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Clinical Investigation

Periprocedural Risk Predictors Affecting Long-Term Prognosis in Patients With Chronic Obstructive Pulmonary Disease Undergoing Coronary Artery Bypass Grafting

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Abstract

Objective: This study sought to identify periprocedural risk predictors that affect long-term prognosis in patients with chronic obstructive pulmonary disease (COPD) undergoing isolated coronary artery bypass grafting (CABG).

Methods: All consecutive 4,871 patients undergoing isolated CABG between May 2005 and June 2021 were included. Patients with and without COPD were compared for baseline demographics and preoperative characteristics. A propensity-matched analysis was used to compare the 2 groups. The primary outcome was long-term incidence of all-cause death.

Results: After matching, 767 patients each were included in the COPD and non-COPD groups; mean age was 71.6 and 71.4 years ($P = .7$), respectively; 29.3% and 32% ($P = .2$) were women, respectively. Intraoperatively, median (IQR) operating room time was higher in the COPD group than in the non-COPD group (5.9 [5.2-7.0] hours vs 5.8 [5.1-6.7] hours, respectively; $P = .01$). Postoperatively, intensive care unit stay ($P = .03$), hospital length of stay ($P = .0004$), and fresh frozen plasma transfusion units ($P = .012$) were higher in the COPD group than in the non-COPD group. Thirty-day mortality was not different between groups (1.3% in the COPD group vs 1% in the non-COPD group; $P = .4$). Median follow-up time was 4.0 years. The rate of all-cause death was higher in the COPD group than in the non-COPD group (138 patients [18.3%] vs 109 patients [14.5%], respectively; $P = .042$). Periprocedural risk predictors for all-cause death in patients with COPD were atrial fibrillation, diabetes, male sex, dialysis, ejection fraction less than 50%, peripheral vascular disease, and Society of Thoracic Surgeons Predicted Risk of Mortality score greater than 4%.

Conclusion: Patients with COPD undergoing isolated CABG had a significantly higher incidence of all-cause death than those without COPD. Herein, risk predictors are provided for all-cause death in patients undergoing isolated CABG.

Keywords: Pulmonary disease, chronic obstructive; coronary artery disease; coronary artery bypass; risk factors

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Introduction

Chronic obstructive pulmonary disease (COPD) in patients with coronary artery disease undergoing isolated coronary artery bypass grafting (CABG) has been widely investigated.[1,2] Since the publication of the Global Initiative for Chronic Obstructive Lung Disease criteria, which are based on spirometry findings,[3] and the inclusion of COPD in the EuroSCORE I and II and the Society of Thoracic Surgeons (STS) risk models,[4,5] COPD has been shown to be a predictive factor for long-term outcomes in patients undergoing CABG with a left internal mammary artery graft to the left anterior descending coronary artery.[6,7] The influence of risk predictors on long-term outcomes in patients with COPD undergoing isolated CABG, however, has often been debated.[8-12]

The main goal of this study was to identify periprocedural risk predictors that affect long-term prognosis in patients with COPD undergoing isolated CABG.

Key Points

- Patients with COPD undergoing isolated CABG have a higher risk of all-cause mortality than do patients without COPD.
- Patients with COPD have a higher incidence of fresh frozen plasma transfusion, longer intensive care unit stays, and greater hospital length of stay than do patients without COPD.
- Patients with COPD undergoing isolated CABG with modifiable risk factors can benefit from these outcomes.

Abbreviations and Acronyms

AF	atrial fibrillation
CABG	coronary artery bypass grafting
COPD	chronic obstructive pulmonary disease
EF	ejection fraction
PVD	peripheral vascular disease
STS	Society of Thoracic Surgeons
STS-PROM	Society of Thoracic Surgeons Predicted Risk of Mortality
SYNTAX	TAXUS Drug-Eluting Stent Versus Coronary Artery Bypass Surgery for the Treatment of Narrowed Arteries

Patients and Methods

Study Population

All consecutive patients who underwent CABG between May 2005 and June 2021 at Lankenau Heart Institute (Lankenau Medical Center, Wynnewood, PA) were identified. The study protocol was approved by the Main Line Health Hospitals Institutional Review Board (45CFR164.512). Patients' individual consent was waived because of the retrospective nature of the study. All patients who underwent isolated CABG were eligible for inclusion. Patients with and without COPD were compared on all demographics and preoperative characteristics. Patients were identified by operation codes in a digital operation registry. Clinical data were collected retrospectively from medical records.

