

Rhythm disorders after isolated mitral valve surgery: Consideration of the variations of the sinoatrial nodal artery in choice of atriotomy

*İzole mitral kapak cerrahisi sonrası ritim bozuklukları:
Atriyotomi seçiminde sinoatriyal nodal arter varyasyonlarının değerlendirilmesi*

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ABSTRACT

Background: This study aims to investigate the effect of atriotomy approaches applied in mitral valve surgery and variations of the sinoatrial nodal artery on postoperative arrhythmias and the need for a temporary or permanent pacemaker.

Methods: Data of 241 patients (108 males, 133 females, mean age: 53.7±12.3 years; range, 18 to 82 years) who underwent isolated mitral valve surgery with a median sternotomy between January 2009 and December 2019 were retrospectively analyzed. The patients were divided into three groups according to the surgical approach for mitral valve exploration as left atriotomy (n=47), transseptal (n=131), and superior transseptal (n=63). By scanning the hospital records, the origin of the sinoatrial nodal artery was determined in the coronary angiography images obtained before surgery. Postoperative rhythm changes were analyzed based on electrocardiography and telemetry recordings.

Results: Temporary pacing was required in 31 (49.2%) patients in the superior transseptal group, 40 (30.5%) patients in the transseptal group, and 12 (25.5%) patients in the left atriotomy group, indicating a statistically significantly higher rate in the superior transseptal group (p=0.013). Permanent pacemaker implantation was required in only one patient (superior transseptal), indicating no significant difference among the groups. The first-degree atrioventricular block was seen in 28 (44.4%) patients in the superior transseptal group, 42 (32.1%) patients in the transseptal group, and 13 (27.7%) patients in the left atriotomy group (p=0.130). The PR interval in the postoperative period was longer in the superior transseptal group than in the left atriotomy group in patients with the sinoatrial nodal artery originating from the right coronary artery (p=0.049). No significant difference was observed among the surgical approaches regarding the PR interval in patients with the sinoatrial nodal artery originating from the left circumflex coronary artery after surgery.

Conclusion: We believe that the choice of atriotomy in isolated mitral valve surgery and sinoatrial nodal artery variations do not affect permanent arrhythmia alone. Still, the superior transseptal approach causes the electrical conduction to slow down temporarily more than the left atriotomy and transseptal method.

Keywords: Atriotomy, mitral valve surgery, pacemaker, sinoatrial nodal artery.

ÖZ

Amaç: Bu çalışmada mitral kapak cerrahisinde uygulanan atriyotomi yaklaşımlarının ve sinoatriyal nodal arter varyasyonlarının ameliyat sonrası aritmiyle ve geçici veya kalıcı kalp pili ihtiyacına etkisi araştırıldı.

Çalışma planı: Ocak 2009 ile Aralık 2019 tarihleri arasında medyan sternotomi ile izole mitral kapak cerrahisi uygulanan 241 hastanın (108 erkek, 133 kadın, ort. yaş: 53.7±12.3 yıl; dağılım, 18-82 yıl) verileri geriye dönük olarak incelendi. Hastalar mitral kapak eksplorasyonu için tercih edilen cerrahi yaklaşıma göre sol atriyotomi (n=47), transseptal (n=131) ve superior transseptal (n=63) olarak üç gruba ayrıldı. Hastane kayıtları taranarak hastaların ameliyat öncesinde çekilen koroner anjiyografi görüntülerinde sinoatriyal nod arterinin kaynağı belirlendi. Ameliyat sonrası dönemdeki kalp ritmi değişiklikleri elektrokardiyografi ve telemetri kayıtlarından incelendi.

Bulgular: Superior transseptal grubunda 31 (%49.2), transseptal grubunda 40 (%30.5) ve sol atriyotomi grubunda 12 (%25.5) hastada geçici pil gerekli olup, superior transseptal grubunda istatistiksel olarak anlamlı düzeyde daha fazla idi (p=0.013). Kalıcı kalp pili implantasyonu hastaların yalnızca birinde (superior transseptal) gerekli olup, gruplar arasında istatistiksel olarak anlamlı bir fark yoktu. Birinci derece atrioventriküler blok superior transseptal grubunda 28 (%44.4), transseptal grubunda 42 (%32.1) ve sol atriyotomi grubunda 13 (%27.7) hastada görüldü (p=0.130). Alt grup analizinde, sinoatriyal nod arteri sağ koroner arterden köken alan hastalarda, ameliyat sonrası dönemde, superior transseptal grubunda PR intervalinin sol atriyotomi grubuna kıyasla daha fazla uzadığı görüldü (p=0.049). Sinoatriyal nod arteri sol sirkumfleks koroner arterden köken alan hastalarda ameliyat sonrası dönemde cerrahi yaklaşımlar arasında PR intervali açısından fark gözlenmedi.

