16TH INTERNATIONAL EXPERTS SYMPOSIUM

CRITICAL ISSUES
in aortic endografting 2012

May 24 & 25

LILLE, FRANCE 2012

« IMAGING »

« NEW CT PROTOCOLS TO LOWER RADIATION DOSE & CONTRAST MEDIA VOLUME BEFORE AND AFTER AORTIC ENDOGRAFTING »

Faculty Disclosure

Martine REMY-JARDIN, MD, PhD

Department of Thoracic Imaging *(Hospital Calmette)*
Department of Cardiovascular Imaging *(Cardiology Hospital)*

University Centre of Lille - FRANCE

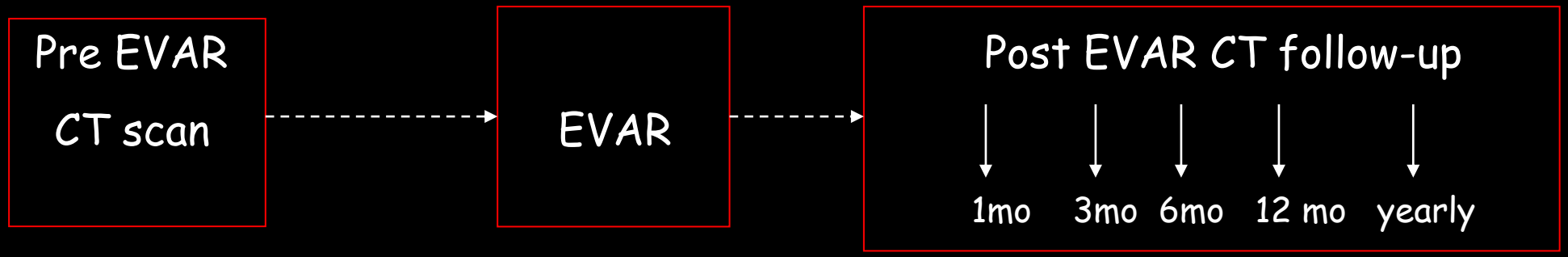
*I have **no financial relationships** to disclose.*

Centre Hospitalier Régional Universitaire de Lille

Université Lille 2 Droit et Santé

Université Lille Nord de France
Pôle de Recherche et d'Enseignement Supérieur

- Pre & postprocedure CT evaluation :



→ *alternative imaging modalities*
→ *imaging strategies*

- CTA protocol :
  - non contrast CT scan ⇢ 7.3 mSv
  - arterial phase ⇢ 7.3 mSv
  - venous phase ⇢ 3.5 mSv

White & Mc Donald CardioVasc Surg 2010

→ *reduced dose per acquisition*
→ *reduced number of CT scans requested*

REDUCED DOSE PER SCAN

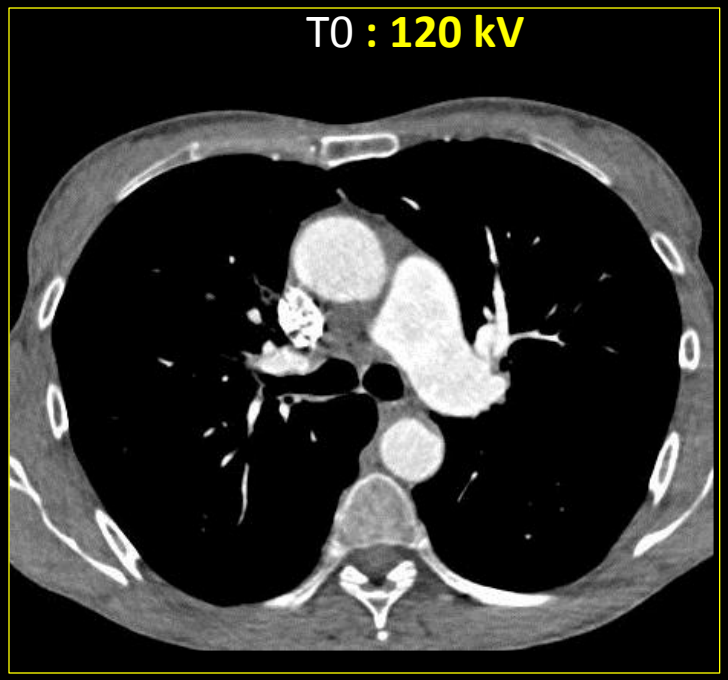
% CT equipment

- Standard MDCT scanners
- Latest generations of CT scanners

STANDARD MDCT EQUIPMENTS

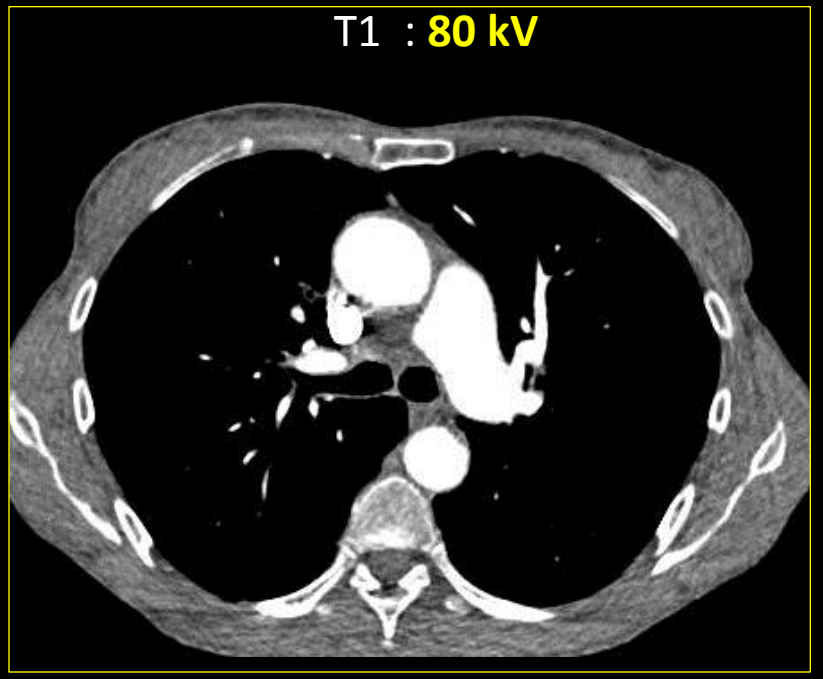
4, 16, 64-slice MDCT scanners

T0 : **120 kV**



DLP: 95 mGy.cm

T1 : **80 kV**



DLP: 38 mGy.cm

Dual-source CT Angiography in Aortic Stent Grafting:

An in vitro Aorta Phantom Study of Image Noise and Radiation Dose

Zhonghua Sun, PhD, Curtise Ng, PhD

Acad Radiol 2010; 17:884–893

→ low-dose scans (100 kV): 30% dose reduction

Low-Dose Multidetector CT Angiography in the Evaluation of Infrarenal Aorta and Peripheral Arterial Occlusive Disease[1]

Roberto Iezzi, MD
Marco Santoro, MD
Riccardo Marano, MD
Carmine Di Stasi, MD
Roberta Dattesi, MD
Miles Kirchin, MD
Giovanni Tinelli, MD
Francesco Snider, MD
Lorenzo Bonomo, MD

