THE USE OF 320 DETECTOR COMPUTED TOMOGRAPHY CORONARY ANGIOGRAPHY TO DIAGNOSE CORONARY ARTERY DISEASE IN EMERGENCY DEPARTMENT PATIENTS WITH CHEST PAIN

By

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To Mom and Dad, for their love and support

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ACS	acute coronary syndrome
CAC	coronary artery calcium
CAD	coronary artery disease
CT	computed tomography
CTCA	computed tomography coronary angiography
CVD	cardiovascular disease
ED	emergency department
ETT	exercise treadmill test
HR	heart rate
IQR	interquartile range
MI	myocardial infarction
MPI	myocardial perfusion imaging

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Chest pain is a common problem with over 7 million emergency department (ED) visits in the U.S. annually. ED physicians are charged with establishing the absence of potentially serious conditions and with accurately diagnosing the source of chest pain without unduly burdening the patient with an extended duration of stay or unnecessary admission to the hospital. Two crucial diagnoses in the cardiac differential diagnosis of chest pain include acute coronary syndrome (ACS) and obstructive coronary artery disease (CAD).

The likelihood of ACS can be minimized with normal findings using a thorough history and physical examination, serial measurements of cardiac serum biomarkers, and serial electrocardiograms. Typically, however, the diagnosis of obstructive CAD requires additional testing. This testing might include electrocardiographic treadmill testing (ETT), myocardial perfusion imaging (MPI), or stress echocardiography and frequently these tests are not available in an ED setting.

A newer technology, computed tomography coronary angiography (CTCA), has sensitivity and specificity for CAD superior to ETT and similar to MPI for establishing the

diagnosis of CAD. CTCA can be reliably performed on a 64-detector computed tomography (CT) scanner which is a tool available in most EDs throughout the day and on every day of the week.

At the University of Florida, the ED faculty was concerned about poor follow-up for patients discharged after chest pain evaluation. To address this, the ED recently switched from a strategy of ordering outpatient stress tests for patients with chest pain, to ordering CTCA in the ED and prior to discharge for these patients. We hypothesized that this change in strategy would reduce the ED duration of stay and increase the detection of CAD. Using two cohorts of patients ($n = 50$ in each, total $n = 100$) we compared the duration of stay in the ED and the detection of CAD in patients before and after this change in clinical care to determine the impact of CTCA.

The duration of stay was not significantly different between the cohorts (417.5 minutes for the CT cohort, 400.0 for the control cohort, $p = 0.53$). Substantially more patients in the CT cohort completed the test ordered for them (96% versus 36% for control cohort, $p < 0.0001$) resulting in more patients being diagnosed with CAD (28% versus 2% in control cohort, $p = 0.0004$). More patients in the CT cohort were diagnosed with obstructive CAD, (12% versus 2%, $p = 0.11$) although this difference was not statistically significant. Within 3 months of the index ED visit, recidivism was the same in both cohorts ($n = 4$, 8%) and no patients in either cohort suffered myocardial infarction (MI) or death.

In conclusion, for patients who present to the ED with chest pain who need additional testing for CAD, a strategy of using CTCA prior to ED discharge is more effective than a strategy of outpatient follow-up testing. The CTCA based strategy

detected more CAD, primarily due to low likelihood of follow-up in the stress testing cohort. Using CTCA did not significantly change the duration of stay in the ED or reduce ED recidivism. No patients suffered MI or death within 3 months of their ED visit.

CHAPTER 1
INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality in the United States for both men and women.[1] The best estimate is that over 82 million Americans (over one in three) suffers from some form of CVD. Fortunately, the rate of death from CVD has decreased 27.8% from 1997 to 2007.[2] Nearly half of this decrease has been attributed to increased use of evidence-based medical therapies.[3]

An important technological component of evidence based medical therapies includes advanced techniques for diagnosing CVD. Several modalities of functional and anatomic testing for CVD are available for physicians to apply in patient care. Of course, no test is completely accurate and each method has unique limitations and levels of precision. One of the biggest challenges, therefore, lies in selecting the right test for the right patient at the right time, ideally based on the patient's pretest likelihood of CVD.[4]

