









# Wide Area Detector CT: Update 2010



**Frank Rybicki MD, PhD**

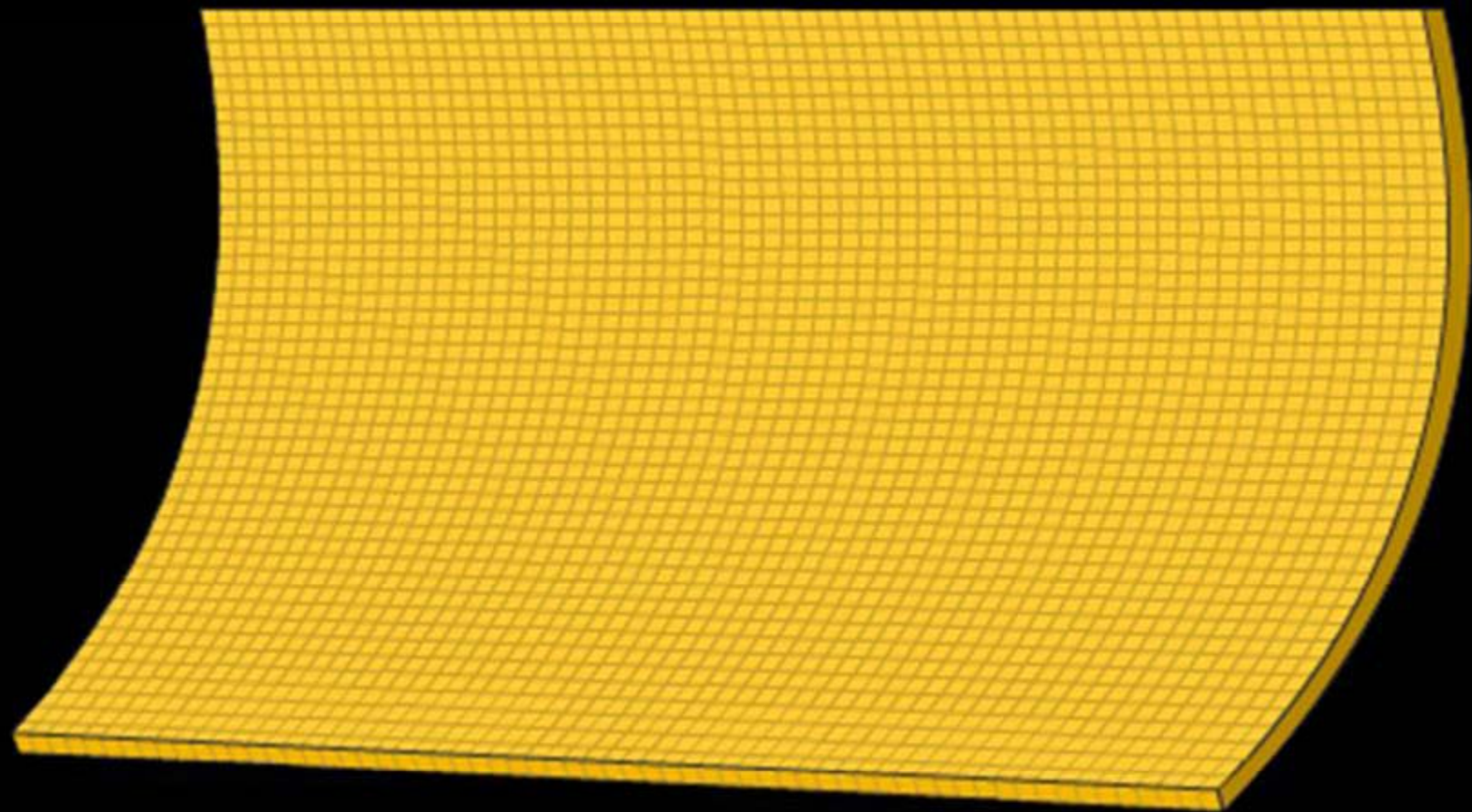
Director, Cardiac CT & Vascular CT/MRI  
Director, Applied Imaging Science Laboratory  
Brigham and Women's Hospital  
Associate Professor, Harvard Medical School

