Role of Cardiac CT in 2007

12th Angioplasty Summit – TCT Asia Pacific
Seoul, Korea
25-27 April 2007

SIM Kui-Hian

MBBS(Hon)(Monash), FRACP, FACC, FESC, FSCAI, FCSANZ

Head, Department Of Cardiology & Head, Clinical Research Centre
Sarawak General Hospital.
Adjunct Professor
Faculty of Medicine & Health Sciences, University Malaysia Sarawak

Sarawak General Hospital

What information does cardiologist want from imaging?

- Coronary artery
  - Ischaemia
- Ventricular Myocardium Function
  - Viability
- Valves
- Morphology

SEPTEMBER 5, 2005

www.timeeurope.com AOL Keyword: TIME

CHINESE CYBERSPIES
COOL NEW SEARCH ENGINES

Sep

HOW TO STOP A HEART ATTAC BEFORE IT HAPPENS

Amazingly detailed new HEART SCANS help doctors spot trouble without surgery. How technology could save your life

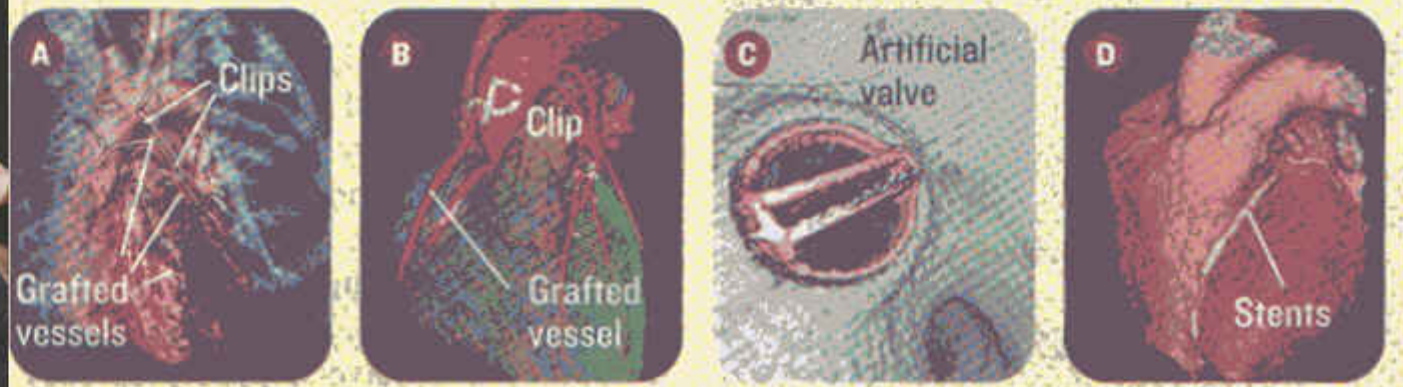
Keeping Track of Treatments

New technologies allow for less-invasive heart procedures. And the latest generation of CT scans makes it easier to monitor these therapies with minimum pain for the patient.

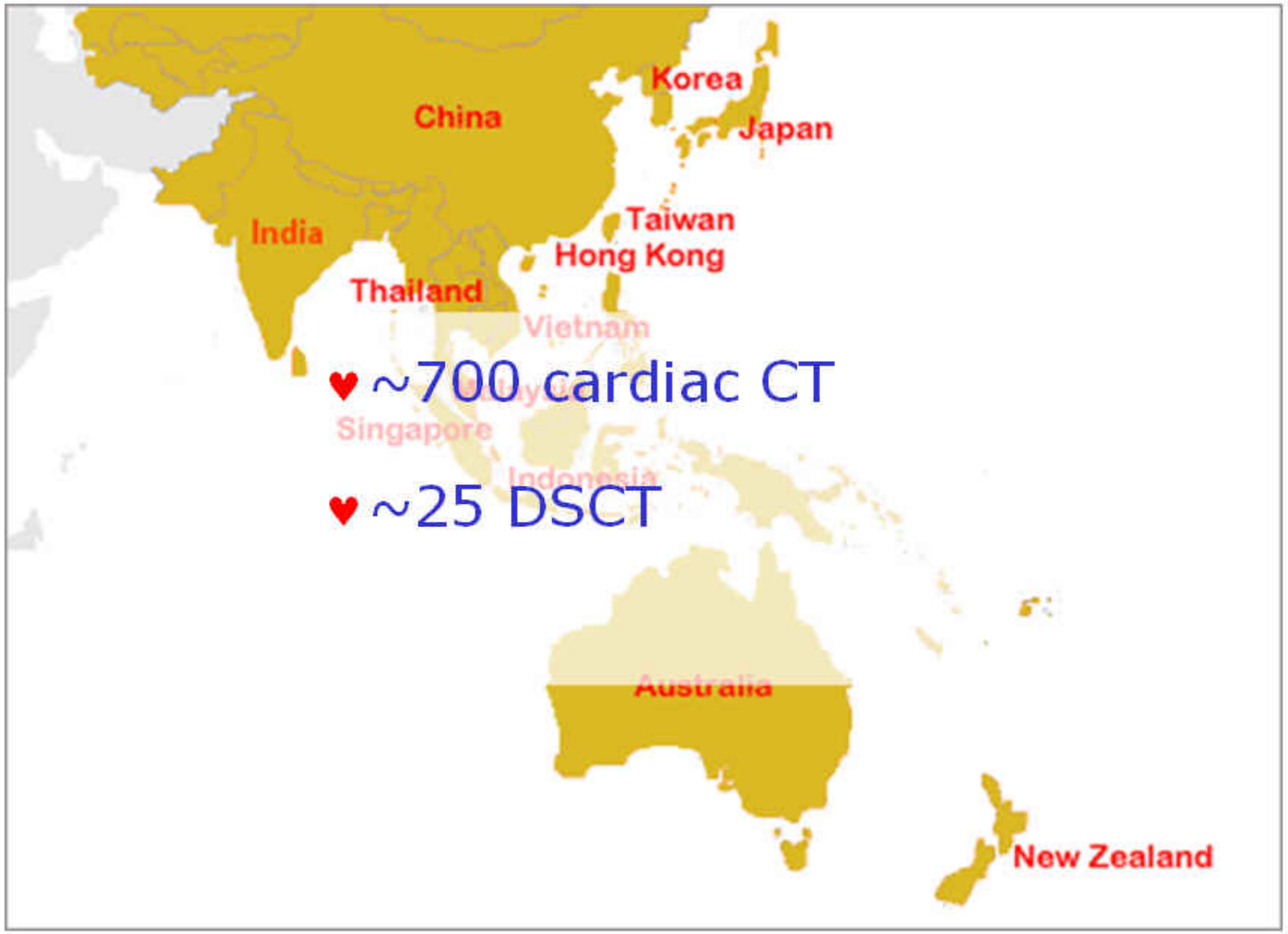
A B BYPASS SURGERY: Surgeons routinely replace plaque-clogged coronary arteries with vessels from elsewhere in the body. Later, these new vessels may themselves clog. Doctors can use scans to see how the grafts are holding up. The images below show the grafted vessels and the clips that hold them.

C VALVE SURGERY: The valves that open to let blood flow between heart chambers may wear out over time. Artificial replacement valves can be monitored periodically.

D STENTS: Scans also allow doctors to verify the success of angioplasty, in which surgeons clear plaque from arteries, then use wire stents to hold them open. The artery below had numerous plaques, and needed four stents—an unusually large number.

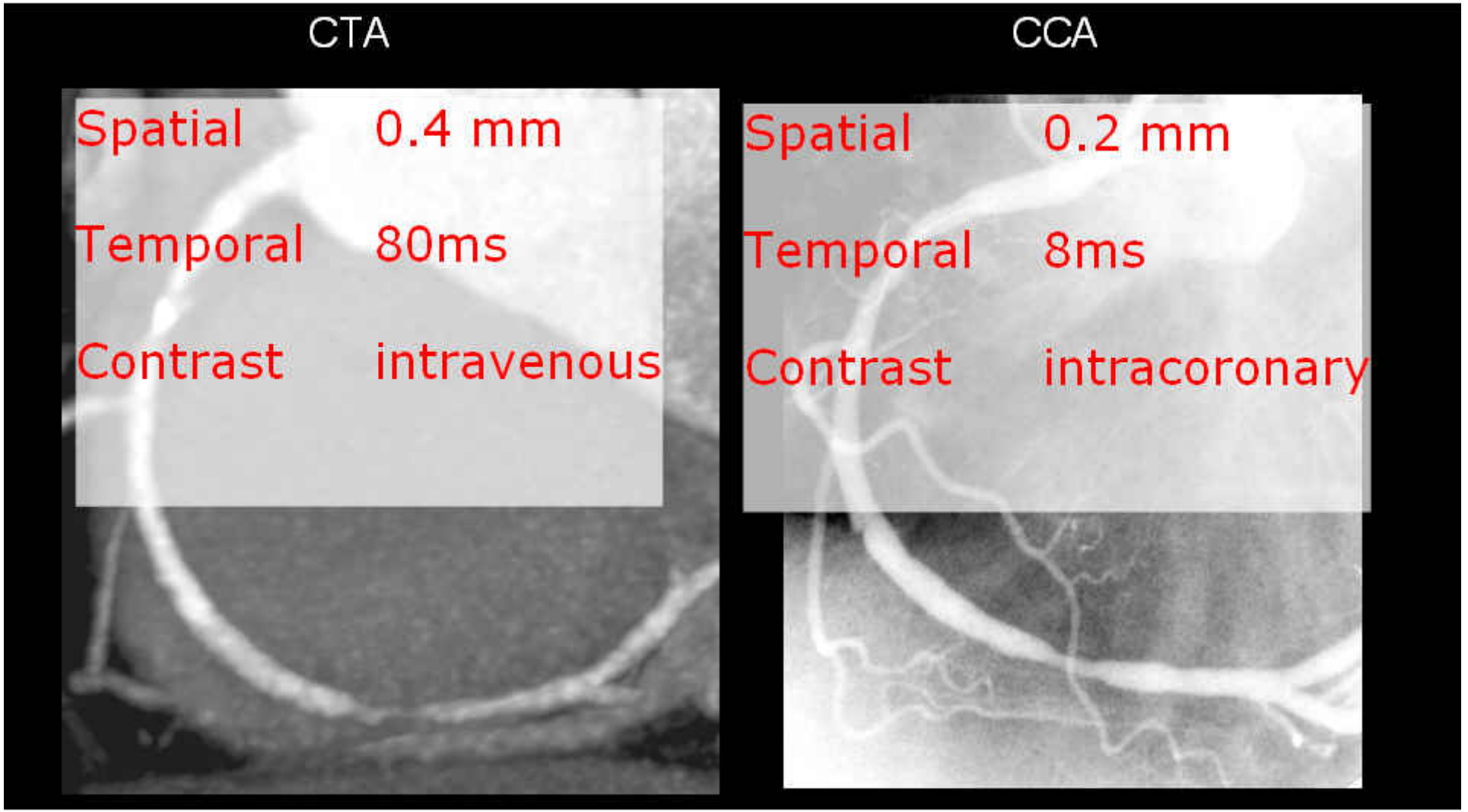


PHOTOGRAPHS: TOSHIBA AMERICA MEDICAL SYSTEMS (BYPASS A), GE HEALTHCARE (BYPASS B, VALVE, STENTS)


Korea
China
Japan
India
Taiwan
Hong Kong
Thailand
Vietnam
~700 cardiac CT
Singapore
Indonesia
~25 DSCT
Australia
New Zealand

- CT - coronary artery
  - obstruction

Distal RCA stenosis



Accuracy of coronary CT angiography using 16-MSCT

Year	Author	No. of patients	Sensitivity	Specificity	Negative predictive value	Not evaluable
2004	Mollett et al	128	92%	95%	98%	3%
2004	Martuscelli et al	64	89%	98%	98%	16%
2005	Morgan-Hughes et al	58	83%	97%	97%	2%
2005	Hoffmann et al	103	95%	98%	99%	6%
2005	Kuettner et al	72	82%	98%	97%	7%
2005	Mollett et al	51	95%	98%	99%	2%
2005	Schuijf et al	45	83%	97%	97%	6%
2005	Achenbach et al	50	94%	96%	99%	5%

Accuracy of coronary CT angiography using 64-MSCT

Year	Author	No. of patients	Sensitivity	Specificity	Negative predictive value	Not evaluable
2005	Leber et al	59	80%	97%	99%	0%
2005	Leschka et al	57	94%	97%	99%	0%
2005	Mollet et al	52	99%	95%	99%	2%
2005	Raff et al	70	86%	95%	98%	12%
2005	Pugliese et al	35	99%	96%	99%	0%
2006	Ropers et al	84	93%	97%	100%	4%

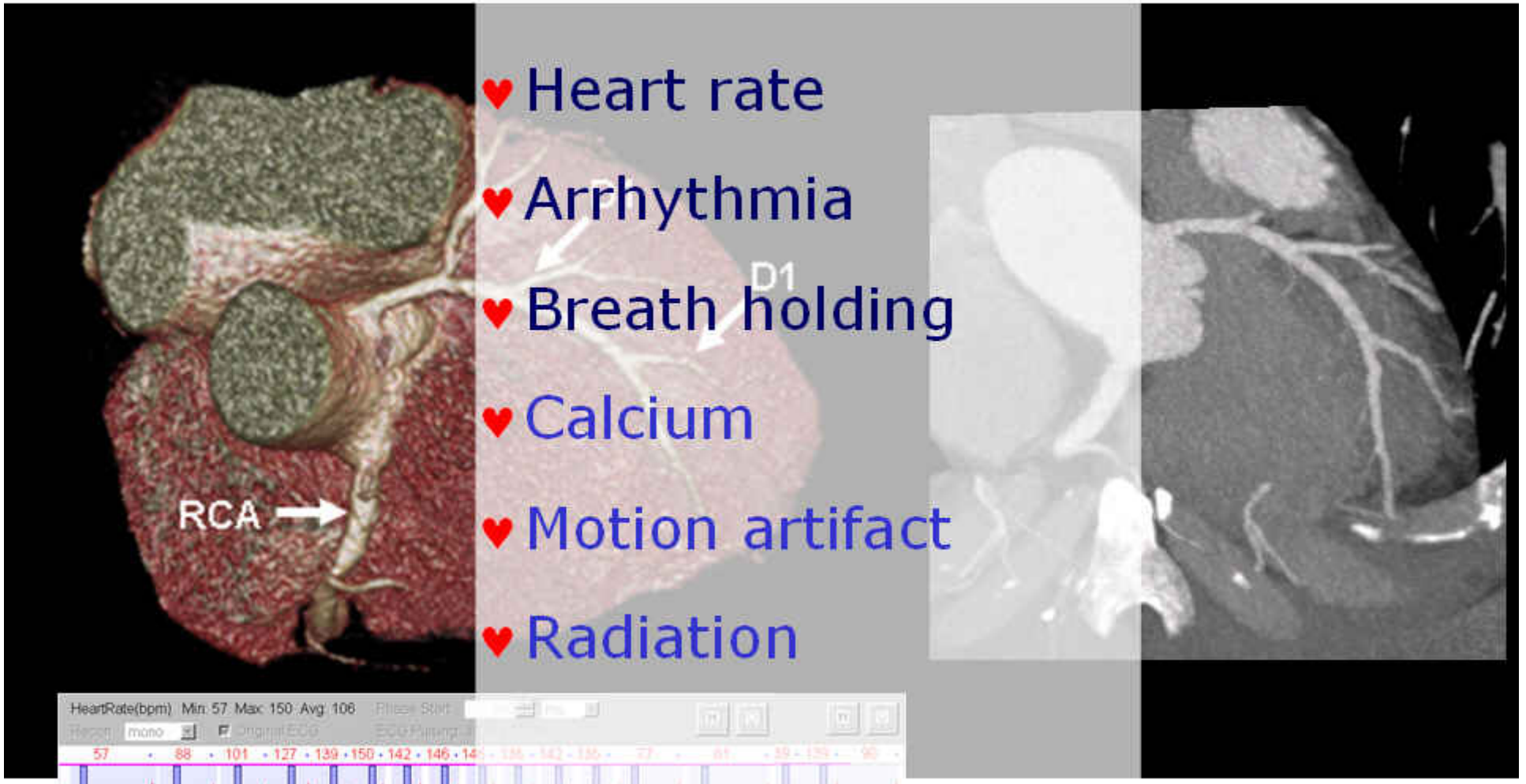
Accuracy of coronary CT angiography using next generation – MSCT

			n	sens	spec	not eval
♥ Roper	AHA 2006	DSCT	40	90%	95%	3%
♥ Leber	AHA 2006	DSCT	40	94%	98%	-
♥ Kurata	AHA 2006	256	9	100%	95%	17%

