thrombosis has been observed. Lung compliance is generally good.
- Later respiratory failure can involve ARDS and bacterial pneumonia



Cytokine Storm
Haemophagocytic Lymphohistiocytosis (HLH) Overlap / DIC

Acute Respiratory Distress Syndrome
The Berlin Definition

Timing	< 1 Week – 'known clinical insult'
Chest Imaging	Bilateral opacities – not fully explained by effusions, lobar/lung collapse, or nodules
Origin of oedema	Respiratory failure not fully explained by cardiac failure/fluid overload (needs assessment – echo)
Oxygenation	with PEEP or CPAP > 5 cmH_2O
Mild	PaO_2/FiO_2 200-300 mmHg
Moderate	PaO_2/FiO_2 100-200 mmHg
Severe	PaO_2/FiO_2 < 100 mmHg

ARDS Task Force – JAMA , 2012

COVID-19 + ARDS

why is it not always "traditional" ARDS?*

- lung compliance (↓ in "traditional ARDS") is often normal, at least initially
- typical strategies for ARDS ventilation (↑PEEP, low FiO_2) may be associated with harm
- ↓ V/Q mismatching
- ↓ recruitability

*noting, of course, that ARDS is a syndrome with many causes, not a single entity

Gattinoni et al. AJRCCM. 2020 Mar 30. PMID: 32228035

can COVID-19 result in ARDS?

- yes, although many critical illnesses/infections can culminate with ARDS
- several studies show patients may have ↓ compliance, consistent with ARDS
- it's unclear if these are patients at one end of the spectrum of if there are different phenotypes

Bhatraju et al. NEJM 2020 Mar 30. PMID MID: 32227758

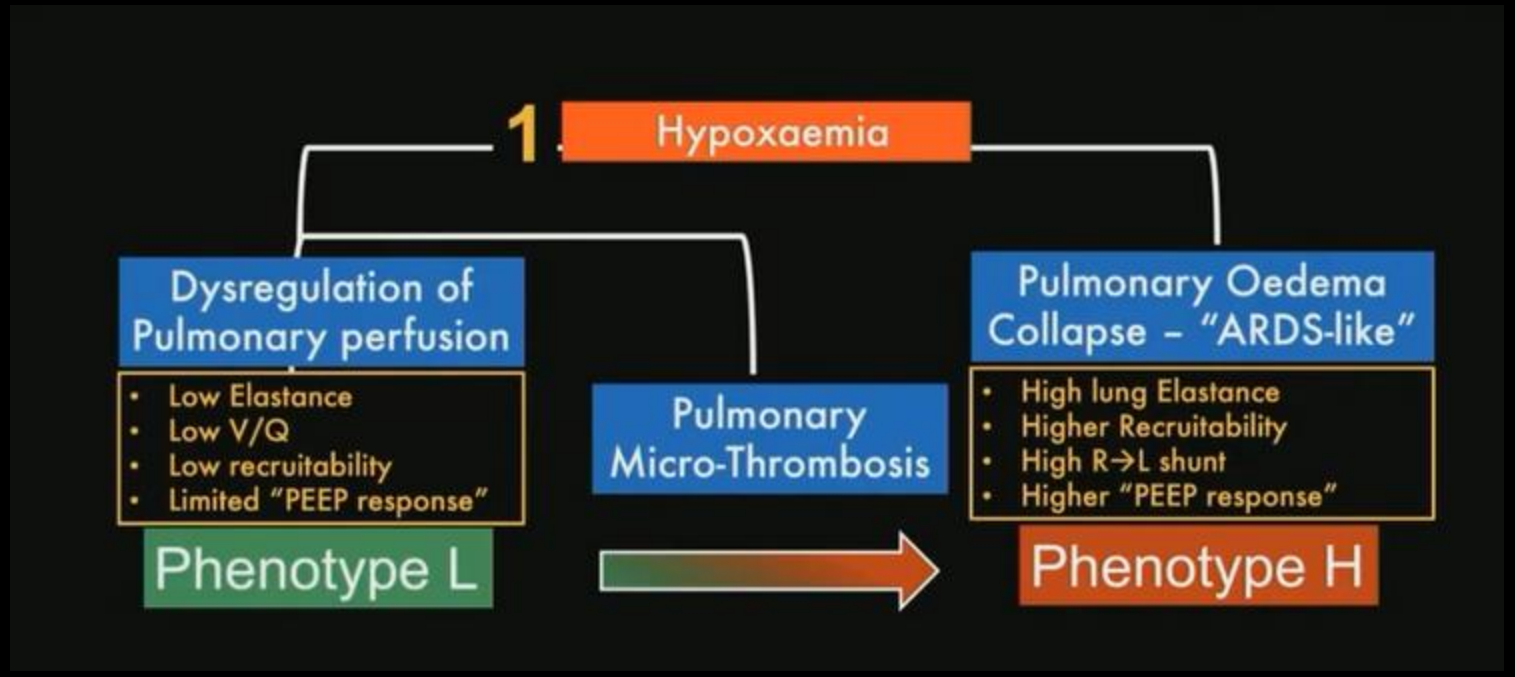
why may this matter?