# Rybicki Disclosures (2010)

	Speakers Bureau	Advisory Board	Grant Support
Toshiba			
Bracco			
Vital Images			

# CT Detector Evolution

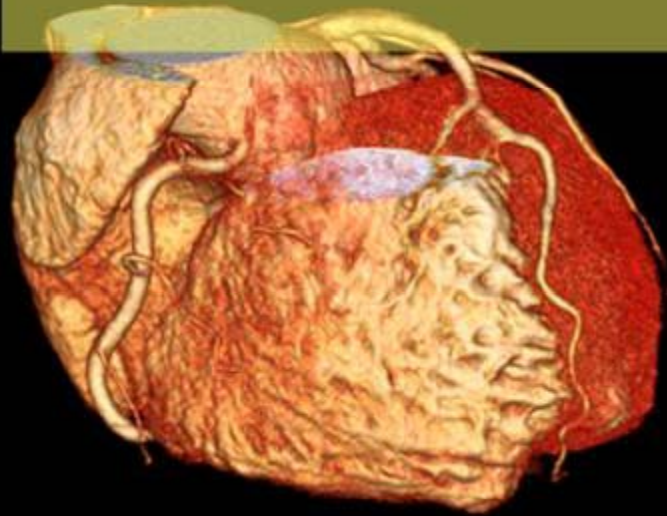
13.2 cm



32000000 32000000 32000000 32000000 32000000 32000000 32000000 32000000

# 64 Slice Helical

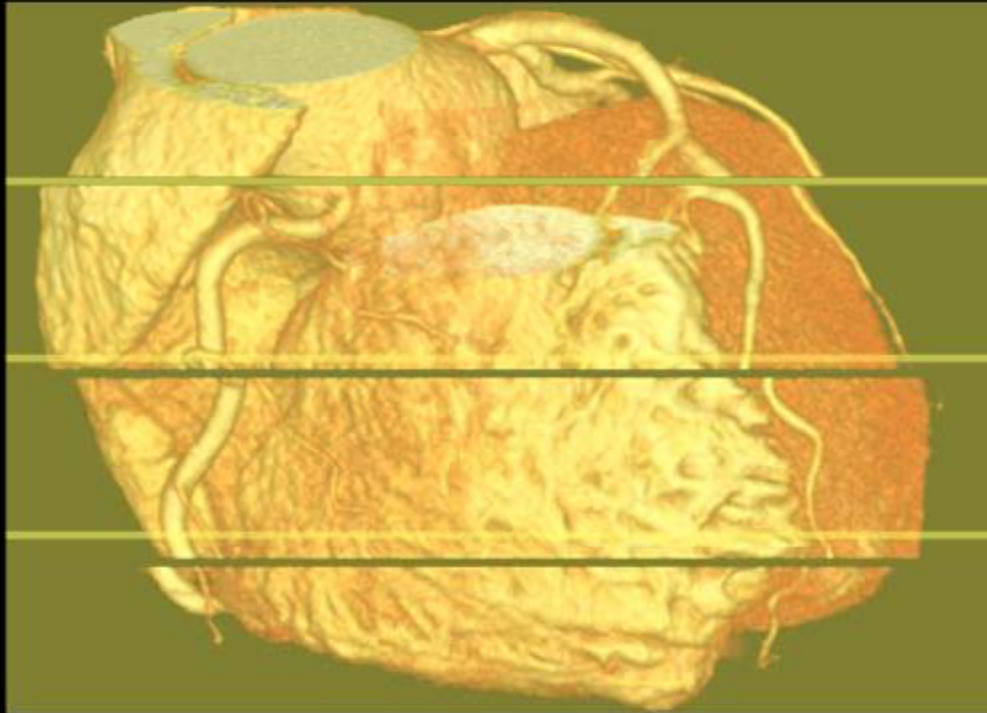
64 Slice



Exposure

**~12 - 15 mSv**

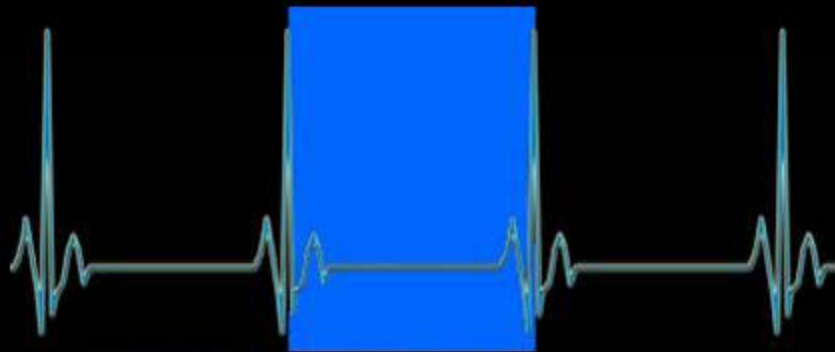
# Step and Shoot Prospective



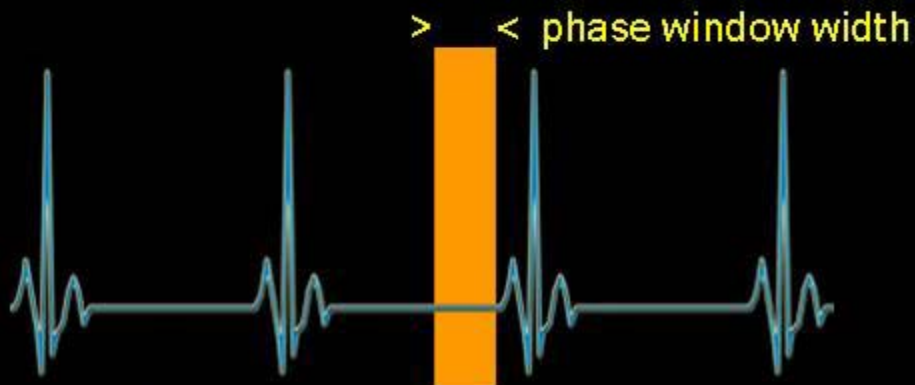
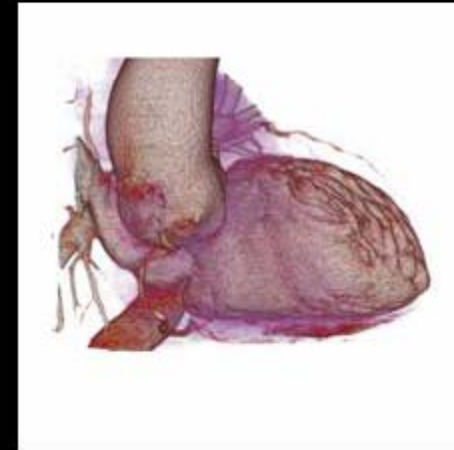
- 64 Detector  
Multiple over-lapped rotations over several heartbeats
- No functional information
- Spatial and contrast variations
- The heart must be pieced together from different moments in time



