New-onset postoperative atrial fibrillation impact on 5-year clinical outcomes and costs

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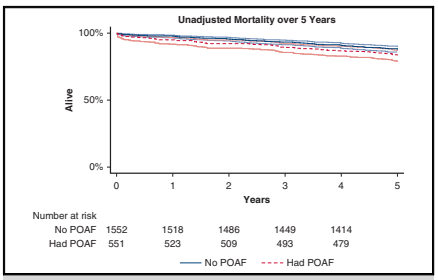
ABSTRACT

Objective: The impact of new-onset postoperative atrial fibrillation (POAF) following coronary artery bypass grafting (CABG) surgery on long-term clinical outcomes and costs is not known. This subanalysis of the Veterans Affairs "Randomized On/Off Bypass Follow-up Study" compared 5-year outcomes and costs between patients with and without POAF.

Methods: Of the 2203 veterans in the study, 100 with pre-CABG atrial fibrillation (93) or missing data (7) were excluded (4.8%). Unadjusted and risk-adjusted outcomes were compared between new-onset POAF (n = 551) and patients without POAF (n = 1552). Five-year clinical outcomes included mortality, major adverse cardiovascular events (MACE, comprising mortality, repeat revascularization, and myocardial infarction), MACE subcomponents, stroke, and costs. A stringent *P* value of ≤.01 was required to identify statistical significance.

Results: Patients with POAF were older and had more complex comorbidities. Unadjusted 5-year all-cause mortality was 16.3% POAF versus 11.9% no-POAF, *P* = .008. Unadjusted cardiac-mortality was 7.4% versus 4.8%, *P* = .022. There were no differences between groups in any other unadjusted outcomes including MACE or stroke. After risk adjustment, there were no significant differences between groups in 5-year all-cause mortality (POAF odds ratio, 1.19; 99% confidence interval, 0.81-1.75) or cardiac mortality (odds ratio, 1.51, 99% confidence interval, 0.88-2.60). Adjusted first-year post-CABG costs were $15,300 greater for patients with POAF, but 2- through 5-year costs were similar.

Conclusions: No 5-year risk-adjusted outcome differences were found between patients with and without POAF after CABG. Although first-year costs were greater in patients with POAF, this difference did not persist in subsequent years. (J Thorac Cardiovasc Surg 2021;161:1803-10)



Unadjusted mortality over 5 years in CABG patients with and without new-onset POAF.

CENTRAL MESSAGE

There was no significant difference in risk-adjusted 5-year clinical outcomes in patients with or without POAF. Greater first-year costs in patients with POAF did not persist in subsequent years.

PERSPECTIVE

After risk adjustment, there were no significant differences in 5-year outcomes (mortality, major adverse cardiac events, stroke, or costs) between coronary artery bypass surgery patients who developed new-onset post-operative atrial fibrillation (POAF) versus those with no POAF.

See Commentaries on pages 1811, 1812, and 1814.

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Abbreviations and Acronyms

AMI	= acute myocardial infarction
CABG	= coronary artery bypass grafting
CI	= confidence interval
MACE	= major adverse cardiovascular events
OR	= odds ratio
POAF	= postoperative atrial fibrillation
ROOBY	= Randomized On vs Off Bypass
ROOBY-FS	= ROOBY Follow-up Study
VA	= Veterans Affairs

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New-onset postoperative atrial fibrillation (POAF) has a well-documented negative impact on short-term and 1-year patient outcomes after coronary artery bypass grafting surgery (CABG), including increased 30-day mortality, longer intensive care unit and hospital lengths of stay, more readmissions, and greater hospital costs.[1-4] The negative consequences of POAF appear to persist to 1 year, with increased morbidity, mortality, and health care–related costs reported[5-8]; however, longer-term outcome studies have been limited in scope, represented by mostly retrospective, single institutional reviews of CABG.[4,9-19]

The Department of Veterans Affairs (VA) "Randomized On vs Off Bypass'' Follow-up Study (ROOBY-FS) coordinated long-term follow-ups for the original randomized, controlled, multicenter On vs Off Bypass trial, which compared on-pump with off-pump surgical revascularization approaches.[20] New-onset POAF was defined as any irregular atrial-based rhythm with a duration of at least 30 minutes that did not exist before the CABG procedure. As previously reported,[5,6] POAF was associated with a greater rate of short-term post-CABG complications, worse risk-adjusted 1-year mortality, and greater 1-year costs. The purpose of this subanalysis was to compare 5-year post-CABG clinical outcomes and costs between patient with versus without POAF.

