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Comparison of visual assessment of coronary stenosis with independent quantitative coronary angiography: Findings from the PROMISE trial

Rohan Shah, MD¹, Eric Yow, MS¹, W. Schuyler Jones, MD^{1,2}, Louis P. Kohl III, MD³, Andrzej S. Kosinski, PhD¹, Udo Hoffmann, MD, MPH⁴, Kerry L. Lee, PhD¹, Christopher B. Fordyce, MD¹, Daniel B. Mark, MD, MPH^{1,2}, Alicia Lowe, AAS¹, Pamela S. Douglas, MD^{1,2}, and Manesh R. Patel, MD^{1,2}

¹Duke Clinical Research Institute, Duke University School of Medicine, Durham, NC

²Division of Cardiology, Department of Medicine, Duke University School of Medicine, Durham, NC

³Hennepin County Medical Center, Minneapolis, MN

⁴Massachusetts General Hospital and Harvard Medical School, Boston, MA

Abstract

Background—The outcomes in patients by visual assessment and quantitative coronary angiography (QCA) for obstructive coronary artery disease (CAD) are not known. Our objective was to compare visual and QCA estimates of obstructive CAD, and assess their relationship to outcomes in stable patients with symptoms of CAD.

Methods—The Prospective Multicenter Imaging Study for Evaluation of Chest Pain (PROMISE) trial randomized 10,003 patients with CAD symptoms to anatomical or functional testing. Site reports of invasive angiography detailing visual stenosis and independent, blinded QCA were performed for obstructive CAD (≥50% stenosis). Disagreement between methods was determined and compared to outcomes (death, myocardial infarction, unstable angina hospitalization, or major procedural complications).

Results—Of 929 patients (9.3% of PROMISE cohort) with angiograms assessed by sites and QCA, 593 (64%) had obstructive CAD per site reports, while 428 (46%) had stenosis ≥50% per QCA. Results differed in 177 patients (disagreement rate 19.1%, $\kappa=0.63$), of whom 171 had CAD per sites but not per QCA. One-year unadjusted Kaplan-Meier event rates were highest (5.1%) when QCA and visual assessment agreed for CAD, lowest (0.9%) when the 2 agreed for no obstructive CAD, and intermediate (3.1%) for patients who had CAD per visual assessment but not per QCA.

Conclusions—Visual estimation of angiograms results in more frequent diagnosis of obstructive CAD as compared with QCA. Concordance of results for presence or absence of obstructive CAD

was associated with high and low event rates, respectively. Disagreement was associated with intermediate event rates, suggesting that cardiologists integrated clinical information into routine visual assessment of angiograms.

Keywords

quantitative coronary angiography; coronary artery disease

BACKGROUND

Since the introduction of coronary angiography, visual estimation of the degree of coronary artery narrowing has been the routine method for determining coronary stenosis severity clinically. However, this method is limited by intra- and inter-observer variability,¹⁻³ observer bias, and significant discordance between visual estimates of coronary artery luminal narrowing and functional significance of stenoses.⁴ Quantitative coronary angiography (QCA), first described almost 40 years ago,⁵ uses computer-based quantitation and may overcome some of the limitations of visual stenosis estimation including observer variability.⁶ Studies comparing QCA to visual estimation suggest that visual estimation may “overestimate” lesion severity,⁷⁻¹¹ although this conclusion assumes QCA as the gold standard. Given such disagreements, it is possible that visual estimation of stenosis and QCA may differ in the clinically important task of prediction of patient outcomes, but this has not been studied.

The objective of this substudy of the Prospective Multicenter Imaging Study for Evaluation of Chest Pain (PROMISE) trial¹² was to determine the rate of agreement and disagreement between visually estimated stenosis and QCA of coronary angiography for obstructive coronary artery disease (CAD), and to compare results from each method to patient outcomes in stable patients presenting with symptoms of CAD.

METHODS

The methods and results of the PROMISE trial have been previously reported.^{12,13} Briefly, PROMISE was a pragmatic randomized controlled trial conducted at 193 participating sites in the United States and Canada in which stable symptomatic outpatients without known CAD were randomized to receive either functional testing (exercise electrocardiogram, stress echocardiogram, or nuclear stress test) or anatomical testing (coronary computed tomographic angiography [CTA]).¹²

All initial tests were performed and interpreted by local physicians at the participating sites, and all additional diagnostic or therapeutic procedures, including performing invasive coronary angiography, were left to the discretion of the patient’s physician. All patients were followed for the primary endpoint of death, myocardial infarction (MI), unstable angina hospitalization, or complications from procedures. The PROMISE trial found no difference in these clinical events over a median 25 months of follow-up with either an initial non-invasive anatomic testing strategy with CTA or a functional testing strategy.