Patient Follow-Up

Follow-up was done at the study outpatient clinic and from the hospital registry. All patients had at least 1 follow-up time point available. If the patient did not present, the referring cardiologist was asked to provide the information for this study. During the study period, 11 surgeons performed CABG procedures at Lankenau Heart Institute.

Primary and Secondary Outcomes

The primary outcome was long-term incidence of all-cause death in patients with COPD undergoing isolated CABG. The secondary outcome was major adverse cardiovascular and cerebrovascular events, including all-cause death, stroke, and myocardial infarction.

Clinical Definitions

Patients with COPD were defined as those with a documented medical history of COPD, regardless of the duration of disease or the need for treatment.

Covariates Included in the Study

Covariate included in the study were age; sex; race; STS Predicted Risk of Mortality (STS-PROM) score; body mass index (BMI); obesity; creatinine level; and comorbidities, such as preoperative dialysis, smoking, hypertension, dyslipidemia, cerebrovascular disease, peripheral vascular disease (PVD), liver disease, diabetes, mediastinal radiation, prior percutaneous coronary intervention, prior CABG, prior myocardial infarction, prior cardiac valve surgery, atrial fibrillation (AF), decreased ejection fraction (EF), number of diseased vessels, left main coronary artery stenosis, and severe proximal left anterior descending coronary artery lesion.

Statistical Analysis

Creatinine clearance was calculated according to the Cockcroft-Gault equation. Continuous variables were assessed for normality and presented as mean (SD) or median (IQR). Propensity score matching was used via a multiple logistic regression, with COPD status as the dependent variable and all demographics and preoperative variables added to the model. A 1:1 greedy nearest-neighbor algorithm, with no replacement match and a caliper width of 0.2%, produced 754 patients in each study group. Success of matching was assessed by computation of the percentage bias (similar to standardized mean difference) of each covariate, with a cutoff of 3.3% to denote acceptable balance. Matched samples were compared using McNemar tests and marginal homogeneity tests for categorical variables and matched paired *t* tests and signed rank tests for continuous variables. Estimated weights were incorporated into Cox proportional hazards regression models for the primary and secondary end points. To illustrate the effect of COPD on long-term survival, Kaplan-Meier cumulative curves were constructed and compared by log-rank test. In addition, adjusted survivor function graphs for matched samples were created. All matched sample adjustments were made with age and STS-PROM score included as covariates. A Cox regression analysis was performed for patients with COPD and without COPD to find risk predictors for all-cause death.

All analyses were performed in Stata, version 17.0 software (StataCorp, LLC). The 95% CIs and *P* values are reported, with $P<.05$ considered significant.

Results

A total of 4,871 consecutive surgical patients were identified. After matching the COPD and non-COPD groups, each had 754 patients.

Preoperative Characteristics

Preoperatively, after 25 preoperative variables were matched, groups were well balanced (Table I).

Intraoperative Outcomes

Intraoperatively, patients with COPD had longer median (IQR) operating room times (5.9 [5.2-7.0] vs 5.8 [5.1-6.7] hours; $P=.017$) than did those in the non-COPD group (Table II).

Postoperative Outcomes

Postoperatively, patients with COPD had a longer median (IQR) intensive care unit stay (49.5 [26.1-95] vs 46.4 [25.2-92] hours; $P=.031$), longer median (IQR) total length of stay (6 [4-8] vs 5 [4-7] days; $P=.0004$), and higher rates of fresh frozen plasma transfusion (5.6% vs 2.9%; $P=.012$) than did patients in the non-COPD group (Table III). Thirty-day mortality and hospital readmission did not differ between groups.

Follow-Up Outcomes

Median (IQR) follow-up time was 3.4 (0.9-6.7) years and 4.0 (1.2-7.9) years for the COPD and non-COPD groups, respectively. Patients with COPD had a significantly higher rate of all-cause mortality than patients in the non-COPD group (18.3% vs 14.5%; $P=.042$) (Table IV; Fig. 1). Major adverse cardiovascular and cerebrovascular events, stroke, myocardial infarction, and repeat intervention were not significantly different between groups.

