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Original Article

Postcardiotomy Venoarterial Extracorporeal Membrane Oxygenation With and Without Intra-Aortic Balloon Pump

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Objectives: To compare the outcomes of patients with postcardiotomy shock treated with venoarterial extracorporeal membrane oxygenation (VA-ECMO) only compared with VA-ECMO and intra-aortic balloon pump (IABP).
Design: A retrospective multicenter registry study.
Setting: At 19 cardiac surgery units.
Participants: A total of 615 adult patients who required VA-ECMO from 2010 to 2018. The patients were divided into 2 groups depending on whether they received VA-ECMO only (ECMO only group) or VA-ECMO plus IABP (ECMO-IABP group).
Measurements and Main Results: The overall series mean age was 63 ± 13 years, and 33% were female. The ECMO-only group included 499 patients, and 116 patients were in the ECMO-IABP group. Urgent and/or emergent procedures were more common in the ECMO-only group. Central cannulation was performed in 47% (n = 54) in the ECMO-IABP group compared to 27% (n = 132) in the ECMO-only group. In the ECMO-IABP group, 58% (n = 67) were successfully weaned from ECMO, compared to 46% (n = 231) in the ECMO-only group (p = 0.026). However, in-hospital mortality was 63% in the ECMO-IABP group compared to 65% in the ECMO-only group (p = 0.66). Among 114 propensity score-matched pairs, ECMO-IABP group had comparable weaning rates (57% *v* 53%, p = 0.51) and in-hospital mortality (64% *v* 58%, p = 0.78).
Conclusions: This multicenter study showed that adjunctive IABP did not translate into better outcomes in patients treated with VA-ECMO for postcardiotomy shock.

Key Words: postcardiotomy; cardiogenic shock; venoarterial extracorporeal membrane oxygenation; intra-aortic balloon pump

POSTCARDIOTOMY SHOCK (PCS) is defined as low cardiac output after cardiac surgery, and is associated with high mortality.[1] Venoarterial extracorporeal membrane oxygenation (VA-ECMO) often is the only treatment option in these patients. The treatment reduces right ventricular preload and afterload, as well as left ventricular (LV) preload, by shunting blood from the right side of the heart to a major systemic artery.[2] A potential problem with VA-ECMO is the retrograde flow of blood in the aorta, resulting in increased LV afterload. Therefore, intra-aortic balloon pump (IABP) counterpulsation sometimes is used as an adjunct to VA-ECMO as it may, in theory, reduce LV afterload and assist with LV unloading.[3] IABP improves coronary blood flow[4] and may enhance cardiac recovery. However, studies on the adjunctive use of IABP with VA-ECMO have provided conflicting results on its efficacy.[3,5-7] Furthermore, studies with homogeneous cohorts, including only patients with PCS, were of limited size or did not have current data.[8] Since PCS is uncommon, multicenter data are required to investigate the usefulness of adjunctive IABP with VA-ECMO in treating patients with PCS. The aim of this study was to compare the outcomes of patients with PCS treated with postcardiotomy ECMO (PC-ECMO) compared to those who received PC-ECMO with IABP.

Materials and Methods

The Postcardiotomy Extracorporeal Membrane Oxygenation (PC-ECMO) Study Cohort

The PC-ECMO registry is a multicenter retrospective collaboration with all consecutive PC-ECMO patients between January 2010 through March 2018. All data were entered into a Microsoft Access database at each participating center, which then were merged by the principal investigator. There were 781 patients and 242 variables in the registry from 19 cardiac centers in different European and Arabian countries. The purpose of the registry was to gather data on this mechanical circulatory support treatment from many sites in order to evaluate its efficacy and outcome.[1,9-17] Each participating center collected data and entered them into a Microsoft Access database. The data from all centers were merged, thoroughly evaluated for errors, and, when needed, the principal investigator contacted site investigators in order to complement the data. Ethical approval was granted from the National Ethical Committee or the Ethical Committee of each participating center.