For example, in evaluating a patient who complains of chest pain, considering the pretest likelihood that the patient has CVD is helpful in selecting the optimal test. Young patients without significant CVD risk factors are unlikely to have CVD. Ordering a test with a low positive predictive value increases the chance of a false positive test, potentially subjecting the patient to unnecessary testing. On the opposite end of the spectrum, older patients with many CVD risk factors are likely to have CVD. In these patients, a test with a low negative predictive value increases the chance of a false negative test, potentially delaying an accurate diagnosis of CVD. Patients with intermediate pretest likelihood of CVD are the most likely to receive valuable diagnostic information from noninvasive testing and are therefore the ideal population for these tests.[5-7]

While the symptoms of CVD are legion, the best known to both physicians and the public is chest pain. Because this symptom is well known to be associated with CVD, patients frequently consider chest pain to be an emergency and seek medical attention in a nearby emergency department (ED). In fact, over 7 million ED visits annually result from a complaint of chest pain.[8] While ED physicians are primarily responsible for identifying life-threatening conditions, they also find themselves in an increasing role as the front line interface between the public and the medical community. Therefore, they bear some responsibility to help patients become established within the healthcare system and must also offer appropriate follow-up. Making accurate diagnoses facilitates better follow-up, and the diagnosis of CVD is important to make. Not only does CVD carry a high burden of mortality, as previously discussed, but advances in evidence based medical therapies provide excellent potential to reduce the burden of morbidity and mortality associated with CVD.

For patients with chest pain presenting to an ED, physicians are encumbered to establish the presence or absence of two important diagnoses. The first is an acute coronary syndrome (ACS). The second is obstructive coronary artery disease (CAD) resulting in angina pectoris. ACS, such as acute myocardial infarction or unstable angina, can be reliably ruled out using serial assessments of the electrocardiogram and cardiac biomarkers, such as serum troponin.[9] Diagnosing obstructive CAD typically requires additional noninvasive testing, and such testing provides the best diagnostic yield in patients with intermediate pretest likelihood of CAD.

ED physicians order tests and noninvasive imaging they consider to be best for the patient, however most imaging tests are only available during business hours and

require travel to facilities outside the ED setting. This reality requires that the ED physician discharge the patient with instructions to follow-up at another time and location for further testing. This strategy frequently fails, with up to half of patients not completing scheduled follow-up testing.[10] Failure to follow up could be due to financial constraints, misunderstandings leading patients to believe that they do not have a medical problem requiring testing, or other reasons. As opposed to other testing modalities, computed tomography coronary angiography (CTCA) is a noninvasive test for CAD potentially available to ED physicians at any time of the day or night.

CTCA is a recently adopted imaging modality that can be performed on most modern computed tomography (CT) scanners. The diagnostic accuracy of CTCA has been shown to be similar to other noninvasive imaging tests for CAD including stress echocardiography,[11] single photon emission tomography,[12] and rubidium based positron emission tomography.[13] Prognostic information can be gleaned from CTCA, and a normal exam is associated with an exceedingly low risk of future cardiovascular events, with a 10-year survival of 99.4%.[14] This prognostic information can readily be obtained in the ED setting.[15] Other research in the ED setting has demonstrated that CTCA can reduce duration of ED stay and reduce costs.[16]

In the past, ED physicians at the University of Florida typically evaluated chest pain by first ruling out ACS and then discharging patients for further CAD evaluation in the outpatient setting. Out of concern that few patients were completing follow-up, this strategy was altered to incorporate CTCA during the ED visit as the primary strategy for diagnosing CAD in intermediate risk patients. We designed this investigation to test the hypothesis that a strategy of CAD testing based on CTCA would be superior to an

outpatient follow-up strategy as measured by the success rate for completion of CAD testing, by the percentage of patients diagnosed with CAD, and by the duration of ED stay.

CHAPTER 2
METHODS

Study Design and Setting

This investigation was conducted in the ED of a large tertiary care medical center. The design is a retrospective cohort study using a historical control group. Patients were considered for inclusion if they presented to the ED with a chief complaint of chest pain, or of other symptoms suggestive of CAD. Based on the patient's history and clinical presentation, the attending ED physician was responsible for determining which patients were at low risk of ACS. These patients underwent serial testing with ECGs and cardiac biomarkers. Once the diagnosis of ACS had been reliably excluded to the satisfaction of the attending ED physician, and further CAD testing was determined to be warranted, patients were nonrandomly assigned either to follow-up outpatient stress testing or CTCA during their index ED visit as described below (Figure 2-1). Two cohorts were thus established, the CT cohort of patients tested for CAD by CTCA, and the control cohort of patients tested for CAD using outpatient follow-up stress testing referral. The Institutional Review Board at the University of Florida approved this research protocol and waived the requirement to obtain consent for access to existing medical records.

