



SUTURELESS VERSUS CONVENTIONAL AORTIC VALVE REPLACEMENT: COMPARATIVE PATHWAYS IN BIOPROSTHETIC VALVE SURGERY

DİKİŞSİZ VE GELENEKSEL AORT KAPAK DEĞİŞİMİ: BİYOPROTEZ KAPAK CERRAHİSİNDE KARŞILAŞTIRMALI YÖNTEMLER

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ABSTRACT

Introduction: Sutureless bioprosthetic valves have emerged as an alternative to conventional sutured valves in surgical aortic valve replacement (SAVR), aiming to improve operative efficiency and postoperative outcomes, particularly in elderly or high-risk patients. However, concerns remain regarding conduction disturbances and rhythm complications. This study aimed to compare early and midterm outcomes of SAVR using sutureless versus conventional bioprosthetic valves.

Methods: This single-center, retrospective observational study included 175 patients who underwent isolated SAVR with either sutureless (n=72) or conventional sutured (n=103) bioprosthetic valves. Preoperative characteristics, intraoperative variables, and postoperative outcomes including cardiopulmonary bypass (CPB) time, aortic cross-clamp time, rhythm disturbances, pacemaker requirement, and mortality—were compared between groups.

Results: A total of 175 patients underwent bioprosthetic aortic valve replacement, with 72 receiving sutureless and 103 receiving conventional valves. Baseline characteristics were similar between groups, except for a higher proportion of NYHA class III in the sutureless group. Sutureless valve implantation was associated with significantly shorter cardiopulmonary bypass and cross-clamp times ($p<0.001$). However, postoperative atrial fibrillation and permanent pacemaker requirement were more frequent in the sutureless group ($p=0.009$ and $p=0.037$, respectively). Follow-up duration was longer in the sutureless group, while late mortality rates were comparable between groups.

Conclusion: Sutureless valve implantation significantly reduces operative times and may enhance surgical efficiency, particularly in elderly patients. However, it is associated with higher rates of permanent pacemaker implantation and postoperative atrial fibrillation.

Keywords: Heart Valve Prosthesis Implantation, Aortic Valve, Treatment Outcome

ÖZET

Giriş: Sütursüz biyoprotez kapaklar, cerrahi aort kapak replasmanında (CAVR) konvansiyonel suturelu kapaklara alternatif olarak geliştirilmiş ve özellikle yaşlı ya da yüksek riskli hastalarda operasyonel verimliliği ve postoperatif sonuçları iyileştirmeyi hedeflemiştir. Ancak ileti sistemi bozuklukları ve ritim komplikasyonlarına ilişkin endişeler devam etmektedir. Bu çalışmanın amacı, sütursüz ve konvansiyonel biyoprotez kapaklarla yapılan CAVR işlemlerinin erken ve orta dönem sonuçlarını karşılaştırmaktır.

Yöntemler: Bu tek merkezli, retrospektif gözlemsel çalışmada, izole CAVR uygulanan toplam 175 hasta değerlendirildi. Hastalar sütursüz (n=72) veya konvansiyonel suturelu (n=103) biyoprotez kapak implantasyonu yapılanlar olarak iki gruba ayrıldı. Preoperatif özellikler, intraoperatif değişkenler ve kardiyopulmoner bypass (KPB) süresi, aort kros-klamp süresi, ritim bozuklukları, kalp pili ihtiyacı ve mortalite gibi postoperatif sonuçlar gruplar arasında karşılaştırıldı.

Bulgular: Toplam 175 hastaya biyoprotez aort kapak replasmanı uygulandı; 72'si sütursüz, 103'ü ise konvansiyonel kapak aldı. Gruplar arasında başlangıç özellikleri benzer olup, yalnızca sütursüz grupta NYHA sınıf III oranı anlamlı olarak daha yüksekti. Sütursüz kapak implantasyonu, anlamlı derecede daha kısa KPB ve kros-klamp süreleriyle ilişkililiydi ($p<0.001$). Ancak sütursüz grupta postoperatif atriyal fibrilasyon ve kalıcı kalp pili gereksinimi daha sık görüldü ($p=0.009$ ve $p=0.037$). Takip süresi sütursüz grupta daha uzun olmasına rağmen, geç dönem mortalite oranları iki grup arasında benzerdi.