Population included in this substudy

This substudy includes patients in PROMISE who received an invasive coronary angiogram as part of their diagnostic work up. Sites were required to upload images of the angiograms performed on study patients into a central database and provide the catheterization report detailing visually read results of the angiogram. The final population used in this analysis included patients for whom both a site report detailing visually read results and a corresponding site-uploaded angiogram for QCA were available. For patients who underwent multiple catheterizations, only the initial diagnostic catheterization was included in the analysis.

Site quantification of coronary stenosis

At each study site, stenosis was visually assessed and reported. Centrally, each site angiogram report was entered into the database as stenosis in the right coronary artery, left anterior descending artery (LAD), proximal LAD, and left circumflex artery, with a maximum level of stenosis categorized as: (1) normal (0%), (2) non-significant/mild or minor (1% to 49%), (3) moderate (50% to 69%), (4) significant/severe (70% to 99%), or (5) occluded (100%). For the left main artery (LM), the maximum level of stenosis was categorized as: (1) normal (0%), (2) non-significant/mild or minor (1% to 49%), (3) significant/severe (50% to 99%), or (4) occluded (100%). If no assessment was recorded for an artery by the site, it was assumed to be normal.

QCA quantification of coronary stenosis

'QAngio XA' post-processing QCA software (Medis Medical Imaging Systems, Leiden, The Netherlands) was used to independently assess each angiogram in a central core laboratory at Duke. QCA was performed according to a standard protocol, in which two orthogonal views were assessed to measure maximum stenosis. Each angiogram was read by a minimum of two readers who were blinded to the results of the site report. The primary reader carefully evaluated each angiogram and performed QCA on each possibly obstructive lesion. The reviewers manually mapped the straight line path of the artery across the lesion, which was then used by the QAngio software to determine the maximum level of stenosis. The secondary reader, a board-certified interventional cardiologist, ensured adequate quality and accuracy of the QCA.

Detailed QCA analysis was performed for the 18 coronary vessel segments, based on the Society of Cardiovascular Computed Tomography coronary segmentation.¹⁴ For every angiogram, the maximum level of stenosis observed was reported for each of the 18 segments from the following categories: (1) 0%, (2) 1% to 29%, or (3) 30%. For stenosis 30%, the numerical value of the stenosis per QCA was reported. Only major cardiovascular vessels and side branches defined as having a diameter of at least 2 mm were included in this analysis.

Obstructive disease and outcomes definitions

Obstructive CAD in a patient was defined as the presence of one or more vessels with a stenosis of 50% or greater. Each patient who underwent invasive angiography was classified as having the presence or absence of obstructive disease per site-based visual estimate and

per QCA analysis. The primary clinical endpoint of PROMISE—a composite of major cardiovascular events that included death from any cause, MI, hospitalization for unstable angina, and major complication of cardiovascular procedures—was assessed for each of the four groups (based on site and QCA agreement or disagreement). The primary endpoint was assessed over the entire follow-up period, starting from day of cardiac catheterization, for each patient

Statistical analysis

Baseline characteristics are presented for all patients within the QCA population, patients in whom site and QCA agreed on the presence of obstructive disease, patients in whom site and QCA agreed on the absence of obstructive disease, and patients in whom site and QCA disagreed. Contingency tables were generated to assess agreement for obstructive disease per patient between site and QCA reads of angiograms. Disagreement rates (when site read and QCA responses differed) were tabulated, and the kappa agreement statistics (with 95% confidence intervals) were estimated. For the four groups defined above, cumulative clinical event rates were calculated with the Kaplan-Meier method¹⁵ utilizing events after catheterization only. Count and percentage of revascularizations for patients in each of the four groups was reported.

Contingency tables and disagreement rates were also presented to assess agreement between sites and QCA separately for each coronary vessel. Each of the 18 segments analyzed was included in the corresponding vessel as per convention. Finally, the agreement was evaluated separately for each of the two groups based on the initial test performed – functional versus anatomical. All statistical analyses were performed with SAS version 9.4.

