A Multi-Tiered Approach to Reducing the Incidence of Renal Replacement Therapy in the Advanced Heart Failure Population Undergoing LVAD Implantation

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INTRODUCTION

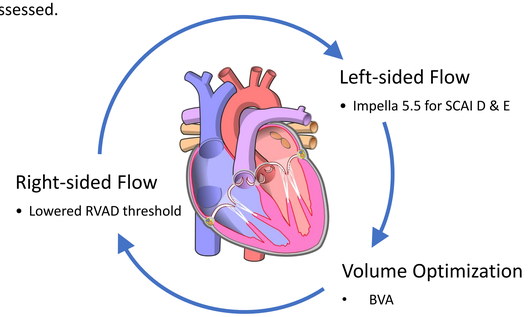
Despite improvements in long-term survival in patients undergoing Left Ventricular Assist Device (LVAD) implantation, severe acute kidney injury (AKI) necessitating renal replacement therapy (RRT) continues to complicate the post-operative course and increases mortality and morbidity. Research examining specific interventions to reduce the rate of post-operative RRT in the LVAD population is currently limited. We investigated the impact of a multi-tiered intervention designed to reduce the rate of post-operative RRT. The intervention was predicated on pre-operative optimization of plasma volume and red blood cell volume and modified thresholds for the utilization of peri-operative temporary mechanical support.

OBJECTIVE

The goal of this study was to assess the impact of 3 process changes on the rate of RRT after LVAD implantation.

METHOD

A single center, retrospective cohort study of all patients who underwent initial LVAD implantation from January 1, 2017 to June 30, 2024 was performed. Patients were stratified into two groups: pre-intervention (January 1, 2017 to September 14, 2022) and post-intervention (September 15, 2022 forward). The intervention consisted of the following three tiers: 1) routine Blood Volume Analysis (BVA) prior to LVAD implantation, 2) pre operative Impella 5.5 implantation for Society for Cardiovascular Angiography and Interventions (SCAI) stages D and E cardiogenic shock patients, and 3) reduced threshold for utilization of a temporary right ventricular assist device (RVAD) in the peri-operative setting. The statistical significance of pre- and post-intervention outcome differences was assessed.

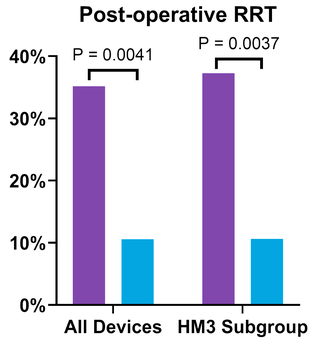


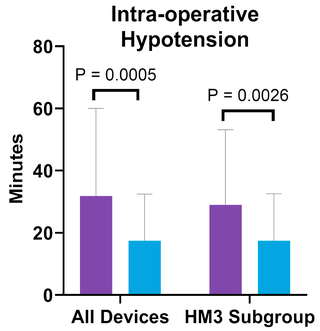
RESULTS

A total of 135 patients were implanted during the study period (n=88 pre-intervention, n=47 post-intervention). The initial patient characteristics and outcomes are shown in the table. The pre and post intervention groups are similar except for these characteristics- the post-intervention group had higher BVA utilization, more mechanical circulatory support, higher CVP, high CVP/PCWP ratio, and lower PA pulsatility index. Even with these extra support, the INTERMACS profile of the two groups are similar, painting the picture of a sicker post-intervention cohort.

The device types are also different. Pre-intervention group had a mix of Heartware, Heartmate 2, and Heartmate 3, whereas the post intervention group was only implemented with heartmate 3.

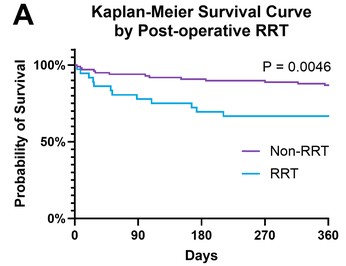
After the intervention, the post-operative RRT rate decreased from 34.1% (30 out of 88) to 10.6% (5 out of 47) (P = 0.0041). In addition, 30-day and 1 year survival increased from 90.9% to 93.6% (P = 0.75) and 79.6% to 87.8% (P = 0.37), respectively. 30-day readmission rate decreased from 28.6% to 16.3% (P = 0.20). Finally, pre- and post-operative median length of stay increased by 2 (P = 0.09) and decreased by 1.5 (P = 0.93) days, respectively.

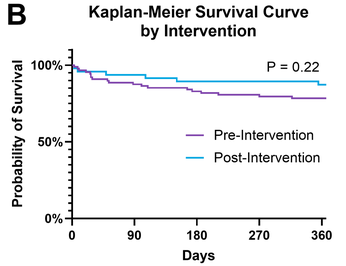


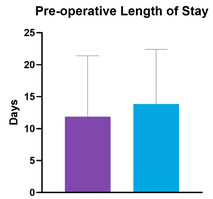


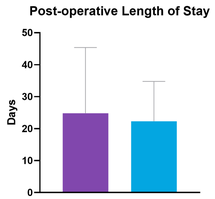
Legend: Pre-Intervention, Post-Intervention

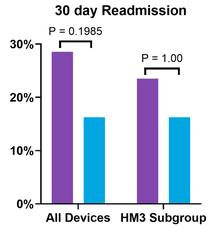
Characteristic	Pre-Intervention (N=88)	Post-Intervention (N=47)	P value
Pre-LVAD BVA	0 (0%)	40 (85.1%)	<0.0001
Pre-LVAD Impella 5.5	1 (1.14%)	14 (29.79%)	<0.0001
Peri-operative RVAD	5 (5.68%)	12 (26.09%)	0.0020
Pre-operative ECMO	0 (0%)	5 (10.6%)	0.0044
Pre-operative hemodynamics (mean ± SD)			
CVP (mmHg)	6.18 ± 2.31	7.74 ± 3.13	0.0076
CVP/PCW	0.30 ± 0.15	0.41 ± 0.25	0.0487
PAPi	4.45 ± 3.37	3.27 ± 1.75	0.0180
INTERMACS profile (No. [%])			
Class 1	5 (5.7%)	6 (12.8%)	0.2700
Class 2	54 (61.4%)	20 (42.6%)	0.0561
Class 3	28 (31.8%)	21 (44.7%)	0.1961
Device Type (No. [%])			
Heartware	23 (26.1%)	0 (0%)	<0.0001
HeartMate 2	6 (6.8%)	0 (0%)	0.0915
HeartMate 3	59 (67.0%)	47 (100%)	<0.0001

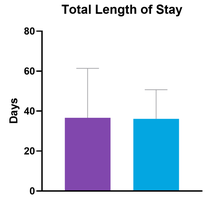


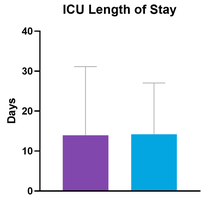












Legend:
Pre-Intervention
Post-Intervention

CONCLUSIONS

A standardized, multi-tiered perioperative strategy targeting volume optimization and timely mechanical circulatory support was independently associated with a substantial reduction in post-LVAD RRT. These findings support the integration of pre-operative BVA and early temporary mechanical support into LVAD care pathways to improve renal outcomes.

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