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ORIGINAL RESEARCH

1-Year Impact on Medical Practice and Clinical Outcomes of FFR_{CT}

The ADVANCE Registry

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ABSTRACT

OBJECTIVES The 1-year data from the international ADVANCE (Assessing Diagnostic Value of Non-invasive FFR_{CT} in Coronary Care) Registry of patients undergoing coronary computed tomography angiography (CTA) was used to evaluate the relationship of fractional flow reserve derived from coronary CTA (FFR_{CT}) with downstream care and clinical outcomes.

BACKGROUND Guidelines for management of chest pain using noninvasive imaging pathways are based on short- to intermediate-term outcomes.

METHODS Patients (N = 5,083) evaluated for clinically suspected coronary artery disease and in whom atherosclerosis was identified by coronary CTA were prospectively enrolled at 38 international sites from July 15, 2015, to October 20, 2017. Demographics, symptom status, coronary CTA and FFR_{CT} findings and resultant site-based treatment plans, and clinical outcomes through 1 year were recorded and adjudicated by a blinded core laboratory. Major adverse cardiac events (MACE), death, myocardial infarction (MI), and acute coronary syndrome leading to urgent revascularization were captured.

RESULTS At 1 year, 449 patients did not have follow-up data. Revascularization occurred in 1,208 (38.40%) patients with an FFR_{CT} ≤0.80 and in 89 (5.60%) with an FFR_{CT} >0.80 (relative risk [RR]: 6.87; 95% confidence interval [CI]: 5.59 to 8.45; $p < 0.001$). MACE occurred in 55 patients, 43 events occurred in patients with an FFR_{CT} ≤0.80 and 12 occurred in those with an FFR_{CT} >0.80 (RR: 1.81; 95% CI: 0.96 to 3.43; $p = 0.06$). Time to first event (all-cause death or MI) occurred in 38 (1.20%) patients with an FFR_{CT} ≤0.80 compared with 10 (0.60%) patients with an FFR_{CT} >0.80 (RR: 1.92; 95% CI: 0.96 to 3.85; $p = 0.06$). Time to first event (cardiovascular death or MI) occurred cardiovascular death or MI occurred more in patients with an FFR_{CT} ≤0.80 compared with patients with an FFR_{CT} >0.80 (25 [0.80%] vs. 3 [0.20%]; RR: 4.22; 95% CI: 1.28 to 13.95; $p = 0.01$).

CONCLUSIONS The 1-year outcomes from the ADVANCE FFR_{CT} Registry show low rates of events in all patients, with less revascularization and a trend toward lower MACE and significantly lower cardiovascular death or MI in patients with a negative FFR_{CT} compared with patients with abnormal FFR_{CT} values. (Assessing Diagnostic Value of Non-invasive FFRCT in Coronary Wave [ADVANCE]; NCT02499679) (J Am Coll Cardiol Img 2020;13:97–105)

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ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome

CAD = coronary artery disease

CI = confidence interval

CTA = computed tomography angiography

DCRI = Duke Clinical Research Institute

FFR_{CT} = fractional flow reserve derived from coronary computed tomography angiography

ICA = invasive coronary angiography

MACE = major adverse cardiac events

MI = myocardial infarction

RR = relative risk

Evaluating patients for obstructive atherosclerotic coronary disease, which can lead to ischemia, remains a central part of clinical care in patients presenting with angina symptoms. The American Heart Association/American College of Cardiology Clinical Guidelines recommend noninvasive cardiac testing in patients with an intermediate cardiovascular disease risk based on the ability of available testing modalities to diagnose and predict downstream clinical outcomes (1). In the United States, coronary computed tomography angiography (CTA) is not currently recommended as a first-line test for patients with symptomatic chest pain (1), despite randomized trial data that have demonstrated similar or better prognostic outcomes compared with standard-of-care noninvasive testing (2). This is, in part, due to limitations in specificity and physician agreement when coronary atherosclerosis is moderate-severe (>50% degree stenosis) (3).

Fractional flow reserve derived from coronary CTA (FFR_{CT}) is a noninvasive physiological test that assesses flow limitation across coronary stenoses with high diagnostic accuracy and good correlation to invasive FFR (4). The short-term 90-day outcomes data from the ADVANCE (Assessing Diagnostic Value of Non-invasive FFR_{CT} in Coronary Care) Registry showed FFR_{CT} modified treatment recommendations in a large majority of patients as compared with coronary CTA alone (5). In addition, a positive FFR_{CT} was associated with revascularization and less negative invasive coronary angiography (ICA). Intermediate-term clinical utility and outcomes data with an FFR_{CT} have been limited to single-center reports. Using 1-year data from the ADVANCE Registry, we evaluated the relationship of FFR_{CT} with clinical outcomes.

