ELSO Webinar 2020.3.30

An assessment of aerosolization via membranous oxygenator and coagulopathy in COVID-19

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Agenda

1. Can COVID-19 cross the membrane of ECMO ?
2. What is known about the coagulopathy in COVID -19

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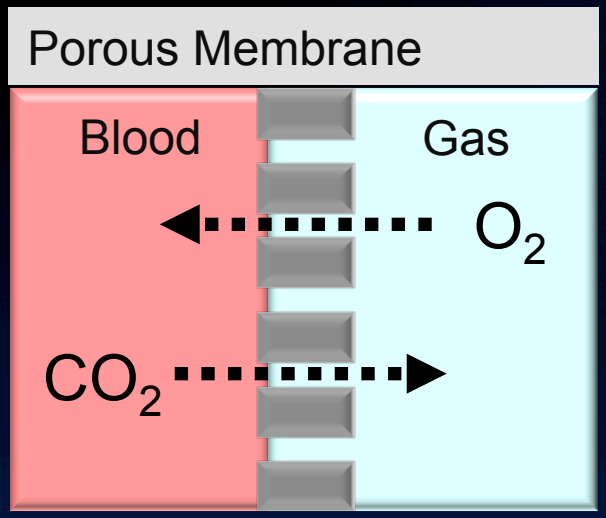
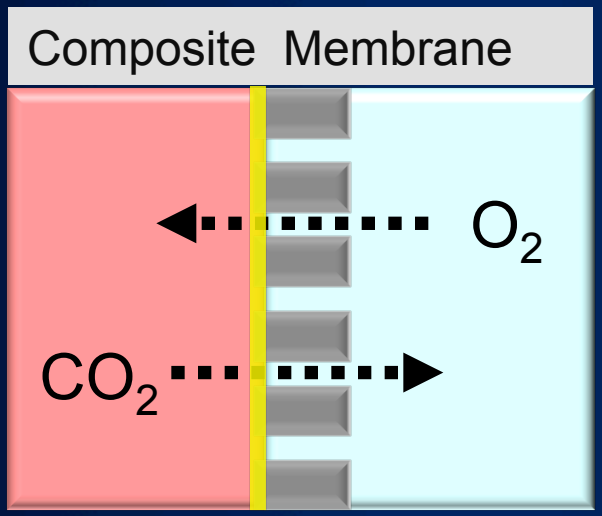
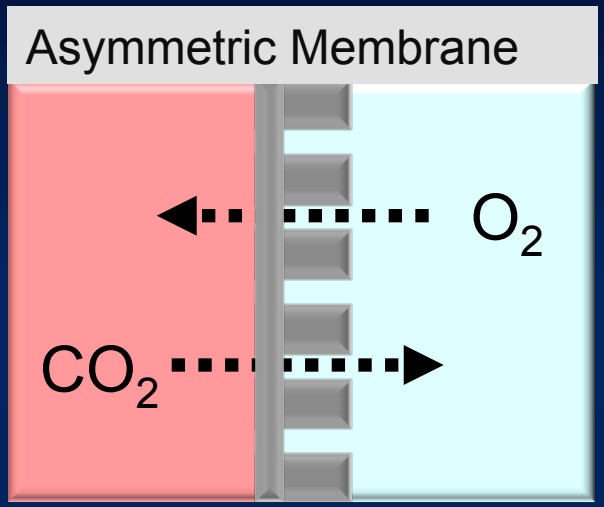
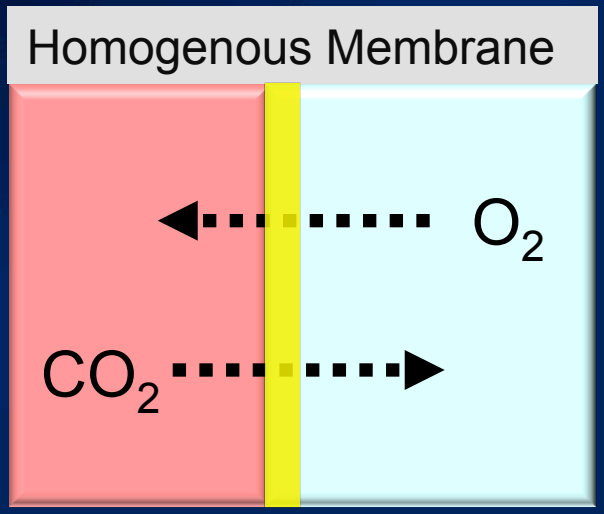
Types of artificial membrane



