Iron in coronary artery plaque is a marker of heart attack risk

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Plaque in a heart artery looks threatening, but cardiologists know that many of these buildups will not erupt, dislodge and block a vessel, causing a heart attack that can be fatal. Some will, however, and the challenge is to figure out atherosclerotic plaque that is dangerous and treat or remove it.

Now, researchers at Mayo Clinic have shown that iron, derived from blood, is much more prevalent in the kind of plaque that is unstable and is thus more likely to promote a myocardial infarction (MI) - heart attack - and possibly sudden death.

The team of researchers has demonstrated through a variety of experiments that iron buildup may be suitable as a marker of risk for a future MI, they reported today at the American Heart Association's Scientific Sessions 2010 in Chicago.

For example, they have found that Dual Energy Computed Tomography (DECT) and three-dimensional computerized tomography (CT) micro scans can detect excess iron in plaque, thus holding promise that in the future a scanning device might be able to noninvasively detect dangerous plaque formations in patients.

"We know that 70 percent of heart attacks are caused by unstable plaque, so what we really need for our patients is a way to identify the plaque that turns evil and puts them at jeopardy," says cardiologist Birgit Kantor, M.D., the study's lead researcher. "The scans we use now just

show narrowing of heart arteries from plaque buildup but that doesn't tell us if the plaque inside those vessels walls is imminently dangerous."

"We think it is possible, based on these findings, to use iron as a natural marker for risk," she says. Dr. Kantor predicts that probably 5-10 years will pass before novel diagnostic scanners to identify these plaques become available in cardiology clinics.

Testing iron as a marker in human arteries

Excess iron in atherosclerotic plaque was noticed decades ago, but little research followed up on that observation, Dr. Kantor says. "The hypothesis then was that iron was the poison that created the plaque, but that was never proven and is in fact unlikely."

Cardiologists now know that plaque can be classified as stable or unstable. Mayo Clinic researchers believe that the amount of iron in the plaque can be seen as a "readout" of prior hemorrhagic, or bleeding, events that put a person at risk for plaque eruption.

In normal heart arteries, small blood vessels known as vasa vasorum bring nutrients to the vessel wall, and when plaque starts to build up inside the artery wall, some of these tiny vessels grow as well to feed them. These vessels can rupture, depositing iron, a component of blood, into the growing plaque. This unstable plaque, which has a large core of dead cells covered by a thin fibrous cap, can eventually rupture, forming a big blood clot that can shut down a heart artery.

"This kind of plaque can bleed and heal, bleed and heal, depositing iron into the buildup," Dr. Kantor says. "This plaque is at risk of breaking up and causing a heart attack."

To conduct this study, the researchers used samples from a unique Mayo

Clinic biobank of heart arteries collected over time from autopsies of 400 patients who died from a suspected heart attack. Small sections from the three main coronary arteries of each patient have been preserved.

In this study, pathologists examined 97 artery samples and separated them into stable and unstable groups based on their appearance under a microscope (dead zones and fiber cap). They classified 31 plaques as stable, 24 as "vulnerable," and 22 as normal and then linked them to patient clinical records to see which patients died from a heart attack.

Then Yu Liu, M.D., Ph.D., the study's first author, applied a stain to the samples to detect iron content. She found iron content in the unstable plaque group was significantly higher than in the other groups. Iron was absent in normal arteries.

In a third step, the researchers scanned a subset of the artery segments using a benchtop micro-CT scanner, and created 3-D images to look for iron deposits in plaque. The CT could identify iron in plaque without the need for staining. "There was a high correlation between the vulnerability of the plaque and the quantity of iron in it," says Dr. Kantor.

Still, non-invasive imaging for plaque does not yet have the necessary resolution to differentiate high risk from low risk plaque in patients, she says, and so the research team is testing other imaging modalities such as photon counting that can overcome these barriers.

Provided by Mayo Clinic