COVID ARDS : Mechanisms of Hypoxemia

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"This Is Not ARDS (TINA)"

People are saying this without appreciating Berlin definition

JAMA 2012


ONLINE FIRST

Acute Respiratory Distress Syndrome
The Berlin Definition

The ARDS Definition Task Force*

The acute respiratory distress syndrome (ARDS) was defined in 1994 by the

NYC hospitals presented different phenotypes locally

a) Vascular clot (giving heparin and lytics)
b) Mucus hypersecretion – bronching
c) Capillary leak – unclear
d) Alveolar flooding with high surface tension- recruitment
e) CHF from myocarditis


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COVID-19 Lung Injury is Not High Altitude Pulmonary Edema

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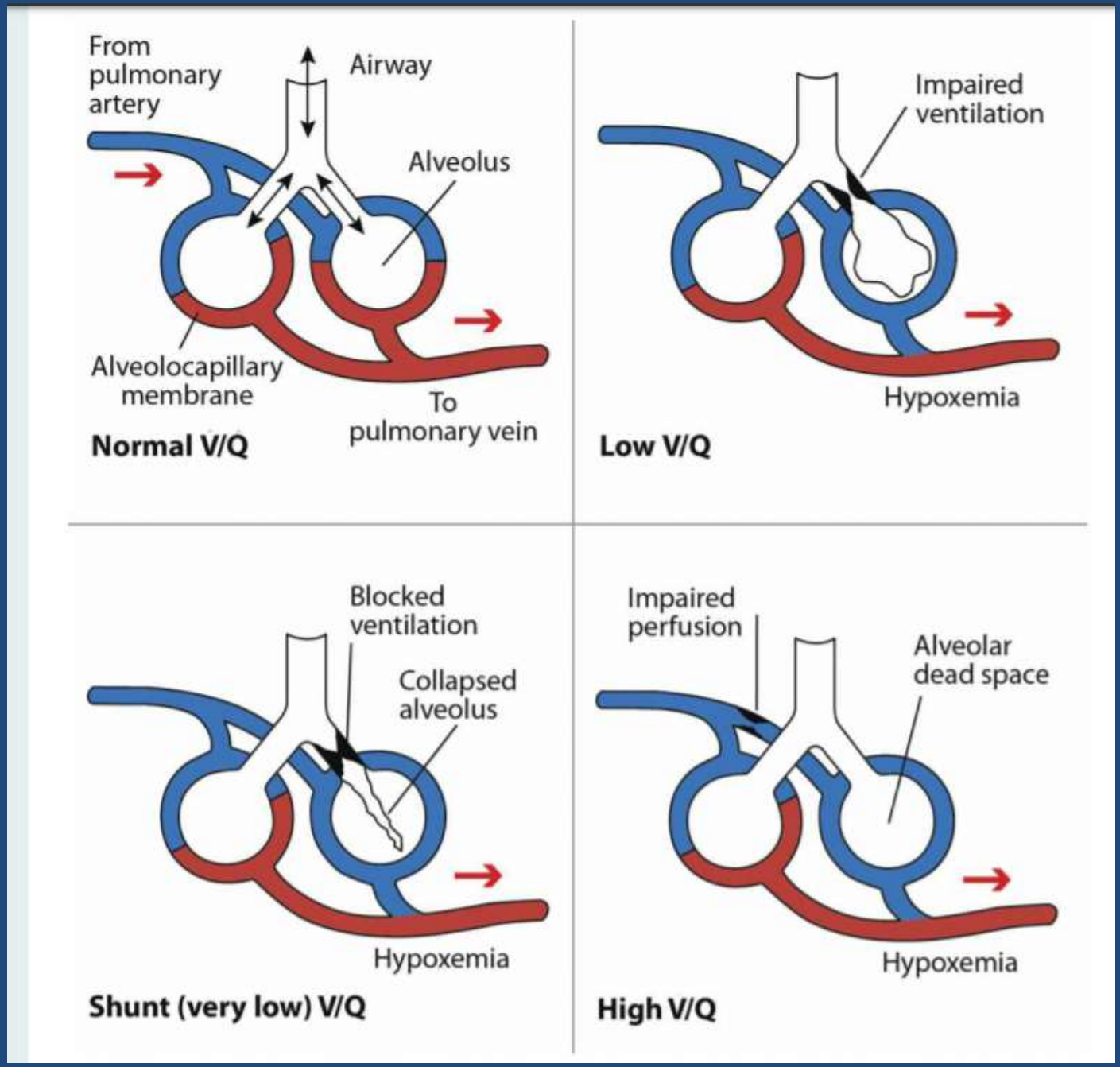
Take Home: Covid is variable as in typical ARDS
Abnormalities in gas exchange, control and mechanics

