UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19 and Pulmonary Embolism

Timothy Morris, MD
Pulmonary/Critical Care, University of California, San Diego
Timothy Fernandes, MD
Pulmonary/Critical Care, University of California, San Diego
Richard Channick, MD
Pulmonary/Critical Care, University of California, Los Angeles
Victor Tapson, MD
Pulmonary and Critical Care, Cedars-Sinai
Nicolas Gallastegui Crestani, MD
Hematology, University of California, San Diego
Daniel Bond, MD
Pulmonary/Critical Care, University of California, San Diego

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

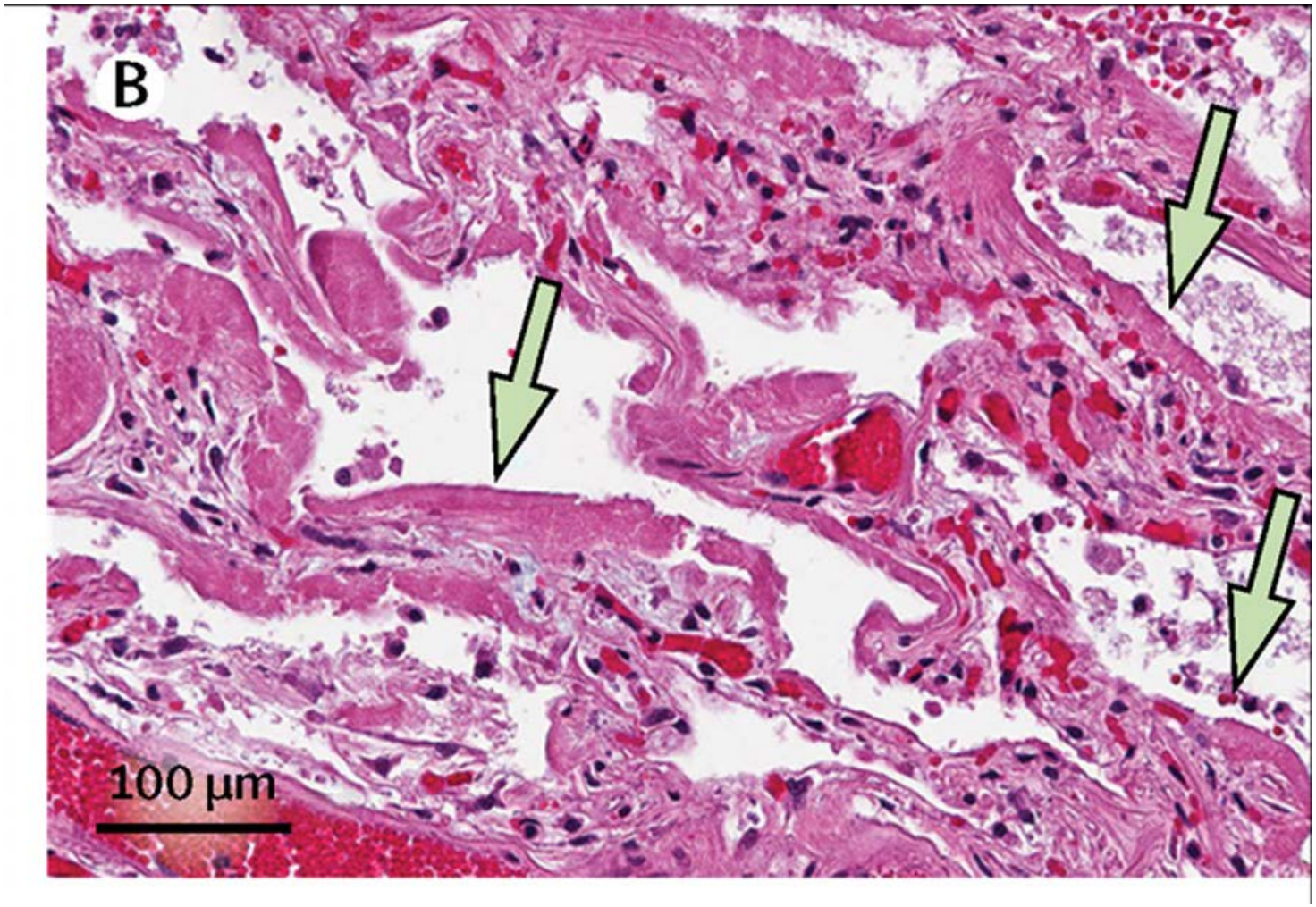
UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

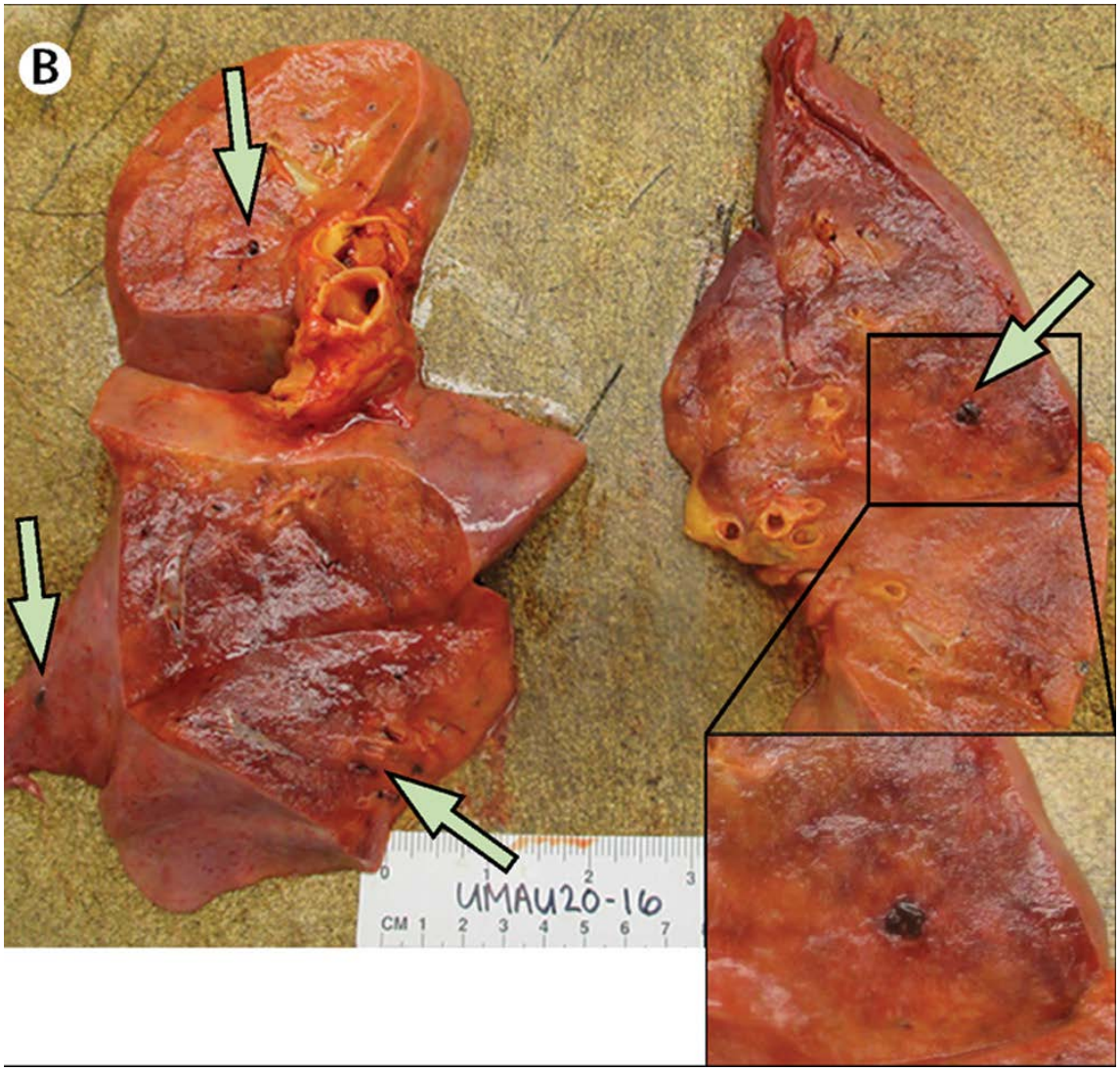
Alveolar fibrin in COVID19-ARDS (like most ARDS)



1. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. Lancet Respir Med. 2020;8(7):681-686.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Small *in situ* thrombosis in COVID19-ARDS



1. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. Lancet Respir Med. 2020;8(7):681-686.

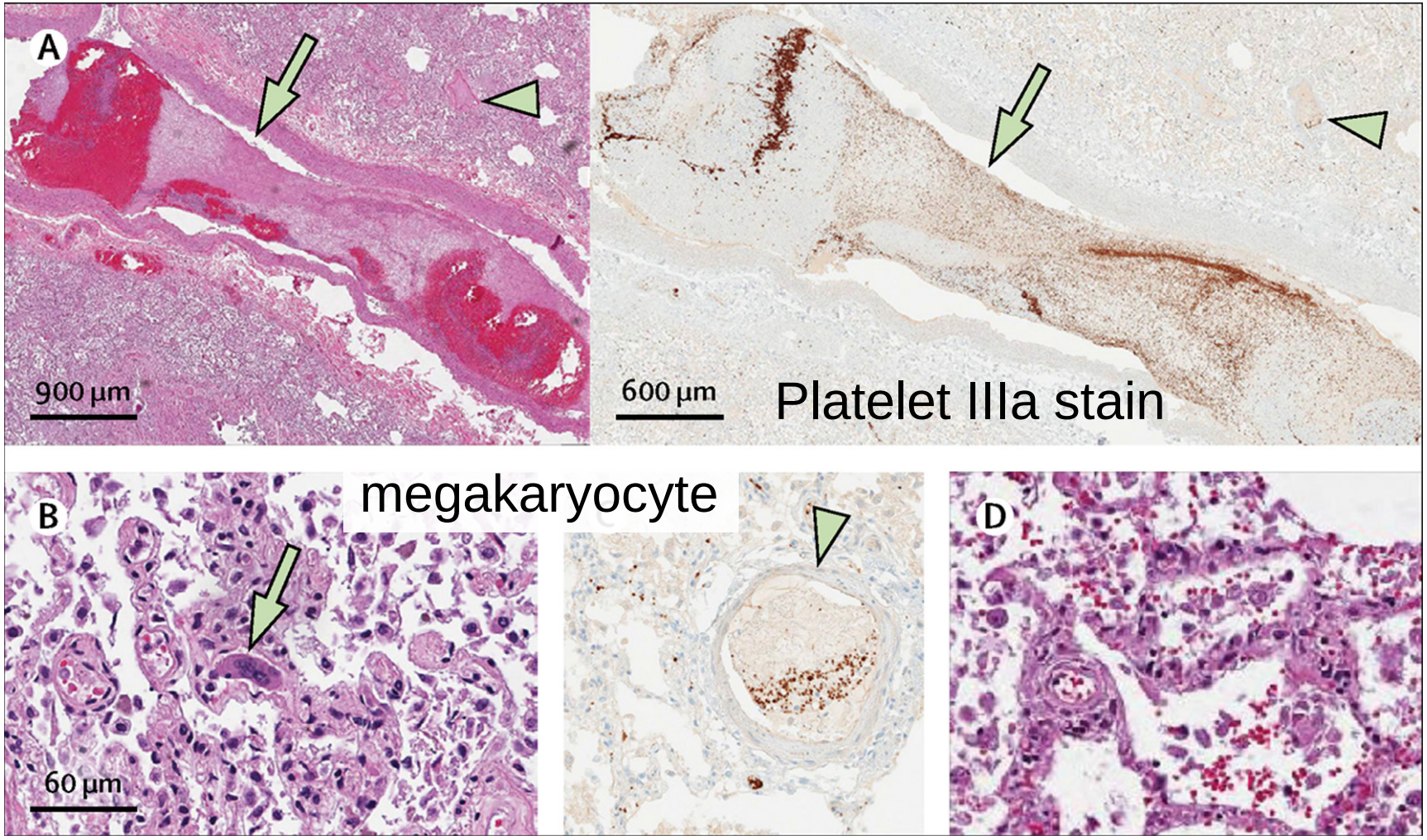
UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Big RV dilatation in COVID19-ARDS

1. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. Lancet Respir Med. 2020;8(7):681-686.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

