Impact of Loop Diuretic Use on Outcomes Following Transcatheter Aortic Valve Implantation

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The use of LDT may signify significant hemodynamic changes and left ventricular remodeling in severe aortic stenosis (AS). Therefore, we sought to determine whether loop diuretic therapy (LDT) is associated with adverse outcomes following transcatheter aortic valve implantation (TAVI) in patients with severe symptomatic AS. Subjects undergoing TAVI at a single institution from June 2008 to December 2017 were analyzed. LDT doses were normalized to oral furosemide daily equivalents. All outcomes were adjudicated using VARC2 criteria. Descriptive statistics, multivariate logistic regression, and propensity score matching were used. Of the 804 subjects studied, 48.3% were on pre-TAVI LDT with a mean dose of 51.1 mg furosemide dose-equivalents. Subjects on LDT were higher risk, frail patients with more co-morbidities including chronic kidney disease, coronary artery disease requiring prior bypass grafting, peripheral arterial disease, atrial fibrillation or flutter, and diabetes with more severe heart failure symptoms. Those on LDT also had worse left ventricular systolic function, lower transvalvular gradients, and markers of adverse left ventricular remodeling, including increased left ventricular mass index and higher rates of concentric and eccentric hypertrophy. On propensity-score matching, death within one year post-TAVI was borderline significantly higher in the pre-LDT as compared with no-LDT group (16.9% vs 10.4 %, p = 0.068). In conclusion, use of pre-TAVI LDT for severe symptomatic AS is associated with a trend towards worse 1-year mortality and is a marker of high-risk, frail individuals with advanced left ventricular remodeling. **(Am J Cardiol 2020;131:67−73)**

Severe aortic stenosis (AS) is an important disease entity that influences both the quality and duration of life. Transcatheter aortic valve implantation (TAVI) is now a well-established treatment option for severe symptomatic AS.[1−6] Loop diuretic therapy (LDT) is often used to relieve vascular congestion symptoms prior to definitive intervention, although it has no known influence on mortality. AS is associated with structural remodeling in the left ventricle resulting in diastolic dysfunction requiring higher left ventricular filling pressures. LDT initiation may signify when compensatory mechanisms from LV remodeling begin to fail, which may be a significant predictor of poor outcomes following AV replacement. This study was designed to assess the association of LDT use on outcomes and preprocedural characteristics in patients with severe symptomatic AS undergoing TAVI.

Methods

Data were collected from a single-center database of consecutive subjects undergoing TAVI from June 2008 to December 2017. Demographic, clinical, echocardiographic, procedural, and outcome variables were collected by data abstraction of the institution's electronic medical record. The Society of Thoracic Surgeons risk score was calculated and reported as a predicted risk of operative mortality for aortic valve (AV) replacement. Frailty was assessed using a composite of objective measures, including the Katz Index of Independence in Activities of Daily Living, 5-meter walk time, grip strength, and presence of weight loss, with greater than or equal to 2 elements being considered frail. Clinical endpoints were defined based on the Valve Academic Research Consortium-2 consensus statement.[7] Survival was determined by review of the medical and public death records. The center's institutional review board has approved the database.

Exposure to LDT, defined as the use of oral or intravenous formulations of furosemide, torsemide, or bumetanide, was assessed on the subject's preprocedure and discharge medication reconciliation for the index hospitalization and was normalized to milligrams (mg) oral furosemide equivalents. The primary outcome was overall survival. Secondary outcomes 30-day and 1-year mortality; 30-day heart failure, and non-heart failure hospitalization; stroke; myocardial infarction; AKI stage 2 (defined as an increase in serum creatinine by 200% to 299%) or AKI stage 3 (defined as an increase in serum creatinine by ≥300% or serum creatinine ≥ 4.0 mg/dl

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with an acute increase of at least 0.4 mg/dl); device success; and early safety.

