Extracorporeal Membrane Oxygenation (ECMO) for Severe Asthma Exacerbations Requiring Mechanical Ventilation

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Rationale: Asthma affects 20 million adults in the United States resulting up to 500,000 hospitalizations each year. Patients admitted to the intensive care unit (ICU) for asthma exacerbations requiring invasive ventilation have a mortality of ~7%. Extracorporeal membrane oxygenation (ECMO) is a salvage technique used in patients with reversible causes of respiratory failure to increase delivery of oxygen, remove CO_2 and allow time for recovery. Case reports, case series and uncontrolled registry studies have examined potential benefits of ECMO for asthma exacerbations with respiratory failure, but no studies have examined outcomes associated with use of ECMO for asthma exacerbations compared to standard care. **Objective**: To assess outcomes associated with use of ECMO during asthma exacerbations requiring invasive ventilation compared to standard care. **Methods**: Patients were extracted from the Premier Healthcare Database from 2010-2020 if they had a primary diagnosis of asthma or asthma exacerbation, or a primary diagnosis of respiratory failure with a secondary diagnosis of asthma or asthma exacerbation, and were treated with invasive mechanical ventilation. Patients were excluded for age < 18 years, no ICU admission, chronic lung disease other than asthma, diagnosis of COVID-19, or if they were not treated with corticosteroids. Hospital mortality was the primary study outcome. Key secondary outcomes included ICU length of stay (LOS), hospital LOS, length of invasive ventilation and hospital costs. Differences in outcomes were assessed using propensity score matching at a 1:2 ratio of ECMO *versus* no ECMO, and by covariate adjustment of the entire study group. **Results**: A total of 20,494 patients with asthma exacerbations requiring invasive ventilation were included in the study, of which 130 were treated with ECMO and 20,364 were not. ECMO use increased over the study period ($p<0.0001$), and patients were treated with ECMO for an average of 4 days. After propensity matching, ECMO (N=103) versus no ECMO (N=206) was associated with reduced mortality (11.4% vs. 23.3%, $p = 0.017$) and increased hospital costs, but no difference in ICU LOS, hospital LOS or length of mechanical ventilation (Table). The covariate-adjusted model replicated these findings (Table). In the propensity-matched analysis, ECMO was also associated with increased renal replacement therapy ($P = 0.02$), shock ($P=0.02$) and 30-day all-cause readmission ($P = 0.01$). **Conclusion**: ECMO was associated with reduced mortality at the cost of increased morbidity in asthmatics requiring invasive ventilation, indicating that ECMO has the potential to save thousands of lives.

Table. Outcomes Associated with ECMO for Asthma Exacerbations						
	Propensity-Matched Model N=309			Covariate Adjusted Model N=20,494		
	OR	**95% CI**	**P Value**	**OR**	**95% CI**	**P Value**
Mortality	0.43	0.22-0.85	0.016	0.38	0.21-0.68	0.001
	Ratio	**95% CI**	**P Value**	**Ratio**	**95% CI**	**P Value**
Hospital Cost	1.76	1.47-2.12	<0.0001	1.65	1.44-1.89	<0.0001
ICU LOS	1.20	0.96-1.49	0.12	1.14	0.98-1.34	0.09
Hospital LOS	1.15	0.91-1.44	0.24	1.08	0.92-1.26	0.34
Length of Invasive Ventilation	1.13	0.91-1.41	0.26	1.08	0.93-1.26	0.30

Abbreviations: ECMO = Extracorporeal Membrane Oxygenation, LOS = length of stay, OR = odds ratio, CI = confidence interval