

MOH Critical Care ECMO Patient Selection Guidelines

1. Introduction:

1.1 Background:

Extracorporeal membrane oxygenation (ECMO) is considered a supportive treatment that provides circulatory and ventilatory support as a bridge to organ recovery. It is a highly demanding technical therapy and is resource intensive while the distribution of this therapy should be as impartial as possible. This modality is indicated whenever there is a failure of optimally applied conventional therapies utilizing unsafe high ventilator settings to correct severe respiratory or circulatory failure in the presence of a potentially reversible disease.

In January 2021 the Saudi Ministry of Health (MOH) has established a nationwide ECMO Program to extend service across the country. with an objective of facilitating the ECMO service all over the MOH hospitals and improve the care delivered to patients with respiratory and cardiac failure. A hotline for ECMO consultations and retrievals through the 1937 center, which increased the served cases and supported the referring hospitals in optimizing the care in such severely critical ill patients.

1.2 Aim and the Scope:

To provide an evidence base practical guide for ECMO provision and referral system which will assure:

- Efficient utilization of ECMO service.
- Outline or enumerate the selection criteria for ECMO candidacy.
- Enhance safety.

1.3 Targeted Population:

All ICU adult patients suffering from acute hypoxic and/or hypercapnic respiratory failure refractory to optimum conventional acute respiratory distress syndrome (ARDS) management.

1.4 Targeted End User:

- Adult critical care medicine physicians
- Adult anesthetist physicians.
- Adult cardiac surgeon.
- Perfusionists.
- ICU nurses.
- Respiratory therapists.

1.5 Conflict of interest: No conflict of interest.

1.6 Funding: None

1.7 Methodology: A group of an ECMO experts from multiple health sectors in the country developed this recommendation based on an extensive up-to-date literature review and international guidelines consideration especially in the COVID-19 pandemic. Any conflict was resolved by voting.

2. Definitions & abbreviation:

ECLS: Extracorporeal life support	VV ECMO: Veno-Venous ECMO.
ECMO: Extracorporeal membrane oxygenation.	VA ECMO: Veno-Arterial ECMO.
ECCO2R: Extracorporeal carbon dioxide removal	ECPR: Extracorporeal cardiopulmonary resuscitation

3. Criteria for Selection of patients needing ECMO referral:

Notes for consideration:

- ECMO should only be considered for carefully selected patients.
- The best outcome is expected when ECMO is instituted early after in the onset of adult respiratory failure.
- Weighing the risks of the procedure to the potential benefits.
- ECMO should not be considered in patients who are unlikely to benefit and in those with significantly reduced life expectancy from pre-existing disease.

Patients with acute refractory respiratory failure will be considered for ECMO if they meet all of the following:

- 1) Age < 65 years old
- 2) Well sedated achieving Richmond Assessment Score (RAS) of -3
- 3) Paralyzed.
- 4) Mechanically ventilated on high settings for less than 7 days.
- 5) Meeting 1 of the 3 following criteria of severity: (Table 1)

#		Prerequisites
1	PaO ₂ /FiO ₂ ratio <50 mm Hg with FiO ₂ ≥80% for >3 hours	Optimized mechanical ventilation setting (Vt set at 6 ml/kg and trial of PEEP≥12-14 cm H ₂ O) and despite possible recourse to usual adjunctive therapies) including optimal paralysis and at least one session of prone position ventilation
2	PaO ₂ /FiO ₂ ratio <80 mm Hg with FiO ₂ ≥80% for >6 hours,	
3	pH <7.25 (with PaCO ₂ ≥60 mm Hg) for >6 hours	-The acidosis should persist despite correction of the metabolic acidosis if present (HCO ₃ >24) (including use of renal replacement therapy) as metabolic causes of acidosis should be corrected first prior attributing the acidosis to CO ₂ -Optimized respiratory rate increased to 35 /min with careful avoidance of auto-

	<p>PEEP) resulting from non-injurious MV settings adjusted to keep Pplat ≤ 32 cm H₂O -Tidal volume should not exceed 6-8ml/kg of Ideal body weight (IBW) First, Vt reduction by steps of 1 mL/kg IBW to 4 mL/kg IBW then PEEP reduction to a minimum of 8 cm H₂O The respiratory rate increased to 35 /min) after correction of the metabolic acidosis if present (HCO₃^{>}24) (including use of RRT) resulting from non-injurious MV settings adjusted to keep Pplat ≤ 32 cm H₂O (First, Vt reduction by steps of 1 mL/kg to 4 mL/kg then PEEP reduction to a minimum of 8 cm H₂O</p>
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4. ECMO may be considered in:

1. Severe air leak syndromes leading to failure of gas exchange despite optimal therapy of air leak and mechanical ventilation setting.
2. Burn and Inhalational injury
3. Immediate cardiac or respiratory collapse due to respiratory causes (for example PE or blocked airway) unresponsive to optimal timely medical therapy
4. Refractory hypoxia secondary to blunt chest trauma despite optimal mechanical ventilation settings.
5. Respiratory failure due to the progression of the primary respiratory disease in a patient already has been evaluated and accepted being actively on the lung transplant list after coordination with the transplant center who will accept the patient afterwards (bridge to transplant)
6. Pulmonary embolism: When it is the cause of respiratory/cardiac failure and shock, consider VA ECMO
7. Less common causes of pulmonary failure with the variable success of ECLS. Such as vasculitis, autoimmune lung disease, Goodpasture syndrome, and rare bacterial, fungal or viral infections should be assessed in collaboration with the primary team to help guide disease-specific treatment and estimate reversibility and chance of recovery.