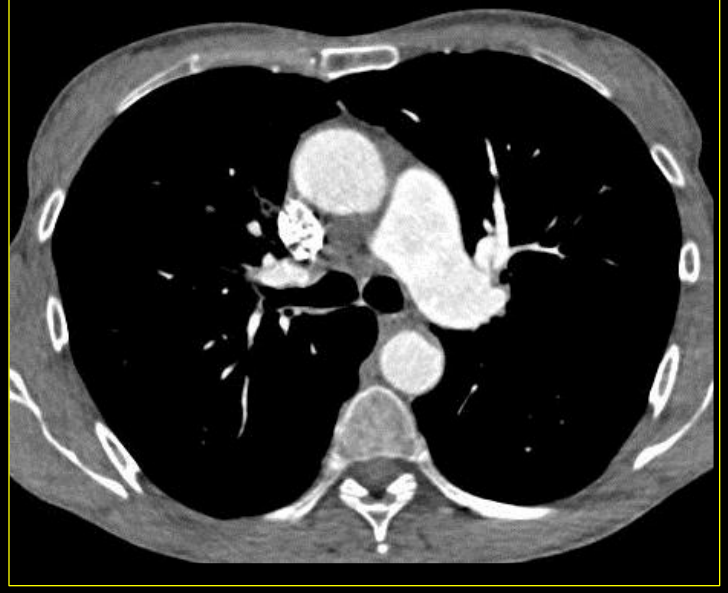
Radiology 2012; 263:287–298

→ low-dose scans (80kV): 50% dose reduction

- Kilovoltage reduction +++ ⟶ dose reduction

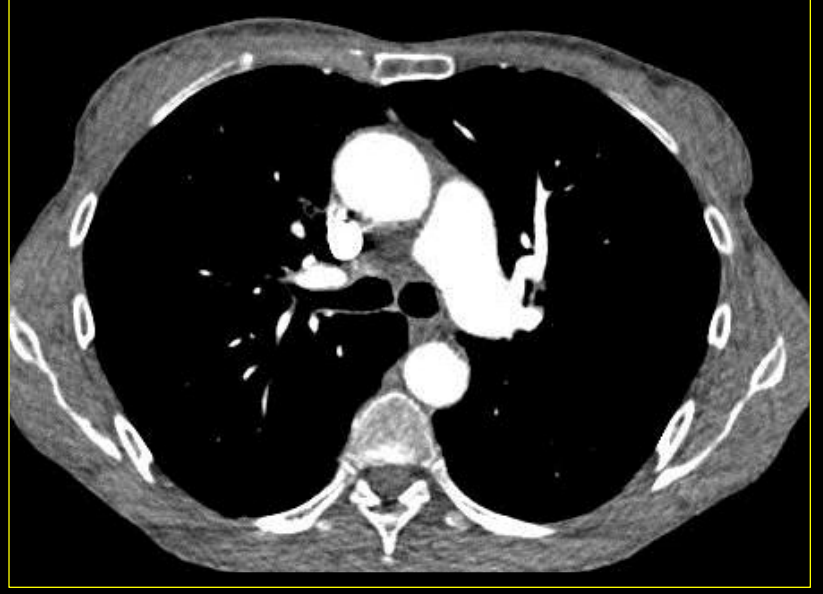
⟶ reduced iodine concentration

T0 **: 120 kV**



DLP: 95 mGy.cm

T1 : **80 kV**



DLP: 38 mGy.cm

« *Ultra low-dose* » CT scan

Grainy appearance

(« image noise »)

« *Ultra low-dose* » CT scan

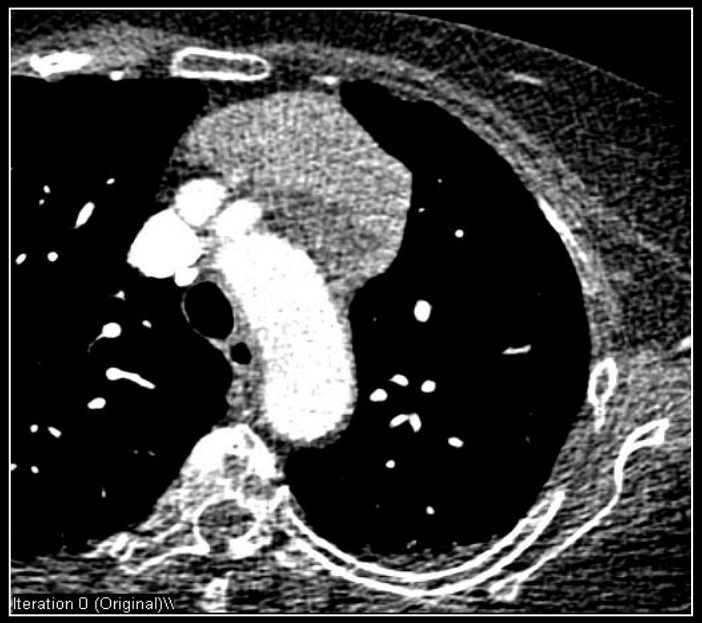
without noise

CHEST COMPUTED TOMOGRAPHY USING ITERATIVE RECONSTRUCTION VS FILTERED BACK PROJECTION (Part 1): EVALUATION OF IMAGE NOISE REDUCTION IN 32 PATIENTS

Authors: Pontana, Francois; Pagniez, Julien; Flohr, Thomas; Faivre, Jean-Baptiste; Duhamel, Alain; Remy, Jacques; Remy-Jardin, Martine

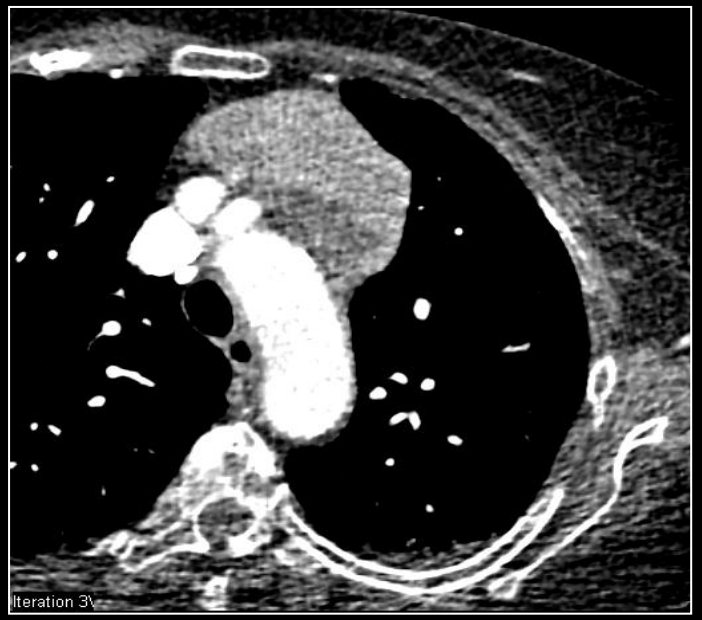
Eur Radiol 2010

Standard reconstruction
(filtered back-projection)



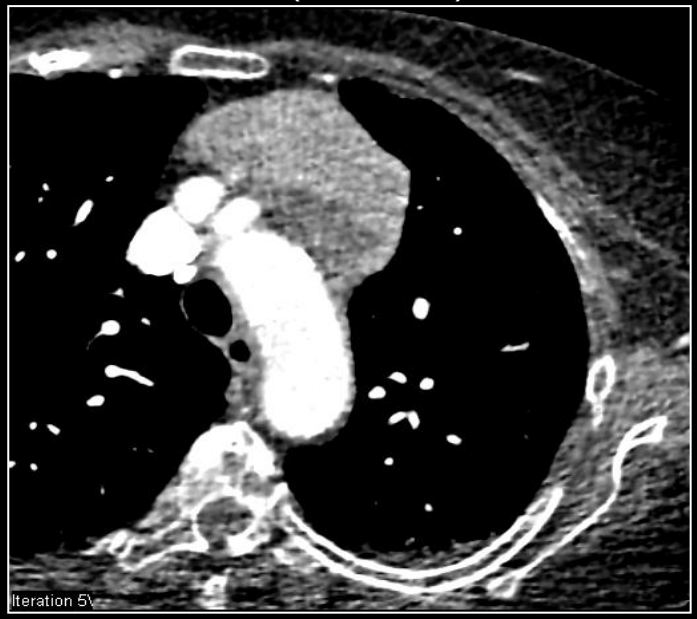
37.6 HU

Iterative reconstruction (IRIS)
(3 iterations)