Study Population

Patients included in the PC-ECMO registry were at least 18 years old and had refractory cardiogenic shock after cardiac surgery.[1] Patients with preoperative VA-ECMO, or those who underwent ventricular-assist-device surgery or heart transplantation, were excluded. For the present study, the following exclusion criteria were applied: preoperative use of IABP (before index surgery), IABP inserted immediately after surgery without VA-ECMO, IABP inserted later after surgery without VA-ECMO, and/or the concomitant use of Impella pump (Fig 1). The study population was divided into 2 study groups: (1) patients who received VA-ECMO as the only circulatory mechanical support (ECMO-only group) and (2) those

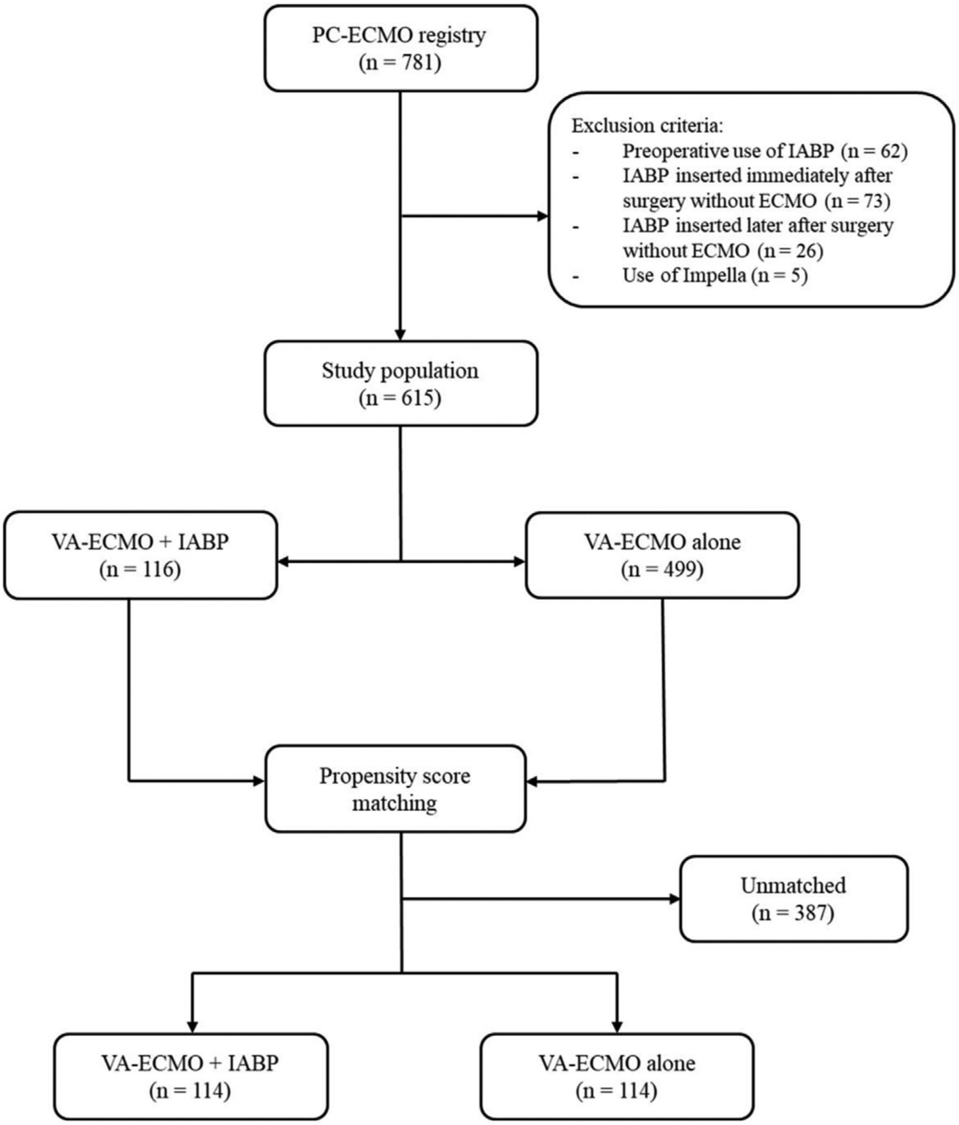

Fig 1. Study flowchart. ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; PC-ECMO, postcardiotomy extracorporeal membrane oxygenation.

who received VA-ECMO with the adjunct of IABP (ECMO-IABP group), in whom the IABP was inserted either concurrently with VA-ECMO or later during VA-ECMO treatment. A subanalysis was conducted on those ECMO-IABP patients who had a concurrent initiation of IABP with VA-ECMO only, and where the study authors excluded patients who received IABP later during the VA-ECMO treatment. Another subanalysis was conducted on patients without LV venting.

