

# The Hard Truth about Hearts

## A test that measures calcium deposits may screen for heart disease

By DAMARIS CHRISTENSEN

**Q**uick. Do you smoke? Exercise? Know your blood pressure? Your cholesterol level? Your coronary calcium score?

Most people have never heard of it, but a coronary calcium score could tell them more about their risk of developing heart disease than the answers to any of the other questions. A coronary calcium score is not only a measure of risk but also a gauge of early disease, say researchers. It directly counts the fatty plaques, which contain calcium deposits, in the heart vessels. These plaques are a major cause of heart attacks and other cardiovascular diseases.

Currently, coronary calcium measurements serve primarily as a tool in research on heart disease rather than a screening tool to ward off the illness. That, however, may soon change.

**E**very 33 seconds someone in the United States dies of heart disease—more than 959,000 people each year. Cardiovascular disease ranks as the leading cause of death in this country.

People who smoke, don't exercise, and weigh too much are all at increased risk for heart disease, as are those who have high blood pressure, high blood cholesterol concentrations, or diabetes. Men are more likely than women to develop heart disease, and older people are at higher risk than younger people.

Improvements in treatments and preventive efforts, such as campaigns to lower high blood pressure and high cholesterol, have helped reduce the toll of cardiovascular disease. Yet public health advocates warn that the growing girth of many Americans and the rising number of people with sedentary lifestyles may reverse this positive trend.

Actually seeing plaques, or counting them, can help people understand how their lifestyles affect their heart (SN: 5/8/99, p. 302). When these fatty deposits accumulate, they narrow the blood vessels, a condition called atherosclerosis. Constricting the vessels that bring blood to the heart foreshadows more severe heart disease.

Information about the state of their blood vessels might give people a kick in the pants to get exercising and lose weight, says Steven N. Blair of the Cooper Institute for Aerobics Research in Dallas. A technology that measures blood vessel plaques might also refine the process of singling out people most at risk, since not everyone who smokes, overeats, or avoids exercise develops heart disease.

In this method, researchers measure calcium in atherosclerotic plaques by taking X-ray snapshots of the heart. The images show coronary calcium as white spots. The density and size of the spots and, by inference, the amount of plaque are reflected in the coronary calcium score.

The beating heart evaded clear X-ray imaging until scientists at the University of California, San Francisco developed electron-beam computed tomography, or EBCT, in the 1980s. In traditional CT, an arm emitting X rays moves around a person. Because the mechanical device travels relatively slowly, pictures of the beating heart come out too blurred to depict small features like the calcium deposits.

An EBCT machine is faster because its X-ray source is a moving electron beam. This device can snap a scan of a heart between beats, in one-tenth of a second, far quicker than other imaging devices.

In the early studies, researchers showed that the number of plaques detected by EBCT after death correlated well with the extent of atherosclerosis measured during the autopsy. Further studies concluded that people with extensive calcium deposits were more likely to suffer chest pains and other forms of heart disease than people without this indication of atherosclerosis.

Research scientists developed a system of quantifying the density and extent of the calcium deposits. They assign a value called the calcium score. The higher this score, the more likely the person is to develop heart disease. Scores of more than 400 would trigger serious concern; scores of 0 to 100 are generally considered signs of extremely healthy arteries.

**O**ver the past decade, many medical scientists have embraced EBCT technology in their research. In one study, people with high coronary calcium scores were five to six times as likely to develop heart disease as people with low calcium scores, says Yadon Arad of St. Francis Hospital in Roslyn, New York. In contrast, people with a traditional risk factor, such as smoking, were three to four times as likely to develop heart disease as people without those risk factors were, he says.

"Importantly, even when traditional risk factors are taken into account, differences in coronary calcium scores can still help predict future heart disease," Arad says.

Some scientists use the technique to track the progression of heart disease as they look for new risk factors for the illness. Currently, about a third of patients who develop the disease report no known risk factors.

Carlos Iribarren, for example, asked whether hostility can trigger heart disease. It would have taken decades to link that behavior in young adults with later cardiovascular problems. In his research at Kaiser Permanente in Oakland, Calif., he found that the most hostile participants had significantly higher calcium scores than those who showed less hostility (SN: 4/17/99, p. 255).

A recent study also indicates that changes in coronary calcium scores over time reflect the success of disease prevention strategies. In a year-long study, researchers of the Electron Beam Tomography Research Foundation and Vanderbilt University, both in Nashville, examined almost 150 people, ages 32 to 75, who had high blood cholesterol concentrations. Among those who took drugs that successfully lowered their blood cholesterol concentration, the coronary calcium scores dropped by about 7 percent. Coronary calcium scores increased by about 50 percent in the people not taking cholesterol-lowering drugs.

The scores also reflected less-than-optimal treatment. They increased by about 25 percent in people taking the drugs whose cholesterol concentrations did not drop to normal, the scientists re-

ported in the Dec. 31, 1998 NEW ENGLAND JOURNAL OF MEDICINE.

Researchers have not yet examined whether other drugs, diet, and exercise are also effective at lowering coronary calcium scores.

**T**he technology seems to be good—accurate, minimally invasive, and a good predictor of cardiovascular events. But the question still remains, “What do we do with the results?” says Diane Bild of the National Heart, Lung, and Blood Institute (NHLBI) in Bethesda, Md.

Widespread screening would require a better understanding of the health relevance of the scores, she says. Because coronary calcium measurements are relatively new, researchers have not yet determined the medical implications of specific scores or established thresholds for amounts of coronary calcium that should be considered dangerous. These values would need to be adjusted for a person’s age and sex. A value that might be normal in a 50-year-old woman would be worrisome in her 40-year-old neighbor. Men generally have higher calcium scores than women.

