

State-of-the-art Cardiac CT

prompts **better, quicker diagnosis** *and shorter hospital stays*

Coronary CT angiography is making its mark on 21st century cardiac medicine. Cardiac imaging pioneers across the globe are demonstrating that dynamic volume CT improves and accelerates patient care and cuts costs by reducing length of stay. It also facilitates diagnosis of sub-clinical atherosclerosis, allowing cardiologists to prescribe preventive treatment to at-risk patients earlier in the disease process.

One early adopter of state-of-the-art cardiac CT angiography is the Piedmont Heart Institute in Atlanta, Ga. The center deployed Toshiba America Medical Systems Aquilion ONE CT system in October 2008 and is tapping into the new scanner to re-invent the standard of care for patients presenting to the ER with chest pain.

The early results are impressive. Since implementing the Aquilion ONE dynamic volume CTA model, the average hospital stay for a patient presenting to the ER with chest pain has dropped from 14 hours to five hours, which is expected to correlate with

reduced costs. Researchers at the institute expect to finalize a formal cost analysis later in 2009. Equally important, Aquilion ONE slashes radiation dose compared to other cardiac imaging modalities including 64-slice CT and nuclear stress studies. A 64-slice CT study at Piedmont exposes the patient to 15 to 25 millisieverts (mSv) of radiation, and a nuclear stress test exposes the patient to a radiation dose of 15 to 28 mSv. On the Aquilion ONE, on the other hand, the radiation dose is between 3 and 6 mSv in most routine patient exams.

Dynamic volume CTA is a winner from all perspectives: clinical, economic and efficiency. This issue, Piedmont Heart Institute shares early outcomes of its coronary CT angiography program with *Cardiovascular Business*.

The conventional standard of care

Prior to adding dynamic volume cardiac CT, Piedmont Heart Institute relied on nuclear perfusion as the imaging study of choice for patients who presented in the ER with chest pain. Specifically, physicians ordered an EKG and cardiac enzyme tests for patients with no history of coronary disease. Patients whose results did not suggest ischemia were referred to nuclear medicine for a nuclear stress test.

The nuclear stress test poses several challenges. For starters, emergent patients must be worked into the nuclear medicine schedule for the study; however, it's difficult to work in all patients, particularly those arriving in the late afternoon or evening. "With nuclear studies, the patient is at the mercy of how much isotope is in stock. The department can run out toward the end of the day," says Szilard Voros, MD, medical director cardiovascular MR and CT. If the hospital can not perform a same-day stress test, the patient is held overnight in an observation unit. Voros estimates that the average chest pain process for negative patients lasts three to six hours with significant variation, particularly for overnight patients.

In addition to presenting operational challenges, nuclear perfusion can be time-consuming and uncomfortable for the patient. It takes three to four hours to complete the entire study, which consists of stress and rest images with each acquisition lasting 10 to 15 minutes.



Since the Toshiba Aquilion ONE dynamic volume CT system was installed last fall, Piedmont Heart Institute in Atlanta has seen a reduction—to five hours from 14—in the average hospital stay of a patient presenting to the emergency department with chest pain. Cost reduction data are currently being compiled.



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Szilard Voros, MD, medical director of cardiovascular MR and CT at Piedmont Heart Institute

The new and improved paradigm

As a matter of perspective, each year 8 million Americans visit emergency departments with chest pain symptoms. Although only 5 to 15 percent of these patients are found to be suffering from a heart attack or other cardiac issue, more than half of these patients are admitted to the hospital for observation and further testing. This, ultimately, could lead to additional diagnostic cost without better treatment.

Piedmont Heart Institute developed a new chest pain strategy based on the Aquilion ONE dynamic volume CT scanner. Turnaround time is shorter, fewer patients are kept overnight and costs are lower. A study at the University of Pennsylvania of 568 patients showed the average ED cost of a patient receiving a first-round CTA averages \$1,240, while stress testing and telemetry monitoring are more than \$4,000 per patient. That means that a patient can have more than \$5,000 in tests even before treatment begins.

At Piedmont, the new standard targets emergent chest pain patients with no previous history of coronary disease. The first steps in the process follow the conventional model. That is, the patient receives an EKG and biomarker assessment. If results do not indicate ischemia, the patient is transported to CT for a coronary CT angiogram.

At this point, the process becomes much more streamlined than under the previous model that utilized a conventional nuclear stress test. Prior to the CT study, a nurse administers beta blockers to reduce the patient's heart rate to less than 65 beats per minute. “We usually need beta blockers to bring the heart rate into the range for a single revolution scan and capitalize on the low radiation dose of the Aquilion ONE,” explains Voros. For most patients, the scan is less than one second, and they are on and off the table in less than 10 minutes. From the patient perspective, Aquilion ONE boosts comfort. It requires a very manageable sub-second breath-hold. In contrast, patients need to hold their breath for eight to 12 seconds to generate diagnostic-quality CT results with 64-slice systems.

Clinical decision-making also is accelerated with the Aquilion ONE paradigm. It takes physicians less than five minutes to read and report on normal scans—which accounts for 70 percent of

the caseload at the institute, says Voros. An abnormal case takes slightly longer at about 10 to 15 minutes. “Often, we report an answer to the ER physician in an hour or hour and 15 minutes after the CT study. The Aquilion ONE makes a tremendous difference in our ability to provide timely clinical data,” says Voros. He partially attributes physicians' ability to supply a rapid response to the Aquilion ONE workstation, which is designed for efficient review of cardiac datasets. The workstation incorporates highly automated tools that anticipate what the cardiologist will want to see and prepares the images in advance. In addition, the center's Aquilion ONE is dedicated to and optimized for cardiac applications, which minimizes the need to revise protocols.

