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Conduction system abnormalities after isolated surgical aortic valve replacement

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ABSTRACT

Objectives: This study aimed to examine the predictive value of preoperative electrocardiogram (ECG) findings for postoperative fascicular and atrioventricular (AV) conduction system defects in patients undergoing surgical aortic valve replacement for isolated aortic stenosis.

Patients and methods: The retrospective study included a total of 74 patients (45 males, 29 females; mean age: 62.9±13.7 years; range, 27 to 82 years) who underwent isolated surgical aortic valve replacement for aortic stenosis between September 2009 and September 2011. Electrocardiogram sheets taken at four time points (before the operation, first postoperative hour, 48th postoperative hour, and before discharge) were evaluated. The primary outcome was the development of AV block of the second or third degree or any type of fascicular conduction defect. The requirement for a temporary or permanent pacemaker during the postoperative stay was a secondary outcome.

Results: Before aortic valve replacement, the three most common ECG findings were left ventricle hypertrophy in 35 (47.3%) patients, T-wave inversion in 29 (39.2%), and left septal fascicular block in 18 (24.2%). None of the study parameters significantly predicted the need for temporary pacemaker requirement after surgery. Patients with preoperative left ventricle hypertrophy (odds ratio [OR]: 2.38, p=0.07), ST segment depression (OR: 3.04, p=0.9), left septal fascicular block (OR: 1.66, 0.34), and right bundle branch block (OR: 4.77, p=0.30) tended to develop postoperative AV block or fascicular block. Preoperative left bundle branch block was the only significant risk for developing advanced conduction disturbances after surgery (OR: 8.60, p=0.009).

Conclusion: The presence of monofascicular, bifascicular, or bundle branch block on the preoperative ECG may predict the likelihood of developing AV block or fascicular conduction system disorders after surgical aortic valve replacement, which should be confirmed in further studies employing continuous ECG monitoring in a larger patient population.

Keywords: Aortic valve replacement, conduction system disturbances, pacemaker, surgery.

Surgical aortic valve replacement is the gold standard of treatment for critical aortic stenosis. Surgical aortic valve replacement continues to be performed today with increasingly favorable outcomes owing to advances in myocardial preservation, surgical technique, and prosthesis quality over the last few decades.[1] Although sutureless aortic valve prosthesis[2] and transcatheter aortic valve replacement[3] have increased in popularity in recent years, the technical imperfections of these procedures are still associated with the risk of significant complications. Aortic valve surgery appears to be on the horizon for a long time in the surgically eligible patient population.

Postoperative conduction system disturbances are one of the most serious complications of aortic valve replacement, whether surgical or transcatheter. According to conventional belief, this involvement is caused by suture trauma to the atrioventricular (AV) conduction fibers near the aortic annulus or by involvement of this segment during the natural course of the disease.[4,5] However, given the anatomical structure of the conduction system, which extends from the atria to the ventricular free wall, defects in different segments of the conduction system cannot be explained solely by suture trauma.[6] Furthermore, in the group of patients who have not undergone cardiac surgery, hypoperfusion and ischemia of the involved system

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are largely responsible for the pathophysiology of acquired conduction system disorders.[7]

Moreover, due to the progressive hypertrophy of the myocardium caused by aortic stenosis, myocardial preservation during cardiac surgery is of particular importance.[8] Effective myocardial preservation during cross-clamping should not only aim to decrease epicardial cooling and ventricular oxygen consumption but also achieve effective septal and subendocardial perfusion. The fascicular conduction system distal to the AV node resides in the septum and subendocardium of the ventricle. Therefore, effective myocardial cooling and cardioplegic preservation appear to be as significant as avoiding surgical suture trauma to preserve the conduction system.[9]

This study aimed to identify potential risk factors for postoperative conduction system disorders in aortic stenosis patients undergoing isolated SAVR. In addition, the association between postoperative conduction system disturbances and the need for a pacemaker and the structural and conduction system findings on the preoperative resting electrocardiogram (ECG) was investigated. As potential risk factors for disturbances in the conduction system, the study also included preoperative demographic characteristics, echocardiographic findings, and data collected during the operation of the patients.

