MRI & CT

Issue: December 2007: Bigger's Now Better

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Spotlight on Cedars-Sinai

Team develops low-dose coronary CT angiogram

A silent killer is on the prowl in the United States, one that is the leading cause of death in men and women.

In the cases of approximately half of its victims, coronary artery disease manifests itself for the first time as a heart attack or cardiac death, according to Daniel S. Berman, MD, chief of cardiac imaging and nuclear cardiology at the S. Mark Taper Foundation Imaging Center, Cedars-Sinai Medical Center, Los Angeles.

"If we knew the patients had coronary artery disease before they come to us, it's estimated that as many as 60% to 80% of cardiac deaths could be avoided by appropriate treatment," Berman said.

With the advent of 64-slice CT scanners, physicians were able to see more reliable, accurate images of the coronary artery, with more than 90% sensitivity and specificity for detecting coronary artery disease. However, the arrival of the new technology came with a backlash regarding its use of large amounts of radiation. Many wondered if it would harm patients rather than help them.

"The publicity associated with CT in general has focused the attention of many interested parties on radiation burden," Berman said. "That's why we thought to find a solution that would reduce radiation exposure dramatically."

Joining many of his colleagues in the medical community, Berman and a team of scientists and clinicians at Cedars-Sinai Medical Center set out to find a way to reduce radiation exposure in CT. What they developed was a new procedure termed the Low-Dose Coronary CT Angiogram.

Using the Siemens Definition, a dual source CT, the team has implemented two different protocols. In the microdose approach, the radiation exposure is reduced by a factor of 10, while the minidose approach reduces radiation exposure by 75%. Currently, at Cedars-Sinai, the microdose technique is used for screening purposes only in asymptomatic patients, while the minidose technique is used in general applications in patients with chest pain, Berman said.

The factor of 10 reduction in the microdose approach is gained by using prospective gating, in which a series of images are obtained at a single phase of the cardiac cycle. The scanner's x-ray beam is turned on for approximately 10% of the time, compared to standard retrospective gating, where the beam is on for 100% of the time. In doing so, the maximal possible dose modulation is achieved while still employing a spiral CT acquisition.

In the minidose approach, also called "70/70," the x-ray beam is maximized at 70% of the cardiac cycle and is dropped down to 4% during the remainder. Investigators found that with this approach, excellent image quality is obtained from 65% to 80% of the cardiac cycle, Berman said. Also, it is more forgiving of irregularity in the patient's heartbeat, he said.

While CCTA is too expensive to be used as a screening test, its benefit is also not understood in patients already known to have coronary artery disease, Berman said. Between these extremes are patients with a low to intermediate risk, he continued, and if the pretest is based on age, sex, type of symptoms, and risk factors, Berman considers CT to be the test of choice.

"The application of coronary CT is in its infancy, and these recent developments are just the beginning of what is likely to be an expanding reduction," Berman said. "There is no question in my mind that its resolution is going to get better, that its efficiency will get better. We can look forward to a time when we can see small enough levels of radiation for CT, when we will be able to use the technique in serial assessments for monitoring therapy."

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During the American Heart Association meeting in Orlando, Fla, the Cedars-Sinai group presented their findings that appropriately selected patients can be effectively imaged with the microdose approach, with a very high rate of success. In work that the group has submitted to the American College of Cardiology for its March 2008 meeting, the group has found that the minidose evaluation results in a higher proportion of patients with interpretable scans than the microdose.

Now the team is working on developing the automatic quantitative tools to measure plaque size so that clinicians can monitor therapy over time with the low dose CT technique, Berman said, adding his group is working on a grant to explore this potential.

"I've been working with cardiac patients for 30 years and have had, throughout my career, the opinion that if we can identify the patients correctly, we can prevent heart attacks," Berman said. "CT is allowing finally this early identification of patients at risk and it may even bring us to the point where we will know which patients need stents or bypass surgery, and which patients can be treated with medicine, even if they have significant coronary stenoses."