Chi-squared test, *t* test, and analysis of variance were used to check for differences between pre-TAVI LDT status in categorical variables and continuous variables, respectively. Missing data were corrected using the multiple imputation technique. Using a prespecified analysis of all pre-procedural covariates, a multivariate logistic regression with a forward stepwise approach was performed for the primary and secondary outcomes. Propensity score matching was also performed, with variables used to create the model listed in Supplementary Table 1. Statistical significance was accepted at $p < 0.05$. All statistical analyses were performed using the SPSS software (version 25; IBM).

Results

From June 2008 to December 2017, 804 subjects underwent TAVI for severe symptomatic trileaflet AS, of which 389 subjects (48.4%) were on LDT (pre-LDT) before TAVI. The average dose of diuretics in the pre-LDT cohort was 51.1 ± 40.1 mg oral furosemide equivalent. Baseline characteristics are summarized in Table 1. Pre-LDT subjects were more likely to be white, and have a history of

Table 1
Baseline characteristics of subjects undergoing TAVI

Variable	Pre-TAVI LDT		Overall (n = 804)	p value
	No (n = 415)	Yes (n = 389)		
Age at TAVI (years)	80.4 ± 9.2	81.1 ± 8.4	80.7 ± 8.8	0.21
Male	228 (54.9%)	213 (54.8%)	441 (54.9%)	0.96
White	353 (85.1%)	351 (90.2%)	704 (87.6%)	0.03
BMI (kg/m^2)	27.7 ± 6.0	29.2 ± 6.3	28.4 ± 6.2	<0.001
Coronary artery disease	290 (69.9%)	317 (81.5%)	607 (75.5%)	<0.001
Myocardial infarction	65 (15.7%)	76 (19.5%)	141 (17.5%)	0.15
Percutaneous coronary intervention	111 (26.7%)	116 (29.8%)	227 (28.2%)	0.33
Coronary artery bypass surgery	97 (23.4%)	121 (31.1%)	218 (27.1%)	0.01
Atrial fibrillation or flutter	133 (32.0%)	192 (49.4%)	325 (40.4%)	<0.001
Peripheral arterial disease	88 (21.2%)	107 (27.5%)	195 (24.3%)	0.04
Stroke	46 (11.1%)	48 (12.3%)	94 (11.7%)	0.58
Diabetes mellitus	124 (29.9%)	184 (47.3%)	308 (38.3%)	<0.001
Hypertension	337 (81.2%)	324 (83.3%)	661 (82.2%)	0.44
Hyperlipidemia	290 (69.9%)	275 (70.7%)	565 (70.3%)	0.80
Chronic kidney disease	89 (21.4%)	170 (43.7%)	259 (32.2%)	<0.001
ESRD on HD	18 (4.3%)	13 (3.3%)	31 (3.9%)	0.46
NYHA Class				
III	241 (58.1%)	264 (67.9%)	505 (62.8%)	0.004
IV	26 (6.3%)	81 (20.8%)	107 (13.3%)	<0.001
STS Risk Score (%)	5.6 ± 3.6	8.2 ± 4.8	6.8 ± 4.4	0.002
<4%	174 (41.9%)	60 (15.4%)	234 (29.1%)	<0.001
4%-<8%	153 (36.9%)	147 (37.8%)	300 (37.3%)	0.79
8%-<15%	78 (18.8%)	146 (37.5%)	224 (27.9%)	<0.001
≥15%	10 (2.4%)	36 (9.3%)	46 (5.7%)	<0.001
Frailty*	185 (50.7%)	186 (66.9%)	371 (57.7%)	<0.001
Creatinine (mg/dl)	1.2 ± 1.1	1.5 ± 1.3	1.4 ± 1.2	0.002
GFR† (ml/min)	60.8 ± 29.3	52.1 ± 26.1	56.6 ± 28.1	<0.001
Hemoglobin (g/dl)	13.0 ± 10.7	11.7 ± 1.8	12.4 ± 7.8	0.02
LDT dose (mg furosemide equivalent)	0 ± 0	51.1 ± 40.1	24.7 ± 37.8	<0.001
Medication				
Aspirin	268 (64.6%)	249 (64.0%)	517 (64.3%)	0.83
Any P2Y12 inhibitor	85 (20.5%)	85 (21.9%)	170 (21.1%)	0.64
Warfarin	56 (13.5%)	105 (27.0%)	161 (20.0%)	<0.001
Novel oral anticoagulant	40 (9.6%)	33 (8.5%)	73 (9.1%)	0.56
Beta-blocker	215 (51.8%)	259 (66.6%)	474 (59.0%)	<0.001
ARB	88 (21.2%)	68 (17.5%)	156 (19.4%)	0.18
ACE-I	127 (30.6%)	111 (28.5%)	238 (29.6%)	0.52
Thiazide diuretic	85 (20.5%)	33 (8.5%)	118 (14.7%)	<0.001
MRA	8 (1.9%)	51 (13.1%)	59 (7.3%)	<0.001
Trans-femoral access	369 (88.9%)	322 (82.8%)	691 (85.9%)	0.01
Balloon-expandable valve	339 (81.6%)	322 (82.8%)	661 (82.2%)	0.68
General Anesthesia	151 (36.4%)	233 (59.9%)	384 (47.8%)	<0.001