METHODS

Patient and Clinical Data

Details for the Randomized On vs Off Bypass (ROOBY) trial and the ROOBY-FS methodology, as well as the 1-year ROOBY POAF findings, have been previously published.[6,20,21] Funded by the Cooperative Studies Program (CSP #517-FS), ROOBY-FS followed veterans enrolled between February 2002 and May 2008 at 18 VA medical centers and compared a comprehensive set of long-term clinical outcomes and costs between on-pump and off-pump coronary bypass grafting treatments. The approvals were granted by the institutional review boards at Stanford University, the Northport VA Medical Center, and the Rocky Mountain Regional VA

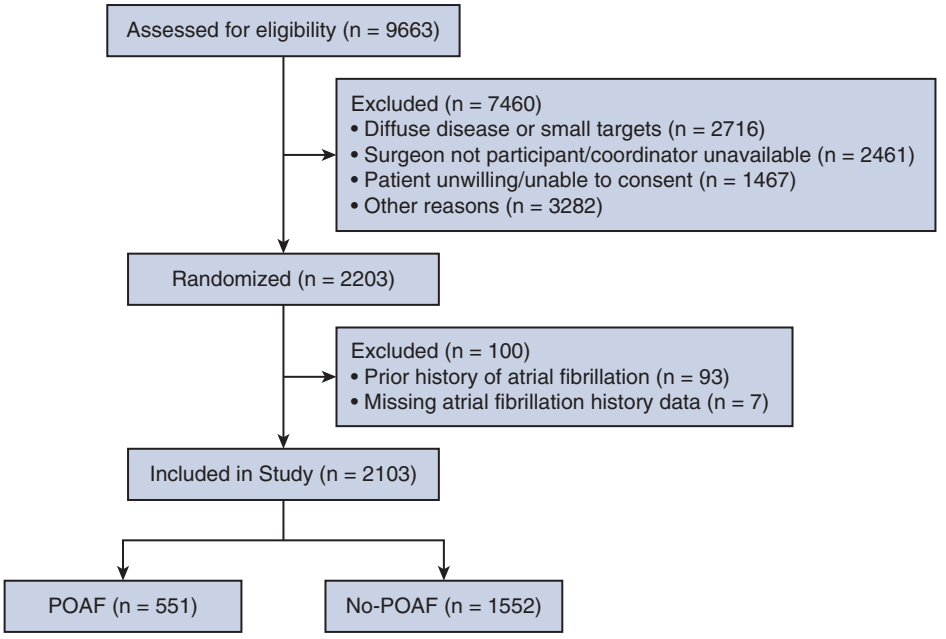

FIGURE 1. Consolidated Standards of Reporting Trials diagram. *POAF*, Postoperative atrial fibrillation.

with waivers for individual informed consent and Health Insurance Portability and Accountability Act authorizations (approval no.: CR #00415; "VA ROOBY Trial Follow-up Extension," Northport, VAMC and 13-1864: "Myocardial Revascularization: On and Off Cardiopulmonary Bypass—Follow-up Extension," Rocky Mountain Regional VAMC; approved through December 27, 2019; Stanford University no. 22249, approved through March 31, 2020). For this subanalysis, analytic support was provided by the VA Palo Alto Health Economics Resource Center in Menlo Park, California, and the Cooperative Studies Program Coordinating Center in Perry Point, Maryland.

Study Population and New-Onset POAF Definition

From the original 2203 nonemergent veterans enrolled in ROOBY, this subanalysis population included the patients without a history of preoperative atrial fibrillation. Five-year outcomes included vital status, repeat revascularization, nonfatal acute myocardial infarction (AMI), and cost outcomes. An endpoints committee (blinded to the treatment assignment; consisting of cardiac surgeons, cardiologists, and nurse coordinators), adjudicated all 5-year post-CABG clinical outcomes. Cause of death was classified as cardiac-related, not cardiac-related, or unknown.[21]

The primary 5-year endpoints included all-cause death and major adverse cardiovascular events (MACE); comprising mortality, repeat revascularization, and nonfatal AMI; secondary endpoints included individual components of MACE, cardiac-death, stroke, and costs.

New-onset POAF was defined as any irregular atrial-based rhythm with a duration of at least 30 minutes that did not exist before the CABG procedure. The determination of long-term stroke was based on a VA or Medicare inpatient admission with a primary stroke diagnosis and a stroke-related Diagnosis-Related Group code in the billing records. The admission date for the stroke-related hospitalization was used as the date of stroke. All patients in the ROOBY trial were closely followed by the research nurse every 2 months by phone until 1-year post-CABG, when they were requested to return for follow-up coronary angiogram and neuropsychologic testing. For this study, follow-up was complete except for 10 patients who were suspected of being lost to follow-up. According to our records, these individuals did not die and had no VA or Medicare fee-for-service use in the past year. Eight (0.52%) of these individuals were in the no-POAF group and 2 (0.36%) of them were in the POAF group. This difference was not significant.

After we excluded pre-CABG costs, the annual hospitalization costs were reported through 5 years based on the VA Managerial Cost Accounting data (a VA activity based cost accounting system), VA purchased care Fee Basis data, and Medicare Part A and B data. All costs were standardized to 2016 dollars using the general consumer price index.[22] The 10 cases listed as lost to follow-up were assigned 0 cost and 0 use because they did not report any events.

Statistical Analysis

The patients with POAF were compared with patients without POAF. Initially, bivariate comparisons were performed for dichotomous variables using χ^2 or Fisher exact tests; continuous variables were evaluated using the Student *t* tests, and time-related outcomes were analyzed by Kaplan–Meier survival analysis with log-rank tests. For dichotomous endpoints, logistic regression models were employed to control for other patient risk factors, including sex, age, marital status, insurance status, smoking history, depression history, use of diabetic medications, chronic obstructive pulmonary disease, peripheral vascular disease, hypertension, aorta quality, and number of bypass grafts (Table E1). For time-to-event endpoints, Cox proportional hazards analyses were employed to adjust for these same factors.