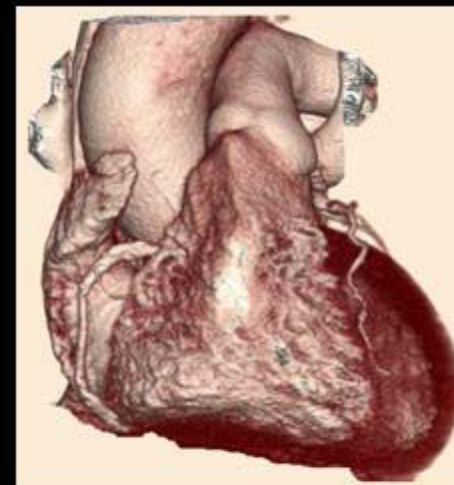
# 320-Detector Row Cardiac Acquisition



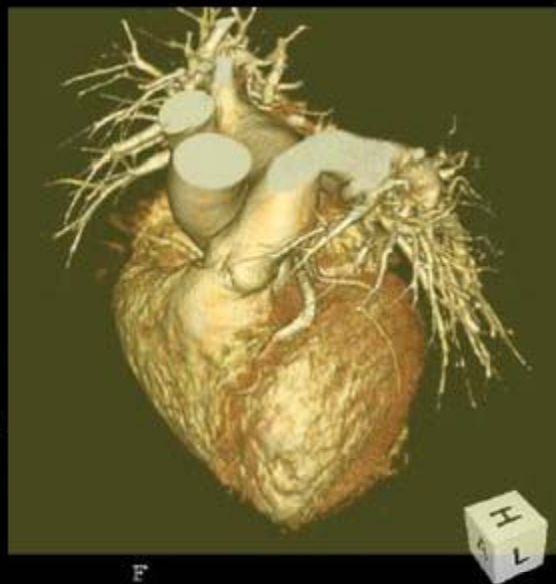
ⓐ **Retrospective**



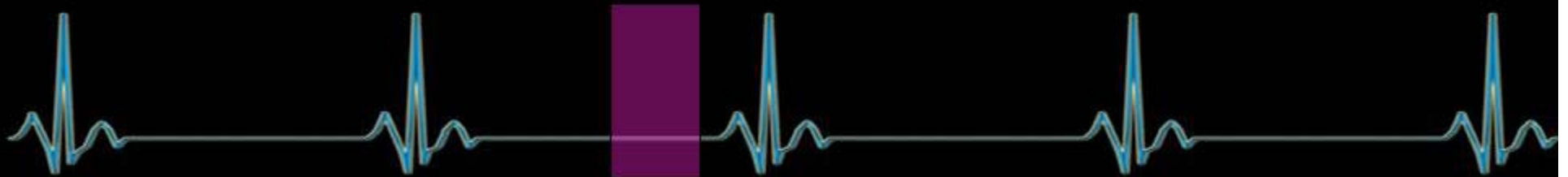
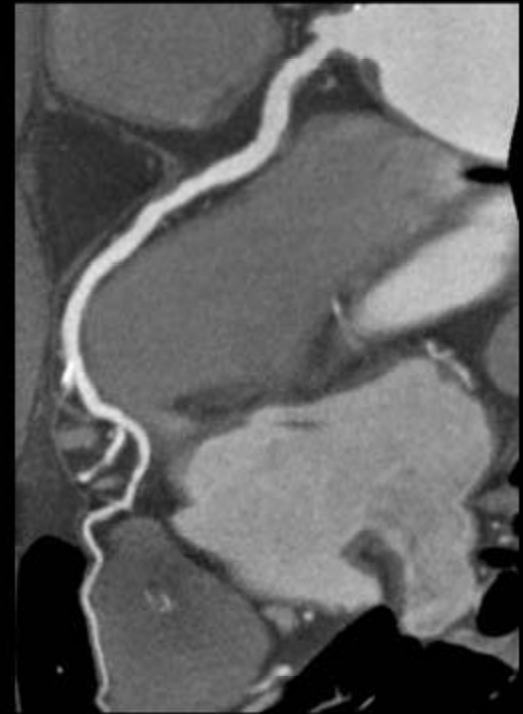
ⓑ **Prospective**



# Prospective ECG gating



16 cm



# Outline

## Cardiac Imaging

- Can practical dose reduction be data driven?
- Can a simple perfusion algorithm be validated?
- Can we extract additional useful data from a standard wide-area detector CT acquisition?

## Other CV Applications

- Whole-brain imaging
- Face transplantation
- Organ perfusion



# Discussion

## Cardiac

Dose reduction is introduced in the context of initial evaluations of the technology, followed by methods for reducing dose while maintaining diagnostic image quality

Perfusion CT is discussed in the context of Core320

Contrast opacification gradients and vascular profiling represent methods for extracting additional data from wide-area detector cardiac CT

## Other Applications

Whole brain imaging without table motion can be achieved with 320 CT

Novel applications such as face transplantation allograft imaging have been enabled by new technologies

Applications for organ perfusion are being explored

## 320 cardiac CT – Initial Experience

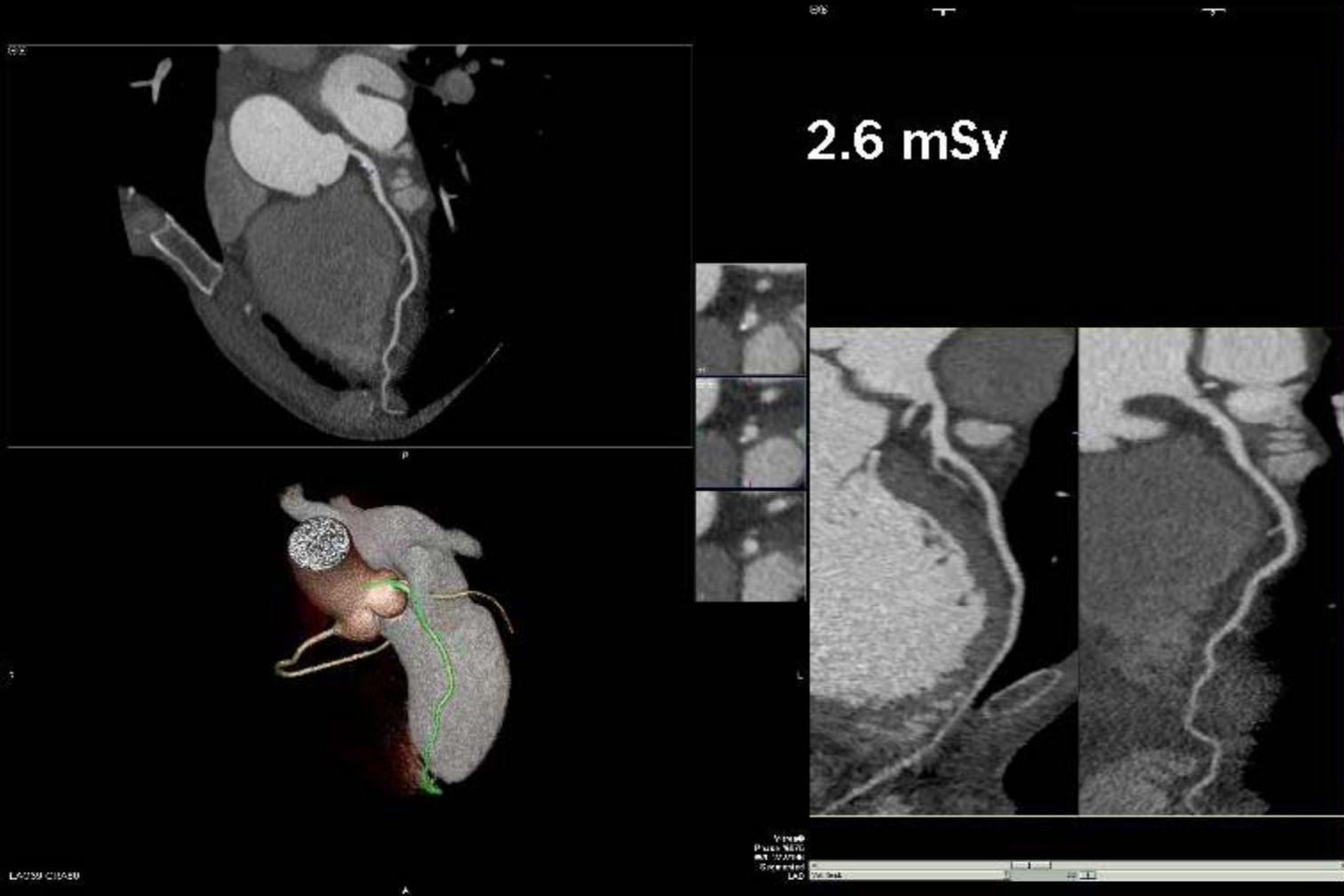
	BMI (kg/m <sup>2</sup> )		ECG-Gating				All
	<30	>30	Pro	Retro	Pro (1R)	Pro (2R-R)	
Mean (SD)	7.9 (3.1)	8.7 (3.7)	7.2 (2.3)	14 (2.8)	6.7 (1.4)	12.6 (3.4)	8.3 (3.4)
Range	4.9-15.6	5.2-18.1	4.9 - 16.5	10.1 - 18.1	4.9 - 9.4	10.4 - 16.5	4.9 - 18.1
<i>p</i>	<0.01		<0.01		<0.01		