Patient Selection

The ED routinely documented all patients referred for outpatient stress testing as a method of quality assurance. This quality assurance logbook was used to identify patients for the control cohort. On June 1, 2009, the ED began the routine use of CTCA for all chest pain patients without ACS who needed further testing for CAD. After this date, all patients considered for CTCA were documented and the logbook was used to

identify patients for the CT cohort. Patients in each cohort were identified sequentially and all patients were included, even if they failed to complete the assigned testing methodology. The first 50 patients documented after June 1, 2009 comprised the CT cohort and the last 50 prior to June 1, 2009 comprised the control cohort. Patients were excluded from the study in either cohort if they had any contraindications for CTCA including: acute or chronic kidney disease with glomerular filtration rate less than 60 mL/minute or allergy to iodinated contrast.

Data Collection

Patient information was collected regarding age, gender, height and weight, chief complaint, medical history, history of tobacco and recreational drug use, prescription medication use, ECGs, and laboratory tests. ED duration of stay was determined using the time of ED arrival and discharge as documented in the medical record. In the control cohort, adherence to referral for follow-up outpatient stress testing within 3 months of ED discharge was determined.

Outcomes

The primary aim of this study was to determine the effect of a CTCA based-strategy on the duration of stay in the ED. Secondary outcomes included, the rate of detection of CAD, the success of each strategy at completing testing, and recidivism (the rate of return ED visit for chest pain). Detection of CAD for the control cohort was defined as patients who both completed follow-up testing as ordered and had a positive test for CAD. Detection of CAD in the CT cohort was defined as discovery of any coronary artery stenotic lesion. Patients with only coronary calcium and without stenosis were not included in the definition of CAD. Obstructive CAD was defined by the detection of any lesion of greater than or equal to 50% luminal stenosis. This definition

was used to maximize the sensitivity for patients who would be suitable candidates for further testing, including invasive angiography.[17] Recidivism was defined as a return visit to the ED within 3 months with chest pain or symptoms suggestive of cardiac ischemia. As a safety outcome, we determined the rate of myocardial infarction (MI) or death within 3 months.

CTCA Acquisition

CTCA studies were acquired using the 320 detector Aquilion One CT Scanner (Toshiba, Nasu, Japan). Beta-blocker use was encouraged for all patients with a heart rate (HR) over 70 beats per minute; however, use was not required and was done at the discretion of the ED physician. A weight-based protocol was used to determine the dose of iodinated contrast (Visipaque™ [iodixanol] 60-90 mL; Amersham Health, Princeton, NJ), tube current (400-580 mA) and tube voltage (120-135 kV). After coronary artery calcium (CAC) scoring was completed, contrast bolus tracking was used and the scan was triggered when contrast density in the descending aorta reached 180 Hounsfield units. Scans were performed with retrospective gating, prospective gating, or dose-modulation based on patient suitability. CTCA studies were reconstructed at 70%, 75%, and 80% of the R-R interval with additional reconstructions performed if necessary and interpreted using a Vitrea® workstation (Vital Images, Minnesota). All studies were read in a preliminary fashion by radiology housestaff with radiology faculty available for oversight. Within 12 hours of any study, final interpretation was provided by both cardiology and radiology faculty who are board certified in cardiovascular CT. Results were communicated to ED faculty immediately upon reading. Abnormal findings were communicated to the patient by the responsible ED faculty. All stenoses were classified

as < 50%, 50-75%, or > 75% stenotic by the consensus of the interpreting faculty physicians, some of whom were investigators in this study.

Statistical Methods and Data Analysis

Using an estimated duration of stay of 480 minutes in the ED, we considered a reduction or increase in length of stay by 60 minutes would be clinically relevant. We set a beta level of 0.8 and determined that a sample size of 50 patients would be adequate to detect a 60 minute change in the duration of stay. We selected two time frames for secondary analysis of our duration of stay data. First we examined duration of stay if the patient arrived during peak ancillary staff availability (8 AM to 5 PM) or not (5 PM to 8 AM). Second, we examined duration of stay if the patient arrived during peak ED patient volume (4 PM to 12 AM) or not (12 AM to 4 PM). Power calculations were performed using G*Power 3.1.[18] Continuous variables were compared using the Student's t-test and Wilcoxon rank-sum test as appropriate for normal and skewed distributions. Categorical data were compared by Fisher's exact test and chi-square as appropriate. Calculations were completed using MyStat version 12 (Systat Software; Chicago, IL). We defined a p value < 0.05 to be statistically significant.

