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Surgical Myocardial Revascularization with a Composite T-graft from the Left Internal Mammary Artery—Comparison of the Great Saphenous Vein with the Radial Artery

Arne Eide[1,*] Jill Jussli-Melchers[1,*] Christine Friedrich[1] Assad Haneya[1] Georg Lutter[1] Jochen Cremer[1] Jan Schoettler[1]

[1] Department of Cardiovascular Surgery, University Hospital of Schleswig-Holstein, Campus Kiel, Germany

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Address for correspondence Jill Jussli-Melchers, MD, Department of Cardiovascular Surgery, University Hospital of Schleswig-Holstein, Campus Kiel, Arnold-Heller-Str. 3, Haus C, 24105 Kiel, Germany (e-mail: MarkaJill.Jussli-Melchers@uksh.de).

Abstract

Background Composite T-grafts between left internal mammary artery (LIMA) and radial artery (RA) are a common concept in complete arterial myocardial revascularization. The aim of the present study was to investigate whether the use of the great saphenous vein (SV) instead of RA leads to comparably good results in terms of outcome in this context.

Methods Patients who underwent myocardial revascularization with a T-graft using RA or a segment of SV to the right coronary artery or circumflex artery between the beginning of 2014 and the end of 2019 at the Department of Cardiovascular Surgery, University Hospital Schleswig-Holstein, Campus Kiel were included. To minimize surgical variation, only patients were observed by a single senior surgeon in the department. Exclusion criteria were previous cardiac surgery, preoperative extracorporeal circulatory support, off-pump surgery, additional aortocoronary bypasses, and cardiac combination procedures.

Results A total of 115 patients were studied. In 55 patients, the T-graft was placed between the LIMA and SV, and in 60 patients, the T-graft was placed between the LIMA and RA. Patients in the SV group were older (70.6 ± 7.8 vs. 58.5 ± 10.0 years; $p < 0.001$), suffered more frequently from non-ST elevation myocardial infarction (12.7 vs. 1.7%; $p = 0.027$), arterial hypertension (83.6 vs. 61.7%; $p = 0.009$), and atrial fibrillation (18.2 vs. 1.7%; $p = 0.003$). They were less likely to be active smokers (16.4 vs. 38.3%; $p = 0.009$) and less likely to have a history of variceal surgery (0 vs. 15.0%; $p = 0.003$). Calcification of the ascending aorta was also found more frequently in the saphenous group (18.2 vs. 3.3%, $p = 0.009$). Operative times and number of distal anastomoses did not differ significantly between the two groups. Postoperative deliriums (16.7 vs. 5.0%; $p = 0.043$) were observed more frequently in venous patients. Wound healing disorders of the leg (11.1 vs. 0%; $p = 0.011$) did only occur in SV group and wound infections of the arm only in the RA group. Complete follow-up was achieved in 74.8% of cases. Median follow-up was 60.3 (39.6; 73.2) months. Serious

Keywords
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- CABG
- T-Graft
- Composite graft
- Saphenous vein
- internal thoracic artery
- aortic bypass anastomosis

* *These authors contributed equally to this study.*

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adverse cardiac–cerebral events (19.0 vs. 22.7%; $p = 0.675$) and mortality (14.5 vs. 6.7%; $p = 0.167$) did not differ significantly between the groups at follow-up. Myocardial infarction (0 vs. 2.5%; $p = 1.000$) and stroke (0 vs. 7.5%; $p = 0.245$) were observed exclusively in RA group. Percutaneous coronary intervention was required in single patients of RA group (0 vs. 15.0%; $p = 0.028$). No patient from either group underwent repeat coronary artery bypass grafting (CABG). The patients of SV group had angiographically competent grafts and open anastomoses. Graft failure was noted in a single patient in RA group, in which case both grafts and native coronary vessels were stented. Kaplan–Meier analysis revealed no significant survival disadvantage for SV group compared with RA group.

Conclusion CABG with a composite T-graft between LIMA and a segment of SV may be comparable to bypass surgery with a composite T-graft between LIMA and RA. This might be true in terms of morbidity and mortality over an intermediate-term observation period. The results of our studies give rise to the hypothesis that the decision not to perform aortic bypass anastomosis may be more important than the choice of graft material.

