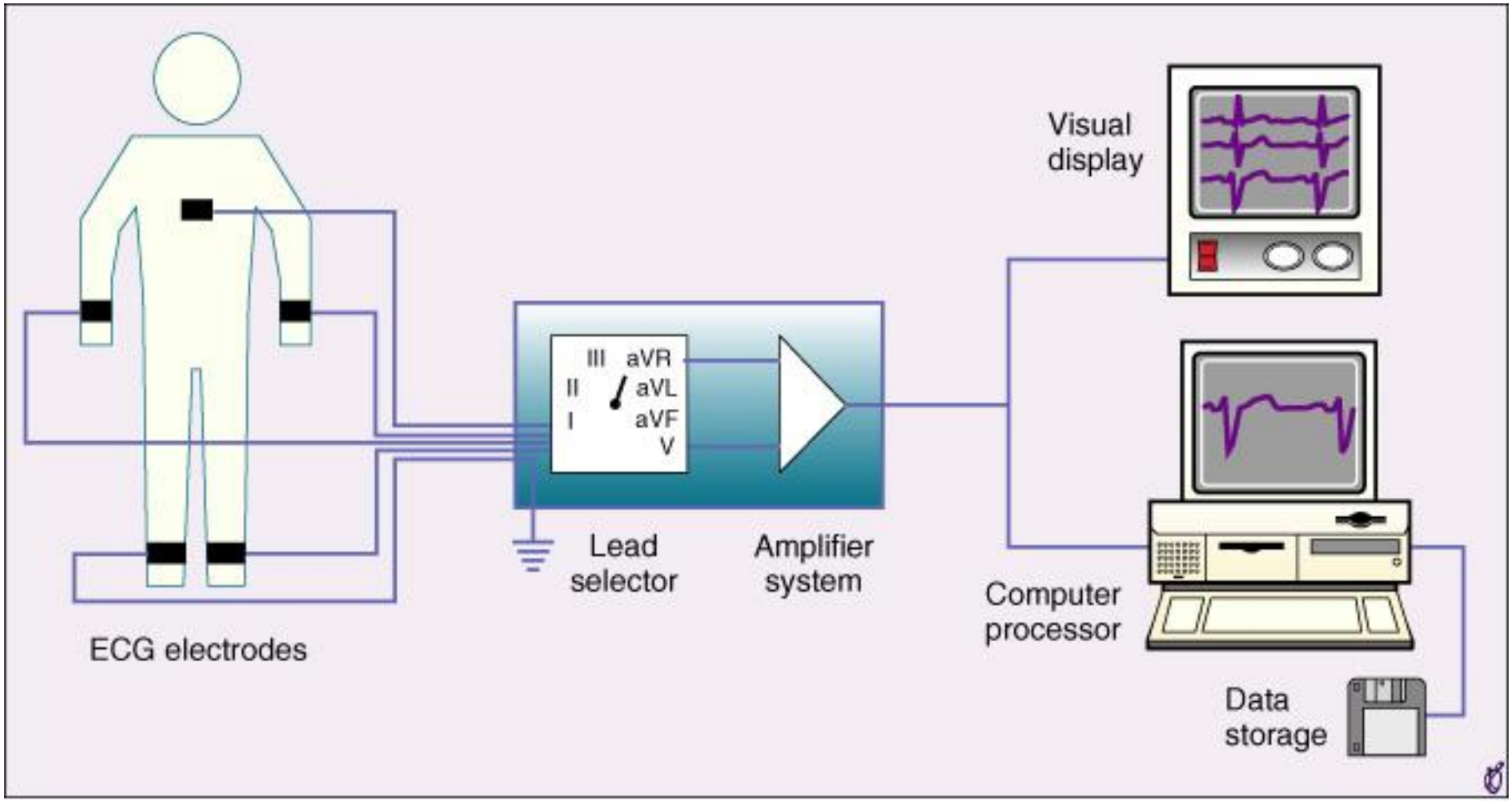
- ECG
- Bayes Theorem
- ETT Bicycle or treadmill?
- Coronary Artery Disease
- New Risk Factors
  - Coronary calcium scores
- Echo

- ECG



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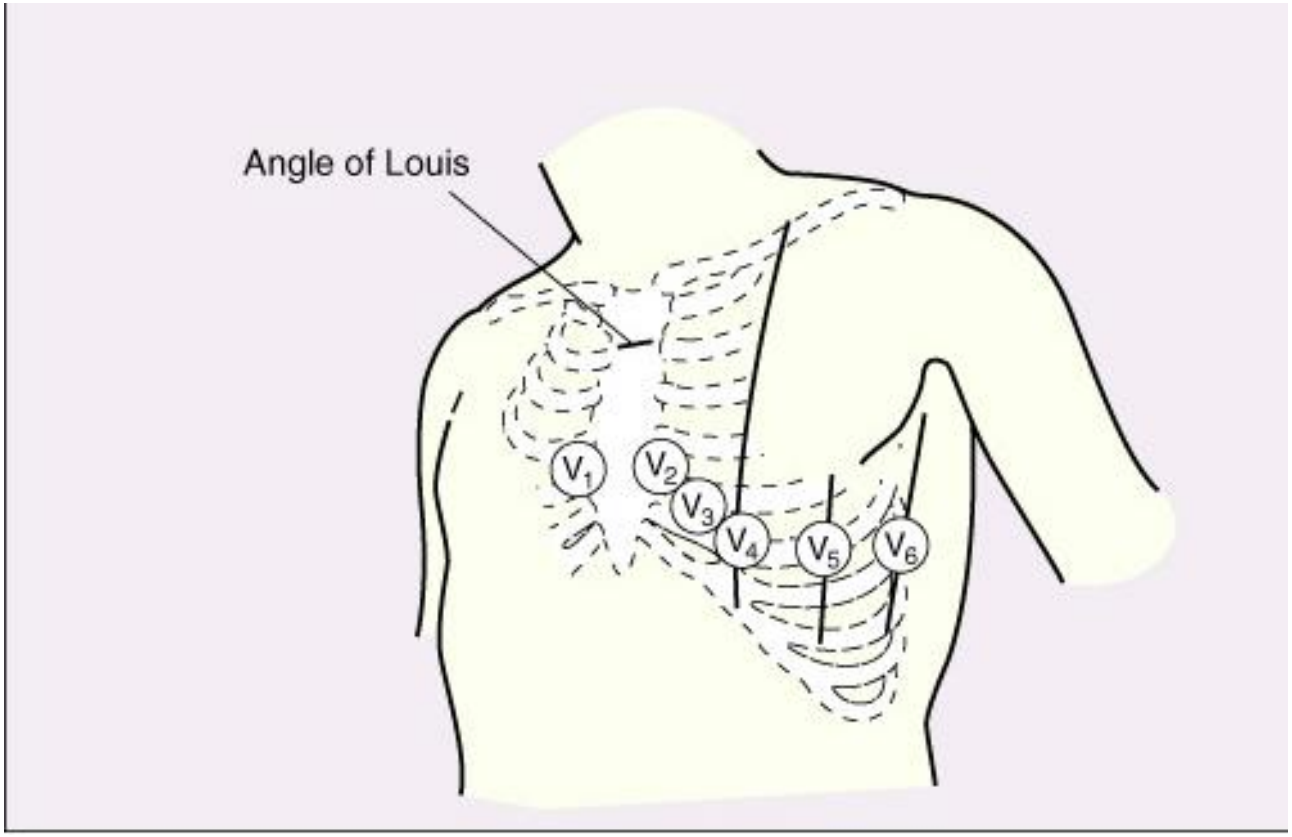
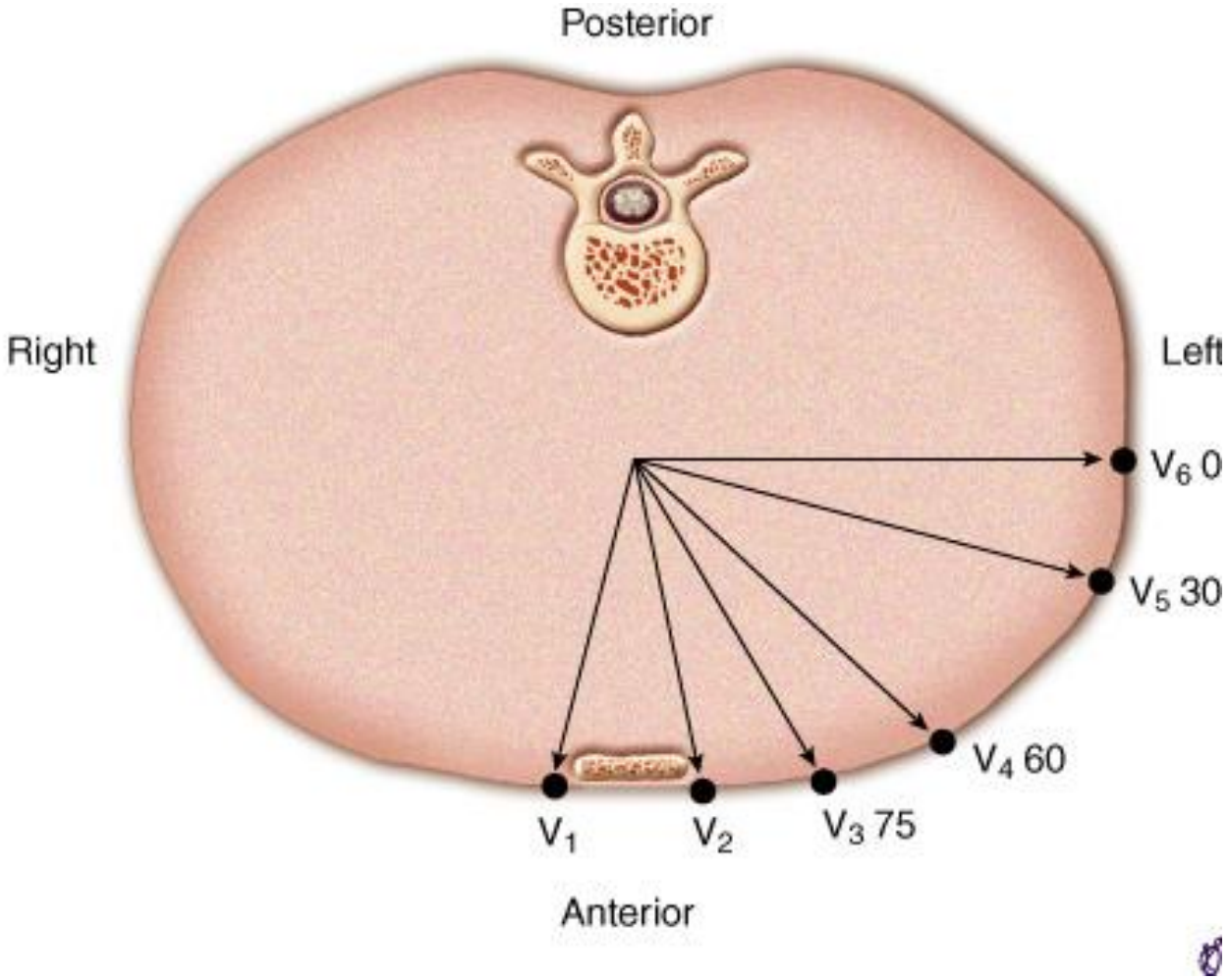
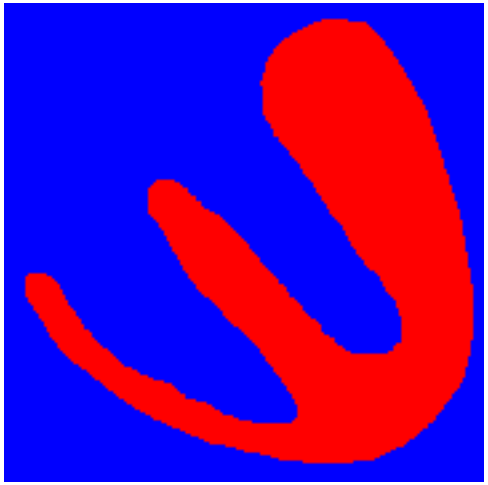
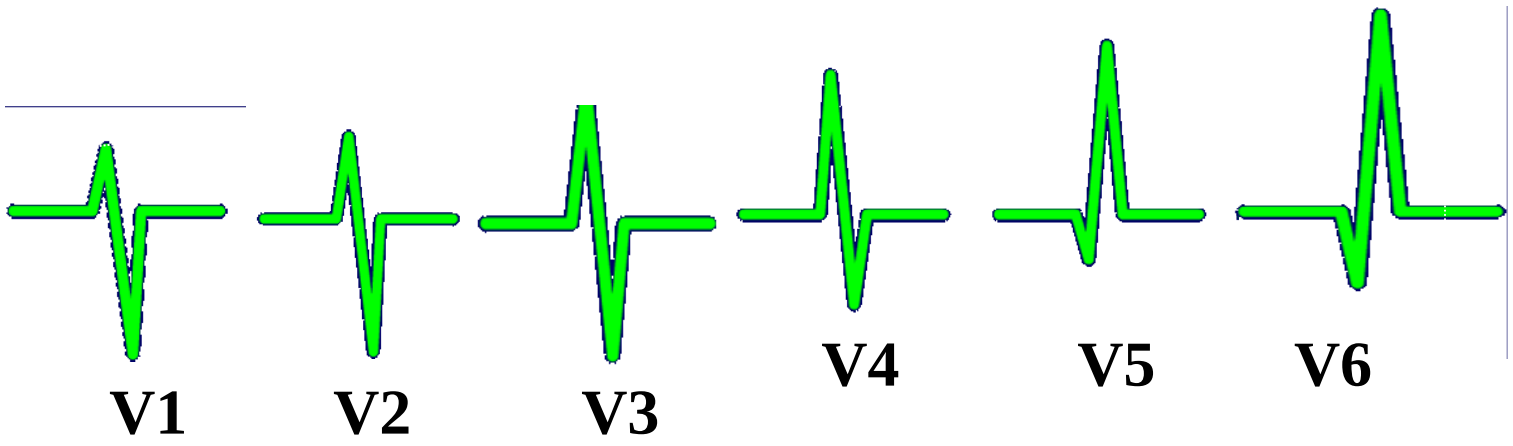


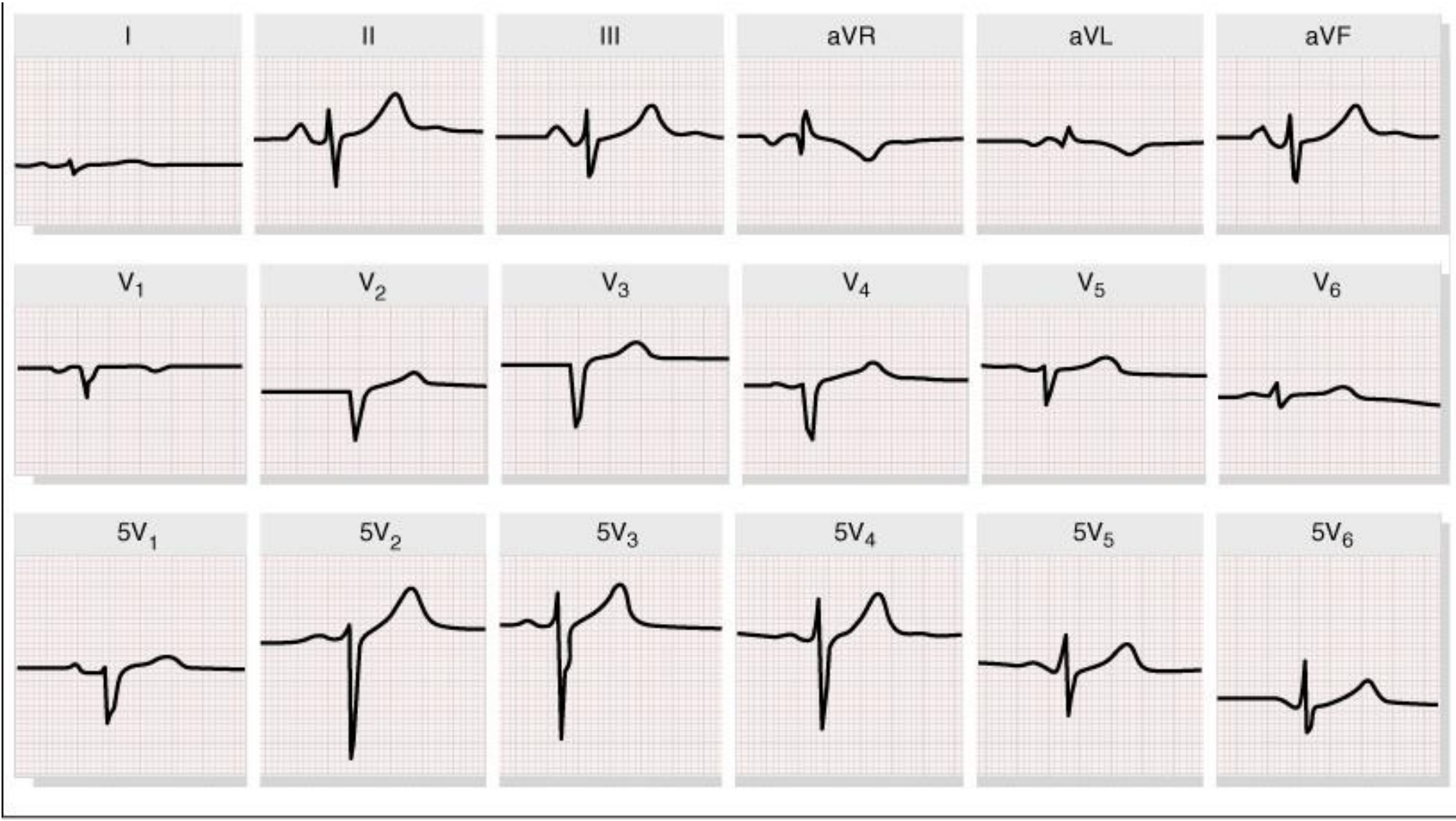
Accurate positioning of Chest leads essential


Posterior
Right
Left
V6 0
V5 30
V4 60
V3 75
V1
V2
Anterior

R Wave Progression







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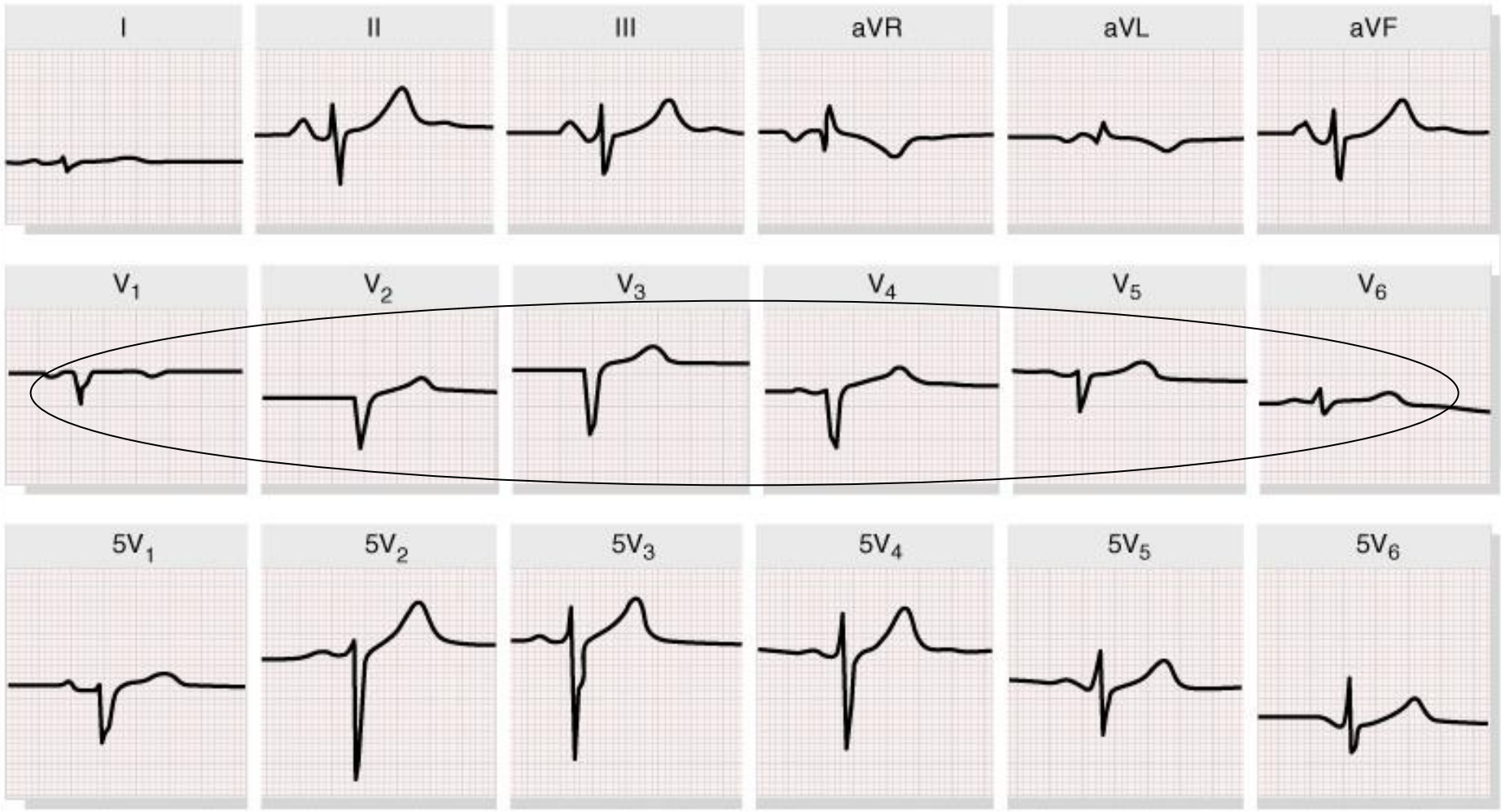

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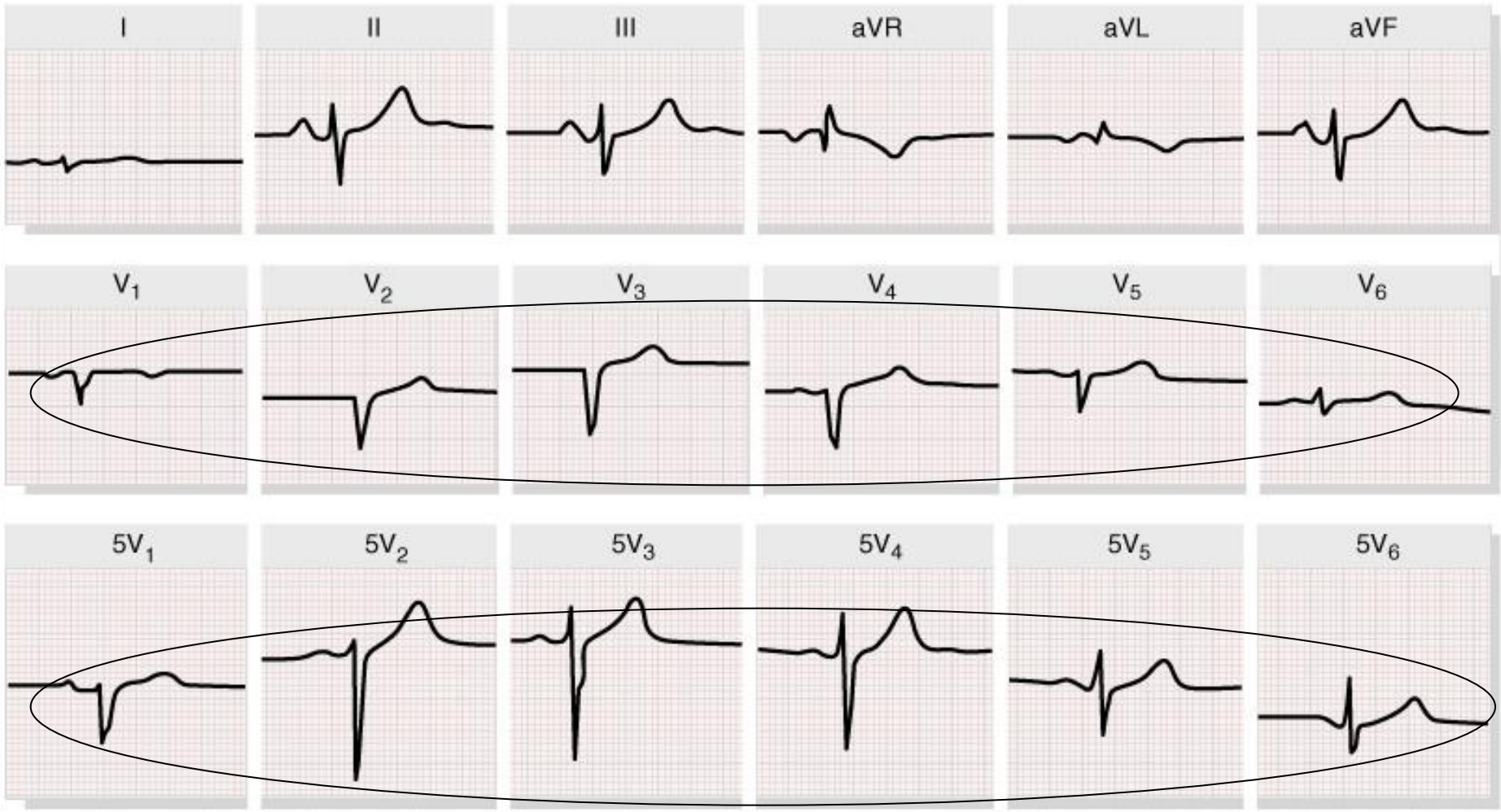

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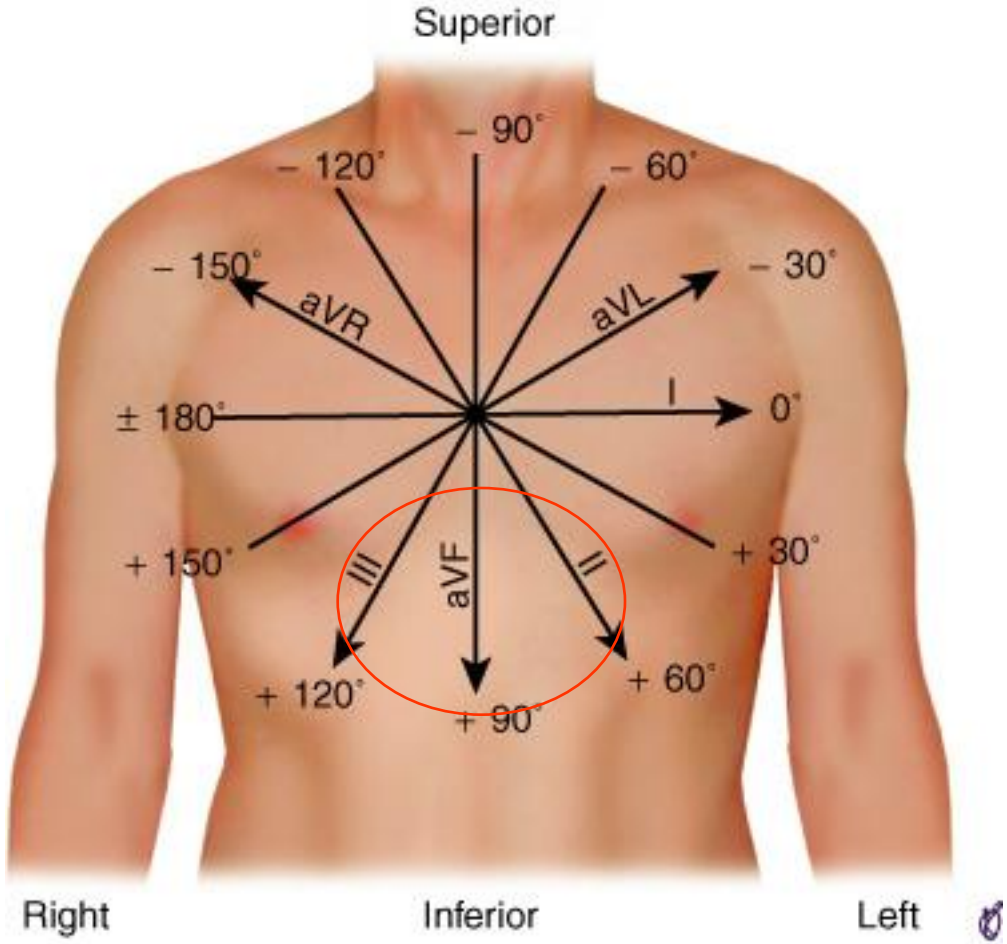

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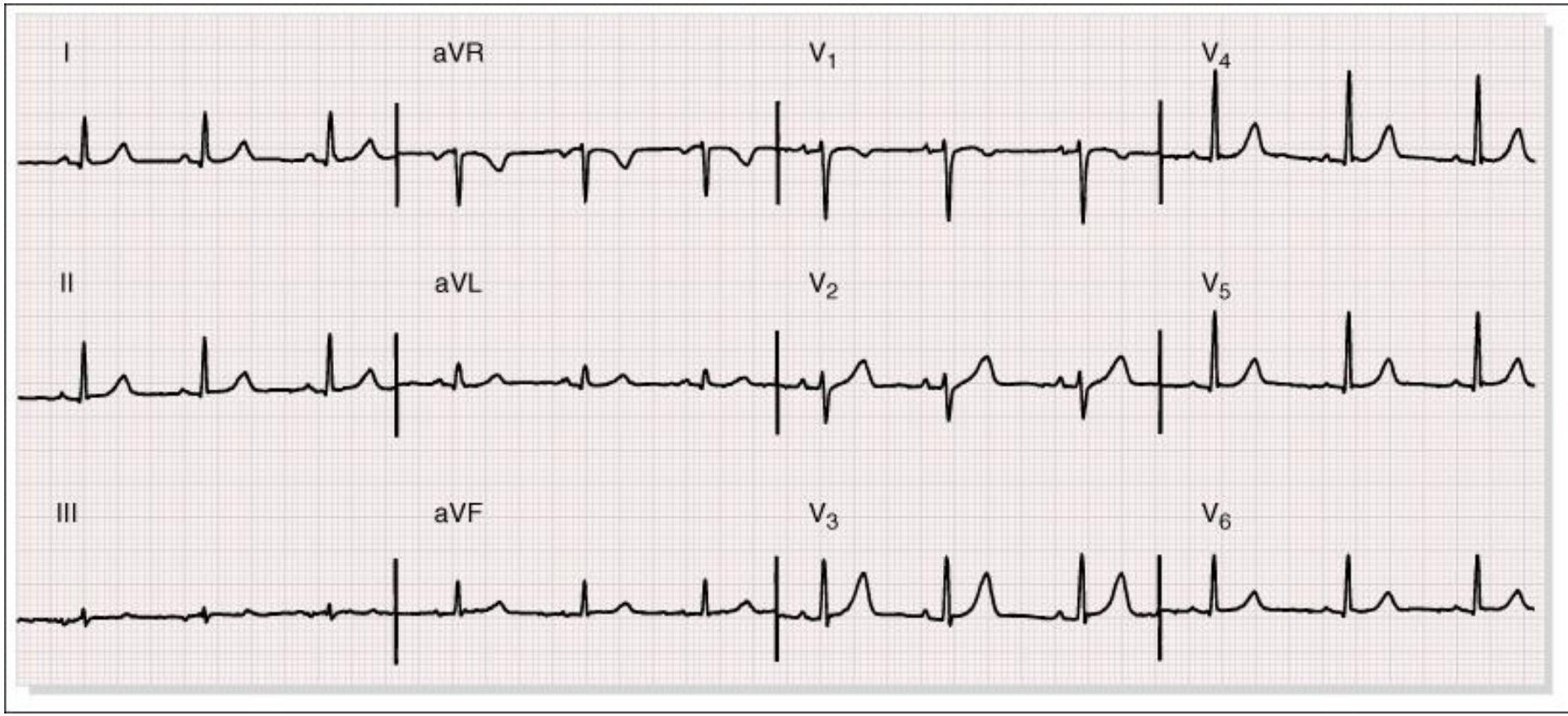
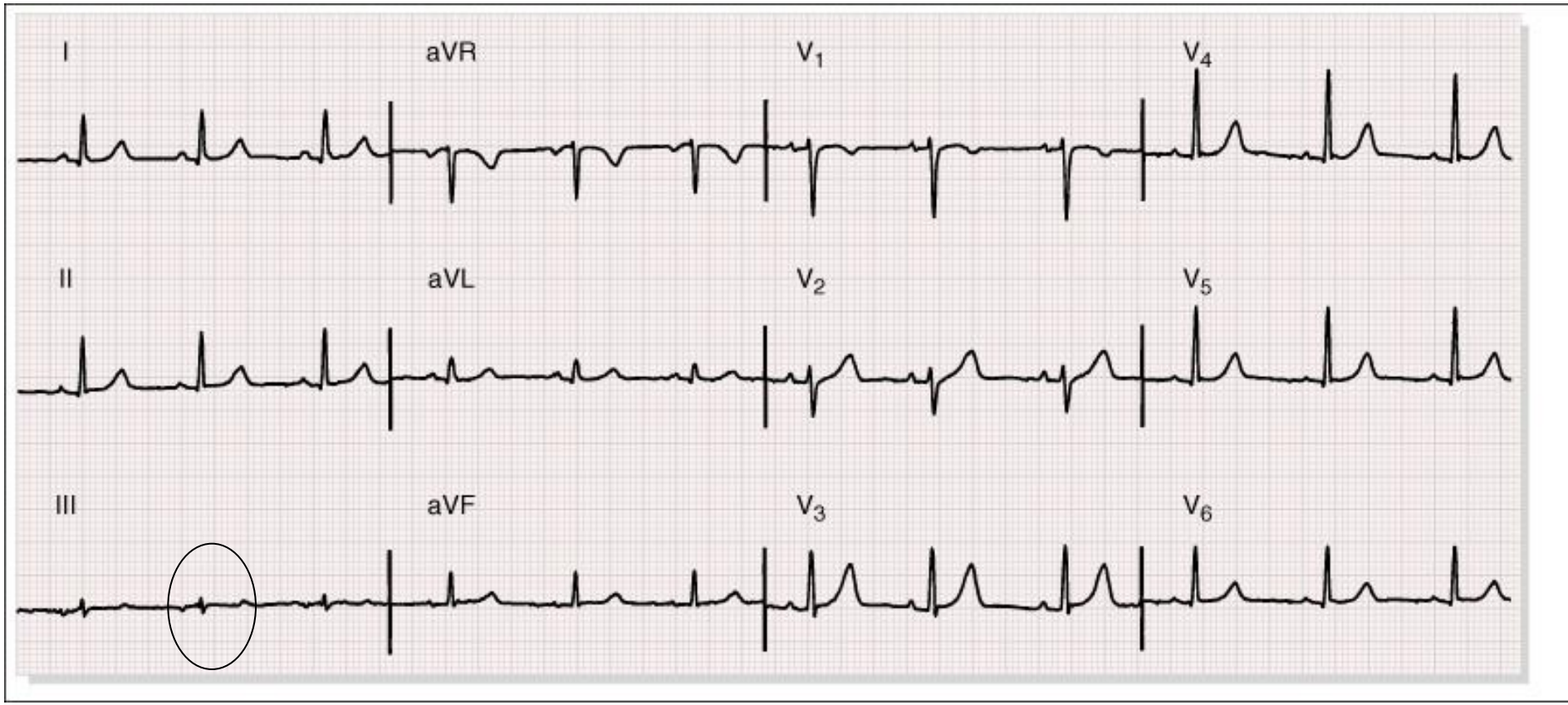