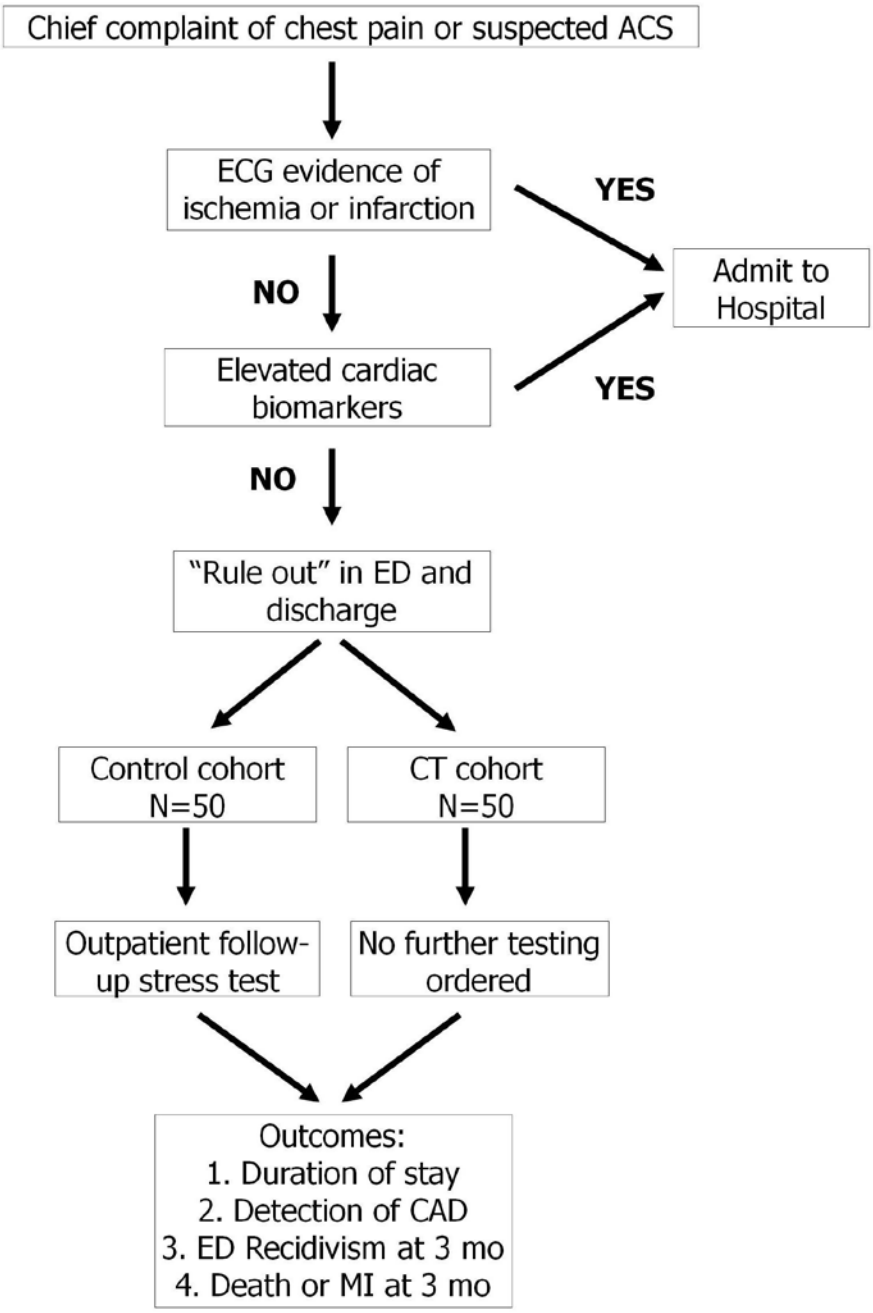

Figure 2-1. Cohort Selection Process. ACS = acute coronary syndrome, CAD = coronary artery disease, CT = computed tomography, ECG = electrocardiogram, ED = emergency department, MI = myocardial infarction

CHAPTER 3
RESULTS

Baseline Characteristics

The mean age of patients in the CT cohort was 47.0 years compared to 41.3 in the control group (p = 0.009). Male patients comprised 50% of the CT cohort versus 44% of controls (p = 0.55) Patients in the two cohorts did not have any significant differences in their mean body mass index, medication use, medical history, or social history (Table 3-1). Family history of CAD was inconsistently recorded and therefore excluded from the investigation. Median duration of chest pain prior to presentation was 12 hours or less for both cohorts (p = 0.35).

