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Research Article

Predictors of 10-Year Survival After Transcatheter Aortic Valve Replacement with First-Generation Aortic Valve: Insights from A Single Center Initial Experience

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Abstract

Aim: This study aimed to identify predictors of 10-year survival in patients undergoing early Transcatheter Aortic Valve Replacement (TAVR) with the first-generation CoreValve system, providing insights from a pioneering single-center experience in Turkey.

Material and Methods: We retrospectively analyzed high-risk patients who underwent TAVR between April 2012 and March 2013. Baseline clinical characteristics and echocardiographic parameters were compared between survivors and non-survivors over a 10-year follow-up period. Survival analysis was performed using Kaplan-Meier curves, and Cox regression models were utilized to identify independent predictors of survival.

Results: The cohort included patients with a mean age of 77.1 ± 7.7 years. The Kaplan–Meier analysis estimated the median survival time at 62 months (95% CI: 33–127), with a mean survival time of 71.6 months (95% CI: 43.9–99.3). Survivors exhibited significantly lower left ventricular (LV) end-diastolic diameter, LV mass index, and LV diastolic-systolic diameter difference compared to non-survivors. In univariate analysis, STS score, pulmonary artery pressure (PAP), LV hypertrophy pattern, LV diameter difference, and LV mass index emerged as potential predictors of long-term survival. STS score and LV diameter difference were independent predictors.

Conclusion: In this study, both STS score and LV diastolic-systolic diameter difference were identified as independent predictors of 10-year survival following TAVR. These findings emphasize the critical role of precise patient evaluation and underscore the potential value of personalized procedural strategies to optimize long-term outcomes in TAVR patients.

Keywords: Transcatheter Aortic Valve Replacement, Survival Analysis, Long-Term Outcome, Echocardiography, Aortic stenosis

INTRODUCTION

We are in the 3rd decade of transcatheter aortic valve replacement (TAVR) applications. Centers are now more experienced, new generation valves are more durable, procedural success is higher and complication rates are lower (1). The TAVR adventure, which started in inoperable and high-risk patients, has expanded its indications to different patient groups over time (2,3). Nowadays, we are in a period where topics such as low-risk and young patients, asymptomatic patients, intermediate AS, elective TAVR, and optimal timing of TAVR are discussed, and studies have shifted from procedural success, complications, early and mid-term outcomes, death and major clinical events to long-term survival (> 10 years) and valve durability (2,4-8).

Although current guidelines recommend TAVR as the first choice for high risk and advanced age and as an alternative to surgery for intermediate risk in AS patients with an indication for intervention, the reluctance to TAVR in patients with high life expectancy is striking (1,4). The most important reason for this is the lack of long-term data on new generation TAVR valves, despite the availability of long-term efficacy and safety data on surgical aortic valve replacement in patients with long life expectancy (1,9). The balance between the patient's survival expectancy and valve durability has a role in determining

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the priorities in the decision for TAVR, and this issue will become clearer with the long-term results of randomized trials.

Despite the favorable results of studies on the application of TAVR in asymptomatic AS, it has not yet entered routine practice in this group (5). Opinions recommending intervention in asymptomatic patients focus on the fact that valve stenosis causes cardiac damage even if it is asymptomatic and the importance of intervening on the valve when this damage is at a reversible stage (5,10). Cardiac damage caused by aortic stenosis is associated with postoperative outcomes and a new staging has been proposed using PARTNER trial data to quantify AS-related cardiac damage (11). According to this staging, higher stages of damage have been shown to be associated with higher mortality rates and prognostic significance (10-12). With these results, it is now recommended that the optimal time of intervention should be determined according to the patient's clinical presentation and the degree of cardiac damage (13).

As can be seen, although TAVR has become an established treatment option in AS, one of the focal points of controversy is the optimal patient selection. For this reason, the necessity of an individualized approach in which the valve, patient and cardiac hemodynamic characteristics are evaluated by a multidisciplinary cardiac team is increasingly emphasized in the guidelines (1,3,14). Studies to improve patient selection criteria should be focused to identify patients who will benefit the most from TAVR (15).

In this study, we evaluated the 10-year outcomes of one of the earliest TAVR centers in Turkey and examined the association of baseline patient characteristics with 10-year survival. The findings, which are thought to be significant in terms of the controversial points mentioned above, are intended to make a hypothetical contribution to the literature.

MATERIAL AND METHODS

Type of Research

This study was a retrospective cohort analysis focusing on the long-term outcomes of a retrospectively designed thesis study (16). The primary outcome of the study was death from all causes. This study was approved by the Scientific Research Ethics Committee of the Karadeniz Technical University (Approval No: 859-713, Decision No: 4237, Date: December 22, 2015).

Population and Sample of the Study

Consecutive patients who underwent TAVR for symptomatic severe AS between April 2012 and March 2013 at Karadeniz Technical University Faculty of Medicine, Department of Cardiology were included in the study. Surgical risk assessment of the patients was evaluated by a heart team based on Logistic Euro SCORE, Euro SCORE II, STS score and comorbidities. TAVR was recommended for patients with high surgical risk. All patients who consented and prepared for the procedure underwent preoperative transthoracic echocardiography (ECHO) and transesophageal ECHO (TOE), coronary angiography, peripheral angiography and/or aortography and computed tomographic angiography. Stents were implanted in patients with coronary stenosis ≥ 70%. TAVR was performed in the catheterization laboratory in the presence of anesthesiologists, cardiovascular surgeons and invasive cardiologists under general anesthesia and a transfemoral approach (TF) with transthoracic ECHO. Procedural success was defined as successful valve implantation with adequate device positioning and function, improvement in paravalvular aortic regurgitation, preserved or improved left ventricular ejection fraction, and absence of intra-procedural mortality.