Risk Factor Analysis for All-Cause Mortality in Patients Without COPD

The Cox regression analysis indicated that risk factors for all-cause mortality in patients without COPD were an STS-PROM score of 4% or higher, dialysis, PVD, diabetes, and EF less than 50% (Table V).

Risk Factor Analysis for All-Cause Mortality in Patients With COPD

The Cox regression analysis indicated that risk factors for all-cause mortality in patients with COPD were male sex, an STS-PROM score of 4% or higher, dialysis, AF, PVD, diabetes, and EF less than 50% (Table V).

Comparison of Risk Factor Analysis for All-Cause Mortality in Patients With and Without COPD

Common periprocedural risk predictors for all-cause mortality among patients with and without COPD were an STS-PROM score of 4% or higher, dialysis, PVD, diabetes, and EF less than 50%. Periprocedural risk predictors for all-cause mortality present only in patients with COPD were male sex and AF (Table V).

TABLE I. Preoperative Characteristics

	Unmatched				Matched			
Characteristic	No COPD n=4,104	COPD n=767	*P* value[a]	SMD, %	No COPD n=754	COPD n=754	*P* value[a]	SMD, %
Age, mean (SD), y	70.9 (11.3)	71.6 (9.9)	.08	3.2	71.4 (11.4)	71.6 (10.0)	.74	0
Sex, No. (%)			<.0001	14.7			.24	−6
Female	950 (23.2)	227 (29.6)			241 (32.0)	221 (29.3)		
Male	3,154 (76.9)	540 (70.4)			513 (68.0)	533 (70.7)		
Race or ethnicity, No. (%)			.01				.96	
White	3,639 (88.7)	666 (86.8)			657 (87.1)	656 (87.0)		
Black or African American	370 (9.0)	91 (11.9)		9.3	89 (11.8)	88 (11.7)		−0.4
Other[b]	95 (2.3)	10 (1.3)		−7.6	8 (1.1)	10 (1.3)		2
Society of Thoracic Surgeons Predicted Risk of Mortality score, median (IQR)	0.9 (0.5-1.8)	1.9 (0.9-4.1)	<.0001	43.6	1.3 (0.6-3.2)	1.8 (0.9-4.0)	<.001	3.4
Body mass index, mean (SD)	29.3 (8.8)	29.5 (6.5)	.49	3	29.6 (5.6)	29.6 (6.4)	.97	0.1
Obesity, No. (%)	1,546 (37.7)	312 (40.7)	.12	6.2	315 (41.8)	309 (41.0)	.76	−1.6
Creatinine level, median (IQR), mg/dL[c]	1 (0.9-1.2)	1 (0.9-1.3)	.001	11	1 (0.9-1.3)	1 (0.9-1.3)	.67	3.1
Dialysis, No. (%)	97 (2.4)	22 (2.9)	.41	3.2	21 (2.8)	21 (2.8)	.999	0
Smoking, No. (%)	1,742 (42.5)	525 (68.5)	<.0001	54.2	531 (70.4)	513 (68.0)	.23	−5
Diabetes, No. (%)	1,650 (40.2)	369 (48.1)	<.0001	16	376 (49.9)	362 (48.0)	.46	−3.7
Hypertension, No. (%)	3,511 (85.6)	694 (90.5)	<.0001	15.2	676 (89.7)	681 (90.3)	.67	2
Dyslipidemia, No. (%)	3,555 (86.6)	676 (88.1)	.26	4.6	659 (87.4)	663 (87.9)	.75	1.6
Cerebrovascular disease, No. (%)	665 (16.2)	233 (30.4)	<.0001	34	207 (27.5)	221 (29.3)	.39	4.5
Peripheral vascular disease, No. (%)	514 (12.5)	208 (27.1)	<.0001	37.2	184 (24.4)	197 (26.1)	.39	4.4
Liver disease, No. (%)	48 (1.2)	14 (1.8)	.137	5.4	12 (1.6)	14 (1.9)	.695	2.2
Prior mediastinal radiation, No. (%)	29 (0.7)	16 (2.1)	<.0001	11.8	14 (1.9)	14 (1.9)	.999	0
Previous percutaneous coronary intervention, No. (%)	1,552 (37.8)	266 (34.7)	0.099	−6.5	263 (34.9)	263 (34.9)	.999	0
Prior CABG, No. (%)	93 (2.3)	19 (2.5)	.72	1.4	19 (2.5)	19 (2.5)	.999	0
Prior myocardial infarction, No. (%)	2,216 (54.0)	508 (66.2)	<.0001	25.2	494 (65.5)	496 (65.8)	.91	0.5
Prior cardiac valve surgery, No. (%)	23 (0.6)	7 (0.9)	.252	4.1	3 (0.4)	7 (0.9)	.21	6.2
Atrial fibrillation, No. (%)	474 (11.6)	119 (15.5)	.002	11.6	108 (14.3)	115 (15.2)	.60	2.7
EF, mean (SD), %	50 (35.1-60)	52 (34.1-58)	.01	12.1	48.9 (15.1)	48.9 (14.6)	.93	0.3