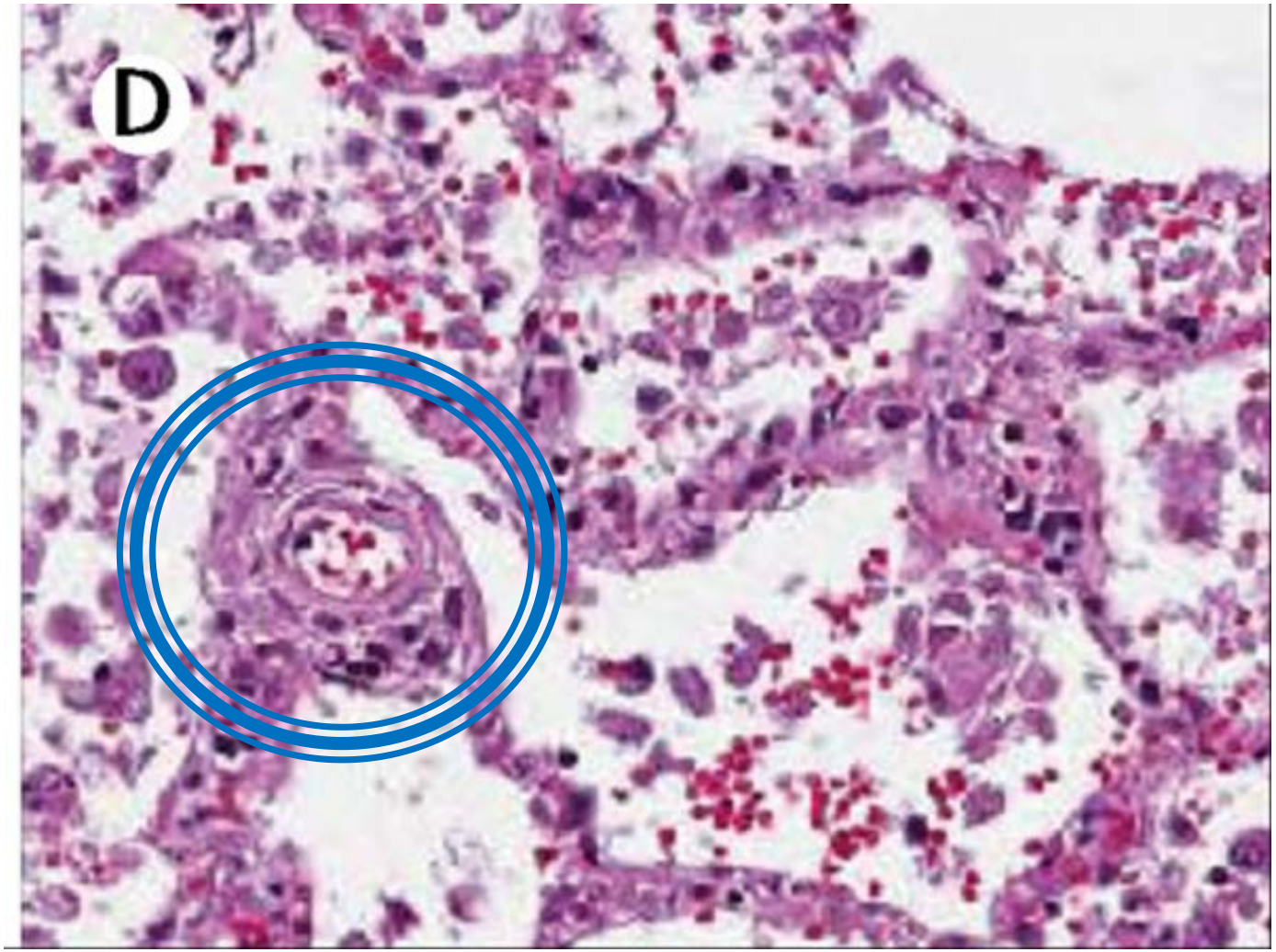
In situ arteriolar thrombosis in COVID19-ARDS



1. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. Lancet Respir Med. 2020;8(7):681-686.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

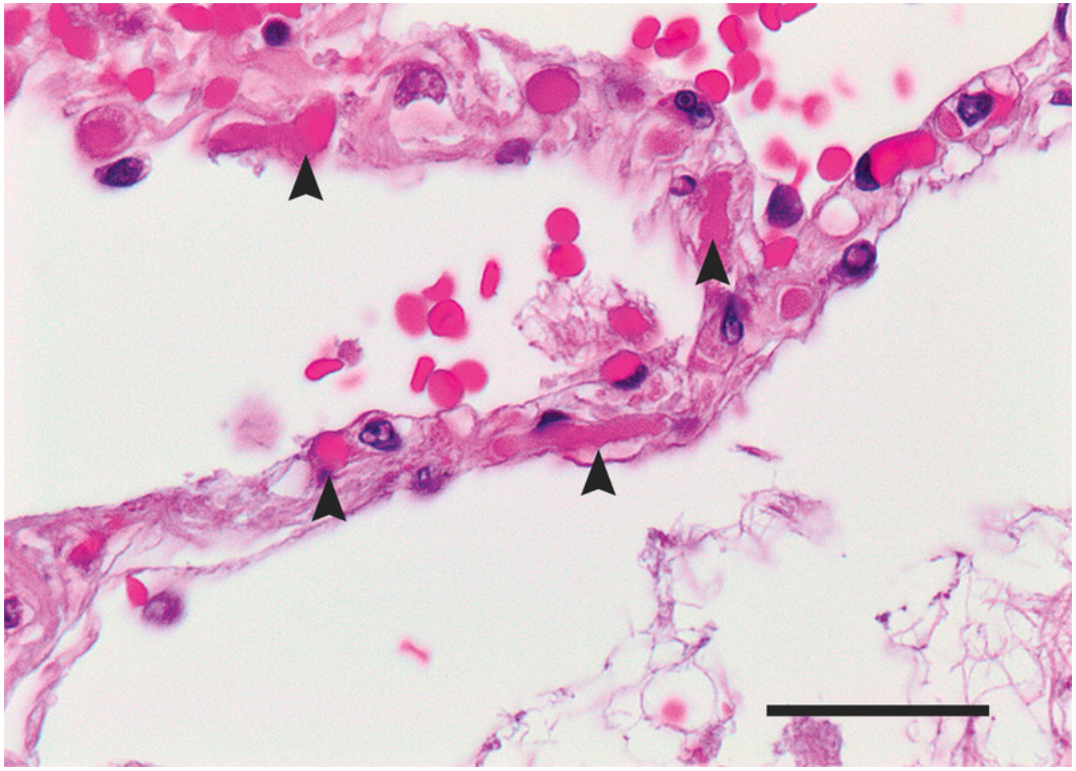
Angiitis in COVID19-ARDS



1. Fox SE, Akmatbekov A, Harbert JL, Li G, Quincy Brown J, Vander Heide RS. Pulmonary and cardiac pathology in African American patients with COVID-19: an autopsy series from New Orleans. Lancet Respir Med. 2020;8(7):681-686.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

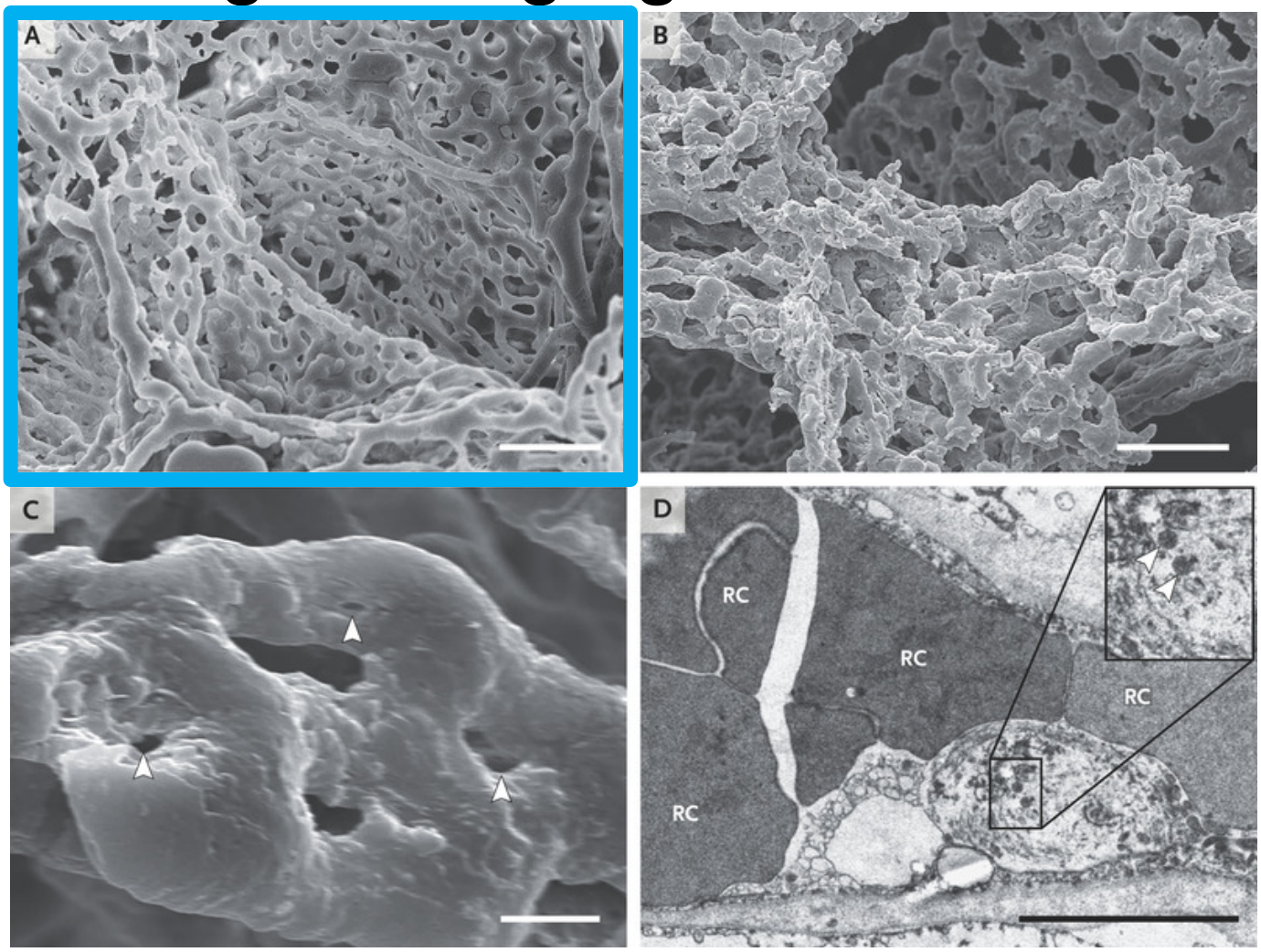
Capillary thrombi



1. Ackermann M, Verleden SE, Kuehnel M, et al. Pulmonary Vascular Endothelialitis, Thrombosis, and Angiogenesis in Covid-19. N Engl J Med. 2020;383(2):120-128.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Angiitis/angiogenesis in COVID19



1. Ackermann M, Verleden SE, Kuehnel M, et al. Pulmonary Vascular Endothelialitis, Thrombosis, and Angiogenesis in Covid-19. N Engl J Med. 2020;383(2):120-128.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

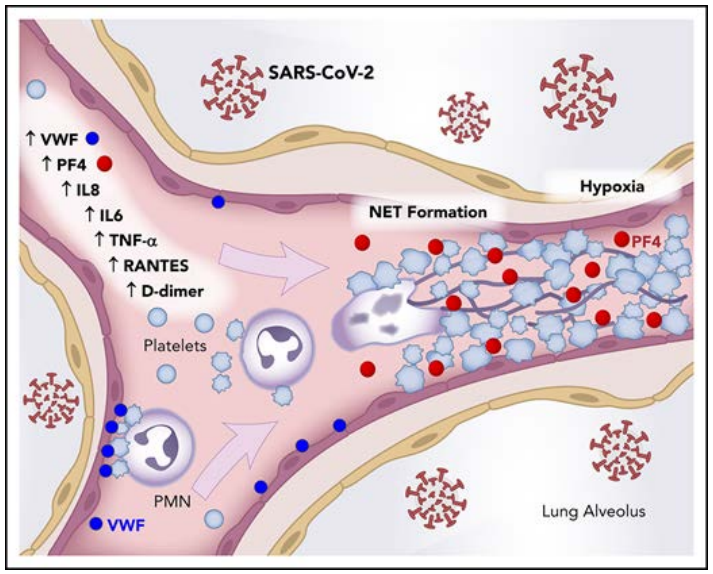
Macro vs Micro Thrombosis

Timothy Fernandes, MD
Division of Pulmonary and Critical Care Medicine
University of California, San Diego

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Inflammation and Hypoxia lead to Thrombosis

- The Coagulation system evolved as an effector pathway of the immune response
  - Neutrophils release NETs to trap bacteria but also lead to platelet aggregation
  - Fibrin is laid down to entrap infected cells/bacteria

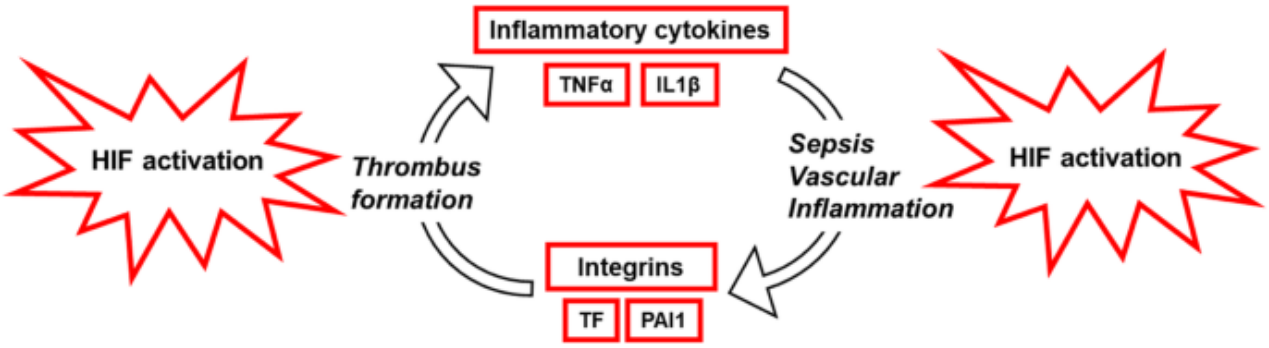


Middleton EA, He X-Y, Denorme F. Neutrophil extracellular traps contribute to immunothrombosis in COVID-19 acute respiratory distress syndrome. Blood. 2020;136:1169–79.

