Comparison of 30-day outcomes of coronary artery bypass grafting surgery verus hybrid coronary revascularization stratified by SYNTAX and euroSCORE

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Objective: The optimal treatment of multivessel coronary artery disease is not well established. Hybrid coronary revascularization by combining the left internal mammary artery–left anterior descending artery graft and drug-eluting stents in non–left anterior descending artery territories might offer superior results compared with sole coronary artery bypass grafting or sole percutaneous coronary intervention.

Methods: We retrospectively analyzed the 30-day outcomes of 381 consecutive patients undergoing coronary artery bypass grafting (n = 301) vs hybrid coronary revascularization (n = 80). In a 2 × 2 matrix, the 2 groups were stratified by the Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery (SYNTAX) score (≤32 vs ≥33) and the European System for Cardiac Operative Risk Evaluation (euroSCORE) (<5 vs ≥5). The composite endpoint (death from any cause, stroke, myocardial infarction, low cardiac output syndrome) and secondary endpoints (worsening postprocedural renal function and bleeding) were determined.

Results: After stratification using the SYNTAX and the euroSCORE, the preoperative characteristics were similar within the 4 groups, except for the ≥33 SYNTAX/>5 euroSCORE. The hybrid coronary revascularization patients were older (77 vs 65 years, $P = .001$). The postoperative outcomes using combined SYNTAX and the euroSCORE stratification showed a similar rate of the composite endpoint for all groups except for patients with ≥33 SYNTAX/>5 euroSCORE (0% for the coronary artery bypass grafting group vs 33% for the hybrid coronary revascularization group, $P = .001$). An analysis of the secondary endpoint showed similar results across all groups, except for in the ≥33 SYNTAX/>5 euroSCORE group, in which bleeding (re-exploration for bleeding and transfusion >3 packed red blood cell units per patient) was 44% in the hybrid coronary revascularization group vs 11% in the coronary artery bypass grafting group ($P = .05$).

Conclusions: Hybrid coronary revascularization is a safe alternative to coronary artery bypass grafting in many patients with multivessel coronary artery disease. However, in high-risk patients with complex coronary artery disease (≥33 SYNTAX/>5 euroSCORE), coronary artery bypass grafting is superior to hybrid coronary revascularization. (J Thorac Cardiovasc Surg 2013;145:1004-12)

The optimal revascularization for multivessel coronary artery disease (CAD) remains controversial. Coronary artery bypass grafting (CABG) offers superior outcomes for patients with diabetes and complex lesions, primarily owing to the left internal mammary artery (LIMA) to the left anterior descending (LAD) artery graft.[1,2] The excellent long-term patency of the LIMA-LAD graft contrasts with the rate of early saphenous vein graft (SVG) failure (6.2%–30% at 12 months),[2-4] which might account for the durable clinical benefit of CABG. In non-LAD coronary arteries, the 12-month rate of drug-eluting stent (DES) restenosis and thrombosis after percutaneous coronary intervention (PCI) is lower than the rate of SVG failure.[5] Therefore, PCI with DES might be a reasonable alternative to SVG for revascularization of non-LAD coronary arteries.

Thus, hybrid coronary revascularization (HCR), combining the LIMA-LAD graft and DES to non-LAD vessels, might become a superior revascularization alternative in multivessel CAD. Several observational studies, including Vanderbilt's experience,[6] have demonstrated that a hybrid strategy is safe, with short-term outcomes similar to those of standard CABG. However, the indication for, and safety of, HCR compared with standard CABG are not well

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Abbreviations and Acronyms

BMS = bare metal stent
CABG = coronary artery bypass grafting
CAD = coronary artery disease
DES = drug-eluting stent
HCR = hybrid coronary revascularization
LAD = left anterior descending (artery)
LIMA = left internal mammary artery
MACCE = major adverse cardiovascular and cerebral events
PCI = percutaneous coronary artery intervention
STS = Society of Thoracic Surgeons
SVG = saphenous vein graft

established. In the present study, we compared the 30-day outcomes of HCR and standard CABG in patients stratified by the complexity of CAD (Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery [SYNTAX] score)[2,7] and surgical risk profile (European System for Cardiac Operative Risk Evaluation [euroSCORE]).[8]

METHODS

After obtaining institutional review board approval, we retrospectively collected data for 500 consecutive patients who had undergone CABG with or without concomitant PCI from April 2005 to March 2009. Patients with multivessel CAD involving the LAD artery and at least 1 other major epicardial artery or left main disease were included in the present study. Patients with concomitant valvular surgical procedures (n = 31), single-vessel CAD (n = 33), previous CABG with patent grafts (n = 9), PCI without stenting as a "bridge" to CABG (n = 2), or post-CABG PCI (n = 27) were excluded. Preprocedural coronary angiographic data were not available for review in 8 patients. Thus, 301 CABG and 80 HCR patients from our group practice were analyzed in the present study. The SYNTAX score for each patient was calculated by 2 cardiologists using the SYNTAX score algorithm, as previously described.[7] The euroSCORE for each patient was also calculated.[8] Patients were stratified into 4 groups according to the SYNTAX score ($\leq$32 vs $\geq$33) and euroSCORE ($\leq$5 vs >5).

A comparison between CABG and HCR within these 4 risk-stratified groups was performed. The primary clinical endpoint was a composite major adverse cardiovascular and cerebral events (MACCE) endpoint, including death from any cause, stroke, myocardial infarction, and low cardiac output syndrome during the 30 days after the procedure. The secondary clinical endpoints were worsening postprocedural renal function and bleeding complication during the 30 days after procedure.

