ECMO TRONG COVID - 19

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NỘI DUNG

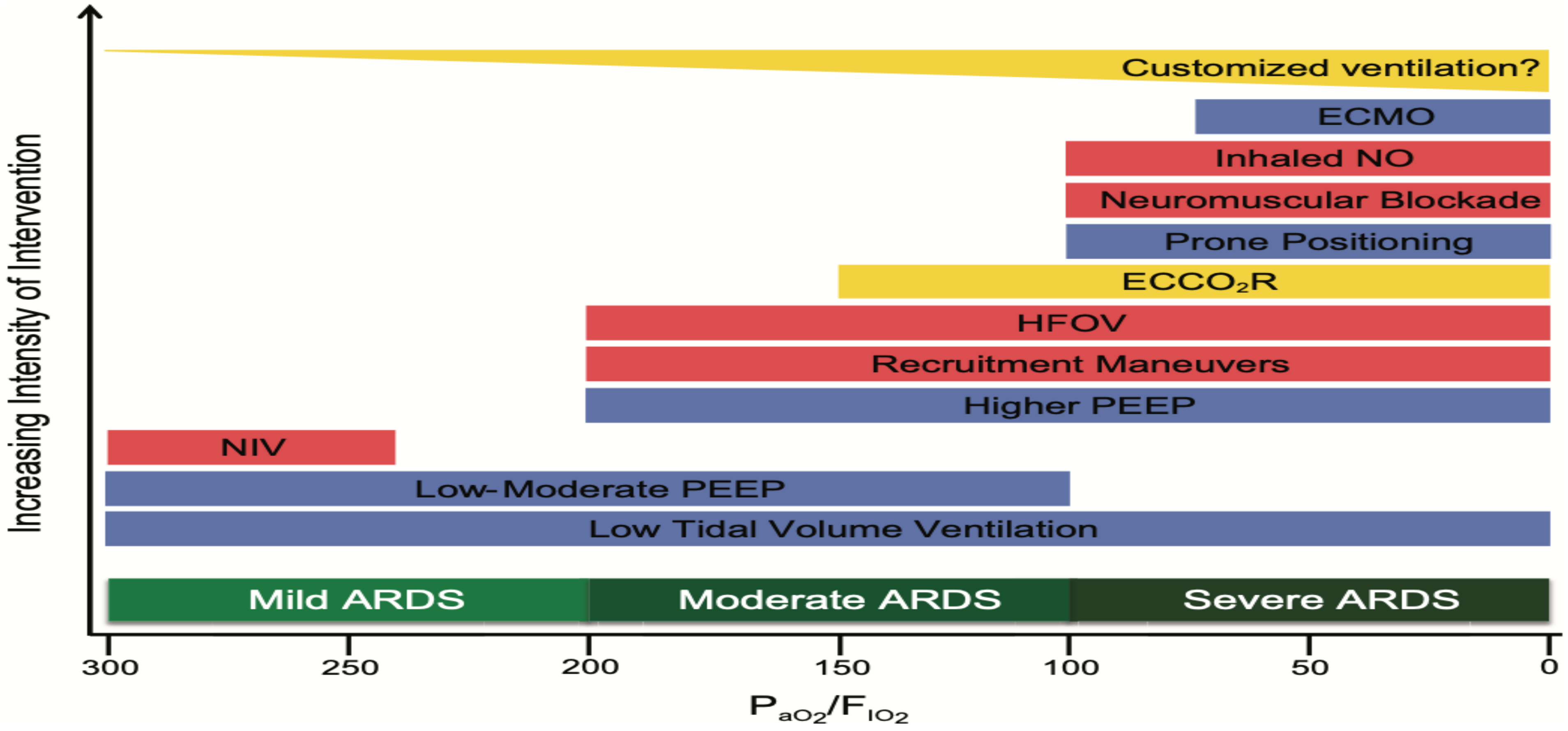
1. Vai trò của ECMO trong COVID -19
2. Điều kiện để vận hành ECMO
3. Chỉ định và chống chỉ định của ECMO trong COVID -19
4. Cách đặt ECMO
5. Theo dõi ECMO
6. Cai ECMO

Đặc điểm lâm sàng COVID - 19

- Thời gian trung bình diễn tiến đến ARDS: 8-12 ngày
- Tỉ lệ ARDS:
    - So với tổng số bệnh COVID: 3%–17%
    - So với số bệnh nhân nhập viện: 20% – 42%
    - So với số bệnh nhân nhập ICU: 67% – 85%
- Tỉ lệ shock tim: ?
- Tử vong ARDS: >70%

https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html

Biện pháp hỗ trợ hô hấp



Fan 2020 "Management of Severe ARDS: New Strategies and Ongoing Challenges" RESPIRATORY CARE APRIL 2020 VOL 65 NO 4

Tử vong ở ECMO – COVID

39%

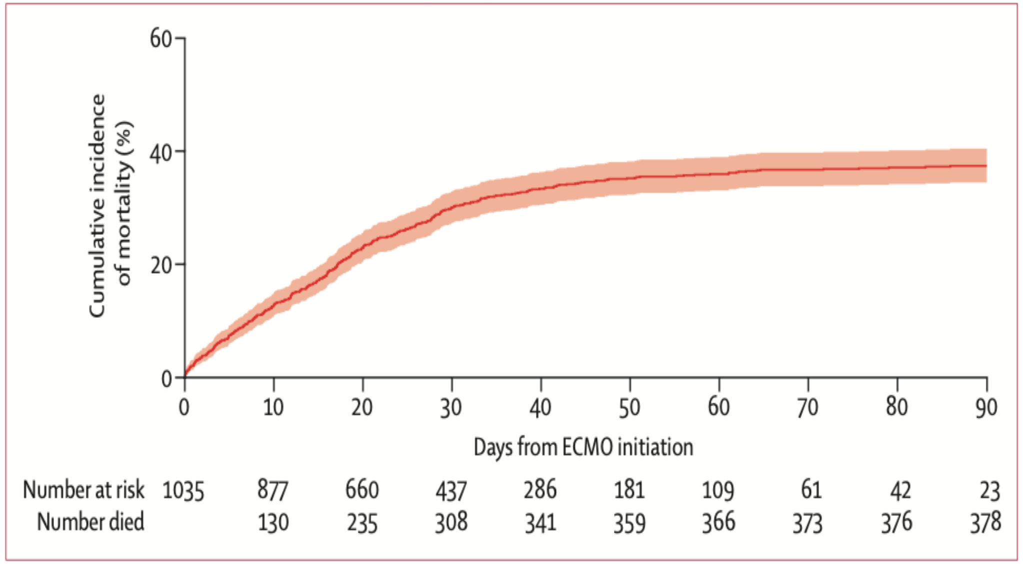
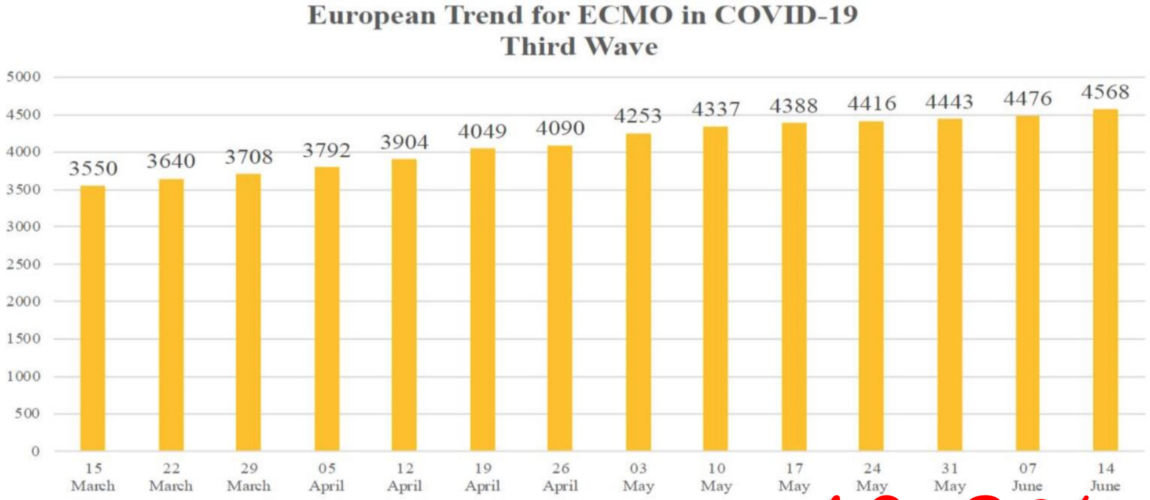
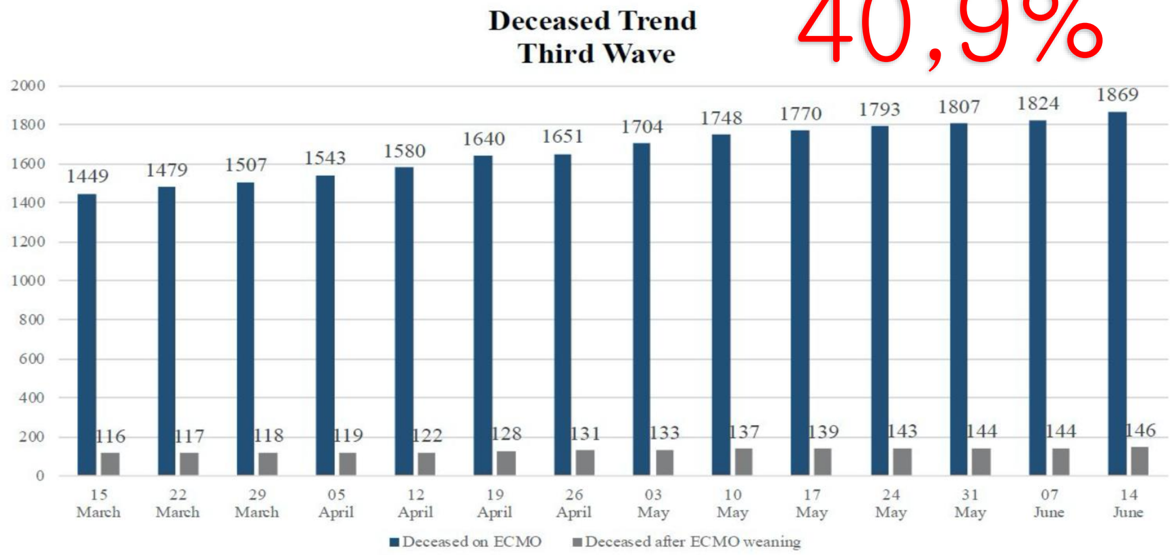


Figure 2: Cumulative incidence of mortality from time of ECMO initiation

Barbaro 2020 Extracorporeal membrane oxygenation support in COVID-19/ an international cohort study of the Extracorporeal Life Support Organization registry Lancet 2020; 396: 1071-78



40,9%



https://www.euroelso.net/covid-19/covid-19-survey/

ECLS Registry Report

International Summary

April, 2021

Report data through 2020

Extracorporeal Life Support Organization
3001 Miller Rd
Ann Arbor, MI 48103 USA

	Total Runs	Survived ECLS		Survived to DC or Transfer	
Neonatal					
Pulmonary	33,400	29,255	87%	24,398	73%
Cardiac	9,561	6,605	69%	4,186	43%
ECPR	2,244	1,574	70%	953	42%
Pediatric					
Pulmonary	11,168	8,084	72%	6,746	60%
Cardiac	13,945	10,103	72%	7,520	53%
ECPR	5,630	3,341	59%	2,388	42%
Adult					
Pulmonary	33,313	22,612	67%	19,734	59%
Cardiac	32,307	19,252	59%	14,378	44%
ECPR	10,115	4,213	41%	3,030	29%
Total	151,683	105,039	69%	83,333	54%

ECMO V-A ở Bệnh nhân COVID-19

Biểu hiện trên hệ tim mạch:

- Nhồi máu cơ tim
- Thuyên tắc phổi
- Bệnh cơ tim
- Rối loạn nhịp
- Hội chứng vành cấp
- ...