Introduction

Myocardial infarction due to coronary artery disease (CAD) is the leading cause of death worldwide.[1] Percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) are the treatment modalities of choice for patients with CAD. Surgical myocardial revascularization remains the gold standard for patients with more complex CAD.[2] For decades, surgical myocardial revascularization with supply of the anterior wall of the heart by in situ left internal mammary artery (LIMA) bypass and of the lateral and posterior areas of the heart by single aortocoronary venous bypasses was the standard cardiac surgical procedure. The confrontation with increasingly older and sicker patients and the simultaneous efforts of cardiac surgeons to further perfect the surgical treatment of CAD have led over time to a variety of different surgical revascularization concepts. The highest maxim is the complete revascularization of all coronary arteries compromised by significant stenoses.[3] In many cardiac surgery centers, there is a trend toward extended arterial revascularization, especially in younger patients because arterial coronary bypasses are considered to have better long-term openness rates than venous bypasses. In situ bypass with the LIMA to the left anterior descending (LAD) artery in combination with an additional arterial bypass with proximal anastomosis to the LIMA to the affected branches of the circumflex system and the right coronary artery has been established by many surgeons.[4] The proximal anastomosis of the right internal mammary artery (RIMA) as a free graft or of the radial artery (RA) with the LIMA is performed in a T- or Y-shape (►**Fig. 1**), respectively, in order to be able to supply all cardiac regions with the limited available arterial graft material in terms of length.[4,5] Complete arterial revascularization cannot be realized in every patient and should not be forced under any circumstances. Especially in elderly patients, there are still numerous reasons for revascularization concepts that include venous grafts in addition to arterial ones. For example, in renal insufficiency with existing or impending dialysis requirement, RA harvesting should be refrained from, or in obesity, RIMA in addition to LIMA should not be used.[6] In

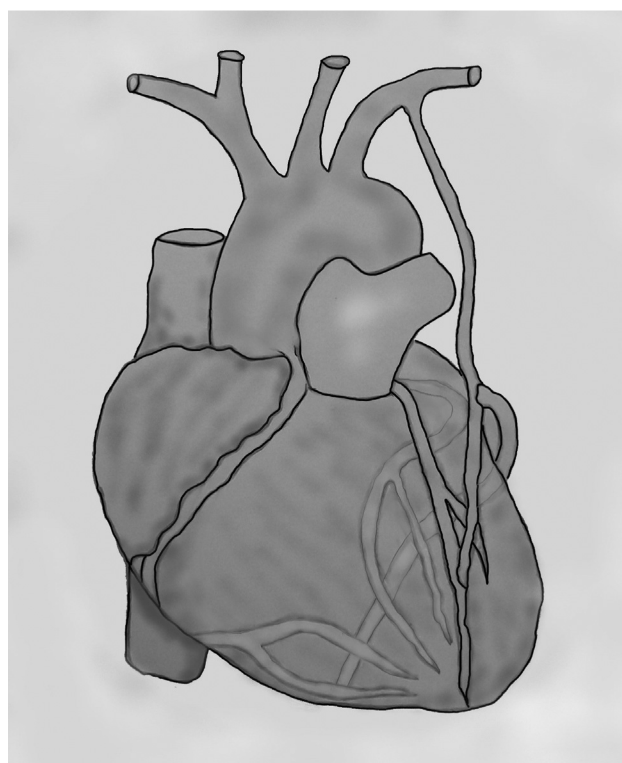

Fig. 1 Surgical myocardial revasculariszation with a composite T-graft. Shown is the principle of surgical myocardial revascularization with an in situ LIMA bypass to the left LAD and a compsite T-graft to the remaining coronary regions up to the posterior wall of the heart. LAD, anterior descending artery; LIMA, left internal mammary artery.

principle, surgical myocardial revascularization with anastomosis of the LIMA with the LAD and the creation of a possibly sequential venous bypass with proximal anastomosis at the LIMA to the lateral and posterior heart wall, in analogy to the widely used T- or Y-bypass construct of purely arterial coronary surgery, is then an option available for selection.[7] By saving length compared with a conventional venous bypass with proximal aortic anastomosis, this technique is sparing with regard to the available graft resources, and unnecessary manipulations of the ascending aorta, such as tangential clamping to make the proximal aortic bypass anastomosis, are eliminated. There are numerous publications comparing the outcome after surgical myocardial revascularization with that after PCI. However, the techniques used for surgical myocardial revascularization cannot be followed in detail. The majority of authors restrict themselves to upper criteria, such as "coronary bypass surgery with or without cardiopulmonary bypass" or "completely arterial versus venous myocardial revascularization." In fact, it has not yet been proven beyond doubt which is more decisive for successful surgical myocardial revascularization, the type of grafts used or the surgical technical aspects, such as the use of T-grafts. In the literature, there are only few publications on studies in coronary patients with an arteriovenous Y- or T-graft between the LIMA and the saphenous vein (SV) for surgical myocardial revascularization.[8–13] Against this background, the aim of the present study is to evaluate whether the construction of a T-graft with a segment of SV is equivalent to the construction of a T-graft with RA in terms of morbidity and mortality.