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Inflammation and Hypoxia lead to Thrombosis

- The Coagulation system evolved as an effector pathway of the immune response
  - Neutrophils release NETs to trap bacteria but also lead to platelet aggregation
  - Fibrin is laid down to entrap infected cells/bacteria
- Hypoxia, via hypoxia-inducible transcriptions factors, lead to prothrombotic state

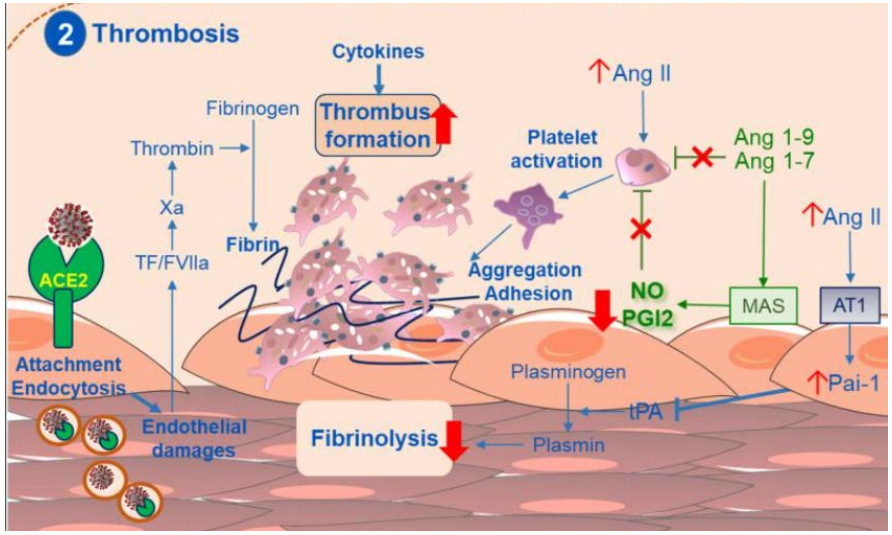


Evans CE. Hypoxia and HIF activation as a possible link between sepsis and thrombosis. Thrombosis Journal. 2019;17.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Inflammation and Hypoxia lead to Thrombosis

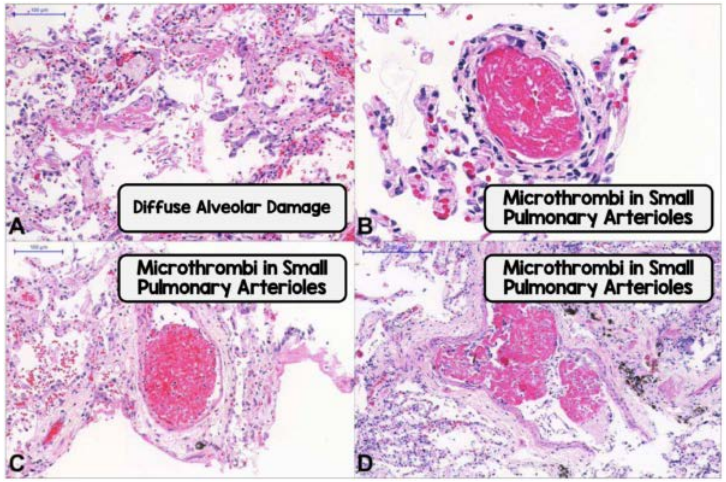
- Endothelial dysfunction can further impair vascular tone and drive more thrombosis
  - Endothelial injury releases tissue factor resulting in thrombin activation



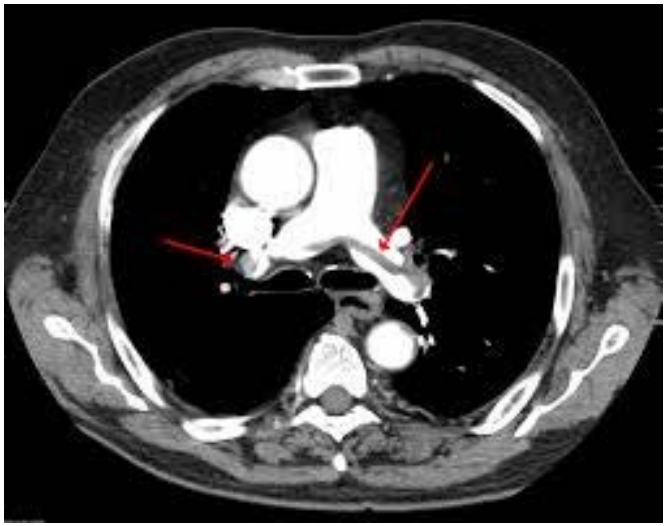
Huertas A, Montani D, Savale L. Endothelial cell dysfunction: a major player in SARS-CoV-2 infection (COVID-19)?. European Respiratory Journal. 2020;56:2001634.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Microthrombosis vs. Macrothrombosis in COVID-19

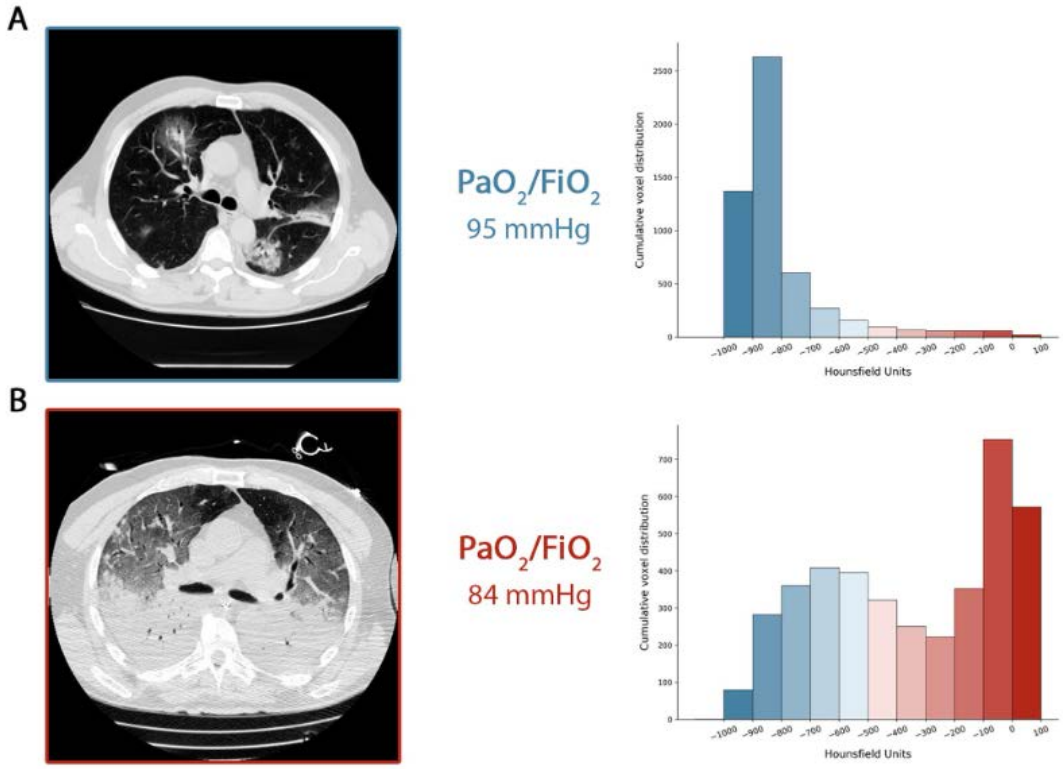


VS.



UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

High Compliance, High Dead Space Phenotype of COVID-19 ARDS



Gattinoni L, Chiumello D, Caironi P. COVID-19 pneumonia: different respiratory treatments for different phenotypes?. Intensive Care Medicine. 2020;**46**:1099–102.

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Is C-ARDS really that different from ARDS?

Viewpoint

COVID-19-associated acute respiratory distress syndrome: is a different approach to management warranted?

Eddy Fan, Jeremy R Beitler, Laurent Brochard, Carolyn S Calfee, Niall D Ferguson, Arthur S Slutsky, Daniel Brodie

Lancet Respir Med 2020; 8: 816–21
Published Online July 6, 2020
https://doi.org/10.1016/S2213-2600(20)30304-0

Interdepartmental Division of Critical Care Medicine, Department of Medicine (E Fan MD, Prof N D Ferguson MD, Prof L Brochard M Prof A S Slutsky MD), Institu of Health Policy, Manageme and Evaluation (E F Prof N D Ferguson), Univers of Toronto, Toronto, C Canada; Department Medicine, University Hea Network and Sinai Hea System, Toronto, ON, Cana (E Fan, Prof N D Ferguso Center for Acute Respirat Failure, New York-Presbyteri Medical Center, New York, N USA (J R Beitler M Prof D Brodie MD); Division Pulmonary, Allergy and Criti Care Medicine, Department Medicine, Columbia Univers College of Physicians a Surgeons, New York, NY, U (J R Beitler, Prof D Brodie); Li

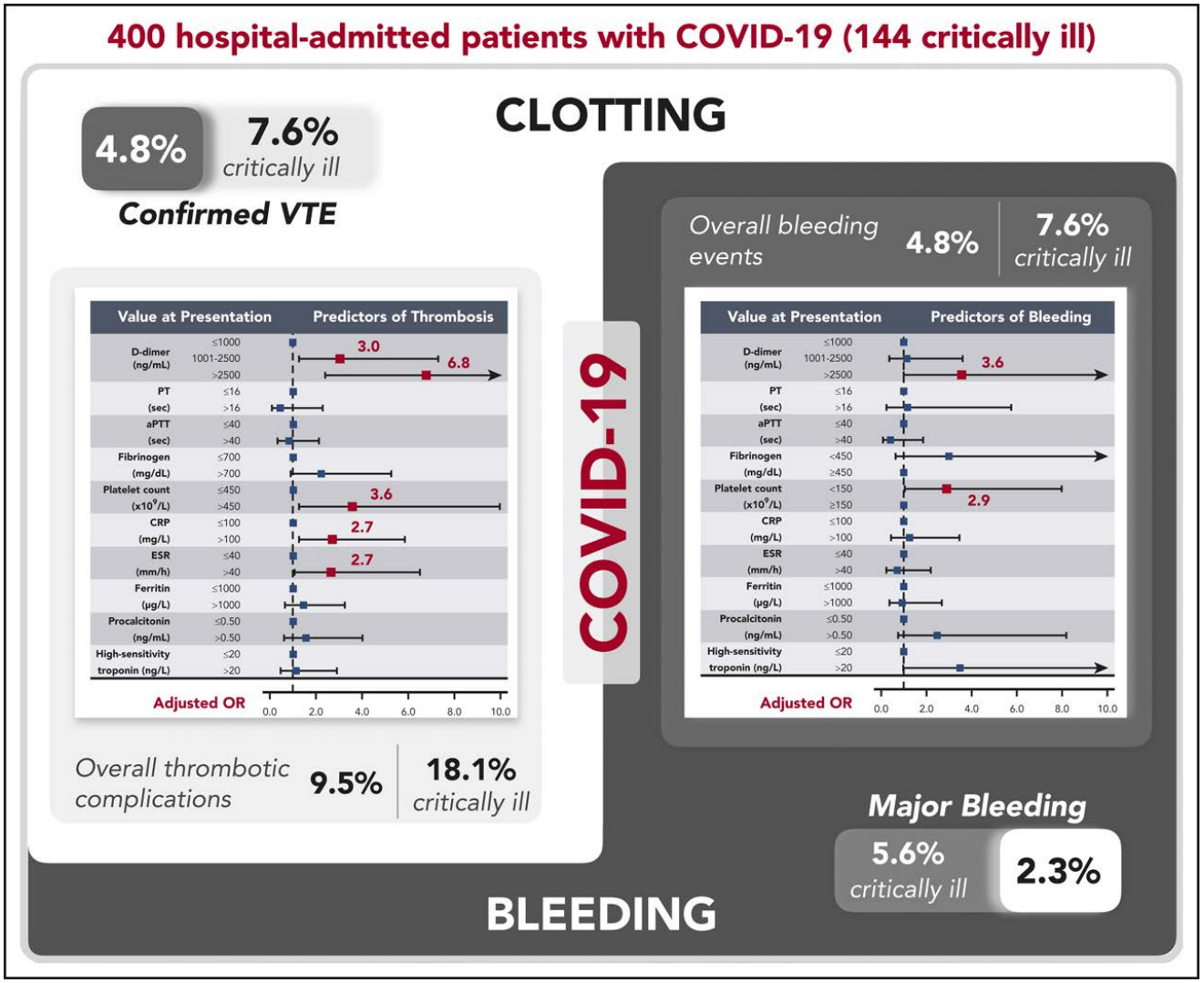
The COVID-19 pandemic has seen a surge of patients with acute respiratory distress syndrome (ARDS) in intensive care units across the globe. As experience of managing patients with COVID-19-associated ARDS has grown, so too have efforts to classify patients according to respiratory system mechanics, with a view to optimising ventilatory management. Personalised lung-protective mechanical ventilation reduces mortality and has become the mainstay of treatment in ARDS. In this Viewpoint, we address ventilatory strategies in the context of recent discussions on phenotypic heterogeneity in patients with COVID-19-associated ARDS. Although early reports suggested that COVID-19-associated ARDS has distinctive features that set it apart from historical ARDS, emerging evidence indicates that the respiratory system mechanics of patients with ARDS, with or without COVID-19, are broadly similar. In the absence of evidence to support a shift away from the current paradigm of ventilatory management, we strongly

"Reports of phenotypic heterogeneity in patients with COVID-19-associated ARDS, although interesting, could easily be over-interpreted or inappropriately applied in the intensive care unit, potentially leading to detrimental ventilatory management strategies in these patients."