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6


I
aVR
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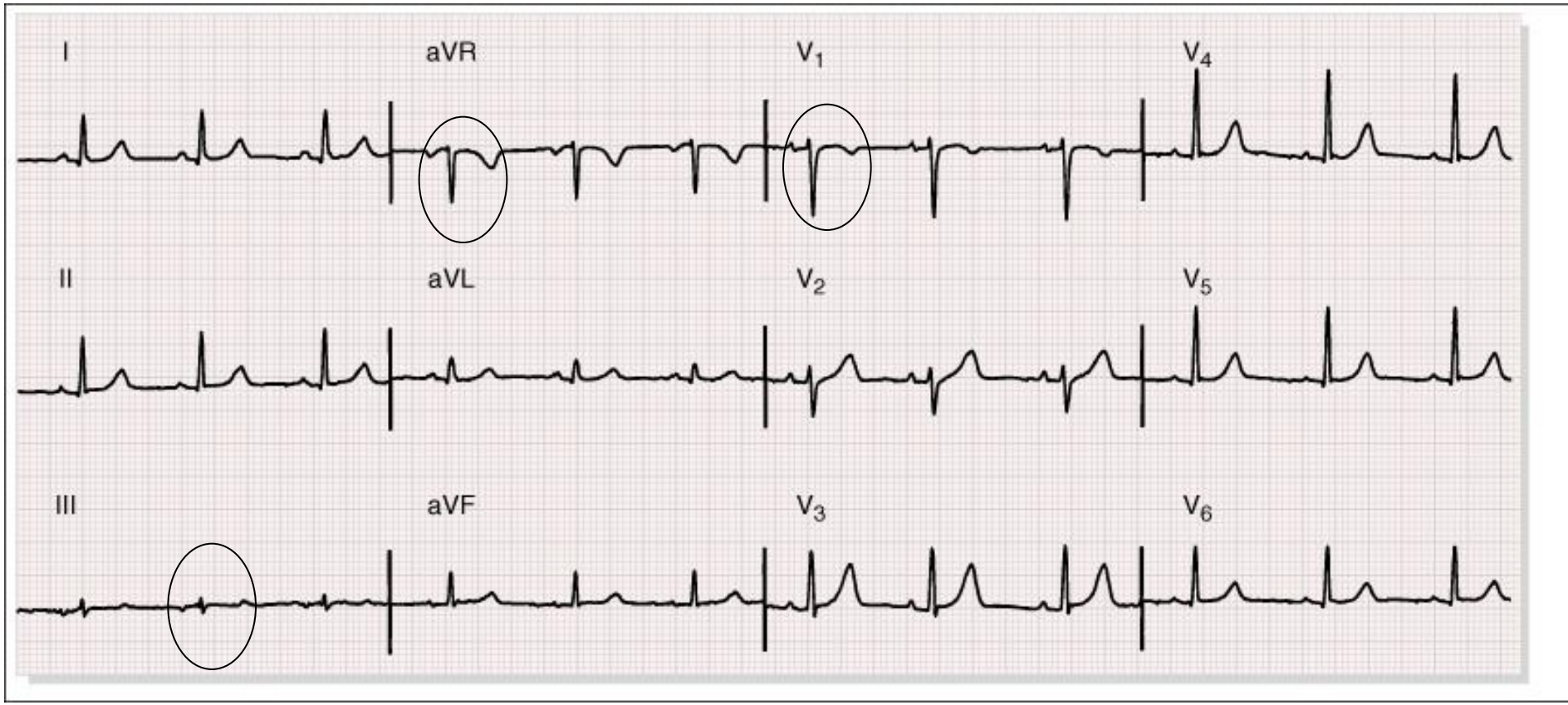
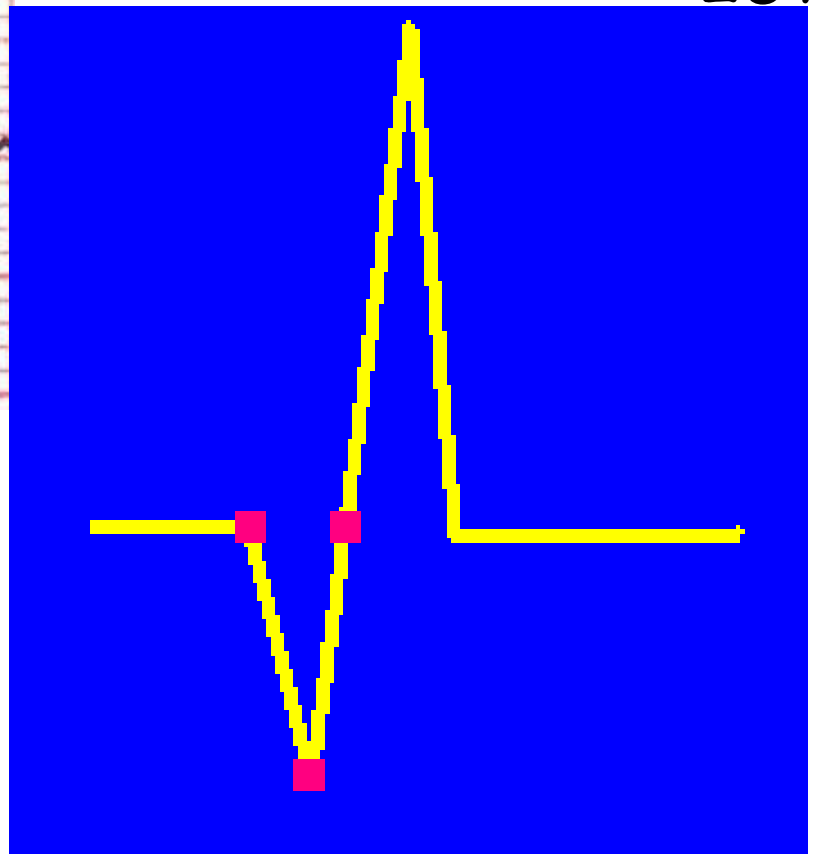

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

Pathological Q Wave

≥ 0.04 sec wide

>25% of R wave



The inadequacy of the resting ECG ‘falsely re-assuring’

150 patients presenting with Angina

66 had normal resting ECG

37/66 at angiography had severe CAD

Br H J 1992;67:53

Bayes Theorem

Rev Thomas Bayes
1702 - 1760

Bayes' theorem
A theory of probability

‘The post test probability is proportional to the pretest probability’

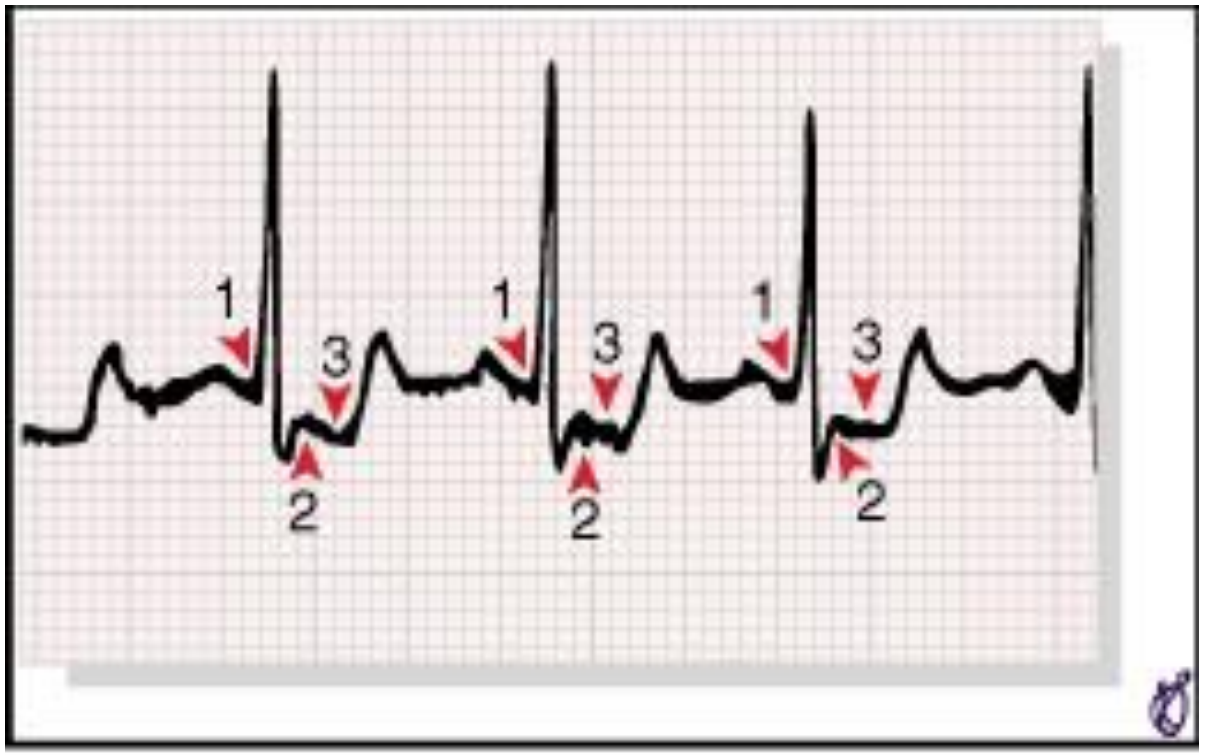
Bayes' theorem
A theory of probability

‘The post test probability is proportional to the pretest probability’

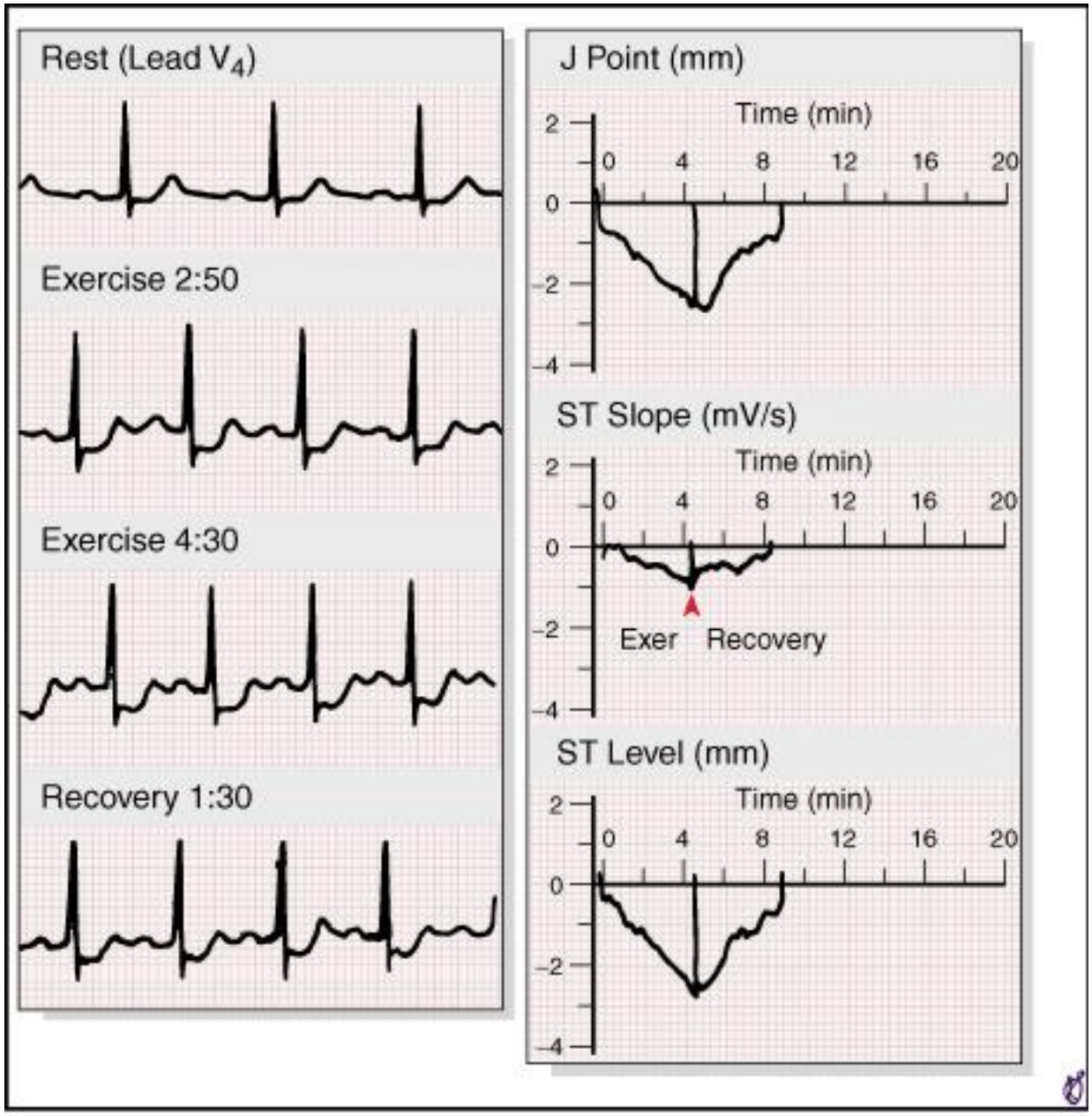
Some-one tested positive for a disease;
the probability that they actually have the disease depends,
not only on the accuracy and sensitivity of the test,
but on their background (prior) probability of the disease.

ETT Bicycle or treadmill?

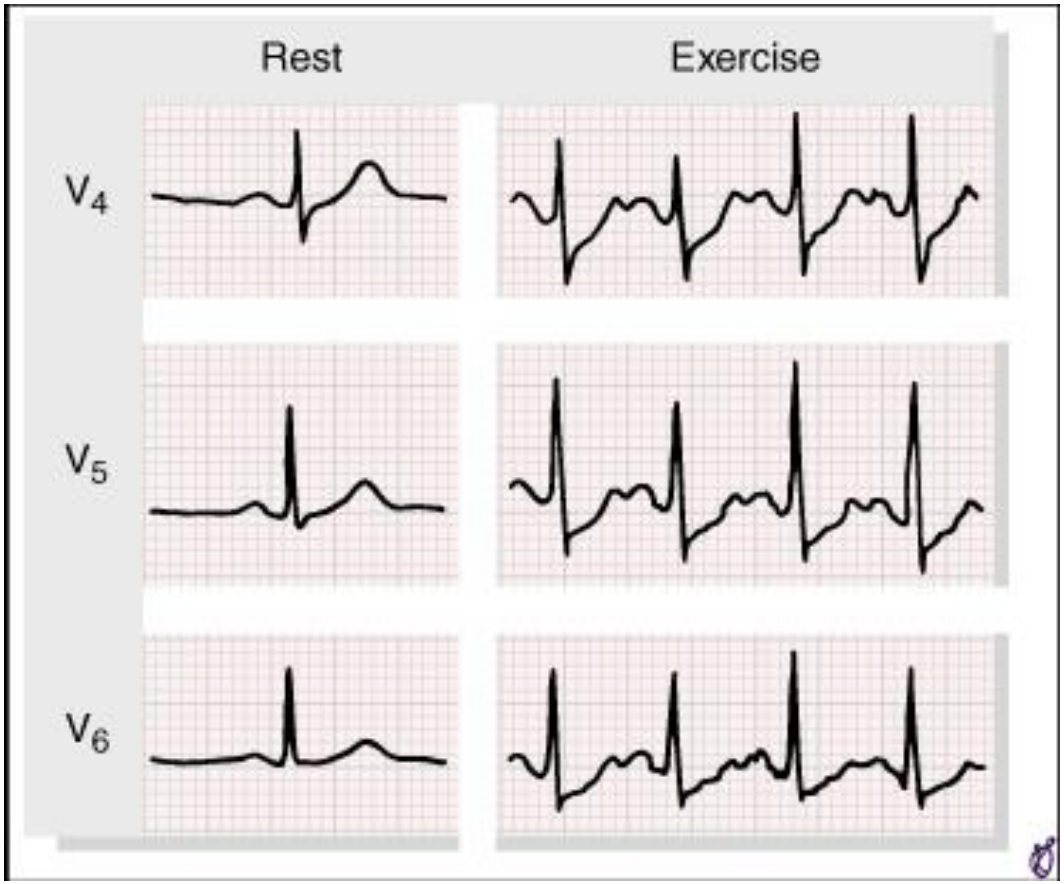
The Exercise ECG



1 = Iso-electric
2 = J point
3 = J + 80 msec



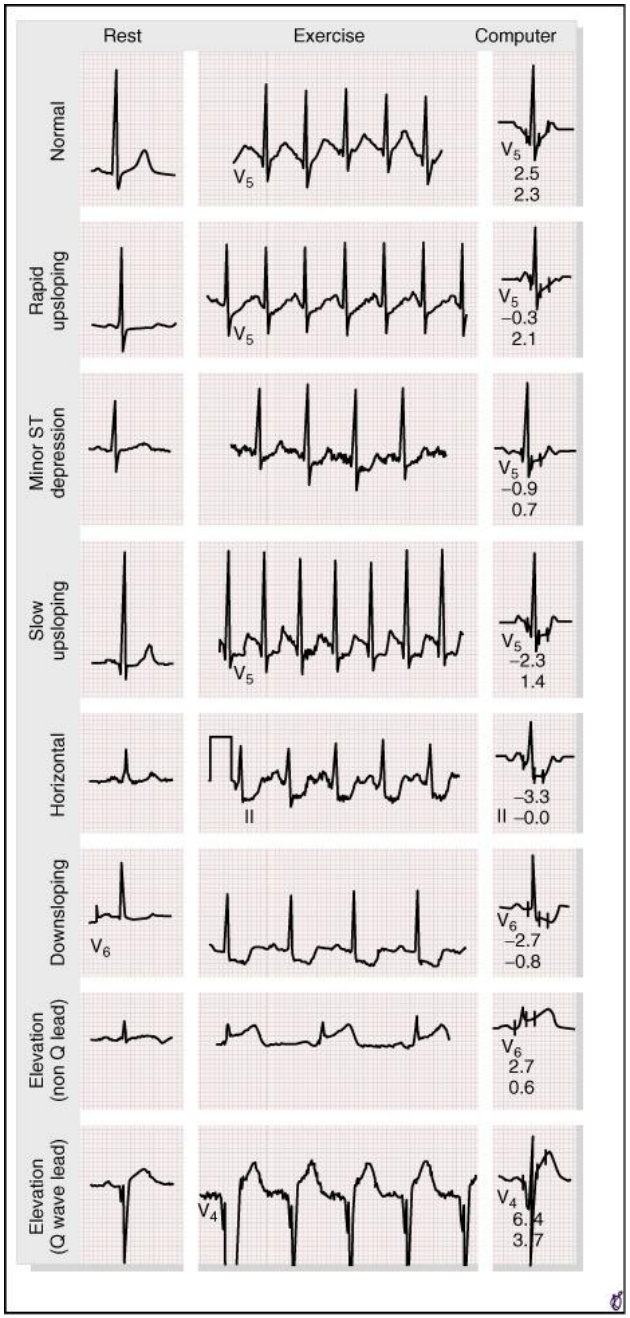
Early positive ETT



J point depression not significant

J

p



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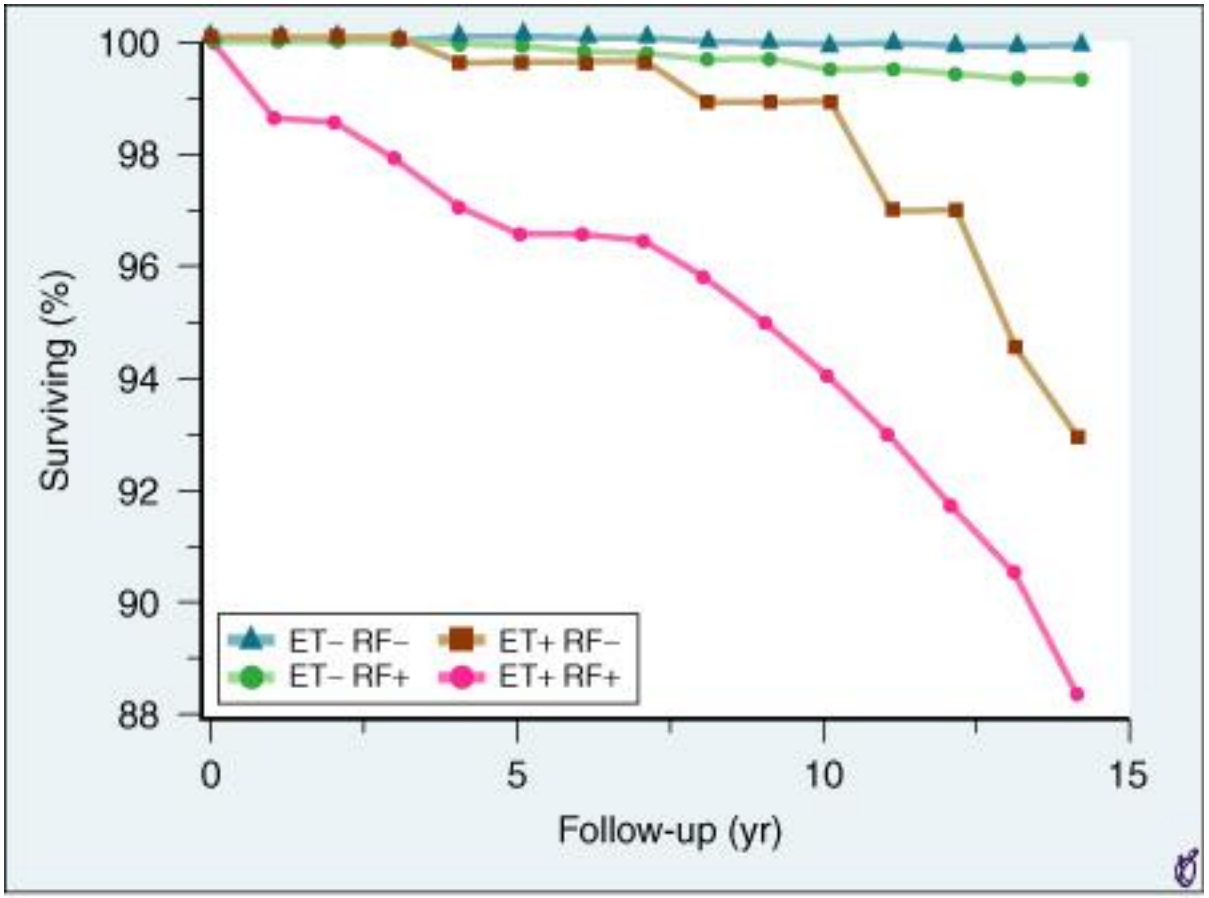
Value of Bruce ETT



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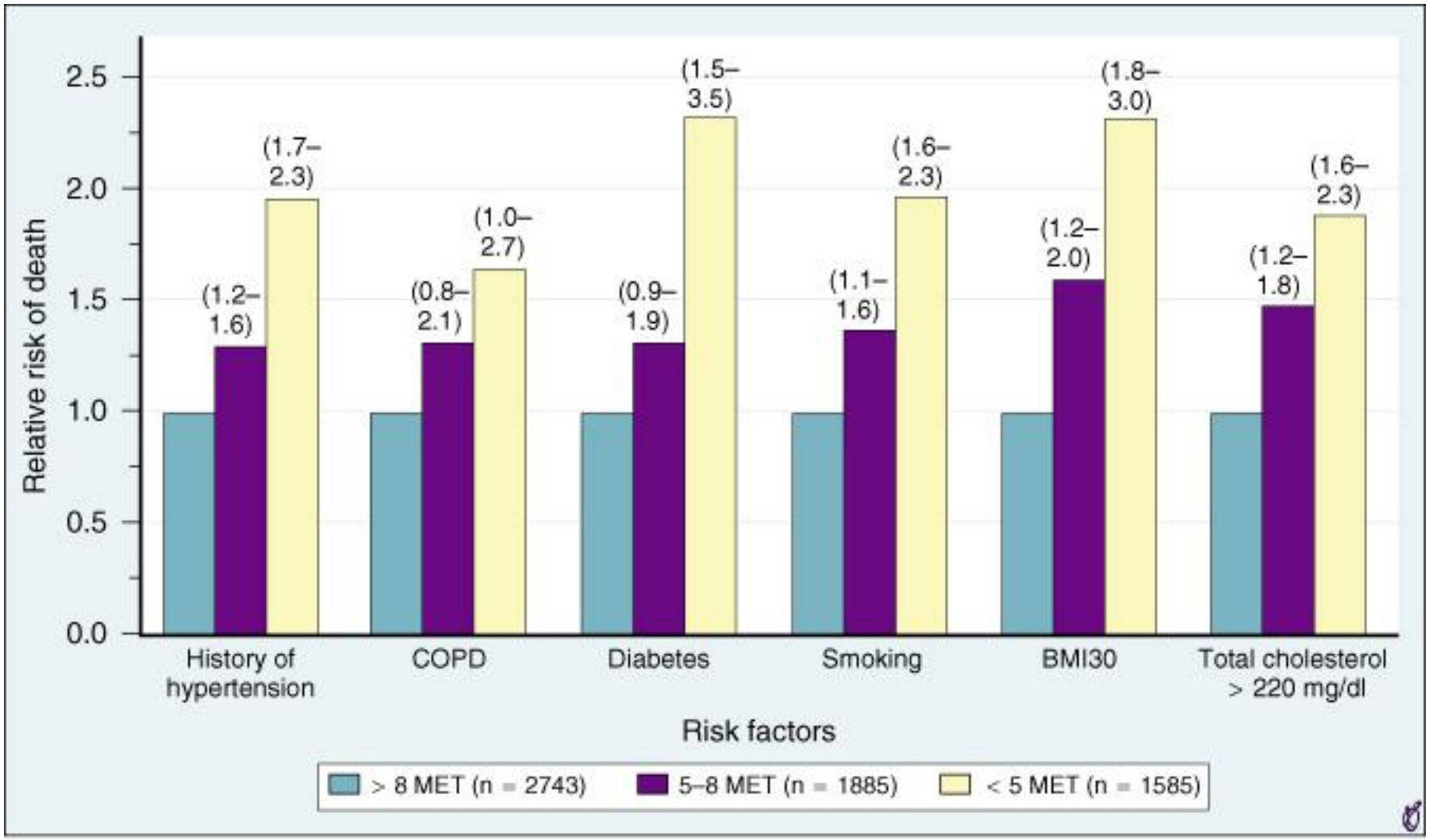
25,927 apparently healthy asymptomatic men 20 to 82 years of age

Importance of Functional Capacity as a predictor of mortality

In low risk individuals
the functional capacity is an overwhelmingly important predictor of mortality (RR 3.96) compared to Thallium perfusion defect

Snader JACC 1997.



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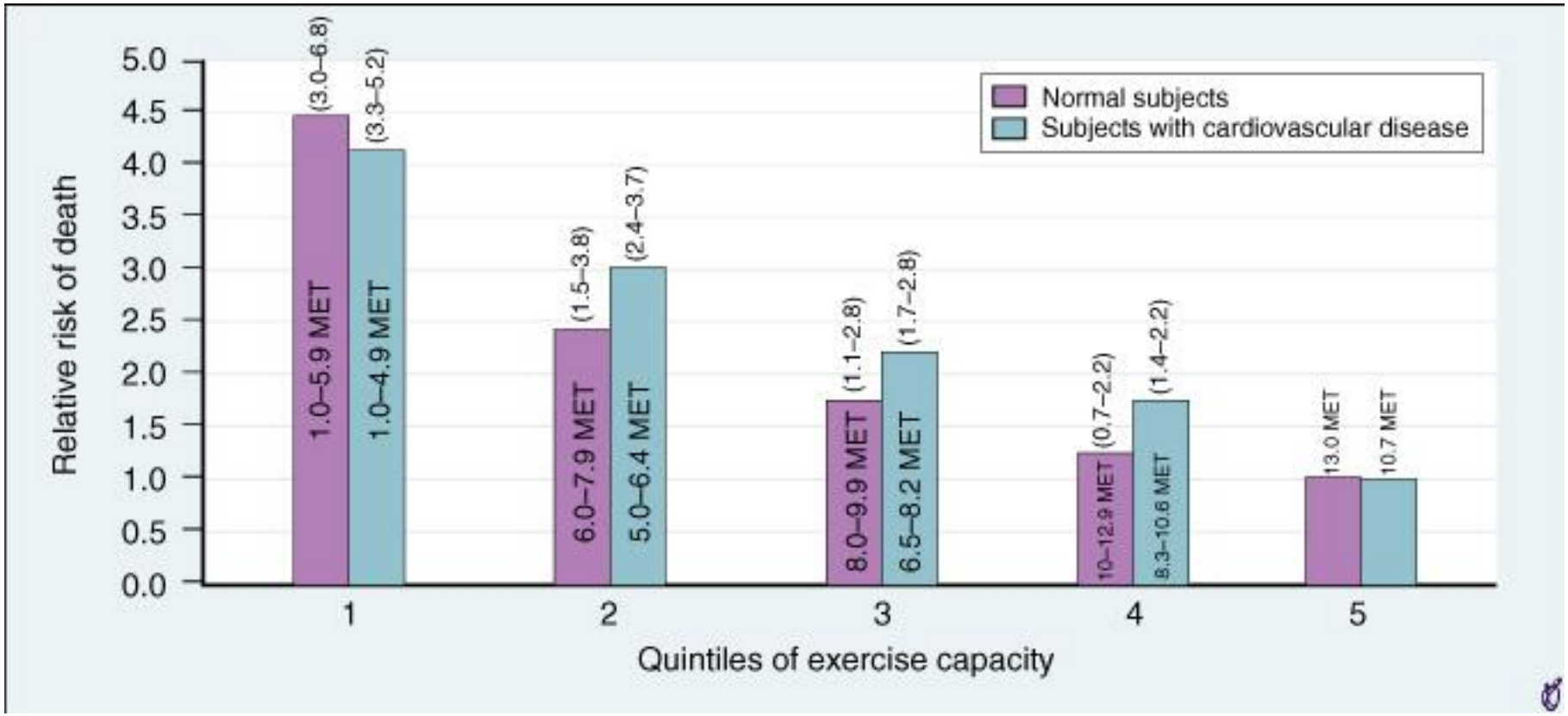
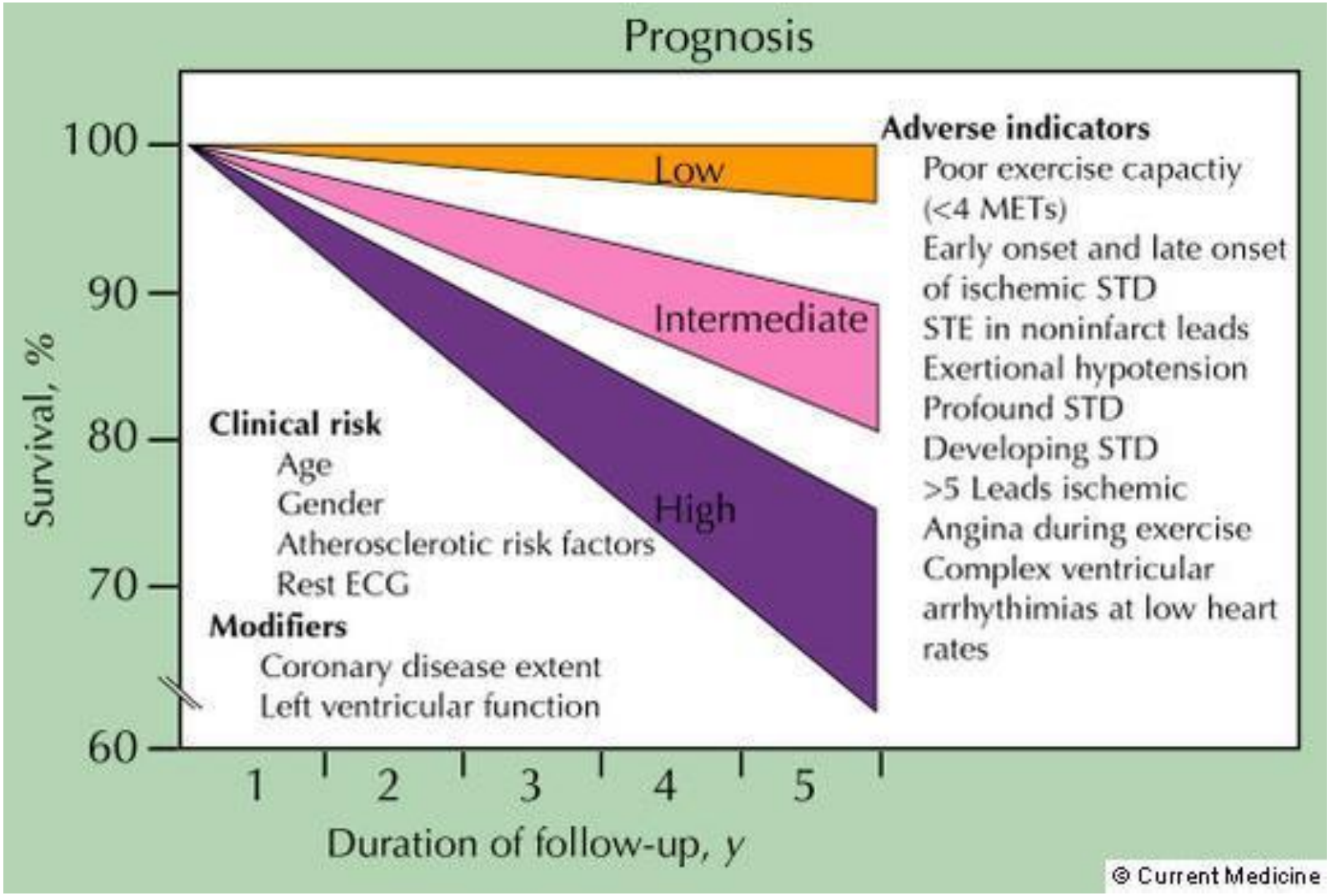
Relative risk of death among subjects with various risk factors
Is related to achieved exercise workloads.

