Ventricular assist device association in improving outcomes in patients resuscitated from out of hospital cardiac arrest

Julie Tram MS-3[1], Andrew Pressman MD, Nai-Wei Chen PhD, David Berger MD, Joseph Miller MD, Robert Welch MD, Joshua Reynolds MD, James Pribble MD, Robert Swor DO[2], and the CARES Surveillance Group

[1] Oakland University William Beaumont School of Medicine, [2]Beaumont Health System- Department of Emergency Medicine

OAKLAND UNIVERSITY WILLIAM BEAUMONT

CARES Cardiac Arrest Registry to Enhance Survival

INTRODUCTION

- Approximately 70% of cardiac arrests occur out of the hospital and although improvements have been made to EMS response protocol, survival rates after resuscitation still remains low[1]. To reduce the high mortality rates there has been increased focus on improving in hospital interventions for resuscitated out-of-hospital cardiac arrest (OHCA) patients[2].
- Despite being available for more than several decades, the intra-aortic balloon pumps (IABP) and percutaneous left ventricular assist devices (pLVAD) are still used sparingly and have yet to become part of the first line treatment protocol for OHCA patients[1]
- There is scant literature assessing these devices post cardiac arrest, none with large sample sizes [3,4,5,].
- Our use of a larger statewide cohort allows for a more robust analysis of the impact of device use

OBJECTIVE

- Our objective is to assess whether the use of pVLADs and IABP are associated with improved survival outcome in patients resuscitated from out-of-hospital cardiac arrest.

METHODS

- Cardiac arrest cases from 1/1/14 to 12/31/17 in the Michigan Cares Registry to Enhance Survival (CARES) and Michigan Inpatient Database (MIDB) were linked using probabilistic linkage methodology
- MIDB provides data on inpatient care and survival outcomes from all MI hospitals
- PLVADs, specifically the Impella, and IABPs were identified using ICD-9 and ICD-10 procedure codes, as was cardiogenic shock. We analyzed outcomes with use of these individually or either (ventricular assist device, VAD)
- Outcome defined as survival to hospital discharge
- Multilevel multi-variable logistic regression was used to assess the independent impact on device use on outcome
- Adjusted for patient characteristics normally predictive of cardiac arrest survival (age, gender, location, Bystander CPR, witnessed, shockable rhythm)

RESULTS

- A total of 3,790 CARES cases were matched with MIDB. Of these patients 1131 (29.8%) survived to hospital discharge.
- In a univariate analysis, use of VAD devices was associated with improved survival to discharge. IABP were used more frequently and associated with a higher survival, compared to use of Impella device (Table 1). For the subset of patients in cardiogenic shock, VAD and IABP were associated with improved survival to hospital discharge (Table 2)
- However, In the adjusted multivariable model VAD use was no longer independently associated with an increased survival (aOR =0.95, 95% CI 0.69, 1.31. (Table 3)
- After adjusting for patient characteristics, VAD use in patients with cardiogenic chock increased the odds of an improved outcome by 14% but not statistically significant (aOR = 1.14, 95% CI 0.74, 1.77) (Table 4)

Table 1: Univariate Model Results: All Patients

	Number of Patients	Survivors	Odds Ratio (95% CI)
Total	3790	1131	
Ventricular Assist Device			
No VAD	3585	1036 (29%)	2.07
VAD	205	95 (46%)	(1,55, 277)
Intra-aortic Balloon Pump			
No IABP	3607	1044 (29%)	2.16
IABP	183	87 (48%)	(1.59, 2.93)
Impella Device			
No Impella	3740	1109 (30%)	1.72
Impella	50	22 (44%)	(0.96, 3.06)

Table 2: Univariate Model Results: Cardiogenic Shock

	Number of Patients	Survivors	Odds Ratio (95%CI)
Total	725	222	
Ventricular Assist Device			
No VAD	583	163 (28%)	1.84 (1.24,
VAD	142	59 (42%)	2.73)
Intra-aortic Balloon Pump			
No IABP	598	167 (28%)	1.98 (1.32,
IABP	127	55 (43%)	2.98)
Impella Device			
No Impella	693	211 (30%)	1.17 (0.54,
Impella	32	22 (34%)	2.54)