Limitation MSCT

- Heart rate
- Arrhythmia
- Breath holding
- Calcium
- Motion artifact
- Radiation

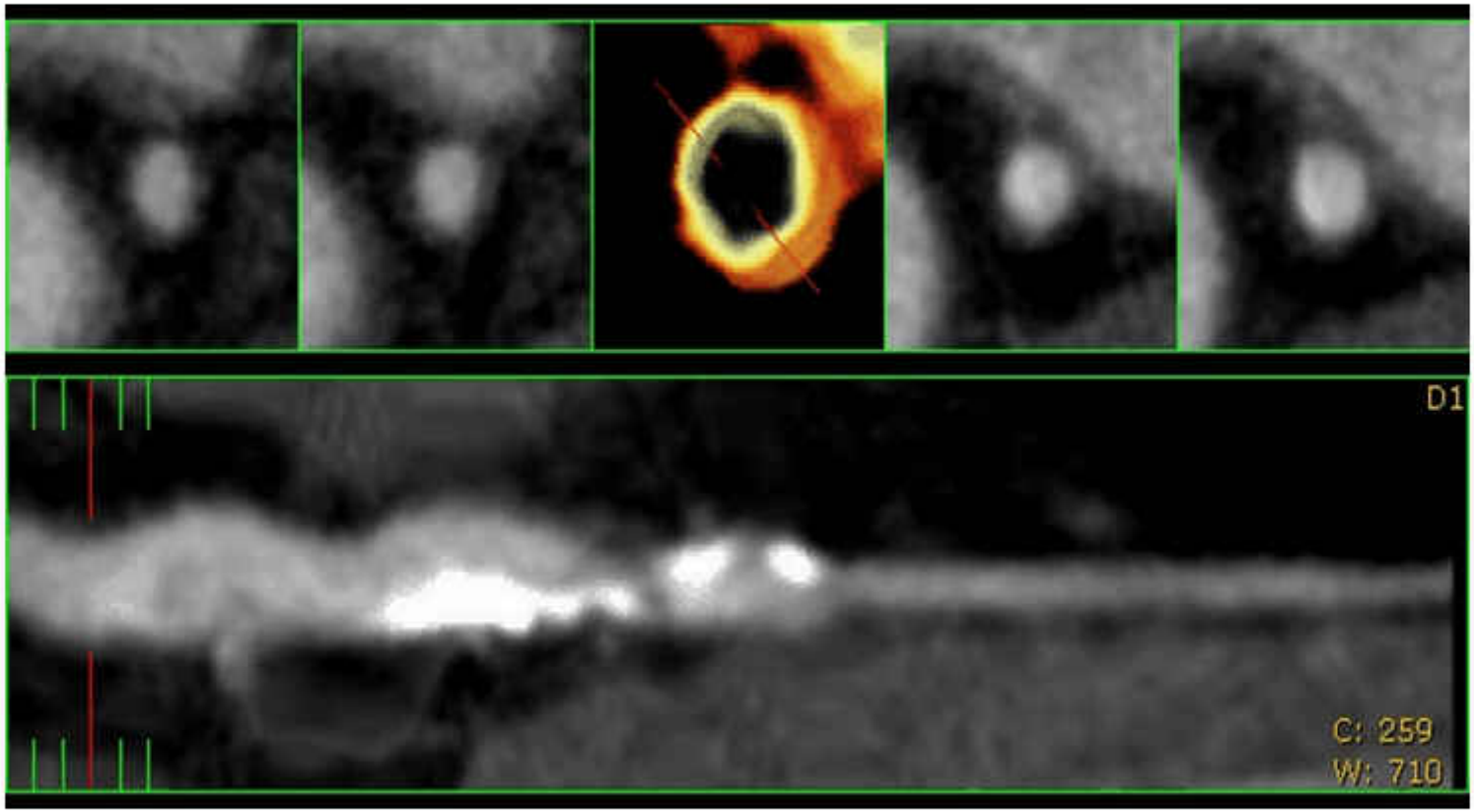
Atrial Fibrillation: Heart rate of 57–150bpm



Courtesy of HK Baptist Hospital, Hong Kong

Sarawak General Hospital

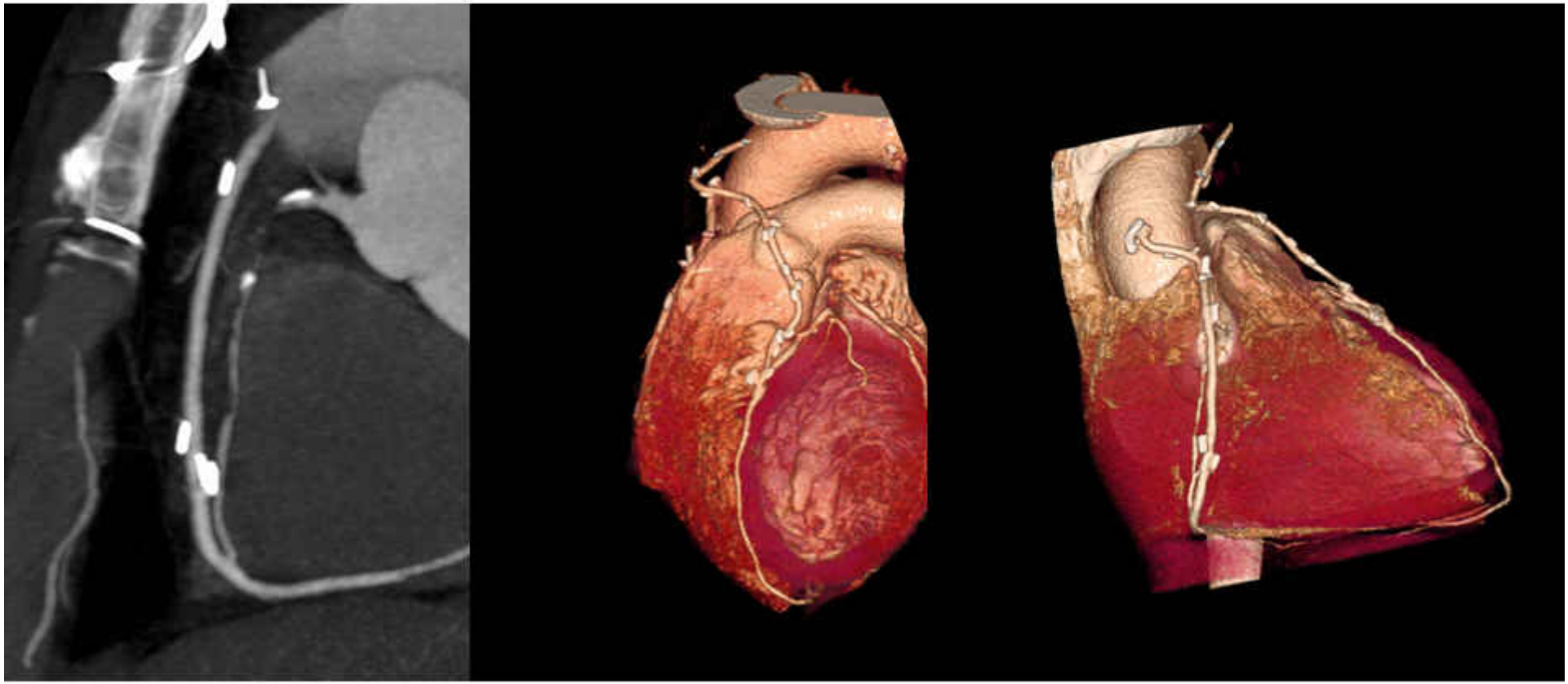
MSCT & Calcium



Augusto Pichard, Washington Hospital Center, DC

♥ CTA & Graft

Grafts



Grafts

- De Feyter, EuroPCR 2006
- 64 MSCTA
  - Patency 100%
  - Graft Disease
    - Sensitivity 91%
    - Specificity 95%
    - Distal vessels ?

♥ CTA & Stent

Stents

- De Feyter, EuroPCR 2006
  - 64 MSCT
  - Left main instent restenosis
    - Sensitivity 100%
    - Specificity 91%
  - Conclusion
    - Confidently rule out presence of instent restenosis
    - Reliably detects instent restenosis

Stent


Patient Transfer Edit View Image Tools Scroll Options Help
SOMATOM
Sensation 64
Cardiac
Coronary Stent
Resolution 0.33 mm
Rotation 0.33 sec
Viewing
Filming
3D
Tools
Image
View
auto
Patient
Taxus Express 2 - 0.052"
Taxus Liberte – 0.038"

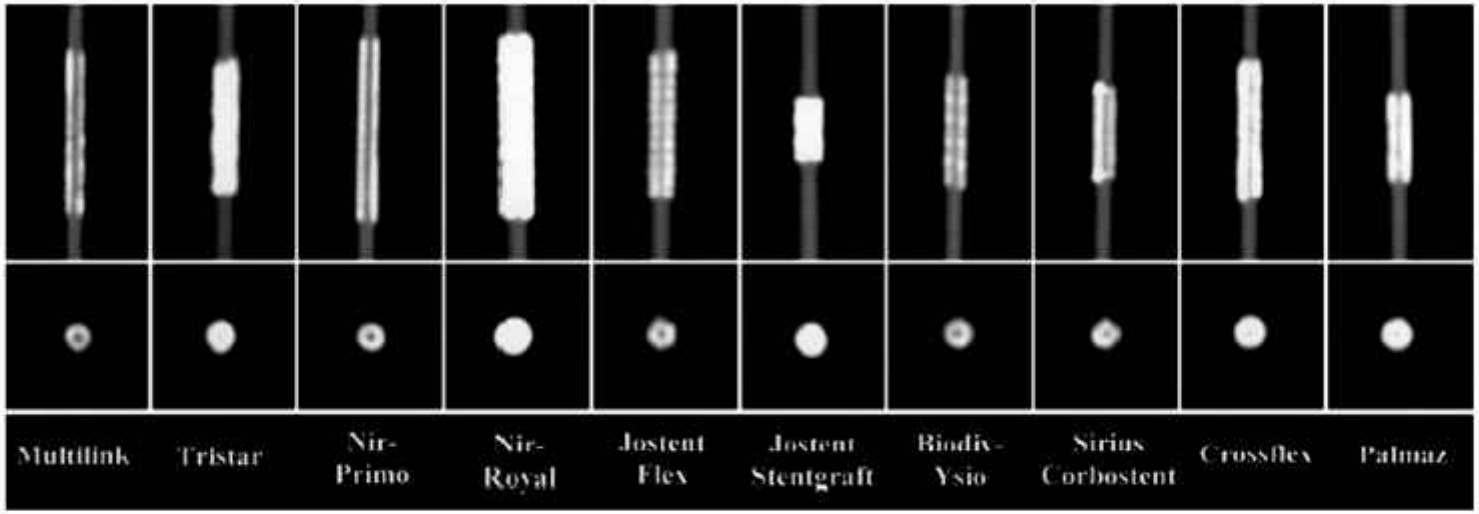
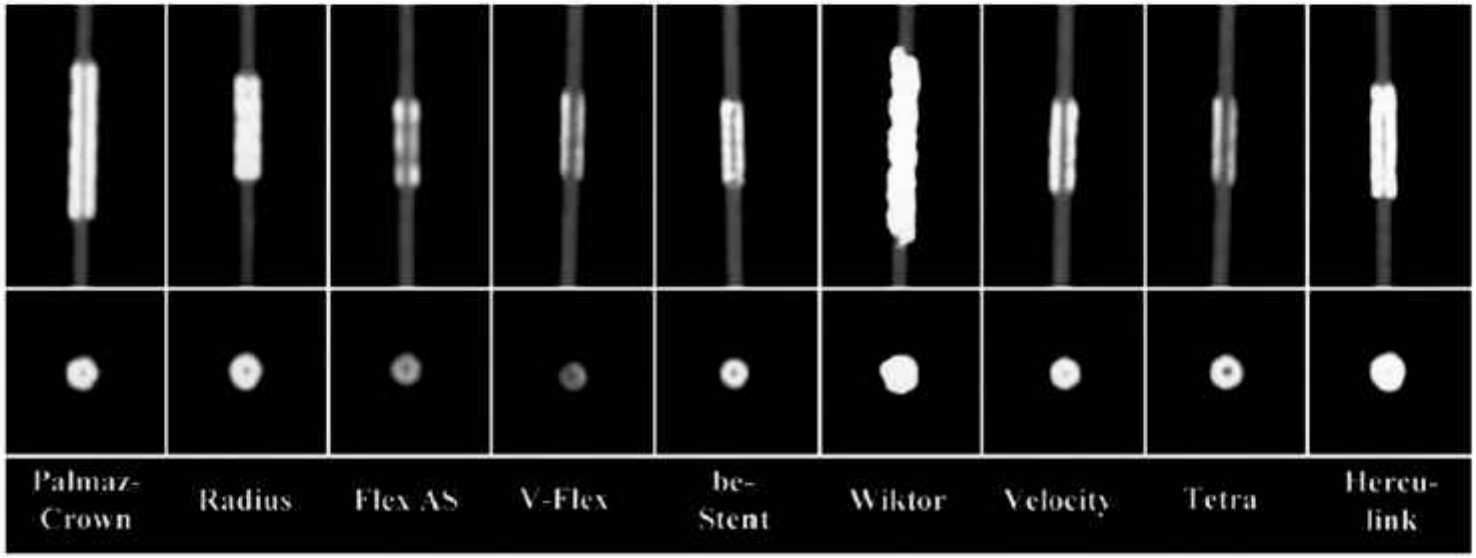
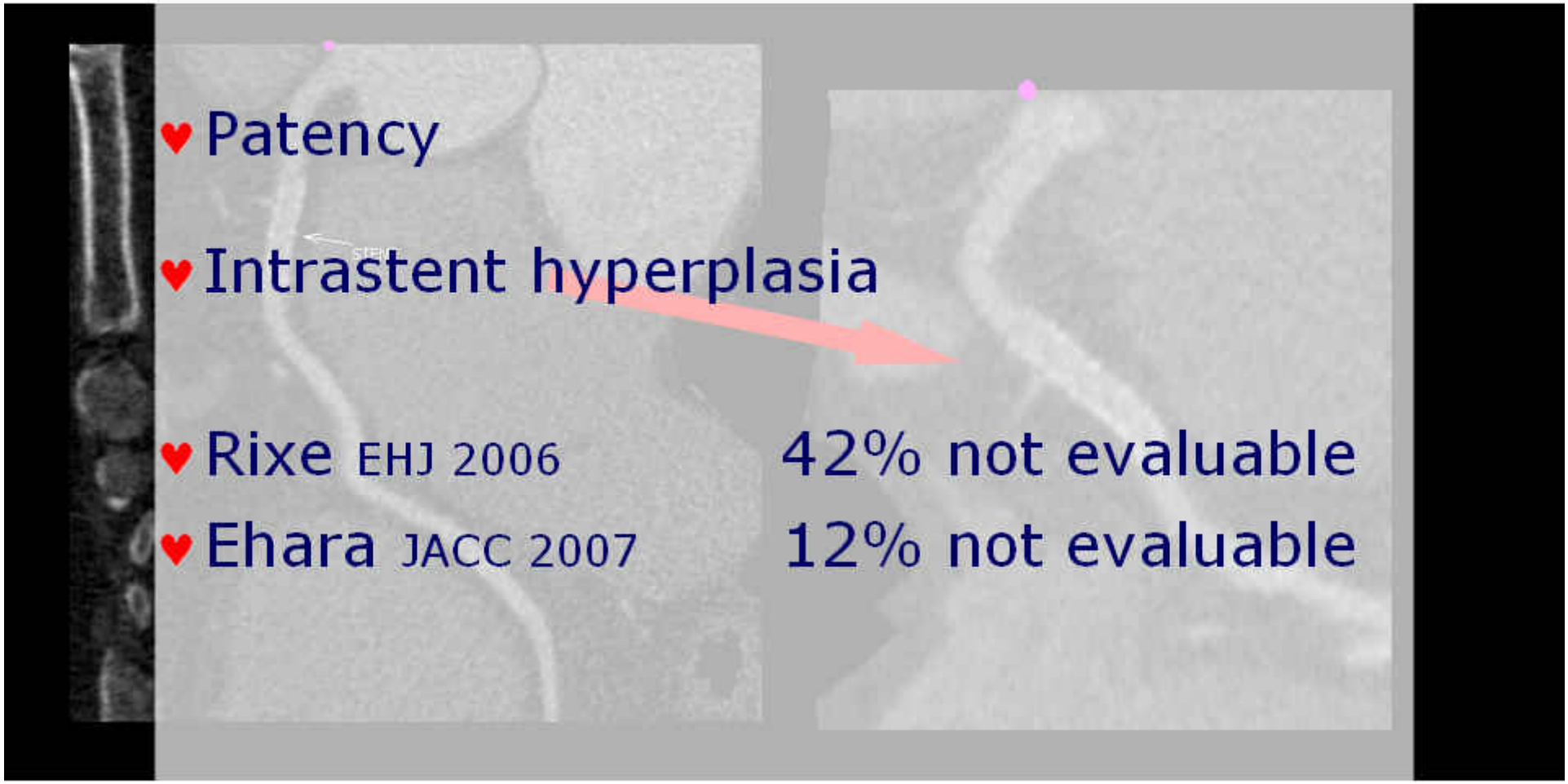


