What Does My Heart Scan Show?

Everything you need to know about your heart scan!

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The people, incidents, and dialogue discussed in this book are borrowed from the author's collective experience, but do not represent actual people or events. Any resemblance to actual persons, living or dead, is entirely coincidental.

Table of Contents

Introduction

I Just Got My Heart Scan Score. Now What?!

Nick's heart scan changed his life.

Before the scan, Nick viewed himself as a healthy, athletic, and successful 49-year-old. He weighed no more than 10 pounds over his high school wrestling weight, he jogged and played tennis regularly, and just plain felt great.

But the fact that his father had died of a heart attack at age 53 troubled him over the years. How could his dad—slender and active, just like Nick—have died unexpectedly? Nick had spent an entire Sunday with him two days before his death, and his dad had been every bit the vigorous man he'd always been, without a hint of any pain or discomfort. He hadn't smoked, and he exercised and even laughed and joked up until the day of his untimely death. Was Nick doomed to repeat his father's fate?

Nick had voiced this concern to his family doctor, who reassured him that his total cholesterol of 154 virtually guaranteed a lifetime of safety from heart attack. But these words eerily echoed the advice delivered to Nick's dad

shortly before his fatal heart attack. To help settle his mind, Nick's physician had him undergo a stress test, a stress thallium, that proved entirely normal. In fact, according to the cardiologist performing the stress test, Nick reached a level ordinarily reserved for competitive athletes.

A nagging suspicion that all was not right led Nick to get a heart scan. The test itself proved no challenge whatsoever. After the obligatory paperwork, the technician applied three EKG leads to his chest, he lay down in the CT scanning device, and 30 seconds later the technician helped Nick off the imaging table and into a seat beside her to review the scan images.

The initial images left Nick stunned. Within the first few "slices" the radiation technologist reviewed, it became clear that an extensive quantity of plaque was hidden within Nick's coronary arteries. He left the scan center following the technologist's reassurance that the official reading by one of the center's cardiologists would follow.

Two days later, Nick received the official report: his heart scan "score" was 1132, a very high score that placed him in the 99th percentile. This meant that his score was in the worst 1 percent of men in his age group.

So it was that Nick's heart scan shattered his view of himself as a healthy, problem-free 49-year-old. Nick felt as if his future were a void loaded with danger. Numerous questions raced through Nick's mind: *Now what? Does this mean I'm about to drop over from a heart attack? Don't I need medication? What about my cholesterol? Shouldn't I get a stent or bypass surgery?*

What Does My Heart Scan Show? is a guidebook for anyone who has undergone a heart scan, or is contemplating having one, but desires more information about what this valuable test means to their health. Like Nick, you will have numerous questions regarding your heart scan score. Understanding your heart scan score could mean the difference between a heart attack in the future or a lifetime free of heart disease.* It could mean obtaining heart procedures that could be life-saving, or it could mean avoiding procedures that could be unnecessary. All that in just one little number!

The Most Important Health Test You Can Get!

Mora had a heart scan at age 47, when she finally acknowledged that her mother's life had many parallels to her own. She especially feared that she was fated to repeat her mom's run-in with heart attack at age 50. Mora's heart scan score: 52, in the 90th percentile for females in the 45-50-year age group (i.e., in the worst 10 percent of women in her age group). Unfortunately, Mora's doctor was unfamiliar with the significance of heart scan scores and advised her that, since she had no symptoms and her

* In this book the phrase "heart disease" will, for simplicity, mean *coronary* heart disease, and does not include valvular heart disease, conditions of heart muscle (cardiomyopathies), pericardial diseases, and other systemic disorders that affect the heart.

cholesterol was only borderline high, she should simply remain alert for the appearance of chest pain over the years. Perhaps he'd consider a stress test somewhere along the way.

Too often, people undergo a heart scan, get a score, and then are left in the dark about its significance. As a result, the score is ignored or forgotten, and the information is never put to good use. That's a terrible shame, because this simple number can be the most important piece of health information you may ever receive.

Your heart scan score contains a world of information. Your score is a measure of the quantity of atherosclerotic plaque lining the arteries of your heart. It can be compared to other people your sex and age and thereby provide a gauge of heart attack risk. Your score is the *sum total of coronary risk factors* like cholesterol and high blood pressure all through your life up until the moment of the scan. Your score can be used to track growth or shrinkage of plaque if you get another scan a year or more after the first. All this is accomplished with ease, safety, and a relatively low cost. No other test can even come close to the power of heart scans to yield health-empowering information!

The sort of advice Mora received is, unfortunately, all too common. What's wrong with wait-

ing for some tell-tale sign of heart disease? First of all, the American Heart Association tabulates extensive data on heart disease in the U.S., and it is quite clear that the first symptom in 50 percent of heart attacks is also the last (i.e., sudden death). Waiting for symptoms is like waiting for the smell of smoke to prevent fire in your home—if you smell smoke, it's already too late. Secondly, stress testing for asymptomatic people, especially women, is notoriously unreliable, with the vast majority of future heart attacks occurring in people with *normal* stress tests. (This is in contrast to people *with symptoms* like chest pain, pressure, or breathlessness, where stress testing *can* be useful.) Thirdly, this "watch and wait" approach in someone like Mora *guarantees* that coronary plaque will grow, usually at the rate of 30-35 percent *per year,* since no effort was made to identify the causes of hidden coronary plaque nor any treatment initiated. *Mora will suffer a heart attack* (or die or develop unstable symptoms of heart disease) *almost certainly by age 55*. The opportunity to prevent this dire event was lost with her doctor's dismissal of her heart scan score. Don't let this happen to you.

When it comes to cardiovascular disease, myths that promote complacency promote disease.
Heart Disease and Stroke Statistics
American Heart Association

Given the fact that nearly 40 percent of us will die of a heart attack, and that cardiovascular disease claims more lives each year than the next five leading causes of death *combined*—cancer, chronic respiratory diseases, accidents, diabetes, and influenza and pneumonia—your heart scan is *never* a wasted effort.

This Is Your Guide to Understanding Your Heart Scan Score.

What Does My Heart Scan Show? is your guide to understanding precisely what your score means. It should answer all your questions about heart attack risk. More importantly, this book should galvanize your resolve to begin a prevention program that aims to *eliminate the risk of heart attack in your lifetime*. In other words, if your heart scan can predict for you, with confidence, your risk for heart attack and even tell *when* it might occur, you should work hard to alter the future.

You and your doctor can indeed accomplish this, given proper guidance and commitment.

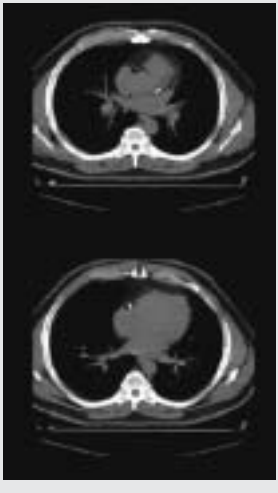
Millions of people have now undergone heart scans across the U.S., yet too few have been given the advantage of a full understanding of this important number. ***What Does My Heart Scan Show?*** will fill this information gap for you.

Chapter 1

What Exactly Is a Heart Scan?

Greg, a 51-year-old pharmaceutical representative, prided himself on his healthy lifestyle. At 5 feet 8 inches tall, he weighed a slender 147 pounds, not much more than he'd weighed as a champion high school wrestler. He felt great and tackled his work and home life with enthusiasm and energy. He was also proud of his cholesterol numbers, held in check for the past 10 years since he'd worked in the pharmaceutical industry and paid closer attention to his health. His most recent panel: HDL 55 mg/dl, LDL 94 mg/dl, triglycerides 123, all excellent according to his family physician. Greg's mom and dad lived into their early 80s without an encounter with heart disease, and Greg was confident that he was free of risk.

Unexpectedly, Greg's older sister informed him that she'd developed unstable chest pain symptoms recently,



Two sample images from Greg's heart scan showing extensive plaque.

requiring hospitalization. She'd undergone a heart catheterization and received two coronary stents, narrowly averting an open heart procedure. This unsettled Greg's complacency, and he now became concerned about his own health. A heart scan subsequently revealed a score of 1387, in the 99th percentile for men his age. This score suggested that, far from being low, Greg's risk was, in fact, an alarming 25 percent per year for heart attack and death.

A sample "slice" from the 30–40 total images from a heart scan (generated by an EBT scanner). You're viewing a cross-section of the chest from the feet, looking up. The subject is lying on his back with his right side to your left, his left side to your right. The spine is the dense white area toward the bottom of the image. The various heart structures are located toward the center of the chest. The coronary calcium is circled in white. This is "scored" (using area and density criteria, or volume criteria) and the score of each image is added to those of all other images to yield a *total* calcium score.

Can cholesterol tell you whether you have hidden coronary plaque?

No. Cholesterol does *not* tell you whether or not coronary plaque is present. It's just a blood fat that is one of *many* causes of coronary plaque, and provides an indirect statistical measure of the *likelihood* of heart disease. Can you have a heart attack with low cholesterol? Absolutely. Can you have high cholesterol yet survive to age 95 with 18 great-grandchildren and never have a stitch of heart disease? No doubt about it.

Does an EKG show hidden coronary plaque?

No. EKGs are just simple electrical measures that may show heart attack while it's in progress or much after the fact.

How about stress tests? Don't they detect hidden coronary plaque?

No, again. Stress tests are a measure of *blood flow* to the heart, abnormal only when flow is substantially reduced. Blockages that occupy 80-90 percent of the diameter of arteries, for instance, would be sufficient to be detectable on a stress test. The problem is that 90 percent of people with hidden (asymptomatic) coronary plaque will have entirely *normal* stress tests—yet are still at risk

for heart attack. In fact, most of the people fated to suffer a heart attack in the next year have normal stress tests.

So how can you detect and measure hidden coronary plaque?

Remember that we'd like to measure it easily, inexpensively, and safely. We don't want invasive procedures that involve scalpels and catheters. We need a test that precisely detects hidden plaque without pain, with virtually no risk, that nearly anybody can get.

That's precisely what a heart scan can do. And it does it better, faster, and easier than any other test available.

We now know that 95 to 99 percent of heart disease occurs at sites WITHOUT artery narrowing. Thus, the old tests we perform to detect narrowing and blockages have really misled us. ***We miss over 95 percent of the heart disease that causes heart attacks****.*

Dr. Steve Nissen
The Cleveland Clinic

What Exactly Is a Heart Scan?

If you've undergone a heart scan, you already know that it's among the easiest and fastest health tests available: hold your breath for 30 seconds

and you're done. It's about as simple as any test can get. No poking, prodding, or pushing, no IVs, no pre-medication, no preparation. Most people are surprised by how easy it is. The most common comment after the scan is finished is, "Is that it?" With this small effort, you'll be provided with the most powerful piece of information you can get about your heart's future.

A heart scan is really 30-40 cross-sectional images (varying depending on your height) of the heart from top to bottom, all obtained in the few seconds you hold your breath. (Holding your breath eliminates motion of the heart due to expansion of the adjacent lungs.) Within each of the 30 or so images, a "slice" of your three coronary arteries can easily be seen. Because each slice overlaps with those above and below it, the scan provides, in effect, a three-dimensional survey of the chest contents.

Each scan is reviewed and a computer applies specific criteria to help decide whether a selected area within your coronary arteries is truly coronary plaque. We then multiply the *area* (in square millimeters) by the *density* of the plaque, and this yields a "score" for this specific plaque. We score all the plaques in every image slice and add all the scores up. This yields a *total* score, the

one reported to you. You will sometimes hear the total score called an "Agatston" score, named after Dr. Arthur Agatston from the University of Miami, who first developed this method of scoring. The Agatston score is now one of the standard calculations performed on all heart scans. (This is the same Dr. Arthur Agatston, by the way, who authored the hugely successful *South Beach Diet*.)