All patients enrolled in the study were referred for coronary artery bypass surgery according to the clinical indications. For HCR, the cardiac surgeon and interventional cardiologist both reviewed the coronary angiographic data in advance. The hybrid approach was presented as an alternative approach to CABG to the patient, and separate consent was obtained. Patients who underwent a planned hybrid procedure received 300 mg of clopidogrel immediately before induction. A total of 20 patients (25%) underwent an "unplanned" hybrid procedure that was performed because of intraoperative findings such as graft defects on completion angiography, poor conduits, or a poor target vessel. The unplanned hybrid patients received 300 mg clopidogrel by way of a nasogastric tube at PCI. Patients who received stents to the graft conduits (SVG or LIMA, n = 27) or native LAD (because of a failed LIMA-LAD graft, n = 2) were excluded from the present analysis. Patients who received stents to non-LAD native vessel because of failed SVG grafts (n = 4) were included in the analysis. All hybrid patients received clopidogrel 75 mg/day for at least 12 months. Unfractionated heparin was used for both PCI and CABG. Heparin was reversed by protamine at the end of CABG in all patients. A sheath had been placed in the left or right femoral artery using the modified Seldinger technique before anticoagulation with heparin. At the end of surgery, the sheath was removed after the heparin was reversed with protamine, and a Syvek Patch (Marine Polymer Technologies, Danvers, Mass) was applied with 12 minutes of manual compression of the groin.

Statistical Analysis

The data are expressed as the mean $\pm$ standard deviation or percentages. For continuous variables, a Mann-Whitney *U* test was used, and the data are expressed as the median. The 2-tailed Fischer exact test was used for categorical variables. Data analysis and statistical analysis were performed using STATA, version 9.0 for Windows (StataCorp, College Station, Tex).

RESULTS

Stratification by SYNTAX Score Only

Patients with SYNTAX score of 32 or less. A total of 293 patients (226 CABG, 67 HCR) had a SYNTAX score of 32 or less (mean, 21 $\pm$ 8). The HCR group had more 3-vessel CAD (82% vs 66%, $P = .015$), and the CABG group had more 2-vessel CAD (30% vs 15%, $P = .018$). Compared with the CABG group, the HCR group had shorter aortic crossclamp ischemic times but a longer total operative time. Other preoperative, intraoperative, and postoperative data were similar among the groups (Table 1). In the HCR group, of 67 patients, 62 (93%) received a DES and 7 (7%) of 69 patients received a bare metal stent (BMS). Each patient received a mean of 2 $\pm$ 1.3 stents. The median number of bypass grafts per patient was 2 in each group (HCR and CABG patients).

Patients with SYNTAX score of 33 or greater. A total of 88 patients (75 CABG, 13 HCR) had a SYNTAX score of 33 or greater (mean, 37 $\pm$ 4). Compared with patients undergoing CABG, the patients undergoing HCR were older (median age, 74 vs 62 years; $P = .015$) and had a greater euroSCORE (median, 6 vs 4; $P = .045$). The cardiopulmonary bypass time and ischemic times were shorter in the HCR group than in the CABG group. The composite MACCE was greater in the HCR group than in the CABG group, primarily owing to increased mortality in the HCR group (HCR, 3/13 [23%] vs CABG, 0/75 [0%]; $P = .003$; Table 2). The mean number of stents per patient in the HCR group was 2.3 $\pm$ 0.8, with 77% (10/13) receiving DES and 23% (3/13) receiving BMS. The median number of grafts per patient in the CABG group was 2 (range, 1–5) and 1 (range, 1–2) in the HCR group ($P = .001$; Table 2).

Stratification by euroSCORE Only

Patients with euroSCORE of 5 or less. A total of 239 patients (193 CABG and 46 HCR) had a euroSCORE of 5 or

ACD

TABLE 1. Preoperative, intraoperative, and postoperative data for SYNTAX ≤32 (n = 293)

Variable	CABG (n = 226)	HCR (n = 67)	*P* value
Preoperative data			
Age (y)	63 (32–89)	62 (39–85)	.707
Men	169 (75)	53 (79)	.519
Diabetes	86 (38)	28 (42)	.669
Hypertension	186 (82)	59 (88)	.348
Dyslipidemia	170 (75)	49 (73)	.750
Cardiogenic shock	3 (1)	1 (1)	1.000
CHF	25 (11)	5 (7)	.495
COPD	48 (21)	17 (26)	.502
History of stroke	18 (8)	3 (4)	.427
PVD	38 (17)	15 (22)	.366
Carotid artery stenosis	34 (15)	11 (16)	.847
Inotropic support	3 (1)	1 (1)	1.000
Preoperative IABP	8 (4)	2 (3)	1.000
Valve disease	34 (15)	7 (10)	.425
Previous cardiac surgery	0 (0)	1 (1)	.229
Acute MI	34 (15)	11 (16)	.847
UA	126 (56)	35 (52)	.675
2-Vessel disease	67 (30)	10 (15)	.018
≥3-Vessel disease	149 (66)	55 (82)	.015
Left main disease	60 (27)	11 (16)	.105
Proximal LAD	87 (39)	23 (34)	.568
LVEF	55 (10–80)	50 (20–70)	.590
Emergent/urgent status	140 (62)	41 (61)	1.000
NYHA class	2 (1–4)	1 (1–4)	.154
Baseline creatinine ≥1.5 mg/dL	14 (6)	7 (10)	.272
euroSCORE	4 (0–14)	4 (0–12)	.948
Intraoperative data			
Planned		49/67 (73)	
Off pump	35 (15)	15 (22)	.198
Grafts (n)	2 (1–5)	2 (1–5)	.001
OR time (min)	374 (138–664)	411 (230–744)	.001
CPB time (min)	92 (28–284)	76 (33–175)	.001
Aortic crossclamp time (min)	64 (12–152)	51 (18–111)	.001
Perioperative outcomes			
Operative mortality	5 (2)	1 (1)	1.000
Length of stay (d)	6 (1–32)	5 (3–97)	.766
Postoperative complications			
PCVA	3 (1)	1 (1)	1.000
ARF/RFHD	8 (4)	2 (3)	1.000
Bleeding/PRBC ≥3	38 (17)	12 (18)	.854
Reoperation for bleeding	7 (3)	3 (4)	.701
Tracheostomy	2 (1)	2 (3)	.225
New atrial fibrillation	49 (22)	11 (16)	.393
PLCOS	10 (4)	0 (0)	.124
Composite outcome*	16 (7)	3 (4)	.579