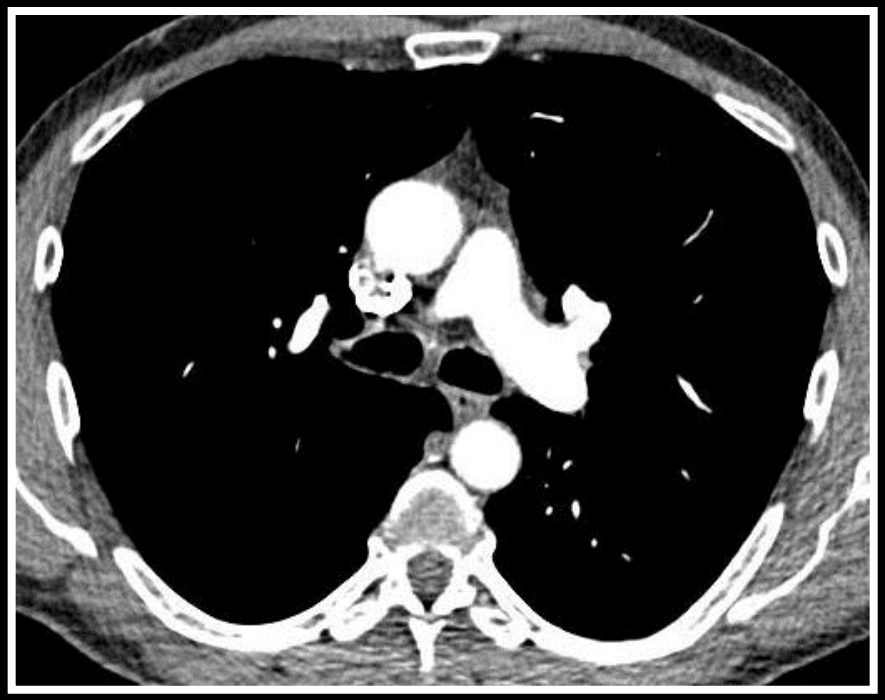
27 HU (-30%)

Iterative reconstruction (IRIS)
(5 iterations)

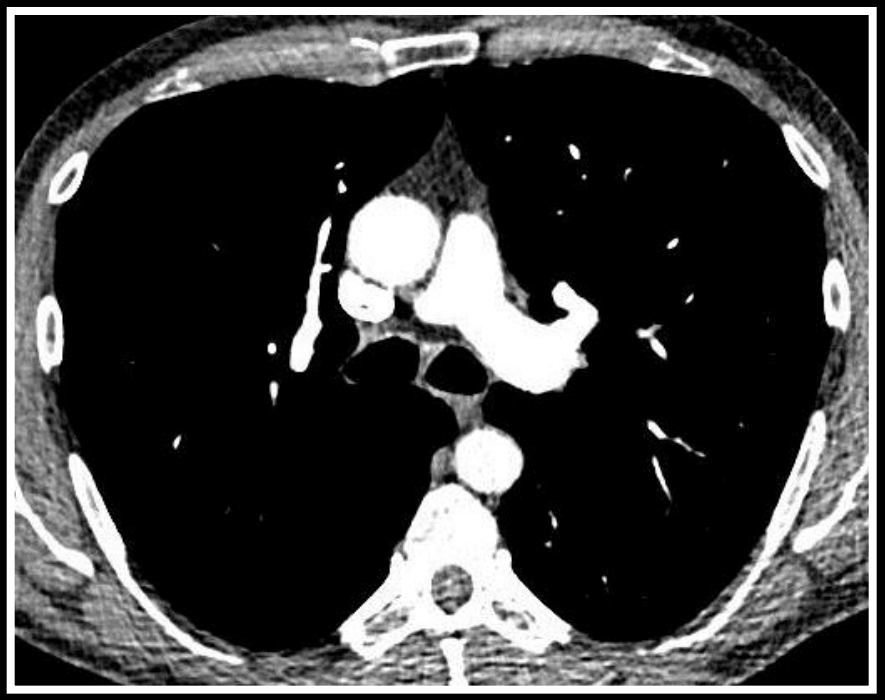


21HU (-50%)

Normal BMI *(22 kg/m2)*



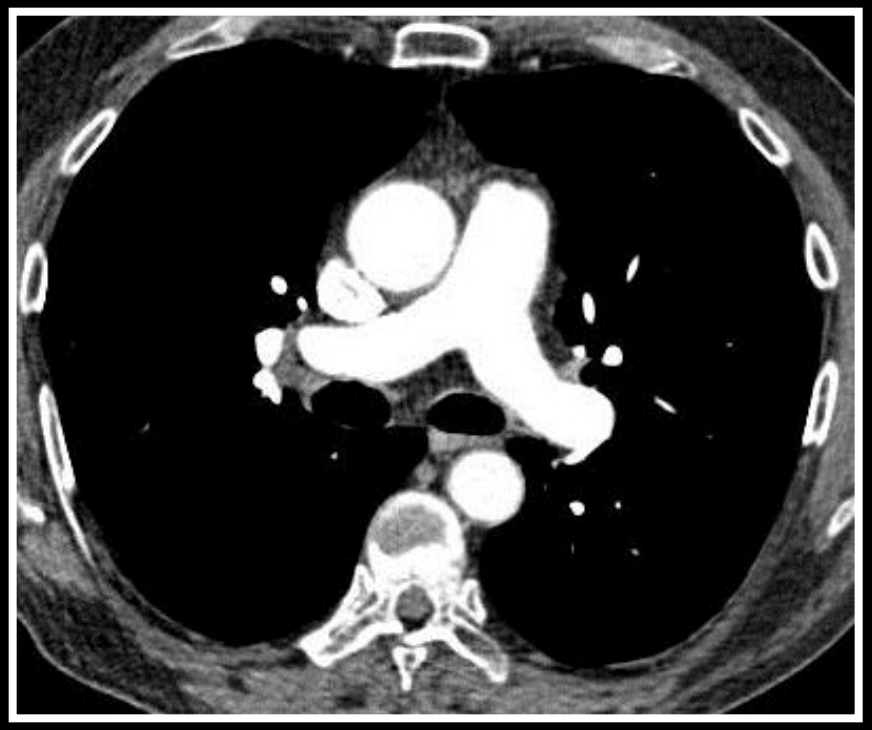
T1:
Standard dose, FBP
100 kVp



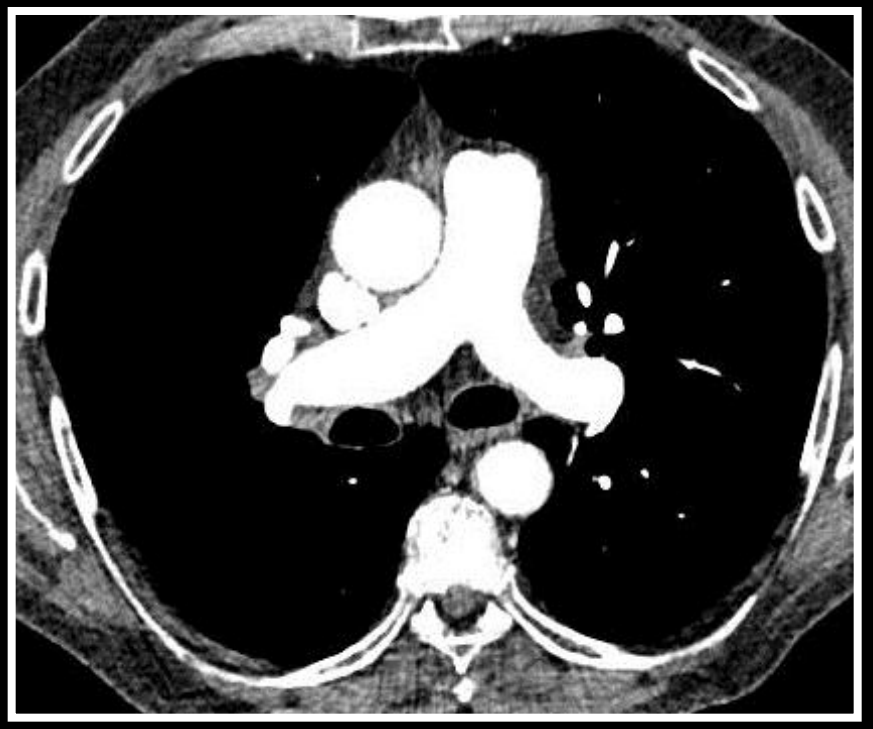
T2 :
« Ultra low-dose », iterative reconstruction
80 kVp

