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Morning Brief : Scientific Review

11 April 2020

The purpose of the Morning Brief is to **summarize** and present key information, research articles and other relevant publications pertaining to critical care and COVID-19. We aim to prioritise information, articles and publications released in the preceding 24-48hours.

Stellenbosch University Research Response Team

STELLENBOSCH UNIVERSITY PULMONOLOGY

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Statistics updates back on Monday

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Content of the brief

COVID-19: Not just typical ARDS

1. Gattinoni *et al*. COVID-19 does not lead to a typical Acute Respiratory Distress Syndrome. AJRCCM online first 30 March 2020. Available at DOI: 10.1164/rccm.202003-0817LE
2. Gattinoni *et al*. COVID-19 pneumonia: different respiratory treatment for different phenotypes? (2020) Intensive Care Medicine. DOI: 10.1007/s00134-020-06033-2

Covid-19 Does Not Lead to a "Typical" Acute Respiratory Distress Syndrome

Luciano Gattinoni[1], Silvia Coppola[2], Massimo Cressoni[3], Mattia Busana[1], Davide Chiumello[2]

- The typical current clinical approach to ventilating patients with severe COVID-19 pneumonia is the same as for severe ARDS, with high PEEP and prone positioning.
- Gattinoni *et al.* report an observation in their first 16 patients with severe COVID-19 which raises concerns about this approach
- A DISSOCIATION between the lung compliance and the shunt fraction severity
- In severe ARDS the lung compliance is usually reduced, as is the shunt fraction
- Their patients had a relatively preserved compliance with a reduced shunt fraction
- **IMPLICATIONs: COVID-19 patients had a well-preserved lung gas volume**

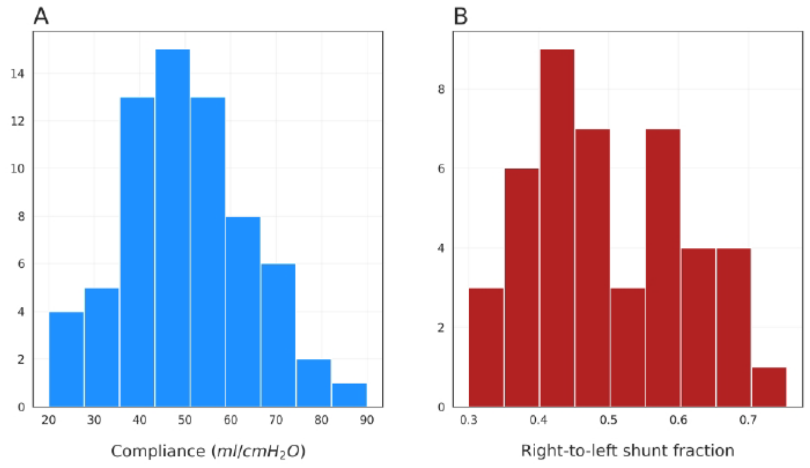

Figure 1

A link to the explanation of the shunt fraction:
https://derangedphysiology.com/main/cicm-primary-exam/required-reading/respiratory-system/Chapter%20081/concepts-venous-admixture-and-shunt

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- They also performed CT chest in order to compare the ratio of shunt fraction to fraction of gasless tissue
- In usual ARDS this ratio is variable, with a mean of 1.25
- In the 8 patients that Gattioni *et al* scanned, the ratio was 3 – HIGH
- This implies **hyper**perfusion of gasless tissue (which is supposed to be hypoperfused due to reflex hypoxic vasoconstriction)
- This suggests that when these patients respond positively to high PEEP and proning, this is not likely to be due to recruitment of lung tissue but rather due to redistribution of perfusion in response to pressure and gravity changes

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Therefore they suggest:

1. Patients treated with Continuous Positive Airway Pressure or Non Invasive Ventilation, presenting with clinical signs of excessive inspiratory efforts, intubation should be prioritized to avoid excessive intrathoracic negative pressures and self-inflicted lung Injury

2. High PEEP in a poorly recruitable lung tends to result in severe hemodynamic impairment and fluid retention;

3. Prone positioning of patients with relatively high compliance results in a modest benefit at the price of a high demand for stressed human resources.

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Intensive Care Medicine

EDITORIAL Un-edited accepted proof

COVID-19 pneumonia: different respiratory treatment for different phenotypes?