Continuous variables presented as mean ± standard deviation.

Categorical variables presented as number (%).

ACE-I = angiotensin-converting enzyme-inhibitor; ARB = angiotensin receptor blocker; ESRD = end-stage renal disease; GFR = glomerular filtration rate; HD = hemodialysis; MRA = mineralocorticoid receptor antagonist; NYHA = New York Heart Association; STS = society of thoracic surgeons.

* Frailty data was available in 643 of the total 804 patients

† GFR measured by Cockcroft-Gault equation

coronary artery disease, coronary artery bypass grafting surgery, chronic kidney disease, diabetes mellitus, atrial fibrillation or atrial flutter, and peripheral arterial disease than those not on LDT (no-LDT). The pre-LDT cohort had a higher body mass index, Society of Thoracic Surgeons predicted risk of mortality, rates of frailty, rates of New York Heart Association Class III or IV symptoms, and utilization of both general anesthesia and alternative access for TAVI. The no-LDT group had higher hemoglobin and glomerular filtration rate as compared with those on pre-LDT. At the time of TAVI, concurrent medical treatment with warfarin, beta-blockers, and mineralocorticoid receptor antagonists was more prevalent in the pre-LDT group while thiazide diuretic therapy was more common in the no-LDT group. Other adjunctive medications were similar at baseline between the 2 groups.

Table 2 describes the baseline echocardiographic of the pre-LDT and no-LDT groups. The pre-LDT group had a significantly lower left ventricular ejection fraction, peak AV velocity, AV mean gradient, and stroke volume index (SVI). Pulmonary artery systolic pressure (PASP), LV mass index (LVMI) and rates of more advanced forms of left ventricular remodeling, including eccentric and concentric hypertrophy, were higher in the pre-LDT group as compared with the no-LDT group. There were also more subjects with LVEF $\leq$ 40%, AV peak velocity $\leq$ 4 m/s, AV mean gradient $\leq$ 40 mmHg in the pre-LDT group as compared with the no-LDT group. The diagnosis of classical low-flow, low-gradient AS but not paradoxical low-flow was more common in the pre-LDT as compared with the no-LDT group. The LDT-group also had higher rates of greater than moderate mitral and tricuspid regurgitation, but not increased rates of greater than moderate aortic regurgitation as compared with the no-LDT group.

Thirty-day post-TAVI echocardiogram data are described in Table 3, with 88.9% of the sample having data available for analysis. Similar to pre-TAVI measurements, the LDT cohort had lower LVEF and SVI as compared with the no-LDT group. There was also increased LVMI and PASP, as well as increased rates of greater than moderate mitral and tricuspid regurgitation in the pre-LDT group as compared with the no-LDT. There was no difference in valve hemodynamics, including peak AV velocity, mean AV gradient, effective orifice area, dimensionless index and rates of patient prosthetic mismatch.