Methods

Patients

Patients who underwent CABG with a T-graft using a RA or a segment of the great SV between the beginning of 2014 and the end of 2019 at the Department of Cardiovascular Surgery, University Hospital Schleswig-Holstein, Kiel Campus, were studied. To minimize surgical variation, only patients from a single senior surgeon in the department were included. Patients with preoperative extracorporeal circulatory life support, without induced cardioplegic arrest, or with additional aortocoronary bypasses or concomittent cardiac surgery procedures were excluded from the studies. All included patients had given written informed consent for research with patient data. The study was approved by the local ethics committee (D 475/20).

Surgical Technique

Under intubation anesthesia, a median sternotomy was performed. The LIMA and RA or vein segment were dissected in parallel. In each case, the arterial grafts were mobilized using an electrocautery device. Arterial harvest from the forearm was performed using the open technique, and venous harvest from the leg was performed using the so-called bridge technique via several mini-incisions. The side branches were interrupted on all bypass vessels with small hemoclips. Connection to the heart–lung machine was made under complete heparinization via the right atrium and the distal ascending aorta. Moderate hypothermia was established after induced fibrillation, clamping of the ascending aorta, and ante- and usually retrograde administration of blood cardioplegia. After incision of the target coronary vessels, distal coronary anastomoses were created with Prolene 8/0. The T-anastomosis was made last, still in cardioplegia arrest, also with Prolene 8/0. For a harmonious course of the LIMA to the anterior wall of the heart, the left pericardium was incised above the phrenic nerve in all patients. After reperfusion, rewarming of the patient, and placement of temporary pacing leads, extracorporeal circulation was discontinued. This was followed by careful hemostasis, placement of chest drains, and wound closures in typical fashion.

Data Collection

Data collection was retrospective. Pre-, intra-, and postoperative variables were taken from medical records. Follow-up was performed by mail. All data collected were documented in anonymized form in an Excel spreadsheet.

Statistical Analysis

Characteristics of the patient groups were presented as mean and standard deviation and compared by unpaired *t*-test for approximately normally distributed continuous variables, while nonnormally distributed continuous data as well as ordinal data were presented as median with 25th and 75th percentiles and compared by Mann–Whitney's *U* test. Normal distribution was assessed by Kolmogorov–Smirnov's test. Categorial data were summarized as absolute (n) and relative (%) frequencies and compared by chi-square test or Fisher's exact test as appropriate. Survival was calculated on right-censored data by Kaplan–Meier's analyses and compared for differences between the groups by log rank test. All tests were performed two sided and a p-value of ≤ 0.05 was regarded as statistically significant. Data analysis was performed using IBM SPSS Statistics for Windows (Version 28.0).

Results

A total of 115 patients who underwent CABG using a T-graft were studied. In 55 patients, the T-graft construction was between the LIMA and the great SV; in the remaining 60 patients, it was between the LIMA and the RA.

Consideration of preoperative variables showed that patients in the saphenous group were significantly older (70.6 ± 7.8 vs. 58.5 ± 10.0 years; $p < 0.001$), suffered significantly more frequently from non-ST elevation myocardial infarction (12.7 vs. 1.7%; $p = 0.027$), arterial hypertension (83.6 vs. 61.7%; $p = 0.009$), and atrial fibrillation (18.2 vs. 1.7%; $p = 0.003$). Patients in this group were significantly less likely to be active smokers (16.4 vs. 38.3%; $p = 0.009$) and significantly less likely to have a history of variceal surgery (0 vs. 15.0%; $p = 0.003$). The other preoperative variables recorded were not significantly different (►**Table 1**).

Regarding intraoperative variables, calcification of the ascending aorta was found significantly more often in the saphenous goup patients (18.2 vs. 3.3%, $p = 0.009$). The use of