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RESULTS

Study population

Out of the 10,003 patients with symptoms suggestive of CAD randomized as part of the PROMISE trial, a site-performed cardiac catheterization report (detailing visual stenosis observed) was available for 1,018 (10.2%), of whom 929 patients had a corresponding paired angiogram available for QCA. The final study population consisted of these 929 patients (9.3% of the overall population) as shown in Figure 1. Data comparing baseline characteristics between the total PROMISE population, QCA population, and non-QCA population are presented in Supplementary Table 1.

Baseline characteristics

Baseline characteristics of patients, stratified by the entire QCA population, patients for whom site and QCA agreed on the presence of obstructive disease, patients for whom site and QCA agreed on the absence of obstructive disease, and patients for whom site and QCA disagreed are summarized in Table 1. In general, patients across all groups had over two cardiovascular risk factors, and the prevalences of the individual risk factors were similar across groups. The mean pretest likelihood of obstructive disease according to a combined Diamond-Forrester and Coronary Artery Surgery Study model¹⁶ was higher in patients for whom site and QCA agreed on the presence of obstructive disease (67.4%), as compared to patients for whom site and QCA agreed on the absence of obstructive disease (58.2%), and patients for whom site and QCA disagreed (59.4%).

Results of initial test (functional vs. anatomical) at baseline

Of the 929 patients, 532 patients (57.3%) received CTA as the initial test while 373 (40.2%) received a functional test as the initial test (Supplementary Table 2). The 24 (2.6%) remaining patients underwent catheterization without a preceding non-invasive test. Of the patients for whom site and QCA agreed on the presence of obstructive disease, 68.9% had a positive CTA (greater than 50% stenosis) and 80.0% had a positive functional test, with evidence of mild, moderate, or severe abnormality/ischemia. Comparatively, 44.5% of patients for whom site and QCA agreed on the absence of obstructive disease had a positive CTA, and 59.4% had a positive functional test.

Site-reported stenosis compared with QCA results: disagreement rates

Overall, the sites found obstructive disease on catheterization in 593 patients, while QCA found obstructive disease in 428 patients. The rate of disagreement between site reports and QCA results for the presence of obstructive disease is presented in Table 2. Of the 929 patients, the site and QCA results agreed in 752 patients (agreement rate of 80.9%) and disagreed in 177 patients (disagreement rate of 19.1%), with an overall $\kappa=0.63$ for agreement, 95% CI 0.58–0.67. Of the 177 patients with disagreement, in all but 6 patients, the sites reported obstructive disease while QCA did not. Since the group of patients with coronary stenosis by QCA but no stenosis by site report was small (N=6 patients), we have limited further discussion of this group.

Disagreement rates for individual vessels

The rate of agreement and disagreement between site and QCA results was determined for each of the three major coronary arteries and the LM (Table 3). The rate of disagreement between sites and QCA for obstructive disease was highest for the LAD (24.1%), overall $\kappa=0.51$, 95% CI 0.46–0.56 and lowest for the LM (3.4%) (κ was not reported for the LM analysis given the small number of patients with disagreement and the disproportionately high number of patients with no obstructive disease in the LM).

Disagreement rates by initial testing strategy

As reported in Table 4, the rate of disagreement between sites and QCA for obstructive disease was higher for patients who received an anatomic test (disagreement rate of 23.3%),

overall $\kappa=0.52$, 95% CI 0.45–0.58, than for patients who received a functional test (13.7%), overall $\kappa=0.72$, 95% CI 0.66–0.79.

Site-reported stenosis compared with QCA results: event rates and revascularization rates

At 1 year, the primary endpoint of death, MI, unstable angina hospitalization, or major complications from cardiovascular procedures/testing occurred in 8.3% of the patients in whom both sites and QCA found disease, 4.7% of the patients in whom sites found disease but QCA did not, and 1.5% of the patients in whom neither sites nor QCA found disease. In patients for whom both sites and QCA agreed on presence of disease, the event rates included death (2.8%), MI (1.4%), and hospitalizations for unstable angina (3.6%). A Kaplan-Meier plot for the primary endpoint showed that unadjusted 1-year primary endpoint event rates were highest (5.1%) when QCA and sites assessment agreed on presence of obstructive disease, lowest (0.9%) when QCA and sites agreed on absence of obstructive disease, and intermediate (3.1%) when sites found disease but QCA did not (Figure 2A). Event rates for the composite of death and MI were higher when QCA and sites agreed on presence of obstructive disease and lower when QCA and sites either disagreed on presence or agreed on absence of obstructive disease (Figure 2B).

