



Coronary Computed Tomography Angiography as the First-Line Test: What Downstream Testing It Prevents and What It Generates

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Introduction

Guidelines now endorse both coronary computed tomography angiography (CTCA) and functional (stress) testing as reasonable first-line strategies for the initial evaluation of stable chest pain, leaving the choice between them to local practice and patient factors. That equivalence in guideline standing has obscured a genuine empirical question: the two strategies generate different downstream testing cascades, and it is those downstream consequences, not the index test alone, that determine what a patient actually experiences after the scan.

This review sets out what two large randomized trials -- one testing CTCA added to standard care, one testing CTA head-to-head against functional testing -- found about the downstream invasive testing, revascularization, preventive therapy, and radiation exposure each strategy generates.

Material and Methods

This is a narrative review drawing on the SCOT-HEART trial's 5-year outcome publication and the PROMISE trial's primary results publication, identified through the sources cited above and by name recognition as the two pivotal randomized trials in this area, without a pre-registered protocol or systematic search string. All percentages, hazard ratios, odds ratios, and confidence intervals reported here are taken directly from the cited sources; none has been invented, estimated, or extrapolated.

Results

SCOT-HEART: CTCA added to standard care reduced hard cardiac events

SCOT-HEART randomized 4,146 patients referred for outpatient assessment of suspected angina to CTCA plus standard care or standard care alone [1]. At a median of 4.8 years, coronary heart disease death or nonfatal myocardial infarction occurred in 2.3% of the CTCA group versus 3.9% of the standard-care group (HR 0.59, 95% CI 0.41-0.84, $P=0.004$) [1]. Figure 1 sets this primary outcome out directly.

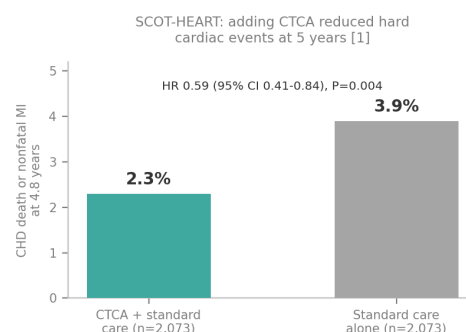


Figure 1: Coronary heart disease death or nonfatal myocardial infarction at 4.8 years, CTCA plus standard care versus standard care alone, SCOT-HEART trial [1].

What CTCA did to downstream invasive testing over 5 years

Over the full follow-up, invasive coronary angiography (23.7% vs 24.2%) and revascularization (13.5% vs 12.9%) did not differ significantly between groups [1]. A post-hoc analysis restricted to events beyond the first year, however, found both procedures occurred significantly less often with CTCA (angiography HR 0.70, $P=0.002$; revascularization HR 0.59, $P=0.015$) [1]. Figure 2 sets the overall rates alongside this later-period reduction: an early wave of CTCA-prompted invasive testing appears to have been offset by fewer unplanned procedures later, once patients found to have obstructive disease on the index scan had already been appropriately investigated and treated.

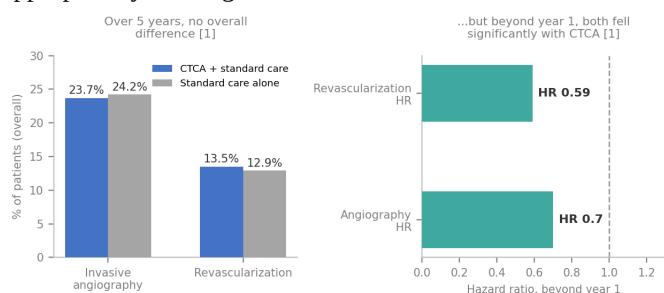


Figure 2: Invasive angiography and revascularization overall (5 years) and by hazard ratio beyond year 1, CTCA plus standard care versus standard care alone, SCOT-HEART trial [1].

This time-dependent pattern is worth dwelling on, because a single 5-year cumulative rate can hide it entirely: reading only the overall angiography and revascularization figures, which do not differ significantly between groups, would suggest CTCA has no effect on downstream invasive testing at all. The beyond-year-1 hazard ratios show the opposite is closer to the truth -- CTCA front-loaded invasive testing into the first year, when scan findings were fresh and actionable, and then reduced it relative to standard care for every year that followed [1].

CTCA changed preventive prescribing

New preventive (statin) therapy was initiated in 19.4% of the CTCA group versus 14.7% of the standard-care group (OR 1.40, 95% CI 1.19-1.65) [1]. Figure 3 sets this out: seeing coronary plaque directly, even nonobstructive plaque that prompted no invasive procedure, measurably changed how often clinicians started preventive medication.

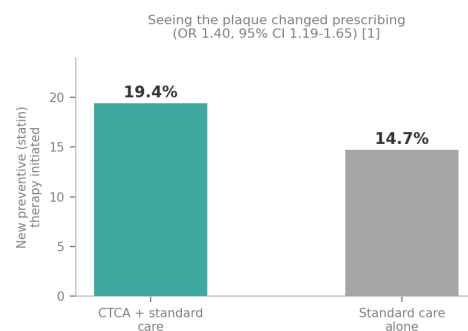


Figure 3: New preventive (statin) therapy initiated, CTCA plus standard care versus standard care alone, SCOT-HEART trial [1].