Some scan centers will also calculate a "volumetric" score, which is simply a three-dimensional measure of plaque volume. Though the number provided for your volumetric score is similar to the conventional score, the numbers can differ somewhat. Many investigators believe that the volumetric score is slightly more accurate, and it may be the preferred number to track if you have two or more scans over a several year period. Nonetheless, the standard "Agatston" heart scan score remains the most commonly used measure.

Who Should Have a Heart Scan?

If you haven't yet undergone a heart scan, how do you decide whether you should get one in the first place? Are there specific criteria you can apply?

Many authorities recommend that men over age 40 and women between ages 45 and 50 be scanned. This is based on the simple observation, in tens of thousands of people, that substantial numbers of men start showing hidden plaque (scores greater than zero) at age 40 and older and women between 45 and 50. Prior to these ages, scores above zero for either sex are unusual. Women are advised to get scans later than men because their development of plaque lags behind men's by approximately 10 years.

Beyond age, there are no useful criteria to decide who should and who shouldn't be scanned. We could, for instance, use LDL cholesterol to decide whom to scan. If we chose anyone with LDL cholesterol greater than 130 mg/dl, we would miss half the people with heart disease. (In other words, approximately 50 percent of people with measurable coronary plaque have LDL cholesterols less than 130 mg/dl.) Likewise, if *low* HDL (less than 40) were our cut-off, we would again miss about half the people with heart disease. Similar failures occur for any other screening parameter you can devise.

Consider this: Can we screen you for the presence of heart disease by screening you with another test first? You may begin to see the absurdity of this approach. A study by Drs. Arad and Guerci at the St. Francis Medical Center in New York, for instance, showed that 67 percent of people classified by the widely-used Framingham risk scoring system (using cholesterol, blood pressure, smoking history, and sex) were mis-classified. People labeled low-risk were actually high-risk; people labeled high-risk were actually low-risk. Another study by Dr. Stephan Achenbach of the Massachusetts General Hospital showed a very poor 28 percent correlation between risk factor scoring systems, like the Framingham system, and heart scan scores. Most concerning is the fact that significant numbers of people classified as low-risk by the Framingham scoring system had extensive coronary plaque.

Cholesterol values and conventional risk factors cannot be reliably used to decide whether or not to have a scan. We therefore rely on age as a guide.

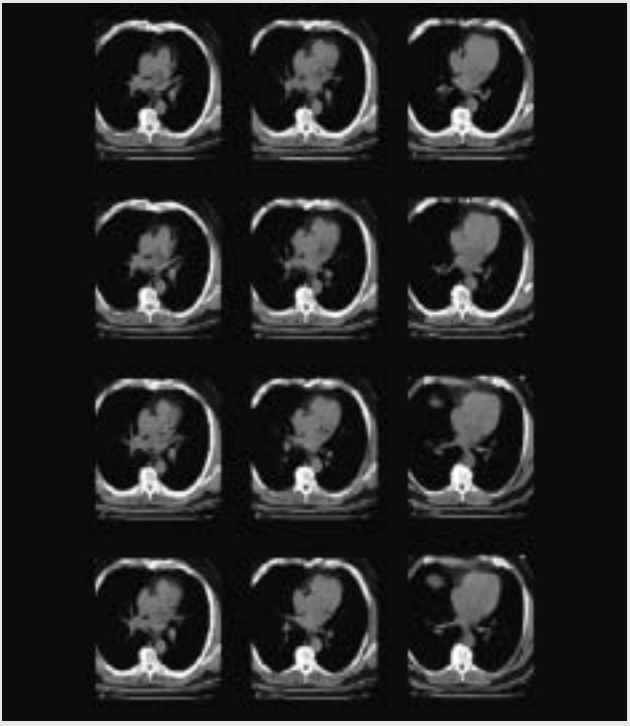
If there is some high-risk measure in your life—parent with heart attack before age 55, diabetes, cholesterol greater than 300, smoking—then you might consider having your scan five years earlier (age 35 for men and 40 for women).

What's the best heart scan score? Zero, or no detectable plaque in any of your scan images. What's terrible? Just like playing golf, the higher your score, the worse it is. But just like asking, "What's a terrible golf score?" the answer for what constitutes a terrible heart scan score is, "It depends!" Certainly, the higher your score, the more plaque you have in your coronary arteries, and the greater your heart attack risk. Scores of 1000 or greater (that's a lot of plaque!) carry a risk for heart attack of *25 percent per year* (if no preventive therapies are initiated), as it did unexpectedly for Greg, whom we discussed earlier. Scores between 0 and 1000 are much more common and carry various degrees of risk in-between. We'll discuss this further.

Why Is It Called a "Calcium Score"?

What precisely is measured on your heart scan?

Children's arteries are flexible, thin-walled tubes, free of plaque, with lining tissue that measures a millimeter or so in thickness. The years take their toll, particularly if there are genetic reasons or noxious factors like smoking, high cholesterol, high-fat meals, high blood sugar, etc.



Sample images from a complete heart scan performed on an EBT scanner. Although only 12 of the total 35 images are shown, you can get an idea that multiple thin “slices” are made through the chest from just below chin level to the bottom of your breastbone. The amount of calcified plaque is then “scored” on each slice and summed to yield a total heart scan score.

The lining tissue of arteries is delicate and easily injured, and reflects that injury by thickening. Within the thickened lining, fibrous structural material, calcium (like that in bone), and inflammatory cells also accumulate. The gruel-like material that results is called "atherosclerotic plaque." (*Athero* is derived from the Greek word for "gruel"; *Sclerosis* means "hardening.")

Many plaque components can't be easily measured in a living human being, such as inflammatory cells or structural tissue. Remember, we're trying to accurately measure plaque without scalpels, catheters, or other invasive methods. Calcium often collects as tiny pebbles and arcs within plaque and can be measured accurately and easily. Interestingly, microscopic studies of atherosclerotic plaque have shown that calcium consistently *occupies 20 percent of the total volume of plaque*. This proportion remains true for women, men, young, old, and whether or not you've already had a heart attack. In other words, *calcium provides an indirect though accurate means to measure total plaque volume*. If we were to measure two cubic millimeters of plaque, for instance, then we would have a total of 10 cubic millimeters (2 x 5) of total plaque.

The Agatston score and the volumetric scores are two slightly different methods to measure coronary plaque, both using calcium as the measured parameter to gauge total plaque.

The rule of coronary calcium scoring is easy: the higher your score, the more plaque lines your coronary arteries. How your score can be used to predict your risk of heart attack and other trouble is the focus of the discussion in Chapter 2.

Is It “Hard” or “Soft” Plaque?

A common misconception is that, since calcium is a hard substance, the coronary calcium score obtained on your heart scan provides a measure of only hard plaque. Not true. Calcium measured is a reflection of *total* plaque, both soft and hard.

Actually, the great majority of people with coronary plaque have a *mixture* of hard and soft plaque, and this can change even day to day, week to week, since plaque is a dynamic, living tissue. In other words, a soft plaque today can develop hard elements tomorrow, and a hard plaque today can evolve to develop soft parts at any time in the future. Most plaques, in truth, are both. That’s why your heart scan score is such a great measure of hidden, *total*, plaque.

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Chapter 2

The Heart Scan Score: A Glimpse into Your Heart's Future

Wouldn't you like to see your future?

You could find out whether heart attack was on the horizon, or whether you'll never have to be concerned with heart attack, stents, or bypass surgery. If you knew that you were fated to suffer a heart attack at, say, age 53, you'd then know that an intensive program of prevention would be necessary to keep this from coming true. On the other hand, if you knew you'd be spared from heart disease in your lifetime, you could dispense with all the fuss about cholesterol and devote your time and energy to other pursuits.

Of course, we can't really see your future in a crystal ball. But the heart scan score is the clos-

est thing we have to foresee your heart's future—better than EKGs, better than cholesterol, better than stress tests, better than relying on how you feel.

If your heart scan score is zero, your risk for heart attack is very low, or nearly zero. (Nobody's risk for heart attack is truly zero; there's always some, even miniscule, risk, even if you're a strapping, healthy 25-year-old.)

If your heart scan score is high, perhaps in the 90th percentile, then your risk for heart attack is significant. The energy you invest now in your prevention program will be well worth it. Not as good as a crystal ball, but darn close.

Aren't Severe Blockages Required to Have a Heart Attack?

A shocking revelation shook the cardiology world in the early 1990s. Up until then, cardiologists believed that coronary plaque grew gradually, got worse and worse until finally one day it became a 90 to 99 percent blockage that cut off blood flow to the heart muscle, yielding symptoms like chest pain. Just a bit more plaque growth and the artery would close and cause heart attack. Numerous studies (based on heart

catheterizations) have now flatly disproven this commonsense theory.

In fact, it is the many "minor" plaques in coronary arteries that can, overnight, cause heart attack. Blockages might be only 10, 20, 30, or 40 percent, but "erupt" because of internal plaque activity, eroding the thin covering separating plaque contents from flowing blood. When internal plaque contents succeed in eroding to the surface (a common phenomenon), a powerful trigger for blood clot formation ensues. A blood clot forms and expands, closing off your coronary artery and resulting in heart attack. In other words, we should try to detect "minor" plaque in a person free of symptoms to anticipate the potential for future heart attack. Although it might be 10 years in the future, the potential is there. Unfortunately, old habits die hard, and many physicians still focus only on trying to detect severe blockages and ignore "minor," though still potentially heart attack-causing, plaque.

Learn from Bill Clinton's Experience.

Former President Bill Clinton underwent stress (thallium) tests every year for five years. After completing his fifth test, he strode out and declared to the press corps, "I aced it!" Indeed, Mr. Clinton continued his jogging and his cholesterol was reported to be excellent at 179 mg/dl.

Shortly afterwards, in September 2004, Mr. Clinton developed chest pains and breathlessness. He was promptly admitted to New York-Presbyterian Hospital. Extensive blockages of all three coronary arteries (greater than 90 percent) were diagnosed through heart catheterization, and Mr. Clinton underwent a quadruple coronary bypass operation.

USA Today reported that "Dr. Allan Schwartz, chief of cardiology at the hospital, said that given the extent of Clinton's blockage there was a 'substantial likelihood that he would have suffered a substantial heart attack in the near future.' Doctors stopped Clinton's heart for 73 minutes and put him on a heart/lung machine, a common practice in bypass surgery. [Surgeon Craig] Smith said that it was 'obvious relatively quickly that what he needed was an operation.'" After the procedure, the doctors boasted of their success, calling the procedure lifesaving. Media reports glowed with descriptions of the high-tech hospital care Mr. Clinton received. Senator Hilary Rodham Clinton publicly expressed her and her daughter, Chelsea's, gratitude for the quality care the former President received in the hospital.

You Mean He Developed Heart Disease Overnight?

Now wait a minute!

Before congratulating our medical system, several questions need to be answered. If coronary disease takes years to develop, why wasn't it recognized earlier, before it threatened his life? How could stress test after stress test be normal when extensive coronary disease was present? How could doctors be satisfied with cholesterol values that permit life-threatening disease to develop? The answers to these questions are already available to us lesser mortals than Mr. Clinton. Had he and his doctors been better informed, *it is highly likely that his procedure would not have been necessary.*

What *Should* Have Happened

Had Mr. Clinton's doctors simply advised him, say, in 1996 on assuming the presidency for his second term, to take a 30-second heart scan, they would have been shocked to learn that his score was very high, probably over 400, signifying extensive hidden coronary plaque. Once Mr. Clinton's high score was identified, a search for the causes should have ensued, followed by correction.
With five minutes of Mr. Clinton's time, a powerful prevention program could have been devised. This kind of information would likely have *eliminated* Mr. Clinton's need for bypass surgery.