PATIENTS AND METHODS

This retrospective study was conducted at the Kartal Koşuyolu Training and Research Hospital between September 2009 and September 2011. Patients aged 25 to 85 who had their first isolated aortic valve replacement for severe aortic stenosis were included in the study. Using archive records and the hospital's electronic database, patient information was accessed, and the data obtained from the information were retrospectively analyzed. Patients who had undergone aortic valve replacement for isolated aortic regurgitation or in combination with coronary artery bypass grafting, other valve surgery, or adult congenital heart surgery were excluded from the study. Patients with more severe aortic, mitral, or tricuspid regurgitation, a history of myocardial infarction, severe left ventricular dysfunction, neurological sequelae, uncontrolled diabetes, hypertension, advanced chronic obstructive pulmonary disease, obesity, permanent pacemaker, and end-stage chronic renal failure were also excluded from the study. Thus, 74 (45 males, 29 females; mean age: 62.9±13.7 years; range, 27 to 82 years) out of 80 patients who underwent isolated aortic valve replacement at our hospital during the specified time period were included. The primary outcome was the development of AV block of the second or third degree or any type of fascicular conduction defect. The requirement for a temporary or permanent pacemaker during the postoperative stay was a secondary outcome.

Archival records were searched for demographic parameters, clinical data, preoperative echocardiographic findings, operative details, intensive care data, and ECG sheets. Electrocardiograms were evaluated at four different time points: *(i)* ECGs taken in the last three days prior to surgery; *(ii)* ECGs taken within 1 h of surgery; *(iii)* ECGs taken 24 h after surgery; *(iv)* ECGs taken prior to discharge from the hospital. The current American Heart Association (AHA)/American College of Cardiology Foundation (ACCF)/Heart Rhythm Society (HRS) Recommendations for the Standardization and Interpretation of the Electrocardiogram Part III: Intraventricular Conduction Disturbances guideline was used for the analysis of ECGs.[10]

Beta-receptor antagonists were stopped in patients with preoperative ECGs showing left bundle branch block but continued in patients with normal preoperative ECGs or fascicular block until 24 h before surgery. Beta-receptor antagonists were started in all patients on the first to second postoperative day unless there was bradycardia or any conduction disturbance.

Surgical and anesthetic considerations

Patients were administered 5 mg of oral diazepam the night before surgery. In the operating room, the patients were monitored with an electrocardiogram and pulse oximetry, and peripheral venous and radial artery catheters were inserted. Anesthesia was induced using 30 to 50 g/kg of fentanyl. As a muscle relaxant, 0.1 mg/kg of pancuronium was used. When necessary, 3 g/kg/min fentanyl infusion and isoflurane inhalation were administered during maintenance. Patients who were intubated were ventilated with 100% oxygen. A pulmonary artery catheter was then inserted through the internal jugular vein. A midline sternotomy was performed. The pericardium was subsequently divided in the shape of an inverted Y and suspended. Before cannulation, 300 to 400 U/kg of heparin was administered, and the activated clotting time was maintained at above 450 sec. The cardiopulmonary bypass (CPB) was initiated. According to the surgeon's preference, retrograde blood cardioplegia was administered from the wall of the right atrium into the coronary sinus. Following the initiation of CPB, the systemic body temperature dropped to 28 to 32°C. After aortic cross-clamping, an initial dose of 10 mL/kg isothermal blood cardioplegia was administered from the aortic root. During CPB, nonpulsatile perfusion was achieved with a hematocrit of 23 to 28%, a pump speed of 2.0 to 2.5 L/min/m, and an arterial mean pressure of 50 to 80 mmHg. Depending on the surgeon's preference, myocardial protection was maintained by administering antegrade or continuous retrograde blood cardioplegia every 15 to 20 min.

An oblique aortotomy was performed, directed towards the noncoronary sinus, to perform a root enlargement procedure on patients with a narrow aortic root. After the aortic valve was exposed, suspenders were placed on all three commissures, and the valve was raised upwards. First, the right aortic leaflets were resected, then the left leaflet was resected. Finally, the noncoronary leaflets were resected. Calcific debris was removed down to the annulus ring. After irrigating and aspirating the interior of the ventricle, valve measurements were taken. In cases where patient prosthesis mismatch was anticipated, the aortotomy incision was extended to the noncoronary sinus annulus, and the root expansion procedure was carried out. According to the preference of the surgeon, 2.0 Ti-Cron™ sutures (Covidien, Mansfield, MA, USA) were prepared with or without a pledget. Depending on the surgeon's preference, the pledgets were placed above or below the annulus when placing the sutures in the annulus. The valve was inserted into the annulus, and the sutures were tied. The incision for the aortotomy was closed. The cross clamp was removed. In the case that pacemaker support was required, inotropic support and epicardial pacing wires were provided. When the patient's temperature returned to normal, the CPB was discontinued by decreasing the flow. Heparin was neutralized by protamine sulfate in a 1:1 ratio. Following the removal of the arterial and venous cannulas and the control of bleeding, a 36-Fr drain was placed in the mediastinum. In all patients, the sternum was closed by inserting a temporary epicardial pacing wire.