Study Outcomes

The primary outcomes were successful weaning from VA-ECMO and in-hospital mortality. Secondary outcomes were reoperation for bleeding and/or cardiac tamponade, stroke, dialysis, liver failure, multiorgan failure, deep sternal wound infection, vascular access site infection, bacteremia, peripheral vascular complications, red blood cell transfusion, chest drainage output at 24 hours, >10 days on VA-ECMO, the use of a postoperative ventricular-assist device and/or heart transplant, and intensive care unit and hospital stay.

Statistical Analysis

Categorical variables were given as numbers and percentages. Continuous variables were reported as mean ± standard deviation or as median with 95% confidence interval (95% CI). The Pearson chi-square test was used for between-group comparisons for categorical variables. In the case of continuous variables, either Student's *t*-test allowing for unequal variances or the Mann-Whitney *U* test was used to test for differences in means or medians between the 2 groups. A propensity score was calculated using logistic regression, with the treatments as the dependent variable. Propensity-score matching was performed using the nearest-neighbor algorithm. The same between-group comparisons were done on the propensity-score-matched groups as in the overall series. In addition, the Kaplan-

Meier method was used to estimate long-term survival in the propensity-score-matched groups, and the log-rank test was used to test for statistical significance between the treatment groups. The significance level of $p < 0.05$ was used throughout. The matched groups' background characteristics and other pre-ECMO variables were compared with standardized mean difference. Statistical analyses were carried out using SPSS version 25.0 (IBM Corp, New York, NY) and R version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). Propensity-score matching was performed using the package MatchIt.[18] The Kaplan-Meier survival curve was produced with Stata version 16.1 (StataCorp, College Station, TX).

Results

Background Characteristics

The study flow chart is shown in Figure 1. There were 116 patients in the ECMO-IABP group and 499 patients in the ECMO-only group. Among the participating centers, the proportion of patients who were in the ECMO-IABP group ranged from 0%-to-75% ($p < 0.001$). The patient characteristics are summarized in Table 1. The overall mean age was 63 ± 13, and 33% were female. There were no significant differences in the age or sex distributions between the groups. The preoperative LV ejection fraction did not differ significantly between the groups. Patients in the ECMO-IABP group were less likely to have undergone the index procedure on an emergent and/or urgent basis. In the ECMO-IABP group, 1 patient (0.9%) had a type-A aortic dissection compared to 57 (11%) in the ECMO-only group ($p < 0.001$). Preoperative dialysis was less common in the ECMO-IABP group compared to the ECMO-only group (p = 0.039). There were no statistically significant differences in the proportion of patients who underwent coronary artery bypass grafting, aortic valve replacement, mitral valve surgery, or aortic surgery (Table 2). Data on the indications for VA-ECMO and data on the ECMO treatment are shown in Table 3. Patients in the ECMO-IABP group were more likely to have central arterial cannulation. LV vents were placed in the right upper pulmonary vein in 9 of 11 patients in the ECMO-IABP group and 25 of 33 patients in the ECMO-only group. LV venting was not associated with in-hospital mortality in the ECMO-IABP group (p = 1.0) or in the ECMO-only group (p = 1.0).

Table 1
Patient Characteristics.