Sonuç: Sütursüz kapak implantasyonu operasyon süresini anlamlı şekilde azaltmakta ve özellikle yaşlı hastalarda cerrahi verimliliği artırabilmektedir. Ancak bu yöntem, postoperatif atriyal fibrilasyon ve kalıcı kalp pili gereksiniminde artış ile ilişkilidir.

Anahtar kelimeler: Kalp Kapak Protezi İmplantasyonu, Aort Kapak, Tedavi Sonucu

INTRODUCTION

Severe symptomatic aortic stenosis is a common valvular heart disease, particularly in the elderly population, and significantly reduces life expectancy if left untreated. Surgical aortic valve replacement (SAVR) is considered an evidence-based treatment option that reduces both mortality and morbidity in this patient group (1). In recent

years, parallel to advances in valve surgery techniques, sutureless valve systems have been introduced into clinical practice as an alternative to conventional sutured bioprosthetic valves.

"Sutureless valves aim to significantly reduce cardiopulmonary bypass (CPB) and aortic cross-clamp

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times by eliminating the need for classical suturing during implantation (2). Owing to this feature, they are thought to positively impact perioperative outcomes, especially in elderly patients, those at high surgical risk, or those with multiple comorbidities. Moreover, when used in conjunction with minimally invasive surgical techniques, sutureless valves may facilitate the procedure and accelerate postoperative recovery (3).

However, certain concerns remain regarding the long-term hemodynamic performance of sutureless valves, the incidence of postoperative conduction system disturbances, and the need for permanent pacemaker implantation. Although comparative data between sutureless valves and conventional sutured bioprostheses regarding surgical parameters and clinical outcomes are increasingly reported in the literature, the findings remain heterogeneous and long-term data are limited. In addition, studies on patient–prosthesis mismatch suggest that moderate mismatch can be tolerated without significantly affecting survival or left ventricular remodeling, further emphasizing the importance of valve hemodynamic performance in AVR patients (4).

The objective of this study is to perform a comparative evaluation of surgical aortic valve replacement (SAVR) using conventional sutured bioprosthetic valves versus sutureless bioprosthetic valves. Specifically, the study examines early surgical and clinical outcomes, including cardiopulmonary bypass time, aortic cross-clamp time, postoperative conduction disturbances, permanent pacemaker implantation rates, intensive care unit stay, and total hospital length of stay. Through this comparison, the study aims to elucidate the potential advantages of sutureless valve implantation in terms of operative efficiency and early postoperative outcomes.

METHODS

This was a single-center, retrospective observational study conducted at SBU Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital. All data were obtained from patient medical records and the institutional electronic hospital database. The study cohort included patients who underwent surgical aortic valve replacement (SAVR) using either conventional sutured bioprosthetic valves or sutureless valves. Patients who underwent additional cardiac procedures or received mechanical valve prostheses were excluded from the analysis. A total of 175 patients were included in the final evaluation. Preoperative characteristics, intraoperative variables, and postoperative outcomes were systematically reviewed and recorded. Of the 175 patients, 72 received sutureless valves and 103 received conventional valves. All patients in the sutureless group had calcific aortic stenosis (with concomitant valve regurgitation in some cases) and a small aortic root.

The study was approved by the institutional ethics committee (Project No: ZTE2025, SBU Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital Ethics Committee, Approval No: 2025.01-09, Date: January 14, 2025).

Two patient groups were compared in terms of early and mid-term outcomes. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range, and categorical variables as counts and percentages. Normality of distribution was assessed using the Shapiro–Wilk test. Comparisons between continuous variables were performed using the Student's t-test or

Mann–Whitney U test, as appropriate. Categorical variables were analyzed using the chi-square or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 175 patients were included in the study. The mean age was 71.4 ± 5.8 years, and 54.3% were male. The mean body surface area was 1.81 ± 0.18 m². According to the NYHA classification, the majority of patients were in class III. Comorbidities included diabetes mellitus in 38.3%, hypertension in 52%, and COPD in 29.7% of patients. The mean preoperative ejection fraction was $57.4 \pm 8.3\%$ (Table 1).

