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VA-ECMO post-cardiotomy: mortality and outcomes. A 10-year cohort

ECMO-VA post-cardiotomía: mortalidad y desenlaces. Cohorte de 10 años

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ABSTRACT

Objective: Veno-Arterial (VA) Extracorporeal Membrane Oxygenation (ECMO) for refractory postcardiotomy cardiogenic shock carries high mortality. The objective was to describe the frequency of mortality and complications in adult patients who required this support after cardiac surgery, as well as the associated factors. **Material and methods:** an observational, descriptive, retrospective study. Records of 30 patients undergoing cardiac surgery requiring VA ECMO support at the "Dr. Gaudencio González Garza" General Hospital between January 1, 2013, and December 31, 2023, were analyzed. Demographic, surgical and complication variables were compared between survivors and non-survivors using t-Student and χ^2 tests. **Results:** thirty patients were included, with a mean age of 44.8 years; 80% were cardiac transplants. Overall mortality was 63.3% (n = 19). The most frequent complications were acute kidney injury (66.7%) and bleeding (60%). No significant differences were found in age (p = 0.14) or support duration (5.73 vs 5.78 days, p = 0.97). Pre-support Left Ventricular Ejection Fraction (LVEF) was the only variable with statistical significance, being paradoxically higher in the deceased group (mean 34.4%) compared to survivors (mean 27.4%) (p = 0.031). **Conclusions:** mortality for post-cardiotomy VA ECMO in our cohort (63.3%) is high, consistent with international reports. Renal failure and bleeding were the predominant complications. Pre-support LVEF was not a predictor

RESUMEN

Objetivo: *el choque cardiogénico refractario postcardiotomía tratado con oxigenación por membrana extracorpórea (ECMO, por sus siglas en inglés) veno-arterial (VA) presenta una elevada mortalidad. El objetivo fue describir la frecuencia de mortalidad y complicaciones en pacientes adultos que requirieron este soporte después de una cirugía cardíaca, así como los factores asociados.* ***Material y métodos:*** *estudio observacional, descriptivo y retrospectivo. Se analizaron los expedientes de 30 pacientes sometidos a cirugía cardíaca que requirieron soporte con ECMO VA en nuestra institución entre el 1 de enero de 2013 y el 31 de diciembre de 2023. Se compararon variables demográficas, quirúrgicas y complicaciones entre sobrevivientes y fallecidos usando pruebas t-Student y* χ^2. ***Resultados:*** *se incluyeron 30 pacientes, con edad media de 44.8 años, 80% fueron trasplantes cardíacos. La mortalidad global fue de 63.3% (n = 19). Las complicaciones más frecuentes fueron insuficiencia renal aguda (66.7%) y sangrado (60%). No se encontraron diferencias significativas en edad (p = 0.14) ni duración del soporte (5.73 vs 5.78 días, p = 0.97). La fracción de eyección del ventrículo izquierdo (FEVI) presoporte fue la única variable con significancia estadística, siendo paradójicamente mayor en el grupo de fallecidos (media 34.4%) comparada con los sobrevivientes (media 27.4%) (p = 0.031).* ***Conclusiones:*** *la mortalidad de pacientes en ECMO VA postcardiotomía en nuestra cohorte (63.3%) es elevada, en concordancia con reportes internacionales. La falla renal y el sangrado fueron las complicaciones predominan-*

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of survival; its paradoxical association with mortality suggests that other perioperative factors are more determinant.

Keywords: extracorporeal membrane oxygenation, cardiac surgery, cardiogenic shock, mortality, heart transplantation.

tes. La FEVI presoporte no fue un predictor de supervivencia; su asociación paradójica con la mortalidad sugiere que otros factores perioperatorios son más determinantes.