- need to rethink reflexively applying "ARDS" treatments/vent settings

@FOAMpodcast

COVID 19 Pneumonitis may not be the same as ARDS

High compliance

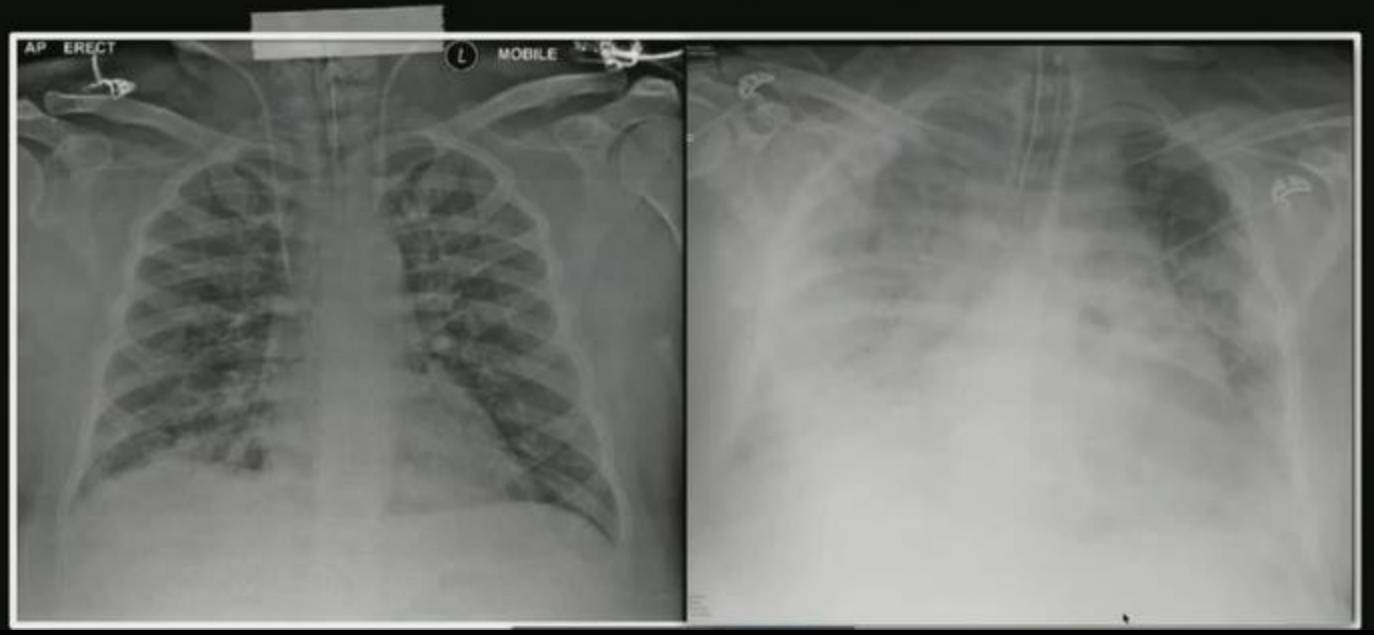


Compliance: volume change that can be achieved per unit pressure change

Elastance: reciprocal of compliance (ie Pressure change that is required to elicit a unit volume change(resistance to expand)

