ORIGINAL ARTICLE

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ECMO Use in Postcardiotomy Syndrome: A Single Center Experince

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Abstract

Objective: Extracorporeal membrane oxygenation (ECMO) is used as a life support system in patients with either cardiac or respiratory failure. The aim of our study was to evaluate our experience with ECMO used for cardiac support in patients with postcardiotomy syndrome (cardiogenic shock) at our center.

Methods: Fifty patients treated with ECMO with cardiac failure either in the intensive care unit or operative room due to failure to wean from cardiopulmonary by-pass were retrospectively inspected. Demographic data, ECMO protocols, and clinical follow-up data were collected and reviewed.

Results: All patients received venoarterial (VA) ECMO because of cardiogenic shock. The mean duration of ECMO was 3.7±3.4 days. The survival rate for ECMO and the survival rate to discharge were 72%. The overall cardiogenic shock mortality rate for ECMO was 28%.

Conclusion: ECMO use in patients with cardiogenic shock (postcardiotomy syndrome) is associated with high mortality. According to our data, VA ECMO may be a beneficial mechanical assist device in short-term for patients with cardiogenic shock with an acceptable weaning rate. The success rate of ECMO may depend on the time of initiation and duration of use.

Keywords: Extracorporeal membrane oxygenation, cardiogenic shock, mortality

INTRODUCTION

Cardiogenic shock is primarily associated with increased mortality and poor outcomes. The progression of cardiogenic shock due to multiple factors causing fatal cardiac dysfunction occurs when medical therapy fails to restore the hemodynamic state (1). Mechanical circulatory support (MCS) may be required to restore cardiac function at this point. Veno arterial extracorporeal membrane oxygenation (VA-ECMO) is a useful tool for patients with severe cardiogenic dysfunction (2). The study presented the outcomes of VA-ECMO use and evaluate early mortality in patients with perioperative cardiogenic shock at our center.

METHODS

Our study was approved by the Ethics Committee of University of Health Sciences Turkey, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (date: 18.05.2023/decision no: 2023-06). Because our study design was a retrospective review of prospectively collected data, the need for informed consent was waived. Between February 2014 and January 2019, 50 consecutive patients with VA-ECMO use due to perioperative cardiogenic shock (postcardiotomy) were identified and included in our retrospective study. ECMO was administered to patients who failed to wean from cardiopulmonary by-pass

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(CBP) or to patients with perioperative cardiogenic shock in the intensive care unit (ICU) with no response to inotropic support or intraortic balloon pump. Patients who failed to wean from CBP had VA-ECMO implanted through the central cannulas. Peripheral VA-ECMO was implanted via groin vessels using the percutaneous Seldinger technique.

Ecmo Protocol

The VA-ECMO initiation and weaning protocol at our institution are the same strategies applied by many other centers around the world. The anticoagulant protocol during VA-ECMO at our institution was performed with intravenous infusion of heparin targeting ACT of 180 to 200 s and aPTT between 60 and 80 s to overcome thromboembolic events. VA-ECMO flows were regulated by keeping the mean pressure above 50 mmHg and mixed oxygen concentration above 60%. Hemoglobin level was maintained above 7 g/L and platelet count was maintained above 50,000 cells/mm^3. Weaning from ECMO was considered at least 72 h from initiation after restoring cardiac functions were evaluated from echocardiogram and clinical hemodynamic parameters. A left ventricular ejection fraction of above 20% at a flow of 2 L/min with stable hemodynamic functions was considered to be an indicator of myocardial recovery. ECMO was terminated because of detorerating myocardial dysfunction and multiorgan dysfunction (mainly unresolved renal and hepatic dysfunction).

Variables

The analysis was performed using our institutional patient database. The variables included: baseline characteristics [patient demographics (age, sex, body mass index, ejection fraction]), presence of diabetes, hypertension, chronic renal insufficiency, pulmonary hypertension, chronic obstructive pulmonary disease, need for vasoactive drugs and preoperative mechanical ventilation, place of VA-ECMO implantation (operating room/intensive care unit), localization of VA-ECMO cannulas (central/peripheral), and outcome data after ECMO use (ECMO duration, ECMO weaning, length of hospital stay and early mortality).