Table 1 Baseline characteristics

	Saphenous vein		Radial artery		*p*-Value
	% Mean ± SD	*n* (55)	% Mean ± SD	*n* (60)	
Age at surgery (y)	70.6 ± 7.8		58.5 ± 10.0		<0.001
Male (%)	76.4	42	76.7	46	0.969
Body mass index (kg/m^2)	28.9 ± 4.8		29.6 ± 5.9		0.792
One-vessel disease (%)	0	0	0	0	1.000
Two-vessel disease (%)	3.6	2	1.7	1	0.606
Three-vessel disease (%)	96.4	53	96.7	58	1.000
LMT stenosis (%)	45.5	25	40.0	24	0.555
EF (%)	52.3 ± 11.7		56.4 ± 10.5		0.084
STEMI <48 h (%)	5.5	3	1.7	1	0.348
NSTEMI <48 h (%)	12.7	7	1.7	1	0.027
Previous CPR (%)	0	0	3.3	2	0.497
Previous MI (%)	25.5	14	36.7	22	0.195
PCI in history (%)	23.6	13	35.0	21	0.182
NIDDM (%)	21.8	12	26.7	16	0.565
IDDM (%)	12.7	7	10.0	6	0.645
Hyperlipidemia (%)	56.4	31	60.0	36	0.693
Arterial hypertension (%)	83.6	46	61.7	37	0.009
Smoker (%)	16.4	9	38.3	23	0.009
Renal insufficiency (%)	12.7	7	5.0	3	0.190
Dialysis (%)	1.8	1	0	0	0.478
Atrial fibrillation (%)	18.2	10	1.7	1	0.003
COLD (%)	12.7	7	5.0	3	0.190
Peripheral artery disease (%)	14.5	8	6.7	4	0.226
Stroke in history (%)	5.5	3	6.7	4	1.000
Malignant disease (%)	7.3	4	5.0	3	0.708
Varikosis (%)	5.5	3	11.7	7	0.326
Variceal stripping (%)	0	0	15.0	9	0.003
Previous failing PCI (%)	5.5	3	1.7	1	0.348
Sleep apnea (%)	5.5	3	3.3	2	0.669
Pumonary hypertension (%)	1.8	1	1.7	1	1.000
Both legs amputated (%)	0	0	1.7	1	1.000

Abbreviations: COLD, chronic obstructive lung disease; CPR, cardiopulmonary resuscitation; EF, ejection fraction; IDDM, insulin-dependent diabetes mellitus; LMT, left main trunk; MI, myocardial infarction; NIDDM, noninsulin-dependent diabetes mellitus; NSTEMI, non-ST elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST elevation myocardial infarction.

the LIMA as a sequential bypass occurred significantly less frequently in this group (7.3 vs. 25.0; $p = 0.011$). Surgical times and number of distal anastomoses did not differ significantly from the radialis group (►**Table 2**).

Apart from postoperative delirium, which was significantly more frequent in the venous group (16.7 vs. 5.0%; $p = 0.043$), and wound healing disorders of the leg (11.1 vs. 0%; $p = 0.011$), both groups did not differ significantly with respect to the postoperative variables. Complete follow-up was achieved in 76.4 and 73.3% of cases, respectively (►**Table 3**).

The median follow-up period was significantly shorter in the venous group (55.1 [35.2; 70.7] vs. 62.6 [53.8; 73.8] months; $p = 0.026$). Major adverse cardiac and cerebral events (19.0 vs. 22.7%; $p = 0.675$) and mortality per se (14.5 vs. 6.7%; $p = 0.167$) did not differ significantly between the venous group and the radialis group at the time of follow-up. Myocardial infarctions (0 vs. 2.5%; $p = 1.000$) and strokes (0 vs. 7.5%; $p = 0.245$) were observed exclusively in the radialis group at subsequent follow-up. PCI was required only in single patients of the radialis group (0 vs. 15.0%;

Table 2 Intraoperative variables

	Saphenous vein	Radial artery	*p*-Value
Operative time (min)	198.7 ± 47.0	201.5 ± 40.1	0.486
Bypass time (min)	101.5 ± 19.0	106.8 ± 19.5	0.067
Cross clamp time (min)	79.4 ± 12.2	84.3 ± 15.8	0.065
Calcification of ascending aorta (%)	18.2	3.3	0.009
Distal anastomoses (*n*)	3.9 ± 0.6	3.8 ± 0.7	0.675
Sequential LIMA bypass (%)	7.3	25.0	0.011

Abbreviation: LIMA, left internal mammary artery.

Table 3 Postoperative variables

	Saphenous vein	Radial artery	*p*-Value
ICU stay (d)	3.4 ± 3.7	3.4 ± 5.2	0.608
Stroke (%)	5.6	1.7	0.343
Delir (%)	16.7	5.0	0.043
Atrial fibrillation (%)	24.1	13.3	0.140
Mechanical ventilation (h)	33.4 ± 59.1	31.1 ± 80.3	0.759
Tracheotomy (%)	0	1.7	1.000
Rethorakotomy (%)	9.1	10.0	0.868
Mediastinitis (%)	0	0	1.000
Dialysis (%)	1.8	1.7	1.000
Hospital stay (d)	40.5 ± 196.6	38.3 ± 188.6	0.547
30-d mortality (%)	5.5	0	0.106
Sternal wound infection (%)	5.5	10.0	0.496
Arm wound infection (%)	0	1.7	1.000
Leg wound infection (%)	11.1	0	0.011
Follow-up complete (%)	76.4	73.3	0.709

Abbreviation: ICU, intensive care unit.