Statistical analysis

Data were analyzed using IBM SPSS version 15.0 software (SPSS Inc., Chicago, IL, USA). Categorical variables were expressed as numbers and percentages, while continuous variables were expressed as mean±standard deviation (SD). To compare categorical data, the chi-square test and Fisher exact chi-square test were used, and the odds ratio was calculated for risk calculations. The statistical significance level was determined to be $p<0.05$.

RESULTS

Table 1 shows the baseline characteristics of the patients, while Table 2 demonstrates the preoperative echocardiography parameters. Nineteen (25%) patients were receiving beta-receptor antagonists prior to surgery. None of these patients had a bundle branch block on their preoperative ECG, but six patients had a left septal fascicular block, and four patients had a left anterior fascicular block. There were no in-hospital deaths. The mean duration of aortic cross-clamping was 73.38±21.76 min, the mean duration of CPB was 99.52±23.90 min, the mean time to extubating was 16.05±41.85 h, and the

Table 1
Baseline characteristics

Variables	n	%	Mean±SD
Age (year)			62.9±13.7
Sex			
Male	45	60.8	
Body mass index (kg/m²)			27.8±4.8
Concomitant diseases			
COPD	15	20	
Carotid artery disease	3	4	
Cerebrovascular disease	4	5	
Coronary artery disease	4	5	
Diabetes mellitus	15	20	
Peripheral artery disease	1	1	
Hypertension	30	40	
Dyslipidemia	4	5	
Tobacco use	16	20	
Preoperative medications			
ACE inhibitor	18	20	
ARB	10	13	
Statins	14	18	
Beta receptor antagonists	19	25	
Bronchodilators	14	18	

SD: Standard deviation; ACE: Angiotensin converting enzyme; ARB: Angiotensin receptor blockers; COPD: Chronic obstructive pulmonary disease.

Table 2 Preoperative echocardiography	
Variables	Mean±SD
Maximum aortic transvalvular gradient (mmHg)	90.66±27.56
Mean aortic transvalvular gradient (mmHg)	60.13±18.79
Velocity (m/s)	4.25±1.22
Interventricular septum (cm)	1.42±0.27
Posterior wall thickness (cm)	1.35±0.22
Ejection fraction (%)	61.95±5.54
Left ventricle end-diastolic diameter (cm)	4.96±0.64
Left ventricle end-systolic diameter (cm)	3.28±0.76

SD: Standard deviation.

mean postoperative bleeding was 419.59±287.26 mL. Eight (1.8%) patients underwent early surgical revision due to bleeding or tamponade.

Table 3 shows the preoperative and postoperative ECG findings at three different time points. Before aortic valve replacement, the three most common ECG findings were left ventricle hypertrophy in 35 (47.3%) patients, T-wave inversion in 29 (39.2%), and left septal fascicular block in 18 (24.2%).

In the first postoperative hour, left ventricle hypertrophy findings remained unchanged in 35 (47.3%) patients, inverted T waves were observed in 27 (36.5%) patients, left septal fascicular block developed in six patients, and left septal fascicular block was present in a total of 24 (32.4%) patients. While left bundle branch block was not present preoperatively, it developed in 19 patients during the first postoperative hour and was observed in 24 (32.4%) patients. While right bundle branch block was not present preoperatively, it developed in five patients during the first hour of recovery and was observed in nine (12.2%) patients.