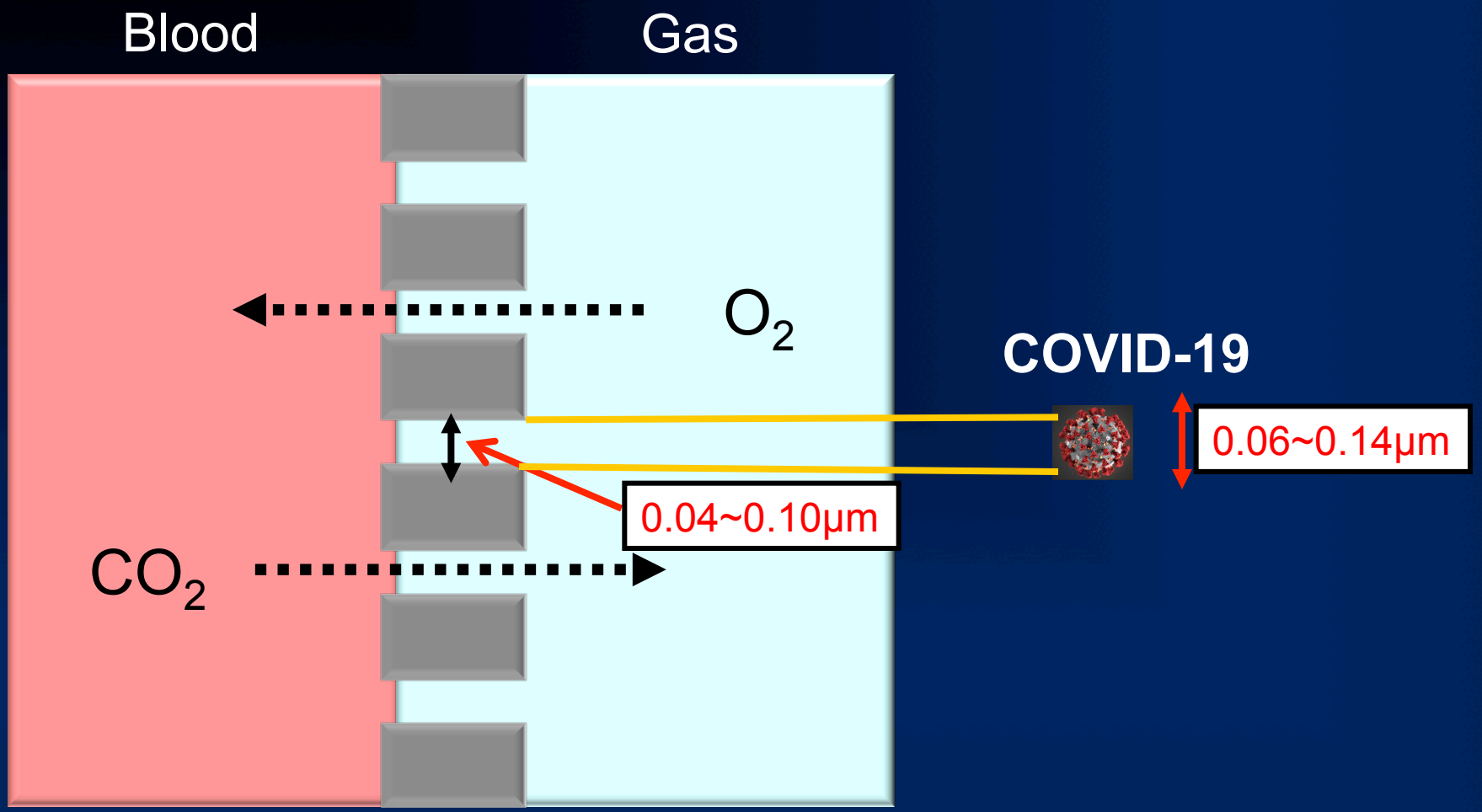




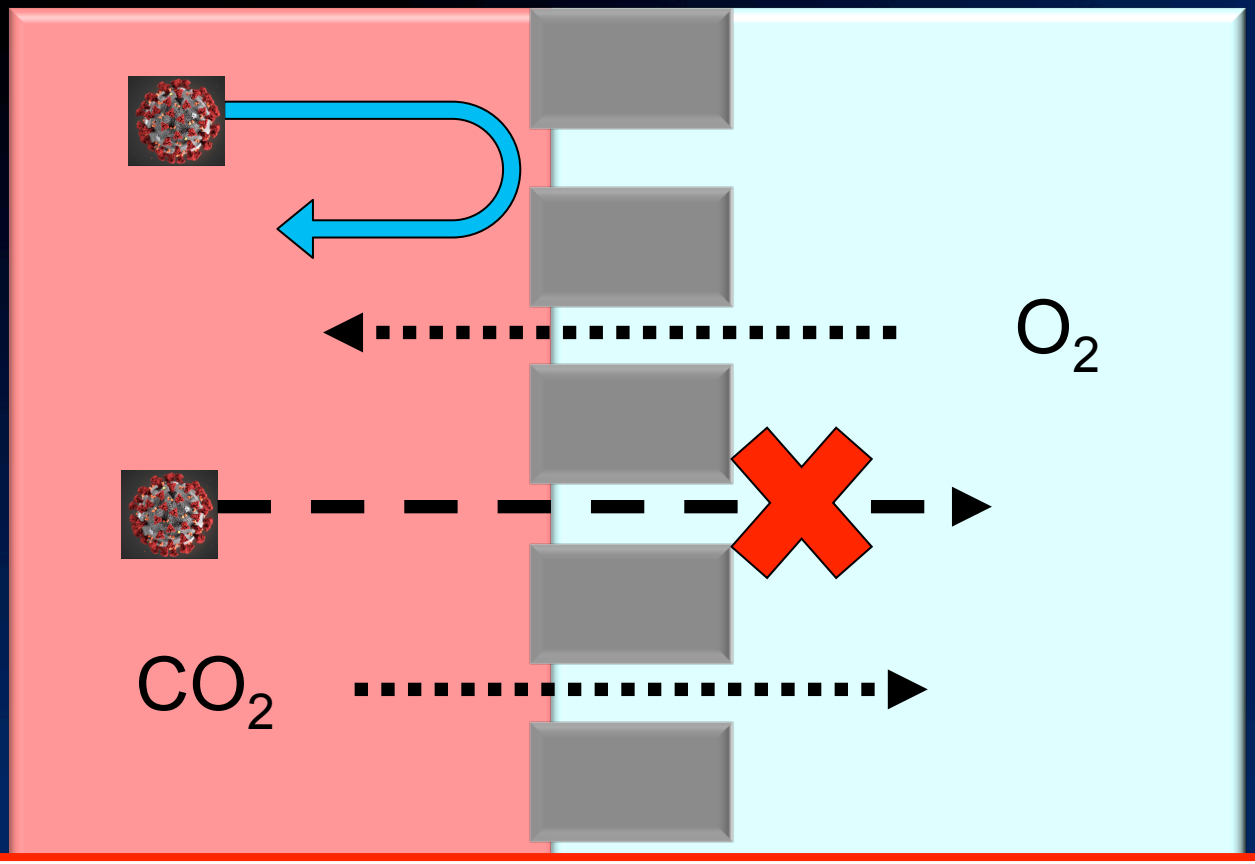


Figures provided from MERA

Comparability of diameters



Permeability of COVID-19