Endpoints of the Study

The primary endpoint of our study was early outcome survival and 30-day mortality after initiation of VA-ECMO support. The mortality rate was observed to be 28%. Cardiac stabilization could not be maintained in 8% of patients who developed fetal arrhythmia and unresolvable cardiogenic shock during VA-ECMO. Eight percent of these patients developed disseminated intravascular coagulopathy. Sepsis and hemorrhagic complications developed in 8% and 4% respectively.

RESULTS

Our study consisted of 50 patients who were retrospectively reviewed. All patients received VA-ECMO either in the ICU (50%) or the operative room (50%). The baseline characteristics are summarized in Table 1. The mean age of our patients was 54.8±14.9 years. ECMO characteristics are summarized in Table 2. The mean duration of ECMO was 3.7±3.4 days. The survival rate for ECMO and the survival rate to discharge were 72%. The mortality rate for ECMO was 28%. Outcomes of ECMO use are summarized in Table 3.

DISCUSSION

Our study presents a single-center experience with patients who had received VA-ECMO support as a result of cardiogenic shock leading from failure to wean from CPB or postoperative acute cardiac dysfunction. Most patients with severe cardiogenic shock with no response to medical therapy are widely treated with transient MCS, which includes ventricular assist devices as well as VA-ECMO (3).

Table 1. Baseline characteristics of the study group

Age, years	54.8±14.9
Gender; Male, n (%) Female, n (%)	15 35
Body mass index, mean ± SD	25.2±4.7
Ejection fraction, mean ± SD (%)	52.4±8.7
Diabetes mellitus, n (%)	13 (26.0%)
Hypertension, n (%)	16 (32.0%)
Chronic renal insufficiency, n (%)	2 (4.0%)
Pulmonary hypertension, n (%)	1 (2.0%)
Chronic obstructive pulmonary disease, n (%)	14 (28.0%)
Need for vasoactive drugs, n (%)	5 (10.0%)
Preoperative mechanical ventilation	1 (2.0%)

SD: Standard deviation

Table 2. ECMO characteristics data

Neuroadrenaline dosage, mcg/kg/min	0.8
Adrenalin dosage, mcg/kg/min	0.5
Hemoglobin, g/dL	12.4±2.5
Place of ECMO implantation • Operatic room, n (%) • Intensive care unit, n (%)	 50% 50%
Localization of the ECMO cannulas • Central, n (%) • Peripheral, n (%)	 50% 50%
ECMO duration, n (days)	3.7±3.4

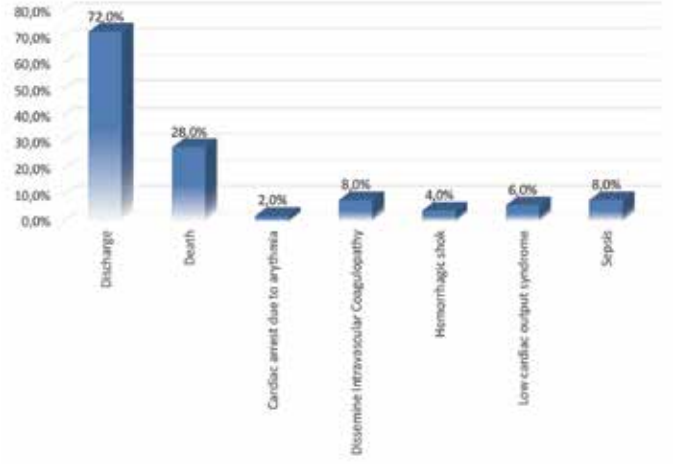
ECMO: Extracorporeal membrane oxygenation

Postoperative cardiogenic shock is associated with high morbidity and mortality (4). den Uil et al. (5) reported a high mortality rate of 62% in patients who had received VA-ECMO treatment due to right ventricular failure in comparison with our study, which revealed a mortality rate of 28%. This discrepancy may be because their study only focused on patients with isolated right or left ventricular failure.