Radiology 2012 *(in press)*

Overweight patient *(25.2 kg/m2)*



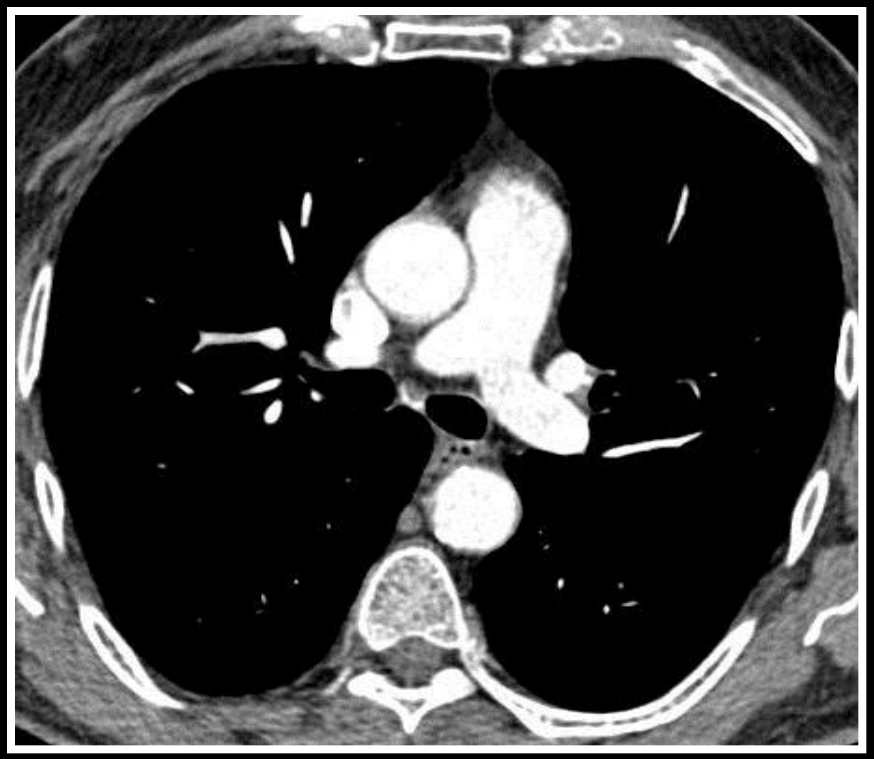
T1:
Standard dose, FBP
120 kVp



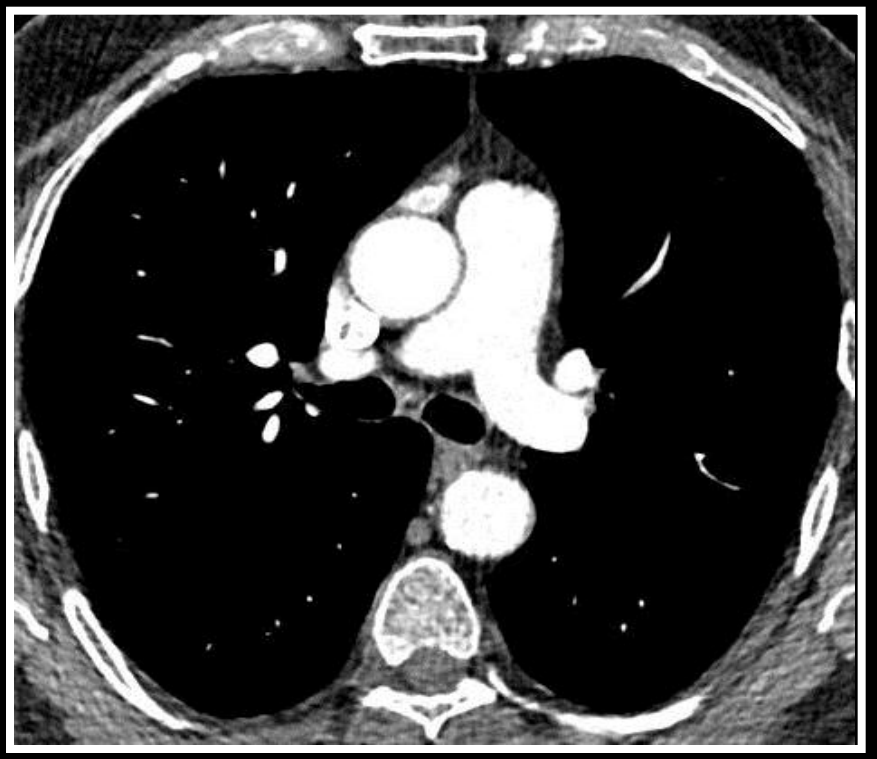
T2:
« Ultra low-dose », iterative reconstruction
100 kVp

Radiology 2012 *(in press)*

Obese patient *(34.5 kg/m2)*



T1:
Standard dose, FBP
120 kVp



T2:
« Ultra low-dose, iterative reconstruction
100 kVp

Radiology 2012 *(in press)*

- **50% dose reduction:** SAFIRE *(product of Siemens Healthcare)*

  Radiology 2012 (in press)

- **30% dose reduction:** ASIR *(product of GE Healthcare)*

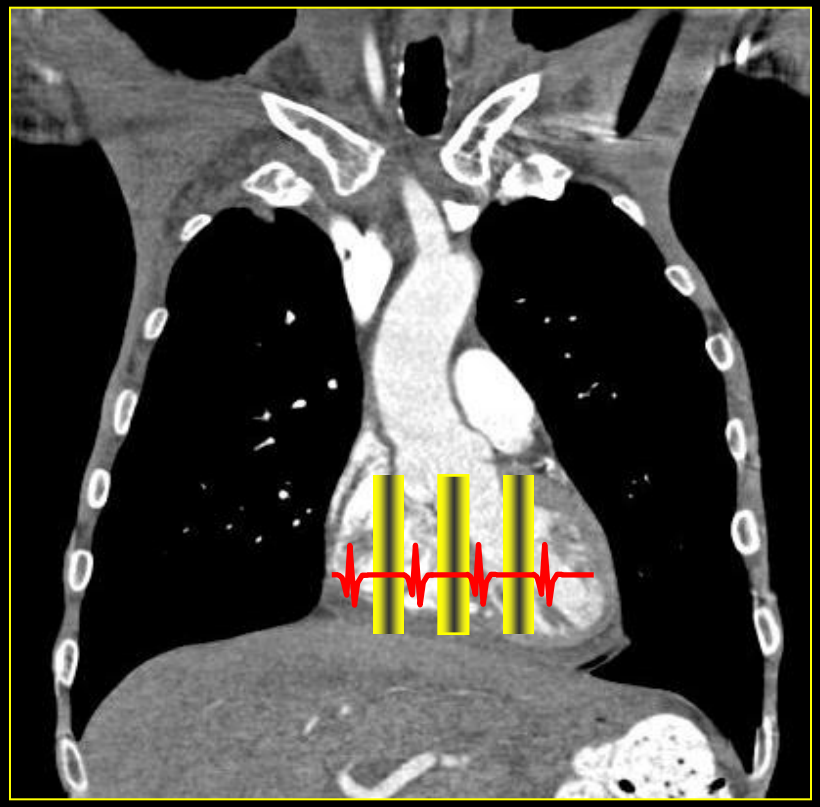
Impact of Adaptive Statistical Iterative Reconstruction (ASIR) on Radiation Dose and Image Quality in Aortic Dissection Studies: A Qualitative and Quantitative Analysis

Daniel Cornfeld[1]
Gary Israel[1]
Ezra Detroy[1,2]
Jamal Bokhari[1]
Hamid Mojibian[1]