Sonuç: İzole mitral kapak cerrahisinde atriyotomi seçimi ile sinoatriyal nod arteri varyasyonları ilişkisinin tek başına kalıcı ritim bozukluğu üzerine etkisi olmadığını düşünmekteyiz. Yine de superior transseptal yaklaşım ile elektriksel iletide geçici yavaşlama, sol atriyotomi ve transseptal yaklaşıma kıyasla daha fazla gözlenmektedir.

Anahtar sözcükler: Atriyotomi, mitral kapak cerrahisi, kalp pili, sinoatriyal nod arteri.

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The left atriotomy (LA) approach is traditionally preferred and frequently used in mitral valve surgery. This approach is not always comfortable due to the small left atrial diameter in the early stage of mitral valve diseases. Therefore, other mitral valve exploration methods have been developed. Guiraudon *et al.*^[1] described the extended vertical transatrial septal approach, which effectively provides appropriate and adequate vision in mitral valve surgery. This method is also known as the superior transseptal (STS) approach. Transseptal (TS) approach, which is limited to the vertical incision of the interatrial septum, is another approach. In this limited TS approach, the anatomical integrity of the left atrial roof is preserved, unlike the other one. Although the sinoatrial (SA) node is not anatomically adjacent to the roof of the interatrial septum, the sinoatrial nodal artery (SNA) can be close to this structure due to variations in the course of it. In a meta-analysis conducted by Vikse *et al.*,^[2] 68% of SNA originated from the right coronary artery (RCA), and there was a single SNA in 95.5%. In the light of the current data, while the mitral valve is explored, SNA may be damaged due to its course, and rhythm disturbances may occur in the postoperative period.^[3,4]

In the present study, we aimed to investigate the effects of these three different exploration methods and the variations of SNA on postoperative arrhythmias and temporary or permanent pacemaker implantation (PPI).

PATIENTS AND METHODS

This single-center, retrospective study was conducted at the Department of Cardiovascular Surgery of a tertiary care center between January 2009 and December 2019. Adult patients who underwent elective isolated mitral valve surgery with a standard median sternotomy in our clinic were included. Patients who underwent an intervention for temporary or permanent pacemakers before surgery and had a history of cardiac surgery were excluded from the study. Finally, a total of 241 patients (108 males, 133 females; mean age: 53.7±12.3 years; range, 18 to 82 years) were enrolled. The patients were divided into three groups according to the surgical approach as LA (n=47), TS (n=131), and STS (n=63). A written informed consent was obtained from each patient. The study protocol was approved by the Ethics Committee of the University of Health Sciences (Date: 26/11/2019-No: 2019-75). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data including age, sex, body mass index, and comorbid diseases were recorded. Left ventricular ejection fraction (LVEF), pulmonary artery pressure (PAP), left atrial diameter, preoperative cardiac rhythm, New York Heart Association (NYHA) classification of symptoms, PR interval of the patients with normal sinus rhythm (NSR) in the preoperative period and mitral valve dysfunction were also noted. By scanning the hospital records, the origin of the SNA was determined in the coronary angiography images obtained before surgery.

Operative techniques

In all cases, ascending aorta, inferior and superior vena cava were selectively cannulated. Antegrade isothermic blood cardioplegia was used to provide the diastolic arrest after aortic cross-clamping (ACC). Superior and inferior vena cava were snared, and total cardiopulmonary bypass (CPB) was initiated.

In the LA group, the atriotomy incision was performed parallel to the interatrial groove. The incision was extended toward the superior vena cava and below as far down the inferior vena cava as possible. Right atriotomy (RA) was performed parallel to the right atrioventricular (AV) junction in the TS group. Then the interatrial septum was opened vertically on a line passing through the middle of the fossa ovalis. In the STS group, a vertical RA was performed anterior to the sulcus terminalis. Next, the incision was extended around the upper base of the right atrial appendage to the interatrial septum. The interatrial septum was opened vertically through the fossa ovalis and parallel to the RA. Finally, the incision was extended to the left atrial dome by combining the right atrium and interatrial septum incision. Thus, the septum incision was made with both RA and LA.

