Duerr and others voice some caveats about the study, however. They point out that the monkeys were exposed to cell-free SIV, while human oral exposure would be more likely to occur through infected cells, which may make it harder to establish an infection in the recipient. There is also evidence that human saliva can render HIV less infectious. And the rectal tests may provide no indication of the relative risks of oral versus anal intercourse, because anal intercourse causes microlesions that can make it easier for the virus to get into the bloodstream.

Christopher Miller, a primate researcher at the University of California, Davis, isn't surprised by the data, however. He and his co-workers have a paper in press that also shows that monkeys can routinely be infected by oral exposure to SIV. Miller suggests that the high rates of oral infection may be because adult, captive primates often have gingivitis in the junction between the teeth and the gums, setting up a route of infection similar to the lesions caused by anal intercourse. Ruprecht counters that the animals her group used were young and had no obvious gingivitis. She suggests that the mechanism of transmission might be through the tonsils, which make a good home for HIV-1, as Ralph Steinman and Melissa Pope at Rockefeller University in New York, working with Sarah Frankel and colleagues at the Armed Forces Institute of Pathology in Washington, D.C., recently reported in *Science* (5 April, p. 115).

Brown's Mayer says he expects the new monkey data will be a hot topic at the international AIDS conference in Vancouver next month. "I think it's going to lead to a lot of discussion, and I hope it makes people take pause," says Mayer. "Right now, there's a certain amount of complacency because of the epidemiology." Duerr notes that CDC recommendations already call for using a condom during mouth-to-penis contact.

Ruprecht is quick to acknowledge that the data in her paper raise more questions than answers. But at the very least they are a further reminder that, until the precise mechanisms of HIV transmission are known, it is safer to refer to "safer" sex.

–Jon Cohen

HEART DISEASE

Chlamydia Linked to Atherosclerosis

For decades, an odd group of bacteria called *Chlamydia* has given microbiologists a series of surprises. These pathogens, once known chiefly for causing illness in parrots, were originally thought to be viruses because they can only grow inside animal cells. Then *Chlamydia* turned out to be behind several sexually transmitted diseases. And in the 1980s, microbiologists recognized that an unusual pear-shaped form was a new species, *C. pneumoniae*, which accounts for about 10% of pneumonia cases—and probably infects most people at one time or another.

Now the *Chlamydia* story is taking an even more startling turn. A small but growing stack of papers links *C. pneumoniae* with atherosclerosis, the clogging and hardening of the arteries that lead to half the deaths in the United States. The latest look at this association, reported in the June issue of the *Journal of the American College of Cardiology*, turned up a surprisingly high incidence of *Chlamydia* in the arteries of patients with atherosclerosis, but found little sign of the pathogen in arteries damaged after heart transplants. The results are spurring additional research on the crucial—and difficult—question of whether the link is causal or merely coincidental.

E. HAMMOND

Heart attackers. *Chlamydia* antibodies glow in diseased artery.

A link between a pathogen and atherosclerosis is "a fascinating idea," says University of Wisconsin cholesterol researcher Alan Attie. But researchers are cautious, because infection theories have come and gone in the past. "I don't think anybody is convinced that [the link] is causal," says University of Chicago pathologist Robert Wissler, "but [the] evidence makes you want to study the whole thing further."

Chlamydia was first connected to atherosclerosis during a screening for infectious agents in heart patients in Finland, reported in 1988 by Pekka Saikku of the University of Helsinki. Epidemiologist J. Thomas Grayston at the University of Washington and colleagues followed up, expecting to disprove the link. "I thought it was unlikely," says Grayston, a respiratory pathogen expert who first identified *C. pneumoniae* as a new species.

Instead, Grayston and others found that heart patients with atherosclerosis generally had high levels of antibodies to *C. pneumoniae* in their blood as compared with controls. The organism itself could be detected in an average of 50% to 60% of diseased coronary arteries. In a paper in the 15 December issue of the journal *Circulation*, Grayston's group extended the findings to carotid arteries as well.

Many of these studies lacked controls, in part because they are hard to find: Atherosclerosis is present at some level in most adults. But in the most recent report, Utah cardiologist Joseph B. Muhlestein and colleagues compared tissue from patients treated for atherosclerosis at LDS Hospital in Salt Lake City with control tissue from people who died of other causes. They tested fresh artery tissue from 90 patients with a *Chlamydia*-specific antibody and found a positive result in 79%—"a very high incidence," says the group's pathologist, Elizabeth H. Hammond. "We were shocked." Of the 24 control specimens, only one, or 4%, showed any sign of the antibody. Additional, unpublished control samples also show no evidence of *Chlamydia*, adds Hammond.

Even though the number of controls is small, the result is important, says Grayston, because the contrast between the two groups is so clear-cut. What's more, the Utah team's controls included 12 samples from people who had undergone heart transplants. The absence of *Chlamydia* in this tissue is especially significant, the Utah researchers say, for these arteries are damaged, but not by atherosclerosis. Thus their results may imply that *Chlamydia* is linked to atherosclerosis itself, not simply to damaged arteries.

Both the Utah and Washington groups are now running studies in animal models of atherosclerosis to investigate how *Chlamydia* travels from the respiratory system to the arteries, and what it might do once it gets there. The ultimate goal is to learn whether the presence of the bacterium is a coincidence or a cause of the fat and cell buildup in arteries. Because atherosclerosis is considered to be a response by the blood vessel to some sort of injury, says Attie, it is plausible that bacterial infection could contribute to the injury, along with such established factors as high cholesterol.

Still, wary physicians note that atherosclerosis has been associated with infections ranging from periodontal disease to herpes, but there's still no conclusive proof that an infectious agent plays the primary causal role in most cases of heart disease. And all sorts of innocent organisms can flock to the scene once a tissue is damaged. "Passengers occur in diseased tissues over and over again," says Wissler.

Yet he and other researchers are mindful of one striking infection theory that didn't go away: Peptic ulcers, long blamed on too much stomach acid, are in most cases the result of infection by the bacterium *Helicobacter pylori*. Whether *C. pneumoniae* will follow in *H. pylori*'s tracks remains to be seen, but Grayston, for one, wouldn't be surprised. "They've always been a fascinating group of bugs," he says.

–Christine Mlot

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