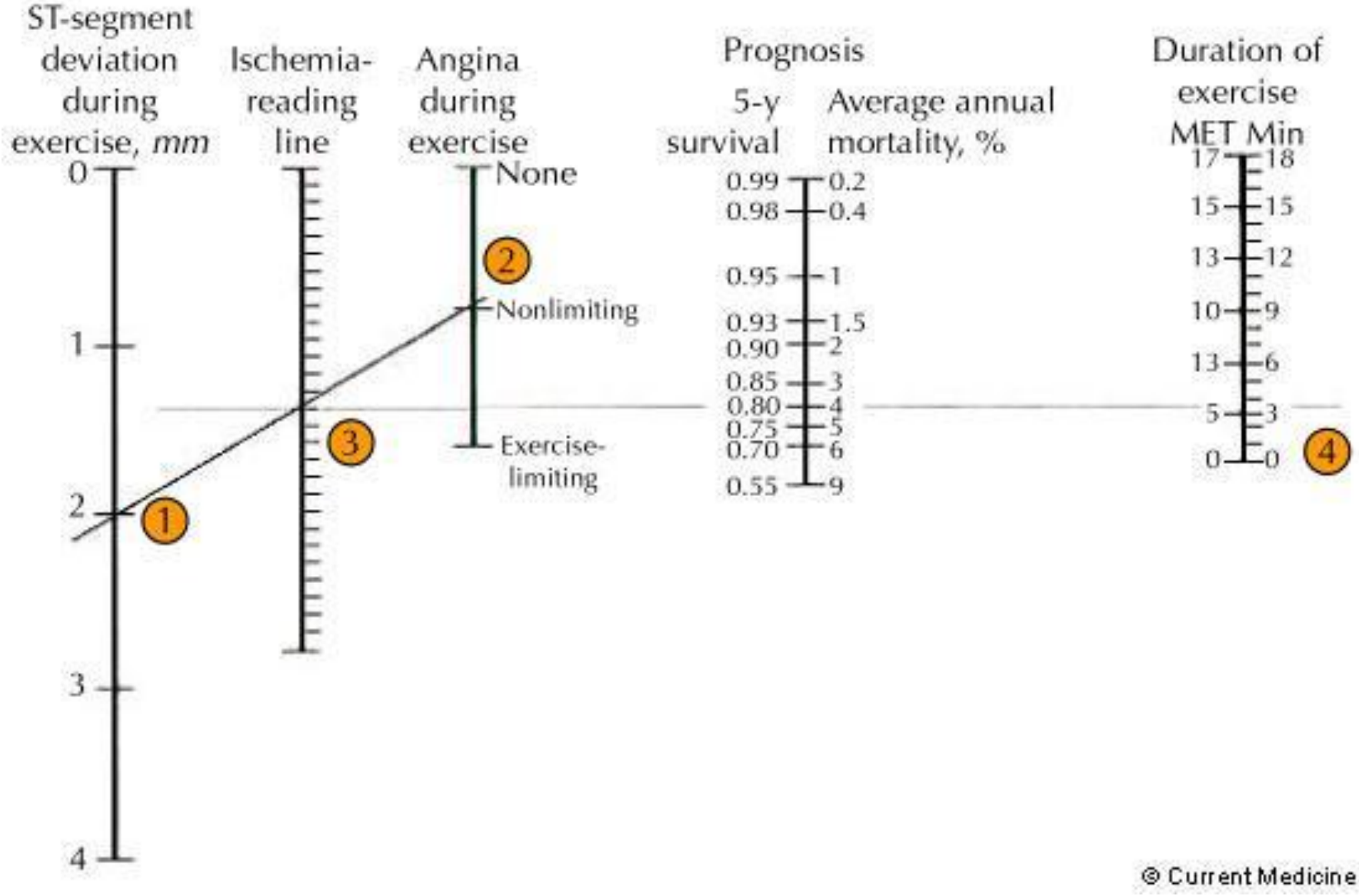


For each 1-MET increase in exercise capacity, the survival improved by 12 percent
N Engl J Med 2002

Survival curves: patients with normal/mildly impaired LV function



Prognostic assessment using Duke treadmill score



Treadmill vs Bicycle

Treadmill **exercise testing** has several advantages over cycle ergometry

- for most people, treadmill walking is a more familiar activity than cycling.
- it involves a larger muscle mass and
- more work against gravity.
- consequently, Oxygen consumption is, on average, 5–10% higher on the treadmill than on a cycle ergometer

Why use a Treadmill vs Bicycle

- Exercise capacity v.important predictor
  - 1 min on Bruce = 8% decrease in mortality
- Strongest predictor of mortality is exercise capacity
- Survey of VA Hospitals >82% use Bruce
- Patients achieve a higher workload on a Treadmill vs Bicycle

Blair JAM 1995
Snader JACC 1997
Myers JCP Rehab 200

Hambrecht RP, Schuler GC, Muth T, et al.

Greater diagnostic sensitivity of treadmill versus cycle exercise testing of asymptomatic men with coronary artery disease.

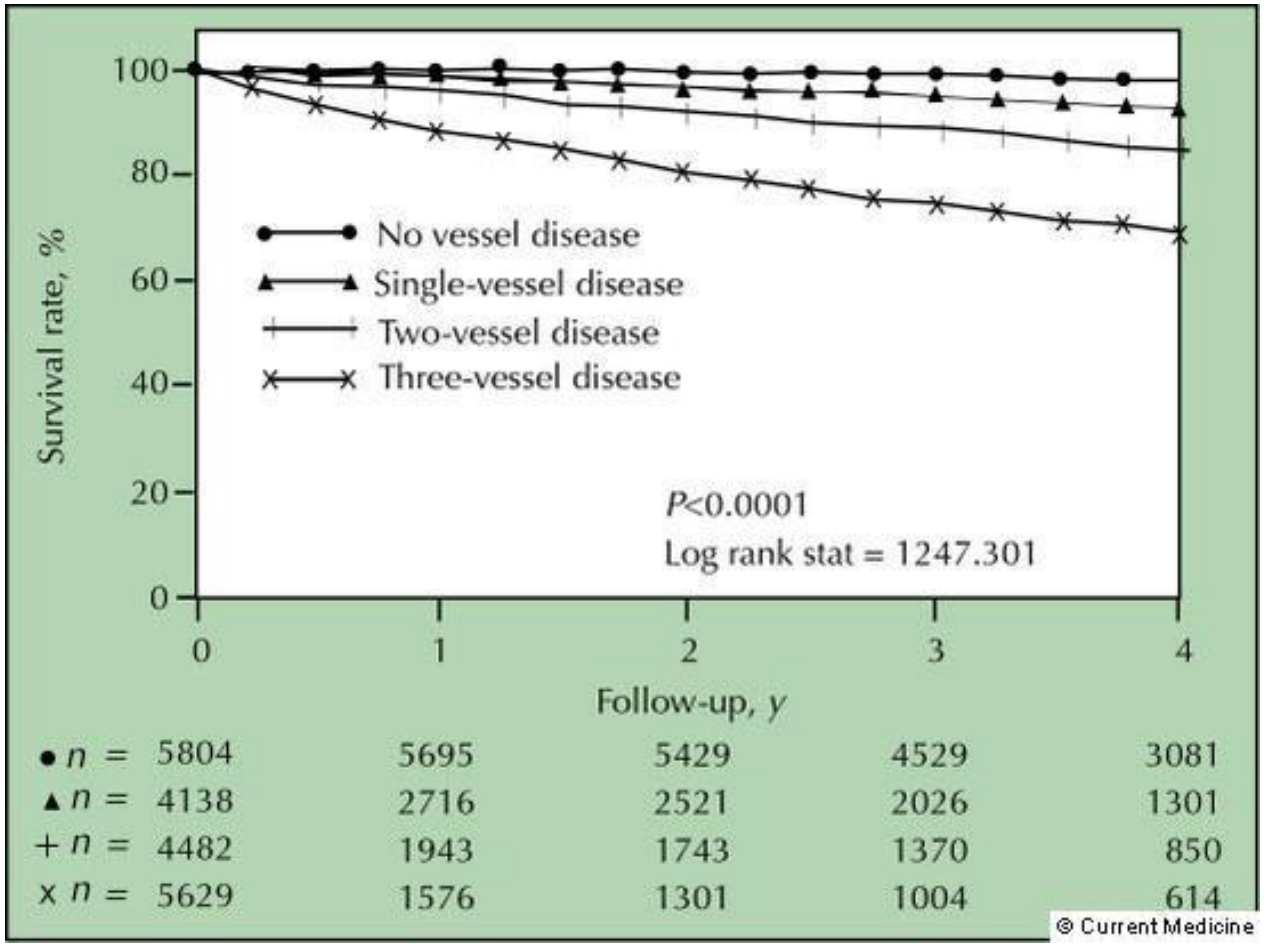
Am J Cardiol 1992;
70: 141–46.

Bicycle vs Treadmill

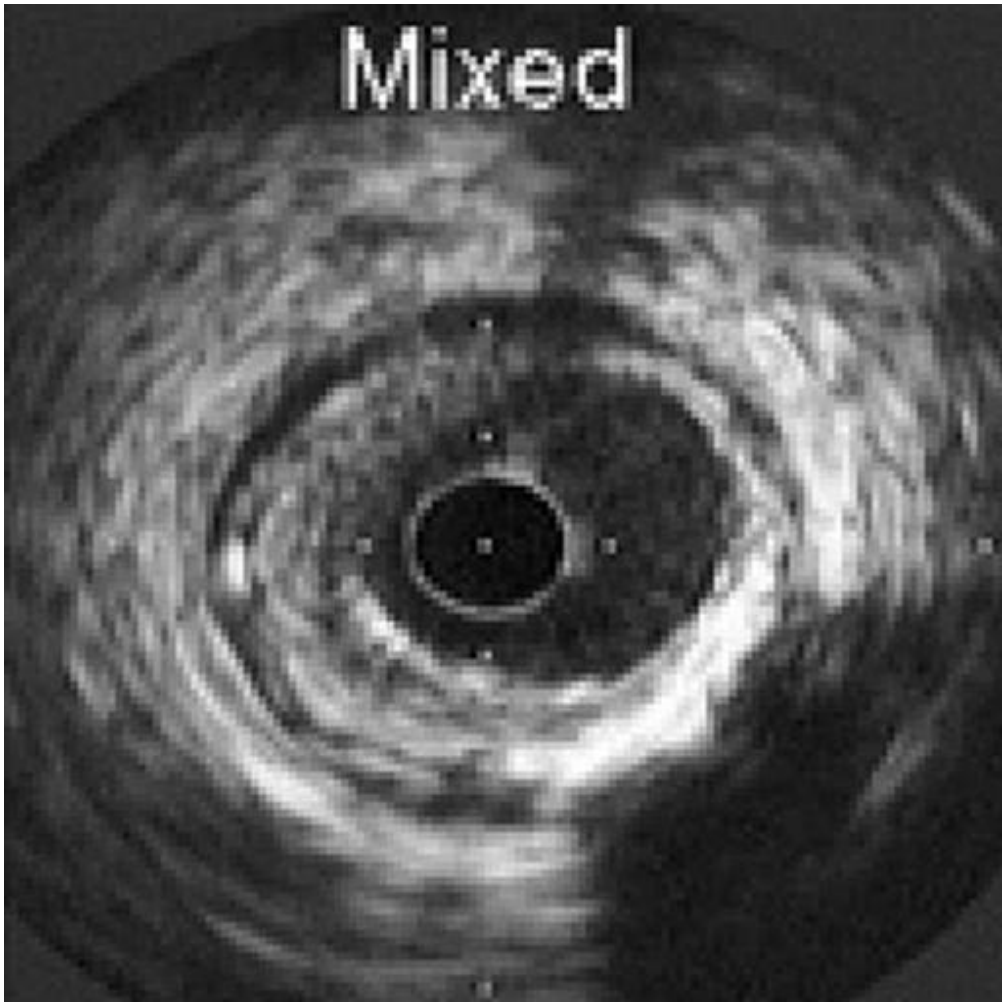
Given two tests in the same patient, the one capable of eliciting a higher level of exercise represents a truer examination of cardiopulmonary function
(rather than the limitations of local muscle fatigue).

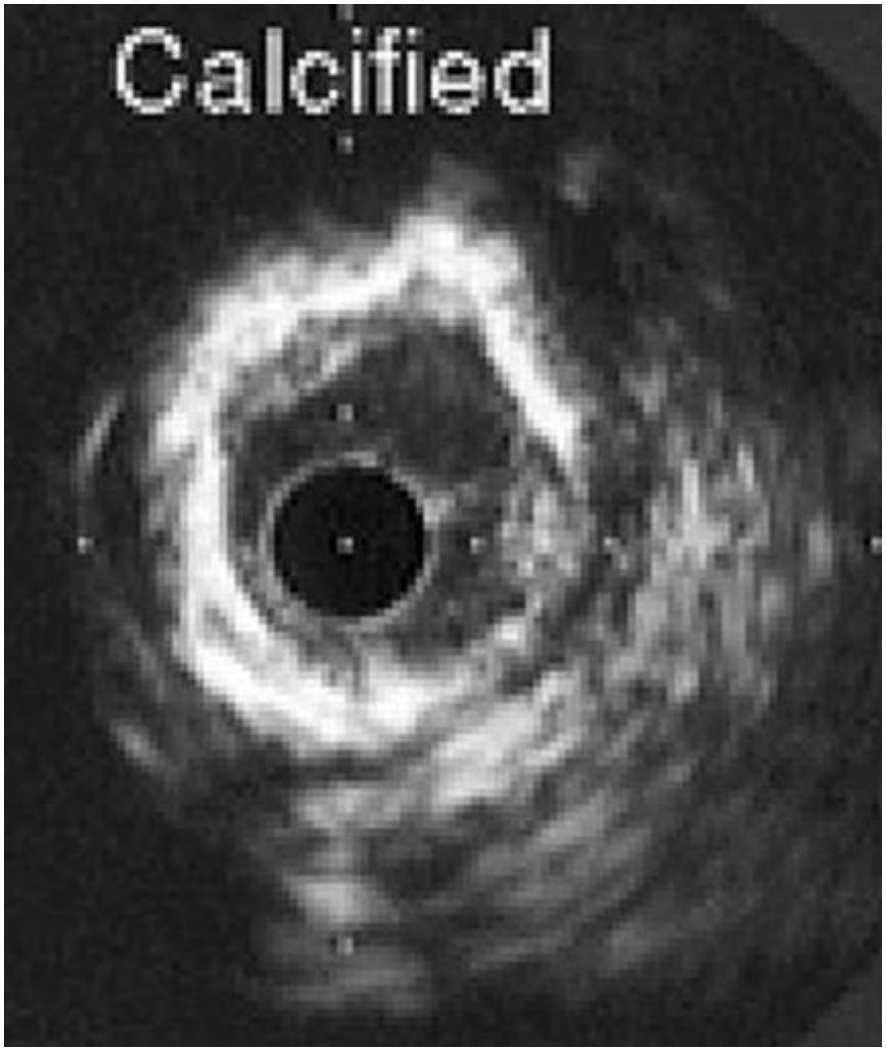
Coronary Artery Disease

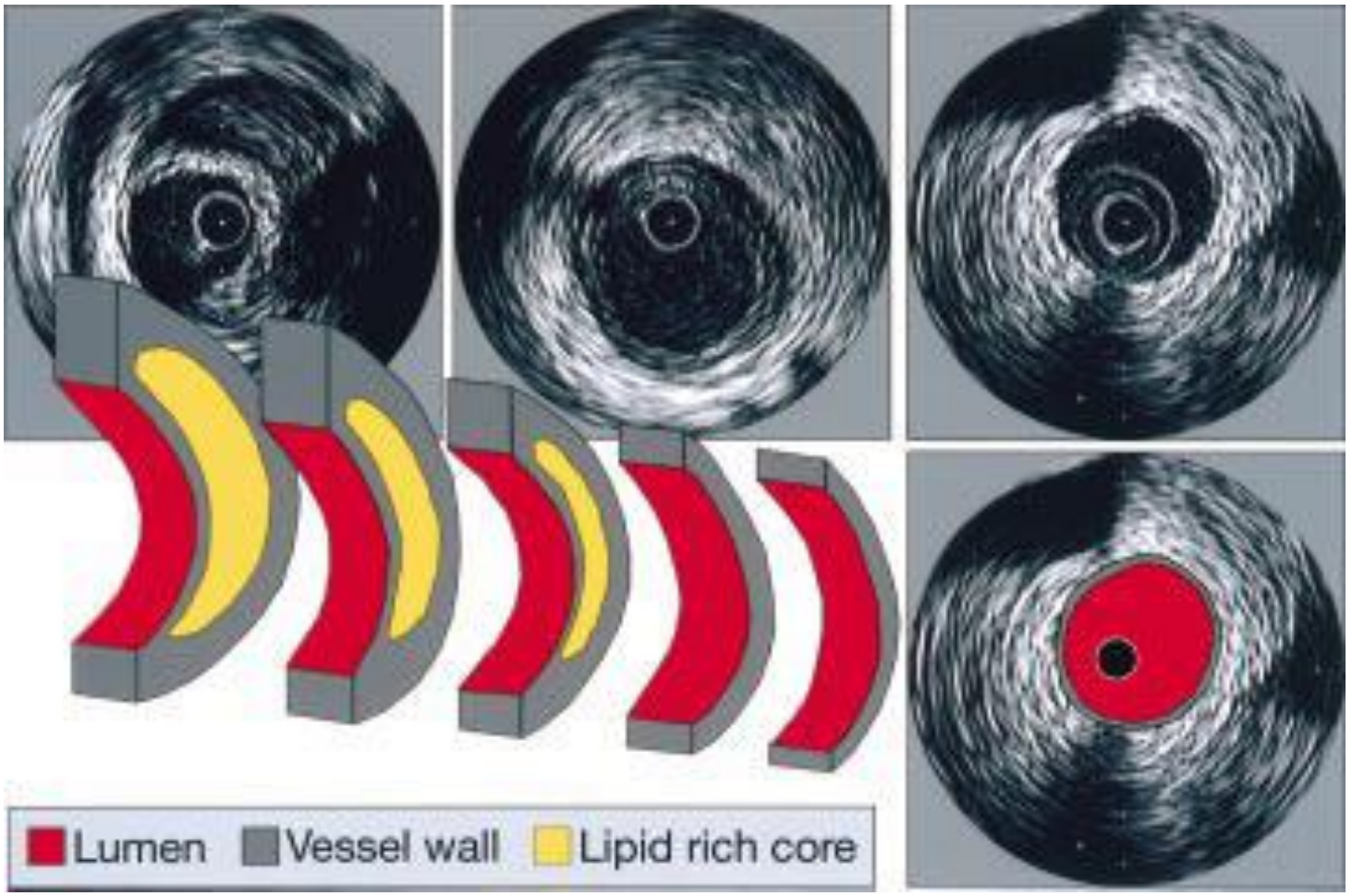
Cumulative 4-year survival of medically treated CAD patients



Atheroma morphology by intravascular ultrasound

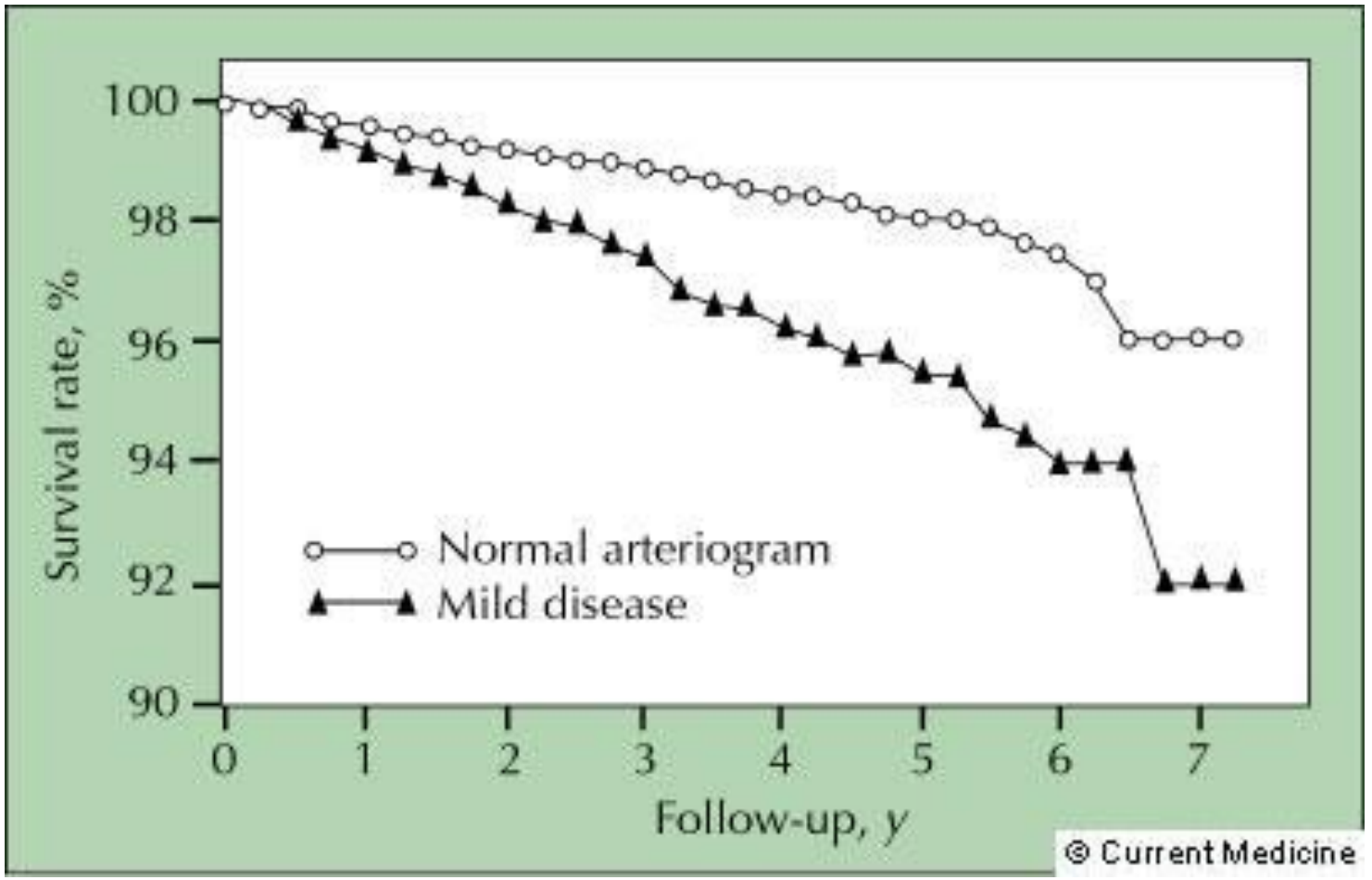




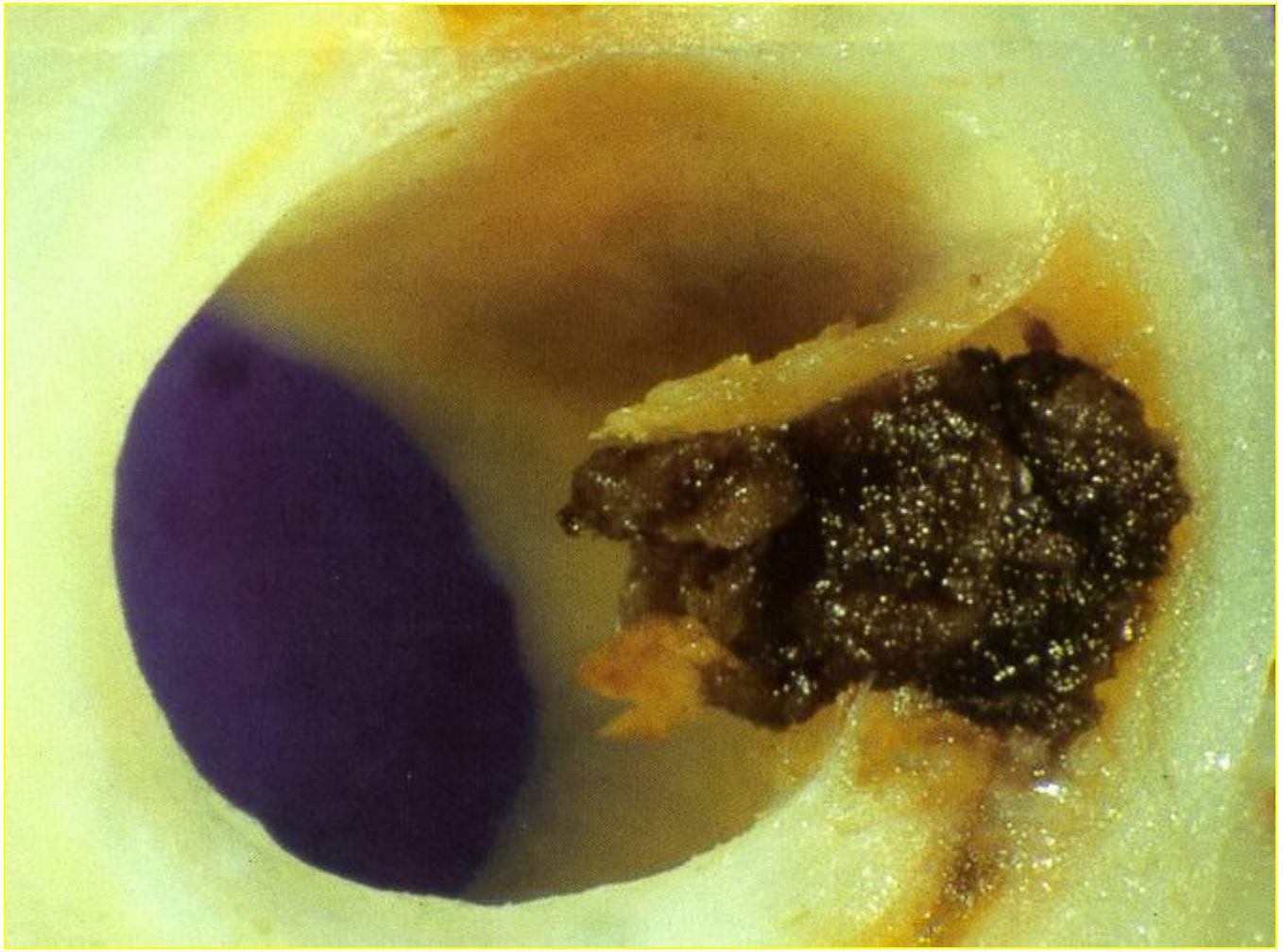


The developing atheroma spares the lumen.
When the lumen is affected, the atheroma is well advanced.

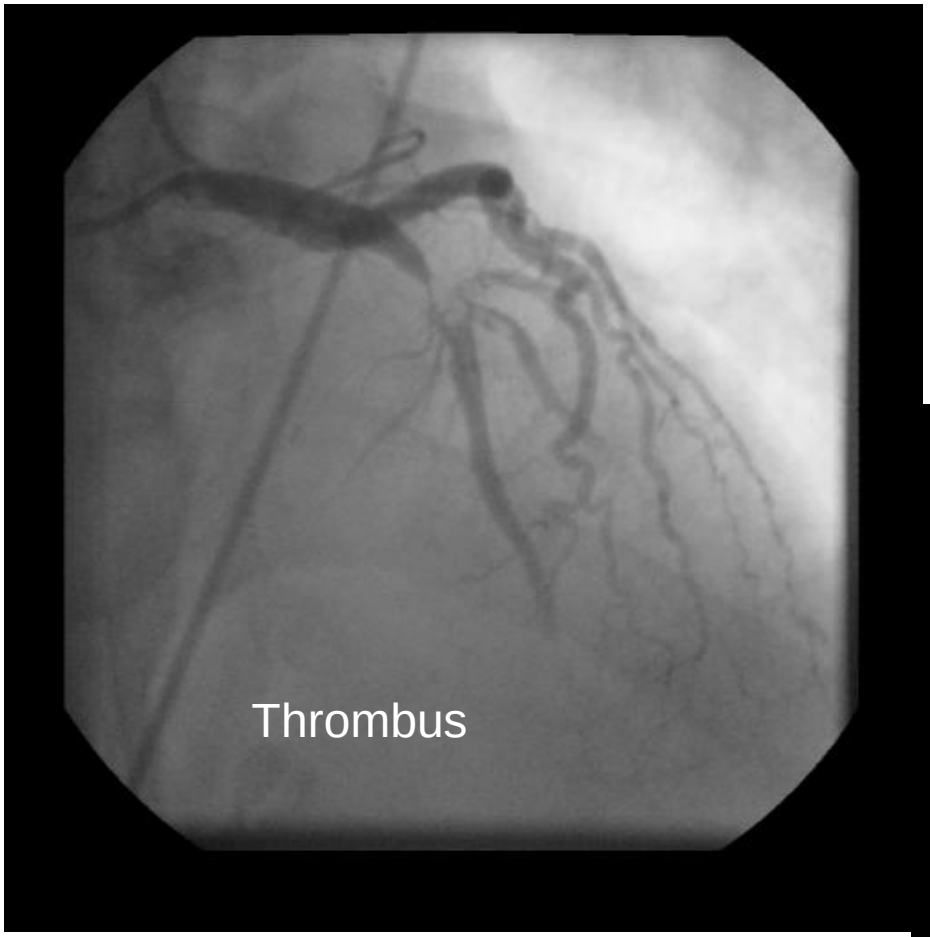
Survival: normal coronary arteriograms vs. ‘mild’ disease