The mean follow-up was 2.67 $\pm$ 1.71 years post-TAVI. Table 4 displays the effect of pre-TAVI LDT on primary and secondary outcomes by post-TAVI by univariate and multivariate analysis. The pre-LDT had an increased risk of unadjusted overall mortality, 1-year mortality, 30-day heart

Table 2
Baseline echocardiographic characteristics of subjects undergoing TAVI

Variable	Pre-TAVI LDT		Overall (n = 804)	p value
	No (n = 415)	Yes (n = 389)		
LVEF (%)	59.9 ± 11.5	52.5 ± 14.6	56.3 ± 13.6	<0.001
LVEF < 40%	32 (7.7%)	83 (21.3%)	115 (14.3%)	<0.001
AV peak velocity (m/s)	4.3 ± 0.6	4.1 ± 0.67	4.2 ± 0.66	0.004
AV peak velocity ≤ 4 m/s	90 (21.7%)	135 (34.7%)	225 (28.0%)	<0.001
AV mean gradient (mm Hg)	45.3 ± 13.7	40.7 ± 13.9	43.0 ±14.0	<0.001
AV mean gradient ≤ 40 (mm Hg)	154 (37.1%)	192 (49.4%)	346 (43.0%)	<0.001
AV area (cm^2)	0.75 ± 0.25	0.72 ± 0.24	0.73 ± 0.24	0.13
AV area ≤ 1 cm^2	358 (86.3%)	346 (88.9%)	704 (87.6%)	0.25
Classical Low-Flow, Low-Gradient Aortic Stenosis*	28 (6.7%)	77 (19.8%)	105 (13.1%)	<0.001
Paradoxical Low-Flow, Low-Gradient Aortic Stenosis†	30 (7.2%)	33 (8.5%)	63 (7.8%)	0.50
LVMI‡ (g/m^2)	108.3 ± 29.8	118.0 ± 33.2	113.0 ±31.8	<0.001
Stroke Volume Index (ml/m^2)	42 ± 12.1	38 ± 21.6	40.1 ± 17.4	<0.001
Remodeling Pattern				
Normal	37 (8.9%)	34 (8.7%)	71 (8.8%)	0.93
Concentric Remodeling	179 (43.1%)	114 (29.3%)	293 (36.4%)	<0.001
Eccentric Hypertrophy	35 (8.4%)	56 (14.4%)	91 (11.3%)	0.008
Concentric Hypertrophy	164 (39.5%)	185 (47.6%)	349 (43.4%)	0.02
PASP (mm Hg)§	39.3 ±14.6	47.1 ± 15.6	43.2 ± 15.6	<0.001
> Moderate Aortic Regurgitation	70 (16.9%)	66 (17.0%)	136 (16.9%)	0.97
> Moderate Mitral Regurgitation	89 (21.4%)	113 (29.0%)	202 (25.1%)	0.01
> Moderate Tricuspid Regurgitation	59 (14.2%)	113 (29.0%)	172 (21.4%)	<0.001

Continuous variables presented as mean ± standard deviation.
Categorical variables presented as number (%).
AV = aortic valve; LVMI = left ventricular mass index; LVEF = left ventricular ejection fraction; PASP = pulmonary artery systolic pressure.
* Classical Low-Flow, Low-Gradient Aortic Stenosis defined as presence of LVEF < 50%, mean gradient <40 mm Hg, AV Area ≤1 cm^2 and Stroke Volume index <35 ml/m^2.
† Paradoxical Low-Flow, Low-Gradient Aortic Stenosis defined as presence of LVEF ≥ 50%, mean gradient <40 mm Hg, AV Area ≤1 cm^2 and Stroke Volume index <35 ml/m^2.
‡ LVMI calculated by Devereux formula.
§ PASP data was available in 582 of the total 804 patients.