Fig. 1 In-plane images (*upper rows*) and through-plane reformations (*lower rows*) of the examined stents. The Radius stent is made of nitinol. The Wiktor stent is made of tantalum; all others are composed of stainless steel (316L). Note partial visibility of the stent lumen depending on the stent type

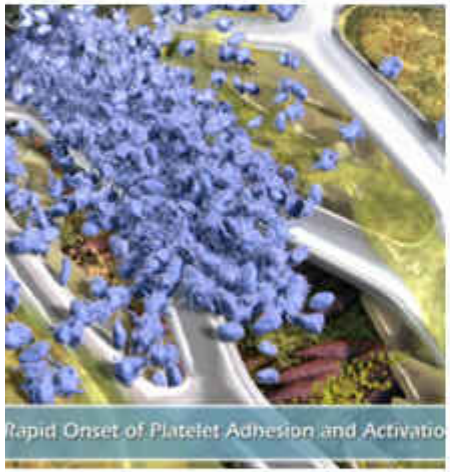
Maintz et al, EJR 2003, 13:830-835

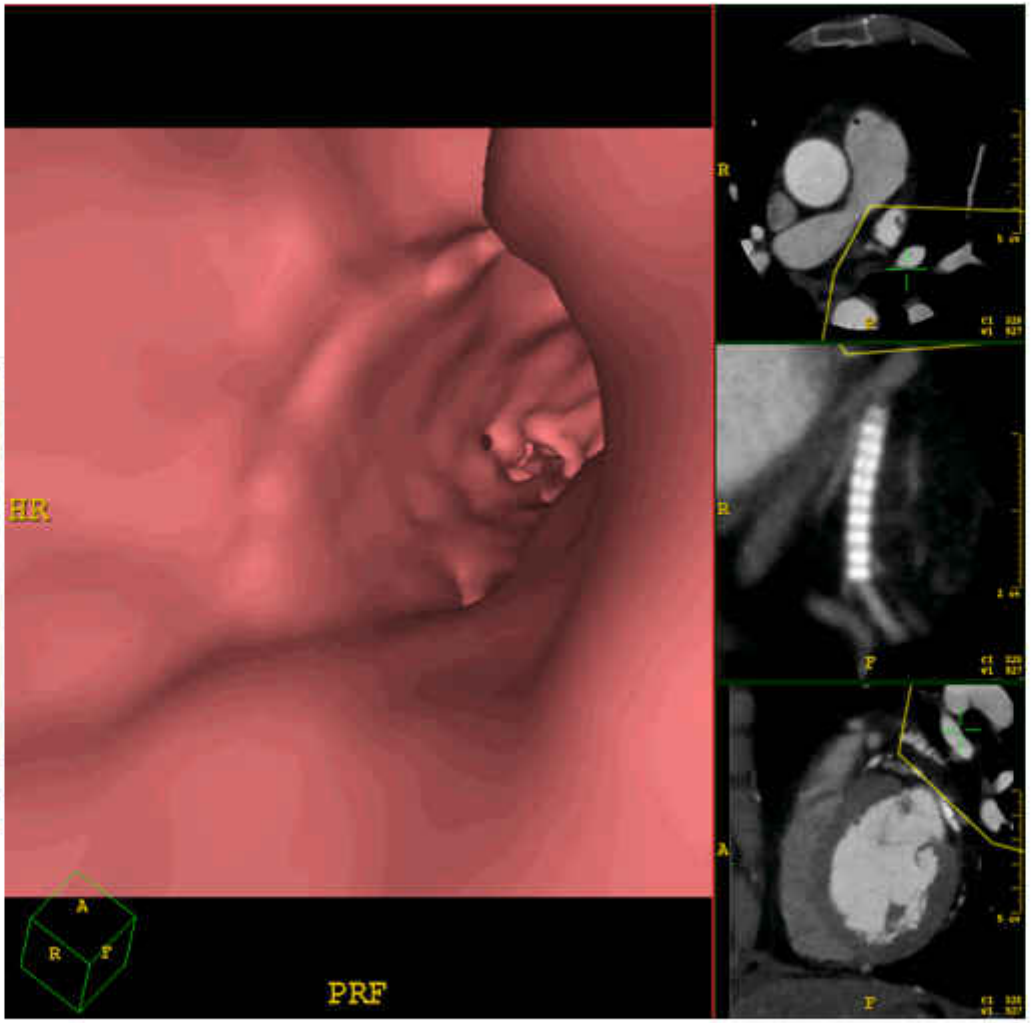


9 months post PCI



Stent



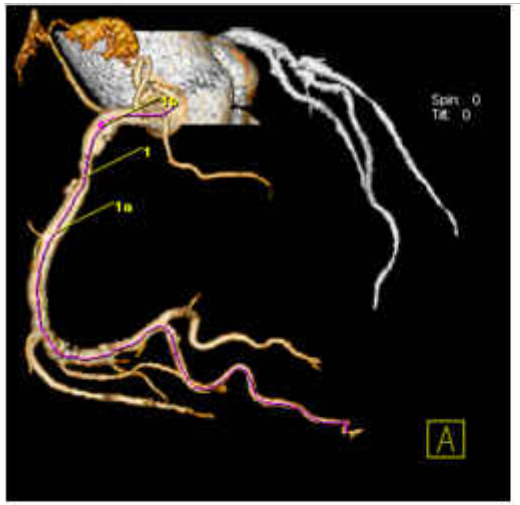


Augusto Pichard, Washington Hospital Center, DC

♥ CTA & PCI

CTA & PCI

- Lesion
  - Size
  - Length
  - Course
  - Composition
  - PCI strategy
  - Revascularization strategy



CTA & PCI

35 pts 40 stents

Table 1	CTA	QCA	*Correlation (P value)*	*Mn p Δ (P value)*
Mean proximal reference diameter (mm)	**3.58±0.57**	**2.98±0.43**	***0.44 (0.01)***	***0.6 (<0.001)***
Mean percentage stenosis (%)	**78.1±15.6**	**67.1±10.9**	***0.49 (0.004)***	***11.0 (<0.001)***
Mean lesion length (mm)	**18.6±6.0**	**14.6±6.9**	***0.55 (0.001)***	***4.0 (0.001)***

Chin SP, Sim KH, et al. Society Cardiac CT ASM, July 2006, Washington DC

Angioplasty Summit TCT Asia Pacific 2007
Wednesday, April 25 ~ Friday, April 27, 2007
The Convention Center of Sheraton Walkerhill Hotel, Seoul, Korea

AS-079

AS-082

Cardiac imaging

Cardiac imaging

. Clinical Impact of 64-Multidetector Computed Tomography on Percutaneous Coronary Intervention of Chronic Total Occlusion

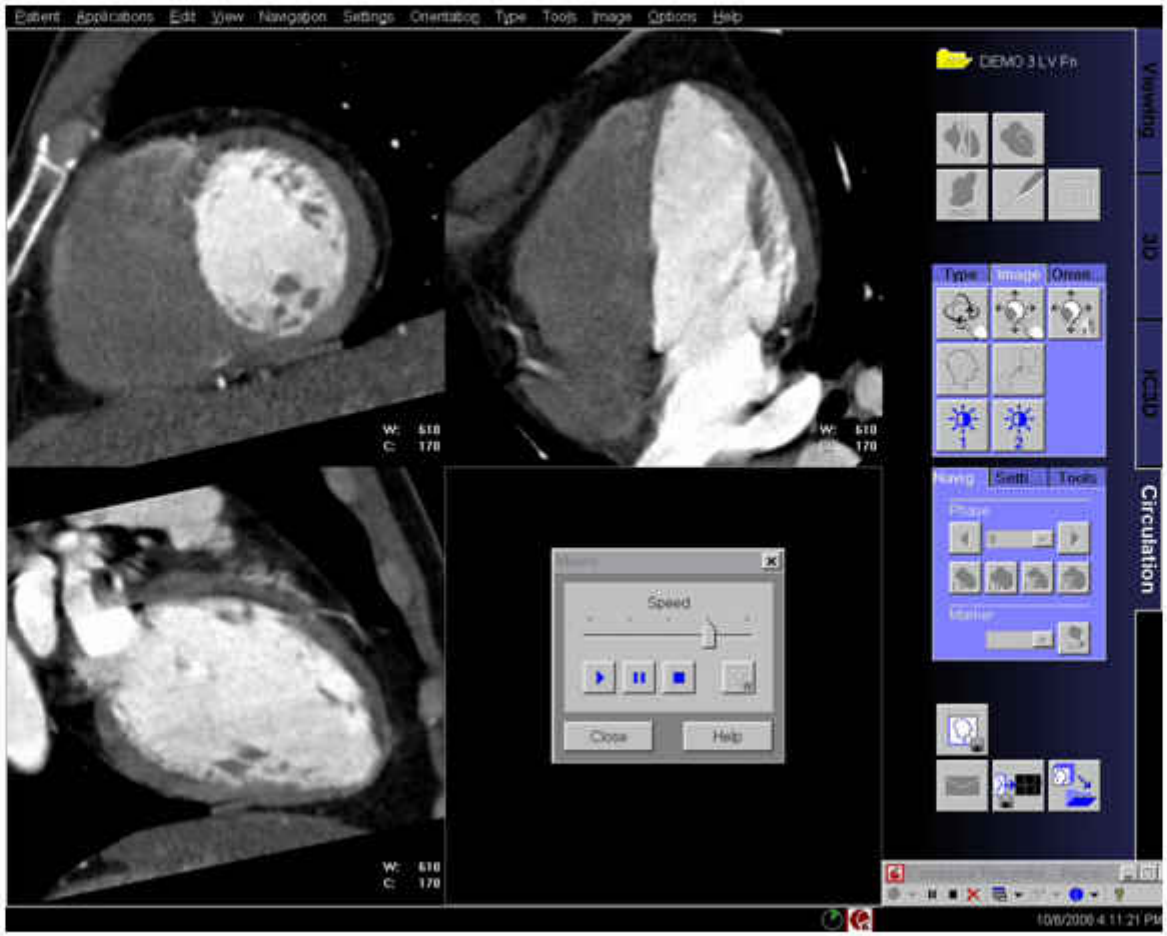
[1]Yonsei University College of Medicine, Yonsei Cardiovascular Center, Cardiology Division, Seoul, Korea (Republic of); [2]Yonsei University College of Medicine, Department of Diagnostic Imaging, Seoul, Korea (Republic of); [3]Heart Center of Chonnam National University Hospital, Gwangju, Korea (Republic of)

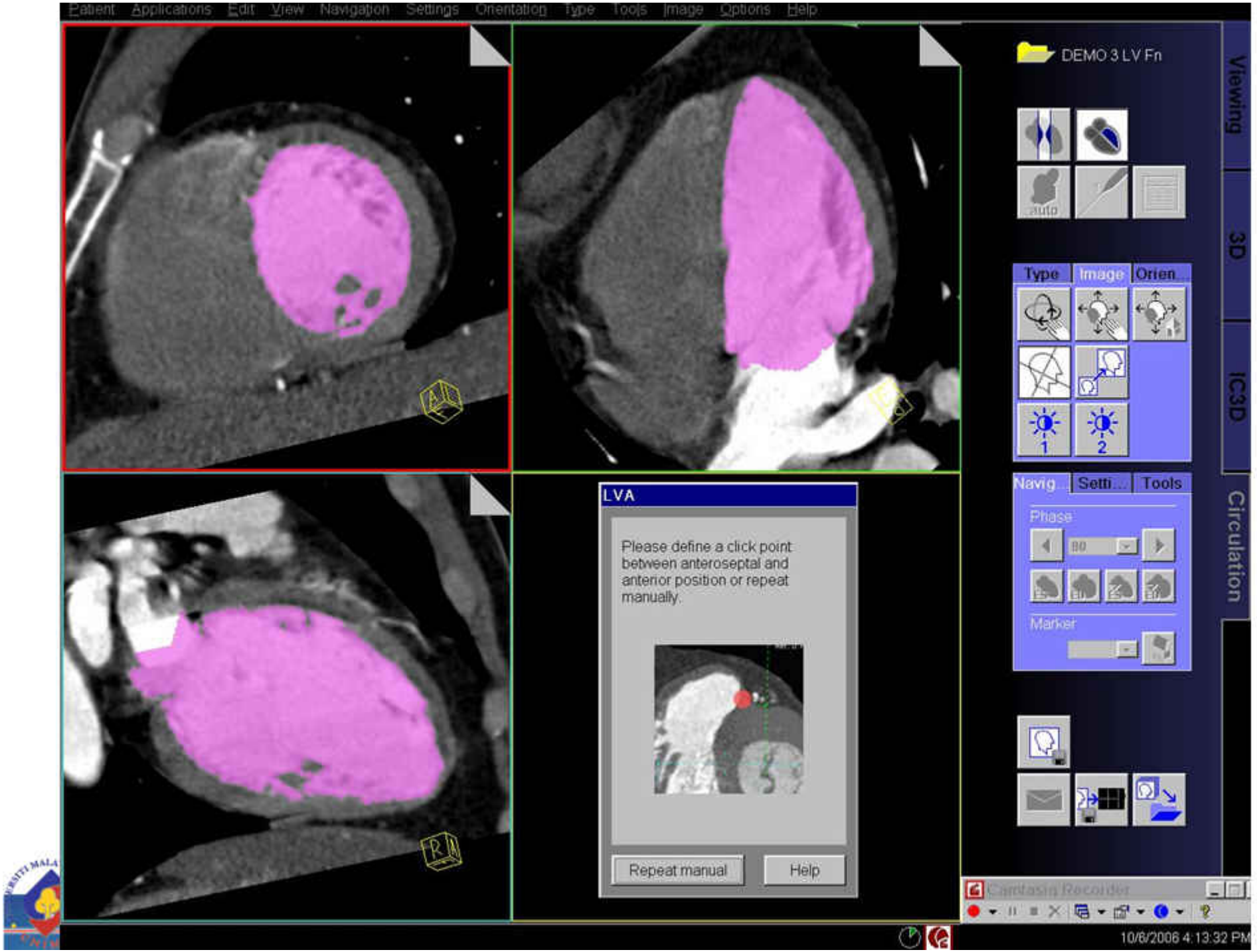
J.R. Cho[1], Y.J. Kim[2], J.Y. Moon[3], J.S. Kim[1], D.Y. Kim[1], H.S. Kim[1], Y.G. Ko[1], D.H. Choi[1], Y.S. Jang[1], N.S. Chung[1], K. Choe[2], W.H. Shim[1], S.Y. Cho[1]