$p = 0.028$), and no patient from both groups underwent redo CABG again (►**Table 4**, ►**Fig. 2**).

►**Table 5** details the coronary angiographic findings. All catheterized patients from the venous group had angiographically competent grafts with open anastomoses. Graft failure was noted only in the radialis group, where both grafts and native coronary vessels were stented in single cases. Majority of coronary angiographic examinations showed excellent results in both groups (►**Figs. 3**–**6**).

Kaplan–Meier's analysis revealed no significant survival disadvantage for the venous group compared with the radialis group (►**Figs. 7** and **8**).

Table 4 Follow-up

	Saphenous vein	Radial artery	*p*-Value
Follow-up (mo)	55.1 (35.2; 70.7)	62.6 (53.8; 73.8)	0.0026
MACCE (%)	19.0	22.7	0.675
Myocardial infarction (%)	0	2.5	1.000
Stroke (%)	0	7.5	0.245
Coronary reintervention (%)	0	15.0	0.028
Reoperation (%)	0	0	1.000
Death (%)	14.5	6.7	0.167

Abbreviations: MACCE, major adverse cardiac and cerebral event (death, myocardial infarction, stroke, or coronary reintervention).

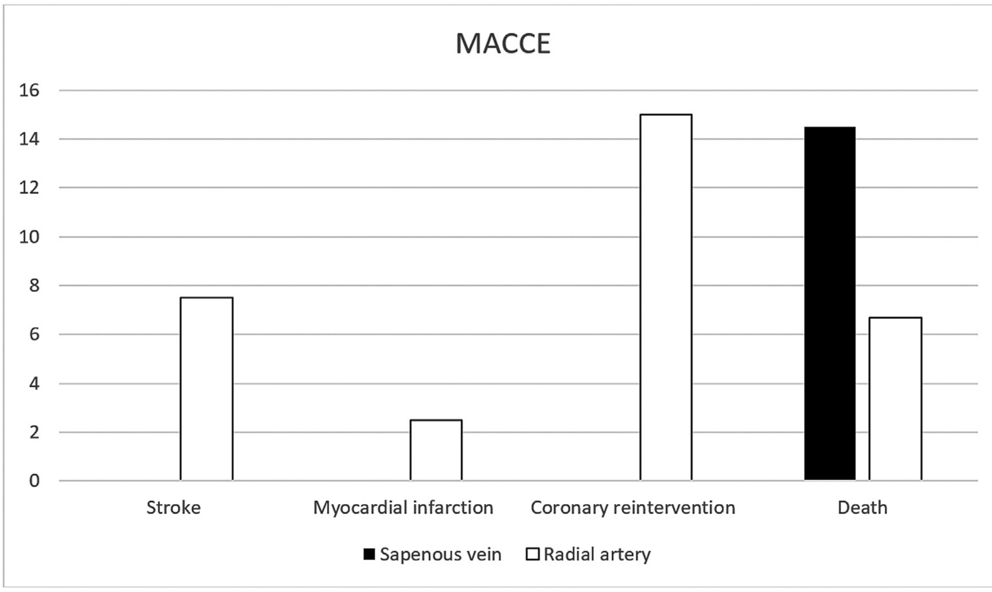

Fig. 2 Major adverse cardiac and cerebral events (MACCE) in % at follow-up.

Table 5 Recardiac catheter

	Total		Saphenous vein		Radial artery		*p*-Value
	n	%	*n*	%	*n*	%	
Recardiac catheter	11	9.6	4	36.4	7	63.6	0.745
LIMA proximal T open	11	100	4	100	7	100	1.000
LIMA distal T open	10	90.9	4	100	6	85.7	1.000
T-anastomosis open	10	90.9	4	100	6	85.7	1.000
Composite graft open	6	54.5	4	100	2	28.6	0.061
PCI LIMA	0	0	0	0	0	0	1.000
PCI composite graft	1	9.1	0	0	1	14.3	1.000
PCI native vessel	5	45.5	0	0	5	71.4	0.061

Abbreviations: LIMA, left internal mammary artery; PCI, percutaneous coronary intervention.