Table 3
Day 30 post TAVI echocardiographic characteristics

Variable	Pre-TAVI LDT		Overall (n = 715)	p value
	No (n = 383)	Yes (n = 332)		
LVEF (%)	59.7 ± 10.5	54.3 ± 12.9	57.2 ± 12.0	<0.001
AV peak velocity (m/s)	2.7 ± 8.2	3.1±11.2	2.2 ± 0.52	0.17
AV mean gradient (mmHg)	11.4 ± 5.2	10.9 ± 5.3	11.1 ± 5.3	0.16
EOA index (cm^2/m^2)	0.9 ± 0.3	0.8 ±0.3	0.9 ± 0.3	0.17
Dimensionless index	0.7 ± 2.7	0.5 ± 0.1	0.6 ± 1.6	0.30
LVMI* (g/m^2)	102.8 ± 30.3	115.0 ± 30.8	108.5 ± 30.7	<0.001
Stroke Volume Index (ml/m^2)	49.8 ± 18.8	35.9 ±13.3	38.0 ± 16.6	0.004
PASP (mmHg)†	38.8 ± 22.3	42.9 ±14.4	40.4 ± 18.8	0.002
Patient Prosthetic Mismatch‡	120 (31.3%)	108 (32.5%)	228 (31.8%)	0.64
> Moderate AV Perivalvular leak	26 (6.8%)	24 (7.2%)	50 (7.0%)	0.81
> Moderate Mitral Regurgitation	54 (14.1%)	85 (25.6%)	139 (19.4%)	<0.001
> Moderate Tricuspid Regurgitation	55 (14.4%)	82 (24.7%)	137 (19.1%)	<0.001

Continuous variables presented as mean ± standard deviation.
Categorical variables presented as number (%).
AV = aortic valve; EOA = effective orifice area; LVEF = left ventricular ejection fraction; LVMI = left ventricular mass index; PASP = pulmonary artery systolic pressure.
* LVMI calculated by Devereux formula.
† PASP data was available in 526 of 715 patients with day 30 echo.
‡ Patient Prosthetic mismatch defined by VARC2 criteria.

Table 4
Analysis of LDT on primary and secondary outcomes post-TAVI by univariate and multivariate analysis

Outcome	Pre-TAVR LDT		Univariate RR for LDT	Multivariate RR for LDT
	No (n = 415)	Yes (n = 389)		
Overall Survival	147 (35.4%)	225 (57.8%)	1.62 (0.001)	1.29 (0.15)
Mortality within 30 days	10 (2.4%)	17 (4.4%)	1.81 (0.12)	1.08 (0.85)
Mortality within 1 year	38 (9.2%)	85 (21.9%)	2.39 (0.001)	1.05 (0.78)
30-day HF readmission	15 (4.0%)	32 (8.2%)	2.05 (0.005)	1.56 (0.19)
30-day non-HF readmission	49 (12.1%)	56 (16.1%)	1.21 (0.26)	1.25 (0.29)
Post-Procedure Stroke	14 (3.4%)	18 (4.6%)	1.36 (0.37)	1.14 (0.74)
Post-Procedure MI	5 (1.2%)	5 (1.3%)	1.05 (0.92)	1.03 (0.96)
Post-Procedure AKI Stage 2 or 3	7 (1.7%)	15 (3.9%)	2.18 (0.06)	2.83 (0.04)
Early Safety	378 (91.1%)	331 (85.1%)	0.93 (0.01)	0.64 (0.06)
Device Success	257 (61.9%)	225 (57.8%)	0.93 (0.24)	0.85 (0.32)

