Kids: Getting under Mom's skin for decades

The bond between mother and child is unbreakable. Sentimental nonsense? Perhaps not. Investigators have found that descendants of fetal cells that escape into the maternal bloodstream during pregnancy may persist for decades after the birth of the child.

"We're finding male DNA [among maternal blood cells] 27 years after the birth of a male child," says Diana W. Bianchi of the New England Medical Center in Boston.

This unexpected discovery suggests that fetal cells can take up permanent residence in the mother and that pregnancy sometimes transforms a woman into a chimeric blend of mother and child, Bianchi and her colleagues report in the Jan. 23 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

This finding may offer clues to the mechanisms underlying autoimmune disorders, organ rejection, and even miscarriages.

"I think there are broad ramifications," says J. Lee Nelson of the Fred Hutchinson Cancer Research Center in Seattle. Nelson studies the interplay between pregnancy and the immune system to understand why more women than men suffer from autoimmune disorders such as rheumatoid arthritis (SN: 10/23/93, p. 266).

Bianchi and her colleagues came across the persistent fetal cells while evaluating a new technique for diagnosing genetic diseases in the fetus. The method consists of identifying escaped fetal cells in a mother's blood and examining the cells' DNA, a less invasive strategy than traditional diagnostic methods, such as amniocentesis, notes Bianchi.

Researchers had a concern about the accuracy of the technique, however. They worried that fetal cells from earlier pregnancies might interfere with the testing of a current pregnancy. Fetal cells can clearly survive in the mother's bloodstream after delivery of a baby, but how long their descendants persist is not clear, says Bianchi.

In the new technique, researchers first look at proteins on the surfaces of blood cells to identify fetal cells. Most maternal blood samples, notes Bianchi, contain very few fetal cells.

After isolating the cells, the investigators use a method called polymerase chain reaction (PCR) to see whether the cells contain a Y chromosome. If they do, the cells came from a male fetus.

In their initial experiments, the Boston group detected male DNA in fetal cells obtained from many pregnant women who later gave birth to daughters. To determine whether laboratory error or contamination had skewed those PCR results, the investigators examined four women who had given birth to sons but were currently pregnant with female fetuses. In all four cases, they found male DNA, adding credence to the belief that cells from earlier fetuses persist.

The Boston group then examined eight women who were not pregnant but who had given birth to a son in the past 3 decades. Six of the eight had fetal cells with a Y chromosome—including one woman who had her last son 27 years ago.

Investigators do not rule out the use of blood-derived fetal cells for prenatal diagnosis, however. They note that the persistent fetal cells have a distinctive profile of surface proteins. This profile should enable researchers to distinguish them from fetal cells that stem from a current pregnancy.

"We thought people should be aware of this potential complication, but you can easily avoid it," says Bianchi.

Specifically, she and her colleagues say they wanted immunologists, such as Nelson, to be aware of the cells' continued existence. Nelson has shown a possible mechanism by which the genetic differences between a mother and her fetus may affect the mother's immune system and ameliorate symptoms of rheumatoid arthritis during pregnancy.

Nelson does not believe that escaped fetal cells play a role in this particular phenomenon. She does suggest that they may help explain other autoimmune disorders, such as the sometimes fatal skin disease called scleroderma, that occur more often in women than men.

Such disparities are usually attributed to differences in men's and women's sex hormones. Nelson, however, contends that hormones can't explain everything and that other sex-specific phenomena are crucial.

"The most obvious thing that separates the sexes is pregnancy," she notes.

If fetal cells establish residence in a mother's bone marrow or other parts of the body, another unknown event may trigger the mother to react against the fetal cells or the cells to react against the mother, says Nelson.

Nelson also recommends that investigators examine whether the creation of a chimeric woman affects the outcome of future pregnancies, perhaps even by causing miscarriages.

Finally, Nelson speculates that study of the enduring fetal cells may suggest ways to prevent rejection of transplanted organs. "If we can understand how those cells happily survive in the mother, it may give us clues to mechanisms of tolerance," she says. —*J. Travis*

Making waves with sound velocity in water

The speed of sound in water is about 1,500 meters per second. When water freezes, this speed rises to about 4,000 meters per second. This behavior exemplifies the general rule that, for any given material, sound waves travel faster in the solid phase than in the liquid.

However, this rule doesn't necessarily hold for all wavelengths, reports Francesco Sette of the European Synchrotron Radiation Facility in Grenoble, France. His team has discovered that sound waves with wavelengths between 0.5 and 3 nanometers travel at the same velocity in both water and ice.

"These results show that, despite the fundamental structural and dynamical differences between water and ice, the dynamical response of the two phases is strikingly similar at very short wavelengths," the researchers conclude in the Feb. 8 NATURE. These wavelengths are roughly equivalent to the spacing between molecules in the material.

The passage of a sound wave through a solid or liquid involves the cyclic displacement of atoms or molecules from their normal positions. As the wave travels through the material, particles get pushed closer together, then farther apart.

For wavelengths considerably longer than the interparticle spacing, the speed at which a sound wave moves depends, in part, on the orderliness of the material. A high degree of order, as in a crystalline solid, allows the wave to travel more quickly than in the same material's more disorganized liquid form.

At shorter wavelengths, this long-range order has less impact on the wave's speed. Instead, microscopic processes such as bonding between molecules and factors such as molecular structure would probably have an enhanced influence on wave propagation.

Sette and his coworkers used X rays to generate short-wavelength sound waves in water at 4°C and ice at -20°C. By precisely measuring changes in the wavelengths of reflected X rays, they could determine how much energy went into the materials and then deduce the characteristic velocity of any high-frequency, collective excitations resulting from the interaction.

From these measurements, the researchers concluded that sound waves with wavelengths less than 3 nm travel through both water and ice at 3,200 meters per second. This value is more than twice the speed of long-wavelength sound in water but less than its speed in ice.

The findings suggest that, for these particular excitations, the interactions between particles in both water and ice have strikingly similar characteristics.

"This result, so far, is specific to water," the researchers caution, "and it will be of great interest to investigate the behavior of other liquids." —*I. Peterson*