The cost data were analyzed using a generalized linear regression with a log link and a gamma distribution to account for non-normality of the distribution after adjusting for baseline risk factors. In the cost regression models, a dummy variable for the VA medical center was included to control for geographic variation in wages; this regression model was used to estimate risk-adjusted mean annual costs.

For all of the comparisons, the protocol's prespecified *P* value of ≤.01 was considered statistically significant.[21] Above this threshold (*P* values >.01 and ≤.15) were considered as possible trends. All *P* values have been reported, however, to permit independent interpretation.

TABLE 1. Patient characteristics

Patient demographics	POAF (n = 551)	No POAF (n = 1552)	*P* value
Age, y, mean (SD)	65.3 (8.5)	62.1 (8.2)	<.0001
White (vs all other)	491 (89%)	1275 (82%)	<.0001
Insurance coverage			
VA only	240 (44%)	865 (56%)	<.0001
Any private insurance	90 (16%)	214 (14%)	
All other (eg, any public insurance)	221 (40%)	473 (30%)	
Current smoker	154 (28%)	561 (36%)	.001
Chronic obstructive pulmonary disease	130 (24%)	297 (19%)	.025
Serum creatinine ≥1.5 mg/dL	59 (11%)	106 (7%)	.004
Cerebrovascular accident	47 (9%)	111 (7%)	.292
Peripheral vascular disease	105 (19%)	218 (14%)	.005
Hypertension	494 (90%)	1318 (85%)	.006
Medically treated diabetes	218 (40%)	583 (38%)	.406
History of depression in past 2 y	63 (11%)	196 (13%)	.463
Ejection fraction <45%	80 (15%)	263 (17%)	.185
Urgent status	76 (14%)	251 (16%)	.185
Quality of aorta			
Good	402 (73%)	1225 (79%)	.013
Moderate	107 (19%)	255 (16%)	
Poor	34 (6%)	57 (4%)	
Unknown	8 (1%)	15 (1%)	
Number of grafts completed, mean (SD)	3.05 (0.90)	2.95 (0.93)	.025

Patients with POAF have a greater risk profile. *POAF*, Postoperative atrial fibrillation; *SD*, standard deviation; *VA*, Veterans Affairs.

RESULTS

Baseline Characteristics

Of the 2203 patients enrolled, 93 were excluded from this substudy for a history of preoperative atrial fibrillation and 7 were excluded for missing preoperative atrial fibrillation data. Of the 2103 included patients, 551 patients (26.2%) developed POAF (Figure 1). There was no significant difference in the incidence of POAF between those assigned to on-pump (268/1056 [25.4%]) or off-pump CABG (283/1047 [27.0%]; $P = .40$). Patients who developed POAF after surgery were older and had more comorbid conditions than those without POAF (Table 1).

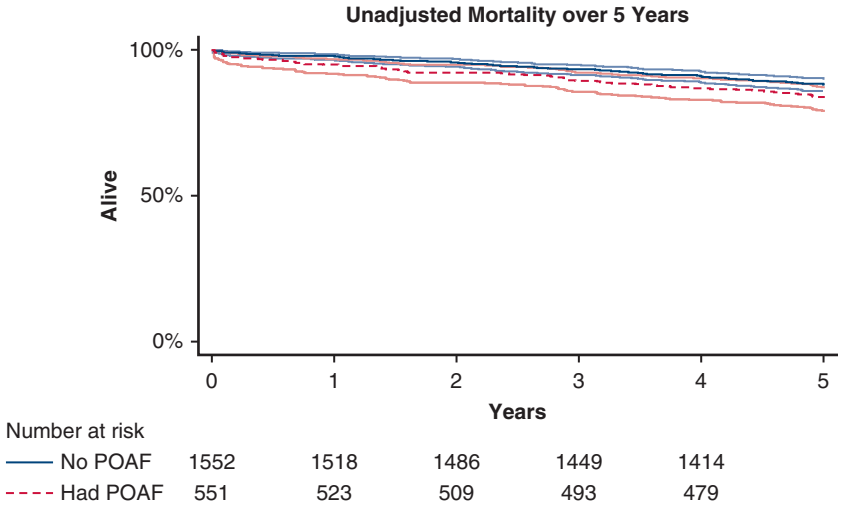

FIGURE 2. Unadjusted mortality over 5 years in patients undergoing coronary artery bypass grafting with POAF versus patients without POAF. *POAF*, Postoperative atrial fibrillation.

ADULT

Clinical Outcomes

Unadjusted 5-year MACE rate was 31% in patients with POAF and 28% in patients without POAF ($P = .239$). With risk adjustment, the odds ratio (OR) was 1.06, 99% confidence interval (CI), 0.80-1.41, $P = .575$. The unadjusted 5-year all-cause mortality rate was 16.3% in patients with POAF versus 11.9% in patients without POAF ($P = .008$, Figure 2). After risk adjustment, there was no significant difference between groups in all-cause mortality (OR, 1.19; 99% CI, 0.81-1.75, $P = .244$) (Table 2). Unadjusted 5-year survival (ie, days alive up to 5 years) was lower for POAF patients (hazard ratio, 1.41; 99% CI, 1.02-1.97; $P = .007$). However, after risk adjustment, there was no significant difference in survival (hazard ratio, 1.22; 99% CI, 0.87-1.72, $P = .130$).