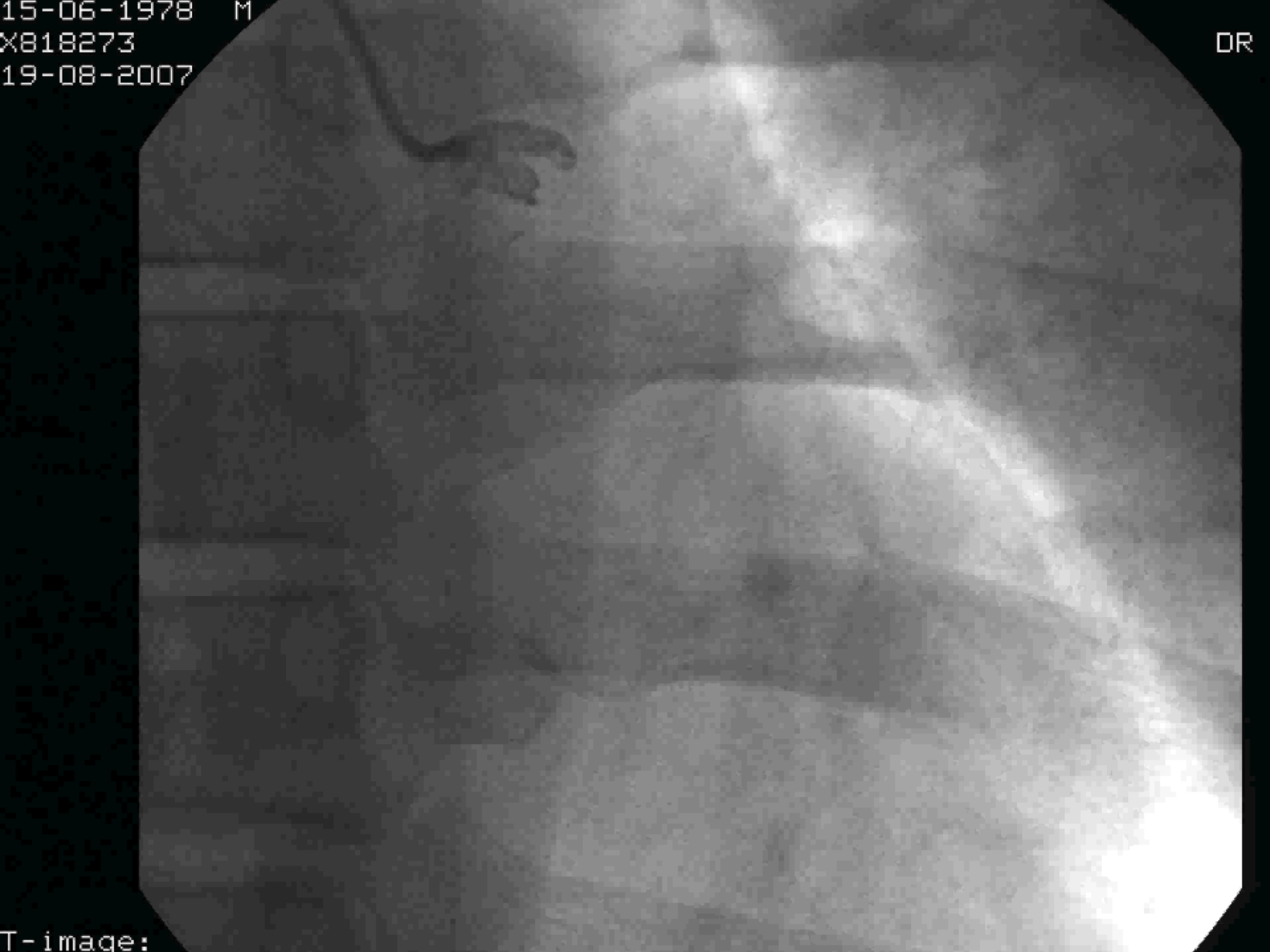


Plaque-fissure and intracoronary thrombus



Courtesy Prof. MJ Davies


Thrombus


15-06-1978 M
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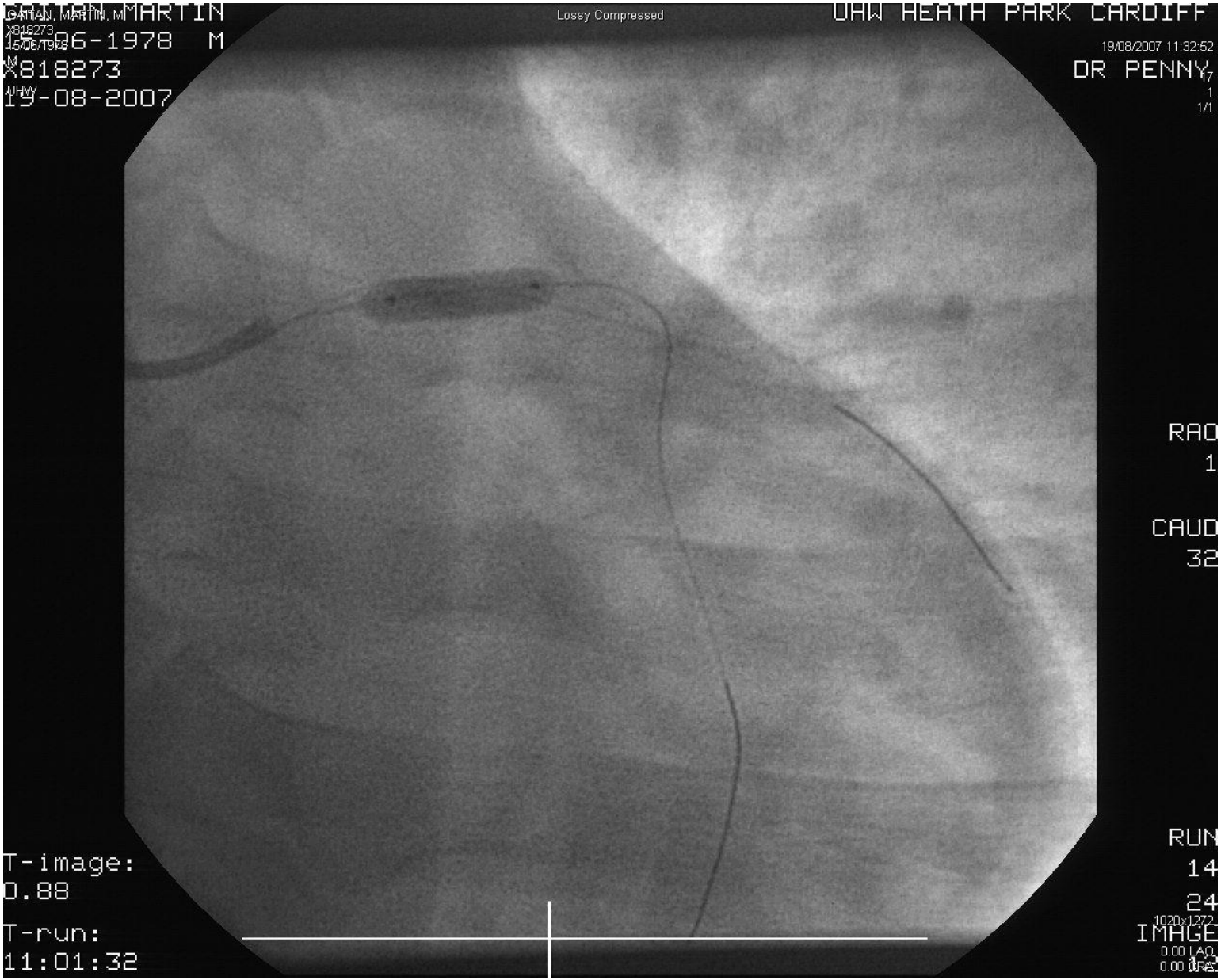
19-08-2007
DR
T-image:


GAHAN, MARTIN, M
X818273
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M
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Lossy Compressed
UHW HEATH PARK CARDIFF
19/08/2007 11:32:52
DR PENNY
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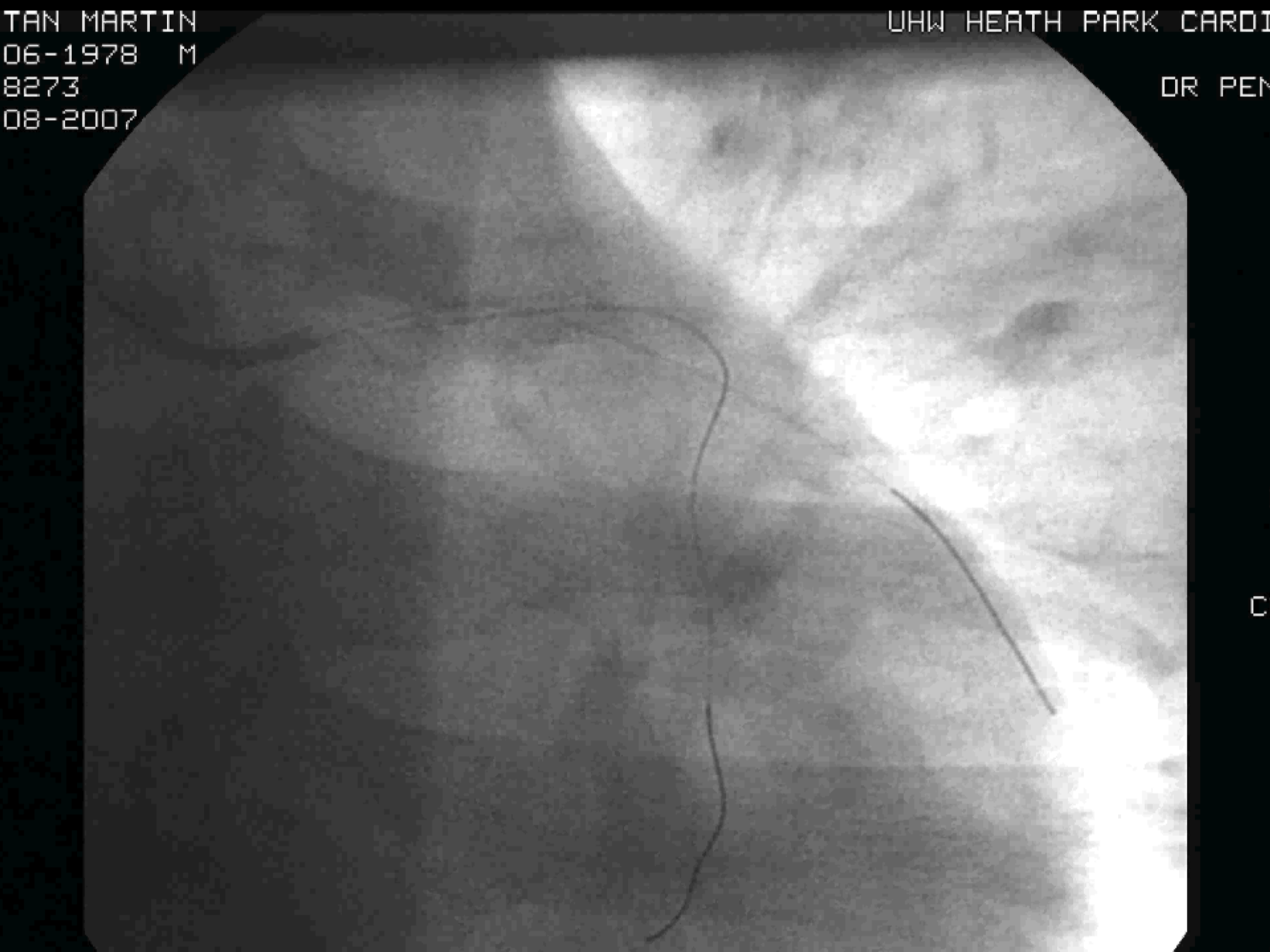
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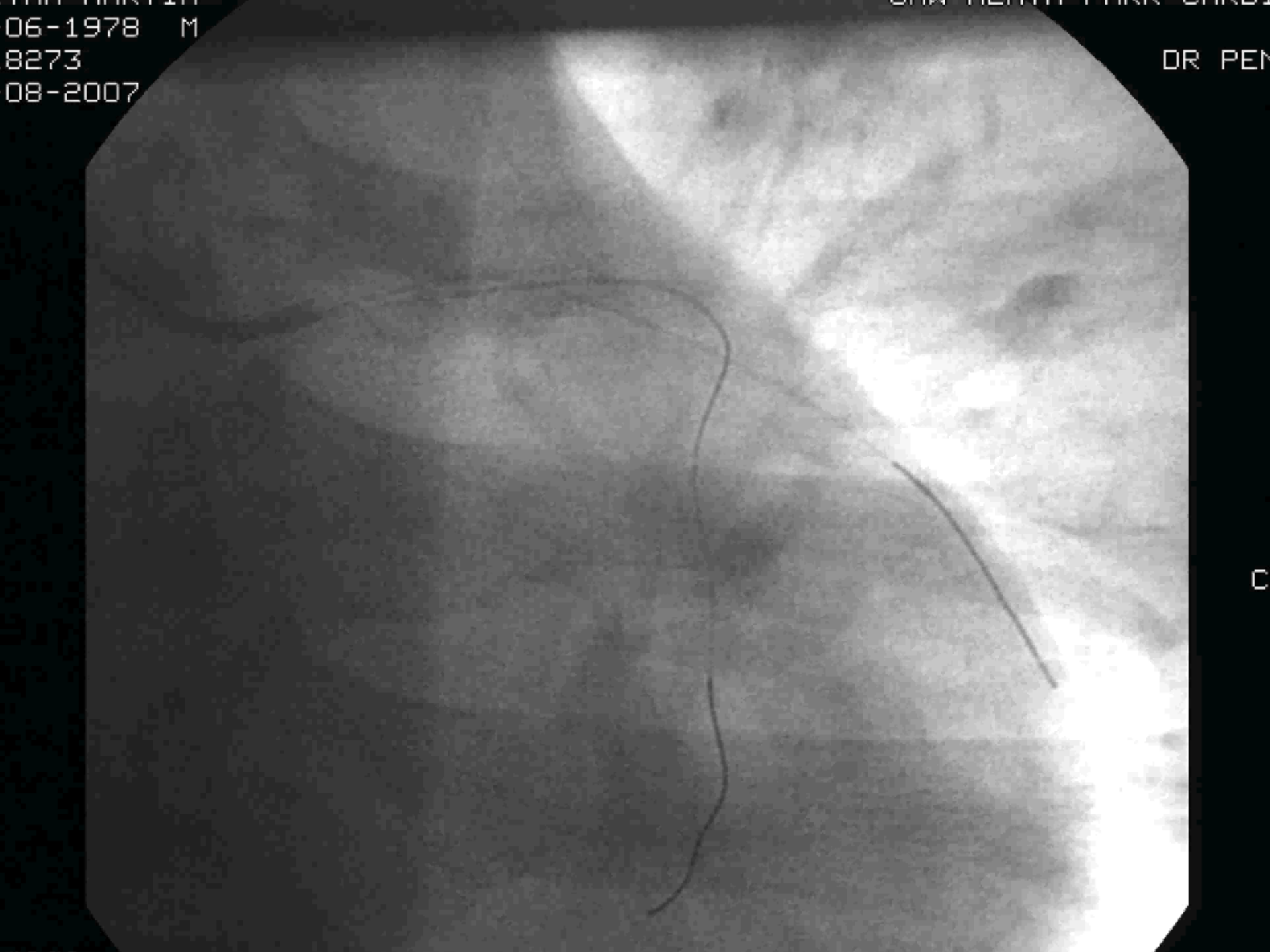
06-1978 M
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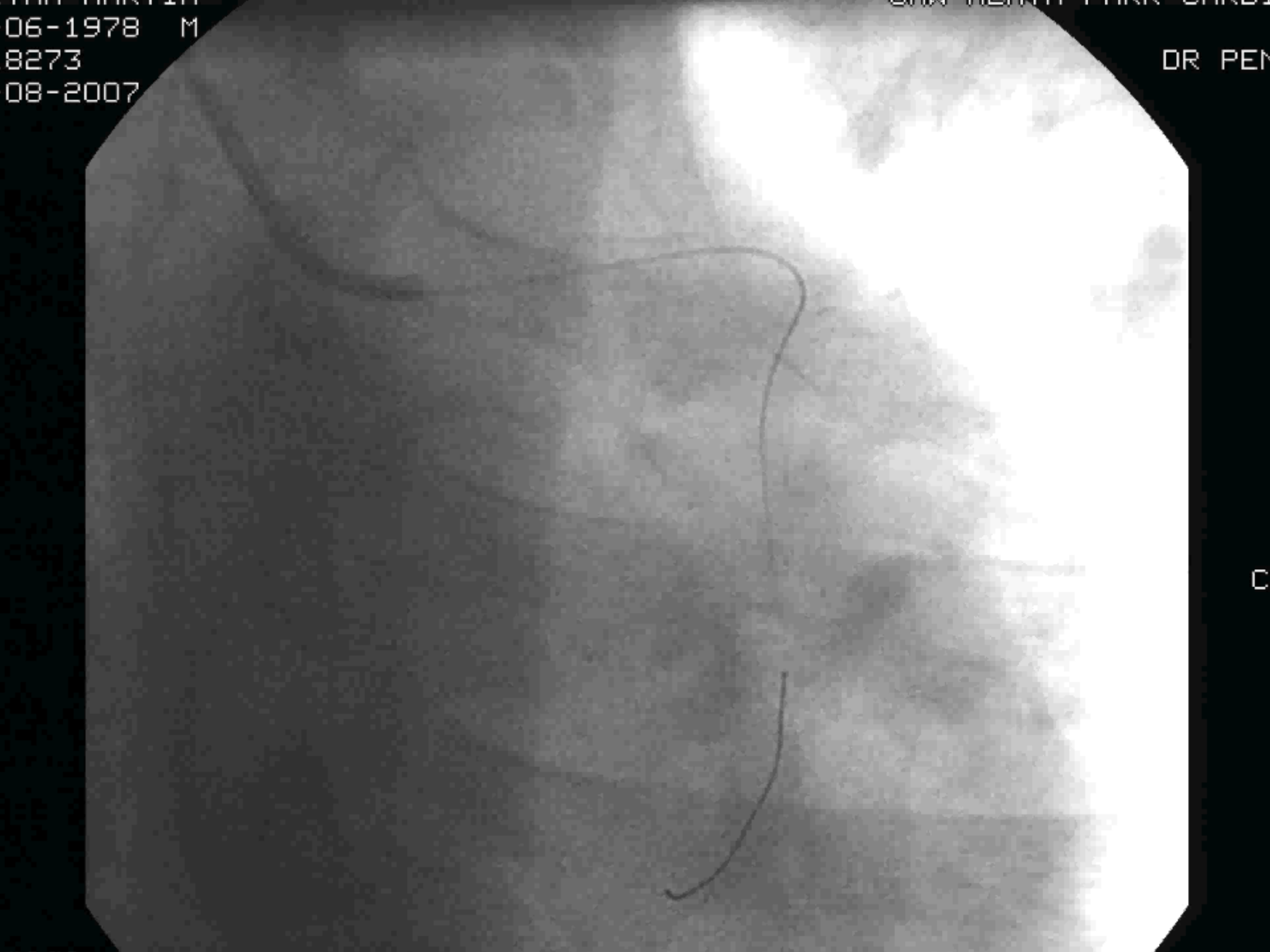
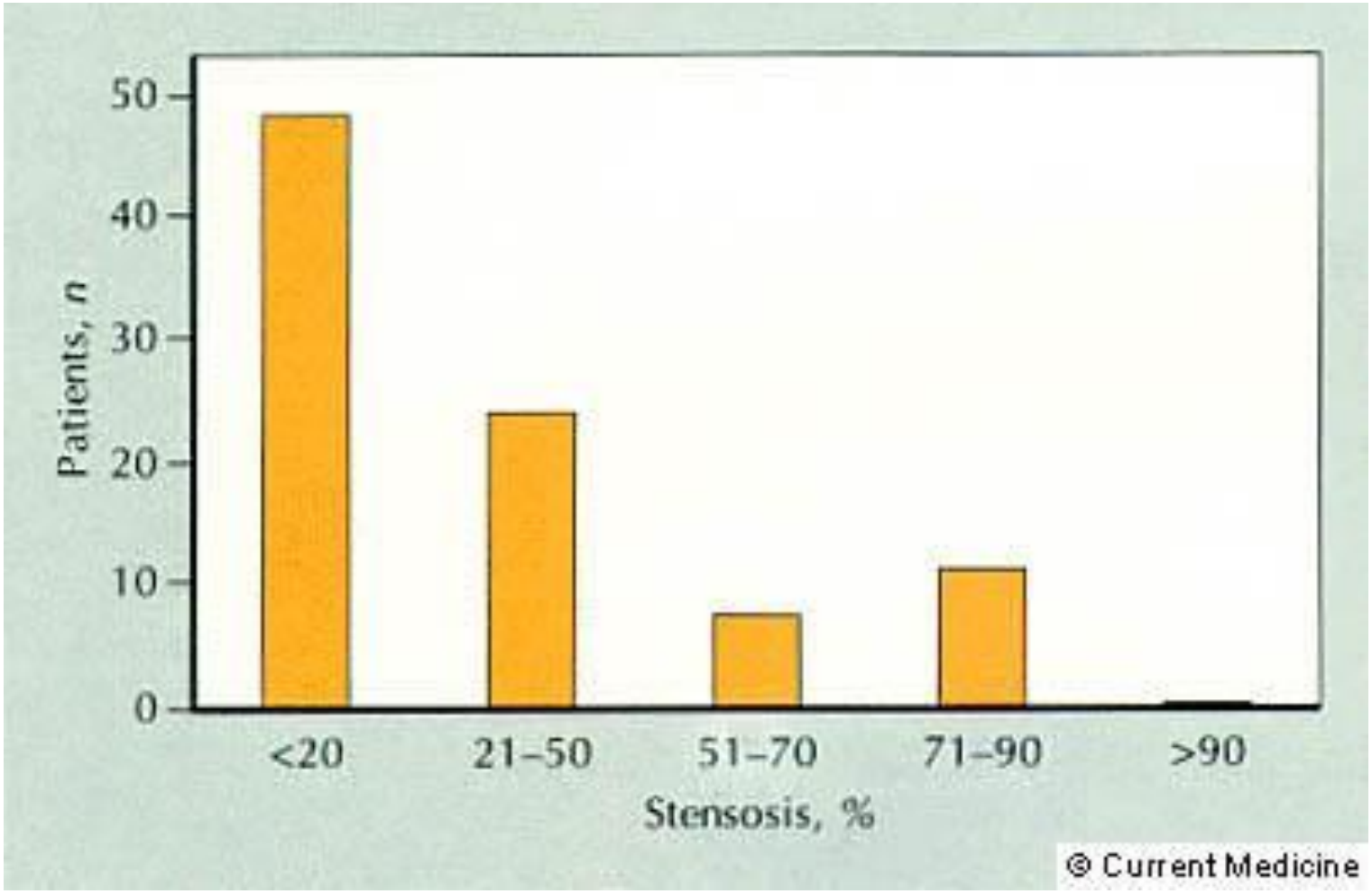
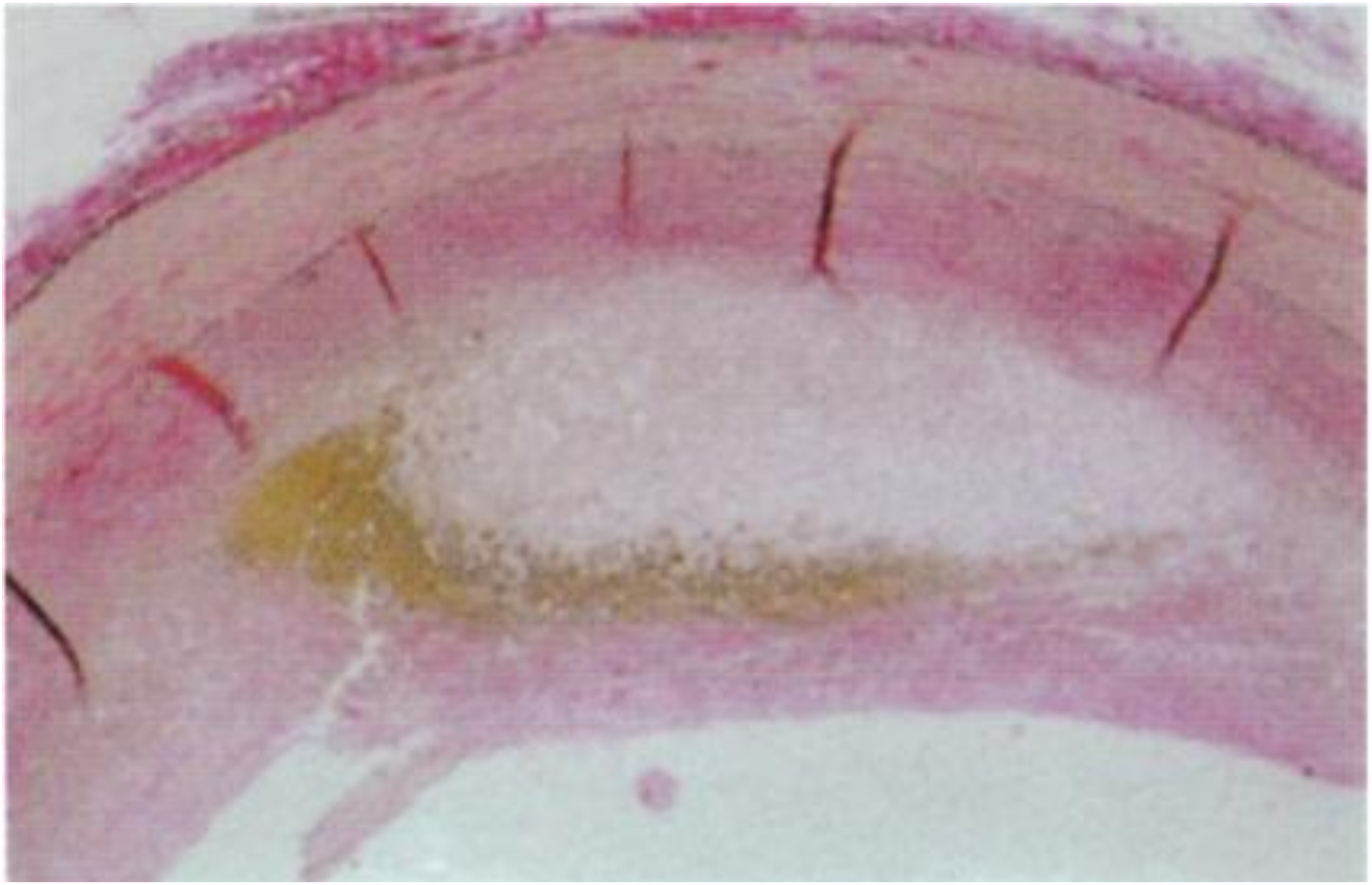
08-2007
DR PEN


06-1978 M
8273
08-2007
DR PEN

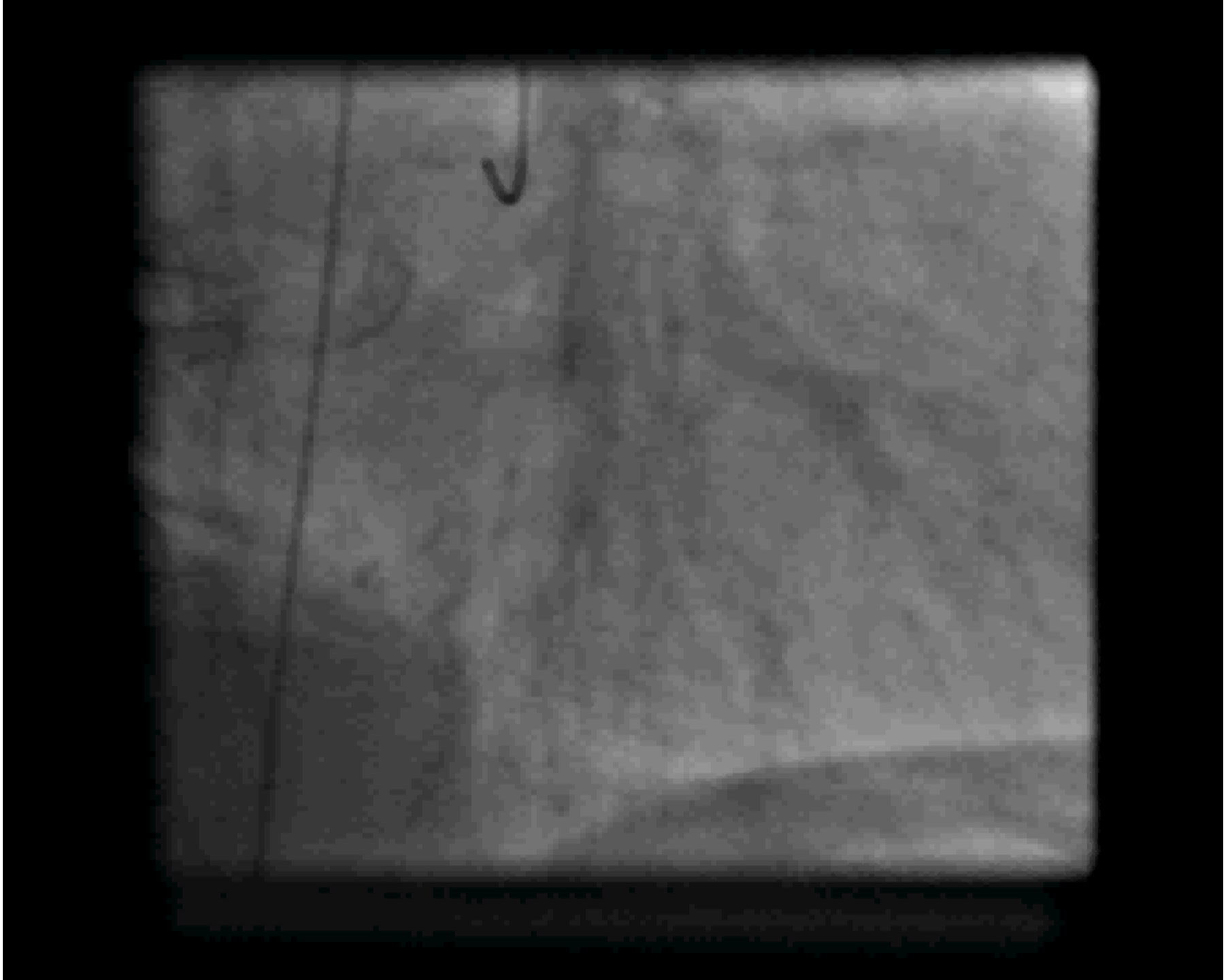
Minor coronary lesions may thrombose and result in subsequent MI



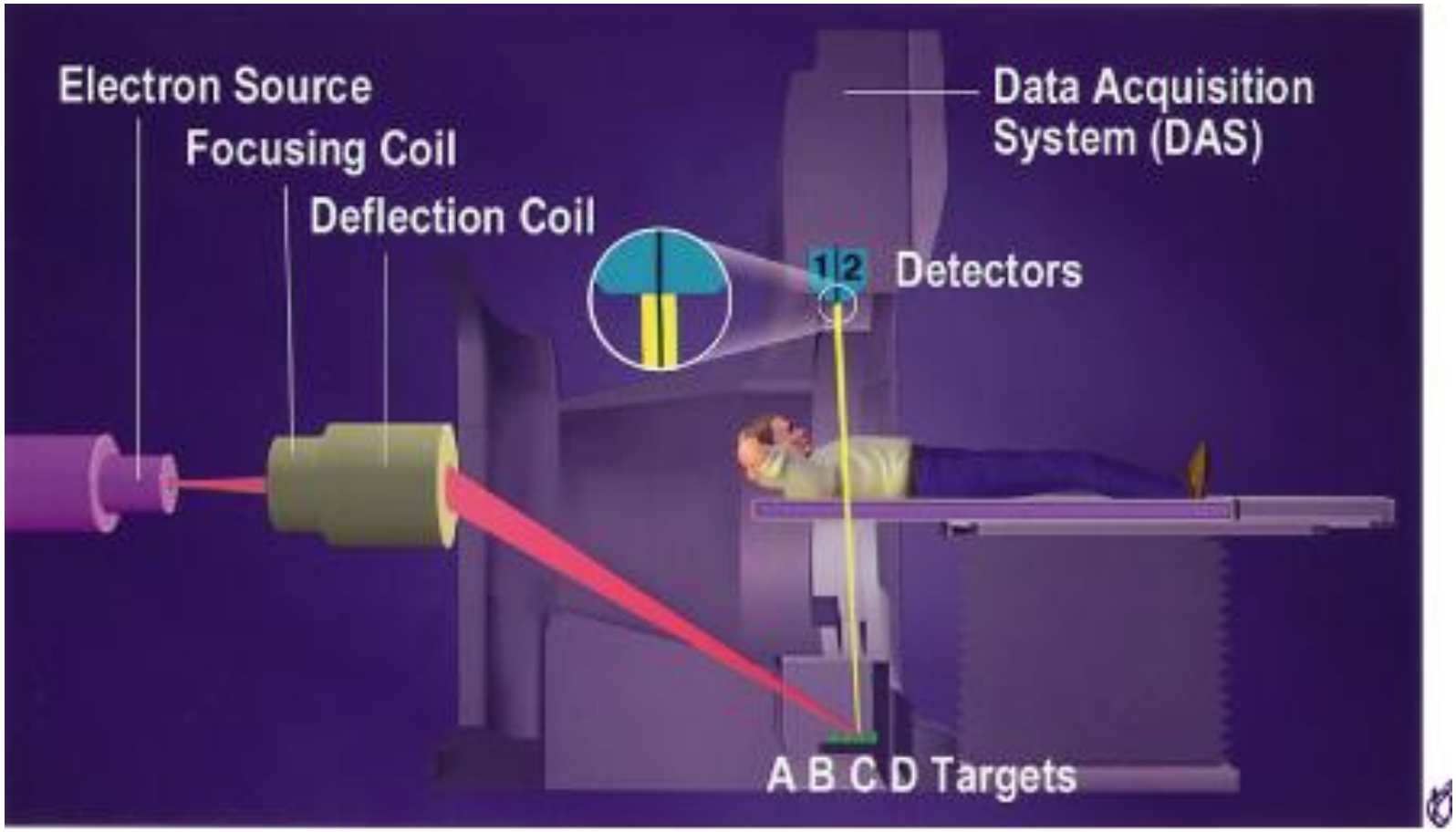
- New Risk Factors
  - Coronary calcium scores



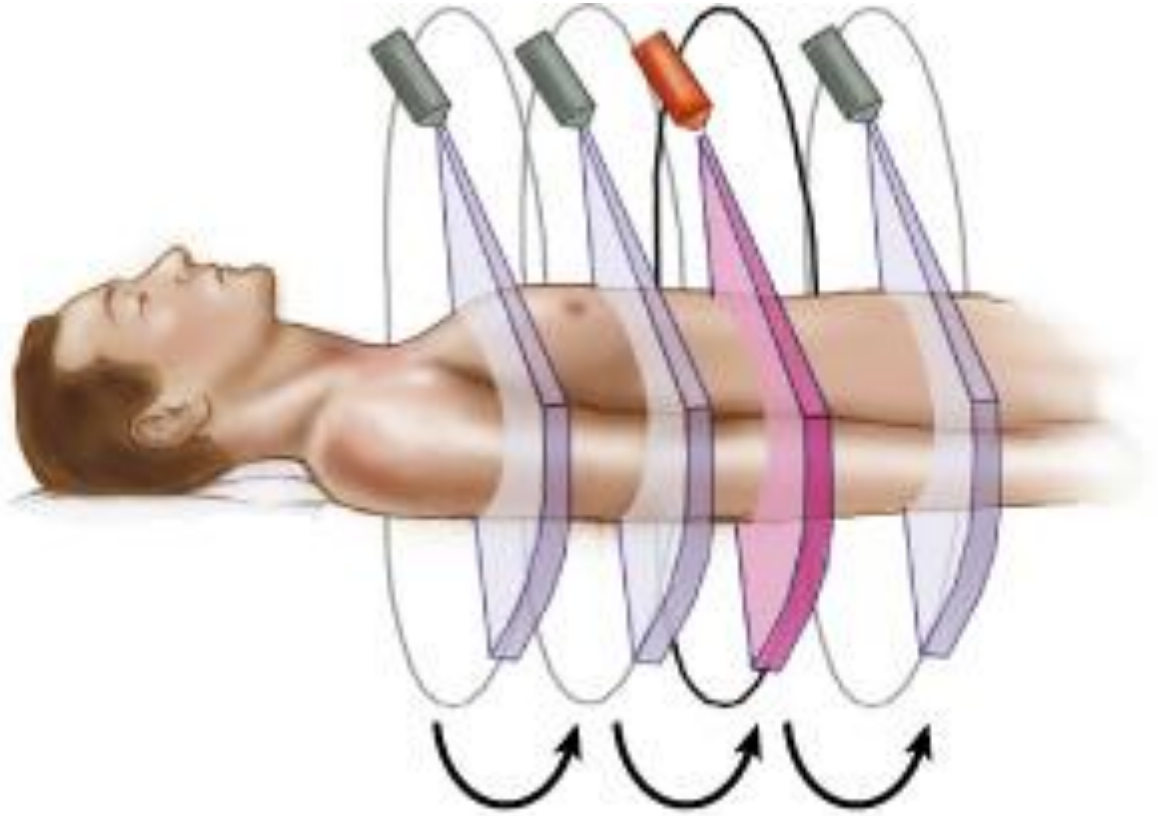
As plaque ages,calcium is laid down
EBCT sensitivity 80 to 90%, specificity 60% for plaque



