CHEST

Comprehensive CT Cardiothoracic Imaging
A New Challenge for Chest Imaging

Riccardo Marano, MD; Federica Pirro, MD; Valentina Silvestri, MD; Biagio Merlino, MD; Giancarlo Savino, MD; Claudia Rutigliano, MD; Agostino Meduri, MD; Luigi Natale, MD; and Lorenzo Bonomo, MD

In the past, thoracic and cardiac imaging were two distinct specialties of radiology. The technical evolution, however, has changed their boundaries with an important impact on CT imaging practices and has opened the new era of "cardiothoracic" imaging, due to the strong anatomic, mechanical, physiologic, physiopathologic, and therapeutic cardiopulmonary correlations. Modern thoracic radiologists can no longer avoid the assessment of heart and coronary arteries, as they used to do with earlier generations of CT scanner. The advent of ECG gating and state-of-art CT scanner faster rotation speed, high spatial and temporal resolution, high-pitch mode, shorter acquisition time, and dedicated cardiac reconstruction algorithms has opened new possibilities for chest imaging, integrating cardiac morphologic and even functional information within a diagnostic chest CT scan. The aim of this review is to briefly show and summarize the concept of integrated cardiothoracic imaging, which redefines the boundaries of chest CT imaging, opening the door to a new radiologic specialty.

CHEST 2015; 147(2):538-551

ABBREVIATIONS: AHT = arterial hypertension; ASD = atrial septal defect; ATS = atherosclerosis; CAD = coronary artery disease; CMP = cardiomyopathy; CTA = CT angiography; CV = cardiovascular; CXR = chest radiograph; DSCT = dual-source CT; HR = heart rate; IHD = ischemic heart disease; IVC = inferior vena cava; LV = left ventricle; MDCT = multidetector CT; PAPVR = partial anomalous pulmonary venous return; PFO = patent foramen ovale; PHT = pulmonary hypertension; RA = right atrium; RV = right ventricle

The imaging of intrathoracic structures has always been susceptible to movement artifacts, mainly due to physiologic movements caused by heart beats or, depending on the patient's clinical conditions and compliance, by uncontrolled coughing, inability to perform and keep adequate breath-hold, esophageal peristalsis, or involuntary Valsalva maneuver. The continuous, impressive technical evolution in the field of CT imaging in the last decade has made it possible to achieve adequate CT image quality in patients with poor respiratory compliance, mainly through the reduction of scan time and higher temporal resolution of the scanner. Similarly, the development of ECG-gated CT imaging and its introduction in the clinical routine, with ever-less radiation exposure, has made it possible to scan the thorax, heart, and great intrathoracic vessels, avoiding the classic step artifacts due to the heart beats, with improved

Manuscript received June 10, 2014; revision accepted August 7, 2014.

AFFILIATIONS: From the Department of Radiological Sciences, Institute of Radiology, Catholic University, Rome, Italy.

CORRESPONDENCE TO: Riccardo Marano, MD, Department of Radiological Sciences, Institute of Radiology, Catholic University, "*A. Gemelli*" Hospital, L.go Agostino Gemelli, 8, 00168, Rome, Italy; e-mail: riccardo.marano@rm.unicatt.it