	17 May	24 May	31 May	07 June	14 June
V-V ECMO	91,6%	91,6%	91,6%	91,6%	91,7%
V-A ECMO	5%	5%	5%	5%	4,9%
Others	3,4%	3,4%	3,4%	3,4%	3,4%

https://www.euroelso.net/covid-19/covid-19-survey/

ECMO TRONG COVID – 19:

CHUẨN BỊ "TRUNG TÂM" ECMO

Chuẩn bị

- **Nguồn lực:** trung tâm ECMO, trang thiết bị.
- **Con người:** "team" được đào tạo về chăm sóc bệnh nhân ECMO.
- **Qui trình:** Đặt và rút ECMO, kiểm soát nhiễm khuẩn, an toàn cho nhân viên y tế

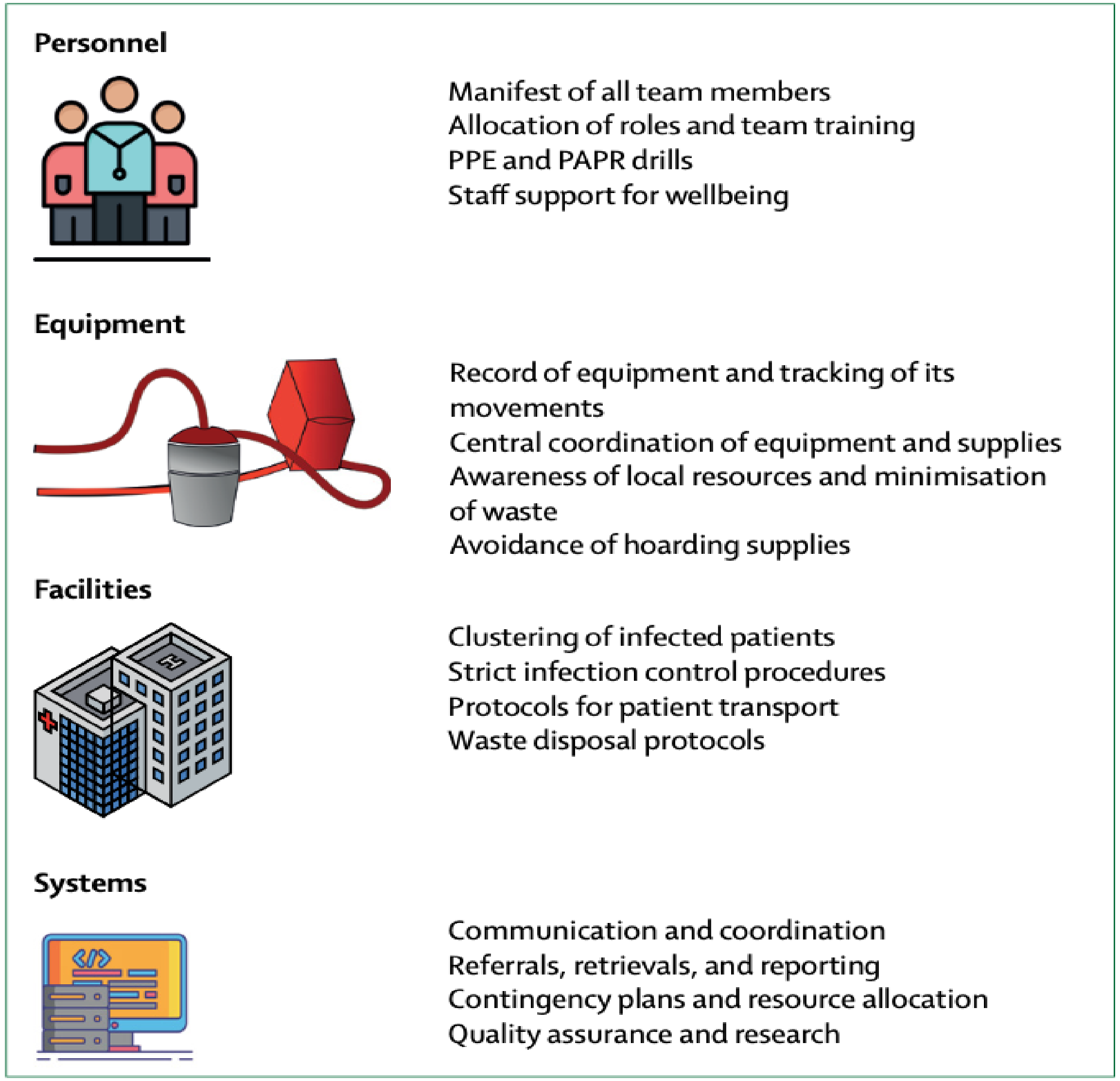
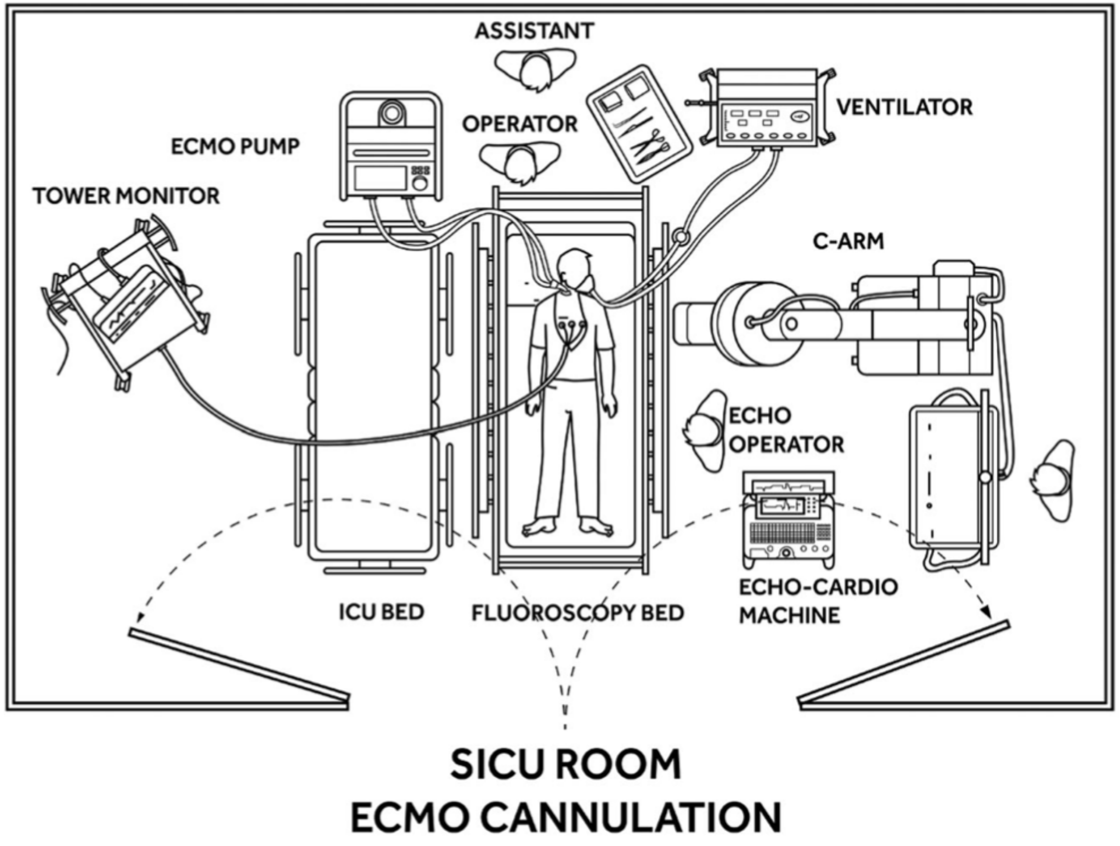


Figure 2: **Key elements for planning of ECMO services**

Ramanathan 2020 "Planning and provision of ECMO services for severe ARDS during the COVID-19 pandemic and other outbreaks of emerging infectious diseases" Lancet Respir Med 2020; 8: 518–26

Đặt canuyn – Chuẩn bị

- Thiết lập phòng đặt canuyn phù hợp với môi trường COVID-19.
- Thiết lập "team" đã được đào tạo về ECMO
- Nên sử dụng an thần, dãn cơ trong quá trình đặt canuyn
- Trang bị PPE đầy đủ
- Sử dụng x-quang, siêu âm tại giường để hướng dẫn hơn là đặt "mù"



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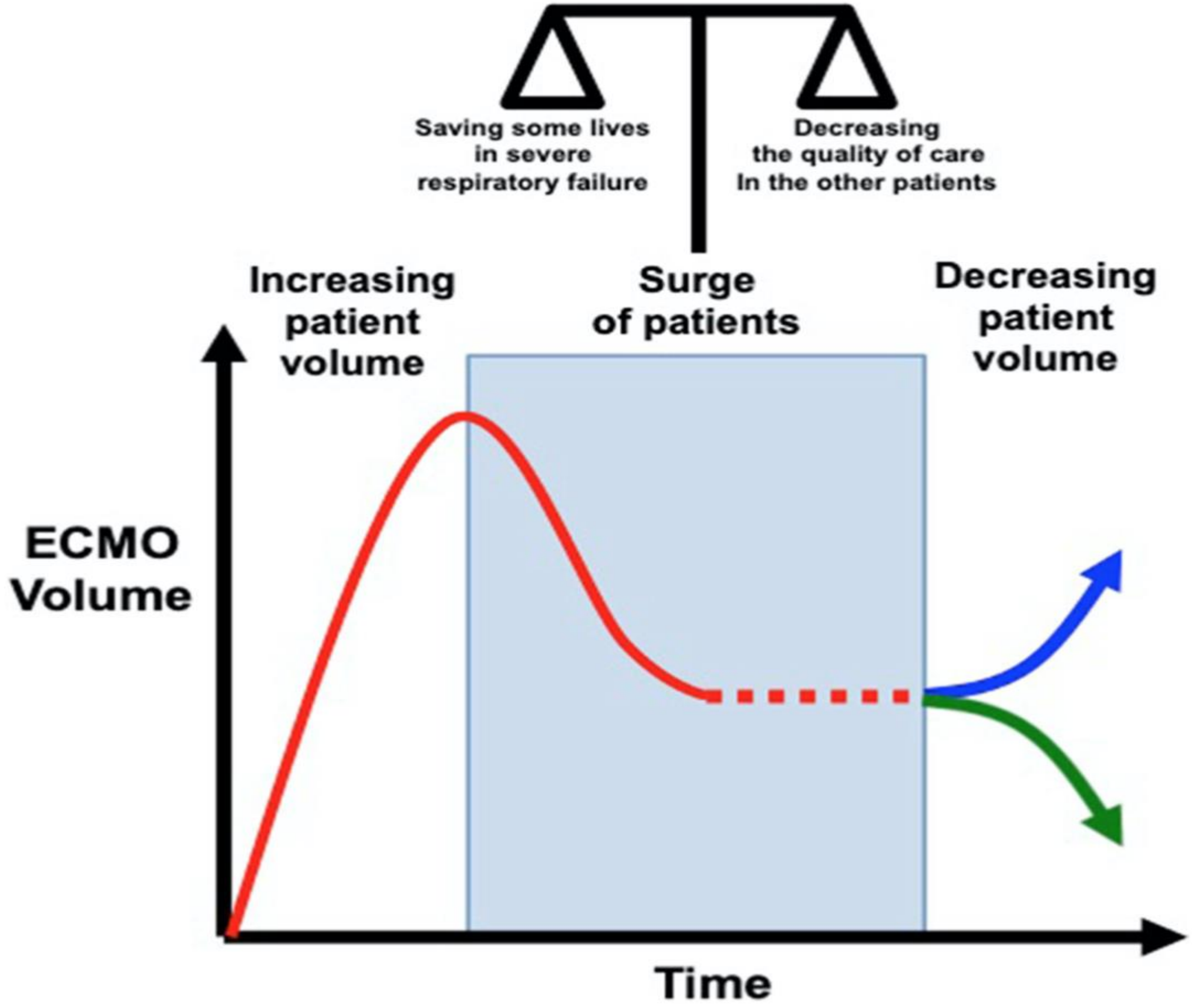