Data are presented as the median (range) or number (percentage). *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *LAD*, left anterior descending (artery); *MI*, myocardial infarction; *UA*, unstable angina; *LVEF*, left ventricular ejection fraction; *NYHA*, New York Heart Association (functional classification); *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

TABLE 2. Preoperative, intraoperative, and postoperative data for SYNTAX ≥33 (n = 88)

Variable	CABG (n = 75)	HCR (n = 13)	*P* value
Preoperative data			
Age (y)	62 (36–83)	74 (53–84)	.015
Men	62 (83)	8 (62)	.129
Diabetes	24 (32)	4 (31)	1.000
Hypertension	65 (87)	10 (77)	.399
Dyslipidemia	59 (79)	9 (69)	.481
Cardiogenic shock	1 (1)	0 (0)	1.000
CHF	11 (15)	1 (5)	.450
COPD	23 (31)	2 (16)	.334
History of stroke	11 (15)	2 (10)	.729
PVD	11 (15)	4 (31)	.224
Carotid artery stenosis	10 (13)	2 (15)	1.000
Inotropic support	2 (3)	0 (0)	1.000
Preoperative IABP	2 (3)	1 (5)	.512
Valve disease	7 (9)	2 (16)	.616
Previous cardiac surgery	3 (4)	0 (0)	1.000
Acute MI	9 (12)	2 (15)	.663
UA	34 (45)	6 (46)	1.000
2-Vessel disease	14 (19)	3 (23)	.710
≥3-Vessel disease	55 (73)	10 (77)	1.000
Left main disease	30 (40)	3 (23)	.355
Proximal LAD	26 (35)	4 (31)	1.000
EF	50 (10–70)	50 (20–65)	.415
Emergent/urgent status	38 (51)	7 (54)	1.000
NYHA class	2 (1–4)	2 (1–3)	.849
Baseline creatinine ≥1.5 mg/dL	12 (16)	0 (0)	.200
euroSCORE	4 (0–15)	6 (1–14)	.045
Intraoperative data			
Planned		11/13 (85)	
Off pump	12 (16)	4 (31)	.243
Grafts (n)	2 (1–5)	1 (1–2)	.001
OR time (min)	378 (250–667)	405 (294–549)	.404
CPB time (min)	91 (32–153)	64 (50–159)	.090
Aortic crossclamp time (min)	61 (21–108)	38 (23–75)	.041
Perioperative data			
Operative mortality	0 (0)	3 (23)*	.003
Length of stay (d)	6 (3–63)	6 (1–32)	.364
Postoperative complications			
PCVA	1 (1)	1 (8)	.275
ARF/RFHD	4 (5)	0 (0)	1.000
Bleeding/PRBC ≥3 U	10 (13)	4 (31)	.210
Reoperation for bleeding	0 (0)	0 (0)	
Tracheostomy	1 (1)	2 (15)	.056
New atrial fibrillation	17 (23)	4 (31)	.501
PLCOS	3 (4)	2 (15)	.156
Composite outcome†	4 (5)	4 (30)	.015

Data are presented as the median (range) or number (percentage). SYNTAX, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *MI*, myocardial infarction; *UA*, unstable angina; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *LAD*, left anterior descending (artery); *EF*, ejection fraction; *NYHA*, New York Heart Association (functional classification); *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PLCOS*, postoperative low cardiac output syndrome. *HCR group, 2 planned and 1 unplanned. †Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

TABLE 3. Preoperative, intraoperative, and postoperative data for euroSCORE ≤5 (n = 239)

Variable	CABG (n = 193)	HCR (n = 46)	*P* value
Preoperative data			
Age (y)	59 (32–80)	58 (39–75)	.310
Men	157 (81)	38 (83)	1.000
Diabetes	65 (34)	21 (46)	.171
Hypertension	152 (79)	39 (85)	.419
Dyslipidemia	155 (80)	37 (80)	1.000
Cardiogenic shock	1 (1)	1 (2)	.349
CHF	13 (7)	2 (4)	.742
COPD	36 (19)	7 (16)	.830
History of stroke	11 (6)	0 (0)	.130
PVD	17 (9)	8 (17)	.107
Carotid artery stenosis	13 (7)	5 (11)	.357
Inotropic support	2 (1)	1 (2)	.475
Preoperative IABP	2 (1)	1 (2)	.475
Valve disease	14 (7)	2 (4)	.744
Previous cardiac surgery	0 (0)	0 (0)	
Acute MI	17 (9)	4 (9)	1.000
UA	97 (51)	21 (46)	.623
2-Vessel disease	52 (27)	7 (15)	.127
≥3-Vessel disease	1426 (65)	38 (83)	.022
Left main disease	55 (29)	8 (17)	.140
Proximal LAD	67 (35)	15 (33)	.864
EF	55 (15–80)	55 (30–70)	.942
Emergent/urgent status	112 (58)	24 (52)	.510
NYHA class	2 (1–4)	1 (1–3)	.600
Baseline creatinine ≥1.5 mg/dL	11 (6)	3 (7)	.736
SYNTAX score	24.5 (7–46.5)	22.5 (12–41)	.188
SYNTAX low score	80 (41)	22 (48)	.044
SYNTAX medium score	65 (34)	20 (43)	.044
SYNTAX high score	48 (25)	4 (9)	.044
euroSCORE	3 (0–5)	2.5 (0–5)	.606
Intraoperative data			
Planned HCR		34/46 (74)	
Off pump	27 (14)	7 (15)	.816
Grafts (n)	2 (1–5)	2 (1–4)	.001
OR time (min)	375 (138–667)	403 (230–744)	.005
CPB time (min)	91 (28–178)	72 (33–143)	.001
Aortic crossclamp time (min)	64.5 (20–147)	50 (18–111)	.001
Perioperative outcomes			
Operative mortality	1 (1)	2 (4)	.096
Length of stay (d)	5 (3–33)	5 (3–97)	.694
Postoperative complications			
PCVA	1 (1)	0 (0)	1.000
ARF/RFHD	6 (3)	1 (2)	1.000
Bleeding/PRBC ≥3 U	24 (12)	8 (17)	.347
Reoperation for bleeding	4 (2)	3 (7)	.132
Tracheostomy	2 (1)	2 (4)	.168
New atrial fibrillation	37 (19)	5 (11)	.280
PLCOS	8 (4)	0 (0)	.359
Composite outcome*	10 (5)	3 (7)	.719