Stress tests are commonly performed to detect hidden coronary plaque. Unfortunately, stress tests ***do not detect*** hidden coronary plaque. This is precisely why you might have a normal stress test on Tuesday but suffer a heart attack on Friday. Stress tests are tests of blood flow, not of coronary plaque. Even if you have extensive coronary plaque but blood flow is maintained—an exceptionally common situation—a stress test will be normal. You'll walk around with loads of plaque just waiting for a trigger to rupture, but you'll be unaware of it if you and your doctor relied on stress testing to detect it.

Then why do cardiologists and surgeons stent and bypass only severe blockages? The people who end up with major heart procedures have, in general, come to attention because they've developed symptoms of chest pressure or breathlessness that lead to stress testing, then heart catheterization. These people are suffering symptoms from poor flow through their coronary arteries and to the heart muscle from a plaque that ruptured. Restoring blood flow through stents or bypass surgery is an effective means to improve blood flow. The plaque that ruptured may have been only a 40 percent blockage the day before. When a plaque has already ruptured, it is indeed a reasonable approach to bypass or stent the blocked artery. However, don't be misled into believing that only severe blockages pose risk.

How Much Blockage Do I Have?

Although we're interested in much more than the question of severe blockages, many people still ask this question. This information can also be helpful in deciding whether further testing, especially stress testing, might be necessary.

The higher your heart scan score, the more likely a severe blockage is present. Here's how it breaks down:

If your score is:	Amount of plaque present
0	None—severe blockage highly unlikely
1-10	Minimal plaque; severe blockage highly unlikely
11-100	Mild quantity of plaque; very low likelihood of severe blockage
101-400	Moderate quantity of plaque; 11-25 percent likelihood of severe blockage
> 400	Extensive/severe plaque with > 50 percent likelihood of severe blockage

Find your score in one of the listed ranges, then find the description of the amount of plaque present. At a score of 200, for example, there is an 11-25 percent chance that a severe blockage is present. (A specific calcium score cannot, however, be equated to a specific percent blockage, as plaque accumulates in various patterns along the lengths of arteries, and does not necessarily all accumulate in one place and thereby create a single severe blockage. The calcium score can be associated only with the *statistical likelihood* of a severe blockage.) Severe blockages can usually be detected by stress tests, since they are likely to block blood flow with exercise.

Remember that *any* amount of plaque, even in the absence of severe blockage, can result in heart attack because of plaque "rupture." The more plaque you have, the greater the likelihood of plaque rupture leading to heart attack.

Your Coronary Calcium Score Predicts Your Individual Risk of Heart Attack.

Study after study has shown that the higher your heart scan score, the greater your risk for heart attack. This is because the more plaque that lines the length of your coronary arteries, the more opportunity there is to rupture and cause heart attack, even if the plaque is only a 20 percent blockage. This remains true even if you feel great, if your cholesterol is low, you're a long-distance jogger, etc. The score is, by far, the most powerful means of predicting your heart's future available. Of course, this does not mean that you can't change your future. In fact, that's exactly what knowledge of your heart scan should prompt you to do. If you find out that you have a high score, the next step is to begin or further improve your prevention program. Your goal: to lower your risk for heart attack to as close to zero as possible. (See Chapter 4.)

Unlike cholesterol, your score represents the *sum total* of factors contributing to coronary plaque growth up until the day of your scan. Let's say, for instance, that you spent the years between ages 30 and 40 overweight, sedentary, smoking, and indulging in unhealthy eating habits. A cho-

lesterol panel during those 12 years may have reflected your unhealthy lifestyle. But, at age 41, you lose 60 pounds, begin an exercise program, follow a healthy diet, and stop smoking. A cholesterol panel after you've achieved all this would be much improved—*even if you had extensive plaque in your coronary arteries*. A heart scan at this point, however, would likely reveal a high score, as it reflects the sum total of influences in your life. Your score would not falsely reassure you, as a cholesterol panel would have.

The Percentile Rank—the Best Heart Attack Predictor of All

To some degree, the quantity of plaque contained in your coronary arteries is a product of "wear and tear," the day in, day out stress your arteries endure. Over age 65, for instance, only around 25 percent of people will have heart scan scores of zero. Therefore, not all scores above zero signify substantial risk for heart attack. For this reason, another measure many scan centers report is called the "percentile rank," a measure of how your score compares to other people in your age

group and sex. This serves to minimize the confounding effect of wear and tear that may not impact on heart attack risk.

In most centers, your total calcium score is compared with a database of 35,000 other people who've also been scanned, based on the enormous experience provided by Dr. George Kondos at the University of Illinois-Chicago. Dr. Kondos's database allows us to compare your score with thousands of people your age and sex. We report this as your "percentile rank." The percentile rank is the best predictor of heart attack risk, even better than your score alone.

For example, a 50-year-old female with a score of 63 falls into a percentile rank of 90 percent. This means that 90 percent of all women her age had lower scores; 10 percent of women her age had higher scores. Although a score of 63 is not all that high, in a 50-year-old female it strongly predicts significant heart attack risk and demands preventive attention. The 90th percentile also tells us that this woman's risk for heart attack is 4.5 percent per year. (See box entitled "What's my risk of heart attack?")

"What's My Risk of Heart Attack?"

Percentile Rank and Annual Risk for Heart Attack

Heart scans are generally reported as both a score and a percentile rank. But it's the percentile rank that's the best predictor of future risk of heart attack.

Percentile Rank	Annual Heart Attack Risk (% per year)
< 25%	< 1%
25-50%	1-2%
50-75%	2-3%
75-90%	3-4%
> 90%	> 4.5%

Multiply the annual rate of risk by 10 to approximate your 10-year risk. For example, if you are in the 50-75th percentile group, your one-year risk of heart attack is only 2-3 percent, but over a 10-year period it's approximately 20-30 percent. This is the risk if nothing is done to address the causes of your plaque. Hopefully, you will not allow this to happen and will, instead, follow a program of prevention to lower your risk.

For added perspective on percentile rank, let's compare the same score in several different people. For a 48-year-old man, a heart scan score of 100 represents a moderate amount of plaque. This score falls in the 75-90th percentile and reflects moderately aggressive plaque growth and moderate risk for heart attack. The identical score of 100 in a 65-year-old man represents the exact same amount of plaque. But this second man's plaque is not as active since it took 65 years to accumulate, rather than 48. This score falls in the 25-50th percentile for men in this age group and poses only a *small* risk for heart attack. The same score of 100 in a 48-year-old woman represents the same amount of plaque but places her score in the 99th percentile, reflecting aggressive plaque growth and *high* risk for heart attack. The significance of your heart scan score therefore depends to a great degree on age and sex, and the best way to judge this is to look at percentile rank. Most scan centers will report percentile rank along with your score. If not, see the table at the end of this chapter to obtain your percentile rank.

Heart Scan Score "Red Flags"

Some heart scan scores should be regarded as "red flags" for potential danger in the near future.

Any score in the 90th percentile or greater would qualify as a red flag, since it carries a heart attack risk of at least 5 percent per year. Here are some general guidelines for identifying scores qualifying as red flags:

- If you are younger than 55 years old, a score greater than 100
- If you are 55 years old or older, a score greater than 200
- Score greater than 1000—This is the most dangerous of all, carrying a heart attack risk of 25 percent per year.

These are scores that could present some risk even in the next few months. Prompt action on your part is warranted. Discuss your score with your physician so that you can talk about intensified prevention, the need for stress testing, and additional testing, if necessary.

Risk for heart attack begins to be a matter to take seriously with scores in the 50th percentile and higher. Scores in the 50th percentile carry a heart attack risk of 1-2 percent per year (roughly 10-20 percent over 10 years) and therefore justify a more intensive approach to prevention to lower your risk. Scores in the 75th percentile, which carry a heart attack risk of 3 percent per year (roughly 30 percent over 10 years) are even higher risk and clearly warrant intensification of your prevention program. (See Chapter 4.) The higher your percentile rank, the higher your risk for plaque rupture and heart attack, and the more important your preventive efforts to reduce heart attack risk become.

Percentile Rank and Calcium Scores

	Age (years)								
	< 40	**40–44**	**45–49**	**50–54**	**55–59**	**60–64**	**65–69**	**70–74**	**>74**
MEN									
25th percentile	0	0	0	1	4	13	32	64	166
50th percentile	1	1	3	15	48	113	180	310	473
75th percentile	3	9	36	103	215	410	566	892	1071
90th percentile	14	59	154	332	554	994	1299	1774	1982
WOMEN									
25th percentile	0	0	0	0	0	0	1	3	9
50th percentile	0	0	0	0	1	3	24	52	75
75th percentile	1	1	2	5	23	57	145	210	241
90th percentile	3	4	22	55	121	193	410	631	709

Adapted from Hoff and Kondos, Am J Cardiol 2001;87:1335–1339

To determine your percentile rank, find your heart scan score range in the above table and find the corresponding percentile rank at the left. For example, if you are a 61-year-old woman with a score of 88, you are in the 75th to 90th percentile.

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What a heart scan meant to…Martin.

At age 57, Martin felt he had it made. He heaved a huge sigh of relief as the financial service company he'd started in his mid-30s and built into a multi-million-dollar business was about to be finally passed on to its new owners.

Over 20 years, Martin had worked 12- (or more) hour days, six or seven days a week. He and his wife, Betty, felt that it was time to take a well-deserved retirement. The plan to sell the business and pass leadership onto another executive team required a full 18 months of toil to bring the successors up to speed. But it was finally done.

As part of their celebration, and before departing for a month-long vacation in the South, Martin's wife had scheduled Martin for a full check-up with his doctor to be certain he was in good health. Everything checked out, including Martin's cholesterol numbers—LDL cholesterol 119 mg/dl, HDL 43 mg/dl, triglycerides 208 mg/dl. He had a normal blood pressure and even passed a stress test. But when the doctor heard that Martin's mother and father had both developed heart disease in their early sixties, he suggested a heart scan.

Martin's heart scan score: 789, a score higher than 99 percent of all other men in his age

group. When Martin heard this, tears came to his eyes. “Twenty years of hard work and now this?”

“Whoooooaaa! Hold on, Martin, don’t panic,” the doctor said. “You have no symptoms, you passed a stress test. Your high score doesn’t mean you need heart procedures, and it doesn’t mean you’re going to drop dead tomorrow. It means that we’ve got to take your prevention program very seriously so that a heart attack doesn’t develop. In fact, I think you should make it your goal to not repeat the history of your mom and dad, and never have a heart attack or require a major heart procedure.”

Martin and Betty postponed their month vacation for a few weeks in order to get started on some of the prevention practices advised by his doctor. But Martin left for the South a confident man, feeling great and a lot smarter about his heart disease risk.

Chapter 3

Why Heart Scans Are *Better* Than Cholesterol

Patti is a health-conscious 43-year-old mother of three school-aged children. Although the kids' school and sports activities keep her on the go, she manages to squeeze aerobics and jogging into her schedule four times a week. At 125 pounds, she is proud to be among the thinnest of the other moms of her children's friends. On the one occasion her cholesterol was checked, her doctor advised her that the numbers were spectacular: HDL cholesterol 86 mg/dl, LDL 77 mg/dl.

Despite the appearance of perfect health, her husband, Eric, just two years older than Patti, suffered a mini-stroke at age 45, which prompted an evaluation of his heart. Extensive coronary disease was identified in Eric and he underwent triple bypass surgery successfully. Patti witnessed the emotional and physical roller coaster her husband endured and couldn't help but wonder whether such a fate was in her future, as well. After several months,

when Eric was finally starting to feel and look his usual self, Patti decided to settle her mind and get a heart scan. Her score: 125, in the 90th percentile. When she related this finding to her family physician, he was dumbfounded and unable to account for why she had this degree of coronary plaque, given her excellent cholesterol levels.