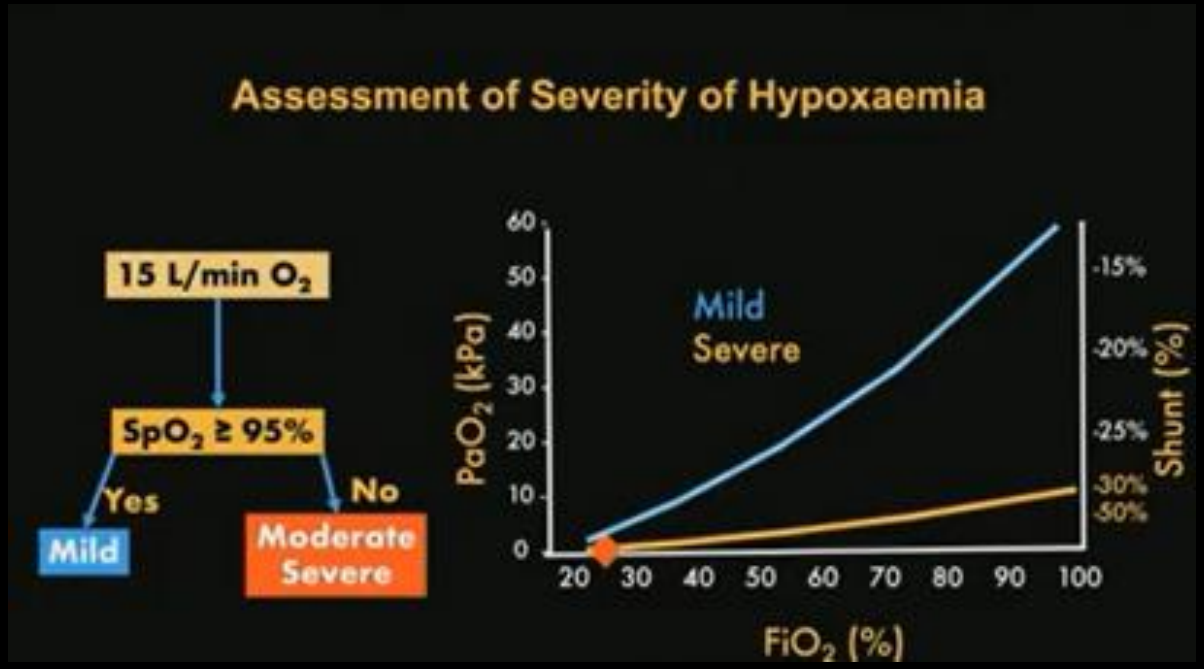
A

B



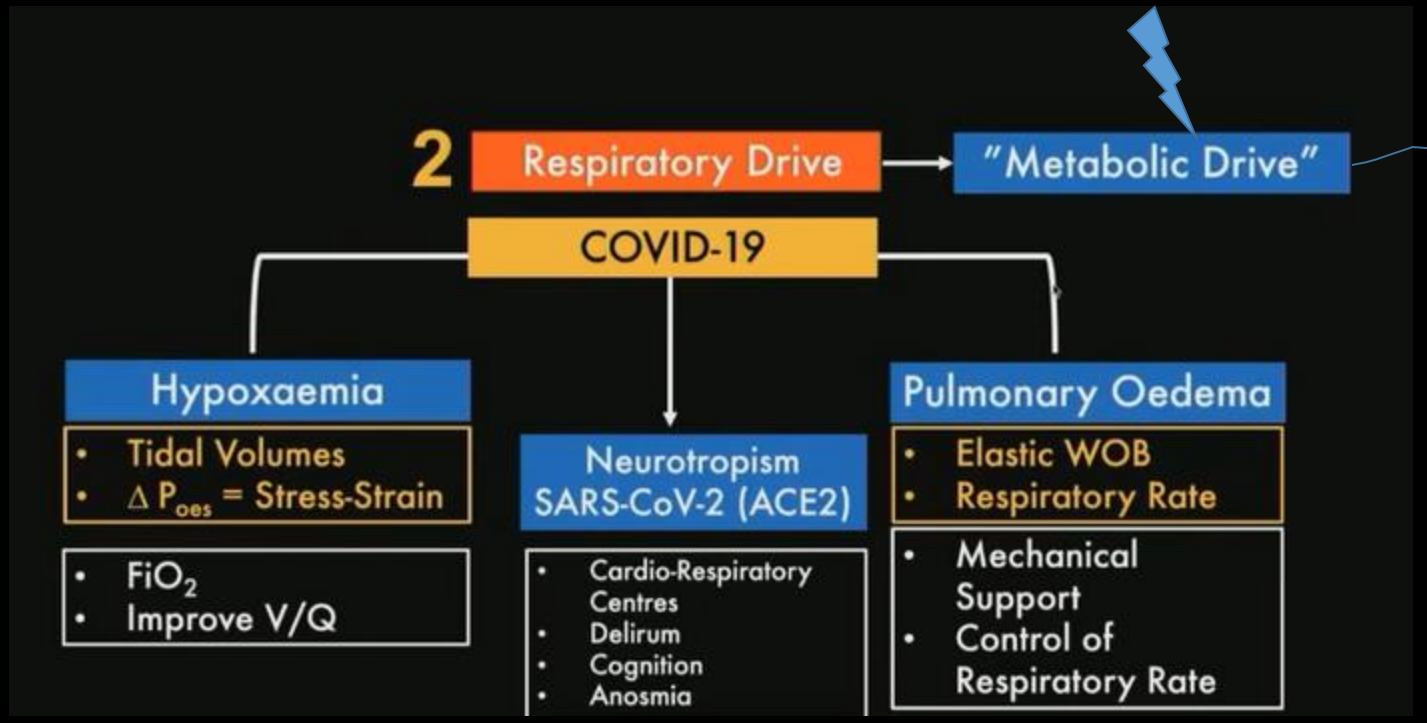
Type L

Type H



Poor response high shunt fraction (ie perfused not ventilated)
Thus may not be reversible with just oxygen