Until scientists know more about the scores, “I would have some misgivings about [coronary calcium] as a screening device,” Bild says.

Many researchers share Bild’s opinion that coronary calcium screening is not quite ready for widespread use. However, about half a dozen of the 50 or so U.S. research institutions that have EBCT machines in place are already offering coronary calcium screening to the public for a fee.

“In my view, EBCT is absolutely ready for prime time,” argues David G. King of Imatron in San Francisco, the company that manufactures the EBCT machine. “Every year in this country, 150,000 people have a first symptom of cardiovascular disease—sudden death. We may be able to prevent this by screening.”

King doesn’t claim that screening is for everyone. “Some teens and twenty-somethings will have coronary calcifications, but generally, screening is likely to be most appropriate for males over 40 with one risk factor for heart disease or for females over 50 with one risk factor. Ideally, they will have been referred by their physician,” he says.

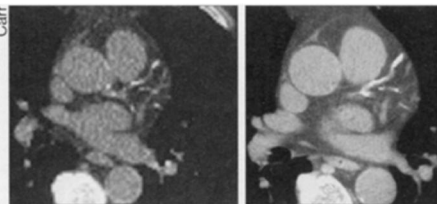
While there is disagreement about the value of screening, many researchers say that coronary calcium scores can direct treatment decisions. Doctors often find it difficult to decide whether to give expensive cholesterol-lowering drugs to patients with blood cholesterol concentrations that are near the borderline between normal and high. The presence or absence of coronary calcium might guide treatment, says King.

A tallying of risk factors is not proof of

incipient heart disease. Some people have high cholesterol scores, for example, yet never develop atherosclerosis. “Tests that can identify atherosclerosis early will tell us what people are reacting to particular risk factors,” says Kim Sutton-Tyrrell of the University of Pittsburgh School of Public Health. She sees coronary calcium scans as such a test.

If a person has high blood cholesterol concentrations but a low coronary calcium score, aggressive cholesterol-lowering treatment might not be warranted. On the other hand, someone with moderate cholesterol concentrations and a high calcium score would be a good candidate for drug therapy.

The coronary calcium measurements are currently of limited use because in many cases, “we could identify disease and still not know whether to treat it,” Sutton-Tyrrell says. For instance, it isn’t clear what to recommend to people with a high calcium score but who have none of the traditional risk factors.



*A scan through the heart from electron beam computed tomography (left) and an electrocardiogram-traditional CT combo (right). In both images, calcium deposits show up as small white spots.*

**E**xpense is a crucial barrier to overcome if coronary calcium screening is ever to be widespread. EBCT machines cost up to \$2 million. “Right now, these tests are in the \$200 to \$400 range. Until they are cheaper, they will not reach prime time,” says Peter W.F. Wilson of the NHLBI’s Framingham (Mass.) Heart Study.

Sutton-Tyrrell adds that insurance companies will probably not pay for the tests until it is clearer what treatments or lifestyle changes are appropriate for people with high or moderate coronary calcium scores.

A variation in the technology may make coronary calcium measurements more affordable in the near future. By hooking up an ordinary hospital CT scanner to an electrocardiogram machine, researchers have taken X rays of a beating heart that show calcium almost as well as an EBCT machine does.

The 10,000 or so CT scanners installed in hospitals across the country normally can’t get a clear picture of the beating heart. An electrocardiogram machine, which traces the heart’s rhythm, allows a computer to select CT images taken of the heart during the six-tenths of a second that it pauses between beats. Adding an electrocardiogram to an existing CT scan-

ner costs about \$100,000—a trivial amount compared with the price of an EBCT machine.

The combination device is currently not quite as fast as an EBCT machine. The combo takes about half a second for a full scan, whereas an EBCT scan requires only one-tenth of a second.

In a study of 36 people, the two technologies yielded similar coronary calcium scores, says J. Jeffery Carr of Wake Forest University Baptist Medical Center in Winston-Salem, N.C. The results from the two methods matched most closely in patients with large amounts of coronary calcium, he reported in March at a meeting of the American Heart Association in Orlando.

Because CTs are already widely available and connecting one to electrocardiogram equipment is not difficult, coronary calcium tests from this combination might be significantly cheaper than tests with EBCT, Carr says. In addition, the tests could be available to more people sooner. This raises the possibility of widespread screening, once the scientific underpinnings are in place, “similar to the way mammography is used to screen women for breast cancer,” he says.

**A**lthough there are other nonsurgical ways of screening for atherosclerosis that are significantly less expensive than coronary calcium screening, none is as sensitive. Researchers found in the early 1960s that the difference between the blood pressure taken from a person’s arm and lower leg could predict future cardiovascular disease. If blood pressure is higher in the leg, it indicates that there is some obstruction of blood flow in the arteries in the leg. This, in turn, implies there is also obstruction of blood flow closer to the heart.

Another test, known as a carotid artery ultrasound, measures the thickness of the lining of the main artery in the neck and thus any buildup of atherosclerotic plaques there.

Pittsburgh researchers recently examined 133 people, ages 70 to 93, none of whom had any signs of cardiovascular disease as measured by differing leg and arm blood pressures or carotid artery ultrasound. The team found a wide range of coronary calcium scores, Sutton-Tyrrell reported at the American Heart Association meeting.

Twenty-five percent of these patients showed coronary calcium scores that the researchers considered elevated. “The only way [early] heart disease was detectable in this population was with EBCT,” she says.

Because of results like these, Wilson says, “many of us are leaning in the direction of saying that people will eventually know their calcium scores the way you know blood pressure or cholesterol levels.” □