Categorical variables presented as number (%).
AKI = acute kidney injury; HF = heart failure; MI = myocardial infarction.
Early Safety is defined by the absence of all of the following at 30 days- mortality; life threatening bleeding; major vascular complication; AKI grade 2 or 3; Stroke, coronary artery obstruction requiring intervention; valve related dysfunction requiring repeat valvuloplasty, TAVR or surgical aortic valve replacement. Device success is defined by the absence of all of the following: procedural mortality, correct positioning of a single prosthetic valve into the correct anatomic position, patient-prosthesis mismatch, mean gradient >20 mm Hg or peak velocity >3 m/s, and moderate to severe aortic regurgitation.

failure readmission, and early complications leading to decreased early safety. On multivariate analysis, pre-TAVI LDT therapy is associated with increased risk of post-TAVI AKI stage 2 or 3 and decreased early safety; however, the effect of pre-TAVI LDT therapy on early and late mortality is not statistically significant, despite a sizeable absolute risk difference. There was also no significant interaction between LDT and glomerular filtration rate on primary and secondary outcomes. Supplemental Tables 2 to 11 displays the full multivariate models for each primary and secondary endpoint. On propensity score matching (n = 366), pre-TAVI LDT was only associated with a trend toward increased 1-year mortality, with a large absolute risk difference (16.9% vs 10.4 %, p = 0.068, Table 5).

Discussion

In this single-center, contemporary study of consecutive patients undergoing TAVI, the following findings were observed: (1) Pre-TAVI LDT was more commonly prescribed in higher risk, frail individuals with multiple comorbidities. (2) Pre-TAVI LDT was associated with a lower LVEF, trans-AV gradients, and echocardiographic evidence of adverse LV remodeling, including increased LVMI and PASP, increased rates of eccentric and concentric

Table 5
Analysis of LDT on Primary and Secondary Outcomes Post-TAVI by Propensity Score Matching

Outcome	Pre-TAVR LDT		Overall (n = 366)	Propensity Score RR for LDT	p value
	No (n = 183)	Yes (n = 183)			
Overall Mortality	87 (47.5%)	87 (47.5%)	174 (47.5%)	1.00	1.00
Mortality within 30 days	5 (2.2%)	3 (1.6 %)	8 (2.2%)	0.60	0.48
Mortality within 1 year	19 (10.4%)	31 (16.9%)	50 (13.7%)	1.63	0.07
30-day non-HF readmission	20 (11.1%)	23 (12.9%)	43 (12.0%)	1.16	0.60
Post-Procedure Stroke	6 (3.3%)	7 (3.8%)	13 (3.6%)	1.15	0.78
Post-Procedure MI	4 (2.2%)	3 (1.6%)	7 (1.9%)	0.72	0.70
Post -Procedure AKI Stage 2 or 3	4 (2.2%)	4 (2.2%)	8 (2.2%)	1	1.00
Early Safety	168 (91.8%)	165 (90.2%)	333 (91.0%)	0.98	0.58
Device Success	117 (63.9%)	105 (57.4%)	222 (60.7%)	0.89	0.20

Categorical variables presented as number (%).

AKI = acute kidney injury; HF = heart failure; MI = myocardial infarction; RR = relative risk.

Early Safety is defined by the absence of all of the following at 30 days- mortality; life threatening bleeding; major vascular complication; AKI grade 2 or 3; Stroke, coronary artery obstruction requiring intervention; valve related dysfunction requiring repeat valvuloplasty, TAVR or surgical aortic valve replacement. Device success is defined by the absence of all of the following: procedural mortality, correct positioning of a single prosthetic valve into the correct anatomic position, patient-prosthesis mismatch, mean gradient >20 mm Hg or peak velocity >3 m/s, and moderate to severe aortic regurgitation.

hypertrophy and concomitant volume and pressure-dependent valvular disease- mitral and tricuspid regurgitation. (3) Pre-TAVI LDT was associated with a trend towards 1-year mortality with a large absolute risk difference on propensity-score matching analysis.