(Continued)

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *MI*, myocardial infarction; *UA*, unstable angina; *LAD*, left anterior descending (artery); *EF*, ejection fraction; *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *NYHA*, New York Heart Association (functional classification); *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

less (mean, 2.67 ± 1.58). The preoperative and postoperative data were similar between the 2 groups. The cardiopulmonary bypass time and ischemic time were shorter in HCR group than in the CABG group (Table 3). In the HCR group, the mean number of stents placed per patient was 2.0 ± 1.4, and most patients (91%) received a DES. The median number of grafts per patient in the CABG and HCR group was 2 (range, 1–5) and 2 (range, 1–4), respectively ($P = .001$).

Patients with euroSCORE greater than 5. A total of 142 patients (108 CABG and 34 HCR) had a euroSCORE greater than 5 (mean, 8 ± 2). The preoperative and postoperative data were similar between the 2 groups. The total operating room time was longer in the HCR group than in the CABG group (Table 4). Of these patients, 85% received a DES and 15% a BMS, with a mean number of stents per patient of 2.2 ± 1.1. The median number of grafts per patient in the CABG and HCR group was 2 (range, 1–5).

Stratification by Both SYNTAX and euroSCORE (2 × 2 Matrix)

The matrix depicted in Figure 1 is divided by the high and low SYNTAX score and low and high euroSCORE. The columns represent division into high and low SYNTAX scores. The rows represent division into the high and low euroSCORE. Each of the 4 components of the matrix represents a different combination of high and low SYNTAX scores and euroSCOREs and their effect on the 30-day composite endpoint for CABG vs HCR.

Patients with SYNTAX of 32 or less and euroSCORE of 5 or Less. A total of 187 patients (145 CABG, 42 HCR) had low coronary complexity and a low-risk profile. The CABG group had a greater percentage of 3-vessel disease and longer ischemic and cardiopulmonary bypass times than the HCR group. The postoperative outcomes were similar (Appendix Table 1). Of the 42 HCR patients, 93% received a DES and 7% a BMS. Each patient received a mean of 2.0 ± 1.4 stents. The median number of grafts per patient in the CABG and HCR groups was 2 (range, 1–5) and 2 (range, 1–4), respectively ($P = .001$).

TABLE 4. Preoperative, intraoperative, and postoperative data for euroSCORE >5 (n = 142)

Variable	CABG (n = 108)	HCR (n = 34)	*P* value
Preoperative data			
Age (y)	71 (45–89)	73 (45–85)	.056
Men	74 (69)	23 (68)	1.000
Diabetes	45 (42)	11 (32)	.422
Hypertension	99 (92)	30 (88)	.511
Dyslipidemia	74 (69)	21 (62)	.532
Cardiogenic shock	3 (3)	0 (0)	1.000
CHF	22 (20)	4 (12)	.317
COPD	35 (33)	12 (35)	.836
History of stroke	17 (16)	5 (15)	1.000
PVD	32 (30)	11 (32)	.831
Carotid artery stenosis	31 (29)	8 (24)	.662
Inotropic support	3 (3)	0 (0)	1.000
Preoperative IABP	8 (7)	1 (3)	.687
Valve disease	27 (25)	7 (21)	.653
Previous cardiac surgery	2 (2)	1 (3)	.563
Acute MI	26 (24)	9 (26)	.821
UA	63 (58)	20 (59)	1.000
2-Vessel disease	29 (27)	6 (18)	.363
≥3-Vessel disease	78 (72)	27 (79)	.504
Left main disease	35 (32)	6 (18)	.129
Proximal LAD	46 (43)	12 (35)	.550
EF	50 (10–70)	50 (20–65)	.695
Emergent/urgent status	66 (61)	24 (71)	.415
NYHA class	2 (1–4)	2 (1–4)	.056
Baseline creatinine ≥1.5 mg/dL	15 (14)	4 (12)	1.000
SYNTAX score	27 (11–56)	26.5 (13–44.5)	.920
SYNTAX low score	35 (32)	13 (38)	.725
SYNTAX medium score	46 (43)	12 (35)	.725
SYNTAX high score	27 (25)	9 (27)	.725
euroSCORE	7 (6–15)	8 (6–14)	.472
Intraoperative data			
Planned HCR		26/34 (76)	
Off pump	20 (19)	12 (35)	.058
Grafts (n)	2 (1–5)	2 (1–5)	.001
OR time (min)	380 (234–558)	418 (264–593)	.030
CPB time (min)	93 (32–284)	75 (36–175)	.131
Aortic crossclamp time (min)	61.5 (12–152)	54.5 (21–96)	.090
Perioperative outcomes			
Operative mortality	4 (4)	2 (6)	.630
Length of stay (d)	6 (1–63)	6 (1–25)	.481
Postoperative complications			
PCVA	3 (3)	2 (6)	.593
ARF/RFHD	6 (6)	1 (3)	1.000
Bleeding/PRBC ≥3 U	24 (22)	8 (24)	1.000
Reoperation for bleeding	3 (3)	0 (0)	1.000
Tracheostomy	1 (1)	2 (6)	.142
New atrial fibrillation	29 (27)	10 (29)	.827
PLCOS	5 (5)	2 (6)	.673
Composite outcome*	10 (9)	4 (12)	.743