Data Collection Tools

The procedural and first 3 years' data in the study were obtained from the data of the thesis study (16), and the subsequent information was obtained by searching the hospital information management system, national health system and patient contact information.

Data Analysis

Numerical variables are expressed as mean and standard deviation (SD) and categorical variables are expressed as number and percentage. Numerical variables are presented as median and interquartile range (IQR) due to the reduction in the number of groups in statistical comparison. Survival analysis was conducted using the Kaplan-Meier method and the log-rank test. Baseline and ECHO data of patients who survived and died at the end of 10 years were compared by Mann-Whitney U test and Fisher's exact test. Variables with $p < 0.20$ in baseline group comparisons were initially considered for univariate Cox regression. However, continuous variables such as the STS score were also analyzed directly as continuous predictors in Cox regression, even if their group comparisons did not reach this threshold. This approach allowed us to capture associations that may not be evident in dichotomized group-level tests. Independent variables were analyzed for multicollinearity by Spearman and VIF analysis and necessary corrections were made before inclusion in the multiple models. The patient who was given surgery after the procedure was excluded from the analysis because he was lost to follow-up. All results were evaluated at 95% confidence interval and $p<0.05$ was considered statistically significant. Analyses were performed using SPSS software (IBM SPSS Statistics for Windows, Version 26.0). Artificial intelligence technologies were used for the selection and interpretation of statistical methods.

RESULTS

A total of 16 patients were included in the study. The mean age of the patient group was 77.1 ± 7.7 years and 50% were female. In one patient, the procedure was unsuccessful, and the patient was referred for surgical treatment. Therefore, the final analysis was performed on 15 patients. Although the maximum clinical follow-up extended to 12 years in some patients, survival analyses were censored at 10 years to ensure standardized statistical reporting and consistency across models. All patients were implanted with a CoreValve® valve via TF approach under general anesthesia. Valve size 26 was used in 6 patients, 29 in 9 patients and 31 in 1 patient. One patient experienced intraoperative mortality, and another was classified as a procedural failure due to severe aortic regurgitation (AR) following valve implantation. The procedure success rate of the center was 87.5%. The mean hospital stay was 7.8 ± 3.5 days. Moderate mitral regurgitation was detected in 7 patients (43.8%). Among these, 1 patient in the survivor group d (16.7%) and 6 patients in the deceased group (66.7%) had moderate regurgitation. In the remaining patients, mitral regurgitation was either absent or only mild (grade 1). Baseline, echocardiographic, procedural and pre-discharge outcomes of the patients are shown in Table 1. During a mean follow-up of 76.7 months (1-146) of 14 patients, one patient underwent valve-in-valve procedure because of valve degeneration, 5 patients developed major bleeding (2 gastrointestinal, 3 intracranial), 3 patients developed major neurologic events, 2 patients died of cardiac causes and 9 patients died of non-cardiac causes. The pre-procedural and post-procedural characteristics of the patients are summarized in Figure 1.

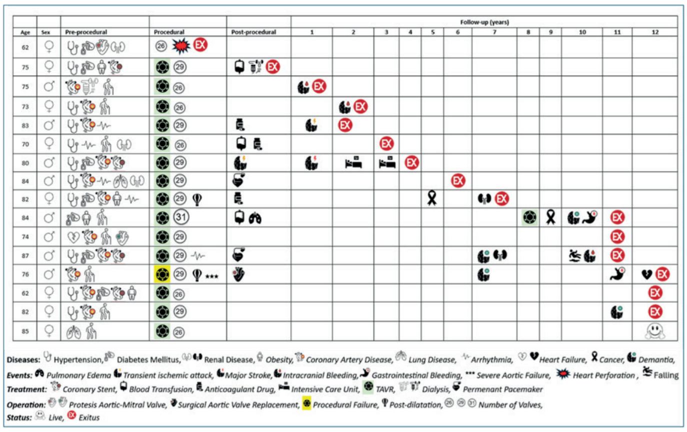

Figure 1. Patient Characteristics, Procedural Details, and Follow-up Outcomes over 12 Years

Timeline chart showing each patient's age, sex, pre-procedural comorbidities, procedural characteristics (valve size, procedural failure, complications), post-procedural events, and long-term follow-up status up to 12 years. Symbols represent specific diseases, events, treatments, and operations as defined in the legend below the figure. "EX" indicates death. Valve sizes are shown as numbers inside circles. Follow-up outcomes include cardiovascular and non-cardiovascular events, re-interventions, and survival status.

At 1st year, 13 patients (86.7%) were alive, with survival rates of 53.3% (8 patients) at 5th year, 40.0% (6 patients) at 10th year, and 6.7% (1 patient) at 12th year. Kaplan-Meier analysis estimated the median survival time at 62 months (95% CI: 33-127), with a mean survival time of 71.6 months (95% CI: 43.9-99.3) (Figure 2). Median survival differed substantially across LVH subtypes, with concentric remodeling patients surviving longest and dilated–concentric hypertrophy patients shortest (Figure 3).

