1. (Question from textbook Ch 4 #8) The Framingham Heart Study was a monumental project not only for cardiovascular disease, but for all of science, health, and medicine. Answers to the following questions may be found at the study's website: http://www.nhlbi.nih.gov/about/framingham/.

   a. What was the initial purpose of the Framingham study?

   b. List 5 definite risk factors for cardiovascular disease, and the year in which they were found to be associated with an increased risk.

2. You are a cardiac surgeon specializing in heart valve replacement. You have two current patients, an 80 year old man and a 4 year old girl. Available you have two device options: a bioprosthetic pericardium valve and a newly developed tissue engineered heart valve (that is approved for clinical trial use in both patients). What would you recommend to each patient and why? Please provide 2-3 sentences for each clearly explaining your recommendation and the reasoning behind your selection. If you need it, additional information can be found in this review article focusing on heart valve tissue engineering. http://circres.ahajournals.org/cgi/content/full/97/8/743

3. Using textbook chapters 4 and 12 and the information we learned in class regarding cardiovascular diseases and atherosclerosis please give three reasons why prevention of CVD is important in both the developed and developing world.

(Question from textbook Ch 12 # 3) An avid runner is out for her morning jog before classes.

a. Before she starts her jog she measures her pulse for 15 seconds. She counts about 17 beats in the 15 seconds. What is her Heart Rate in beats per minute?
b. This same jogger buys a heart rate monitor because she wants to see her heart rate through different parts of her run. When she is in the middle of her workout the monitor reads her heart rate as 119 bpm. If she were to feel her pulse at this same time for 15 seconds about how many beats would she feel?
c. Assuming that her heart Stroke Volume (SV) is about 70 ml, what would her Cardiac Output (CO) be in both parts a and b?
d. If her Ejection Fraction (EF) is 77%, using the Stroke Volume from above, what is her End Diastolic Volume (EDV)?
e. On average, the normal stroke volume is 70ml. The HR can drop to as low as 20 bpm when sleeping, while it is normally 70 bpm when awake. Compare the cardiac output when a person is at rest to when they are asleep.

f. After a heart attack, a patient's ejection fraction drops to only 20%. His EDV is 135 ml and heart rate is 90 bpm. Calculate SV and CO and compare these values to the normal values.

4. You have coronary artery disease caused by atherosclerotic plaques that are occluding two large arteries that feed your heart muscle. You are offered treatment with PCTA, a stent (bare metal or drug-eluting), or CABG. Thinking about the factors we discussed in class, which would you select for yourself and why? Please provide a paragraph (>3 sentences) describing your selection and reasoning.

5. (Question adapted from textbook Ch 12 # 13) Please read the New York Times article below (or use the webpage) and then answer the following questions. http://www.nytimes.com/2004/03/21/health/21HEAR.html

a. Discuss the advantages of placing more emphasis on prevention of heart disease.
b. Discuss the challenges of implementing successful prevention efforts. Why do you think our society places so much more emphasis on treatment of end stage heart disease rather than preventive measures?
c. You are given a referral by your internist to see Dr. Waters at the University of California. Your angiogram has shown a narrowing in one of your coronary arteries although you are not currently experiencing any chest pain or other symptoms. After reading this article, if Dr. Waters asked you to join his study and offered you the choice of either joining the patient group who receives angioplasty or the group who receives no angioplasty but instead a strict regimen of cholesterol lowering drugs, which would you chose? Please provide 2-3 sentences explaining your choice

New Studies Question Value of Opening Arteries

By GINA KOLATA
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A new and emerging understanding of how heart attacks occur indicates that increasingly popular aggressive treatments may be doing little or nothing to prevent them.

The artery-opening methods, like bypass surgery and stents, the widely used wire cages that hold plaque against an artery wall, can alleviate crushing chest pain. Stents can also rescue someone in the midst of a heart attack by destroying an obstruction and holding the closed artery open.

But the new model of heart disease shows that the vast majority of heart attacks do not originate with obstructions that narrow arteries.

Instead, recent and continuing studies show that a more powerful way to prevent heart attacks in patients at high risk is to adhere rigorously to what can seem like boring old advice — giving up smoking, for example, and taking drugs to get blood pressure under control, drive cholesterol levels down and prevent blood clotting.

Researchers estimate that just one of those tactics, lowering cholesterol to what guidelines suggest, can reduce the risk of heart attack by a third but is followed by only 20 percent of heart patients.

"It's amazing and it's completely backwards in terms of prioritization," said Dr. David Brown, an interventional cardiologist at Beth Israel Medical Center in New York.

Heart experts say they understand why the disconnect occurred: they, too, at first found it hard to believe what research was telling them. For years, they were wedded to the wrong model of heart disease.

"There has been a culture in cardiology that the narrowings were the problem and that if you fix them the patient does better," said Dr. David Waters, a cardiologist at the University of California at San Francisco.

The old idea was this: Coronary disease is akin to sludge building up in a pipe. Plaque accumulates slowly, over decades, and once it is there it is pretty much there for good. Every year, the narrowing grows more severe until one day no blood can get through and the patient has a heart attack. Bypass surgery or angioplasty — opening arteries by pushing plaque back with a tiny balloon and then, often, holding it there with a stent — can open up a narrowed artery before it closes completely. And so, it was assumed, heart attacks could be averted.

But, researchers say, most heart attacks do not occur because an artery is narrowed by plaque. Instead, they say, heart attacks occur when an area of plaque bursts, a clot forms over the area and blood flow is abruptly blocked. In 75 to 80 percent of cases, the plaque that erupts was not obstructing an artery and would not be stented or bypassed. The dangerous plaque is soft and fragile, produces no symptoms and would not be seen as an obstruction to blood flow.