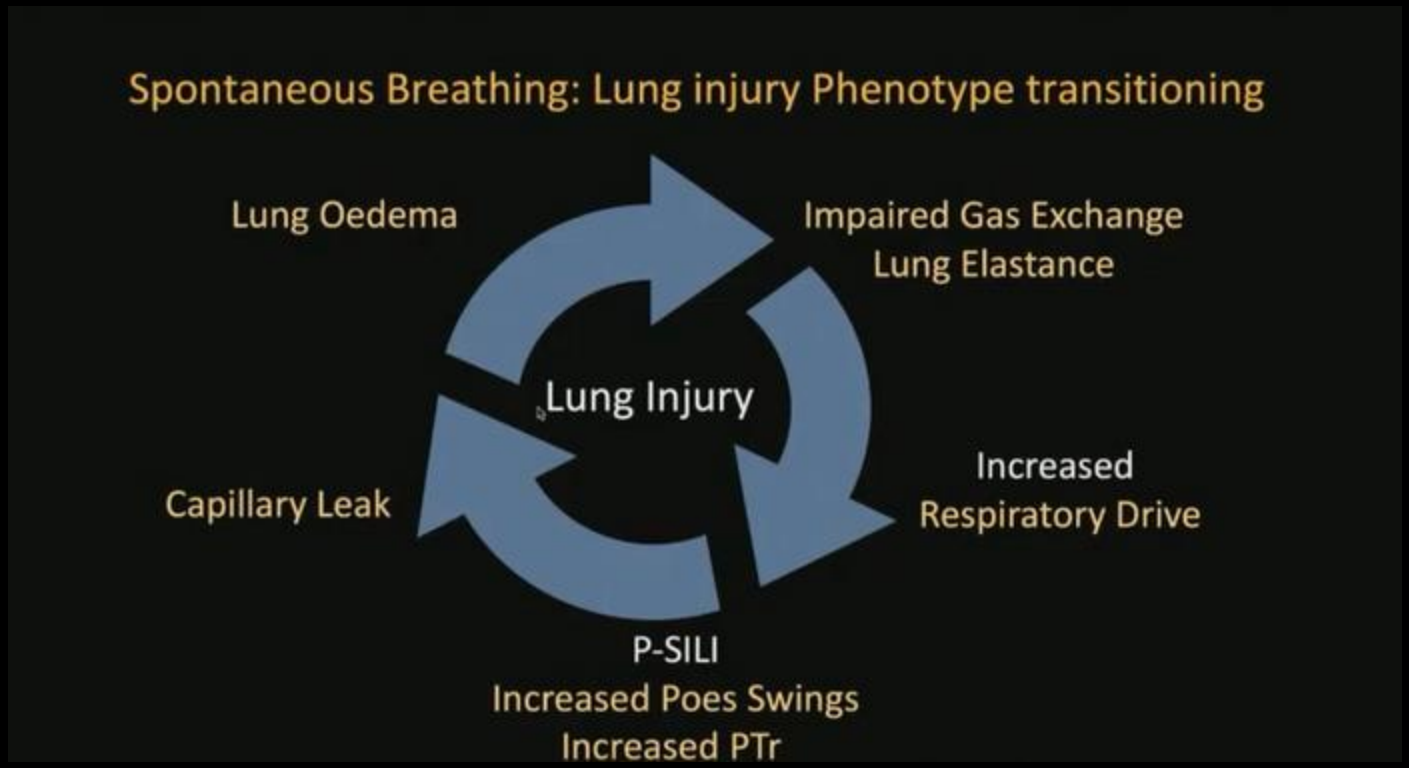
Febrile and Inflammatory response



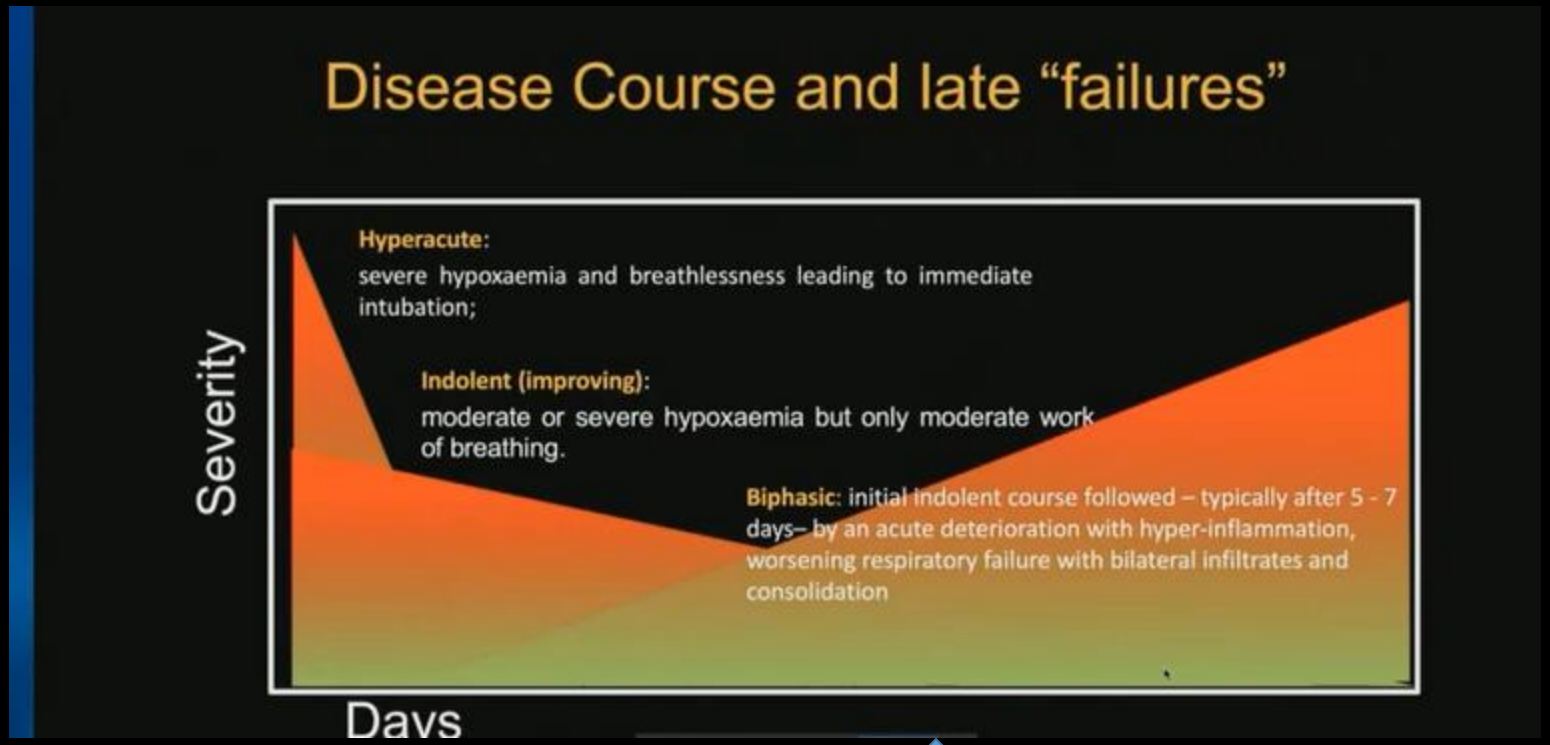
Oxygen consumption and demand

Perception of WOB

Spontaneous Breathing: Lung injury Phenotype transitioning



Disease Course and late “failures”



CRP, Ferritin

Avoidance of Intubation

- Tachypneoa, hypoxemia, do not seem to be indication

- Mental status, Increased Dyspneoa, $PaCO_2$ rising – better indicators

ROX Index

- ROX is defined as the ratio of oxygen saturation as measured by pulse oximetry (SpO2) divided by the fraction of inspired oxygen (FiO2) in relation to the respiratory rate ((SpO2/FiO2)/RR

- A ROX index ≥4.88 associated with a lower risk for intubation.

TRIAGE

HYPOXIC SpO_2<90%

LIKELY OR KNOWN COVID? → N → **RESUS 1-2**

Y

UNSTABLE / CRASHING? → Y → **RESUS 4**

N

- NASAL PRONG OXYGEN 4L/MIN + SURGICAL MASK ON PATIENT
- SENIOR DR REVIEW

RESUS

RESPIRATORY ASSESSMENT POD

SIGNIFICANT INCREASED WORK OF BREATHING?

Chest discomfort & pleuritic pain may result in fast shallow breaths without other features. The patient may otherwise appear abnormally comfortable for their degree of hypoxia

Y

NEGATIVE PRESSURE ROOM

- CLINICAL EVALUATION, CXR, POCUS
- INCREASE FiO_2
- ASSESS PRONING RESPONSIVENESS IF TOLERATED
- D/W ICU
- *CONSIDER* HIGH FLOW NASAL CANNULA WITH SURGICAL MASK OVER CANNULA (STAFF IN FULL PPE / N95)

TYPE H 😨

Significant dyspnoea may represent a more advanced stage of lung injury and greater need for invasive ventilation

N

- CLINICAL EVALUATION, CXR, POCUS
- ASSESS PRONING RESPONSIVENESS
- CONSIDER INCREASE FiO_2

TYPE L 🙂

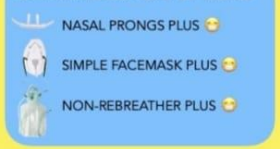
Hypoxia partly due to abnormalities in pulmonary blood flow, which may respond to changes in patient positioning. Because the lungs are not severely affected, the patient does not feel as breathless

⚠ PATIENTS MAY PROGRESS TO TYPE H NEED FREQUENT MEDICAL REVIEW ⚠

PRONING

- PATIENT ALERT, COOPERATIVE, ABLE TO TURN THEMSELVES
- REMOVE ECG LEADS BEFORE TURNING
- CAUTION WITH IV LINES, IDC, ETC
- DOCUMENT ANY CHANGE IN RR AND SPO2
- PATIENT CAN ALSO TRY LYING ON EITHER SIDE