Causes of Hypoxemia in General

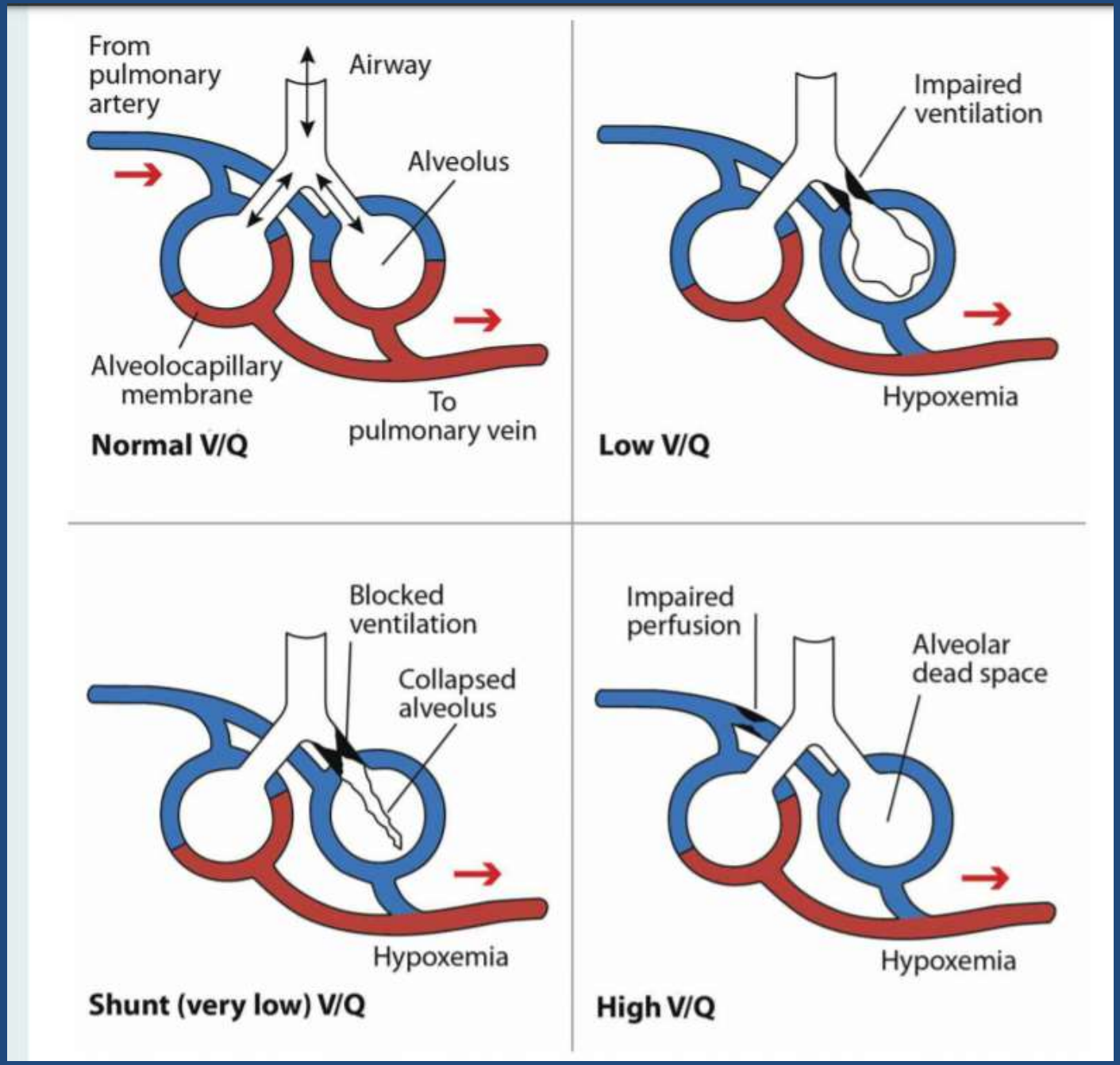
1. Low PiO2
2. Low V/Q
3. Shunt
4. Hypoventilation
5. Low mixed venous oxygen