Table 3: Multi-variable Model Results: All Patients

	Odd Ratio (95% CI)	p
VAD	0.95 (0.69, 1.31)	0.76
Age	0.98 (0.98, 0.99)	<.001
Public vs Home Residence	1.92 (1.57,2.34)	<0.001
Bystander Witnessed vs Unwitnessed	1.56 (1.30, 1.88)	<0.001
Bystander CPR vs No CPR	1.27(1.05, 1.52)	0.01
Shockable Rhythm vs non-shockable	4.86 (4.11,5.75)	<0.001

Table 4: Multi-variable Model Results: Cardiogenic Shock

	Odd Ratio (95% CI)	p
VAD	1.14 (0.74, 1.77)	0.55
Age	0.98 (0.98,1.00)	0.06
Public vs Home Residence	1.81 (1.20, ,2.74)	0.01
Bystander Witnessed vs Unwitnessed	1.40 (0.92,2.12)	0.01
Bystander CPR vs No CPR	1.12 (0.75, 1.68)	0.58
Shockable Rhythm vs non-shockable	4.27(2.91,6.27)	<0.001

DISCUSSION

Our findings suggests that VAD use may be associated with mortality benefit and should still be considered as an adjunct to standard treatment protocol. VAD use, notably IABPs may be particularly beneficial for post- arrest patients who suffer from cardiogenic shock. Our findings are also important as literature evaluating VAD use in the OHCA population is sparse despite the frequency of post arrest patients.[2] This study support the need for further research to evaluate the benefits of these devices in post-cardiac arrest patients.

LIMITATIONS

- Despite our use of a large statewide dataset encompassing a four years there was a low frequency of VAD use- IABP use was only 4.8% and Impella device used 1.3% of cases
- Unable to identify reasons for VAD use
- VAD population likely in more critically ill population

CONCLUSION

Although limited by a low frequency of use, VAD device use, or IABP use alone was positively associated with survival to discharge in post-cardiac arrest patients in a univariate model. However, in a multi-variable model, VAD use was not associated with an independent improvement in post arrest survival.

REFERENCES

1. Pressman A, Sawyer KN, Devlin W, Swor R. Association between percutaneous hemodynamic support device and survival from cardiac arrest in the state of Michigan. Am J Emerg Med [Internet]. Elsevier Inc.; 2018;36(5):834-7. Available from: https://doi.org/10.1016/j.ajem.2017.10.036
2. Nichol G, Aufderheide TP, Eigel B, Neumar RW, Lurie KG, Bufalino VJ, et al. AHA Policy Statement Regional Systems of Care for Out-of-Hospital Cardiac Arrest A Policy Statement From the AHA and Resuscitation; Council on Cardiovascular Nursing; Council on Clinical Cardiology; Advocacy Committee; and Council on Quality of Care and Outcomes Research Endorsed by the NASEMSO. 2010 [cited 2018 Jul 16]; Available from: http://www.americanheart.org/presenter.jhtml
3. Wernly, B., Seelmaier, C., Leistner, D. et al. Clin Res Cardiol (2019) 108: 1249. https://doi.org/10.1007/s00392-019-01458-2
4. Basir, B, Schreiber, T, Dixon, S, et al. Feasibility of early mechanical circulatory support in acute myocardial infarction complicated by cardiogenic shock: The Detroit cardiogenic shock initiative. *Catheter Cardiovasc Interv*. 2018; 91: 454- 461. https://doi.org/10.1002/ccd.2742
5. . Ouweneel DM, de Brabander J, Karami M, et al. Real-life use of left ventricular circulatory support with Impella in cardiogenic shock after acute myocardial infarction: 12 years AMC experience. *European Heart Journal: Acute Cardiovascular Care*. 2018;8(4):338-349. doi:10.1177/2048872618805486

IRB#: 2018-072