Intraoperative data including CPB time, ACC time, and type of mitral valve procedure were evaluated.

Postoperative data

All groups were compared in terms of the amount of drainage, use of inotropic support, use of temporary pacemakers, intensive care unit (ICU), and hospital follow-up time, re-exploration, PPI, and mortality in the postoperative period. In addition, we collected LVEF and PAP data from echocardiograms which were routinely performed on Day 4 after surgery.

In our center, the follow-up procedure for patients undergoing heart valve surgery includes continuous

telemetry monitoring for the first 48 h and daily electrocardiography (ECG). After discharge, ECGs are taken at the first, second, and fourth weeks. In this study, the rhythm monitoring reports of all patients were analyzed.

Statistical analysis was performed using the SPSS for Windows version 26.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean \pm standard deviation (SD), median (min-max) or number and frequency, where applicable. The distribution of the variables was measured using the Kolmogorov Smirnov test. Analysis of variance ANOVA with the Tukey test and Kruskal-Wallis test were used to examine independent quantitative data. The chi-square test was used to analyze independent qualitative data, and the Fisher exact test was used, when the chi-square test conditions were not met. A *p* value of <0.05 was considered statistically significant.

RESULTS

Demographic data and preoperative comorbid factors are summarized in Table 1. There was no significant difference among the three groups.

All ECGs and echocardiograms of the patients in the preoperative period were analyzed. Three groups were compared in terms of left atrial diameter, LVEF, and PAP. There was no significant difference among the groups ($p=0.162$, $p=0.264$, and $p=0.430$, respectively). There was also no significant difference among the groups in terms of the preoperative rhythm ($p=0.051$). Preoperative data are summarized in Table 2.

The mean ACC time was 67.4 ± 22.4 min in the LA, 65.9 ± 19.8 min in the TS, and 78.8 ± 35.9 min in the STS group. The mean CPB time was 100.9 ± 30.1 min in the LA, 100.7 ± 30.4 min in the TS, and 115.8 ± 51.6 min in the STS. There was no significant difference in the mean ACC and CPB time among the groups (for CPB time $p=0.222$ and for ACC $p=0.116$). However, the mean ACC was significantly longer in the STS group than the TS group ($p=0.042$).

The groups were compared in terms of AV block development based on the ECG recordings during the hospitalization period. Although the rate of patients with first-degree AV block in the STS group was higher than the other two groups (44.4%), there was no statistically significant difference ($p=0.130$). Furthermore, in pairwise comparison in terms of the first-degree AV block, there was no significant difference between the STS and LA groups ($p=0.072$). Similarly, the second- and third-degree AV block rates were similar among the groups ($p>0.05$).

During the 30-day postoperative period, new-onset atrial fibrillation (AF) was observed in 11 (35.4%) patients in the LA group, 53 (52.4%) patients in the TS group, and 24 (43.6%) patients in the STS group. There was no significant difference among the groups ($p=0.098$).

The rate of temporary pacing was 49.2% in the STS group and significantly higher than in the other groups ($p=0.013$). However, there was no significant difference between the LA (25.5%) and TS (30.5%) groups in pairwise comparison ($p>0.05$). The groups were compared in terms of PPI. Only one patient had

Table 1. Demographics and comorbidities

	Left atriotomy (n=47)			Transseptal (n=131)			Superior transseptal (n=63)			<i>p</i>
	n	%	Mean \pm SD	n	%	Mean \pm SD	n	%	Mean \pm SD	
Age (year)			54.1 \pm 10.7			54.5 \pm 12.5			51.5 \pm 13.0	0.274*
Sex										
Female	26	55.3		75	57.3		32	50.8		0.698†
Body mass index (kg/m ²)			27.4 \pm 5.9			28.4 \pm 5.7			27.1 \pm 5.7	0.197‡
Diabetes mellitus	18	38.3		34	26.0		13	20.6		0.110†
Hypertension	19	40.4		55	42.0		21	33.3		0.507†
COPD	29	61.7		72	55.0		35	55.6		0.717†
Cerebro-vascular accident	8	17.0		8	6.1		6	9.5		0.083†
Chronic kidney disease	4	8.5		15	11.4		3	4.8		0.313†

SD: Standard deviation; COPD: Chronic obstructive pulmonary disease; * One-way ANOVA; † Chi-square test; ‡ Kruskal-Wallis test.

a necessity for PPI in the STS group. There was no statistically significant difference among the groups ($p>0.05$).