Variables	Overall Series			Propensity Score-Matched Pairs		
	ECMO-IABP n = 116	ECMO only n = 499	p value	ECMO-IABP n = 114	ECMO only n = 114	Standardized Mean Difference
Demographics						
Age, mean ± SD, y	62 ± 15	63 ± 13	0.38	62 ± 15	62 ± 15	0.001
Female patients, n (%)	34 (29%)	171 (34%)	0.31	34 (30%)	34 (30%)	0.0
BMI, mean ± SD, kg/m^2	27 ± 5	27 ± 5	0.66	27 ± 5	27 ± 5	0.028
BMI >30, n (%), kg/m^2	31 (27%)	127 (26%)	0.78	30 (26%)	24 (21%)	0.12
Presentation and cardiac status, n (%)						
Urgent and/or emergent procedure	47 (41%)	262 (53%)	0.020	46 (40%)	52 (46%)	0.11
Prior cardiac surgery	31 (27%)	122 (24%)	0.61	29 (25%)	29 (25%)	0.0
CCS angina class IV	22 (19%)	76 (15%)	0.33	22 (19%)	19 (17%)	0.069
NYHA class III or IV	64 (55%)	322 (65%)	0.060	63 (55%)	59 (52%)	0.070
Prior myocardial infarction	37 (32%)	146 (29%)	0.58	36 (32%)	34 (30%)	0.038
Prior PCI	22 (19%)	72 (15%)	0.20	22 (19%)	26 (23%)	0.086
LVEF			0.21			0.33
>50%	52 (45%)	225 (45%)		51 (45%)	59 (52%)	
31%-50%	36 (31%)	159 (32%)		36 (32%)	31 (27%)	
21%-30%	22 (19%)	65 (13%)		21 (18%)	11 (10%)	
<21%	6 (5.2%)	48 (10%)		6 (5.3%)	12(11%)	
Comorbidities						
Diabetes, n (%)	33 (28%)	108 (22%)	0.12	33 (29%)	36 (29%)	0.22
Hemoglobin, mean ± SD, g/L	129 ± 19	124 ± 23	0.011	129 ± 19	130 ± 21	0.062
eGFR, median (95% CI), mL/min/1.73 m^2	71 (52-88)	66 (48-83)	0.068	71 (52-88)	66 (52-83)	0.13
Type A aortic dissection, n (%)	1 (0.9%)	57 (11%)	< 0.001	1 (0.9%)	1 (0.9%)	0.0
Dialysis, n (%)	1 (0.9%)	26 (5.2%)	0.039	1 (0.9%)	1 (0.9%)	0.0
Stroke, n (%)	9 (7.8%)	38 (7.6%)	0.96	8 (7.0%)	10 (8.8%)	0.065
Extra-cardiac arteriopathy, n (%)	10 (8.6%)	75 (15%)	0.072	10 (8.8%)	15 (13%)	0.14
Pulmonary disease, n (%)	18 (16%)	70 (14%)	0.68	17 (15%)	174(12%)	0.077
Atrial fibrillation, n (%)	29 (25%)	130 (26%)	0.82	27 (24%)	27 (24%)	0.0
EuroSCORE II, median (95% CI), %	7.2 (2.5-17)	8.2 (3.2-20.1)	0.11	6.7 (2.4-17)	6.2 (2.2-11.7)	0.073

Abbreviations: BMI, body mass index; CCS, Canadian Cardiovascular Society (class); CI, confidence interval; eGFR, estimated glomerular filtration rate; ECMO-IABP, extracorporeal membrane oxygenation plus intra-aortic balloon pump; EuroSCORE II, European System for Cardiac Operative Risk Evaluation II; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association (class); PCI, percutaneous coronary intervention; SD, standard deviation.

Table 2
Data on Index Procedures.

Variables	Overall Series			Propensity-Score-Matched Pairs		
	ECMO-IABP n = 116	ECMO only n = 499	p Value	ECMO-IABP n = 114	ECMO only n = 114	Standardized Mean Difference
Index procedures						
CABG, n (%)	57 (49%)	214 (43%)	0.22	57 (50%)	45 (39%)	0.21
AV replacement, n (%)	42 (36%)	140 (28%)	0.83	41 (36%)	34 (21%)	0.13
AV repair, n (%)	3 (2.6%)	2 (0.4%)	0.049	3 (2.6%)	0 (0.0%)	0.23
MV replacement, n (%)	36 (31%)	119 (24%)	0.11	36 (32%)	31 (27%)	0.096
MV repair, n (%)	15 (13%)	58 (12%)	0.70	15 (13%)	17 (15%)	0.051
TV replacement, n (%)	3 (2.6%)	17 (3.4%)	0.65	3 (2.6%)	4 (3.5%)	0.051
TV repair, n (%)	10 (8.6%)	54 (11%)	0.48	10 (8.8%)	13 (11%)	0.087
Aortic surgery, n (%)	16 (14%)	125 (25%)	0.009	14 (12%)	16 (14%)	0.052
Aortic root surgery, n (%)	8 (6.9%)	72 (14%)	0.030	7 (6.1%)	11 (9.6%)	0.13
Aortic arch surgery, n (%)	1 (0.9%)	36 (7.2%)	0.010	1 (0.9%)	4 (3.5%)	0.18
VSD and/or ventricular valve repair, n (%)	5 (4.3%)	14 (2.8%)	0.40	5 (4.4%)	3 (2.6%)	0.095
Surgery for adult congenital heart disease, n (%)	5 (4.3%)	12 (2.4%)	0.26	5 (4.4%)	6 (5.2%)	0.041
Septal myectomy, n (%)	1 (0.9%)	2 (0.4%)	0.52	1 (0.9%)	0 (0%)	0.13
Maze and/or LAA closure	4 (3.4%)	14 (2.8%)	0.71	4 (3.5%)	2 (1.8%)	0.11
Pulmonary thromboendarterectomy, n (%)	0 (0.0%)	10 (2.0%)	0.12	0 (0.0%)	3 (2.6%)	0.23
Other major cardiac procedures, n (%)	17 (15%)	57 (11%)	0.34	3 (2.6%)	5 (4.4%)	0.095
Aortic crossclamp time, median (95% CI), min	130 (90-188)	115 (78-164)	0.11	130 (90-188)	105 (77-1459)	0.26
Cardiopulmonary bypass time, median (95% CI), min	234 (144-326)	208 (140-295)	0.11	234 (144-326)	196 (118-266)	0.35

