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Analysis of Different Blood Infections in Patients Undergoing Extracorporeal Membrane Oxygenation

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ABSTRACT

Extracorporeal membrane oxygenation (ECMO) is one of the most important strategies to treat severe acute respiratory failure or cardiac failure. **Objectives:** The main objective of the study is to analyze the different blood infections in patients undergoing extracorporeal membrane oxygenation. **Material and methods:** This cross-sectional study was conducted in Shalamar Medical and Dental College, Lahore from March 2019 to March 2020. The data was collected from 69 patients who visited the OPD of the hospital. The data was collected from those patients who received ECMO therapy. **Results:** The data were collected from 69 patients. We observed 3 episodes of bloodstream infection and 10 infections with negative blood cultures. Among patients without bloodstream infection, we reported 8 cases of pneumonia (7 episodes with the positive tracheal specimen and 1 case with positive bronchoalveolar lavage) and 2 episodes of infection with negative microbiological investigations. **Conclusion:** It is concluded that Gram-negative bacteria are the predominant pathogens causing BSI during ECMO treatment. Severe organ failure increases the risk of BSI in patients receiving ECMO.

INTRODUCTION

Extracorporeal membrane oxygenation (ECMO) is one of the most important strategies to treat severe acute respiratory failure or cardiac failure. The application of ECMO in adults has increased rapidly since influenza A H1N1 epidemic and the completion of the CESAR trial. Despite the growing implementation of adult ECMO, mortality due to severe acute respiratory failure or cardiac failure remains relatively high. The overall survival rate for these patients in the extracorporeal life support organization (ELSO) registry was 56%, and it varied depending on the patient population and health care providers.

Nosocomial infection is a complication commonly seen and usually contributes to a high mortality rate. Multiple factors increase the risk of nosocomial infection in patients receiving ECMO. Furthermore, the incidence of bloodstream infections (BSIs) remains substantial, thus impacting the prognosis of patients treated with ECMO. Therefore, the management of patients with a BSI during ECMO remains a challenge.

Extracorporeal membrane oxygenation (ECMO) represents an effective tool for the treatment of heart and lung failure. Nevertheless, clinicians may encounter many hardships in the management of this innovative therapeutic option. One of the most problematic challenges is to define the presence and onset of infection and sepsis because these critically ill patients invariably present clinical signs of systemic inflammatory response. In such patients, the systemic inflammatory response syndrome (SIRS) is due to both the underlying acute disease and the host response to the presence of the extracorporeal circuit itself. The issue is critical because mortality in sepsis is high and early therapeutic intervention can improve prognosis. On the other hand, broad use of antibiotics in all patients with SIRS may lead to a prevalence of resistant strains with increasing toxicity and costs. Moreover, when ECMO is used as a bridge to other potential therapeutic options, including organ transplant and long-term assist device implantation, the presence of infection is to be rigorously established to evaluate whether patients' eligibility criteria are met.

Objectives

The main objective of the study is to analyze the different blood infections in patients undergoing extracorporeal membrane oxygenation.

MATERIAL AND METHODS

This cross-sectional study was conducted in Shalamar Medical and Dental College, Lahore from March 2019 to March 2020. The data was collected from 69 patients who visited the OPD of the hospital. The data was collected from those patients who received ECMO therapy. All the demographic, clinical, and diagnostic parameters were collected carefully. All patients were intubated during ECMO support, except 1 patient with non–H1N1-related pneumonia who received VV ECMO after the failure of noninvasive ventilation.

The data was collected and analyzed using SPSS version 19. All the values were explained in mean and standard deviation.

RESULTS

The data was collected from 69 patients. We observed 3 episodes of bloodstream infection and 10 infections with negative blood cultures. Among patients without bloodstream infection, we reported 8 cases of pneumonia (7 episodes with the positive tracheal specimen and 1 case with positive bronchoalveolar lavage) and 2 episodes of infection with negative microbiological investigations.

Table No. 01: Different types of infections among selected patients

Patient	Extracorporeal support	Type of infection	Pathogen
1	VV ECMO	Pneumonia	*Acinetobacter baumannii*
2	VV ECMO	Bloodstream	*Candida albicans*
3	VV ECMO	Pneumonia	*Stenotrophomonas maltophilia*
4	VV ECMO	Pneumonia	*Enterobacter aerogenes*
5	VV ECMO	Pneumonia	No pathogen isolated
7	VA ECMO	Pneumonia	*Aspergillus fumigatus*
8	VA ECMO	Pneumonia + bloodstream	*Escherichia coli*
		Pneumonia	*Klebsiella pneumoniae*
9	VA ECMO	Bloodstream	*Candida albicans*
12	VA ECMO	Cholecystitis	No pathogen isolated
13	VA ECMO	Pneumonia	*Staphylococcus aureus*

Table No. 02: Analysis of risk factors for BSIs.

Risk factors	OR (95%CI)	P value
Pre-ECMO SOFA score	1.174 (1.039–1.326)	0.010
MRSA prophylactic regimen		0.104
CRRT during ECMO		0.365
ECMO support duration, days		0.146
Ventilator duration before ECMO weaning, days		0.041

DISCUSSION

Controversies still exist concerning the necessity of prophylaxis for ECMO treatment. In our research, all patients were given intravenous prophylactic antibiotics during the process of ECMO support. However, the incidence of overall infection was still high. Additionally, BSIs were more commonly seen in patients with anti-MRSA regimens. This increased likelihood of BSI in the anti-MRSA group is probably linked to dysbiosis (imbalance of guts microbial environment) of the intestinal flora and bacterial translocation. Therefore, we speculate that prescription anti-MRSA medications to prevent BSIs should be used with caution in ECMO patients. Other studies also have shown that antibiotic prophylaxis did not reduce ECMO-related infection. Thus, the ELSO Infectious Disease Task Force does not recommend the administration of antimicrobial agents to prevent infectious complications during ECMO support and advises not to prolong it beyond 48 hours after cannulation.

There is a higher risk of nosocomial infection with a longer ECMO duration. Several previous studies have reported a similar clear association between the risk of nosocomial infection and ECMO duration. Burket *et al*. have reported that the incidence of BSIs increased from 9.5 to 64.5 infections per 1000 days of ECMO for patients with ECMO lasting from 3–10 days to 21–30 days. Moreover, the duration of ventilator support before ECMO weaning was similarly related to BSI occurrence as long-term ventilator support increased the incidence of ventilator-associated pneumonia and secondary BSIs.4 Of note, BSIs may also prolong the duration of ECMO or the duration of ventilator use. In the currents study, patients with BSI had a significantly longer duration on ECMO (8 vs. 5.8 days) and ventilator duration before ECMO weaning (10 vs. 6 days) although we failed to prove that the duration of ECMO or ventilator duration was an independent risk factor for BSIs due to the limited sample size.

CONCLUSION

It is concluded that Gram-negative bacteria are the predominant pathogens causing BSI during ECMO treatment. Severe organ failure increases the risk of BSI in patients receiving ECMO.

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