This preventive-prescribing gap is plausibly the mechanistic link between the imaging finding and the trial's headline 5-year outcome: a scan that visualizes atherosclerosis directly, including plaque that is not yet obstructive enough to warrant any procedure, appears to prompt a change in long-term medical management that a purely functional test, which shows only whether a stenosis currently limits flow, does not.

PROMISE: CTA generated more downstream catheterization, not less

PROMISE randomized 10,003 symptomatic patients with suspected coronary artery disease to an initial strategy of CTA or functional testing (exercise electrocardiography, stress nuclear imaging, or stress echocardiography) [2]. Cardiac catheterization within 90 days occurred in 12.2% of the CTA group versus 8.1% of the functional-testing group -- CTA generated more downstream invasive testing, not less [2]. Figure 4 sets this comparison out directly.

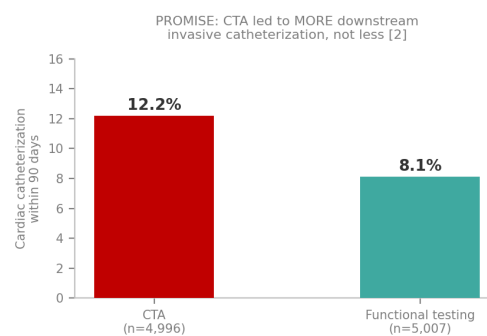


Figure 4: Cardiac catheterization within 90 days, CTA versus functional testing, PROMISE trial [2].

Those extra catheterizations were somewhat better targeted

Of the catheterizations that did occur, a smaller share revealed no obstructive coronary artery disease in the CTA group than in the functional-testing group (3.4% vs 4.3%, $P=0.02$) [2]. Figure 5 sets this out: CTA's extra downstream catheterizations were, on this measure, somewhat more likely to find disease worth treating, even though there were more of them in absolute terms.

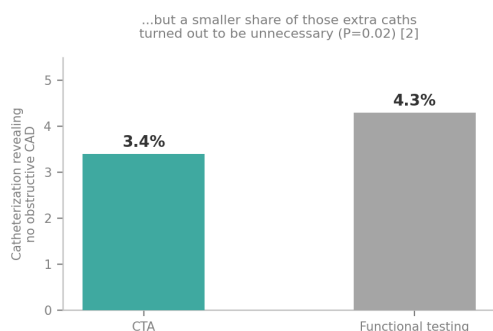


Figure 5: Cardiac catheterization revealing no obstructive coronary artery disease, CTA versus functional testing, PROMISE trial [2].

Framed as a diagnostic-yield question rather than a volume question, PROMISE's catheterization data support a specific claim: CTA generated a larger number of downstream catheterizations, but a smaller proportion of them were, in retrospect, unnecessary. Whether that modest gain in per-procedure yield offsets the larger absolute increase in procedures performed, and the radiation and cost that come with each one, is a value judgment this trial's data inform but do not settle on their own.

Clinical outcomes were equivalent, but CTA carried more radiation

PROMISE's primary composite clinical outcome (death, myocardial infarction, hospitalization for unstable angina, or major procedural complication) occurred in 3.28% of the CTA group versus 3.01% of the functional-testing group at 25 months, a nonsignificant difference (HR 1.04, 95% CI 0.83-1.29, P=0.75) [2]. Mean cumulative radiation exposure within 90 days was higher with CTA (12.0+/-8.5 mSv vs 10.1+/-9.0 mSv, P<0.001) [2]. Figure 6 sets both findings out together: equivalent clinical outcomes, achieved with a higher radiation cost under the CTA-first strategy.

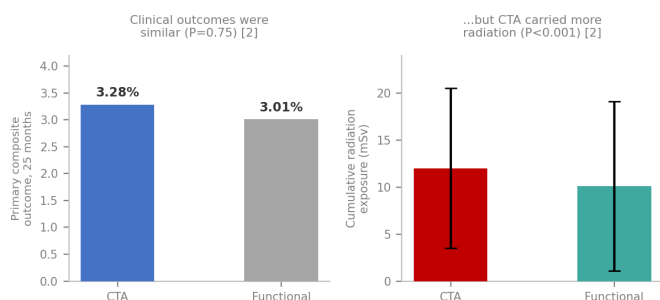


Figure 6: Primary composite clinical outcome at 25 months and cumulative radiation exposure within 90 days, CTA versus functional testing, PROMISE trial [2].

Discussion

These two trials answer different questions and should not be read as contradicting one another. SCOT-HEART asked whether adding CTCA to standard clinical assessment improves hard outcomes, and found that it does, through a pathway that included more preventive therapy and, in the longer run, fewer unplanned invasive procedures rather than more. PROMISE asked whether CTA is an acceptable substitute for functional testing as the initial test, and found clinical outcomes equivalent, but at the cost of more downstream catheterization and more radiation exposure in the short term. Read together, CTCA's value proposition looks less like 'fewer downstream tests' and more like 'better-targeted downstream care over a longer horizon, purchased with somewhat more testing and radiation up front.'