The unadjusted cardiac-related mortality rate was 7.4% for patients with POAF and 4.8% for patients without POAF, $P = .022$, which was not considered statistically significant per the prespecified $P \leq .01$ threshold. The risk-adjusted association of POAF with cardiac-related death was OR 1.51 with 99% CI 1.00-2.29, $P = .049$. The primary cause of death was cardiac in 41 of 90 deaths (45.56%) in the POAF group versus 75 of 185 (40.54%) in the no-POAF group ($P = .43$). For the other secondary endpoints including AMI, repeat revascularization, and stroke, there were no statistically significant differences between patients with POAF and without POAF in either unadjusted or risk-adjusted outcomes (Table 2). Additional analyses on 5-year outcomes, overall and stratified by on- versus off-pump CABG, did not show statistically

TABLE 2. Five-year unadjusted and risk-adjusted clinical outcomes

Outcome variables	Unadjusted results			Risk-adjusted results	
	POAF (n = 551)	No POAF (n = 1552)	*P* value	Odds ratio (99% CI)	*P* value
Major adverse cardiovascular event	169 (31%)	435 (28%)	.239	1.06 (0.80-1.41)	.575
All-cause death	90 (16%)	185 (12%)	.008	1.19 (0.81-1.75)	.244
Cardiac-related death	41 (7%)	75 (5%)	.021	1.51 (0.88-2.60)	.049
Acute myocardial infarction	63 (11%)	164 (11%)	.573	1.11 (0.73-1.68)	.538
Repeat revascularization	66 (12%)	198 (13%)	.635	1.03 (0.69-1.54)	.831
Percutaneous coronary intervention*	61 (11%)	185 (12%)	.594	1.03 (0.68-1.56)	.834
Coronary artery bypass graft*	6 (1%)	13 (1%)	.592	1.13 (0.28-4.59)	.816
Stroke	18 (3%)	45 (3%)	.664	0.98 (0.47-2.04)	.931

Other than unadjusted 5-year mortality rates, there were no 5-year clinical outcome differences identified between POAF and no-POAF patient subgroups. *POAF*, Postoperative atrial fibrillation; *CI*, confidence interval. *Note: 1 patient in the POAF group had percutaneous coronary intervention and coronary artery bypass grafting on the same day.

TABLE 3. Annualized risk-adjusted costs (2016 dollars)

Year	POAF (n = 551)		No POAF (n = 1552)		Difference, $
	Mean, $	99% CI	Mean, $	99% CI	
1	78,930	72,419-85,442	63,630	60,910-66,350	15,301*
2	18,822	16,527-21,116	17,733	16,446-19,020	1089
3	17,760	14,987-20,534	14,995	13,774-16,215	2766
4	17,867	15,376-20,358	16,596	14,962-18,229	1271
5	21,016	17,807-24,226	18,213	16,576-19,849	2803

No significant difference between POAF versus no POAF costs beyond 1 year were found. These annualized costs include converted patients. Numbers may not add due to rounding. *POAF*, Postoperative atrial fibrillation; *CI*, confidence interval. *$P \leq .01$.

significant differences among the on-pump POAF as compared with off-pump POAF (Table E1). There were also no significant differences in any of these 5-year outcomes when center effects were included (Table E2). The complete regression results are shown in Table E3.

Costs

After risk adjustment, POAF was associated with a greater average cost (2016 dollars) at 1 year ($78,930) compared with patients without POAF ($63,630; Table 3). However, annual costs were not statistically different for the 2 groups beyond 1 year (Figure 3). The greater 1-year cost in POAF group was largely attributable to hospital costs during the index surgery hospitalization.

In a sensitivity analysis, patients who required intraoperative conversion from one revascularization technique to the other technique were excluded, and this had no resultant effect on the interpretation of the cost data. In those without conversions, adjusted average costs in year 1 were $77,620 and $62,778 for patients with POAF and patients without POAF, respectively. By year 2, those respective numbers were $19,404 and $17,540 ($P = .174$) and in year 5, the patients with POAF had an average cost of $20,232 and the patients without POAF had an average cost of $18,222 ($P = .290$).

DISCUSSION

We have previously reported that patients undergoing CABG with new-onset POAF are older, have more complex comorbidities, and have worse 30-day and 1-year clinical outcomes and greater costs than patients who do not develop POAF.[5,6] This ROOBY-FS subanalysis reports 5-year post-CABG clinical outcomes and costs comparing patients with POAF with patients without POAF. No risk-