5. Specific consideration:

5.1 Respiratory failure and septic shock:

- a. The risk-benefit ratio of ECMO in patients who are on vasopressors should be considered on a case-by-case basis.
- b. Source of septic shock should be aggressively treated and the presence of ECMO should not make the pursuit of surgical or interventional intervention for the source of

infection control less likely due to anticoagulation use as it may be held for procedures, especially on high ECMO flow.

- c. Candidates should be assessed for organ failure by SOFA score for eligibility (Multi-organ failure syndrome (SOFA > 15) is a contraindication due to poor outcome.)
- d. Cause, type and severity of shock should be determined to decide about the type of extracorporeal support:
 - o Refractory vasodilatory shock and severe un-resolving microcirculatory shock.
 - o Presence of associated acute myocardial depression/cardiogenic shock
- e. VA ECMO or VVA ECMO may be considered a rescue option for those patients if acute myocardial depression is profound (all the following criteria are required):
 - Acute onset of global cardiac dysfunction (patient without a history of cardiac disease or heart failure or has previous documentation of normal cardiac function on echocardiography).
 - Acute low ejection fraction below 25%
 - Low central/mixed venous saturation despite optimal fluid and inotropic therapy
 - Evidence of hypo-perfusion due to the concomitant cardiogenic shock
High dose of two or more inotrope/vasopressors requirement

5.2 Hypercapnic respiratory failure:

- a. Severe, sustained isolated uncompensated hypercapnia with respiratory acidosis (eg. pH < 7.1) despite appropriate ventilator and patient management may be the primary indication for ECLS (e.g., refractory asthma) or may prompt earlier ECLS in patients with co-existent hypoxemia and ventilation difficulties.
- b. Concomitant metabolic acidosis should be treated aggressively, including sodium bicarbonate administration and/or renal replacement therapy as needed. ECMO should not be utilized as an alternative treatment of severe acidosis.
- c. Specific extracorporeal CO₂ removal devices may be appropriately deployed in severe hypercapnic respiratory failure without concomitant hypoxia (FiO₂ requirement <0.5).

5.3 Acute right ventricular (RV) failure in the setting of ARDS. Acute reversible right ventricular failure is known to be associated with severe ARDS especially on high ventilatory setting with high intrathoracic pressure from high PEEP and peak pressure and reactive vasoconstriction of pulmonary vessels due to hypoxia

- The RV function may improve with:
 - o improved oxygenation
 - o management of the sepsis
 - o normalization of respiratory acidosis
 - o lowering PEEP and intrathoracic pressure.
- VV ECMO can be considered once PE is ruled out.

6. Adult ECMO ineligibility criteria (associated with a poor outcome):

- ❖ There are no absolute contraindications to ECMO as each patient is considered individually concerning risks of the procedure and potential benefits.

6.1 There are conditions, however, that are associated with a poor outcome despite ECMO, and can be considered relative contraindications:

1. Pre-existing conditions which affect the quality of life (e.g.; existing chronic illness with poor long-term prognosis).
2. Irreversible brain damage, intracranial bleeding, or poor baseline neurological function.
3. Mechanical ventilation at high settings (FiO₂ >.9, P-plat >30) for 7 days or more.
4. Major immunosuppression (absolute neutrophil count <500/mm³)
5. Non-recoverable comorbidity such as terminal malignancy.
6. Futility: evidence of advanced non-reversible multi organ failure and or untreatable primary disease.
7. End-stage lung disease (long term home oxygen therapy)
8. septic shock with multi-organ failure with SOFA score more than 16-18
9. Do not resuscitate (DNR) order

6.2 Special notes:

- ❖ Patients with a single contraindication, but otherwise sensed to benefit from ECLS support where the potential benefits outweigh the risks might be discussed with one of the ECMO committee members

7. Process of referring potential ECMO cases to ECMO centers:

7.1 Steps of referral to ECMO:

- a. Apply the selection criteria mentioned above to your patient. (using the referral form).
- b. Call 1937 and press 1 to reach the lifesaving line.
- c. Ask for the ECMO consultant on call (service available 24/7).
- d. Complete the ECMO referral form, which will be provided by the ECMO coordinator.
- e. Once the referral is completed and submitted, the ECMO consultant will discuss the case thoroughly with the referring physician. (put a time frame for the response)
- f. The ECMO consultant will decide whether the case is indicated or not.