Abbreviations: AV, aortic valve; CABG, coronary artery bypass grafting; CI, confidence interval; ECMO-IABP, extracorporeal membrane oxygenation plus intra-aortic balloon pump; LAA, left atrial appendage; MV, mitral valve; TV, tricuspid valve; VSD, ventricular septal defect.

Table 3
VA-ECMO Indications and ECMO Treatment Data.

Variables	Overall Series			Propensity-Score-Matched Pairs		
	ECMO-IABP n = 116	ECMO only n = 499	p Value	ECMO-IABP n = 114	ECMO only n = 114	p Value
Ventricular failure, n (%)			0.52			0.49
Left ventricular failure	33 (28%)	125 (25%)		32 (28%)	26 (23%)	
Right ventricular failure	27 (23%)	142 (28%)		27 (24%)	32 (28%)	
Left and right ventricular failure	46 (40%)	188 (38%)		45 (40%)	46 (40%)	
Neither	6 (5.2%)	36 (7.2%)		6 (5.3%)	9 (7.9%)	
Unknown	4 (3.4%)	9 (1.8%)		4 (3.5%)	1 (0.1%)	
VA-ECMO indication, n (%)						
Failure to wean from CPB	42 (40%)	197 (36%)	0.52	42 (50%)	42 (50%)	1.0
Heart failure after weaning from CPB	62 (53%)	236 (47%)	0.23	60 (53%)	54 (47%)	0.43
Ventricular arrhythmias after weaning from CPB	10 (8.6%)	37 (7.4%)	0.66	10 (8.8%)	8 (7.0%)	0.62
Cardiac arrest after weaning from CPB	11 (9.5%)	37 (7.4%)	0.46	11 (9.6%)	10 (8.8%)	0.82
Respiratory failure after weaning from CPB	5 (4.3%)	43 (8.6%)	0.12	5 (4.4%)	12 (11%)	0.08
ARDS after weaning from CPB	1 (0.9%)	18 (3.6%)	0.23	1 (0.9%)	5 (4.4%)	0.21
Septic shock after weaning from CPB	3 (2.6%)	10 (2.0%)	0.72	3 (2.6%)	2 (1.8%)	1.0
Pulmonary embolism	1 (0.9%)	4 (0.8%)	1.0	1 (0.9%)	2 (1.8%)	1.0
Other indication	7 (6.0%)	25 (5.0%)	0.66	7 (6.1%)	8 (7.0%)	0.79
ECMO data						
Arterial pH before VA-ECMO, median (95% CI)	7.3 (7.2-7.4)	7.3 (7.2-7.4)	0.13	7.3 (7.2-7.4)	7.3 (7.2-7.4)	0.07
Arterial lactate before VA-ECMO, mean ± SD	7.0 ± 4.4	6.9 ± 4.7	0.94	6.9 ± 4.4	6.5 ± 4.4	0.84
Central arterial cannulation, n (%)	54 (47%)	132 (27%)	< 0.001	54 (47%)	25 (22%)	< 0.001
Left ventricular vent, n (%)	11 (9.5%)	33 (6.6%)	0.28	11 (9.6%)	7 (6.1%)	0.33
Time on VA-ECMO, median (95% CI), d	5.0 (2.9-8.9)	5.3 (2.0-9.8)	0.73	5.0 (2.9-9.0)	5.7 (2.0-9.0)	0.78

Abbreviations: ARDS, acute respiratory distress syndrome; CI, confidence interval; CPB, cardiopulmonary bypass; ECMO-IABP, extracorporeal membrane oxygenation plus intra-aortic balloon pump; SD, standard deviation; VA-ECMO, venoarterial extracorporeal membrane oxygenation.

Table 4
Outcomes.