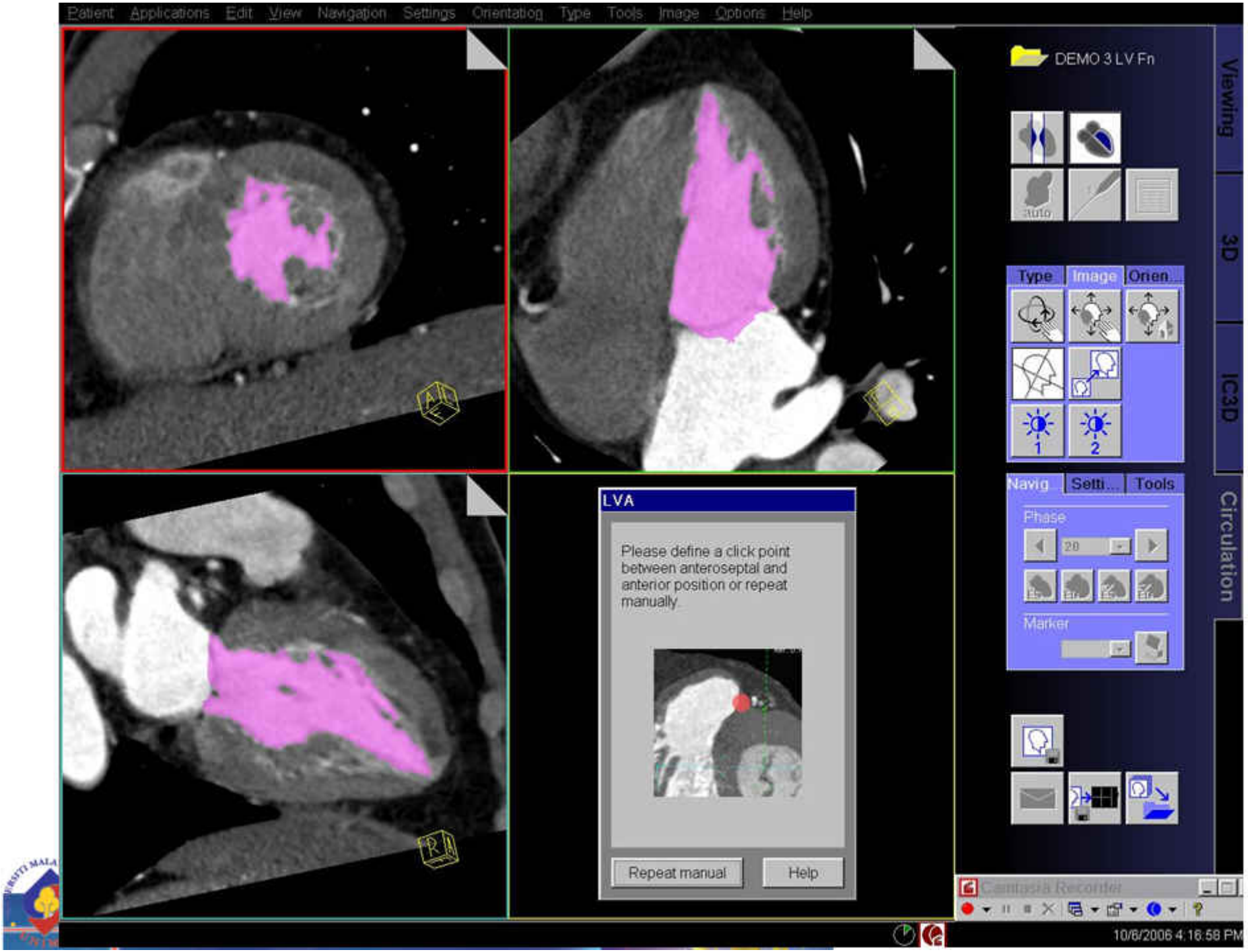
Background:
The main reason for failure of percutaneous coronary intervention (PCI) of chronic total occlusion (CTO) is calcified plaque, which either prevents the passage of a guidewire or is likely to rupture after balloon angioplasty. 64-multidetector computed tomography (MDCT) of the coronary artery can accurately evaluate the location and amount of calcium in occluded segment, as well as the lesion length. We sought to evaluate multiple MDCT-derived parameters that can affect procedural outcome of PCI in CTO patients.

- **CT**
  - LV function
  - Regional Wall Motion
  - Viability

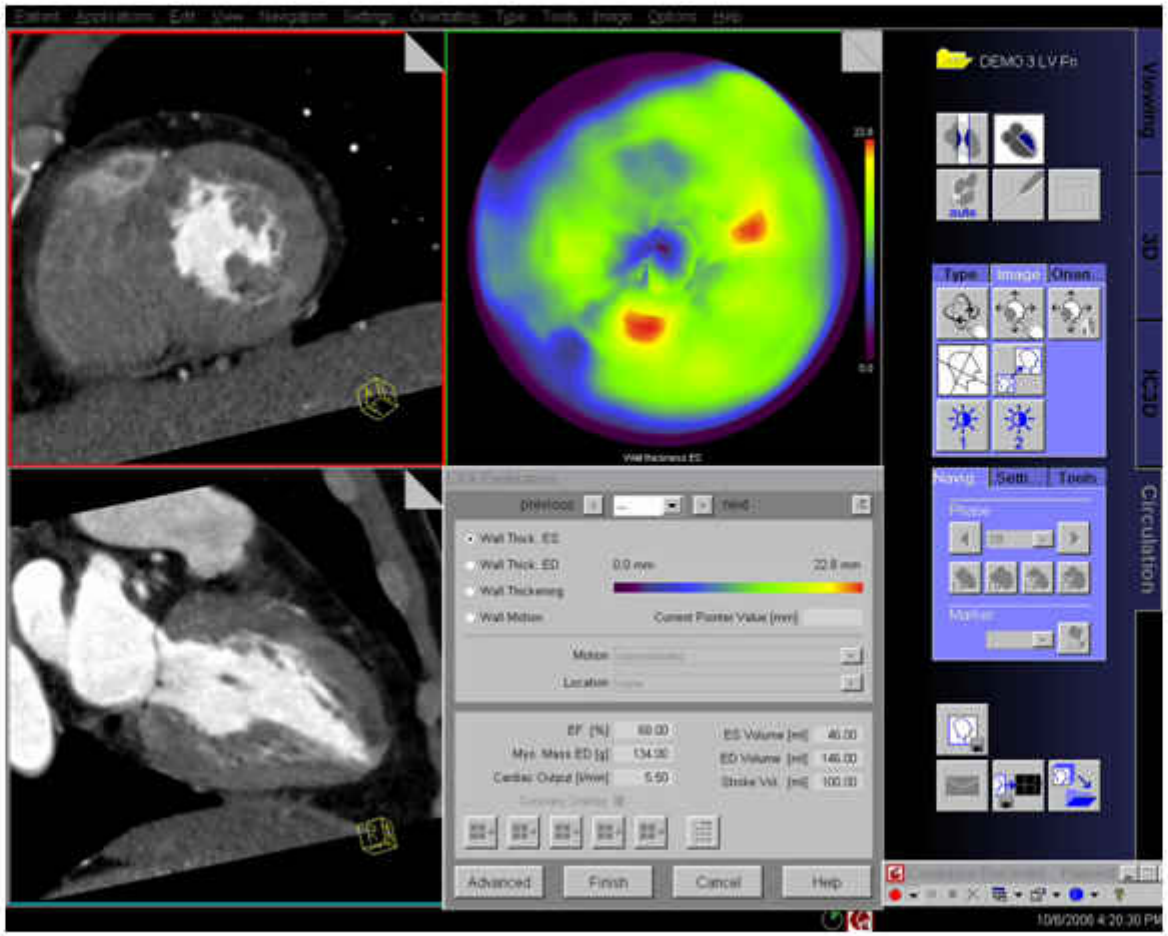
LV function @ NO extra cost




Patient Applications Edit View Navigation Settings Orientation Type Tools Image Options Help
DEMO 3 LV Fn
Viewing
3D
IC3D
Circulation
auto
Type
Image
Orien...
1
2
Navig...
Setti...
Tools
Phase
Marker
LVA
Please define a click point between anteroseptal and anterior position or repeat manually.
Repeat manual
Help
Camtasia Recorder
10/6/2006 4:13:32 PM


Patient Applications Edit View Navigation Settings Orientation Type Tools Image Options Help
DEMO 3 LV Fn
Viewing
3D
IC3D
Circulation
Type
Image
Orien...
Navig
Setti...
Tools
Phase
Marker
LVA
Please define a click point between anteroseptal and anterior position or repeat manually
Repeat manual
Help
Camtasia Recorder
10/8/2006 4:16:58 PM

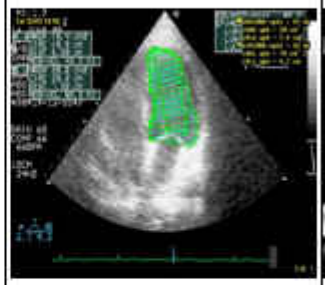
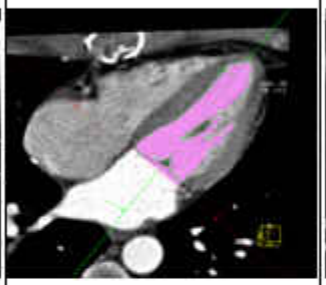
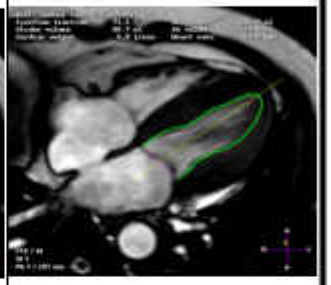
CT LV function



LV Function

Echo vs CT vs MRI

32 patients (All 3 procedures within 48 hrs)

	 2 D Echo Simpson	 64 MDCT ALEF	 CMR Simpson	 CMR ALEF
LVEF	49.13% ±15.9%	50.00% ±15.9%	47.65% ±16.88%	50.72% ±16.55%

r=0.80 p<0.01

r=0.92 p<0.01

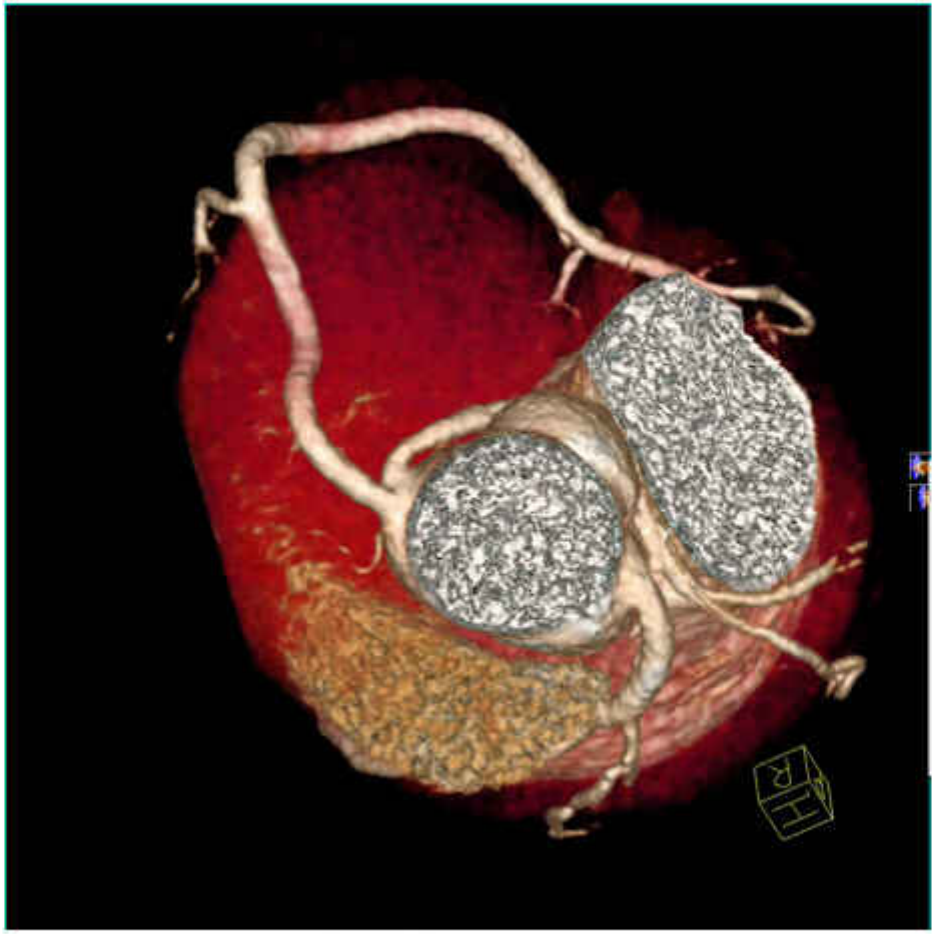
r=0.94 p<0.01

Annuar R, KH Sim, et al. WCC / ESC September 2006.
Accepted European Radiology March 2007

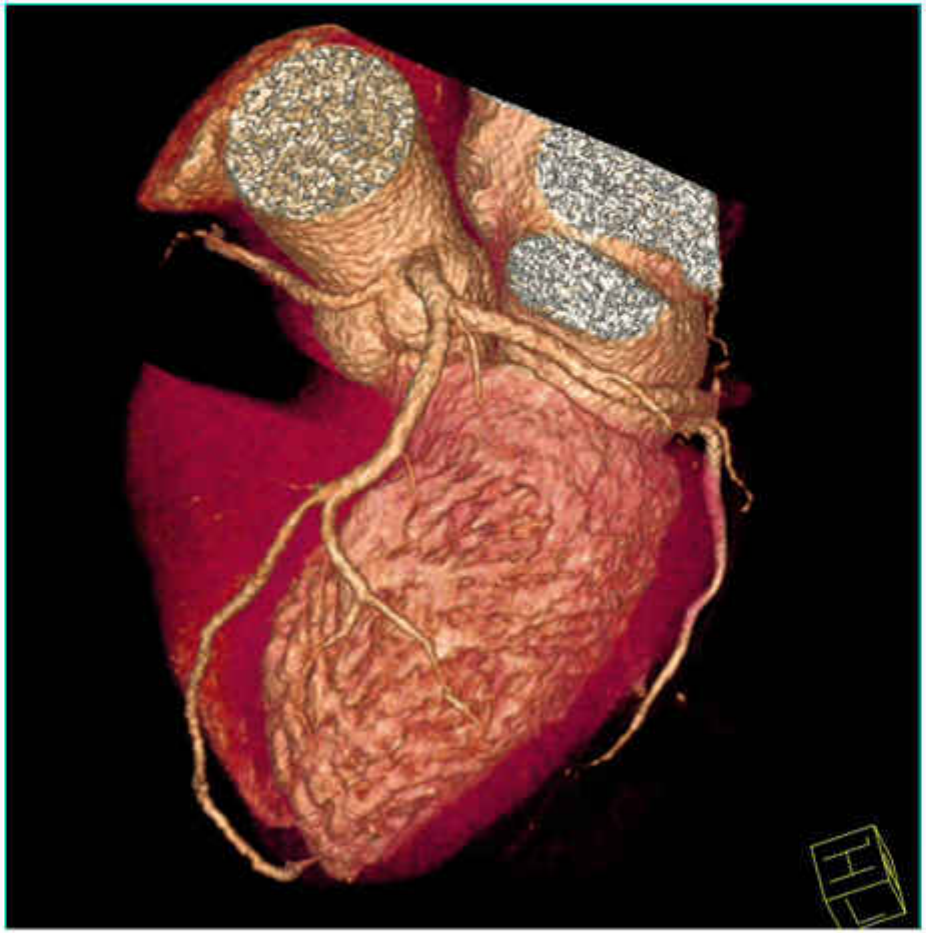
CT – Other application

- Anomalous coronary artery
- Congenital heart
- Valvular heart
- Great vessels

Anomalous LCx



Anomalous RCA



Case Study Congenital Heart

IMAGES IN CARDIOLOGY

doi: 10.1136/hrt.2006.088898

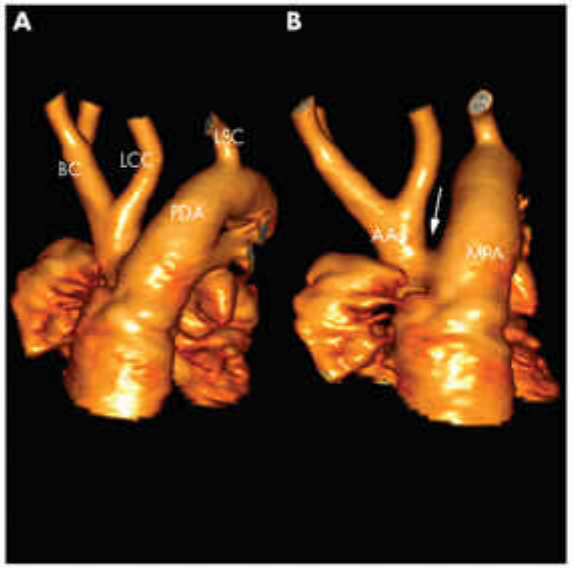
Interrupted aortic arch and aortopulmonary window demonstrated on 64-slice multidetector computed tomography angiography

A 3-day-old infant was referred for cardiac assessment because of multiple congenital anomalies including facial dysmorphism, cleft lip and palate and exomphalos minor. Echocardiography revealed type B interrupted aortic arch and large aortopulmonary window. The interventricular septum was intact.