Table 3
Pre- and postoperative ECG findings

	Preoperative		1st hour		24th hour		Discharge	
Postoperative ECG finding	n	%	n	%	n	%	n	%
Left ventricle hypertrophy	35	47.3	35	47.3	35	47.3	35	47.3
Inverted T waves	29	39.2	27	36.5	29	39.2	26	35.1
Left septal fascicular block	18	24.3	24	32.4	13	17.6	10	13.5
Right ventricle hypertrophy	14	18.9	14	18.9	14	18.9	14	18.9
Left anterior fascicular block	7	9.5	6	8.1	4	5.4	4	5.4
Left bundle branch block	5	6.8	24	32.4	8	10.8	9	12.2
Right bundle branch block	4	5.4	9	12.2	10	13.5	11	14.9
Left posterior fascicular block	3	4.1	4	5.4	2	2.7	1	1.4
Incomplete left bundle branch block	3	4.1	2	2.7	4	5.4	3	4.1
Atrial fibrillation	2	2.7	2	2.7	2	2.7	2	2.7
Incomplete right bundle branch block	-	-	1	1.4	-	-	1	1.4
Atrial flutter	-	-	3	4.1	1	1.4	-	-
Sinus tachycardia	-	-	8	10.8	3	4.1	-	-
Junctional tachycardia	-	-	1	1.4	-	-	-	-
1st degree AV block	-	-	3	4.1	1	1.4	-	-
2nd degree Mobitz type 2 AV block	-	-	4	5.4	2	2.7	-	-
3rd degree AV block	-	-	2	2.7	3	4.1	3	4.1
Atrial escape r27 rhythm	-	-	1	1.4	-	2.7	-	-
Accelerated atrial rhythm	-	-	-	-	1	4.1	-	-
Accelerated junctional rhythm	-	-	-	-	4	5.4	-	-
Bifascicular block	-	-	8	10.8	3	4.1	-	-

ECG: Electrocardiogram; AV: Atrioventricular.

At the 24th postoperative hour, left ventricle hypertrophy persisted in 35 (47.3%) patients, and inverted T waves persisted in 29 (39.2%) patients, while left septal fascicular block findings disappeared in 11 patients and were observed in 13 (17.6%) patients. Left bundle branch block resolved in 16 patients and persisted in eight (10.8%). While rates of left ventricle hypertrophy and inverted T waves persisted in discharge ECGs, septal fascicular block disappeared in eight patients who had it prior to surgery and regressed to a total of 10 (13.5%) patients. Left bundle branch block persisted in nine (12.2%) patients at discharge. In addition, other ECG abnormalities developed in a small number of patients and gradually returned to normal. Nine (12.1%) patients underwent root enlargement procedure, six of these had septal fascicular block, and two had left bundle branch block in the postoperative period.

Ten (13.5%) patients required a temporary pacemaker after surgery. Pacemaker indications included slow atrial fibrillation in two, sinus bradycardia and first degree AV block in one, Mobitz

Table 4
Comparison of study parameters between patients receiving and not receiving temporary pacemaker support after isolated aortic valve replacement

	TPM (+) (n=10)		TPM (-) (n=64)				
	n	%	n	%	OR	95% CI	*p*
Age (>60 year)	6	60.0	47	73.4	0.543	0.136-2.160	0.381
Sex							
Male	8	80.0	37	57.8	2.91	0.574-14.853	0.181
BMI (<29 kg/m²)	4	40.0	23	35.9	1.188	0.304-4.650	0.804
IVS (>1.3)	8	80.0	37	57.8	2.91	0.574-14.853	0.181
Mean gradient (>60 mmHg)	5	50.0	29	45.3	1.207	0.318-4.580	0.782
HCT decline (>10%)	4	40.0	32	50.0	0.667	0.172-2.589	0.556
Duration of aortic clamping (>90 min)	0	0.0	14	21.9	0.397	0.046-3.404	0.100
Duration of CPB (>100 min)	3	30.0	28	43.8	0.551	0.131-2.325	0.412
Hypothermia (<31°C)	2	20.0	21	32.8	0.512	0.100-2.626	0.416

TPM: Temporary pacemaker; OR: Odds ratio; CI: Confidence interval; BMI: Body mass index; IVS: Interventricular septum; HCT: Hematocrit; CPB: Cardiopulmonary bypass.

Table 5
A comparison of the frequency of preoperative ECG abnormalities in patients who had or did not have postoperative atrioventricular block or fascicular block

	Postoperative AVB or FB						
	Present (n=30)		Absent (n=44)				
Preoperative ECG finding	n	%	n	%	OR	95% CI	*p*
Left ventricular hypertrophy	18	60.0	17	38.6	2.38	0.92-6.15	0.071
Right ventricular hypertrophy	6	20.0	8	18.2	1.125	0.34-3.65	0.845
ST segment depression	7	23.3	4	9.1	3.04	0.80-11.52	0.091
Left anterior fascicular block	4	13.3	3	6.8	2.10	0.43-10.16	0.431
Left posterior fascicular block	2	6.7	1	2.3	3.07	0.26-35.49	0.562
Left septal fascicular block	9	30.0	9	20.5	1.667	0.57-4.86	0.347
Left bundle branch block	5	16.7	0	0	8.60	0.95-77.84	0.009*
Right bundle branch block	3	10.0	1	2.3	4.77	0.47-48.31	0.30

ECG: Echocardiogram; AVB: Atrioventricular block; FB: Fascicular block; OR: Odds ratio; CI: Confidence interval.

type 2 AV block in four, and idioventricular rhythm in three. Three (4.1%) patients who developed third degree AV block required permanent pacemaker implantation before discharge. Table 4 shows the univariate analysis to identify potential predictors of the postoperative need for a temporary pacemaker. Although there was a tendency for the male sex, interventricular septum >1.2, shorter aortic clamping, and CPB times in patients requiring temporary pacemaker, none of these variables were statistically significant, according to univariate analysis. As a result, no multivariate regression model was created.