Variables	Overall Series			Propensity-Score-Matched Groups		
	ECMO-IABP n = 116	ECMO Only n = 499	p Value	ECMO-IABP n = 114	ECMO only n = 114	p Value
Primary endpoints, n (%)						
Successful weaning from VA-ECMO	67 (58%)	231 (46%)	0.026	65 (57%)	60 (53%)	0.51
In-hospital mortality	73 (63%)	325 (65%)	0.66	73 (64%)	66 (58%)	0.78
Secondary endpoints						
Reoperation for bleeding and/or tamponade, n (%)	47 (41%)	199 (40%)	0.85	47 (42%)	46 (40%)	0.85
Stroke, n (%)	17 (15%)	98 (20%)	0.23	17 (15%)	17 (15%)	0.98
Dialysis, n (%)	55 (47%)	280 (56%)	0.090	53 (47%)	64 (56%)	0.15
Liver failure, n (%)	33 (28%)	191 (38%)	0.048	33 (29%)	43 (38%)	0.16
Multiorgan failure, n (%)	53 (46%)	264 (53%)	0.16	53 (47%)	56 (49%)	0.69
DSWI, n (%)	1 (0.9%)	16 (3.2%)	0.17	1 (0.9%)	1 (0.9%)	1.0
Vascular access site infection, n (%)	3 (2.6%)	48 (9.6%)	0.013	3 (2.6%)	13 (11%)	0.010
Bacteremia, n (%)	17 (15%)	136 (27%)	0.005	17 (15%)	31 (27%)	0.02
Peripheral vascular complications, n (%)	16 (14%)	37 (7.4%)	0.027	16 (14%)	11 (9.6%)	0.30
RBC transfusion, median (95% CI), units	15 (7.3-28)	15 (8.0-30)	0.64	15 (8.0-28)	14 (7.0-33)	0.87
>9 RBC units transfused, n (%)	77 (66%)	344 (69%)	0.57	77 (68%)	74 (65%)	0.74
Chest drain output at 24 h, median (95% CI), mL	835 (470-1605)	900 (560-1850)	0.20	855 (470-1605)	900 (550-1635)	0.63
ICU stay, median (95% CI), d	15 (8-23)	11 (4-23)	0.062	14 (8.0-22)	14 (5.0-30)	0.72
Hospital stay, median (95% CI), d	19 (8-35)	15 (4-23)	0.053	19 (8.0-33)	21 (6.0-42)	0.79
VA-ECMO duration >10 d, n (%)	23 (20%)	123 (25%)	0.27	23 (20%)	27 (24%)	0.52
Postoperative VAD or heart transplant, n (%)	6 (5.2%)	12 (2.4%)	0.11	6 (5.3%)	4 (3.5%)	0.52

Abbreviations: CI, confidence interval; DSWI, deep sternal wound infection; ECMO-IABP, extracorporeal membrane oxygenation plus intra-aortic balloon pump; ICU, intensive care unit; RBC, red blood cell; VAD, ventricular assist device; VA-ECMO, venoarterial extracorporeal membrane oxygenation.

Excluding patients with LV vents did not affect the outcomes and other main findings of this study.

Outcomes of the Unmatched Groups

A higher proportion of patients in the ECMO-IABP group were weaned successfully from VA-ECMO (Table 4). The in-hospital mortality in the ECMO-IABP group was 66%, compared to 65% in the ECMO- only group (p = 0.066). Liver failure, vascular access site infection, and bacteremia were significantly more common in the ECMO-only group. Peripheral vascular complications occurred in 14% (n = 16) in the ECMO-IABP group compared to 7.4% (n = 37) in the ECMO-only group (p = 0.27). Successful weaning from VA-ECMO occurred in 67 patients (58%), compared to 231 patients (46%) in the ECMO- only group (p = 0.026). One-year survival was 32% (95% CI 28%-36%) in the ECMO-only group and 34% (95% CI 25%-43%) in the ECMO-IABP group (p = 0.55).

Propensity-Score-Matched Groups

The variables used to calculate the propensity scores are shown in Figure 2. Several other propensity score matching models were tested, but they had more covariate imbalance and fewer matched pairs. One of these models included LV venting, peripheral versus central cannulation, cardiopulmonary bypass time, and aortic crossclamping time. The model yielded fewer matched pairs and more covariate imbalance but similar outcome results to the main model that the study authors present in the current study.

