

Therapeutic Efficacy of Venovenous ECMO in Acute Respiratory Distress Syndrome

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Background:

- ❖ ARDS is a life-threatening condition characterized by poor oxygenation and "stiff" lungs. It is associated with capillary endothelial injury and alveolar damage that carries a grave mortality rate as high as 45% in severely diseased lungs.¹
- ❖ Significant respiratory distress develops within 72 hours of predisposing events with impaired ventilation causing hemodynamic instability due to poor tissue perfusion. Subsequently, after the acute lung injury state, patients present in acute respiratory distress with dyspnea, tachypnea, and hypoxemia being the main symptoms.²
- ❖ There is limited investigation of the benefits of venovenous ECMO as a therapeutic modality in ARDS patients compared to mechanical ventilation strategies.

PICOT:

- ❖ In adult patients (18+) does the use of venonvenous ECMO improve the survival of patients with severe ARDS in comparison to mechanical ventilation?

Summary of Evidence Search:

<u>Database:</u>	<u>Yielded:</u>	<u>Reviewed:</u>	<u>Included:</u>
Ebsco Host	460	10	2
PubMed	406	5	1
Dynamed	1	1	1
UpToDate	12	1	1
Cochrane	5,941	10	1
<u>Total:</u>	6,820	27	6

Review of the Literature:

Keywords: *Acute respiratory distress syndrome, venovenous ECMO, survival, mechanical ventilation, long-term effects, complications*

Inclusion: 18 years old, patients placed on mechanical ventilation, and patients who met the disease criteria for ARDS, patients on mechanical ventilation or ECMO

Exclusion: pregnant ARDS patients, patients suffering from severe cardiac hemodynamic compromise with limited vascular access, patients with severe irreversible anoxic brain injury, patients who were severely immunocompromised, patients with advanced comorbid conditions that limit recovery, and the situation in which ECMO presents with limited availability

Results:

Table-1: Combes et. al ECMO v. Mechanical Ventilation 60-Day Mortality

Primary Endpoint: 60-Day Mortality Rate	Mechanical Ventilation:	ECMO:	Crossover to ECMO:
Relative Risk:	RR: 0.76	RR: 0.70	RR: 0.62

- ❖ EOLIA trial was designed to investigate therapeutic venonvenous ECMO in patients with refractory ARDS (**Table-1**).
- ❖ Relative risk of venonvenous ECMO utilization was lower in ARDS patients compared to mechanical ventilation
- ❖ Combes et al. concluded that at 60 days, 44 patients (35%) in the ECMO group and 57 (46%) in the control group had died which was confounded with crossover from mechanical ventilation to ECMO.

Table-2: Shrestha et al. In-Hospital Mortality v. ICU Mortality comparing ECMO and Mechanical Ventilation

	In-Hospital Morality-Rate (30-Days)	ICU Mortality-Rate (30-Days)	In-Hospital Morality-Rate (90-Days)	ICU Mortality-Rate (90-Days)
Odds Ratio	OR: 0.75	OR: 1.00	OR: 0.59	NS

- ❖ Shrestha et al. also concluded that patients treated with ECMO had lower odds of mortality at both 30- and 90-days mortality (**Table-2**).

Table-3: Wang et al. Comparison of In-hospital Mortality and Bleeding Complications for ECMO Therapy

ECMO:MV	30-Days	60-Days	1-year
In-hospital Mortality:	OR: 1.37	OR: 0.57	OR: 0.48
Bleeding Complications:	NS	OR: 2.64	NS

- ❖ Wang et al. meta-analysis demonstrated that ECMO was associated with reduced 60-day and 1-year mortality, but increased ICU mortality compared to mechanically ventilated ARDS patients (**Table-3**).
- ❖ ECMO therapy provided in severe refractory ARDS patients was associated with more severe complications than mechanical ventilation.

Discussion:

- ❖ Venovenous extracorporeal lung support has shown promise for the management of ARDS, offering benefits such as adequate lung rest measures, a decreased incidence of ventilatory-induced lung injury, and hemodynamic stabilization without compromising right ventricular function.
- ❖ Combes et al. were limited in reporting total mortality among the mechanically ventilated group.
- ❖ The use of venovenous ECMO should be considered on an individual basis for adults with severe ARDS at appropriate ECMO centers.
- ❖ Wang et al. found that there was a substantial reduction in mortality by one year in patients who received ECMO.
- ❖ Use of venovenous ECMO should be utilized through an individualized approach.

Limitations/Further study:

- ❖ Treatment failure outcomes and secondary analyses of mortality that included observational studies were prone to bias.
- ❖ Variables that influenced the duration of ECMO and mechanical ventilation settings, number of mechanically ventilated days, prone positioning before ECMO, and different populations.
- ❖ The duration of hospital stays according to Shrestha et al. concluded only the patients who had survived.

Conclusion:

- ❖ When initiated within appropriate timeframe for ECMO cannulation prior to severe hemodynamic compromise in severe ARDS patients, ECMO has proven to have a positive effect on survival and mortality rate; however, this was proven effective at tertiary care centers with advances resources and highly specialize staff. The use of venovenous ECMO remains relative resource intensive and is associated with adverse effects. It is crucial to emphasize that further research is imperative to develop clinical protocols that can reduce complications with ECMO. With further guideline development for ARDS management, contributions to this research could be instrumental in improving patient outcomes.

References:

1. Diamond M, Peniston HL, Sanghavi DK, Mahapatra S. Acute Respiratory Distress Syndrome. In: *StatPearls*. StatPearls Publishing; 2024. Accessed March 30, 2024. <http://www.ncbi.nlm.nih.gov/books/NBK436002/>
2. Sottile PD, Schmidt EP, Mould KJ. The Acute Respiratory Distress Syndrome. In: Schmidt GA, Kress JP, Douglas IS, eds. *Hall, Schmidt and Wood's Principles of Critical Care*. 5th Edition. McGraw Hill; 2023. Accessed November 11, 2023. accessmedicine.mhmedical.com/content.aspx?aid=1201803291
3. Combes A, Hajage D, Capellier G, et al. Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome. *N Engl J Med*. 2018;378(21):1965-1975. doi:10.1056/NEJMoa1800385
4. Shrestha DB, Sedhai YR, Budhathoki P, et al. Extracorporeal Membrane Oxygenation (ECMO) Dependent Acute Respiratory Distress Syndrome (ARDS): A Systematic Review and Meta-Analysis. *Cureus*. Published online June 6, 2022. doi:10.7759/cureus.25696
5. Wang J, Wang Y, Wang T, Xing X, Zhang G. Is Extracorporeal Membrane Oxygenation the Standard Care for Acute Respiratory Distress Syndrome: A Systematic Review and Meta-Analysis. *Heart Lung Circ*. 2021;30(5):631-641. doi:10.1016/j.hlc.2020.10.014



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