Original Article

Radial artery graft in coronary artery bypass surgery 1 week to 1 year postoperation

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Background: The actual patency rate of the radial artery (RA) grafts 1 week and 1 year after coronary artery bypass grafting (CABG) has not been extensively reported on. We used coronary computed tomography angiography (CCTA) to evaluate the patency rate of RA grafts and compared it with that of saphenous vein (SV) grafts.

Methods: In this observational cohort study, 80 patients who underwent urgent or elective CABG with RA and SV grafts at Ruijin Hospital from August 2019 to June 2021 were included. Follow-up CCTA scans were completed about 1 year postoperation in the out-patient clinic. We graded the grafts into four classes: A, excellent; B, graft diameter <50% of target coronary artery; O, occluded; and S, string sign. Both S and O were defined as graft failure.

Results: The patients' mean age was 58.48±8.06 years, and 87.5% (70/80) of the patients were male. The 1-week patency rate of the left internal mammary artery (LIMA), RA, and SV grafts were 98.7% (75/76), 76.3% (61/80), and 93.8% (75/80), respectively. At 1 year, the patency rate of the LIMA, RA, and SV grafts were 97.4% (74/76), 80.0% (64/80), and 81.3% (65/80), respectively. The RA graft patency rate was lower than was the SV graft patency rate perioperatively [relative risk (RR): 0.918; 95% confidence interval (CI): 0.852–0.990; P=0.007]. Moreover, 63.6% (7/11) of RA grafts graded S and 25.0% (2/8) of RA grafts graded O were defined as patent (graded A or B) at 1 year postoperation. Compared with SV grafts, more RA grafts improved (RA: 12/80, 15.0%; SV: 0%) and fewer RA grafts deteriorated (RV: 10/80, 12.5%; SV: 19/80, 23.8%) from 1 week to 1 year (P=0.001). The patency rate of the 2 types of grafts became similar at 1 year postoperation (RR: 0.560; 95% CI: 0.113–2.781; P>0.99).

Conclusions: RA grafts had a lower patency rate than did SV grafts 1 week after operation. However, because of the "revival" phenomena and lower attrition rate, the patency rate of the two kinds of grafts did not show any significant difference at 1 year.

Keywords: Coronary artery bypass grafting (CABG); radial artery (RA); patency rate

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Introduction

Coronary artery bypass grafting (CABG) represents the gold standard treatment for multivessel coronary artery disease (CAD). The use of the left internal mammary artery (LIMA) is now a quality indicator of CABG, as superiority of LIMA to the left anterior descending (LAD) coronary artery (1). The radial artery (RA) was first reported as a secondary conduit for CABG by Carpentier in 1971. Many studies have shown that the RA, which potentially offers the survival advantage of arterial grafting, is an attractive second arterial conduit after the LIMA (2-4).

However, an important question regarding the efficacy of CABG is the patency of the grafts. Obstructive graft failure is consistently associated with substantial morbidity, whether clinically driven or found on routine angiography (5). Achouh *et al.* (6) reported that most radial graft occlusions occurred within the first year postoperation, which was followed by an extremely slow decrease in patency. Concerns with regard to RA patency in the early postoperation period limit RA grafting during CABG. However, there is little research concerning RA graft lesions at 1 week postoperation before discharge, and few studies have compared the 1-week and 1-year patencies of RA grafts with those of saphenous vein (SV) grafts. We therefore carried out this study to describe the RA grafts lesions at 1 week and 1 year postoperation and to compare the patency of RA grafts with that of SV grafts at these time points. We also aimed to identify the risk factors associated with early lesions in RA grafts. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-574/rc).

Highlight box

Key findings

- The patency rate of radial artery (RA) grafts was lower than that of SV grafts at 1 week postoperation, but the patency rate of the two graft types did not show any significant difference at 1 year postoperation.

What is known and what is new?

- RA is an attractive second arterial conduit, and the revival phenomenon has been observed in RA grafts.
- The patency rate of RA grafts at 1 week and 1 year after coronary artery bypass grafting has not been extensively investigated. In this study, compared to saphenous vein (SV) grafts, more RA grafts improved (RA: 12/80, 15.0%; SV: 0%), and fewer RA grafts deteriorated (RA: 10/80, 12.5%; SV: 19/80, 23.8%) from 1 week to 1 year (P=0.001). Moreover, 63.6% (7/11) of string sign RA grafts and 25.0% (2/8) of occlusion RA grafts at 1 week were defined as patent at 1 year postoperation.