OXYGEN DELIVERY OPTIONS



- NASAL PRONGS PLUS 😎
- SIMPLE FACEMASK PLUS 😎
- NON-REBREATHER PLUS 😎

COVID-19

GRADED RESPİRATORY SUPPORT

Nasal Cannula (NC) 5L/min

|

Nonrebreather (NRB) 15L/min

|

High flow nasal cannula (HFNC)

|

CPAP

|

Endotracheal intubation

Level C evidence

RESPIRONICS

Awake proning

COVID-19 awake proning

Prone position ventilation

Proposed mechanisms for prone positioning

Induces homogeneous compliance across the chest wall – Anterior chest wall – Weight of mediastinum – Improved displacement of abdomen contents

Better recruitment of posterior/dependent lung zone

May lead to an alteration of blood flow and better ventilation/perfusion matching

Improved drainage effect on respiratory secretions

Reducing ventral-dorsal transpulmonary pressure difference

Reduced lung compression

Improved lung perfusion

“At this point, I'm happier w/ lower sats (low to mid 80s) and focused on work of breathing + mental status as triggers for intubation”

Patient Selection

- IS the pathology reversible? (the current state)
- Is the patient able to recover?
- Frailty scale?
- Co-morbidities and end organ dysfunction
- Gestalt based on years of experience

Management of Respiratory Failure

Suspected or Confirmed COVID-19

Severity

Phenotype Screen

Failure and Escalation

Respiratory Failure
SpO_2/FiO_2 <300
Bilateral infiltrates on CXR or USS

Conventional Oxygen Therapy (COT)
O_2 Flow 0-15 L/min

Targets:
- SpO_2 88-92%
- RR < 30/min

No

No Ceiling of Escalation

Optional Trial Pending intubation
(Single trial) CPAP with Hood 10 cmH_2O, FiO_2 0.6 – Assess Work of Breathing

Targets:
- SpO_2 88-92%
- PaO_2 ≥ 8 kPa
- $PaCO_2$ < 6 or pH > 7.30
- P_{plat} ≤ 28 cmH_2O

Intubation + MV (bleep 0153)
Volume Control ventilation
- Tidal Volume 8 mL/Kg PBW
- PEEP 8 cmH_2O
- RR – initially to $ETCO_2$ 4-5 kPa

If not shocked at presentation
Low dose vasoconstrictors – minimise fluids

Driving Pressure (ΔP) <14 cmH_2O

No

Reduce Vt to 6 mL/Kg PBW

Yes

Keep Vt at 8 mL/Kg PBW

SpO_2 ≤ 92% with FiO_2 > 0.6

Targets:
- SpO_2 88-92%
- PaO_2 ≥ 8 kPa
- $PaCO_2$ < 6 or pH > 7.30
- P_{plat} ≤ 30 cmH_2O
- ΔP ≤ 15 cmH_2O

Neuro-Muscular Blockade
Increase PEEP in 2 cmH_2O steps up to 15 cmH_2O

SpO_2 ≤ 92% with FiO_2 > 0.6-0.7

Obtain Echo As soon as feasible

Compliance ≥ 40 mL/cm_2O

No

Aim to Switch to: APRV (Call for advice)
Initial settings:
P_{high} 26-28 cmH_2O; P_{low} 0 cmH_2O; T_{high} 5 s; T_{low} 0.5 s; Slope 0

Aim to Combine
If targets not achieved

Yes

First Strategy
Prone Position
Same ventilatory Settings as above

Hypoxaemia refractory to prone position or APRV for ≥ 6 hours (or sooner if life-threatening)

Discuss with ECMO Consultant
ECMO candidate?