For a clinician choosing a first-line test today, SCOT-HEART supports CTCA as an addition to standard assessment when the goal is reducing hard cardiac events over years, while PROMISE cautions that, as a direct substitute for functional testing, CTA should be expected to generate more near-term invasive testing and radiation exposure rather than less, even though clinical outcomes end up equivalent.

Study limitations

This is a narrative review, not a systematic review with a pre-registered protocol, and it draws on two randomized trials that differ in design: SCOT-HEART tested CTCA as an addition to standard care, while PROMISE tested CTA as a substitute for functional testing, so the two trials are not directly comparable head-to-head despite both involving coronary CT imaging. SCOT-HEART's post-hoc, beyond-year-1 analysis of angiography and revascularization was not the trial's prespecified primary comparison and should be interpreted with the appropriate caution given to post-hoc subgroup timing analyses. PROMISE's functional-testing arm pooled three different test modalities (exercise electrocardiography, stress nuclear imaging, and stress echocardiography) rather than comparing CTA against each individually, so this review cannot say whether CTA's downstream testing pattern differs from any one functional modality specifically. Neither trial's imaging protocols reflect the most current CT scanner generations, which have reduced radiation dose substantially since these trials were conducted, so the radiation gap reported in PROMISE likely overstates the gap with contemporary equipment.

Conclusion

Coronary CTCA, added to standard clinical assessment, reduced hard cardiac events over 5 years in SCOT-HEART, through more preventive therapy and fewer unplanned invasive procedures over the longer term. As a first-line substitute for functional testing in PROMISE, CTA produced equivalent clinical outcomes but generated more downstream catheterization and higher radiation exposure in the short term. Both findings can be true at once, and choosing between CTCA and functional testing as a first-line strategy should depend on which of these two questions -- added value over standard assessment, or substitution for an established alternative -- most closely matches the clinical decision actually being made.

Neither trial reported results stratified by pretest probability of obstructive coronary disease, so this review cannot say whether the downstream testing patterns described here hold uniformly across low-, intermediate-, and high-risk patients, or whether one subgroup accounts disproportionately for the extra catheterizations PROMISE observed with CTA. Current CT scanners also generate substantially lower radiation doses than the equipment used in these trials, so any radiation-exposure comparison performed today would need to be repeated with contemporary dose data rather than assumed to carry over unchanged from PROMISE.

A further practical implication concerns how imaging findings are acted upon locally. SCOT-HEART's longer-term reduction in unplanned invasive procedures depended on clinicians actually changing preventive prescribing and follow-up in response to CTCA findings, rather than treating a nonobstructive scan as reassurance requiring no action; centers introducing CTCA as a first-line test should expect to see its benefit only if local practice similarly translates imaging findings into changed preventive management, not merely into a different initial test being ordered.

Cost and access also differ meaningfully between the two strategies in ways neither trial was designed to measure directly. CTCA requires scanner availability, iodinated contrast, and radiologist or cardiologist interpretation expertise that is not uniformly distributed across health systems, while functional testing infrastructure is generally more widely available in community settings; a program's choice of first-line strategy will in practice often be constrained by which infrastructure it already has, independent of which strategy the trial evidence more strongly favors for a given clinical question. Future trials directly randomizing CTCA against functional testing while also capturing downstream preventive-therapy prescribing, as SCOT-HEART did, would help resolve whether PROMISE's added catheterization burden with CTA is offset by the kind of longer-term prescribing and outcome benefit SCOT-HEART observed, or whether that benefit was specific to CTCA's use as an addition to standard

care rather than as a substitute for functional testing.

Trial	N	Design	Primary comparison	Key downstream result
SCOT-HEART [1]	4,146	CTCA + standard care vs standard care	5-year CHD death/MI	HR 0.59; fewer late procedures
PROMISE [2]	10,003	CTA vs functional testing	25-month composite outcome	HR 1.04; more early catheterization

Table 1: Design and key downstream-testing result of the two randomized trials reviewed here [1,2].

Set side by side this way, the two trials' apparent tension resolves into a question of what each was actually testing. SCOT-HEART measured the effect of adding a test to an existing clinical pathway and found that the extra information changed management enough to reduce hard events years later. PROMISE measured the effect of substituting one first-line test for another already in place and found the substitution outcome-neutral but not cost-neutral, in catheterization volume and radiation alike. Neither result generalizes automatically to the other question, and a health system deciding how to deploy CTCA needs to be clear about which of the two decisions it is actually making before reaching for either trial as justification.

1. Newby DE, Adamson PD, Berry C, et al. "Coronary CT Angiography and 5-Year Risk of Myocardial Infarction" (SCOT-HEART). *N Engl J Med* 379(2018):924-933.

2. Douglas PS, Hoffmann U, Patel MR, et al. "Outcomes of Anatomical versus Functional Testing for Coronary Artery Disease" (PROMISE). *N Engl J Med* 372(2015):1291-1300.

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