Biomedicine

Child-to-toddler HIV transmission

More than 15 studies have shown that HIV, the virus that leads to AIDS, doesn't spread between family members just because they live together. But researchers now report a case in which an uninfected toddler got the virus from an infected child living in the same household. Both were born to mothers infected with HIV, but only the one child got the virus from its mother, says Donald T. Dubin, a molecular geneticist at the Robert Wood Johnson School of Medicine in Piscataway, N.J.

Dubin and his colleagues base this conclusion on the high degree of similarity between the viruses in the two youngsters. In addition, the genetic makeup of the HIV infecting the toddler did not match closely that of its mother's HIV, they report in the Dec. 16, 1993 New England Journal of Medicine. Furthermore, the same genetic mutation in both children's HIV made the virus resistant to AZT, an anti-HIV agent, even though only the child with the initial infection had been treated with this drug.

No sexual abuse had occurred, and the uninfected toddler was not known to have had contact with blood from the infected child, says Dubin. However, the two often played and sometimes slept together and used the same toothbrush. The child with HIV often suffered ear- and nosebleeds and bled after brushing its teeth. The toddler often had a rash. The researchers suspect that unobserved transmission occurred through contact with infected blood.

"It's important not to overreact or be alarmist about [this finding]," warns Dubin, who calls for parents and caregivers to be sure to follow the existing guidelines for handling infected blood. Likewise, Robert J. Simonds and Martha F. Rogers at the Centers for Disease Control and Prevention in Atlanta say that HIV-infected children should not be excluded from schools, homes, or day-care centers. They stress that this report represents a rare, unusual occurrence. In an editorial accompanying the Dubin report, they also emphasize the need for proper infection-control procedures to be practiced where children with AIDS live, learn, and play.

Immunologists engineer weak-boned mice

Researchers studying the function of an immune-system messenger called interleukin-4 (IL-4) have inadvertently created a strain of mice that develops osteoporosis. In osteoporosis, bone thins until it becomes fragile and breaks easily. These newly created mice contain a gene that causes them to make excess IL-4. "It appears that the IL-4 is somehow decreasing the production of new bone," says David B. Lewis, an immunologist at the University of Washington in Seattle.

The scientists had wanted to know how increasing the amount of this messenger in the body affects the production of immune system components called T-cells. For some reason, that genetic change also causes both male and female mice to become more and more hunchbacked during their first few months of life, says Lewis. Their bones are translucent and become progressively thinner and more oval compared to normal mice, he and his colleagues report in the Dec. 15, 1993 Proceedings of the National Academy of Sciences.

Typically, two kinds of cells continually remove and replace old bone. Osteoporosis can develop when bone-building cells slack off or bone-eating cells become overactive, Lewis explains. The skeletons of the mice seem to develop normally, but after birth they begin to lose bone mass.

The scientists have monitored these mice for 12 generations and know that half of each litter develops very predictable bone weakening. They hope other researchers will use the mice to study ways to rev up bone-building activity and, possibly, to develop new treatments for osteoporosis. Meanwhile, Lewis and his colleagues are looking at what happens if they block the effects of IL-4; they hope to see less bone loss.

Energy

Energy record set in magnetic fusion

Taking another step along the long road to extracting energy from the fusion of atomic nuclei, researchers at the Princeton University Plasma Physics Laboratory last month achieved record levels of controlled fusion power. Using a magnetically confined mixture of equal parts of deuterium and tritium (heavy isotopes of hydrogen) as fuel, they generated more than 3 million watts of power in a burst lasting about 1 second. In subsequent tests, they raised the fusion reactor's output to more than 5 million watts.

The Princeton results handily beat the previous fusion power record of 1.7 million watts, set in 1991 at the Joint European Torus (JET) laboratory in Culham, England (SN: 11/16/91, p.308). Nonetheless, the Princeton reactor produced only about one-eighth as much energy as it required to create and maintain the high-temperature plasma of charged particles within which nuclear fusion takes place.

The experiments, conducted at the Tokamak Fusion Test Reactor, will continue through most of 1994. Researchers hope to reach a power output of 10 million watts, and they expect these investigations will yield data important for the design of future reactors. The reactor, contaminated with radioactive tritium, will be closed down and dismantled after the experiments are completed.

Accelerator route to nuclear energy

There's more than one way to generate nuclear energy. Researchers have already explored various ways of harnessing both nuclear fission and nuclear fusion using atomic nuclei ranging from hydrogen to uranium and plutonium. Now, physicist Carlo Rubbia, director of the European Laboratory for Particle Physics (CERN) in Geneva, Switzerland, has announced an alternative scheme. The technique requires the use of particle accelerators to supply neutrons to drive fission reactions involving thorium-232, an isotope of a plentiful, radioactive metal.

In essence, a high-energy beam of protons shot at a target made up of heavy atomic nuclei knocks out neutrons. Collisions between these neutrons and thorium nuclei transform thorium-232 into uranium-233. Hit by additional neutrons, uranium-233 nuclei rapidly split in two, releasing energy and additional neutrons. These neutrons induce further production and fission of uranium-233, but at a level insufficient to keep the reaction going on its own. The proton accelerator simultaneously supplies extra neutrons to help sustain the nuclear reaction.

Rubbia concedes that his idea is highly speculative. But he argues that his proposal — still very much at the theoretical stage and based on sophisticated computer simulations — would reduce the risk of serious accidents, produce no long-lived radioactive waste, and eliminate unwanted, lethal by-products such as plutonium. He believes that a working reactor could be developed quickly using existing technology. In one possible design, the thorium fuel itself serves as the target of the proton beam, and water used to cool the device also slows neutrons to increase their interactions with nuclei.

However, critics have questioned Rubbia's claims, and many nuclear experts are skeptical that such reactors would be economically feasible and competitive with other nuclear reactor designs. At the same time, Charles D. Bowman of the Los Alamos (N.M.) National Laboratory has disputed the novelty of Rubbia's scheme. Bowman and his group recently filed a patent on a similar accelerator-based technique, which would be used not only for generating power but also for transmuting radioactive waste into elements safer to handle.

Undaunted, Rubbia plans to continue developing his concept after he retires as CERN director at the end of this year.