Discussion

For decades, surgical myocardial revascularization with supply of the anterior heart area by in situ bypass with the LIMA and of the lateral and posterior heart regions by single aortocoronary venous bypasses represented the optimal cardiac surgical procedure for the treatment of CAD.[14] In order to save graft length and to reduce the number of aortic bypass anastomoses, a trend toward sequential bypasses, that is, the supply of multiple myocardial regions by single bypasses, has developed over the years.[15] Nowadays, the gold standard, especially in younger patients and particularly in diabetics, is considered to be pure arterial myocardial revascularization using LIMA, RIMA, and RAs.[16] Because of the shorter length of arterial grafts available, completely arterial bypass surgery often involves sequential bypasses and T- or Y-shaped proximal anatomoses of the RA or the RIMA as a free graft on the LIMA.[4,5] Proximal T-anastomoses between a venous bypass and the LIMA in the context of coronary bypass surgery have played a minor role in terms of numbers so far, publications on this are consequently very rare. Therefore, the present study aimed to investigate whether T-grafts with the great SV can compete with T-grafts with the RA in terms of postoperative morbidity and mortality.

A total of 115 patients who underwent cardiac surgery and T-grafting by a single surgeon at the Department of Cardiovascular Surgery, University Hospital Schleswig-Holstein, Kiel Campus, during the 6-year period from the beginning of 2014 to the end of 2019 were retrospectively studied. In 55 patients, the great SV and in 60 patients, the RA were used for the T-graft to the LIMA.

Male gender is considered a risk factor for the development of CAD.[17] Therefore, it is not surprising that significantly more men than women were included in the present study. The mean age in the RA patient group was significantly lower than in the group with a venous T-graft. This reflects the common practice of providing young patients with arterial bypass grafts only, if possible. Almost without

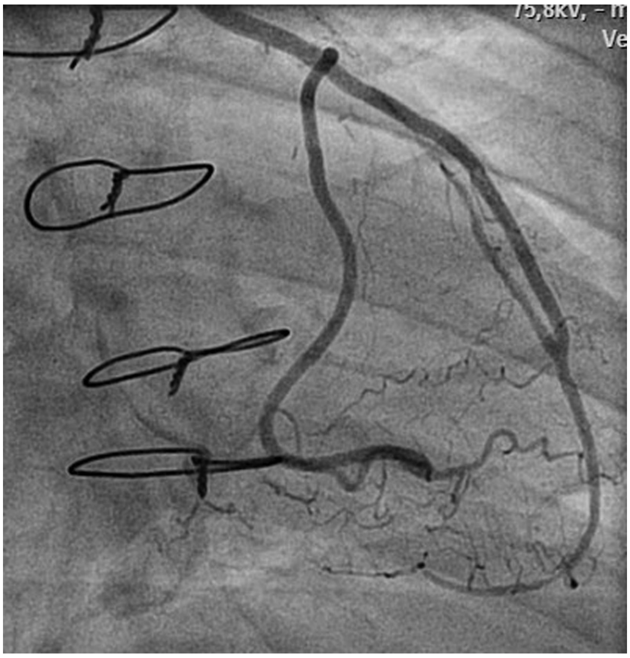

Fig. 3 Coronary angiography during follow-up after composite T-graft with a radial artery and two distal anastomoses. Angiographic image shows patency of grafts (LIMA to LAD and radial artery to third left marginal artery [M3]). LAD, anterior descending artery; LIMA, left internal mammary artery.

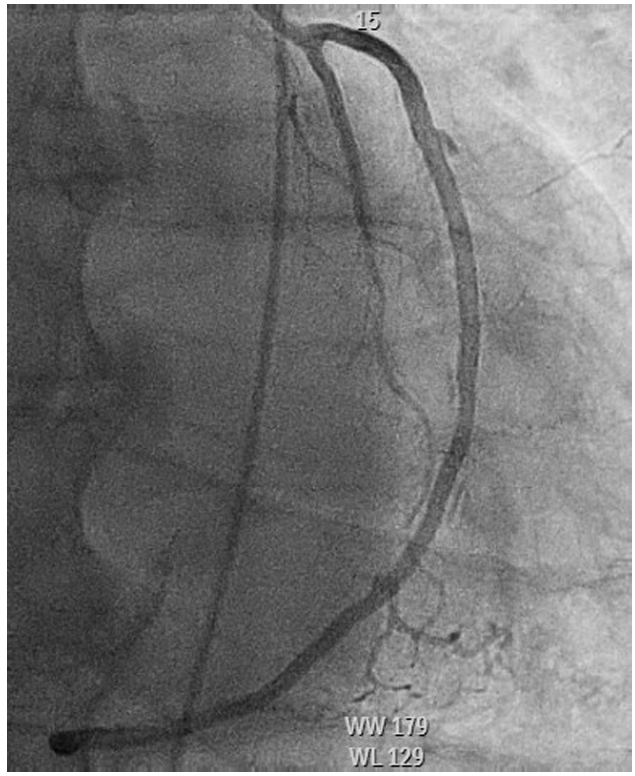

Fig. 5 Coronary angiography during follow-up after composite T-graft with a saphenous vein with three distal anastomoses. Angiographic image shows patency of grafts (LIMA to LAD and saphenous vein to M2 and PDA). LAD, anterior descending artery; LIMA, left internal mammary artery; PDA, posterior descending artery.