Continued

TABLE I. Preoperative Characteristics, continued

Characteristic	Unmatched				Matched			
	No COPD n=4,104	COPD n=767	*P* value[a]	SMD, %	No COPD n=754	COPD n=754	*P* value[a]	SMD, %
EF <50%, No. (%)	1,101 (26.8)	311 (40.6)	<.0001	29.3	304 (40.3)	300 (39.8)	.82	–1.1
No. of diseased coronary vessels, No. (%)			.501				.55	
1	398 (9.7)	61 (8.0)	–		58 (7.7)	61 (8.1)	–	
2	1,030 (25.1)	195 (25.4)	–	0.8	180 (23.9)	190 (25.2)	–	3.1
3	2,523 (61.5)	483 (63.0)	–	3.1	487 (64.6)	475 (63.0)	–	–3.3
4	153 (3.7)	28 (3.7)	–	–0.4	29 (3.9)	28 (3.7)	–	–0.7
Left main coronary artery stenosis >50%, No. (%)	1,017 (24.8)	214 (27.9)	.068	7.1	213 (28.3)	208 (27.6)	.77	–1.5
Severe proximal left anterior descending coronary artery lesion >70%, No. (%)	3,450 (84.1)	637 (83.1)	.483	–2.7	618 (82.0)	629 (83.4)	.47	3.9

CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; EF, ejection fraction; SMD, standardized mean difference.

[a] $P < .05$ was considered significant.

[b] "Other" included Latino and American Indian.

[c] SI conversion factor: To convert mg/dL to μmol/L, multiply by 88.4.

Discussion

The study findings were as follows:

- All-cause death in patients with COPD is higher than in patients without COPD.
- Postoperatively, patients with COPD had a longer intensive care unit stay, longer hospital length of stay, and a higher rate of blood product transfusions than patients without COPD.
- Risk predictors present only in patients with COPD were male sex and AF.

Comments

This analysis provided several novel insights into the population with COPD undergoing isolated CABG. First, mortality in patients with COPD was higher than in patients without COPD. Second, risk predictors for long-term prognosis in patients with COPD included male sex and AF.

All-Cause Death in Patients With and Without COPD

A recent clinical study conducted by the University of Toronto[13] found that patients with COPD had a 30% higher incidence of all-cause mortality and 4.9% higher hospital costs than patients without COPD. In the trial, patients with COPD were older than 70 years of age and were more likely to be male, of a lower income quintile, residents of long-term care, and admitted to the hospital before surgery than those without COPD. They were also more likely to have other preexisting conditions, such as coronary artery disease, congestive heart failure, and lung cancer. A greater proportion of patients with COPD had frailty and medium to high comorbidity. Patients with COPD more frequently underwent orthopedic surgery, open upper abdominal surgery, and vascular surgery.