Duration of Stay

The median duration of stay in the ED was 417.5 minutes (359.0 – 581.0 interquartile range [IQR]) for the CT cohort and 400.0 minutes (338.0 – 471.0 IQR) for the control cohort (p = 0.53) (Figure 3-1, Table 3-2). When patients arrived during peak ancillary staff availability (8 AM to 5 PM), duration of stay was 384.0 minutes versus 382.0 minutes (p = 0.72), while arrival from 5 PM to 8 AM duration of stay was 453.0 minutes versus 432.0 minutes (p = 0.49). When patients arrived during peak ED patient volume (4 PM to 12 AM), duration of stay was 551.0 minutes versus 421.0 minutes (p = 0.07), while arrival from 12 AM to 4 PM duration of stay was 393.5 versus 393.0) (p = 0.93). Fewer patients in the CT cohort (n = 35, 70%) had three sets of cardiac biomarkers checked during the ED visit as compared to the control cohort (n = 47, 94%).

Detection of CAD and Clinical Outcomes

In the control cohort, only 18 patients (36%) completed outpatient stress testing while all but two patients in the CT cohort completed CTCA (96%, $p < 0.0001$) (Table 3-2). One patient assigned to the CT cohort was not scanned due to inability to establish IV access and the second patient was unable to be scanned due to a scanner malfunction. Neither of these patients (a 39 year old woman and a 58 year old man) underwent further CAD testing over the following 3 months.

Of the 48 patients from the CT cohort who successfully completed CTCA, 31 had CAC scores of zero, with median CAC for the cohort of zero. CTCA for three patients was not evaluable due to incorrect bolus timing (n = 2) and arrhythmia (n = 1), however all three patients had CAC of zero. Of 42 patients with data available for HR, the median was 53.5 beats per minute. Radiation dose data were not available in the radiology reports. CAD (defined as the presence of a stenotic lesion) was detected in 14 CT cohort patients compared to 1 patient in the control cohort ($p = 0.0004$). Obstructive CAD was detected in 6 CT cohort patients compared to 1 control patient ($p = 0.11$) (Figure 3-2)**.**

During three months of follow-up, 4 patients in each cohort sought repeat evaluation in the ED ($p > 0.99$). (Table 3-3) No patients suffered death or MI during the subsequent three months.

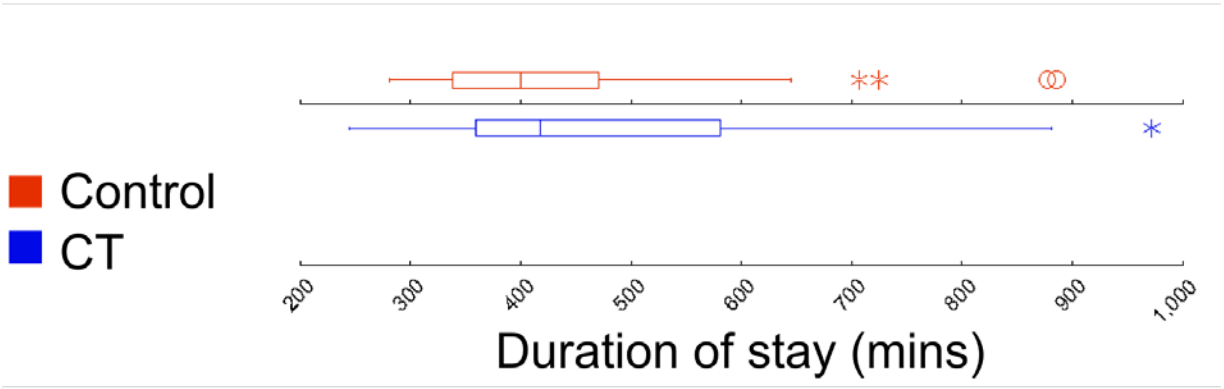

Figure 3-1. Emergency department duration of stay. This figure is a box and whisker plot of the distribution of duration of stay for each patient. The central vertical line represents the median duration of stay while the values within one standard deviation (SD) of the median are included in the boxes. Values inside the whiskers are within two SDs of the median. Asterisks represent values within 3 SDs of the median and circles are values beyond 3 SDs. CT = computed tomography, mins = minutes.

