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Research Letter

Impact of a Cardiology-Based Shock Team on Institutional Venoarterial Extracorporeal Membrane Oxygenation Use for Cardiogenic Shock

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The use of venoarterial extracorporeal membrane oxygenation (VA-ECMO) for the treatment of cardiogenic shock is rapidly expanding,[1] but 4 randomized trials have shown a neutral effect on survival from VA-ECMO use in this population.[2] Patient selection and timing of cannulation have been proposed as potential causes for these neutral results.[3] These same issues are considered important barriers in clinical practice, where delays in recognition of cardiogenic shock and delivery of VA-ECMO may negate the technology's utility.

Shock teams have been proposed as an effective tool to improve identification and treatment of cardiogenic shock, and their implementation is associated with improved outcomes in patients treated with mechanical circulatory support.[4,5] Whether the shock team can affect the use of VA-ECMO specifically has not been described.

The effect of a cardiology-based shock team at Lenox Hill Hospital on VA-ECMO utilization and outcomes in cardiogenic shock was evaluated. The characteristics and outcomes of patients with cardiogenic shock treated with VA-ECMO during the 18 months before (pre–shock team era, January 2021-June 2022) and after (shock team era, July 2022-December 2023) the creation of the local shock team were compared. This study was approved by the Northwell Health Institutional Review Board.

Lenox Hill Hospital is a tertiary-care center with cardiothoracic surgery capabilities and advanced heart failure transplant cardiology (AHFTC) consulting services but no onsite durable left ventricular assist device or heart transplantations. Before the shock team, ECMO cannulations were performed mainly by the cardiothoracic surgery attending physician, who determined the adequacy of cannulation. No specific ECMO cannulator was on call, and physicians requesting ECMO would call cardiothoracic surgery directly.

The shock team was composed of cardiologists from 3 subspecialties: AHFTC, interventional cardiology, and cardiac intensive care. The interventional cardiologist on the shock team was listed as "ECMO cannulator" in the call schedule. The small number of cardiothoracic surgery attending physicians at the center limited their involvement in this system.

The shock team was activated by a single phone call to the hospital operator based on predefined criteria distributed between hospital units. The call was initially triaged by the AHFTC attending physician. All cases potentially requiring VA-ECMO were discussed with the rest of the shock team members, and nonemergent cases were also discussed with the central shock team at the flagship left ventricular assist device orthotopic heart transplantation center. Hard criteria for patient selection were used only for extracorporeal cardiopulmonary resuscitation (CPR) cases, including age younger than 70 years, ventricular fibrillation as the initial cardiac rhythm, and bystander CPR. In all other cases, although no hard criteria existed, candidates for heart replacement therapies were strongly considered for ECMO selection.

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After cannulation, patients were admitted to the cardiothoracic intensive care unit and the cases co-managed by AHFTC and critical care physicians, with continuous bedside perfusionist presence. Patients who required support for more than 48 hours were transferred to the heart transplantation–capable center. Outcomes for patients transferred out were verified with the receiving center.

During the study period, 34 patients were cannulated for VA-ECMO for various etiologies of cardiogenic shock (Table I). There was a 140% increase in VA-ECMO case volume during the shock team era (n = 24) compared with the pre–shock team era (n = 10), with a notable decrease in patient age.

Abbreviations

AHFTC, advanced heart failure transplant cardiology
CPR, cardiopulmonary resuscitation
VA-ECMO, venoarterial extracorporeal membrane oxygenation

TABLE I. Clinical and Procedural Characteristics Among Patients Cannulated for Venoarterial ECMO Before and After Shock Team Creation

	Pre–shock team era (n = 10)	Shock team era (n = 24)	*P* value[a]
Male sex, No. (%)	6 (60)	18 (75)	.38
Age, median (IQR), y	71 (68-78)	55 (42-62)	.01
Body surface area, median (IQR), m^2	1.89 (1.5-2.0)	1.94 (1.8-2.1)	.25
Cannulation team, No. (%)			.01
Interventional cardiology	2 (20)	16 (67)	
Cardiothoracic surgery	8 (80)	8 (33)	
Cannulating team for non–postcardiotomy cardiogenic shock cases, No. (%)			.35
Cardiothoracic surgery	2 (33)	3 (16)	
Interventional cardiology	4 (67)	16 (84)	
Etiology of cardiogenic shock, No. (%)			.68
Acute myocardial infarction	3 (30)	4 (17)	.38
Acute heart failure	1 (10)	4 (17)	.62
Ventricular arrhythmias	1 (10)	2 (8)	.87
Pulmonary embolism	0 (0)	1 (4)	.51
Myocarditis	0 (0)	3 (13)	.24
Postcardiotomy cardiogenic shock	4 (40)	5 (21)	.25
Rescue of procedural complications	1 (10)	5 (21)	.68
CPR performed, No. (%)			
CPR before cannulation	3 (30)	14 (58)	.13
Extracorporeal CPR (yes/no)	0 (0)	6 (25)	.12
Place of cannulation, No. (%)			.49
Catheterization laboratory	4 (40)	9 (37.5)	.89
Operating room	5 (50)	7 (29)	.25
Intensive care unit	1 (10)	7 (29)	.23
Emergency department	–	1 (4.2)	.23
Baseline clinical variables			
Mean arterial pressure, median (IQR), mm Hg	83 (72-91)	83 (76-101)	.15
Lactate level, median (IQR), mmol/L	6.8 (1.7-8.9)	5.5 (2.4-12)	.49
Creatinine, median (IQR), mg/dL	1.2 (0.9-1.6)	1.09 (0.8-1.6)	.72

