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Research Article

The impact of additional right ventricular branch grafting on electrocardiographic and echocardiographic parameters

Sağ ventrikül dalına ek bypass greftlemenin elektrokardiyografik ve ekokardiyografik parametreler üzerindeki etkisi

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Abstract

Aim: This study aimed to evaluate the impact of additional coronary artery bypass grafting (CABG) to right ventricular (RV) branches on echocardiographic and electrocardiographic parameters, with a focus on RV function and electrical stability.

Material and Methods: A retrospective review was conducted on patients who underwent CABG with significant right coronary artery (RCA) disease between January 2017 and December 2022. Patients were included and divided into two groups: Group 1 (n = 34) received grafts only to the distal RCA branches (posterior descending artery or posterolateral branch); Group 2 (n = 34) underwent grafting to both the distal RCA and the RV branch. Preoperative and discharge periods, echocardiographic and electrocardiographic parameters were compared between groups.

Results: Both groups had comparable baseline characteristics, including echocardiographic and electrocardiographic parameters. At discharge, tricuspid annular plane systolic excursion (TAPSE) was lower in Group 1 compared to Group 2 (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; $p < 0.001$). The ratio of diastolic dysfunction was higher in Group 1 compared to Group 2 (91.2% vs. 61.8%; $p < 0.001$). The mean QT dispersion (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; $p = 0.031$) and mean P wave dispersion (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; $p = 0.048$) levels were lower in Group 2 compared to Group 1.

Conclusion: Additional bypass grafting of the RV branch in patients with significant RCA disease was associated with improved RV function and more favorable electrocardiographic parameters.

Keywords: Coronary artery bypass grafting, P-wave dispersion, right ventricular function, right coronary artery, ventricular repolarization, TAPSE, transannular plane systolic excursion

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Öz

Amaç: Bu çalışma, sağ ventrikül (SV) dallarına ek koroner arter bypass greftleme (KABG) işleminin ekokardiyografik ve elektrokardiyografik parametreler üzerindeki etkisini, özellikle SV fonksiyonu ve elektriksel stabiliteye odaklanarak değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Ocak 2017 ile Aralık 2022 tarihleri arasında belirgin sağ koroner arter (SKA) hastalığı nedeniyle KABG uygulanan hastalar retrospektif olarak incelendi. Hastalar dahil edilerek iki gruba ayrıldı: Grup 1 (n = 34), sadece distal RCA dallarına (posterior desendan arter veya posterolateral dal) greft uygulanan hastaları içerirken, Grup 2 (n = 34), hem distal SKA hem de SV dalına greft uygulanan hastaları içeriyordu. Gruplar arasında ameliyat öncesi ve taburculuk dönemindeki ekokardiyografik ve elektrokardiyografik parametreler karşılaştırıldı.

Bulgular: Gruplar arasında başlangıçta ekokardiyografik ve elektrokardiyografik parametreler dahil olmak üzere temel özellikler açısından fark bulunmamaktaydı. Taburculuk döneminde, triküspit anüler düzlem sistolik ekskürsiyonu (TAPSE) değeri Grup 1'de Grup 2'ye kıyasla daha düşüktü (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; $p < 0.001$). Diyastolik disfonksiyon oranı Grup 1'de Grup 2'ye göre daha yüksekti (%91.2 vs. %61.8; $p < 0.001$). Ortalama QT dispersiyonu (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; $p = 0.031$) ve ortalama P dalgası dispersiyonu (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; $p = 0.048$) değerleri Grup 2'de Grup 1'e kıyasla daha düşüktü.

Sonuçlar: Belirgin RCA hastalığı olan hastalarda RV dalına ek bypass greftleme, SV fonksiyonlarında iyileşme ve daha olumlu elektrokardiyografik parametrelerle ilişkilendirildi.

Anahtar Kelimeler: Koroner arter bypass greftleme, P dalgası dispersiyonu, sağ ventrikül fonksiyonu, sağ koroner arter, ventriküler repolarizasyon, triküspit anüler düzlem sistolik ekskürsiyonu

Introduction

The right coronary artery (RCA) plays a critical role in supplying blood to the right atrium and right ventricle (RV). Is main branches include the conus branch, sinoatrial nodal branch, RV, right marginal branches, atrioventricular (AV) nodal branch, posterolateral (PL) branch, and the posterior descending artery (PDA) (1). The majority of RCA stenosis or occlusions occur in the proximal segment, likely due to the anatomical predisposition for atherosclerotic plaque formation in this region (2).