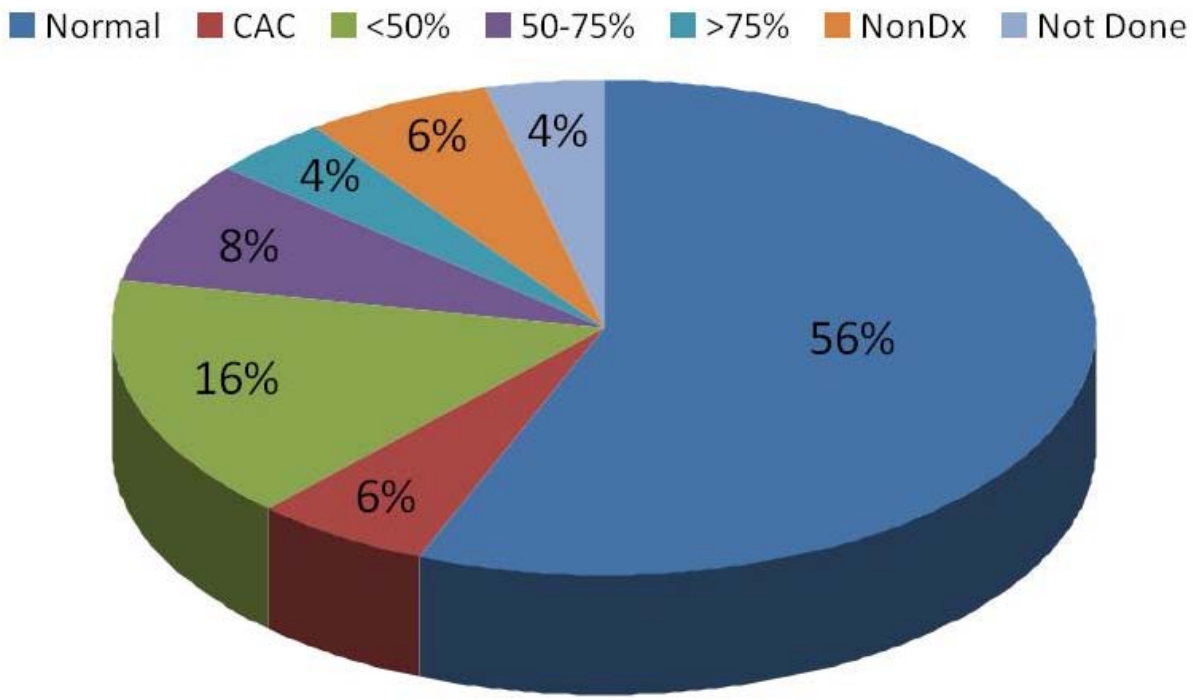

Figure 3-2. Results of CTCA. This pie chart demonstrates the distribution of findings on CTCA with the largest proportion (56%) of patients having a normal exam. Patients with only coronary calcium and without any stenotic lesions are denoted in this chart as CAC. CAC = coronary artery calcium, NonDx = nondiagnostic.

Table 3-1. Baseline Characteristics

	CT Cohort n=50	Control Cohort n=50	p value
Age, yrs (SD)	47.0 (10.7)	41.3 (10.5)	0.009
BMI, kg/m^2 (SD)	31.5 (7.6)	31.6 (11.2)	0.94
Pulse, bpm (SD)	79 (11)	87 (16)	0.007
Creatinine, mg/dL (SD)	0.85 (0.2)	0.9 (0.6)	0.59
Male, n (%)	25 (50)	22 (44)	0.55
Diabetes Mellitus	6 (12)	6 (12)	> 0.99
Current Smoker	14 (28)	18 (36)	0.39
Former Smoker	2 (4)	0 (0)	0.50
Hypertension	20 (40)	19 (38)	0.84
Hyperlipidemia	9 (18)	6 (12)	0.40
Anxiety	11 (22)	11 (22)	> 0.99
Acute Cocaine Use	3 (6)	2 (4)	> 0.99
Days of CP, median*	0.5	0	0.35
Medications on presentation			
Aspirin	9 (18)	4 (8)	0.24
RAS inhibitor	6 (12)	8 (16)	0.56
Beta blocker	9 (18)	2 (4)	0.06
Statin	3 (6)	3 (6)	> 0.99

BMI = body mass index, bpm = beats per minute, CP = chest pain, CT = computed tomography, dL = deciliter, kg = kilogram, mg = milligram, m^2 = meter squared, RAS = renin/angiotensin system, SD = standard deviation, yrs = years

*Median duration of chest pain prior to admission. Chest pain that started on the date of admission was coded as zero days.

