

GEOMETRY OF BLOOD VESSELS MAY INFLUENCE HEART DISEASE

News from Ohio State University

The geometry of blood vessels may be a direct risk factor for developing cardiovascular disease, the cause of almost half the deaths in the United States.

A new study has found a relationship linking cardiovascular disease to the angle between an artery (which carries blood from the heart) and blood vessels branching off from the artery. The larger the angle, the greater the susceptibility to the build-up of plaque, which causes arteries to narrow and can lead to cardiovascular disease.

"These plaque lesions seem to have preferences for the branching points and the curved areas of arteries," said Morton Friedman, professor of biomedical engineering at Ohio State University. The study was published in a recent issue of the *Journal of Biomechanics*.

Friedman and Zhaohua Ding, a graduate student in biomedical engineering at Ohio State and co-author of the study, looked at hearts from 15 cadavers. They focused on the left anterior descending coronary artery, which supplies the main pumping chamber of the heart with blood, and the angles of smaller vessels branching from this artery. The geometry of these branches is similar to that of a straight tube with a side arm.

The researchers injected the coronary arteries of each heart with radiopaque gel. The gel allowed them to see X-ray views of the arteries from several directions. By looking under a microscope at sections of an artery, they found that the vessel was thicker around larger angles. "The results don't tell us the extent to which a larger branch angle makes a person more susceptible to developing cardiovascular disease," Friedman said.

Atherosclerosis, or narrowing of the arteries, starts as lesions form on a vessel wall. It can happen anywhere in the body, though some arteries are more susceptible to plaque development than are other areas of the body. "The place that you really don't want it to happen is in the coronary arteries," Friedman said. Atherosclerosis eventually prevents blood from flowing to the heart muscle.

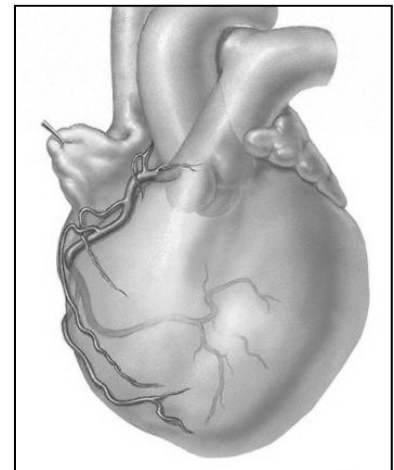
Friedman also said fluid mechanics plays an important role in vessels where plaque deposits and lesions form. Blood flowing around a bend, or through branches, places different shear stresses on vessel walls.

Although researchers don't fully understand the mechanism of plaque formation, they do know that thickening is likely to begin where shear stress is lower. The shear

stress in a vessel branch depends on its angle.

Other than following routine disease-prevention measures, little can be done about the risk factor branch angles pose. "It isn't a factor that's thought about in the same terms as diet, exercise, cholesterol or diabetes," Friedman said. "You would caution a person about their 'bad' branches and suggest things they could do to avoid potential cardiovascular disease."

The research was supported by the National Institutes of Health. Hearts were donated by the Ohio State's Department of Pathology, Louisiana State University and the University of Maryland.



The dominant right coronary artery gives several branches before continuing as the posterior-descending artery

Heart Disease Statistics

- Every 34 seconds a person in the United States dies from heart disease
- More than 2,500 Americans die from heart disease each day.
- Every 20 seconds, a person in the United States has a heart attack.
- At least 250,000 people die of heart attacks each year before they reach a hospital.
- Studies show that under-educated people are more likely to suffer heart attacks.
- The countries with the highest death rates from heart disease are the Soviet Union, Romania, Poland, Bulgaria, Hungary, and Czechoslovakia. The countries with the lowest are Japan, France, Spain, Switzerland, and Canada.
- Almost 6 million hospitalizations each year (in the United States) are due to cardiovascular disease.
- Since 1900, Cardio Vascular Disease has been the number 1 killer in the United States for every year but 1918.
- Every 33 seconds, a person dies from Cardio Vascular Disease in the United States.