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METHODS

The ADVANCE Registry (NCT02499679) has been described previously (6). Briefly, to understand the effect of FFR_{CT} on clinical practice in the real world, a multicenter international registry of patients being investigated for clinically suspected coronary artery disease (CAD) with documented stenosis of at least 30% on coronary CTA was performed. Patients were prospectively enrolled at 38 sites in Europe, North America, and Japan from July 15, 2015, to October 20, 2017. Clinically stable patients were recruited following the documentation of the presence of CAD on coronary CTA by enrolling sites. All patients provided written informed consent following Institutional Review Board review and approval.

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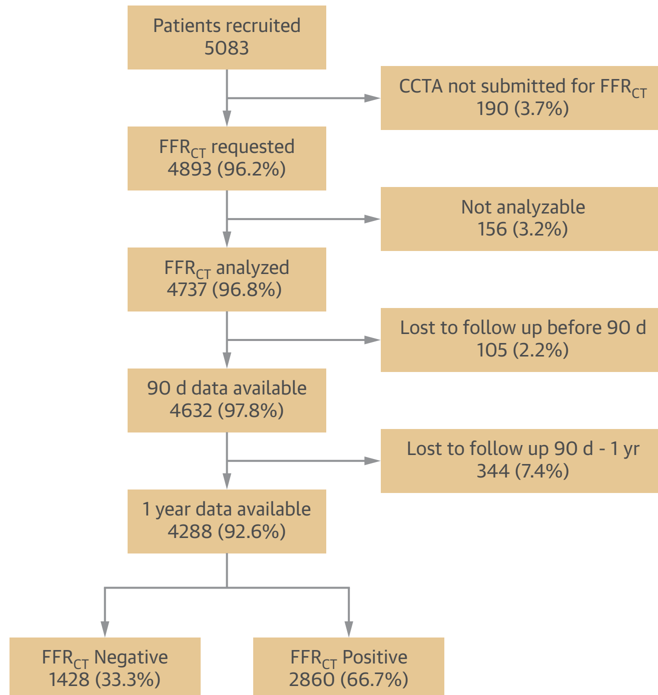
In an effort to understand clinical effect, site investigators reported an initial management plan and treatment strategy based on coronary CTA alone for each patient in accordance with local practice and interpretation of coronary CTA. As with invasive coronary assessment, the decision to further investigate coronary CTA results with an FFR_{CT} was directed by the physician interpreting the scan with a recommendation to consider FFR_{CT} for stenoses in the 30% to 90% range. All FFR_{CT} analyses were performed in a single center (HeartFlow, Inc., Redwood City, California). Once the FFR_{CT} result was made available, the site investigators were asked to report a treatment strategy based on the new information of the coronary CTA combined with the locally interpreted FFR_{CT} result. A positive FFR_{CT} was deemed to be a value $\leq$0.80 as the lowest per-patient value as previously published in the invasive and noninvasive literature (6). As with real-world studies, subsequent clinical management decisions, including revascularization or medical therapy, were at the discretion of the local referring physician. The study did not dictate interpretation or management decisions.

DESIGN AND OUTCOMES ASSESSMENT. The ADVANCE Registry was designed as a pragmatic real-world registry. Therefore, simple data forms and processes aimed at ease of site access and enrollment were implemented. Each site was asked to report outcomes at standard time points. For potential clinical events, sites were asked to complete case report forms. Pre-specified outcomes of interest included survival free from major adverse cardiovascular events (MACE) inclusive of myocardial infarction (MI), all-cause mortality, or unplanned hospitalization for acute coronary syndrome (ACS) leading to revascularization. In addition, cardiovascular death in combination with MI was assessed through 1 year as was the incidence of revascularization. Event adjudication was performed using standard definitions by an independent clinical events committee at the Duke Clinical Research Institute (DCRI) (Durham, North Carolina) whose members were blinded to clinical and coronary CTA data.

The study was funded by research grants from HeartFlow, Inc. The DCRI served as the core laboratory for FFR_{CT} analysis as part of the site versus core analysis of care patterns. The trial database was managed by iMedNet (Minnetonka, Minnesota). Principal investigators, subinvestigators, and study coordinators at each site accessed iMedNet and were responsible for data entry. The DCRI had access to these databases for data entry, resolving queries, and locking data. HeartFlow did not have access to clinical adjudication forms. The ADVANCE Steering Committee had access to all of the data and drafted and finalized the manuscript.