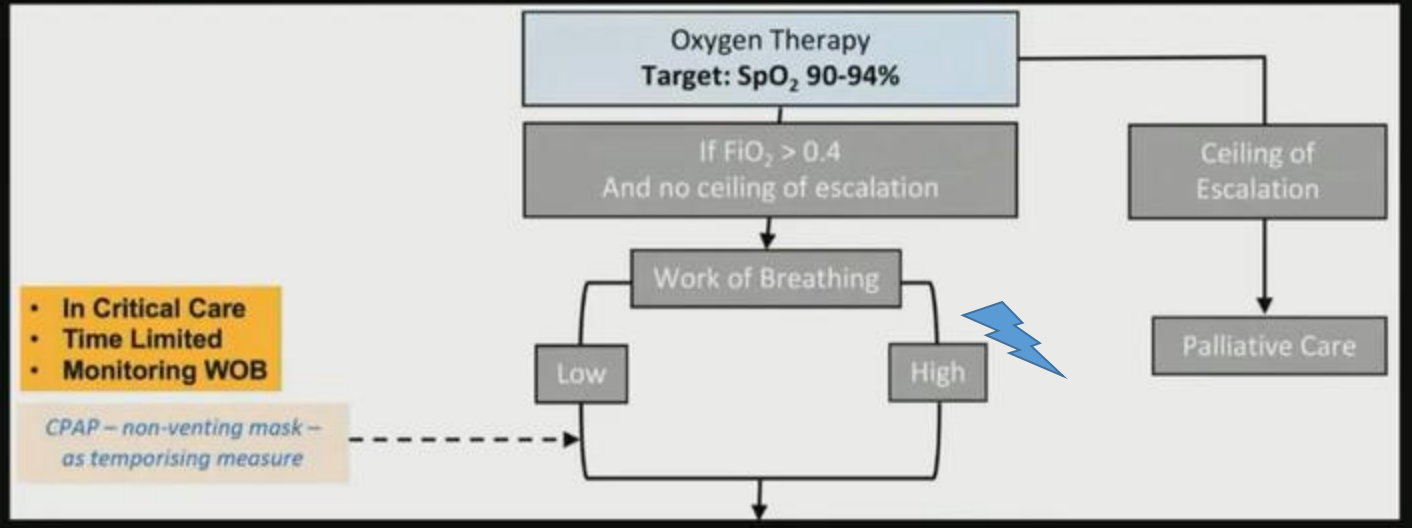
No

Review Targets and Strategy

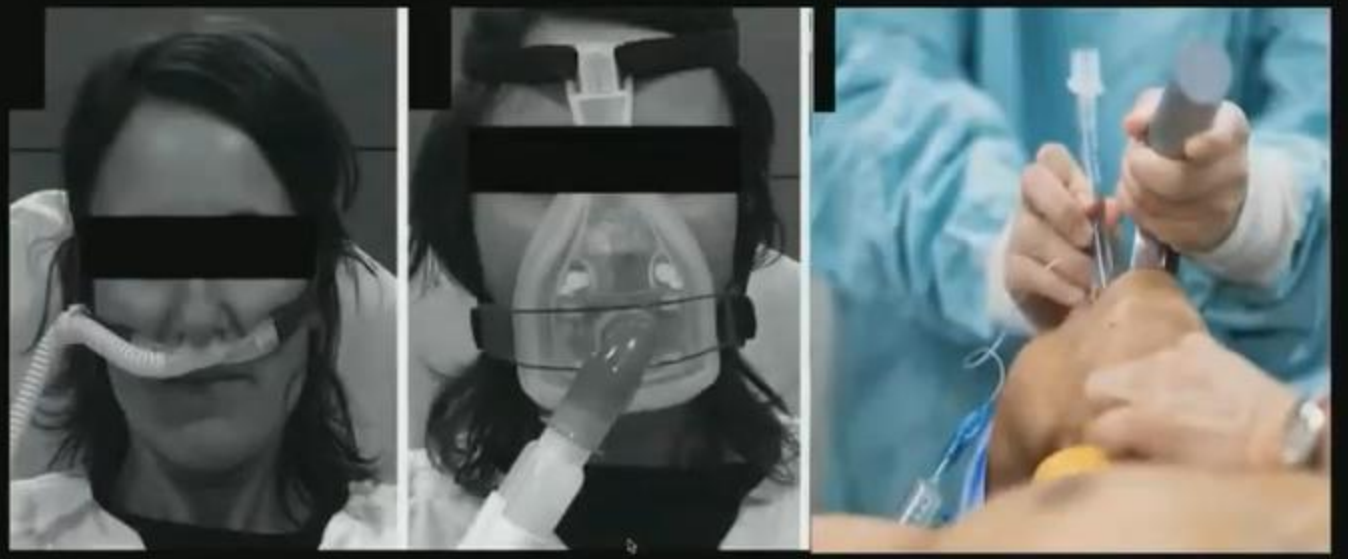
Yes

VV-ECMO

Management of Respiratory Failure (COVID-19): 'Non-Invasive assessment'



HFNC, NIV, CPAP...intubate?