Fig. 1 Potential curve of ECMO case volume during the COVID-19 pandemic. During surge conditions, ECMO usage will be variable (red dashed line), including the potential of being abandoned altogether. As the pandemic resolves and patient volume decreases, there may be increasing resource availability and ECMO use (blue arrow) or decreasing demand (green arrow)

Abrams 2020 "ECMO during the COVID-19 pandemic: when is it unjustified?"

ECMO TRONG COVID – 19:

CHỈ ĐỊNH – CHỐNG CHỈ ĐỊNH

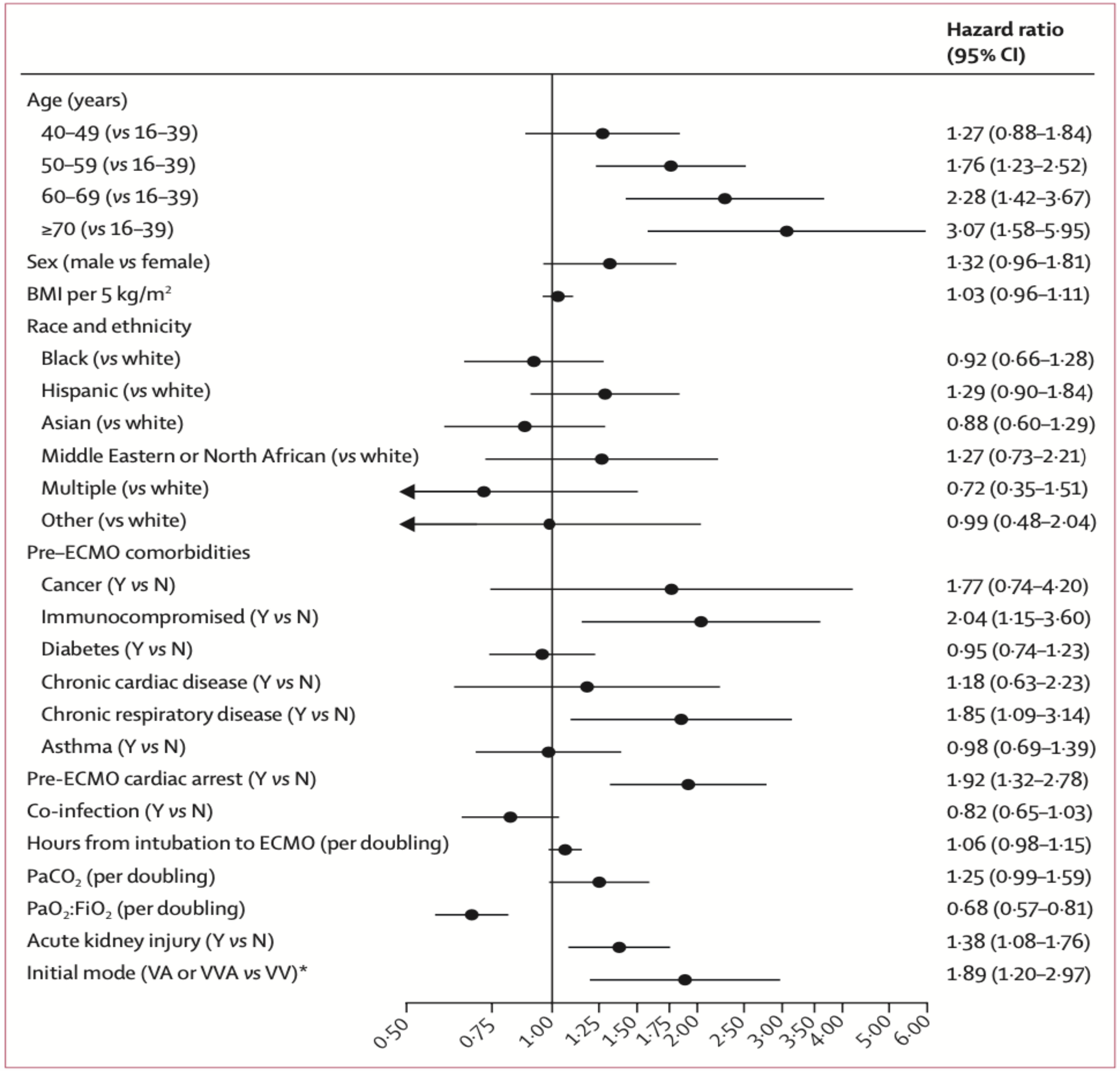


Figure 3: **Cox model for factors associated with in-hospital mortality in patients with COVID-19 supported with ECMO**

Barbaro 2020 Extracorporeal membrane oxygenation support in COVID-19/ an international cohort study of the Extracorporeal Life Support Organization registry Lancet 2020; 396: 1071–78

Supady *et al. Crit Care* (2021) 25:90
https://doi.org/10.1186/s13054-021-03486-9

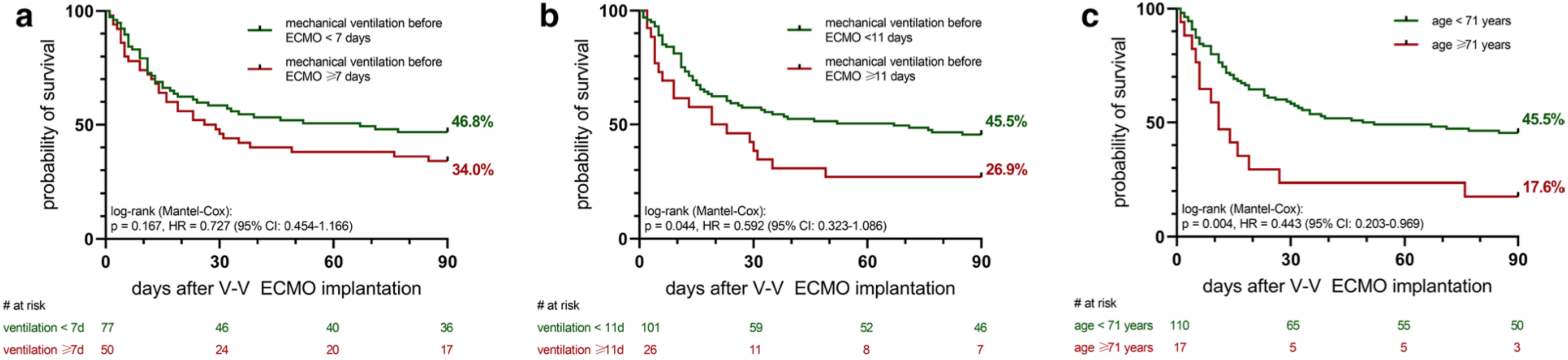
Critical Care

RESEARCH LETTER

Open Access

Survival after extracorporeal membrane oxygenation in severe COVID-19 ARDS: results from an international multicenter registry

Alexander Supady[1,2,3*], Fabio Silvio Taccone[4], Philipp M. Lepper[5], Stephan Ziegeler[6] and Dawid L. Staudacher[1,2] for the COVEC-Study Group



Chống chỉ định

Table 1. Indications and Contraindications for ECMO in COVID-19 Infected Adults

Relative contraindications
- Age ≥ 65 years
- Obesity BMI ≥ 40
- Immunocompromised status
- No legal medical decision maker available
- Advanced chronic underlying systolic heart failure
- High dose vasopressor requirement (and not under consideration for VA or V-VA ECMO)

Table 1. Indications and Contraindications for ECMO in COVID-19 Infected Adults

Absolute contraindications
- Advanced age
- Clinical Frailty Scale category ≥ 3
- Mechanical ventilation > 10 days
  - Significant underlying comorbidities: CKD ≥ III
  - Cirrhosis
  - Dementia
  - Baseline neurologic disease which would preclude rehabilitation potential
  - Disseminated malignancy
  - Advanced lung disease
  - Uncontrolled diabetes with chronic end-organ dysfunction
  - Severe deconditioning
  - Protein-energy malnutrition
  - Severe peripheral vascular disease
  - Other preexisting life-limiting medical condition
  - Nonambulatory or unable to perform activities
- Severe multiple organ failure
- Severe acute neurologic injury, *e.g.*, anoxic, stroke
- Uncontrolled bleeding
- Contraindications to anticoagulation
- Inability to accept blood products
- Ongoing CPR