Coronary artery bypass grafting (CABG) is a well-established treatment for advanced coronary artery disease, and revascularization of the RCA is traditionally achieved with a single graft anastomosis (3). In most conventional CABG procedures, grafting is directed to the PDA or the PL branch of the RCA (4). However, the right ventricular branches often arise from the proximal portion of the RCA, which may be less frequently targeted. As a result, the right ventricle may not receive optimal blood supply, and postoperative right ventricular dysfunction may occur if critical RV branches remain inadequately revascularized (5, 6).

Previous studies suggest that a sequential grafting strategy for the RCA, addressing not only the distal branches (PL/PDA) but also the proximal right ventricular branches, could improve RV function postoperatively (7, 8). Based on these findings, we hypothesized that performing an additional anastomosis to the RV branch might lead to differences in right ventricular functions when compared to grafting a single distal segment of the RCA. Therefore, this study aimed to evaluate the impact of additional CABG to RV branches on echocardiographic and electrocardiographic parameters, with a focus on RV function and electrical stability.

Material and Methods

This retrospective study was conducted on patients who underwent CABG surgery at the Cardiovascular Surgery Clinic of Lokman Hekim University Health Practice and Research Center between January 2017 and December 2022. The study was approved by the Lokman Hekim Hospital's Ethics Committee (Date: 23.12.2021, Decision No: 2021/158) and was carried out in accordance with the relevant ethical guidelines and the Helsinki Declaration (2013 Brazil revision). The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

During the study period, a total of 150 patients who underwent CABG surgery with both stenotic/occluded suitable (>1.5 mm) RCA RV branches and stenotic/occluded distal RCA were retrospectively evaluated. The inclusion criteria were patients over the age of 18 with complete data. Exclusion criteria included patients who underwent conversion, valve procedures, or had a history of CABG, as well as those who required intra-aortic balloon pump or extracorporeal membrane oxygenation. Patients with unobstructed or adequately sized RV branches were also excluded. A total of 89 patients who met the inclusion and exclusion criteria were assessed for eligibility in the analysis. All patients had RCA-dominant coronary anatomy and significant RCA stenosis. The patients were divided into two groups. Group 1 included 50 patients whose RV branch diameter was insufficient (<1.5 mm), where distal anastomoses were performed on the RCA trunk or its posterior branches, and no additional bypass was performed to the RV branch. Group 2 consisted of 39 patients with a sufficient RCA RV branch diameter who received grafts both to the distal RCA and the RV branch. After matching both groups in a 1:1 ratio for age and gender, a total of 68 patients were included in the study, with 34 patients in each group.

The hospital's electronic information system and patient files were used to gather demographic and clinical data at both the preoperative and discharge periods.

Surgical Technique

Standard anesthesia monitoring, including radial arterial and central venous catheters, was utilized. Central venous access was typically via the jugular vein, and midazolam was used for anxiolysis when needed. Anesthesia was induced and maintained with propofol, etomidate, volatile anesthetics, opioids (sufentanil or fentanyl), and muscle relaxants. Patients were kept in a supine position at normothermia, with the cardiopulmonary bypass pump prepared but unprimed.

A median sternotomy was performed to harvest the left and right internal thoracic arteries (LITA and RITA), as well as radial artery and saphenous vein grafts. Heparin (2 mg/kg) was administered before distal LITA ligation, maintaining an activated clotting time of 200–300 seconds. Epicardial stabilizers, including the Octopus and Starfish devices (Medtronic), were used for immobilization during anastomoses, with suction pressures set to –400 mmHg. Coronary arteries were taped proximally and distally with silastic sutures, and coronary shunts were routinely applied.

The procedure began with bypassing the RCA and its right ventricular branches, followed by proximal anastomoses. Subsequent anastomoses were performed in the circumflex (Cx) region and diagonal arteries. The LITA-to-LAD anastomosis was completed last to avoid tension on the graft during earlier steps. Doppler ultrasound was used to measure graft blood flow (mL/min) after all anastomoses, followed by protamine administration.