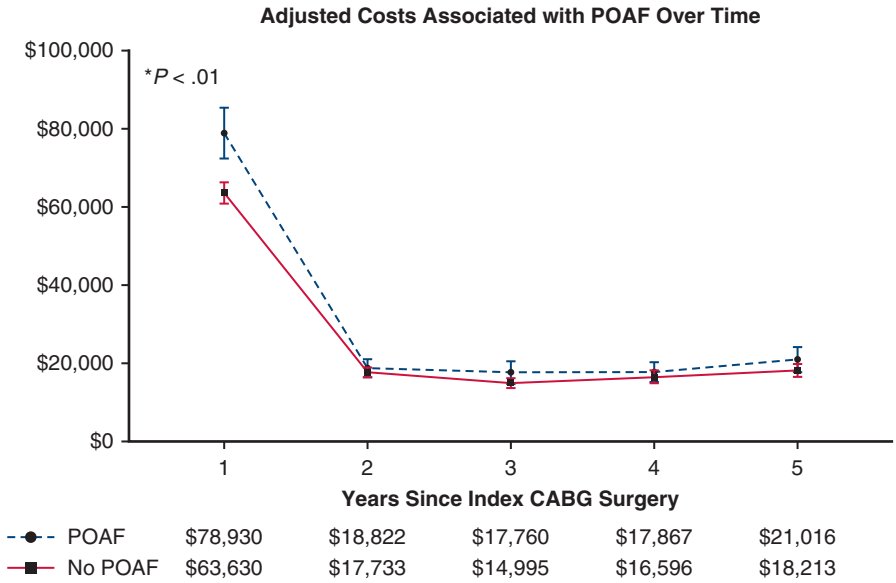

FIGURE 3. Yearly risk-adjusted costs by POAF status over 5 years (mean and 99% confidence intervals representing 2016 dollars). *POAF*, Postoperative atrial fibrillation; *CABG*, coronary artery bypass grafting.

VIDEO 1. The corresponding author explaining the importance and relevance of their paper. Video available at: https://www.jtcvs.org/article/S0022-5223(19)32774-6/fulltext.

adjusted differences were identified for 5-year all-cause mortality, MACE, AMI, repeat revascularization, or stroke. Compared with patients without POAF, patients with POAF trended toward having greater 5-year cardiac mortality (risk adjusted OR, 1.51; 99% CI, 0.88-2.60; $P = .049$). As previously reported, patients with POAF had greater 1-year costs (~$15,000), but this cost difference did not persist during subsequent years.[6]

Affecting up to one third of patients undergoing CABG, POAF is a very common complication,[5,18] associated with adverse perioperative outcomes and increased 1-year mortality.[2,6-8,19] Beyond the first year, however, the literature is mixed, with contradictory results published.[4,8-19,23,24] Methodologic differences across studies may explain some variation. Many of these studies used limited risk adjustment, such as only adjusting for warfarin use,[19] whereas others performed no risk adjustment at all.[4,15] Our study has the advantage of complete 5-year follow-up on all patients. In addition, risk adjustment accounted for risk factors such as ejection fraction that are often missing in observational data (variables are listed in Table 1). In this study, POAF was not associated with greater rates of risk-adjusted 5-year adverse outcomes or 2- to 5-year costs. Thus, comprehensive risk adjustment appears to be an important consideration to be able to appropriately compare longer-term clinical outcomes of patients with POAF versus patients without POAF.

As a separate issue, the timing of mortality among patients with POAF post-CABG has not been well studied. It is known that patients with POAF commonly leave the hospital in sinus rhythm but with an increased risk of future atrial fibrillation.[9,17,25,26] Given the challenges of longitudinal follow-up, very few studies have been able to compare late rates of adverse events. Although we have reported greater risk-adjusted all-cause and cardiac-specific mortality for patients with POAF who underwent CABG at 1 year, these differences did not persist at 5 years. Our findings suggest that beyond 1 year, the outcomes in patients who develop POAF are related to patients' comorbidities present and not necessarily the POAF itself. Identifying which postoperative and/or postdischarge processes of care (eg, chronic anticoagulation, beta-blocker therapy,

