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Coronary CTA: Faster and Safer

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Case 1

- 74 year old man
- One week of vague chest discomfort, worse in past 2 days
- History of glaucoma
- In ER, hemodynamically stable
- Soft systolic ejection murmur

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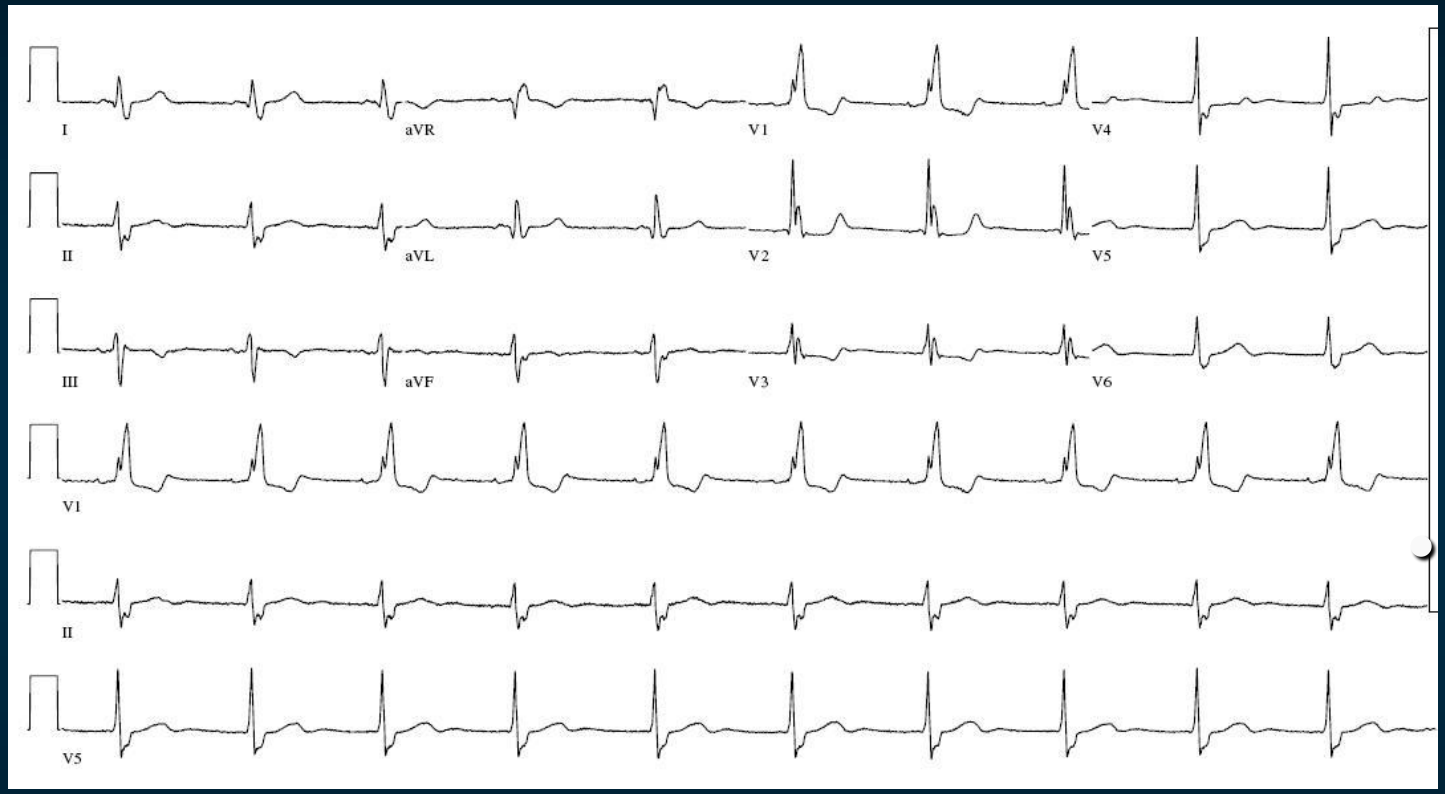
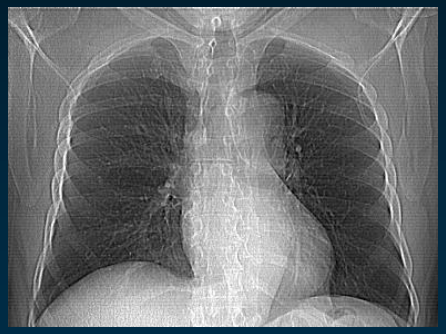
Case 1





Labs:

- Tn 0.08
- MB 2.4

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Case 2

- 59 year old woman with 2 days of intermittent chest discomfort
- In ER hemodynamically stable
- Exam unremarkable