Inotropic agents were needed more in the STS group than the other groups ($p=0.024$). In the STS group, the mean amount of drainage was significantly higher than the other groups ($p<0.005$). The mean extubation time and the duration in the ICU in the STS group were also significantly longer than the other groups ($p=0.008$, $p=0.009$, respectively). However, there was no significant difference between the LA and the TS groups in terms of these parameters in the pairwise comparison ($p>0.05$). Postoperative data are summarized in Table 3.

A total of 168 patients with NSR both in the preoperative period and on the fourth postoperative day were selected. Seventeen patients did not have coronary artery imaging performed in the preoperative period. There was no dominant SNA in 14 patients. The origin of SNA was RCA in 75 patients and left circumflex (LCx) artery in 62 patients.

The subgroups which contain the patients with SNA originating from the RCA were compared in terms of PR interval postoperatively. The mean PR interval was 161.7 ± 47.3 ms in the LA, 189.5 ± 48.3 ms in the TS, and 206.0 ± 42.3 ms in the STS postoperatively. There was no significant difference among the subgroups ($p=0.061$). In pairwise comparison, however, PR interval was significantly longer in the STS group than the LA group after surgery ($p=0.049$). In the postoperative period, the mean value of the PR interval was also longer in the STS group than TS group, although there was no statistically significant difference between the two groups ($p=0.188$).

The subgroups including the patients with SNA originating from the LCx artery were compared. The mean PR interval was 203.9 ± 55.9 ms in the LA, 181.1 ± 47.8 ms in the TS, and 196.5 ± 52.2 ms in the STS postoperatively. There was no significant difference among the subgroups ($p=0.346$). The results are summarized in Table 4.

Table 2. Preoperative data

	Left atriotomy (n=47)			Transseptal (n=131)			Superior transseptal (n=63)			p
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	
Ejection fraction (%)			56.1±8.9			56.8±9.0			59.1±6.3	0.264*
PAP (mmHg)			40.2±13.1			39.5±13.3			41.6±12.2	0.430*
Left atrium diameter (mm)			53.5±9.9			50.6±10.0			50.4±8.8	0.162*
Rhythm										0.051†
NSR	32	68.1		101	77.1		55	87.3		
AF	15	31.9		30	22.9		8	12.7		
PR interval (ms)			156.5±29.3			156.0±26.2			158.2±24.2	0.718*
NYHA Class										0.090†
I	1	2.1		4	3.1		0	0		
II	33	70.2		109	83.2		53	84.1		
III	13	27.7		18	13.7		10	15.9		
Mitral disease										0.651†
Rheumatic	25	53.2		83	63.4		34	54.0		
Non-rheumatic	22	46.8		48	36.7		29	46.0		
Mitral dysfunction										0.241†
Regurgitation	26	55.3		78	59.5		45	71.4		
Stenosis	5	10.6		19	14.5		8	12.7		
Regurgitation and stenosis	16	34.0		34	26.0		10	15.9		

SD: Standard deviation; PAP: Pulmonary artery pressure; NSR: Normal sinus rhythm; AF: Atrial fibrillation; NYHA: New York Heart Association; * Kruskal-Wallis test; † Chi-square test