FIGURE 1 **The CONSORT Diagram**



CCTA = coronary computed tomography angiography; FFR_{CT} = fractional flow reserve derived from coronary computed tomography angiography.

STATISTICAL ANALYSIS. The planned analysis included evaluation of the primary endpoint of MACE at 1 year and downstream clinical management. The analysis was planned to be evaluated based on FFR_{CT} positivity and negativity and on-site recommendations following the receipt of the FFR_{CT} results. Baseline demographics, risk factors, symptom status, and outcomes (MACE, cardiovascular death or MI, unplanned hospitalization for ACS leading to revascularization, and all revascularizations) at 1 year are presented based on FFR_{CT} findings. Continuous variables are presented as median (interquartile range) and categorical variables are presented as percentage. Mann-Whitney-Wilcoxon nonparametric tests were used for continuous variables and chi-square tests were used for categorical variables. Survival curves for time-to-event analysis were constructed based on all available follow-up data with the use of Kaplan-Meier estimates and were compared with the use of a log-rank test. A 2-sided p value <0.05 was considered

TABLE 1 Patient Demographics and Coronary CTA/FFR_{CT} by Outcomes at 1 Year

	Patients With FFR_{CT} (n = 4,737)	Patients With FFR_{CT} and No 1-Year Follow-Up (n = 418)	Patients With MACE at 1-Year Follow-Up (n = 55)	Patients With No MACE and 1-Year Follow-Up (n = 4,264)
Age, yrs	66.00 (59.00-73.00)	66.52 (59.00-75.00)	69.02 (62.00-75.50)	65.93 (59.00-73.00)
Male	66.20	63.64	72.73	66.32
Angina type				
None	24.57	23.92	20.00	24.70
Typical	21.64	20.81	23.64	21.69
Dyspnea	9.96	8.61	21.82	9.94
Atypical	36.46	39.71	23.64	36.30
Noncardiac pain	6.27	4.78	7.27	6.40
Unknown	1.10	2.15	3.64	0.96
Diabetes	21.89	22.97	32.73	21.65
Hypertension	59.85	59.57	58.18	59.90
Smoking status	16.82	19.86	14.55	16.56
Coronary CTA findings				
<50%	1,324 (27.95)	139 (33.25)	8 (14.55)	1,177 (27.60)
≥50%	3,409 (71.97)	279 (66.75)	46 (83.64)	3,084 (72.33)
Coronary CTA not evaluable	4 (0.08)	0 (0.00)	1 (1.82)	3 (0.07)
>0.80 FFR_{CT}	1,592 (33.61)	158 (37.80)	12 (21.82)	1,422 (33.35)
≤0.80 FFR_{CT}	3,145 (66.39)	260 (62.20)	43 (78.18)	2,842 (66.65)

Values are median (interquartile range), %, or n (%).

CTA = computed tomography angiography; FFR_{CT} = fractional flow reserve derived from coronary computed tomography angiography; MACE = major adverse cardiac events.

significant for all tests. All statistical analyses were performed using SAS software version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS

The ADVANCE Registry enrolled a total of 5,083 patients, and 4,893 of them had coronary CTA submitted for FFR_{CT} analysis. As previously reported from the ADVANCE Registry, of these submitted, 4,737 (96.80%) were of sufficient image quality for FFR_{CT} analysis. Patients were followed by sites at 90 days and to 1 year for clinical events (Figure 1), with 449 patients without available 1-year follow-up data.

TABLE 2 All Events at Follow-Up

Type of Event	90 Days	From 90 Days to 1 Year	1 Year
Mortality			35
CV mortality			15
MI			12*
ACS leading to unplanned hospitalization and revascularization			8
Revascularization			
PCI	1,026	185	
CABG	150	28	