AJR 2011; 196:W336–W340

- **Reduced iodine concentration**

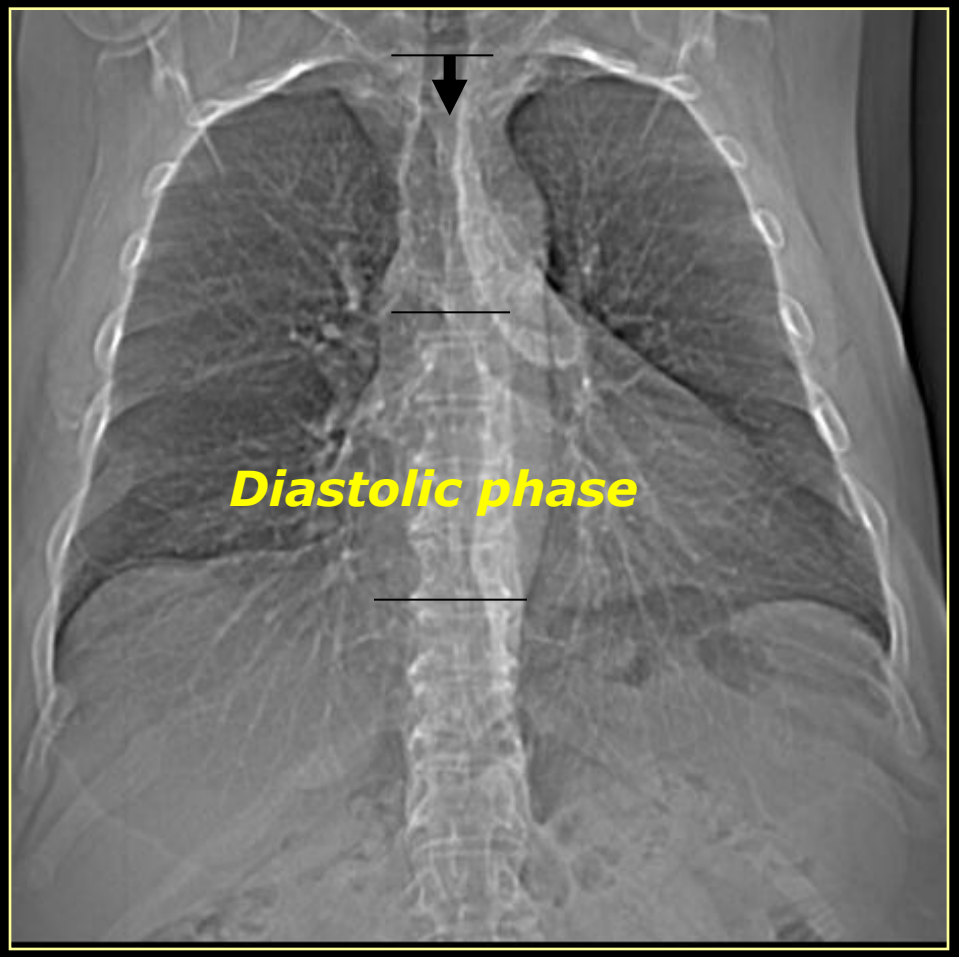
THORACIC AORTA



Retrospective ECG gating

« Retrospective » ECG gating

« Prospective » ECG gating



Acquisition time : *0.68 s*

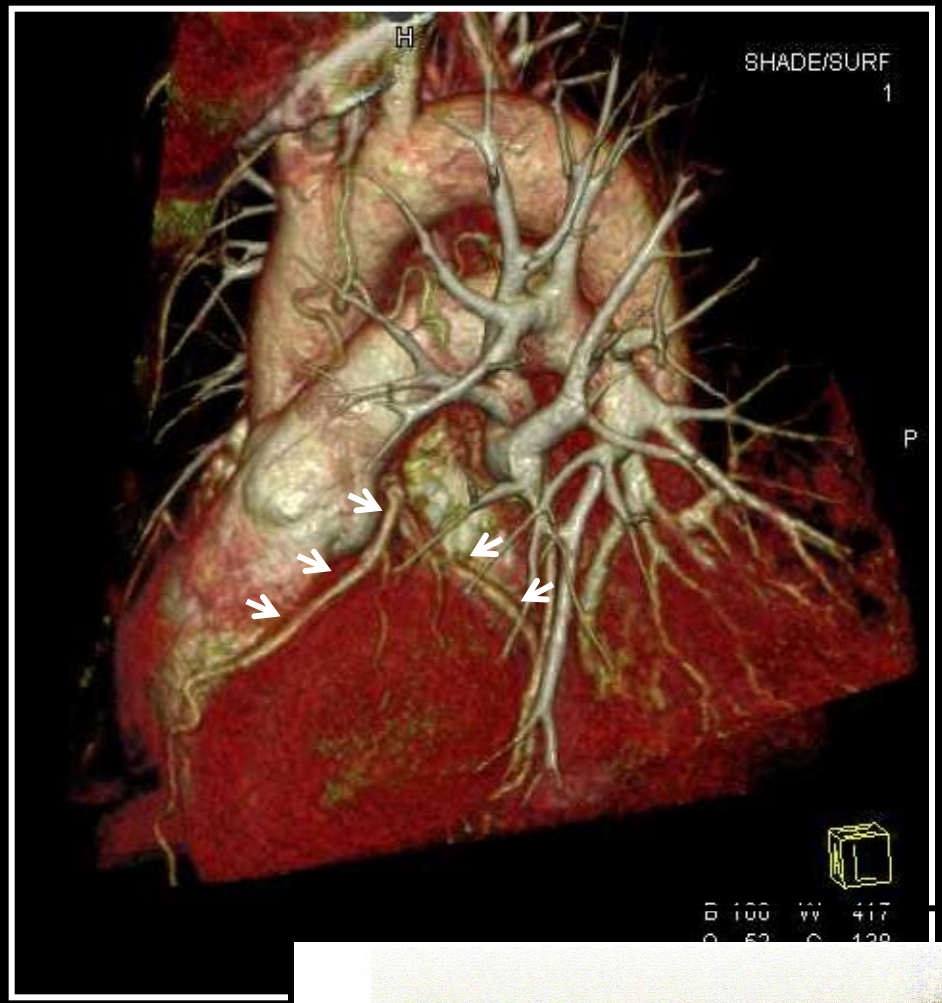
RADIATION DOSE

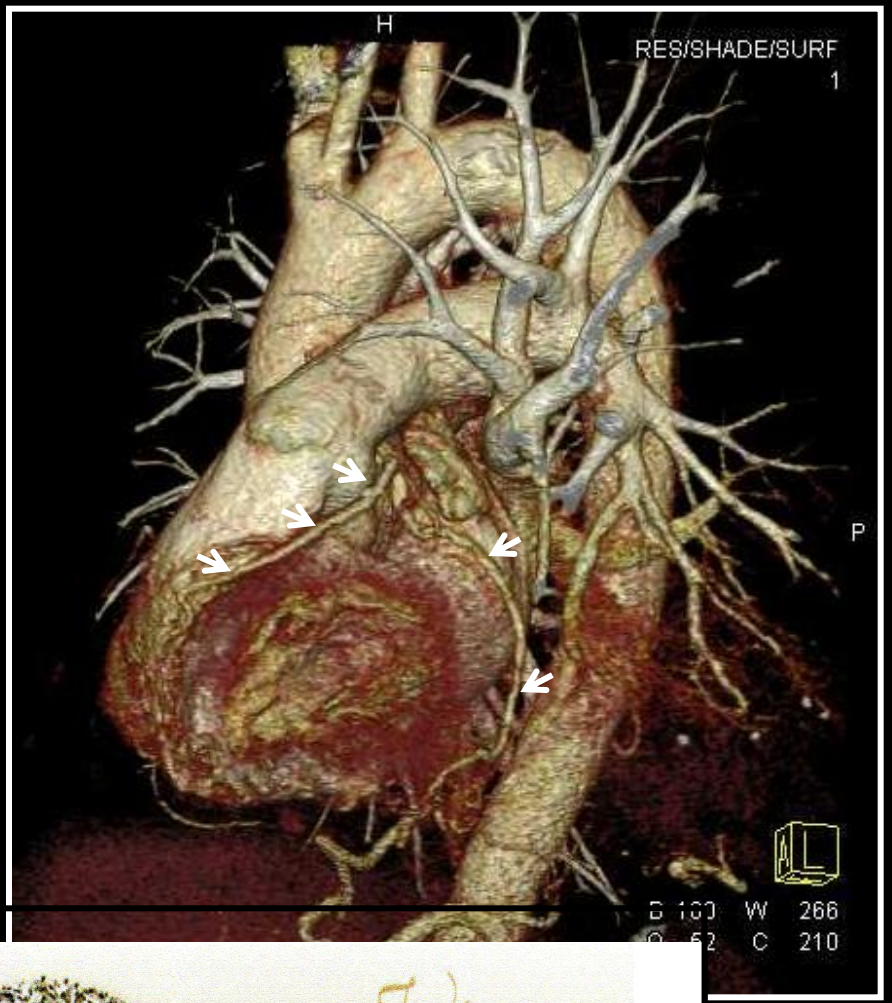
Entire chest CT examination

(Dose-Length-Product)