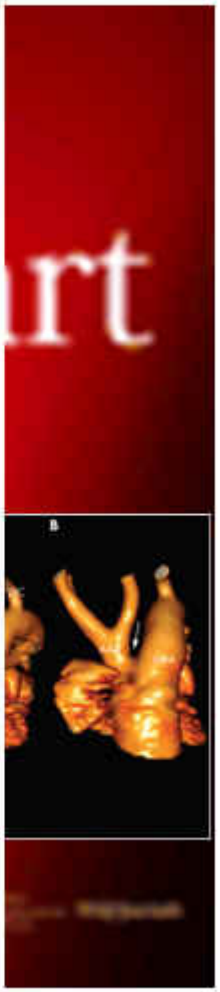
A 64-slice multidetector computed tomography (MSCT) angiography (Sensation 64, Siemens, Germany) was performed using high resolution protocol (slice thickness 0.75 mm, pitch factor 1.2) without electrocardiographic gating. A total of 6 ml of intravenous contrast was injected through a 24 G cannula in the right saphenous vein. No sedation was given and the actual scan time was 1.97 s. Following acquisition, three-dimensional volume rendered images were reconstructed using Syngo InSpace4D application software.

The study illustrated interruption of the aortic arch between the left common carotid and left subclavian arteries, giving rise to the classic "V" sign appearance. The descending aorta was fed by a large patent ductus arteriosus (panel A: BC, brachiocephalic artery; LCC, left common carotid artery; LSC, left subclavian artery; PDA, patent ductus arteriosus). The spatial relationship between the vessels was clearly demonstrated. In addition, there was a large communication existing between the ascending aorta and the proximal main pulmonary artery which represented a large aortopulmonary window (panel B: arrow; AAo, ascending aorta; MPA, main pulmonary artery). Conservative management was advocated subsequently after the diagnosis of trisomy 13 was revealed on karyotyping.

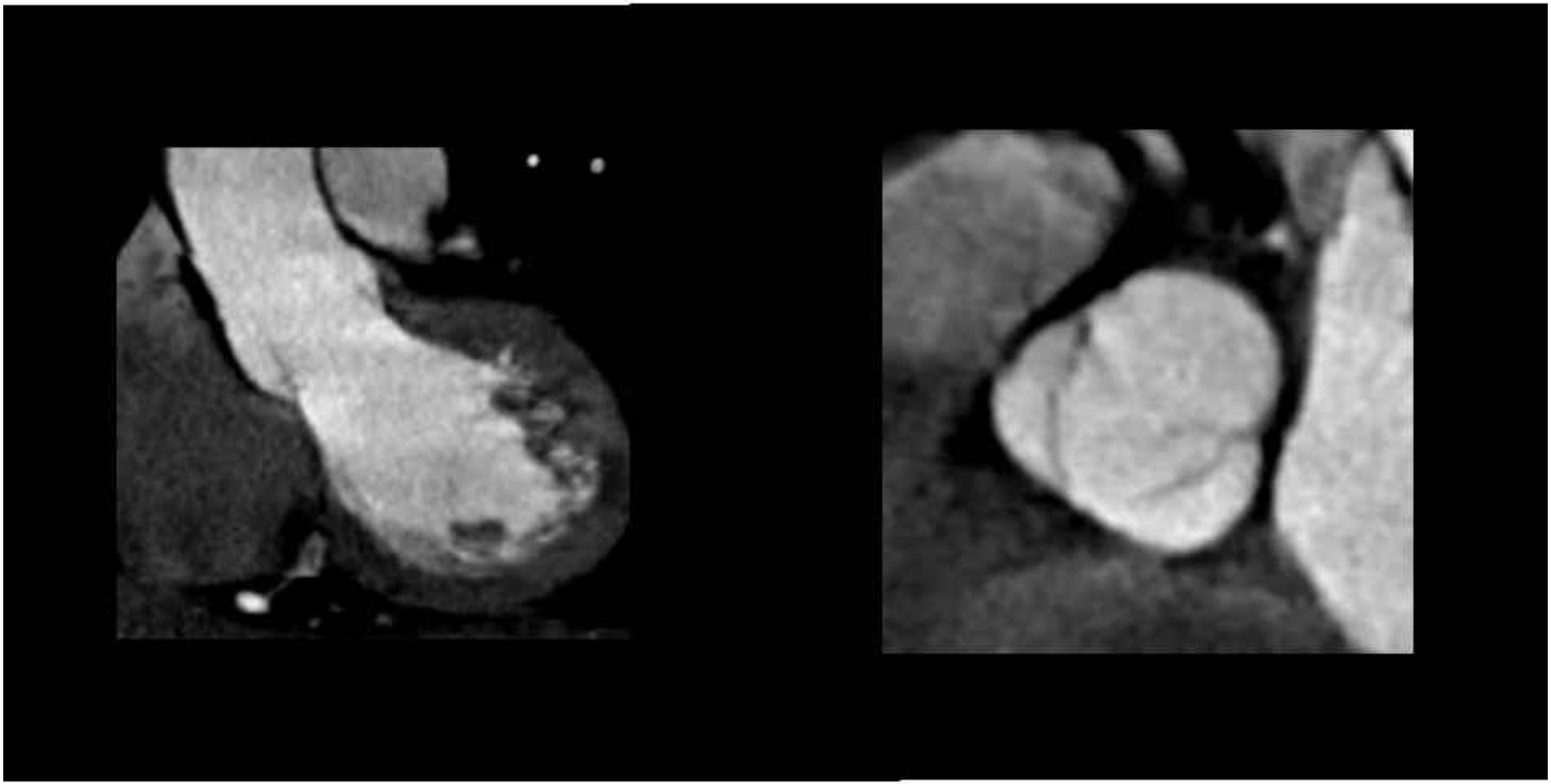
MSCT provided a fast and non-invasive way for accurate morphological evaluation in this case.



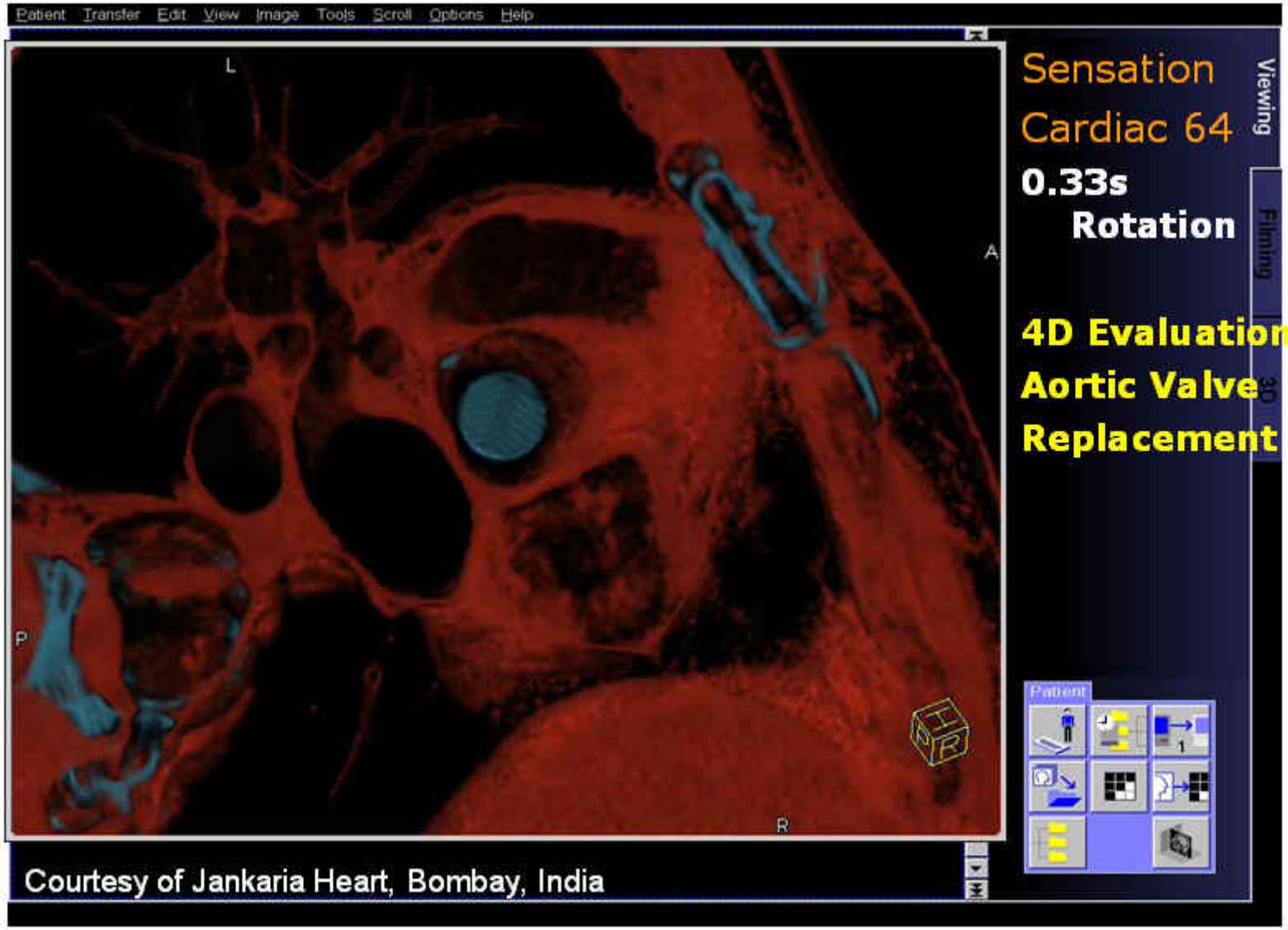
M N L Wong
L G Chan
K H Sim
martin.wong@health.gov.my