Electrocardiography

A 12-lead ECG recorder (Nihon Kohden, Tokyo, Japan) was utilized, set to a paper speed of 25 mm/s and a sensitivity of 10 mm/mV. All ECG recordings were assessed by a single cardiologist who was blinded to the patients' details. ECG parameters, including minimum and maximum P wave duration (Pmin, Pmax), P wave dispersion (Pd), PR distance (PRd), minimum and maximum QT wave duration (QTmin , QTmax), QT dispersion (QTd), were measured across all leads, and their averages were calculated. The onset and offset of the P wave were evaluated as the junction between the P wave pattern and the isoelectric line. The Pmax was accepted as the lengthiest P wave and the lengthiest atrial conduction time. The Pd was computed with the formula Pd = Pmax - Pmin. The QT interval was evaluated as the distance between the onset of the Q wave and the offset of the T wave. The QTd dispersion was calculated using the measurements of the highest and lowest values of QT interval.

Echocardiography

Echocardiography was evaluated using a 2.5-MHz transducer and the Vivid-5 System (GE Medical Systems, Horten/Norway) with by an experienced cardiologist. Left ventricular ejection fraction (LVEF) was computed using the modified Simpson's biplane method. Transannular plane systolic excursion (TAPSE) was measured in the apical four-chamber view using an M-mode cursor positioned at the lateral tricuspid annulus, where the tricuspid valve plane intersects with the free wall of the right ventricle. A value of less than 16 mm was indicative of right ventricular systolic dysfunction (9). Systolic pulmonary artery pressure (sPAP) is calculated by summing right atrial pressure with peak pressure gradient between the peak of the right ventricle and the apex of the right atrium. To assess diastolic dysfunction, the E and A waves were recorded using pulse wave (PW) Doppler positioned at the tips of the mitral valve leaflets in the apical four-chamber view. An E/A ratio below 1 was considered indicative of stage 1 diastolic dysfunction.

Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA) software. The normal distribution of numerical variables was assessed using the Kolmogorov-Smirnov test. Data exhibiting a normal distribution were presented as mean ± standard deviation, and comparisons between groups were made using the Student's T-test. Non-normally distributed data were displayed as median (interquartile range (IQR): 25-75 percentiles) and comparisons between groups were conducted using the Mann-Whitney U test. Value of $P < 0.05$ were considered statistically significant.

Results

The study included 68 patients with a mean age of 63.4 ± 9.0 years, of whom 56 were men and 12 were women. The mean age and male ratio were comparable between Group 1 and Group 2. Hypertension was present in 82.4% of the patients, while 57.4% had diabetes mellitus, with no significant intergroup differences. The use of medications, including RAS inhibitors, beta blockers, and statins, was comparable between the groups. The mean number of diseased vessels was 2.5 ± 0.8, and the average number of grafts per patient was 3.3 ± 0.8, with no statistically significant intergroup differences. Regarding graft types, 83.8% of patients received LITA grafts, while radial artery grafts and saphenous vein grafts were used in 57.4% and 100%, respectively. On-pump procedures were performed in 50% of patients, with no significant intergroup variation ($p = 0.999$). Postoperative inotropic agent use was required in 33.8% of patients, with similar rates between groups ($p = 0.333$). Postoperative atrial fibrillation (AF) occurred in 10.3% of patients, with no significant difference between groups ($p = 0.271$) (Table 1).

Table 1. Demographic and clinical characteristics of the study population.

Variables	All population n = 68	Group 1 n = 34	Group 2 n = 34	P-value
Age, years	63.4 ± 9.0	63.6 ± 8.0	63.1 ± 10.0	0.821
Male gender, n (%)	56 (82.4)	26 (76.5)	30 (88.2)	0.203
Smoking, n (%)	51 (75.0)	25 (73.5)	26 (76.5)	0.779
Hypertension, n (%)	56 (82.4)	28 (82.4)	28 (82.4)	0.999
Diabetes mellitus, n (%)	39 (57.4)	18 (52.9)	21 (61.8)	0.462
Drugs, n (%)				
RAS inhibitors	47 (69.1)	27 (79.4)	20 (58.8)	0.066
Beta Blockers	42 (61.8)	20 (58.8)	22 (64.7)	0.618
Statin	31 (45.6)	15 (44.1)	16 (47.1)	0.808
OAD-Insulin	39 (57.4)	18 (52.9)	21 (61.8)	0.462
Inhalers	7 (10.3)	3 (8.8)	4 (11.8)	0.690
Antiplatelets	40 (58.8)	17 (50.0)	23 (67.6)	0.139
Anticoagulants	2 (2.9)	0	2 (5.9)	0.151
No. of vessels with disease	2.5 ± 0.8	2.4 ± 0.8	2.5 ± 0.8	0.608
No. of grafts	3.3 ± 0.8	3.1 ± 1.1	3.5 ± 1.0	0.140
Type of graft, n (%)				
LITA	57 (83.8)	29 (85.3)	28 (82.4)	0.747
Radial artery	39 (57.4)	21 (61.8)	18 (52.9)	0.461
Saphenous vein	68 (100)	34 (100.0)	34 (100.0)	0.999
On-pump, n (%)	34 (50.0)	20 (58.8)	14 (41.2)	0.146
Inotropic agent required, n (%)	23 (33.8)	13 (38.2)	10 (29.4)	0.442
Postoperative AF, n (%)	7 (10.3)	5 (14.7)	2 (5.9)	0.231
1-years mortality, n (%)	4 (5.9)	3 (8.8)	1 (2.9)	0.303