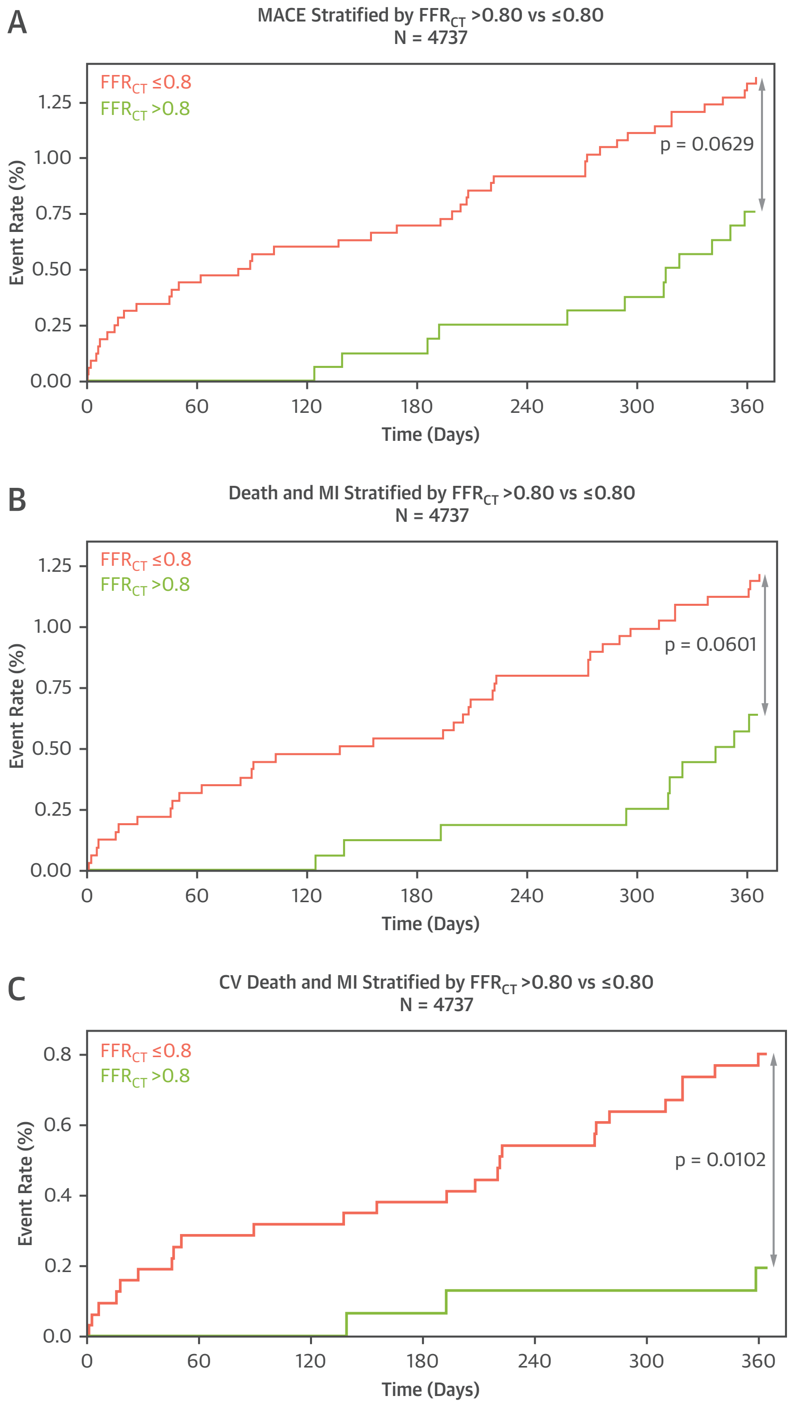
*The total major adverse cardiac events are based on time to event. There was 1 myocardial infarction (MI) event (13 total in follow-up) that occurred in a patient after an acute coronary syndrome (ACS) with unplanned hospitalization leading to revascularization.

CABG = coronary artery bypass grafting; CV = cardiovascular; PCI = percutaneous coronary intervention.

BASELINE DEMOGRAPHICS AND EVENTS. Patient demographics and coronary CTA and FFR_{CT} findings in those who did and did not experience MACE and in those who did not have 1-year follow-up visits recorded are presented in Table 1. Events at 1 year of follow-up and all revascularizations within 90 days and from 90 days to 1 year are presented (Table 2). At 1 year, there were 55 MACE when evaluated as time to first event: 35 all-cause deaths, 12 MIs, and 8 ACS with unplanned hospitalization leading to revascularization. Of the 35 deaths, 15 were deemed cardiovascular related.

1-YEAR CLINICAL EVENTS BY FFR_{CT}. Among patients undergoing FFR_{CT} analysis, there were 55 MACE at 1 year (1.16%). Patient demographics and coronary CTA and FFR_{CT} findings in those who did and did not experience MACE and in those who did not have 1-year follow-up visits recorded are presented in Table 1. Of the 55 MACE, 43 occurred in patients with an FFR_{CT} ≤0.80 and 12 occurred in those with an FFR_{CT} >0.80 (RR: 1.81; 95% confidence interval [CI]: 0.96 to 3.43; p = 0.06) (Central Illustration). Time to first all-cause death or MI occurred in 38 (1.20%) patients with an FFR_{CT} ≤0.80 as compared with 10 (0.60%) patients with an FFR_{CT} >0.80 (RR: 1.92; 95% CI: 0.96 to 3.85; p = 0.06) (Central Illustration). Time to first cardiovascular death or MI was significantly more common among patients with an FFR_{CT} ≤0.80 compared with an FFR_{CT} >0.80 (25 [0.80%] vs.

