



COVID & ECMO Paris experience...

Guillaume LEBRETON, MD, PhD

Associate Professor of Cardiac surgery

Director of CPB & ECMO programs

Pitié Salpêtrière Hospital, Sorbonne University, Paris



COVID & ECMO... *It will not work !*

About pathophysiology & cytokines ...

COVID-19, ECMO, and lymphopenia: a word of caution

Extracorporeal membrane oxygenation (ECMO) can serve as life-saving rescue therapy for refractory respiratory failure in the setting of acute respiratory distress syndrome, such as that induced by coronavirus disease 2019 (COVID-19). In the study by Yang and colleagues,¹ who compared clinical characteristics and outcomes in patients with severe COVID-19, five (83%) of six patients receiving ECMO died. Although this sample was small, and specific baseline characteristics and disease courses were almost unknown, it raises concerns about potential harms of ECMO therapy for COVID-19.

Lymphocyte count has been associated with increased disease severity in COVID-19.^{1,2} Patients who died from COVID-19 are reported to have had significantly lower lymphocyte counts than survivors.² As such, we need to consider the potential compounding immunological insults involved with initiation of an extracorporeal circuit in these patients. During ECMO, substantial decreases in the number and function of some populations of lymphocytes is commonplace.³ As it might be hypothesised that repletion of lymphocytes could be key to recovery from COVID-19, lymphocyte count

should be closely monitored in these patients receiving ECMO.

Ruan and colleagues² also showed that interleukin-6 (IL-6) concentrations differed significantly between survivors and non-survivors of COVID-19, with non-survivors having up to 1-7-times higher values. During ECMO, IL-6 concentrations are consistently elevated and inversely correlated with survival in children and adults.⁴ Those that survived ECMO were able to normalise their IL-6 concentrations, whereas those that died had persistently elevated values. Moreover, elevated IL-6 concentrations in lung induced by initiation of ECMO have been convincingly shown to be associated with parenchymal damage in animal models of venovenous ECMO.⁵

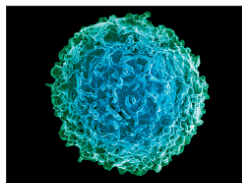
While not to discourage the use of ECMO, based on the abovementioned observations, the immunological status of patients should be considered when selecting candidates for ECMO. More reports are needed to understand the potential benefits or harms of extracorporeal life support in severe COVID-19 and future authors should be encouraged to provide more data for this subset of patients. Lastly, clinicians should consider tracking both lymphocyte count and IL-6 during ECMO to monitor patient status and prognosis.

I declare no competing interests.

Brandon Michael Henry
brandon.henry@cchmc.org

Cardiac Intensive Care Unit, The Heart Institute, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45229, USA; and Pediatric COVID-19 Open Data Analysis Group, Cincinnati, OH, USA

- 1 Yang X, Yu Y, Xu J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med* 2020; published online Feb 24. [https://doi.org/10.1016/S2213-2600\(20\)30079-5](https://doi.org/10.1016/S2213-2600(20)30079-5).
- 2 Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive Care Med* 2020; published March 3. DOI:10.1007/s00134-020-05991-x.
- 3 Bizzarro MJ, Conrad SA, Kaufman DA, Rycus P. Infections acquired during extracorporeal membrane oxygenation in neonates, children, and adults. *Pediatr Crit Care Med* 2011; 12: 277-81.
- 4 Risnes I, Wagner K, Ueland T, Mollnes T, Aulkrust P, Svennevig J. Interleukin-6 may predict survival in extracorporeal membrane oxygenation treatment. *Perfusion* 2008; 23: 173-78.
- 5 Shi J, Chen Q, Yu W, et al. Continuous renal replacement therapy reduces the systemic and pulmonary inflammation induced by venovenous extracorporeal membrane oxygenation in a porcine model. *Artif Organs* 2014; 38: 215-23.



© 2019 Wellcome Open Access, under CC BY. National Institute of Health's Science Photo Library



Published Online
March 13, 2020
[https://doi.org/10.1016/S2213-2600\(20\)30119-3](https://doi.org/10.1016/S2213-2600(20)30119-3)

SARS Cov 2: inflammation +++

- IL6 provokes lung injury, ARDS
- Non survivors
 - *increased IL6*
 - *low Lymphocytes*

ECMO provokes inflammation

- increase IL6 level
- Parenchymal damage (animal)
- ECMO will make patients worse

COVID: No place for ECMO ?

www.thelancet.com/respiratory Vol 8 April 2020





COVID & ECMO... *It will not work !*

About Chinese experience...