Considerations

1 – Infection Control

2- Support Required

WOB
Failure rate
Hypoxaemia
Tolerance
Control of TPP

3- Duration of Disease

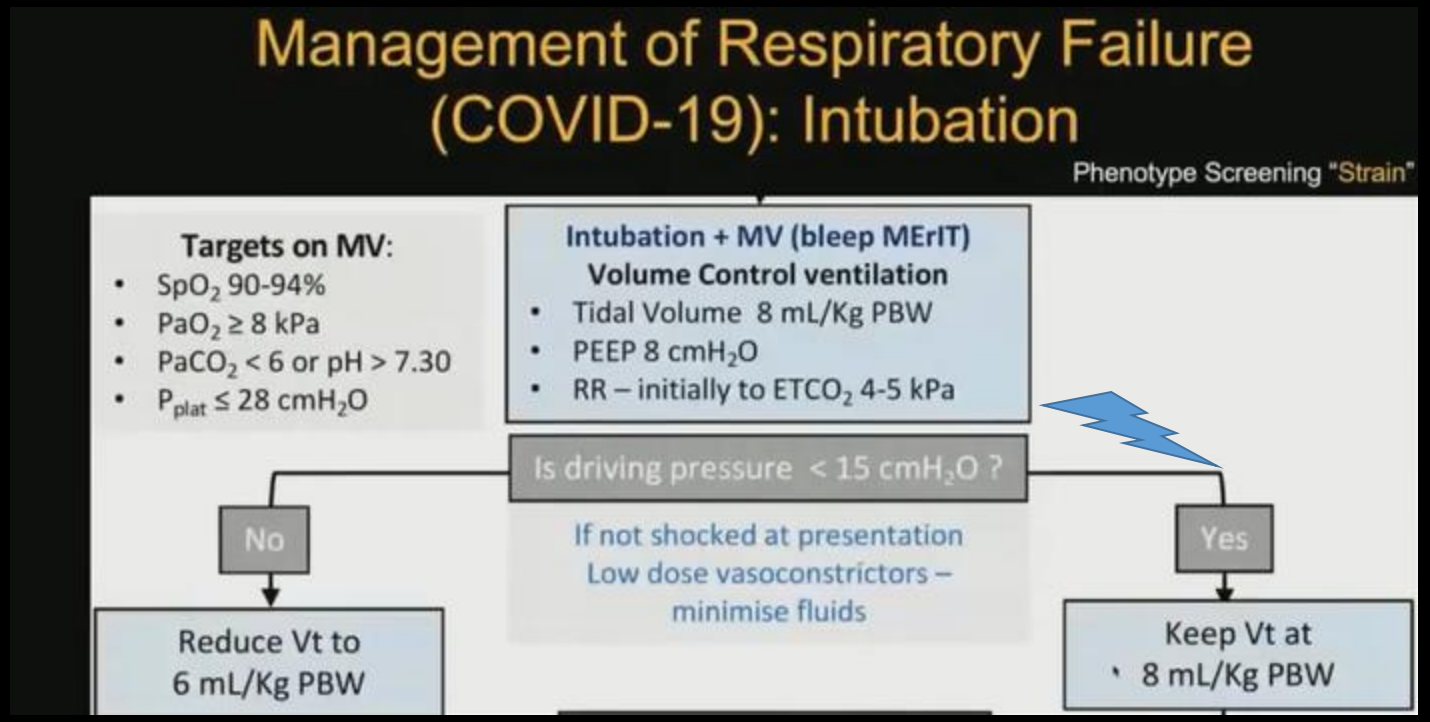
4- Resources

ICU beds
Staffing
Ventilators
Oxygen

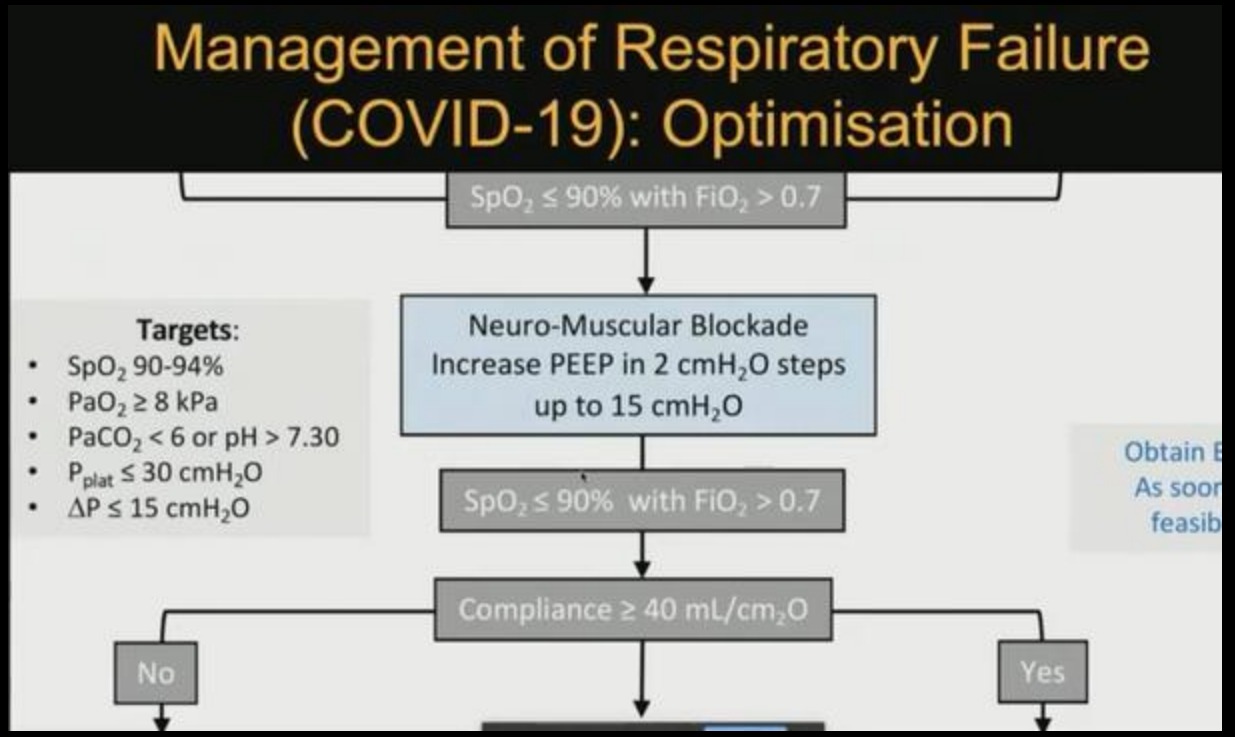
NIV

- De novo resp failure - greater risk of NIV failure
- Higher rate of Intubations
- Higher Tidal volumes may lead to VILI
- When this intubation is done – often delayed and too late in the clinical course
- Higher ICU mortality

Management of Respiratory Failure (COVID-19): Intubation



TV/ (P plat- Peep)



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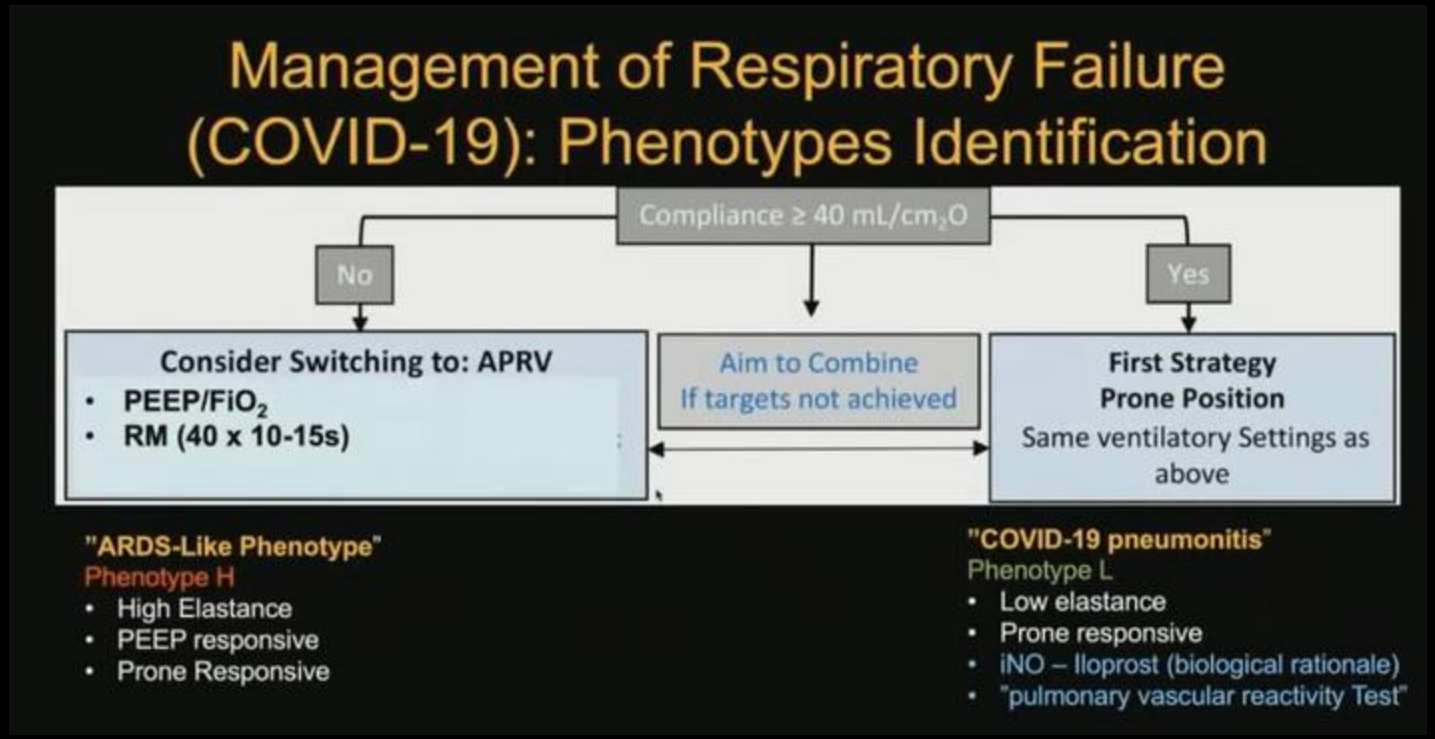