Pro gated patients with 60-100% phase window (n=25)

Dose = 6.8 ± 1.4 mSv

Rybicki FJ, Otero H, Steigner ML et al. International Journal of Cardiovascular Imaging 24:535-46, 2008

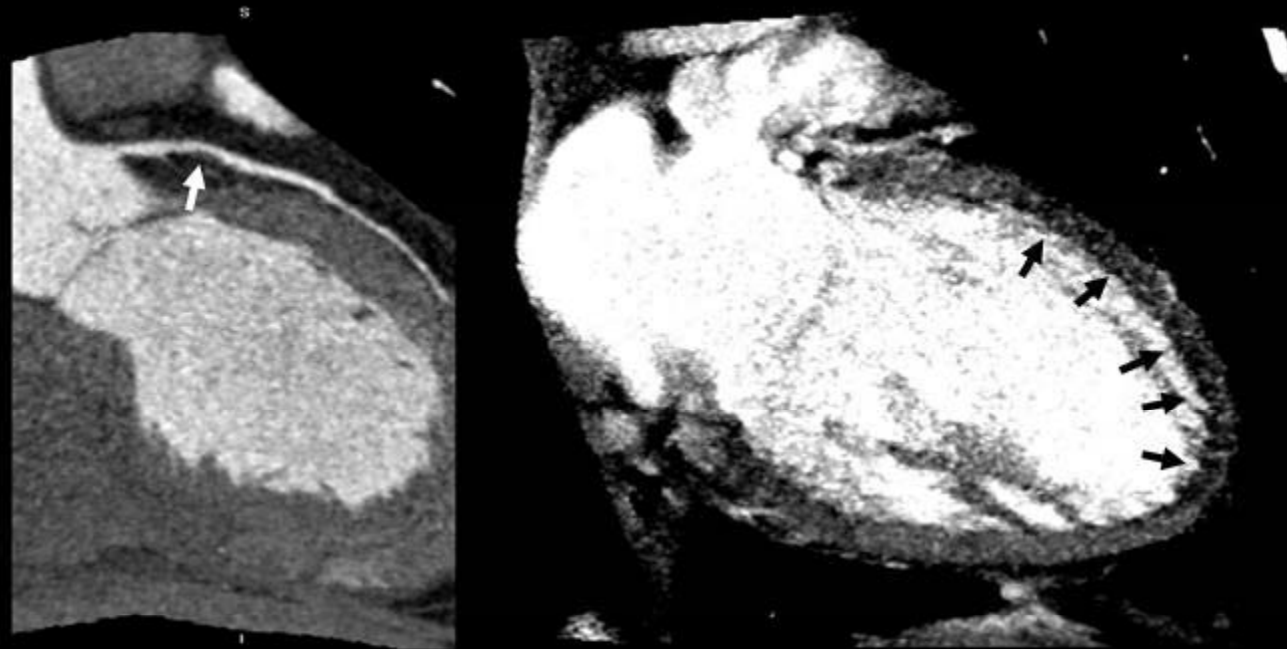
# Lower Dose Imaging (100 kV)



# Myocardial Perfusion

**57 yo woman with hypertension and hyperlipidemia  
complaining of atypical chest pain**

adenosine stress CT perfusion imaging

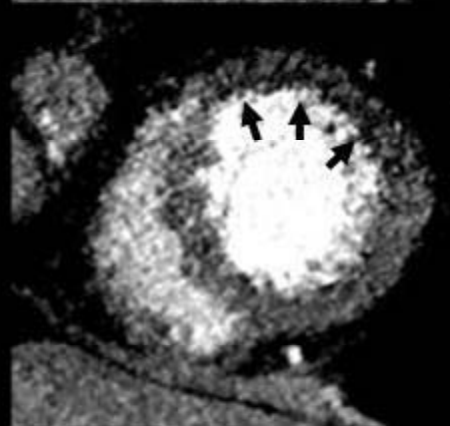
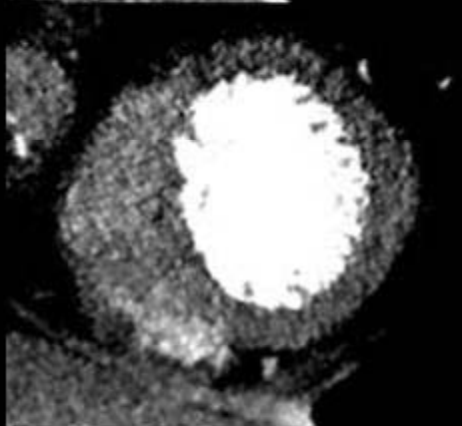
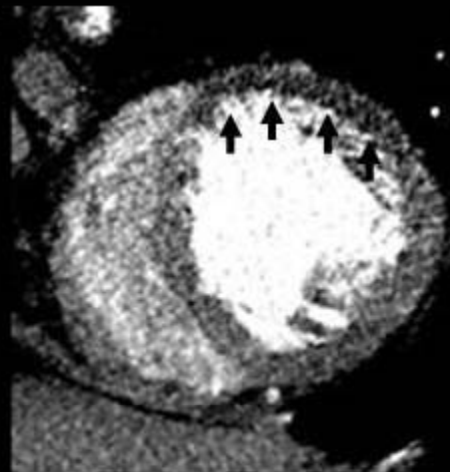
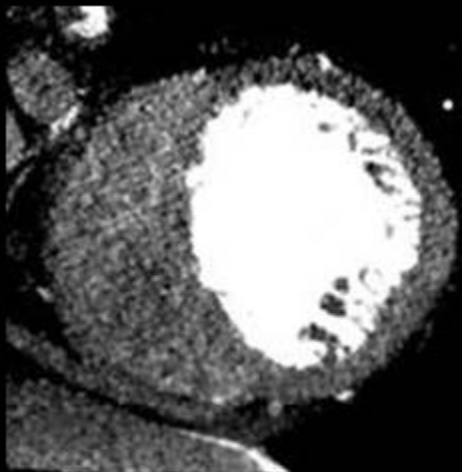