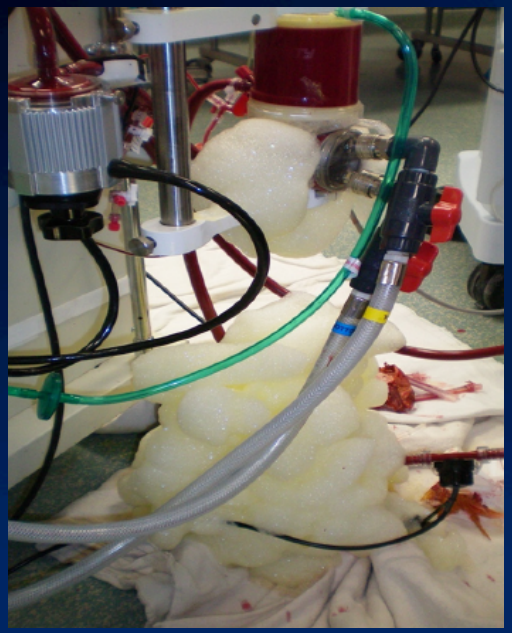


Coating Material ↓ Charge Potential

the risk of crossing membrane is lower than respiratory tract with endotracheal tube and mechanical ventilation

What should bear in mind

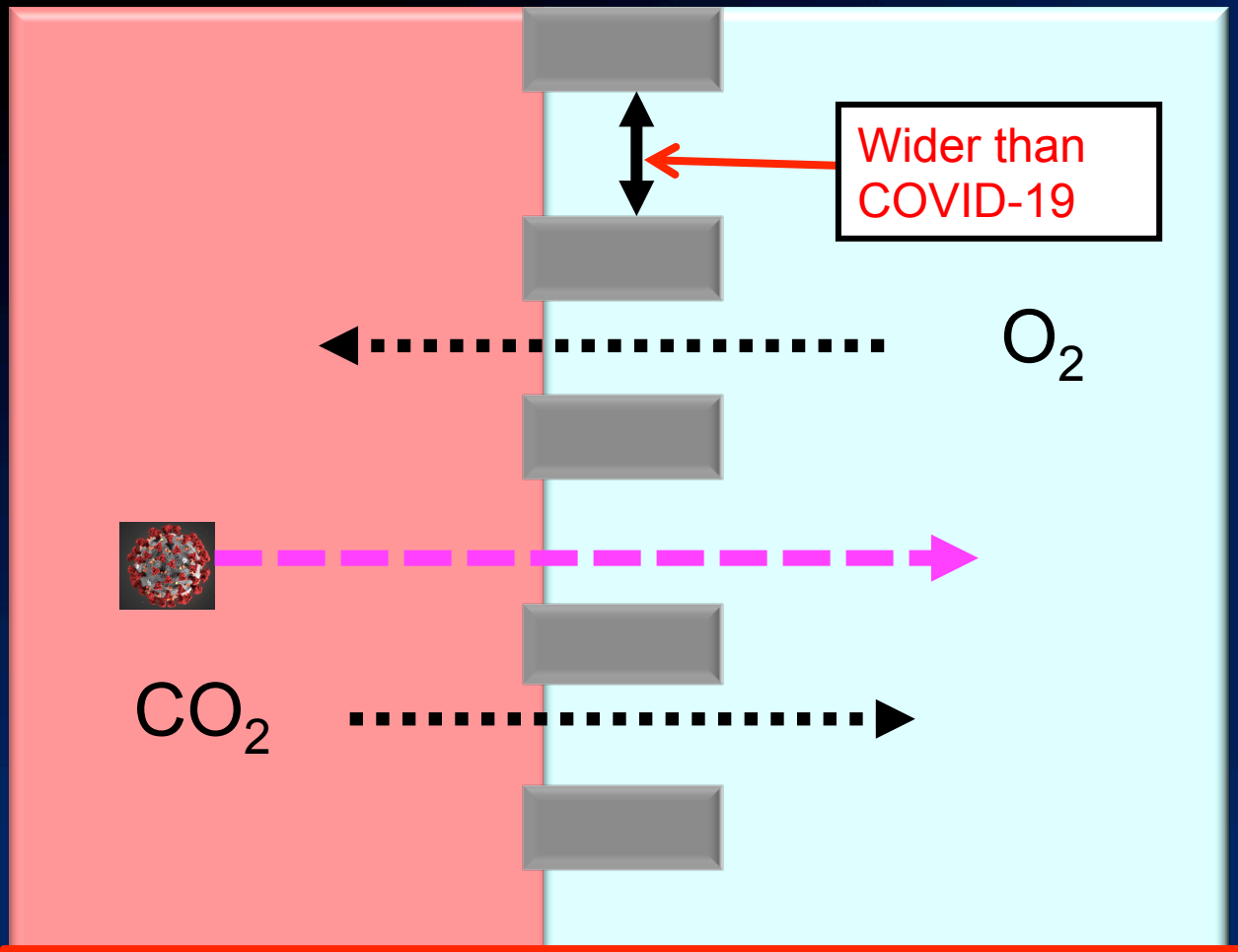
※ When the membrane become deteriorated along with long ECMO run.