Fan E, Beitler JR, Brochard L. COVID-19-associated acute respiratory distress syndrome: is a different approach to management warranted?. The Lancet Respiratory Medicine. 2020;8:816–21.

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Bleeding and Clotting in COVID-19



Hanny Al-Samkari,Rebecca S. Karp Leaf,Walter H. Dzik,Jonathan C. T. Carlson,Annemarie E. Fogerty,Anem Waheed,Katayoon Goodarzi,Pavan K. Bendapudi,Larissa Bornikova,Shruti Gupta,David E. Leaf,David J. Kuter,Rachel P. Rosovsky, COVID-19 and coagulation: bleeding and thrombotic manifestations of SARS-CoV-2 infection, Blood, 2020.

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

There are over 30 currently enrolling clinical trials for anticoagulation paradigms in COVID-19

TABLE 1 Registration details (as of June 17, 2020) and study characteristics of trials evaluating anticoagulant interventions in hospitalized patients with COVID-19

Study acronym or PI	Trial ID	Source registry	Countries	Date of registration	Estimated study completion date
COVID-HEP	NCT04345848	ClinicalTrials.gov	Switzerland	7 April 2020	March 2021
CORIMMUNO-COAG	NCT04344756	ClinicalTrials.gov	France	9 April 2020	September 2020
RAPID COVID COAG	NCT04362085	ClinicalTrials.gov	Canada, Ireland, Saudi Arabia, United States	20 April 2020	December 2020
HeSAcovid	RBR-949z6v	REBEC	Brazil	6 May 2020	July 2020
COALIZAO ACTION	NCT04394377	ClinicalTrials.gov	Brazil	8 May 2020	December 2020
COVID PACT	NCT04409834	ClinicalTrials.gov	United States	28 May 2020	May 2021
Berger et al.	NCT04359277	ClinicalTrials.gov	United States	20 April 2020	April 2021
REMAP-CAP	NCT02735707	ClinicalTrials.gov	Australia, Belgium, Canada, Croatia, France, Germany, Hungary, Ireland, Netherlands, New Zealand, Portugal, Romania, Saudi Arabia, Spain, United Kingdom, United States	20 April 2020[b]	December 2021
ATTACC	NCT04372589	ClinicalTrials.gov	Brazil, Canada, Mexico, United States	24 April 2020	January 2021
Albaghdadi et al.	NCT04377997	ClinicalTrials.gov	United States	1 May 2020	January 2021
HEP-COVID	NCT04401293	ClinicalTrials.gov	United States	20 May 2020	April 2021
IMPACT	NCT04406389	ClinicalTrials.gov	United States	26 May 2020	June 2021
COVID-19 HD	NCT04408235	ClinicalTrials.gov	Italy	26 May 2020	June 2021
COVI-DOSE	NCT04373707	ClinicalTrials.gov	France	1 May 2020	October 2020[a]
X-Covid 19	NCT04366960	ClinicalTrials.gov	Italy	24 April 2020	November 2020
Heparin-SARS-CoV2	EUCTR2020-001891-14-ES	EU Clinical Trials Register	Spain	5 May 2020	Not provided
Perepu et al	NCT04360824	ClinicalTrials.gov	United States	13 April 2020	April 2021
IMPROVE-COVID	NCT04367831	ClinicalTrials.gov	United States	27 April 2020	April 2021
COVID-PREVENT	NCT04416048	ClinicalTrials.gov	Germany	2 June 2020	May 2021
ACOVACT	NCT04351724	ClinicalTrials.gov	Austria	10 April 2020	December 2020

Tritschler T, Mathieu M, Skeith L. Anticoagulant interventions in hospitalized patients with COVID-19: A scoping review of randomized controlled trials and call for international collaboration. Journal of Thrombosis and Haemostasis. 2020;18:2958–67.

UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Operation Warp Speed: ACTIV-4 Anti-thrombotics

- ACTIV-4 Inpatient Protocol
  - Therapeutic vs. Prophylactic anticoagulation
  - 2000 Hospitalized patients
  - Primary Endpoint: 21 Day Organ Support (respiratory or vasopressor) Free Days
  - Secondary Endpoint: Composite endpoint of death, pulmonary embolism, systemic arterial thromboembolism, myocardial infarction, or ischemic stroke at hospital discharge or 28 days
  - Anticipated study completion by March 2021

- ACTIV-4 Inpatient Protocol (ASA/Apixiban/Placebo; 7000 patients)

- ACTIV-4 Convalescent Protocol

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

APL antibodies with COVID19

Table 1. Prevalence of antiphospholipid antibodies in serum from COVID-19 patients (n=172)

aPL antibody	Number positive (manufacturer's cut-off)	%	Number positive (titer ≥40 units)	%
aCL IgG	8	4.7%	2	1.2%
aCL IgM	39	23%	13	7.6%
aCL IgA	6	3.5%	1	0.58%
$a\beta_2$GPI IgG	5	2.9%	3	1.7%
$a\beta_2$GPI IgM	9	5.2%	7	4.1%
$a\beta_2$GPI IgA	7	4.1%	3	1.7%
aPS/PT IgG	42	24%	21	12%
aPS/PT IgM	31	18%	21	12%
any positive aPL	89	52%	52	30%

1. Zuo Y, Estes SK, Ali RA, et al. Prothrombotic autoantibodies in serum from patients hospitalized with COVID-19. Sci Transl Med. 2020.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

But lots of viral infections have APL Ab

Infection type	*No. of positive patients/total (%)*
Anticardiolipin antibodies	
HIV + no OI ($n = 19$)[18,21,22,25,26,31,33,35,68–78]	840/1499[a] (56)
HIV + all combined OI ($n = 6$)[28,31,43,45,76,79]	193/306 (63)
Hepatitis C virus ($n = 20$)[19,23,27,29,30,32,34,36,38,40,80–89]	368/1785 (21)
Hepatitis B virus ($n = 9$)[24,30,36,68,83,88–91]	93/483 (19)
Epstein-Barr virus ($n = 4$)[64,68,92,93]	68/137 (50)
Human T-lymphotropic virus type 1 ($n = 3$)[16,17,45]	31/191 (16)
Hepatitis A virus ($n = 1$)[64]	2/2 (100)
Human herpesvirus type 6 ($n = 1$)[37]	19/32 (59)
Lymphotropic viruses ($n = 1$)[75]	8/20 (40)
Parvovirus B19 ($n = 1$)[20]	8/60 (13)
Varicella zoster virus ($n = 1$)[68]	8/12 (67)

1. Abdel-Wahab N, Talathi S, Lopez-Olivo MA, Suarez-Almazor ME. Risk of developing antiphospholipid antibodies following viral infection: a systematic review and meta-analysis. Lupus. 2018;27(4):572-583.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

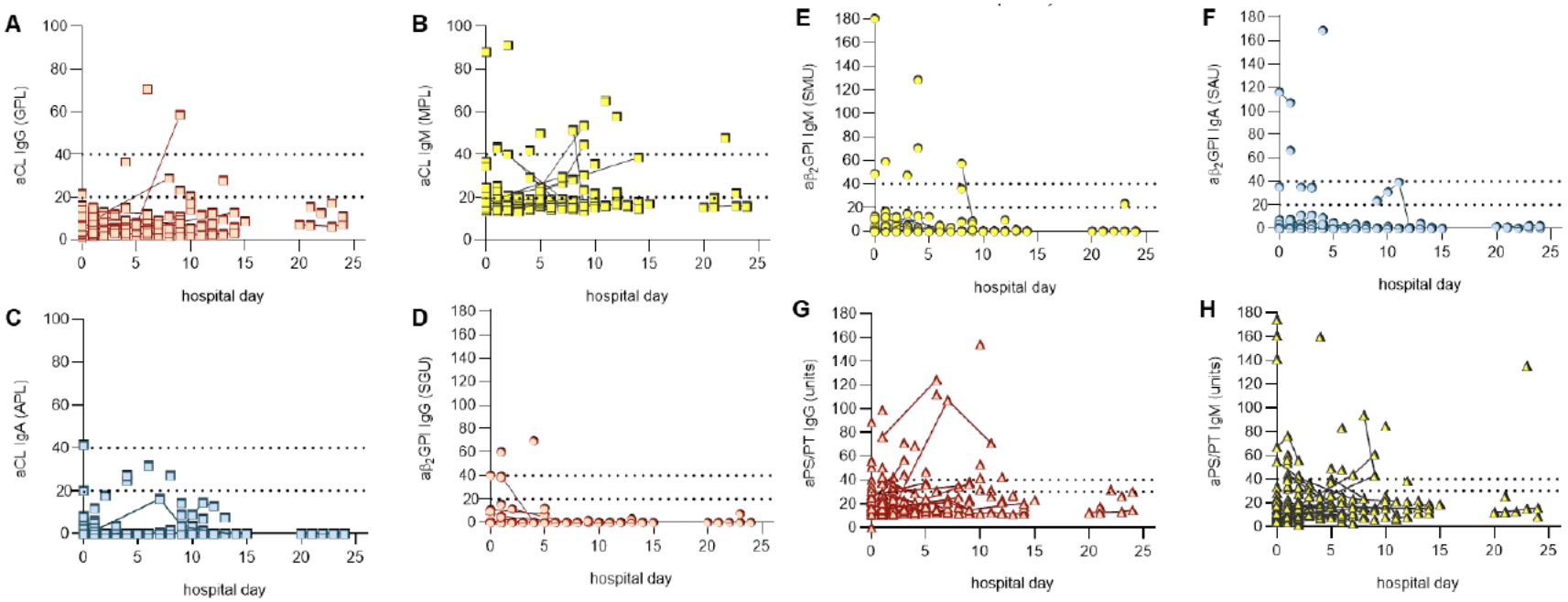
Viral-associated APL Ab aren't necessarily associated with VTE

Infection type (total number of studies)[a]	*Thromboembolic* — *No. of positive/ Patients with infection and aPL antibodies (%)*
Hepatitis C virus ($n=9$)[27,29,30,34,36,39,40,85,87]	20/178 (11.2)
HIV ($n=6$)[18,21,26,41,46,71]	0/171
HIV + OI ($n=3$)[43,45,79]	1/111 (<1)
Hepatitis B virus ($n=5$)[24,30,39,90,91]	4/75 (5)
Epstein-Barr virus ($n=1$)[46]	0/19
Human herpesvirus type 6 ($n=1$)[37]	0/19
Human T-lymphotropic virus type 1 ($n=1$)[16]	0/23
Parvovirus B19 ($n=1$)[20]	

1. Abdel-Wahab N, Talathi S, Lopez-Olivo MA, Suarez-Almazor ME. Risk of developing antiphospholipid antibodies following viral infection: a systematic review and meta-analysis. Lupus. 2018;27(4):572-583.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

APL antibodies in COVID19 are mostly in the first week or two



1. Zuo Y, Estes SK, Ali RA, et al. Prothrombotic autoantibodies in serum from patients hospitalized with COVID-19. Sci Transl Med. 2020.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Persistent ACL and A-PT Ab are associated with VTE

	Persistent		Persistent or transient	
APLA subtype	OR (95% CI)	*P*	OR (95% CI)	*P*
ACLA IgG	10.0 (1.8-56)	.013	2.8 (0.5-16)	.211
ACLA IgM	32.7 (4.2-256)	.001	10.0 (1.8-56)	.013
Anti-β_2-GPI IgG	17.3 (2.6-116)	.885	10.6 (1.7-65)	.010
Anti-β_2-GPI IgM	6.7 (1.2-37)	.036	9.2 (1.5-55)	.015
Anti-PT IgG	3.5 (0.7-19)	.155	3.1 (0.6-18)	.179
Anti-PT IgM	3.6 (0.3-46)	.358	2.6 (0.4-17)	.292

1. Male C, Foulon D, Hoogendoorn H, et al. Predictive value of persistent versus transient antiphospholipid antibody subtypes for the risk of thrombotic events in pediatric patients with systemic lupus erythematosus. Blood. 2005;106(13):4152-4158.