The final propensity-score matching resulted in 114 matched pairs. The propensity-score-matched results are provided in Tables 1 to 4. All variables had a standardized mean difference of <0.1 except for extracardiac arteriopathy and estimated glomerular filtration rate, which both had <0.2 in standardized mean difference (Table 1). In-hospital mortality was 64% in the ECMO-IABP group and 58% in the ECMO-only group (p = 0.78). The incidence of stroke was lower in the ECMO-IABP group, although the difference did not reach a significant difference (p = 0.051) Figure 3. shows the estimated long-term survival in the propensity score-matched groups. The 1-year mortality was 37% (95 CI 28%-46%) in the ECMO-only group and 32% (95% CI 28%-36%) in the ECMO-IABP group (p = 0.70).

Subanalysis of Concurrent IABP Initiation-Only Patients

The study authors excluded 39 patients in whom the IABP treatment was not initiated concurrently with VA-ECMO, in order to assess whether only concurrent initiation of IABP was associated with better survival. The exclusion of these patients did not significantly affect the outcome results. Indeed, in-hospital survival was 61% in the ECMO-IABP group and 65% in the ECMO-only group (p = 0.49). Long-term survival was similar in the study groups as well (p = 0.49).

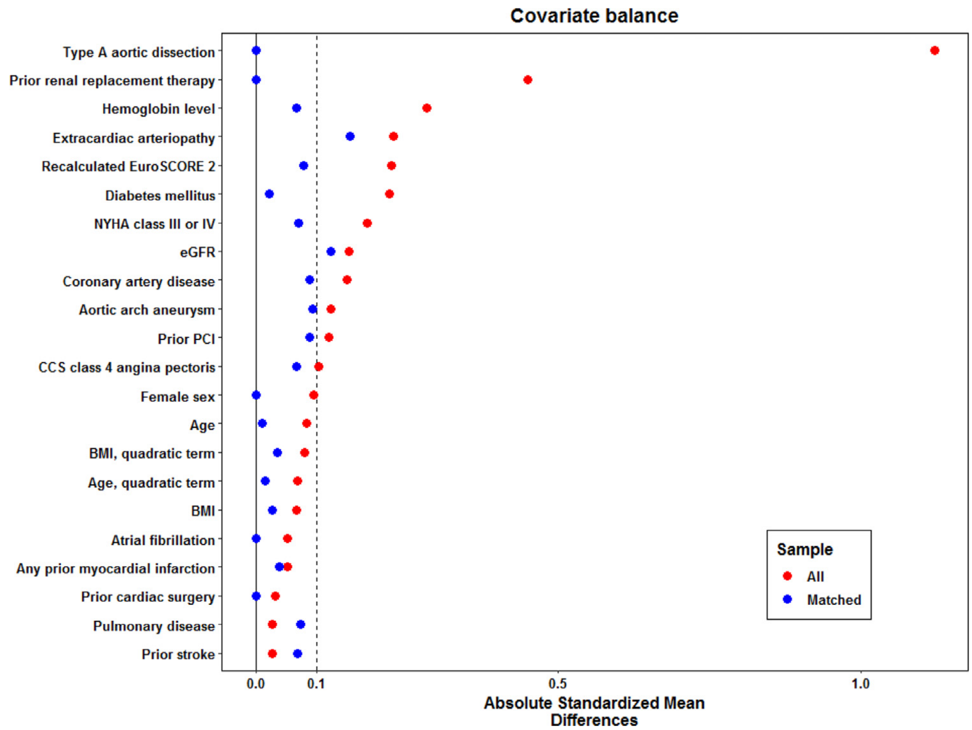

Fig 2. Covariates used in the regression model to calculate propensity scores and their absolute standardized mean difference before and after matching. BMI, body mass index; CCS, Canadian Cardiovascular Society (class); GFR, estimated glomerular filtration rate; NYHA, New York Heart Association; PCI, percutaneous coronary intervention.

Discussion

The present study did not find any association between concurrent IABP use and short-term or long-term mortality of patients receiving VA-ECMO therapy for PCS. The large database allowed the study authors to use propensity-score matching to get rather large study groups, which were well-balanced in baseline and operative covariates.

Previous studies on the usefulness of concurrent IABP provided conflicting results on this issue. A meta-analysis, including patients requiring VA-ECMO for mixed causes of cardiogenic shock, showed no additional benefit of adjunctive IABP treatment.[6] In a more recent meta-analysis, adjunctive IABP use was associated with slightly decreased in-hospital death.[5] Still, these meta-analyses did not investigate the effects of concurrent IABP in patients with PCS only.