Table 1. Demographic Characteristics of All Patients

	Total Patient n:175 (%100)		
	Mean	SD	MIN - MAX
Age / year	71,4 $\pm$ 5,8		44 - 84
Male Gender n %	95 (%54,3)		
Body surface area /m ²	1,81 $\pm$ 0,18		1,32 - 2,41
NYHA 2 n %	47 (%26,9)		
NYHA 3 n %	106 (%60,6)		
NYHA 4 n %	22 (%12,6)		
DM n %	67 (%38,3)		
HT n %	91 (%52)		
COPD n %	52 (%29,7)		
Preoperative Atrial Fibrillation n %	13 (%7,4)		
Kreatin mg/dl	0,92 $\pm$ 0,31		0,4 - 3
CRP mg /dl	7 $\pm$ 15,7		0,3 - 130,9
Preoperative Ejection Fraction (%)	57,4 $\pm$ 8,3		25 - 70

Abb. NYHA: New York Heart Association, DM: Diabetes Mellitus, HT: Hypertension, COPD: Chronic Obstructive Pulmonary Disease, CRP: C-Reactive Protein

Perioperative and early clinical outcomes showed a mean cardiopulmonary bypass (CPB) time of 101.1 ± 49.8 minutes and a cross-clamp time of 67 ± 36.6 minutes. Postoperative atrial fibrillation occurred in 25.7% of patients, and the average length of hospital stay was 10.9 ± 12.8 days. Permanent pacemaker implantation was required in only 1.7% of cases, and 92% did not require any pacing support. Most patients had no paravalvular leak, and moderate-to-severe leaks were rare. The mean follow-up duration was 34.8 ± 28.7 months, with a late mortality rate of 16.6% (Table 2).

When comparing preoperative characteristics between the sutureless and conventional valve groups, there were no significant differences in age, sex, body surface area, comorbidities, or ejection fraction. However, the proportion of NYHA class III was significantly higher in the sutureless group, while NYHA class II was significantly lower ($p < 0.001$ and $p = 0.045$, respectively) (Table 3).

Perioperative and postoperative comparisons revealed significant surgical advantages in the sutureless group. CPB and cross-clamp times were significantly shorter by approximately 38 and 34 minutes, respectively ($p < 0.001$ for both). However, the incidence of postoperative atrial

Table 2. Perioperative and Early-to-Midterm Clinical Outcomes in All Patients

	Total Patient n:175 (%100)		
	Mean	SD	MIN - MAX
CPB time (min)	101,1 ± 49,8		31 - 350
Cross clamp time (min)	67 ± 36,6		19 - 261
Postoperative atrial fibrillation n %	45 (%25,7)		
Postoperative ejection fraction (%)	56,2 ± 8,1		25 - 65
Hospital length of stay (days)	10,9 ± 12,8		0 - 123
Postoperative stroke	6 (%3,4)		
Postoperative hemorrhage	1 (%0,6)		
No pacemaker required	161 (%92)		
Temporary pacemaker required	11 (%6,3)		
Permanent pacemaker required	3 (%1,7)		
Paravalvular leak – none	146 (%83,6)		
Paravalvular leak – mild	17 (%9,7)		
Paravalvular leak – mild-to-moderate	5 (%2,9)		
Paravalvular leak – moderate	5 (%2,9)		
Paravalvular leak – severe	2 (%1,1)		
Reoperation required	4 (%2,3)		
Due to endocarditis	3 (%1,7)		
Due to paravalvular leak	1 (%0,6)		
Rehospitalization	22 (%12,6)		
Due to elevated INR	16 (%9,1)		
Due to infection	2 (%1,1)		
Due to pericardial effusion	2 (%1,1)		
Due to atrial fibrillation	2 (%1,1)		
In-hospital mortality	8 (%4,6)		
Follow-up duration (months)	34,8 ± 28,7		Q1:12 - Q3:48
Late mortality	29 (%16,6)		
Due to stroke	9 (%5,1)		
Due to hemorrhage	1 (%0,6)		
Due to other causes	4 (%2,3)		
Due to acute coronary syndrome	1 (%0,6)		
Due to malignancy	4 (%2,3)		

Abb. CPB: CardioPulmonary Bypass

fibrillation was higher in the sutureless group ($p=0.009$). Permanent pacemaker implantation occurred only in the sutureless group and was statistically significant ($p=0.037$). Conversely, the need for temporary pacing was significantly higher in the conventional group ($p=0.028$). Although the mean follow-up duration was longer in the sutureless group, late mortality rates were comparable between the two groups (Table 4).