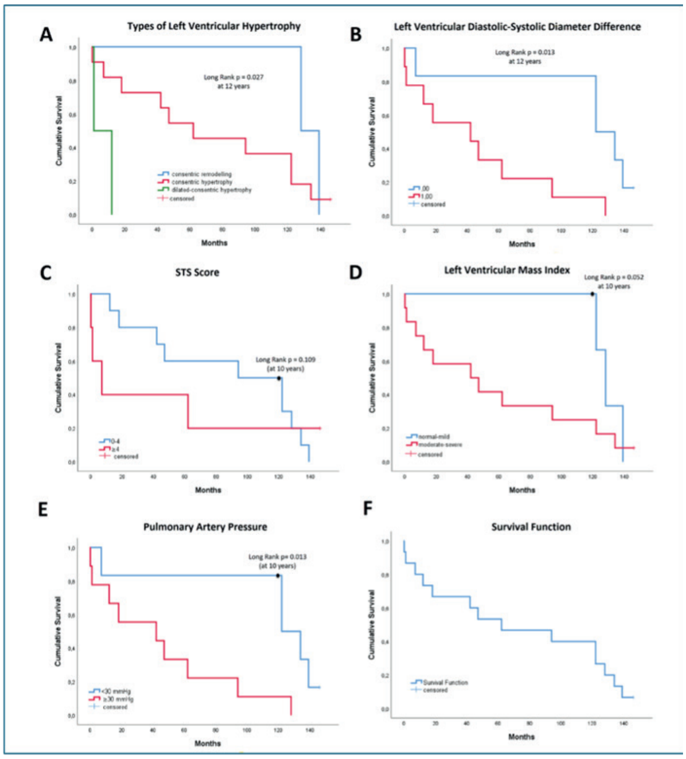

Figure 2. Kaplan-Meier Survival Analyses According to Baseline Clinical and Echocardiographic Variables

Kaplan-Meier plots comparing cumulative survival over follow-up time for different subgroups:

(A) Types of left ventricular hypertrophy (concentric remodeling, concentric hypertrophy, dilated-concentric hypertrophy).

(B) Left ventricular diastolic-systolic diameter difference.

(C) Society of Thoracic Surgeons (STS) score (<4 vs ≥4).

(D) Left ventricular mass index (normal/mild vs moderate/severe).

(E) Pulmonary artery pressure (<30 mmHg vs ≥30 mmHg).

(F) Overall survival function for the entire cohort.

Log-rank p-values and censoring markers are indicated.

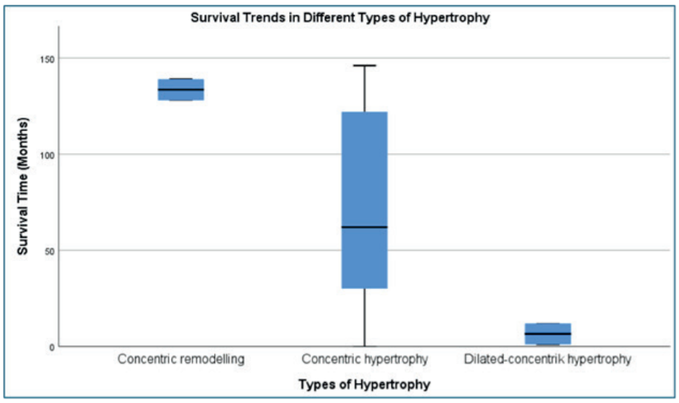

Figure 3. Survival Time Distribution by Type of Left Ventricular Hypertrophy

Box-and-whisker plot showing the distribution of survival times (months) for patients with concentric remodeling, concentric hypertrophy, and dilated-concentric hypertrophy. Median survival is indicated by the horizontal line within each box, the box represents the interquartile range (IQR), and whiskers indicate the range. Outliers, if present, are shown as individual points.

Table 1. Baseline patient characteristics according to 10-year survival*

		Survival Analysis Cohort (n=15)	
	TAVR Population (n=16)	Survival (n=6)	Non-survival (n=9)
Basal properties			
Age, (μ ± SS)	77.1 ± 7.7	79.0 ± 9,47	76.0 ± 7.14
Gender, n (F)	8	3/3	4/5
Body mass index, kg/m2 (μ ± SD)	27.3 ± 6.8	27 ± 5.19	27,7 ± 8.17
Hypertension, % (n)	68.8 (11)	50 (3)	88.9 (8)
Diabetes, % (n)	37.5 (6)	50 (3)	44.5 (4)
Coronary artery disease, % (n)	81.25 (13)	83.3 (5)	77.7 (7)
Atrial fibrillation, % (n)	25 (4)	0	44.5 (4)
Logistic Euro SCORE, (μ ± SS)	19.3 ± 11.9	15.3 (13.4-27.3)	17.5 (12.0-24.1)
Euro SCORE II, (μ ± SS)	9.9 ± 2.4	10.0 (9.0-11.0)	10.0 (9.0-11.0)
STS score, (μ± SS)	3.7 ± 1.3	2.9 (3.6-5.3)	3.9 (1.9-4.0)
Baseline echocardiographic features			
LV end-systolic diameter	30.3 ± 5.2	30.8 ± 6.2	30.7 ± 5.8
LV end-diastolic diameter	46.6 ± 5.7	44.5 ± 5.9	49.8 ± 4.4
LV ejection fraction	55.5 ± 14.9	54.3 ± 18.2	55.2 ± 14.0
LV relative wall thickness	0.59 ± 0.16	0.56 ± 0.06	0.60 ± 0.21
Pulmonary artery pressure	33.9 ± 12.4	28.6 ± 8.1	40.78 ± 14.5
Mean aortic valve gradient	55.6 ± 19.7	62.5 ± 22.5	50.3 ± 17.3
Mitral regurgitation moderate n (%)	7 (%43.8)	1(%16,7)	6 (%66.7)
Process results			
Processing time (minutes)	122.2 ± 54.6		
Post-dilatation, % (n)	12,5 (2)		
Valve embolization, % (n)	31.3 (5)		
Paravalvular severe AR, % (n)	12.5 (2)		
Death, % (n)	6.3 (1)		
Results before discharge			
Need for surgery	6.3 (1)		
Pulmonary edema	12.5 (2)		
Acute renal failure/dialysis	6.3 (1)		
Permanent pacemaker for AV block	6.3 (1)		
Vascular complications	12.5 (2)		
Major bleeding	6.3 (1)		
Stroke/transient ischemic attack	6.3 (1)		
Infection	37.5 (6)		
Death	12.5 (2)		
Length of hospital stay (days)	7.8 ± 3.5		