Recent evidence suggests prolonged time to functional recovery after major surgery among older patients with comorbid conditions, which would include patients with COPD.[14] Compared with the Toronto clinical study,[13] this study found similar outcomes for all-cause

TABLE II. Intraoperative Characteristics

	Unmatched			Matched		
Characteristic	No COPD n = 4,104	COPD n = 767	*P* value[a]	No COPD n = 754	COPD n = 754	*P* value[a]
Saphenous venous graft, No. (%)	2,050 (50.0)	397 (51.8)	.36	404 (53.6)	391 (51.9)	.50
Internal mammary coronary artery, No. (%)			<.001			.79
Single	3,543 (86.3)	690 (90.0)		680 (90.2)	680 (90.2)	
Both	491 (12.0)	56 (7.3)		58 (7.7)	55 (7.3)	
None	70 (1.7)	21 (2.7)		16 (2.1)	19 (2.5)	
Radial artery graft use, No. (%)	765 (18.6)	128 (16.7)	.2	138 (18.3)	127 (16.8)	.46
No. of grafts, median (IQR)	2 (1-3)	2 (1-3)	.93	2 (1-3)	2 (1-3)	.62
No. of grafts, No. (%)			.28			.97
1	1,728 (42.1)	310 (40.4)		304 (40.3)	305 (40.5)	
2	689 (16.8)	139 (18.1)		133 (17.6)	135 (17.9)	
3	985 (24.0)	203 (26.5)		189 (25.1)	199 (26.4)	
4	525 (12.8)	90 (11.7)		97 (12.9)	90 (11.9)	
≥5	177 (4.3)	25 (3.3)		31 (4.1)	25 (3.3)	
Multiarterial CABG, No. (%)	1,026 (25.0)	152 (19.8)	.002	165 (21.9)	150 (19.9)	.35
Total arterial CABG, No. (%)	1,082 (26.4)	195 (25.4)	.59	169 (22.4)	192 (25.5)	.16
On-pump	559 (13.6)	132 (17.2)	.009	113 (15.0)	128 (17.0)	.29
Surgery priority, No. (%)			.008			.01
Elective	2,227 (54.3)	384 (50.1)		357 (47.4)	382 (50.7)	
Urgent	1,836 (44.7)	381 (49.7)		382 (50.7)	370 (49.1)	
Emergent	41 (1.0)	2 (0.3)		15 (2.0)	2 (0.3)	
Operative time, median (IQR), h	5.8 (5.1-6.7)	5.9 (5.2-7.0)	.01	5.8 (5.1-6.7)	5.9 (5.2-7.0)	.02
All types of blood transfusion, No. (%)	711 (17.3)	187 (24.4)	<.001	186 (24.7)	181 (24.0)	.77
Red blood cell units, No. (%)	605 (14.7)	167 (21.8)	<.0001	169 (22.4)	161 (21.4)	.62
Cryoprecipitate units, No. (%)	153 (3.7)	34 (4.4)	.35	31 (4.1)	34 (4.5)	.70
Platelet units, No. (%)	279 (6.8)	62 (8.1)	.2	69 (9.2)	61 (8.1)	.47
Fresh frozen plasma units, No. (%)	83 (2.0)	24 (3.1)	.06	25 (3.3)	24 (3.2)	.88
Extubated in the operating room, No. (%)	3,220 (78.5)	535 (69.8)	<.001	538 (71.4)	525 (69.6)	.45

CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease.

[a] $P < .05$ was considered significant.