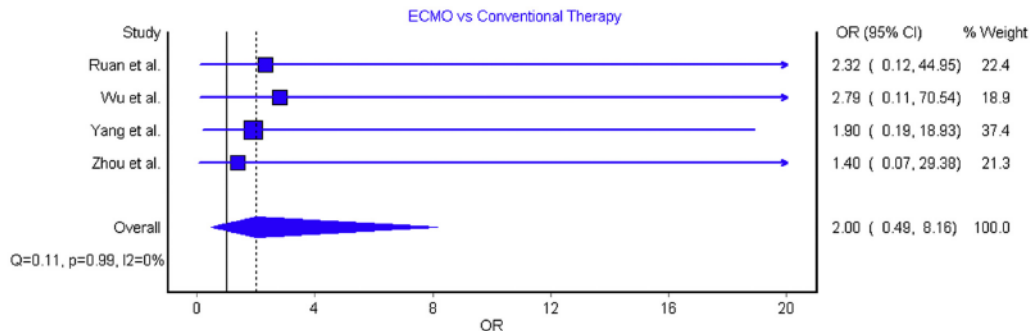
Letter to the Editor

Poor survival with extracorporeal membrane oxygenation in acute respiratory distress syndrome (ARDS) due to coronavirus disease 2019 (COVID-19): Pooled analysis of early reports



Brandon Michael Henry

Cardiac Intensive Care Unit, The Heart Institute, Cincinnati Children's Hospital Medical Center, OH, USA



Authors	Age (yrs): ^a	# of patients: n = (# ARDS patients)	Conventional ARDS Therapy: n=	Conventional ARDS Therapy Survivors: n (%)	ECMO: n=	ECMO -Survivors: n (%)
Ruan Q et al. 2020	Survivors: 67 (15-81) Non-Survivors: 50 (44-81)	150 (62)	55	7 (12.7%)	7	0 (0%)
Wu et al. 2020	51 (43-60)	210 (84)	83	40 (48.2)	1	0 (%)
Yang X et al. 2020	59.7 (13.3)	52 (35)	29	9 (31.0%)	6	1 (16.6%)
Zhou F et al. 2020	56.0 (46.0-67.0)	191 (59)	56	9 (16.1%)	3	0 (0%)

^a Data presented as mean (SD) or median (IQR). ARDS - Acute Respiratory Distress Syndrome.