Within the first 48 h after surgery, 30 (40.5%) patients experienced fascicular block or AV block. Although patients with preoperative left ventricle hypertrophy, ST segment depression, left septal fascicular block, left bundle branch block, and right bundle branch block were more likely to develop postoperative AV block or fascicular block, only the risk of having left bundle branch block was statistically significant.

DISCUSSION

The main finding of our study is that preoperative ECG findings are related to the risk of postoperative AV block or fascicular block in patients undergoing isolated aortic valve replacement for isolated aortic stenosis. In our study, the risk of postoperative AV block or fascicular block appeared to be two to four times higher in patients with preoperative ECG findings of left ventricular hypertrophy, left anterior fascicular block, left posterior fascicular block, left septal fascicular block, or right bundle branch block, but this result was not statistically significant. However, this risk was statistically significantly 8.60 times higher in patients with preoperative left bundle branch block, indicating that the slowdown in the conduction system in patients with preoperative left bundle branch block progressed to a more advanced block after surgery or that the symptoms of left bundle branch block persisted. Furthermore, patients who required a temporary pacemaker after surgery tended to be male and to have an enlarged interventricular septum, although these associations were not statistically significant. Age, obesity, advanced disease, and other previously suggested operative parameters were not significantly associated with an increased risk of requiring a temporary pacemaker following surgery.

Numerous studies have attempted to reveal the relationship between aortic stenosis, aortic valve replacement, and conduction system disorders. In an early report, Follath and Ginks[11] demonstrated that intraventricular conduction system defects are common (26%) following aortic valve surgery. Due to the close proximity between the aortic valve and the conduction system, it is believed that direct trauma caused during surgery is the cause of the problem. This trauma may be caused by suture damage, calcific material compression, or compression of the conduction tissue by the valve stent.[12] In fact, it has been demonstrated that continuous suturing increases the incidence of postoperative AV conduction system disorders compared to intermittent suturing.[13] Conduction defects may also be associated with total bypass time, cross-clamp time, and cardioplegia administration route.[14-16] These findings indicate that ischemic damage to the conduction system is predominant. These factors were not found to be associated with the outcome in our study. This outcome is due to advancements in surgical technique as well as myocardial preservation.

The most common finding in our study group's preoperative ECGs was that the criteria for left ventricular hypertrophy (Sokolow-Lyon criteria) were met in nearly one out of every two patients (47%). A drug study demonstrated the significance of these criteria in patients with aortic stenosis, and the left ventricular hypertrophy criteria in patients with aortic stenosis were shown to be associated with poor prognosis in asymptomatic patients.[8] In our study, 60% of patients with AV block or fascicular block in the postoperative period had preoperative left ventricular hypertrophy, and while this finding did not reach statistical significance, it increased the risk of AV block by 2.38 times (p=0.071).

In patients with aortic valve disease, histological abnormalities of the conduction system are common, and various hypotheses have been advanced as to their causes, including mechanical (increased left ventricular pressure) and ischemic factors and age-related or primary degenerative disease of the conduction system.[17] Fascicular block, on the other hand, refers to partial blocks that occur in the intraventricular conduction system, which is distal to the AV node of the conduction system and is considered to be divided into two distinct branches: left bundle branch block and right bundle branch block. The diagnostic criteria for this system's blockages were documented in 1985, revised in 2009, and given their current form. In the years that followed, numerous studies on the clinical significance of conduction disorders in the fascicular conduction system were conducted.[10] Coronary artery disease is almost always associated with intraventricular conduction system disorders, according to these studies. Patients with myocardial asynchrony are more likely to develop left bundle branch block and left posterior fascicular block after myocardial infarction, as reported by Janion et al.[18] In a meta-analysis investigating the incidence and prognostic significance of postoperative conduction system disorders in patients undergoing coronary artery bypass grafting, Kumbhani et al.[19] reported that the incidence ranged from 3.4 to 55.8%, and contrary to the findings of previous studies, the association between these conduction disorders and a poor prognosis was unclear. Researchers attributed this result to technical advancements in cardiac surgery and the optimization of techniques for myocardial preservation.