Management of Respiratory Failure (COVID-19): Failure & Escalation

Hypoxaemia refractory to prone position or APRV for ≥ 6 hours (or sooner if life-threatening)

Discuss with ECMO Consultant
ECMO candidate?

No

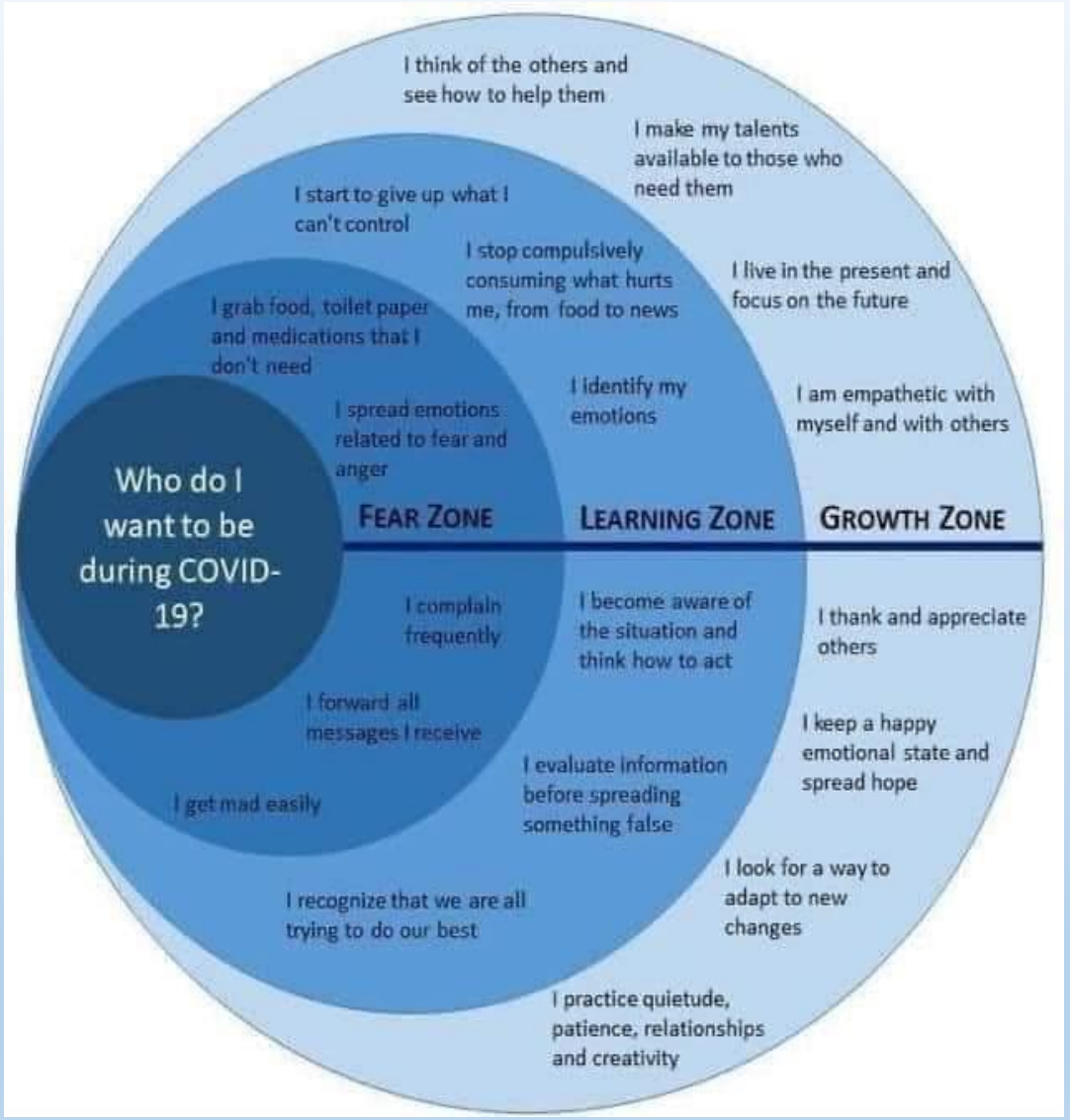
Review Targets and Strategy

Yes

VV-ECMO

Summary

- Early recognition of hyper-acute disease: need for immediate intubation and high risk of cardiovascular events;
- Short and judicious use of CPAP/NIV for haemodynamically stable patients with moderate hypoxaemia; low respiratory drive and low inflammatory phenotype. Beware of biphasic course
- Early differentiation of L Phenotype (preserved compliance, dysregulated pulmonary perfusion). Do not use high PEEP or PEEP/FiO_2 scales . This is not ARDS!


I think of the others and see how to help them
I make my talents available to those who need them
I start to give up what I can't control
I stop compulsively consuming what hurts me, from food to news
I live in the present and focus on the future
I grab food, toilet paper and medications that I don't need
I identify my emotions
I am empathetic with myself and with others
I spread emotions related to fear and anger
Who do I want to be during COVID-19?
FEAR ZONE
LEARNING ZONE
GROWTH ZONE
I complain frequently
I become aware of the situation and think how to act
I thank and appreciate others
I forward all messages I receive
I keep a happy emotional state and spread hope
I evaluate information before spreading something false
I get mad easily
I look for a way to adapt to new changes
I recognize that we are all trying to do our best
I practice quietude, patience, relationships and creativity