Continued

TABLE I. Clinical and Procedural Characteristics Among Patients Cannulated for Venoarterial ECMO Before and After Shock Team Creation, *Continued*

	Pre–shock team era (n = 10)	Shock team era (n = 24)	*P* value[a]
Cannulation configuration, No. (%)			.18
Central	4 (40)	3 (12)	.07
Peripheral	6 (60)	21 (88)	.07
Arterial cannula size (peripheral, n = 27), No. (%)			.57
16-17F	2 (33)	12 (57)	.3
18-19F	4 (67)	9 (42.9)	.3
Distal perfusion cannula	4 (67)	17 (81)	.46
Outcomes			
Time on ECMO, median (IQR), d	4.5 (2.5-6.8)	5 (2-14)	.26
Bleeding Academic Research Consortium type 3-5 bleeding, No. (%)	2 (20)	2 (8)	.33
Survival to hospital discharge, No. (%)	3 (30)	15 (63)	.08
Transferred out for advanced therapy evaluation, No. (%)	3 (30)	14 (58)	.13

CPR, cardiopulmonary resuscitation; ECMO, extracorporeal membrane oxygenation.

[a] $P < .05$ was considered statistically significant.

SI unit conversion: To convert mg/dL to μmol/L (creatinine), multiply by 76.25.

Patients in both eras had similar pre-ECMO lactate levels. In the shock team era, 17 (71%) patients were escalated to ECMO from previous mechanical circulatory support devices, with 11 (65%) patients receiving intra-aortic balloon pump and 6 (35%) receiving the Impella CP heart pump (ABIOMED) compared with 6 (60%) in the pre–shock team era, where 3 (50%) had an intra-aortic balloon pump and 3 (50%) had an Impella CP pump. The percentage of cases undergoing CPR before VA-ECMO nearly doubled in the shock team era (14 [58%] vs 3 [30%]), and cannulation during ongoing (extracorporeal) CPR was newly adopted after creation of the shock team, accounting for 6 (25%) of cases.

During the shock team era, most cannulations were performed peripherally by interventional cardiology, with smaller arterial cannula sizes, higher use of distal perfusion catheters, and cannulations occurring in more varied hospital locations. Survival to discharge increased (from 30% to 63%) after creation of the shock team. One patient in the shock team era underwent heart transplantation at the flagship hospital, while all other survivors had native heart recovery. The proportion of Bleeding Academic Research Consortium type 3 to 5 bleeding events was lower in the shock team era, and no disabling stroke occurred in either group. Lower bleeding rates may be related to greater use of peripheral cannulation with smaller arterial cannula sizes and lower-risk patient profiles.

In this single-center report, the creation of a cardiology-based shock team was associated with a substantial increase in VA-ECMO utilization for cardiogenic shock over a short period. Several factors may be responsible for these findings. First, the preestablished criteria and clear mechanisms of shock team activation potentially led to earlier involvement of the ECMO team. Second, the integration of all components of the shock team into cardiology probably improved communication and shared decision-making between stakeholders. Third, systematic prescreening for heart replacement therapy candidacy before cannulation in non–extracorporeal CPR cases probably led to the selection of younger patients with fewer co-morbidities and a higher likelihood of survival.

As VA-ECMO use grows beyond the operating room, novel models of ECMO use are needed to improve consistency in delivering this potentially life-saving therapy for patients with all cardiogenic shock etiologies and in all hospital areas. In addition, pragmatic models applicable in centers with limited staffing are needed. This study suggests that a cardiology-based shock team can serve this purpose effectively.

Limitations of this study include its small sample, its retrospective nature, and the lack of data regarding the overall number of shock team ECMO evaluations during the study period.

In sum, effective delivery of VA-ECMO in cardiogenic shock requires the articulation of timely recognition of cardiogenic shock, proper patient candidacy assessment, and rapid deployment of the cannulation team. The shock team can facilitate each of these stages. Further studies should assess the replicability of this model.

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