The rate of revascularization at 30 days was highest in patients who had obstructive disease according to both site reports and QCA (80.8%) (Table 5), but was only 48.0% when sites found obstructive disease but QCA did not. In patients with obstructive disease per site reports, revascularization rates were higher when QCA found obstructive disease than when QCA found no obstructive disease (percutaneous coronary intervention: 64.2% vs. 39.2%; coronary artery bypass graft: 18.7% vs. 8.8%).

DISCUSSION

This substudy of the PROMISE trial compared visually estimated coronary artery stenosis with independent, blinded QCA analysis of the corresponding coronary angiographic images in 929 patients with symptomatic chest pain who underwent an invasive coronary catheterization as part of their diagnostic work-up. The results from this study identify the following four major findings. First, visual estimation of stenosis has a higher rate of finding obstructive coronary lesions when compared with QCA. Second, cardiovascular event rates and revascularization rates were high in patients for whom QCA and visual estimation were concordant for obstructive disease and low in patients in whom neither method diagnosed obstructive CAD. Third, the disagreement between visual estimation of stenosis and QCA was most pronounced for the LAD. Finally, contrary to expectations, when visual estimation reported obstructive disease and QCA did not, the cardiovascular event rates were intermediate between those with concordance for disease and concordance for no obstructive disease.

In our analyses, we found that visual reads noted the presence of obstructive disease more frequently when compared with QCA. This finding is consistent with prior studies, which have shown that physicians “overestimate” lesion severity during visual reading of angiograms when compared with QCA methods.^{7,9,10} These previous studies were generally performed in patients undergoing percutaneous coronary intervention, and thus all had

significant coronary stenosis. This study expands these findings to suggest that visual estimation of lesion severity overestimates lesions across all levels of stenosis when compared with QCA.

The reasons why visual estimation routinely overestimates stenosis are likely multifold. It has been suggested that visual observers may have a tendency to assess area stenosis rather than vessel diameter stenosis,^{7,8} although another study did not find this to be the case.¹⁰ It has also been noted that there may be a tendency among visual readers to overestimate stenosis in smaller vessels.¹⁰ Additionally, lesion length affecting estimation of true diameter and calcification affecting opacification may lead to overestimation. It must be noted that physiologic prediction of flow from stenosis is also difficult in cases where there are longer lesions, and some of the differences between QCA and visual estimation may stem from this. In theory, QCA might help alleviate some of the above-mentioned sources of error.

Given this disagreement, it is important to question whether visual estimation or QCA is the more accurate method to predict clinical outcomes. In this study, both cardiovascular event rates as well as rates of revascularization within the first 30 days were lower for patients in whom sites found obstructive disease but QCA did not, compared with patients in whom both the sites and QCA reported disease, suggesting a lower cardiovascular disease risk in this discordant group. Physiologically, as lesion severity increases, even small changes in diameter can have significant physiologic and hemodynamic consequences. However, given that event rates were higher in the discordant group than when both methods did not find obstructive disease, visual stenosis even in the absence of positive QCA may identify patients with residual cardiovascular risk.

The enhanced prognostic implications of site-reported data in this intermediate group could be due to the inability of QCA to account for other factors that may be identified by the procedure-performing physician upon clinical evaluation of the patient. Our findings likely indicate some degree of integration of the patient's clinical presentation and pre-catheterization information with visual stenosis at time of angiography. Furthermore, the presence of typical angina, results of functional testing, and additional lesion-specific information from intravascular ultrasound or fractional flow reserve (which were not available during QCA analysis) could have been factored into the visual assessment of lesion stenosis and the decision for revascularization. Disagreement may also be in part due to the fact that QCA stenosis does not take into account factors such as inferior angiogram quality/haziness that may influence clinicians' decisions. However, as noted above, visual estimation too is not perfect, and in cases where clinical and angiographic data conflict, invasive coronary physiology testing with fractional flow reserve and/or instantaneous wave-free ratio should be employed for an accurate assessment.

The rate of disagreement between sites and QCA was greatest for the LAD, intermediate for the right coronary artery and left circumflex artery, and lowest for the LM. While the paucity of LM stenosis may explain the low result, the reason for a higher rate of disagreement in the LAD is less evident. A possible explanation might be the length of these arteries. The QCA data include the proximal, medial, and distal parts of the LAD as well as the major

branches of the LAD. The long length of the LAD, with multiple branches covering a large territory, potentially affects assessment. It may also be that physicians' assessments of stenosis are influenced by the known higher clinical risk associated with LAD lesions compared to other vessels. Our findings suggest the opportunity for invasive physiologic testing to improve characterization of all the major coronary vessels, especially the LAD.