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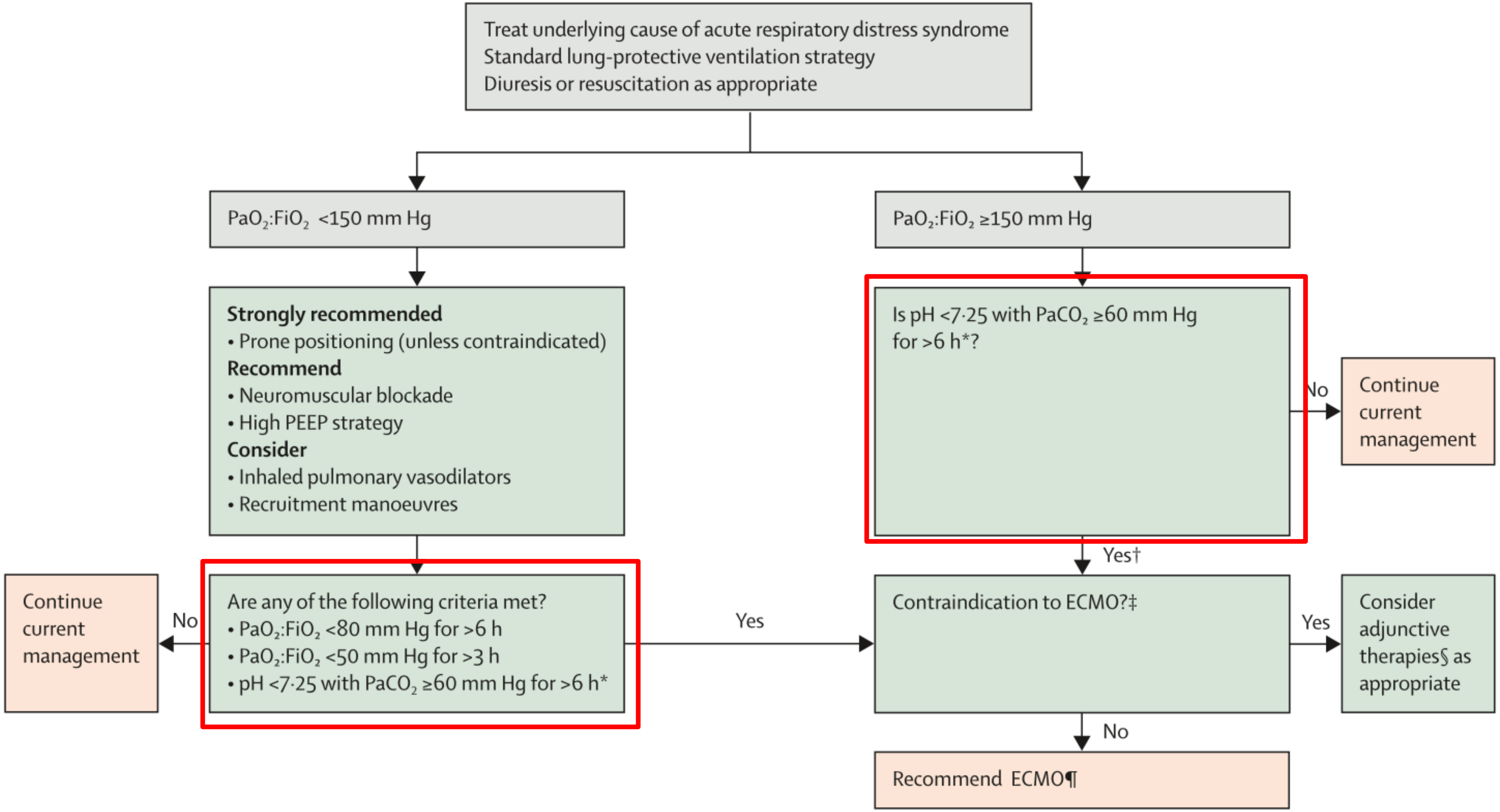
VV ECMO: chỉ định



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VA-ECMO

- Chỉ định VA ECMO giống với chỉ định hiện tại cho các tình trạng suy tuần hoàn khác
  - Thiếu tưới máu mô kéo dài
  - HATT <90mmHg, CI < 2.2L/ min/m2, trong khi sử dụng noradrenaline > 0.5 mcg/kg/min, dobutamine > 20 mcg/kg/min hoặc tương đương

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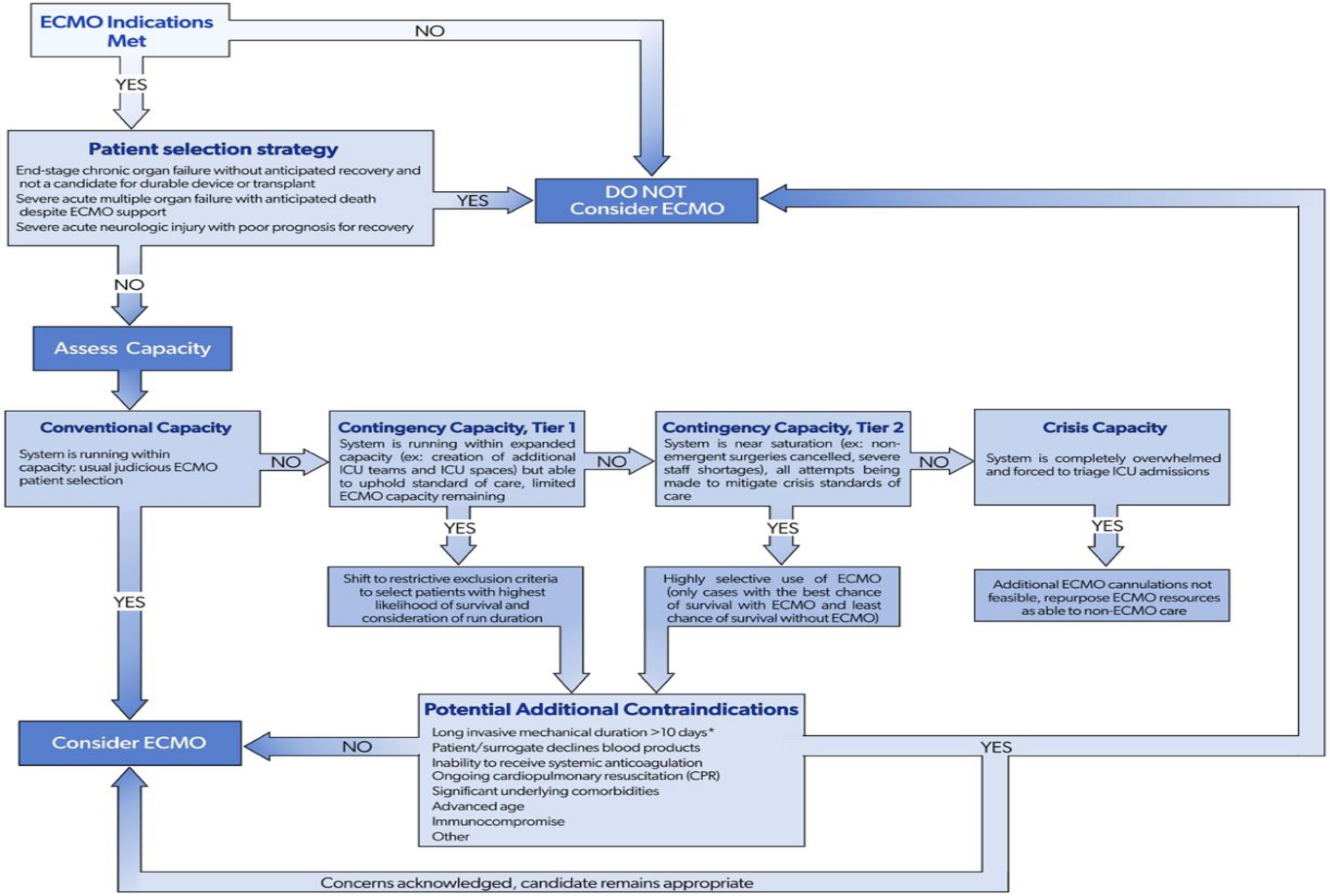
Chỉ định ecmo



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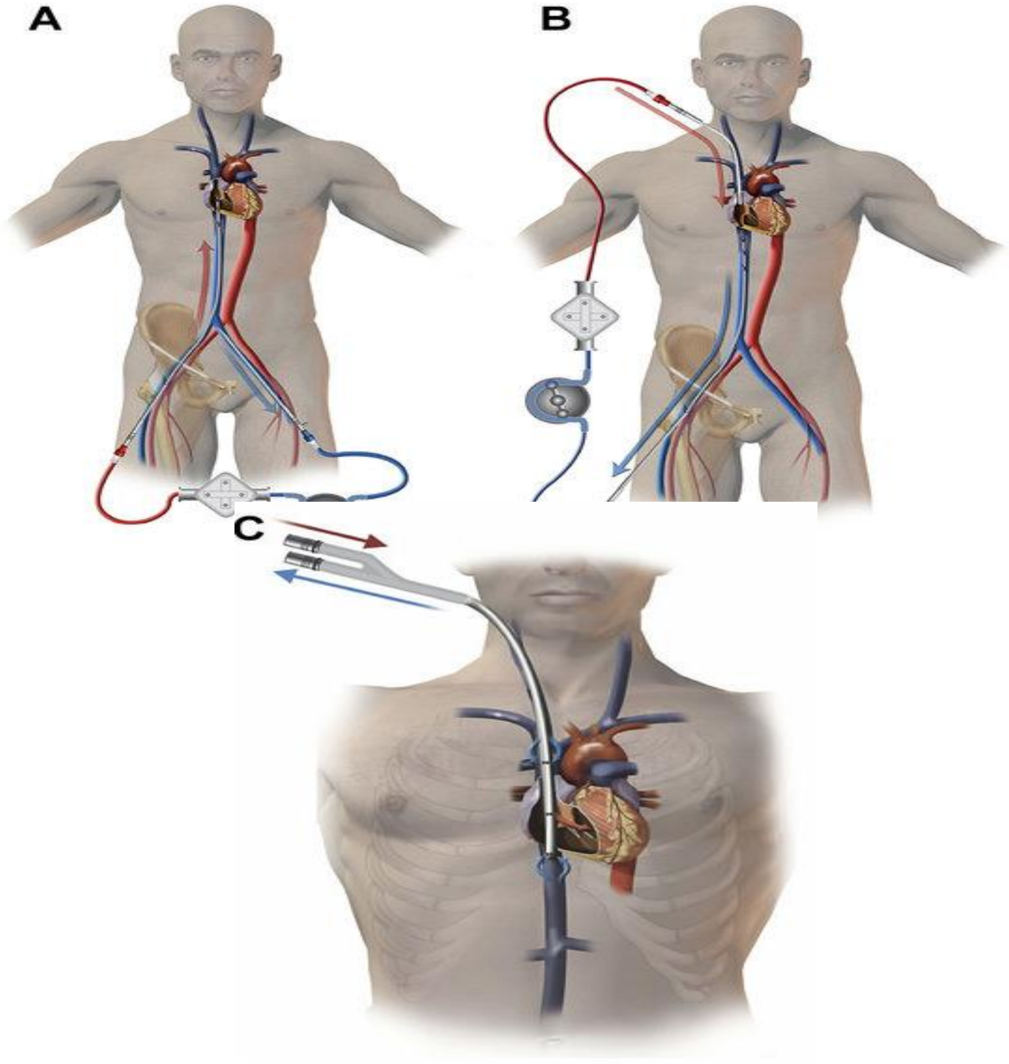
ECMO TRONG COVID – 19:

ĐẶT CANNULA ECMO

Đặt canuyn – VV ECMO



- **Lựa chọn cannula**
  - Ưu tiên sử dụng ống lớn (>=25 Fr) để lấy máu ra
  - Cannula trả máu về 19-23Fr
  - Cannula 2 nòng?
- **Lựa chọn mô hình:**
  - Mô hình "đùi – đùi" hay "đùi – cảnh" đều được khuyến cáo

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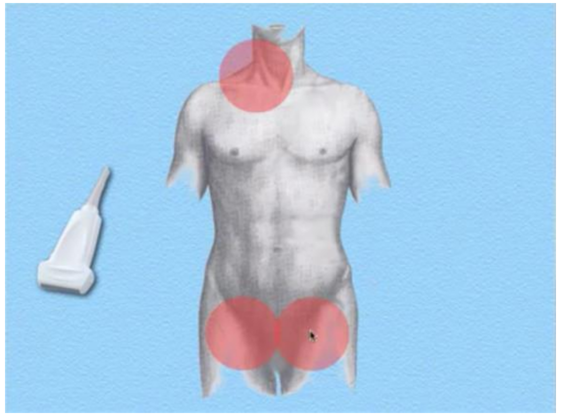
LỰA CHỌN KÍCH THƯỚC CANNULA