EBCT uses a rotating electron beam and a stationary tungsten target



MSCT scanners employ an x ray beam and multiple detectors



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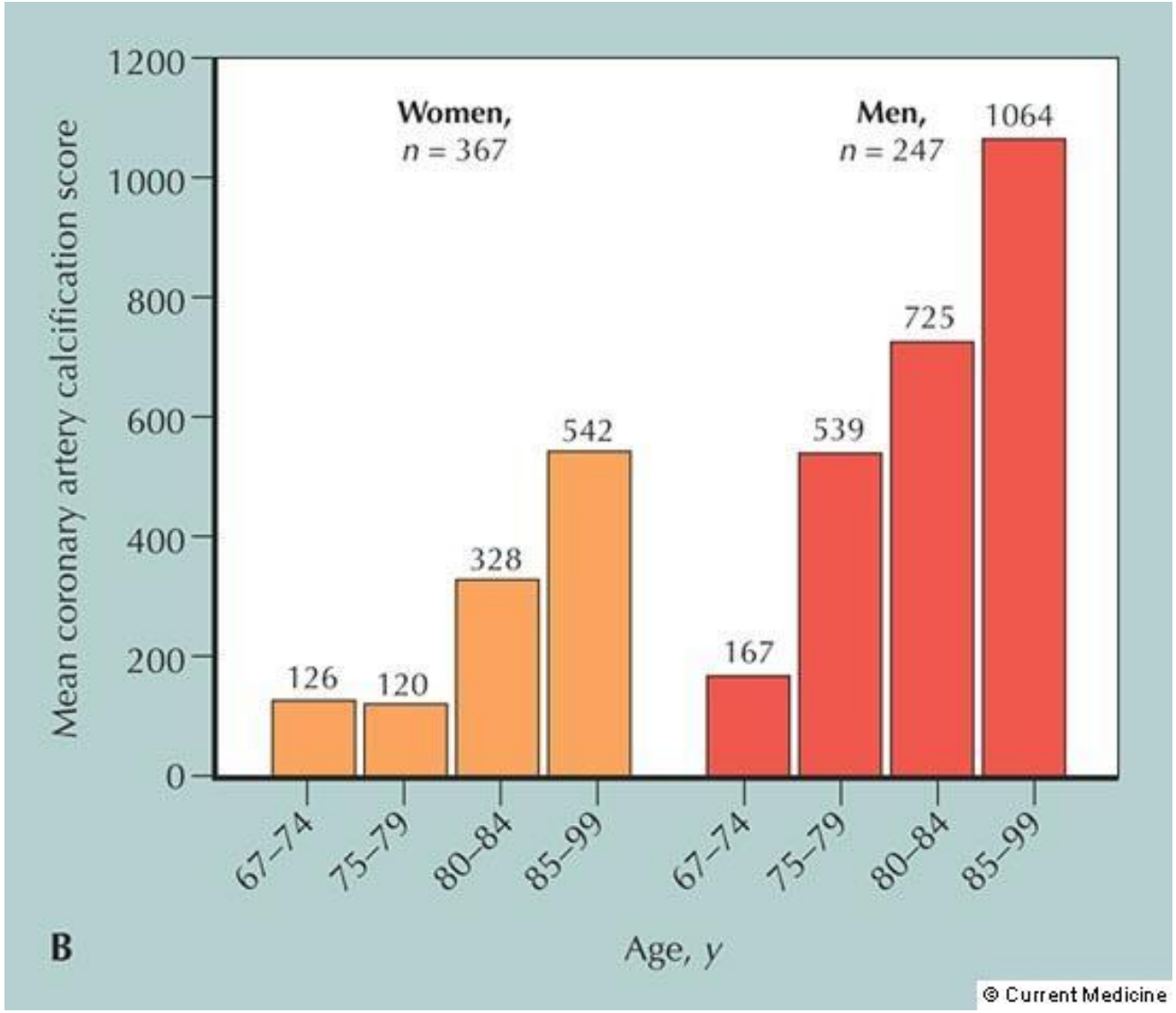
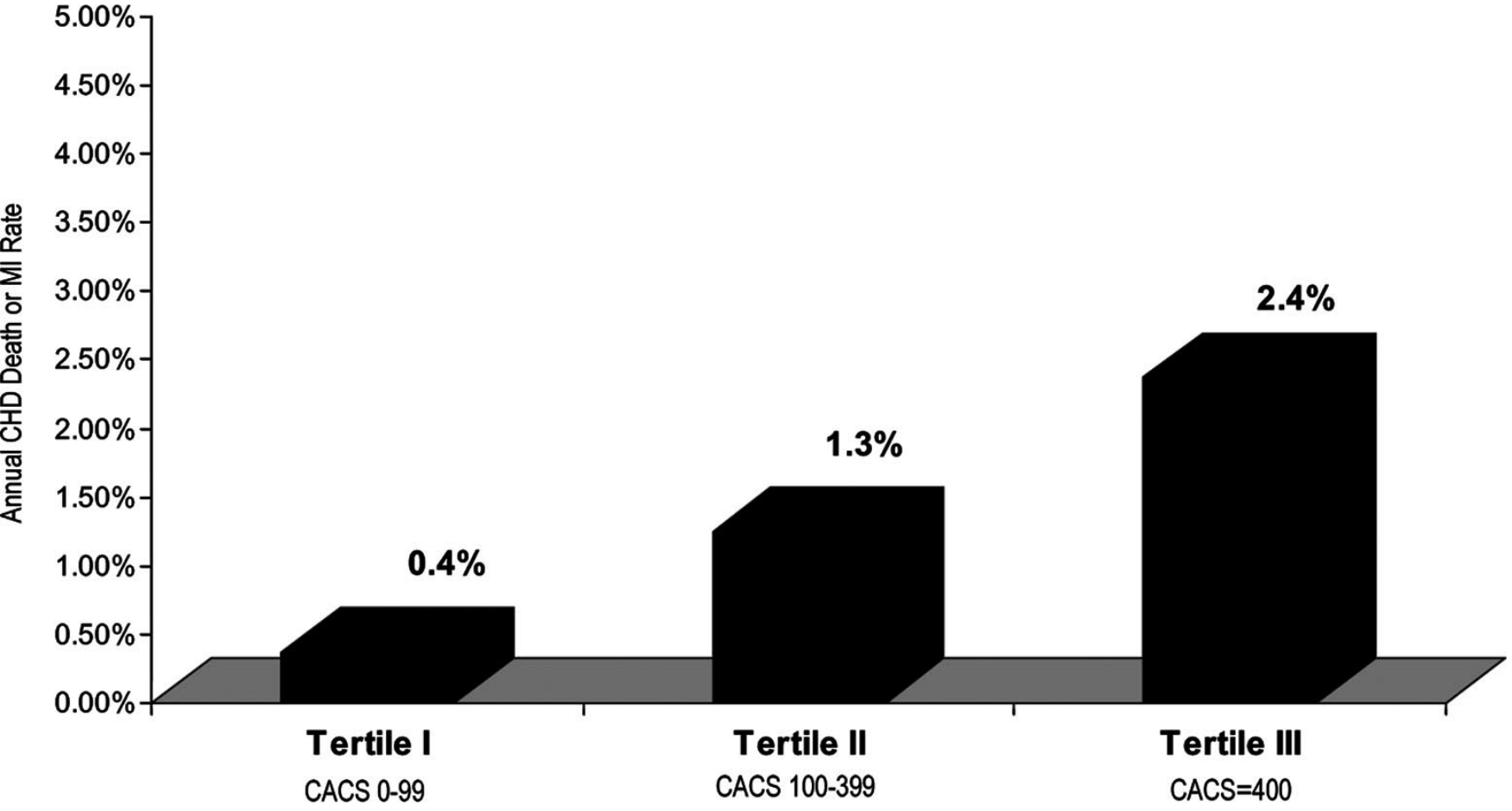
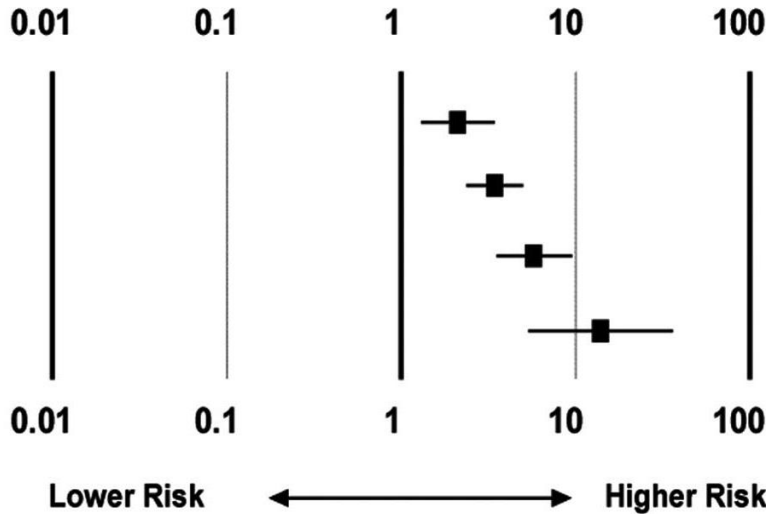
Coronary artery calcification scores



Estimated Annual Risk of Death or MI with increasing calcium scores in patients at intermediate risk of coronary heart disease



CACS	RR	(95% CI)	Events / N		p
			Higher Risk	Low Risk*	
1-112	1.9	(1.3-2.8)	67 / 9,514	45 / 12,163	0.001
100-400	4.3	(3.1-6.1)	110 / 5,209	49 / 11,817	<0.0001
400-999	7.2	(5.2-9.9)	182 / 3,940	49 / 8,649	<0.0001
1,000	10.8	(4.2-27.7)	14 / 196	6 / 905	<0.0001



In patients with an intermediate risk with a CAC score ≥ 400:

the patient's 10-year CHD risk is equivalent to that noted with diabetes or peripheral arterial disease

ACC/AHA 2007 Clinical Expert Consensus Document on Coronary Artery Calcium Scoring

Asymptomatic individuals with an intermediate risk may be reasonable
candidates for CHD testing using CAC as a potential means of modifying risk prediction and altering therapy.

On the other hand, there is little to be gained by testing with CAC in patients with low risk.

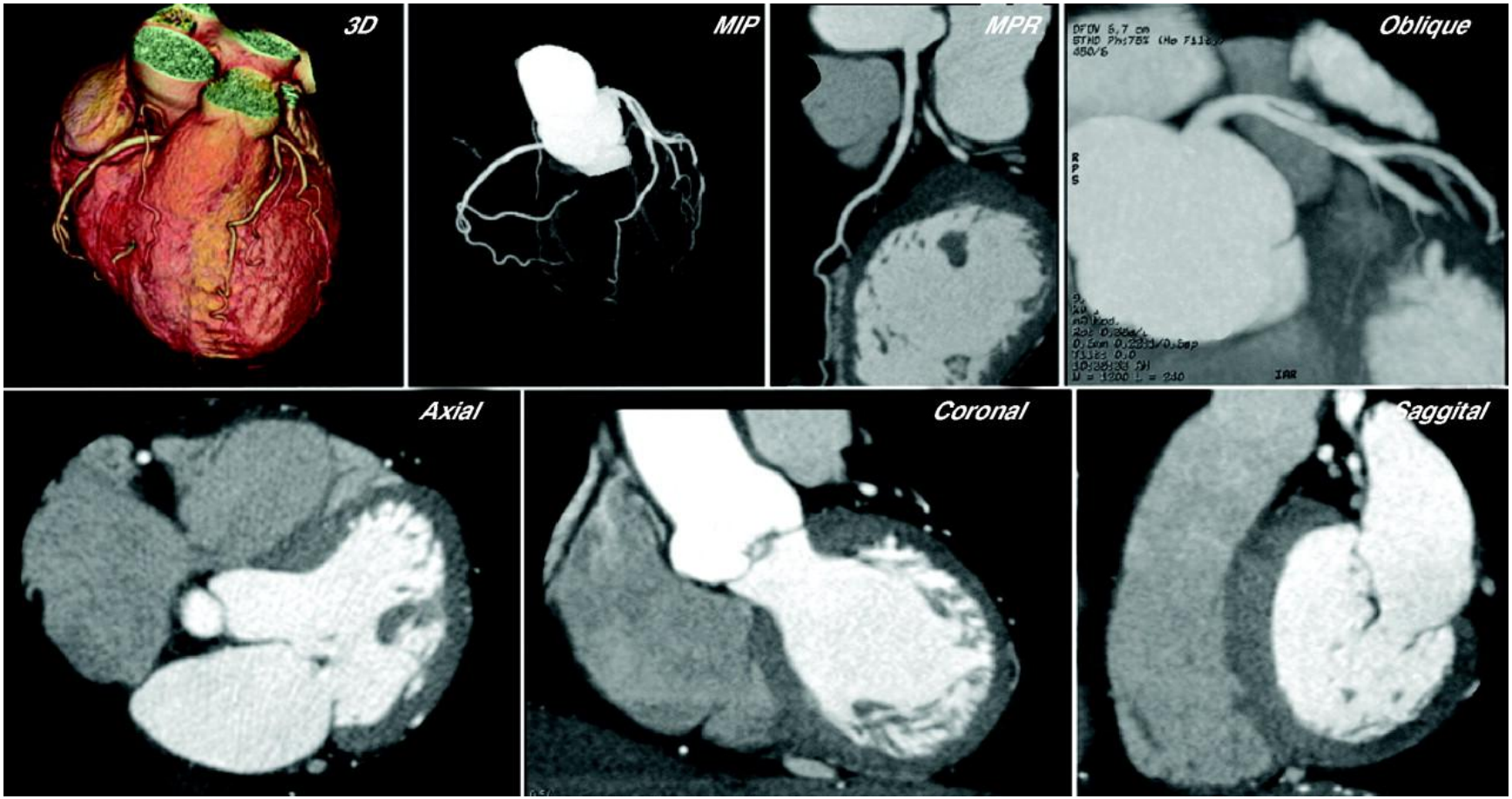
Patients at high risk eg Diabetes should be treated aggressively anyway

New role for MSCT

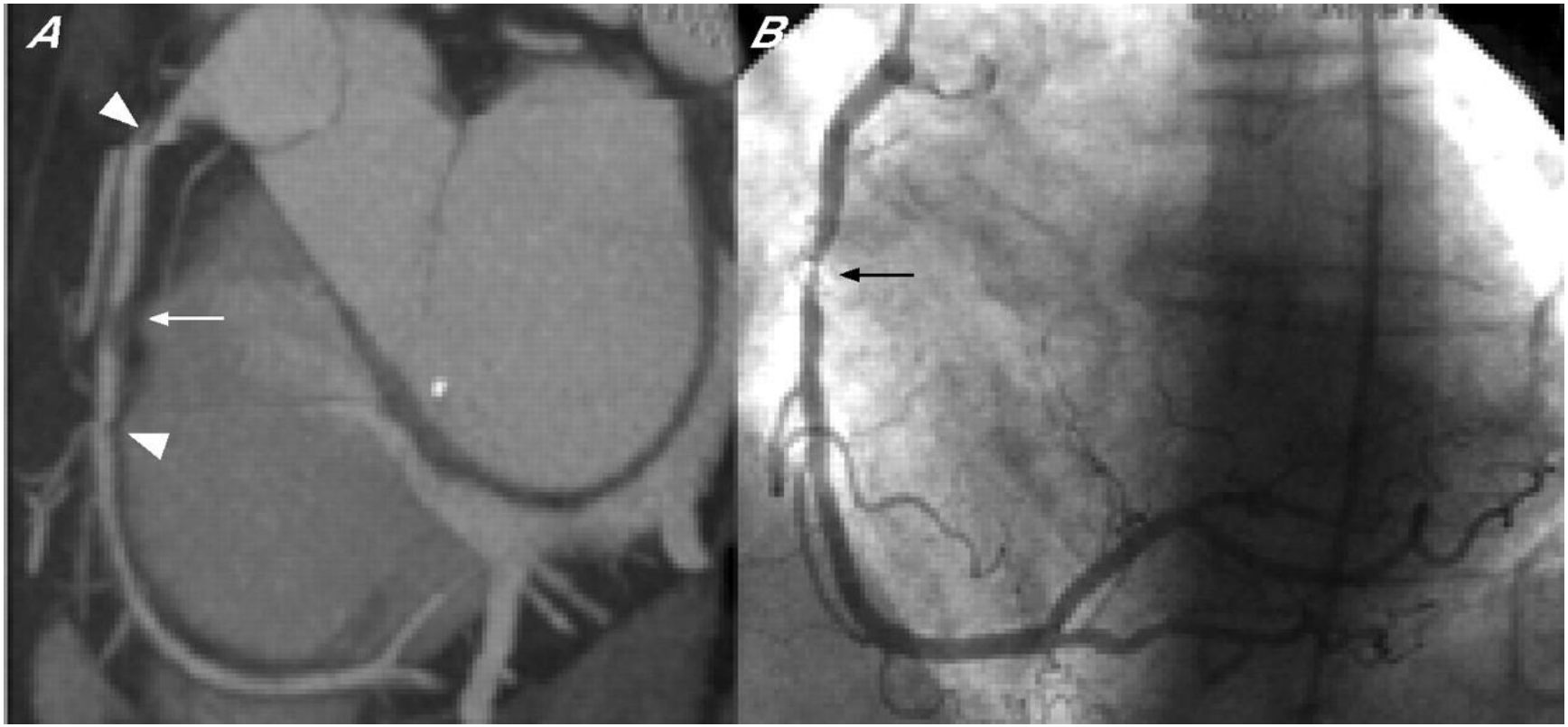
Non-invasive coronary angiography

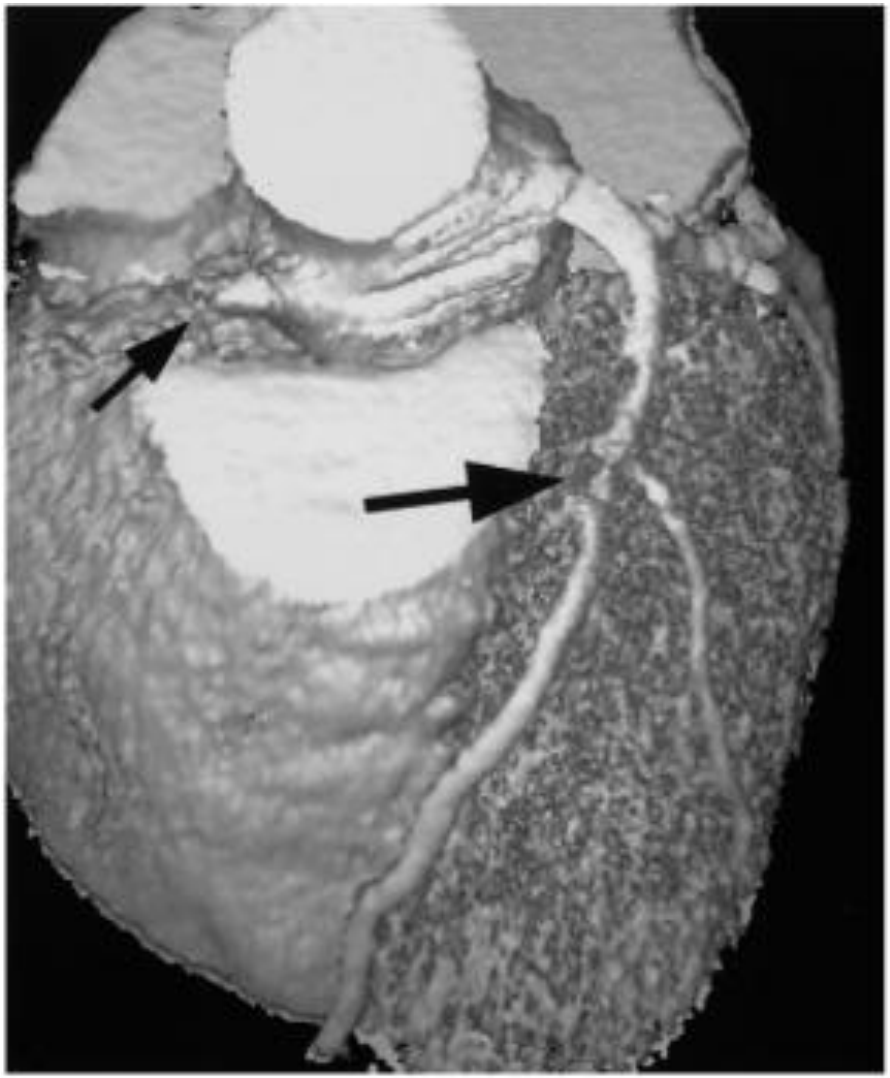
Dual imaging (calcium and lumen) maybe major advance

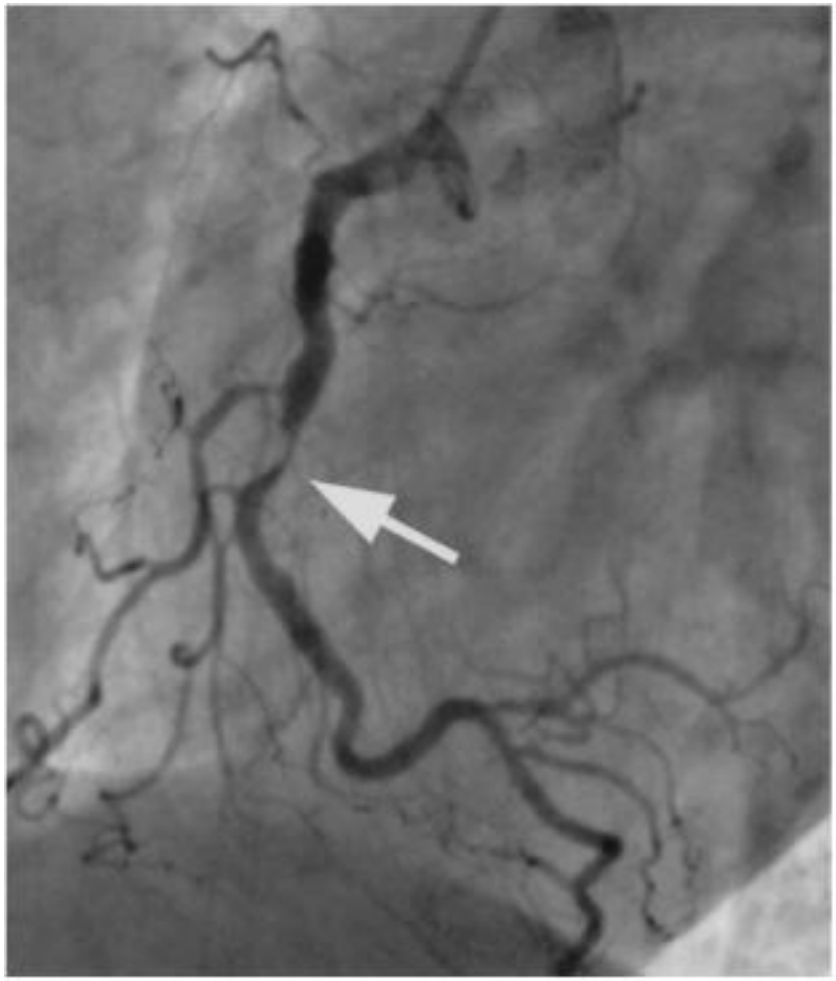
64-slice cardiac images of a normal heart and coronary arteries



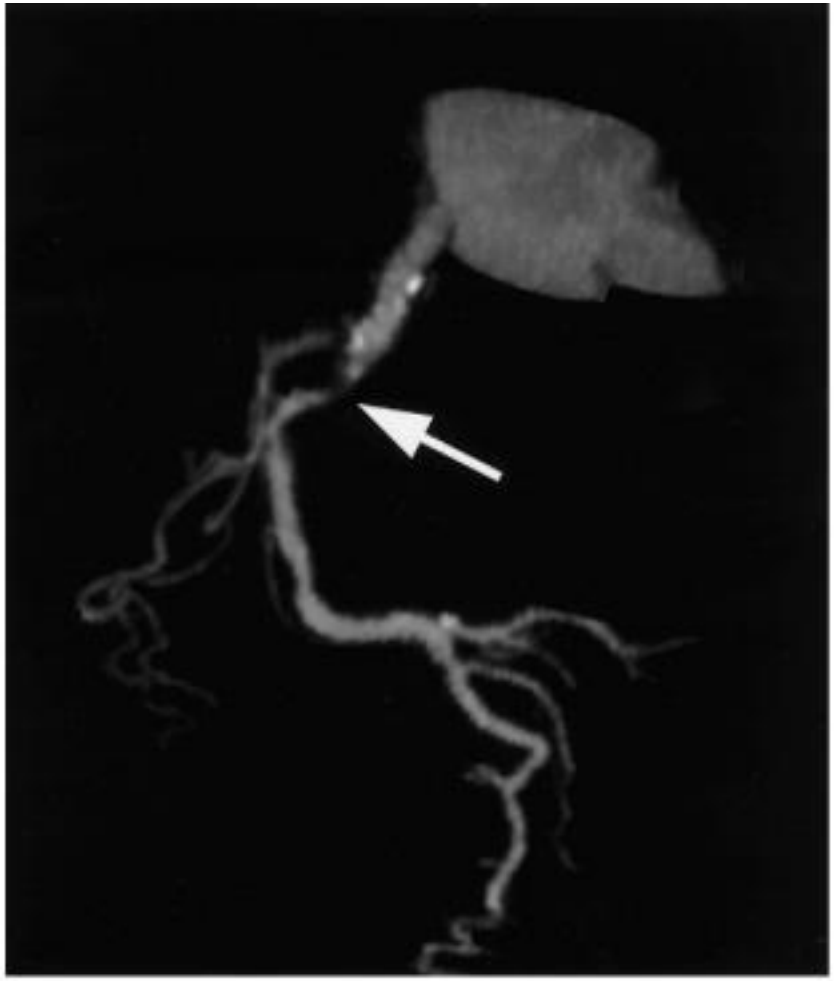
64-slice coronary CT (A) and conventional coronary angiogram (B) demonstrating a lesion (arrow) in the mid-right coronary artery.







B



A

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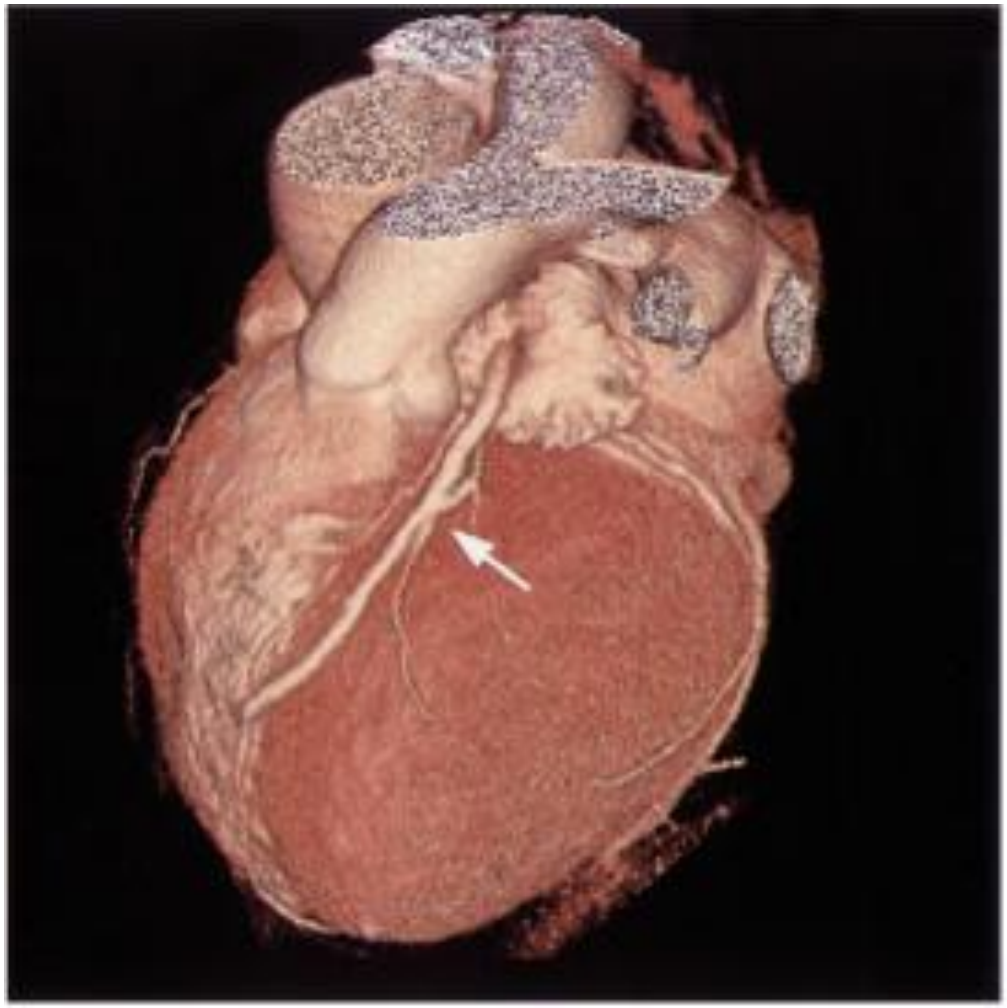
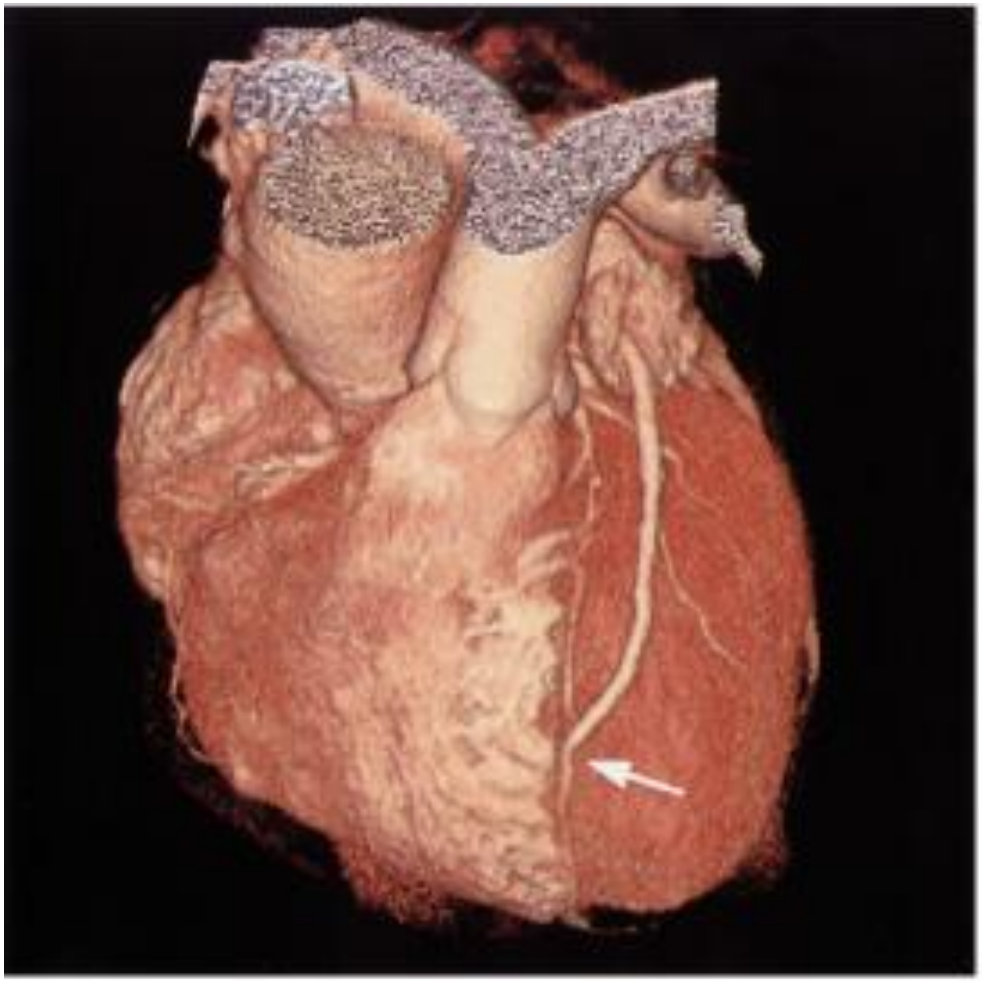
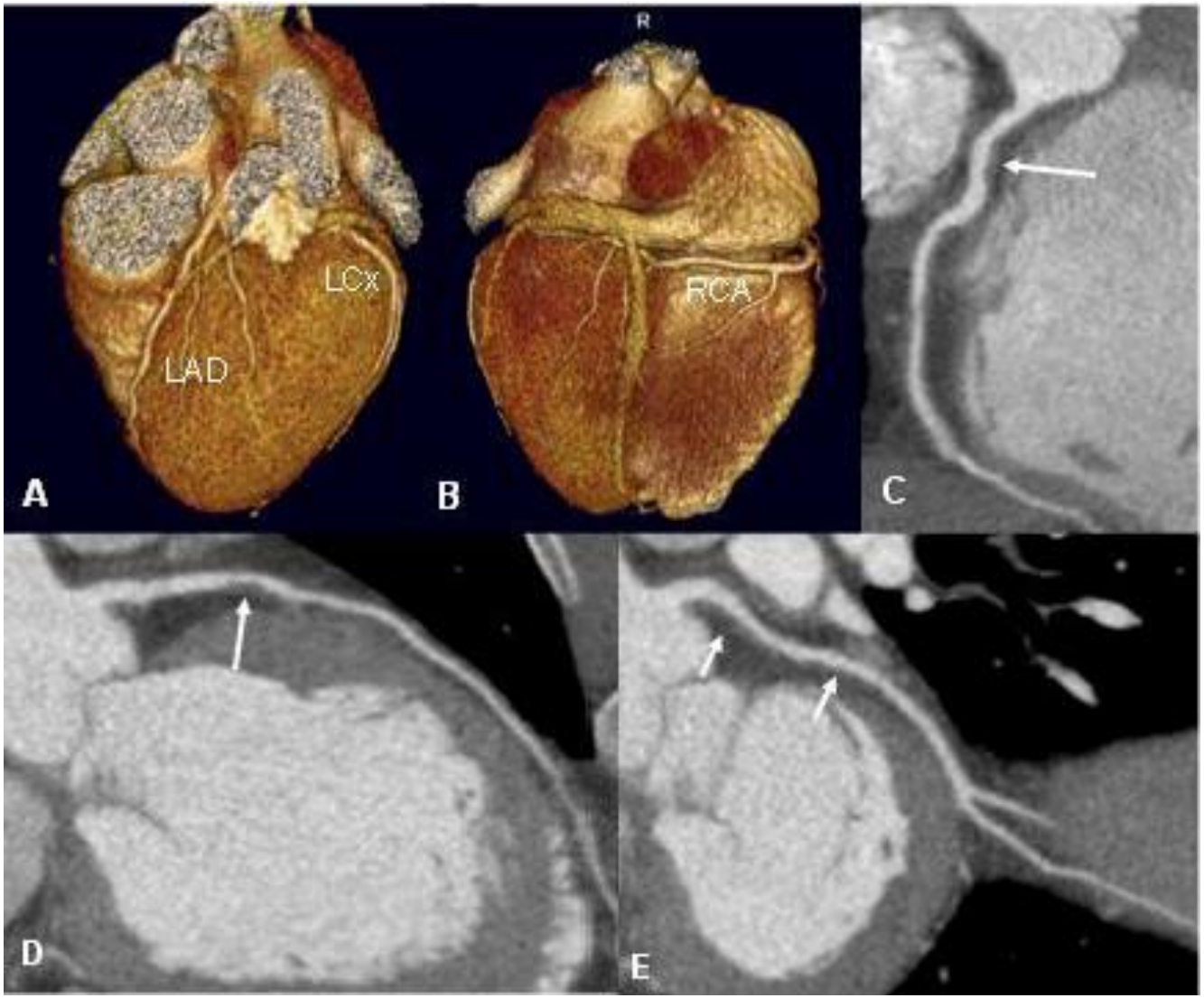