CENTRAL ILLUSTRATION Kaplan-Meier Event Curves for MACE



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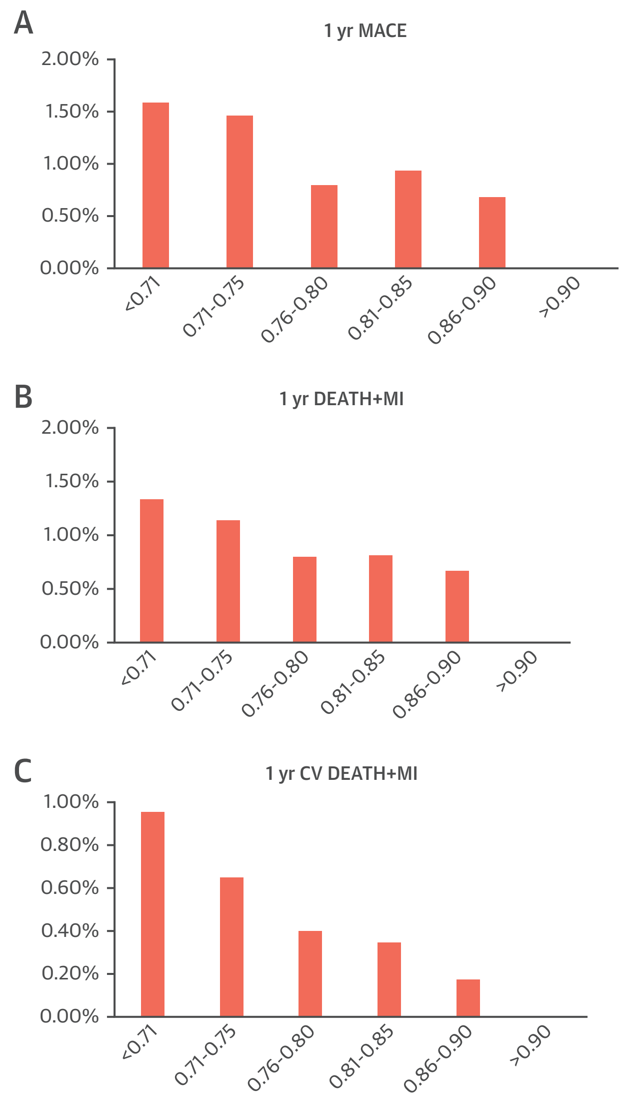
(A) All-cause mortality, myocardial infarction (MI), or acute coronary syndrome leading to unplanned hospitalization with urgent revascularization ($p = 0.06$); **(B)** MI and all-cause mortality alone ($p = 0.06$); and **(C)** cardiovascular (CV) death and MI ($p = 0.01$) at 1 year stratified by fractional flow reserve derived from coronary computed tomography angiography (FFR_{CT}) positive (≤ 0.80) and negative values (>0.80). Note that events are based on time to event analysis and there was 1 MI event that occurred in a patient after an acute coronary syndrome with unplanned hospitalization leading to revascularization. MACE = major adverse cardiac events.

FIGURE 2 **Distribution of Event-Free Survival by Categorical FFR_{CT} Values**



(A) Major adverse cardiac events (MACE), **(B)** death and myocardial infarction (MI), and **(C)** cardiovascular (CV) death and MI.

3 [0.20%]; RR: 4.22; 95% CI: 1.28 to 13.95; $p = 0.01$) (**Central Illustration**). At 1 year, 3 of 1,592 (0.19%) patients with an FFR_{CT} >0.80 had an MI and no patients experienced cardiovascular death. Of those with a negative FFR_{CT} and MI, 1 patient had known disease and had undergone prior percutaneous coronary intervention (PCI) during the study period, and 1 patient with an FFR_{CT} of 0.85 had diffuse aneurysmal atherosclerotic disease with thrombus. In addition, patients who experienced MACE had lower mean FFR_{CT} values than did those who did not (0.70 ± 0.13 vs. 0.74 ± 0.12; $p = 0.02$), and event free survival for MACE, all-cause death or MI, and cardiovascular death or MI tended to increase as FFR_{CT} values decreased (**Figure 2**).