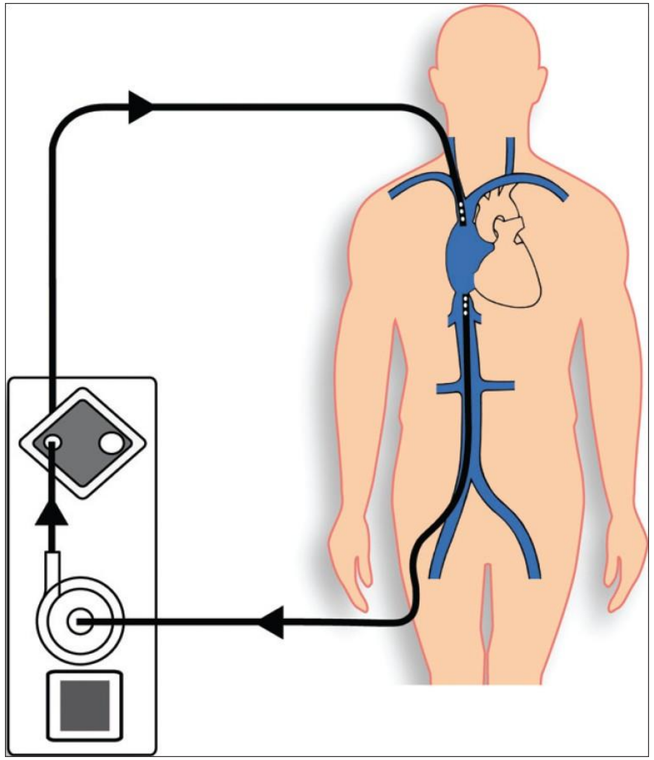
- Đo kích thước động mạch, tĩnh mạch bằng siêu âm
- 1 F = 1/3 mm
- Tính size của cannula:



$$\text{Size cannula (F)} = d_{\text{ĐM/TM}}\ (\text{mm}) \times 3$$

LỰA CHỌN LOẠI CANNULA

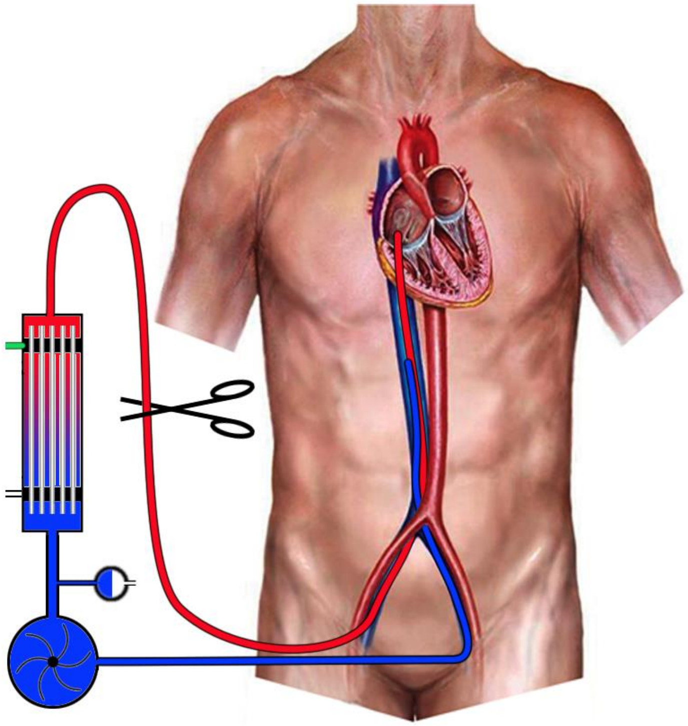
Veno-venous mode: femoro-jugular cannula



	Cannula lấy máu ra (Outflow)	Cannula trả máu về (Inflow)
Vị trí đặt	Tĩnh mạch đùi	Tĩnh mạch cảnh trong
Vị trí đầu cannula	Chổ nối tĩnh mạch chủ dưới với nhĩ phải	Chổ nối tĩnh mạch chủ trên với nhĩ phải
Loại cannula	Tĩnh mạch	Động mạch
Chiều dài	55 cm	23cm

LỰA CHỌN LOẠI CANNULA

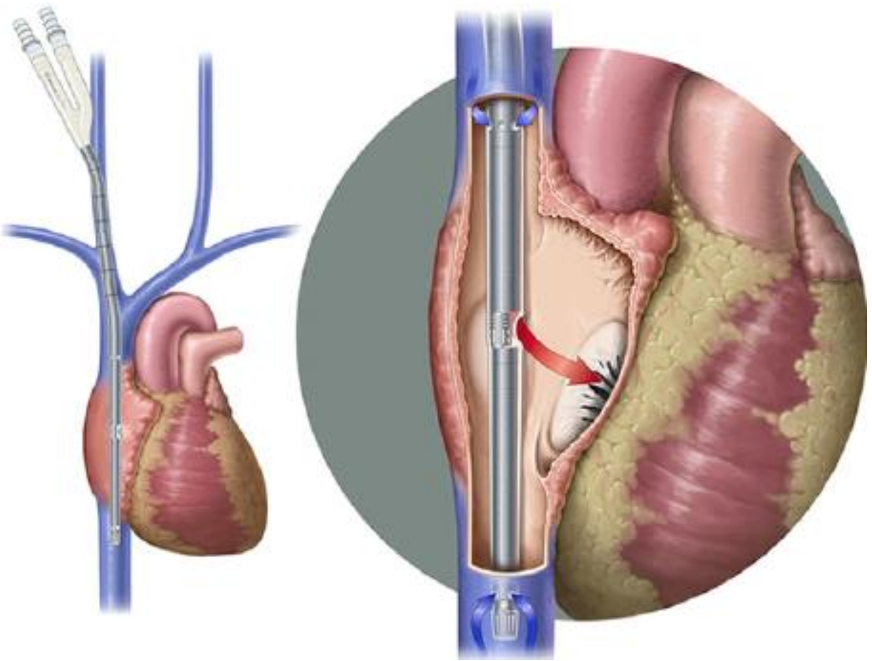
Veno-venous mode: femoro-femoral cannula



	Cannula lấy máu ra (Outflow)	Cannula trả máu về (Inflow)
Vị trí đặt	Tĩnh mạch đùi	Tĩnh mạch đùi
Vị trí đầu cannula	Tĩnh mạch chủ dưới đoạn trên gan	Trong nhĩ phải gần lỗ van 3 lá
Loại cannula	Tĩnh mạch	Tĩnh mạch
Chiều dài	38 cm	55 cm

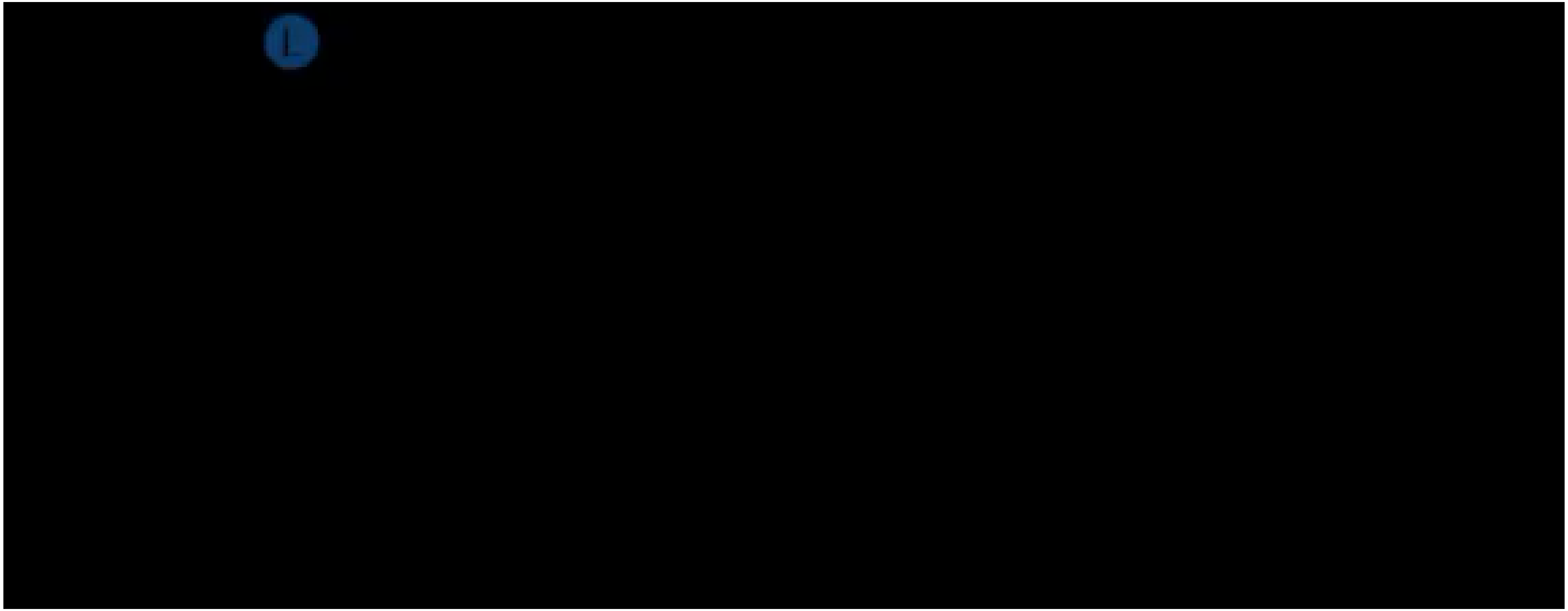
LỰA CHỌN LOẠI CANNULA

Veno-venous mode: dual-lumen cannula



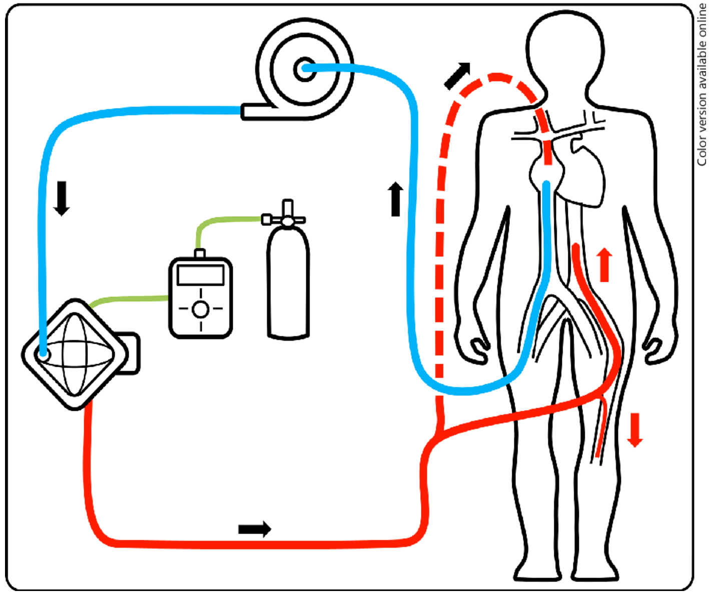
- Vị trí: tĩnh mạch cảnh trong phải
- Đầu cannula đặt đến tĩnh mạch chủ dưới
  - Rút máu qua các lỗ ở tĩnh mạch chủ dưới và tĩnh mạch chủ trên
  - Trả máu về nhĩ phải gần lổ van 3 lá

