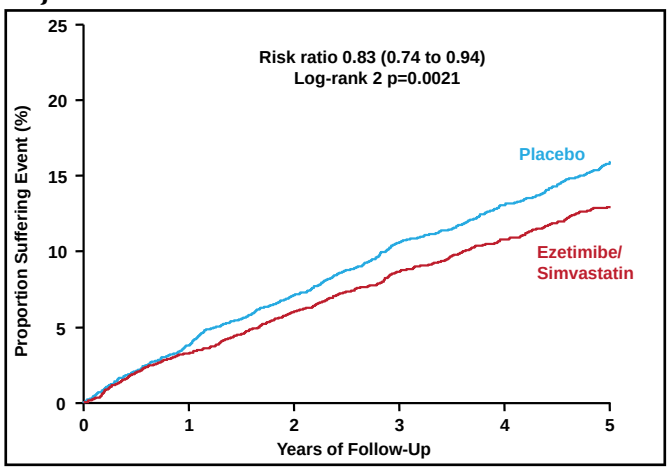
Figure 2. Reduced LDL Cholesterol Cut the Incidence of Major Atherosclerotic Events in Advanced CKD Patients.



LDL=low-density lipoprotein.
Reprinted with permission from The *Lancet* 2011. Baigent C et al. The effects of lowering cholesterol with simvastatin plus ezetimibe in patients with chronic kidney disease.

Future research will focus on reducing the risk of acute renal failure, defining optimal revascularization and reperfusion strategies, reducing bleeding, and the assessment and treatment of nontraditional CKD-related risk factors (eg, anemia, brain natriuretic peptide, parathyroid hormone, calcium, phosphorus, homocysteine, inflammation, thrombotic factors, and oxidative stress).

The Use of CT Angiography in the Diagnosis of Coronary Artery Disease

Written by Toni Rizzo

High Resolution with CT Angiography

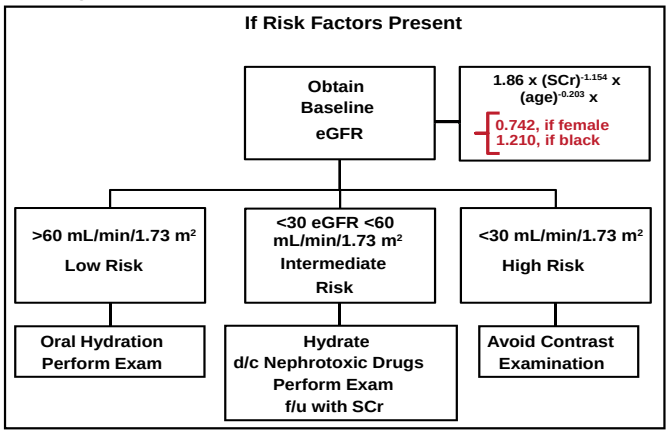
Lawrence M. Boxt, MD, Albany Medical Center, Albany, New York, USA, described the features of computed tomography angiography (CTA) and how these features allow high temporal and spatial resolution of specific cardiac structures. In CTA, the X-ray tube rotates around the patient 3 times per second—much faster than the 1- to 3-second rotation time of conventional CT—providing high temporal resolution. Spatial resolution is high due to the small size (0.6 mm) of the cardiac CT scanner detectors, which ultimately produce 3D images composed of cubes called voxels that are 0.6 mm on a side. The small size allows creation of high-resolution, artifact-free coronary artery and cardiac reconstructions.

CTA data are collected throughout the cardiac cycle, producing a stack of 3D data for each of a series of phases of the cardiac cycle, starting from end diastole through to end systole and back to end diastole. Looking at the data over time allows visualization of cardiac structure as well as cardiac motion. The 3D dataset can be manipulated to select, extract, and view any plane through the heart. Using surface-rendered 3D, part of a structure with a specific attenuation can be identified and the rest of the structure subtracted to produce detailed images of the heart's outer surface. This technique is used for evaluation of coronary artery bypass grafts. Multiplanar reconstruction involves identifying a specific structure such as a coronary artery and locating in each slice to construct multiplanar reconstructions of the entire artery length.

Risks and Benefits of CTA

Iodinated contrast media may induce contrast-induced nephropathy (CIN), defined as a 25% increase in serum creatinine (SCr) from baseline, and may result in acute kidney failure. CIN occurs in 3.3% to 8% of contrast administrations in individuals without pre-existing renal impairment and in 12% to 26% of administrations in those with renal disease or diabetes. Patients at risk for CIN can be identified and prevention strategies implemented (Figure 1) [Levey AS et al. *Ann Intern Med* 2003]. Low-risk patients are given oral hydration prior to CTA.

Figure 1. Evaluation of High CIN Risk and Prevention Strategies.



eGFR=estimated glomerular filtration rate; SCr=serum creatinine.
Reproduced with permission from LM Boxt, MD.

Intermediate-risk patients should receive hydration, discontinue potentially nephrotoxic drugs before CTA, and have follow-up SCr afterwards. Contrast examination should generally be avoided in high-risk patients.

Radiation exposure is another concern. Hausleiter et al. [*Circulation* 2006] studied the radiation doses received during 16- and 64-slice CTA and the impact of different scan protocols on dose. They found that the higher spatial and temporal resolution of 64-slice CTA is associated with an increased radiation dose compared to 16-slice CTA (14.8±1.8 vs 10.6±1.2 mSv). Dose-modulating algorithms significantly reduced the radiation exposure

(Table 1). Dose can also be reduced using the step-and-shoot acquisition technique, which delivers a dose of 2.5±0.8 mSv (range 1.2 to 4.4). Using this technique for diagnosis of significant coronary stenoses, Scheffel et al [*Heart* 2008] found that the overall patient-based sensitivity, specificity, positive predictive value, and negative predictive value were 100%, 93%, 94%, and 100%, respectively.