What is the implication, and what should change now?

- More attention should be paid on improving the perioperation outcomes of RA grafts.

Methods

Patients

An observational cohort study was conducted. From August 2019 to June 2021, there were 118 patients with CAD who had undergone urgent or elective CABG with RA grafts at Ruijin Hospital. Of these patients, 18 refused to participate in the clinical trials. Of the remaining 100 patients, 80 patients accepted both RA graft and SV grafts. All 80 (80/118, 67.8%) patients who underwent coronary computed tomography angiography (CCTA) at 1 week were included in this study. CCTA was also completed for these patients at 1 year in the out-patient clinic. The indication for RA utilization was a target vessel stenosis >70% on coronary arteriography as judged by a specialist physician. Any prior RA punctures including for blood gas sampling, pressure monitoring, or transradial angiography was considered a contraindication for using the RA. We also abandoned RA usage in patients with severe left ventricular dysfunction [left ventricular ejection fraction (LVEF) <35%], severe ascending aortic calcification, Raynaud disease, or severe chronic renal disease requiring hemodialysis access. All patients were enrolled in two randomized control trials conducted in the Department of Cardiovascular Surgery at Ruijin Hospital (7,8). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the ethics committee of Ruijin Hospital affiliated with Shanghai Jiao Tong University (approval No. 2019 [42]). All study participants provided informed consent.

The primary outcome was the RA occlusion rate on CCTA at 1 week postoperation. The secondary outcomes were the occlusion rates on CCTA of RA and SV grafts at 1 year postoperation and the graft lesion aggravation rate from 1 week to 1 year.

Surgical methods

An Allen test of <10 s was a precondition of harvesting the RA. All the RAs were harvested from the nondominant arms, with the traditional open technique being exclusively

used. The RA was no-touch isolated from the perivascular sheath and accompanying veins. A special buffer solution containing heparin and papaverine was used to flush the RA lumen before and after transection with no extra pressure, and the isolated RA was then stored in a solution until anastomosis (9). The SVs of the thigh were harvested with traditional open incision. The SV was removed with scissors without peripheral adipose tissue. All patients underwent off-pump CABG (OPCAB) with no conversion to cardiopulmonary bypass. Proximal anastomosis of the RA to the hood of the LIMA or SV graft was performed only if the length of the RA was insufficient. No patients required an additional SV graft to the RA graft target due to intraoperative RA spasm. The transit time flow measurement (TTFM) was conducted intraoperatively before administration of protamine sulfate. A mean graft flow (MGF) <20 mL/min or a pulsatility index (PI) >5 indicates malfunction of the graft, for which repeat anastomosis should be considered (10).

According to Tranbaugh *et al.* (2), diltiazem was administrated via intravenous infusion after anesthesia and continued until oral nitrate or diltiazem was substituted. The antispasm treatment was continued 3 to 6 months postoperation for every patient. All patients were prescribed antiplatelet therapy and statins from the first day after CABG. Dual antiplatelet therapy was the standard treatment, and single antiplatelet therapy was administrated when the platelet count was lower than 70×10^{12}/L. Patients with recurrent atrial fibrillation accepted a compound antithrombotic therapy of aspirin (100 mg) and rivaroxaban (10 or 15 mg) once a day. Other concomitant medications, such as β-blockers, angiotensin-converting enzyme inhibitors (ACEIs), or angiotensin receptor blockers (ARBs), were selected by surgeons according to American College of Cardiology/American Heart Association guidelines (11-13).

CCTA procedure and interpretation

CCTA was performed using a third-generation dual-source computed tomography system (SOMATOM Force; Siemens Healthineers, Erlangen, Germany). Metoprolol (25–50 mg) was prescribed to patients orally if the heart rate was above 80 beats per minute 1 hour before scanning.

CCTA images were evaluated by two experienced radiologists who had access to the operation records. According to the Fitzgibbon criteria (14), we graded the grafts into four classes: A, excellent; B, graft diameter <50% of target coronary artery; O, occluded; and S, string sign (*Figure 1*). Grades B, O, and S were considered to indicate graft disease or lesion. Grades O and S were defined as graft failure or occlusion. The grade of a graft was decided by the most severe stenosis of the proximal anastomosis, the graft body, and the distal anastomoses. For sequential anastomosis, one occlusion of any of the distal anastomoses was considered to be occlusion of the whole graft vessel. S was defined as a full-length slim graft trunk diameter of less than 1.5 mm and unobstructed proximal and distal anastomoses (15-18).

