

P: In patients undergoing evaluation of chest pain
I; Does the use of coronary CT-A
C: compared to coronary angiography (i.e. "the gold standard")
O: Adequately rule out significant coronary artery disease

Article	Study	Patient Group	Results	Conclusions	Weaknesses
Zhonghua S, et al. Eur Jour of Rad 67 (2008) 78-84 Diagnostic value of 64-slice CT angiography in coronary artery disease: A systematic review	Systematic Review PubMed & Medline search for coronary CTA vs. coronary angiography. 1998-2007 15 articles included for analysis Major Exclusion: non-English articles	15 Aricles n=30-134 64 slice scanners Mean age = 53-67yo Pooled estimate of suspected CAD/known CAD=63%/53%. (Suspected CAD = typical or atypical CP, elevated ST, recommended for cath) Definitions: Signif stenosis > 50% High grade > 75%	96% segments assessable by CTA Primary reasons for unassessable segments: motion artifacts, severe coronary artery calcifications, BMI Patient Based (12): Sens=97%, Spec=88%, PPV=94%, NPV=95% Vessel Based (6): Sens=92%, Spec=92%, PPV=78%, NPV=98% Segment Based (12) Sens=90%, Spec=96%, PPV=75%, NPV=98% Main coronaries (4): LM: 100%, 99%, 90%, 100% LAD: 93%, 93%, 80%, 98% RCA: 93%, 92%, 82%, 97% LCX: 83%, 91%, 79%, 97% No signif difference b/w detecting CAD in prox, middle, and distal segments except in prox & distal RCA.	64 slice CTA has high diagnostic accuracy when compared to conventional angiography. Patient based NPV good enough (95%)?.	High prob pts. Able to extrapolate to low prob ED obs pt? What do you do w/non critical stenosis (1-49%) not addressed. Req cath?
Mowatt G, et al. Heart. Jul 2008 doi:10.1136/heart.2008.145292. (online publication) 64-slice computed tomography angiography in the diagnosis and assessment of coronary artery disease: systematic review and meta-analysis	Systematic Review Multiple database search for articles comparing coronary CTA vs conventional angiography (articles 2002 and beyond) Major Exclusion: Non-English articles	40 non-randomized studies comparing 64 slice CT w/coronary angiography. 21 full text studies, 19 abstracts. Pt's underwent both CTA and angio Total n > 2400 67% male mean age = 54-69 Study pops incl suspected CAD, known CAD, or both. Also incl pts w/prev PCI or CABG & suspected ACS.	Patient Based (18): Sens=99%, Spec=89%, PPV=93%, NPV=100% Segment Based: 90%, 97%, 76%, 99% Vessel Based (17): 90%, 97%, 76%, 99% Main coronaries: Median NPV for all arteries ≥98%. Highest NPV,PPV in LM Inadequate scans: 2% of pts, 8% of segments	64 slice CT is highly sensitive in detection of significant CAD (≥50% stenosis). Very good pt based NPV. Est Rad Dose CTA: 7.5-21.4 mSv CA: 4-8 mSv CXR: 0.1-0.5 mSv Chest CT: 8 mSv A/P CT: 10 mSv Background rad: 3 mSv/year	"Suspected CAD" undefined, but likely similar to definition above. Not all included studies were blinded Some studies did not include data from unassessable scans in analysis Patient population studied are likely higher prob than our ED obs pts.
Stein P.D. et al. The Am Jour of Med (2008) 121, 715-725 64-Slice CT for Diagnosis of Coronary Artery Disease: A Systematic Review	Systematic Review Medline, OldMedLine, Ovid, Cochrane search for CTA vs angio Searched all languages	45 studies: -29: natural coronary arteries -8: stented arteries -8: bypass grafts -Reference Test: Coronary angio (43 studies) or intravascular US (2 studies) Ave prevalence of CAD=61% Other study pop characteristics not stated.	Patient Based (23): For signif stenosis ≥ 50%: Sens=98%, Spec=88%, PPV=93%, NPV=96%. For high grade stenosis ≥70%: Sens=91%, Spec=88% Segment based (21) 90%, 96%, 73%, 99% Prev=12% Main Coronaries (13): LM: 100%, 99%, 91%, 100% LAD: 93%, 95%, 84%, 98% LCX: 88%, 95%, 76%, 98% RCA: 90%, 96%, 83%, 98%	A neg 64 slice CTA can reliably exclude significant CAD. Pt based NPV good enough (96%)? A pos CTA may require further testing because of relatively high false positive rate	Same weaknesses as above. Unevaluable/ technically inadequate segments excluded from calc of sens & spec. "Suspected of having CAD" undefined. Characteristics of study subjects not stated.