(Continued)

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF*, congestive heart failure; *COPD*, chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *LAD*, left anterior descending (artery); *EF*, ejection fraction; *MI*, myocardial infarction; *UA*, unstable angina; SYNTAX, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *NYHA*, New York Heart Association (functional classification); *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

Patients with SYNTAX of 32 or less and euroSCORE greater than 5. The group with a SYNTAX score of 32 or less and euroSCORE greater than 5 included 81 CABG patients and 25 HCR patients. The outcomes were similar, except that the HCR group had a longer operating room time (Appendix Table 2). The mean number of stents placed per patient in the HCR was 2.0 ± 1.2, with most (88%) receiving a DES. The median number of grafts per patient in the CABG and HCR groups was 2 (range, 1–4) and 2 (range, 1–5), respectively ($P = .001$).

Patients with SYNTAX of 33 or greater and euroSCORE of 5 or less. The patients with a SYNTAX of 33 or more and euroSCORE of 5 or less included 52 patients (48 CABG, 4 HCR). The preoperative, intraoperative, and postoperative data were similar (Appendix Table 3). Of the 4 HCR patients, 3 (75%) received a DES and 1 (25%) a BMS, for a mean of 2.5 ± 1.0 stents placed per patient. The median number of grafts in the CABG and HCR groups was 2 (range, 1–4) and 1 (range, 1–2) respectively ($P = .005$).

Patients with SYNTAX of 33 or greater and euroSCORE greater than 5. In the final group of 36 patients (27 CABG and 9 HCR), the HCR patients were older (median age, 77 vs 65 years; $P = .001$). The composite MACCE was 33% in the HCR group and 0% in the CABG group ($P = .012$). Bleeding complications and postoperative low cardiac output syndrome were also more frequent in the HCR group (Appendix Table 4). The mean number of stents per patient was 2.4 ± 0.9, with most patients receiving DES (78%) and fewer (22%) BMS. The median number of grafts per patient in the CABG and HCR groups was 2 (range, 1–5) and 1 (range, 1–2), respectively ($P = .027$).

DISCUSSION

The principal finding of our study was that HCR is safe and feasible for many patients with multivessel CAD. However, patients with SYNTAX of 33 or greater and euroSCORE greater than 5 experienced better outcomes with standard CABG than with HCR. The present study focused on the safety of HCR compared with standard CABG. We

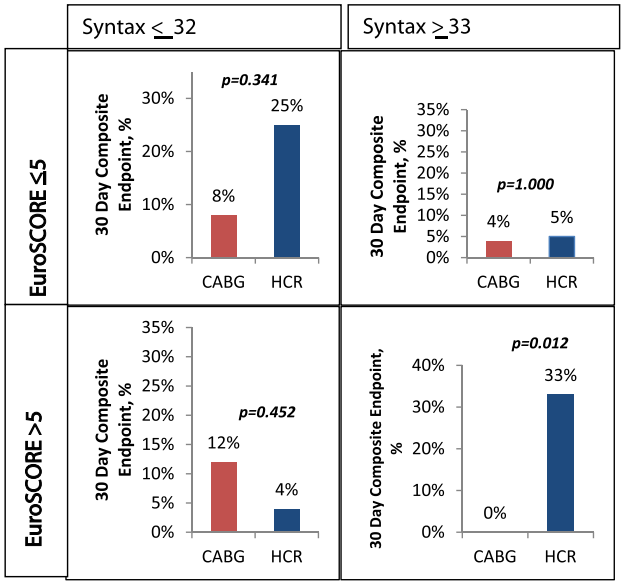

FIGURE 1. The 30-day composite cardiac and cerebrovascular outcomes in the coronary artery bypass grafting *(CABG)* group and hybrid coronary revascularization *(HCR)* stratified by Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery (*SYNTAX*) and European System for Cardiac Operative Risk Evaluation *(euroSCORE)*.

sought to explore the utility of the SYNTAX and euroSCORE to identify patients suitable for HCR. The 30-day rate of MACCE for HCR vs CABG was similar in patients with a low to intermediate SYNTAX score (≤32). Among patients in the HCR group with a high SYNTAX score, the rate of MACCE significantly increased, but the outcomes in the CABG group were not influenced by the SYNTAX score. Although the euroSCORE alone did not discern MACCE, the HCR group had significantly greater MACCE compared with the CABG group in patients with a combination of a SYNTAX score of 33 or greater and euroSCORE greater than 5. Similar results were reported after the stratification of patients with 3-vessel disease in the original SYNTAX trial[1] and Arterial Revascularization Therapies Study Part registry.[9] These results reflect the fact that the complexity of the coronary lesion directly affects the outcomes of PCI, and the success of CABG is primarily related to the quality of the distal targets and patients' overall health, and not to the coronary lesions themselves. Our findings suggest that HCR should be carefully scrutinized in patients with high (≥33) SYNTAX scores, in particular in those with a concomitant high (>5) euroSCORE.

Few series have compared the results of HCR vs CABG.[6,10] In our previous report of HCR, we did not find significant differences in the 30-day outcomes.[6] Similarly, in a series of 104 HCR patients with multivessel disease who were propensity matched to 104 off-pump CABG patients, the 30-day outcomes were similar and the MACCE at 18 months of follow-up was better in the HCR than in the off-pump CABG group because of the high rate of readmission to the hospital and neurologic events in the CABG group.[10] This is in concordance with the observation from the SYNTAX trial,[1] underscoring the lower invasiveness of PCI and lower stroke rate compared with standard CABG.