Table 3. Intraoperative and postoperative data

	Left atriotomy (n=47)			Transseptal (n=131)			Superior transseptal (n=63)			p
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	
Aortic cross-clamp time (min)			67.4±22.4			65.9±19.8			78.8±35.9	0.116*
CPB time (min)			100.9±30.1			100.7±30.4			115.8±51.6	0.222*
Procedure										
MVR	46	97.9		118	90.1		38	60.3		<0.001†
MVP	1	2.1		13	9.9		25	39.7		
LVEF (%)			52.9±8.9			53.1±10.2			53.5±8.0	0.823*
PAP (mmHg)			31.3±7.5			32.0±9.2			32.9±8.1	0.622*
Day 4 after surgery										
NSR	29	61.7		91	69.5		50	79.4		} 0.037†
AF	16	34		28	21.4		9	14.3		
Nodal rhythm	2	4.3		12	9.2		4	6.3		
First degree AV block	13	27.7		42	32.1		28	44.4		0.130†
Second degree AV block	0	0		1	0.8		0	0		0.656†
Third degree AV block	1	2.1		1	0.8		3	4.8		0.187†
Temporary pacing‡	12	25.5		40	30.5		31	49.2		0.013†
Day 7 after surgery										
NSR	29	61.7		91	69.5		53	84.1		} 0.037†
AF	17	36.2		38	29		9	14.3		
Nodal rhythm	0	0		0	0		1	1.6		
New-onset AF in postoperative 30-days§	11	35.4		53	52.4		24	43.6		0.211†
PPI	0	0		0	0		1	1.6		0.242†
Use of inotropic agent¶	19	40.4		42	32.1		33	52.4		0.024†
Drainage (mL)			489.4±173.2			477.1±140.1			542.9±128.2	<0.001*
Re-exploration¶¶	6	12.8		9	6.9		2	3.2		0.150†
Extubating time (h)			17.2±18.4			15.8±15.0			55.9±351.4	0.008*
ICU stay (day)			3.6±11.2			3.5±14.3			3.6±17.6	0.009*
Hospital stay (day)			11.3±13.8			10.8±15.6			10.0±17.1	0.261*
Rehospitalization	5	10.6		17	13		2	3.2		0.101†
Reoperation	0	0		2	1.5		2	3.2		0.429†
Mortality	2	4.3		5	3.8		1	1.6		0.664†

SD: Standard deviation; CPB: Cardiopulmonary bypass; MVR: Mitral valve replacement; MVP: Mitral valvuloplasty; LVEF: Left ventricular ejection fraction; PAP: Pulmonary artery pressure; NSR: Normal sinus rhythm; AF: Atrial fibrillation; AV: Atrioventricular; PPI: Permanent pacemaker implantation; ICU: Intensive care unit; * Kruskal-Wallis test; † Chi-square test; ‡ Patients who needed cardiac pacing during weaning from CPB or in early postoperative stage; § Patients who had normal sinus rhythm in preoperative stage and had at least one time AF on ECG follow-ups in 30-day period after surgery. Because of preoperative NSR condition, n values of groups were changed; ¶ Patients who needed at least two of dopamine, epinephrine and norepinephrine support at the same time in early postoperative stage; ¶¶ Re-exploration because of hemorrhage, pericardial fluid or tamponade.

DISCUSSION

Rhythm disturbances are common problems after heart valve surgery. The conduction system is close to the valve structures. In addition, exploration methods applied during the operation may damage the arteries of the conduction system and reduce blood perfusion.

In the present study, we compared the atriotomy methods commonly used in mitral valve surgery in terms of postoperative rhythm disorders, considering the variations of the SNA. Our study results showed that the atriotomy method and variations of the SNA had no permanent effects on rhythm, but temporary

Table 4. Comparison of the surgical approaches in terms of the preoperative and postoperative PR interval in subgroups

	Left atriotomy (n=11)	Transseptal (n=48)	Superior transseptal (n=16)	<i>p</i>
	Mean±SD	Mean±SD	Mean±SD	
RCA				
PR preoperative (ms)	146.7±25.2	161.1±22.8	157.4±20.5	0.170*
PR postoperative (ms)	161.7±47.3	189.5±48.3	206.0±42.3	0.061*
	Left atriotomy (n=14)	Transseptal (n=28)	Superior transseptal (n=20)	<i>p</i>
	Mean±SD	Mean±SD	Mean±SD	
LCx artery				
PR preoperative (ms)	162.9±28.7	152.9±27.3	161.6±28.5	0.436*
PR postoperative (ms)	203.9±55.9	181.1±47.8	196.5±52.2	0.346*

SD: Standard deviation; RCA: Right coronary artery; LCx: Left circumflex; * One-way ANOVA.

rhythm disturbances were more often in patients who were operated on with the STS method.

Several studies have reported that SA node dysfunction and nodal arrhythmias were more frequent after mitral valve surgery with the STS approach.^[5,6] The internodal pathways and SNA have been proposed to be harmed using the STS approach. In the light of these data, we compared three atriotomy methods in terms of AV block in our study. The rate of first-degree AV block was higher in the STS group than the others; however, there was no significant difference among the groups ($p>0.05$). On the other hand, the need for a temporary pacemaker was significantly higher in STS patients ($p=0.013$).

