One of the primary goals in treating patients with Coronary Artery Disease (CAD) is to prevent the sudden deaths and disability caused by unexpected heart attacks. Many well-documented scientific studies in large groups of patients have shown that vigorous risk factor treatment using cholesterol lowering drugs and healthy lifestyle prevent or reduce the risk of heart attack, bypass surgery and balloon or stent procedures. The recently published COURAGE trial showed that patients with significant coronary artery narrowing treated with balloon angioplasty and stents showed no benefit over intense non-invasive medical treatment without these procedures. Moreover, coated stents may cause some additional risk of blood clotting or thrombosis in the coronary arteries that has already somewhat reduced their use.

Although the basis for preventing and reversing vascular disease is well established, clinical implementation of this knowledge is commonly neglected in favor of crisis management and invasive procedures. Since these procedures are necessary for some patients, the essential question is who needs these procedures and when. Reliable knowledge on the extent and severity of coronary artery disease and what intensity of treatment is effective or whether coronary heart disease is stabilizing or progressing is important as a guide to invasive or medical management before an unexpected heart attack occurs. Non-invasive positron emission tomography or PET imaging of the heart provides this essential information as the guide to optimal treatment that also indicates when invasive procedures are needed or not. However, most types of noninvasive imaging fail to provide reliable accuracy despite overstated claims of their benefit. In this issue, PET News presents the first in a series of reports on non-invasive heart imaging in order to clarify some of the strengths and weaknesses of different heart scans available to physicians and patients.

Recent Publicity about Zetia

Several years ago, a new cholesterol lowering drug, ezetimibe, (Zetia) was introduced that helped reduce LDL cholesterol levels by blocking the gastrointestinal absorption of cholesterol. Zetia was designed to be used in combination with the statins, not to replace them. In comparison to the statins, Zetia does not have the same healing effects on the endothelial lining of the coronary arteries as the statins. In addition, it lacks the anti-inflammatory effects on the walls of the arteries and the anti-thrombosis (anti-platelet) effects seen with the statin drugs.

A recent published article (ENHANCE Trial) measured the atherosclerotic plaques in the carotid arteries of patients taking simvastatin with those taking a combination of simvastatin and Zetia over a 2-year period. The combined therapy did not show a greater reduction in the thickness of the atherosclerotic plaque despite comparable lowering of LDL cholesterol levels. This has raised the question whether Zetia adds any benefit to the statin alone.

The ENHANCE trial does not give conclusive answers about the role of ZETIA in lipid management. This trial did not measure clinical outcomes such as chest pain, heart attacks, or strokes. There were no adverse side effects of Zetia identified in the study. Although statin therapy continues to be the primary and most beneficial drug therapy for patients with high cholesterol levels, some patients do not tolerate statins in doses sufficient to lower LDL adequately. In such patients, Zetia should be used in combination with whatever dose of statins is tolerated. For such patients who are unable to tolerate higher doses of statin drugs due to side effects, the addition of Zetia may be necessary to achieve lipid goals.

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Non-invasive Imaging of the Heart

Non-invasive heart scanning to identify CAD early, to assess its severity accurately for deciding on invasive procedures, and to accurately assess changes in the coronary arteries during treatment, is a central issue in cardiovascular medicine today. Having an accurate non-invasive imaging test is an important ally for physicians in making the most difficult decisions in treating patients with heart disease.

However, the many different technologies for heart scanning, or imaging, are confusing and poorly understood by most people including many physicians and cardiologists. Each technology has strengths for obtaining specific restricted information about the heart but may be inadequate for obtaining other information about the heart. Frequently, excessive claims are made for accuracy or clinical usefulness beyond the actual technical capacity of the scanner. Lack of technical expertise, economic interest, the excitement of new technology and plain wishful thinking play prominent roles in such claims. Recent advances in Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) have suggested that they would be useful for screening for heart disease or for following patients with coronary artery disease. This article will describe the differences between CT, MRI, and PET (Positron Emission Tomography) imaging of the heart.

Non-invasive heart scanners for CAD make one of two fundamentally different kinds of pictures or images. Non-invasive CT or MRI angiograms provide anatomic or structural images of the coronary arteries, like an invasive coronary arteriogram (angiogram and arteriogram are the same). However, they do not provide direct information about blood flow through the arteries to the heart muscle. In contrast, PET provides an image of the blood flow in the heart muscle at resting and stress conditions after blood has flowed through the coronary arteries but the arteries are not viewed directly.

Both anatomic and blood flow images may be important and each has specific advantages, particularly for early or advanced CAD, or for following changes in severity of CAD. Each technology also has strict quality requirements that make the scan suitable or not for specific purposes. Any scanner used to measure changes in severity of coronary artery narrowing must be very sensitive to blood flow or have very high resolution for measuring very small anatomic changes.