The euroSCORE was developed from a multinational European adult cardiac surgery database to provide a simple additive risk model for the European cardiac surgery patients. In North America, the Society of Thoracic Surgeons (STS) established a national adult cardiac surgery database in 1989. The STS has developed an algorithm for the preoperative calculation of risk for CABG surgery using data collected in the STS National Adult Cardiac Surgery Database. Despite substantial demographic differences between the North American patients and European patients, the euroSCORE, when tested using the STS national adult cardiac surgery database, performs well and can be used as a risk stratification tool.[11] We chose to use the euroSCORE to discern the clinical risk profile of patients instead of the STS risk algorithm because the euroSCORE has been shown to have better discriminative power to predict 30-day mortality compared with the STS clinical algorithm used in coronary artery bypass operations only.[12] The better discrimination power is related to the significant differences between scores with regard to the initial patient population on which each score design was based.

The SYNTAX score, calculated using lesion assessment based on coronary angiography, provides a useful tool to objectively decide which patient is suitable for PCI vs CABG. The SYNTAX score has not yet been validated for patients with previous intervention (PCI or CABG) or in the setting of acute myocardial infarction. In a post hoc analysis of 1397 patients enrolled in the Limus Eluted from A Durable vs ERodable Stent coating (LEADERS) trial, the SYNTAX score was applied to an all-comers population including patients with acute coronary syndromes and with previous PCI and had showed predictive discriminatory power for risk assessment.[13] In our study, the SYNTAX score provided a useful tool for clinical decision making related to appropriateness of hybrid revascularization vs standard CABG.

Study Limitations

The present study was an uncontrolled retrospective series, and patient treatment was decided by surgeon and cardiologist preference. The number of HCR patients in the combined SYNTAX and euroSCORE group was small, and this could affect the incidence of events noted in this group. A larger study is needed to better define the clinical outcomes using the SYNTAX and euroSCORE between CABG and HCR. We included patients with acute myocardial infarction and previous PCI, which might have affected the SYNTAX score. Similarly, the euroSCORE has been shown to have lower predictive performance

for higher scores compared with low-risk scores. Therefore, in the high SYNTAX and high euroSCORE group, the predictive value of the euroSCORE could be affected negatively.

The present study tested the 30-day mortality and other MACCE. We are currently in the process of studying the 1- and 3-year MACCE in both groups.

CONCLUSIONS

The present study is the first to apply SYNTAX score and euroSCORE to compare the safety outcomes in patients who underwent HCR vs CABG. Both procedures offer equal safety outcomes for most patients. However, in patients with complex coronary disease (as assessed by the SYNTAX score) and a high clinical risk profile (as assessed by the euroSCORE), CABG might offer superior 30-day outcomes. A larger and prospective study with long-term follow-up is necessary to validate these initial findings.

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APPENDIX 1

Definitions

Operative mortality: in-hospital death or death for any reason occurring within or after 30 days postoperatively.

Hospital length of stay: hospital length of stay from the date of surgery to the date of discharge.

Hypertension: if there was a documented history of hypertension treated by antihypertensive medication before surgery.

Myocardial infarction (MI): acute if present 7 days or less from the last documented MI or evolving, if, at surgery, Q waves or ST changes were present, along with a creatine kinase-MB greater than 5% of the total creatine kinase.

Urgent surgery: procedure required during the same hospitalization to minimize the risk of additional clinical deterioration.

Emergent surgery: if ischemic dysfunction (ongoing ischemia despite maximal medical treatment or intra-aortic balloon pump, acute/evolving MI, pulmonary edema requiring intubation), or shock.

Low cardiac output syndrome: a cardiac index of 2.0 L/min/m^2 or less, requiring triple inotropic support to maintain a systolic pressure greater than 90 mm Hg for at least 30 minutes and/or placement of an intra-aortic balloon pump and/or ventricular assist device.

Perioperative MI: appearance of new Q waves and/or a creatine kinase-MB fraction of 100 IU/L or greater.

Bleeding: necessity for reexploration of the thorax for suspected bleeding during the postoperative period.

Stroke: evidence in the postoperative period of a new central neurologic deficit persisting for longer than 72 hours; if the neurologic deficit resolved within 72 hours, it was considered a *transient ischemic attack*.

Acute renal failure: an increase in creatinine to twice the preoperative value.

APPENDIX TABLE 1. Preoperative, intraoperative, and postoperative data for euroSCORE <5/SYNTAX <32 (n = 187)

Variable	CABG (145)	HCR (n = 42)	*P* value
Preoperative data			
Age (y)	59 (32–80)	57.5 (39–75)	.350
Men	115 (79)	36 (86)	.505
Diabetes	52 (36)	19 (45)	.284
Hypertension	111 (77)	37 (88)	.132
Dyslipidemia	113 (78)	33 (79)	1.000
Cardiogenic shock	1 (1)	1 (2)	.400
CHF	10 (7)	2 (5)	1.000
COPD	24 (17)	7 (17)	1.000
History of stroke	8 (6)	0 (0)	.202
PVD	14 (10)	7 (17)	.264
Carotid artery stenosis	9 (6)	4 (10)	.493
Inotropic support	2 (1)	1 (2)	.536
Preoperative IABP	2 (1)	1 (2)	.536
Valve disease	13 (9)	2 (5)	.527
Previous cardiac surgery	0 (0)	0 (0)	
Acute MI	15 (10)	4 (10)	1.000
UA	76 (53)	19 (45)	.483
2-Vessel disease	40 (28)	6 (14)	.103
≥3-Vessel disease	95 (66)	35 (83)	.035
Left main disease	35 (24)	7 (17)	.402
Proximal LAD	54 (37)	14 (33)	.718
LVEF	55 (25–70)	55 (30–70)	.914
Emergent/urgent status	84 (58)	22 (52)	.597
NYHA class	2 (1–4)	1 (1–3)	.471
Baseline creatinine ≥1.5 mg/dL	6 (4)	3 (7)	.423
SYNTAX	21.5 (7–32)	21 (12–32)	.612
euroSCORE	3 (0–5)	2.5 (0–5)	.662
Intraoperative data			
Planned HCR		32/42 (76)	
Off pump	22 (15)	7 (17)	.811
Grafts (n)	2 (1–5)	2 (1–4)	.001
OR time (min)	371 (138–664)	403 (230–744)	.004
CPB time (min)	90 (28–178)	76 (33–140)	.001
Aortic crossclamp time (min)	64 (20–147)	51 (18–111)	.001
Perioperative outcomes			
Operative mortality	1 (1)	1 (2)	.400
Length of stay (d)	5 (3–28)	5 (3–97)	.993
Postoperative complications			
PCVA	0 (0)	0 (0)	
ARF/RFHD	4 (3)	1 (2)	1.000
Bleeding/PRBC ≥3 U	17 (12)	8 (19)	.301
Reoperation for bleeding	4 (3)	3 (7)	.198
Tracheostomy	1 (1)	1 (2)	.400
New atrial fibrillation	25 (17)	4 (10)	.332
PLCOS	5 (3)	0 (0)	.589
Composite outcome*	6 (4)	2 (5)	1.000