Statistical analysis and data collection

All data were collected from the medical records and verified by two clinical research coordinators. Continuous variables are presented as the mean and standard deviation (SD) or the median and interquartile range; categorical variables are presented as counts and percentages. Comparisons across the groups were performed with a two-tailed unpaired *t*-test for continuous variables and with the χ^2 test or Fisher exact test for categorical variables. The self-paired comparison of the RA graft and SV graft patency was performed with the McNemar test. The Kruskal-Wallis test was used to compare rank variables between groups. Logistic regression was used to estimate the relationship between a dependent variable and one or more independent variables. $P<0.05$ was considered statistically significant for all analyses. All the analyses were performed with the SPSS version 28 (IBM Corp., Armonk, NY, USA).

Results

Patients

From August 2019 to June 2021, 118 patients with CAD underwent urgent or elective CABG with RA grafts at Ruijin Hospital. Among these patients, 80 (80/118, 67.8%) who agreed to participate in the study and underwent CCTA at 1 week were included in this study. All of these patients underwent 1-year follow-up CCTA in the out-patient clinic at Ruijin Hospital or another hospital. *Table 1* summarizes the preoperative characteristics. In brief, the patients' mean age was 58.48±8.06 years, with a range of 35 to 70 years, and 87.5% (70/80) percent were male. The prevalence rate of previous myocardial infarction (MI) and previous stroke was 43.8% (35/80) and 13.8% (11/80), respectively, and 40.0% (32/80) of the patients had