Our study revealed a mortality of 28%. Although the level of mortality is too high incooperative to our patient's profile, this may be because most of our patients had received VA-ECMO because of postoperative cardiogenic shock, whereby some patients developed hemorrhage, sepsis and some had irreversible cardiogenic shock syndrome. In addition, the duration of VA-ECMO in these patients was high, causing negative effects associated with therapy occured as outlined in Table 3.

Postcardiotomy syndrome may be associated with high morbidity and mortality. This is due to the effect of CPB or poor myocardial protection, which may result in postoperative myocardial dysfunction. Postoperative myocardial dyscontractility may cause myocardial stunning that results in early postoperative cardiogenic shock (6). Proper treatment strategies to allow recovery of myocardial tissue should be taken after cardiogenic shock has occurred. Our study analysis revealed that ECMO weaning was possible 3.7±3.4 days in our patient group, which was slightly lower than that in other studies (7). This difference occurred because most of our patients had many other cormobodies, which may have contributed to high mortality as a result of postoperative infection that required massive therapy and cardiogenic failure. Our study revealed a mortality of 28% after VA-ECMO treatment due to cardiogenic shock. ECMO therapy-related comorbidities may have hindered the recovery process and contributed to the high mortality observed in our study.

Table 3. ECMO outcomes



ECMO: Extracorporeal membrane oxygenation

However, the best cardiac support for patients with acute cardiogenic shock is still regarded as VA-ECMO. In addition, there are other implantable cardiac systems, such as Impella Roller Pump, Tandem Right Ventricular Assist Device (RVAD), and Protek Duo, which can be used as direct right ventricular by-pass devices, whereas VA-ECMO is an indirect right ventricular by-pass (8). In addition, minimally invasive MCS is preferable in cardiogenic shock (9). During peripheral VA ECMO, RV function may be affected due to an increase in the pressure of the pulmonary circulation as a result of the undecompressed left ventricle. This may lead to RV dilatation pushing the ventricular septum into the left ventricle, thereby affecting the left ventricular geometry (10). In our study, 50% of our patients had peripheral VA-ECMO, which may have negatively affected our patient 's outcome. In this state, VA ECMO may be used in combination with RVAD to improve right ventricular function. Osaki et al. (11) have reported a case where RVAD with VA-ECMO was implanted, resulting in full recovery without heart failure.

During our study, anemia and high CK-MB during VA ECMO were associated with high mortality. Likewise, preoperative low hemoglobin levels are associated with high mortality, as reported in other studies (12). There are also other studies where my high CK-MB during VA ECMO therapy is considered an indicator of mortality (13).

Study Limitations

The retrospective nonrandomized nature and limited number of patients from a single institution reduces the statistical power of the study. Moreover, our single-center experience does not allow generalization. Our study focused on short-term outcomes and were not evaluate long-term results.

CONCLUSION

Our data revealed a high mortality rate for patients suffering from cardiogenic shock before VA-ECMO implantation, although 72% were successfully weaned off ECMO. Thus, VA-ECMO in patients with cardiogenic shock is a feasible and life saving. Further large-scale, multicenter studies are necessary to evaluate ECMO therapeutic measures in the treatment of cardiogenic shock.

Ethics

Ethics Committee Approval: University of Health Sciences Turkey, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery

Training and Research Hospital (date: 18.05.2023/decision no: 2023-06).

Informed Consent: Retrospective sudy.

Peer-review: Internally and externally peer reviewed.

Authorship Contributions

Concept: M.B., M.K., Design: M.B., M.K., Data Collection or Processing: M.B., M.K., Analysis or Interpretation: M.B., Literature Search: M.K., Writing: M.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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