RELATIONSHIP OF FFR_{CT}, STENOSIS, AND DOWNSTREAM CLINICAL MANAGEMENT. Downstream clinical management was significantly different among groups depending on stenosis severity and FFR_{CT} value. Timing of revascularization during follow-up was most often within 90 days for those patients with an FFR_{CT} ≤0.80, and 1,208 (38.4%) patients with an FFR_{CT} ≤0.80 were revascularized (34.90% within 90 days, 3.50% between days 91 and 365) compared with 89 (5.6%) with an FFR_{CT} >0.80 (4.4% within 90 days, 1.20% between days 91 and 365) (RR: 6.87; 95% CI: 5.59 to 8.45; $p < 0.001$) (**Figure 3A**). When further categorized based on stenosis severity, those with 50% stenosis and an FFR_{CT} ≤0.80 were significantly more likely to be revascularized compared with patients with ≥50% stenosis and an FFR_{CT} >0.80 ($p < 0.001$) and those with <50% stenosis and an FFR_{CT} ≤0.80 (**Figure 3B, Table 3**). The revascularization-to-ICA ratio was 66.70% (1,155 of 1,733) for those with ≥50% stenosis and an FFR_{CT} ≤0.80, while the revascularization-to-ICA ratio was 29.5% (81 of 273) in those with ≥50% stenosis and an FFR_{CT} >0.80.

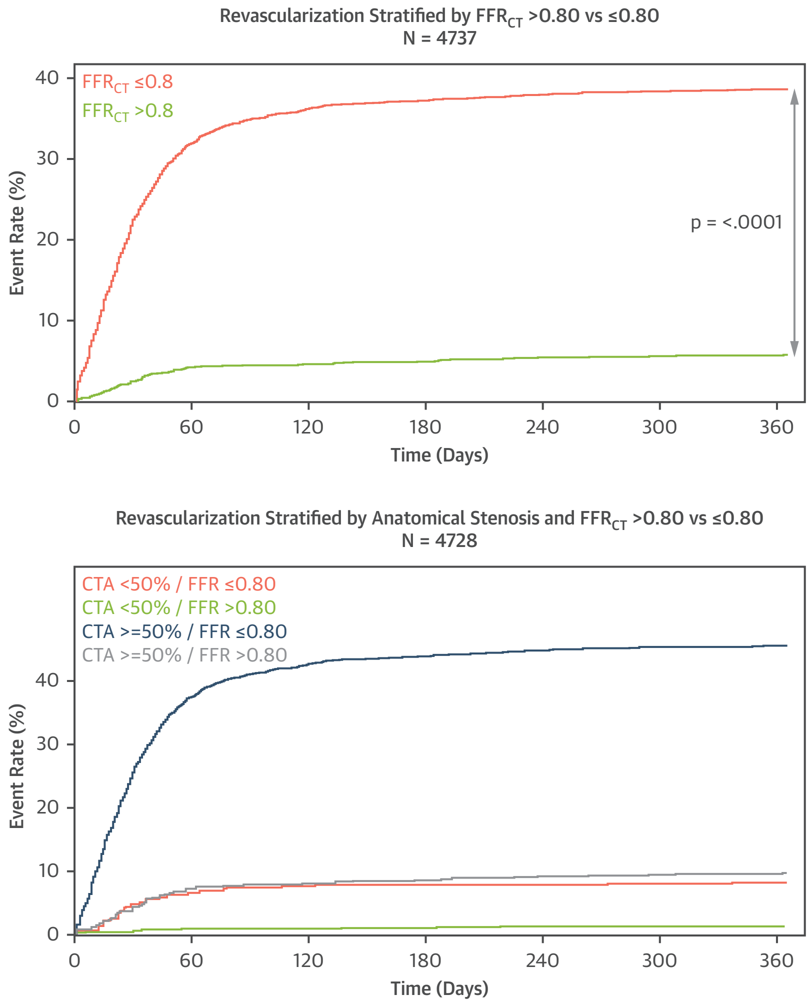
When FFR_{CT} was evaluated in a categorical fashion, there was an inverse relationship between FFR_{CT} and the rate of revascularization (FFR_{CT} <0.71: 57.5%, FFR_{CT} 0.71 to 0.75: 27.5%, FFR_{CT} 0.76 to 0.80: 15.9%, FFR_{CT} 0.81 to 0.85: 6.9%, FFR_{CT} 0.86 to 0.90: 3.9%, FFR_{CT} >0.90: 4.6%; $p < 0.001$) (**Table 4**).