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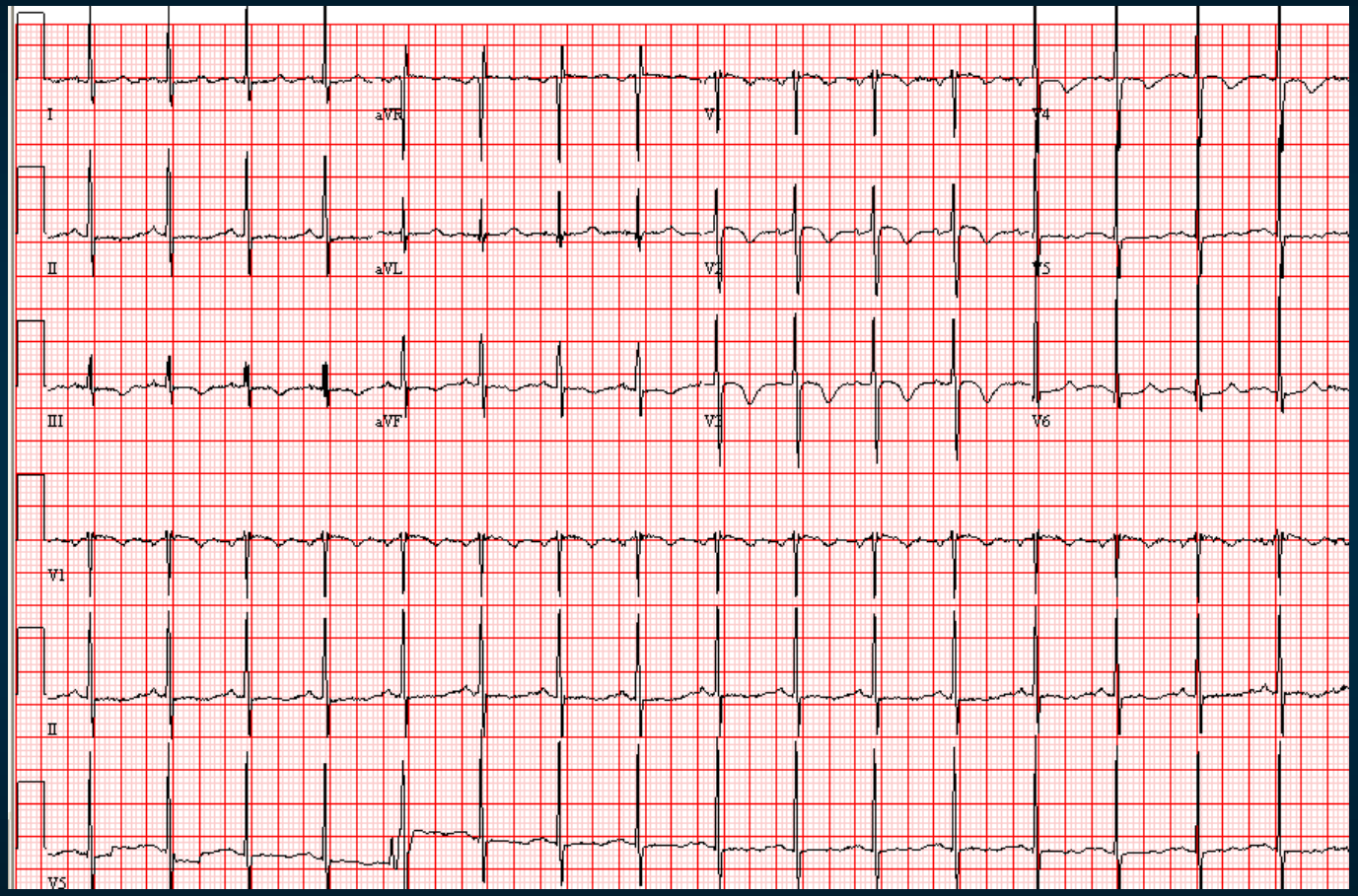
Case 2 ECG & Chest x-ray



- Labs:
  - Tn 0.45
  - MB 3.5

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Case 3

- 26 year old man with no past medical history
- 12 hr. of chest discomfort
- Presents to local ER
- No acute distress; stable
- Exam unremarkable

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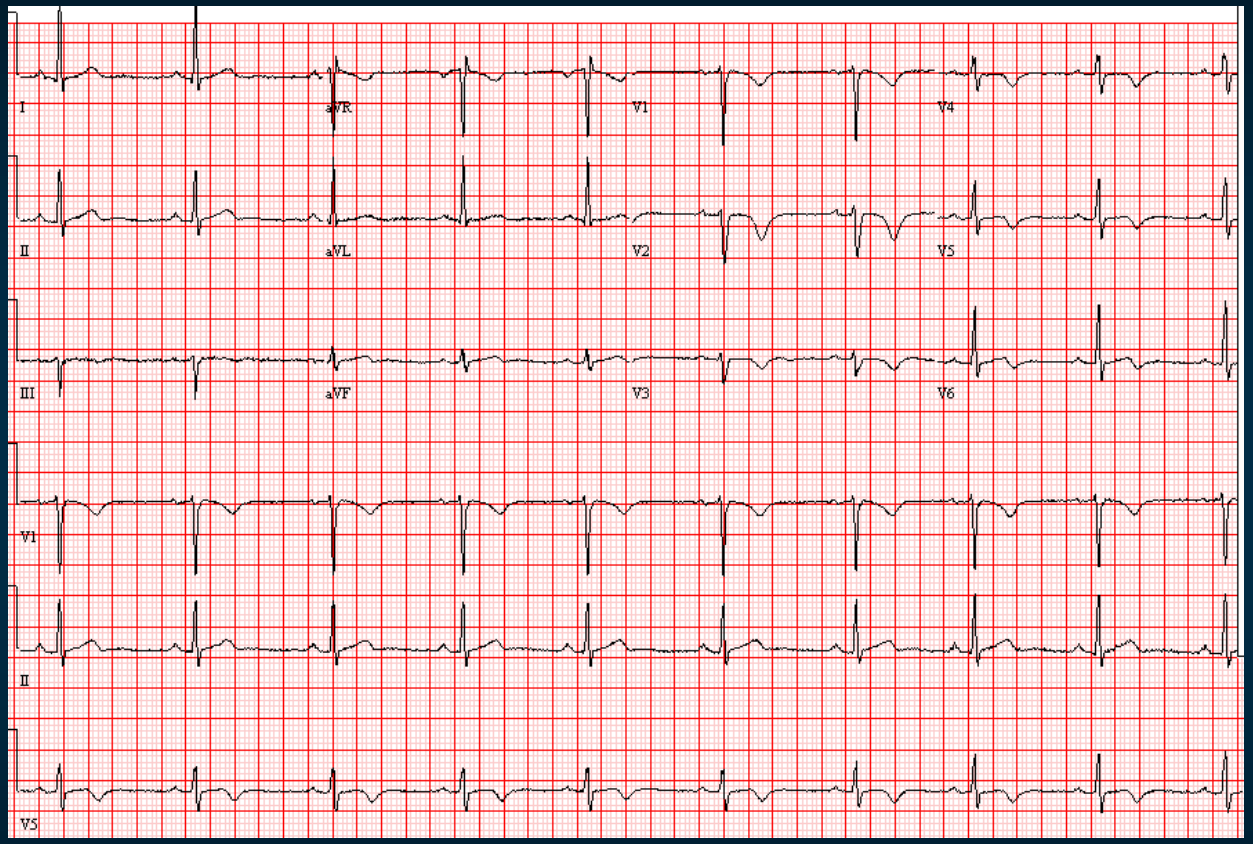
Case 3 ECG & Chest x-ray