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *MI,* myocardial infarction; *UA,* unstable angina; *LAD,* left anterior descending (artery); *LVEF,* left ventricular ejection fraction; *NYHA,* New York Heart Association (functional classification); *HCR*, hybrid coronary revascularization; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PRBC*, packed red blood cells; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

APPENDIX TABLE 2. Preoperative, intraoperative, and postoperative data for euroSCORE >5/SYNTAX <32 (n = 106)

Variable	CABG (n = 81)	HCR (n = 25)	*P* value
Preoperative data			
Age (y)	72 (46–89)	72 (45–85)	.941
Men	54 (67)	17 (68)	1.000
Diabetes	34 (42)	9 (36)	.648
Hypertension	75 (93)	22 (88)	.437
Dyslipidemia	57 (70)	16 (64)	.623
Cardiogenic shock	2 (2)	0 (0)	1.000
CHF	15 (19)	3 (12)	.554
COPD	24 (30)	10 (40)	.464
History of stroke	10 (12)	3 (12)	1.000
PVD	24 (30)	8 (32)	.808
Carotid artery stenosis	25 (31)	7 (28)	1.000
Inotropic support	1 (1)	0 (0)	1.000
Preoperative IABP	6 (7)	1 (4)	1.000
Valve disease	21 (26)	5 (20)	.607
Previous cardiac surgery	0 (0)	1 (4)	.236
Acute MI	19 (23)	7 (28)	.791
UA	50 (62)	16 (64)	1.000
2-Vessel disease	27 (33)	4 (16)	.132
≥3-Vessel disease	54 (67)	20 (80)	.319
Left main disease	25 (31)	4 (16)	.201
Proximal LAD	33 (41)	9 (36)	.816
LVEF	55 (10–65)	50 (20–60)	.375
Emergent/urgent status	56 (69)	19 (76)	.619
NYHA class	2 (1–4)	1 (1–4)	.168
Baseline creatinine ≥1.5 mg/dL	8 (10)	4 (16)	.471
SYNTAX	23 (11–32)	22 (13–31)	.797
euroSCORE	7 (6–14)	8 (6–12)	.641
Intraoperative data			
Planned HCR		17/25 (68)	
Off pump	13 (16)	8 (32)	.092
Grafts (n)	2 (1–4)	2 (1–5)	.001
OR time (min)	385 (234–558)	413 (264–593)	.038
CPB time (min)	94 (38–284)	76 (36–175)	.109
Aortic crossclamp time (min)	62 (12–152)	58 (21–96)	.154
Perioperative outcomes			
Operative mortality	4 (5)	0 (0)	.571
Length of stay (d)	6 (1–32)	6 (3–19)	.603
Postoperative complications			
PCVA	3 (4)	1 (4)	1.000
ARF/RFHD	4 (5)	1 (4)	1.000
Bleeding/PRBC ≥3 U	21 (26)	4 (16)	.422
Reoperation for bleeding	3 (4)	0 (0)	1.000
Tracheostomy	1 (1)	1 (4)	.418
New atrial fibrillation	24 (30)	7 (28)	1.000
PLCOS	5 (6)	0 (0)	.590
Composite outcome*	10 (12)	1 (4)	.452

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *MI,* myocardial infarction; *UA,* unstable angina; *LAD,* left anterior descending (artery); *LVEF,* left ventricular ejection fraction; *NYHA,* New York Heart Association (functional classification); *HCR*, hybrid coronary revascularization; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PRBC*, packed red blood cells; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

APPENDIX TABLE 3. Preoperative, intraoperative, and postoperative data for euroSCORE <5/SYNTAX >33 (n = 52)