Fig. 4 Coronary angiography during follow-up after composite T-graft with a radial artery and four distal anastomoses. Angiographic image shows patency of grafts (LIMA to LAD and radial artery to intermediate ramus, M1 and PDA). LAD, anterior descending artery; LIMA, left internal mammary artery; PDA, posterior descending artery.

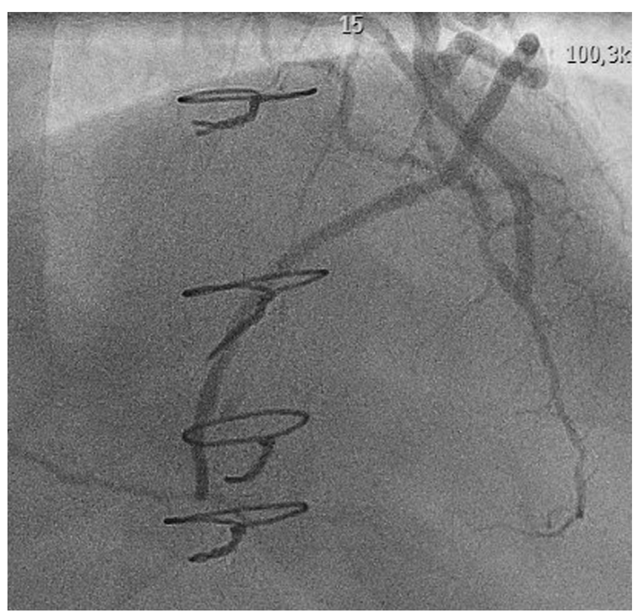

Fig. 6 Coronary angiography during follow-up after composite T-graft with a saphenous vein and four distal anastomoses. Angiographic image shows patency of grafts (LIMA to LAD and saphenous vein to D1, M1, and PDA). LAD, anterior descending artery; LIMA, left internal mammary artery; PDA, posterior descending artery.

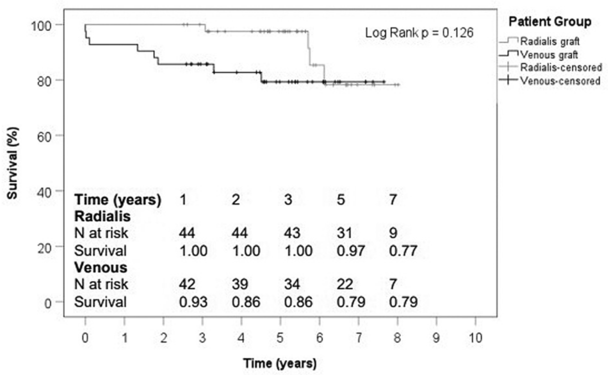

Fig. 7 Survival after surgery.

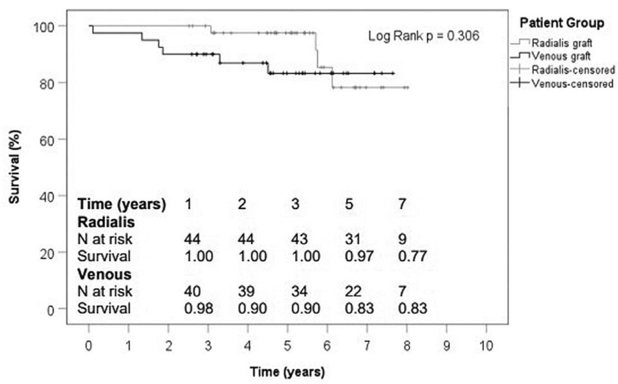

Fig. 8 Survival of 30-day survivors.

exception, the included patients suffered from coronary three-vessel disease. The comorbidity of patients with venous T-graft was understandably greater than in the other patients, who tended to be younger. Thus, preexisting arterial hypertension and preexisting atrial fibrillation were significantly more frequent in our collective with venous T-graft.

Coronary revascularization, whether with the RA or the great SV, was performed with identical technique in both groups. Intraoperative metrics, such as operative time, bypass time, and clamping time, did not differ significantly and are comparable with data in the literature. In the collective with venous T-graft, the percentage of patients with significant calcifications in the ascending aorta was higher, presumably because of more advanced age.