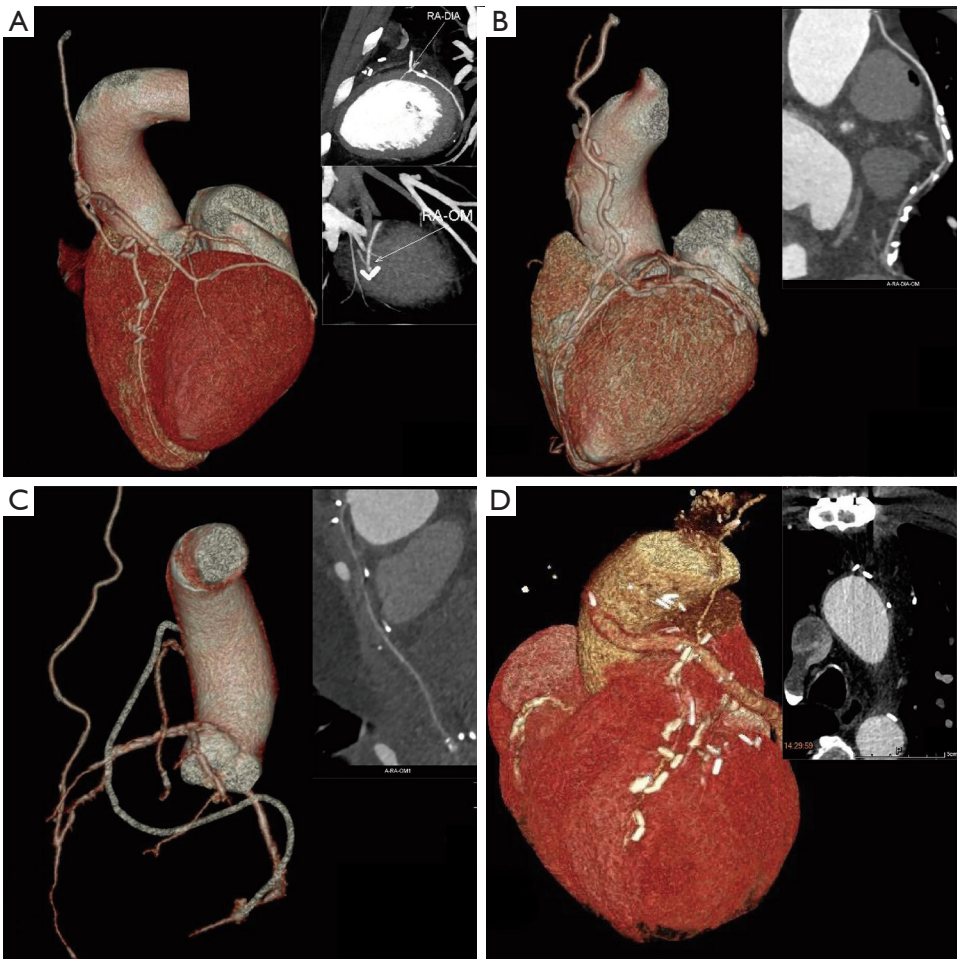

Figure 1 Examples of A, B, S, and O grades of CABG grafts. (A) CCTA graph of grade A; (B) CCTA graph of grade B; (C) CCTA graph of grade S; (D) CCTA graph of grade O. The small panel at the right top of each picture shows the full length of the RA graft if it is not occluded. RA, radial artery; DIA, diagonal branch; OM, obtuse marginal branch; CABG, coronary artery bypass grafting; CCTA, coronary computed tomography angiography.

left main CADs. Preoperative echocardiography showed that the LVEF was 60.68%±7.39% [42–73%], and the left ventricular end-diastolic dimension (LVEDD) was 50.76±5.03 [40–65] mm. The vast majority (95.0%, 76/80) of patients had triple vessel disease.

Operative data

The operative data of the 80 patients in this study are presented in *Table 2*. All patients accepted RA and SV grafts. The mean number of grafts per patient was 3±0.32, with an average of 1.98±0.27 RA grafts and 1.02±0.16 SV grafts per patient. The mean number of distal anastomoses per patient was 3.82±0.72, with an average of 2.15±0.48 arterial distal anastomoses and 1.68±0.65 venous distal anastomoses per patient. Moreover, 11 proximal anastomoses of the RA to the hood of the LIMA or SV graft were performed due to insufficient RA length (19,20). Among the RA grafts, 71 were anastomosed to the LAD or left circumflex artery (LCX) and 9 RA grafts were anastomosed to the right coronary artery (RCA). The mean MGF of the LIMA, RA, and SV grafts were 62.80±37.78, 48.96±31.23, and 78.39±51.96 mL/min, respectively. The mean PI of the LIMA, RA, and SV grafts were 2.45±0.89, 2.21±1.07, and 3.17±3.14, respectively. No patients required an additional SV graft to the RA graft target due to intraoperative RA spasm.

Table 1 Characteristics of the patients at baseline

Characteristics	All patients (n=80)	RA patency at 1 week (n=61)	RA occlusion at 1 week (n=19)	P value
Age (years)	58.48±8.06	58.92±8.10	57.05±7.99	0.382
Male sex	70 (87.5)	56 (91.8)	14 (73.7)	0.052
BMI (kg/m^2)	25.15±3.57	24.97±3.55	25.74±3.65	0.416
Hypertension	54 (67.5)	47 (77.0)	7 (36.8)	0.001*
Systolic pressure (mmHg)	132.58±19.77	133.84±21.05	128.53±14.66	0.310
Diastolic pressure (mmHg)	75.05±11.32	75.67±11.59	73.05±10.44	0.382
Mean pressure (mmHg)	93.26±12.68	93.59±13.51	92.23±9.99	0.712
Serum lipid				
HDL (mmol/L)	0.96±0.21	0.97±0.21	0.93±0.19	0.511
LDL (mmol/L)	2.28±0.92	2.33±0.96	2.12±0.79	0.407
LP(a) (g/L)	0.26±0.29	0.27±0.28	0.24±0.32	0.650
Triglyceride (mmol/L)	1.64±0.84	1.63±0.83	1.66±0.90	0.904
Cholesterol (mmol/L)	3.84±1.08	3.88±1.08	3.70±1.08	0.534
Diabetes				
HbA1c (%)	6.77±1.33	6.83±1.22	6.57±1.67	0.454
Previous MI	35 (43.8)	28 (45.9)	7 (36.8)	0.487
Previous stroke	11 (13.8)	9 (14.8)	2 (10.5)	0.632
Scr (μmol/L)	83.24±28.85	86.64±31.26	72.32±15.18	0.058
Smoking				0.886
None	30 (37.5)	23 (37.7)	7 (36.8)	
Quit	10 (12.5)	7 (11.5)	3 (15.8)	
Current	40 (50.0)	31 (50.8)	9 (47.4)	
Preoperative echocardiography				
LA (mm)	39.01±4.24	39.02±4.47	39.00±3.53	0.988
LVEDD (mm)	50.76±5.03	50.79±5.39	50.68±3.77	0.939
LVESD (mm)	34.30±5.63	34.59±5.91	33.37±4.62	0.412
LVEF (%)	60.68±7.39	60.10±7.57	62.53±6.64	0.213
LM stenosis	32 (40.0)	20 (32.8)	12 (63.2)	0.018*
Diseased vessels				
Double	4 (5.0)			
Triple	76 (95.0)			