—Elaine Sanchez

New Technology: Next Generation of Radiation Treatment Arrives

At a medical symposium in Dearborn, Mich, radiation oncologist Alvaro Martinez, MD, found his inspiration to develop a piece of brand-new, cutting-edge radiotherapy technology in the unlikeliest place—a Ford Motor Company meeting of automotive engineers.

More than 5 years later, on September 10, an application of the auto technology that was used to detect defects in engine blocks successfully treated a breast cancer patient at Beaumont Hospitals in Royal Oak, Mich.

Stemming from the idea to marry real-time CT imaging with a medical linear accelerator, Martinez and a team of physicists and physicians from Beaumont Hospitals invented and patented Omnibeam, a fast, accurate, and painless robotic technology that automatically adjusts the radiation field during treatment.

"Omnibeam is a dramatic new clinical advance in radiation therapy for cancer," said Martinez, corporate chairman of radiation oncology for Beaumont Hospitals, in a press release. "The combination of improved imaging coupled with robotic technology is vastly better than other radiation machines for cancer therapy."

The advanced imaging technology, powered by the $3.3 million Elekta Axesse machine, is specially designed for the treatment of tumors deep within the body. It can account for a patient's moment-to-moment external movements, in addition to the natural repositioning of internal organs. The robotic component tracks these movements on a real-time basis, modifying the treatment accordingly.

Because patient position on the treatment table can be adjusted three-dimensionally, translational and rotational errors can easily be corrected. As a result, radiologists can precisely deliver large doses of radiation to smaller areas, in addition to very large or irregularly shaped tumors.

"It allows you to target the tumor more accurately and reduce the amount of normal tissue that you're radiating," said Inga Grills, MD, director of the extracranial stereotactic radiation therapy program at Beaumont Hospitals. "Hopefully, in the long term, this will lead to better patient outcomes in terms of tumor control as well as side effects."

Grills said the main advantage to using Omnibeam over other technologies in the market is that it allows radiologists to target the tumor directly while imaging it three-dimensionally, in real time. Another benefit for patients is that it is faster, with an average procedure lasting 20 minutes. Furthermore, unlike other treatments that require physicians to implant fiducials within the individual, Omnibeam is noninvasive and painless.

—E. Sanchez

Virtual Colonoscopy Effective for Colorectal Cancer Screening

A large comparative study in the October 4 issue of the *New England Journal of Medicine* shows that computed tomographic colonography (CTC), otherwise known as virtual colonography, yields detection rates for advanced neoplasia similar to those attained using traditional optical colonoscopy. These results suggest that CTC, already validated as a diagnostic tool, can be useful in screening situations as well.

"One of the reasons there's been sort of a slow adoption of this new technique has been that most of the studies performed to date have been in symptomatic or high-risk patient groups," noted Judy Yee, MD, staff physician and chief of radiology at the San Francisco Veterans Affairs Medical Center. "This is one of the largest studies looking at the use of CTC for screening, and is applicable to a much larger overall patient population." American Cancer Society guidelines recommend that both men and women over age 50 receive annual screening for colorectal cancer.

CTC has certain advantages over conventional colonoscopy screening methods. "It's less invasive, and you don't require sedation, so patients can schedule this test first thing in the morning," Yee said. "CTC's also safer than colonoscopy. There's a significantly lower perforation risk, so it's useful in patients who are considered high-risk for colonoscopy, the frail and elderly, or patients who might be at a higher bleeding risk, like patients who are on aspirin. And it's useful in patients who can't undergo sedation."

Because most studies so far have measured CTC against optical colonoscopy, it's still difficult to discern whether CTC might in fact offer improved detection. But advances in visualization technology certainly give radiologists capabilities in reading CTC that they simply do not have when reading traditional colonoscopy studies. CAD for virtual colonoscopy highlights polyps at set size