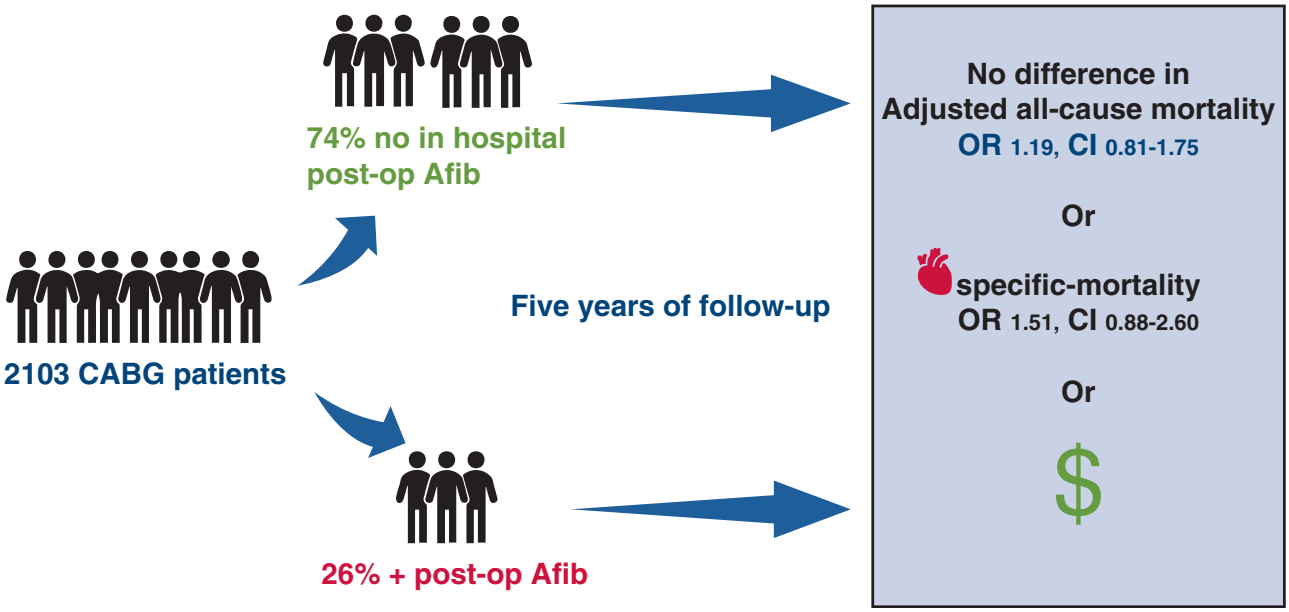

FIGURE 4. Pictorial summary of the study demonstrating no significant difference in risk-adjusted all cause or cardiac related mortality and costs in patients with and without postoperative atrial fibrillation. *CABG*, Coronary artery bypass grafting; *OR*, Odds ratio; *CI*, confidence interval.

and/or aggressive comorbidity management) may mitigate long-term risk requires further study.[27,28]

The impact of POAF on long-term stroke is also controversial. Some single-center retrospective reviews and claims database analyses suggest there may be a potential link.[14,29] A recent meta-analysis of 16 studies (108,711 patients) documented an association of POAF with increased stroke risk (adjusted effect size 1.25, $P < .001$) at a median of 2 years follow-up, although significant variability in POAF impact was observed across studies.[30] Contrary to the meta-analysis, this ROOBY-FS subanalysis found POAF was not associated with increased rates of 5-year stroke. Concordant with our results, 2 studies using propensity score matching for risk adjustment found no significant difference in the rate of long-term stroke.[17,31]

The vast majority of the literature evaluating the impact of POAF on resource use has been limited to the perioperative period.[1-3] We have previously reported an additional ~$14,000 in costs for POAF patients during the first year after CABG, which was confirmed using additional robust risk adjustment for an estimate of $15,300.[6] In this study, we found no annualized cost differences between groups after the first year post-CABG. As one of the main drivers of cost immediately postoperatively is complications, it may be that the lack of clinical differences in POAF and no-POAF groups in years 2-5 is driving similar costs (Video 1).[32]

The results of the current study should be looked at in the context of the advances in the pre- and postoperative care and changes in the management of POAF over the past decades. Early pharmacologic or electrical cardioversion and use of direct oral anticoagulants instead of warfarin[33] have changed the face of POAF management, although the long-term results of such strategies remain speculative. In Video 1, the corresponding author explains the importance and relevance of this article.

Limitations

The lack of significant 5-year clinical outcome differences requires careful interpretation. Patients with POAF are higher risk with greater disease burden. These findings may reflect that patients with POAF may have received additional attention or care that improved their risk-adjusted clinical outcomes, particularly in a clinical trial that included close follow-up. Several other limitations are inherent as this is a VA-based study. As nearly all of the ROOBY trial's subjects were male veterans (99.9%), these findings may not be generalizable to females or nonveterans receiving a CABG procedure. Unfortunately, the details for longitudinal anticoagulation use beyond 1 year, which may have affected stroke risk, was not captured in ROOBY-FS. Also, the stroke incidence may have been underestimated because the diagnosis of a stroke after the 1-year follow-up visit relied on a hospital admission with a primary stroke diagnosis or a stroke-related Diagnosis-Related Group code recorded in either the VA or Medicare billing records. The importance and relevance of the findings in this paper are explained by the corresponding author in Video 1.

CONCLUSIONS

In this study, POAF after CABG was not significantly associated with adverse 5-year risk-adjusted clinical outcomes. Mirroring these clinical results, the initially greater 1-year POAF annualized costs did not persist in subsequent years. Based on this ROOBY-FS subanalysis, POAF after isolated CABG does not appear to be an independent predictor of 5-year mortality or major morbidity. Thus, future quality improvement strategies should focus primarily on the preoperative and perioperative strategies to lessen the burden of POAF and postdischarge care of patients with POAF within the first post-CABG year period to potentially improve early postoperative clinical outcomes and costs. Figure 4 depicts a summary of the study showing no difference in risk-adjusted all cause or cardiac-related mortlaity and costs in patients with or without POAF.

Conflict of Interest Statement

Dr Ebrahimi is a Speaker for NovoNordisk, Amarin, and Janssen. All other authors have nothing to disclose with regard to commercial support.

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Key Words: atrial fibrillation, veterans, treatment outcome, costs and cost analysis

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TABLE E1. Five-year outcomes, overall and stratified by on-/off-pump

Outcome variables		POAF	POAF on-pump	POAF off-pump
MACE	Odds ratio	1.06	1.06	1.05
Days to death	HR	1.22	1.17	1.19
All-cause death	Odds ratio	1.19	1.18	1.14
Cardiac death	Odds ratio	1.51	1.45	1.54
AMI	Odds ratio	1.11	0.88	1.34
Revascularization	Odds ratio	1.03	1.19	0.91
PCI	Odds ratio	1.03	1.19	0.90
CABG	Odds ratio	1.13	2.86	1.27
Stroke	Odds ratio	0.98	0.75	1.09

None of these differences are statistically significant. *POAF*, Postoperative atrial fibrillation; *MACE*, major adverse cardiovascular events; *HR*, hazard ratio; *AMI*, acute myocardial infarction; *PCI*, percutaneous coronary intervention; *CABG*, coronary artery bypass grafting.

