



Research Correspondence

Association of chronic kidney disease with in-hospital outcomes of transcatheter mitral valve repair



Percutaneous edge-to-edge transcatheter mitral valve repair (TMVr) using MitraClip® has been approved for the treatment of degenerative mitral valve regurgitation (MR). Chronic kidney disease (CKD) is shown to be an independent predictor for worse outcomes for transcatheter aortic valve replacement.¹ The presence of chronic MR may further deteriorate renal function. However, an association of CKD and/or end-stage renal disease (ESRD) and mortality in patients undergoing TMVr has not been well described. In the EVEREST II trial, the prevalence of CKD was 23%.² Most major randomized clinical trials have excluded such CKD patients from the cohorts.² Therefore, this study aims to find an association between CKD/ESRD and in-hospital outcomes of TMVr in “real-world” hospitalizations.

This study used National Inpatient Sample (NIS) data from the year 2012 to 2014. The NIS database has been described earlier which is sponsored by HealthCare Cost and Utilization Project.³ Briefly, the NIS includes more than 4000 hospitals across the United States which represents 95% of the US population. This study identifies adult hospitalizations (age ≥ 18 years) with TMVr using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code 35.97 which is specific for mitral valve repair (N=2570). Hospitalizations with CKD were identified using ICD-9-CM diagnosis codes 585.1–585.5 and 585.9.⁴ Hospitalizations with ESRD were identified using ICD-9-CM diagnosis code 585.6 or procedures code of hemodialysis (39.95) or peritoneal dialysis (54.98).⁴ Calculation of cost was performed by merging cost-to-charge ratio (CCR) with the total cost. These CCR files are provided by the sponsor. The severity of co-morbid conditions was defined using Deyo modification of Charlson co-morbidity Index (CCI). Mann-Whitney *U* test was used for comparison of continuous variables, while Fischer's Exact test was utilized for comparison of categorical variables. Finally, multivariate logistic regression analysis was performed to analyze adjusted outcomes and age, gender, race and Elixhauser comorbidities were included in the model. This study was exempted from the intuitional review board committee review. Additionally, all the principles outlined in the Helsinki Declaration of 1975, as revised in 2000, have been followed in all the experiments involving human subjects during the current study.

A total of 500 (19.5%) hospitalizations were identified having CKD and 130 (5%) hospitalizations with having ESRD. Baseline differences existed between the groups (Table 1). Mean age was higher in the CKD group (79.1 vs. 72.2 years, $P < 0.001$) while lower in the ESRD group (64.7 vs. 72.2 years, $P < 0.001$) as compared to those without CKD or ESRD. Patients in the CKD (93%)

and ESRD (88.5%) presented with much higher comorbidities as demonstrated by $CCI \geq 3$. All Elixhauser comorbidities were higher in the CKD and ESRD group except for chronic pulmonary disease and liver disease. Primary outcome of this study, in-hospital mortality was significantly higher in CKD (5% vs. 1.8%, adjusted $P < 0.001$, adjusted Odds Ratio (OR): 5.83, Confidence Interval (CI): 1.54–22.02) and ESRD (7.7% vs. 1.8%, adjusted $P < 0.001$, adjusted OR: 7.98, CI: 1.12–56.8) group. Additionally, all other secondary outcomes such as acute renal failure, blood loss requiring transfusion and permanent pacemaker implantation were higher in the CKD and ESRD group after performing the adjusted analysis. Less hospital discharges were made to home and more were made to other acute care facilities with CKD/ESRD. These translated to the longer length of stay in the ESRD group and higher median cost in CKD as well as ESRD group.

This study demonstrated an important association between CKD or ESRD and in-hospital outcomes for hospitalizations with TMVr. In-hospital outcomes increased with the presence of CKD and were even higher with the presence of ESRD in TMVr hospitalizations when compared with those patients without CKD/ESRD. As demonstrated by Ohno et al. in his study, CKD is an independent predictor of worse outcomes.¹ This could be one of the reasons for higher in-hospital mortality in CKD and even higher in-hospital mortality in the ESRD group.^{1,5} These results are in agreement with a previously published study with a relatively small number of cohorts.^{1,5} However, acute kidney injury post procedure was present in a much higher proportion of hospitalizations as compared to previously published study with a relatively small number of cohorts.¹ Appropriate strategies should be adopted which may include a reduction in contrast use for pre-procedure testing, withdrawing nephrotoxic medications, and utilizing cardio-renal team consultation for hospitalizations with CKD or ESRD undergoing TMVr. Although CKD patients treated with MitraClip have worse outcomes, the therapy has been shown to be safe and effective for the treatment of MR¹ and improve estimated glomerular filtration rate and possibly kidney function.⁵ The now complete COAPT trial (Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients With Functional Mitral Regurgitation) may give more insight on patients with functional MR, however this subset of patients with heart failure is far more ill with many more comorbidities.