Berdajs et al.^[7] indicated that prolonged ACC and CPB time were the risk factors for various degrees of AV block after mitral valve surgery. In our study, the STS group had longer ACC and CPB times than the other groups. In addition, the first-degree AV block after mitral valve surgery was more often in the STS group than the other groups, although it did not reach statistical significance among the groups ($p>0.05$).

Misawa et al.^[8] observed that the PR interval was longer in the early period after mitral valve surgery with the STS approach in patients with NSR preoperatively. They reported that SNA was sacrificed with the STS due to its course when it originated from the RCA, and the blood perfusion of SA node reduced in the early phase, as the patients often had a single SNA. García-Villarreal et al.^[9] also reported that PR interval and P-wave abnormalities were the most common abnormalities in the early postoperative period with STS. In the current study, we compared the exploration methods regarding PR

interval in patients who had SNA originating from the RCA. The PR interval was longer in patients operated with STS than the LA ($p=0.049$). The findings of our study are consistent with the literature.

In a retrospective study with 469 patients, Boulemden et al.^[3] reported that the surgical approaches to mitral valve surgery with the LA, TS, and STS approaches did not affect PPI. They also found that concomitant tricuspid valve surgery and advanced age (>70 years) were the main risk factors. In our study, patients who underwent isolated mitral valve surgery were included, and PPI was inserted in only one patient in the STS group due to a complete AV block. There was no statistically significant difference among the three surgical approaches. The aforementioned study reported that the SNA arising from the left coronary arterial system in patients operated with the superior septal approach was not a risk factor for PPI. This finding is consistent with our results.

In a study conducted by Masiello et al.,^[10] the LA and STS approaches were compared, and the rate of nodal rhythm in the postoperative period was significantly higher in the STS group. In our study, we observed nodal rhythm in two (4.2%) patients in the LA group, in 12 (9.1%) patients in the TS group, and four (6.3%) patients in the STS group. There was no statistically significant difference among the groups in terms of the frequency of nodal rhythm.

Furthermore, Kernis et al.^[11] reported in their study with 762 sinus rhythm patients who underwent mitral valve surgery due to mitral insufficiency that newly developed AF was found in 24% of cases ($n=180$). In our study, 188 patients were in sinus

rhythm during preoperative ECG follow-up, while 88 patients (46.8%) had AF rhythm on at least one ECG within the first 30 days after surgery. Due to the higher incidence of postoperative AF in our study, it was considered that patients with rheumatic mitral stenosis were also included. The paroxysmal AF in mitral stenosis is more common than in mitral insufficiency.^[12,13] Therefore, we observed the highest rate of new-onset AF and rheumatic mitral valve disease in TS. In several studies, the rate of new-onset AF was compared between atriotomy methods, and the results were controversial.^[14,15] In our study, new-onset AF was more common in TS than in the other groups.

Nonetheless, there are some limitations to this study. The single-center, retrospective design is the main limitation. In addition, preoperative conventional or computed tomography coronary angiographies were retrospectively analyzed. The origin of SNA was identified from images for each patient considering the variations as described previously.^[2] The images of 24 patients could not be achieved. In 17 patients, the origin of the dominant SNA could not be determined. Dominant SNA originating from RCA or LCx artery could be detected in 200 patients. Only 137 patients in whom a dominant SNA could be detected maintained the NSR after surgery.

In conclusion, the type of atrial incision and variations of the sinoatrial nodal artery do not affect postoperative mortality and permanent pacemaker implantation in isolated mitral valve surgery alone. Although prolonged PR interval, varying degrees of atrioventricular block, and temporary pacemaker use are more common in the superior transseptal approach, no permanent results can be achieved. This can be attributed to the enlarged incisions created in the atrial and septal structures containing the heart's conduction system and possible damage to the sinoatrial nodal artery. The superior transseptal approach also prolongs the operation time, and length of hospital and intensive care unit stay with the increased amount of postoperative bleeding. Since superior transseptal provides a better surgical vision than the other techniques, it is mainly applied to patients primarily considered for mitral valve repair in our center. The transseptal and left atriotomy approaches have similar results in the postoperative period. Therefore, we believe that the transseptal approach is safe instead of left atriotomy in patients with a small left atrial diameter. Each exploration method has surgical difficulties and postoperative outcomes. Therefore, each patient should be evaluated

individually, and the appropriate method should be selected.

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