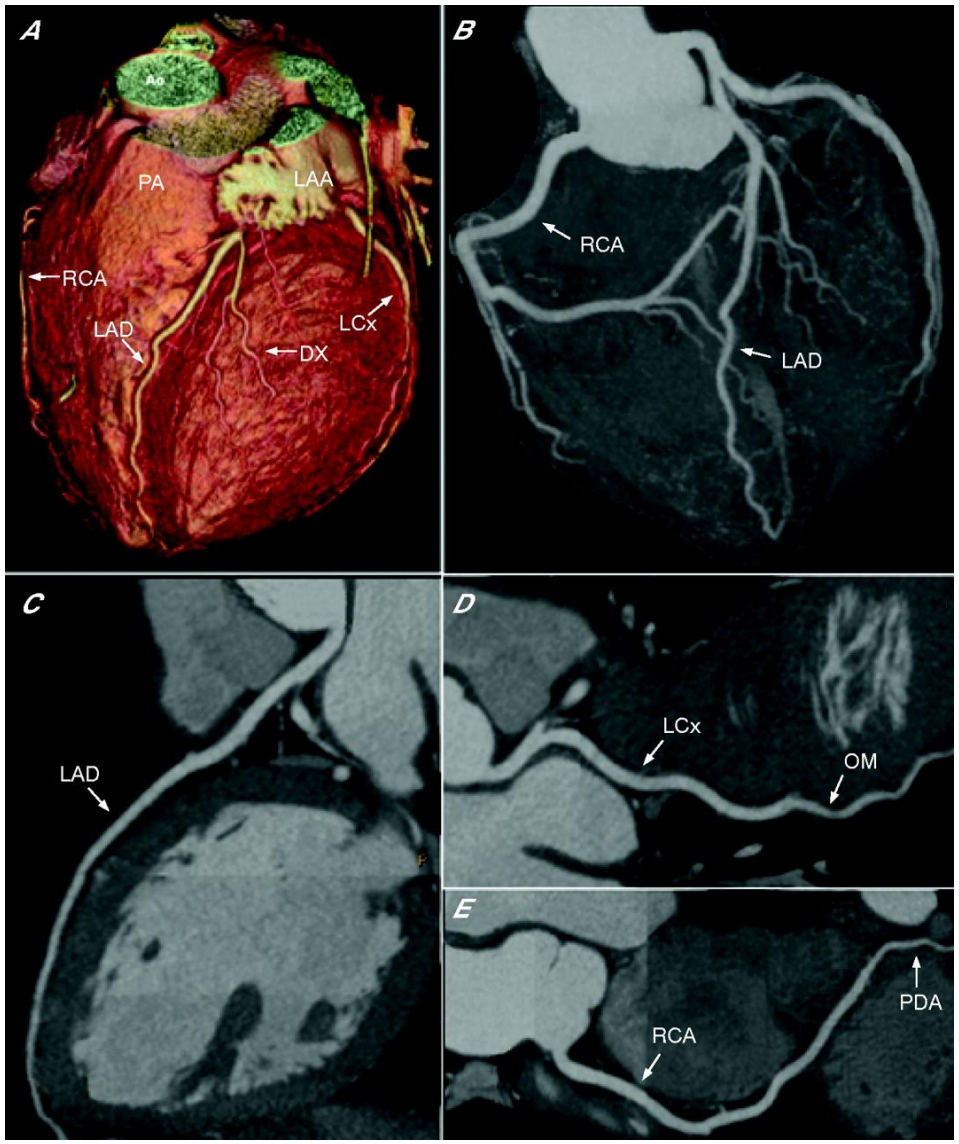


Non-invasive MSCT for calcium score and angiography



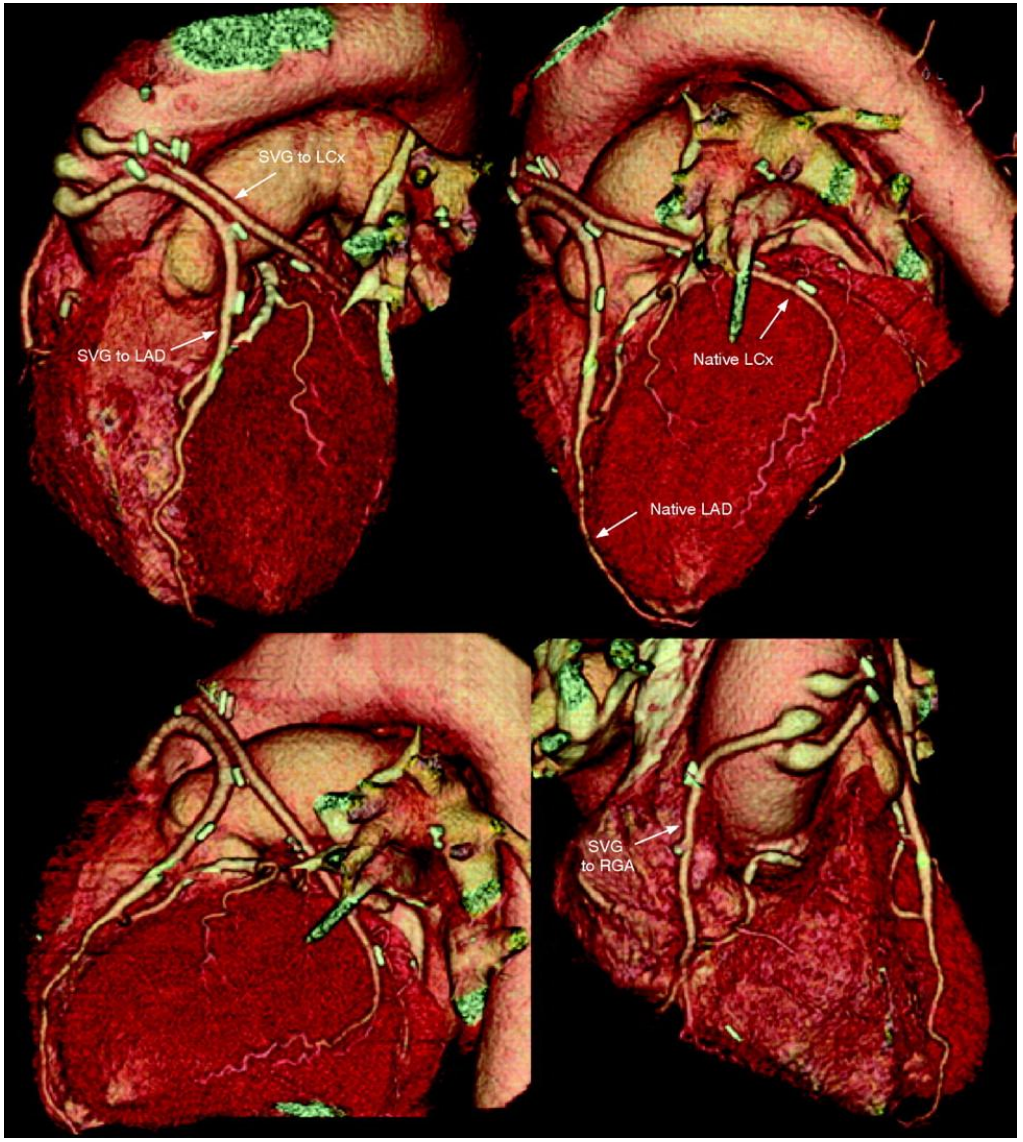
3D reconstruction showing
Coronary irregularities in a Diabetic without calcification

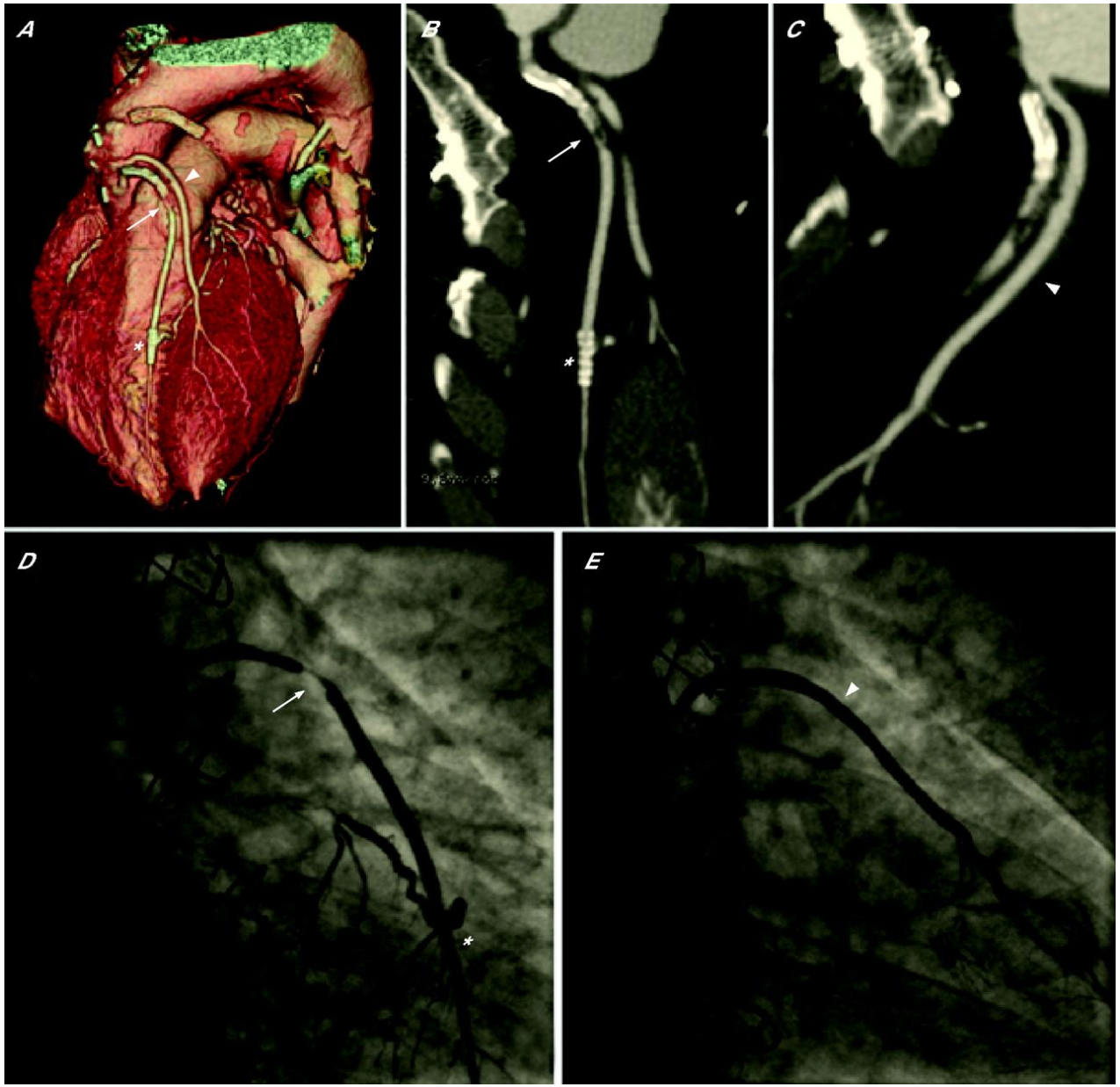
64-slice coronary CT images of a normal coronary tree.



Schussler, J. M et al. Heart 2007;93:290-297

Patent grafts to the left anterior descending (LAD), left circumflex (LCx) and right coronary artery (RCA)

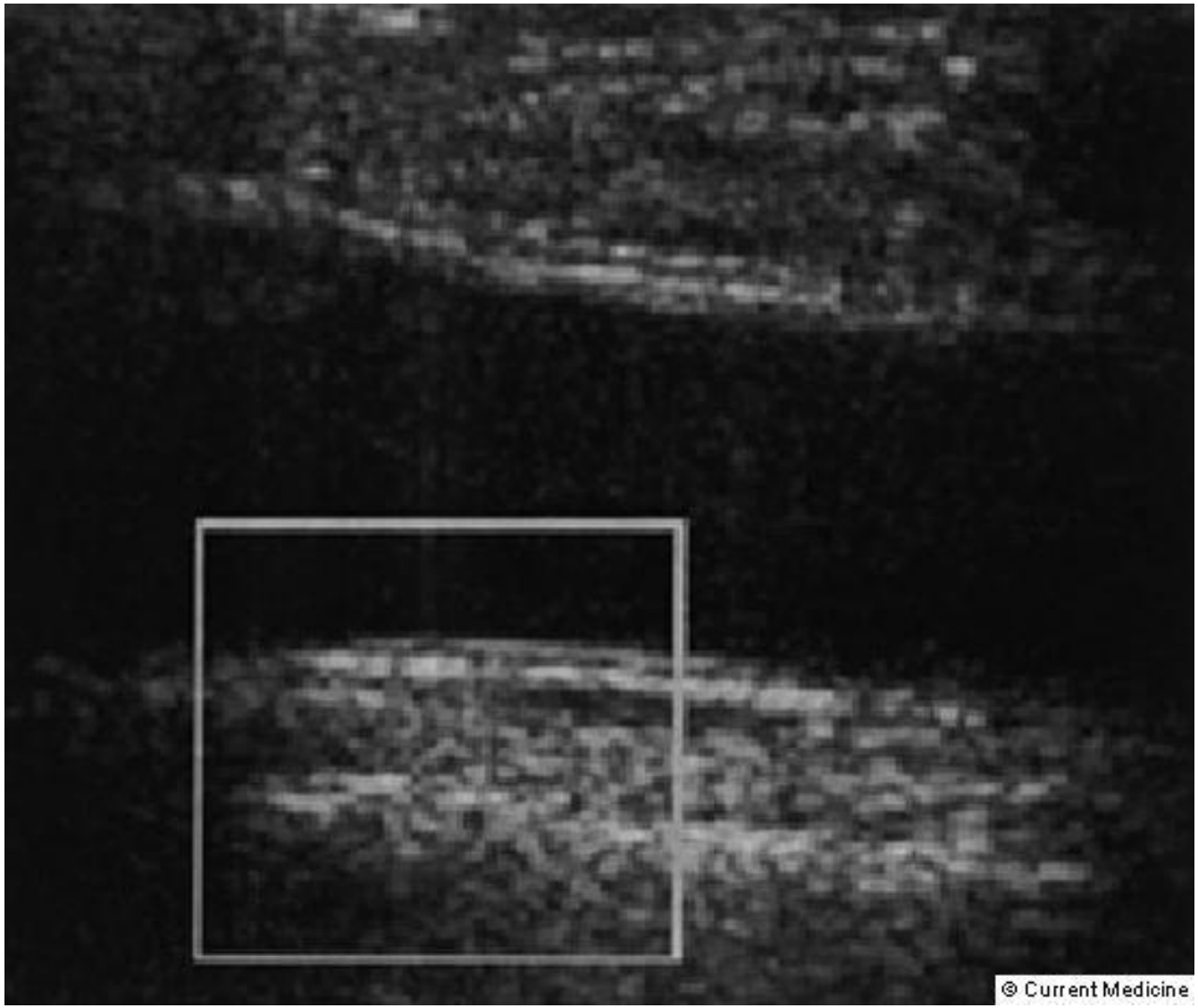




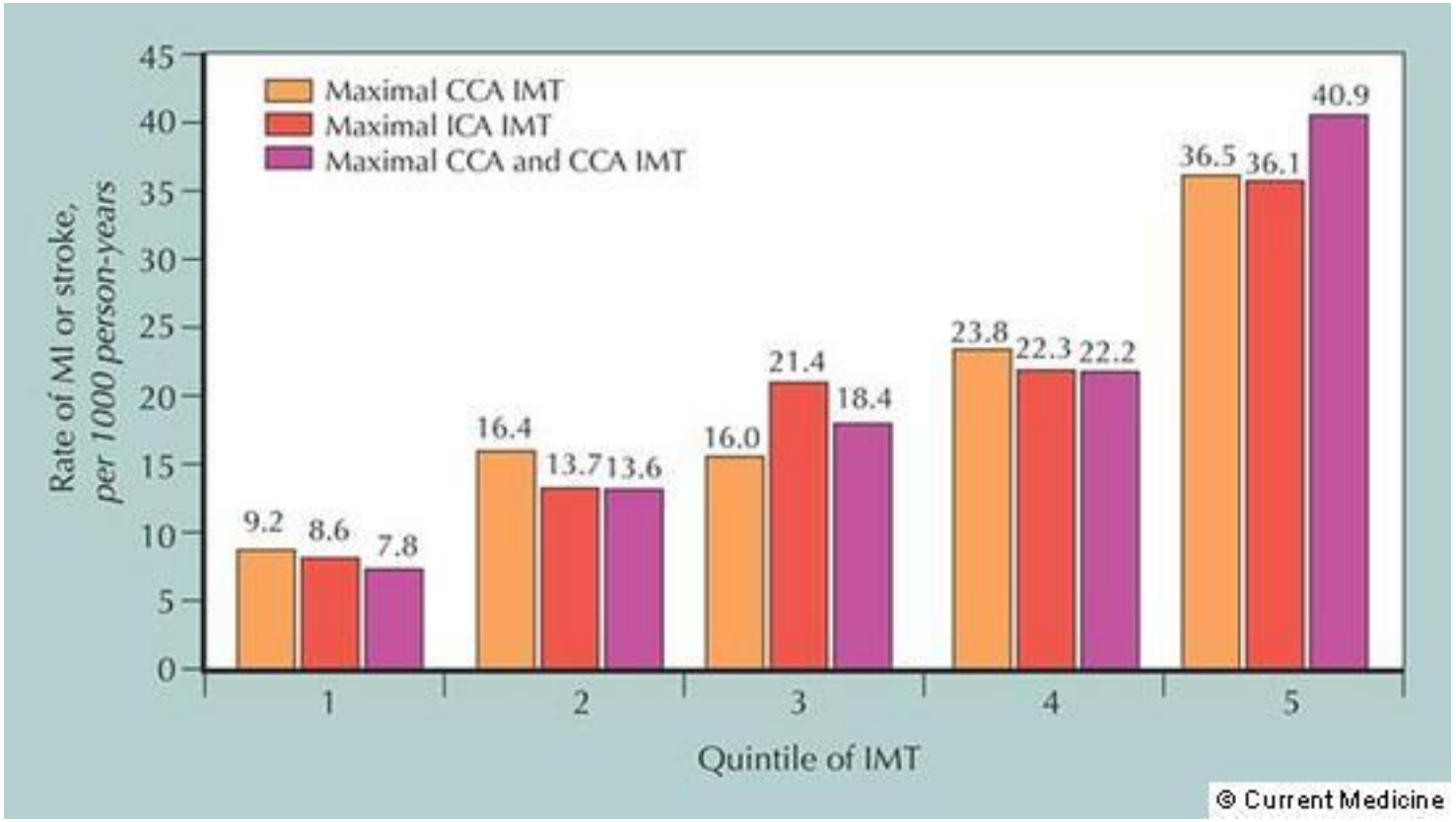
Lesion in the graft to the LAD and a patent graft to the diagonal branch. Invasive angiography confirm these findings.

Other novel ways of assessing risk

Carotid artery
Intimal medial thickness



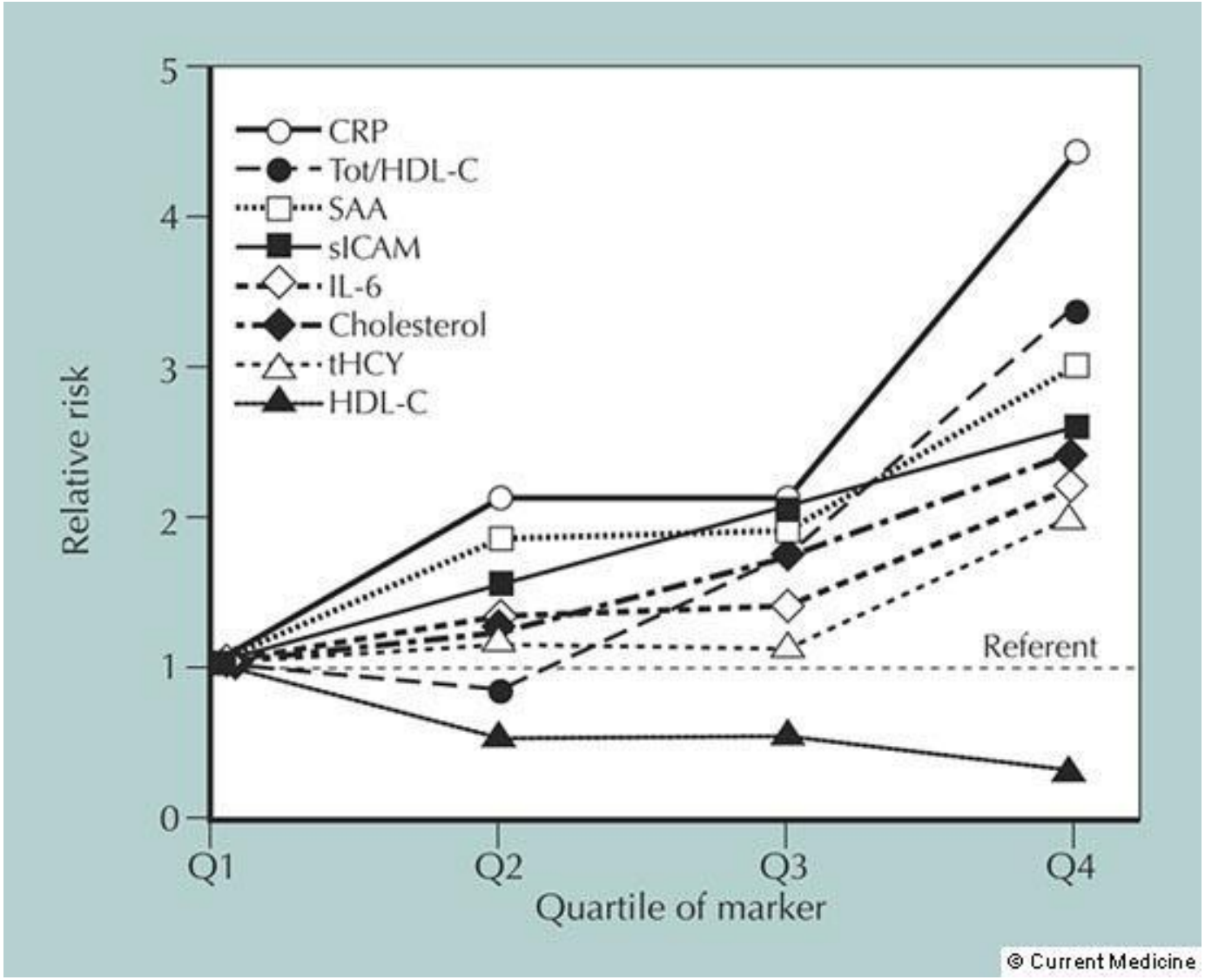
Greater carotid intimal:medial thickness and risk of cardiovascular sequelae

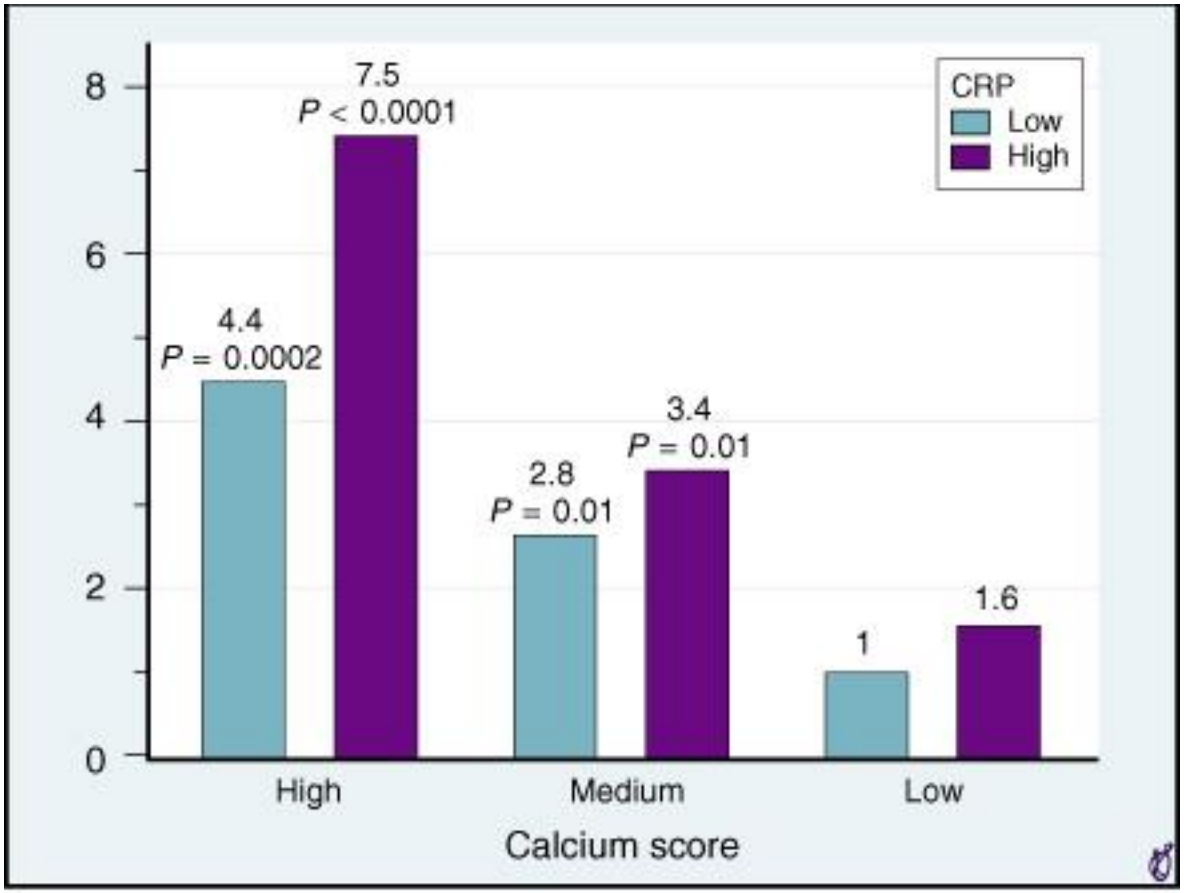


Other novel risk factors:

Importance of inflammatory markers

Inflammation markers and relative risk





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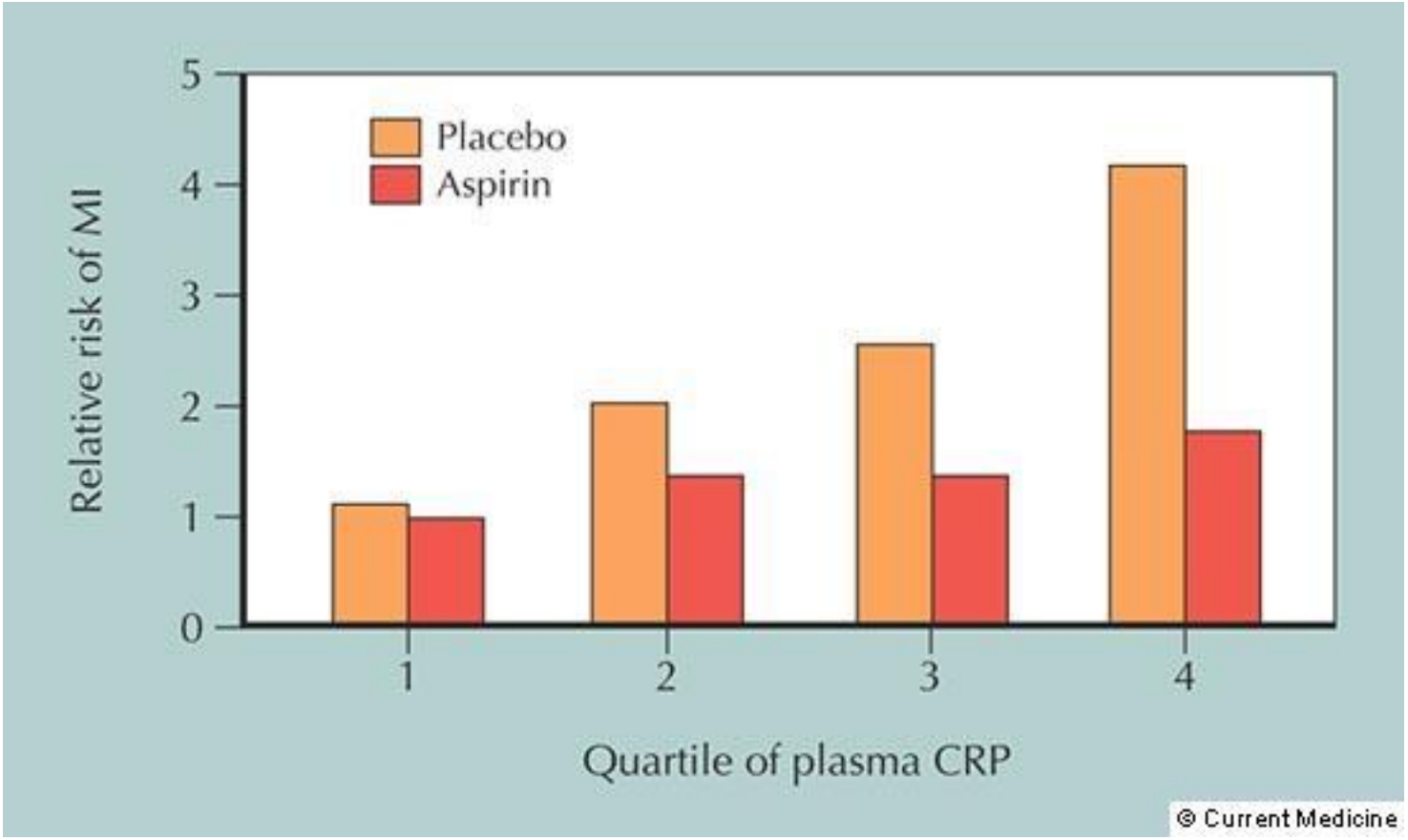
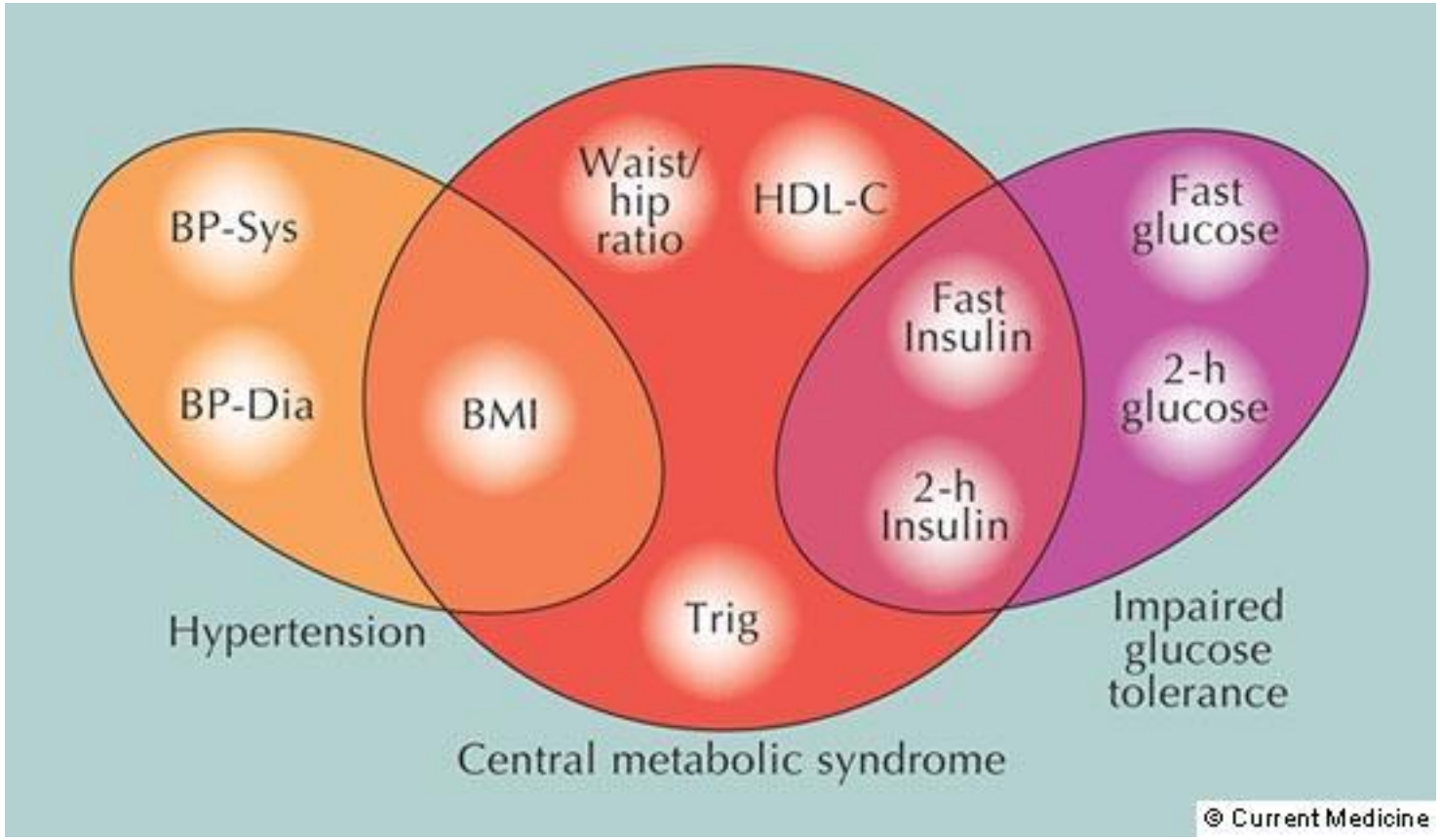
Risk ratios of nonfatal myocardial infarction, coronary death