Palabras clave: *oxigenación por membrana extracorpórea, cirugía cardíaca, choque cardiogénico, mortalidad, trasplante cardíaco.*

Abbreviations:
AKI = Acute Kidney Injury
ECMO = Extracorporeal Membrane Oxygenation
LVEF = Left Ventricular Ejection Fraction
VA = Veno-Arterial

Veno-Arterial (VA) Extracorporeal Membrane Oxygenation (ECMO) represents a sophisticated life support modality, frequently deployed in the cardiothoracic arena as a hemodynamic adjunct for post-cardiotomy patients precipitating into refractory cardiac failure, thereby necessitating a strategic bridge to recovery, decision-making, or transplantation.[1] VA ECMO provides a temporary reprieve, which facilitates diagnostic elucidation and therapeutic intervention. Ultimately, this fosters the potential for myocardial recovery.[2,3]

Notwithstanding its therapeutic utility, VA ECMO support is not devoid of complications. International literature cites substantial hospital mortality rates associated with VA ECMO support. A 2017 meta-analysis revealed survival-to-discharge rates ranging from 24.8 to 40% in patients presenting with refractory post-cardiotomy cardiogenic shock, underscoring the gravity of this clinical scenario.[4]

Hemorrhagic complications resulting from induced anticoagulation and a proinflammatory state, which can lead to renal failure, are frequent challenges that significantly contribute to morbidity and mortality.[5,6] Although descriptions exist in the literature, it is fundamental to analyze outcomes in national reference centers to develop strategies to decrease mortality.

The present study aims to describe the mortality frequency, predominant complications, and scrutinize associated factors within a 10-year cohort of adult patients necessitating VA ECMO support during the postoperative period following cardiac surgery at our institution.

MATERIAL AND METHODS

A retrospective, descriptive, and observational study was undertaken, encompassing a thorough review of medical records from patients who underwent cardiac surgery and necessitated VA ECMO support at our institution spanning January 1, 2013, to December 31, 2023.

Inclusion criteria comprised records of patients aged 18-75 years, of either gender, requiring VA ECMO therapy post-cardiac surgery. Exclusion criteria included concomitant use of other ventricular assist devices during ECMO therapy. Records with incomplete data were eliminated.

Data retrieval was conducted retrospectively from clinical records, utilizing SPSS statistical software for analysis. Descriptive statistics, including measures of central tendency (mean) and dispersion (standard deviation), as well as frequencies, were employed to characterize variables of interest.

Comparative analyses between surviving and deceased patients utilized Student's T-test for quantitative variables and Pearson's χ^2 test for categorical variables, with $p < 0.05$ deemed statistically significant.

The study received approval from the institutional Ethics and Research Committee, classified as risk-free due to its retrospective and observational nature, warranting a waiver of written informed consent. Patient data confidentiality was ensured throughout.

RESULTS

The study cohort comprised 30 patients requiring VA ECMO support following cardiac surgery. The mean age was 44.8 years, with an average weight of 69 kg. Males accounted for 57% (n = 17) of the population. The most prevalent comorbidities were Type II Diabetes Mellitus (30%) and Systemic Arterial Hypertension (20%). Regarding the surgical procedure, 80% (n = 24) were heart transplants. Central cannulation was the predominant configuration, used in 87% of cases.

Overall mortality for the cohort was 63.3% (n = 19) *(Fig. 1)*. Acute Kidney Injury (AKI) was the most frequent complication, affecting 66.7% (n = 20) of patients, followed by bleeding in 60% (n = 18). Other documented complications included limb ischemia (23.3%), thrombosis (10%), and cerebrovascular events (6.7%) *(Fig. 2)*.

Bivariate analysis of quantitative variables *(Table 1)* revealed no statistically significant differences between survivors and non-survivors regarding age (49.7 vs 41.9 years; p = 0.14), weight (p = 0.63), aortic cross-clamp time (p = 0.18), or duration of ECMO support (5.73 vs. 5.78 days; p = 0.97).

Notably, the pre-support Left Ventricular Ejection Fraction (LVEF) was the sole quantitative variable demonstrating statistical significance. Paradoxically, LVEF was higher in the deceased group (mean 34.4%) compared to the survivor group (mean 27.4%) (p = 0.031) *(Fig. 3)*.

Regarding categorical variables *(Table 2)*, no significant association with mortality was found for sex (p = 0.33),

comorbidities (diabetes mellitus, p = 0.87; hypertension, p = 1.00), or cannulation type (p = 0.25). Similarly, the incidence of complications, including AKI (p = 0.50), bleeding (p = 0.39), and thrombosis (p = 0.61), did not differ significantly between groups. *Fig. 4* illustrates the distribution of surgical procedures stratified by outcome.