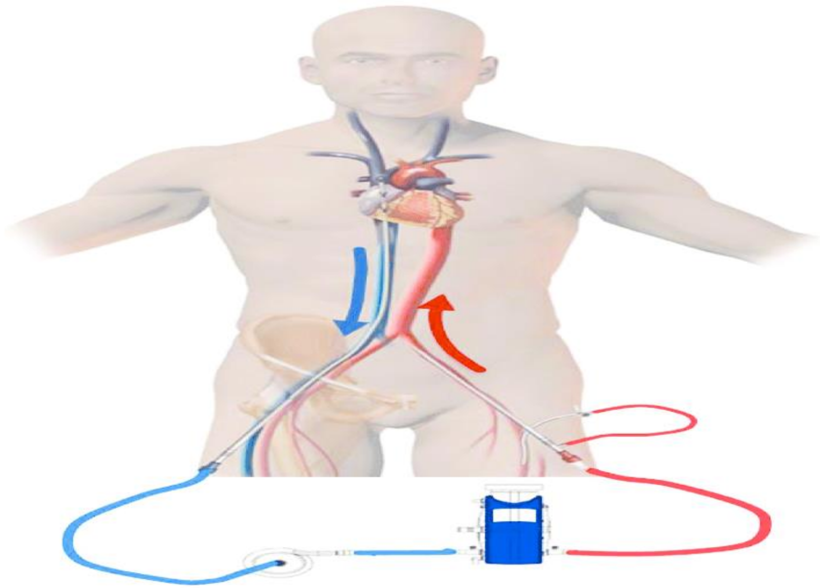
Video đặt ECMO V-V



Đặt canuyn – VA, V-VA ECMO

- Sử dụng mô hình "đùi – đùi"
- Đặt catheter tái tưới máu để tránh thiếu máu chi





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LỰA CHỌN LOẠI CANNULA

Veno-arterial ECMO: femoro-femoral cannula

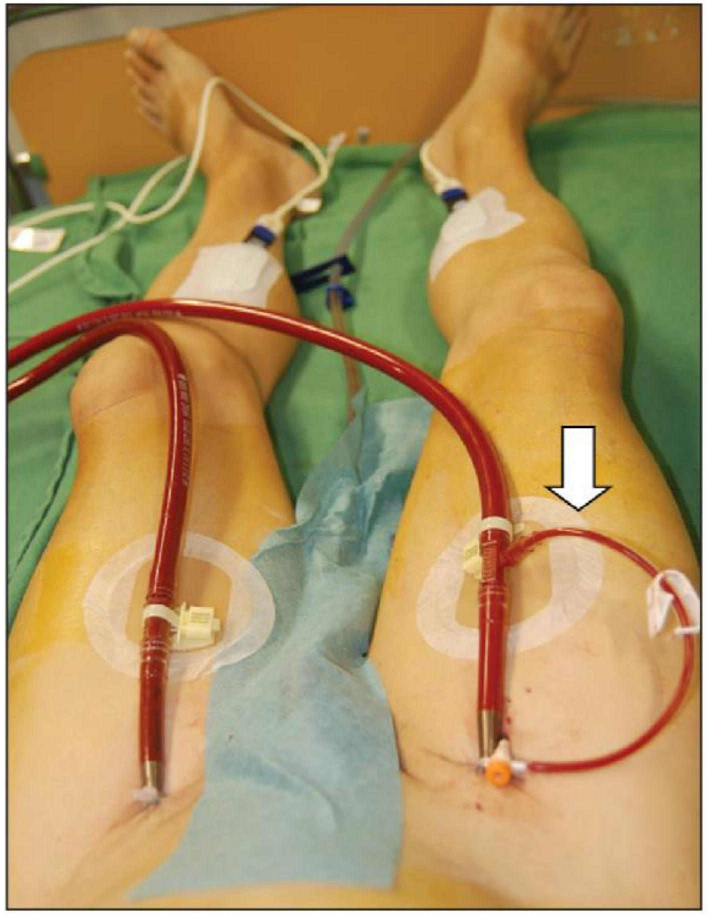

Figure 1 Correct cannula placement with a

	Cannula lấy máu ra (Outflow)	Cannula trả máu về (Inflow)	Cannula tái tưới máu (back flow)
Vị trí đặt	Tĩnh mạch đùi	Động mạch đùi chung	Động mạch đùi nông
Vị trí đầu cannula	Tĩnh mạch chủ dưới chổ nối với nhĩ phải	Động mạch chủ đoạn dưới thận	
Loại cannula	Tĩnh mạch	Động mạch	
Chiều dài	38-55 cm	15-23 cm	

ECMO TRONG COVID – 19:

THEO DÕI ECMO

Chăm sóc và theo dõi bệnh nhân ECMO

Respiratory

lung protective MV strategy; target:
$P_{PLAT} \leq 25$ cm H_2O
RR 4 -10 bpm
PEEP 10-15 cm H_2O
driving pressure <15 cm H_2O
$FiO_2 < 50\%$ to maintain $SpO_2 \geq 80\text{-}85\%$
avoiding dyssynchronies

US & Radiology

perform echographic scans and XR at bedside as needed, and diagnostic CT scans only if results likely to change management or outcome due to potential infection threat

consider ultrasound screening to exclude DVT involving lower limbs/IVC*; perform echocardiography if concerns for cardiac failure/CS

Therapeutics

Currently, in COVID-19, not enough evidence to issue any recommendation on:
- specific therapies; decide to utilize on case by case basis, possibly within RCTs; PK/PD of these therapies on ECMO unclear, potentially altered: follow standard dosing guidelines for critically ill
- routine use of steroids if respiratory failure or ARDS; may be use if septic shock
- extracorporeal cytokine hemadsorption if septic shock; its effect on drug elimination or virus clearance unknown

Hematological

follow existing anticoagulation guidelines and institutional protocols considering higher end targets, and be cautios if using lower blood flow rates (<2L in adults) given greater thrombotic risk*

not enough evidence to guide transfusion thresholds; judiciously use blood products based on coagulation parameters and clinical scenario; target:
Hb ≥ 7-8 gm/dL
PLT >50000 10^9/L
fibrinogen >100 mg/dl

antifibrinolytics not recommended*

not enough data to issue any recommendation about antiplatelet agents, maybe beneficial*, or convalescent plasma transfusion on ECMO

Gastrointestinal

early enteral nutrition (within 48 hours) initiated with low doses, increased to target over 3-5 days

avoid prolonged nutrition deficit if patient recovery anticipated

cautious use of prokinetics for delayed gastric emptying**

use standard, contact and droplets precautions evaluating for gastric residual volume or handling diarrhoeal stool or vomitus

* hypercoagulable/prothrombotic state and thrombocytopenia reported in COVID-19 patients

** COVID-19 patients are at increased risk of prolonged QTc/arrhythmias in the presence of cardiomyopathy and use of azithromycin or hydroxychloroquine

ECMO Monitoring

continuous bedside monitoring if enough staff, with frequent circuit/device checks to verify functioning and early detect complications

daily monitor pre/post membrane lung blood gases and transmembrane pressure gradient to assess oxygenator function

remote monitoring if resources/expertise available, and proper patient volume

due to eventual hypercoagulable state*, increased frequency of circuit exchanges may be needed: keep a primed circuit available at all times

Procedures

judiciously define need and timing to avoid unnecessary staff exposure

bronchoscopy only if diagnostic or therapeutic benefit (proper PPE); consider apnea, if tolerated, to minimize aerosol generation during procedure

cautious percutaneous tracheostomy after careful consideration of risk-to-benefit ratio case-by-case

Mobilization

early mobilization in COVID-19 patients on ECMO unlikely to be feasible at most centers, with unclear benefit and definite risks

instruct bedside nurses on in-bed PT maneuvers to limit personnel exposure and PPE use

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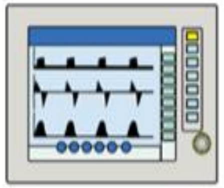
Hô hấp

Management strategy or procedure

Pulmonary

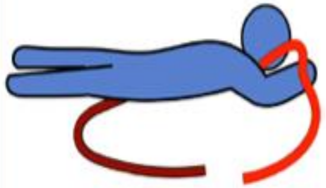


Mechanical Ventilation

No data to suggest deviation from commonly performed low-volume, low-pressure ventilator management for COVID-19 patients receiving ECMO for pulmonary support.

Tracheostomy

Percutaneous tracheostomy appears to be safe and feasible for patients with COVID-19.



Prone positioning

Prone positioning during ECMO is feasible, data are preliminary (demonstrate a potential association with lower mortality) but a recommendation cannot be offered at this time.

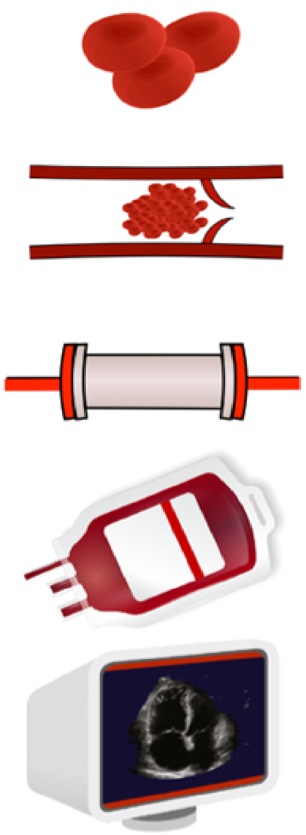
Awake ECMO

Early extubation strategy with awake ECMO may be feasible in COVID-19, but insufficient evidence to support recommendation.

Extracorporeal Membrane Oxygenation for COVID-19: Updated 2021 Guidelines from the Extracorporeal Life Support Organization

Huyết học và theo dõi huyết động

Hematologic & Hemodynamics



Coagulopathy

COVID-19-induced coagulopathy appears to increase risk of both thrombotic and hemorrhagic events; however, normalized to run duration, rates of bleeding and circuit clotting similar to historical data: insufficient data to suggest deviation from usual anticoagulation practices on ECMO.

Deep Venous Thrombosis

There may be a propensity for clotting with COVID-19 and ECMO: low threshold to pursue imaging for suspected DVT suggested, but insufficient data to recommend routine surveillance for DVT.

Cytokine Removal

Elevated cytokine profiles have been observed in COVID-19, but seem to be lower than in other causes of ARDS, sepsis and CAR T-cell-mediated cytokine release syndrome: extracorporeal hemadsorption or elimination therapies can only be recommended within the context of clinical trials.

Blood Transfusions

There is no evidence to deviate from usual institutional practice for blood transfusion thresholds during ECMO.

Hemodynamic Monitoring

Cardiac complications of COVID-19 have been reported, e.g., myocarditis, stress cardiomyopathy, acute right ventricular failure, pulmonary embolism, or acute coronary syndrome. Remaining vigilant to detect evidence of acute hemodynamic deterioration on V-V ECMO recommended.