Data are presented as n (%) or mean ± SD. *, P≤0.05. None (smoking), never smoked; quit (smoking), quit from smoking for more than 1 year; current (smoking), smoked within the past year. RA, radial artery; BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein; LP(a), lipoprotein (a); HbA1c, glycosylated hemoglobin; MI, myocardial infarction; Scr, serum creatinine; LA, left atrium; LVEDD, left ventricular end-diastolic dimension; LVESD, left ventricular end-systolic dimension; LVEF, left ventricular ejection fraction; LM, left main coronary disease; SD, standard deviation.

Table 2 Intraoperative and perioperative data

Characteristics	All patients (n=80)	Patients with RA patency (n=61)	Patients with RA occlusion (n=19)	P value
LIMA graft	76 (95.0)			
LIMA flow (mL/min)	62.80±37.78			
LIMA PI	2.45±0.89			
RA proximal				0.717
Aortic artery	69 (86.3)	53 (86.9)	16 (84.2)	
LIMA or SV	11 (13.8)	8 (13.1)	3 (15.8)	
RA sequential	13 (16.3)	10 (16.4)	3 (15.8)	0.95
RA flow (mL/min)	48.96±31.23	49.85±29.11	46.10±38.01	0.651
RA PI	2.21±1.07	2.08±0.93	2.63±1.36	0.05*
SV sequential	47 (58.8)			
SV flow (mL/min)	78.39±51.96			
SV PI	3.17±3.14			
Max value within 3 days postoperation				
CK-MB (ng/mL)	9.06±10.86	8.43±8.28	11.05±16.83	0.363
CTnI (ng/mL)	1.41±1.96	1.33±1.47	1.66±3.11	0.524
Myoglobin (ng/mL)	256.39±186.22	270.03±195.99	212.62±146.62	0.243
ECG postoperation				
LA (mm)	37.26±4.57	37.30±4.83	37.16±3.74	0.91
LVEDD (mm)	47.86±5.46	47.75±5.88	48.21±3.92	0.753
LVESD (mm)	32.85±6.30	33.10±6.86	32.05±4.05	0.531
LVEF (%)	59.88±8.18	59.44±8.73	61.26±6.07	0.4

Data are presented as n (%) or mean ± SD. *, P≤0.05. RA, radial artery; LIMA, left internal mammary artery; PI, pulse index; SV, saphenous vein; CK-MB, creatine kinase, MB form; CTnI, cardiac troponin I; ECG, electrocardiography; LA, left atrium; LVEDD, left ventricular end-diastolic dimension; LVESD, left ventricular end-systolic dimension; LVEF, left ventricular ejection fraction; SD, standard deviation.

RA grafts outcome from 1 week to 1 year

The 1 week patency rate of the LIMA, RA, and SV grafts were 98.7%, 76.3%, and 93.8%, respectively (*Table 3*). The perioperative patency rate of RA grafts was obviously lower than that of the SV grafts [76.3% *vs.* 93.8%; relative risk (RR): 0.918; 95% confidence interval (CI): 0.852–0.990; P=0.007]. At 1 year postoperation, the patency rate of the RA grafts was the same as that of the SV grafts (80.0% *vs.* 81.3%; RR: 0.560; 95% CI: 0.113–2.781; P>0.99; *Table 4*) but was still much lower than that of the LIMA grafts (80.0% *vs.* 97.4%, P<0.01). This was because of the revival of RA grafts observed on CCTA. Moreover, 7 (7/11, 63.6%) RA grafts graded S and 2 (2/8, 25.0%) RA grafts graded O at 1 week were defined as patent (graded A or B) at 1 year postoperation, while no SV graft revival occurred during the follow-up period. Among the RA grafts, 15.0% (12/80) improved within 1 year, which was not observed in the SV grafts. Additionally, more SV grafts lesions were aggravated than were RA grafts (SV: 19/80, 23.8%; RA: 10/80, 12.5%). Therefore, more RA grafts improved and more SV grafts deteriorated from 1 week to 1 year (Kruskal-Wallis test, P=0.001). The change of RA grafts grade from 1 week to 1 year postoperation is shown in *Figure 2*.