A great cholesterol value is no guarantee of being spared from heart disease, not even close. How can this be? Isn't high cholesterol the number one cause of heart disease in America?

Contrary to popular opinion, high cholesterol is *not* the most common cause of heart disease. There are many other causes for heart disease—cholesterol is just one item on the list.

The numbers provided by a cholesterol panel are also not etched in stone, but are likely to change over time. Anyone who has had his cholesterol checked more than once quickly recognizes the variable nature of this test. Differences of 50 or more points within just a few weeks are not uncommon, even if you've not made any changes in your lifestyle. It's therefore hard, if not impossible, to decide from a single cholesterol panel whether or not you have hidden heart disease.

Conversely, *high* cholesterol values do not necessarily ensure a future of heart disease:

Barbara, a 50-year-old marketing manager, had struggled with her weight ever since the delivery of her third child at age 36, and now tipped the scales at 189 pounds at all of 5 feet 2 inches tall. Her doctor had warned her repeatedly about the need to lose weight, particularly to control her early diabetes, as well as to reduce LDL cholesterol, most recently 198 mg/dl, and raise HDL, low at 40 mg/dl. In an effort to twist Barbara's arm, her doctor advised her to undergo a heart scan. He reasoned that clear-cut evidence of coronary plaque would finally persuade Barbara to commit to lifestyle changes. Lo and behold, Barbara's score: zero—no detectable plaque whatsoever, despite her apparent high-risk features.

The heart scan can swing both ways. It can show you hidden coronary plaque when risk factors suggest you should not have any, or it can reveal no coronary plaque when risk factors suggest that it should be present.

Why the discrepancy? First of all, risk factors are just that: measures of *risk*, not of the disease itself. In the same way, driving too fast on the freeway is a risk factor for an auto accident, but it is not the same as an accident. Otherwise, most of us would have accidents every day!

Coronary plaque, such as that measured during a heart scan, is *an actual measure of the disease itself*, i.e., coronary disease. Just as you can have car accidents while driving too fast or driv-

ing slowly, you can have coronary plaque regardless of whether cholesterol is high or low. The presence of coronary plaque and cholesterol correspond statistically, but often do not agree in a specific individual.

...plaque imaging is...not to be confused with risk factors, which merely estimate a probability of developing atherosclerosis. Rather, [plaque imaging] directly measures atherosclerosis, irrespective of the presence or absence of risk factors; it provides the final common denominator and is ***the most powerful predictor of cardiac events****.*

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Another confounding aspect to risk factors like LDL cholesterol is that they are just snapshots at a specific point in time. For instance, what if you spent the first 40 years of your life overweight, eating badly, and smoking? You turn a corner in your early 40s, lose 30 pounds, eat healthy foods, exercise, and lower your cholesterol. Although the unhealthy period of your life

caused a lot of plaque to appear and grow, cholesterol values obtained after your transformation would not reflect this. This is a dramatic example but less dramatic situations occur everyday.

Conversely, a heart scan would show coronary plaque because it reflects the *sum total* of causes, cholesterol and others, that make plaque appear and grow. Your heart scan score is much more than a simple snapshot in time subject to day-to-day change. It reflects the sum total of effects over your entire life up until the day of your scan. This information is far more powerful and accurate than fluctuating cholesterol values.

Then What Exactly *Is* Cholesterol?

What *does* cholesterol tell you? Cholesterol is a fatty substance carried by various proteins in the blood that can become deposited within the thin lining of your arteries' walls, creating plaque. The originators of the concept of cholesterol measurement several decades ago acknowledged that it was an indirect and somewhat flawed index of risk for heart disease. As understanding of the diverse causes of heart disease has evolved, it has also become clear that there are many causes of heart disease that have nothing to do with choles-

terol. Among these causes are inflammation (most commonly measured as c-reactive protein, or CRP), lipoprotein(a), homocysteine, fibrinogen, and high insulin levels. These factors can occur with low cholesterol as easily as they can occur with high cholesterol.

Nonetheless, cholesterol is indeed statistically related to heart disease. Large studies like the Framingham study and MRFIT, tracking tens of thousands of apparently normal people, have conclusively shown that the higher your cholesterol, the more likely you are to have a heart attack, up to a maximum risk of three-fold higher. Both studies also showed that the great majority (80 percent) of heart attacks occurred among the group of people with average cholesterols, neither high nor low. People in the low cholesterol group were not entirely safe, either, as they also suffered heart attacks, though at a statistically lower rate than those with high cholesterol.

The difficulty with cholesterol comes when trying to apply statistical observations on large groups of people to a single individual—it all too frequently breaks down. It's especially difficult in people with average cholesterol values. Say we have a 50-year-old woman with a total cholesterol of 200, LDL cholesterol of 135. Can you predict

whether she's going to have a heart attack within the next ten years? Can you predict that she might lead a life free of heart disease? No, you cannot, yet this is the question your doctor tries to answer.

If we use cholesterol as our initial decision-making point, we will be misled all too often. You could also submit to extensive surveys of laboratory tests in the hopes of identifying some or all of the potential causes of coronary plaque. Or, you could simply and easily measure the end result of *all* risk factors combined and get a heart scan.

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What a heart scan meant to…Linda.

Linda prided herself on her high-energy personality. At age 59, she had more energy than many 30-year-olds. Since her oldest child married and moved from home, she had plenty of time to devote to healthy eating and exercise. She held down a full-time job, as well, as a marketing manager for a small architectural firm. At 5 foot 2 inches and 120 pounds, Linda was also quite proud of the fact that she weighed *half* that of many friends and coworkers.

The only dark cloud in Linda's otherwise terrific life was that her husband, Donald, was struggling with heart disease. After a bypass operation at age 54 followed by two catheterizations and three stents, Linda worried about Donald's long-term health and whether they'd be able to enjoy the retirement they'd planned in three years. Linda really gave no thought whatsoever to the idea of whether or not she had heart disease, too. After all, it was cancer that had taken her mother at age 66, and a sister had undergone a mastectomy several years earlier for early breast cancer. But it was Donald's concern for Linda and his wish that she not have to suffer the hospitalizations and procedures that he'd endured that prompted him to buy a heart scan for his wife for Mother's Day.

Linda reluctantly gave in to Donald's wish, mostly to not seem ungrateful for his concern. Her

score: 168, in the 97th percentile for women in her age group. An unusual quantity of calcified plaque was also seen in the aorta just above the heart, a finding that the interpreting cardiologist warned was a risk for future stroke. Linda was stunned. Far from being the one spared from heart disease, Linda saw that her future was going to be just like her husband's unless preventive action was taken right away.

Thankfully, Linda quickly saw the silver lining in this news: It was a reason to work together with her husband on improving their lifestyles. She obtained some insight into what Donald had been experiencing, as well, and it actually brought them closer in their relationship. Having knowledge of her risk really crystallized Linda's commitment to her prevention program and she's proven a source for tremendous support and inspiration to her husband.

Chapter 4

Does My Testing End Here? Will I Need Other Tests?

Does a heart scan provide all the answers for your heart?

As powerful as a heart scan can be, it doesn't provide all the answers to every heart question. After getting your heart scan, the need for further testing is determined by a number of factors, but mostly by how high your total score is and whether you have symptoms that could be attributable to your heart (which should be decided by your doctor). Other factors can enter into your doctor's decision, such as the appearance of your EKG (if it's abnormal, this might tip the scales in favor of further testing), if there's anything in your history to suggest a prior heart attack or other heart-re-

lated event, and other heart-related issues like blood pressure and the presence of atherosclerotic plaque in other areas of the body, like the carotids or leg arteries.

Let's discuss some of the most common questions that arise following a heart scan:

Do I Need a Stress Test?

What exactly is a stress test? A stress test is nothing more than an opportunity to observe how you and your heart react to exercise, usually on a treadmill, over a few minutes of effort. The exercise itself is really no different from what you might do on your own. After all, you could just walk on a treadmill at the gym and achieve the same amount of exertion as most medically-monitored stress tests.

Walking on a treadmill is a means of physically challenging the heart, increasing the heart muscle's need for blood flow to supply oxygen. For this reason, treadmill tests often incorporate increasing walking speed as well as incline to incrementally subject the heart to greater and greater work. If you're unable to walk due to arthritis or other limitations, the treadmill can be replaced by various pharmacologic methods of stimulating the heart muscle.

The stress portion of the test, whether by treadmill or otherwise, is often combined with one of several methods to assess the adequacy of blood flow to the heart. Thallium imaging, a method that gauges blood flow to the heart muscle, is among the most common. Echocardiography is an alternate imaging method used to observe the heart muscle's ability to meet increased work demands by observing its contraction pattern.

Stress tests are limited by the fact that, unless blood flow to the heart is markedly diminished, they will be entirely normal. If your coronary arteries are lined with, for example, dozens of 20-40 percent blockages, none of which block blood flow, your stress test will be entirely normal. You won't have chest pain with exercise, nor will you be breathless. Your EKG will be normal and the images of your heart (thallium, echo, or other) will show normal blood flow or normal heart function. Your extensive coronary plaque will not be detected and you'll likely be told (inaccurately) that your heart is fine. But you are sitting on a time bomb made of hidden plaque, just waiting for that trigger to rupture, since your unrecognized and unmeasured plaque likely will not prompt you or your doctor to take any preventive action.

It is clear that stress tests are an ineffective means to screen asymptomatic people for hidden coronary plaque. These limitations of stress tests have been repeatedly recognized by the American Heart Association. Stress tests, however, can be used effectively in other ways. They can be an especially useful method for your doctor to sort out the significance of symptoms. If you report an ache in your chest to your doctor, an EKG and a stress test can help understand whether the chest discomfort is an impending heart attack or some other cause. Other causes might include a hiatal hernia (when the upper stomach slides up and down through a hole in the diaphragm), esophagitis (inflammation of the esophagus), gallstones, and other problems, since many disorders cause similar symptoms. Symptoms that are reproduced while walking on a treadmill and that are associated with specific abnormalities on the EKG or imaging portion of the test can more confidently be blamed on heart disease.

Stress tests, in their many forms, are, therefore, tests of coronary blood flow, not of coronary plaque. Of course, if coronary plaque accumulates in such a fashion that blood flow is substantially cut back, then a stress test will show abnormalities. You can presume, then, that if your stress test

is abnormal, there's a good chance that you have extensive coronary plaque sufficient to block flow. Further tests such as heart catheterization may then be indicated; this should be decided by your doctor.

But if you have a *normal* stress test, you cannot safely assume that no coronary plaque is present. Plaque can, in fact, be extensive without cutting back on blood flow. That's precisely what heart scanning can measure. Unlike stress tests, heart scans are black or white, never murky. Either you have plaque or you don't, and when you have plaque you can be told precisely how much down to a cubic millimeter of confidence.

When Is a Stress Test Useful?

If you have symptoms of chest discomfort, breathlessness, fatigue, heartburn, etc., then a stress test is reasonable regardless of heart scan score.

However, if no symptoms are present, then your heart scan score can be used to decide whether a stress test provides any additional information. (Of course, your doctor may advise otherwise, depending on your specific situation.)

If your score is:	Likelihood of abnormal stress test
0-10	< 1%
11-100	2-3%
101-400	5-6%
401-1000	9-12%
> 1000	20-32%

This provides a good place to start thinking about the need for a stress test (thallium or equivalent). If, for instance, your calcium score is 25 and you have no symptoms of chest discomfort, breathlessness, etc., the likelihood of an abnormal stress test is only 2-3 percent. Most physicians and patients would therefore choose not to pursue this additional testing. On the other hand, scores of greater than 400 should nearly always prompt additional evaluation like stress testing. Some of

these people may require “revascularization,” or a procedure to restore flow to the involved area, such as stent placement or bypass surgery.