In our study, it is believed that the left anterior fascicular block was observed with at the same frequency before and after the operation for two reasons. The main component of the fascicular conduction system is the left anterior fascicle, and its blockage results in permanent change. The second reason is that the perfusion of the left anterior fascicle is provided by the proximal septal marginal branches of the left anterior descending artery; therefore, it is not uncommon for a well-preserved heart free of coronary artery disease to be discovered as a new finding following surgery. The left posterior fascicle runs along the posterior surface of the septum and, unlike the left anterior fascicle, branches into the myocardium in a weaker and more extensive manner. Since it is supplied by both the right and left sides of the coronary circulation, it is resistant to ischemia. Consequently, it is the most uncommon type of fascicular block.[20] Our study confirmed that left and right bundle branch blocks are not uncommon in these patients during the preoperative period and that they occur in a certain percentage of patients following surgery.

In our study group, left septal fascicular block was the third most common preoperative finding (24% of patients). Due to the thickening of the interventricular septum in nearly all of the preoperative patients in our study group and the absence of initial Q waves indicating septal depolarization, which is an essential criterion for septal fascicular block,[21] we deemed it appropriate to include this finding as a risk factor in this patient group. Left septal fascicular block may be associated with a low risk for the development of AV block or fascicular block in the postoperative period (OR 1.667 [0.571-4.862]), but this risk is not statistically significant. However, left septal fascicular block was by far the most prevalent ECG finding in the first 48 h following surgery (32.4% of patients).

There are few studies linking intraventricular conduction system disorders to aortic valve disease and surgery. Similar to our study, El-Khally et al.[22] found that a newly developed left bundle branch block and left anterior fascicular block following surgery increased the risk of adverse events by eightfold. Left bundle branch block increased the risk of adverse events by the same rate in both our study and this study involving patients with isolated SAVR (8.0- *vs.* 8.6-fold). In our study, aortic regurgitation patients were excluded, a more isolated group was created, and intraventricular conduction system disorders were examined in greater diagnostic and time-based detail by dividing them into four distinct time points. In numerous studies, the only conduction system disorders recorded were left bundle branch block, left anterior hemiblock, and right bundle branch block. Left septal fascicular block was not included in these studies since globally accepted criteria have not been established or perhaps because large clinical studies or meta-analyses have not yet demonstrated the prognostic significance of this finding.[10]

Dawkins et al.[23] reported that 8.5% of 354 patients who underwent isolated SAVR required a permanent pacemaker. In their report, they provided a summary of the studies published in prior years, as well as the incidence of pacemaker need reported in these studies. Erdoğan et al.[24] investigated patients who required a permanent pacemaker and their risk factors within the next decade. Half of the patients in their study (21 of 49) with permanent pacemakers had undergone aortic valve replacement. The incidence of AV block was low in our study. In patients with AV block of the first and second degrees, the decreasing frequency of occurrence at subsequent time points indicates that these disorders are transient. Three (4.7%) patients developed AV block of the third degree postoperatively; these patients required permanent pacemaker implantation. The patient with Mobitz type 2 AV block was monitored with a temporary pacemaker until the day of discharge with normal ventricular rhythm and returned to normal sinus rhythm prior to discharge. Consequently, 4.1% of patients in this study required a permanent pacemaker during the early period.

This study has some limitations. The was retrospective in design, its patient population was small, and it was conducted over a two-year period. The absence of a control group also contributed to the lack of statistical significance in our study results. We believe that a prospective study employing continuous ECG monitoring in a larger patient group may yield more meaningful results to elucidate the significance of fascicular conduction system disorders in this patient population.

In conclusion, the presence of monofascicular, bifascicular, or bundle branch blocks on the preoperative ECG may predict the likelihood of developing AV block or fascicular conduction system disorders after SAVR. Predictive value of preoperative structural ECG abnormalities of the intraventricular conduction system should be elucidated in a prospective study employing continuous ECG monitoring in a larger patient population, as suggested by our findings.

Ethics Committee Approval: This thesis study was performed with the permission and approval of the Medical Directory Department of Kartal Kosuyolu Training and Research Hospital. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Concept, design, data collection and interpretation, literature review and writing the article: E.A.; Concept, critical review of the article: H.S.

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