DISCUSSION

This study delineates the outcomes of a decade-long cohort of patients necessitating post-cardiotomy VA ECMO support at a national referral center. The observed mortality rate stood at 63.3%, corroborating our alternative hypothesis (H1 > 40%) and aligning with international registry reports, which cite hospital mortality rates ranging from 50% to 70% for this high-acuity population.[4,7]

Notably, 80% of our cohort comprised post-heart transplant patients, a subgroup characterized by severe ventricular dysfunction linked to ischemia time, contributing to the elevated mortality. A striking finding was the paradoxical association between LVEF and mortality. Patients who succumbed exhibited a significantly higher mean LVEF (34.4%) compared to survivors (27.4%) (p = 0.031), countering the conventional assumption that lower LVEF implies poorer prognosis. This may be attributed to overestimation of LVEF in the context of maximal inotropic support or the influence of perioperative factors and extracardiac complications on outcomes.

The predominant complications in our cohort were acute kidney injury (66.7%) and bleeding (60%), mirroring reports in other series and highlighting key clinical challenges in VA ECMO management. The necessity for systemic anticoagulation, compounded by the circuit-induced

Table 1: Comparison of quantitative variables and complications between survivors and deceased patients.

Variable	Deceased (Mean)	Survivors (Mean)	Student's T-test	p
Age	41.9	49.7	−1.52	0.14
Weight (kg)	69.7	67.7	0.49	0.63
Height (m)	1.62	1.63	−0.15	0.88
Aortic clamping time (min)	93.8	83.1	1.37	0.18
Cardiopulmonary bypass time (min)	204.2	178.2	1.64	0.11
LVEF (%)	34.4	27.4	2.28	0.031
ECMO Duration (days)	5.78	5.73	0.04	0.97

ECMO = Extracorporeal Membrane Oxygenation. LVEF = Left Ventricular Ejection Fraction.

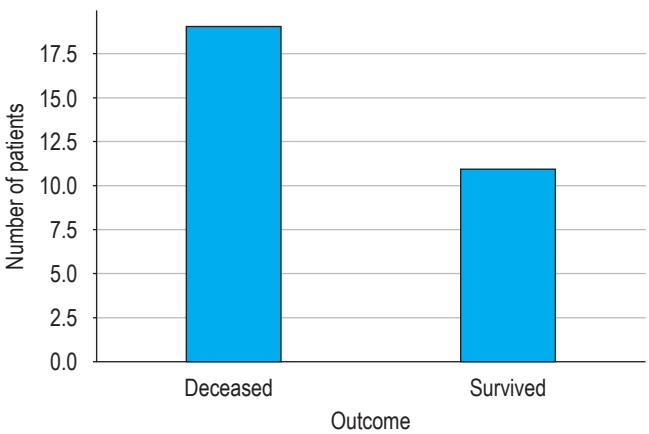

Figure 1: Frequency of global mortality in the cohort of 30 patients, 63.3% (n = 19) of the patients died (yes), while 36.7% (n = 11) survived (no).

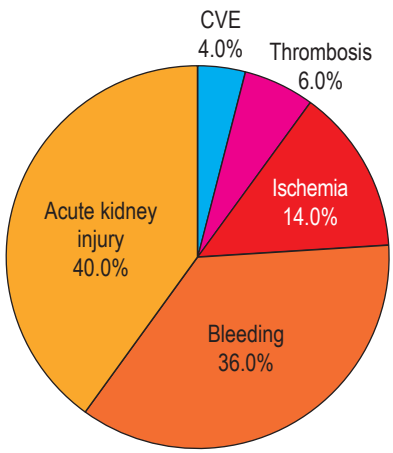

Figure 2:

Distribution of the main complications in the total cohort (n = 30).
CVE = Cerebrovascular Event.