Valves

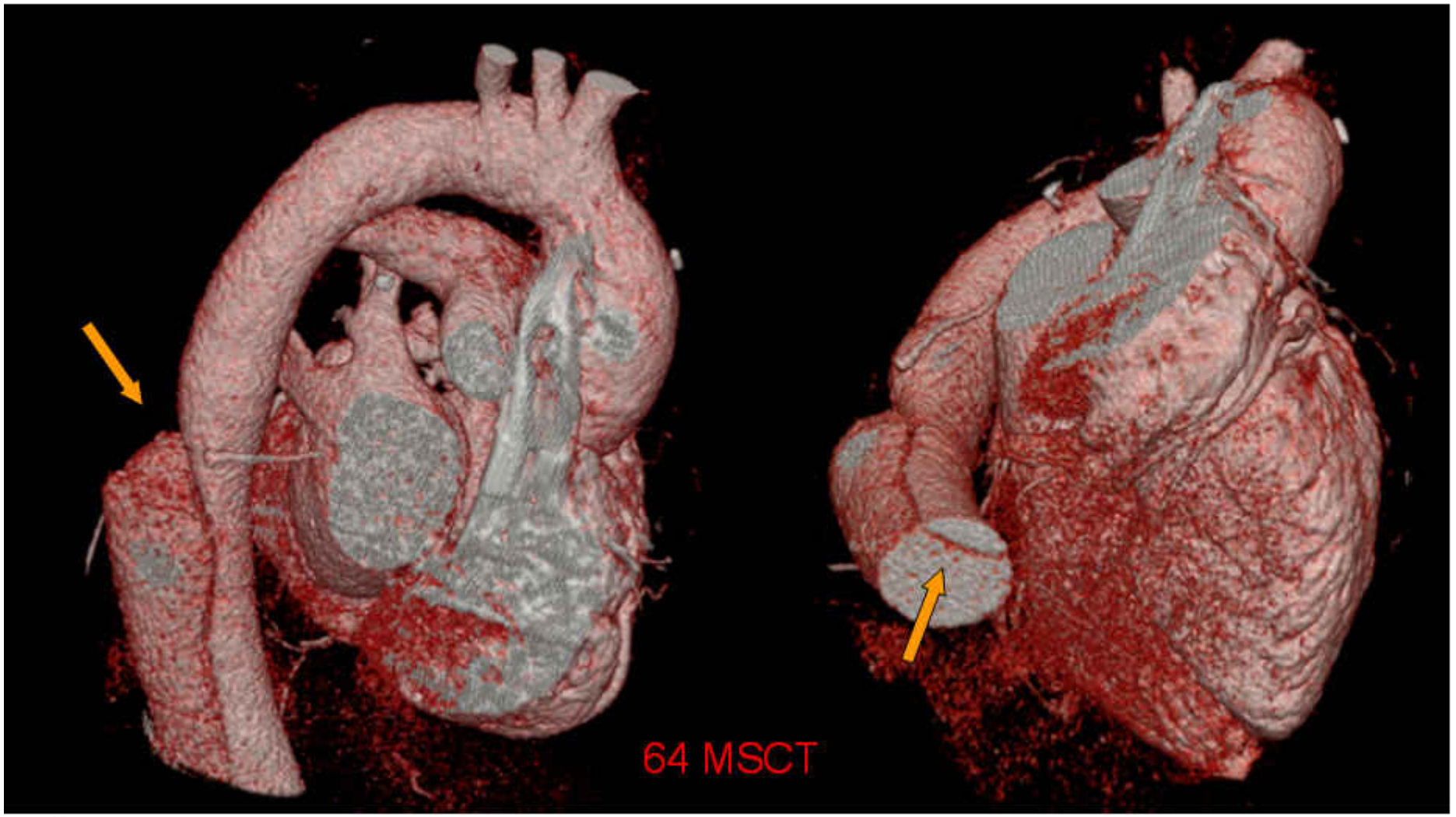


Valves

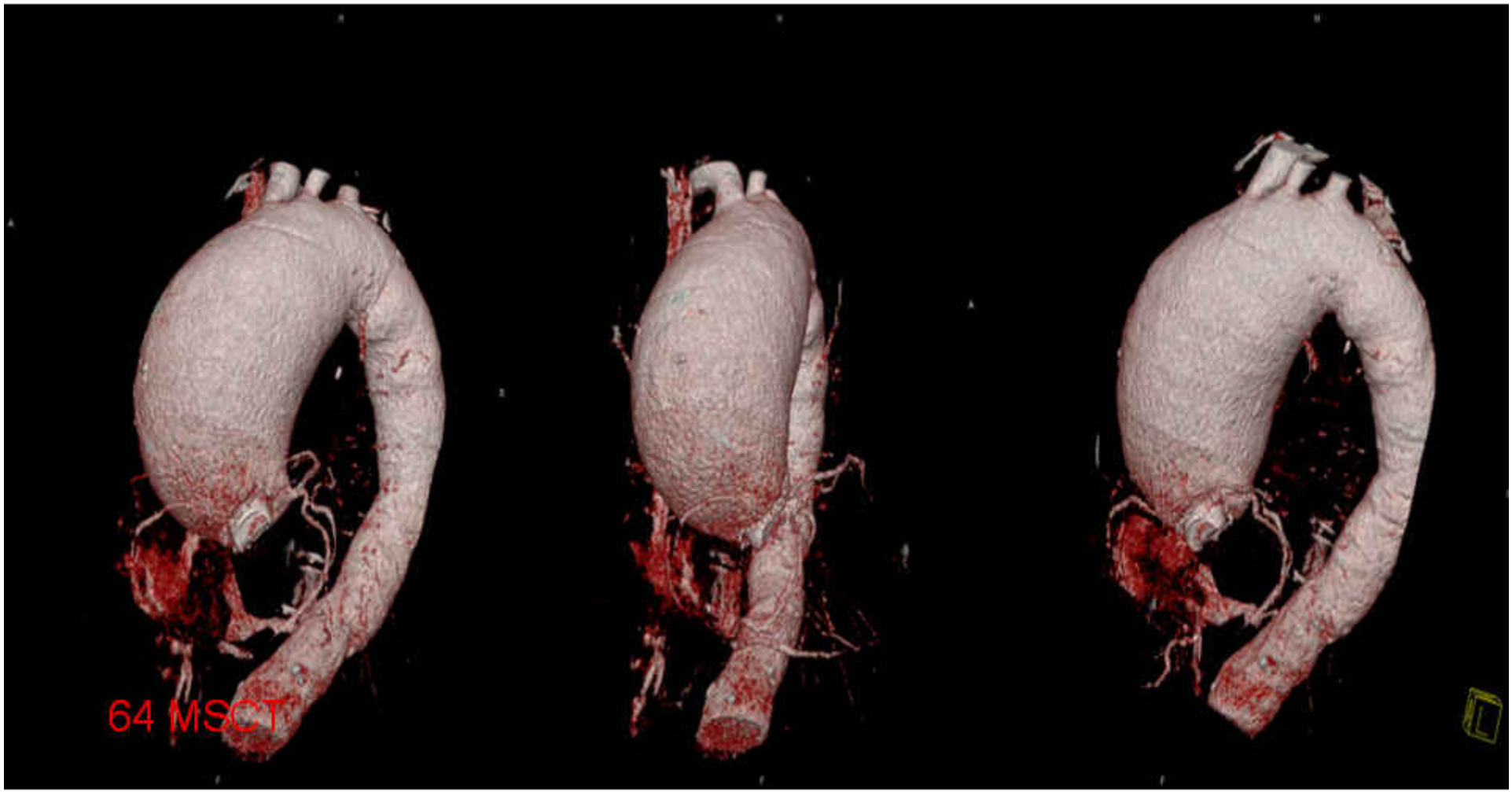

Patient Transfer Edit View Image Tools Scroll Options Help
L
A
P
R
Sensation
Cardiac 64
0.33s
Rotation
4D Evaluation
Aortic Valve
Replacement
Viewing
Filming
3D
Patient
Courtesy of Jankaria Heart, Bombay, India

Chest Pain

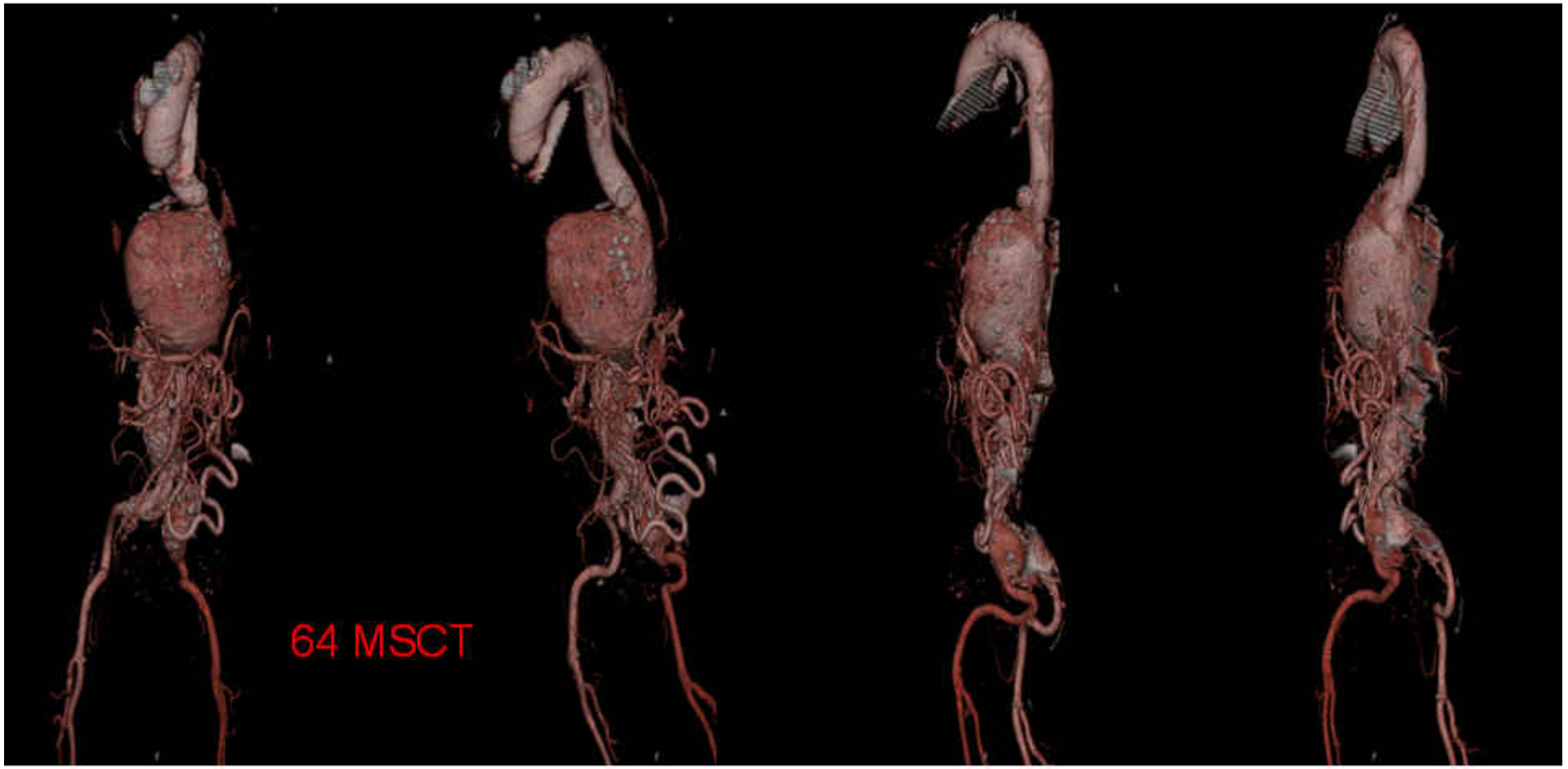
Aortic dissection

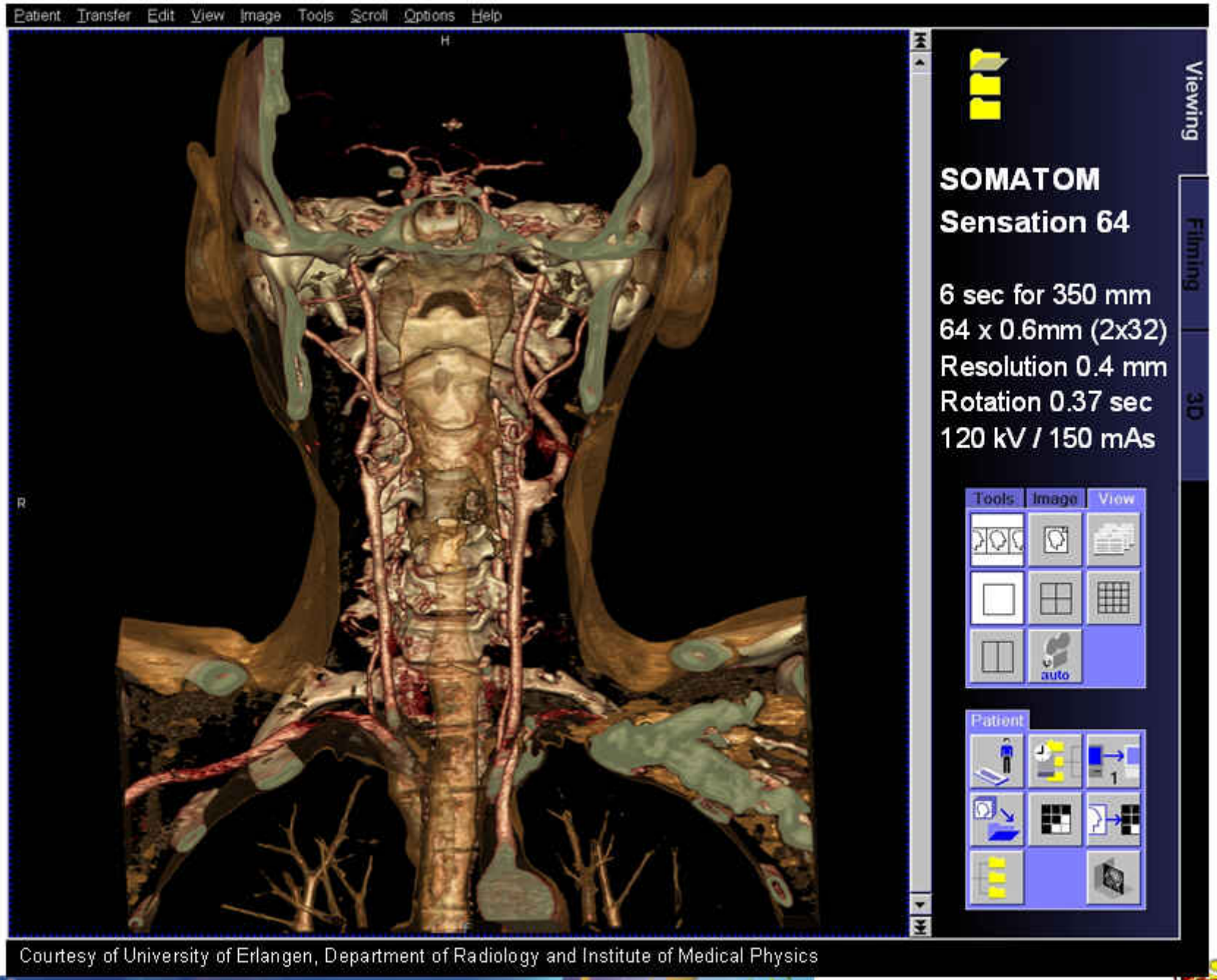


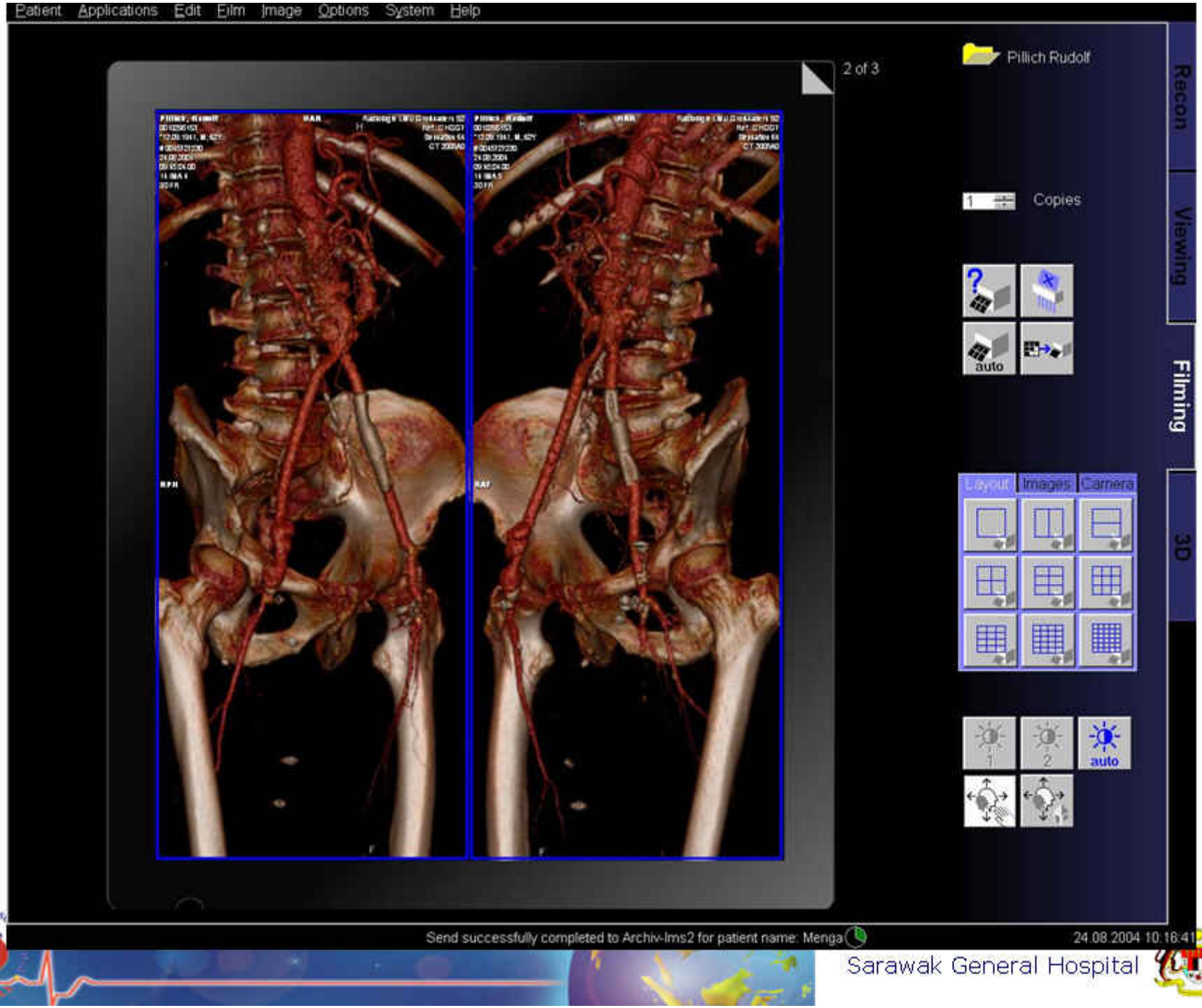
Ascending Aortic Arch Aneursym



Thoracic Aneurysm




Patient Transfer Edit View Image Tools Scroll Options Help
H
R
F
Viewing
Filming
3D
SOMATOM
Sensation 64
6 sec for 350 mm
64 x 0.6mm (2x32)
Resolution 0.4 mm
Rotation 0.37 sec
120 kV / 150 mAs
Tools
Image
View
auto
Patient
1
Courtesy of University of Erlangen, Department of Radiology and Institute of Medical Physics


Patient Applications Edit Film Image Options System Help
2 of 3
Pillich Rudolf
Recon
Viewing
Filming
3D
Copies
auto
Layout
Images
Camera
1
2
auto
Send successfully completed to Archiv-Ims2 for patient name: Menga
24.08.2004 10:16:41