Table 3-2. Outcomes

	CT Cohort n=50	Control Cohort n=50	p value
Duration of stay (minutes), median (IQR)	417.5 (359.0-581.0)	400.0 (338.0-471.0)	0.53
Subgroup Analysis			
Arrival between 5p-8a	n=23 453.0 (388.0-678.8)	n=25 432.0 (366.5-546.5)	0.49
Arrival between 8a-5p	n=27 384.0 (323.3-542.0)	n=25 382.0 (334.5-426.5)	0.72
Arrival between 4p-12a	n=12 551.0 (422.0-712.0)	n=21 421.0 (366.5-486.5)	0.07
Arrival between 12a-4p	n=38 393.5 (320.0-545.0)	n=29 393.0 (337.3-452.5)	0.93
Additional ED outcomes			
3rd troponin checked	35 (70%)	47 (94%)	0.003
3rd ECG checked	30 (60%)	47 (94%)	< 0.0001
3 month follow-up outcomes			
Completed noninvasive testing	48 (96%)	18 (36%)	< 0.0001
Any CAD Diagnosed	14 (28%)	1 (2%)	0.0004
Obstructive CAD (>50% stenosis)	6 (12%)	1 (2%)	0.11
Return ED visit	4 (8%)	4 (8%)	> 0.99

CAD = coronary artery disease, CT = computed tomography, ECG = electrocardiogram, ED = emergency department, IQR = interquartile range

Table 3-3. Recidivism Patients

	Age	Gender	DM	HTN	Tobacco	Anxiety
CT Cohort						
Patient #9	60	M	Yes	Yes	No	No
Patient #34	43	F	No	Yes	Yes	No
Patient #44	43	F	No	No	No	No
Patient #45	51	F	No	Yes	No	Yes
Control Cohort						
Patient #19	42	F	No	Yes	Yes	No
Patient #31	58	F	No	Yes	Yes	Yes
Patient #34	56	M	No	Yes	Yes	No
Patient #40	21	F	No	No	Yes	No

CT = computed tomography, DM = diabetes mellitus, F = female, HTN = hypertension, M = male

CHAPTER 4
DISCUSSION AND CONCLUSIONS

Discussion

Testing for CAD using a CTCA based strategy for ED patients with chest pain was more effective than a strategy of outpatient stress testing. As compared to outpatient stress testing, a CTCA based strategy had no significant effect on ED duration of stay and detected a greater number of patients with both nonobstructive and obstructive CAD. No patients in either cohort suffered MI or death and the same number in each cohort returned to the ED for evaluation of chest pain during 3 months of follow-up.

Our investigation has demonstrated that for ED patients with chest pain and without ACS who warrant further testing for CAD, a CTCA based strategy detected both nonobstructive and obstructive CAD in more patients as compared with a strategy of outpatient stress testing. Prior studies have documented this phenomenon in stable outpatients.[19, 20] We recognize that several factors could contribute to these differences including the greater ability of CTCA to diagnose nonobstructive CAD, low follow-up rates in the control cohort, and the nonrandomized design of our investigation.

Because CTCA can detect nonobstructive lesions while ETT, MPI, and stress echocardiography detect myocardial ischemia, greater detection of nonobstructive CAD is an expected finding. A CTCA based strategy, therefore, is an opportunity to provide unique and robust prognostic information. For patients without CAD, the prognostic value of a zero calcium score has been well established and is a valuable tool in reassuring patients about their risk of cardiovascular events.[14, 21] Three patients had nondiagnostic CTCA studies, however their CAC scores were zero and therefore they

could still be reassured of low cardiovascular risk. Patients with nonobstructive CAD can be reassured of a similarly low cardiovascular event risk over the next 12 months.[22] These two groups accounted for 84% of the patients in our CT cohort. When patients are diagnosed with CAD, that knowledge provides physicians an opportunity to intervene and potentially reduce the burden of cardiovascular events. Further study is needed to establish if earlier diagnosis could alter future clinical outcomes.[23] In addition, future studies should address new strategies to effectively communicate low risk results to patients to reduce return visits to the ED for the same complaints.