To the author's knowledge, this is the first analysis to evaluate the association of LDT and post-TAVI or SAVR outcomes. In a single-center study, Durand et al. evaluated the predictors and prognosis of post-TAVI readmission for heart failure, and of these predictors, there was a trend toward increased loop diuretic use (66.7% vs 57% p = 0.05).[8]

While perhaps not causative, the previously mentioned data suggest that the use of pre-TAVI LDT is a marker of a more advanced disease state of severe AS and that definitive therapy rather than medical optimization should be rapidly pursued. There are many possibilities for these findings, all of which are likely synergistic. There were significant differences between the baseline characteristics of the 2 groups including frailty, medical co-morbidities, use of alternative access and early complications, all of which have been shown to individually influence post-TAVI outcomes and likely contribute to the difference between pre-LDT and no-LDT groups.[4,8–14]

Chronic pressure overload of progressive AS is associated with progressive myocardial hypertrophy, myocardial dysfunction due to abnormal interstitial fibrosis, and altered contraction through maladaptive adaptations to cardiac sarcomeres.[15] Clinically this leads to signs and symptoms of congestion, progressive diastolic dysfunction, pulmonary vascular remodeling, and finally, systolic dysfunction. All of these are amplified in the presence of other cardiovascular diseases, especially coronary artery disease. B-type-natriuretic peptide levels correlate with symptoms of congestion before TAVI. In a single study that evaluated B-type-natriuretic peptide levels pre- and post-TAVI, B-type-natriuretic peptide improved the most in subjects with preserved systolic function and elevated transvalvular gradients. However, there are mixed associations with preprocedural B-type-natriuretic peptide levels on post-TAVI outcomes.[16–19] Progressive diastolic dysfunction and pulmonary hypertension are predictors of worse late post-TAVI outcomes.[20-22] In a substudy of the PARTNER cohort, subjects who had more significant regression of ventricular hypertrophy were shown to have lower rates of rehospitalization and composite of death and rehospitalization.[23] Also, treatment post-TAVI with angiotensin-converting enzyme-inhibitor and angiotensin receptor blocker, which have been shown to promote favorable remodeling, have improved rates of both heart failure hospitalization and death, especially in patients with preserved systolic function.[23,24]

This study has many limitations inherent to a single-center, retrospective cohort trial. Due to the nature of data abstraction, it is possible that late complications and rehospitalization rates were under-reported. All data were abstracted systematically, and all follow-up visits at 1-month and 1-year post-TAVI addressed postprocedure complications.

Also, it was not possible to measure the effect of change in diuretic dosing over time. In the multivariate model, it is possible that the hazard ratios are reflective of unmeasured covariates, specifically diastolic dysfunction. Diastolic dysfunction was purposefully omitted from this analysis because of the inherent difficulties and inaccuracies associated with its measurement in a real-world population. The use of a propensity score-matched analysis also strengthened these findings.

Conclusion

In conclusion, in this single-center, retrospective study, LDT therapy before TAVI for severe symptomatic AS is a marker of high-risk individuals with echocardiographic evidence of adverse left ventricular remodeling and may be associated with worse post-TAVI outcomes.

Authors Contribution

Eric P. Cantey, MD - Conceptualization, Data Curation, Methodology, writing-original draft. Kevin Y. Chang, MD

- Conceptualization, Data Curation, Methodology, writing-original draft. John E. A. Blair, MD - Conceptualization, writing-review and editing. Kent Brummel, MD - Conceptualization, Data Curation, writing-review and editing. Ranya N. Sweis, MD - Conceptualization, writing-review and editing. Duc T. Pham, MD - Conceptualization, writing-review and editing. Adin-Christian Andrei Ph.D. - Formal analysis. Andrei Churyla, MD - Conceptualization, writing-review and editing. Mark J. Ricciardi, MD - Conceptualization, writing-review and editing. S. Chris Malaisrie, MD- Conceptualization, writing-review and editing. Charles J. Davidson, MD - Conceptualization, writing-review and editing. James D. Flaherty, MD - Conceptualization, Methodology, supervision, writing-review and editing.

Disclosures

The authors declare that they have no conflicts of interests.

Supplementary materials

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