AR: Aortic regurgitation, AV: atrioventricular, LV: Left ventricle, TAVR: Transcatheter aortic valve replacement,
**Sixteen patients were initially enrolled in the study. In one patient, the procedure was unsuccessful and the patient was referred for surgical treatment; therefore, analyses were conducted on 15 patients.*

Table 2. Baseline categorical variables and 10-year survival (Fisher's Exact Test)

Variable	Subgroup	Survival (n=6)		Non-survival (n=9)		p value
		Number	%	Number	%	
Gender	Male	3	50.00	4	44.44	1.000
	Woman	3	50.00	5	55.6	
Age	<80	2	33.33	5	55.56	0.608
	≥80	4	66.66	4	44.44	
Hypertension	No	3	50.00	1	11.11	0.
	Yes	3	50.00	8	88.89	
Diabetes Mellitus	No	3	50.00	5	55.56	1.000
	Yes	3	50.00	4	44.44	
Hyperlipidemia	No	3	50.00	7	77.78	0.329
	Yes	3	50.00	2	22.22	
Smoking	No	5	83.33	9	100.00	0.438
	Yes	1	16.66	0	.00	
Atrial Fibrillation	No	6	100.00	5	55.56	0.103 ⱡ
	Yes	0	.00	4	44.44	
STS score	<4	5	83.33	5	55.56	0.580
	≥4	1	16.66	4	44.44	
LV mass index (gr/m2)*	Normal-Mild	3	50.00	0	.00	0.044 ⱡ
	Moderate-Se-vere	3	50.00	9	100.00	
Type of LV hypertrophy**	CR	2	33.33	0	.00	0.066
	CH	4	66.66	7	77.78	
	DCH	0	.00	2	22.22	

Fisher's exact test results
ⱡ: Variables included in univariate analysis,
CH: Concentric hypertrophy, CR: Concentric remodelling, DCH: Dilated concentric hypertrophy, LV: Left ventricle, STS: Society of Thoracic Surgeons
**: Normal-Mild 43-108 g/m2, Moderate-Severe: >108 g/m2*
***(43)*

Table 3. Baseline continuous variables and 10-year survival (Mann–Whitney U Test)

Variable	Survival (n=6)		Non-survival (n=9)		p value
	Median (IQR 25-75)	Mean Rank	Median (IQR 25-75)	Mean Rank	
Age	83 (74 - 85)	8.33	75 (73 - 82)	7.78	0.272
Body mass index	26.1 (24.2 - 30.1)	9.58	25.7 (21.5 - 29.4)	6.94	0.864
Logistic Euro SCORE	15.3 (13.4 - 27.3)	7.67	17.5 (12.0 - 24.1)	8.22	0.864
STS score	2.97 (1.8 - 4.0)	5.33	3.9 (3.6 - 5.3)	9.78	0.066 ⱡ
LV end-systolic diameter	28.5 (26 - 37)	8.08	29.0 (27 - 36)	7.94	0.955
LV end-diastolic diameter	44.0 (42 - 45)	5.25	48.0 (47 - 54)	9.83	0.050 ⱡ
Relative wall thickness	0.55 (0.53 - 0.59)	8,25	0.54 (0.51 - 0.66)	7.83	0.864
LV ejection fraction	63.5 (45 - 66)	8.0	60.0 (51 - 67)	8.0	1.000
Left atrium diameter	40.0 (37 - 43)	6.42	44 (37 - 47)	9.06	0.272
E/e'	12.5 (11.3 - 14.3)	4.33	10.5 (10 - 24)	3.75	1.000
Pulmonary artery pressure	25 (25 - 28)	5.42	40 (30 - 45)	9.72	0.066 ⱡ
TAPSE	20 (16.5-21)	7.50	17 (16-19)	6.17	0.600
LV D-S diameter difference	14 (12-16)	4.67	17 (17-19)	10.22	0.018 ⱡ

Mann Whitney U test results
ⱡ: Variables included in univariate analysis
D-S: Diastolic-systolic LV: Left ventricle, TAPSE: Tricuspid annular plane systolic excursion, TR: Tricuspid regurgitation,

Table 4. Cox regression analysis (univariate and multivariate) of predictors of 10-year survival