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at $p < 0.05$. AF, atrial fibrillation; LITA, left internal thoracic artery; OAD, oral antidiabetic drugs; RAS, renin-angiotensin system.

Preoperatively, LVEF was similar between groups (Group 1: 46.5 ± 11.7% vs. Group 2: 46.9 ± 9.1%; p = 0.881). The means of sPAB, TAPSE, heart rate, Pd and QTd were also comparable between between Group 1 and Group 2 (p > 0.05 for all). Diastolic dysfunction was present in 97.1% of patients overall, with Group 1 showing a slightly higher prevalence (100% vs. 94.1%, p = 0.473) (Table 2).

At discharge, LVEF improved across all patients, with no significant intergroup differences (Group 1: 49.7 ± 10.1% vs. Group 2: 49.4 ± 7.9%; p = 0.994). TAPSE was significantly lower in Group 1 compared to Group 2 (11.7 ± 2.7 mm vs. 15.1 ± 2.3 mm; p < 0.001). Similarly, sPAB tended to be lower in Group 2, but the difference did not reach statistical significance (p = 0.089). The ratio of diastolic dysfunction was higher in Group 1 compared to Group 2 (91.2% vs. 61.8%; p < 0.001). The mean QTd (54.6 ± 15.4 ms vs. 63.7 ± 18.5 ms; p = 0.031) and mean Pd (22.5 ± 5.3 ms vs. 26.2 ± 8.8 ms; p = 0.048) levels were lower in Group 2 compared to Group 1 (Table 2).

At discharge, the decreases in sPAB, Pd, and QTd levels were more pronounced in Group 2 than in Group 1 s (Δp < 0.05). Group 1 exhibited a more pronounced reduction in TAPSE levels compared to Group 2 (Δp < 0.05). At the time of discharge, Group 2 showed a greater reduction in the proportion of patients with diastolic dysfunction compared to preoperative levels (Δp < 0.05) (Table 3).

Discussion

To the best of our knowledge, this study is one of the few to evaluate the impact of additional CABG to RV branch arteries on electrocardiographic and echocardiographic parameters. Our findings suggest that grafting to RV branches is associated with improvements in RV function.

Decreased RV function following CABG is a clinically significant problem, particularly in the early postoperative period (10). In this context, several mechanisms have been proposed, including perioperative myocardial ischemia, cardiopulmonary bypass, intraoperative cardiac injury, cardioplegia, inflammation, pericardial disruption or adhesions, and inadequate revascularization of critical RV branches (11-13). Even mild reductions in RV performance can adversely affect hemodynamics and clinical outcomes, emphasizing the need for tailored surgical strategies to preserve RV function.

Anatomically, most significant lesions of the RCA occur in its proximal segment or main trunk. Since the RV marginal branches often originate proximally, these branches are at risk of inadequate perfusion when stenosis or occlusion occurs in the proximal RCA (14). Sequential grafting or dedicated bypasses to these RV branches can improve RV perfusion.

Table 2. Comparison of electrocardiography and echocardiographic parameters before and after surgery in Group 1 and Group 2.