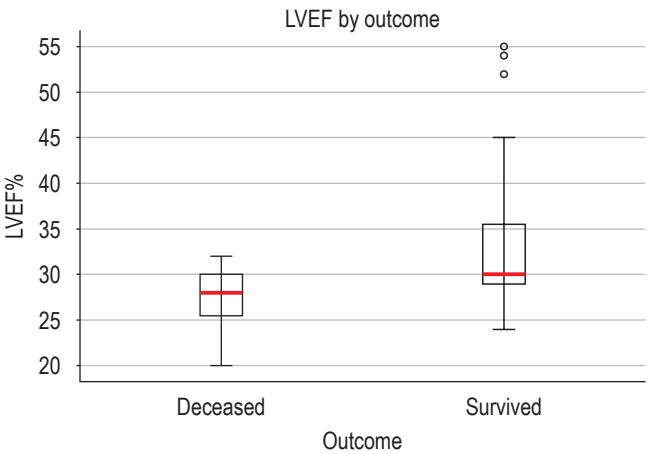

Figure 3: Boxplot comparing Left Ventricular Ejection Fraction (LVEF) by outcome. A significantly higher median and mean LVEF is observed in the deceased group (yes) compared to survivors (no) (p = 0.031).

proinflammatory state, creates a precarious balance impacting morbidity and mortality.[6,8]

This study is limited by its retrospective, single-center design and reduced sample size (N = 30), constraining multivariate analysis. Nonetheless, it serves as a valuable local reference for clinical outcomes.

CONCLUSIONS

The mortality rate in patients receiving VA ECMO following cardiac surgery in our cohort was 63.3%, reflecting the severity of this population and consistent with data from international centers.

The only variable demonstrating a statistically significant relationship with mortality was LVEF, which was unexpectedly higher in the non-survivor group.

No significant differences in mortality were identified when analyzing other demographic variables, comorbidities, or cannulation type.

The use of VA ECMO in this context was associated with a considerable risk of complications, especially acute kidney injury (66.7%) and bleeding events (60%), which represented the main clinical challenges.

There is a need to implement institutional protocols for the early detection of candidates and the preventive management of complications, especially those related to renal protection and bleeding control.

Table 2: Comparison of categorical variables and complications between survivors and deceased patients.

Variable	Survived N = 11 n (%)	Deceased N = 19 n (%)	χ^2	p
Type II diabetes mellitus	4 (36)	5 (26)	0.03	0.87
Systemic arterial hypertension	2 (18)	4 (21)	0.00	1.00
Chronic kidney disease	1 (9)	1 (5)	0.00	1.00
Cannulation Type	8 (73)	18 (95)	1.33	0.25
Acute kidney injury	6 (55)	14 (74)	0.45	0.50
Cerebrovascular event on ECMO	0 (0)	2 (11)	0.13	0.72
Ischemic events on ECMO	5 (45)	2 (11)	3.00	0.08
Bleeding during ECMO therapy	5 (45)	13 (68)	0.72	0.39
Thrombosis during ECMO therapy	2 (18)	1 (5)	0.26	0.61

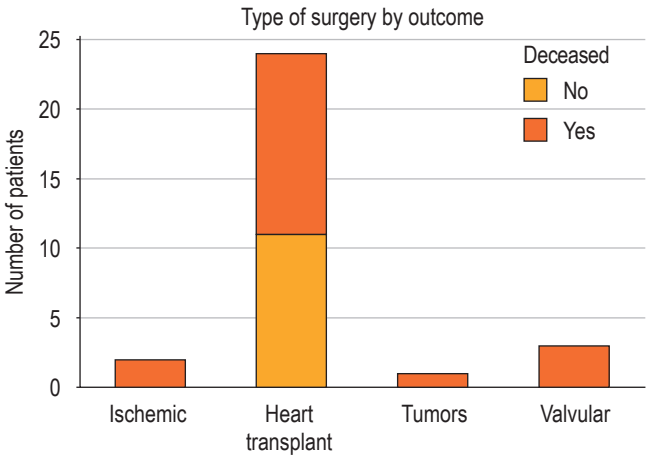

Figure 4: Stacked bar chart showing the distribution of surgery types (ischemic, transplant, tumor, valvular) according to outcome (deceased [yes] vs survivor [no]), in number of patients.

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