Oxygen damage: Role in preeclampsia?

Roughly 7 percent of pregnant women develop preeclampsia, a potentially fatal disorder of unknown origin that appears during the last trimester. It can involve a number of symptoms, including sudden weight gain, swelling of the face and fingers, headaches, abdominal pain and high blood pressure. Delivery of the baby remains the only cure. But one small study offers new insights into this mysterious ailment – and hints at a possible vitamin treatment.

Margaret K. McLaughlin and her colleagues at the University of Cincinnati College of Medicine noted two provocative preeclampsia findings emerging from a growing but diffuse body of research. First, blood from affected women possesses evidence of greater lipid damage than the blood of healthy women, including pregnant women. Second, some unidentified factor in the blood of preeclamptic women – perhaps a product of that lipid oxidation – makes their blood serum more toxic to endothelial cells, such as those lining blood vessels.

In a new study reported in the June OBSTETRICS AND GYNECOLOGY, McLaughlin, Sandra T. Davidge and their team found that blood from preeclamptic women possesses a strikingly lower ability to inhibit biologically damaging oxidation than does blood from other pregnant women. The researchers assayed spontaneous oxidation of tissue from sheep brains, alone or in the presence of human blood serum. Serum from nonpregnant individuals inhibits oxidation by about 45 percent. But as pregnancy progresses, McLaughlin and her co-workers found, the blood's capacity to inhibit oxidation typically doubles, reaching 90 percent.

The big surprise, McLaughlin says, is that in terms of inhibiting oxidation, serum from preeclamptic women "looks nonpregnant" – that is, it appears not to inhibit oxidation by more than about 45 percent.

This striking difference in oxidation inhibition between women with normal and preeclamptic pregnancies suggests either that the disease occurs when women have insufficient antioxidants "or, more likely, that they used them up because there's a lot of [oxidative] injury going on," says James M. Roberts, an obstetrics researcher at the University of Pittsburgh's medical school. If it turns out that excess oxidation products cause the vascular effects of preeclampsia, treatment might be as simple as administration of antioxidant vitamins, Roberts suggests.

And that's exciting, he says, because while some preventive therapies can reduce a woman's risk of preeclampsia, "nobody's ever shown any treatment that works once a woman is sick." – *J. Raloff*

Teasing out dietary cholesterol's impact

To defend their predilection for meat and dairy products, many people cite nutrition studies indicating that cholesterol consumption has little, if any, effect on cholesterol levels in the blood. Cardiologists counter by citing other studies linking dietary cholesterol to significant elevations in serum cholesterol and an increased risk of heart disease.

Who's right? Both, according to a preventive cardiologist from the University of Utah in Salt Lake City.

Paul N. Hopkins pooled data from 27 studies comparing dietary and serum cholesterol levels. Such meta-analyses hunt for trends statistically masked within the smaller, component studies. His findings, detailed in the June AMERICAN JOURNAL OF CLINICAL NUTRITION, appear to reconcile the seemingly divergent data on cholesterol. As a rule, the new analysis shows, the higher an individual's initial serum and dietary cholesterol levels, the less likely that raising or lowering dietary cholesterol will alter serum cholesterol.

So for most people, another egg or two per day should produce little change in blood cholesterol, Hopkins says. Why? Since the 400 milligrams of cholesterol contained in the typical U.S. daily diet have already saturated the body's need for the fat-like substance, any additional cholesterol accumulates in the liver rather than the blood. On the other hand, for people who typically eat less than 160 mg of cholesterol daily, such as Mexico's Tarahumara Indians, an extra egg or two might seriously spike their naturally low serum cholesterol.

Hopkins notes that genetics plays a far larger role than baseline cholesterol-consumption patterns in determining a person's responsiveness to dietary cholesterol – accounting for about 50 percent of the variability seen in the populations he studied.

Within the diet, saturated fat remains the most important single influence on serum cholesterol levels. Hopkins says dietary cholesterol probably accounts for most of the remaining variability seen – perhaps some 20 percent.

One of the biggest surprises, Hopkins observed, "is how easily the liver is saturated [with cholesterol]," a finding whose significance has not yet been studied. That saturation takes only 400 to 500 mg per day – the equivalent of two eggs. – *J. Raloff*

Galactic black hole: X marks the spot?

It looks more like a pirate's treasure map than a picture taken by the Hubble Space Telescope. Researchers this week released a Hubble photo depicting a dark X that may mark the exact location of a black hole believed to be hiding at the heart of a spiral galaxy called M51.