If some people need to have a stress test anyway, why bother with a heart scan? *Because the majority of people (greater than 90 percent) with coronary plaque will have normal stress tests*. As discussed above, *any* quantity of coronary plaque—whether or not it yields a stress test abnormality—carries risk for heart attack. Even people with a score of 400—a high score signifying advanced and extensive plaque—have only a 9-12 percent chance of detecting heart disease by stress testing. The other 88-91 percent with normal stress tests would be told their coronaries were fine, even though they’re really loaded with plaque.

The majority of people who have heart disease have no symptoms whatsoever and therefore have "silent" coronary plaque. But as heart scan scores increase, so does the likelihood that plaque is bulky and large, and that blood flow will be reduced during exercise, thereby yielding an abnormal stress test. Stress test abnormalities will be detected in a fairly predictable way judging by your heart scan scores. If your heart scan score is 200, for instance, the likelihood of a stress test abnormality is around 5-6 percent. See the chart to gauge your likelihood of an abnormal stress test based on your heart scan score. If you undergo a stress test because of a high heart scan score and the stress test proves abnormal, then your doctor will need to talk to you about further testing (e.g., heart catheterization). When blood flow is reduced to the heart muscle, the likelihood of dangerous events (heart attack, unstable heart rhythms, heart failure) increases.

Will I Need a Heart Catheterization?

If you've had your heart scan, will you need heart catheterization?

First of all, if you do not have symptoms such as chest pain/pressure, breathlessness, or other

symptoms attributable to your heart (a decision that should be made by your doctor), just having plaque detected by itself is *almost never* a reason to have a heart catheterization. In other words, you might have a relatively high score, say 500, that at age 53 puts you in the 99th percentile. But if you don't have symptoms, then proceeding directly to invasive procedures is rarely justified. *Just having plaque is an insufficient reason to proceed directly to major procedures*. It *is* a reason to consider stress testing, however, with the likelihood of abnormality by stress testing dependent on how high your score is. (See page 62.)

There are three principal reasons to have a heart catheterization:

• **Symptoms**—If you have chest pain, breathlessness, or other symptoms that your doctor feels are suspicious for heart disease, a catheterization might be considered, since the likelihood of a severe blockage (from a plaque that has ruptured) and impending heart attack are greater.

• **Abnormal stress test**—Abnormal findings on a stress test indicate poor blood flow to the heart muscle. This presents dangers that can

make physical exertion and exercise unsafe, and can raise the near-term risk of heart attack.

• **Abnormal heart muscle (left ventricular) function**—This is a very serious finding that suggests that a heart attack has occurred in the past or is about to occur.

Most people who've undergone a heart scan and have no symptoms should have a stress test prior to any conversation about the need for heart catheterization. The need for major cardiac procedures like heart catheterization, which then often lead to stents, bypass surgery, etc., in *asymptomatic* people should be based on the finding of "ischemia," or poor blood flow to one or more territories of the heart, *not* simply on the presence of plaque. This point is so important and so often misunderstood that it bears repeating: Even though your heart scan score identifies the presence of plaque, having plaque by itself is almost *never* a reason to have heart catheterization or other invasive procedures.

If you have no symptoms and your calcium score is greater than zero, before the need for invasive cardiac procedures is decided, you will need a stress test. It's as simple as that.

What about Stents and Bypass Surgery?

Similar to the decision to proceed with heart catheterization, the decision to have stents or bypass surgery should proceed logically and only when properly indicated. It is appropriate, for instance, to get to this point if you've had a stress test due to a high heart scan score, the stress test shows abnormalities suggesting poor blood flow, and a heart catheterization shows severe blockages and/or diminished heart muscle strength. Stents or bypass surgery to restore flow may be a logical solution in this situation.

But just having plaque is still insufficient reason to proceed directly to stents or bypass. The same logical sequence that leads to heart catheterization should be employed to make the decision to proceed to stents or bypass, as well.

Is there a role for "prophylactic" stents or bypass? Say you have a high heart scan score like 400, have no abnormalities by stress testing, and no symptoms. You therefore probably have many low-grade, "mild" blockages in the 20-40 percent blockage range. Should you have multiple stents or bypass grafts put in just to prevent a heart attack? Absolutely not. Procedures, even in the best hands, carry risks, and the risk of the procedure

can, in many instances, exceed the dangers of just having plaque. Procedures are also not perfect. Stents implanted into arteries provoke a tissue growth response and you could conceivably start with a minor blockage of 20 percent that ends up 40 percent six months after your stent is placed! Bypass grafts inserted into arteries with minor blockage often do not "take" because the vigorous flow in the artery can cause the graft to close (because of competing sources of flow and collapse of the graft). For these reasons, no one advocates stents or bypass surgery as a preventive procedure for "mild" blockages.

Does this mean that, if you have plaque and don't need a procedure, that you're simply out of luck and resigned to a heart attack in your future? No. In fact, this is the best situation of all (besides, of course, not having any plaque). It means that you've had your coronary plaque detected before danger is imminent, allowing you time to develop a prevention program and shut down your plaque to prevent a future heart attack. It's okay to have plaque, but you don't want *active* plaque. In the next chapter, we'll discuss how your heart scan can become the centerpiece of your heart disease prevention program.

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What a heart scan meant to…Corrine.

"Corrine, it's really time you started worrying about your own health," advised Corrine's older brother, Drew, just after his most recent hospitalization for his heart. And she knew he was right.

Corrine herself had wondered on many occasions whether heart disease was in her future, too. Her concerns were particularly acute during visits to Drew in the hospital during his numerous admissions over the years. Drew was older than Corrine by only seven years, but by age 65 had endured a bypass surgery, countless heart catheterizations, and seven stents.

Heart disease was clearly in the family, as their dad had suffered a heart attack at the age of 51, though had survived another 10 years afterwards, and his father before him shared a similar history. Corrine had read that the onset of heart disease in women tended to occur a decade later than men, but that safety cushion had already passed. Drew began his struggle with heart disease at age 46, and Corrine was now 58 years old.

After the prodding from her brother, Corrine agreed to have her heart scan. Her score: 217, in the 99th percentile compared to other women in her age group (heart attack risk 4.5 percent per year). Corrine's stress test was normal, and she suffered no symptoms during the test and hadn't had any chest pain or breathlessness on her own. Her doctor

therefore helped Corrine develop a prevention program that included daily exercise, weight loss of 18 pounds, and treatment for her somewhat high LDL cholesterol and low HDL, with the goal of keeping Corrine from repeating Drew's history.

Chapter 5

What Should I Do with My Heart Scan Score?

You've undergone a scan and you're now the proud owner of your very own heart scan score. What will happen to your score if you sit back and complacently do nothing?

The answer is simple: Your score will increase—dramatically.

Elliot is a busy, ambitious real estate broker. At 52 years old, he was in good physical shape, playing ball with his teenage kids on the weekends and singles tennis once a week, not to mention the walking he did as part of his business. Elliot's wife, Rachel, had undergone a heart scan as soon as it became available in their area, and was thrilled with her score of zero. But she was concerned about Elliot, since his mother had died of a heart attack without warning at age 63. When they first talked about it, Elliot promptly rejected the idea, refusing to believe that he could

have any hidden heart disease since he felt fine, even during exercise. But Elliot finally caved in after repeated prodding from Rachel. His score: 162, in the 75th percentile. Elliot was a little surprised at first, but lack of time and the distractions of life and work eventually caused him to forget about his scan. Anyway, when he mentioned his heart scan score to his family doctor, the doctor just shrugged. "You feel fine, don't you? Don't worry about it."

Another year passed. Elliot never gave his heart scan another thought, but Rachel did. She remained very concerned about Elliot's score and the lack of direction provided by his doctor. For his 53rd birthday, Rachel bought Elliot another scan. This time the score was 228, a 40 percent increase. This really grabbed Elliot's attention and he agreed to seek help to deal with his rapidly growing heart attack risk.

If, like Elliot, nothing is done to address the causes of your plaque, the score will increase 30 percent, 40 percent, or more per year. Once plaque gets a foothold in your coronary arteries, it can grow at a dizzying pace. Imagine if your investments grew at this pace—you'd be rich in just a few years! Of course, plaque cannot continue to grow at this rate or else you would become one large hunk of plaque. Instead, plaque grows and becomes progressively more unstable until that day when it erupts, exposing its internal contents to blood, triggering blood clot formation, and you experience a heart attack.

People who allow their plaque to grow at a rate greater than 20 percent per year may experience as much as a *20-fold higher* risk of heart attack compared to someone who keeps his score stable. By allowing his score to increase 40 percent over just a single year, Elliot exposed himself to a risk 20-fold higher than was necessary.

Let's agree that we should not allow that to happen.

Lipids—Tools for Control of Your Score

Once you've had a heart scan, you know precisely how much plaque is hidden in your coronary arteries. We also know that, if you do nothing to correct the causes—which you *shouldn't* do—then your score will increase 30 percent per year, on average.

Here's where your cholesterol, or "lipid," panel comes in. Although lipids have limited usefulness to uncover hidden coronary plaque, they can be used as important tools to gain control of plaque.

The standard lipid panel consists of four basic measures:

- Total cholesterol
- LDL cholesterol

- HDL cholesterol
- Triglycerides

You and your doctor should review your lipids *in light of your heart scan score*, as your score will influence how to approach your lipid patterns. In fact, the treatment for your lipids will depend heavily on your heart scan score.

To illustrate how your heart scan score influences management of your lipid values, let's say that your lipids show the following:

Total cholesterol	**223 mg/dl**
LDL cholesterol	**138 mg/dl**
HDL cholesterol	**45 mg/dl**
Triglycerides	**199 mg/dl**

Your numbers are neither great nor terribly bad. Your LDL cholesterol, for instance, is around average for American adults (average LDL 131 mg/dl; average LDL for people with heart attacks 134 mg/dl). Your pattern could be responsible for a fatal heart attack at age 50, or no heart disease at all in your lifetime—your lipid panel won't tell you which. But, say your heart scan score was zero, meaning no detectable plaque whatsoever. Since your heart attack risk based on a score of zero is nearly zero for the next three to five years,

a program of lifestyle changes, like nutritional strategies to lower cholesterol (see box on page 85), might be all that is necessary. Because your risk is extremely low, it can't be substantially lowered further by cholesterol medicines or other prescription agents. Why go crazy over cholesterol if your risk for heart attack is nearly unmeasurable? While you and your doctor shouldn't ignore your lipids, the approach can proceed over an unhurried timeline and the intensity of effort will be far less.

What if you have the same lipid numbers above but your heart scan score is 1200? You have extensive hidden plaque. Even if you feel great and your stress test is normal, your risk for heart attack is an alarming 25 percent per year. Given the risks identified by your extremely high heart scan score, you and your doctor need to attack your lipids very seriously. While lifestyle and nutritional strategies will be important, you might more readily consider medication to bring your risk under control. The lipid endpoints achieved through your treatment program will also be more demanding, with a lower LDL and total cholesterol target, higher HDL, and lower triglycerides. In other words, your high risk for heart attack dictates a more intensive approach to prevention than if your score were zero.

The quantity of plaque hidden in your coronary arteries therefore determines how to manage your lipid values. Without knowledge of the extent of your hidden plaque, you're wandering in the dark. With this concept in mind, let's tackle each of the lipid measures one by one:

LDL Cholesterol

The tools for lowering LDL cholesterol have become very powerful since the "statin" cholesterol-lowering drugs entered the arena. There are also many helpful nutritional strategies you can use to lower LDL. Lowering LDL cholesterol should be among your priorities if you have a heart scan score above zero.