<p>Herzog, C. et al. Rad Jul 2007 (244): 1 Significant Coronary Artery Stenosis: Comparison on Per-Patient and Per-Vessel or Per-Segment Basis at 64-Section CT Angiography</p>	<p>Blinded, Prospective, Observational Cohort</p> <p>Pts scheduled to undergo conventional coronary angiography b/w Oct 2004 – Jul 2005 for eval of CP at USC.</p> <p>Pts received a 64 slice CTA followed by conventional angio.w/in 24 hrs.</p> <p>2 experienced Cardiovasc Radiologists reviewed CTA's (blinded to pt's clin data)</p> <p>3 experienced Cardiologists interpreted coronary angiograms (blinded to results of CTA).</p>	<p>N=55 pts, 165 vessels, 825 segments</p> <p>Inclusion: - Symptomatic CP - Low pretest prob of CAD (=atypical clin presentation, nondiagnostic EKG, neg Trop-T, inconclusive risk fx profile (ie. HTN, DM, hypercholesterolemia, nicotine use, Fam Hx)</p> <p>Exclusion: - Unstable Sxs, vital signs, or EKG findings - Prev CABG or stent - Cr > 2.0 - Potential pregnancy - Allergy to iodinated contrast</p> <p>Mean age = 67yo</p>	<p>Assessable vessels = 92.4% -Reasons for poor visualization:: small vessel size (i.e. <1.5mm)(54%), motion artifacts (30%), misregistration (16%) -non visualized vessels were considered negative in the analysis (unlike prev studies that throw out the data).</p> <p>Per Patient Basis: ≥50% stenosis: Sens=100%, Spec=83%, PPV=76%, NPV=100% ≥70% stenosis: 100%, 92.9%, 81.2%, 100%</p> <p>Per vessel: ≥50% stenosis: 88.8%, 91.5%, 74.4%, 96.7% ≥70% stenosis: 80.9%, 96.5%, 77.2%, 97.2%</p> <p>Per segment: ≥50% stenosis: 81.9%, 97.1%, 69.4%, 98.5% ≥70% stenosis: 68.6%, 97.6%, 72.7%, 98.6%</p> <p>Accuracy of grading stenosis: -56% incorrectly graded -38.8% underestimated -17.2% overestimated -9 stenosis of ≥50% missed (2 motion artifact, 7 small vessel size)</p>	<p>64 Slice coronary CTA can reliably exclude significant coronary artery stenosis in atypical CP (High NPV), but + results likely need further eval (poor accuracy).</p>	<p>Still higher pre-test prob pt than "typical" ED obs pt. Incidence of true disease=34%, increasing sensitivity.</p> <p>Portion of research grants provided by Siemens Medical Solutions (manufacturer of 64 slice CT scanner)</p>
<p>Hoffman, U. et al. Circulation 2006 (114); 2251-2260. Coronary Multidetector Computed Tomography in the Assessment of Patients w/Acute Chest Pain.</p>	<p>Blinded, Prospective Observational Cohort</p> <p>Pts presenting to Mass General ED w/CP being admitted for ACS r/o.</p> <p>Pts received a MDCT prior to admission.</p> <p>Admitted pts got serial EKGs and enzymes, and subsequent cardiac testing (exercise stress, stress perf imaging, or cath as deemed clinically indicated).</p> <p>All MDs involved in standard clin care were blinded to results of MDCT</p> <p>Outcomes: 1) ACS during index hospitalization (acute MI or UA as defined by AHA guidelines) 2) Major CV adverse events at ~5mo f/u. (recurrent ischemic CP resulting in MI, coronary revasc, or cardiac death). 3) Compare the CTA findings b/w ACS non-ACS groups.</p>	<p>N=103 Major Inclusion: - > 5min of CP w/in prev 24 hrs - No or nondiagnostic EKG changes - Nml initial cardiac enzymes - Sinus rhythm - Admitted for MI r/o - Ability to perform a breathhold of 10-15s</p> <p>Exclusion: - HD or clinical instability (SBP<80, clinically signif a/v arrhythmia, persistent CP despite therapy) - Perceived interference w/standard of cared</p> <p>Clin Characteristics of Pts . All, ACS, Non-ACS Age: 54±12, 59.8±16.4, 52.8±11.2 Male(%): 60, 86, 55 BMI: 29.9±8.6, 29.31±3.68, 0.02±9.13 DM(%): 12.6, 28.6, 10.9 HTN(%): 46.6, 71.4, 43.5 Hi Chol(%): 56.3, 64.3, 54.3 H/O CAD(%): 9.7, 28.6, 6.7 Smoker (%): 45.6, 71.4, 42.4</p> <p>Clin PreTest Prob (ED MDs): - Low: n=68 (66%) - Mod: n=26 (25%) - High: n= 9 (9%)</p>	<p>14 ACS (5 MI, 9 UA) - demonstrated through angio, +enzymes, or stress test</p> <p>89 ACS r/o - serial trop's, EKG neg, & exer stress (3), stress perf imaging (57), dob stress echo (5), cath (3)</p> <p>8 Caths total: - 5 MI - CTA correctly detected signif stenosis in all 5 MIs - CTA correctly r/o'd signif stenosis in other 3 caths</p> <p>Signif Coronary Artery Stenosis (>50%) by CTA: - 73 pts (71%), none had ACS: NPV=100% - 13 pts signif stenosis detected, 8 had ACS. - 17 pts signif stenosis could not be excluded (prev stent (7), severe calcification (8), poor signal to noise ratio (1), tachy (1)). 6 had ACS → spec=82%, PPV=47% - excluding pts w/prev stent, PPV=61%</p> <p>CTA findings: Coronary Atherosclerotic Plaque - 41 pts (40%) no plaques, no ACS: NPV 100% - 62 pts (60%), plaque detected: including all 14 w/ACS: PPV=23% -mean # of segments w/plaques: ACS=9.1±4.5, Non ACS=4.5±3.2. P<0.001</p> <p>F/u: 81/89 (91%) - 5.2 ± 0.3 months - No major CV adverse event</p> <p>ACS event rate & prevalence of any plaques -Low: 9%, 53% -Mod: 19%, 69% -High: 33%, 89%</p> <p>Ave increase in odds of having ACS for every segment w/plaque -Traditional risk factors = 1.58 -Categorized clinical estimates = 1.49</p>	<p>In pts who present w/CP to ED w/init w/u inconclusive, absence of coronary artery plaque or significant stenosis on CTA has excellent NPV.</p> <p>In pts where CAD detected on CTA, extent of plaque could potentially be used to improve risk stratification</p> <p>Pt's w/stents often unable to r/o significant stenosis.</p> <p>Ave prep/procedure & interpret time=12±1 min & 10±8 min</p> <p>97% tolerated procedure well (nausea, claustrophobia, extravasation of contrast, n=1 each)</p> <p>Estimated radiation exposure CTA: 6-11 mSv Stress perf imaging: 8-10 mSv</p>	<p>Small number of actual ACS events</p>