Table 1. 16- and 64-Slice CTA Radiation Doses in Patients Scanned with Different Scanning Protocols.

	16-Slice CT			64-Slice CT		
	120 kV without Dose Modulation	120 kV with Dose Modulation	100 kV with Dose Modulation	120 kV without Dose Modulation	120 kV with Dose Modulation	100 kV with Dose Modulation
No. of patients	30	50	50	50	50	30
Male gender	20 (67)	33 (66)	34 (68)	34 (68)	36 (72)	21 (70)
BMI (kg/m^2)	26.9±3.2	27.5±4.5	26.4±2.9	26.2±3.2	26.6±4.7	25.6±2.3
Heart rate (bpm)	61.3±11.3	60.7±9.5	57.8±5.3	60.1±10.4	57.5±7.2	57.0±8.2
Scan length (mm)	128.2±11.8	125.9±9.2	124.0±7.7	125.9±12.5	123.9±11.8	122.0±17.7
Tube current (mA)	510.0±40.3	304.5±42.3*	387.6±18.9*	870.0±55.6	551.0±58.2**	537.8±50.7**
Pitch	0.18±0.01	0.18±0.01	0.21±0.02*	0.2±0	0.2±0	0.2±0
$CTDI_{vdi}$ (Gy)	42.1±3.6	25.2±2.9*	19.4±1.0*	58.8±6.3	38.3±3.1**	22.0±1.8**
Image noise (HU)	29.3±6.9	28.3±6.8	36.9±9.4*	39.2±10.2	37.7±8.6	50.0±10.4**
Contrast-to-noise ratio	7.3±3.1	8.1±3.4	8.8±2.9	6.4±2.1	6.7±2.3	7.0±1.9
Signal-to-noise ratio	11.1±3.9	11.9±4.3	11.9±3.7	8.9±2.5	9.2±2.8	9.2±2.5
Dose estimate (mSv)	10.6±1.2	6.4±0.9*	5.0±0.3*	14.8±1.8	9.4±1.0**	5.4±1.1**

Data are n (%) or mean±SD; *p<0.025 for comparison with 16-slice CT scanning protocol using 120 kV without ECG-dependent dose modulation; **p<0.025 for comparison with 16-slice CT scanning protocol using 120 kV without ECG-dependent dose modulation.

CT=computed tomography; CTDI=computed tomography dose index; ECG=electrocardiogram; HU=Hounsfield unit. Hausleiter J et al. *Circulation* 2006;113:1305-10.

Based on these data and other studies evaluating the accuracy and prognostic value of CTA, Dr. Boxt concluded that CTA is a rapid, safe, and efficient means of investigating patient complaints of chest pain. CTA is a highly sensitive indicator of the absence of coronary artery disease (CAD) and provides morphologic information for CAD risk assessment and clinical prognosis. The risks associated with CTA—namely CIN and radiation exposure—should be considered when determining which imaging procedure is best for a given patient.

Impacting the Cardiac Care of a Nation

Written by Toni Rizzo

W. Lowell Maughan, MD, Trinidad and Tobago Health Sciences Cardiovascular Initiative (TTHSI), Johns Hopkins Medicine International (JHMI), Baltimore, Maryland, USA, described the TTHSI partnership with Johns Hopkins Medicine International to improve cardiovascular (CV) care in Trinidad and Tobago. Cardiovascular disease (CVD) accounts for 37% of all deaths in Trinidad and Tobago. In an effort to reduce CV mortality and morbidity in Trinidad and Tobago, the local government contracted with JHMI to provide training, equipment, and expertise to develop CV services in the public sector. Resources provided by JHMI included weekly faculty and staff travel and teaching, equipment to support training and services, and program development expertise. Deployment of these resources was guided by leadership from all regions and a national workshop.

The initiative approach was to confirm needs and priorities with Trinidad and Tobago partners, and achieve consensus on the services that should be available in the public sector and where those services should be located. This process was achieved through a group of health system and education leaders, cardiovascular caregivers, and JHMI cardiology faculty.

The key recommendations for CV service distribution made by the National Workshop 2011 were that 1) each health center should provide basic CV services, such as electrocardiogram and preventive measures, and 2) each district health facility should manage acute myocardial infarction and provide echocardiography, stress testing, Holter monitoring, and anticoagulation clinics. In addition, regional hospitals should have a cardiologist on staff and a Coronary Care Unit. Larger hospitals should also have a catheterization laboratory and at least 1 hospital should offer comprehensive cardiac care and a cardiology fellowship. By 2012, many of the recommended programs had been implemented or were in the process of acquiring equipment or planning implementation. Currently, the program goals are on schedule to be achieved by February 2013.

Eighty-one JHMI cardiology faculty and staff have participated in the program, providing 275 faculty training weeks and 171 staff training weeks. More than 125,000 trainee hours have been provided. Primary care physician CV training has been attended by 982 physicians. More than 3000 physicians and staff have been trained in basic ECG interpretation. Eighty-eight inpatient nurses and more than 600 outpatient nurses have been trained. A new cardiology fellowship graduated 3 cardiologists, and 2 more will graduate in the coming year.

This program has demonstrated a unique approach to rapidly develop public sector CV services in a developing country. A successful program should have the following features: adequate financing to fund a visiting academic program, overlapping priorities and missions, in-country training to increase the chance of retention of expertise, intensive education and training over a defined short interval to sustain enthusiasm and commitment, an equipment budget that allows trained personnel to provide services, and partnerships with existing entities for a sustainable impact.