	Unadjusted			Adjusted*		
Variable	HR	95% CI	p	HR	95% CI	p value
Atrial Fibrillation	2.150	0.57 - 8.15	0.260	-	-	-
LV mass index (categorical)	36.317	0.16 - 8.45	0.251	-	-	-
LV end-diastolic diameter	1.103	0.98 - 1.24	0.102	-	-	-
Type of LV hypertrophy	2.980	1.22 - 7.27	0.016	-	-	-
Pulmonary artery pressure	8.863	1.08 - 72.5	0.042	-	-	-
STS score	1.853	1.08 - 3.19	0.026	2.244	1.39 - 16.92	0.012
LV D-S diameter difference	1.184	1.02 - 1.38	0.023	1.223	1.06 - 1.68	0.032
LV mass index	1.029	1.001 - 1.058	0.047	1.033	0.99 - 1.13	0.091

Of the 15 patients, 9 (60%) were events (death) and 6 (40%) were censored (survival); there were no missing or excluded patients.
HR: Hazard Ratio, LV: Left ventricle, D-S: Diastolic-systolic STS: Society of Thoracic Surgeons, Chi Square = 11,210, p=0.011.

At 10th year, LV mass index, LV end-diastolic diameter and LV diastolic-systolic diameter difference were found to be lower in the survival group compared to the non-survival group (p=0.044, p=0.050, p=0.018) (Table 3). Eight variables with p<0.20 in Tables 2 and 3 were analyzed by univariate Cox regression, and 5 of them were planned to be included in the multivariate model (LV hypertrophy type, pulmonary artery pressure, STS score, LV mass index and LV diastole-systole diameter difference) (Table 4). While categorical LV mass index was associated with survival in baseline group comparison (p =0.044, Table 2), it did not remain significant in Cox regression (p = 0.251, Table 4). In contrast, when analyzed as a continuous variable, LV mass index was a significant predictor of survival (p = 0.047, Table 4). In univariate Cox regression, the type of LV hypertrophy was significantly associated with survival (p = 0.016, Table 4). However, this association did not persist in the multivariate analysis.

Patients considered to have concentric dilated LV hypertrophy, according to a new classification, died earlier, and the last patient alive at 12th year was in the concentric remodeling stage according to this classification (42,43). Although the effect on survival was found to be significant in the univariate analysis depending on the type of LV hypertrophy (p=0.066), it was excluded from the multivariate model because it was thought to distort the effect of the model due to the imbalance in the distribution of patients in the categories. (Table 4).

According to the results of multivariate Cox regression analysis including STS score, LV diastole-systole diameter difference and LV mass index variables, only STS score (p=0.012) and LV diastole-systole diameter difference (p=0.032) had a significant effect on survival. The model was significant overall (p=0.011) (Table 4).

DISCUSSION

In this study, we evaluated the 10-year survival results of a center with early TAVR experience in Turkey and examined the relationship between baseline patient characteristics and long-term survival. Although LV mass index, LV hypertrophy pattern, and pulmonary artery pressure showed associations with survival in univariate analyses, they did not remain significant in the multivariate model. This finding highlights that only STS score and LV diastolic-systolic diameter difference serve as independent predictors of long-term outcomes in our cohort. Although the type of LV hypertrophy showed a significant association with survival in the univariate analysis, it did not remain significant after multivariate adjustment. This suggests that its prognostic impact may be mediated through or confounded by other factors such as STS score or LV diameter difference.

Patient Recruitment

The patient group consisted of younger patients and patients with lower STS scores compared to studies in which high-risk patients were recruited in the same period (17-20). This result can be related to the early experience period when patient selection was more subjective, and the conservative approach of the center in patient selection. On the other and it allowed comparison of the study results with studies conducted with other risk groups.

Procedural outcomes

Procedural success was achieved in 87.5%, and complication rates remained within acceptable limits during the early experience period (21-23). Over time, with the learning curve now surpassed, procedural success rates have improved, and complication rates have declined, attributed to increased operator experience and advancements in TAVR technology (1,22,23).

Survival outcomes: In studies with intermediate and high-risk patient groups according to STS and age, 5-year survival was 30-60% and 10-year survival was 8-11% (19,24-31). In the recently published long-term results of the Italian registry study with CoreValve implantation and similar patient characteristics to this study, the 12-year survival rate was 4.5% and only 23.9% (21.0%-26.8%) of deaths were cardiovascular deaths (32). When compared with these results of experienced centers in TAVR, it is noteworthy that the long-term survival results of our center (5-year 53.3%; 10-year 40%; 12-year 6.7%) are better. This result may be due to the fact that the patient group we defined as high risk had a lower STS score. Because STS score also predicted 10-year survival in the results of this study. However, the fact that the results were better than the 10-year survival results reported for low-risk patient groups (18-35%) strongly suggests that this success is not only due to the risk levels of the patients (8,33). Accordingly, it can be concluded that the STS score has a predictive effect on long-term survival, but is not the only factor influencing survival, and that correct patient selection and a meticulously conducted TAVR process can compensate for the disadvantages associated with early experience. This result is encouraging for physicians and centers new to TAVR.

Survival-related findings

Whether the patient's survival expectancy is longer than the valve lifespan may change the priorities in the decision for TAVR. And the presence and extent of cardiac damage is critical for the timing of TAVR. In this respect, long-term results of TAVR are needed, especially in the current era of limited patient data over 10 years.

The STS score gives a 30-day mortality risk, and it has been shown that this score is associated with longer-term outcomes (1). However, since it is a score developed for surgery, it does not include some risks specific to TAVR, which is a shortcoming. In this study, the survival group had a lower STS score without statistical significance (Table 2). This may be due to the median differences between the groups not being strong enough. However, the significance in the univariate analysis for survival (p=0.026) indicates that it predicts survival, and this significance increases with other variables (p=0.012) (Table 4). These results support the use of the STS score to predict long-term survival after TAVR, but modification of the score to include TAVR-specific risks may make it more reliable for TAVR.