When Hubble radioed the image to Earth late last year, technicians at NASA's Goddard Space Flight Center in Greenbelt, Md., were so captivated with the bizarre graphic that they immediately brought it to the attention of Admiral Richard Truly, then administrator of NASA. But the image – along with other recent Hubble findings – is proving far more than a pictorial curiosity, says Holland C. Ford, an astronomer with Johns Hopkins University and the Space Telescope Science Institute in Baltimore. The observations suggest that M51 and some of its relatives, all of which sport moderately luminous centers, share a common lineage with a group of galaxies known as Seyferts, which possess cores 100 times as bright.

"This tells us there's a real continuity in physical phenomena from the most luminous to the least luminous; we don't have a half-dozen different galaxy types that we're dealing with," says Ford. He presented the findings June 8 at a meeting of the American Astronomical Society in Columbus, Ohio.

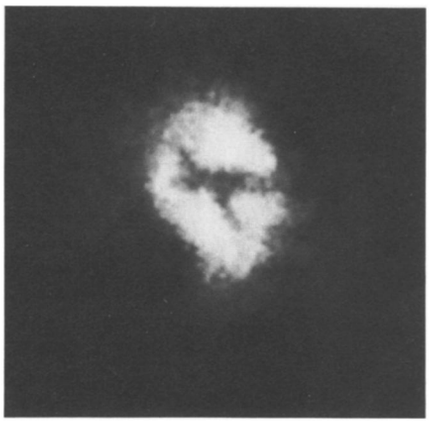
For years, astronomers have suspected that relatively small black holes fuel the energetic activity found at the core of M51 and several other galaxies, called LINERs (for low-ionization narrow emission-line region), just as larger black holes may power the more luminous cores of Seyfert galaxies. But the theory faced a major obstacle: As observed from Earth, not all LINERs and Seyferts radiate in the same pattern.

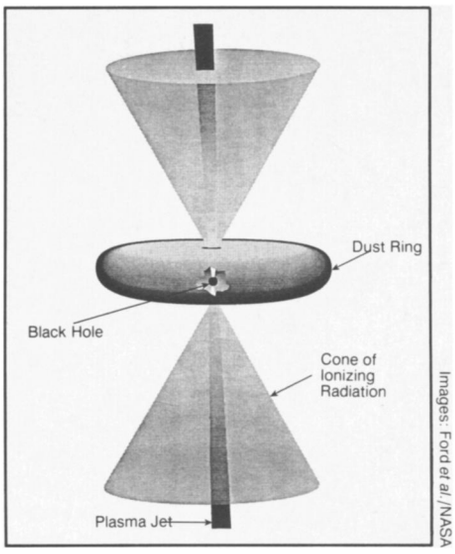
To address that problem, researchers speculated that the differences might stem from the orientation of doughnut-shaped clouds of gas and dust thought to surround the proposed black holes in these galaxies. Viewed edge-on, such a doughnut would hide the black hole, and the galaxy's center would seem to emit only narrow bands of light. However, an observer looking at the ring face-on – straight through the hole of the doughnut – would probably detect a wide band of frequencies. Thus, a diverse group of galaxies with active nuclei might possess similar powerhouses.

But another problem remained: No one had ever found direct evidence of a dusty doughnut.

Ford and his colleagues weren't looking for the elusive structure when they used Hubble's wide-field/planetary camera to study M51's nucleus last December. They

Hubble image (near right) shows dark X against the nucleus of the galaxy M51. The X may mark a black hole with as much mass as a million suns. The wider arm of the X may represent a dust ring seen edge-on. Drawing (far right) depicts dusty, light-obscuring ring that may hide a black hole at M51's center. Recent evidence suggests that the dusty ring determines the direction in which jets of hot gas are ejected from the vicinity of the black hole. The ring may also confine radiation – emitted by infalling matter – in oppositely directed cones that ionize gas caught in their beams.





Images: Ford et al./NASA

merely wanted to follow up on ground-based radio and optical observations of M51, a flat, spiral galaxy seen nearly face-on from Earth. Those studies had provided tantalizing evidence that M51 has an active nucleus: Its core contains hot, ionized gas moving at speeds of up to 2 million miles per hour, as well as material packed into two gas-inflated bubbles.