TABLE III. Postoperative Characteristics

Characteristic	Unmatched			Matched		
	No COPD n=4,104	COPD n=767	*P* value[a]	No COPD n=754	COPD n=754	*P* value[a]
Total intensive care unit stay, median (IQR), h	44.1 (24.7-72.7)	49.7 (26.2-95.3)	<.0001	46.4 (25.2-91.7)	49.5 (26.1-95.0)	.03
Total length of stay, median (IQR), d	5 (4-7)	6 (4-8)	<.001	5 (4-7)	6 (4-8)	<.001
All types of blood transfusion, No. (%)	1,243 (30.3)	297 (38.7)	<.001	281 (37.3)	289 (38.3)	.67
Red blood cell units, No. (%)	1,210 (29.4)	289 (37.7)	<.001	273 (36.2)	281 (37.3)	.66
Cryoprecipitate units, No. (%)	161 (3.9)	39 (5.1)	.14	26 (3.5)	39 (5.2)	.09
Platelet units, No. (%)	226 (5.5)	50 (6.5)	.27	47 (6.2)	49 (6.5)	.83
Fresh frozen plasma units, No. (%)	133 (3.2)	43 (5.6)	.001	22 (2.9)	42 (5.6)	.01
Stroke, No. (%)	26 (0.6)	2 (0.3)	.21	7 (0.9)	1 (0.1)	.03
Superficial sternal wound infection, No. (%)	13 (0.3)	4 (0.5)	.38	3 (0.4)	4 (0.5)	.71
Deep sternal infection, No. (%)	12 (0.3)	4 (0.5)	.31	8 (1.1)	4 (0.5)	.25
Reoperation for bleeding, No. (%)	38 (0.9)	9 (1.2)	.52	7 (0.9)	9 (1.2)	.62
Prolonged ventilation >24 h, No. (%)	142 (3.5)	61 (8.0)	<.001	49 (3.5)	59 (7.8)	.31
New kidney failure, No. (%)	66 (1.6)	26 (3.4)	.001	19 (2.5)	26 (3.5)	.29
New dialysis, No. (%)	14 (0.3)	11 (1.4)	<.001	4 (0.5)	11 (1.5)	.07
New atrial fibrillation, No. (%)	900 (21.9)	196 (25.6)	.03	165 (21.9)	193 (25.6)	.08
30-d readmission, No. (%)	303 (7.4)	88 (11.5)	<.001	66 (8.8)	86 (11.4)	.09
30-d mortality, No. (%)	40 (1.0)	10 (1.3)	.41	16 (2.1)	10 (1.3)	.22

COPD, chronic obstructive pulmonary disease.

[a] *P* <.05 was considered significant.

mortality. In addition, these findings highlight the importance of careful risk prediction and decision-making for patients with COPD who are considering surgery.

Periprocedural Risk Predictors for All-Cause Mortality in Patients With COPD

DeRose et al[15] investigated clinical outcomes in patients with COPD and a low EF. A total of 544 consecutive patients with low EF (<25%) who underwent isolated CABG were included. Patients who underwent concomitant cardiac valve surgery or aneurysmectomy were excluded from the study. Indications for CABG were based on standard clinical and angiographic criteria. Complete revascularization was the policy of Lankenau Heart Institute, and reliance on echocardiography, particularly transesophageal echocardiography, in addition to anatomy determined the number of anastomoses. The authors reported a 32% 10-year survival in patients with COPD and decreased left ventricular function. Death rates have been reported to be higher among Black patients than among White patients with COPD, reflecting a greater force of all-cause mortality among Black people in the general population, and an update from the national lung and transplant list observed that Black patients with COPD died sooner than their White counterparts.[16]

Association Between COPD and the SYNTAX Clinical Trial

Altogether, the high event rates and the lack of significant weighted differences between COPD and

TABLE IV. Cumulative Long-Term Outcomes

	Unmatched			Matched		
Outcome	No COPD n=4,104	COPD n=767	*P* value[a]	No COPD n=754	COPD n=754	*P* value[a]
Long-term outcomes						
Mortality (all-cause), No. (%)			<.001			.04
No	3,683 (89.7)	625 (81.5)		645 (85.5)	616 (81.7)	
Yes	421 (10.3)	142 (18.5)		109 (14.5)	138 (18.3)	
Major adverse cardiac and cerebrovascular event, No. (%)				29 (3.9)	33 (4.4)	.6
Stroke	82 (2.0)	15 (2.0)	.94	14 (1.9)	15 (2.0)	.85
Myocardial infarction	98 (2.4)	21 (2.7)	.56	16 (2.1)	20 (2.7)	.50
Reoperation	477 (11.6)	91 (11.9)	.85	74 (9.8)	91 (12.1)	.16
Angina	443 (10.8)	91 (11.9)	.38	70 (9.3)	91 (12.1)	.08
Follow-up time, median (IQR), y						
Mortality (all-cause)	4.0 (1.2-7.9)	3.4 (0.9-6.7)	.005	3.3 (1.0-6.4)	3.5 (0.9-6.8)	.44
Major adverse cardiac and cerebrovascular event	3.9 (1.1-7.8)	3.4 (0.9-6.6)	.007	3.2 (0.9-6.3)	3.4 (0.9-6.6)	.33
Stroke	3.9 (1.2-7.8)	3.4 (0.9-6.7)	.007	3.2 (1.0-6.3)	3.4 (0.9-6.7)	.32
Myocardial infarction	3.9 (1.2-7.8)	3.4 (0.9-6.6)	.005	3.3 (0.9-6.3)	3.4 (0.9-6.7)	.39
Reoperation	3.6 (1.1-7.3)	3.0 (0.8-6.1)	.002	3.0 (0.9-6.0)	3.0 (0.8-6.1)	.80
Angina	3.6 (1.1-7.4)	3.0 (0.8-6.2)	.002	3.0 (0.9-6.1)	3.0 (0.8-6.2)	.78

COPD, chronic obstructive pulmonary disease.