Clinical Bottom Line

The one liner: Coronary CTA's that show no significant stenosis or are plaque free have very good NPV, and would be very useful in ruling out ACS in ED patients w/CP, but data suggests positive results are much less reliable.

Multiple studies including systematic reviews have shown that coronary CTA performs very well compared to conventional coronary angiography, particularly in ruling out significant coronary artery stenosis, with NPV ranging between 95-100% on patient based studies. Although most studies concluded that CTA was adequate in ruling out significant CAD, I question whether a 5% false negative rate is low enough in a life threatening disease process that our EM culture is already hypervigilant (and perhaps borderline paranoid) over.

Although, some studies evaluate both low risk and high risk patients, most studies use a patient population that is at higher risk for cardiac events than probably our "typical" chest pain obs patient. So are we able to extrapolate this data to our patient population? Based on statistical principles, if we were to assume that the prevalence of disease is lower in our population than those groups studied, it should theoretically strengthen our NPV, so I don't see this as a downside. Keeping in mind, however, that the studies actually investigating the low risk patient are small.

On the flip side, what do you do with a positive study? False positive rates range b/w 6-24%, and some studies suggest that up to half of the stenoses are incorrectly graded. Does any plaque seen mean the patient needs to go on to cath to confirm it? If not, what is our cut off? Are we going to be sending many more people for unnecessary catherizations, which itself is not a benign procedure, and further subjects patients to more radation.

In terms of radiation exposure, coronary CTA's seem to be about equal to regular chest CTs. Although we are fairly liberal with our use of CT's, it's not a negligible amount of radiation. Is the radiation risk too high for very low risk patients (e.g. some of our CP obs patients)?