Courtesy of Richard T. George and Joao A.C. Lima, Johns Hopkins University, Division of Cardiology

# Myocardial Perfusion

Rest

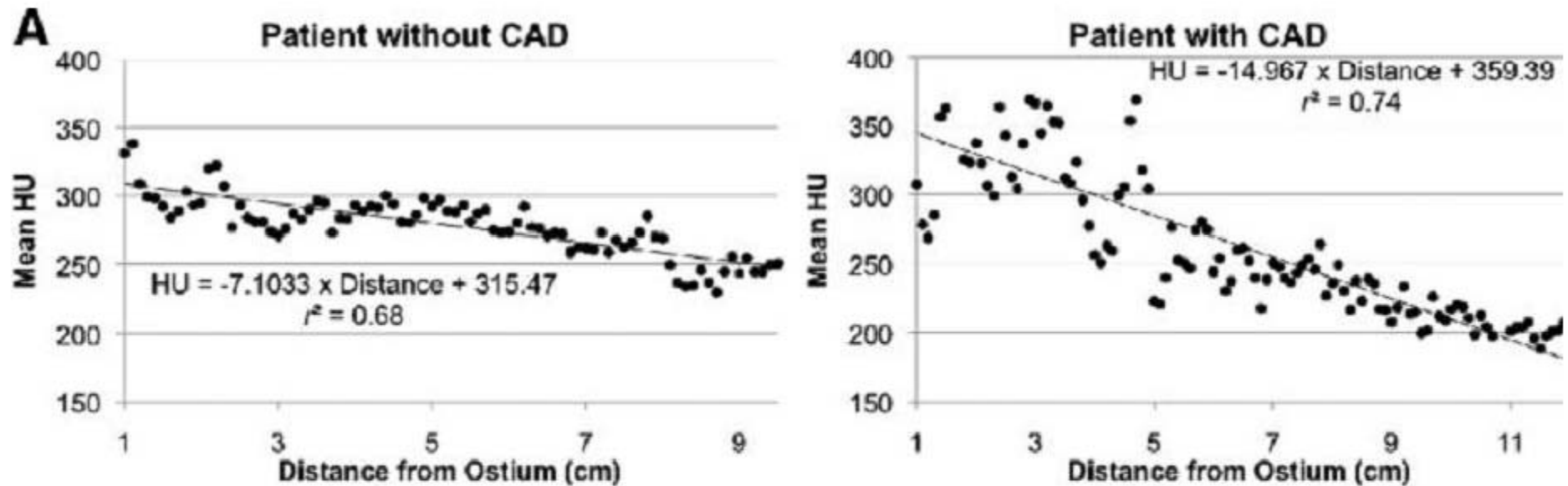
Stress



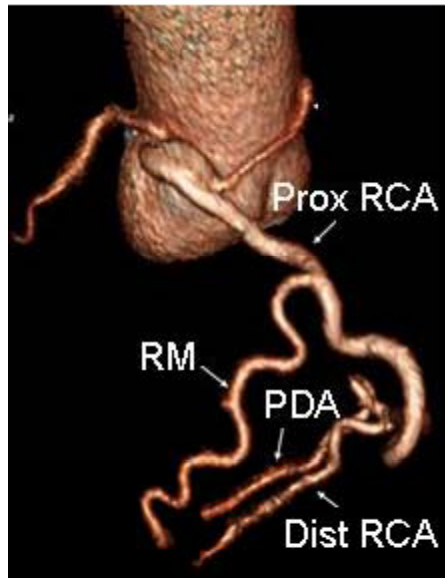
3 mm short axis  
reconstructions

Courtesy of Richard T. George and Joao  
A.C. Lima, Johns Hopkins University,  
Division of Cardiology