The increased detection of CAD in the CT cohort is also expected given the low rate of follow-up observed in the control cohort. Failure to follow up has been linked to many factors,[24-26] some of which can be overcome by completing testing prior to ED discharge. Because our investigation is a comparison of patient care strategies, the low follow-up rate reinforces the limitations of delayed outpatient stress testing as a patient care strategy. Because CTCA can be reliably performed on a CT scanner with at least 64 detectors,[27] the strategy we have described could be used at many EDs. Few hospitals have 24 hour, immediate reading of CTCA studies, but we have demonstrated that a strategy of routine CTCA with prompt preliminary reading is safe.

Because our diagnostic strategy was not conducted by randomized assignment, the true prevalence of CAD may not be similar between the cohorts. If we assume, however, that the CT cohort is an accurate reflection of CAD prevalence, the disparity in coronary findings compared to the control cohort is worrisome. Despite the fact that the same population was used to construct the CT and control cohorts, the routine use of CTCA detected obstructive CAD in 12% of patients as compared to 2% detected by

outpatient follow-up testing in the control cohort. This observation suggests that patients with obstructive CAD may go undiagnosed when delayed outpatient stress testing is employed. Prior reports have documented a similar magnitude of missed diagnoses.[28]

The rapid adoption of new CT imaging techniques and the theoretical risks associated with medical radiation has raised appropriate concerns.[29] We share concerns about the potential overuse of diagnostic imaging studies; however, all patients in our study were determined to warrant further CAD testing based on the judgment of the treating physician. Previous work documents that CTCA is more sensitive and specific at detecting CAD than ETT and a direct comparison of these two testing modalities may not be a fair comparison. We have endeavored, however, to compare two strategies: immediate CTCA versus delayed stress testing. While outpatient stress testing is commonly used by EDs, we have demonstrated that this strategy is not only incapable of detecting nonobstructive CAD, but may frequently fail to detect obstructive CAD.

We observed no significant change in duration of stay in the ED. Because many forces affect the duration of stay, our investigation may not have altered clinical care enough to detect a difference. In the CT cohort, ED physicians less frequently ordered three sets of cardiac biomarkers. This suggests that they found the CTCA clinically useful in accelerating decisions about disposition and therefore CTCA has potential to reduce ED duration of stay. Mixed results have been found with prior investigations on how CTCA affects the duration of stay.[16, 30] Because our investigation was conducted using the first 50 patients in the ED evaluated using a CTCA strategy, the test may not have been optimally used by technologists and physicians. The duration of stay in the

CT cohort was nonsignificantly higher than the control cohort, and waiting for a CTCA scan and the results could be causing an increase that this investigation was not powered to detect. We could not account for the time savings garnered by avoiding outpatient stress testing and this could potentially confer benefit in a formal cost-benefit analysis.

Based on 3 months of follow-up data, a CTCA based strategy appears to be safe, given a cardiovascular event rate of 0%. Prior studies on CTCA have described similar event rates with both short and long term follow-up.[31-33] We suspect that the low event rate is likely related to the purposeful selection of patients with low to intermediate pretest likelihood of cardiovascular events. Our analysis was not powered to detect a difference in recidivism, however we observed 4 patients in each cohort return to the ED with chest pain within 3 months. Further study will be necessary to determine if comprehensive evaluation of chest pain with CTCA is reassuring enough to convince patients to not return to the ED with similar chest pain, but instead pursue less costly care for their chest discomfort.

Our study has several limitations. As a retrospective cohort study, our study does not have the benefits of a randomized trial which would have minimized differences between the two patient populations, yet few differences were observed in the baseline characteristics. The difference in pulse may be related to the nearly significant difference in baseline beta blocker use. Age difference may reflect the nonrandom selection of patients with the ED staff ordering tests on older patients they considered to be at higher risk of CAD and could lead to a higher prevalence of CAD in the CT cohort. Our study is limited by the fact that we only reviewed records for our own institution.

Conclusions

For symptomatic ED patients who warrant noninvasive testing for CAD, a strategy of immediate CTCA is superior to delayed outpatient stress testing for detecting CAD. A delayed outpatient stress testing strategy may fail to diagnose obstructive CAD and such a strategy is limited by low follow-up rates. A CTCA based strategy does not significantly affect on the ED duration of stay. Patients with chest pain and no evidence of ACS can safely be discharged with an expectation of low cardiovascular event risk in the ensuing 3 months.

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BIOGRAPHICAL SKETCH

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