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Laboratory criteria for antiphospholipid syndrome

1. Lupus anticoagulant (LA) present in plasma, on two or more occasions at least 12 weeks apart.

2. Anticardiolipin (aCL) antibody of IgG and/or IgM isotype on two or more occasions, at least 12 weeks apart

3. Anti-b2 glycoprotein-I antibody of IgG and/or IgM isotype on two or more occasions at least 12 weeks apart

1. Miyakis S, Lockshin MD, Atsumi T, et al. International consensus statement on an update of the classification criteria for definite antiphospholipid syndrome (APS). J Thromb Haemost. 2006;4(2):295-306.

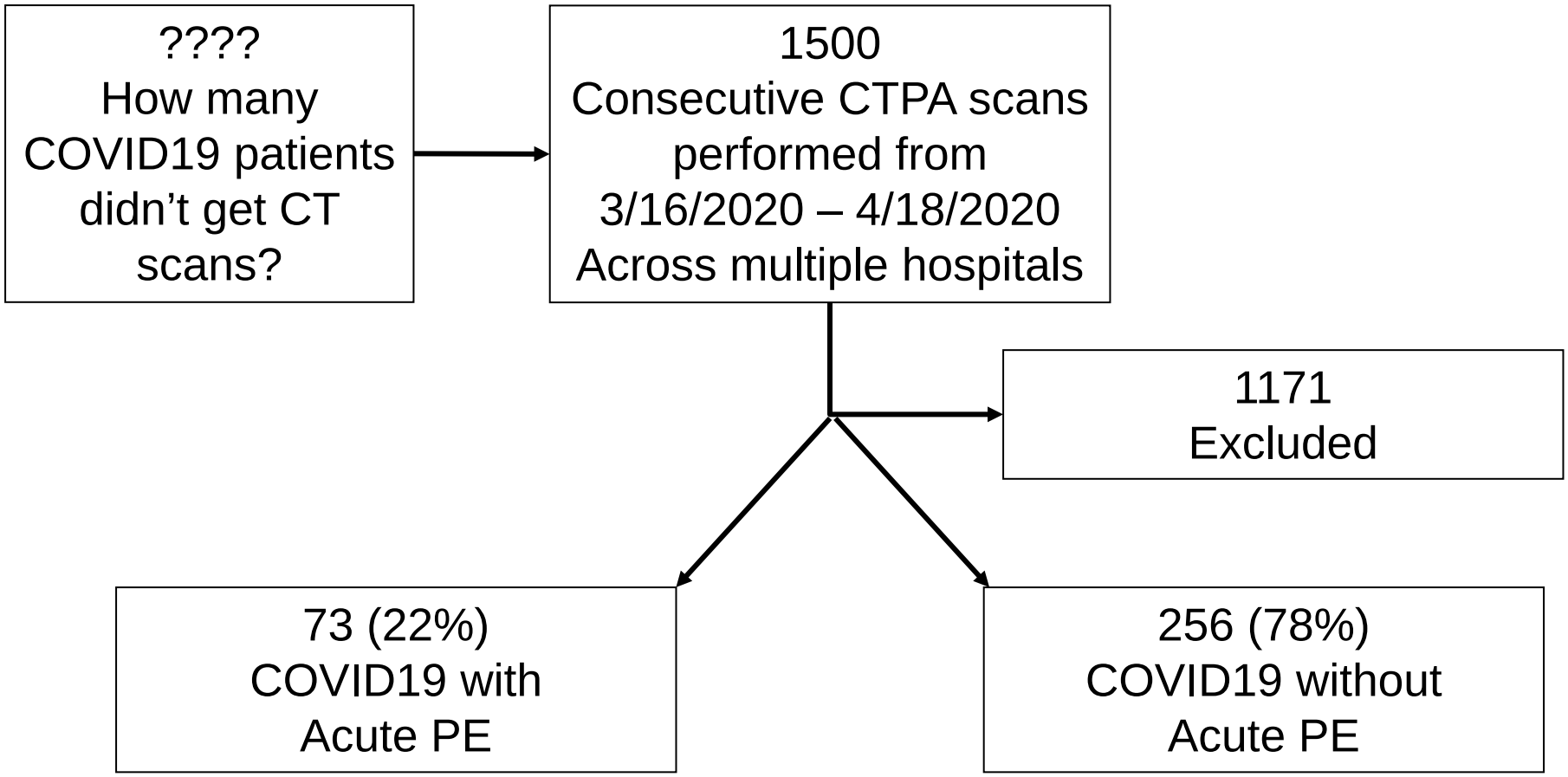
UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

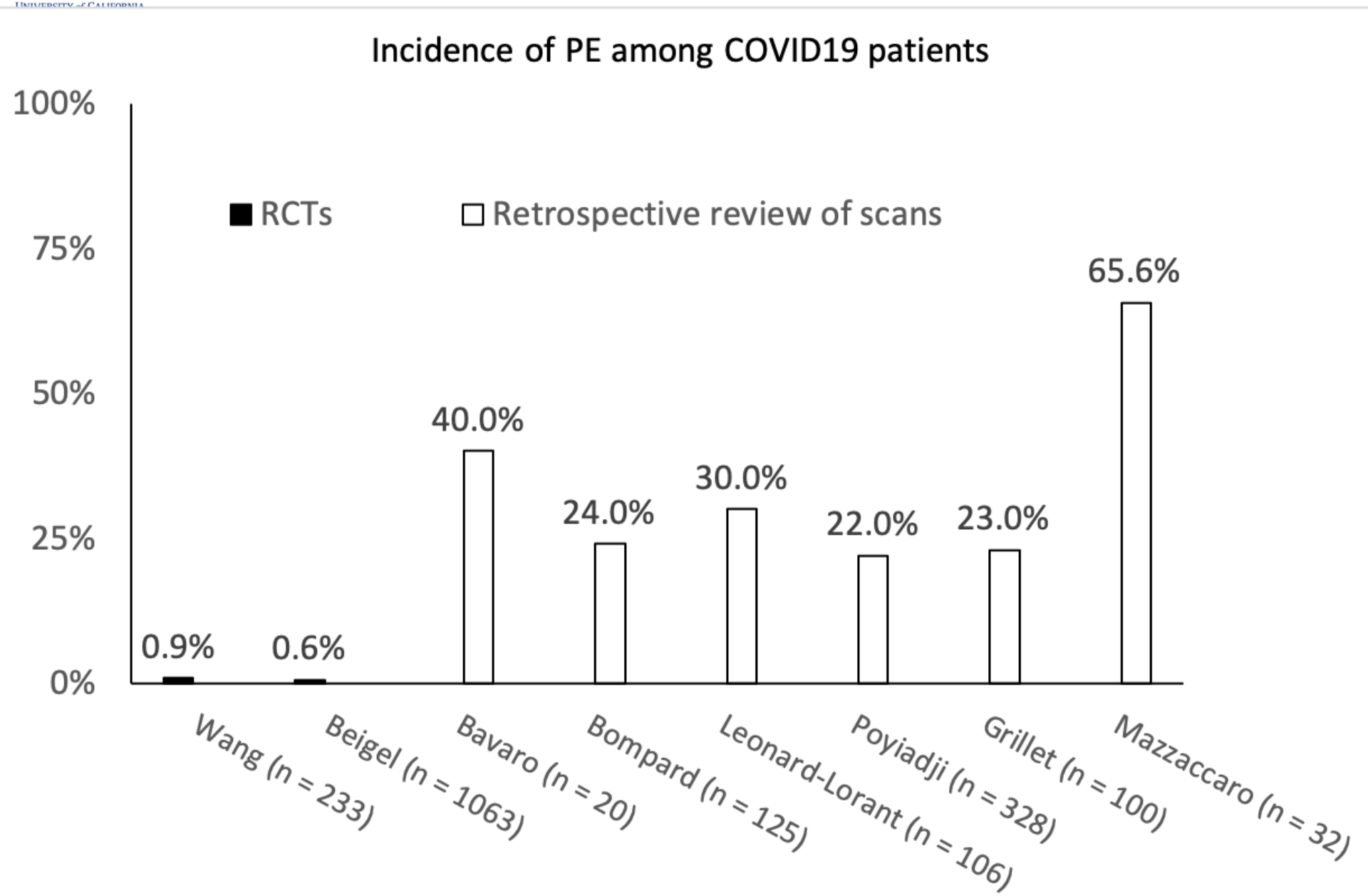
- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

High incidence of PE among COVID19 who get scanned



1. Poyiadji N, Cormier P, Patel PY, et al. Acute Pulmonary Embolism and COVID-19. Radiology. 2020:201955.


Incidence of PE among COVID19 patients
100%
75%
50%
25%
0%
RCTs
Retrospective review of scans
0.9%
0.6%
40.0%
24.0%
30.0%
22.0%
23.0%
65.6%
Wang (n = 233)
Beigel (n = 1063)
Bavaro (n = 20)
Bompard (n = 125)
Leonard-Lorant (n = 106)
Poyiadji (n = 328)
Grillet (n = 100)
Mazzaccaro (n = 32)

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

COVID19

- Pathological features
- Macro vs Micro
- Serological markers
- Epidemiology
- Case presentations

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Case presentations

Daniel Bond, MD
Fellow,
Division of Pulmonary and Critical Care Medicine
University of California, San Diego

Case #1

Case presentation #1

- 53 yo M with history of HTN and HLD who presented to the ED with progressive SOB following recent COVID-19 diagnosis 6 days prior to admission.

Admission vital signs

- T 100.9F
- HR 69
- BP 125/73
- RR 30
- SpO2 94% on RA

- BMI 31.6

Physical exam

- Gen: No acute distress, speaking complete sentences
- CV: Regular rate and rhythm, no murmur, rubs or gallops
- Lungs: Clear bilaterally
- GI: Abdomen soft and non-tender
- Ext: No swelling or erythema
- Skin: No rashes, wounds

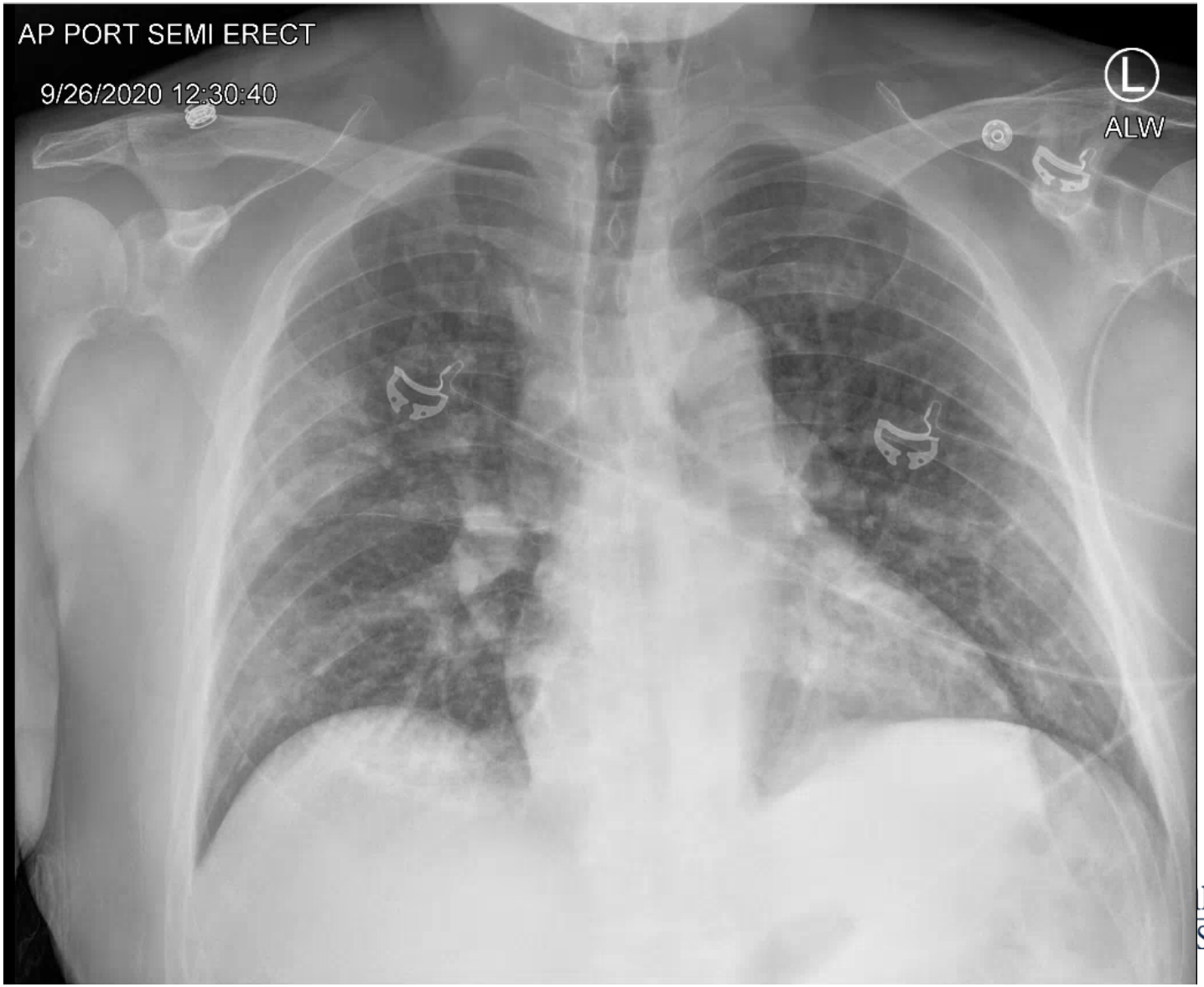
Initial labs

- CBC
  - 6.1 > 15.1/45.6 < 158
    - 71% segs, 21% lymph, 8% mono, 0% eos/basophils
- BMP – 136 / 4 / 96 / 26 / 13 / 1.0 < 113
- Liver enzymes – Normal except AST 49, ALT 52