- Labs:
  - Tn 1.02
  - MB 2.9

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Chest Pain: Common Reason for ED Visit

- 7,169,000 visits in US in 2009
  - CDC Nat'l Hospital Ambulatory Medical Care Survey
- Only 15-25% actually have ACS
  - Lindsell CJ et al. The Internet Tracking Registry of Acute Coronary Syndromes. Ann Emerg Med 2006; 48: 666-669
- Between 0.5% and 4% of ACS are missed and mistakenly discharged from ED

Risk Stratification

- Risk scores
  - TIMI, GRACE, PURSUIT, HEART
- Exercise ECG / ECG stress test
- Stress imaging
  - SPECT
  - Echo
- Coronary imaging
  - Cardiac CT

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		n	Sens.	Spec.	Not evaluable
64 SLICE CT					
Herzog	Radiology 2007	50	89%	92%	--
Mühlenbruch	Eur Radiol 2007	51	87%	95%	--
Shabestari	Am J Cardiol 2007	143	94%	97%	2%
Cademartiri	Radiol Med 2007	72	100%	99%	--
Hausleiter	Eur Heart J 207	114	100%	92%	8%
Sheth	Am Heart J 2008	80	90%	96%	3%
Bayrak	Acta Cardiol 2008	100	91%	97%	--
Brodoefel	Eur J Radiol 2008	102	91%	99%	11%
Meijboom	JACC 2008	245	88%	94%	--
DUAL SOURCE CT					
Weustink	JACC 2007	100	95%	95%	--
Johnson	Invest Radiol 2007	35	88%	98%	2%
Leber	Eur Heart J 2007	90	90%	98%	--
Scheffel	Eur Radiol 2006	30	96%	98%	--
Ropers	JACC 2007	100	90%	98%	4%
Achenbach	iJACC 2008	50	97%	97%	2%
Brodoefel	Radiology 2008	100	91%	92%	10%
Alkadhi	Eur Heart J 2008	150	97%	95%	2%
Xu	Int J Card Imag 2010	84	97%	98%	--
320 ROW CT					
Dewey	Circulation 2009	30	89%	96%	--
De Graaf	Eur Heart J 2009	64	87%	97%	1%

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Coronary Computed Tomographic Angiography for Systematic Triage of Acute Chest Pain Patients to Treatment (The CT-STAT Trial)

James A. Goldstein, M.D., F.A.C.C., Kavitha M. Chinnaiyan, M.D., F.A.C.C., Aiden Abidov, M.D., Ph.D., F.A.C.C., Stephan Achenbach, M.D., F.A.C.C., Daniel S. Berman, M.D., F.A.C.C., Sean W. Hayes, M.D., Udo Hoffmann, M.D., John R. Lesser, F.A.C.C., M.D., Issam A. Mikati, M.D., F.A.C.C., Brian O'Neil, M.D., Leslee J. Shaw, Ph.D., F.A.C.C., Michael Y.H. Shen, F.A.C.C., M.D., Uma S. Valeti, M.B.B.S., F.A.C.C., and Gilbert L. Raff, M.D., F.A.C.C., for the CT-STAT Investigators

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Inclusion & Exclusion Criteria

- Acute chest pain onset within 12 hrs
- Normal or non-diagnostic EKG for ischemia
- TIMI risk score ≤ 4

- Known prior CAD
- Elevated cardiac biomarkers
- ST-elevation or depression ≥ 1 mm in 2 contiguous leads or ≥ 2 mm T inversion
- Known ejection fraction < 45%

J Am Coll Cardiol 2011;58:1414-1422

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Clinical Events

Table 2 Early and Late Clinical Events

Event	CCTA Group (n = 361)	MPI Group (n = 338)	p Value
Early (index visit)			
Index visit ICA	24 (6.7%)	21 (6.2%)	0.80
Index visit PCI	9 (2.5%)	8 (2.4%)	0.90
Index visit CABG	4 (1.1%)	0 (0%)	0.12
MI	1 (0.3%)	5 (1.5%)	0.11
Other unstable angina	3 (0.8%)	3 (0.9%)	1.00
Death	0 (0%)	0 (0%)	NA
Radiation, median, mSv	11.5 (6.8–16.8)	12.8 (11.6–13.9)	0.02
Scanner availability, h	7.1 ± 2.3	8.4 ± 3.2	0.065
Late (6-month follow-up)	n = 330	n = 297	
Late ICA	2 (0.6%)	1 (0.3%)	1.00
Late PCI	1 (0.3%)	0	1.00
Late CABG	0	0	NA
Late other unstable angina	0	0	NA
Late MI	0	0	NA
Late death	0/361	0/337	NA
Repeat ED (cardiac)	2 (0.6%)	4 (1.3%)	0.43
Repeat hospitalization (cardiac)	0	0	NA
Cumulative events			
ICA	26 (8.0%)	22 (7.4%)	0.78
PCI	10 (3.1%)	8 (2.7%)	0.78
CABG	4 (1.2%)	0 (0%)	0.13
MI	1 (0.3%)	5 (1.7%)	0.11
Additional unstable angina	3 (0.9%)	3 (1.0%)	1.00
All events	17 (5.2%)	12 (3.7%)	0.36

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Study Outcomes

Table 3 **Study Outcomes: Efficiency, Cost, and Safety**

Outcomes	CCTA Group (n = 361)	MPI Group (n = 338)	p Value
Time to diagnosis, h	2.9 (2.1–4.0)	6.2 (4.2–19.0)	<0.0001
Total ED costs, $	2,137 (1,660–3,077)	3,458 (2,900–4,297)	<0.0001
MACE events in patients with normal index test	2/268 (0.8%)	1/266 (0.4%)	0.29

Values are median (25th–75th percentiles) or n/N (%).