(Massey HT, et al.
Ann Cardiothorac Surg.
2019;8(1):32-43.)

Plasma Leak → Aerosolization

Plasma leak is major risk



COVID-19 might go through the membrane

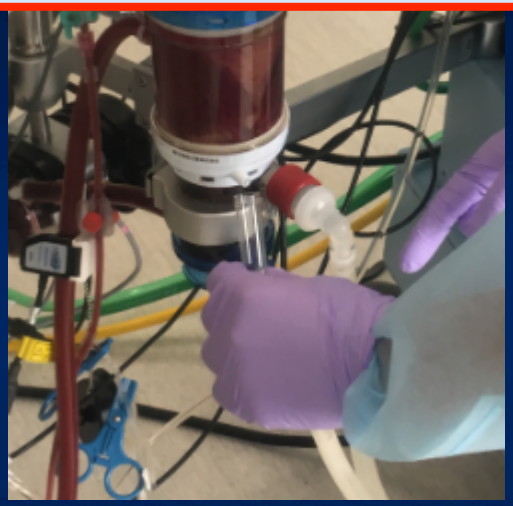
Experiences in Japan

Our Hospital –

10-days long-run membrane without plasma leak

(com apan)

Other hospital got
positive PCR from exhalation port
during plasma leak



→Positive

Exhalation port
→Negative

Approach on this topic

1. Lower the threshold of changing artificial lung

2. Prevent spread of aerosol from the exhalation port, especially during transport.

Agenda

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Coagulopathy in COVID-19

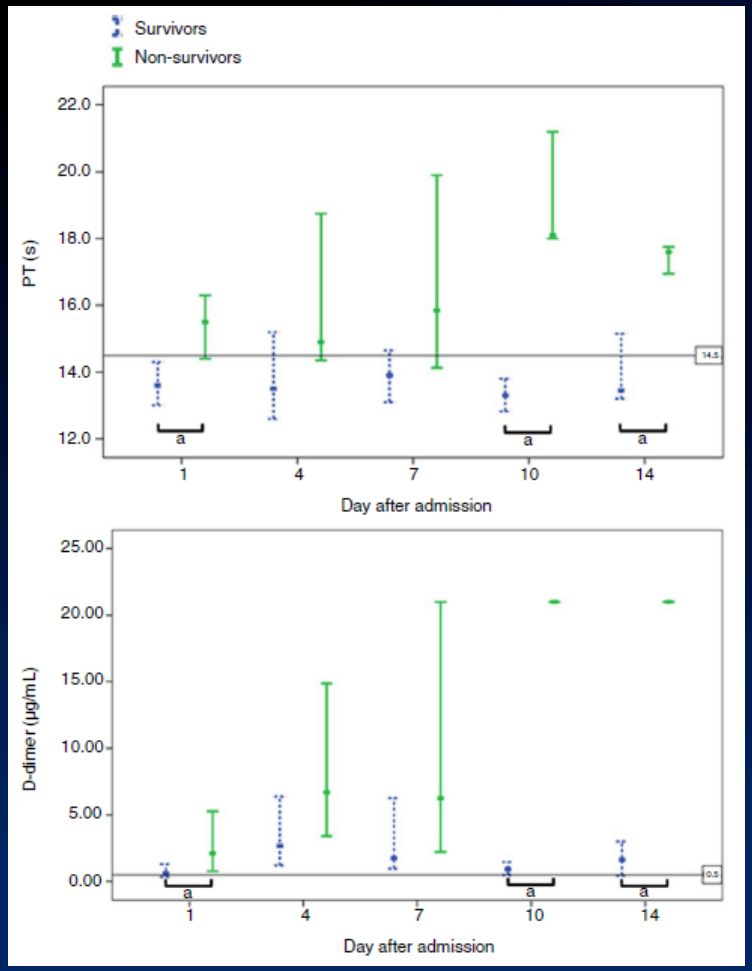
TABLE 1 Coagulation parameters of NCP patients on admission