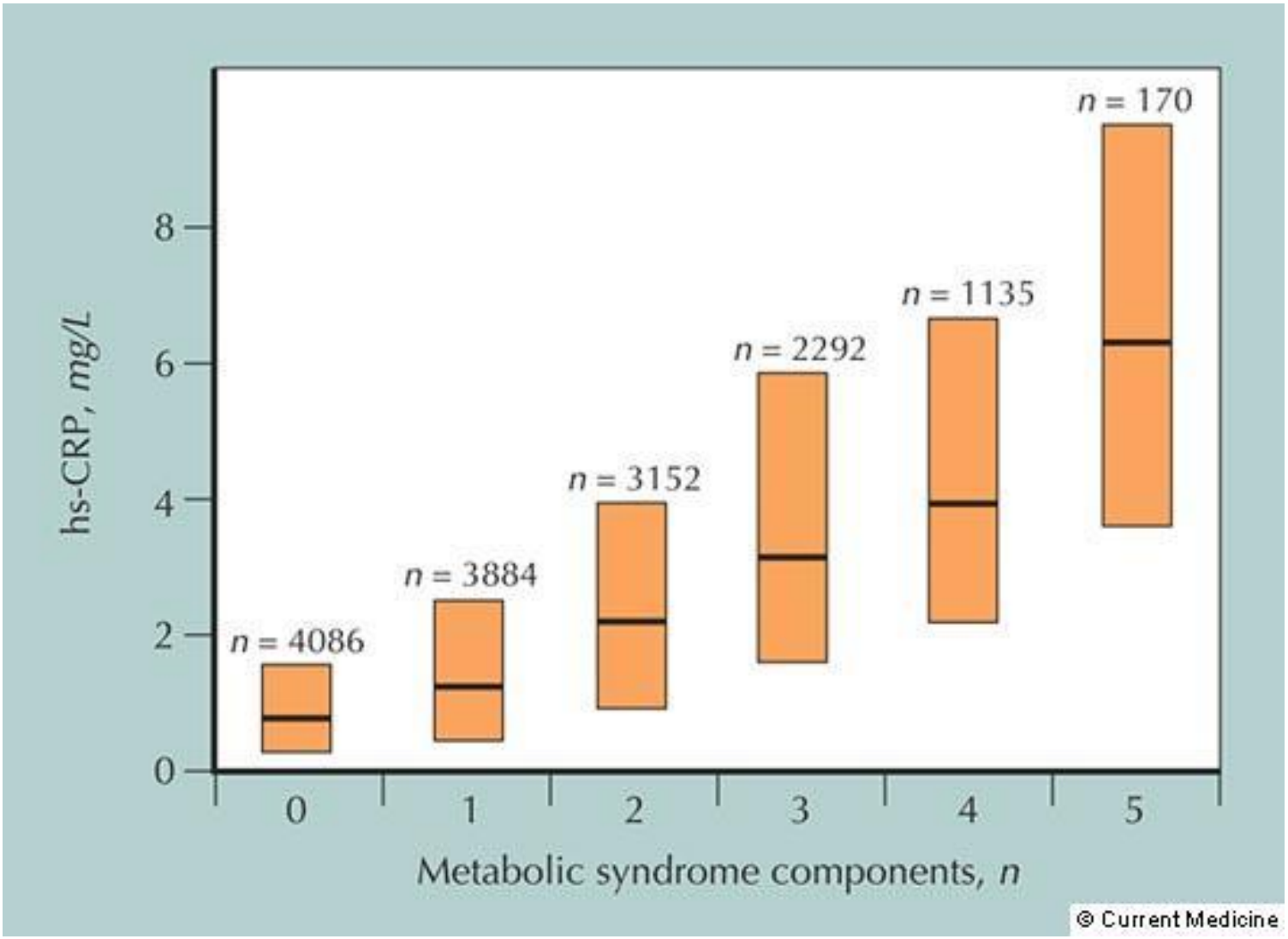
C-reactive protein concentrations at entry into the Physicians Health Study



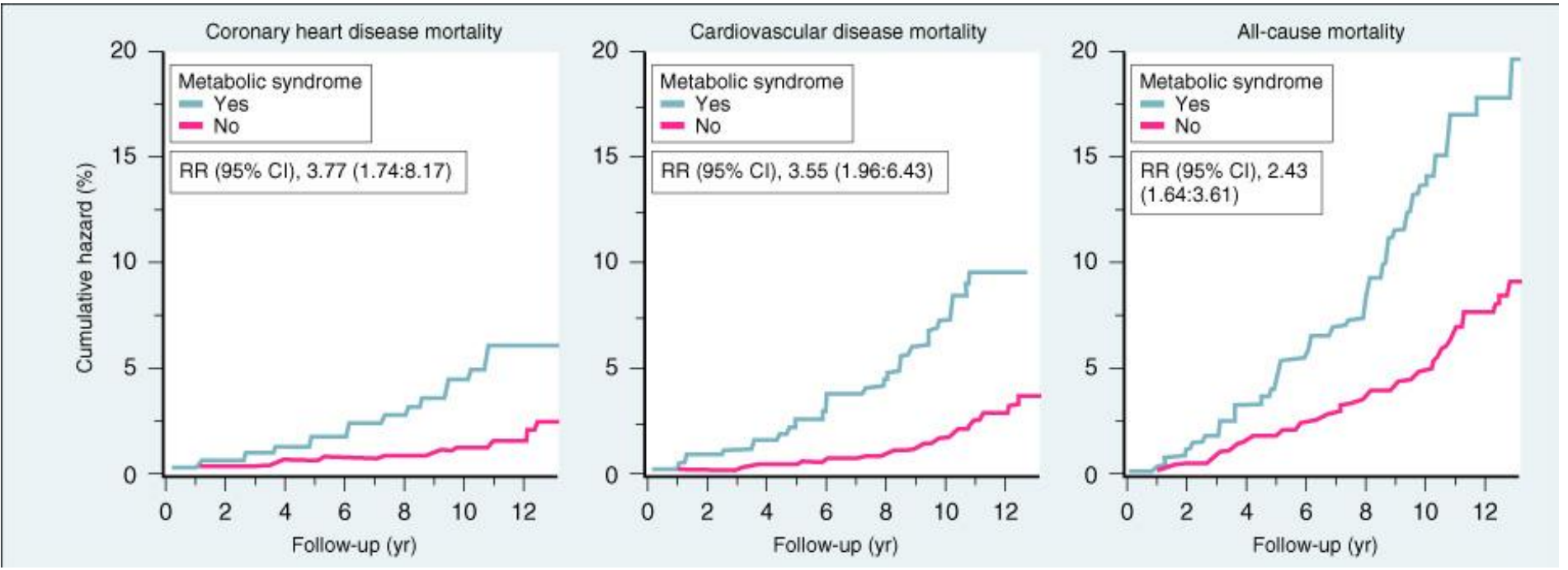
Risk factors for a metabolic syndrome



C-reactive protein increases with a rising number of metabolic risk factors



mortality among individuals with and without metabolic syndrome



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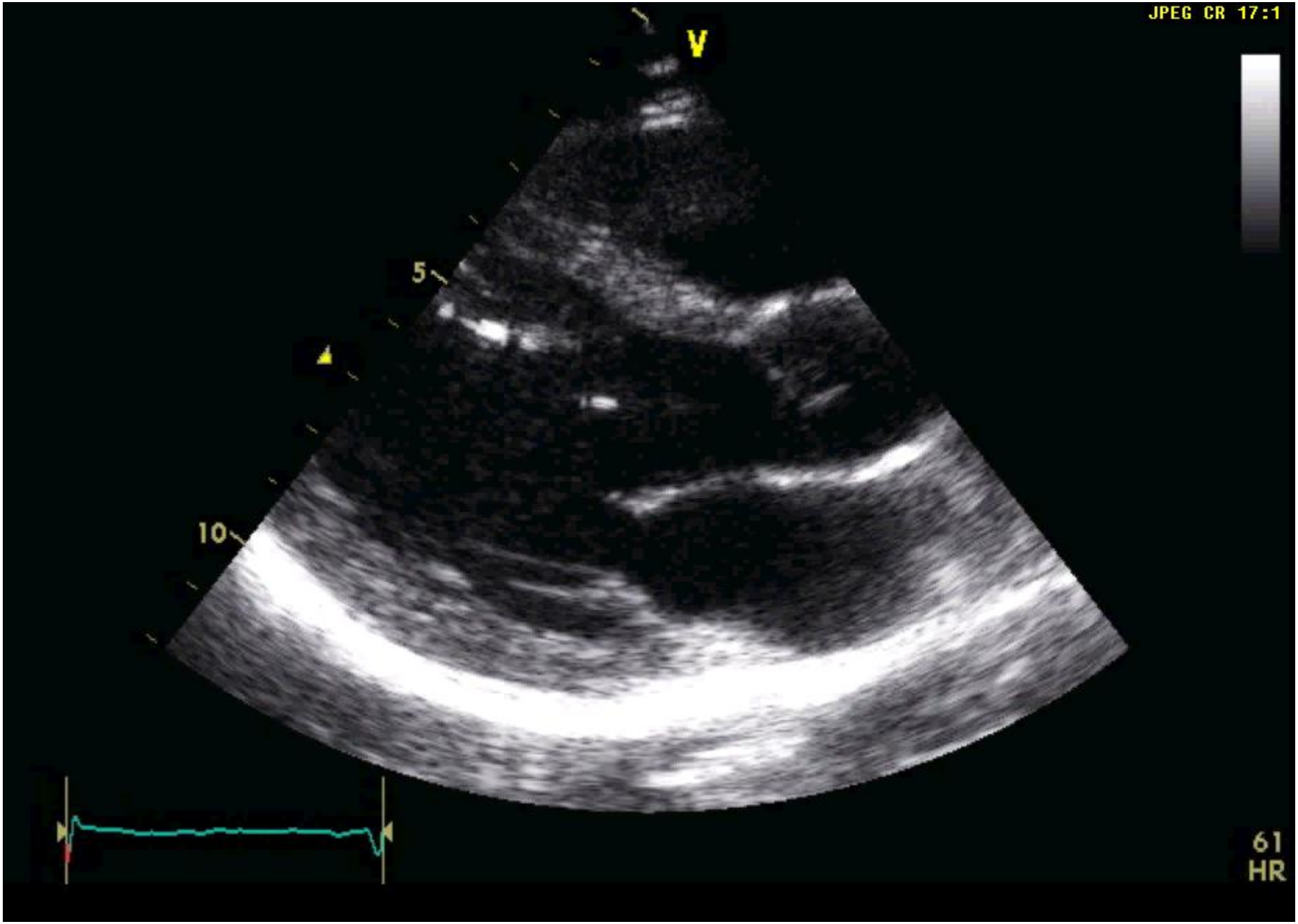
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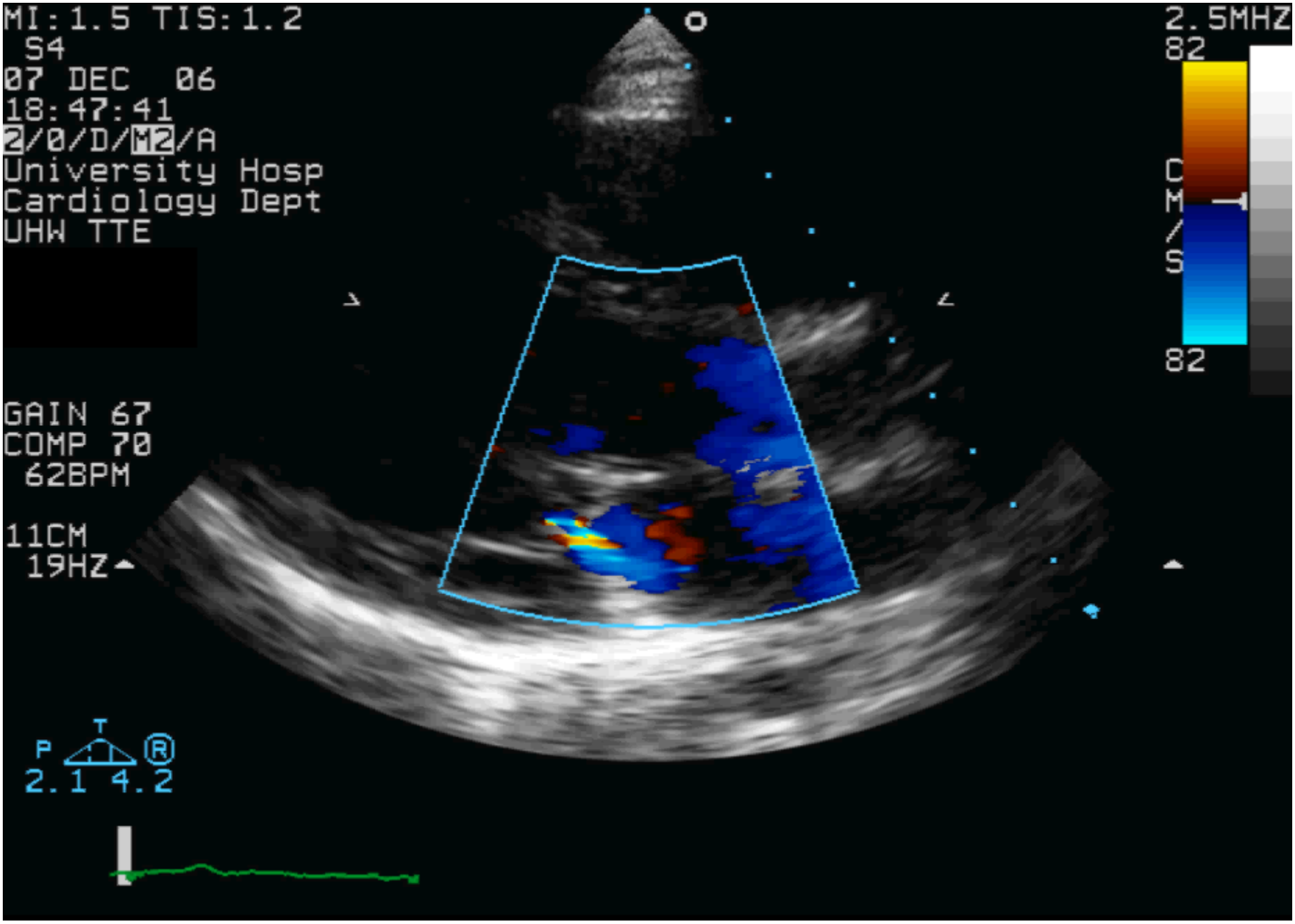
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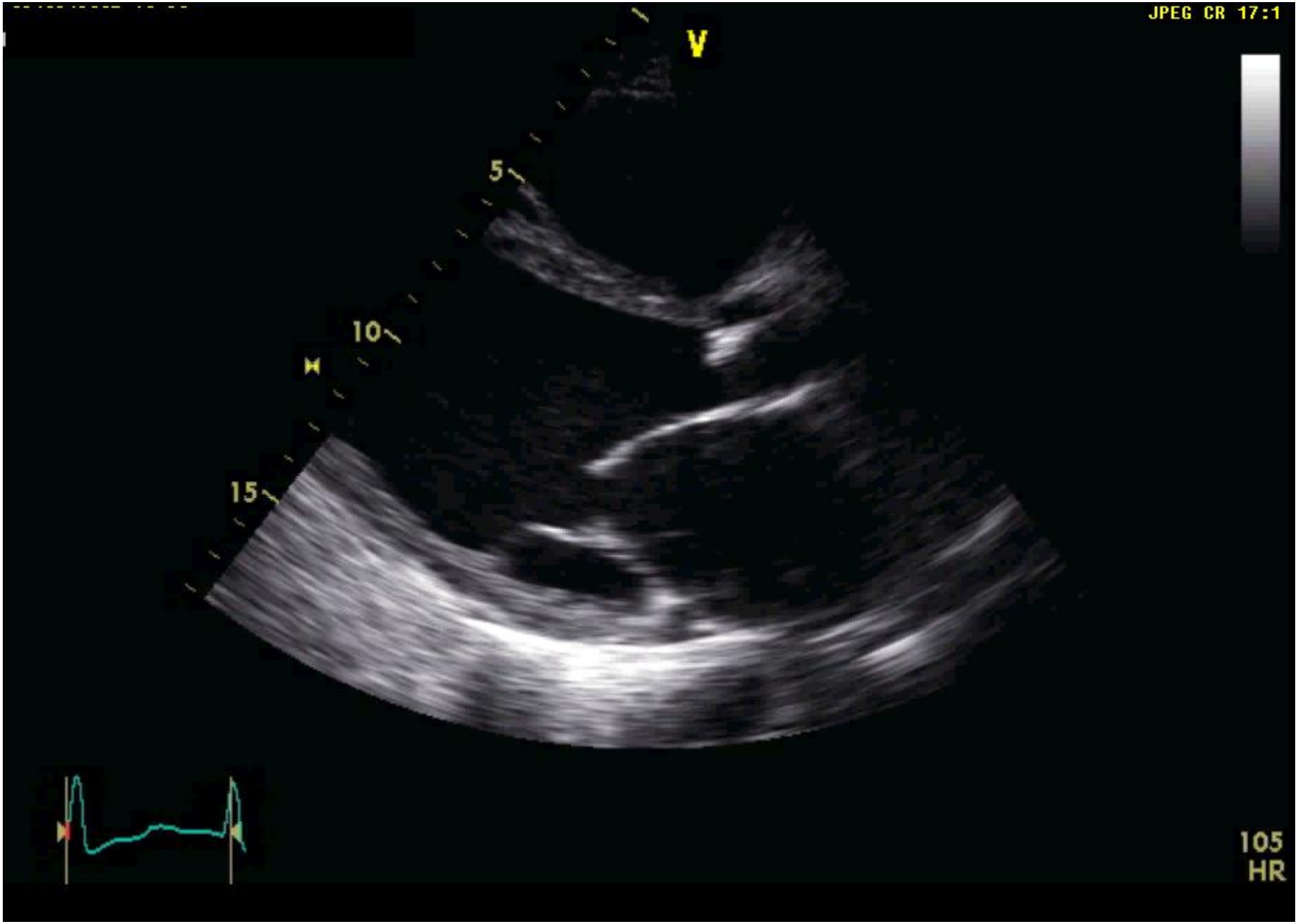
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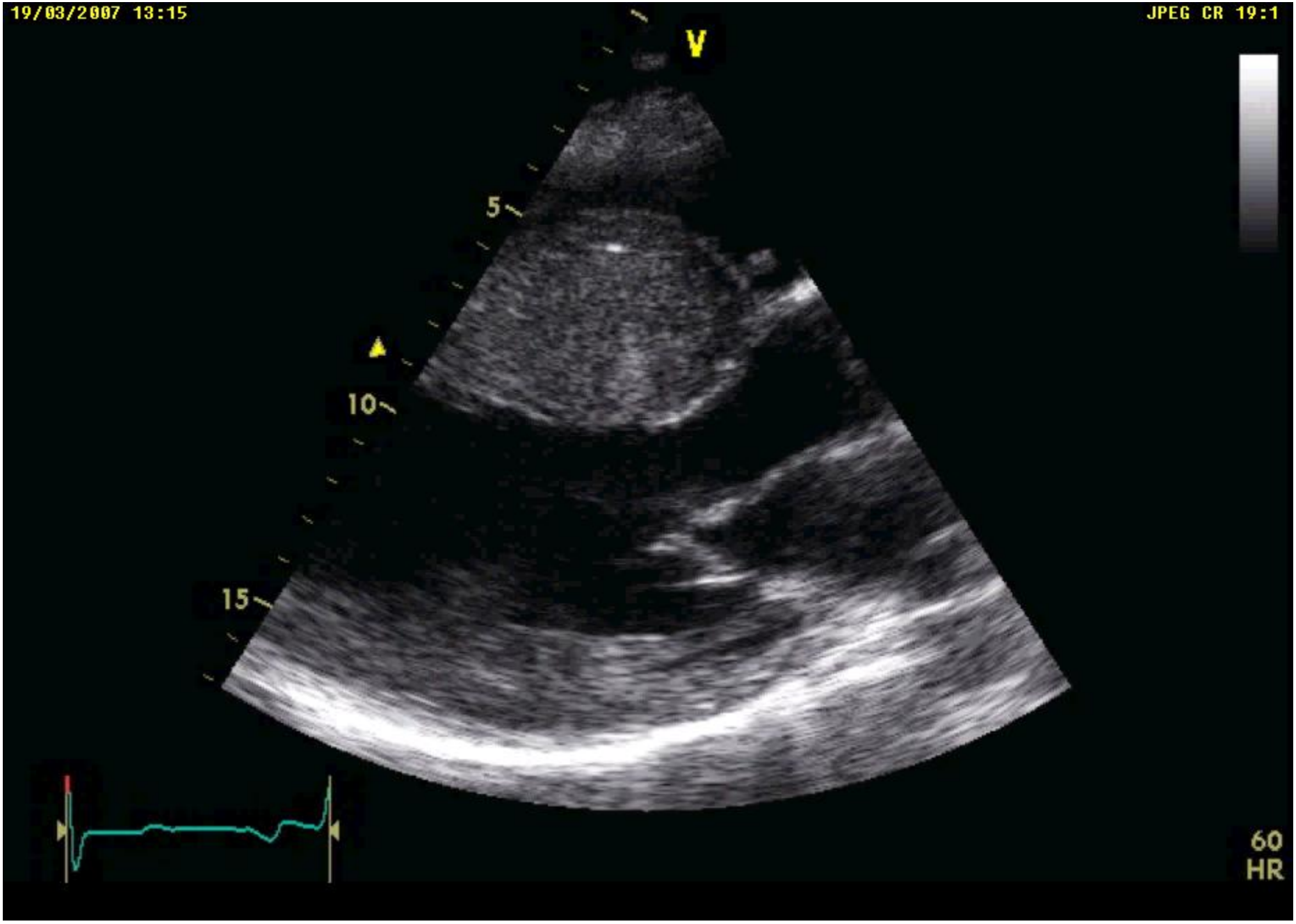
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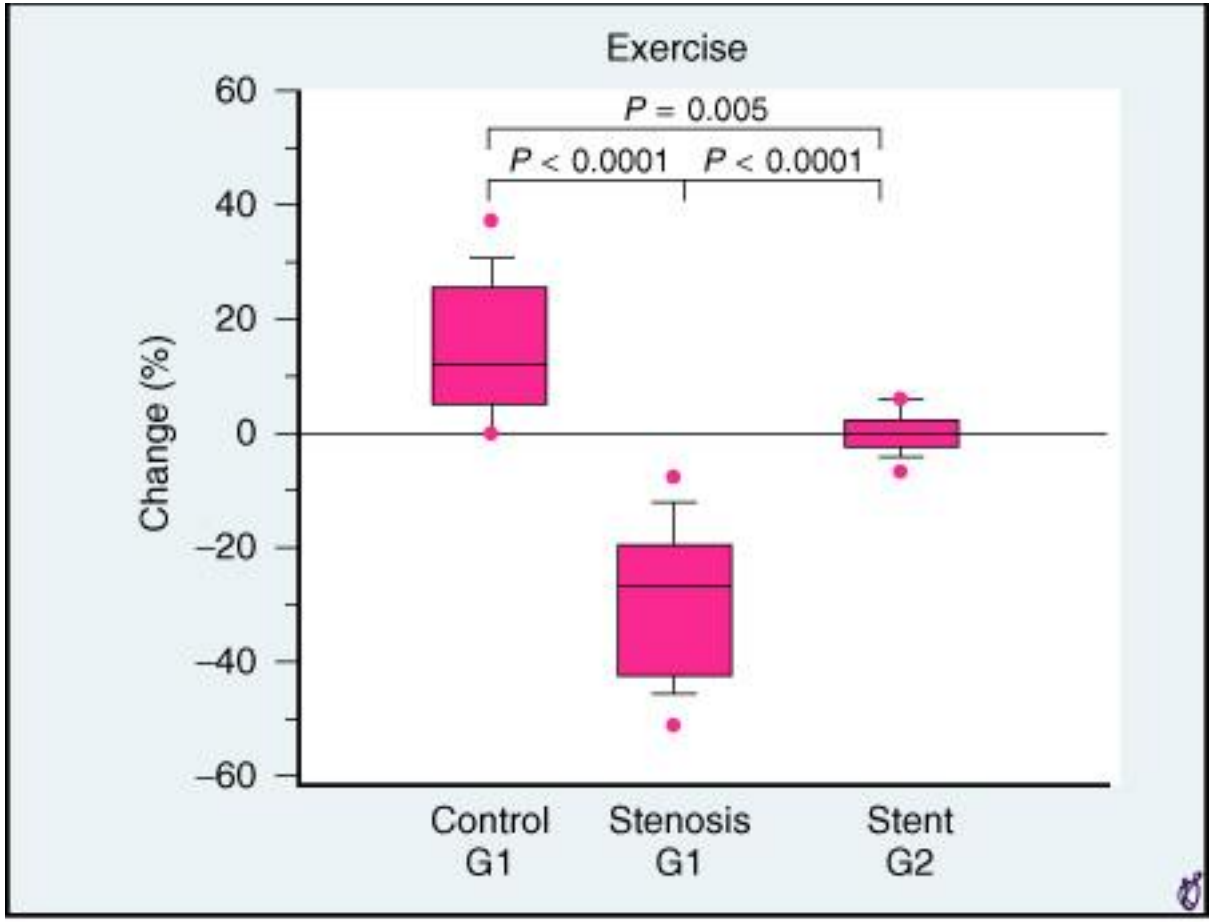

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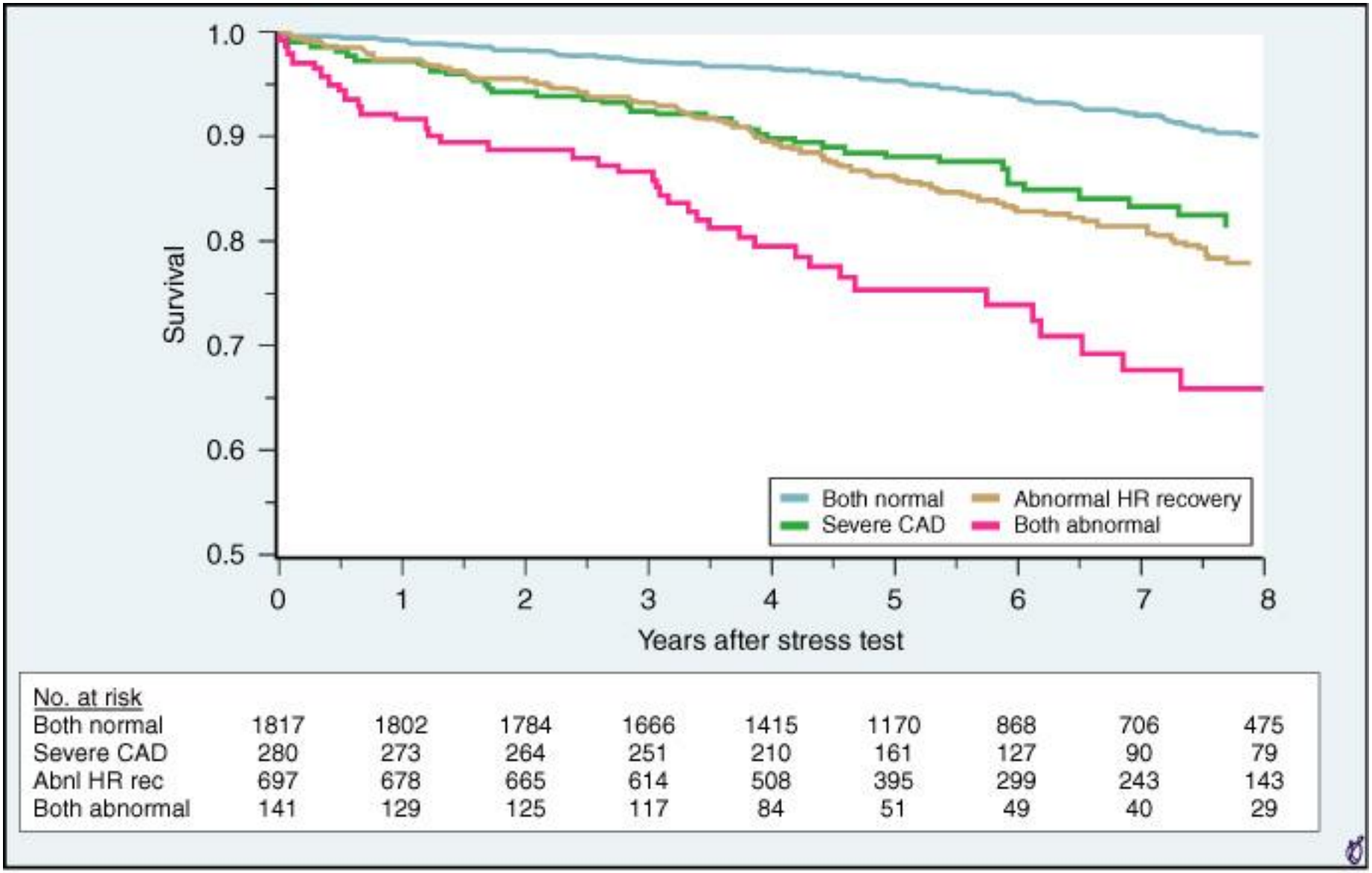

No. at risk									
Both normal	1817	1802	1784	1666	1415	1170	868	706	475
Severe CAD	280	273	264	251	210	161	127	90	79
Abnl HR rec	697	678	665	614	508	395	299	243	143
Both abnormal	141	129	125	117	84	51	49	40	29

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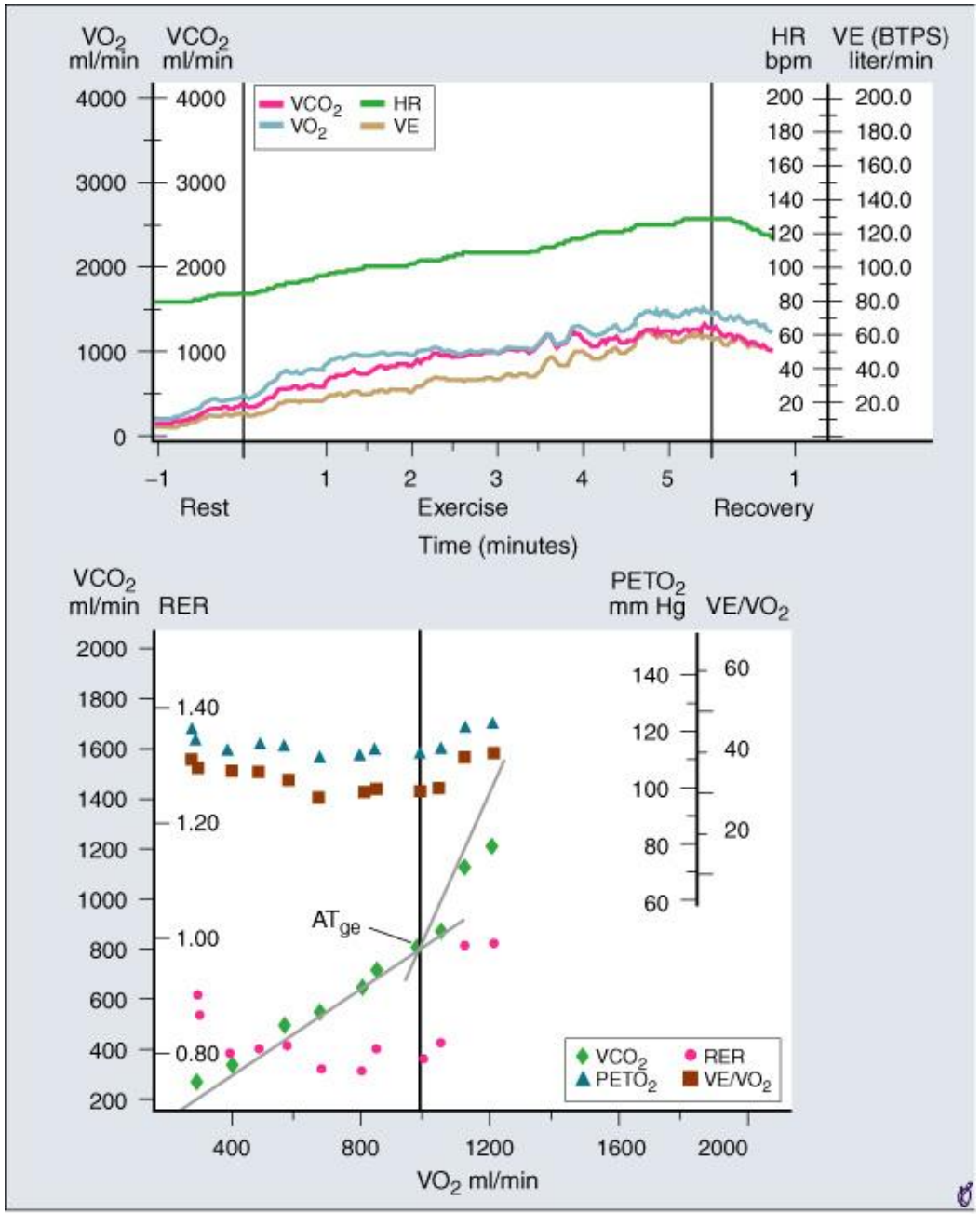