How far should LDL be lowered? A good starting place is to refer to the Adult Treatment Panel (ATP) of the National Cholesterol Education Program. This is a set of guidelines drafted by authorities on cholesterol to provide a reference for your doctor to use in considering treatment for cholesterol.

The ATP defines a person as "high-risk" if there is probability of heart attack or other cardiac event of 20 percent over a 10-year period. If you're 50 years old, for instance, your risk of heart

attack would be 20 percent by age 60. People who clearly qualify as high-risk include anyone who has suffered a prior heart attack or had angioplasty, stent, or bypass surgery, and anyone with carotid artery disease, leg artery blockages, abdominal aneurysm, or diabetes. You can also be high-risk with some combinations of two or more risk factors. (See box on page 80 entitled "How to calculate your 10-year risk: The Framingham Risk Calculator.")

From a heart scan viewpoint, a score in the *75th percentile or greater* should be regarded as high-risk, since scores in this range carry a 10-year risk of 20 percent or greater. Any score *above* the 75th percentile clearly qualifies as high-risk, since the 10-year risk is even higher.

Anyone in the high-risk category is advised to have LDL cholesterol lowered to less than 100 mg/dl through lifestyle, diet, and medication, if necessary. A recently updated set of guidelines drafted by the Adult Treatment Panel (NCEP Report, 2004) suggests that targeting 70 mg/dl might be considered, but makes this optional. This update was based on several recent clinical trials that proved that lower LDL cholesterol targets translated into less heart attack and death, as well as greater plaque regression.

How to Calculate Your 10-Year Risk: The Framingham Risk Calculator

The ATP guidelines apply the risk calculations based on the Framingham study. This scoring system incorporates the following risk factors:

- **Total cholesterol**
- **HDL cholesterol**
- **Smoking**
- **Systolic blood pressure**

A 10-year risk for coronary events is then calculated. To have your 10-year risk calculated, go to the National Heart, Lung, and Blood Institute website (www.nhlbi.nih.gov) and enter "risk calculator" into the search bar. You then enter your personal information on each of the risk factors into the boxes and a 10-year risk will be calculated.

In this approach, high-risk is arbitrarily defined as risk for heart attack of 20 percent or greater over 10 years. Intermediate-risk is defined as a risk of 10-20 percent over 10 years. Low-risk is less than 10 percent over 10 years. Keep in mind that this framework is only a *suggested guideline*, not a set of rules. You and your doctor may choose to modify this approach to suit your unique goals and medical situation. Some people, for instance, because of the murkiness of heart attack prediction, prefer to follow guidelines for the high-risk category even if they are really intermediate-risk. In this way, they may maximize the protection provided by a prevention program.

The ATP classifies "intermediate-risk" as a 10-year risk of heart attack of 10-20 percent. People with combinations of two or more risk factors generally fall into this category. For people in the intermediate-risk category, ATP recommends lowering LDL cholesterol to less than 130 mg/dl. The recent updates make a target LDL of 100 mg/dl or less optional. A heart scan score percentile rank of 50-75 percent would fit into this category.

Lastly, ATP guidelines suggest lowering LDL cholesterol to 160 mg/dl if you fall into the low-risk category with likelihood of heart attack of 10 percent or less over the next 10 years. This corresponds to a heart scan percentile rank of less than the 50th percentile.

Keep in mind that the ATP guidelines are just that: *guidelines*. They are *not* rules. There are no penalties to pay if you and your doctor choose to follow a different course. The ATP guidelines are only advice based on evidence gained through large clinical trials. They represent a consensus viewpoint drafted by committee. You and your doctor may choose to modify these guidelines to suit your particular situation and needs.*

* In our program of coronary regression, in which we aim to *reduce* your heart scan score, we target lipid panel values of 60/60/60, i.e., an LDL cholesterol of 60 mg/dl or less, HDL cholesterol of 60 mg/dl or greater, and triglycerides of 60 mg/dl or less. This is detailed in the book ***Track Your Plaque: The only heart disease prevention program that shows how to use the new heart scans to detect, track and control coronary plaque***. Please refer to this book if a program of plaque regression, or shrinkage, interests you, or go to www.trackyourplaque.com.

Why Do We Need Heart Scans If We Can Calculate Our Heart Attack Risk?

Some people ask whether heart scans are really necessary if we can gauge our risk for heart attack by using predictors like the Framingham risk calculator (see box on page 80).

One of the drawbacks of risk calculators is that they are population-based measures. They are helpful for predicting risks within large groups of people. Their great weakness is in predicting the risk of a specific individual.

To illustrate, imagine if you were told that driving on the freeway at greater than the speed limit of 65 mph carries a three-fold greater risk of dying in a car accident than driving below the speed limit. If you drive 68 mph, does this mean you will die in a high-speed accident? Does driving 63 mph mean you'll never die in an accident? Of course not. These are measures of relative risks based on the behavior of large populations. The same applies to risk calculators.

This leads to a phenomenon called "mis-classification of risk." The risk calculator may, for instance, suggest a low risk for heart attack of 3 percent over 10 years. But your heart scan—*a specific gauge of your individual risk*—might suggest a risk of 20 percent. In this instance, your individual measure, i.e., your heart scan score, is a far more precise reflection of your risk. If you start with a heart scan as the basis for your prevention program, then risk calculators like the Framingham scheme simply shed light on how to best approach treatment to reduce risk, but fall short on determining whether you have heart disease in the first place.

There are several approaches to lowering LDL cholesterol:

• **Statin agents**—These are the cholesterol-lowering drugs Lipitor ™ (atorvastatin), Crestor™ (rosuvastatin), Zocor™ (simvastatin), Pravachol™ (pravastatin), and Mevacor™ (lovastatin). LDL is lowered from 25 to 60 percent on these agents, depending on the one chosen and dose.

• **Bile acid binding agents**—Nowadays, the only common agent remaining in this class is colvesevalam (Welchol™). The LDL-lowering potency is rather modest and this agent is most commonly used with the statin drugs to increase effectiveness.

• **Ezetimibe** (Zetia™) is in a class by itself, as it is neither a statin drug nor does it bind cholesterol in the intestinal tract, but blocks the absorption of cholesterol across the intestinal lining. It is most commonly used with statin drugs, as it quadruples their potency with no substantial increase in side effects. It can lower LDL by 18 percent when used alone.

There are several specific nutritional supplement approaches worth knowing about, as well, that can lower LDL cholesterol 20 to 50 points. (See box on page 85.) Any of the nutritional strategies listed can be used safely with any of the prescription agents described above.

HDL Cholesterol

Most people are surprised to learn that the most common reason to have coronary plaque in the first place is low HDL cholesterol, not high cholesterol. The ATP panel defines low HDL as less than 40 mg/dl, although it may be a risk factor up to a level of 60 mg/dl.

HDL is a protective class of blood particles responsible for a process called "reverse cholesterol transport," or scavenging cholesterol from plaque. HDL is therefore critically important for regression of plaque.

Of every 100 people with heart disease, at least 50 have low HDL. It is the cause of heart disease in many people who've been told that either they have no reason for heart disease, or they have a cause that is untreatable. Both statements are simply untrue.

Healthy Strategies That Help Lower Cholesterol (Total and LDL):

• **Raw almonds**—Rich in fiber and monounsaturated fats, a handful (1/4-1/2 cup) of raw almonds daily lowers cholesterol around 10 percent. Almonds also blunt spikes in blood sugar after eating and prevent diabetes. They're tremendously filling, and since almonds take the edge off a sweet tooth, are great for sugar addicts who need a snack.

• **Soy protein powder**—Soy products are a source of many fascinating substances, like isoflavones. But the protein powder itself (sold in 1 lb. canisters) is a tremendous way to reduce cholesterol through soy's tendency to suppress the liver's production of cholesterol. Even the FDA, ordinarily charged with reviewing drugs, has endorsed the value of soy protein powder. Three tablespoons (25 gms) a day in fruit smoothies, protein shakes, or blended in your yogurt or other foods will lower LDL by around 12 percent. Soy protein is also finding its way into a variety of products like low-carb pasta and bread, soy cheese, and soy chips. Just check the label and add up the protein content, aiming for a total of 25 grams of soy protein every day.

• **Pectin**—Found in apples and the rinds of citrus fruits, pectin is a natural fiber that lowers cholesterol; the same foods also provide flavonoids that yield broad health effects. Be extra lazy when you peel

your citrus fruits and leave as much of the white rind on as possible. Pectin is also available as capsules, in which case several grams per day can be used.

• **Soluble fibers**—Among the best is oat bran. Containing twice the quantity of the healthy fiber beta-glucan as oatmeal, oat bran is a versatile source of soluble fiber that can lower cholesterol 10-15 percent while also reducing blood sugar and providing roughage for bowel health. Starchy beans, like black, pinto, Spanish, red, and kidney, also provide significant soluble fibers that can lower LDL. One-half cup of beans per day can be an easy way to lower cholesterol. Note that fibers like wheat fiber found in whole wheat bread and bran cereals do nothing for your cholesterol.

• **Phytosterols**—These soybean oil derivatives lower cholesterol 12-15 percent. Two butter substitute products are available on the market containing phytosterols: Take Control and Benecol. Two tablespoons per day is the recommended "dose," but beware of calories. Minute Maid also produces an orange juice product containing phytosterols called Heart Wise. Two glasses (8 oz. each) of phytosterol-containing orange juice per day lowers LDL cholesterol 12 percent.

How do you raise HDL? Niacin, or vitamin B3, can significantly raise HDL up to 30 percent. Although it's a vitamin, hot flushing and other side effects make this best taken under medical supervision. A class of prescription drugs called the *fibrates* (Lopid™, or gemfibrozil; Tricor™, or fenofibrate) can also raise HDL.

Diet can help a great deal. HDL is very sensitive to body weight: gain weight and HDL plummets. But a standard low-fat diet does not raise HDL, and super low-fat diets *lower* HDL. HDL increases with losing excess weight. Exercise raises HDL, and going from a sedentary lifestyle to a moderately active lifestyle (walking thirty minutes per day five days a week) typically raises total HDL two to five points. Most people with low HDL can raise it about five to ten points with a combination of changes in diet and exercise. Omega-3 fatty acids found in fish oil have a modest effect in raising HDL.

Triglycerides

Triglycerides can be a confusing subject. They are not direct causes of coronary plaque. But they are a powerful *indirect* cause.

Low HDL Is Only the Tip of the Iceberg

Low HDL is just the tip of the iceberg. Lurking beneath the surface are several other closely related abnormalities that can drive plaque growth.

People who have low HDL also commonly have a smorgasbord of small LDL particles, high triglycerides, and abnormal triglyceride-rich lipoproteins called VLDL (very low density lipoprotein). These abnormalities can occur singly or in various combinations.

Low HDL suggests potential for hypertension (high blood pressure), glucose intolerance ("pre-diabetes"), and full-blown diabetes. This combination is often called the Metabolic Syndrome, or Syndrome X. The expression of hypertension and diabetes are, like HDL, weight-sensitive—the more overweight you are, the more likely you'll develop these patterns.

The lower your HDL below 60 mg/dl, the more likely you are to conceal the entire constellation of abnormalities that can occur along with low HDL. The entire pattern can be assessed with a more extended analysis called *lipoprotein testing*. (For more information on lipoproteins and how they can be used to augment your program of prevention, go to www.trackyourplaque.com.)

Triglycerides are an indirect cause because they cause the formation of multiple hidden particles, or lipoproteins, in the blood that can be potent causes of coronary plaque (especially small LDL particles and VLDL).

