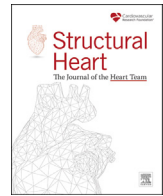




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Outcomes of Thirty-Day Readmission in Patients With Heart Failure on Index Hospitalization Undergoing Transcatheter Edge-to-Edge Mitral Repair: Insights from the United States Nationwide Readmission Database



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Transcatheter edge-to-edge mitral repair (TEER) has been deemed to be safe and effective in treating both symptomatic patients with severe functional mitral regurgitation (MR) despite guideline-directed medical therapy and those with degenerative MR deemed high risk for surgery.¹ Furthermore, there are emerging data on the use of TEER in patients with MR and cardiogenic shock as a study by Simard et al.² reported lower mortality and heart failure (HF) hospitalizations in those with successful TEER implantation. However, there is a paucity of information regarding readmission outcomes within the context of patients who have undergone TEER for acute HF (AHF) during the initial hospitalization. Therefore, the objective of our study is to assess the 30-day readmission outcomes among patients who were hospitalized with AHF during the index admission for TEER.

We used the United States Nationwide Readmission Database (NRD) to identify patients who underwent TEER between October 1, 2015, and November 30, 2019. TEER and AHF were identified using the International Classification of Diseases, 10th edition (ICD-10) codes O2UG3JZ and (I50.21, I50.23, I50.31, I50.33, I50.41, and I50.43), respectively. The definition of AHF was determined by the ICD-10 codes used, which covered AHF cases with both reduced ejection fraction (EF) and preserved EF. These codes included I50.21 (acute systolic HF), I50.23 (acute on chronic systolic HF with reduced EF), I50.31 (acute diastolic HF), I50.33 (acute on chronic diastolic HF), I50.41 (acute systolic and diastolic HF), and I50.43 (acute on chronic combined systolic and diastolic HF). Categorical variables are presented as percentages and compared using Pearson's chi-square or Fisher's exact tests. Continuous variables are reported as medians with an interquartile range and compared using the Mann-Whitney U test. A multivariable logistic regression model was developed to compute the adjusted odds ratio and 95% confidence interval for the 30-day readmission outcomes adjusted for age, sex, mode of admission, and Charlson comorbidity index. The cumulative incidence of 30-day readmission and mortality was assessed using the log-rank function with nonweighted data. A two-tailed *p*-value of 0.05 was considered statistically significant.

A total of 30,624 weighted hospitalizations for TEER were included, of which 12,195 (39.8%) had AHF on index hospitalization. Patients in the AHF group had lower rates of elective admission and higher rates of HF at baseline. Patients with AHF during index admission had significantly higher rates of mortality (4.1%), cardiogenic shock (9.5%), acute kidney injury (AKI) (29.0%), and intra-aortic balloon pump (IABP) use (3.8%) compared to patients without AHF (mortality: 0.9%, cardiogenic

Abbreviations: AHF, acute heart failure; AKI, acute kidney injury; EF, ejection fraction; IABP, intra-aortic balloon pump; ICD-10, International Classification of Diseases, 10th edition; MR, mitral regurgitation; NRD, Nationwide Readmission Database; TEER, transcatheter edge-to-edge mitral repair.

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shock: 1.0%, AKI: 5.9%, IABP use: 0.5%). Among patients who got readmitted at 30 days, the readmission rate (15.6% vs. 10.5%, $p < 0.01$) and readmission mortality (8.5% vs. 5.1%, $p < 0.01$) were higher in the AHF group. Meanwhile, the AHF group also had higher rates of AKI, cardiogenic shock, and the need for IABP at 30-day readmissions. Length of stay was longer by 3 days, and the cost of rehospitalization was higher in the AHF group. Kaplan-Meier survival curve showed reduced survival at 30 days for patients who had AHF.

In our large-sample retrospective study, we report the following principal findings: 1) one in three patients admitted for TEER have coexisting AHF, and 2) TEER hospitalizations complicated by AHF have higher 30-day all-cause readmissions, mortality, complication rates, cost of hospitalization, and longer length of stay compared to those without AHF.

Although HF is ubiquitous comorbidity in patients undergoing TEER, the subset of AHF is less well studied. It is estimated that nearly 40% of the US adults with low EF who are admitted for AHF have concomitant moderate to severe MR.³ Reconciliation of data from randomized controlled trials that evaluated TEER suggested that the procedural benefit is limited to chronic HF patients with reduced EF and concomitant moderate to severe MR who remain symptomatic despite medical therapy.¹⁻³ A benefit of TEER in patients with MR and cardiogenic shock has been demonstrated in a recent study by Simard et al² using registry data. Our study reports worse 30-day morbidity and mortality in patients with AHF during index hospitalization undergoing TEER. To our knowledge, our study is the first to assess the impact of AHF on index hospitalization for TEER procedures at a national level. Due to the inclusion of 30-day HF readmissions in the US Centers for Medicare and Medicaid Services administered Hospital Readmission Reduction Program, preventative interventions are necessary to decrease HF readmissions following mitral TEER in patients with AHF. A prior study has recommended a multidisciplinary approach for patient selection and periprocedural risk optimization in this high-risk patient population undergoing TEER to improve short-term and long-term outcomes.⁴ Additionally, the early and frequent postdischarge outpatient follow-up has been suggested in the HF literature as an intervention to ensure intensive optimization of medical therapy in patients with AHF.⁵ It is likely that a substantial number of patients with AHF undergoing TEER may also benefit from such interventions that have demonstrated a benefit for outcomes such as all-cause death and HF readmission.

Our study's scope was limited since it did not contain comprehensive information on procedural success and complication rates, echocardiographic parameters, etiology of AHF, medication usage, and hemodynamic parameters. Similarly, it should be noted that the NRD is not equipped to capture events that transpire outside of the hospital. Therefore, the outcomes of our study should be interpreted specifically as 30-day readmission outcomes, rather than as 30-day event rates. The NRD database lacks information on procedure characteristics, success

rates, and operator skill, which may impact outcomes. As a result, future research could investigate the impact of operator skill and volume on AHF patients undergoing TEER. Furthermore, the outcomes of the study were not determined through central adjudication, but rather based on ICD-10 coding for administrative claims.

In summary, we report that patients undergoing TEER on index hospitalization complicated by AHF had worse 30-day outcomes including readmission, mortality, in-hospital complications, and resource utilization. Future studies are needed to better assess the risk predictors, guide patient selection, and best practices for optimal outcomes in AHF patients undergoing TEER.

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Ethics Statement

The research was conducted ethically and all the authors are in agreement with this statement. The NRD is a publicly available database with no individually identifiable data, and thus does not constitute research with human subjects (as defined under 45CFR46:102).

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Disclosure Statement

The authors report no conflict of interest.

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