Fortunately, no myocardial infarction was detected in any of the included patients during the postoperative hospital stay. This may be interpreted as an indication that the patients' bypasses were primarily sufficient and that clinically relevant bypass occlusions had not occurred in the early phase. The collected low stroke rate of 5.6% in the venous group and 1.7% in the radialis group supports the hypothesis that early-stage neurologic complications after CABG may be associated with tangential clamping of the ascending aorta.[18] Overall, 30-day mortality in our collective was encouragingly low and did not differ significantly, at 5.5% in the vein group and 0% in the radialis group. Osswald and coworkers analyzed nearly 5000 of their patients who had received CABG and observed a 30-day mortality of 5.6%.[19]

Of course, actual evidence of bypass openness in the later postoperative course would be very interesting from a scientific point of view. Suitable imaging techniques for this purpose are coronary angiography and, since a few years, cardio-computed tomography (CT).[20] These techniques are not routinely used postoperatively because of the radiation exposure involved, but only when symptoms of myocardial ischemia recur. Postoperative coronary angiography was performed in 11 of our patients due to recurrence of angina pectoris. No patient was followed up by cardiac CT. Coronary angiographies performed in patients in the venous group showed openness of all bypasses created, without exception. In the radial group, however, partial occlusion of the grafts was seen in a few individual cases, which were treated by PCI of the affected graft segments or native coronary vessels. Due to the low catheter rate of less than 10%, no conclusions can be drawn from this.

Common practice to monitor success after myocardial revascularization, even in large studies such as the SYNTAX trial, is therefore to determine other criteria.[2] Thus, instead of actual evidence of bypass openess, attention is paid to survival, incidence of postoperative myocardial infarction and stroke, and need for repeat myocardial revascularization. Since the present study had a retrospective design, the outcome analysis based on these "major adverse cardiac and cerebral events" was also appropriate.

Postoperative survival is certainly the most important follow-up marker. For many years, very encouraging survival rates have been described after surgical CABG. Our results also show a good mid-term prognosis after surgical myocardial revascularization with T-graft, regardless of whether the great SV or the RA was used in addition to the LIMA. In previous studies by other research groups with aortocoronary bypasses using the great SV or the RA, the survival probability in the first postoperative years was also not significantly different.[21]

Surgical myocardial revascularization should protect against future myocardial infarction. By bridging all coronary areas compromised by stenoses, a good protection is in principle guaranteed. However, if myocardial infarction occurs in the course after bypass surgery, this does not necessarily mean that a bypass has closed. For example, using coronary angiography, Rupprecht et al found intact bypass grafts in 27% of their patients who had signs of myocardial ischemia in the early postoperative period.[22] Fortunately, only one of our patients in the radialis group suffered a myocardial infarction without serious consequences by the time of follow-up.

CAD is associated with an increased risk of stroke.[23] Late postoperative strokes often cannot be attributed causally to surgery. For prevention, oral anticoagulants and regular cardiological control examinations with duplex sonography of the carotid arteries are used. Nevertheless, 7.5% of our radialis patients suffered a stroke by the time of follow-up. None of the affected patients was severely neurologically impaired as a result. In the venous group, no patient suffered a stroke.

Obviously, the younger a patient is at the time of primary surgery, the greater the likelihood of having to undergo CABG again over time. Even arterial bypass grafts do not always last a lifetime in very young patients. The term "need for repeat revascularization" includes PCI after surgical myocardial revascularization. Fortunately, there was no need for repeat revascularization in the medium term in the venous T-graft group studied. None of the patients in either group has had to undergo repeat CABG, and only in isolated cases did coronary stents have to be implanted for graft failure in the radialis group by the time of follow-up.

The present study provides evidence that the arteriovenous T-graft is not inferior to the arterioarterial T-graft in terms of medium-term patient outcome. These results and obvious advantages of the technique, such as length savings of the venous bypass and no need for tangential aortic clamping, could lead to further dissemination of this revascularization concept. At the very least, 0% rate of postoperative myocardial infarction found and the good mid-term outcomes in terms of need for repeat revascularization, stroke, and survival are impressive. A prospective randomized study with complete angiographic follow-up and a longer observation period would now be desirable.

Limitations

The present work has the disadvantages of a retrospective study. Postoperative coronary angiography with visualization of T-grafts was performed only in single cases of recurrent angina pectoris.

Conclusion

Surgical myocardial revascularization with a T-graft between the LIMA and a segment of the great SV for complete myocardial revascularization may compete with complete arterial bypass grafting with a T-graft between the LIMA and a RA in terms of morbidity and mortality over a medium-term observation period postoperatively. The results of our investigations give rise to the hypothesis that the decision not to perform an aortic bypass anastomosis may be more important than the decision: vein or RA.

Conflict of Interest
None declared.

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