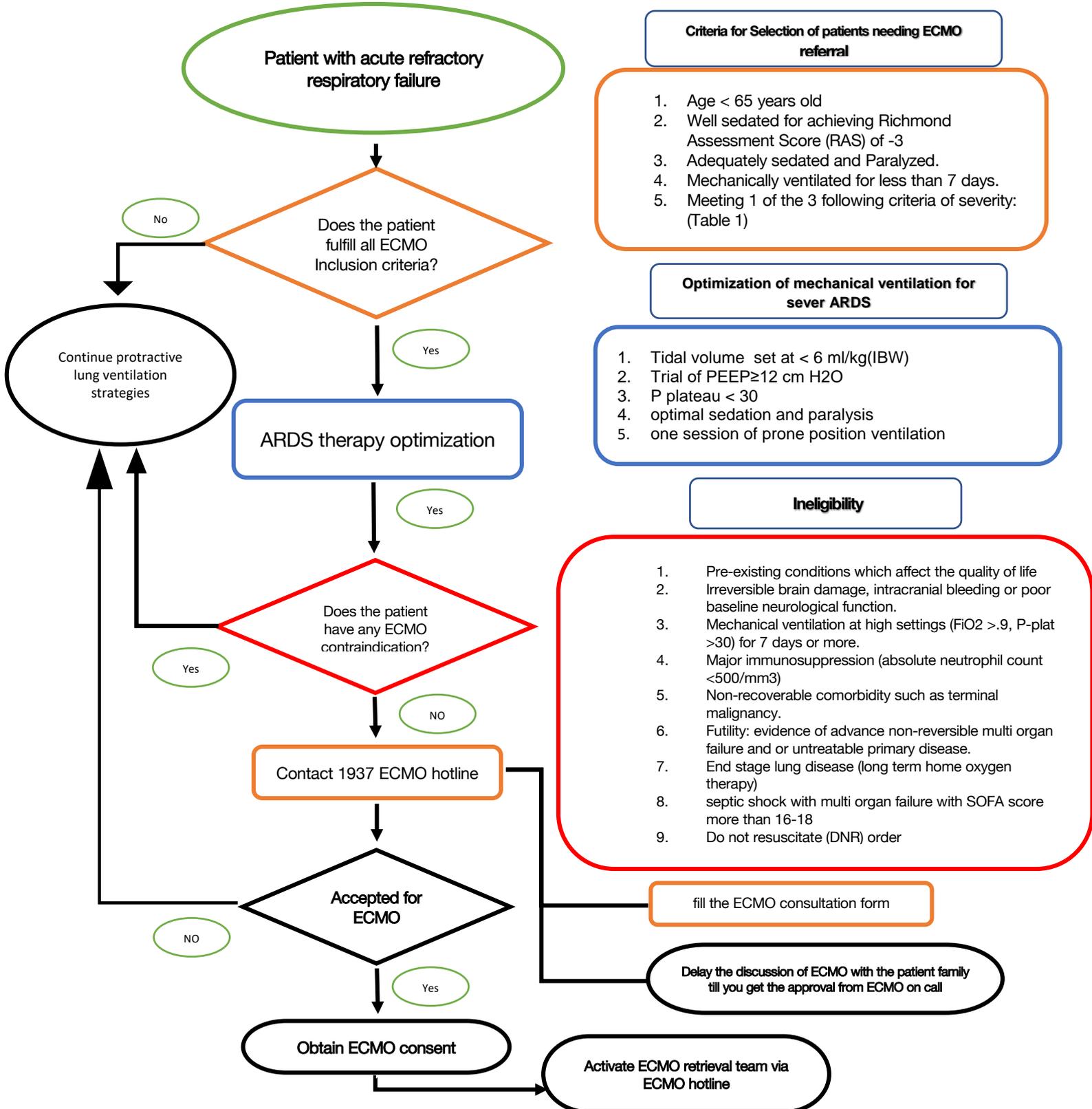
If the case is accepted:

- a. The referring physician will secure the consent from the patient's next of kin as per the referring hospital procedure consent policy and explain the advantages and

disadvantages of the ECMO as per the recommendations of the ECMO consultant on call. The consent must include patient transfer to the ECMO center designated by the ECMO consultant on call.

- b. The referring physician should communicate with ECMO consultant if consent is not secured.
- c. If the next of kin refuse the procedure, the case will be closed.
- d. Once consent is secured, the referring hospital will immediately create an official referral on Ehalaty through the medical coordination office in the referring hospital to the ECMO center recommended by the ECMO consultant and provide the Ehalaty number to the 1937 lifesaving coordinator assigned to the case.
- e. The referring physician will continue to manage the patient as per known standard ARDS management guidelines utilizing protective lung until the ECMO retrieval team arrives.
- f. The referring physician should follow the ECMO consultant recommendations that will be sent in writing as a reply to the ECMO referral form in advance if any.

Flow Chart for Initiation of ECLS for Acute Respiratory Failure



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