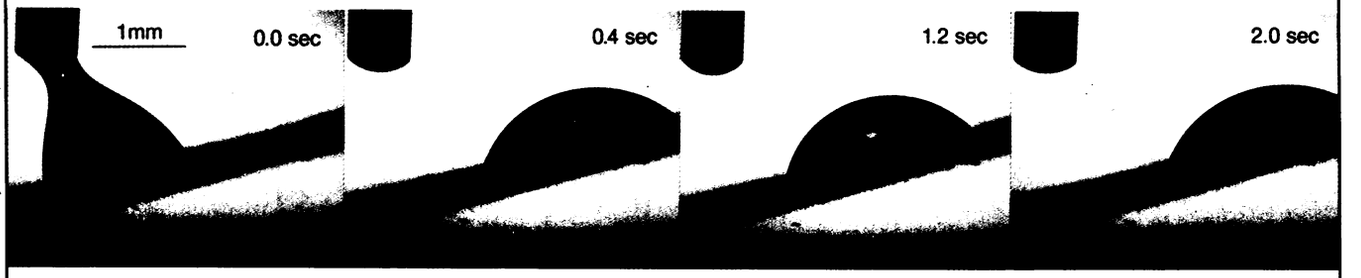
Two newly released Hubble images provide the sharpest views yet of M51's core. One shows a pair of cone-shaped searchlights streaming out from the center in opposite directions, each leaving a glowing trail of ionized gas. The other image, taken at a different wavelength, shows the dark X, with the fatter arm bisecting the apex of the twin searchlights.

Ford and his co-workers propose that this arm represents an edge-on view of the doughnut that researchers have long sought – a rotating ring of cold gas and dust that somehow got tipped out of the plane of the flattened galaxy. The doughnut may obscure the "central engine" – the presumed black hole at the core of M51 – as well as infalling material from an inner disk of hot gas needed to feed the black hole. The researchers speculate that the doughnut, about 100 light-years in diameter, also directs the ionizing radiation emitted by the infalling matter. Light passing through the hole would emerge as twin cones, similar to the image Hubble obtained.

Since a rotating doughnut has a characteristic light spectrum, researchers intend to test these ideas by analyzing emissions near the fat arm of the X. This week, astronomers will analyze spectra taken with a telescope in Hawaii. Later this year, Ford's team plans to use Hubble's faint-object spectrograph for a similar study.

The thinner arm of the X remains a puzzle. It could represent a second doughnut seen edge-on or gas and dust interacting with the galaxy's energetic core, says Ford. In either case, it indicates that astronomers still don't fully understand what drives the fireworks at the center of M51. *– R. Cowen*

Chemical tug can make water flow uphill



Chaudhury & Whitesides/SCIENCE

No photographic illusion, this water droplet really is charging uphill. Under the right conditions, water defies gravity and slips up a slope (left to right), even when the surface tilts 15° upward, says Manoj K. Chaudhury, a physicist at Dow Corning Corp. in Midland, Mich. He and Harvard University chemist George M. Whitesides worked this trick by exposing a silicon wafer to a plume of a silicon-carbon chlorine compound called decyltrichlorosilane.

The vapor plume makes the wafer surface hydrophobic, or water repelling. The scientists distribute the vapor so that more reacts with the lower end of the wafer and less at the top. Because water tends to move toward the least hydrophobic surfaces, it will slide upward, Chaudhury explains. By varying the wafer's time of exposure to the vapor, the scientists control the degree of difference between water-repelling properties of the top and bottom edges of the wafer.

The researchers treated a 4-centimeter-long wafer, put a 1-microliter drop on it and photographed the drop's movements over a 5-millimeter-long section. The gradient in the wafer's hydrophobic properties causes a gradient in the surface tension experienced by the droplet, says Chaudhury. The front edge of the drop feels a more attractive force than the back edge, so the drop oozes upward at rates of 1 to 2 millimeters per second. On flat surfaces, larger drops move faster than smaller ones, but tinier ones move more readily on slopes, the scientists report in the June 12 SCIENCE.

In the past, other researchers created temperature gradients to push a drop uphill, "but nobody has shown this using a chemical gradient like we did," Chaudhury says.

French theorists predicted several years ago that scientists could use hydrophobic forces to move water. But to get the chemical gradient to work, Chaudhury and Whitesides discovered they needed to make the surface very smooth and free of defects. "Once you know how to do it, it's simple," says Chaudhury. They have made other liquids slide uphill as well, including thick ones.

Though done to satisfy the scientists' curiosity, this experiment could lead to a better understanding of fluid dynamics of individual drops, especially the physics involved at the junction of air, liquid and solid boundaries, Chaudhury says. It will also aid in the study of the interaction of thermal and chemical forces on drop movements, he adds.