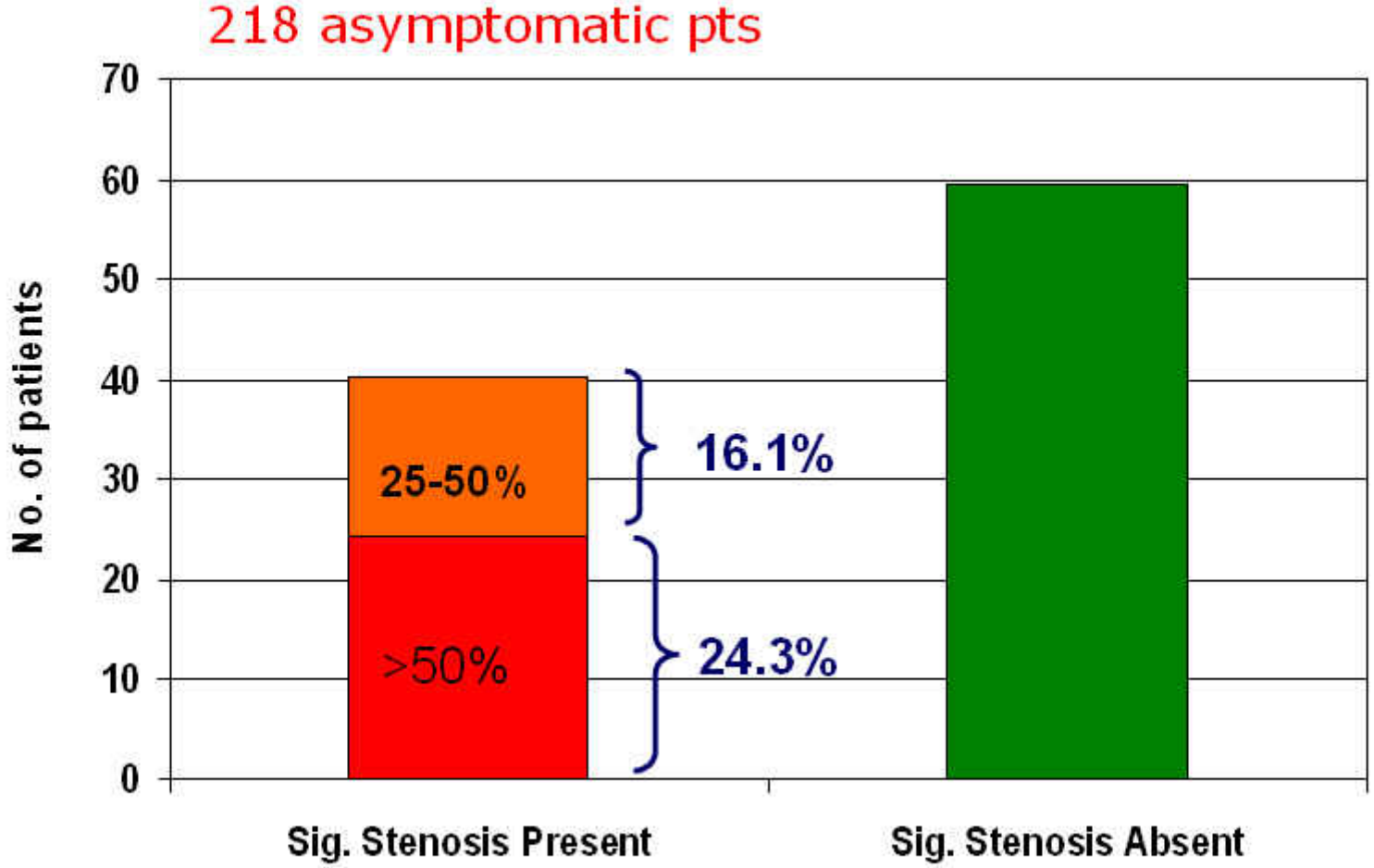
- **CTA - emerging**
- Subclinical disease

Atypical 'cardiac' chest pain: 10-year cardiovascular risk levels by Framingham and PROCAM scores

	N =70	**'Normal' scan**	**'Abnormal' scan**
Framingham 'Low Risk' (<10%)	43 (61.4%)	35 (81.4%)	8 (18.6%)
PROCAM 'Low Risk' (<10%)	59 (84.3%)	46 (78.0%)	13 (22.0%)
Framingham 'Medium-High Risk'	27 (38.6%)	18 (66.7%)	9 (33.3%)
PROCAM 'Medium-High Risk'	11 (15.7%)	7 (63.6%)	4 (36.4%)

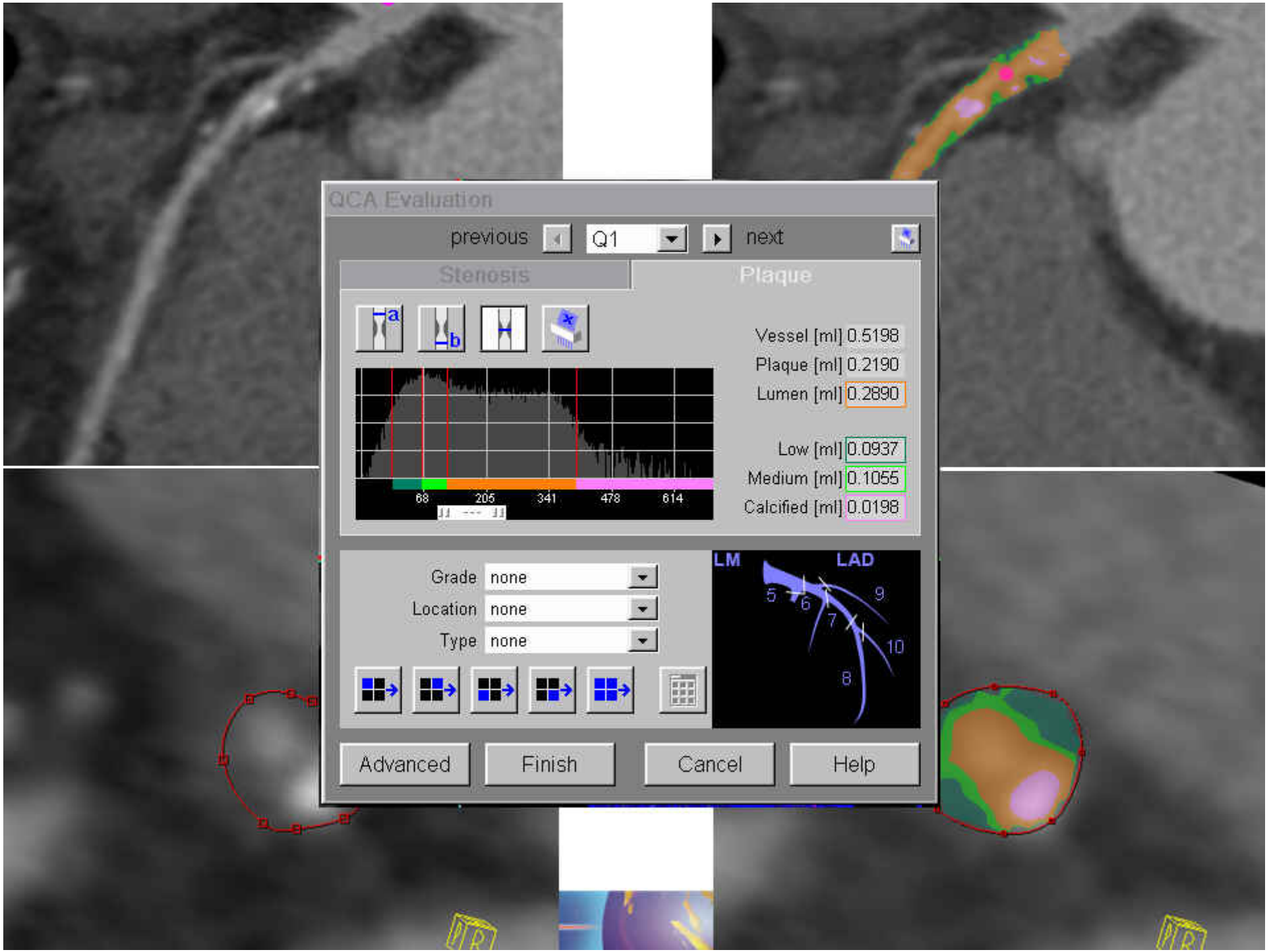
Ang CK, Sim KH, et al. J Geria Card; Mar 2006

Prevalence of Coronary disease in Asymptomatic Type II Diabetes

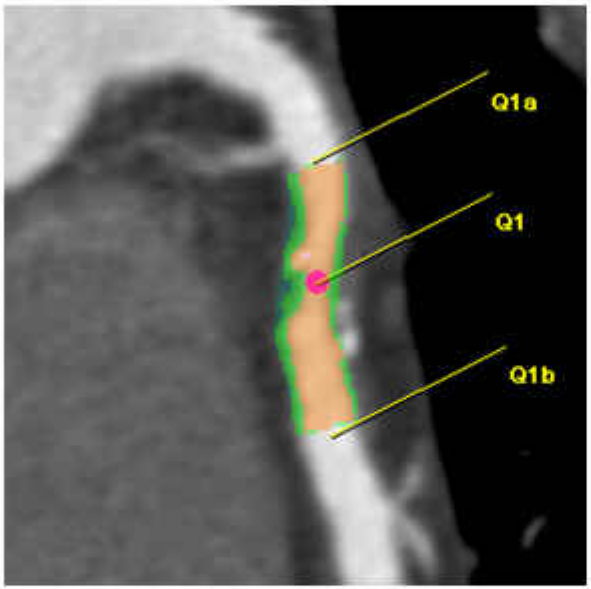


CTA – emerging

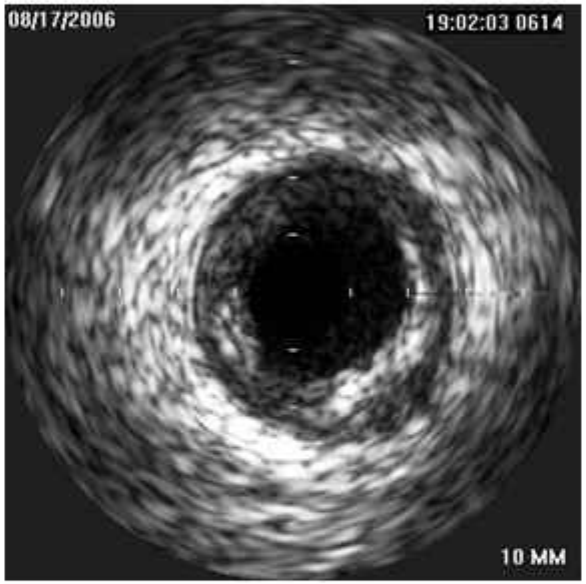
- Plaque


QCA Evaluation
previous
Q1
next
Stenosis
Plaque
Vessel [ml] 0.5198
Plaque [ml] 0.2190
Lumen [ml] 0.2890
Low [ml] 0.0937
Medium [ml] 0.1055
Calcified [ml] 0.0198
68
205
341
478
614
Grade none
Location none
Type none
LM
LAD
5
6
7
8
9
10
Advanced
Finish
Cancel
Help

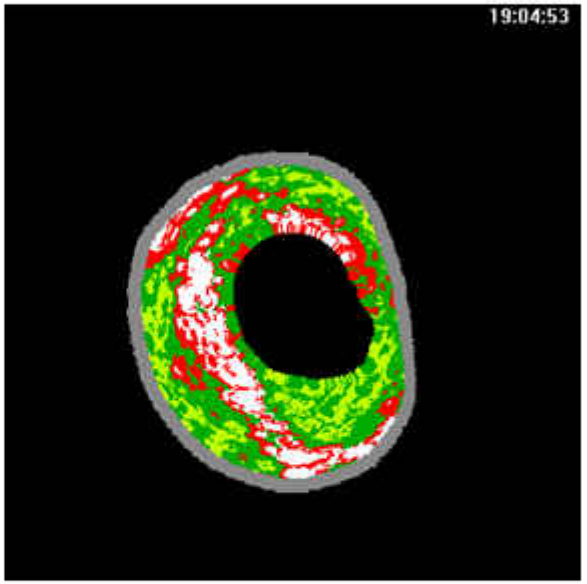
IVUS and virtual histology vs CT histology