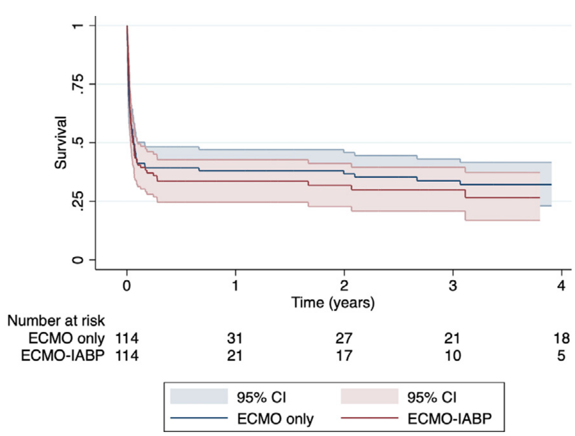

Fig 3. Kaplan-Meier estimates of long-term survival in the propensity-score-matched groups. CI, confidence interval; ECMO, extracorporeal membrane oxygenation; ECMO-IABP, extracorporeal membrane oxygenation plus intra-aortic balloon pump.

A few studies have reported results on only PCS patients. In 2001, Smedira et al reported on 202 patients who received VA-ECMO for PCS and demonstrated that the lack of concurrent IABP was a predictor of in-hospital death.[8] However, a German retrospective study from 2010 on 517 patients who had VA-ECMO for PCS showed that the use of concurrent IABP was not associated significantly with better survival.[19] A more recent study by Chen et al, including 152 patients who required VA-ECMO for PCS, did show that short-term survival was higher in patients who had concurrent initiation of IABP with VA-ECMO compared to those who did not have IABP. In addition, patients with a concurrent initiation of IABP had a lower proportion of renal replacement therapy and neurologic complications but a higher proportion of thrombotic events.[3]

In the unmatched groups, a significantly higher proportion of patients were weaned from VA-ECMO in the ECMO-IABP group. This was in line with the meta-analysis by Aso et al in which 83% of the patients with adjunctive IABP were successfully weaned compared to 73% with ECMO-only ($p < 0.001$).[20] Again, this study included patients with multiple etiologies for cardiogenic shock. In the present propensity-score matched groups, however, there was no association between adjunctive IABP use and successful weaning.

In the current study, the insertion of an LV vent was not associated with in-hospital mortality. It remains to be demonstrated if other ways of LV unloading can improve the rates of successful weaning and survival. In an observational study, the use of adjunctive Impella heart pump has been shown to be associated with significantly better survival rates in patients on VA-ECMO for cardiogenic shock because of ischemic and nonischemic causes.[21] The present multicenter PC-ECMO registry included a very limited number of patients with adjunctive Impella; therefore, it was not possible to evaluate its outcome.

Despite the lower incidence of extracardiac arteriopathy in the ECMO-IABP group, the incidence of peripheral vascular complications was double that of the ECMO-only group ($p < 0.027$). This was concerning because the higher incidence in the ECMO-IABP group likely was a direct result of the IABP insertion itself. However, such a difference was not demonstrated in the propensity-score analysis. The incidence of vascular access site infections in the ECMO-only group was 3 times that of the ECMO-IABP group. One possible explanation is that extracardiac arteriopathy was more common in the ECMO- only group. Bacteremia also was more common in the ECMO-only group, but it is not known how many patients developed overt sepsis.

Strengths and Limitations of the Study

The major strength of the present study was that the database used for this study is one of the largest on postcardiotomy VA-ECMO. The retrospective nature of this registry is the major limitation of this study. The reason for IABP utilization was not available. Detailed data on the LV-unloading effects of IABP were not gathered in this dataset. Data on hemodynamics and inotropes and/or vasopressors pre−VA-ECMO and post−VA-ECMO initiation were not available. The weaning strategies and management of the VA-ECMO applied by the participating centers were not available for collection.

Conclusion

This multicenter, multinational, retrospective, observational study on patients treated with VA-ECMO for PCS sought to evaluate the outcome of using adjunctive IABP with VA-ECMO. Short-term and long-term mortality were similar in both groups in both the unmatched and the propensity-score-matched groups. Although the direct effects of IABP on hemodynamics and LV unloading could not be evaluated, the similar clinical outcomes of both groups do not support the use of adjunctive IABP in patients treated with VA-ECMO for PCS.

Conflict of Interest

None.

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