- Pro-BNP – 67 pg/ml (normal 0-899)
- Troponin 5th Gen – 6ng/L (normal <22 ng/L)
- D-Dimer – 221 ng/mL (normal <241ng/mL)

- Rapid Covid-19 Assay - Positive

CXR



UNIVERSITY of CALIFORNIA SAN DIEGO SCHOOL OF MEDICINE

Hospital course

- Admitted to Medicine and started on Remdesivir
  - initially saturating well on RA, overnight requiring 2-3L via NC to maintain sat >88%
- HD 4 – Increasing oxygen requirement overnight, now requiring NRB
  - Transferred to ICU and started on Dexamethasone 6mg daily
  - Over the next several days remains on NRB with intermittent self proning and occasional desaturations
- HD 9 – Increased WOB and significantly elevated D-dimer

D-Dimer (normal <241 ng/mL)

9/26/2020 1148	9/28/2020 0518	10/2/2020 0239	10/5/2020 0334	10/8/2020 0228
221 *	210 *	812 * ▲	6,232 * ▲	3,458 * ▲

UC San Diego HEALTH SCIENCES

Next step?

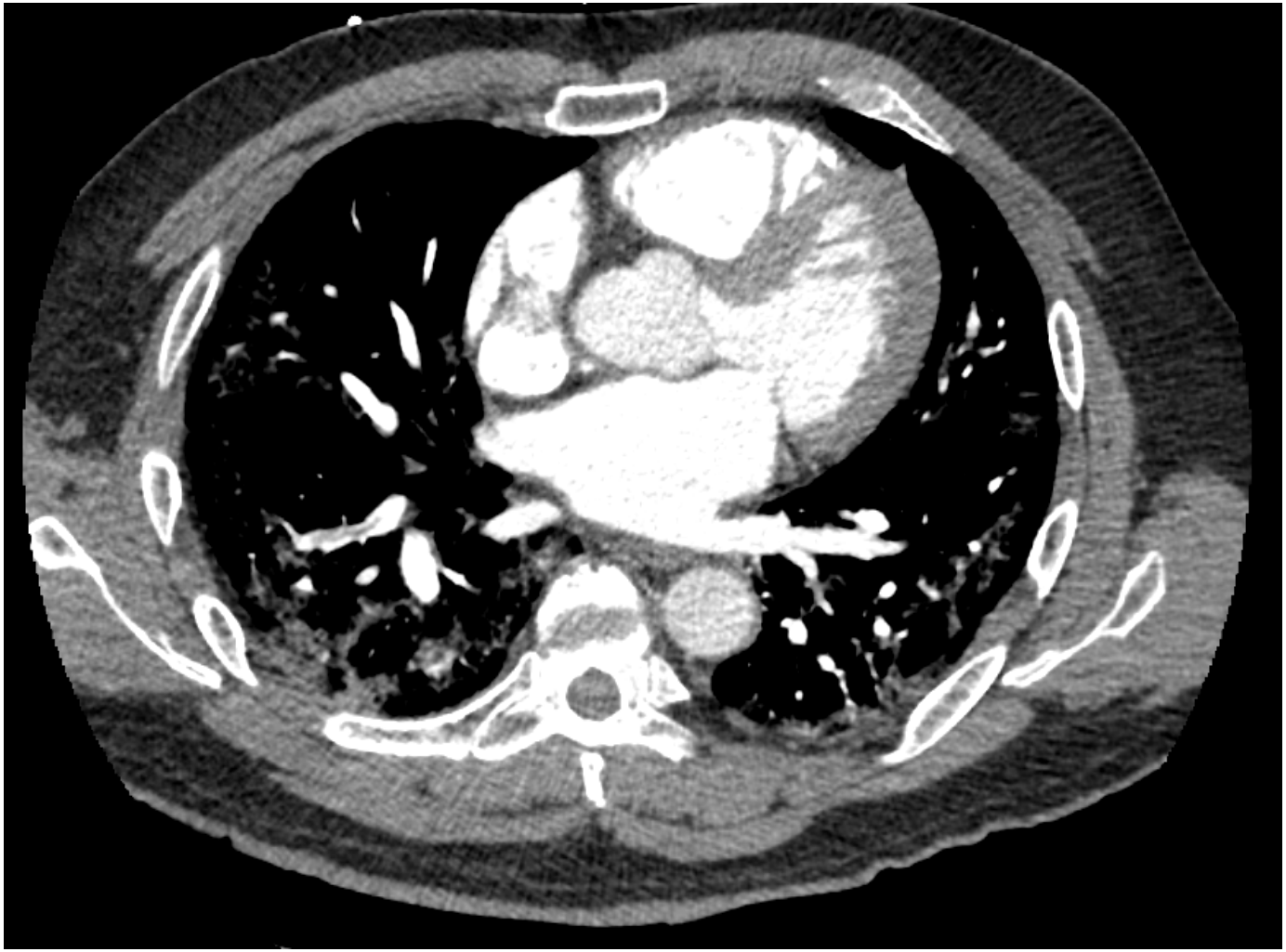
Dr. Timothy Fernandes, UCSD Pulmonary and Critical Care

Dr. Richard Channick, UCLA Pulmonary and Critical Care

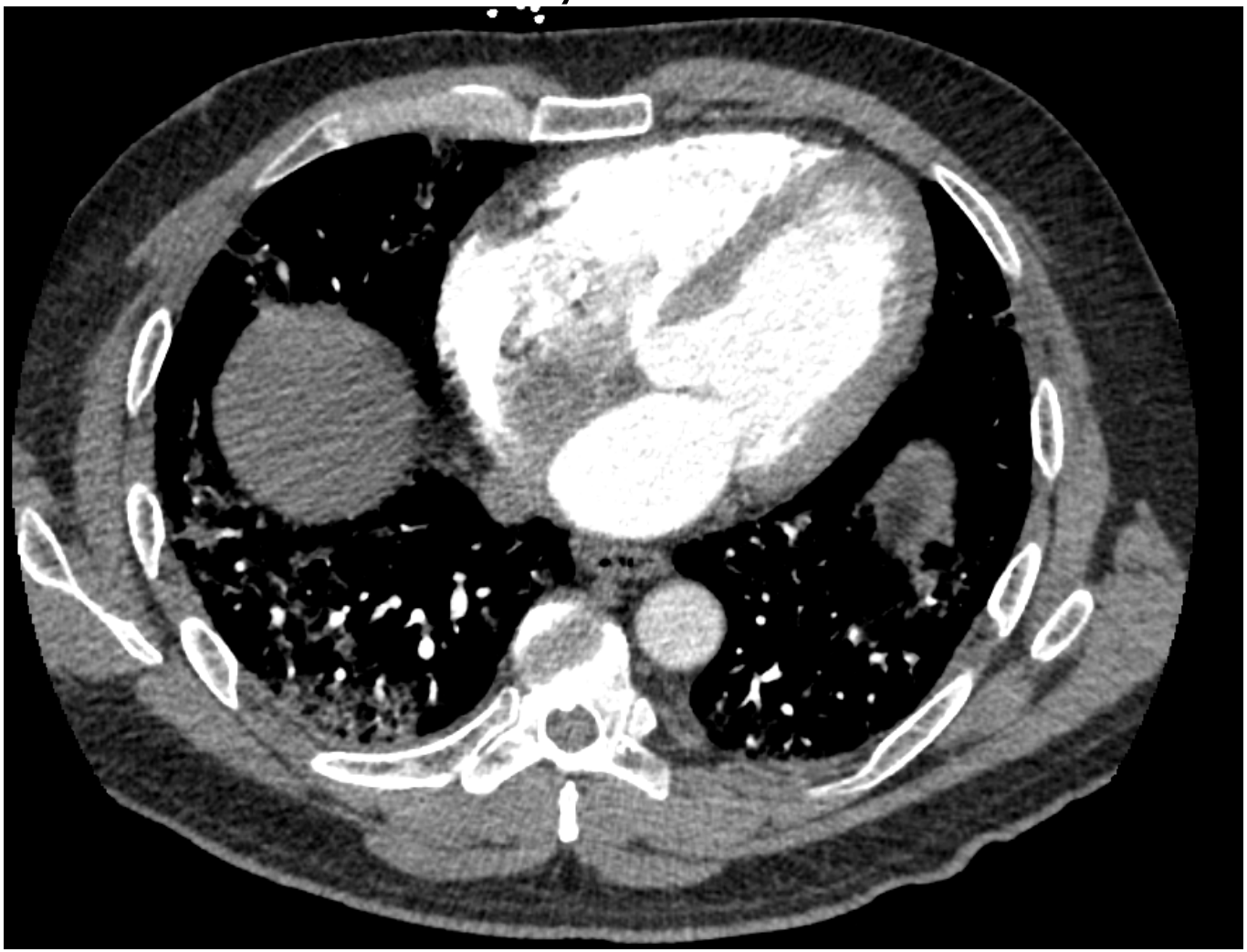
Dr. Victor Tapson, Cedars-Sinai Pulmonary and Critical Care

Dr. Nicolas Gallastegui Crestani, MD UCSD Hematology

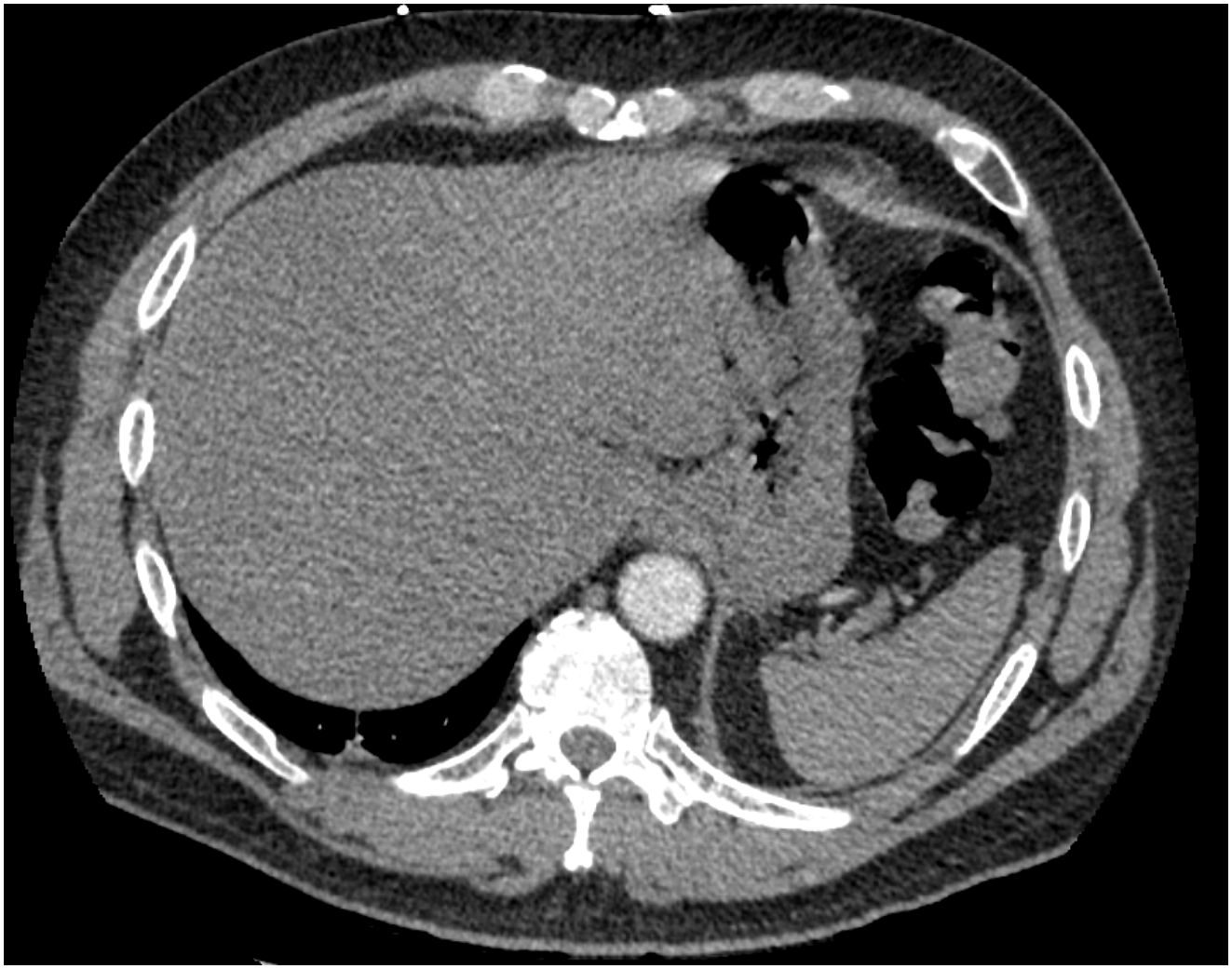
Case 1, CT slide 1



Case 1, CT slide 2



Case 1, CT slide 3



Hospital course

- Rx Heparin IV
- LE US: No evidence of DVT
- Oxygen gradually weaned down to NC
- HD 11 Transferred out of the ICU
- Transitioned from Heparin to Apixiban
- HD 15 Discharged home on RA