At Piedmont Heart Institute, physicians provide calcium scoring and CT angiography results on all chest pain patients. “The calcium score provides significant prognostic information, but it isn't sufficient to rule out disease in asymptomatic patients,” explains Voros. The calcium score provides data about calcified plaque, which accounts for 20 percent of all plaque. CT angiography takes the next step and identifies non-calcified plaque, so both results are essential.

Aquilion ONE helps sites obtain essential data with a much lower radiation dose. Voros and his colleagues recently completed a radiation dose study of calcium scoring comparing a 64-slice scanner to the Aquilion ONE. The study showed a 35 percent reduction in radiation dose with the Aquilion ONE; Voros expects even greater dose reduction when researchers compare CT angiography radiation dose of 64-slice systems to the Aquilion ONE.

The dynamic volume CTA model allows the heart center to optimize its clinical resources as well. “Like nuclear perfusion, CTA requires one technologist and one nurse, but the length of time they are dedicated to each patient is much shorter,” Voros says. On the clinician side, review time is similar for both exams.

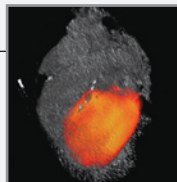
The clinical differences between the cardiac imaging studies are critical. Nuclear perfusion imaging looks at myocardial perfusion and indirectly assesses coronary artery blockages. In contrast, coronary CT angiography directly assesses coronary anatomy. In addition, Aquilion ONE allows the physician to detect subclinical atherosclerosis. Because subclinical atherosclerosis is not hemodynamically significant, nuclear perfusion study re-

Cardiac CT Angiography vs. Nuclear Perfusion: A Clinical Timeline

Nuclear Perfusion Study

Day One

- 3:00 p.m.** Patient presents to the ER complaining of chest pain.
- 3:30 p.m.** EKG and cardiac enzyme results come back as normal.
- 3:45 p.m.** ER physician refers patient to nuclear medicine for stress test.
- 4:00 p.m.** Nuclear medicine is unable to accommodate patient into schedule.
- 5:00 p.m.** Patient is held for overnight observation in the telemetry unit. Physician orders serial cardiac enzymes.



Medical University of South Carolina

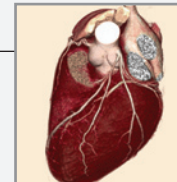
Day Two

- 9:00 a.m.–**
- 1:00 p.m.** Patient undergoes nuclear stress test.
- 2:00 p.m.** Physician reports study as normal and rules out myocardial infarction. Physician does not prescribe aspirin and statins for subclinical atherosclerosis. Patient discharged from hospital.

Aquilion ONE Coronary CT Angiography Study

Day One

- 3:00 p.m.** Patient presents to the ER complaining of chest pain.
- 3:30 p.m.** EKG and cardiac enzyme results come back as normal.
- 3:45 p.m.** ER physician refers patient to cardiac CT.
- 4:00 p.m.** Patient undergoes cardiac CT.
- 5:00 p.m.** Interpreting physician detects subclinical atherosclerosis and prescribes aspirin/statin regimen.
- 6:00 p.m.** Patient goes home.



Toshiba America Medical Systems

Day Two

- 8:00 a.m.** Patient begins aspirin/statin therapy.
- 8:30 a.m.** Patient returns to work.

sults for patients with underlying atherosclerosis are normal. Patients with subclinical atherosclerosis, however, can be managed with aggressive medical interventions to minimize the risk of a cardiac event. Voros says CT angiography detects underlying atherosclerosis in 30 to 40 percent of “normal” chest pain patients. In contrast, a nuclear perfusion study on the same patients would be interpreted as normal, so the physician would not recommend preventive treatment.

Several months into its deployment of the Aquilion ONE scanner, Piedmont Heart Institute has started to ramp up processes. In January 2009, the hospital incorporated CT angiography into its chest pain pathways as the default study for ER patients.

Peering into the future

The institute’s Aquilion ONE project is focused on advancing and validating new CT applications, Voros notes as he turns an eye toward the future. While current clinical applications focus on the diagnosis of arterial blockages in symptomatic patients, research now underway could prove CT’s merits in assessing asymptomatic patients. Voros and others are looking closely at the assessment of overall plaque burden via volumetric CT in asymptomatic patients that could some day allow cardiologists

to identify and treat patients like NBC TV journalist Tim Russert prior to a fatal cardiac event.

Another potential Aquilion ONE application is perfusion imaging. “By combining arterial data and perfusion evaluation, Aquilion ONE may enable one-stop shop cardiac imaging for patients with suspected or known coronary artery disease,” shares Voros. In the single-shop model, an Aquilion ONE study replaces three imaging tests—nuclear myocardial perfusion imaging, an echocardiogram and invasive coronary angiogram. The conventional workup requires more than 500 heartbeats, several days and a radiation dose of up to 40 to 45 mSv.

The new model at a glance

Volumetric CT angiography is changing the clinical evaluation of patients presenting to the ER with symptoms of coronary artery disease. Instead of ordering a nuclear study, physicians order a CT angiogram. The new model saves time and staff resources, and it provides additional diagnostic data that provides physicians the information needed to diagnose and treat subclinical atherosclerosis. As researchers accumulate data, Aquilion ONE applications will expand, delivering further improvements in coronary imaging, diagnosis and treatment. **CVB**