MACE = major adverse cardiac events; other abbreviations as in Tables 1 and 2.

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ACC.12

ACC-i2 with TCT

ACRIN PA 4005: Multicenter Randomized Controlled Study of a Rapid 'Rule-out' Strategy Using CT Coronary Angiogram Versus Traditional Care for Low-Risk ED Patients with Potential ACS

Harold Litt MD-PhD
University of Pennsylvania
Philadelphia, PA

ACRIN-PA

- Eligibility criteria
  - Signs/symptoms of potential ACS
  - TIMI score 0-2, no acute ischemia on ECG
- Exclusion criteria
  - Clearly non-cardiac pain
  - Contraindications to CCTA
- Testing
  - Cardiac CT (Coronary CTA)
  - Stress Testing ± Imaging per local protocol

GO FOR ACC.12 CHICAGO
ACC.12
ACC-i2 with TCT

Results - Safety

- No 30-day MACE in 640 pts with neg CTA
  - 0% event rate, 95% CI 0–0.57%

Outcome	Coronary CTA (N=908)	Traditional Care (N=462)	% Difference ** (95% CI)
Cardiovascular Events			
Death	0	0	0
AMI *	10 (1%)	5 (1%)	0.02% (-5.6, 5.7)
Composite Death & AMI	10 (1%)	5 (1%)	0.02% (-5.6, 5.7)
Revascularization	24/893 (2.7%)	6/457 (1.3%)	1.4% (-4.3, 7.0)

GO FOR ACC.12 CHICAGO
ACC.12
ACC-i2 with TCT

Results – Efficiency

- CCTA more often discharged from ED
  - 50% vs. 23% (95% CI 21.4-33.2)
- LOS shorter
  - Overall CCTA vs. trad care: 18 vs. 25 hrs*
  - Negative testing: 12 vs. 25 hrs*
- More CCTA pts diagnosed with CAD
  - 9.0 vs. 3.5% (95% CI 0-11.2)

GO FOR ACC.12 CHICAGO
ACC.12
ACC-i2 with TCT

Results – Resource Utilization

- No significant differences in 30-day resource utilization (CCTA vs. trad care)

Use of Resources	CCTA-based (%)	Traditional Care (%)	95% CI for Difference
Catheterization	5.1	4.2	-4.8 to 6.6
Revascularization	2.7	1.3	-4.3 to 7.0
Repeat ED visit	8.0	7.5	-5.2 to 6.2
Re-hospitalization	3.1	2.4	-4.9 to 6.4
Cardiologist visit	7.1	3.8	-2.4 to 9.0

GO FOR ACC.12 CHICAGO
ACC.12
ACC-i2 with TCT

ROMICAT II - Rule Out Myocardial Ischemia/Infarction Using Computer Assisted Tomography

NHLBI U01HL092040

A Multicenter Randomized Comparative Effectiveness Trial of Cardiac CTA vs. Standard Evaluation in Acute Chest Pain Patients in the Emergency Department

Udo Hoffmann, Quynh A. Truong, Hang Lee, Eric Chou, Pamela K. Woodard, John T. Nagurney, James H. Pope, Thomas Hauser, Charles White, Scott Weiner, Alexander Goehler, Pearl Zakroysky, Ruth Kirby, Douglas Hayden, Stephen D. Wiviott, Jerome Fleg, G. Scott Gazelle, David Schoenfeld, James E. Udelson
for the ROMICAT II Investigators

ROMICAT II

Primary Endpoint - Length of Hospital Stay

ROMICAT II

Mean LOS ± SD (hrs)	CCTA	Standard ED Eval	p-value
All	23.2 ± 37.0	30.8 ± 28.0	0.0002
Final Dx not ACS	17.2 ±24.6	27.2 ± 19.5	<0.0001
Final Dx ACS	86.3 ±72.2	83.8 ±61.3	0.87

Secondary Endpoints - Safety

ROMICAT II

	CCTA N=501	Standard ED Eval N=499	p-value
Safety Missed ACS (n, %)	0 (0)	0 (0)	-
Follow-up at 28 days MACE (n, %)	2 (0.4)	5 (1.0)	0.37
Time to Diagnosis in hours (mean ± SD)	**10.4 ± 12.6**	**18.7 ± 11.8**	**0.0001**

Costs of Care

ROMICAT II

Costs*	CCTA mean ± SD	Standard ED Eval mean ± SD	% Diff	p-value
ED#	2,053 ± 1,076	2,532 ± 1,346	-19%	<0.0001
Hospital	1950 ± 6,817	1,297 ± 5,316	+50%	0.17
Total	4,004 ± 6,907	3,828 ± 5,289	+5%	0.72

* cost per patient (dollars) in a subset of 650 patients from 5 centers
# includes observation unit

Cardiac CT in the ER is Appropriate

Acute Symptoms With Suspicion of ACS (Urgent Presentation)			
• Definite MI	I (1)		
• Persistent ECG ST-segment elevation following exclusion of MI	U (6)		
• Acute chest pain of uncertain cause (differential diagnosis includes pulmonary embolism, aortic dissection, and ACS ["triple rule out"])	U (6)		
Pretest Probability of CAD	**Low**	**Intermediate**	**High**
• Normal ECG and cardiac biomarkers	A (7)	A (7)	U (4)
• ECG uninterpretable	A (7)	A (7)	U (4)
• Nondiagnostic ECG OR • Equivocal cardiac biomarkers	A (7)	A (7)	U (4)