Extracorporeal membrane oxygenation for severe acute respiratory distress syndrome associated with COVID-19: a retrospective cohort study

*Matthieu Schmidt, David Hajage, Guillaume Lebreton, Antoine Monsel, Guillaume Voiriot, David Levy, Elodie Baron, Alexandra Beurton, Juliette Chommeloux, Paris Meng, Safaa Nemlaghi, Pierre Bay, Pascal Leprince, Alexandre Demoule, Bertrand Guidet, Jean Michel Constantin, Muriel Fartoukh, Martin Dres, Alain Combes, for the Groupe de Recherche Clinique en REanimation et Soins intensifs du Patient en Insuffisance Respiratoire aiguE (GRC-RESPIRE) Sorbonne Université, and the Paris-Sorbonne ECMO-COVID investigators**

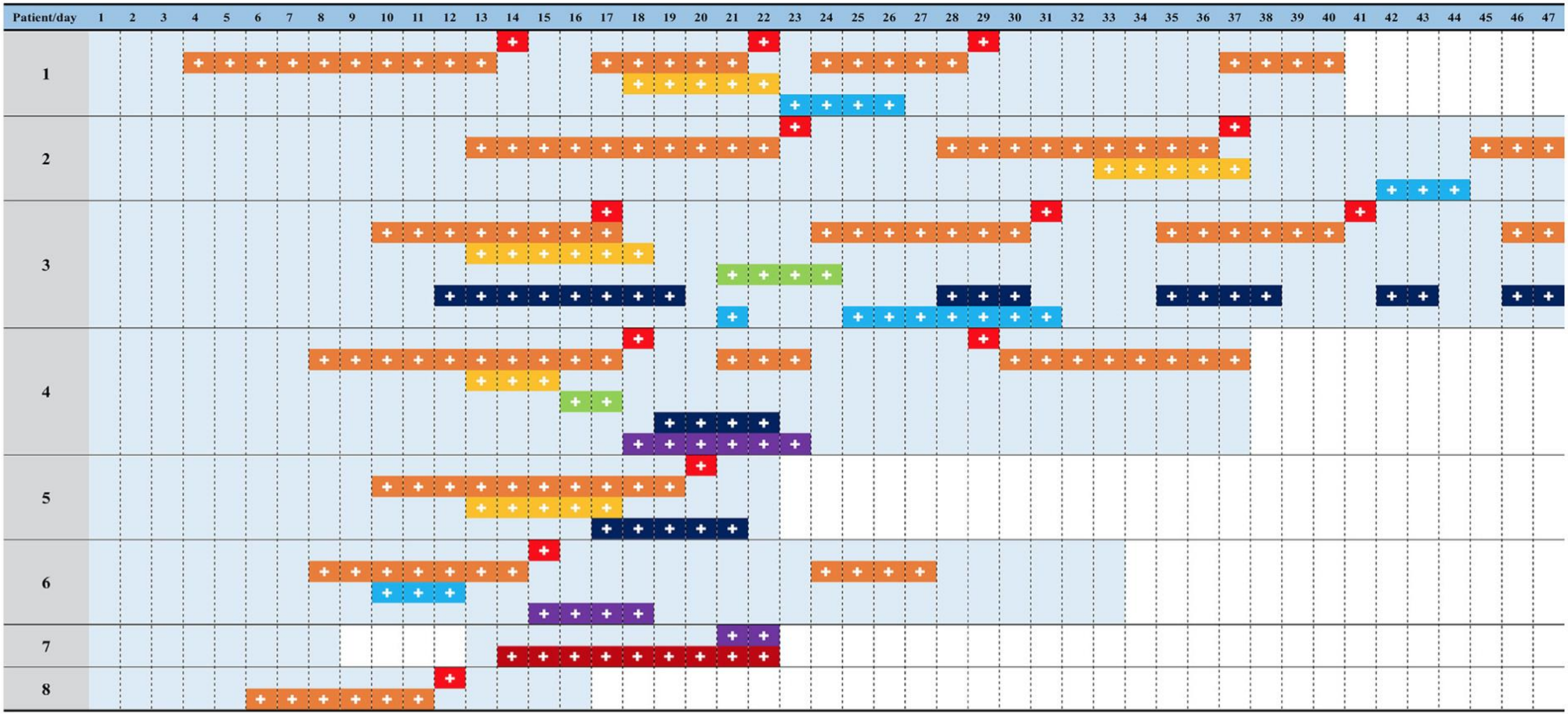
Summary

Background Patients with COVID-19 who develop severe acute respiratory distress syndrome (ARDS) can have symptoms that rapidly evolve to profound hypoxaemia and death. The efficacy of extracorporeal membrane oxygenation (ECMO) for patients with severe ARDS in the context of COVID-19 is unclear. We aimed to establish the clinical characteristics and outcomes of patients with respiratory failure and COVID-19 treated with ECMO.

Lancet Respir Med 2020
Published Online
August 13, 2020
https://doi.org/10.1016/S2213-2600(20)30328-3

ECMO-related complications	
≥1 ECMO-circuit changes	22 (27%)
Intravascular haemolysis	11 (13%)
Clogged circuit requiring change	3 (4%)
Repeat ECMO needed after decannulation	1 (1%)
Severe thrombocytopenia (<50 × 10^9 cells per L) during the first 3 days‡	5 (6%)
ECMO setting or insertion changes§	4 (5%)
Heparin-induced thrombocytopenia	2 (2%)
Massive haemorrhage	35 (42%)
Oronasal bleeding	20 (24%)
Haemothorax	7 (8%)
Cannula	5 (6%)
Other site	13 (16%)

Blood-product transfusion	
Patients who received ≥1 red blood cell units	64 (77%)
Number of red blood cell units per patient	3 (1–11)
Patients who received ≥1 platelet units	11 (13%)
Patients who received ≥1 fresh-frozen plasma units	9 (11%)
Patients who received ≥1 fibrinogen concentrates	12 (14%)
Stroke	5 (6%)
Ischaemic	1 (1%)
Haemorrhagic	4 (5%)
Antibiotic-treated cannula infection	19 (23%)
Pulmonary embolism	16 (19%)



ECMO day; ☐ non-ECMO day; Oxygenator replacement; Oxygenator thrombus; Trachea hemorrhage; Cannulation site hemorrhage; Oronasal hemorrhage; Bleeding at puncture point; Thoracic hemorrhage; Deep vein thrombosis

Fig 3. Thrombosis and bleeding events of 8 patients (up to May 20, 2020).

Guo 2020 "Anticoagulation Management in Severe Coronavirus Disease 2019 Patients on Extracorporeal Membrane Oxygenation"

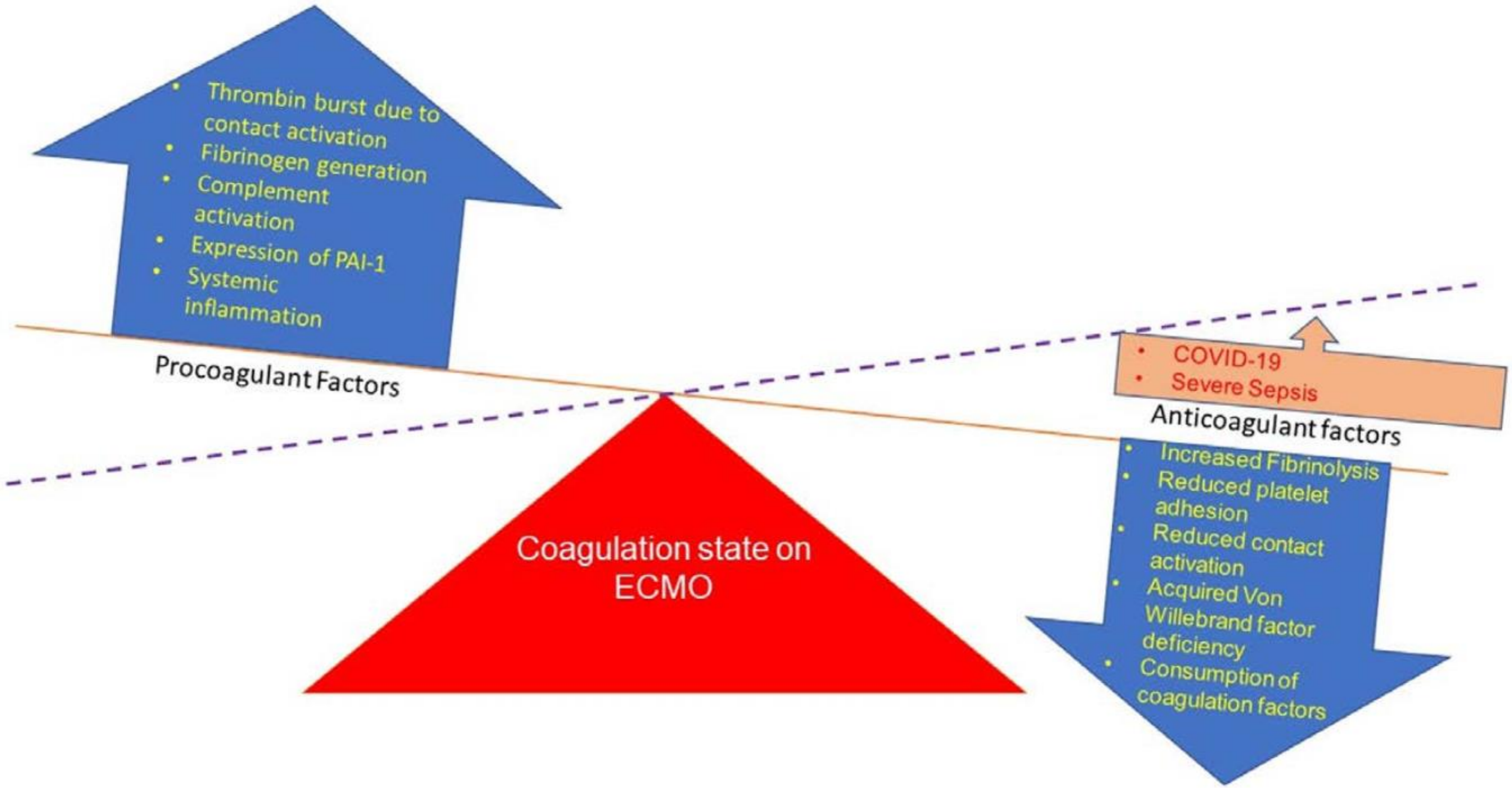


Figure 1. Effect of a hyperinflammatory state on coagulation in patients receiving extracorporeal membrane oxygenation (ECMO). COVID-19, novel coronavirus disease 2019; PAI-1, plasminogen activator inhibitor-1. full color online

Yusuff 2020 "Thrombosis and Coagulopathy in COVID-19 Patients Requiring Extracorporeal Membrane Oxygenation" ASAIO Journal

Kháng đông

- Sử dụng phác đồ Heparin như nhưng bệnh nhân ECMO non-COVID
- Duy trì mức kháng đông ở giới hạn trên: **cân nhắc**
- Theo dõi kĩ khi lưu lượng dòng ECMO thấp < 2L/phút
- Cân nhắc kháng kết tập tiểu cầu ở những bệnh nhân tăng đông.
- Sử dụng kháng đông đường tĩnh mạch khác: Argatroban, Bivalirudin khi có HIT xảy ra

Extracorporeal Life Support Organization Coronavirus Disease 2019 Interim Guidelines: A Consensus Document from an International Group of Interdisciplinary Extracorporeal Membrane Oxygenation Providers

Argatropan protocol

➢ **Khởi đầu bằng Argatropan**

- Prime màng ECMO: 50mcg cho mỗi 750ml dung dịch prime
- Bolus: 100mcg/kg
- Duy trì: 2mcg/kg/phút
- Theo dõi: aPTT mỗi 4-6h, duy trì mục tiêu 60-90s