From the standpoint of heart disease, we are most concerned about triglyceride levels of up to 400 mg/dl, as this is the range in which triglycerides contribute to growth of coronary plaque. When triglycerides are greater than 400, your doctor will need to consider whether other conditions might be to blame, such as high blood sugar, underactive thyroid, kidney disease, or certain genetic disorders (e.g., familial hypertriglyceridemia). Levels this high may or may not contribute to heart disease risk. In the rare instances when triglycerides are greater than 1000, the pancreas (in your abdomen) can suffer damage. Levels this high need to be urgently addressed by your doctor.

Triglyceride levels of 100-400 occur commonly and can contribute significantly to plaque growth. What makes triglycerides so evil? First of all, triglycerides are present in virtually all hidden lipoprotein particles to various degrees, such as VLDL and small LDL. The higher the triglyc-

eride level (up to around 400), the greater the quantity of these other particles, all of which are potent causes of plaque growth. Only when triglycerides are less than 100 do hidden triglyceride-containing particles cease to be a factor. The ATP guidelines target a triglyceride level of less than 150 mg/dl.

Replacing carbohydrate calories (from potatoes, candy, and soft drinks, and flour-containing products like breads, bagels, pasta, and cakes) with protein and healthy fats like the monounsaturates from raw nuts, olive and canola oils, or the omega-3s from fish and flaxseed products, will all help reduce triglycerides. Avoiding processed foods containing high-fructose corn syrup is crucial, as this ubiquitous additive (in everything from low-fat salad dressings to breads) raises triglycerides significantly. Fish oil supplements (but not flaxseed oil) can dramatically lower triglycerides. Prescription agents that lower triglycerides include niacin (doses greater than 500 mg, which should be monitored by your physician), the fibrates like gemfibrozil (Lopid™) and fenofibrate (Tricor™), and the statin agents, especially atorvastatin (Lipitor™) and rosuvastatin (Crestor™).

Total Cholesterol

Of the four measures on the standard lipid panel, total cholesterol is the least helpful, as it is a combined measure of LDL, HDL, and triglycerides:

Total cholesterol = LDL + HDL + triglycerides/5

This makes total cholesterol a source of confusion when there are changes in *any* of the other three measures. For instance, if your LDL goes up and your HDL goes down—both undesirable changes—you won't be able to judge this by your total cholesterol because they will cancel each other out.

The only time total cholesterol might be helpful is when you don't have the other numbers available (e.g., in a cholesterol screening). In this case, a total cholesterol score above 200 mg/dl is potentially concerning and a reason to have the full lipid panel tested. Unfortunately, many people with total cholesterols in a favorable range (less than 200 mg/dl) have been told that they are not at risk for heart disease. The most glaring error in this advice is that low HDL cholesterol can still occur with low total cholesterols.

Your Heart Scan Score—a Reason to Re-think Your Cholesterol

In thinking about your heart's future, the best place to start is with your heart scan score. *Then* look at your cholesterol numbers in light of your score. The very same cholesterol numbers in a person with a heart scan score of zero should be viewed very differently from, say, a person with a score of 500. These are two different people with very different risks of heart attack, *despite the very same cholesterol numbers*.

Once you've had your heart scan, a serious conversation with your doctor is in order to review just what your cholesterol numbers now mean. Don't delay! The sooner you begin your prevention program, the sooner you'll be on your way to a life free of heart disease, now armed with the tremendous insight of your heart scan score.

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What a heart scan meant to…Frank.

At 58, Frank had spent the last 18 years in fear of succumbing to heart disease. It all hit him when his dad was hospitalized for congestive heart failure. Frank remembered his dad as an active, vital man in his late 50s, but saw his health deteriorate dramatically as this process unfolded. Witnessing his dad's struggle triggered Frank to think seriously about his own health.

Frank started with a conversation with his doctor that resulted in a cholesterol panel. The results were, in a word, disastrous. Frank remembered the initial values well: LDL 218 mg/dl, HDL 34 mg/dl, triglycerides 890 mg/dl. Several different prescription medicines, weight loss of nearly 28 pounds, a new exercise program, and counseling from a nutritionist all followed. Even then, Frank's cholesterol values, particularly his triglycerides, failed to come under full control. Frank felt doomed.

When his doctor recommended a heart scan, Frank jumped at the idea, though feared the worst. He rationalized that he'd finally get a look at what he'd been fearing all those years. His score: a big, fat zero—no detectable plaque whatsoever. Frank was surprised, confused, and elated, all at the same time. Frank's doctor, thankfully, was knowledgeable about the significance of Frank's heart scan. He explained to him, "Frank, this is great news. Despite your terrible cholesterol numbers

over many years, something has allowed your body to not deposit any plaque in your coronaries. Your heart attack risk is extremely low over the next five years."

"I don't get it. If my numbers have been so bad, but no plaque has formed, can't I just stop all my treatments and forget about it?"

"I know you're tempted to do that, Frank. But I think that, while we don't have to push your treatment program to extremes as we would, say, if your score were 500 or 1000, we should still keep you on a health program that keeps your cholesterol numbers within a reasonable range. But we know that we have the luxury of time to do so, and you can relax knowing that you are unlikely to be in any danger for a good, long time." Frank's doctor also pointed out that his lipid panel also suggested potential for diabetes (low HDL and high triglycerides), another reason to maintain a healthy lifestyle and continue treatments.

Heart scans can work both ways. They can show when coronary plaque is hidden, unsuspected, and far worse than you'd predict from your cholesterol numbers. Or, your heart scan can show that little or no plaque has developed contrary to bad cholesterol numbers. Both ways, it can be very enlightening information in your life.

Chapter 6

When Should I Have Another Scan?

You have your heart scan score. What happens if you just sit back and hope for the best?

If you've read the preceding sections, you now know that your heart scan score will increase at the alarming rate of 30-35 percent per year. Since you're reading this book, we hope that you're not going to just sit back and do nothing. In fact, we hope that this knowledge spurs you to begin a new chapter in health to keep your score from increasing.

Let's say that you have a heart scan at age 45 and your score is 200. This concerns you and your doctor. The cholesterol numbers that were previously viewed as satisfactory are now viewed in a new light, and your doctor recommends that your LDL cholesterol of 145 should now be reduced to

100 mg/dl, maybe even 70, your HDL of 38 mg/dl should be increased to at least 45 mg/dl, and your triglycerides of 199 mg/dl should be reduced to 150 mg/dl. Your doctor recommends a diet low in saturated fat, replacing refined carbohydrates with unrefined, using healthy oils like olive and canola, eliminating soft drinks and processed snacks, and that you cut back on the beers you'd have several times a week. You add a walking program four days a week. Over a year's effort, you feel great and you're proud of the 12 pounds you've lost.

You ask your doctor, "I think I've done a great job of turning my life around. I eat better, exercise, and my cholesterol numbers are where you recommended. Has it worked?"

Good question. Just how *do* you know whether your program has worked? Does surviving to your next birthday without heart attack qualify as a satisfactory answer? Is remaining free of chest pain or other symptoms good enough?

For most people, just feeling good and continuing life tells you *nothing* about whether your prevention program has been effective. Your plaque may have stopped growing, it could have shrunk, or it could have doubled—you'd feel the same regardless.

Does a stress test prove that you're safe on your prevention program? Most people understand that stress tests are flawed measures of heart disease. Just remember former President Bill Clinton's story. Stress tests every year for five years failed to identify the unstable, extensive coronary plaque he had prompting bypass surgery. Stress tests do not effectively uncover nor measure hidden coronary plaque in the great majority of people. Then how can we expect a stress test to determine whether your coronary plaque has responded to your treatment program? Stress tests are essentially useless for this purpose.

Then how do you gauge what's happened to your coronary plaque?

Easy—just have another heart scan. Think about it and it makes perfect sense. If you start with a scan that precisely quantifies the amount of plaque concealed in your coronary arteries, why not measure your coronary plaque again, after you've engaged in a program to gain control of your heart disease risk? It's as easy as that.

You should consider undergoing a second scan *no sooner* than one year after the first. Since it takes most people several months to reach their cholesterol goals alone, don't consider a second

scan until prevention program goals have been achieved and maintained for a year. This way, you'll have a score that reflects a full year of effort. You and your doctor will be able to calculate your percent per year increase or decrease in score. (Many scan centers will calculate this for you, even if the interval between scans is not an exact year. In this case, you'll be provided an *annualized* rate of increase or decrease.)

Can't I Just Assume My Plaque Hasn't Grown If I Stick to My Program?

Many people ask: Doesn't having a "perfect" cholesterol value with treatment (e.g., a statin drug) *guarantee* that your heart scan score doesn't increase? How about a perfect lifestyle—strict adherence to diet, vigorous exercise, etc.?

Unfortunately, with our present knowledge, *nothing* absolutely guarantees that your score won't increase. However, healthy strategies can indeed *slow* plaque growth substantially and will, in many, completely halt it, or even shrink plaque in some. But you cannot assume that plaque has stopped growing just by following your program. Lowering cholesterol, eating healthy, etc. are unquestionably helpful and enhance the likelihood

of improving your score, but no specific measure guarantees it. (For a more detailed discussion of strategies to lower your score, read ***Track Your Plaque: The only heart disease prevention program that shows how to use the new heart scans to detect, track and control coronary plaque***. Available through Amazon.com, bookstores, or through www.trackyourplaque.com.)

The only way to assess results in a specific individual is to remeasure the quantity of plaque present—get another scan. Another scan no sooner than a full year after your first scan, and after you've achieved your prevention program goals, will provide you with important feedback on the effects of your efforts over this time period. Depending on the results of your repeat scan, you and your doctor can adjust your health program accordingly.

Jim—the Value of a Second Scan

Jim's first heart scan was an eye-opener for him. At 40, Jim knew that his lifestyle was not exactly perfect, but not that bad either. He was 5 feet 11 inches tall, weighed 225 pounds, and wore much of his excess weight around his middle. His initial cholesterol numbers were LDL 153 mg/dl, HDL 35 mg/dl, and triglycerides 211 mg/dl—neither terrible nor cause for celebration. Jim's heart scan score was 34 (75th percentile, 3 percent per year risk for heart attack, 30 percent over 10 years), suggesting that his lifestyle and cholesterol numbers were permitting more plaque growth than might have been predicted simply by looking at LDL, etc., despite his relatively young age.

This knowledge prompted Jim to follow a diet low in saturated fat, include three times more vegetables and fruits in his diet than before, slash his intake of cookies, bagels, chips, and other refined starches, and—reluctantly—add daily walking to his schedule.

After this great start, Jim's motivation flagged over the next two-and-a-half years, especially as work pressures piled up and some home struggles with a teenager demanded his attention. Hospitalization of a close colleague with a heart attack refocused Jim's attention on his own health,

and he decided to review his heart's status with another scan. The repeat score: 48, representing a 14.8 percent annual rate of increase. Though not perfect (e.g., no change or even a negative rate of growth or plaque shrinkage), it was a good deal better than the expected rate of increase of 30-35 percent per year.

This news reinvigorated Jim's motivation to improve on his program. After a discussion with his doctor, Jim was determined to lose an additional 15 pounds, raise HDL, increase the dose of fish oil he'd been taking to further reduce triglycerides, and accept an increase in his statin medication. His goal in two years: no plaque growth, no increase in his score.

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Chapter 7

Be a Heart Disease Prevention Success Story!

Back in 1980, doctors could hazard only a crude guess as to whether someone had hidden heart disease. Even if you could detect silent heart disease, there wasn't much you could do about it short of major procedures. Our parents and grandparents really had no choice but to wait for a catastrophe like heart attack to strike to find out whether they had hidden heart disease.

Thankfully, times have changed. We now live in a new age of heart disease prevention. CT heart scans represent a method of measuring hidden coronary plaque available to nearly everyone in the U.S. We can detect the potential for heart attack 10 years before it becomes reality. We do so with ease and precision, without discomfort, in about 30 seconds.