Risk factors of RA graft failure

At 1 week postoperation, compared with the RA failure

Table 3 Outcomes of grafts on CCTA 1 week and 1 year postoperation

Graft type	Patency, n (%)		Failure, n (%)	
	A	B	S	O
1-week RA	56 (70.0)	5 (6.3)	11 (13.8)	8 (10.0)
1-year RA	57 (71.3)	7 (8.8)	3 (3.8)	13 (16.3)
1-week SV	69 (86.3)	6 (7.5)	0	5 (6.3)
1-year SV	54 (67.5)	11 (13.8)	0	15 (18.8)
1-year LIMA	72 (94.7)	2 (2.6)	0	2 (2.6)

CCTA, coronary computed tomography angiography; RA, radial artery; SV, saphenous vein; LIMA, left internal mammary artery.

Table 4 Self-paired four-fold table of RA grafts and SV grafts

Outcome of graft	Total, n (%)	RA patency, n (%)	RA failure, n (%)	P value	RR (95% CI)
1 week				0.007	0.918 (0.852–0.990)
SV patency	75 (93.8)	56 (70.0)	19 (23.8)		
SV failure	5 (6.3)	5 (6.3)	0		
Total	80 (100.0)	61 (76.3)	19 (23.8)		
1 year				>0.99	0.560 (0.113–2.781)
SV patency	65 (81.3)	51 (63.7)	14 (17.5)		
SV failure	15 (18.8)	13 (16.3)	2 (2.5)		
Total	80 (100.0)	64 (80.0)	16 (20.0)		

RA, radial artery; SV, saphenous vein; RR, relative ratio; CI, confidence interval.

group (grade O and S), the RA patent group (grade A and B) had lower PI (2.08 *vs.* 2.63, P=0.05), a lower proportion of left main disease (32.8% *vs.* 63.2%, P=0.018), and a greater proportion of hypertension (77.0% *vs.* 36.8%, P=0.001).

Discussion

In this observational cohort study, the patency rate of RA grafts and SV grafts did not show any significant difference at 1 year postoperation although the RA grafts had a much lower patency rate at 1 week.

We found that the patency rate of RA grafts in the early postoperative period was much lower than that of LIMA grafts and SV grafts, even with antispasmodic treatment. However, the revival phenomenon was observed for RA grafts (*Figure 3*). The patency rate of RA grafts increased within 1 year postoperation compared with 1 week. According to Achouh *et al.*, most radial graft occlusions occur within the first 6 months of operation, and beyond 1 year, the RA graft patency trend is linear, with a very low attrition rate for up to 20 years (6). The 10-year results of the Radial Artery Patency and Clinical Outcomes (RAPCO) study showed that RA patency was significantly higher than that of the free right internal mammary artery (RIMA) and higher than that of the SV, although this latter difference was not statistically significant (3). We speculated the overlap of the RA graft and SV graft patency rates would occur at about 1 year after CABG, with the advantage of RA grafts over SV grafts becoming increasingly evident at 1 year after CABG.

Therefore, more attention should perhaps be paid on improving the early-stage outcomes of RA grafts. Spasm of the RA, stenosis of the target coronary artery, and competitive flow are recognized as the determinants of RA patency (21-23). The Radial Artery Database International Alliance (RADIAL) project proposed that long-term use of calcium channel antagonist therapy is associated with a nominally significantly lower risk of RA graft occlusion (4). Meanwhile, Schwann *et al.* reported that using verapamil in the storage solution was enough for antispasmodic