Table 3. Preoperative Demographic and Clinical Characteristics of Patients Undergoing Sutureless and Conventional Bioprosthetic Aortic Valve Replacement

	SUTURELESS n:72 (%41,1)	CONVENTIONAL n:103 (%58,9)	p
	Mean SD MED	Mean SD MED	
Age / year	71,3 ± 6,6 72	71,4 ± 5,2 71	0,926
Male Gender n %	36 (%50)	59 (%57,3)	0,341
Body surface area /m ²	1,81 ± 0,19 1,79	1,8 ± 0,16 1,79	0,719
NHYA 2 n %	9 (%12,5)	38 (%36,9)	<0,001*
NHYA 3 n %	50 (%69,4)	56 (%54,4)	0,045*
NHYA 4 n %	13 (%18,1)	9 (%8,7)	0,067
DM n %	27 (%37,5)	40 (%38,3)	0,858
HT n %	41 (%56,9)	50 (48,5)	0,274
COPD n %	27 (%37,5)	25 (%24,3)	0,06
Preoperative Atrial Fibrillation n %	4 (%5,6)	9 (%8,7)	0,43
Creatinine mg/dl	0,88 ± 0,23 0,82	0,95 ± 0,36 0,9	0,228
CRP mg /dl	5,81 ± 7,55 3,8	7,8 ± 19,5 3,08	0,075
Preoperative Ejection Fraction (%)	58,4 ± 8 60	56,7 ± 8,5 60	0,123

Abb. NYHA: New York Heart Association, DM: Diabetes Mellitus, HT: Hypertension, COPD: Chronic Obstructive Pulmonary Disease, CRP: C-Reactive Protein

DISCUSSION

In our study, patients who underwent surgical aortic valve replacement with sutureless bioprostheses demonstrated significant surgical advantages compared to those who received conventional sutured valves; however, certain considerations regarding rhythm-related complications, such as conduction disturbances and postoperative atrial fibrillation (AF), were identified.

In the sutureless valve group, mean cardiopulmonary bypass and aortic cross-clamp times were 78.7 and 46.7 minutes, respectively—significantly shorter than those in the conventional group, which were 116.7 and 81.2 minutes ($p<0.001$). This surgical time advantage aligns with previously reported reductions of 10–20 minutes in the literature and may positively influence perioperative outcomes, particularly in elderly, frail patients with multiple comorbidities (2,5). Shortened operative times may contribute to the reduction of adverse events such as low cardiac output, renal dysfunction, pulmonary complications, and prolonged intensive care requirements (6).

Alongside these advantages, we observed an increased risk of rhythm complications. The requirement for permanent pacemaker implantation was observed exclusively in the sutureless group, occurring at a rate of 4.2% ($p=0.037$). This finding may be attributed to mechanical pressure exerted on the atrioventricular conduction system by the radially expanding nitinol frame of the prosthesis, and similar rates have been reported in previous studies (7,8). Conversely, the need for temporary pacemaker implantation was significantly lower in the sutureless group (1.4%) compared to the conventional group (9.7%) ($p=0.028$). If we consider that every patient

Table 4. Comparison of Perioperative and Postoperative Clinical Outcomes Between Sutureless and Conventional Bioprosthetic Aortic Valve Replacement