Systolic PAP is a parameter that has been shown to be associated with adverse outcomes and mortality after TAVR (34). The results of the study on the relationship between PAP and survival are not surprising in this respect.

LV mass index is a parameter obtained by dividing LV mass by body surface area and provides information about LV hypertrophy and can be evaluated by ECHO. It has been shown that LV mass index significantly decreased within 6-months after TAVR (35). In AS-related cardiac damage staging, a LV mass index above 95 g/m2 in women and 115 g/m2 in men was defined as stage-2 cardiac damage. And it has been shown that valve intervention before cardiac damage progresses is associated with favorable outcomes in 5-year follow-up (11). In this study, the significant effect of LV mass index on survival in univariate analysis (p=0.047) lost its significance in multivariate analysis (p=0.091) (Table 4). This apparent discrepancy arises from the analytic approach: although categorical LV mass index showed group-level differences, only its continuous form maintained significance in survival modeling. This suggests that subtle gradations in LV mass index, rather than dichotomized categories, may carry greater prognostic value.

The most surprising result in the study was the strong association of LV diastole-systole diameter difference with 10-year survival. Considering that an increase in LV mass index, which is an indicator of hypertrophy, may anatomically narrow the ventricular cavity, the long survival of patients with a small diastolic-systolic diameter difference seems to be a contradictory result. However, considering that there was no difference between the death and survival groups in terms of LV end-systolic diameter and relative wall thickness, it can be said that this difference is a geometric pattern in which the LV end-diastolic diameter is enlarged (Table 3). Different LV geometric patterns have been shown to be associated with unfavorable outcomes in hypertensive patients (36-38). Among the 4 different patterns, concentrically enlarged LV hypertrophy indicates a more severe cardiac stress and has been shown to be associated with higher CV mortality (35,37). It has also been suggested that this may be a factor that worsens the prognosis of patients by creating negative effects on the right ventricle (37). Since the effect of aortic stenosis on the ventricle is like that of hypertension, LV hypertrophy was evaluated according to this classification in the present study and survival outcomes were found to parallel the severity of these geometric patterns (Figure 3). Therefore, performing TAVR before or after a certain threshold of LV hypertrophy may be decisive for long-term outcomes. Closer follow-up of myocardial changes and LV geometry parameters with ECHO, cardiac magnetic resonance imaging and computed tomography, especially in patients with AS that has not progressed to the severe stage and in the follow-up of patients with severe AS who do not require intervention because they are asymptomatic, can be used to more precisely determine when the LV begins to decompensate and may optimize the timing of aortic valve replacement (39). These findings on the association of LV geometry and myocardial properties with long-term outcomes in TAVR may also provide a clue to the association of LV remodeling processes with mortality risk. If this is the case, it may raise the issue that the use of agents such as angiotensin converting enzyme inhibitors, which have proven favorable effects on remodeling, may improve survival after TAVR. It is clear that the association of different patterns of LV hypertrophy and LV systolic-diastolic dynamics with AS should be examined in larger patient groups in order to generalize the results.

Limitations

This study has several important limitations that must be considered when interpreting the findings. The small sample size, reflective of our center's early TAVR experience and restrictive patient selection criteria at the time, substantially limits statistical power and generalizability. The retrospective design introduces inherent risks of incomplete, inaccurate, or missing data, particularly for long-term follow-up and valve durability assessments, as some information was obtained through external medical records or patient contact.

The analyses were performed on patients treated exclusively with the first-generation CoreValve device, which may not reflect outcomes achievable with newer-generation valves that are now standard in clinical practice. In addition, the limited sample size constrains the reliability of multivariate analyses, and these results should be interpreted as exploratory and hypothesis-generating rather than confirmatory. Finally, the absence of systematic long-term echocardiographic follow-up restricts detailed evaluation of structural valve deterioration. Despite these limitations, this study offers one of the longest follow-ups of TAVR patients in our region and provides rare, real-world historical data that may serve as a reference point for future, large-scale prospective research.

CONCLUSION

In this study, both STS score and LV diastolic-systolic diameter difference were identified as independent predictors of 10-year survival, underscoring their prognostic value in long-term risk stratification. As one of the earliest TAVR experiences in Turkey with first-generation CoreValve, the findings should be interpreted with caution given the small sample size, retrospective design, and historical device use. Nonetheless, the unique 10-year follow-up provides valuable insight that may inform future prospective studies in contemporary TAVR practice.

Informed Consent

Due to the retrospective cohort design of the study, informed consent was not required.

Author Contributions

AH: Concept and design, Supervision, Data collection and processing, Analysis and/or interpretation, Literature review, Text, Critical review. MK: Concept and design, Supervision, Analysis and/or interpretation, Critical review. OG: Supervision, Analysis and/or interpretation, Critical review. HI: Critical review.

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Conflict of Interest

Dr. HI served as a proctor for CoreValve implantations during the early phase of the TAVI program at the study center. He has no financial interest in the current study. He was not involved in the study design, data analysis, or interpretation of results, but reviewed the manuscript critically to support its scientific accuracy based on procedural experience.

The authors declare that there is no financial or non-financial conflict of interest related to this study.