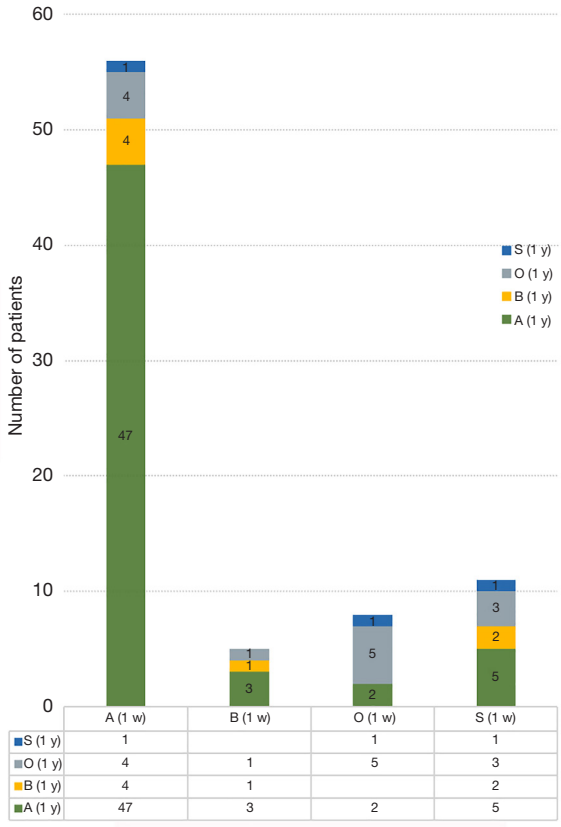

Figure 2 The change in RA graft grade from 1 week to 1 year postoperation. There were 56 grade A, 5 grade B, 8 grade O, and 11 grade S RA grafts 1 week after CABG. The 1-year RA grafts grades are shown by the color bars. Green bars represent grade A, yellow bars represent grade B, gray bars represent grade O, and blue bars represent grade S. 1 y, 1-year; 1 w, 1-week; A, grade A; B, grade B; O, grade O; S, grade S; RA, radial artery; CABG, coronary artery bypass grafting.

treatment (24). A meta-analysis of randomized controlled trials advised a target vessel stenosis of at least 70% to minimize the impact of competitive flow (24). Most of RA grafted anastomoses to the obtuse marginal artery in this study. Antispasm treatment was administrated for every patient from anesthesia induction up to at least 3–6 months postoperation. We typically follow the practice of using RA graft in CABG; however, at 1 week, the proportion of both RA graft occlusion and string sign were still as high as 23.8% in this group of patients, which was much higher than that of LIMA graft and SV graft. We further found that the PI in the RA graft patency group was lower than that of the RA graft failure group (2.08±0.93 *vs.* 2.63±1.36, P=0.05). We speculate that there must be some other risk factors that result in the failure or spasm of the RA grafts in the early postoperative period (22,25-27). We analyzed the data and found that hypertension is likely to have some association with RA graft failure within 1 week postoperation (*Table 5*). Appropriate antispasm treatment without low blood pressure may be important in the early postoperative period. For RA graft target selection, we new techniques, such as quantitative flow ratio, may be more accurate than visual angiographic assessment in evaluating the appropriate target vessel. Moreover, no-touch SV harvesting should be more strongly considered, as Dreifaldt *et al.* have reported excellent outcomes at 8-year follow-up. Finding the appropriate secondary graft for each patient with CAD is critical for effective treatment (28).

At present, the RA is considered to be an attractive second arterial conduit, as it is an excellent match in size to the coronary arteries not involving concerns regarding wound complication or bleeding. However, increasing the RA grafts patency in the early postoperative period needs further study. Our study reported the real patency rate of RA grafts at 1 week and 1 year postoperation assessed with CCTA. The outcomes indicate that perhaps a CCTA scan before discharge can be beneficial for patients with CAD who undergo CABG with RA grafts. More attention and outpatient review may be needed in patients with RA graft failure.

Limitations

Our study has several limitations. First, a single-center study design was used with relatively small sample size. Second, the graft patency was evaluated with CCTA and not coronary arteriography. Although CCTA has been proven to be a less invasive and an effective tool for evaluating graft patency, it is hard to distinguish spasm from occlusion. Our evaluation for RA graft grade may be more strict than that of other studies, as only excellent patency with a smooth wall on CCTA was considered to be grade A, and any focal nonpermeability was considered to be occlusion of the whole graft. Third, we selected more important targets for the RA grafts than for the SV grafts, which may constitute a source of bias. Moreover, 71 RA grafts were anastomosed to the LAD or LCX while only 10 SV grafts were anastomosed