Causes of Hypoxemia in COVID

1. Low PiO2
2. Low V/Q
3. Shunt
4. Hypoventilation
5. Low mixed venous oxygen



Google images



Low venous oxygen can lead to arterial hypoxemia when there is shunt

Overventilating one lung unit does not make up for underventilating another due to oxyHb curve

Google images

Gattinoni et al. AJRCCM 2020 COVID not typical ARDS ?

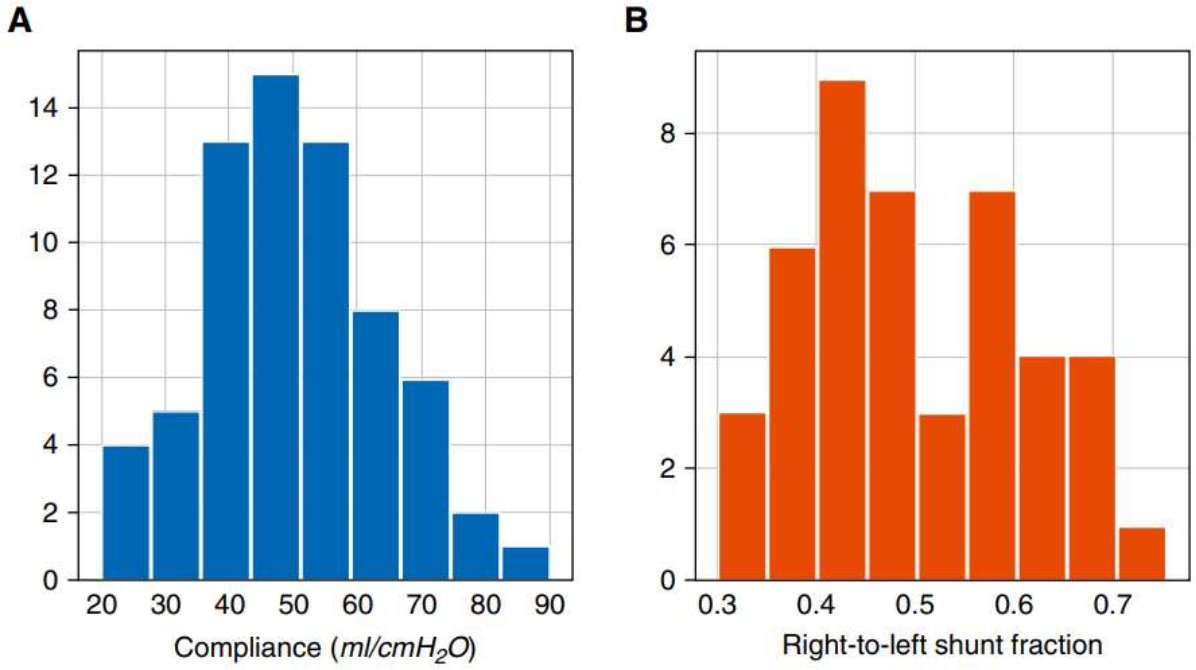


Figure 1. (*A*) Distributions of the observations of the compliance values observed in our cohort of patients. (*B*) Distributions of the observations of the right-to-left shunt values observed in our cohort of patients.