This study lacks information on a number of clips utilized, echocardiographic parameters (e.g. mitral regurgitation), and an indication for the treatment in addition to other inherent limitations associated with any retrospective analysis. Another major limitation is that the confidence interval for the selected outcomes was huge which undermines the precision of the estimates. Since patients with CKD and ESRD are more likely to present with functional MR, this study may include those

Table 1
Demographics, baseline characteristics and in-hospital outcomes of patients undergoing transcatheter mitral valve repair.

Variable	No CKD or ESRD (N=1960)	CKD (N=535)	P value for No CKD vs CKD	ESRD (N=130)	P value for No ESRD vs ESRD
Age, years	72.2 (15.2)	79.1 (10.4)	<0.001	64.7 (13.0)	<0.001
Woman	43.3%	37%	0.010	46.1%	0.53
White	69.9%	62%	<0.001	50%	<0.001
Black	5.4%	3%		19.2%	
Other	24.7%	35%		30.8%	
Charlson's comorbidity index					
0	17.8%	0%	<0.001	0%	<0.001
1	27.3%	0%		0%	
2	21.7%	7%		11.5%	
≥3	33.2%	93%		88.5%	
Elixhauser comorbidities					
Diabetes	20.1%	28%	<0.001	23.1%	0.41
Hypertension	63.7%	78%	<0.001	80.8%	<0.001
Obesity	7.2%	8%	0.55	15.4%	<0.001
Peripheral vascular disease	8%	18%	<0.001	19.2%	<0.001
Chronic pulmonary disease	24.2%	24%	0.92	15.4%	0.021
Congestive heart failure	1.8%	2%	0.77	7.7%	<0.001
Liver disease	3.3%	5%	0.08	3.8%	0.76
In-hospital outcomes					
In-hospital mortality	1.8%	5%	0.066	7.7%	0.046
Acute renal failure	13.9%	25%	0.007	38.5%	<0.001
Blood loss requiring transfusion	19.1%	25%	0.19	30.8%	0.15
Permanent pacemaker requirement	1.5%	2%	0.75	7.7%	0.027
Discharge to home	62.3%	57%	<0.001	19.2%	<0.001
Transfer to other facility ^a	1.8%	2%	0.77	3.8%	<0.001
Length of stay, median (IQR)	4 (2–8)	4 (2–9)	0.74	14 (4–28)	<0.001
Cost, median (SD)	\$38,541 (\$35,381)	\$40,426 (\$27,719)	<0.001	\$71,151 (\$124,817)	<0.001

Abbreviations: CKD, chronic kidney disease; ESRD, end stage renal disease; IQR, inter-quartile range; SD, standard deviation.

Values are in mean (standard deviation) or %.

International Classification of Disease, Ninth Revision, Clinical Modification codes used: Acute renal failure – 584.xx, blood loss requiring transfusion - 998.11, 998.12, 285.1, 99.0, and permanent pacemaker requirement - 37.70–37.79, 37.80–37.89, 00.50, 00.52, 00.53.

^a This includes transfer to short term facility, skilled nursing facility or intermediate care facility.

hospitalizations for off-label use as MitraClip is currently only approved for the treatment of degenerative MR in the United States.

In conclusion, the presence of CKD or ESRD is associated with worse in-hospital outcomes for hospitalizations with TMVr. Together, this may increase resource utilization and increase the overall cost of care. Hospitalizations for TMVr with CKD or ESRD may require additional care to reduce short-term as well long-term outcomes. It remains to be seen if higher mortality is associated with the procedure itself or higher pre-procedural risk-factors. We need to be cognizant that this CKD/ESRD subset of patients is at very high risk, and our decision making for each step of the workup to TMVr process needs to be carefully managed to optimize outcomes.

Conflict of interest

The authors report no relationships that could be construed as a conflict of interest.

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