COVID & ECMO... *in Paris*

Regional network & Centralization



**ECMO COVID
Practical guide**



**Hotline
COVID ECMO**



**Expert group
Bi-Weekly visio**

Expert group

Hotline COVID ECMO

- Indications
- Bed management
- Mobile unit

ECMO Pooling

- *Pumps, circuits,...*

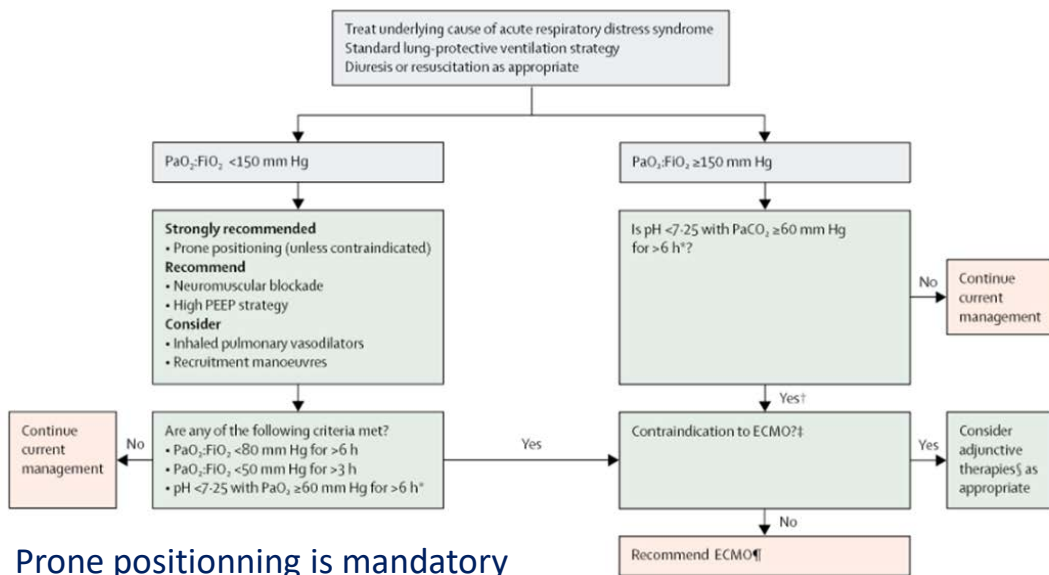
Continuous follow-up

- Results assessment
- Adjustment of (contra-)indications
- Stock management...



COVID & ECMO... in Paris

Indications & network



Prone positioning is mandatory

Strict EOLIA criteria

Lancet Resp Med , 2019

Contra-indications

- Age > 65yrs
- Severe Comorbidities
- Advanced COPD, cardiac failure, Cirrhosis (Child B/C), home O2...
- Severe immunocompromised status
- Hematological cancer, advanced cancer...
- Cardiac arrest
- Except witnessed, with bystander CPR, low-flow <15 minutes
- MV duration > 10 days
- Multiple organ failure
- Except isolated AKI...
- BMI>35 kg/m2





COVID & ECMO... *in Paris*

Regional network & Centralization



ECMO COVID
Practical guide



Hotline
COVID ECMO



Expert group
Bi-Weekly visio

Expert group

Hotline COVID ECMO

- Indications
- Bed management
- Mobile unit

ECMO Pooling

- *Pumps, circuits,...*

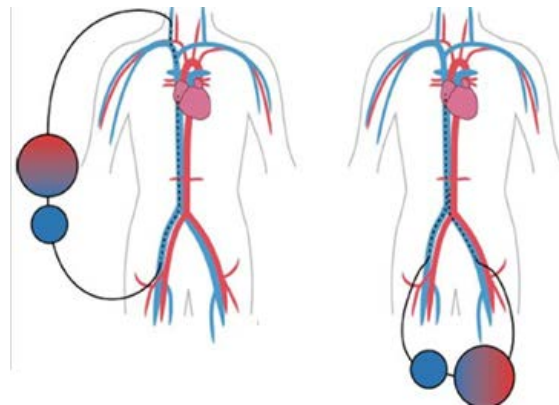
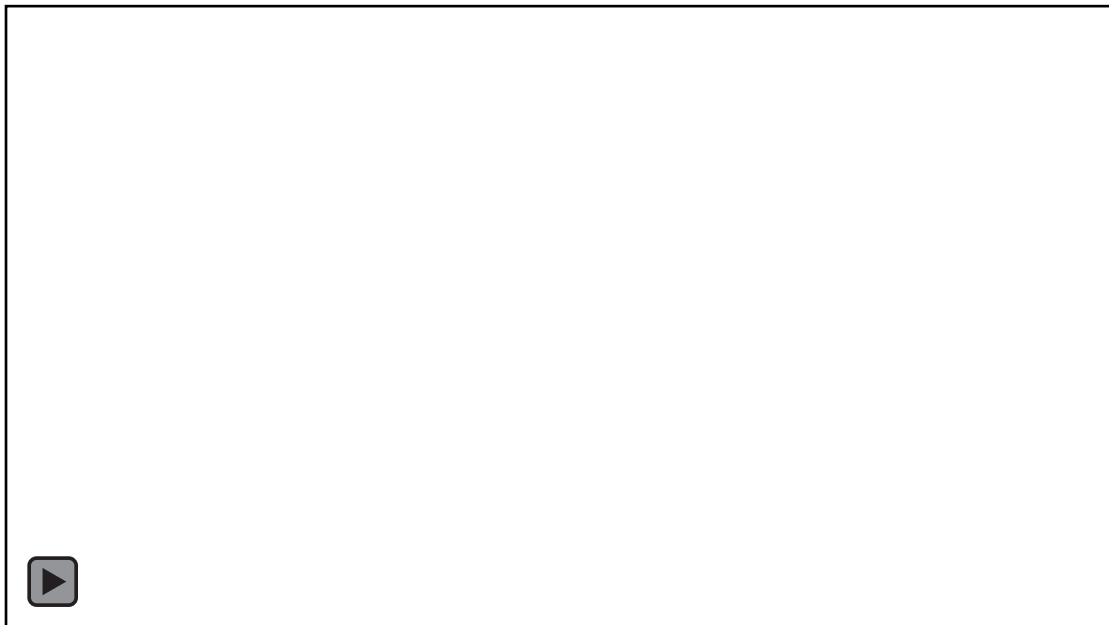
Continuous follow-up

- Results assessment
- Adjustment of (contra-)indications
- Stock management...