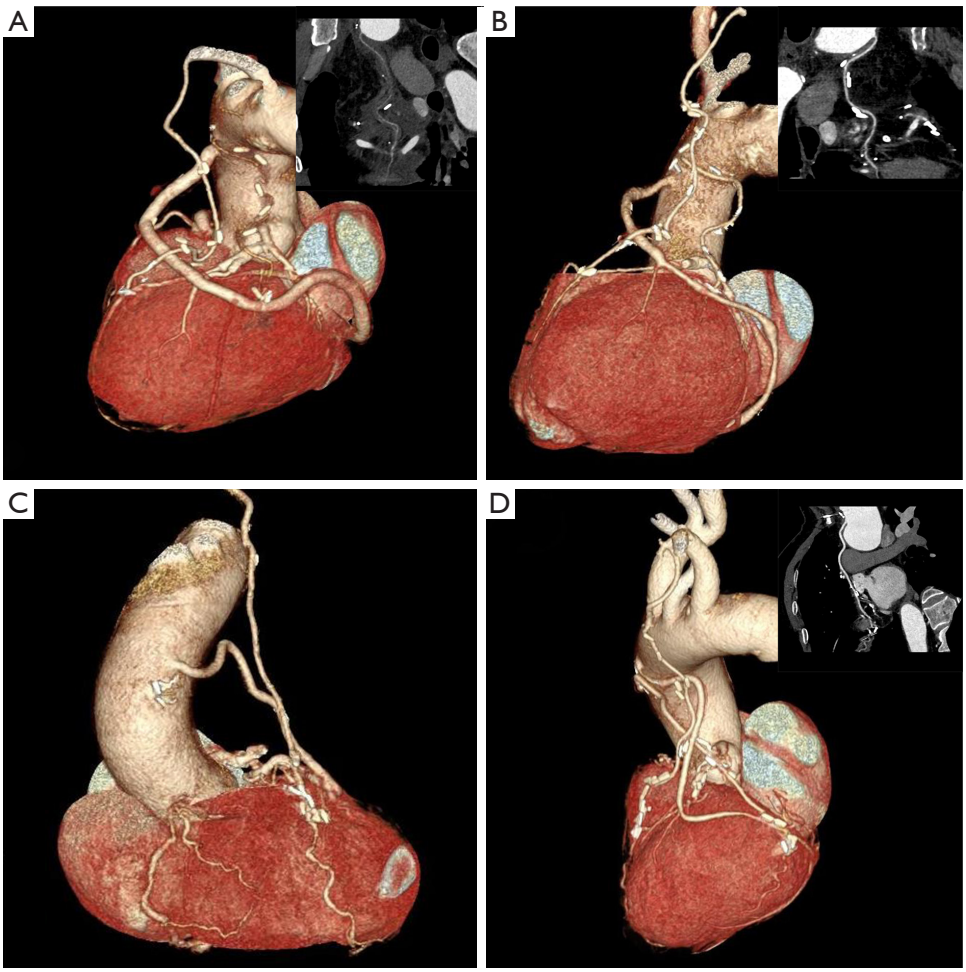

Figure 3 Revival phenomenon of RA grafts. (A) Grade S and (B) grade A show the revival of RA grafts from grade S. (C) Grade O and (D) grade A show the revival of the RA grafts from grade O. The small panel at the right top of each image shows the full length of the RA graft if it is not occluded. RA, radial artery.

Table 5 Logistic regression of risk factors for 1-week RA failure

Variables	P value	OR (95% CI)
Age	0.224	0.889–1.028
Gender	0.102	0.749–24.245
LM disease	0.158	0.703–8.732
Hypertension	0.010	0.055–0.672
PI	0.271	0.782–2.401

RA, radial artery; OR, odds ratio; CI, confidence interval; LM, left main coronary disease; PI, pulse index.

to the diagonal branch or LCX.

Conclusions

The patency rate of RA grafts may be lower than that of SV grafts 1 week postoperation (76.3% *vs.* 93.8%, P=0.007). However, due to the revival phenomenon and lower attrition rate of RA grafts, the patency rate was not significantly different in these two graft types at 1 year postoperation (80.0% *vs.* 81.3%, P>0.99).

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the ethics committee of Ruijin Hospital affiliated with Shanghai Jiao Tong University (approval No. 2019 [42]). All study participants provided informed consent.

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