CT VH



Volcano IVUS

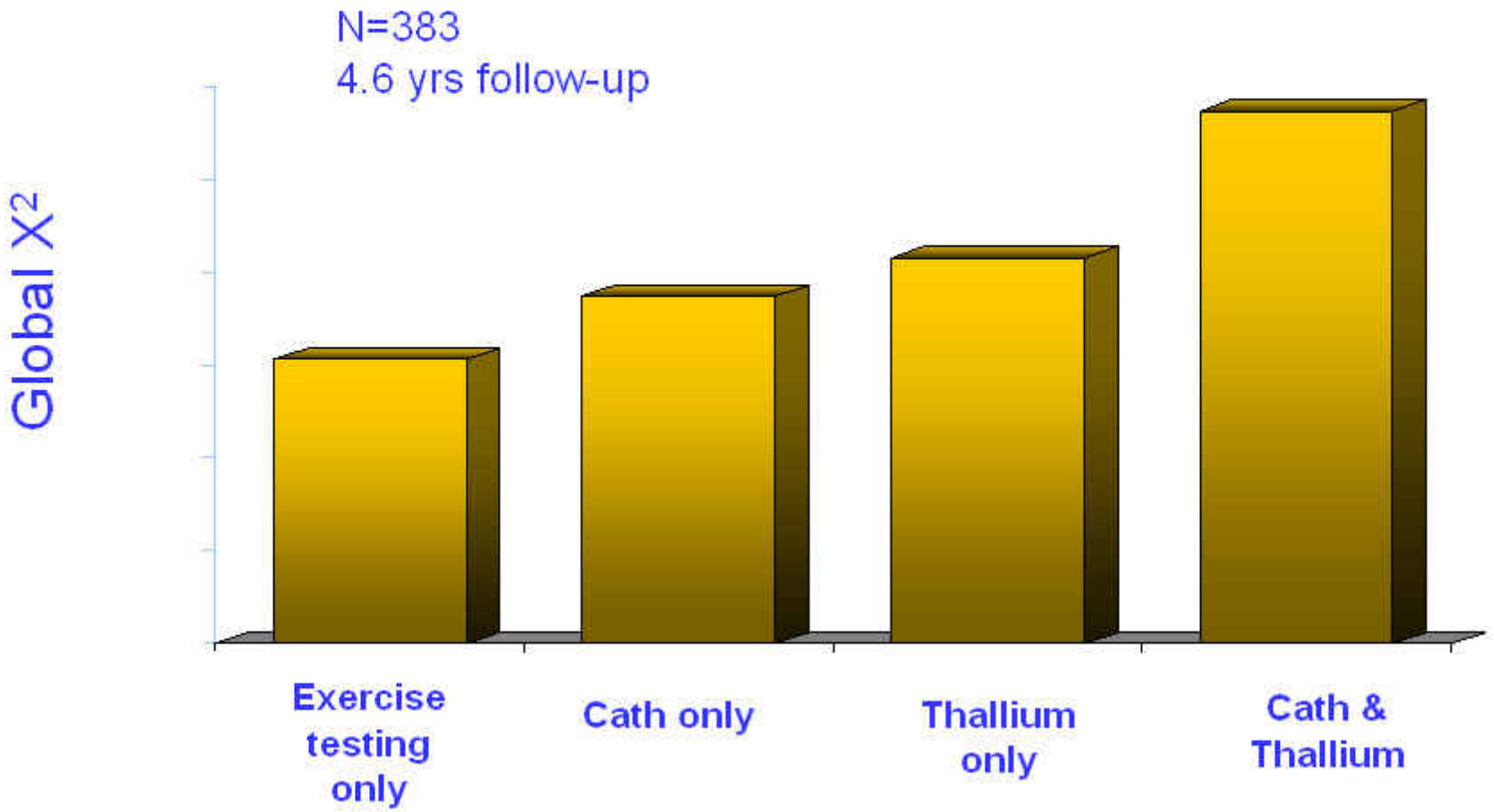


Volcano VH

CTA – emerging

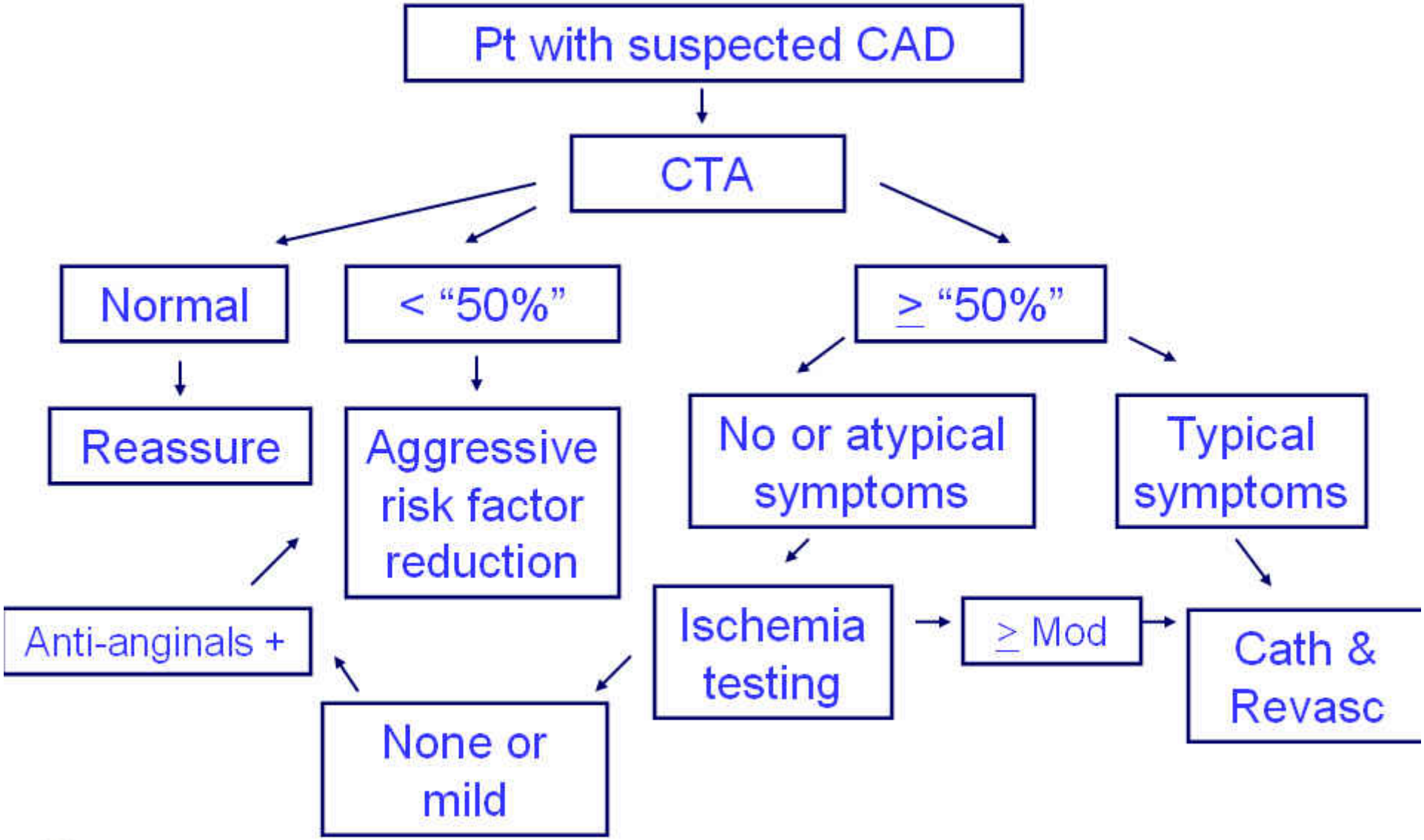
- Prognostic value

Incremental prognostic value of exercise testing, planar thallium (1.5 - 2 mCi) & cath



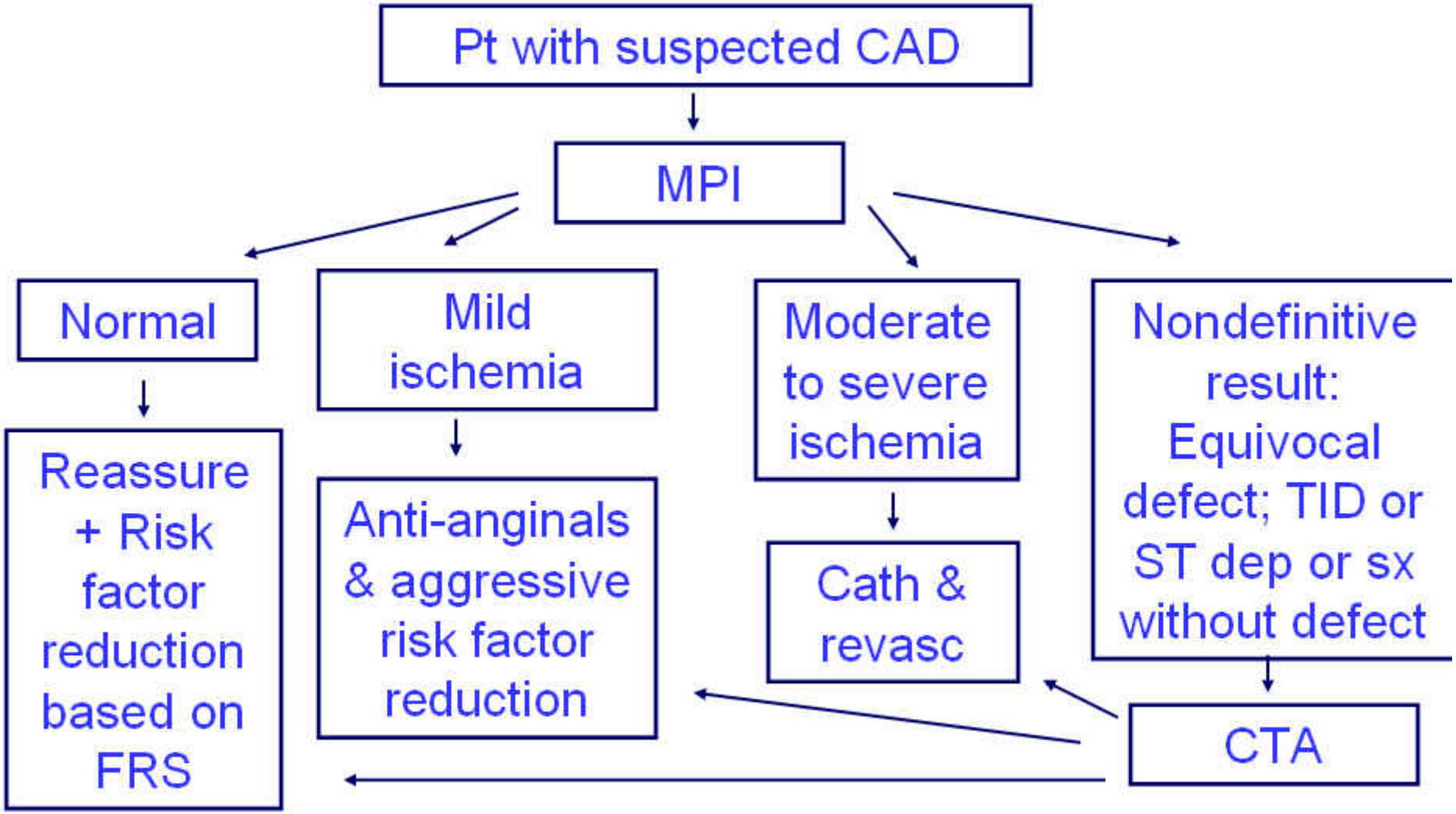
Kaul S. Circ 1988;77:745-58

Exploring a CTA 1st algorithm



Thomas G., President American Society of Nuclear Cardiology, Singapore Live 2007

Exploring an ischemia test 1st algorithm



Thomas G., President American Society of Nuclear Cardiology, Singapore Live 2007

♥ Conclusions CTA

- Clinical likelihood for coronary artery stenosis
  - Age
  - Gender
  - Risk factors
  - Symptoms

No Angio ?? CT Angio Cath Angio

"To Rule Out Coronary Artery Disease"

Is this a patient who does not need a cardiac cath? *Dr Achenbach*

- Negative predictive value 99%.
- More accurate than
  - Exercise stress test
  - Stress echocardiography
  - Stress thallium or technetium
  - Stress perfusion MRI
  - "Heart" & "Mind" does not get stressed

Asymptomatic Patient

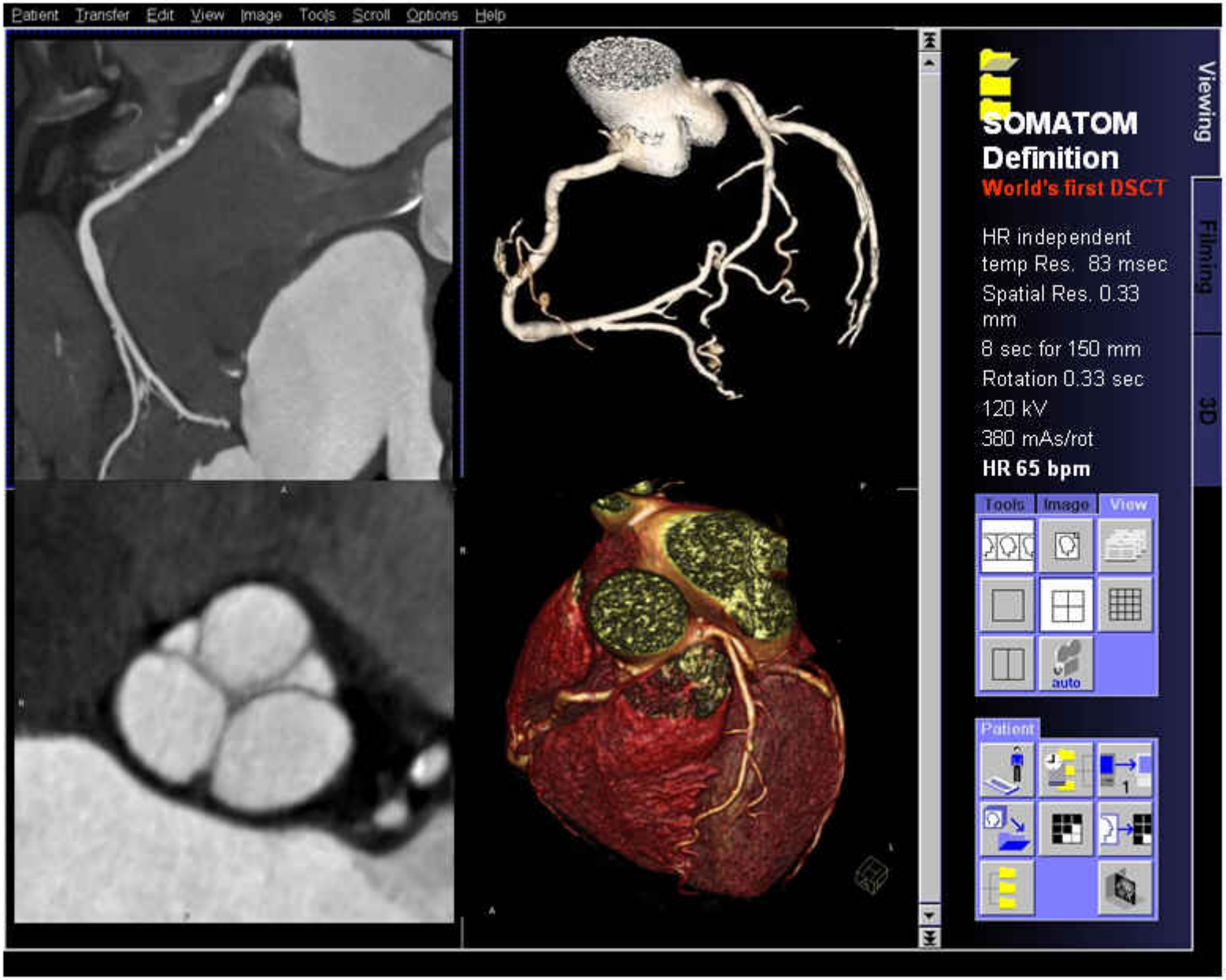
- Family history of CAD or SCD
- Multiple risk factors – 10 yrs >10% but <20%
- ECG abnormalities on routine check-up
- Equivocal stress test
  - Employment or insurance
- Adult non-coronary surgery in
  - ASD repair
  - Valvular repair
  - Cardiac tumor surgery
  - AAA surgery

Symptomatic Patient

- Atypical chest pain
- ? Syndrome X in a pre-menopausal lady
- Dilated cardiomyopathy
- Anomalous coronary arteries, ectasia or aneurysms

Other Indications

- Post-CABGs
- Post-stent
  - For stents > 3mm in size
- Cardiac tumors



Courtesy of University Medical Center Grosshadern / Munich, Germany

Sarawak General Hospital

Journal of the American College of Cardiology
© 2006 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 48, No. 7, 20
ISSN 0735-1097/06/$32.
doi:10.1016/j.jacc.2006.07.0

ACCF/ACR/SCCT/SCMR/ASNC/NASCI/SCAI/SIR APPROPRIATENESS CRITERIA

ACCF/ACR/SCCT/SCMR/ASNC/NASCI/SCAI/SIR 2006 Appropriateness Criteria for Cardiac Computed Tomography and Cardiac Magnetic Resonance Imaging*

A Report of the American College of Cardiology Foundation Quality Strategic Directions Committee Appropriateness Criteria Working Group, American College of Radiology, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, American Society of Nuclear Cardiology, North American Society for Cardiac Imaging, Society for Cardiovascular Angiography and Interventions, and Society of Interventional Radiology

CCT/CMR WRITING GROUP

Robert C. Hendel, MD, FACC
Manesh R. Patel, MD
Christopher M. Kramer, MD, FACC†
Michael Poon, MD, FACC‡

Sarawak General Hospital

Journal of the American College of Cardiology
© 2005 by the American College of Cardiology Foundation and the American Heart Association
Published by Elsevier Inc.

Vol. 46, No. 2, 2005
ISSN 0735-1097/05/$30.00
doi:10.1016/j.jacc.2005.04.033

ACCF/AHA CLINICAL COMPETENCE STATEMENT ON CARDIAC CT AND MR

ACCF/AHA Clinical Competence Statement on Cardiac Imaging With Computed Tomography and Magnetic Resonance

JACC July 2005

A Report of the American College of Cardiology Foundation/ American Heart Association/American College of Physicians Task Force on Clinical Competence and Training

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging, and the Society for Cardiovascular Angiography & Interventions

Endorsed by the Society of Cardiovascular Computed Tomography

WRITING COMMITTEE MEMBERS

MATTHEW J. BUDOFF, MD, FACC, FAHA, *Chair*

MYLAN C. COHEN, MD, MPH, FACC, FAHA†
MARIO J. GARCIA, MD, FACC‡
JOHN McB. HODGSON, MD, FSCAI††
W. GREGORY HUNDLEY, MD, FACC, FAHA*
JOAO A. C. LIMA, MD, FACC, FAHA
WARREN J. MANNING, MD, FACC, FAHA**
GERALD M. POHOST, MD, FACC, FAHA
PAOLO M. RAGGI, MD, FACC‡‡
GEORGE P. RODGERS, MD, FACC
JOHN A. RUMBERGER, MD, PHD, FACC
ALLEN J. TAYLOR, MD, FACC, FAHA

Journal of the American College of Cardiology
© 2006 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 48, No. 2, 2006
ISSN 0735-1097/06/$32.00
doi:10.1016/j.jacc.2006.04.071

EXPEDITED REVIEW

Noncardiac Findi… With Multidetect…

Yoshinobu Onuma, MD,* Ker… MD,*
Hiroyoshi Nakajima, MD, PH…

Tokyo, Japan

Medico – Legal

Medico – Moral

Medico – Economic

OBJECTIVES We inve… multide-
tector c…

BACKGROUND Multide… n cardiac
MDCT … sed.

METHODS A total o… iologists assessed the heart, while radiologists reviewed the other organs.

RESULTS A total of 346 new, noncardiac findings were identified in 292 patients (58.1%). A total of 114 patients (22.7%) had clinically significant findings including 4 cases of malignancy (0.8%).

CONCLUSIONS There were a significant number of noncardiac findings in cardiac MDCT. To avoid missing clinically important findings, physicians who analyze cardiac MDCT scan—either radiologists or cardiologists—should carefully evaluate all the organs irradiated in the scan. (J Am Coll Cardiol 2006;48:xxx) © 2006 by the American College of Cardiology Foundation