[a] $P < .05$ was considered significant.

non-COPD groups, except for mortality, in this analysis suggest the need to weight more clinical events. In this context, COPD was found to be an independent predictor of mortality in the TAXUS Drug-Eluting Stent Versus Coronary Artery Bypass Surgery for the Treatment of Narrowed Arteries (SYNTAX) trial[17] and remains one of the prognostic indexes in the SYNTAX II score.[18] The SYNTAX trial was a randomized, prospective, multicenter trial (85 centers in 18 countries) with an all-comers design. In this trial, patients with COPD undergoing either CABG or percutaneous coronary intervention experienced a hazard ratio for all-cause mortality at 4 years of 2.84 (95% CI, 1.64-4.9) and 1.35 (95% CI, 0.74-2.47), respectively. In addition, patients with COPD had a higher SYNTAX score.

Therefore, health care professionals should pay additional attention to patients with COPD and use multidisciplinary care and self-management, a double health care approach that might improve clinical outcomes after isolated CABG independent of the CABG procedure used.[19,20]

Implications of This Study

This study has long-term implications for patients with COPD undergoing isolated CABG, with a particular focus on periprocedural risk predictors. In this context, this study reported a 4% higher probability of all-cause mortality in patients with COPD than in patients without COPD. In a medical and surgical climate that is increasingly complex, the ability of cardiac surgeons to accurately provide an estimate of long-term survival in patients with COPD undergoing CABG will be extremely valuable.[15]