	SUTURELESS n:72 (%41,1)			CONVENTIONAL n:103 (%58,9)			p
	Mean	SD	MED	Mean	SD	MED	
CPB time (min)	78,7 ± 36,5		71,5	116,7 ± 52		104	<0,001*
Cross clamp time (min)	46,7 ± 26,5		41,5	81,2 ± 36,1		73	<0,001*
Postoperative atrial fibrillation n %	26 (%36,1)			19 (%18,4)			0,009*
Postoperative ejection fraction (%)	56,7 ± 8,1		60	55,8 ± 8,2		60	0,236
Hospital length of stay (days)	10,7 ± 16,9		7	11 ± 8,9		8	0,036*
Postoperative stroke	1 (%1,4)			5 (%4,9)			0,215
Postoperative hemorrhage	-			1 (%1)			>0,99
No pacemaker required	68 (%94,4)			93 (%90,3)			0,319
Temporary pacemaker required	1 (%1,4)			10 (%9,7)			0,028*
Permanent pacemaker required	3 (%4,2)			-			0,037*
Paravalvular leak – none	57 (%79,2)			89 (%86,4)			0,205
Paravalvular leak – mild	9 (%12,5)			8 (%7,8)			0,298
Paravalvular leak – mild-to-moderate	2 (%2,8)			3 (%2,9)			>0,99
Paravalvular leak – moderate	3 (%4,2)			2 (%1,9)			0,403
Paravalvular leak – severe	1 (%1,4)			1 (%1)			>0,99
Reoperation required	2 (%2,8)			2 (%1,9)			>0,99
Due to endocarditis	1 (%1,4)			2 (%1,9)			>0,99
Due to paravalvular leak	1 (%1,4)			-			0,411
Rehospitalization	7 (%9,7)			15 (%14,6)			0,342
Due to elevated INR	6 (%8,3)			10 (%9,7)			0,756
Due to infection	-			2 (%1,9)			0,513
Due to pericardial effusion	1 (%1,4)			1 (%1)			>0,99
Due to atrial fibrillation	-			2 (%1,9)			0,513
In-hospital mortality	3 (%4,2)			5 (%4,9)			0,83
Follow-up duration (months)	39 ± 29,1		36	31,8 ± 30,1		19	0,01*
Late mortality	11 (%15,3)			18 (%17,5)			0,7
Due to stroke	5 (%6,9)			4 (%3,9)			0,367
Due to hemorrhage	1 (%1,4)						0,411
Due to other causes	1 (%1,4)			3 (%2,9)			0,644
Due to acute coronary syndrome	-			1 (%1)			>0,99
Due to malignancy	2 (%2,8)			2 (%1,9)			>0,99

Abb. CardioPulmonary Bypass

who received a permanent pacemaker had previously used a temporary pacemaker, this finding actually suggests that postoperative rhythm problems also occurred in the conventional group, but these were significantly reversible. Studies on sutureless valves have demonstrated that factors such as implantation technique, prosthesis sizing, and surgical experience directly influence the requirement for pacemaker implantation (5,6). Notably, the 4.2% permanent pacemaker rate observed in our series lies at the lower end of the reported 6–9% range, potentially reflecting optimization of surgical technique.

In our study, the incidence of postoperative atrial fibrillation was significantly higher in the sutureless group (36.1% vs. 18.4%; $p = 0.009$). This finding is consistent with the variability in AF incidence reported in the literature and may be associated with indirect effects of sutureless valve implantation on the right atrium or sinoatrial node region (9). Although operative times were shorter in the sutureless group, the higher incidence of AF is noteworthy. Literature indicates that postoperative AF is influenced by multiple factors including age, left atrial enlargement, and surgical trauma, and may lead to temporary morbidity (10).

Therefore, we recommend close rhythm monitoring in the postoperative period for patients receiving sutureless valves and prompt initiation of antiarrhythmic therapy or rhythm management strategies when necessary.

Additionally, our study found no significant differences between the two groups in terms of hospital readmission, the need for redo surgery, or early mortality rates. This suggests comparable short-term clinical efficacy and safety for both valve types. Previous reports have also shown no significant differences between sutureless and conventional bioprostheses with regard to early reintervention, hospital readmission, and mortality (11). The low and similar mortality rates in both groups may reflect careful patient selection and procedures performed by an experienced surgical team.

Comparable long-term clinical outcomes between sutureless and conventional valves support the safe use of this technology, particularly in elderly and high-risk patients. The absence of significant differences in key clinical outcomes such as hospital readmission, reoperation, and early mortality further suggests that both techniques represent safe and effective options in appropriately selected patients. Sutureless valves offer improved surgical efficiency by reducing procedural times and may provide an advantage in terms of transient conduction disturbances. However, due attention must be paid to patient selection and meticulous implantation technique, particularly due to the increased risk of permanent pacemaker requirement and postoperative AF.

This study is subject to limitations inherent to its retrospective, single-center design, including potential selection and data collection bias. The relatively small sample size also limits the statistical power to assess infrequent events. Further multicenter studies with larger patient populations are warranted.

CONCLUSION

Sutureless aortic valve replacement offers significant advantages in terms of operative time and recovery; however, it requires caution due to the increased risk of permanent pacemaker implantation and postoperative atrial fibrillation.

Ethics Committee Approval: The study was approved by the institutional ethics committee (Project No: ZTE2025, SBU Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital Ethics Committee, Approval No: 2025.01-09, Date: January 14, 2025).

Informed Consent: Patient consent is waived due to the study's retrospective design. However the study is conducted in accordance with the Declaration of Helsinki.

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