COVID & ECMO... *in Paris*

Mobile Unit & ECMO implantation



VV ECMO	Drainage	Reinjection
Femoro-jugular	Venous Canula 25-29 Fr 55 cm	Arterial canula 19-21-23 Fr 15 cm
Femoro-femoral		Venous Canula Distal reinjection 19Fr 60 cm



COVID & ECMO... in Paris

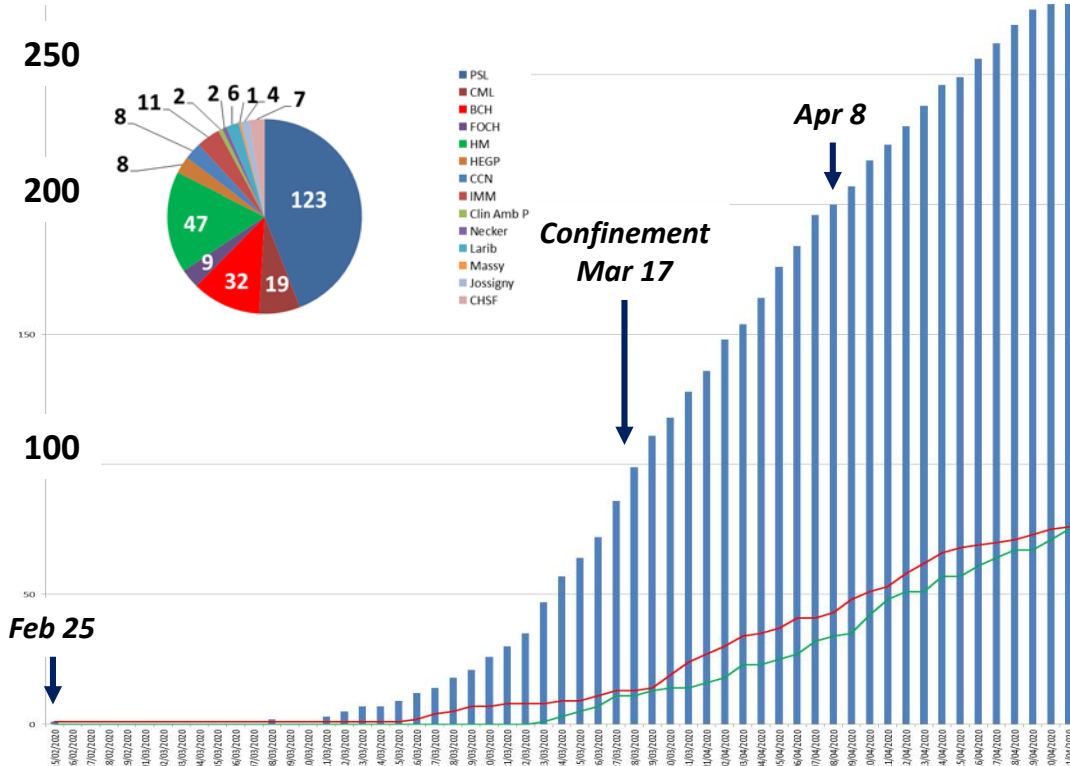
ECMO Implantations

Apr 21:
279

Paris Area – 21% COVID: ICU
ICU: 1200 beds increased to 2600
15 ECMO centers (CTS centers)

Feb 25th – Apr 21st	279 patients
Female	20.3%
Age	51 ± 9.2
BMI	29.9 ± 4.8
Mec. Vent.	5.5 [3-7] days
pH	7.3 [7.26 - 7.36]
PaO2	61 [55-70]
PaCO2	60 [50.7-69.7]
P/F	60 [55.2-69]
PEEP	12 [10-14]
Plat P	30 [30-32]
Vt	400 [360-430]
RR	30 [28-32]