ADULT

TABLE E2. Five-year outcomes, overall and stratified by site effect

Outcome variables		POAF	POAF with site fixed effect
MACE	Odds ratio	1.06	1.07
Days to death	HR	1.22	1.27
All-cause death	Odds ratio	1.19	1.25
Cardiac death	Odds ratio	1.51	1.56
AMI	Odds ratio	1.11	1.12
Revascularization	Odds ratio	1.03	1.04
PCI	Odds ratio	1.03	1.05
CABG	Odds ratio	1.13	1.11
Stroke	Odds ratio	0.98	1.02

None of these differences were statistically significant. *POAF*, Postoperative atrial fibrillation; *MACE*, major adverse cardiovascular events; *HR*, hazard ratio; *AMI*, acute myocardial infarction; *PCI*, percutaneous coronary intervention; *CABG*, coronary artery bypass grafting.

TABLE E3. Regression tables

Variables	MACE OR (99% CI)	Days to death HR (99% CI)	5-y all-cause death OR (99% CI)
POAF	1.06 (0.80-1.41)	1.22 (0.87-1.72)	1.19 (0.81-1.75)
Female vs male	1.21 (0.24-6.07)	0.85 (0.06-11.36)	0.81 (0.06-11.28)
Age, y			
<55	1.00 (0.55-1.79)	0.47 (0.22-0.99)	0.41 (0.18-0.92)
55-64	0.92 (0.56-1.53)	0.40 (0.21-0.74)	0.35 (0.18-0.67)
65-74	0.97 (0.61-1.54)	0.71 (0.44-1.15)	0.65 (0.37-1.14)
75+		Reference	
White vs all other	0.95 (0.68-1.34)	0.97 (0.65-1.46)	0.95 (0.60-1.51)
Insurance coverage			
Any private	0.90 (0.59-1.36)	0.67 (0.37-1.21)	0.62 (0.33-1.18)
VA and other public	1.13 (0.80-1.61)	1.09 (0.69-1.74)	1.14 (0.69-1.88)
VA only		Reference	
Smoking status			
Past smoker	1.13 (0.78-1.65)	0.92 (0.56-1.52)	0.94 (0.55-1.62)
Current smoker	1.21 (0.81-1.81)	1.39 (0.81-2.37)	1.44 (0.81-2.57)
Never smoked		Reference	
Chronic obstructive pulmonary disease	1.09 (0.80-1.50)	1.27 (0.88-1.83)	1.36 (0.90-2.06)
Serum creatinine ≥1.5 mg/dL	1.92 (1.24-2.98)	2.28 (1.48-3.51)	2.63 (1.58-4.38)
Peripheral vascular disease	1.27 (0.90-1.79)	1.55 (1.06-2.25)	1.61 (1.05-2.48)
Ejection fracture <45%	1.35 (0.97-1.87)	1.72 (1.19-2.49)	1.84 (1.21-2.80)
Hypertension	1.11 (0.75-1.63)	0.88 (0.53-1.45)	0.87 (0.51-1.50)
History of depression in past 2 y	1.16 (0.79-1.71)	1.29 (0.81-2.05)	1.32 (0.78-2.22)
Medically treated diabetes	1.06 (0.81-1.39)	1.57 (1.13-2.18)	1.71 (1.18-2.47)
Quality of aorta			
Poor	1.65 (0.92-2.97)	1.79 (1.02-3.15)	1.93 (0.98-3.83)
Moderate	1.60 (1.16-2.21)	1.72 (1.17-2.54)	1.76 (1.15-2.72)
Good		Reference	
NA	1.03 (0.31-3.41)	1.48 (0.43-5.11)	1.56 (0.36-6.66)
Number of grafts	0.97 (0.85-1.12)	0.98 (0.83-1.15)	0.98 (0.81-1.17)

	5-y cardiac death OR (99% CI)	AMI OR (99% CI)	Revascularization OR (99% CI)
POAF	1.51 (0.88-2.60)	1.11 (0.73-1.68)	1.03 (0.69-1.54)
Female vs male	NA	1.40 (0.18-10.83)	1.18 (0.16-8.93)
Age, y			
<55	0.67 (0.21-2.15)	1.94 (0.75-5.01)	3.35 (1.37-8.20)
55-64	0.52 (0.20-1.38)	1.70 (0.72-4.01)	3.01 (1.34-6.75)
65-74	0.84 (0.38-1.87)	1.88 (0.85-4.16)	1.84 (0.83-4.06)
75+		Reference	
White vs all other	0.87 (0.45-1.66)	0.84 (0.52-1.36)	0.95 (0.60-1.50)
Insurance coverage			
Any private	0.96 (0.41-2.22)	0.98 (0.53-1.79)	1.13 (0.66-1.92)
VA and other public	0.95 (0.45-2.00)	0.98 (0.60-1.62)	1.15 (0.73-1.80)
VA only		Reference	
Smoking status			
Past smoker	1.07 (0.47-2.41)	0.81 (0.49-1.36)	1.24 (0.75-2.06)
Current smoker	1.52 (0.63-3.65)	1.00 (0.58-1.72)	1.00 (0.58-1.71)
Never smoked		Reference	