L. Gattinoni[1], D. Chiumello[2], P. Caironi[3], M. Busana[1], F. Romitti[1], L. Brazzi[4], L. Camporota[5]

- The authors report that of 150 ventilated patients with severe COVID-19 pneumonia, >50% retained near normal lung compliance despite severe hypoxaemia (as described in the 16 patients in the previous article)
- They and other colleagues have noted heterogeneity in presentation, physiological abnormalities and response to interventions
- They propose a "time-related disease spectrum within two primary phenotypes":
  - COVID-19 pneumonia type L
  - COVID-19 pneumonia type H

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Type L

- Early in presentation
- **Low** elastance (nearly normal compliance) and normal lung gas volume
- **Low** ventilation/perfusion ratio and loss of hypoxic vasocontstriction
- **Low** lung weight (related to the amount of fluid in the lungs), and only minor ground glass opacities on the CT
- **Low** lung recruitability (because the lungs are mostly well-aerated)

Type H

(These patients meet the diagnostic criteria for ARDS)

- Evolves later
- **High** elastance (and reduced compliance) due to lung oedema
- **High** right-to-left shunt due to perfusion of oedematous lung regions
- **High** lung weight, lungs look more like typical ARDS on CT
- **High** lung recruitability

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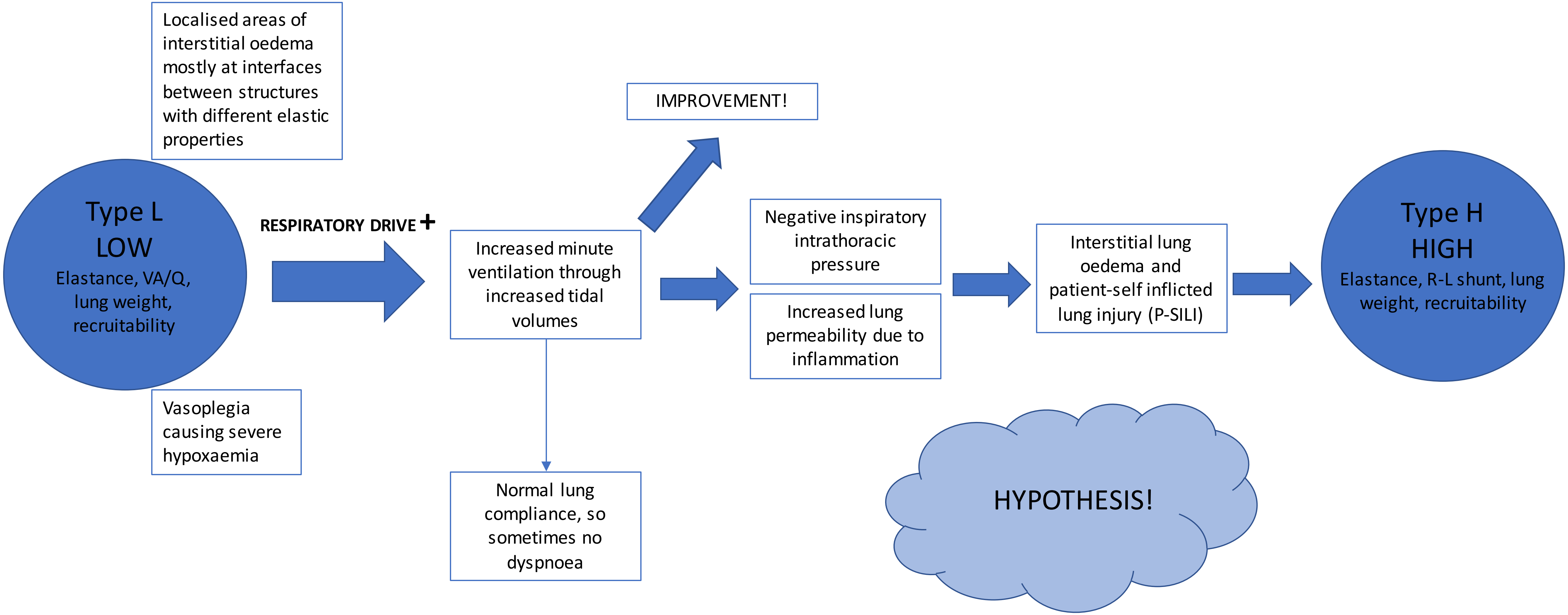