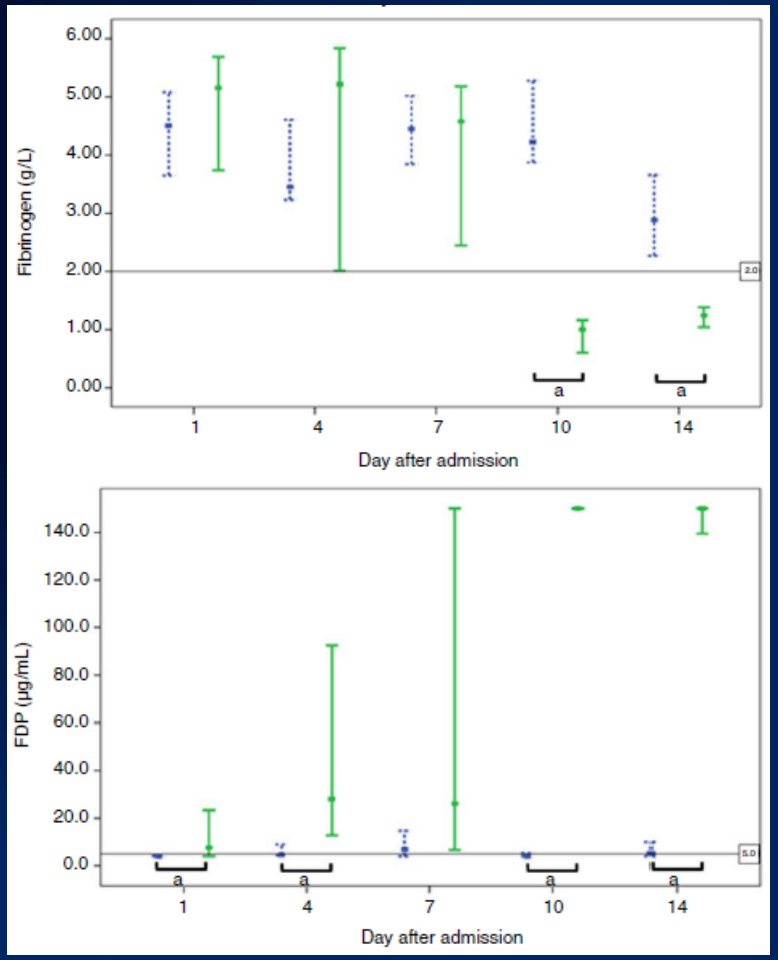
Parameters	Normal range	Total (n = 183)	Survivors (n = 162)	Non-survivors (n = 21)	*P* values
Age (years)		54.1 ± 16.2	52.4 ± 15.6	64.0 ± 20.7	<.001
Sex (male/female)		98/85	82/80	16/5	.035
With underlying diseases		75 (41.0%)	63 (38.9%)	12 (57.1%)	.156
On admission					
PT (sec)	11.5-14.5	13.7 (13.1-14.6)	13.6 (13.0-14.3)	15.5 (14.4-16.3)	<.001
APTT (sec)	29.0-42.0	41.6 (36.9-44.5)	41.2 (36.9-44.0)	44.8 (40.2-51.0)	.096
Fibrinogen (g/L)	2.0-4.0	4.55 (3.66-5.17)	4.51 (3.65-5.09)	5.16 (3.74-5.69)	.149
D-dimer (μg/mL)	<0.50	0.66 (0.38-1.50)	0.61 (0.35-1.29)	2.12 (0.77-5.27)	<.001
FDP (μg/mL)	<5.0	4.0 (4.0-4.9)	4.0 (4.0-4.3)	7.6 (4.0-23.4)	<.001
AT (%)	80-120	91 (83-97)	91 (84-97)	84 (78-90)	.096

Abbreviations: APTT, activated partial thromboplastin time; AT, antithrombin activity; FDP, fibrin degradation product; NCP, novel coronavirus pneumonia; PT, prothrombin time (PT).