Note n's are different
Values not that different from other studies of early ARDS
Fair amount of shunt ? Amenable to PEEP or recruitment

Gattinoni et al. AJRCCM 2020 COVID not typical ARDS ?

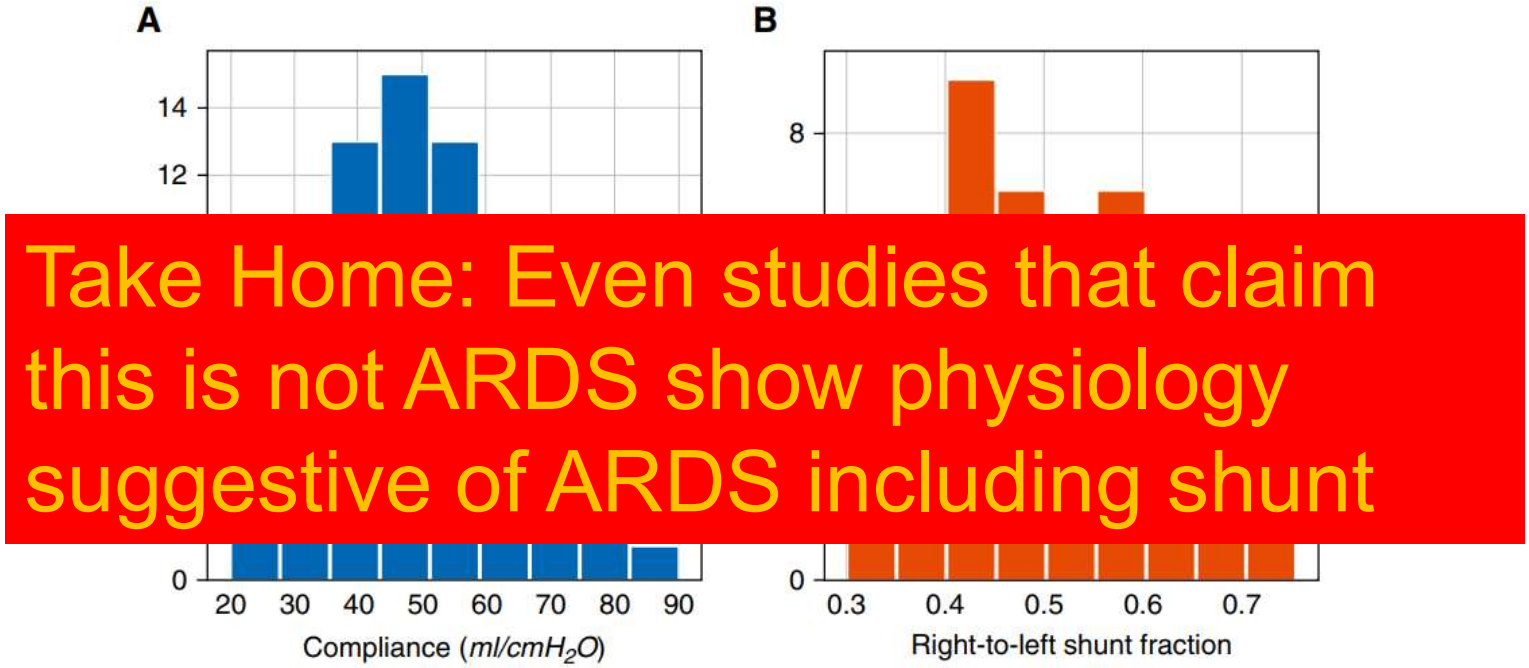


Figure 1. (*A*) Distributions of the observations of the compliance values observed in our cohort of patients. (*B*) Distributions of the observations of the right-to-left shunt values observed in our cohort of patients.