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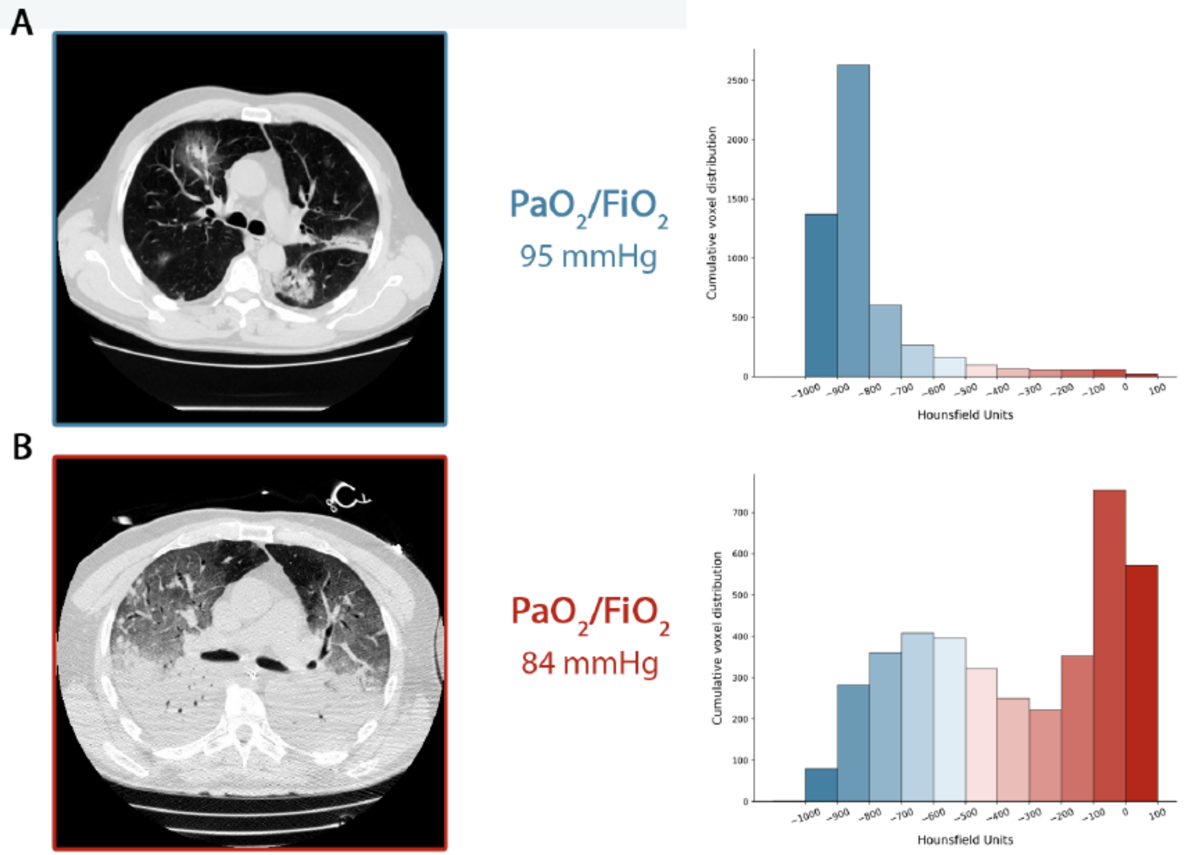
Figure 1



Panel A: CT scan acquired during spontaneous breathing. The cumulative distribution of the CT number is shifted to the left (well aerated compartments), being the 0 to -100 HU compartment, the non-aerated tissue virtually 0. Indeed, the total lung tissue weight was 1108 g, 7.8% of which was not aerated and the gas volume was 4228 ml. Patient receiving oxygen with Venturi mask, inspired oxygen fraction of 0.8.

Panel B: CT acquired during mechanical ventilation at end-expiratory pressure at 5 cmH_2O of PEEP. The cumulative distribution of the CT scan is shifted to the right (non-aerated compartments) while the left compartments are greatly reduced. Indeed, the total lung tissue weight was 2744 g, 54% of which was not aerated and the gas volume was 1360 ml. The patient was ventilated in Volume Controlled mode, 7.8 ml/kg of tidal volume, respiratory rate of 20 breaths per minute, inspired oxygen fraction of 0.7

The same patient early in disease evolution, and again later. Similar degree of hypoxaemia, markedly different amount of aerated lung.

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Suggestions for management:

Type L

- They respond to reversal of hypoxaemia, so turn up FiO2
- Monitor inspiratory pressure swings (via oesophageal manometry) or work of breathing (via CVP swing or other clinical method), or P0.1 or $P_{occlusion}$ if intubated.
- Large inspiratory pressure swings (to above $15cmH_2O$) increase the risk of lung injury, so these patients should be intubated sooner rather than later
- Once intubated and deeply sedated, these patients can be ventilated with slightly higher tidal volumes than usually recommended if required by hypercapnoea
- Prone positioning may not be helpful and should be a rescue manoeuvre only
- Keep PEEP low, 8 – 10 cmH_20
- Early intubation may stop the progression to Type H

Type H

- Treat as traditional severe ARDS

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This summary was prepared by
Dr Jane Shaw, pulmonologist, as part of the daily brief to the TBH ICU team