DOI: 10.1378/chest.14-1403

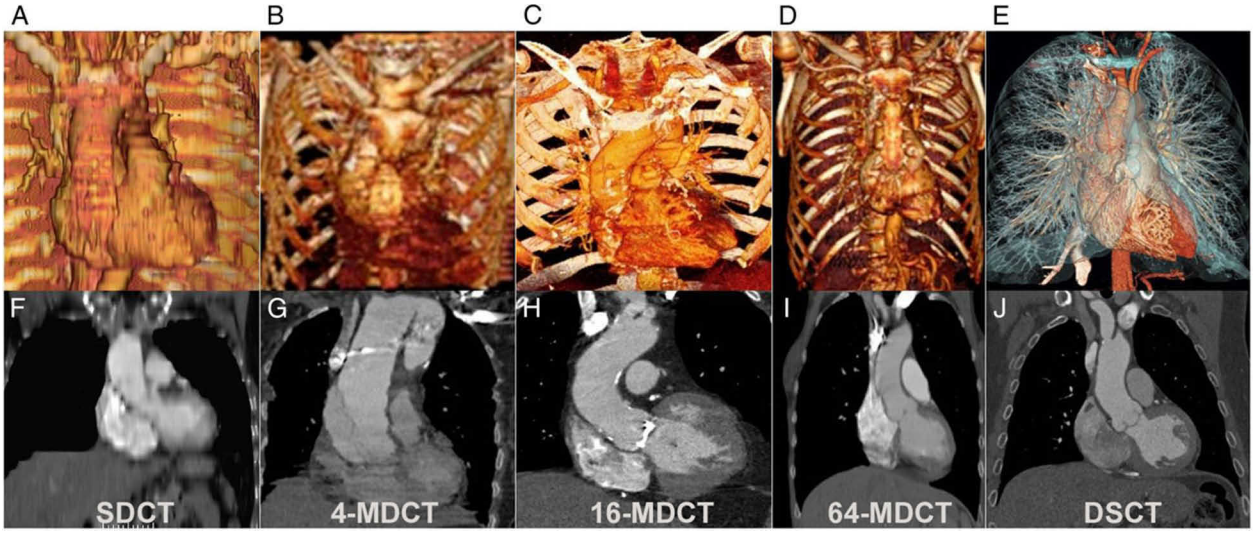

Figure 1 – *Evolution of CT imaging technology over the last 14 y from the SDCT scan (A, F); to the 4-row (B, G), 16-row (C, H), and 64-row (D, I) MDCT scan; to the more recent DSCT scan (E, J), with consequent tremendous improvement in image quality of chest CT scan performed without cardiac synchronization. A-E, 3D volume rendering images from a thoracic aorta CT angiography. F-J, Corresponding coronal multiplanar reconstruction images from the same CT angiography displayed in A-E. DSCT = dual-source CT; MDCT = multidetector CT; SDCT = single-detector CT.*

detection, analysis, and quantification of findings by suppressing all paracardiac motion artifacts.

In the past, thoracic and cardiac imaging were two distinct specialties of radiology. The technical evolution, however, has changed their boundaries with important impact on CT imaging practices and opened the new era of "cardiothoracic" imaging, given the strong embryologic, anatomic, mechanical, physiologic, physiopathologic, and therapeutic cardiopulmonary correlations. Modern thoracic radiologists can no longer avoid the assessment of heart and coronary arteries as they used to do with earlier generations of CT scanner. The advent of ECG gating and the faster rotation speed, high spatial and temporal resolution, high-pitch mode, shorter acquisition time, and dedicated cardiac reconstruction algorithms of state-of-the-art CT scanners have opened new possibilities for chest imaging, possibly integrating cardiac morphology, and even function information, within a diagnostic chest CT scan. The aim of this review is to briefly show and summarize the concept of integrated cardiothoracic

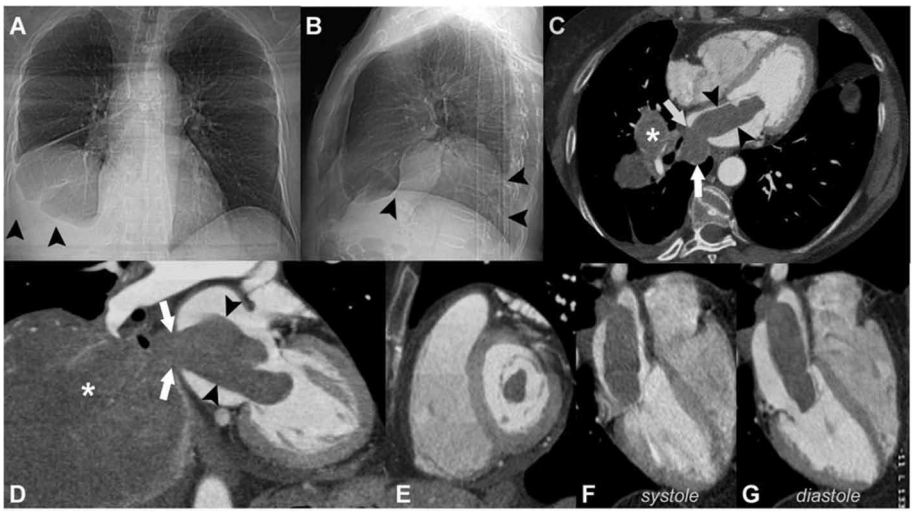

Figure 2 – *High-grade sarcoma of the right pleura in a 61-y-old woman with infiltration of the right inferior pulmonary vein and extension in the left atrium. A, B, The frontal and lateral chest radiographs show a homogeneous, intrathoracic, basal and posterior opacity with obliteration of the right costophrenic angles and deletion of the right hemidiaphragm (arrowheads). C, D, The axial and coronal images from a chest CT scan performed with ECG gating show the solid lesion (*), associated with extension of solid tissue through the ostium (arrows) of the right inferior pulmonary vein within the left atrium (arrowheads). E-G, The images reconstructed along the short and horizontal long cardiac axes show the left intraatrial extension of the tissue, with a diastolic protrusion through the mitral valve (in E and G).*