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Statements

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. Srinivasan A, Wong F, Wang B. Transcatheter aortic valve replacement: Past, present, and future. Clinical cardiology. Jan 2024;47(1):e24209. doi:10.1002/clc.24209
2. Ternacle J, Hecht S, Eltchaninoff H, et al. Durability of transcatheter aortic valve implantation. EuroIntervention : journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology. Jul 15 2024;20(14):e845-e864. doi:10.4244/eij-d-23-01050
3. Vahanian A, Beyersdorf F, Praz F, et al. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. European heart journal. Feb 12 2022;43(7):561-632. doi:10.1093/eurheartj/ehab395
4. Cesario V, Oliva O, De Biase C, et al. Who Lives Longer, the Valve or the Patient? The Dilemma of TAVI Durability and How to Optimize Patient Outcomes. Journal of clinical medicine. Oct 14 2024;13(20)doi:10.3390/jcm13206123
5. Généreux P, Iung B. TAVI in asymptomatic patients with severe aortic stenosis: pros and cons. EuroIntervention : journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology. Nov 18 2022;18(10):793-795. doi:10.4244/eij-e-22-00043
6. Leon MB, Smith CR, Mack MJ, et al. Transcatheter or Surgical Aortic-Valve Replacement in Intermediate-Risk Patients. The New England journal of medicine. Apr 28 2016;374(17):1609-20. doi:10.1056/NEJMoa1514616
7. Talanas G, Laconi A, Kereiakes DJ, et al. Long-Term Outcomes of Transcatheter vs Surgical Aortic Valve Replacement: Meta-analysis of Randomized Trials. Journal of the Society for Cardiovascular Angiography & Interventions. Jul 2024;3(7):102143. doi:10.1016/j.jscai.2024.102143
8. Thyregod HGH, Jørgensen TH, Ihlemann N, et al. Transcatheter or surgical aortic valve implantation: 10-year outcomes of the NOTION trial. European heart journal. Apr 1 2024;45(13):1116-1124. doi:10.1093/eurheartj/ehae043
9. Salaun E, Mahjoub H, Girerd N, et al. Rate, Timing, Correlates, and Outcomes of Hemodynamic Valve Deterioration After Bioprosthetic Surgical Aortic Valve Replacement. Circulation. Sep 4 2018;138(10):971-985. doi:10.1161/circulationaha.118.035150
10. Tastet L, Tribouilloy C, Maréchaux S, et al. Staging Cardiac Damage in Patients With Asymptomatic Aortic Valve Stenosis. Journal of the American College of Cardiology. Jul 30 2019;74(4):550-563. doi:10.1016/j.jacc.2019.04.065
11. Généreux P, Pibarot P, Redfors B, et al. Staging classification of aortic stenosis based on the extent of cardiac damage. European heart journal. Dec 1 2017;38(45):3351-3358. doi:10.1093/eurheartj/ehx381
12. Okuno T, Heg D, Lanz J, et al. Staging cardiac damage associated with aortic stenosis in patients undergoing transcatheter aortic valve implantation. International journal of cardiology Heart & vasculature. Apr 2021;33:100768. doi:10.1016/j.ijcha.2021.100768

13. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Journal of the American Society of Echocardiography : official publication of the American Society of Echocardiography. Jan 2015;28(1):1-39.e14. doi:10.1016/j.echo.2014.10.003
14. Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. Feb 2 2021;143(5):e35-e71. doi:10.1161/cir.0000000000000932
15. Ajmal Z, Rehman ZU, Ishtiaq A, et al. Comparative Outcomes of Transcatheter Versus Surgical Aortic Valve Replacement in Moderate-Risk Patients With Aortic Stenosis: A Systematic Review of Clinical Trials. Cureus. Sep 2024;16(9):e70268. doi:10.7759/cureus.70268
16. Hoşoğlu A. Merkezimizde transkateter aort kapak implantasyonu yapılan hastalarda erken ve geç dönem sonuçlar. 2016;
17. Leon MB, Smith CR, Mack M, et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. The New England journal of medicine. Oct 21 2010;363(17):1597-607. doi:10.1056/NEJMoa1008232
18. Buellesfeld L, Gerckens U, Schuler G, et al. 2-year follow-up of patients undergoing transcatheter aortic valve implantation using a self-expanding valve prosthesis. Journal of the American College of Cardiology. Apr 19 2011;57(16):1650-7. doi:10.1016/j.jacc.2010.11.044
19. Yakubov SJ, Adams DH, Watson DR, et al. 2-Year Outcomes After Iliofemoral Self-Expanding Transcatheter Aortic Valve Replacement in Patients With Severe Aortic Stenosis Deemed Extreme Risk for Surgery. Journal of the American College of Cardiology. Sep 22 2015;66(12):1327-34. doi:10.1016/j.jacc.2015.07.042
20. O'Hair D, Yakubov SJ, Grubb KJ, et al. Structural Valve Deterioration After Self-Expanding Transcatheter or Surgical Aortic Valve Implantation in Patients at Intermediate or High Risk. JAMA cardiology. Feb 1 2023;8(2):111-119. doi:10.1001/jamacardio.2022.4627
21. Yücel G, Paker T, Akçevin A, et al. [Transcatheter aortic valve implantation: the first applications and early results in Turkey]. Turk Kardiyoloji Dernegi arsivi : Turk Kardiyoloji Derneginin yayin organidir. Jun 2010;38(4):258-63. Transkateter aort kapak yerleştirme: Türkiye'deki ilk uygulamalar ve erken sonuçlar.
22. Magyari B, Kittka B, Goják I, et al. Learning Curve for Starting a Successful Single-Centre TAVR Programme with Multiple Devices: Early and Mid-Term Follow-Up. Journal of clinical medicine. Feb 14 2024;13(4)doi:10.3390/jcm13041088
23. Moat NE, Ludman P, de Belder MA, et al. Long-term outcomes after transcatheter aortic valve implantation in highrisk patients with severe aortic stenosis: the U.K. TAVI (United Kingdom Transcatheter Aortic Valve Implantation) Registry. Journal of the American College of Cardiology. Nov 8 2011;58(20):2130-8. doi:10.1016/j.jacc.2011.08.050
24. Şentürk B, Dursun H, Çöllüoğlu T, et al. Evaluation of structural valve deterioration and bioprosthetic valve failure utilizing the new European consensus definition in patients undergoing TAVI with first-generation devices: Outcomes beyond 5 years from a single center in Turkey. Anatolian journal of cardiology. Aug 2021;25(8):579-587. doi:10.5152/AnatolJCardiol.2021.37670
25. Elbasha K, Kaur J, Abdelghani M, et al. Ten-year Durability, Hemodynamic Performance, and Clinical Outcomes after Transcatheter Aortic Valve Implantation Using a Self-expanding Device. Cardiology and therapy. Sep 2024;13(3):529-540. doi:10.1007/s40119-024-00369-2
26. Mack MJ, Leon MB, Smith CR, et al. 5-year outcomes of transcatheter aortic valve replacement or surgical aortic valve replacement for high surgical risk patients with aortic stenosis (PARTNER 1): a randomised controlled trial. Lancet (London, England). Jun 20 2015;385(9986):2477-84. doi:10.1016/s0140-6736(15)60308-7
27. Leon MB, Piazza N, Nikolsky E, et al. Standardized endpoint definitions for transcatheter aortic valve implantation clinical trials: a consensus report from the Valve Academic Research Consortium. European heart journal. Jan 2011;32(2):205-17. doi:10.1093/eurheartj/ehq406
28. Testa L, Latib A, Brambilla N, et al. Long-term clinical outcome and performance of transcatheter aortic valve replacement with a self-expandable bioprosthesis. European heart journal. May 21 2020;41(20):1876-1886. doi:10.1093/eurheartj/ehz925
29. Sathananthan J, Lauck S, Polderman J, et al. Ten year follow-up of high-risk patients treated during the early experience with transcatheter aortic valve replacement. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions. Feb 15 2021;97(3):E431-e437. doi:10.1002/ccd.29124
30. Panico RA, Giannini C, De Carlo M, et al. Long-term results and durability of the CoreValve transcatheter aortic bioprosthesis: outcomes beyond five years. EuroIntervention : journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology. Mar 20 2019;14(16):1639-1647. doi:10.4244/eij-d-18-00779
31. Didier R, Eltchaninoff H, Donzeau-Gouge P, et al. Five-Year Clinical Outcome and Valve Durability After Transcatheter Aortic Valve Replacement in High-Risk Patients. Circulation. Dec 4 2018;138(23):2597-2607. doi:10.1161/circulationaha.118.036866
32. Testa L, Giannini C, Costa G, et al. Transcatheter aortic valve replacement with corevalve self-expanding bioprosthesis: Clinical and durability data up to 12 years. Cardiovascular revascularization medicine : including molecular interventions. Apr 2025;73:23-30. doi:10.1016/j.carrev.2024.07.013
33. Biancari F, D'Errigo P, Barbanti M, et al. Ten-year outcomes after transcatheter or surgical aortic valve replacement in low-risk patients: The OBSERVANT study. International journal of cardiology Heart & vasculature. Dec 2024;55:101545. doi:10.1016/j.ijcha.2024.101545

34. Khalil S, Tabowei G, Kaur M, et al. Effect of Pulmonary Hypertension on Survival Outcomes in Patients With Transcatheter Aortic Valve Replacement: A Systematic Review and Meta-Analysis. Cureus. Apr 2024;16(4):e58540. doi:10.7759/cureus.58540
35. Chau KH, Douglas PS, Pibarot P, et al. Regression of Left Ventricular Mass After Transcatheter Aortic Valve Replacement: The PARTNER Trials and Registries. Journal of the American College of Cardiology. May 19 2020;75(19):2446-2458. doi:10.1016/j.jacc.2020.03.042
36. Verdecchia P, Angeli F, Mazzotta G, et al. Impact of Chamber Dilatation on the Prognostic Value of Left Ventricular Geometry in Hypertension. Journal of the American Heart Association. May 24 2017;6(6)doi:10.1161/jaha.117.005948
37. Tadic M, Cuspidi C, Vukomanovic V, Kocijancic V, Celic V. The impact of different left ventricular geometric patterns on right ventricular deformation and function in hypertensive patients. Archives of cardiovascular diseases. May 2016;109(5):311-20. doi:10.1016/j.acvd.2015.12.006
38. Tadic M, Cuspidi C, Vukomanovic V, Kocijancic V, Celic V. Right ventricular remodeling and updated left ventricular geometry classification: is there any relationship? Blood pressure. Oct 2016;25(5):292-7. doi:10.3109/08037051.2016.1172868
39. Dweck MR, Loganath K, Bing R, et al. Multi-modality imaging in aortic stenosis: an EACVI clinical consensus document. European heart journal Cardiovascular Imaging. Oct 27 2023;24(11):1430-1443. doi:10.1093/ehjci/jead153