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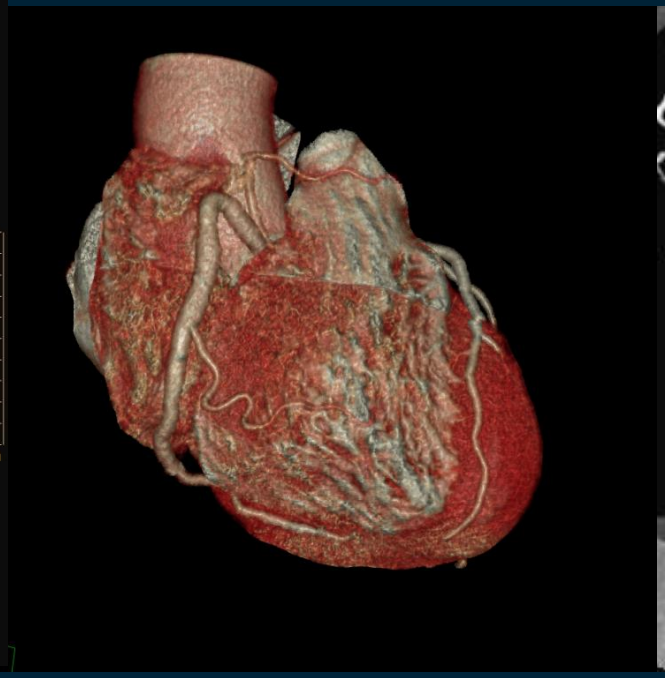
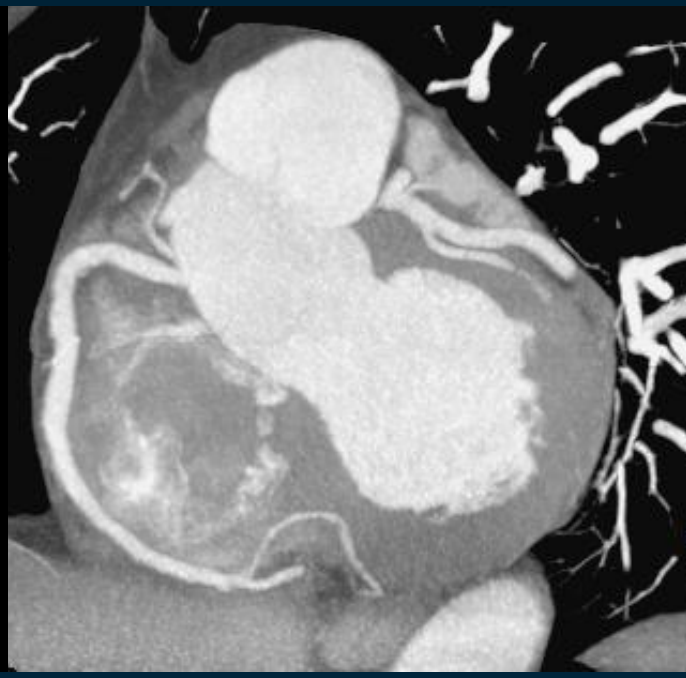
Case 1

74 yr old man, chest pain worse in last 2 days, Tn 0.08

Right Coronary Artery





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Case 1 Left Anterior Descending

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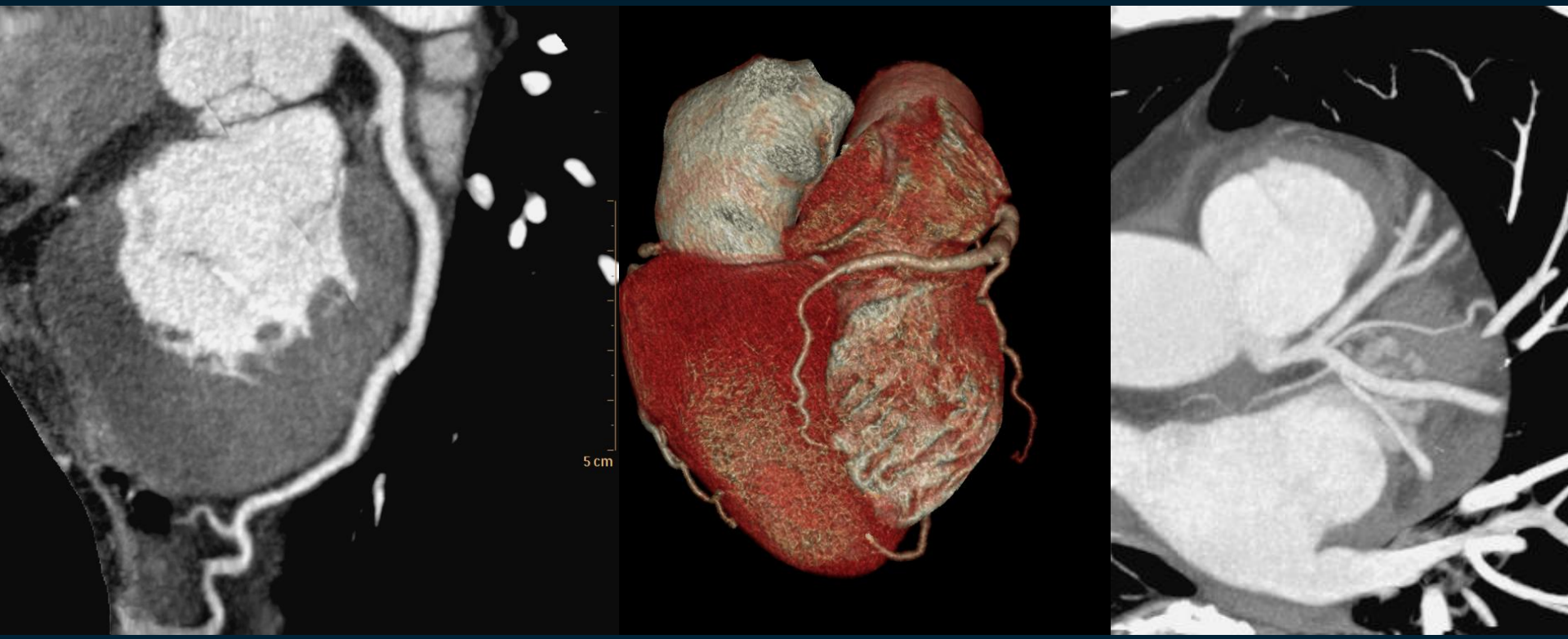
Case 1 Circumflex