Comments

Dr. Timothy Fernandes, UCSD Pulmonary and Critical Care

Dr. Richard Channick, UCLA Pulmonary and Critical Care

Dr. Victor Tapson, Cedars-Sinai Pulmonary and Critical Care

Dr. Nicolas Gallastegui Crestani, MD UCSD Hematology

Case #2

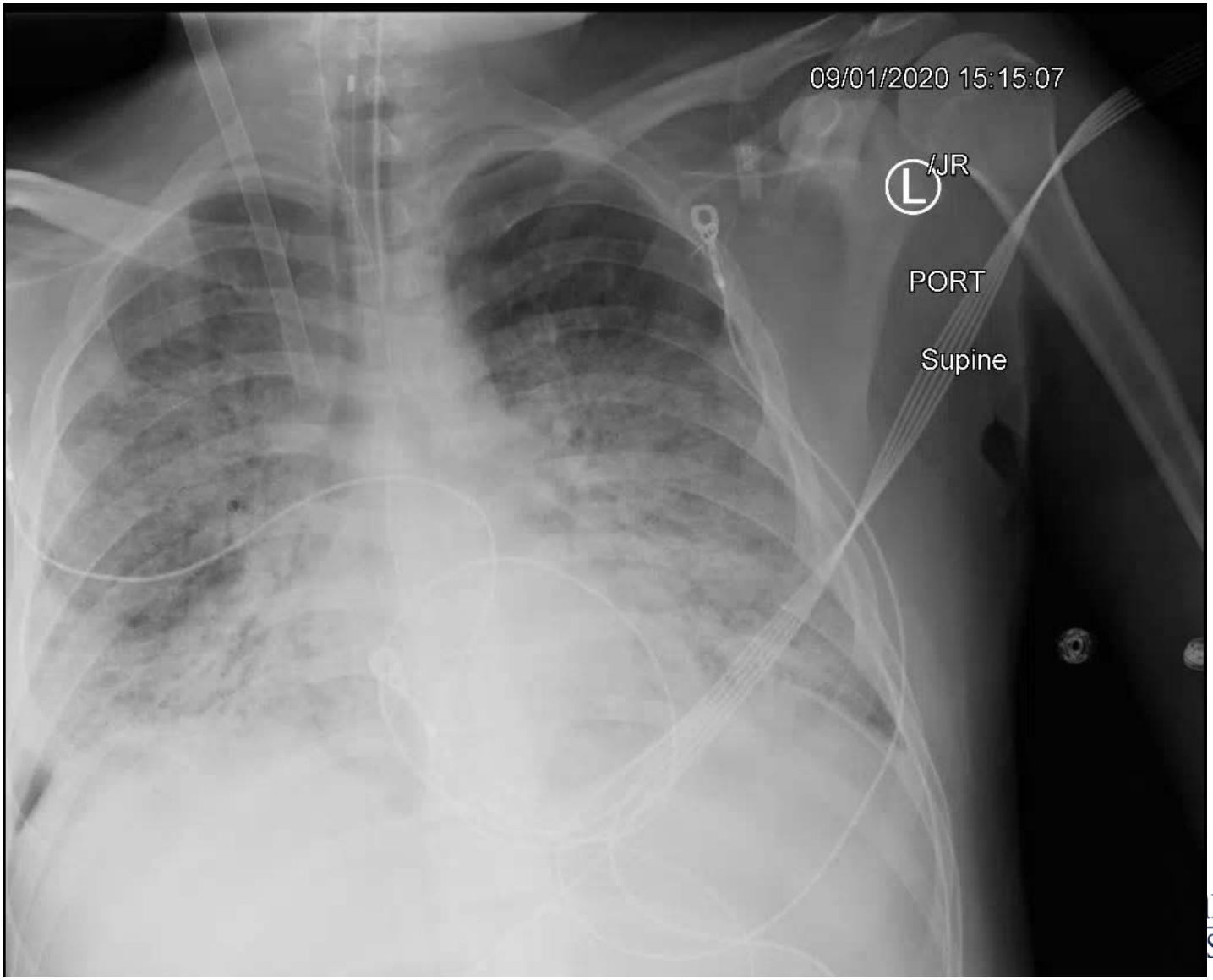
Case presentation #2

- 34 yo man
  - Poorly controlled non-insulin dependent T2DM
  - HTN
- Transferred from OSH with COVID-19 ARDS for consideration of VV-ECMO

Hospital course

- Admitted to OSH after 1 week of dyspnea
- Received Remdesivir, Dexamethasone and convalescent plasma
- HD 12 Intubated
- HD 15 Transferred to UCSD

CXR



Continued

- HD 16 Cannulated for VV-ECMO (P/F = 55)
  - Started on Heparin gtt (goal Xa 0.11-0.3)
- HD 26 Percutaneous tracheostomy
  - HD 26-29 Heparin held due to oozing from trach site
- HD 30-60 Required ECMO flows of ~6L/min and Sweep 6-8 lpm,
  - pulmonary compliance ~10-20 ml/cmH20

Continued

- HD 57 acute episode of hypotension
  - Previously on no vasopressors now requiring norepinephrine 26mcg/min, epinephrine 0.06mcg/kg/min, and phenylephrine 200mcg/min despite IVF boluses
- Unstable for transport

Next step?

Dr. Timothy Fernandes, UCSD Pulmonary and Critical Care

Dr. Richard Channick, UCLA Pulmonary and Critical Care

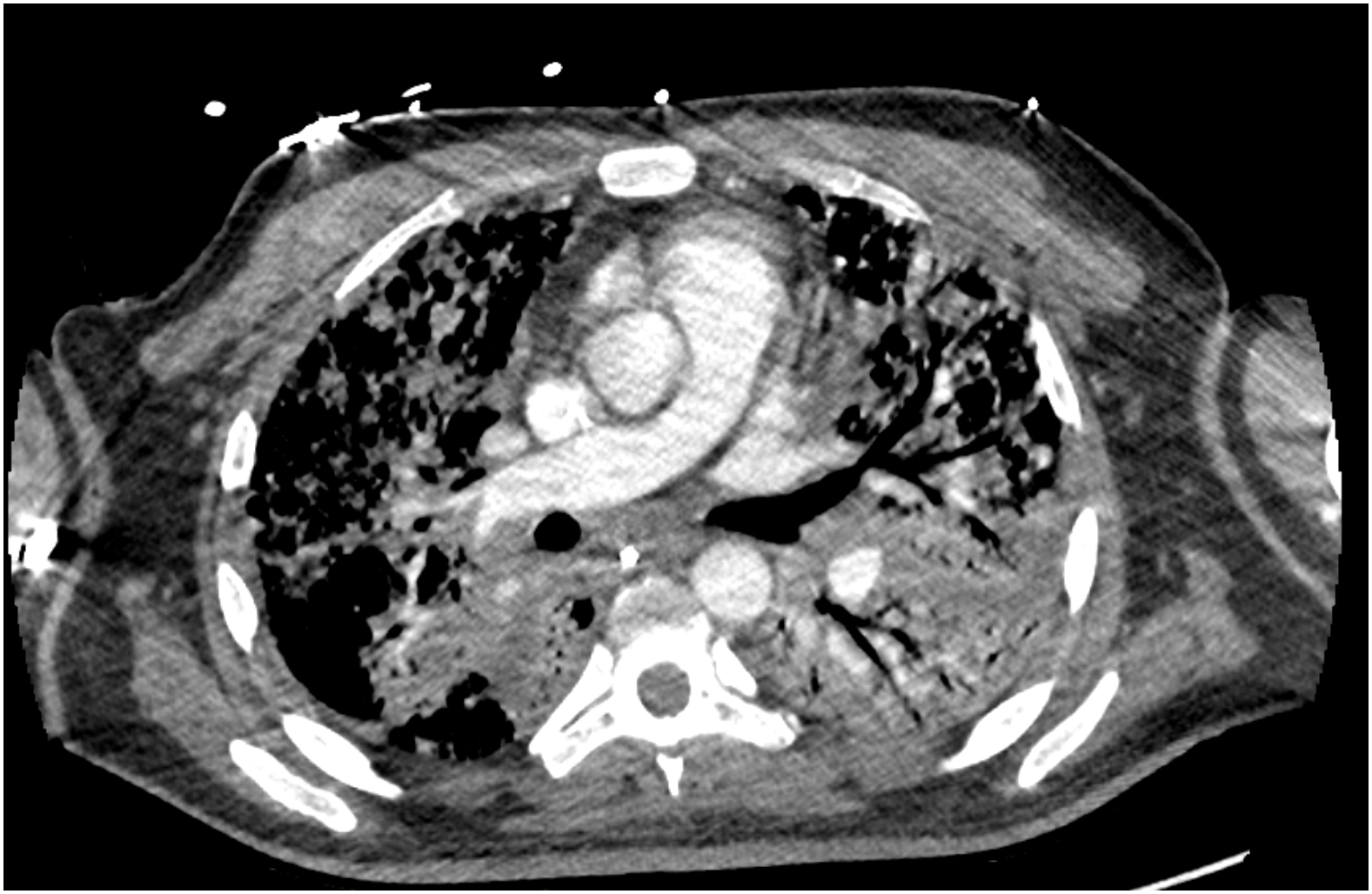
Dr. Victor Tapson, Cedars-Sinai Pulmonary and Critical Care

Dr. Nicolas Gallastegui Crestani, MD UCSD Hematology

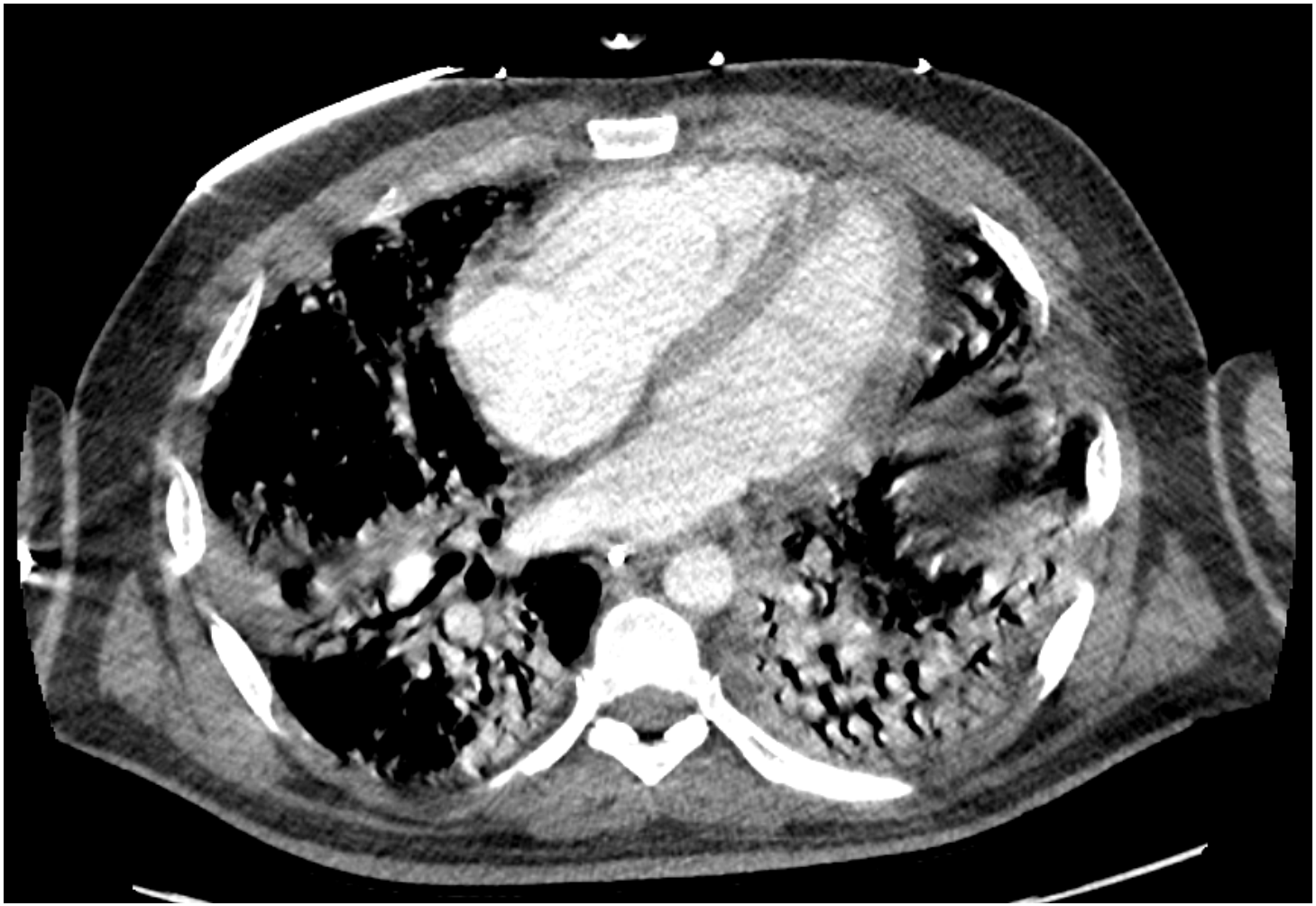
Continued

- Concern for possible PE
  - Empiric treatment with therapeutic heparin (Xa 0.2-0.45)