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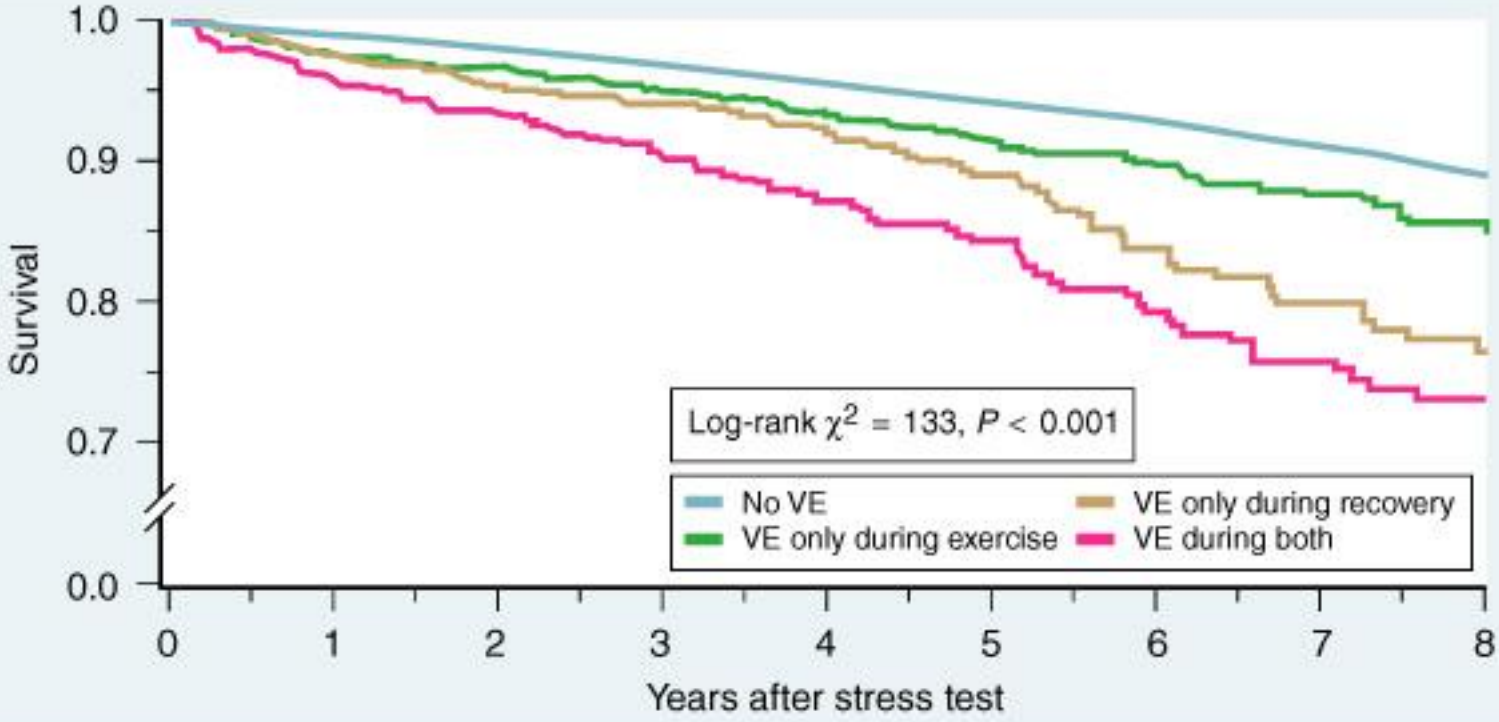

No. at risk									
No VE	27219	26295	22900	19576	16708	13971	11283	9292	6480
VE only during exercise	945	900	840	687	598	504	418	352	255
VE only during recovery	589	564	474	425	331	276	226	162	121
VE during both	491	459	403	329	265	231	190	148	122

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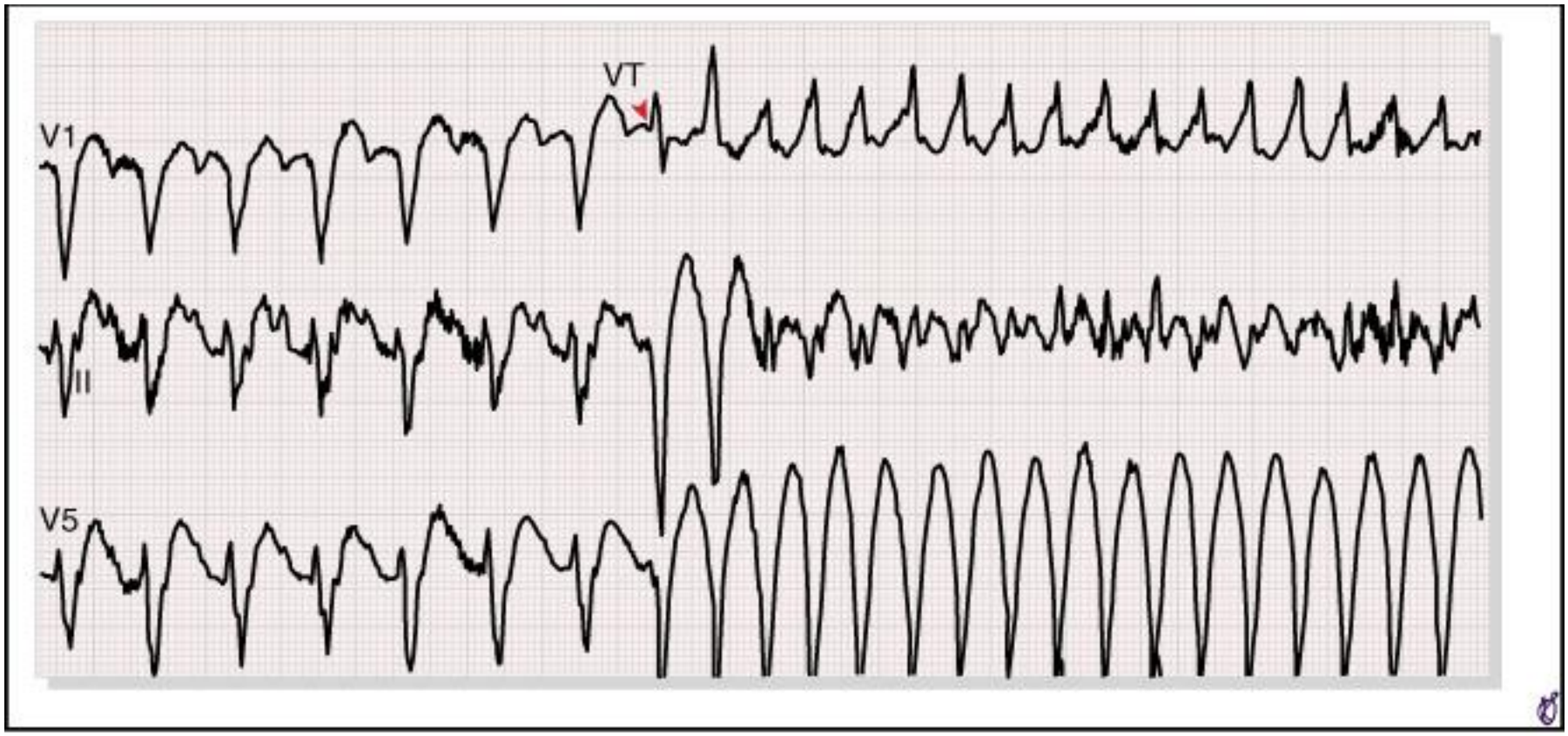

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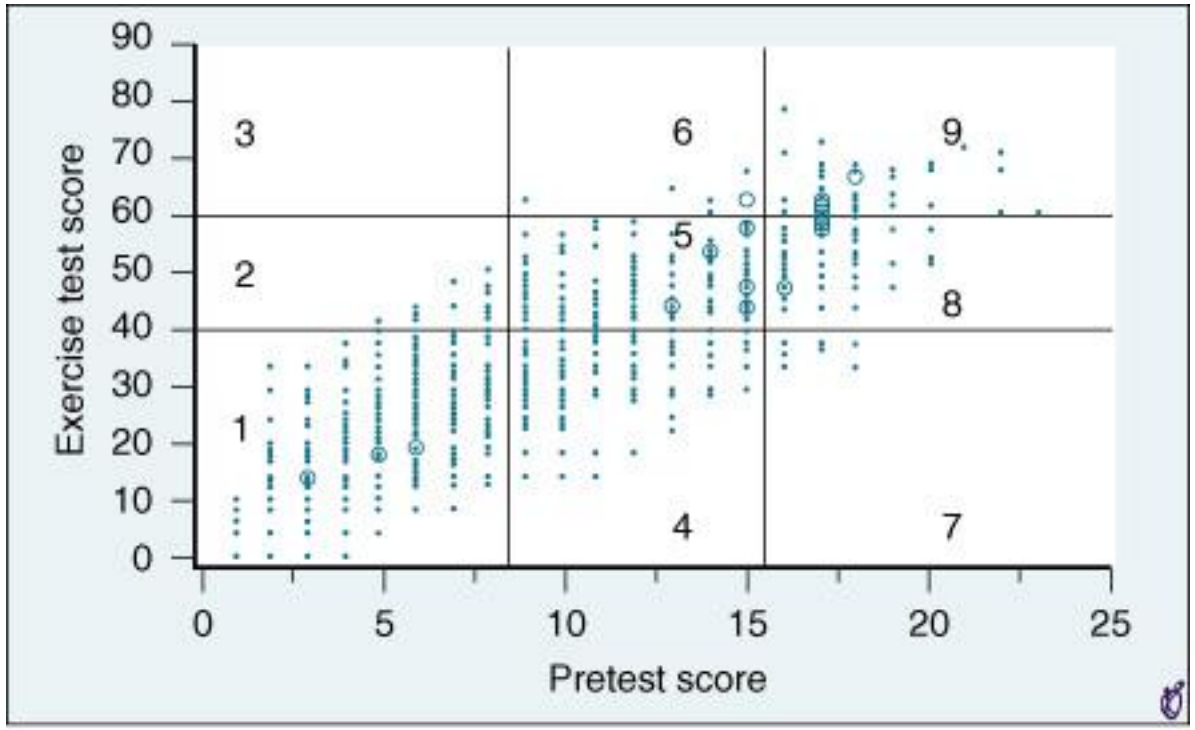

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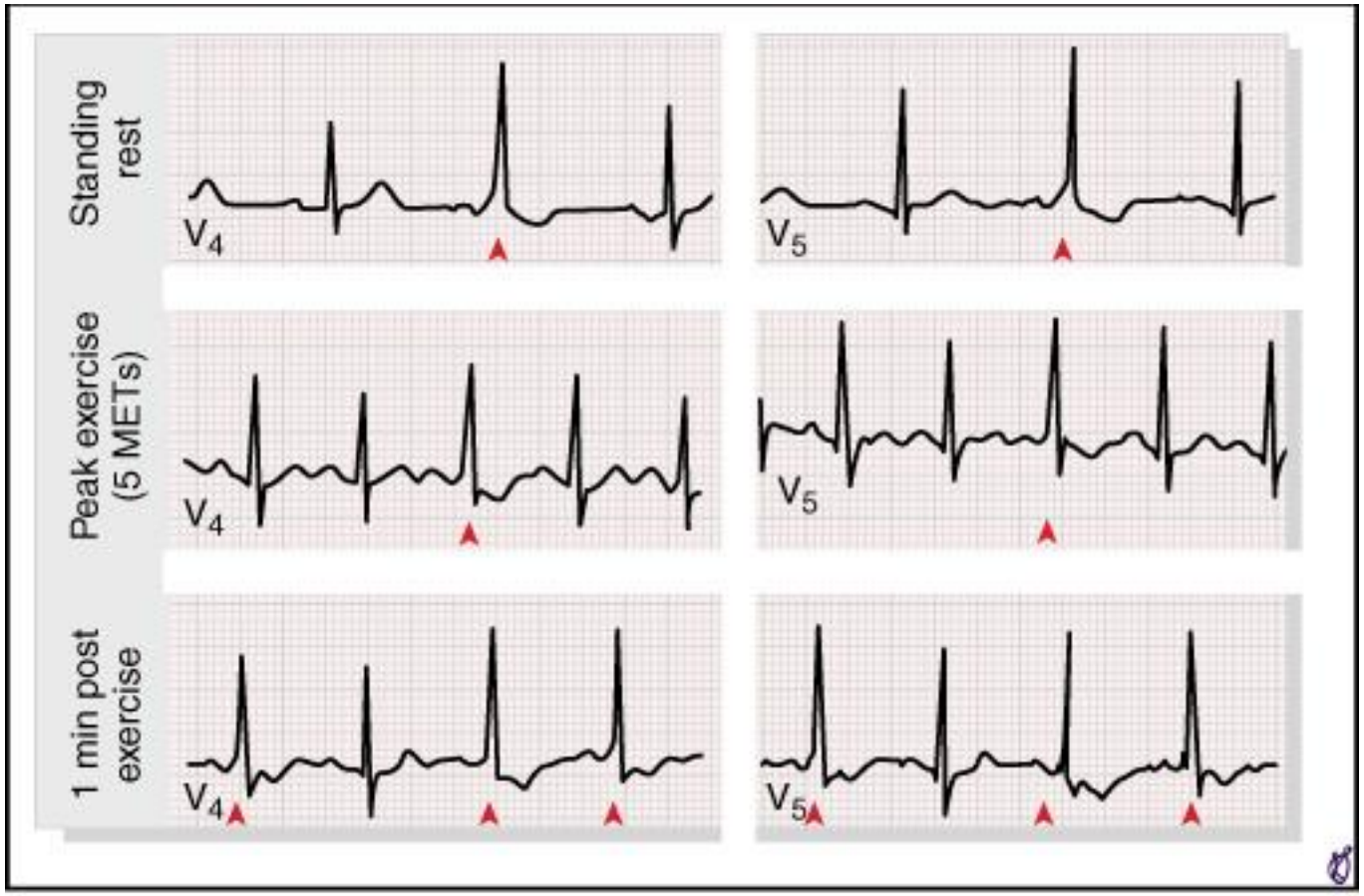

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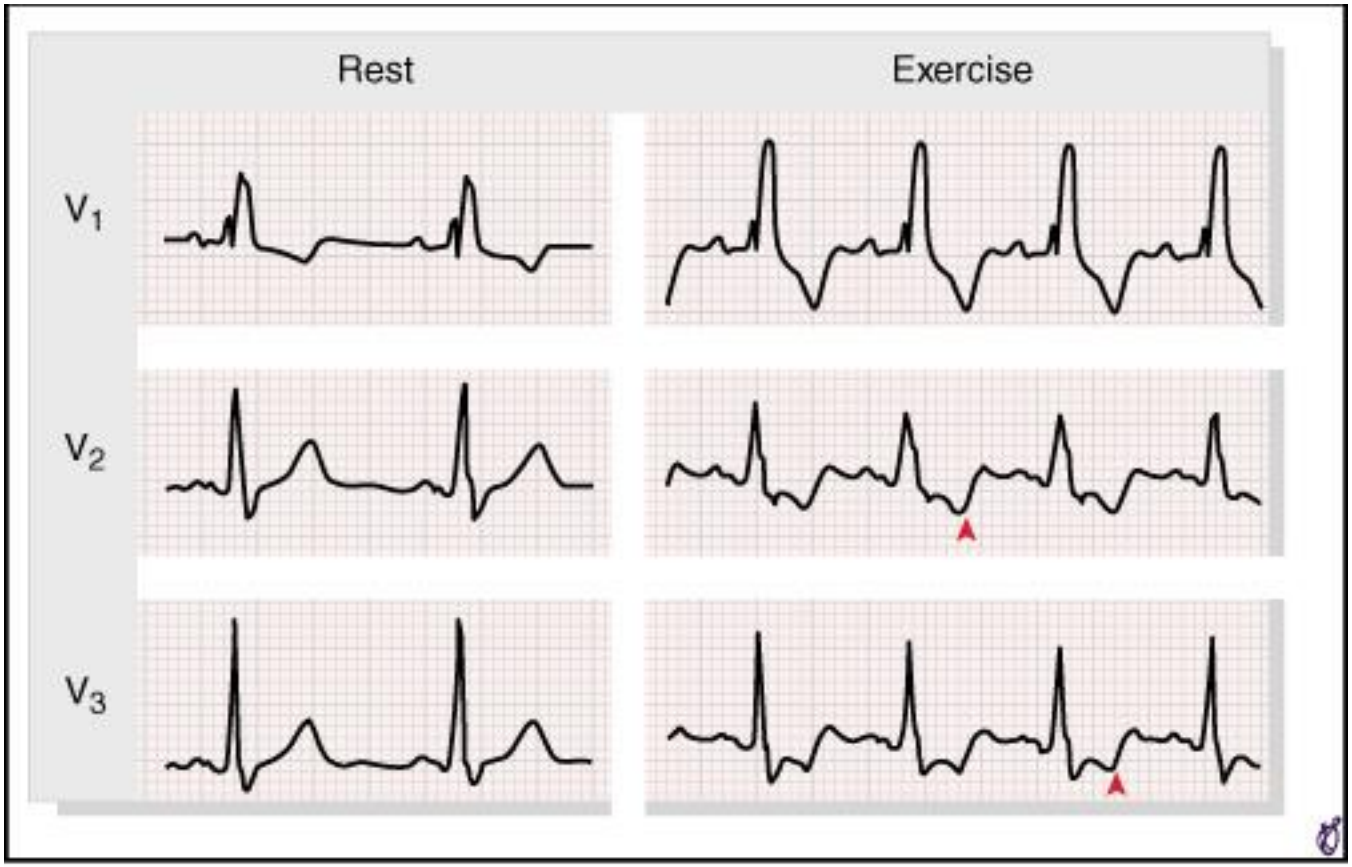
| Functional Class | Clinical Status | O_2 Cost ml/kg/min | METs | Bicycle Ergometer | Treadmill Protocols | | |



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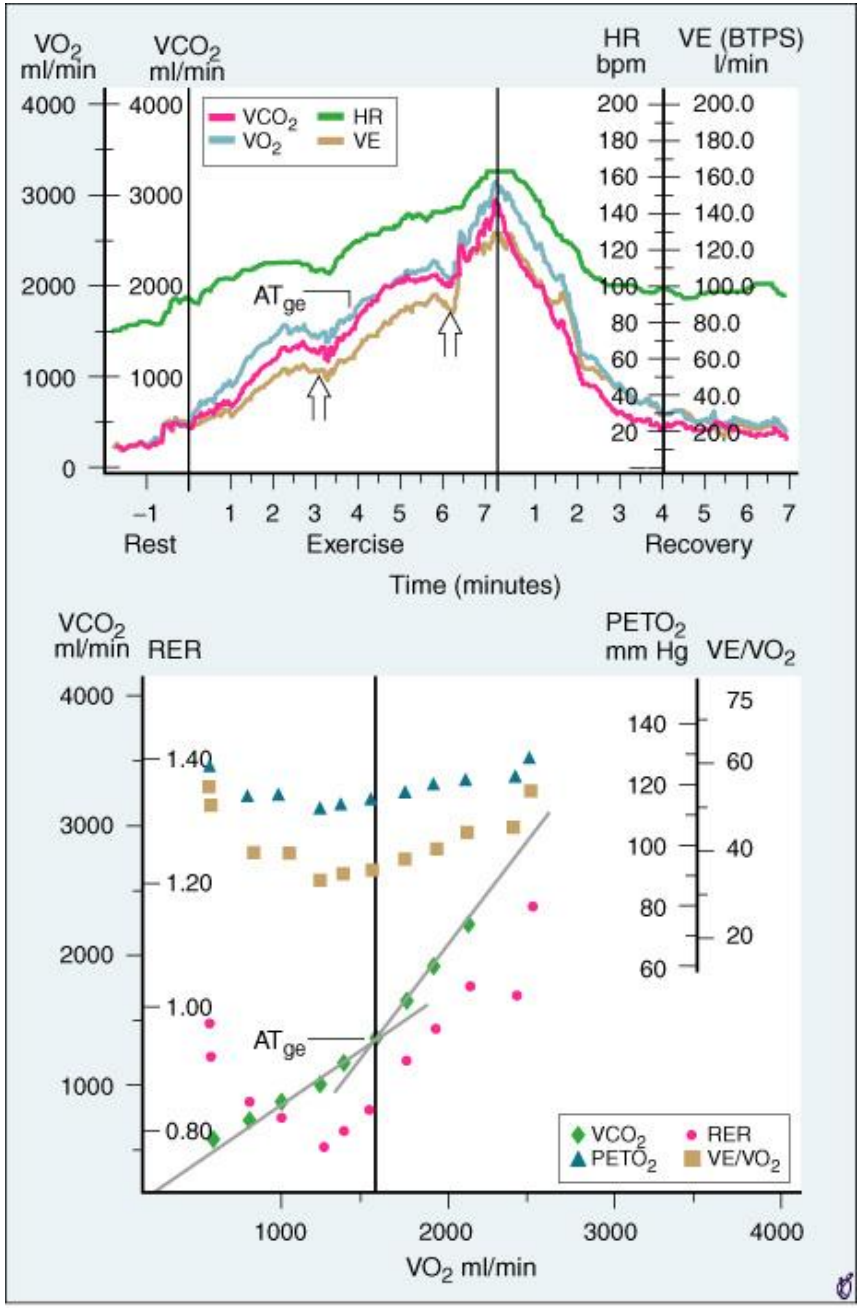

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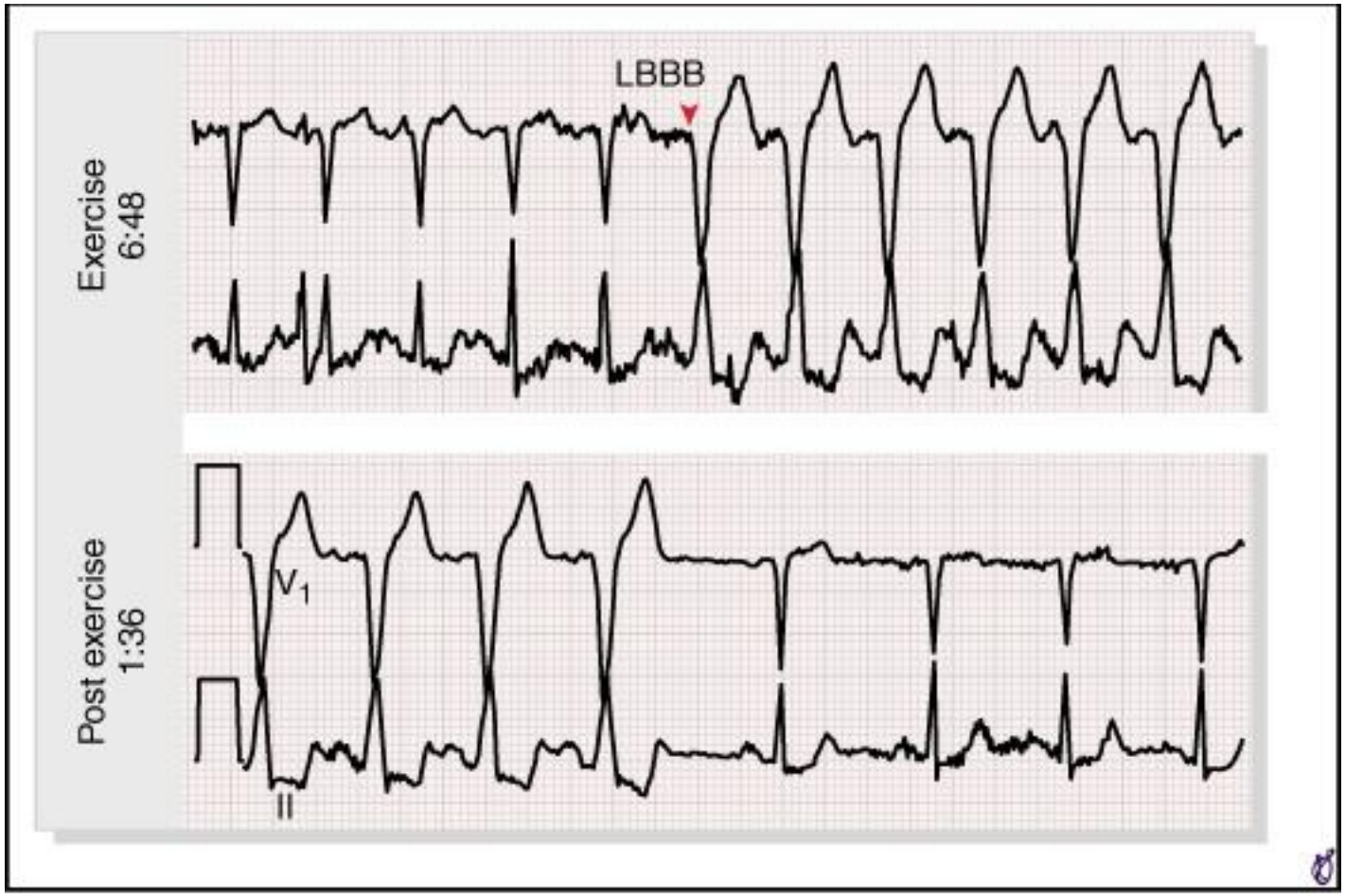

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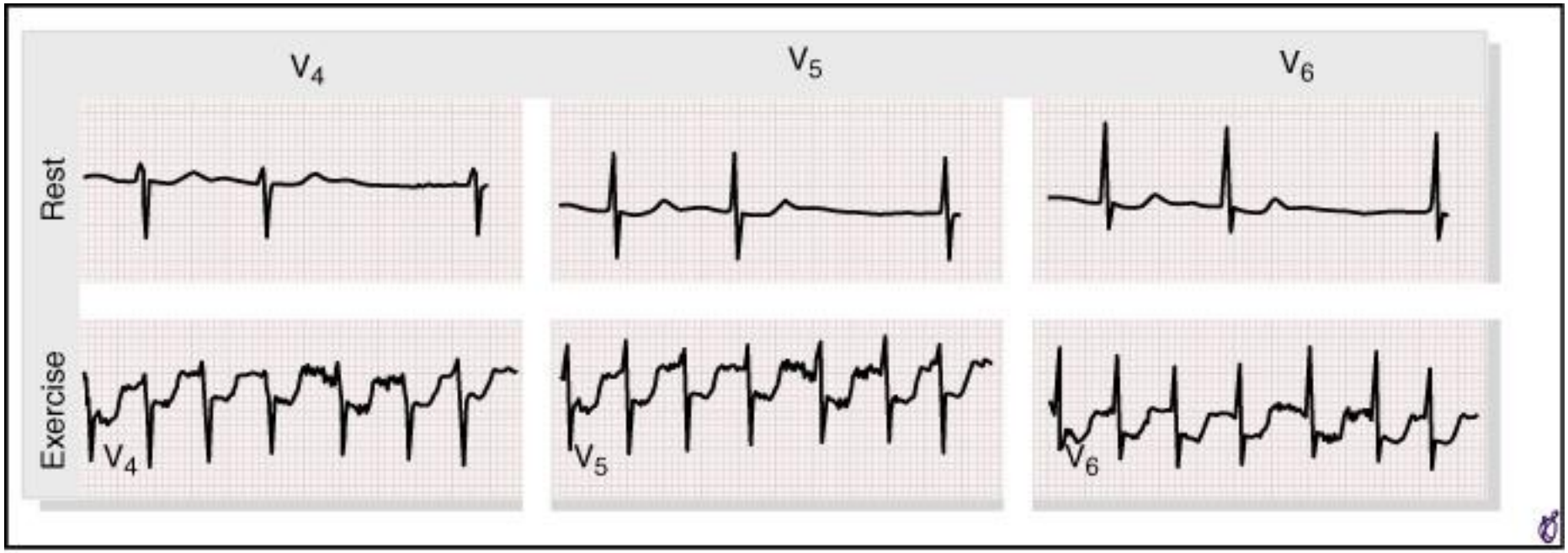

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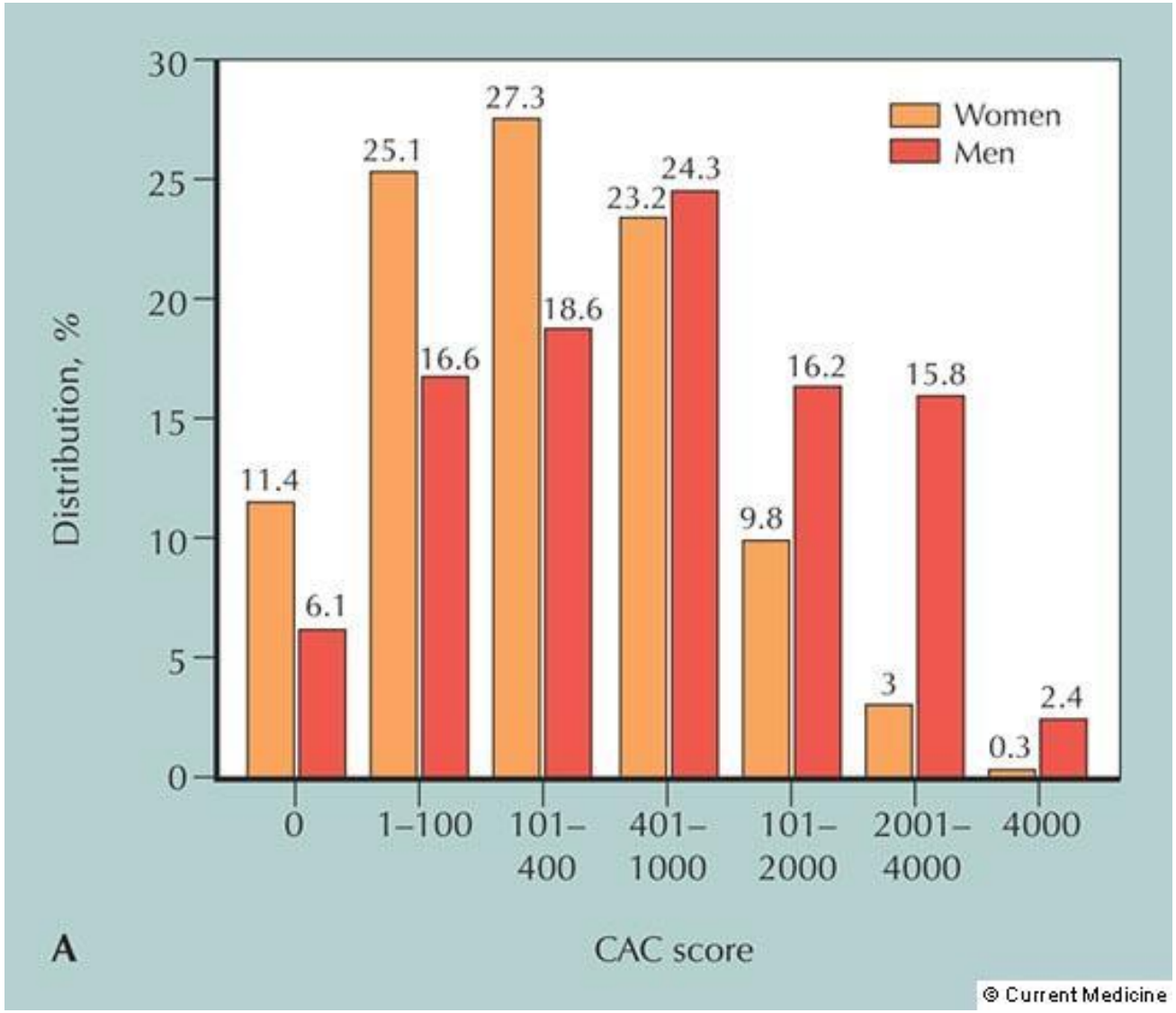
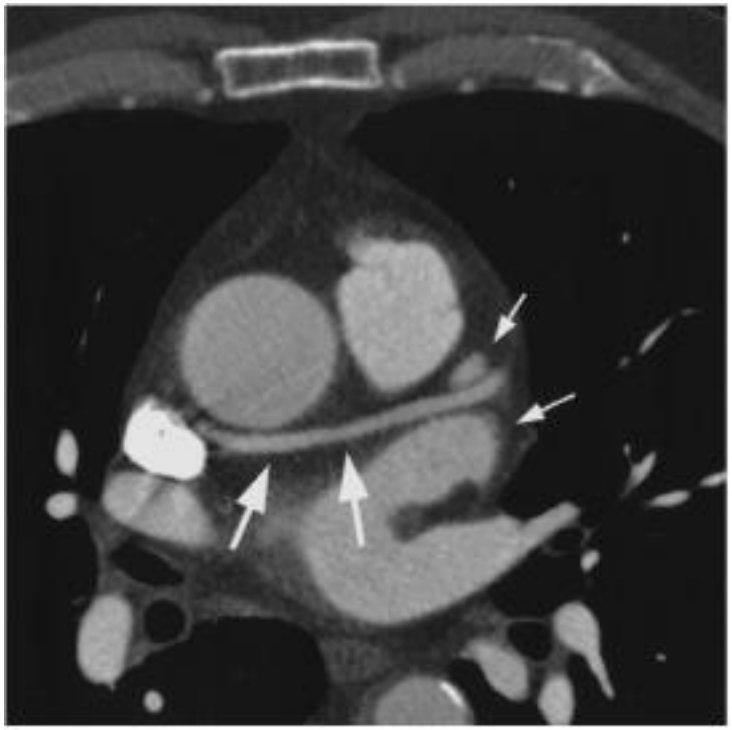
Coronary artery calcification scores





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