- **Retrospective** ECG-gated CTA: **# 500** mGy.cm

- **Prospective** ECG-gated CTA: **# 150** mGy.cm





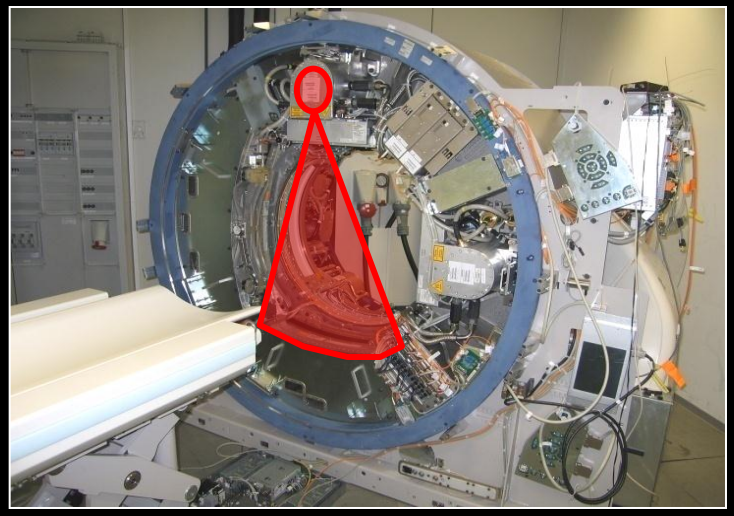
ECR 2011 Vienna March 3–7

Presentation Title: Dual-source nongated CT angiography of the chest: impact of high temporal resolution and high pitch mode on cardiogenic motion artefacts

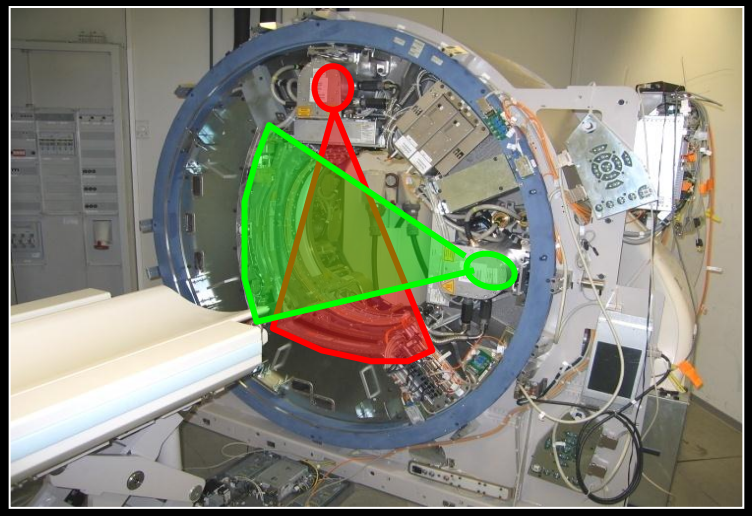
Presentation Number: B-757

Author Block: C. Darchis, N. Tacelli, J.-B. Faivre, T. Santangelo, M. Remy-Jardin, J. Remy; *Lille/FR*
(The presenting author is underlined.)

TEMPORAL RESOLUTION



*Temporal resolution: **rot time /2***

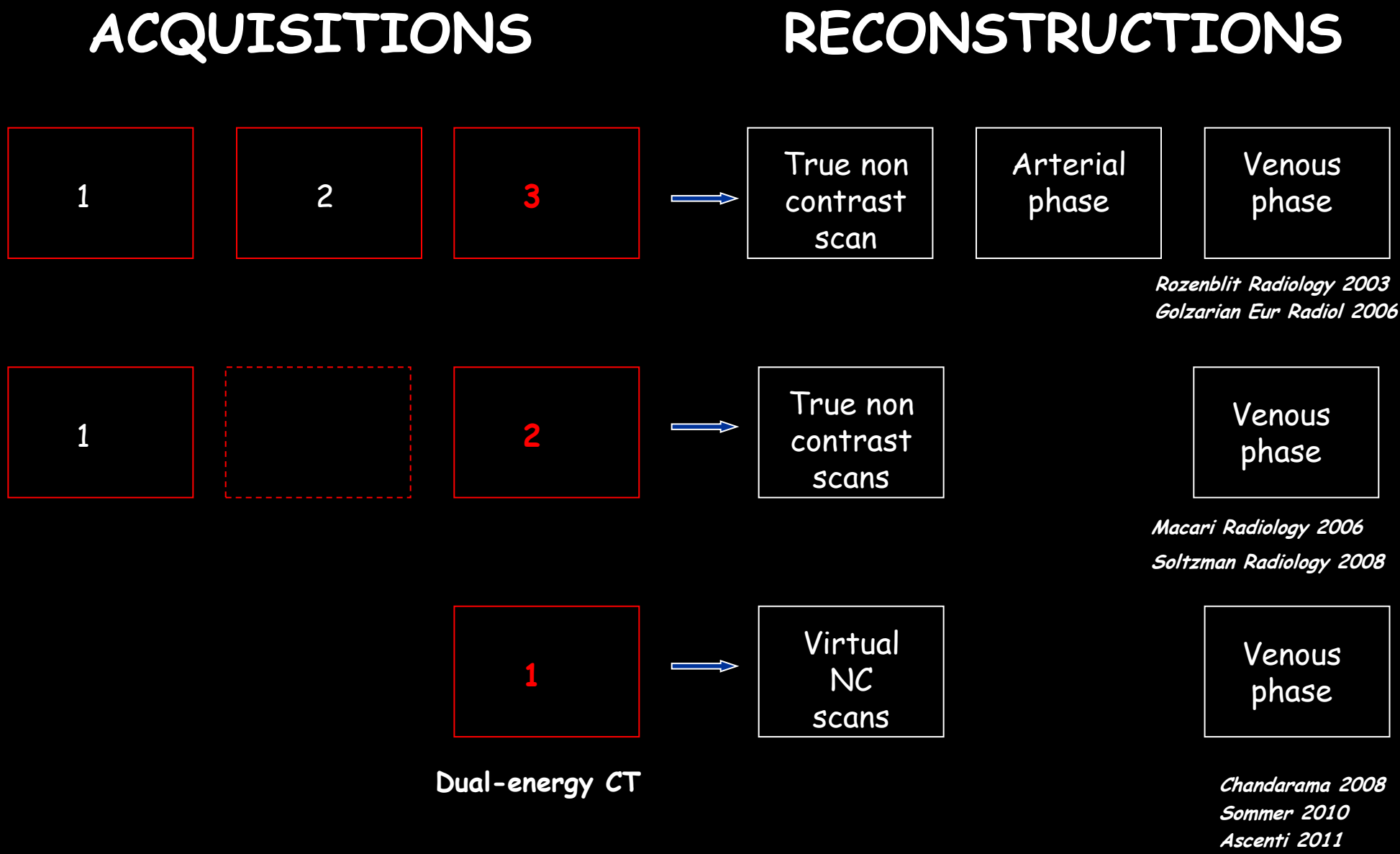


*Temporal resolution: **rot time/4***

	Philips	Toshiba	Siemens	GE
collimation	**128² x 0.62mm**	**320 x 0.5 mm**	**2 x 64² x 0.6mm**	**64 x 0.625mm**
coverage	**80 mm**	**160 mm**	**38 mm**	**40 mm**
rotation time	**330 ms**	**350 ms**	**280 ms**	**350 ms**
temp resol	**165 ms**	**175 ms**	**75 ms**	**175 ms**

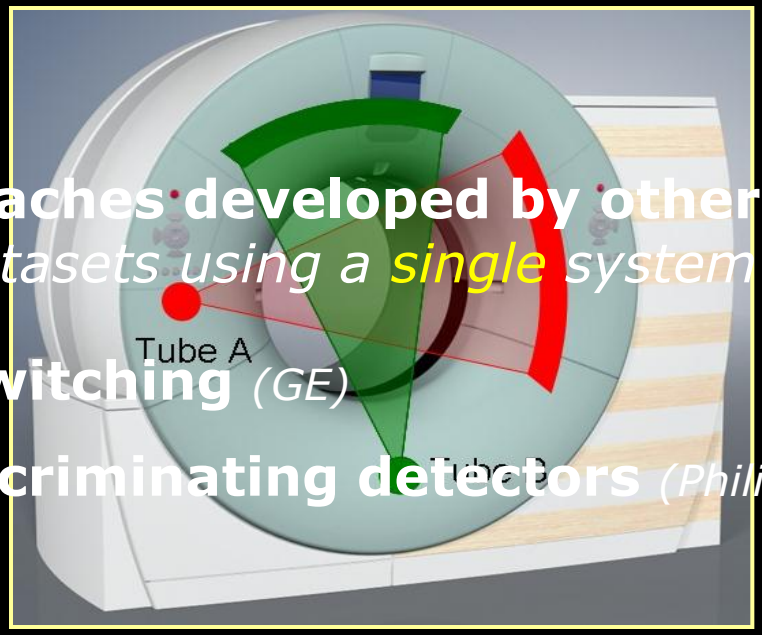
- REDUCED DOSE PER CT SCAN

- REDUCED NB OF ACQUISITIONS


ACQUISITIONS
RECONSTRUCTIONS
1
2
3
True non contrast scan
Arterial phase
Venous phase
Rozenblit Radiology 2003
Golzarian Eur Radiol 2006
1
2
True non contrast scans
Venous phase
Macari Radiology 2006
Soltzman Radiology 2008
1
Virtual NC scans
Venous phase
Dual-energy CT
Chandarama 2008
Sommer 2010
Ascenti 2011