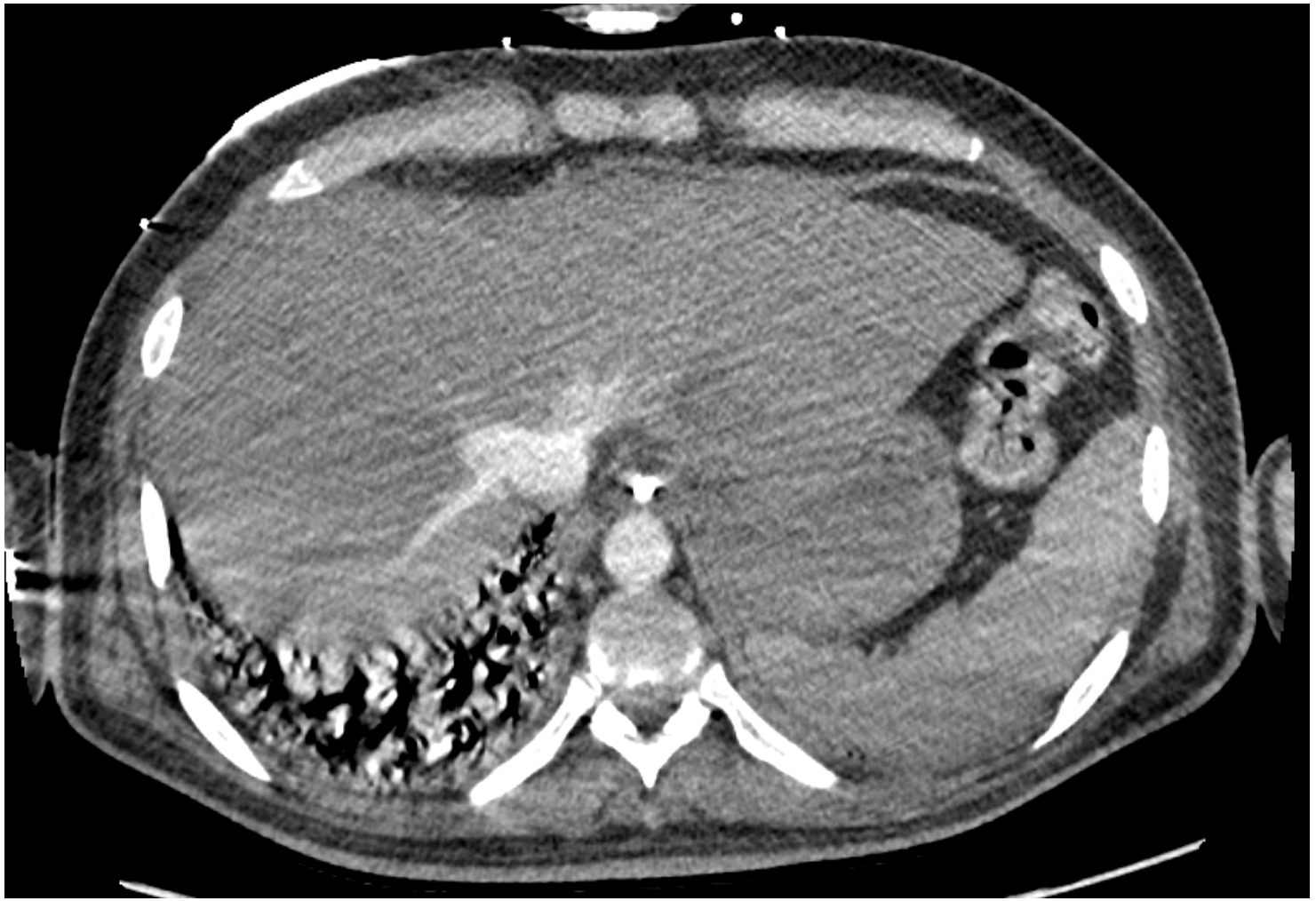
Case 2, CT slide 1



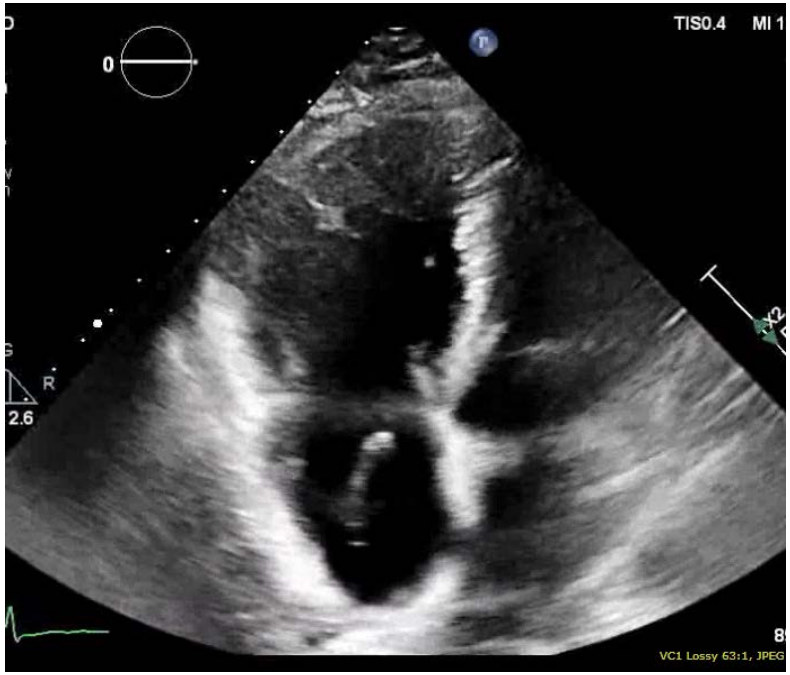
Case 2, CT slide 2

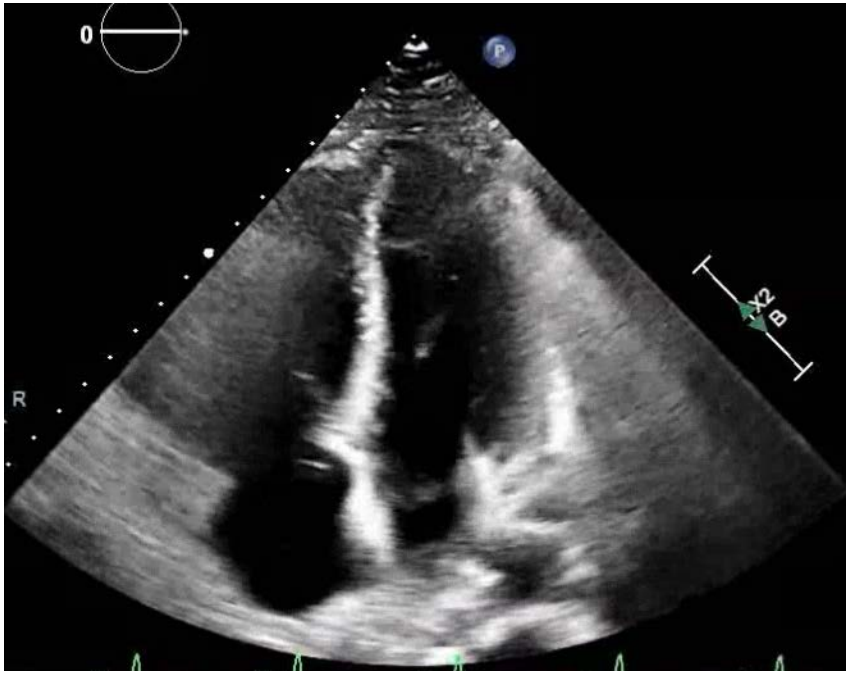


Case 2, CT slide 3



Echocardiogram





Hospital course

- Serial TTE with continued concern for RV thrombus

- Platelets drop from ~250 -> 120 over 4 days
  - PF4 0.446 (normal <0.400 OD) -> transitioned to bivalirudin gtt (Goal PTT 60 to 90 seconds)

Next step?

Dr. Timothy Fernandes, UCSD Pulmonary and Critical Care

Dr. Richard Channick, UCLA Pulmonary and Critical Care

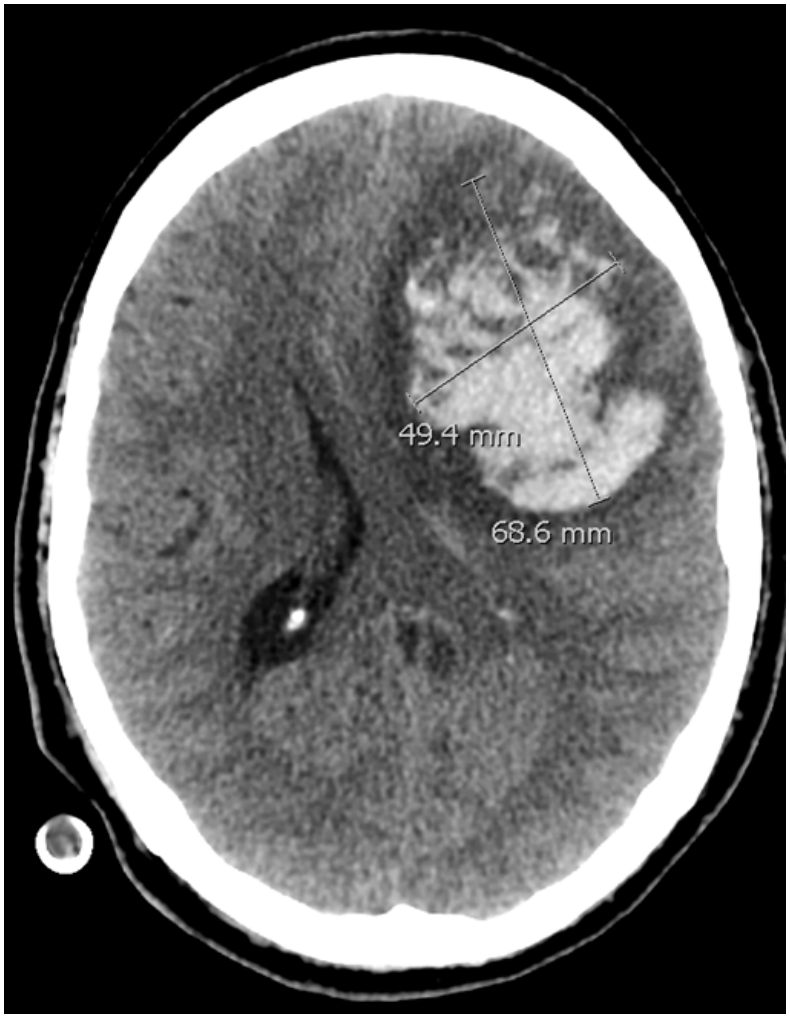
Dr. Victor Tapson, Cedars-Sinai Pulmonary and Critical Care

Dr. Nicolas Gallastegui Crestani, MD UCSD Hematology

Hospital course

- HD 66 - Patient's left pupil is fixed and dilated

CT Head



Hospital course

- HD 71 – Transitioned to Comfort Care

Comments

Dr. Timothy Fernandes, UCSD Pulmonary and Critical Care

Dr. Richard Channick, UCLA Pulmonary and Critical Care

Dr. Victor Tapson, Cedars-Sinai Pulmonary and Critical Care

Dr. Nicolas Gallastegui Crestani, MD UCSD Hematology

UNIVERSITY of CALIFORNIA
SAN DIEGO
SCHOOL OF MEDICINE

Open discussion: COVID-19 and PE