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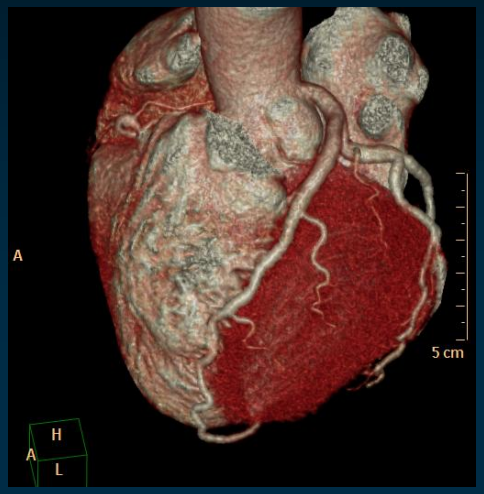
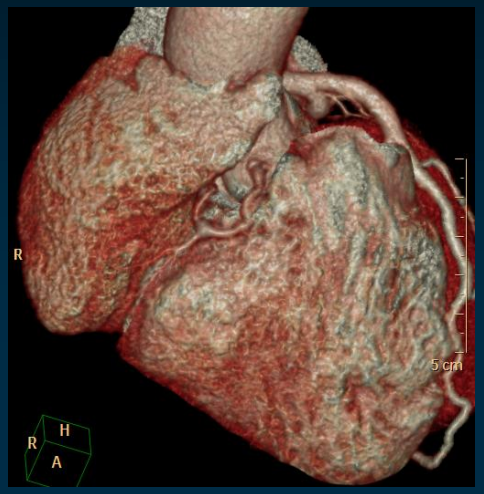
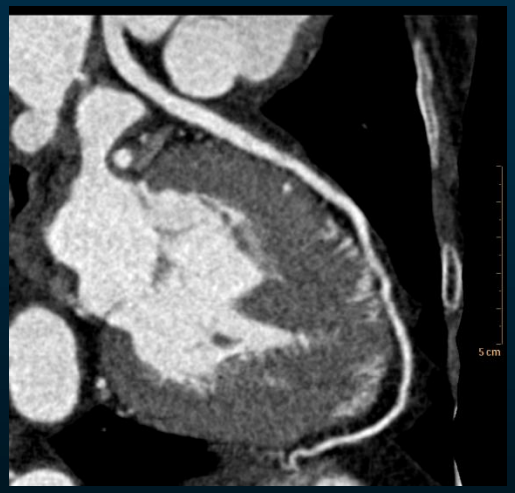
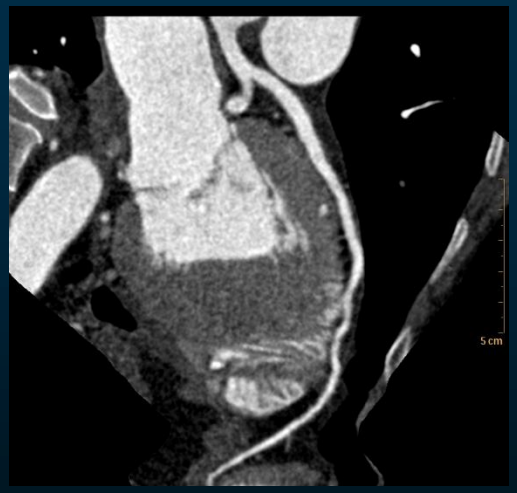
Case 2

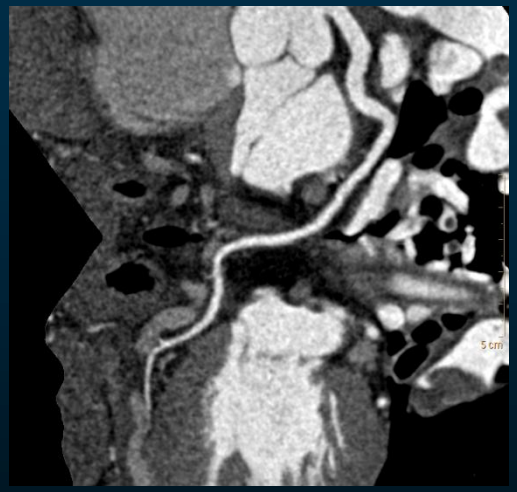
59 yo woman, 2 d of chest pain, TWI, Tn 0.45