Variable	CABG (n = 48)	HCR (n = 4)	*P* value
Preoperative data			
Age (y)	60 (36–80)	59.5 (53–64)	.877
Men	42 (88)	2 (50)	.107
Diabetes	13 (27)	2 (50)	.569
Hypertension	41 (85)	2 (50)	.134
Dyslipidemia	42 (88)	4 (100)	1.000
Cardiogenic shock	0 (0)	0 (0)	
CHF	3 (6)	0 (0)	1.000
COPD	12 (25)	0 (0)	.562
History of stroke	3 (6)	0 (0)	1.000
PVD	3 (6)	1 (25)	.281
Carotid artery stenosis	4 (8)	1 (25)	.341
Inotropic support	0 (0)	0 (0)	
Preoperative IABP	0 (0)	0 (0)	
Valve disease	1 (2)	0 (0)	1.000
Previous cardiac surgery	1 (2)	0 (0)	1.000
MI	2 (4)	0 (0)	1.000
UA	21 (44)	2 (50)	1.000
2-Vessel disease	12 (25)	1 (25)	1.000
≥3-Vessel disease	31 (65)	3 (75)	1.000
Left main disease	20 (42)	1 (25)	.639
Proximal LAD	13 (27)	1 (25)	1.000
LVEF	53 (15–70)	47.5 (45–55)	.507
Emergent/urgent status	28 (58)	2 (50)	1.000
NYHA class	2 (1–3)	1.5 (1–3)	.755
Baseline creatinine ≥1.5 mg/dL	5 (10)	0 (0)	1.000
SYNTAX	36 (33–46.5)	36.8 (34–41)	.809
euroSCORE	3 (0–5)	2.5 (1–4)	.780
Intraoperative data			
Planned HCR		2/4 (50)	
Off pump	5 (10)	0 (0)	1.000
Grafts (n)	2 (1–4)	1 (1–2)	.005
OR time (min)	379 (250–667)	394 (370–437)	.607
CPB time (min)	91 (49–153)	67 (50–93)	.079
Aortic crossclamp time (min)	65 (31–108)	40 (32–75)	.090
Perioperative outcomes			
Operative mortality	0 (0)	1 (25)*	.077
Length of stay (d)	5 (3–33)	6.5 (5–32)	.132
Postoperative complications			
PCVA	1 (2)	0 (0)	1.000
ARF/RFHD	2 (4)	0 (0)	1.000
Bleeding/PRBC ≥3 U	7 (15)	0 (0)	1.000
Reoperation for bleeding	0 (0)	0 (0)	
Tracheostomy	1 (2)	1 (25)	.149
New atrial fibrillation	12 (25)	1 (25)	1.000
PLCOS	3 (6)	0 (0)	1.000
Composite outcome†	4 (8)	1 (25)	.341

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *MI,* myocardial infarction; *UA,* unstable angina; *LAD,* left anterior descending (artery); *LVEF,* left ventricular ejection fraction; *NYHA,* New York Heart Association (functional classification); *HCR*, hybrid coronary revascularization; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PRBC*, packed red blood cells; *PLCOS*, postoperative low cardiac output syndrome. *Respiratory failure. †Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.

APPENDIX TABLE 4. Preoperative, intraoperative, and postoperative data for euroSCORE >5/SYNTAX >33 (n = 36)

Variable	CABG (n = 27)	HCR (n = 9)	*P* value
Preoperative data			
Age (y)	65 (45–83)	77 (47–84)	.001
Men	20 (74)	6 (67)	.686
Diabetes	11 (41)	2 (22)	.438
Hypertension	24 (89)	8 (89)	1.000
Dyslipidemia	17 (63)	5 (56)	.712
Cardiogenic shock	1 (4)	0 (0)	1.000
CHF	7 (26)	1 (11)	.648
COPD	11 (41)	2 (22)	.438
History of stroke	7 (26)	2 (22)	1.000
PVD	8 (30)	3 (33)	1.000
Carotid artery stenosis	6 (22)	1 (11)	.652
Inotropic support	2 (7)	0 (0)	1.000
Preoperative IABP	2 (7)	0 (0)	1.000
Valve disease	6 (22)	2 (22)	1.000
Previous cardiac surgery	2 (7)	0 (0)	1.000
MI	7 (26)	2 (22)	1.000
UA	13 (48)	4 (44)	1.000
2-Vessel disease	2 (7)	2 (22)	.255
≥3-Vessel disease	24 (89)	7 (78)	.581
Left main disease	10 (37)	2 (22)	.685
Proximal LAD	13 (48)	3 (33)	.700
LVEF	43 (10–70)	55 (20–65)	.069
Emergent/urgent status	10 (37)	5 (56)	.443
NYHA class	2 (1–4)	2 (1–3)	.120
Baseline creatinine ≥1.5 mg/dL	7 (26)	0 (0)	.156
SYNTAX	36.5 (33–56)	35.5 (33–44.5)	.621
euroSCORE	7 (6–15)	9 (6–14)	.562
Intraoperative data			
Planned HCR		9/9 (100)	
Off pump	7 (26)	4 (44)	.409
Grafts (n)	2 (1–5)	1 (1–2)	.027
OR time (min)	377 (275–519)	423 (294–549)	.522
CPB time (min)	91 (32–141)	60 (58–159)	.659
Aortic crossclamp time (min)	57 (21–97)	38 (23–74)	.377
Perioperative outcomes			
Operative mortality	0 (0)	2 (22)	.057
Length of stay (d)	6 (4–63)	6 (1–25)	.630
Postoperative complications			
PCVA	0 (0)	1 (11)	.250
ARF/RFHD	2 (7)	0 (0)	1.000
Bleeding/PRBC ≥3 U	3 (11)	4 (44)	.050
Reoperation for bleeding	0 (0)	0 (0)	
Tracheostomy	0 (0)	1 (11)	.250
New atrial fibrillation	5 (19)	3 (33)	.384
PLCOS	0 (0)	2 (22)	.057
Composite outcome*	0 (0)	3 (33)	.012

Data are presented as the median (range) or number (percentage). *euroSCORE*, European System for Cardiac Operative Risk Evaluation; *SYNTAX*, Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery; *CABG*, coronary artery bypass grafting; *HCR*, hybrid coronary revascularization; *CHF,* congestive heart failure; *COPD,* chronic obstructive pulmonary disease; *PVD*, peripheral vascular disease; *IABP*, intra-aortic balloon pump; *MI,* myocardial infarction; *UA,* unstable angina; *LAD,* left anterior descending (artery); *LVEF,* left ventricular ejection fraction; *NYHA,* New York Heart Association (functional classification); *HCR*, hybrid coronary revascularization; *OR*, operating room; *CPB*, cardiopulmonary bypass; *PCVA*, postoperative cerebrovascular accident; *ARF/RFHD*, acute renal failure/renal failure requiring hemodialysis; *PRBC*, packed red blood cells; *PLCOS*, postoperative low cardiac output syndrome. *Composite cardiac and cerebrovascular outcome: operative mortality, MI, PCVA, PLCOS.