(Continued)

TABLE E3. Continued

	5-y cardiac death OR (99% CI)	AMI OR (99% CI)	Revascularization OR (99% CI)
Chronic obstructive pulmonary disease	1.42 (0.79-2.58)	0.82 (0.51-1.32)	0.82 (0.51-1.31)
Serum creatinine ≥1.5 mg/dL	1.84 (0.86-3.95)	1.27 (0.68-2.39)	1.12 (0.57-2.19)
Peripheral vascular disease	1.07 (0.56-2.02)	1.46 (0.90-2.37)	0.83 (0.49-1.41)
Ejection fracture <45%	2.59 (1.49-4.50)	1.09 (0.67-1.76)	1.07 (0.68-1.70)
Hypertension	0.81 (0.38-1.76)	1.19 (0.67-2.12)	1.29 (0.75-2.21)
History of depression in past 2 y	1.85 (0.93-3.66)	1.35 (0.81-2.24)	0.84 (0.48-1.46)
Medically treated diabetes	1.64 (0.97-2.77)	1.03 (0.70-1.52)	0.86 (0.60-1.24)
Quality of aorta			
Poor	2.27 (0.88-5.84)	1.43 (0.61-3.38)	1.72 (0.76-3.86)
Moderate	1.28 (0.67-2.43)	1.49 (0.94-2.35)	1.42 (0.91-2.22)
Good		Reference	
NA	0.96 (0.08-12.08)	1.10 (0.16-7.34)	0.87 (0.17-4.33)
Number of grafts	1.05 (0.82-1.35)	1.19 (0.97-1.45)	0.91 (0.75-1.10)
	PCI OR (99% CI)	**CABG OR (99% CI)**	**Stroke OR (99% CI)**
POAF	1.03 (0.68-1.56)	1.13 (0.28-4.59)	0.98 (0.47-2.04)
Female vs male	1.26 (0.17-9.40)	NA	NA
Age, y			
<55	3.88 (1.51-9.96)	0.31 (0.01-7.31)	0.36 (0.09-1.45)
55-64	3.22 (1.36-7.60)	1.23 (0.16-9.24)	0.37 (0.13-1.05)
65-74	2.03 (0.88-4.69)	0.79 (0.08-7.84)	0.46 (0.16-1.27)
75+		Reference	
White vs all other	0.91 (0.57-1.46)	1.65 (0.24-11.38)	0.94 (0.39-2.27)
Insurance coverage			
Any private	1.17 (0.68-2.03)	0.63 (0.10-4.17)	0.97 (0.38-2.51)
VA and other public	1.20 (0.75-1.91)	0.66 (0.21-2.14)	0.78 (0.32-1.91)
VA only		Reference	
Smoking status			
Past smoker	1.32 (0.78-2.23)	0.50 (0.10-2.41)	1.45 (0.50-4.27)
Current smoker	1.03 (0.58-1.81)	0.62 (0.13-3.01)	1.56 (0.45-5.45)
Never smoked		Reference	
Chronic obstructive pulmonary disease	0.86 (0.53-1.39)	0.42 (0.05-3.56)	0.76 (0.29-1.98)
Serum creatinine ≥1.5 mg/dL	1.00 (0.49-2.05)	2.37 (0.42-13.36)	1.22 (0.42-3.55)
Peripheral vascular disease	0.78 (0.45-1.36)	1.52 (0.31-7.54)	1.38 (0.57-3.35)
Ejection fracture <45%	1.04 (0.65-1.68)	1.45 (0.33-6.28)	1.04 (0.42-2.55)
Hypertension	1.29 (0.74-2.26)	1.27 (0.19-8.54)	2.20 (0.55-8.74)
History of depression in past 2 y	0.87 (0.49-1.53)	0.45 (0.03-6.70)	0.72 (0.20-2.59)
Medically treated diabetes	0.85 (0.58-1.25)	1.11 (0.37-3.35)	1.26 (0.62-2.55)
Quality of aorta			
Poor	1.54 (0.66-3.60)	3.42 (0.43-27.12)	0.35 (0.02-5.23)
Moderate	1.49 (0.94-2.34)	1.08 (0.18-6.35)	1.64 (0.76-3.56)
Good		Reference	
NA	0.87 (0.17-4.35)	NA	NA
Number of grafts	0.87 (0.72-1.07)	1.51 (0.82-2.77)	1.08 (0.80-1.45)

MACE, Major adverse cardiovascular events; *OR*, odds ratio; *CI*, confidence interval; *HR*, hazard ratio; *POAF*, postoperative atrial fibrillation; *VA*, Veterans Affairs; *NA*, insufficient cell size to estimate; covariate excluded from model; *AMI*, acute myocardial infarction; *PCI*, percutaneous coronary intervention; *CABG*, coronary artery bypass grafting.

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