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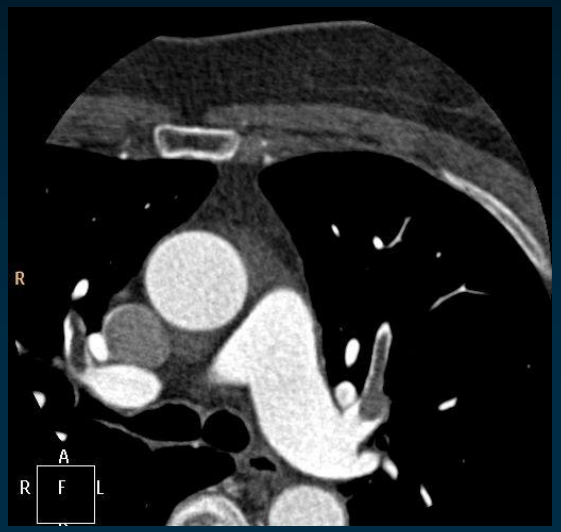
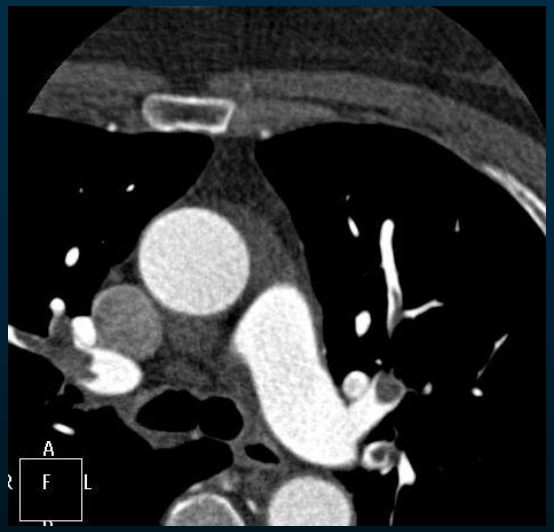
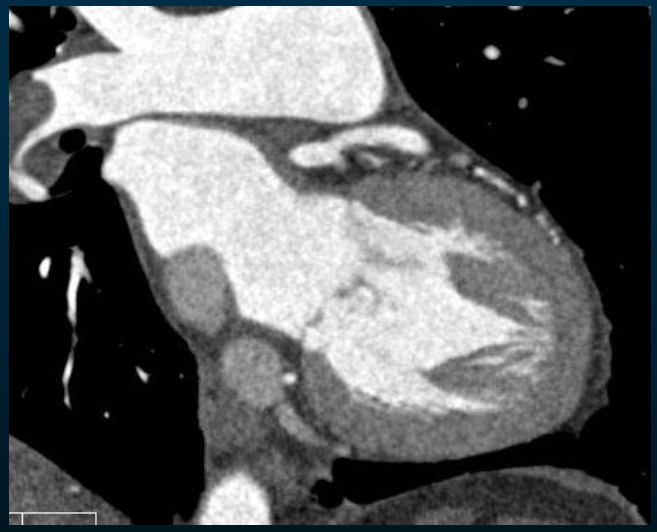
Case 2







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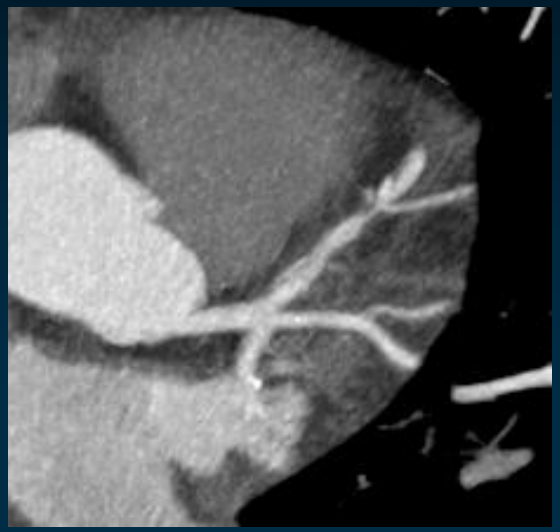
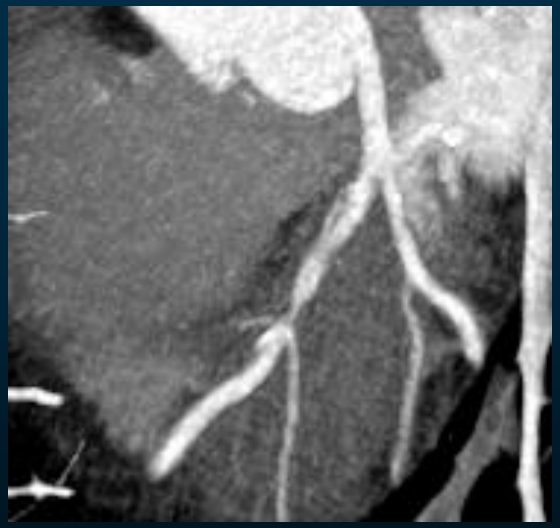
Case 3 Coronary CT Angiogram

26 yr old man, 12 hr ch pain, TWI, Tn 1.02





Moderate amount of plaque

Stenosis, proximal LAD

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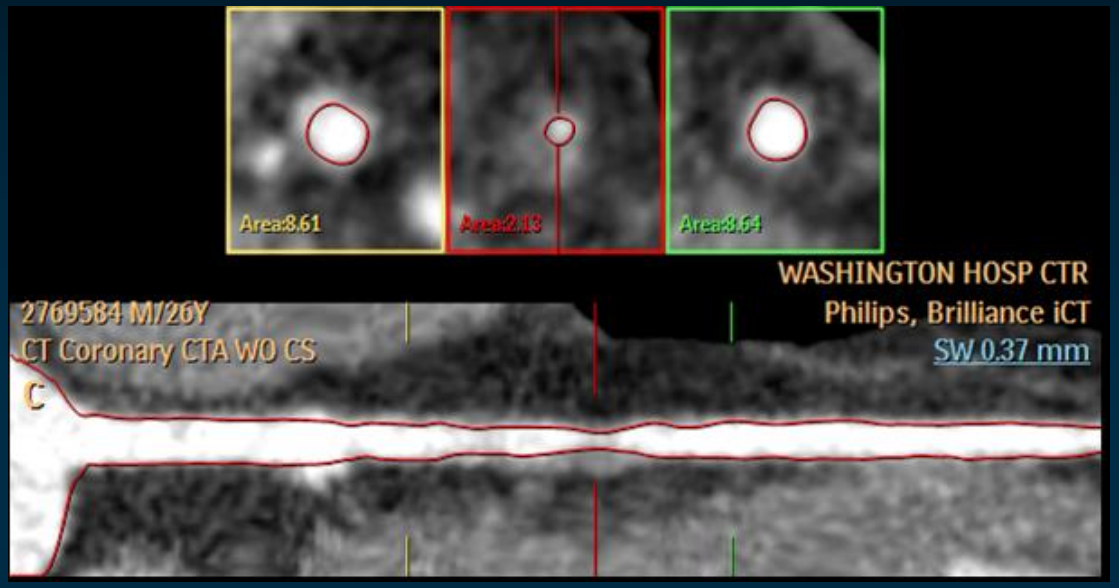
Case 3 Stenosis Quantification