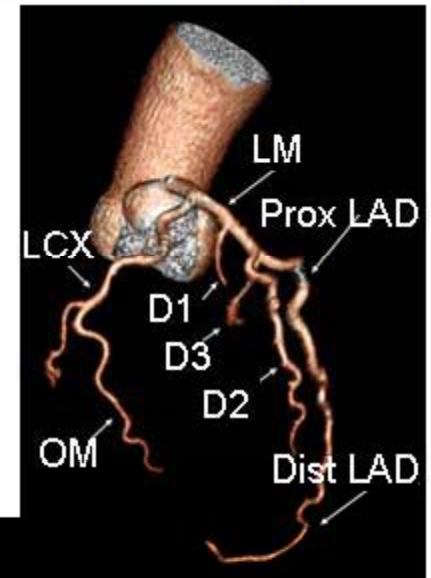
# Contrast Opacification Gradients



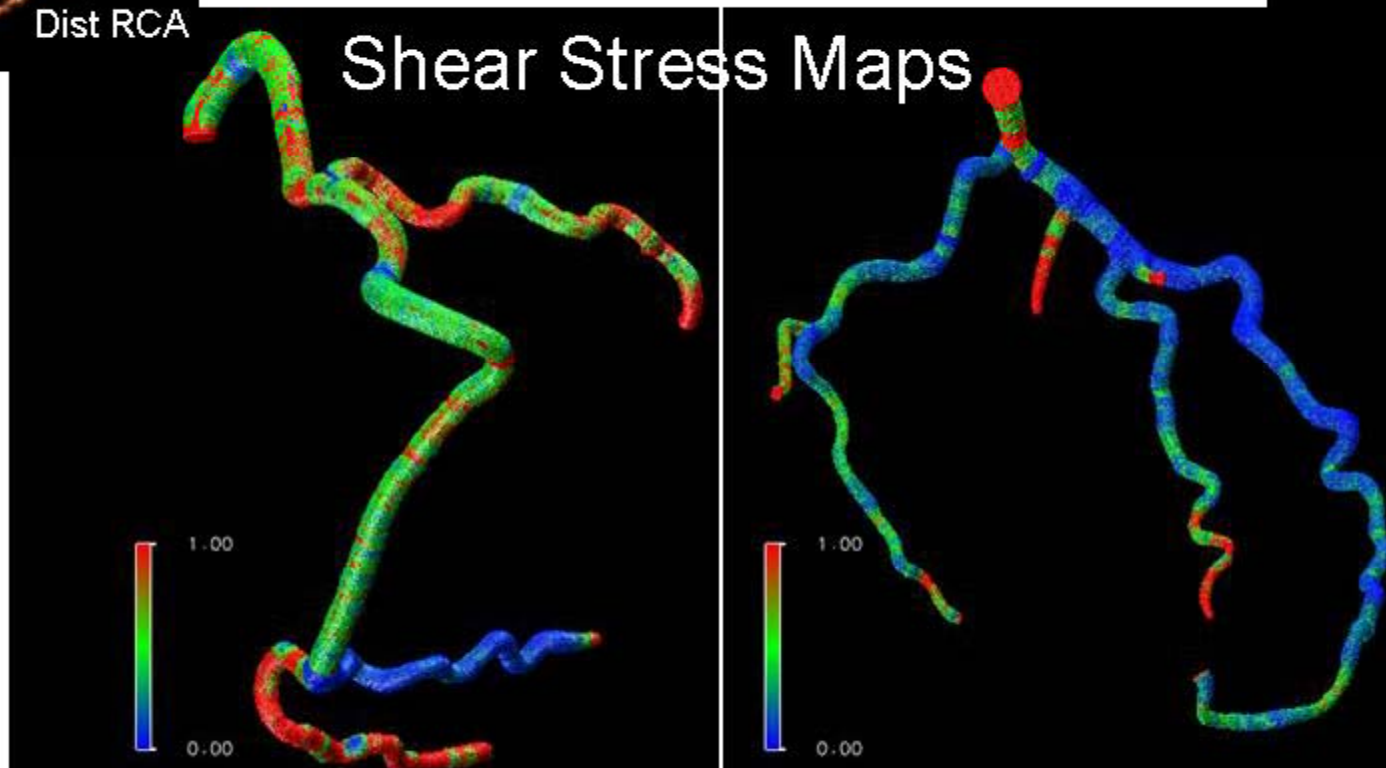
# 44 y.o. male, smoker, atypical CP, neg markers