Measuring Coronary Artery Narrowing

The average diameter of a coronary artery is only 3 mm, with some arteries being somewhat larger and others being somewhat smaller. As an example, a 70% blockage of this 3mm diameter artery would reduce the diameter to approximately 0.9 mm. If the artery then improved to a 50% narrowing, the diameter would increase to 1.5mm, that is 0.6 mm larger than the original more severe narrowing. Or, if the artery worsened to a 90% narrowing, the remaining open diameter would be only 0.3 mm, that is 0.6mm worse than the original diameter. Therefore, in order to determine whether the artery had improved from 70% to 50% or had worsened from 70% to 90%, the arteriogram would have to measure accurately 0.6mm bigger or smaller than the original size. Many studies of cholesterol lowering medications have documented stabilization and regression of coronary atherosclerosis using invasive coronary arteriograms. However, the anatomic changes that occur in the blockages are actually very small, averaging 0.3mm in large groups of patients, a number that is less then the resolution limit for determining any significant change in an individual by an invasive arteriogram. The risk of heart attacks or other coronary events in response to vigorous risk factor treatment is reduced disproportionately much more than expected for the small anatomic changes. This disproportionately greater reduction in heart attacks or other coronary events is due to plaque stabilization and decreased plaque inflammation that would otherwise cause the plaque to rupture open with thrombosis and sudden heart attack. Thus, small anatomic changes predict major corresponding changes in the risk of coronary events.

CT or MRI Coronary Angiograms

Computerized quantitative analysis of a high quality invasive coronary arteriogram can just barely measure 0.6mm. Many studies have shown that visual estimation of the invasive arteriogram as routinely done in clinical practice is totally unable to see such small changes. Non-invasive CT or MRI angiogram in clinical practice have a resolution or power of measuring small dimensions that is one half to one third the resolution of the invasive arteriogram. The smallest dimension that the non-invasive CT or MRI angiogram can resolve is about 1.0mm to 1.2mm, not 0.6mm.

Therefore, the non-invasive CT or MRI angiogram cannot determine the severity of coronary artery narrowing in the range 30% to 70% diameter narrowing. This limitation has been proven in at least three good scientific reports from clinical centers that are enthusiastic about CT or MRI angiograms. These centers found that
in comparison to the invasive coronary arteriogram, the CT or MRI arteriogram failed to measure accurately 30% to 70% diameter coronary artery narrowing. Correspondingly, the non-invasive CT or MRI angiogram cannot tell whether a coronary artery narrowing has progressed from 50% to 90% narrowing or improved from 50% to 30% narrowing. This limitation is the same for a 64 slice CT scanner as it is for a 16 slice scanner since the size of the x-ray detectors that make the images is the same in the 64 and 16 slice scanners except for more of them to cover a bigger area in the 64 slice scanner.

Based on hard scientific data and principles of imaging physics, non-invasive CT and MRI angiograms cannot accurately determine the severity of coronary artery narrowing or determine whether there has been progression or regression of disease. Nevertheless, CT and MRI angiograms are increasingly used, and their use will continue due to their newness, slick marketing, physician and patient enthusiasm, economic profit and acceptance without questions. Therefore, how can they be useful?

Since their resolution is not good enough to differentiate among 30% to 70% coronary artery narrowing, enthusiasts have taken a different approach of using non-invasive CT or MRI angiograms to determine crudely whether a patient has greater or lesser than a 50% narrowing, as the basis for doing an invasive arteriogram. Once the crude CT angiogram is positive, the doctor is medically obligated to proceed to a more detailed test to clearly define the problem so the patient is recommended to have an invasive coronary angiogram. The plain CT scan for coronary calcification (not the CT angiogram) is useful for detecting atherosclerosis in the wall of the coronary artery but does not indicate whether there is coronary artery narrowing.

**PET Imaging of the Heart**

As demonstrated in numerous studies of cholesterol lowering medications documenting stabilization and regression of coronary atherosclerosis, small anatomic changes in coronary arteries predict major corresponding changes in the risk of coronary events. Currently, as demonstrated above, non-invasive CT and MRI angiograms cannot adequately quantify severity of blockage or its changes due to inadequate technical resolution. In these same regression trials, Cardiac PET scans show dramatic improvement in blood flow corresponding to the major reduction in coronary events of heart attack, PTCA, and bypass surgery. The reason for this is that PET measures blood flow (the end result of changes in blockages) rather than the anatomic blockage itself.