Finally, the rate of disagreement between visually estimated stenosis and QCA was higher for patients who received an anatomic test initially (i.e., CTA) when compared with patients who received a functional test. This result may be surprising to some who may expect the use of CTA to lead to better correlation for determination of obstructive disease. A possible explanation is that while CTA, similar to angiography, provides an anatomic visualization of the artery, a functional test may provide additional information regarding the patient's clinical status that may help the physician better evaluate the angiographic lesion in the context of the patient's overall clinical status. Alternatively, the site physicians who interpreted invasive angiography may have been influenced by the stenosis reported on CTA, again providing an opportunity for improvement with either non-invasive or invasive physiologic measures.

Limitations

This is a post hoc analysis of the PROMISE population and should be regarded as hypothesis generating rather than definitive. As such, this study was not powered to demonstrate a specific difference in patient subsets for disagreement between site-reported stenosis and QCA results. QCA has its own limitations that have been previously noted,^{9,17} including that QCA does require a minimal amount of user input, albeit less than visual stenosis estimation, and as such is not free from user variability.

Conclusion

Our study finds that routine visual estimation of angiograms notes the presence of obstructive CAD with a higher frequency than QCA. Visual estimation and QCA agreement on presence of obstructive CAD was associated with higher cardiovascular event rates and revascularization rates, and agreement for no obstructive CAD was associated with low event and revascularization rates. However, obstructive disease present by site visual estimation and absent by QCA was associated with intermediate rates. These findings suggest that opportunities exist to improve the routine interpretation of coronary angiography. Given the limitations of angiography, a strong case can be made for the increased use of invasive coronary physiology testing to arbitrate and guide management in patients with moderate coronary disease.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Disclosures:

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Figure 1.

Derivation of study population from total PROMISE trial population. Abbreviations: cath, catheterization; PROMISE, Prospective Multicenter Imaging Study for Evaluation of Chest Pain; QCA, quantitative coronary angiography.

Number at Risk:

OD: Site=Yes and QCA=Yes	330	306	282	226	170	115	62	15
OD: Site=No and QCA=No	422	395	362	282	218	136	71	18
OD: Site=Yes and QCA=No	171	159	145	112	85	58	31	8

Number at Risk:

OD: Site=Yes and QCA=Yes	330	305	282	226	170	115	62	15
OD: Site=No and QCA=No	422	404	375	295	229	145	78	20
OD: Site=Yes and QCA=No	171	158	147	112	89	61	33	9

Figure 2.

Kaplan-Meier plot for (A) primary endpoint (death, myocardial infarction, unstable angina hospitalization, or major procedural complications) and (B) death and myocardial infarction for groups, based on site and QCA determination of obstructive disease. Given the low number of patients with Site=No and QCA=Yes (6), no Kaplan-Meier rates were reported or graphed. Abbreviations: OD, obstructive disease; QCA, quantitative coronary angiography.

Table 1

Baseline characteristics.

Variable	All QCA patients (N=929)	Patients for whom QCA and site agree on presence of OD (N=422)	Patients for whom QCA and site agree on absence of OD (N=330)	Patients for whom QCA and site disagree (N=177)
Demographics				
Age (y) - mean $\pm$ SD	62.6 $\pm$ 8.3	63.1 $\pm$ 8.4	61.6 $\pm$ 8.3	63.0 $\pm$ 8.1
Female sex	371 (39.9%)	123 (29.1%)	176 (53.3%)	72 (40.7%)
Racial or ethnic minority	137 (14.8%)	71 (16.9%)	49 (14.8%)	17 (9.7%)
Cardiac risk factors				
BMI (kg/m ²) - mean $\pm$ SD	31.0 $\pm$ 6.4	30.3 $\pm$ 5.9	32.2 $\pm$ 7.1	30.3 $\pm$ 6.1
Hypertension	647 (69.6%)	300 (71.1%)	221 (67.0%)	126 (71.2%)
Diabetes	255 (27.4%)	117 (27.7%)	84 (25.5%)	54 (30.5%)
Dyslipidemia	647 (69.6%)	288 (68.2%)	230 (69.7%)	129 (72.9%)
Family history of premature CAD	314 (33.9%)	138 (32.9%)	101 (30.6%)	75 (42.4%)
Peripheral or cerebrovascular disease	76 (8.2%)	35 (8.3%)	28 (8.5%)	13 (7.3%)
CAD equivalent	304 (32.7%)	139 (32.9%)	104 (31.5%)	61 (34.5%)
Metabolic syndrome	391 (42.1%)	184 (43.6%)	136 (41.2%)	71 (40.1%)
Current or past tobacco use	550 (59.2%)	255 (60.4%)	195 (59.1%)	100 (56.5%)
Sedentary lifestyle	463 (49.9%)	204 (48.6%)	179 (54.2%)	80 (45.2%)
History of depression	194 (20.9%)	64 (15.2%)	94 (28.5%)	36 (20.3%)
Risk factor burden and risk score				
No risk factors	17 (1.8%)	8 (1.9%)	5 (1.5%)	4 (2.3%)
Risk factor burden - mean $\pm$ SD	2.6 $\pm$ 1.1	2.6 $\pm$ 1.1	2.5 $\pm$ 1.1	2.7 $\pm$ 1.2
Combined Diamond-Forrester and Coronary Artery Surgery Study risk score - mean $\pm$ SD	62.6 $\pm$ 20.8	67.4 $\pm$ 19.9	58.2 $\pm$ 21.3	59.4 $\pm$ 19.7