Variables	All population n = 68	Group 1 n=34	Group 2 n=34	P-value
Preoperative				
LVEF, %	46.7 ± 10.4	46.5 ± 11.7	46.9 ± 9.1	0.881
sPAB, mm Hg	35.1 ± 9.0	34.5 ± 9.3	35.6 ± 8.2	0.607
Diastolic dysfunction, n (%)	66 (97.1)	34 (100.0)	32 (94.1)	0.473
TAPSE, mm	18.4 ± 3.1	18.2 ± 3.6	18.7 ± 2.3	0.524
HR, beats / minute	84.8 ± 21.0	84.4 ± 18.6	85.3 ± 23.4	0.859
Pd, msn	28.3 ± 7.5	28.9 ± 8.3	27.7 ± 6.6	0.490
QTd, msn	75.6 ± 22.1	76.0 ± 21.4	75.2 ± 23.2	0.892
Discharge				
LVEF, %	49.3 ± 9.0	49.7 ± 10.1	49.4 ± 7.9	0.994
sPAB, mm Hg	30.7 ± 7.1	32.1 ± 7.7	29.1 ± 6.6	0.089
Diastolic dysfunction, n (%)	52 (76.5)	31 (91.2)	21 (61.8)	0.004*
TAPSE, mm	13.4 ± 2.8	11.7 ± 2.7	15.1 ± 2.3	<0.001*
HR, beats / minute	80.5 ± 15.9	81.1 ± 14.5	80.0 ± 17.1	0.201
Pd, msn	24.5 ± 7.4	26.2 ± 8.8	22.5 ± 5.3	0.048*
QTd, msn	59.2 ± 17.4	63.7 ± 18.5	54.6 ± 15.4	0.031*

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at p < 0.05. HR, heart rate; LVEF, left ventricular ejection fraction; Pd, P-wave dispersion; QTd, QT dispersion; sPAB, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

Table 3. Electrocardiography and echocardiographic parameter changes at discharge between Group 1 and Group 2.

Variables		Preoperative	Discharge	P-values	ΔP-values
LVEF, %	Group 1	46.5 ± 11.7	49.7 ± 10.1	<0.001*	0.885
	Group 2	46.9 ± 9.1	49.4 ± 7.9	<0.001*	
sPAB, mm Hg	Group 1	34.5 ± 9.3	32.1 ± 7.7	<0.001*	0.008*
	Group 2	35.6 ± 8.2	29.1 ± 6.6	<0.001*	
Diastolic dysfunction, n (%)	Group 1	34 (100.0)	31 (91.2)	0.083	<0.001*
	Group 2	32 (94.1)	21 (61.8)	0.001*	
TAPSE, mm	Group 1	18.2 ± 3.6	11.7 ± 2.7	<0.001*	<0.001*
	Group 2	18.7 ± 2.3	15.1 ± 2.3	<0.001*	
HR, beats / minute	Group 1	84.4 ± 18.6	81.1 ± 14.5	<0.001*	0.754
	Group 2	85.3 ± 23.4	80.0 ± 17.1	<0.001*	
Pd, msn	Group 1	28.9 ± 8.3	26.2 ± 8.8	0.009*	<0.001*
	Group 2	27.7 ± 6.6	22.5 ± 5.3	<0.001*	
QTd, msn	Group 1	76.0 ± 21.4	63.7 ± 18.5	<0.001*	<0.001*
	Group 2	75.2 ± 23.2	54.6 ± 15.4	<0.001*	

The data are expressed as the mean ± SD, median (IQR), or frequency (%). * indicates statistical significance at $p < 0.05$. ΔP-values denotes the changes in parameters before and after surgery, highlighting the differences between the groups. HR, heart rate; LVEF, left ventricular ejection fraction; Pd, P-wave dispersion; QTd, QT dispersion; sPAB, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

The current study had several notable limitations. First, the retrospective design may limit the ability to establish causal relationships between treatment patterns and outcomes. Second, potential confounding factors such as lifestyle behaviors, dietary sodium intake, and medication adherence were not thoroughly explored. Additionally, medication adherence was not examined. Finally, the sample was limited to a single healthcare setting, which may limit the generalizability of findings to broader populations. A previous study reported that additional grafting to the RV branch significantly reduced postoperative pressures of RA, pulmonary systolic and diastolic, and pulmonary capillary wedge, while also indirectly reducing left ventricular end-diastolic pressure (15). In this study, patients who underwent additional grafting to the RV exhibited a more pronounced decrease in sPAB levels.