	Measurements - LAD		
	Reference	Lesion	Difference
Area	8.6 mm²	2.1 mm²	76 %
Current Diam.	3.1 mm	1.4 mm	55 %
Effective Diam.	3.3 mm	1.6 mm	52 %
Minimum Diam.		1.4 mm	58 %

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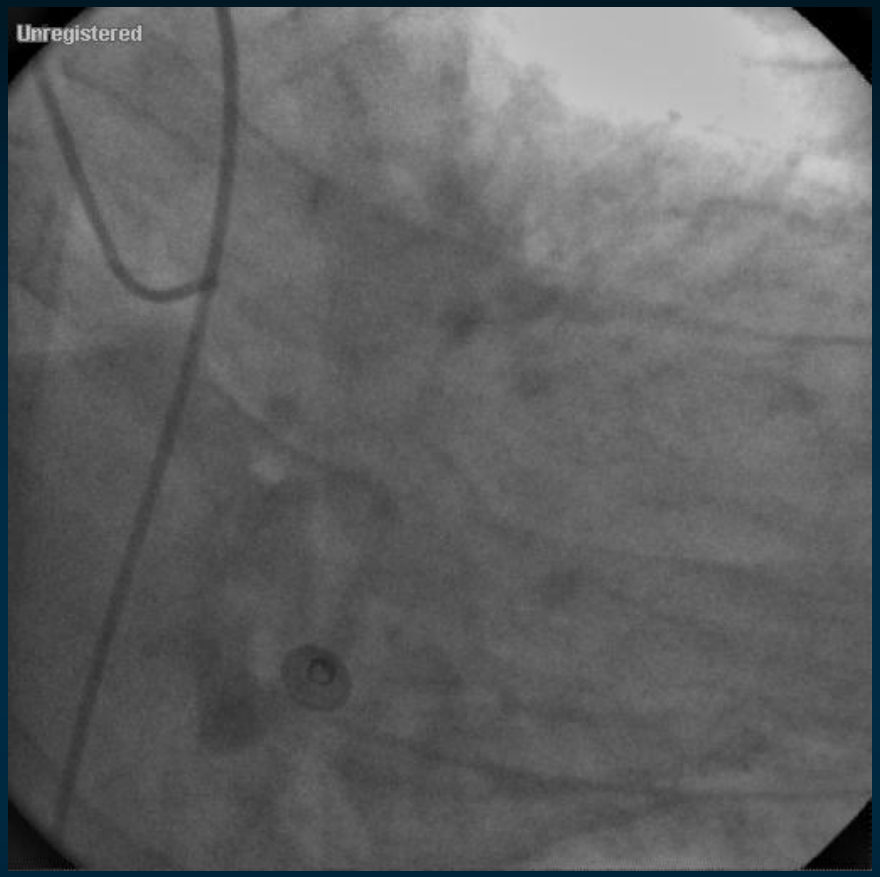
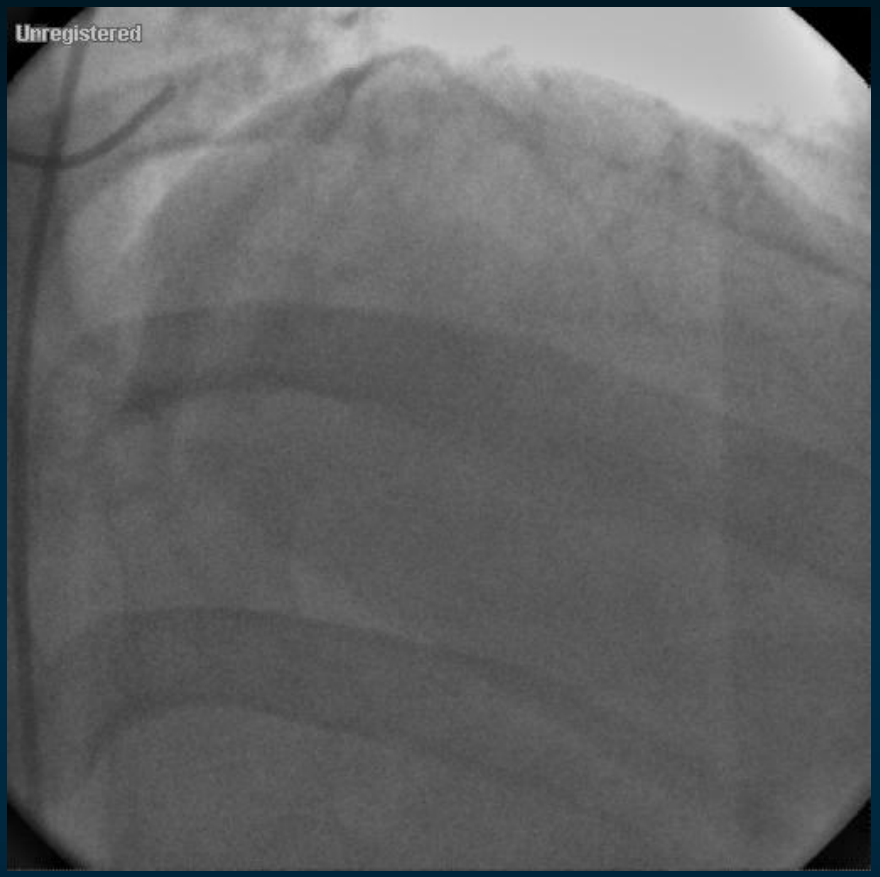
Case 3





- Subsequent labs: Tn 1.02 to 0.46 to 0.51 to 0.47
- MB 2.9 to 1.5 to 1.9 to 1.5
- Triglycerides: 1000 mg/dL

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Conclusions

- Coronary CTA is fastest way to reliably and non-invasively exclude significant CAD
- Since most acute chest pain patients do not have significant CAD, coronary CTA can safely trigger rapid discharge from ED
- Rapid triage of these patients reduces costs and increases efficiency
- CT can detect other, non-coronary and non-cardiovascular causes of acute chest pain
- CT can detect ***early*** atherosclerosis that physiologic testing will miss
- Coronary CTA should be the first line test for this clinical scenario