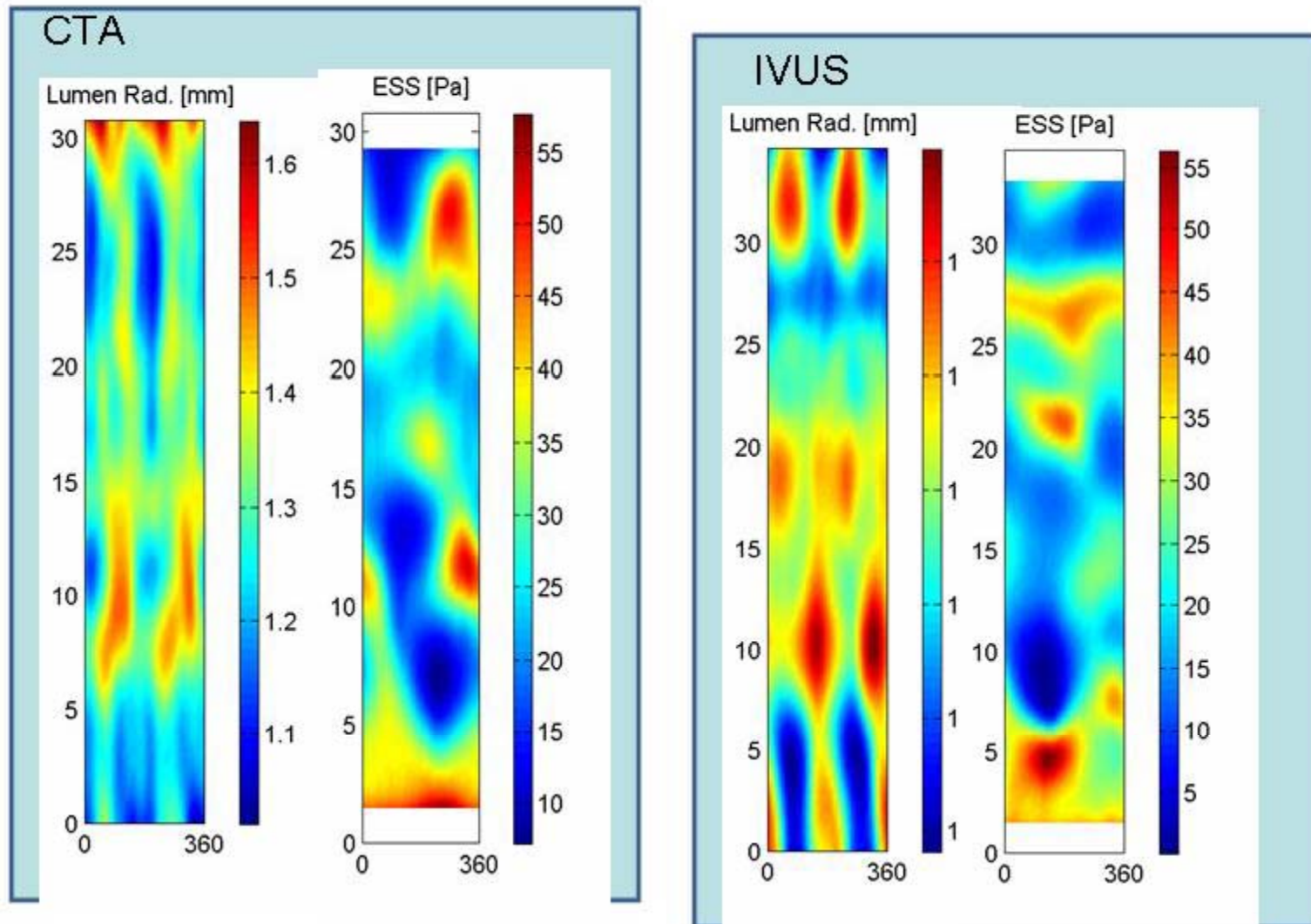
## CTA Lumen Rendering



## Shear Stress Maps

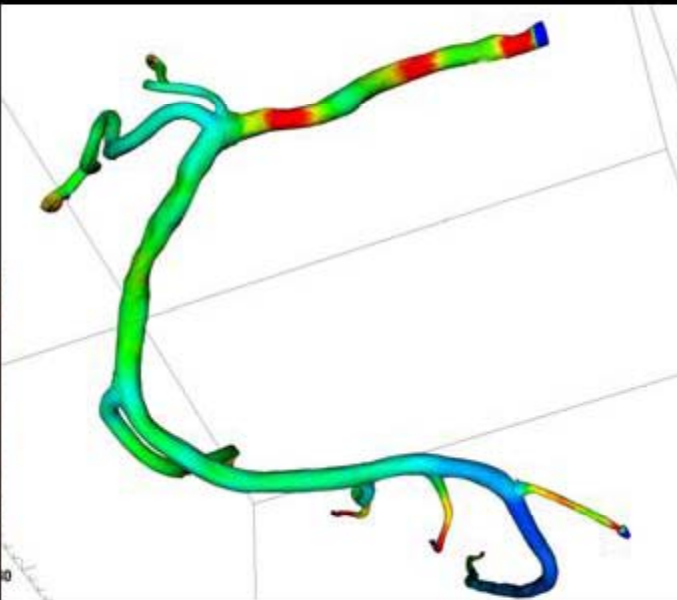


# Comparison of CTA & IVUS Derived Lumen Size / ESS Profiles

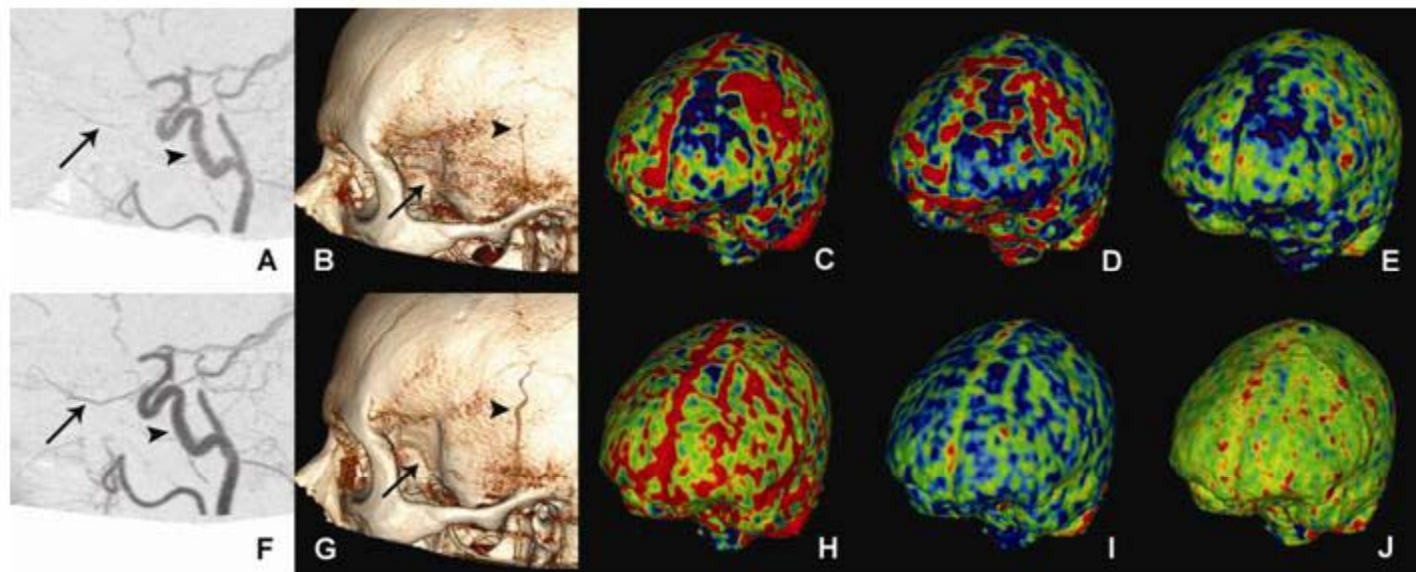
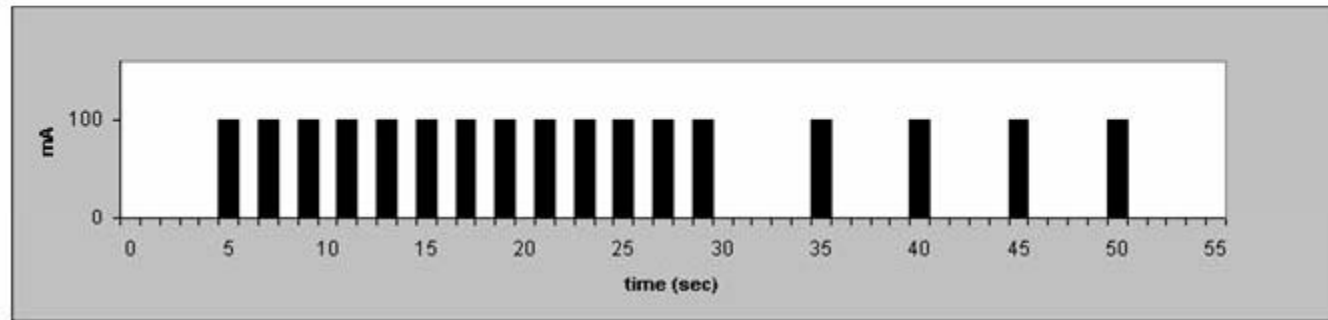


Ramkumar PG, Mitsouras D, Feldman CL et al. New advances in cardiac computed tomography. *Current Opinion in Cardiology* 24: 596-603, 2009





## 320 Detector Row CT Neuroimaging



Yahyavi-Firouz-Abadi N, Wynn BL, Rybicki FJ, et al. American Journal of Neuroradiology 30: 1409-11, 2009