Early detection can mean complete elimination or dramatic reduction of risk. If you understand precisely how much plaque you have, you can focus more effectively on a program to gain control of it. You won't have to rely solely on murky cholesterol numbers that may or may not cause heart attack. Instead, you can rely on *a measure of the disease itself*—your heart scan score.

Don't be satisfied simply with detection of your coronary plaque. Don't let it end there. Tools to keep plaque from growing and substantially reducing risk for heart attack are worlds better today. You require specific answers to the question, "Why do I have plaque in the first place?" The better you and your doctor understand how you developed plaque, the more powerful your prevention program will be in turning off heart attack risk.

And don't let your heart disease prevention program end with you. Pass the word on! Educate your family and friends. Tell them that heart disease should not be a surprise. Forty percent of the people around you will die of heart disease, yet those people likely have no inkling whatsoever. Measure it, understand it, and control it, with the goal of complete elimination of danger of heart attack and the need for procedures.

For more information on how to gain control over your heart's future by using heart scans, read ***Track Your Plaque: The only heart disease prevention program that shows how to use the new heart scans to detect, track and control coronary plaque,*** *available at Amazon.com, BarnesandNoble.com, bookstores, or through www.trackyourplaque.com.*

Appendix

Incidental Findings on Heart Scans and What They Mean

Obviously, heart scans are meant to uncover the presence of hidden coronary plaque. The scanners capable of such detailed imaging of minute calcified plaque are very powerful machines that provide images of many other structures in the chest adjacent to the heart. This means that, along with images of your coronaries, a heart scan yields loads of information on other hidden processes.

In this section, we list a variety of common findings on heart scans that, though they may have nothing to do with coronary plaque and heart attack risk, can still have important implications for your health.

Enlarged Aorta and Calcium in the Aorta

The aorta is the major artery of the body. It emerges from the top of the heart and branches into all other arteries like the carotid arteries, the arteries to the arms and legs, abdominal organs, etc. Heart scans provide images of the aorta emerging upward from the heart, called the ascending aorta, and the portion that curves and then heads downward through the chest towards the abdomen, called the transverse and descending thoracic aorta. (Because heart scans image the chest only, the abdominal aorta is not imaged. Many centers can image this for you if you or your doctor desire and specifically request it.) Being the first vessel receiving blood ejected from the heart, the aorta is also the most likely to become enlarged when blood is ejected at high pressure. High pressure is, of course, measured as high blood pressure.

High blood pressure must be present for years before the aorta becomes enlarged. The normal aorta measures no more than 4.0 cm in an adult (external diameter). Diameters greater than 4.0 cm suggest that forces to cause it to enlarge have been at work for several years.

Other causes of an enlarged aorta are factors that weaken the lining of its wall and make plaque grow, just like the plaque in your coronary arteries. Just as plaque in the coronaries is accompanied by calcium, so too is plaque in the aorta. The risk factors that create coronary plaque are therefore the same ones that create aortic plaque, like high LDL cholesterol, low HDL cholesterol, smoking, and diabetes. The calcium in the aorta is not generally quantified but is instead described as mild, moderate, or severe.

Occasionally, the aorta may enlarge due to specific congenital disorders that weaken the structural tissues of arteries (e.g., Marfan's syndrome).

An enlarged aorta presents two concerning consequences: development of an aortic aneurysm and stroke. Once the aorta enlarges to a diameter greater than 4.5 cm, it is officially classified as an aneurysm. Surgical replacement is often recommended when the aorta reaches 5.5 cm, since the likelihood of rupture increases dramatically at this diameter. Enlarged aortas frequently are lined with atherosclerotic plaque. Like the coronary arteries, where plaque can rupture and cause heart attack, aortic plaque can also rupture. However, because of the greater diameter of the aorta, ruptured aor-

tic plaque does not close off the aorta, but small fragments of both plaque and any overlying blood clot that has formed can break off and travel to other parts of the body. Most commonly, these fragments go to the arteries of the brain and cause stroke.

Should your heart scan report mention that your aorta is enlarged, discuss this with your doctor with the goal of preventing it from getting any larger, reducing your risk of stroke, and avoiding a major operation. Likewise, if your aorta contains calcified plaque, discuss with your doctor how this finding will impact on your prevention program. Many authorities suggest that calcified plaque in the aorta be tackled just like calcified plaque in coronary arteries and that lipid issues need to be intensified to prevent further plaque growth and perhaps diminish risk for stroke.

Aortic Valve Calcium

Controlling the flow of blood ejected from the heart and into the aorta is an ingenious piece of natural engineering called the aortic valve. Just like any valve in the plumbing of our home or car,

the aortic valve serves a similar function: to allow the flow of blood in one direction and prevent it from flowing backward into the heart. Viewed end-on, the aortic valve looks like a pie cut in three pieces. The three slices, or leaflets, are anchored to the aorta, allowing each leaflet to open and close with each beat of the heart.

Unfortunately, the aortic valve is subject to wear and tear, just like brake pads in your car and the cartilage in your knees. It's also only recently been appreciated that the same factors that create plaque in your coronaries and aorta can also do so in the aortic valve. As plaque material accumulates along the aortic valve leaflets, they become stiff. Part of the plaque accumulation, wear and tear, and stiffness is calcium deposition, the same rock-like substance that accumulates in your coronaries.

If your heart scan showed aortic valve calcium, this alerts you to the fact that aortic valve disease may be in your future. (Please note that aortic *valve* calcium is distinct from aortic calcium.) Although calcium in the aortic valve usually develops alongside calcium in the coronaries, they occasionally occur independently without the other. But just as coronary calcium should trigger a re-evaluation of your prevention program, so too should aortic valve calcium.

Most of the time, the finding of aortic valve calcium is described as mild, moderate, or severe. Moderate and severe levels may lead to a need for echocardiography, an easy, sound-based test that can more precisely quantify the severity of valve dysfunction. Echocardiograms are better at this since they can assess valve leaflet mobility and measure velocity of blood flow across the valve, which can be used to calculate the severity of valve stiffness or dysfunction.

Pericardial Thickening and Pericardial Fluid

Did you ever wonder how the heart manages to beat 60 times a minute, 24 hours a day, all while nestled right in between the two lungs, also inflating and deflating with their own rhythm out of sync with the beating heart? It does so largely due to the insulating effect of a tough sac encasing the heart called the pericardium. The pericardial sac contains around 50 cc of a lubricating fluid that allows the heart to do its work with as little friction as possible.

Just as the adjacent lungs are prone to infection, particularly with viruses and resulting in pneumonia, so too can viruses infect the pericardium. Most of the time, you're not even aware of it. Occasionally, pericardial infection with a virus yields sufficient inflammation, or pericarditis, to cause a characteristic sharp pain in the chest. Of course, we are all exposed to numerous viruses throughout our lives and more than one bout of pericarditis can occur over your lifetime.

Each bout of pericardial inflammation leaves its scar by causing thickening of the pericardium. After several bouts, some people are left with a visibly thickened (defined as greater than 1 cm in thickness) pericardium. Rarely, a very thickened pericardium can actually squeeze the heart, disrupting its function and resulting in breathlessness and leg swelling. This is called pericardial constriction.

Should your pericardium be thickened on your heart scan, discuss this with your doctor to decide whether your pericardium is thickened without consequence, or whether it could account for symptoms and warrants further evaluation.

Sometimes inflammation can also cause excess lubricating fluid, or an effusion, to develop. This can also be uncovered on your heart scan. If

you've recovered from a viral illness within the last four or so weeks, your effusion might simply be a consequence of your infection and will likely and gradually get resorbed. However, if the effusion is substantial in size or if there is no recent history of a viral infection, further evaluation might be necessary. At the very least, many physicians will recommend another evaluation to reassess how much fluid remains after several weeks to see whether the fluid has been resorbed. Rarely, for large or persistent fluid collections, additional evaluation might be necessary to discover a cause such as hidden cancers or inflammatory diseases like lupus.

Lung Nodules

With the ability to see detail down to a millimeter, heart scans commonly uncover a myriad of findings in the lungs. Remember that flu you had last winter? It may have left some streaky lines as a souvenir of the virus infecting your lungs (viral pneumonitis). How about the 20 years of smoking before you quit at age 40? That left hundreds of little blank spaces—holes—in your lungs (emphysematous "blebs"), even though your smoker's cough has long since dried up.

But the finding that is most common, and represents a potentially dreaded cancer, is that of lung nodules. As the term suggests, lung nodules are little pebbles or balls of tissue, generally greater than 1.0 cm in diameter. A nodule can be a remnant of some long-ago infection, or it can be a malignant tumor that originated in the lung tissue or metastasized there from another source, like the colon or liver. For radiologists, distinguishing the two varieties of nodules is a daily exercise, and they will point out that nodules with abundant calcium are almost always benign and left from some prior infection. The problem lies with uncalcified or mildly calcified nodules—they could be benign or malignant. Thankfully, only around 5 percent of all incidentally discovered nodules are malignant.

If your heart scan uncovered one or more lung nodules, it often comes with advice to repeat the lung portion of the scan in several months (usually three to six months) as a means of gauging whether it is stable in size (benign) or is growing (malignant). Although this is not a very satisfactory approach because it leaves you sweating the issue for the months while you're waiting for the next scan, it may spare you from a biopsy. Sometimes a repeat scan, but with administration of x-

ray dye, is advised to provide more detail of the nodule itself, as well as the surrounding lung tissue. Other times, consultation with a pulmonologist or thoracic surgeon is advised so that the nodule can be directly studied under a microscope, i.e, a biopsy is performed. PET scanning is also emerging as a helpful tool to characterize nodules that is being used in some centers.

Should you have a lung nodule identified on your heart scan, don't panic! Discuss the finding with your doctor to decide the best means to evaluate it further. Lung nodules are, unfortunately, quite common and only a small minority truly prove to be cancerous.

Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

X

Y

Z

Special offer to readers . . .

Take your heart disease prevention program to the next level!

If you've had a heart scan and want to develop the most powerful prevention program available, consider reading ***Track Your Plaque: The only heart disease prevention program that shows how to use the new heart scans to detect, track and control coronary plaque***.

Track Your Plaque helps you understand precisely *why* you have hidden coronary plaque. More importantly, you need to know *what to do about it*! ***Track Your Plaque*** is a complete guidebook that shows you how to:

1) Identify the causes of your coronary plaque with methods that go far beyond simple-minded cholesterol measures, and

2) Effectively treat the causes and gain control of your plaque.

"This is the best book I have read for preventing heart disease disasters. It is well written, comprehensive, and gives you an easy, life-long method to keep your heart healthy, so you never have to have a heart attack. I read a lot of books on this subject, and this is the best by far."

Dr. Daniel Beskind
Clinical Assistant Professor of Emergency Medicine,
University of Arizona

"***Track Your Plaque*** shatters many of the myths associated with heart disease and answers several questions that have bothered me for years: *How can you pass a stress test and then die from a heart attack? How can your cholesterol be normal or 'under control' but you can still have a heart attack? Do I have to suffer the same fate as my father?* This book is packed with information regarding the early detection of heart disease and its hidden causes. This book was written for patients, but should be required reading for doctors."

Steve B.
Waterford, WI

Track Your Plaque is available on Amazon.com and BarnesandNoble.com for $19.95. ***Track Your Plaque*** is also available from the www.trackyourplaque.com website. Please go to the www.trackyourplaque.com website for more information on becoming a member of the ***Track Your Plaque*** program and to find out more about our interactive counseling programs, our ***Track Your Plaque*** video seminar, new discussions from world experts, and other exciting content all devoted to controlling and conquering coronary plaque. Become a member and the book, ***Track Your Plaque***, is included at no extra cost!