Courtesy A Combes





COVID & ECMO... *in Paris*

Stock management

ECMO shortage

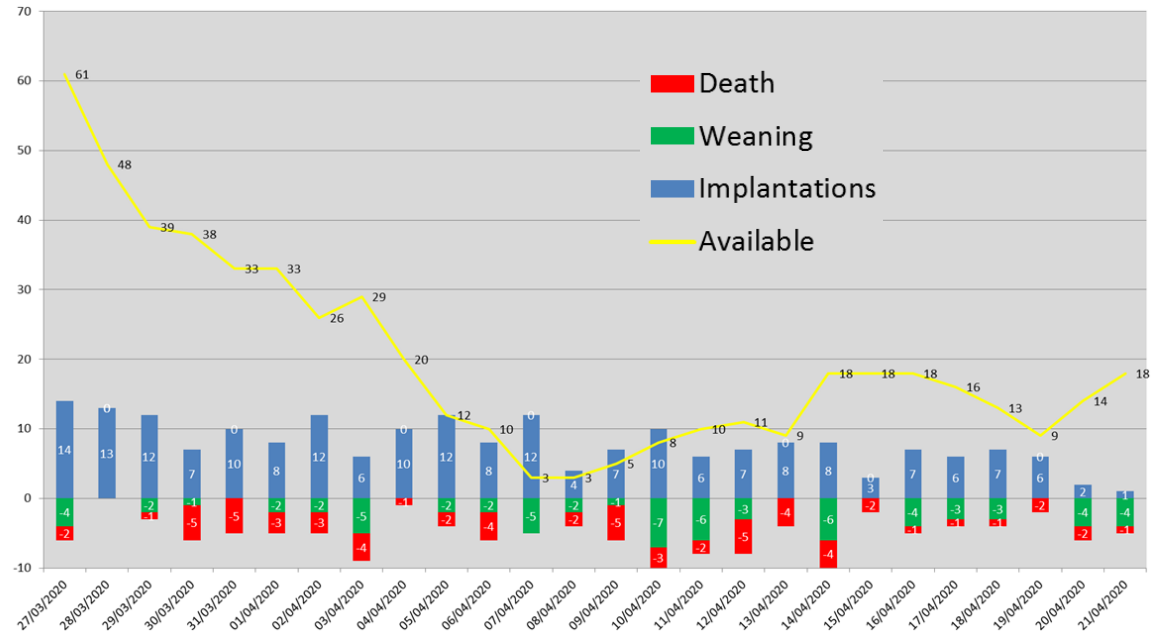
Continuous follow-up

ECMO Pooling

- Pump
- Circuits
- Cannula

Few new pumps

- Companies
- France (little affected regions)...
- Germany/Austria





COVID & ECMO... *in Paris*

Regional network & Centralization



ECMO COVID
Practical guide



Hotline
COVID ECMO



Expert group
Bi-Weekly visio

Expert group

Hotline COVID ECMO

- Indications
- Bed management
- Mobile unit

ECMO Pooling

- *Pumps, circuits,...*

Continuous follow-up

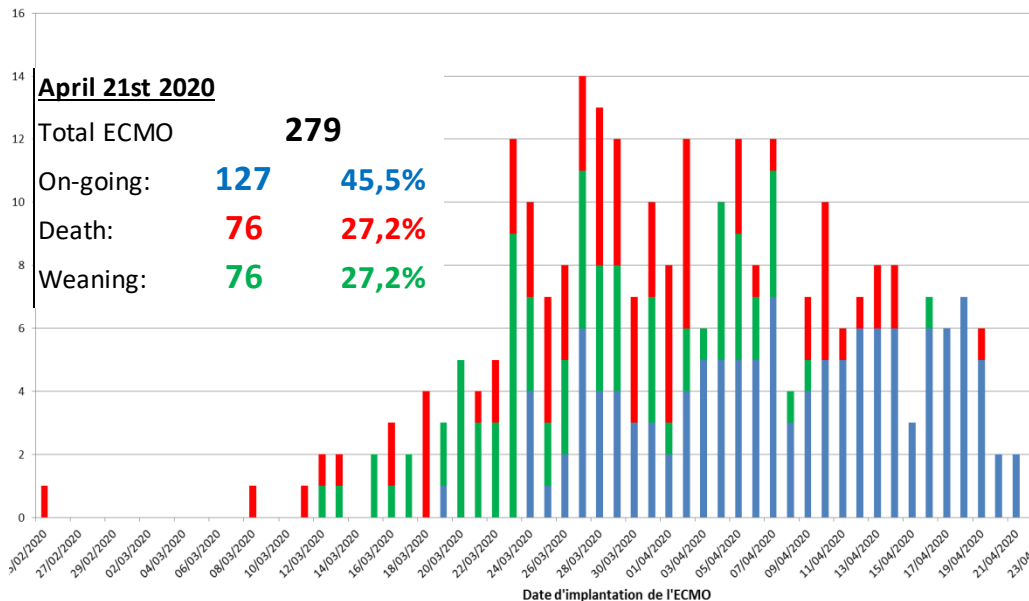
- Results assessment
- Adjustment of (contra-)indications
- Stock management...