Take Home: Even studies that claim this is not ARDS show physiology suggestive of ARDS including shunt

Note n's are different
Values not that different from other studies of early ARDS
Fair amount of shunt ? Amenable to PEEP or recruitment

Respiratory Pathophysiology of Mechanically Ventilated Patients with COVID-19: A Cohort Study

To the Editor:

Respiratory parameters on intubation		
Bilateral infiltrates on chest X-ray	97%	64/66
Pa_{O_2}:FI_{O_2}, median (IQR)	182 (135–245)	65/66
Estimated physiological dead-space fraction, median (IQR)	0.45 (0.38–0.58)	65/66
Ventilatory ratio, median (IQR)	1.25 (1.06–1.44)	65/66
Ventilator parameters on intubation, median (IQR)		
Positive end-expiratory pressure, cm H_2O	10 (8–12)	66/66
Plateau pressure, cm H_2O	21 (19–26)	48/66
Driving pressure, cm H_2O	11 (9–12)	48/66
Static compliance, ml/cm H_2O	35 (30–43)	48/66
Resistance, cm H_2O/L/s	5 (4–7)	48/66

COVID physiology looks like typical ARDS
Early intubation practices may make COVID look less sick

Ziehr et al. AJRCCM 2020

What can we do about Hypoxemia in COVID ?

1. Adequate PEEP
   (watch CO, mixed venous O2, deadspace)
2. Recruitment maneuver
3. Prone positioning
4. ECMO ?
5. Inhaled NO or prostacyclin
6. Tolerate Hypoxemia ?? (no NEJM 2020)

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Liberal or Conservative Oxygen Therapy for Acute Respiratory Distress Syndrome

Loic Barrot, M.D., Pierre Asfar, M.D., Ph.D., Frederic Mauny, M.D., Ph.D., Hadrien Winiszewski, M.D., Florent Montini, M.D., Julio Badie, M.D., Jean-Pierre Quenot, M.D., Ph.D., Sebastien Pili-Floury, M.D., Ph.D., Belaid Bouhemad, M.D., Ph.D., Guillaume Louis, M.D., Bertrand Souweine, M.D., Ph.D., Olivier Collange, M.D., Ph.D., Julien Pottecher, M.D., Ph.D., Bruno Levy, M.D., Ph.D., Marc Puyraveau, M.Sc., Lucie Vettoretti, Ph.D., Jean-Michel Constantin, M.D., Ph.D., and Gilles Capellier, M.D., Ph.D., for the LOCO$_2$ Investigators and REVA Research Network*

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Respir Med. 2018 August ; 141: 150–158. doi:10.1016/j.rmed.2018.06.030.

Salvage therapies for refractory hypoxemia in ARDS

Sujith V. Cherian[a], **Anupam Kumar**[b], **Karunakar Akasapu**[c], **Rendell W. Ashton**[d], **Malaygiri Aparnath**[e], and **Atul Malhotra**[f]

CRITICAL CARE PERSPECTIVE

Why COVID-19 Silent Hypoxemia Is Baffling to Physicians

Martin J. Tobin, Franco Laghi, and Amal Jubran

Division of Pulmonary and Critical Care Medicine, Hines Veterans Affairs Hospital and Loyola University of Chicago Stritch School of Medicine, Hines, Illinois

AJRCCM 2020

Emphasize traditional physiology
Blunted ventilator drive may yield severe hypoxemia

High Respiratory Drive and Excessive Respiratory Efforts Predict Relapse of Respiratory Failure in Critically Ill Patients with COVID-19

Running title $P_{0.1}$ and ΔP_{occ} in COVID-19

Authors: 1. Pierre Esnault*[1], MD, MSc

Unpublished : Ludovico Messineo and Scotty Sands
Breathhold studies suggest high drive may be protective

Summary:

1. Hypoxemia is characteristic of COVID ARDS likely from V/Q and shunt primarily
2. Profound hypoxemia can sometimes surprise patient/docs
3. Whether high ventilatory drive is good or bad is not entirely clear
4. Hypoxemia needs to be treated: PEEP and prone primarily