Positron Emission Tomography (PET) provides a picture or image of the blood flow in centimeter blocks of heart muscle at resting and stress conditions. It differs from CT or MRI because it does not measure the size of the coronary artery directly. However, blood flow through the coronary artery to the heart muscle under stress conditions is limited by the radius of the artery raised to the 4th power (the radius multiplied by itself four times). Therefore, a small change in radius or diameter of the artery that cannot be accurately measured by CT or MRI anatomic imaging is magnified into a much larger change in blood flow in centimeter blocks of heart muscle that are readily seen on PET images. This basic rule of fluid dynamics demonstrates the sensitivity of PET to changes in coronary blood flow.

In the example above, the improvement from 70% to 50% narrowing that cannot be measured by CT or MRI angiogram causes a major improvement in the PET scan from a green color on the baseline stress PET image to yellow or red on the follow-up stress PET image. Similarly, worsening from a 70% to 90% narrowing that cannot be measured by CT or MRI angiogram causes a severe change from green on the baseline PET scan to dark blue on the follow-up stress PET scan. Therefore, for following changes in severity of coronary artery disease, PET images of the blood flow in the heart is much better than the CT or MRI angiogram. In fact, we have published in a peer reviewed scientific report that the PET is even better than the invasive arteriogram for following progression or regression of coronary artery disease because the blood flow is such a magnified signal of very small changes in the diameter of the coronary arteries.

In conclusion, PET imaging continues to be the most effective non-invasive way to detect early, mild coronary artery disease, to determine improvement or worsening in coronary artery disease before a heart attack, or to determine the need for invasive procedures such as balloon angioplasty or bypass surgery.
What is Lp(a)?

Although the prevention and treatment of heart disease have greatly improved in the past two decades, there are still approximately 1.5 million people who have heart attacks each year. About half of these people have what is considered by the general medical community to be “normal” cholesterol levels. Recent studies have uncovered additional new information about cholesterol and the importance of even further analysis of the lipid particles in addition to standard lab measurements of cholesterol levels. One of these newer “risk factors” is an elevated level of Lipoprotein (a). Lipoprotein (a) is an inherited condition in which the LDL particles have an abnormal protein attached to the cholesterol molecule. High levels of Lipoprotein (a) are associated with an increased risk of developing coronary artery disease. Lp(a) acts as a magnifier of the risk due to the LDL cholesterol levels.

Having a comprehensive analysis of your cholesterol levels can point to treatment that differs from traditional cholesterol lowering therapy and is more effective in slowing, halting, or reversing the progression of CAD. There are two approaches to treating high levels of Lp(a). The only medications that lower Lp(a) directly are pharmacologic doses of niacin and to some extent estrogens. However, the high doses of niacin required to lower Lp(a) may not be tolerable in some patients due to flushing. A second approach to treating elevated Lp(a) is to lower the LDL to 50mg/dl or less with medications such as the statin drugs so that the risk of LDL levels that gets magnified by the Lp(a) is low to start with.

Having a genetic lipid abnormality does not mean you are destined to get coronary artery disease. Rather it emphasizes the importance of maintaining lifestyle modifications of weight control, low fat diet, regular moderate exercise, and not smoking in addition to medications that block the adverse effects of the genetic lipid abnormalities. This combined lifestyle and pharmacologic management is the core of Dr. Gould's Program for Prevention and Reversal of Coronary Artery Disease.

Blood flow in the heart muscle imaged by positron emission tomography (PET) during stress conditions. In the upper panel, white and red show the highest blood flow; blue and green show severely reduced blood flow in the biggest coronary artery on the front of the heart called the Left Anterior Descending Coronary Artery. After the stent, the blood flow is normal as in the lower panel. As the basis for a definitive answer, the PET scan identifies severe life-threatening blockage of the coronary arteries requiring a stent or bypass surgery or whether these procedures can be avoided with greater benefit from non-invasive medical treatment.
If you met Cliff Scates, you probably would not guess he is a “heart patient”; he does not fit the typical profile of an overweight middle-aged inactive American male. Cliff had always been active in sports and never overweight. Consequently, a slight chest discomfort and mild feeling of indigestion with exercise, caught him by surprise. He was only 50 years old, had no family history of early heart disease and his basic cholesterol numbers were considered normal. But his positive stress test and arteriogram showed a severe blockage in the main Left Anterior Descending artery and milder blockages in two other arteries.

Cliff handled this “bad news” with the calm, quiet, but methodical strength that had helped him face numerous other challenges in life. First, he sought a second opinion and guidance at the Weatherhead PET Center for Prevention and Reversal of Atherosclerosis. After discussions with Dr. Gould, he decided on a cardiac PET scan to get the definitive information on whether an invasive intervention such as a stent or bypass surgery was needed. In Cliff’s case, his PET showed a large area of severely reduced blood flow to the whole front side of his heart, objective proof for a stent procedure that Dr. Gould recommended.