The rate of diastolic dysfunction at discharge was reduced in patients who underwent additional RV grafting. A previous study found that the rate of RV dysfunction was lower in the group with complete revascularization of extended RCA branches than in the single bypass group (16). A study involving 35 coronary artery disease patients, 20 with sequential grafts and 5 with individual grafts, reported that sequential complete revascularization of the right coronary artery enhanced RV diastolic function (7). Additionally, TAPSE values, which reflect RV systolic function, significantly decrease after CABG (17). In the present study, TAPSE—a key indicator of RV systolic function—was notably higher at discharge in the group receiving grafts to both the distal RCA and the RV branch. A study on patients with significant RCA stenosis found that those who received bypasses grafting to both the distal RCA and RV branch experienced a smaller reduction in TAPSE values by postoperative day 7 compared to those who underwent a single distal bypass. TAPSE values normalized by postoperative day 90 in the former group (6). Although our findings align with previous observations that complete revascularization of all relevant RV branches can preserve or enhance TAPSE, additional prospective trials would be beneficial to elucidate the precise mechanistic link.

Atrial fibrillation is also the most prevalent complication in cardiac surgery (18). Following coronary bypass surgery using sequential and single grafting techniques, the reported incidence of atrial fibrillation ranges from 2% to 42% (6, 19, 20). In a previous study, the incidence of postoperative atrial fibrillation was reported to be lower in patients who received grafts to both the distal RCA and the RV branch compared to those who underwent a single distal bypass (6). Similarly, in this study, patients who underwent additional grafting to the RV branch showed a trend toward a reduced incidence of postoperative atrial fibrillation. This finding aligned with the more pronounced decrease in postoperative Pd levels noted in this group. Elevated Pd has been associated with atrial conduction heterogeneity and a higher risk of atrial arrhythmias, particularly atrial fibrillation (21). By improving RV perfusion—and potentially ameliorating right atrial stretch—comprehensive RCA revascularization may help stabilize atrial electrical activity, thereby lowering Pd and possibly reducing the burden of postoperative arrhythmias. On the other hand, QTd reflects the variability in ventricular repolarization times and is a known risk factor for ventricular arrhythmias. This study demonstrated a significant decrease in QTd among patients receiving additional RV branch grafts. This finding implies that improved RV perfusion through targeted grafting not only enhances mechanical function but also contributes to electrical stability, thereby potentially reducing the risk of life-threatening ventricular arrhythmias post- sequential CABG.

Several limitations should be considered in interpreting these findings. First, the retrospective design and relatively small sample size may limit the generalizability of the results. Second, the exclusion of patients with valve procedures might reduce real-world applicability. Third, long-term outcomes were not available, restricting our ability to assess the sustained impact of comprehensive RCA revascularization on RV function and cardiac events. Future prospective, multicenter studies with larger cohorts and extended follow-up are warranted to validate these findings and elucidate the long-term benefits of RV branch grafting in CABG procedures.

Conclusion

This study highlights that additional grafting to RV branches during CABG improves RV function and enhances electrical stability, as shown by higher TAPSE values and reduced P-wave and QT dispersion. Incorporating RV branch grafting into CABG procedures may lead to better mechanical and electrical outcomes, particularly in patients with significant RCA stenosis. Moreover, extensive RCA revascularization, encompassing the RV branch, could enhance hemodynamics and lower the likelihood of postoperative arrhythmias.

Conflict of Interest/ Funding

The study received no financial support from any individual or organization, and the authors declare no conflict of interest.

Ethics Committee Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Lokman Hekim University Non-Interventional Clinical Research Ethics Committee (Date: 23.12.2021, Decision No: 2021/158).

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Conflicts of Interest

The authors declare they have no conflicts of interest.

Financial Disclosure

The authors declared that this study has received no financial support.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author, [O.Y.].

Author Contributions

Concept – O.Y., Design- O.Y. and Ö.Ö., Supervision – O.Y. and Ö.Ö., Data collection and/or processing - O.Y., Y.N., N.Ç., and Ö.Ö., Analysis and/or interpretation - O.Y., Y.N., N.Ç., and Ö.Ö., Writing – O.Y., Critical review- Y.N., N.Ç., and Ö.Ö. All authors read and approved the final version of the manuscript.