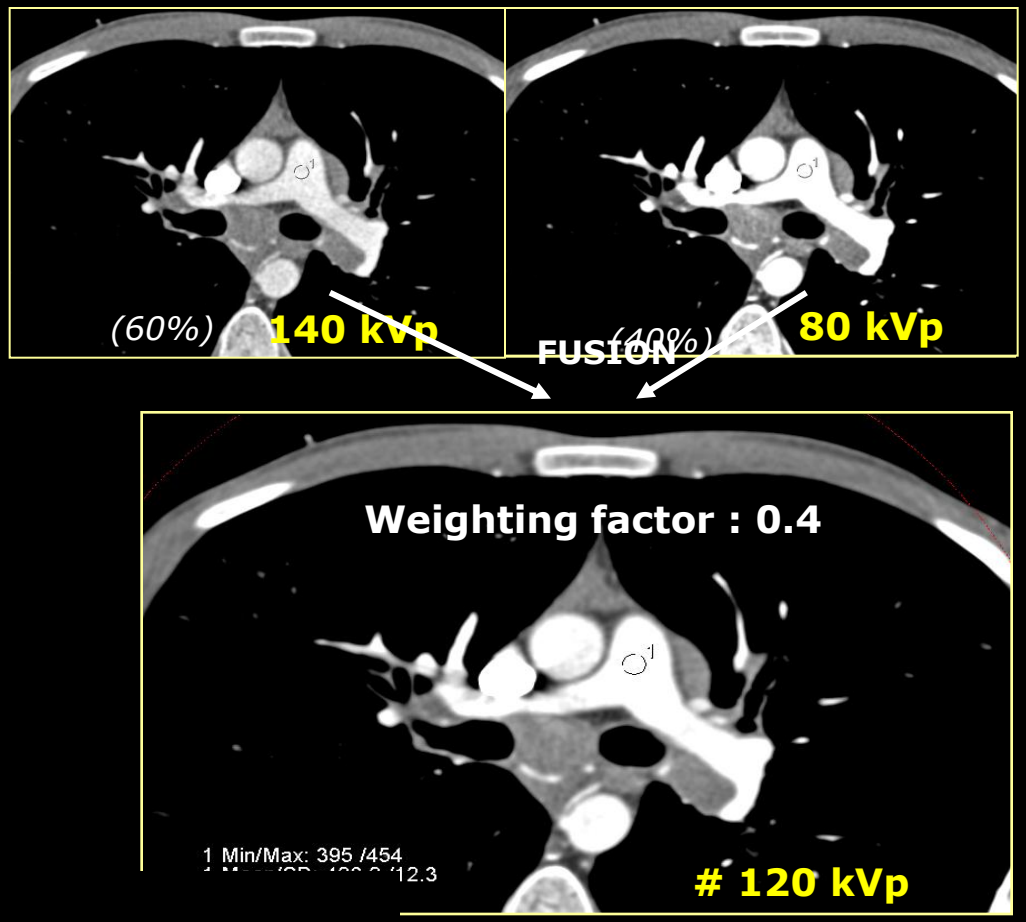
- **Technological advances in MDCT** → dual-source CT *(Siemens)*

- **Acquisition of CT data**
  - at the same energy → *dual-source scanning*
  - at 2 distinct tube voltage settings during a single acquisition → *dual-energy (DE) imaging*



- **Alternative approaches developed by other manufacturers**
  multiple kV datasets using a single system
  - **rapid kV switching** *(GE)*
  - **energy-discriminating detectors** *(Philips)*

IMAGE FUSION IN DUAL ENERGY

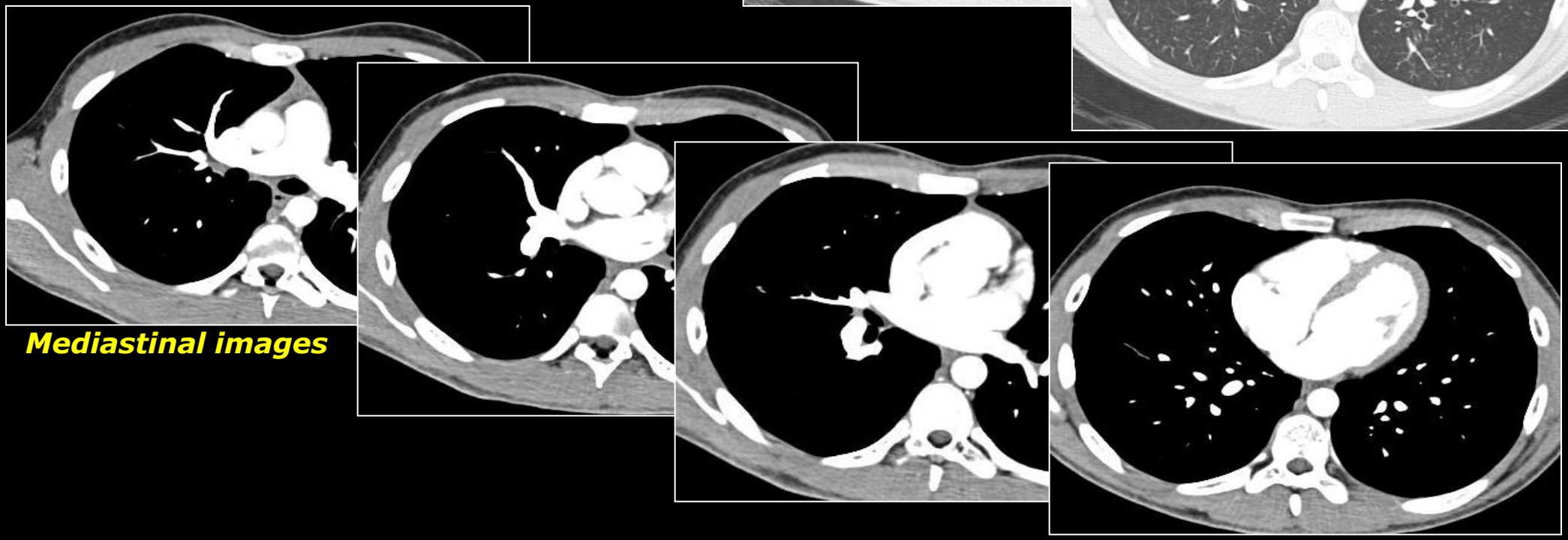


Lower noise with 140 kVp. Better contrast with 80 kVp.