(J Thormb Haemost. 2020. Feb 19)

COVID-19 could show DIC





71.4% of the non-survivors matched the International Society on Thrombosis and Haemostasis (ISTH) diagnostic criteria

Coagulopathy is associated with the severity

	All patients (n=41)	ICU care (n=13)	No ICU care (n=28)	p value
Platelet count, x 10^9 per L	164·5 (131·5–263·0)	196·0 (165·0–263·0)	149·0 (131·0–263·0)	0·45
<100	2/40 (5%)	1/13 (8%)	1/27 (4%)	0·45
≥100	38/40 (95%)	12/13 (92%)	26/27 (96%)	..
Prothrombin time, s	11·1 (10·1–12·4)	12·2 (11·2–13·4)	10·7 (9·8–12·1)	0·012
Activated partial thromboplastin time, s	27·0 (24·2–34·1)	26·2 (22·5–33·9)	27·7 (24·8–34·1)	0·57
D-dimer, mg/L	0·5 (0·3–1·3)	2·4 (0·6–14·4)	0·5 (0·3–0·8)	0·0042

Lancet 2020; 395: 497–506

Table 4. Bivariate Cox Regression of Factors Associated With ARDS Development or Progression From ARDS to Death

	ARDS		Death	
Patient characteristics and findings	HR (95% CI)	*P* value	HR (95% CI)	*P* value
Coagulation function				
PT, s	1.56 (1.32-1.83)	<.001	1.08 (0.84-1.38)	.54
APTT, s	0.97 (0.94-1.01)	.13	0.96 (0.91-1.00)	.06
D-dimer, µg/mL	1.03 (1.01-1.04)	<.001	1.02 (1.01-1.04)	.002

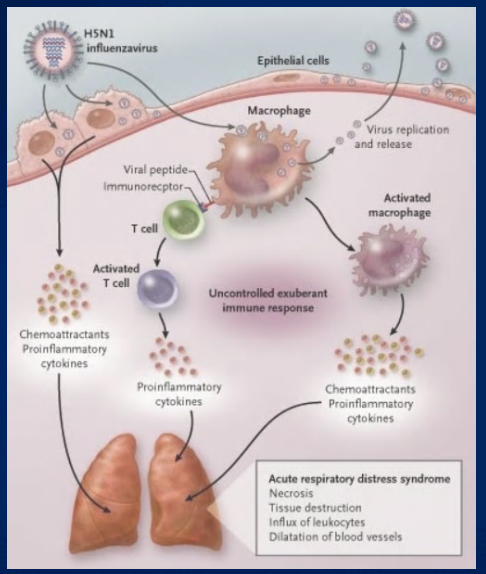
(JAMA Internal Med. 2020. Mar 13)

Underlining mechanism

1. Cytokine storm ? (Lancet 2020. March 13.)

2. elevated ferritin and IL-6 suggesting that mortality might be due to virally driven hyperinflammation ? (Intensive Care Med 2020. March 3.)

The severe cases of COVID-19 might be classified into hyperinflammatory ARDS phenotype



Experiences in Japan

1. Some cases had severe bleeding complications (intracranial hemorrhage, hemothorax, etc)

2. The complication of bleeding is more frequent than that of thrombosis.

3. Some cases showed DIC with hyperfibrinolysis

Approach on this topic

1. Coagulopathy is one of the indicator whether the patients become worse or not (Clin Chem Lab Med. 2020 Mar 16.)

2. Coagulopathy and Cytokine storm might be target to be treated.

3. More data on complication of bleedings and thrombosis is needed.

Take home messages

1. Virus might cross membrane during the plasma leak

2. Coagulopathy is associated with the severity of COVID-19 and death.

3. Coagulopathy might be a indicator of disease progression and a target to be treated.

Thank you for kind attention

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