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Editorial

Extracorporeal Membrane Oxygenation Seems to be a Life-Saving Bridge to Recovery from Severe Acute Respiratory Distress Syndrome resulting from Burn or Inhalation Injury

Yu-Jen Chiu[1,2] and Cherng-Kang Perng[1,2]*

[1]*Department of Surgery, Taipei Veteran General Hospital, Taiwan*
[2]*Department of Surgery, National Yang Ming University, Taiwan*

***Corresponding author**
Cherng-Kang Perng, Department of Surgery, Taipei Veteran General Hospital, 19/F, No. 201, Sec. 2, Shipai Rd., Beitou Dist., Taipei City 112, Taiwan, Tel: 886-2-2871-2121; Fax: 886-2-2875-7041; Email: ckperng@vghtpe.gov.tw

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ABBREVIATIONS

ECMO: Extracorporeal Membrane Oxygenation; ARDS: Acute Respiratory Distress Syndrome; VV: Veno Venous; VA: Venoarterial

EDITORIAL

Refractory respiratory failure is one of the most prevalent causes of death in burn patients, resulting from an overwhelming cascade of airway inflammation, pulmonary shunting and augmented micro-vascular pressure gradient [1]. Once acute respiratory distress syndrome (ARDS) occurs, mortality rate becomes extraordinarily elevated [2]. Mechanical ventilation is the primary therapy by using a lung-protective strategy to avoid superimposing additional damage on the already-injured pulmonary alveoli, including limited peak inspiratory pressure to ventilate the lung, low tidal volume, higher positive end-expiratory pressure and sedation with neuromuscular blockade [2]. However, when a critical volume of alveolar unit has failed, such ventilation is unable to provide life-saving respiratory support. These patients require an increase in peak inspiratory pressure to drive larger tidal volume for ventilation, which increases risks of ventilator-induced lung injury [3]. Ironically, they are the very patients who need a lung-protective strategy the most to allow for "lung rest." Extracorporeal membrane oxygenation (ECMO) seems to be considered as an alternative treatment to solve this problem without overstretching the injured lung. In early studies, the results failed to demonstrate favorable outcomes in ECMO-treated groups. The high incidence of bleeding and thrombotic complications attested to this inexperience [4]. Nevertheless, over recent years, ECMO has become more reliable with improvements in equipment, and increased experience. It has remarkably progressed to become an alternative tool to treat patients with severe cardiac and pulmonary dysfunction refractory to conventional management [5,6]. Several observational studies and randomized clinical trials have demonstrated that ECMO treatment might improve outcome in children and adults with severe respiratory failure [6,7]. These promising studies stimulated interests in using ECMO as potential therapy for burn patients with severe ARDS. However, experience and literature on the ECMO treatment with burn patients are limited, and the consequently findings are varied.

LITERATURE REVIEW OF ECMO TREATMENT INPEDIATRIC BURN PATIENTS

Bartlett et al., in 1982 reported the first series of successful ECMO treatments in neonatal patients [8]. Following this lead, researchers began to experiment with pediatric respiratory ECMO. Although ECMO in neonatal respiratory failure has been supported by randomized trials, only three retrospective studies and six case reports focusing on pediatric burn patients have been published to date [1]. Most studies in this field have reported favorable outcomes after ECMO treatment. Asmussen et al., in 2013 further conducted a systematic review of ECMO in hypoxemic respiratory failure resulting from burn and/or smoke inhalation injury. Available studies have mostly focused on the pediatric population. The main results have suggested that (1) a tendency of favorable outcomes in ECMO groups than in conventional groups; (2) an ECMO run-time of less than 200 h correlated with higher survival; (3) patients with scald burns had a tendency of higher survival than with flame burns; (4) no difference on mortality between PaO2/FiO2 ratios of more or less than 60 mmHg as ECMO initiation [1]. Although the published trials included patients that were recruited over two decades, these results increased physicians' confidence in using

ECMO as a lifesaving modality for pediatric patients with burns and respiratory failure.

LITERATURE REVIEW OF ECMO TREATMENT IN ADULT BURN PATIENTS

Unlike ECMO for pediatric patients with ARDS, researchers in early studies failed to demonstrate credible benefits of outcomes in adult patients. Until the publication of the CESAR trial, results of the trial clearly showed an improvement in the death rate and severe disability at six months in the ECMO treatment arm [7]. Two observational studies also showed high survival rates of ECMO in patients with influenza A (H1N1) with refractory hypoxemia [6,9]. Previously, only few case reports for assessing ECMO for adults in the field of burn and/or smoke inhalation were reported. In recent two years, four case series were reported. Two case series reported by Hsu et al., and Soussi et al., revealed poor overall survival rates (16.7% and 9%) [10,11]. Soussi et al., demonstrated that ECMO might not be used in the situation based on their findings [11]. However, other two case series reported favorable outcomes of ECMO treatment in burn patients (survival rates: 80% and 60%) [12,13]. The survival rates were varied between these four studies. We found that all patients died if receiving Venoarterial (VA)-ECMO treatment. However, most patients with Venovenous (VV)-ECMO treatment successful weaned from ECMO and survived to discharge. Furthermore, instead of ECMO related complications, most patients died from sepsis, cardiogenic shock or multi-organ failure. Only one patient was reported to have major bleeding upon ECMO cannulation in the studies. We thought that the most important reason for the survival difference was because of the indications for ECMO treatment. VV-ECMO seems to be a bridge to recovery from severe respiratory failure resulting from severe burn or inhalation injury. However, applying ECMO in burn patients with sepsis-related ARDS or cardiogenic shock may be catastrophic.

CONCLUSION

The results from available literature are encouraging, although limited by the shortcomings of small sample size. ECMO may be a lifesaving bridge of recovery for burn patients with severe lung injury who are nonresponsive to maximal medical management. We should not postpone ECMO treatment for these patients. We believe that there is an increase in patient survival as the result of improvements in equipment and physician experience, as previous studies have reported [14]. More cases are needed to draw more robust conclusions.

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