References

1. Villa AD, Sammut E, Nair A, Rajani R, Bonamini R, and Chiribiri A. Coronary artery anomalies overview: The normal and the abnormal. World J Radiol. 2016;8(6):537-55.
2. ElGuindy MS and ElGuindy AM. Aneurysmal coronary artery disease: An overview. Glob Cardiol Sci Pract. 2017;2017(3):e201726.
3. Kamel WA, Zarif B, and Elhendawy SAK. Saphenous Vein Graft Patency When Anastomosed to Distal Right Coronary Artery versus Right Posterior Descending Artery: A Comparative Study. The Egyptian Journal of Hospital Medicine. 2022;87(1):2269-74.
4. Zhao Z, Fu C, Zhang LX, Zhang GD, and Chen Y. Perioperative observations of different bypass modes of a right coronary system based on instantaneous blood flow during the operation. J Cardiothorac Surg. 2020;15(1):217.
5. Savas G, Yazici S, and Terzi S. A proximal right coronary artery occlusion presenting with ST-segment depression in leads II, III, and aVF. Anatol J Cardiol. 2020;24(6):411-14.
6. Ali Sahin M, Yokusoglu M, Kuralay E, and Ozal E. Can Right Ventricular Branch Bypass Alleviate Right Ventricular Dysfunction? Tex Heart Inst J. 2022;49(5):e217607.
7. Ozerdem G, Katrancioglu N, Candemir B, Saricam E, Ozturk O, and Berkan O. Effect of sequential coronary artery bypass venous grafting on right ventricular functions assessed by tissue Doppler echocardiography. Cardiovasc J Afr. 2012;23(2):63-6.

8. Umana Pizano JB, Arain FD, Harb SC, Bakaeen FG, and Elgharably H. Is right ventricular free wall revascularization underrated? Sequential bypass of mid-right coronary artery to resolve acute right ventricular dysfunction. JTCVS Tech. 2023;21:118-21.
9. Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. J Am Soc Echocardiogr. 2010;23(7):685-713; quiz 86-8.
10. Roshanali F, Yousefnia MA, Mandegar MH, Rayatzadeh H, and Alinejad S. Decreased right ventricular function after coronary artery bypass grafting. Tex Heart Inst J. 2008;35(3):250-5.
11. Chinikar M, Rafiee M, Aghajankhah M, et al. Right ventricular dysfunction and associated factors in patients after coronary artery bypass grafting. ARYA Atheroscler. 2019;15(3):99-105.
12. Paparella D, Yau TM, and Young E. Cardiopulmonary bypass induced inflammation: pathophysiology and treatment. An update. Eur J Cardiothorac Surg. 2002;21(2):232-44.
13. Shiraishi M, Kimura N, and Yamaguchi A. Early cardiac contractility outcome of reoperative coronary artery bypass grafting using right gastroepiploic artery. J Card Surg. 2021;36(11):4103-10.
14. Nguyen T, Ngo K, Vu TL, et al. Introducing a Novel Innovative Technique for the Recording and Interpretation of Dynamic Coronary Angiography. Diagnostics (Basel). 2024;14(12)
15. Olearchyk AS. Coronary artery bypass supplemented by grafting of the right ventricular branches. Vascular surgery. 1993;27(7):531-38.
16. Guney MR and Eren E. Revascularization of multiple bypassable extended right coronary arteries. J Thorac Cardiovasc Surg. 2004;127(4):1133-8.
17. Korshin A, Gronlykke L, Nilsson JC, et al. Tricuspid annular plane systolic excursion is significantly reduced during uncomplicated coronary artery bypass surgery: A prospective observational study. J Thorac Cardiovasc Surg. 2019;158(2):480-89.
18. Hashemi Jazi M, Amirpour A, Zavvar R, Behjati M, and Gharipour M. Predictive value of P-wave duration and dispersion in post coronary artery bypass surgery atrial fibrillation. ARYA Atheroscler. 2012;8(2):59-62.
19. Park SJ, Kim HJ, Kim JB, et al. Sequential Versus Individual Saphenous Vein Grafting During Coronary Arterial Bypass Surgery. Ann Thorac Surg. 2020;109(4):1165-73.
20. Hou X, Zhang K, Liu T, et al. The expansion of no-touch harvesting sequential vein graft after off-pump coronary artery bypass grafting. J Card Surg. 2021;36(7):2381-88.
21. Perez-Riera AR, de Abreu LC, Barbosa-Barros R, Grindler J, Fernandes-Cardoso A, and Baranchuk A. P-wave dispersion: an update. Indian Pacing Electrophysiol J. 2016;16(4):126-33.