COVID & ECMO... in Paris

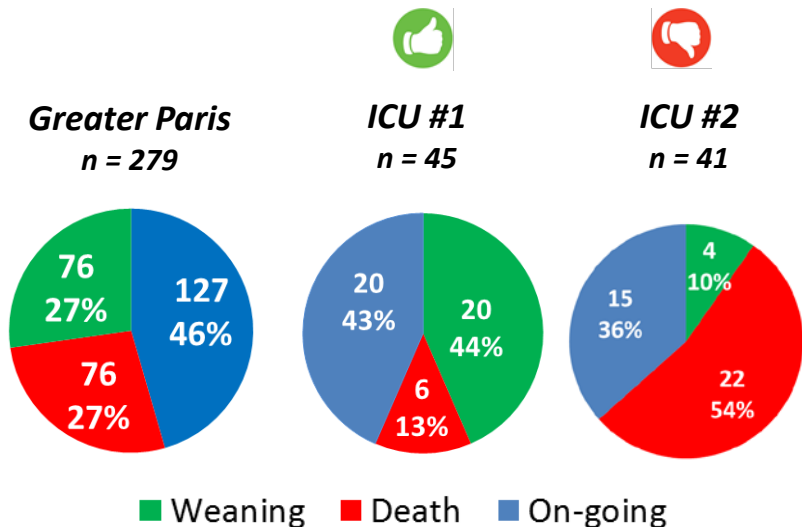
Preliminary Results

Still on-going...



Different centers...

... different results





COVID & ECMO... *in Paris*

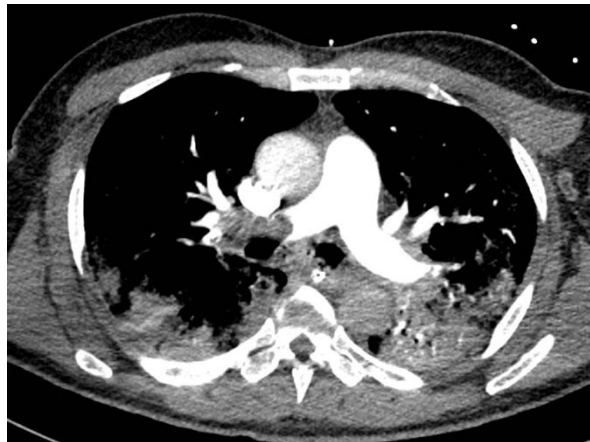
Anticoagulation

COVID: Thromboembolism & coagulopathy

Pulmonary embolism +++

In one ICU (A. Combes), about 51 patients:

- 3 PE with cardiogenic shock
- 4 PE under ECMO support !!!
- 1 died before ECMO: autopsy = PE



Sars Cov 2:



- ↗ D-dimeres
- ↗ FDPs, PT
- ↘ Platelets

VV ECMO COVID



- Ratio TCA = 2-2,5
- antiXa = 0.3 UI/mL
- IV Unfractionned Heparin +++



COVID & ECMO... *in Paris*

Take home messages

NOT ALL PATIENTS DIE ON ECMO !!!

Most patients stabilized while on ECMO

SARS Cov 2 & ARDS

- VERY severe lung disease
- **Good Anticoagulation** is mandatory +++
- **Expert centers** +++

TOO EARLY TO DRAW ANY CONCLUSIONS

We need time to evaluate our results

- *Some patients weaned <10 days of ECMO*
- *Few patients extubated & ICU discharged*
- *Others may require weeks of support*





Guillaume LEBRETON

Department of Thoracic & Cardiovascular Surgery
Pitié-Salpêtrière Hospital, Sorbonne University, Paris
guillaume.lebreton@aphp.fr