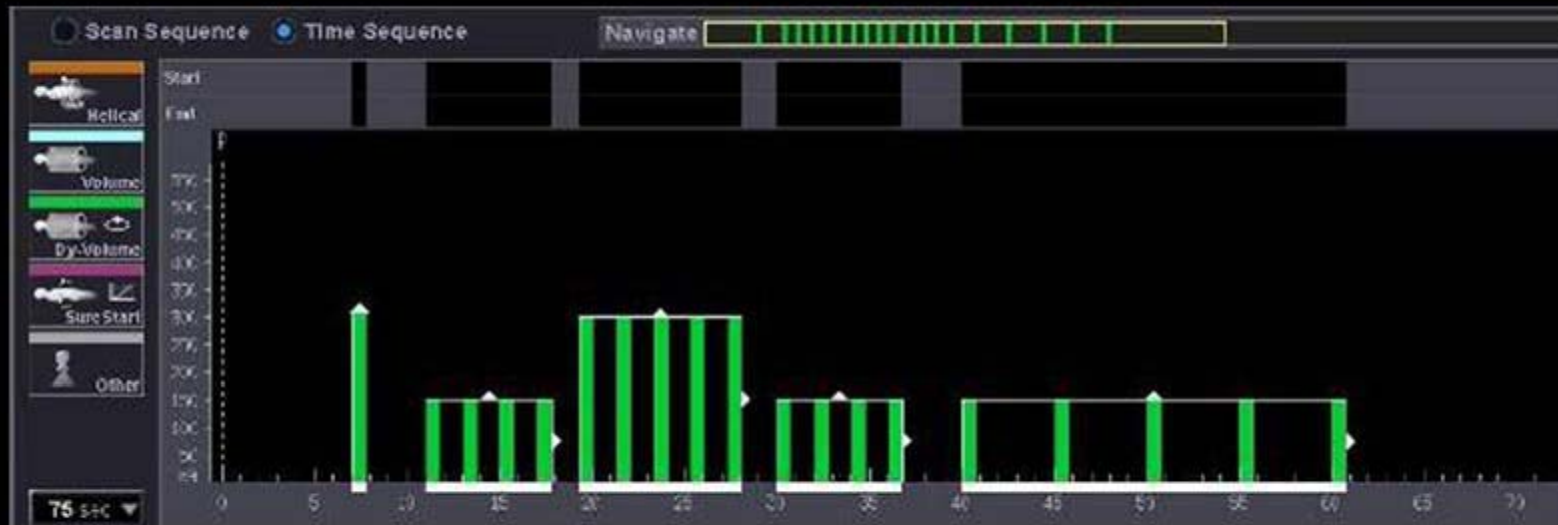
# 320 CT for face transplantation

**36 yo man s/p midface injury  
after gunshot wound: loss of  
nasoethmoid complex,  
bilateral orbital floors, maxilla,  
palate, mandible, upper and  
lower lips, anterior tongue**

**Soga S, Ersoy H, Mutsouras D, et al. Surgical Planning for Composite Tissue  
Allotransplantation of the Face Using 320-Detector Row Computed Tomography,  
JCAT 2010, *in press***

**U.S. Department of Defense W911QY-09-C-021**

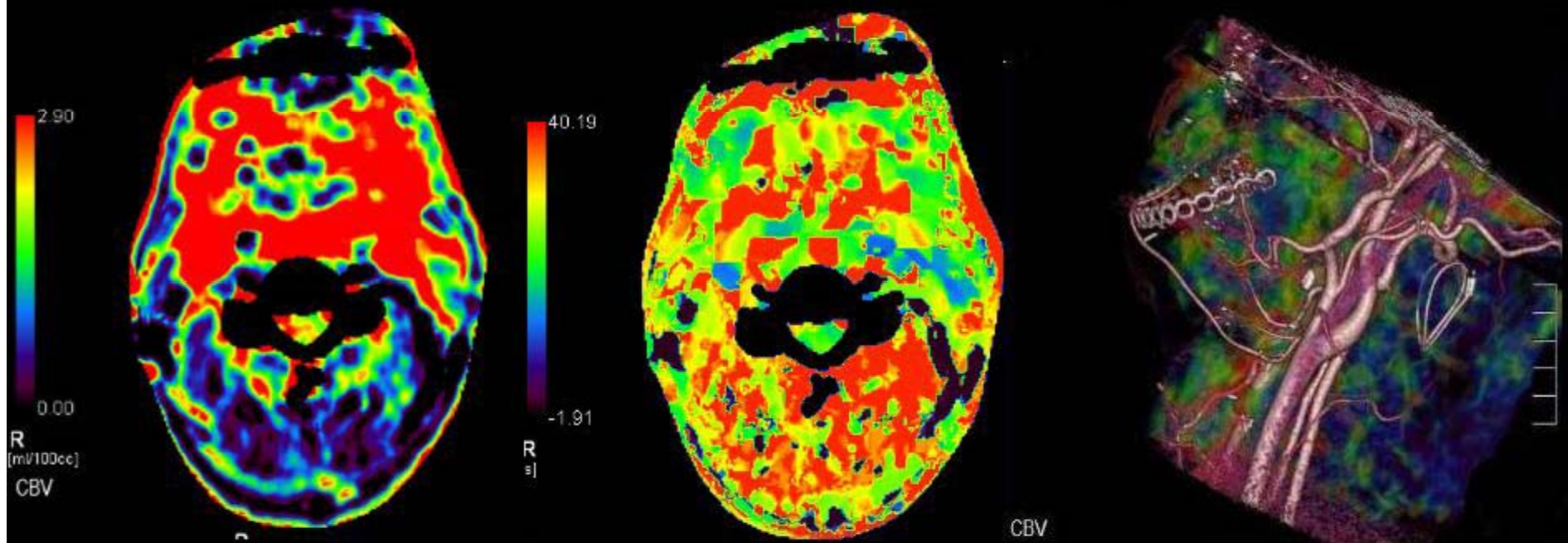
# 320 CT protocol – Face Transplant



Scan Type	kVp	mA	Rot. Time	Start Sample Time	Acquisition Interval	Total Acquisition Time
One Shot (Mask)	80kVp	310 mA	0.75 sec	7 sec	—	1 sec
Dynamic	80 kVp	150 mA	0.75 sec	11 -17 sec	2 sec	8 sec
Dynamic	80 kVp	300 mA	0.75 sec	19 -27 sec	2 sec	6 sec
Dynamic	80 kVp	150 mA	0.75 sec	30 -36 sec	2 sec	6 sec
Dynamic	8 kVp	150 mA	0.75 sec	40 - 60 sec	5 sec	20 sec

Effective dose <10 mSv: 1.9 mSv for head plus 7.4 mSv for neck

## SVD – Relative blood volumes



Software is designated for cerebral blood perfusion - relative tissue perfusion blood volume and time to peak mapping

# Renal donor CT: vascular mapping plus perfusion