➢ **Chuyển từ Heparin sang Argatropan**

- Prime màng ECMO: 50mcg cho mỗi 750ml dung dịch prime
- Bolus: không
- Duy trì: 2mcg/kg/phút, ngưng Heparin ngay khi khởi động Atgatropan
- Theo dõi: ACT mỗi 1h trong 2 tiếng đầu, duy trì ACT>200, aPTT mỗi 4-6h, duy trì mục tiêu 60-90s

Wu 2018 "Argatroban Protocol for Extracorporeal Membrane Oxygenation (ECMO)" Anticoagulation Safety Committee: 6/26/2018; ECMO & Advanced Technologies CMT: 7/16/2018

Argatropan protocol

aPTT (seconds)	STANDARD INFUSION RATE CHANGE	HEPATIC DYSFUNCTION INFUSION RATE
Less than 60	Increase by 0.5 mcg/kg/min	Increase by 0.25 mcg/kg/min
60 to 90	None	None
90 to 110	Hold infusion for 30 minutes Decrease by 0.5 mcg/kg/min	Hold infusion for 30 minutes Decrease by 0.25 mcg/kg/min
110 to 120	Hold infusion for 45 minutes Decrease by 1 mcg/kg/min	Hold infusion for 45 minutes Decrease by 0.5 mcg/kg/min
Greater than 120	Stop infusion Call MD STAT	Stop infusion Call MD STAT

***Target aPTT range may be adjusted per physician discretion based on clinical status**

Wu 2018 "Argatroban Protocol for Extracorporeal Membrane Oxygenation (ECMO)" Anticoagulation Safety Committee: 6/26/2018; ECMO & Advanced Technologies CMT: 7/16/2018

Truyền máu

Hướng dẫn ELSO ECMO COVID

- Duy trì:
  - He[illegible]obin[illegible]) ≥ 7–8 g/d[illegible]
  - Pla[illegible]/L
  - Fibri[illegible]ogen > [illegible]0mg/dl.

Hướng dẫn ELSO ECMO ARDS

- Duy trì:
  - Hemoglobin (Hb) ≥ 10–12 g/dl
  - Platelet > 80,000/L
  - Fibrinogen > 150mg/dl.

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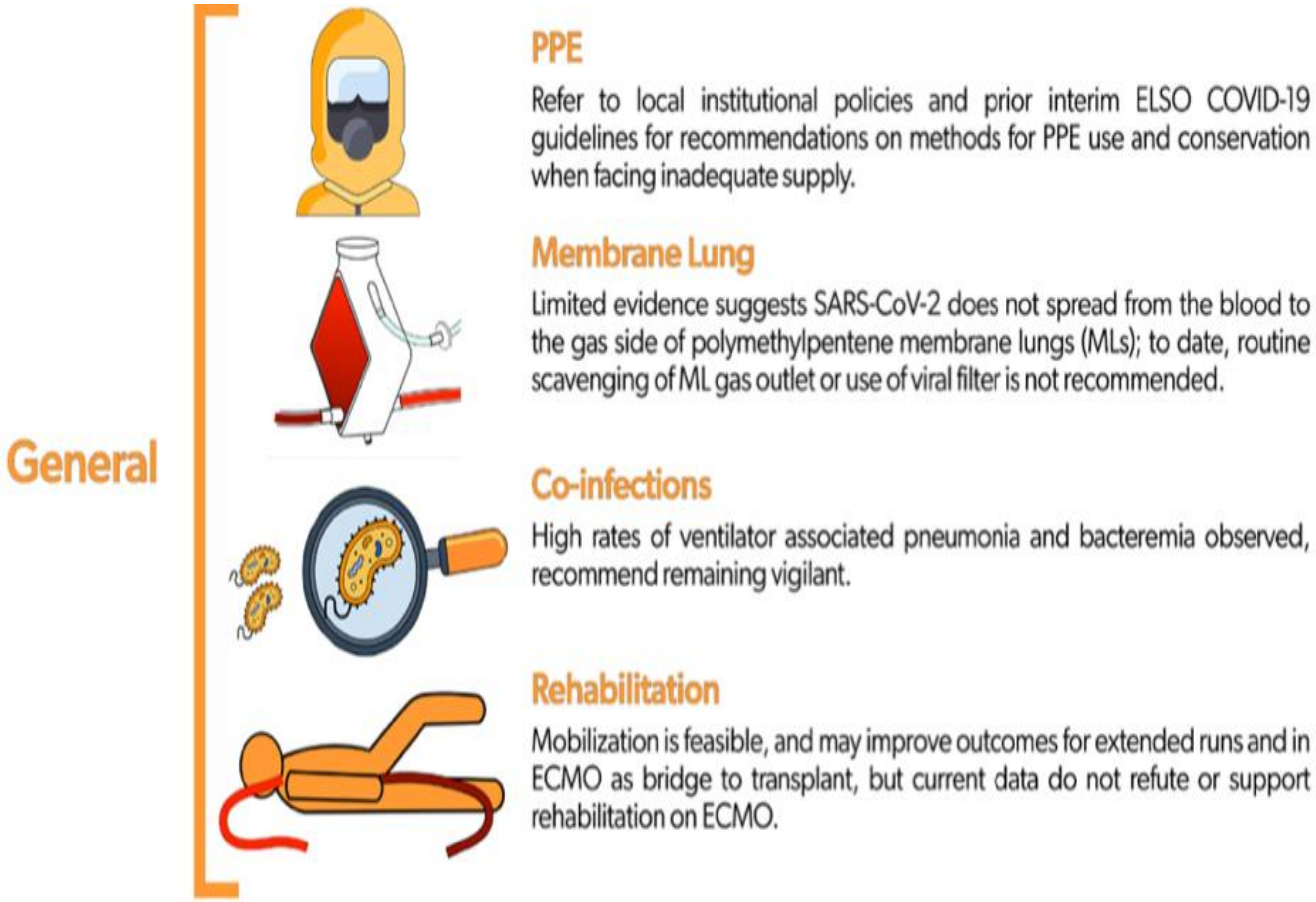
Theo dõi chung



Extracorporeal Membrane Oxygenation for COVID-19: Updated 2021 Guidelines from the Extracorporeal Life Support Organization

ECMO TRONG COVID – 19:

CAI VÀ RÚT ECMO

Cai và rút ECMO

- **Cai ECMO**: Sử dụng tiêu chuẩn như bệnh nhân non-COVID:

  - **VV-ECMO:** Thử cai ECMO (sweep gas = 0 L/min), tăng hỗ trợ máy thở: VT ≤ 6–8ml/kg, PPLAT ≤ 30cm H2O, PEEP ≤ 16cm H2O, FiO2 ≤ 0.5. Duy trì 2-4h, nêu thông khí đạt: pH>7.3, SaO2>88%, bệnh nhân có thể cai ECMO

  - **VA-ECMO:** giảm dòng hỗ trợ, sử dụng siêu âm đánh giá mức độ hồi phục của tim: LVEF > 20-25%, AV VTI > 12cm, TDSa > 6cm/s

- **Rút ECMO:** Sử dụng PPE đầy đủ, tránh tiếp xúc trực tiếp với máu và dịch tiết

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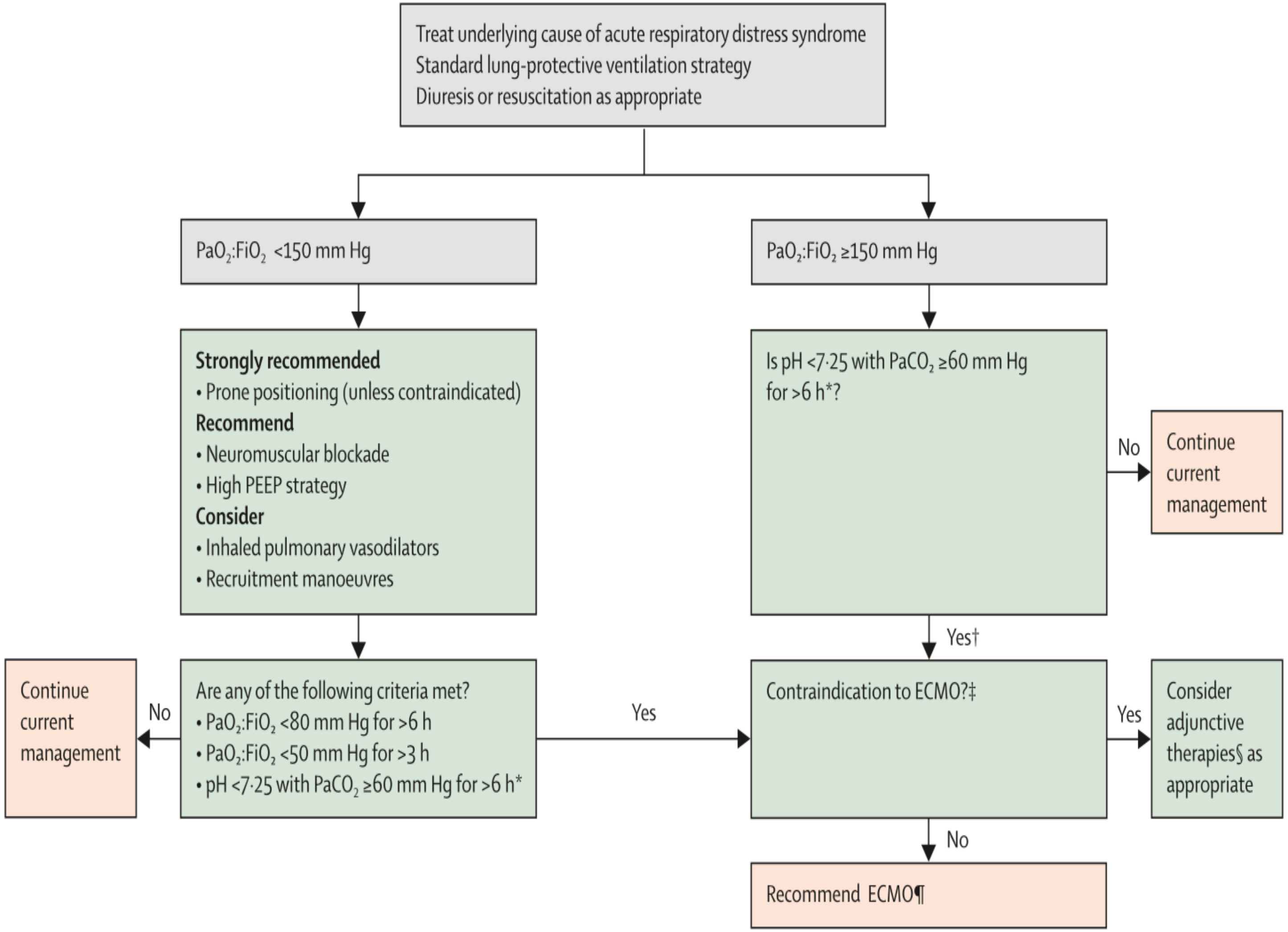
TAKE HOME MESSAGE

- ECMO là một trong những lựa chọn bệnh nhân COVID-19 có suy hô hấp tuần hoàn kháng trị
- Việc tiến hành ECMO cho bệnh nhân COVID-19 nên dựa trên nguồn lực hiện có.
- Tiêu chuẩn lựa chọn bệnh nhân có thể nghiêm ngặt hơn.



Thank you for your patience