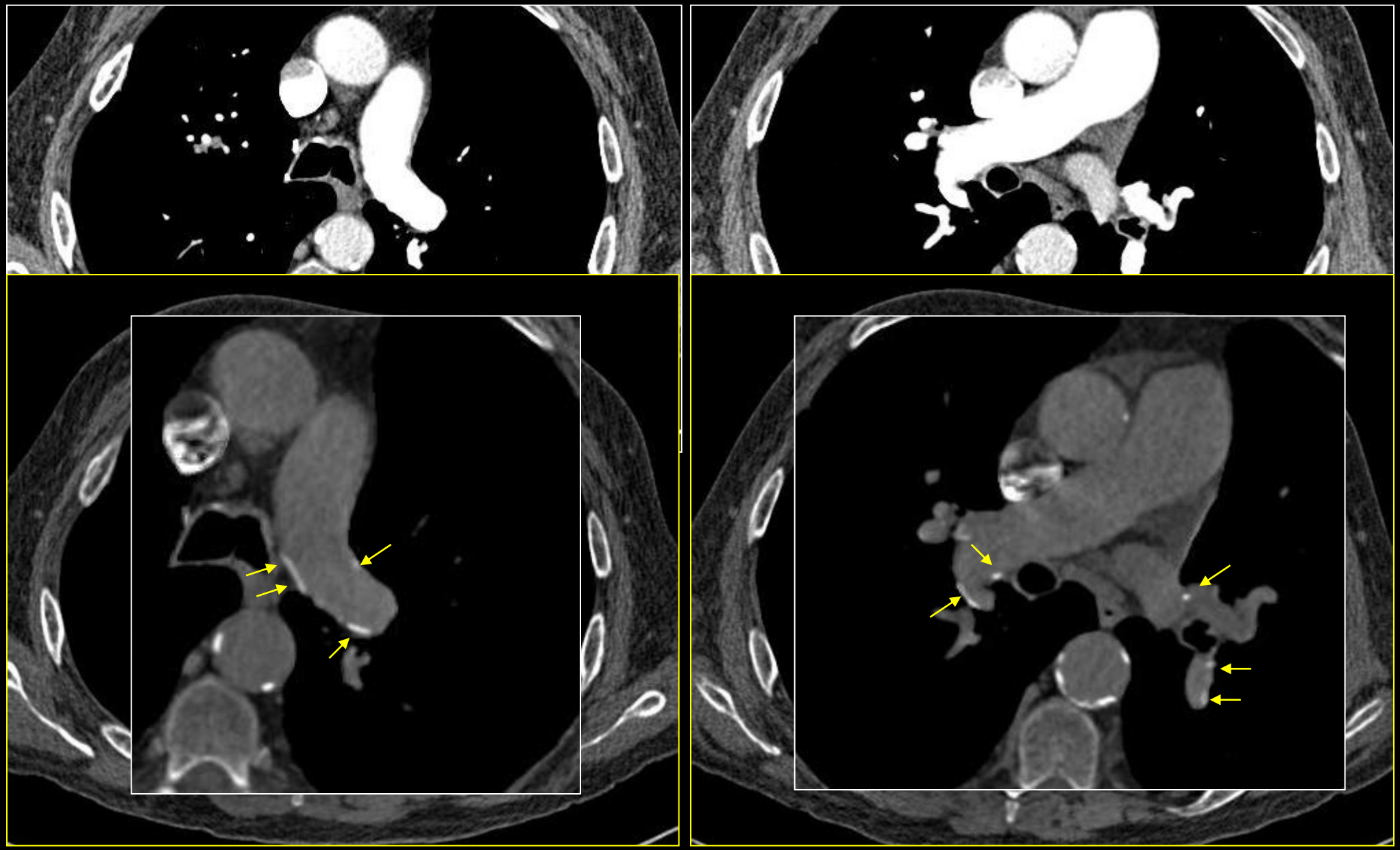
Behrendt et al. Invest. Radiol. 2009; 44: 1-6

DIAGNOSTIC SCANS

Lung images



Mediastinal images



Abdominal Aorta: Evaluation with Dual-Source Dual-Energy Multidetector CT after Endovascular Repair of Aneurysms—Initial Observations[1]

Hersh Chandarana, MD
Myrna C. B. Godoy, MD
Ioannis Vlahos, MD
Anno Graser, MD
James Babb, PhD
Christianne Leidecker, PhD
Michael Macari, MD

Radiology 2008; 249:692–700

Image Quality of Virtual Noncontrast Images Derived from Dual-energy CT Angiography after Endovascular Aneurysm Repair

Wieland H. Sommer, MD,[1] Anno Graser, MD,[1] Christoph R. Becker, MD, Dirk A. Clevert, MD, Maximilian F. Reiser, MD, Konstantin Nikolaou, MD, and Thorsten R.C. Johnson, MD

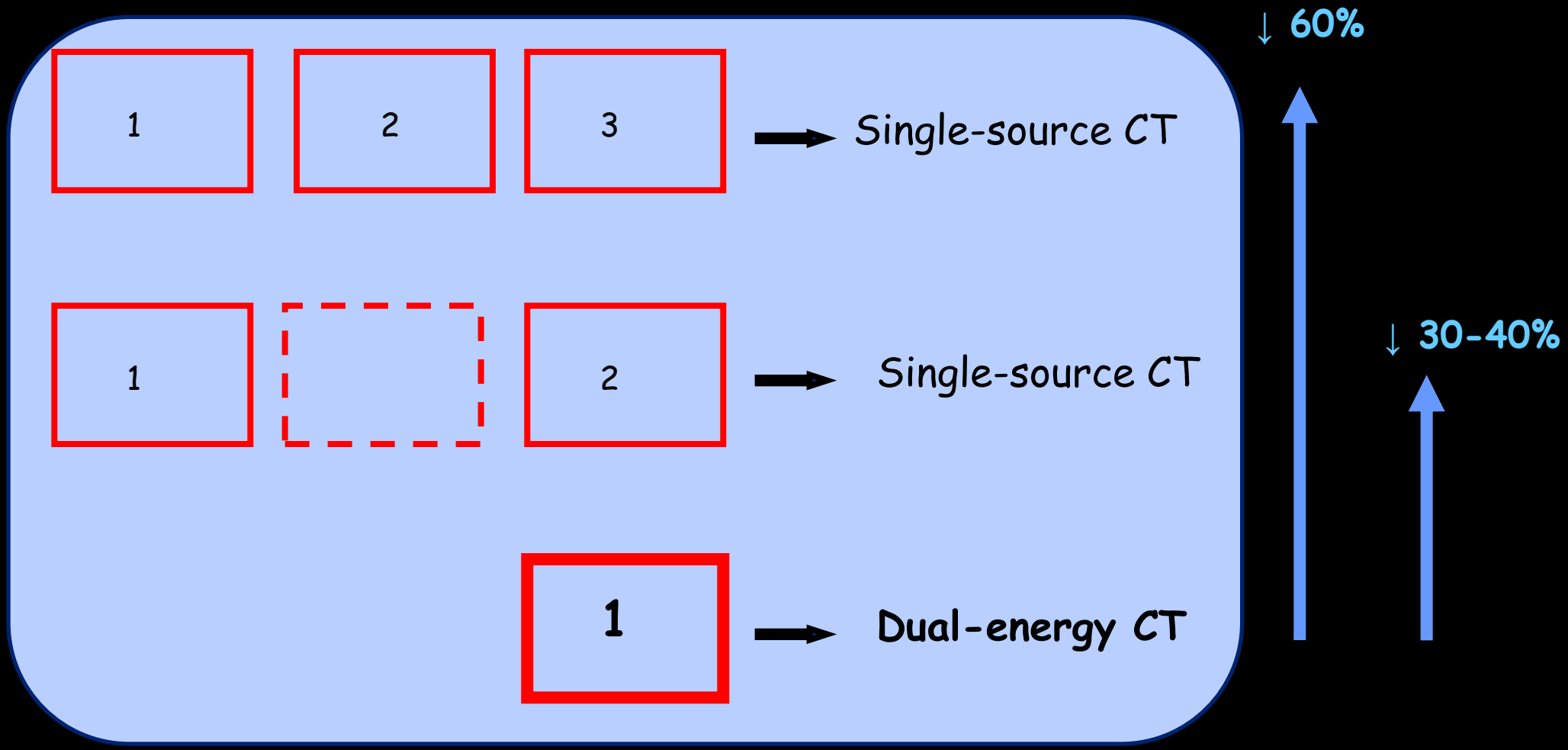
J Vasc Interv Radiol 2010; 21:315–321

Dual-Energy CT for Detection of Endoleaks After Endovascular Abdominal Aneurysm Repair: Usefulness of Colored Iodine Overlay

Giorgio Ascenti[1]
Silvio Mazziotti
Salvatore Lamberto
Antonio Bottari
Simona Caloggero
Sergio Racchiusa
Achille Mileto
Emanuele Scribano

AJR 2011; 196:1408–1414

ACQUISITIONS



VIRTUAL MONOCHROMATIC SPECTRAL (VMS) IMAGING

- **Experimental study** *Matsumoto et al Radiology 2011*
  - *fast kV switching*
  - *keV → best image quality ?*
  - *VMS imaging at # 70 keV: - lower image noise*
    - higher CNR
    - 120 kVp CT for a given radiation dose

- **Clinical study** *Delsalle et al (Radiology 2012, in press)*
  - *dual-source CT (140 kVp; 80 kVp) (24% contrast agent)*
  - *best image quality at 60 keV (PAs, PVs & aorta) & 100 keV (syst veins)*

The key anatomical structures : adequately analyzed by the reading of two series of mediastinal images generated from the same acquisition.

- Standard CT angiogram
- High-temporal resolution CTA
- Dual - energy CTA