After the stent, Dr. Gould outlined a treatment plan, and educated Cliff about coronary artery disease, diet, exercise and medications to prevent future problems. Part of his treatment was a special analysis of his lipids looking for genetic abnormalities that may have contributed to coronary disease. Cliff was found to have an elevated Lp(a) an inherited extra protein on the LDL cholesterol particle. He was started on a medication to help correct that abnormality. “Dr. Gould made me realize that my life was not “over” just because I have heart disease, he challenged me to be mindful of my condition and to stabilize it with my new lifestyle and medications to correct the genetic abnormalities.”

Since the stent procedure in 1999, Cliff has followed a strict healthy lifestyle and continues to face life with enthusiasm. His follow-up PET scan was normal. He has become an inspiration to many others and the resident “heart expert’ to his family, friends and co-workers. Cliff attributes his success to the full support and cooperation of his wife and family.

This year, as a test of his success nine years after his stent, Cliff wanted to ride in the annual MS-150 Bike ride from Houston to Austin. He had ridden it several times before but was a little nervous since he was diagnosed with heart disease. His daughter, Kimberly, began training with him last fall and the two of them crossed the finish line in front of the state capital in Austin on April 23 of this year. He considers this “a true blessing”. For his discipline, enthusiasm, and inspiration, Cliff Scates has earned the title of HEART STAR.
Stress Management and the Heart

The relation between stress and coronary heart disease is important but unclear. Part of the problem is how stress is defined and how it is measured since it is highly subjective. What is stressful for one person is not necessarily stressful for another. Some observations indicate a direct causal relation between certain types of stress and atherosclerosis. Clearly in some people with coronary heart disease, emotional stress causes or makes chest pain worse. More commonly, stress disrupts our ability to manage other risk factors for coronary heart disease. When under stress, people are more likely to smoke, eat unhealthy food, skip their exercise, and have their blood pressure go up. All of these changes exacerbate coronary heart disease.

Some types of stress trigger hormonal and metabolic changes in the body. These metabolic and hormonal changes may increase cholesterol levels, blood pressure, the intensity of inflammation in the cholesterol plaque, the tendency for coronary artery spasm or blood clots leading to heart attacks. However, the effects of stress appear to be mediated principally through other recognized risk factors that also adversely affect these hormonal factors.

The stress of working hard or being busy does not increase the risk of atherosclerosis as long as other risk factors are controlled. If the stress of being busy results in smoking, eating high-fat foods, and inactivity, the risk of atherosclerosis will be increased because of these other lifestyle risk factors. Since stress is often associated with poor control of these recognized risk factors, stress management is an important part of a comprehensive reversal program.

An essential element of successful stress management is its integration into daily living. As with low fat food and daily exercise, stress management needs to fit within the daily activities of working, eating, sleeping, social exchange, and so forth. A two-week retreat may relieve the stresses of daily living; however, it may not help for the rest of the year. You may not have the time or the resources for a two-week retreat or even for an hour daily workout or meditation; therefore the basic stress management techniques must be worked into the daily workday. Below are several simple daily practices that take little time but take advantage of basic physiologic body reactions that have been scientifically demonstrated. They are suitable for people on a very busy schedule as well as those who operate at a more leisurely pace.

1. After a workout, lie on the floor, totally relaxed for 5 minutes and focus on breathing. (Remember this feeling of total relaxation)

2. Take a 5-minute break three times daily, hold all calls, get comfortable and focus on breathing and totally relaxing your arms and legs (don’t fall out of the chair).

3. Concentrate on your walking style when going to meetings etc. (Relax your shoulders, swing your arms, and focus on slow rhythmic breathing, not on the tense anticipation of the meeting).

4. Make an effort to de-stress your body, whenever you are tense. (Relax clenched fists, shoulders, jaws, and focus on breathing)

5. Learn to recognize stress, fatigue and hunger separately to avoid overeating. (Eating does NOT relieve stress or fatigue but stress and fatigue cause “comfort eating”).

6. Remember the Real priorities of life. (Your life is the first priority, take care of it!)

Food for Thought

The United States Department of Agriculture has an easy to use nutrient database to help you determine the nutritional breakdown of virtually any kind of food. The website address is:
http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl

Recent Additions to the Healthy Commercial Food Products List
• Bumble Bee albacore Tuna Steak: 4 oz. serving has 34 gm protein, 2.5 gm fat and 170 cal
• Diestel Turkey Breast Pastrami: 99% fat free. It’s delicious! (Whole Food Market)
• Guylian Belgian Chocolate (no sugar added) serving size 8 squares/28 grams 120 calories, 9 gm fat, 1 gm protein