Data are n (%) except where indicated.

Abbreviations: BMI, body mass index; CAD, coronary artery disease; OD, obstructive disease; QCA, quantitative coronary angiography; SD, standard deviation.

Table 2

Site versus QCA agreement assessment for obstructive disease.

	QCA result obstructive disease			Disagreement* rate	Kappa (95% CI)
	No	Yes	Total		
Site-reported obstructive disease				177 (19.1%)	0.63 (0.58–0.67)
No	330	6	336		
Yes	171	422	593		
Total	501	428	929		

* Disagreement is defined as when site and core lab responses are not equal.

Abbreviations: CI, confidence interval; QCA, quantitative coronary angiography.

Table 3

Site versus QCA agreement assessment for obstructive disease by individual vessel.

	QCA result obstructive disease			Disagreement* rate	Kappa (95% CI)
	No	Yes	Total		
Right coronary artery					
Site-reported obstructive disease				133 (14.3%)	0.66 (0.61–0.71)
No	594	10	604		
Yes	123	202	325		
Total	717	212	929		
Left main artery					
Site-reported obstructive disease				32 (3.4%)	[†]
No	891	2	893		
Yes	30	6	36		
Total	921	8	929		
Left circumflex artery					
Site-reported obstructive disease				128 (13.8%)	0.62 (0.56–0.67)
No	653	13	666		
Yes	115	148	263		
Total	768	161	929		
Left anterior descending artery					
Site-reported obstructive disease				224 (24.1%)	0.51 (0.46–0.56)
No	477	9	486		
Yes	215	228	443		
Total	692	237	929		

* Disagreement is defined as when site and core lab responses are not equal.

[†] Kappa not reported given small number of patients with disagreement and disproportionately high number of patients with no disease compared to patients with disease in left main artery.

Abbreviations: CI, confidence interval; QCA, quantitative coronary angiography.

Table 4

Site versus QCA agreement assessment for obstructive disease by testing strategy.

	QCA result obstructive disease			Disagreement* rate	Kappa (95% CI)
	No	Yes	Total		
Anatomic testing					
Site-reported obstructive disease				124 (23.3%)	0.52 (0.45–0.58)
No	128	2	130		
Yes	122	280	402		
Total	250	282	532		
Functional testing					
Site-reported obstructive disease				51 (13.7%)	0.72 (0.66–0.79)
No	187	4	191		
Yes	47	135	182		
Total	234	139	373		

* Disagreement is defined as when site and core lab responses are not equal.

Abbreviations: CI, confidence interval; QCA, quantitative coronary angiography.

Table 5

Revascularization rates by groups based on site versus QCA results of obstructive disease.

Obstructive disease site reported	Obstructive disease QCA result	Total number of patients	Patients with revascularization *	CABG	PCI
No	No	330	4 (1.2%)	1 (0.3%)	3 (0.9%)
No	Yes	6	0 (0.0%)	0 (0.0%)	0 (0.0%)
Yes	No	171	82 (48.0%)	15 (8.8%)	67 (39.2%)
Yes	Yes	422	341 (80.8%)	79 (18.7%)	271 (64.2%)

* Revascularizations (percutaneous coronary intervention [PCI] or coronary artery bypass graft [CABG]) between 0 and 30 days after angiography date are presented.