RELATIONSHIP OF SITE POST-FFR_{CT} TREATMENT RECOMMENDATION AND 1-YEAR ACTUAL CLINICAL MANAGEMENT. The majority of patients ($n = 2,679$) in whom medical therapy was the recommended treatment strategy following FFR_{CT} continued on only medical therapy at 1 year ($n = 2,490$ [92.9%]), with 189 (7.1%) undergoing revascularization (166 PCI and 23 coronary artery bypass grafting). Similarly, when the site recommendation was for revascularization ($n = 1,416$), the majority ($n = 975$ [68.9%]) were revascularized, with 842 (59.5%) undergoing PCI and 133 (9.4%) undergoing coronary artery bypass grafting. The revascularization-to-ICA ratio was 77.00% (975 of 1,267) in patients for whom revascularization was recommended.

DISCUSSION

The 1-year clinical outcomes following FFR_{CT} are reported from a large prospective multicenter registry that included patients from Japan, North America, and Europe. These findings build on the prior report of 90-day outcomes and other single-center datasets

FIGURE 3 Kaplan-Meier Event Curves for Revascularization



(A) FFR_{CT} values and **(B)** combination of stenosis and FFR_{CT}. Abbreviations as in Figure 1.

(6-8), and highlight a number of findings that have the potential to inform clinical practice. In patients with clinically suspected CAD and at least 30% stenosis observed on coronary CTA, the 1-year outcomes show low rates of MACE events in all registry patients. In patients with an FFR_{CT} in all vessels >0.80, there was a trend toward lower MACE. In addition, among those with an FFR_{CT} >0.80 as compared with ≤0.80, the exploratory outcome of cardiovascular death and MI was significantly lower,

TABLE 3 Relationship Between Anatomical Stenosis Physiology and Downstream Treatment at 1 Year

Actual Treatment (1 Year)	Total (N = 4,728)	CTA <50%/FFR_{CT} ≤0.80 (n = 593)	CTA <50%/FFR_{CT} >0.80 (n = 746)	CTA ≥50%/FFR_{CT} ≤0.80 (n = 2,544)	CTA ≥50%/FFR_{CT} >0.80 (n = 845)
Invasive coronary angiography	975 (20.60)	116 (19.60)	89 (11.90)	578 (22.70)	192 (22.70)
Medical therapy	2,461 (52.10)	429 (72.30)	649 (87.00)	811 (31.9)	572 (67.70)
PCI	1,116 (23.60)	46 (7.80)	7 (0.90)	990 (38.90)	73 (8.60)
CABG	176 (3.70)	2 (0.30)	1 (0.10)	165 (6.50)	8 (0.90)

Values are n (%). For all groups, p < 0.0001.
Abbreviations as in Tables 1 and 2.

TABLE 4 Actual Treatment Stratified by FFR_{CT} as a Categorical Variable at 1 Year

Actual Treatment Plan (1 Year)	Total (N = 4,737)	<0.71 (n = 1,530)	0.71–0.75 (n = 615)	0.76–0.80 (n = 1,000)	0.81–0.85 (n = 867)	0.86–0.90 (n = 595)	>0.90 (n = 130)
Medical therapy	3,440 (72.60)	650 (42.50)	446 (72.50)	841 (84.10)	807 (93.10)	572 (96.10)	124 (95.40)
Revascularization	1,297 (27.40)	880 (57.50)	169 (27.50)	159 (15.90)	60 (6.90)	23 (3.90)	6 (4.60)

The chi-square p value is <0.001 for the table trend across fractional flow reserve derived from computed tomography angiography (FFR_{CT}) values.

and revascularization was less frequent (5.80% vs. 38.40%) and unlikely after 90 days. In keeping with prior invasive physiology studies, the rate of revascularization and cardiovascular death or MI showed an inverse correlation to FFR_{CT} values.

With regard to clinical adoption and utility of FFR_{CT} within the registry, we found good adherence to the post-FFR_{CT} site recommendations in clinical practice. Importantly, 92.90% of patients in whom medical therapy alone was recommended following receipt of FFR_{CT} results remained on medical therapy without revascularization or MACE at 1 year. These data together with the broader outcomes data indicate the safety of patient management following the incorporation of FFR_{CT} into a decision pathway and in most patients with a negative FFR_{CT}, the avoidance of invasive evaluation.