That is why, heart experts say, so many heart attacks are unexpected — a person will be out jogging one day, feeling fine, and struck with a heart attack the next. If a narrowed artery were the culprit, exercise would have caused severe chest pain.

Heart patients may have hundreds of vulnerable plaques, so preventing heart attacks means going after all their arteries, not one narrowed section, by attacking the disease itself. That is what

happens when patients take drugs to aggressively lower their cholesterol levels, to get their blood pressure under control and to prevent blood clots.

Yet, researchers say, old notions persist.

"There is just this embedded belief that fixing an artery is a good thing," said Dr. Eric Topol, an interventional cardiologist at the Cleveland Clinic in Ohio.

In particular, Dr. Topol said, more and more people with no symptoms are now getting stents. According to an analysis by Merrill Lynch, based on sales figures, there will be more than a million stent operations this year, nearly double the number performed five years ago.

Some doctors still adhere to the old model. Others say that they know it no longer holds but that they sometimes end up opening blocked arteries anyway, even when patients have no symptoms.

Dr. David Hillis, an interventional cardiologist at the University of Texas Southwestern Medical Center in Dallas, explained: "If you're an invasive cardiologist and Joe Smith, the local internist, is sending you patients, and if you tell them they don't need the procedure, pretty soon Joe Smith doesn't send patients anymore. Sometimes you can talk yourself into doing it even though in your heart of hearts you don't think it's right."

Dr. Topol said a patient typically goes to a cardiologist with a vague complaint like indigestion or shortness of breath, or because a scan of the heart indicated calcium deposits — a sign of atherosclerosis, or buildup of plaque. The cardiologist puts the patient in the cardiac catheterization room, examining the arteries with an angiogram. Since most people who are middle-aged and older have atherosclerosis, the angiogram will more often than not show a narrowing. Inevitably, the patient gets a stent.

"It's this train where you can't get off at any station along the way," Dr. Topol said. "Once you get on the train, you're getting the stents. Once you get in the cath lab, it's pretty likely that something will get done."

One reason for the enthusiastic opening of blocked arteries is that it feels like the right thing to do, Dr. Hillis said. "I think it is ingrained in the American psyche that the worth of medical care is directly related to how aggressive it is," he said. "Americans want a full-court press."

Dr. Hillis said he tried to explain the evidence to patients, to little avail. "You end up reaching a level of frustration," he said. "I think they have talked to someone along the line who convinced them that this procedure will save their life. They are told if you don't have it done you are, quote, a walking time bomb."

Researchers are also finding that plaque, and heart attack risk, can change very quickly — within a month, according to a recent study — by something as simple as intense cholesterol lowering.

"The results are now snowballing," said Dr. Peter Libby of Harvard Medical School. "The disease is more mutable than we had thought."

The changing picture of what works to prevent heart attacks, and why, emerged only after years of research that was initially met with disbelief.

Early attempts to show that opening a narrowed artery saves lives or prevents heart attacks were unsuccessful. The only exception was bypass surgery, which was found to extend the lives of some patients with severe illness but not to prevent heart attacks. It is unclear why those patients lived longer; some think the treatment prevented their heart rhythms from going awry, while others say that the detour created by a bypass might be giving blood an alternate route when a clot formed somewhere else in the artery.

Some early studies indicated what was really happening, but were widely dismissed. As long ago as 1986, Dr. Greg Brown of the University of Washington at Seattle published a paper showing that heart attacks occurred in areas of coronary arteries where there was too little plaque to be stented or bypassed. Many cardiologists derided him.

Around the same time, Dr. Steven Nissen of the Cleveland Clinic started looking directly at patients' coronary arteries with a miniature ultrasound camera that he threaded into blood vessels. He found that the arteries were riddled with plaque, but almost none of it was obstructing blood vessels. Soon he began proposing that the problem was not the plaque that produced narrowings but the hundreds of other areas that were ready to burst. Cardiologists were skeptical.

In 1999, Dr. Waters of the University of California got a similar reaction to his study of patients who had been referred for angioplasty, although they did not have severe symptoms like chest pain. The patients were randomly assigned to angioplasty followed by a doctor's usual care, or to aggressive cholesterol-lowering drugs but no angioplasty. The patients whose cholesterol was aggressively lowered had fewer heart attacks and fewer hospitalizations for sudden onset of chest pain.

The study "caused an uproar," Dr. Waters said. "We were saying that atherosclerosis is a systemic disease. It occurs throughout all the coronary arteries. If you fix one segment, a year later it will be another segment that pops and gives you a heart attack, so systemic therapy, with statins or antiplatelet drugs, has the potential to do a lot more." But, he added, "there is a tradition in cardiology that doesn't want to hear that."

Even more disquieting, Dr. Topol said, is that stenting can actually cause minor heart attacks in about 4 percent of patients. That can add up to a lot of people suffering heart damage from a procedure meant to prevent it.

"It has not been a welcome thought," Dr. Topol said.

Stent makers say they do not mislead doctors or patients. Their new stents, coated with drugs to prevent scar tissue from growing back in the immediate area, are increasingly popular among cardiologists, and sales are exploding. But there is not yet any evidence that they change the course of heart disease.

"It's really not about preventing heart attacks per se," said Paul LaViolette, a senior vice president at Boston Scientific, a stent manufacturer. "The obvious purpose of the procedure is palliation and symptom relief. It's a quality-of-life gain."