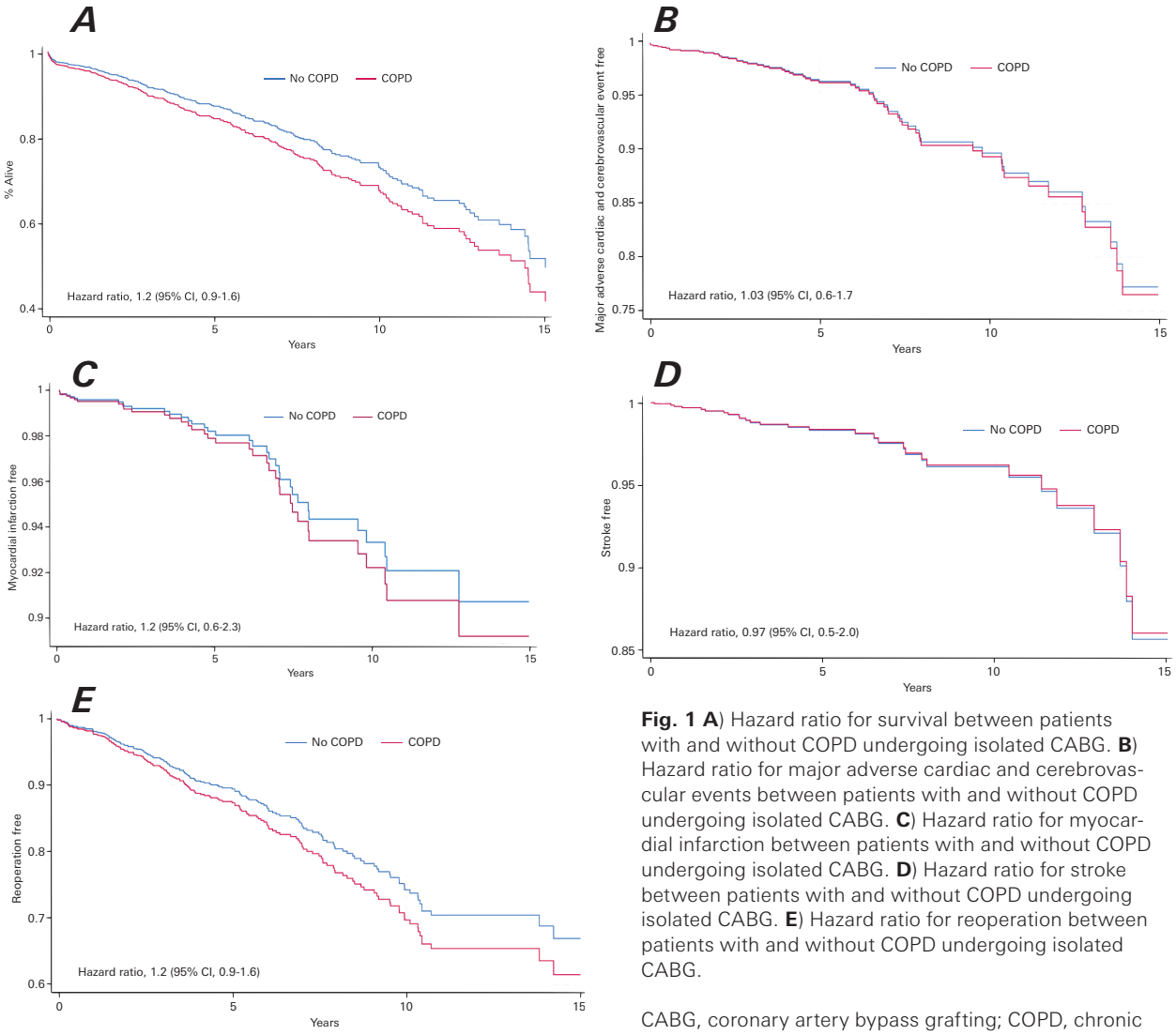

Fig. 1 A) Hazard ratio for survival between patients with and without COPD undergoing isolated CABG. **B**) Hazard ratio for major adverse cardiac and cerebrovascular events between patients with and without COPD undergoing isolated CABG. **C**) Hazard ratio for myocardial infarction between patients with and without COPD undergoing isolated CABG. **D**) Hazard ratio for stroke between patients with and without COPD undergoing isolated CABG. **E**) Hazard ratio for reoperation between patients with and without COPD undergoing isolated CABG.

CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease.

TABLE V. Risk Predictor Comparison for All-Cause Mortality in Patients With and Without COPD

Comparator	Patients with COPD Hazard ratio (95% CI)	Patients without COPD Hazard ratio (95% CI)
Male sex	1.9 (1.2-1.9)[a]	1.5 (0.95-2.5)
White race	1.4 (0.8-2.5)	1.2 (0.6-2.1)
Society of Thoracic Surgeons Predicted Risk of Mortality score ≥4%	3.9 (2.7-5.6)[a]	3.5 (2.3-5.4)[a]
Dialysis	4.6 (2.3-9.3)[a]	4.4 (2.4-8.1)[a]
Hypertension	2.0 (0.9-4.3)	1.6 (0.7-3.5)
Atrial fibrillation	1.9 (1.3-2.8)[a]	0.9 (0.6-1.8)
Peripheral vascular disease	1.9 (1.3-2.7)[a]	2.0 (1.3-2.9)[a]
Diabetes	2.0 (1.4-3.0)[a]	1.7 (1.1-2.6)[a]
Ejection fraction <50%	2.5 (1.7-3.7)[a]	2.4 (1.6-3.7)[a]

COPD, coronary obstructive pulmonary disease.

[a] Significant hazard ratio for all-cause mortality.

Limitations

This retrospective study was subject to all limitations inherent to a nonrandomized study, including potential selection bias regarding which patients underwent CABG in the COPD vs non-COPD groups. The rigorous propensity-matched analysis, however, limited these biases. In addition, the study included a large time frame (2005-2021), and many advanced techniques and changes in medical treatments occurred during this period. Another limitation is the single-center data; therefore, this analysis warrants further validation from multicenter studies. Moreover, the lack of granular data on COPD severity is a limitation of the study, as are the lack of data on the impact of COPD on prolonged ventilation, pneumonia, and need for tracheostomy.

Conclusion

Patients with COPD undergoing isolated CABG had a significantly higher incidence of all-cause death than did those without COPD. Herein, risk predictors are provided for all-cause death in patients undergoing isolated CABG.

Article Information

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