Our findings align with previously published single-center data as well as the invasive physiology literature (7,8). Patients with CAD but absence of significant pressure loss as manifest by a low FFR, enables the discrimination of those who are more likely to be adequately managed with medical therapy alone versus those who are more likely to require invasive evaluation and revascularization. These findings help confirm the findings from smaller patient populations, highlighting the capacity of FFR_{CT} to better determine which patients could be considered for ICA with the intention of revascularization. Notably, the event rate of MACE in the ADVANCE Registry was 1.50% for patients with reduced FFR_{CT} compared with 0.19% for patients with negative FFR_{CT} >0.80. A corollary is that the incorporation of FFR_{CT} may mitigate the high reported rates of ICA following the detection of moderate atherosclerosis by coronary CTA. It is important to highlight that the presented work is strictly observational in nature and the extent to which those patients with an FFR_{CT} >0.80 would have been deferred for ICA on the basis of CTA alone is not known.

With increasing health care expenditures, there is ever-expanding focus on appropriate resource utilization. To that end, the historically high rates of nonobstructive disease at the time of ICA (9) are being increasingly scrutinized. Prior studies such as the PLATFORM (Prospective Longitudinal Trial of FFRCT: Outcome and Resource Impacts Study) (10) and CONSERVE (Coronary Computed Tomographic Angiography for Selective Cardiac Catheterization) (11) studies have highlighted the potential for CTA and FFR_{CT} to help inform ICA referral in an effective and safe fashion. Our data build on these experiences, with a rate of nonobstructive disease during ICA in the setting of an FFR_{CT} <0.80 of <15% and a PCI-to-ICA ratio, a marker of catheterization laboratory efficiency, of 77%. These findings underscore a prior hypothesis-generating post hoc analysis of the PROMISE (Prospective Multicenter Imaging Study for Evaluation of Chest Pain) trial (12,13). Lu et al. (13) reported that introducing FFR_{CT} following a “positive” coronary CTA may have reduced ICA after CTA by 28% (50 of 181), decreased the rate of ICA without 50% stenosis by 44% (from 27% [49 of 181] to 15% [20 of 131]), and increased the rate of ICA leading to revascularization by 24% (from 49% [88 of 181] to 61% [80 of 131]). These results add to the current knowledge and practical utility and safety of an FFR_{CT}-driven patient pathway in the “real-world” management of CAD with the ability to discriminate risk, improve invasive catheterization to revascularization rates, and potentially act as a gatekeeper to the catheterization lab. Given the observational nature of these findings and the absence of randomized trial evidence, 2 multicenter randomized trials have begun with the intention to test the hypothesis that a CTA-FFR_{CT} strategy will inform clinical practice in a fashion that improves clinical outcomes and is cost effective in diverse health care environments (FORECAST [Fractional Flow Reserve Derived from Computed Tomography Angiography in the Assessment and Management of Stable Chest Pain] [NCT03187639] and PRECISE [Prospective Randomized Trial of the Optimal Evaluation of Cardiac Symptoms and Revascularization] [NCT03702244] studies).

STUDY LIMITATIONS. Although the ADVANCE Registry enrolled real-world patients from across the globe and represents a large sampling of those undergoing FFR_{CT} from different health care systems, it remains a registry and as such is subject to potential referral bias inherent in local practices. Additionally, given the structure of the registry design and clinical practice, the testing or management post-imaging was not randomized, and local physicians interpreted and acted on test results. This does not allow this observational registry to make treatment conclusions and randomized trials are needed to address this gap. This analysis does not attempt to colocalize the segment with a stenosis to a given FFR_{CT} value. As a result, discordant vessels could have been combined in this patient-level analysis. One-year patient visits were not mandated if follow-up could be obtained via other mechanisms, such as phone calls or electronic health review, subsequently leaving some patients with further follow-up not available in the locked database. As a result, there could be a number of events not captured in this observation. The baseline characteristics of patients without 1-year follow up are presented in **Table 1**, along with those for whom 1-year follow-up data were available.

CONCLUSIONS

The 1-year outcomes from the ADVANCE FFR_{CT} Registry show low rates of events in all patients, with less ICA and revascularization and a trend toward lower MACE and significantly lower cardiovascular death or MI in patients with a negative FFR_{CT} compared with patients with abnormal FFR_{CT} values.

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PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: FFR_{CT} is used to evaluate patients with suspicion of CAD. The noninvasive FFR_{CT} value is generated based on computational fluid dynamics and has been shown to correlate to invasive FFR.

COMPETENCY IN PATIENT CARE: The 1-year outcomes from the ADVANCE Registry trend toward lower MACE and significantly lower cardiovascular death and MI in patients with negative FFR_{CT} (>0.80) compared with those with positive FFR_{CT}.

TRANSLATIONAL OUTLOOK: This intermediate-term outcome analysis from a real-world registry provides the safety data for deferral of invasive evaluation in patients with negative FFR_{CT}.

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