Biomedicine

DES sons show changes in brain function

In the 1950s and 1960s, physicians commonly prescribed a drug called diethylstilbestrol (DES) to prevent miscarriage and premature birth. The safety of the drug, a synthetic form of the sex hormone estrogen, was first challenged in 1971. Since then, numerous studies have found that daughters of women who had taken DES during pregnancy ran an increased risk of developing a rare cancer of the vagina and cervix. For DES-exposed sons, some studies demonstrated a link between the drug and genital abnormalities.

A scientific report in HORMONES AND BEHAVIOR (vol. 26, p.62-75) finds statistically significant evidence that males exposed to DES in the womb may undergo subtle alterations in brain function.

"This is the first evidence in human males that prenatal exposure to sex hormones — specifically DES — is involved in the development of both brain organization and sex-differentiated cognitive abilities," says principal investigator June M. Reinisch of the Kinsey Institute for Research in Sex, Gender, and Reproduction at Indiana University in Bloomington.

Reinisch and her colleague Stephanie A. Sanders, also at the Kinsey Institute, began their investigation by recruiting 10 male subjects age 9 to 21 who had been exposed to DES in the womb but who showed no signs of DES-related birth defects. The researchers also recruited 10 male siblings in the same age group who had not been exposed to DES during gestation.

The subjects and their brothers then took the Witelson Dichhaptic Shapes Test, an evaluation that measures brain lateralization, or the tendency to use one side of the brain while completing a task. The participants were first told to reach into a box containing unfamiliar geometric shapes, Sanders explains. After feeling the shapes, the subjects had to match the shapes in the box with those depicted in a picture, she says.

Correct matches among the DES-exposed group were evenly distributed between both hands, a response that is more typical of the way girls and women score on this test. (Men and boys tend to get better scores with the nonpreferred hand.) The brothers in the control group showed the typical male pattern. Both groups got the same number of right answers, Reinisch points out.

It may be that DES-exposed males use both sides of the brain in matching the shapes, a trait most commonly seen in females. That doesn't mean that DES-exposed males are more feminine than their nonexposed brothers, the researchers emphasized. The test results simply mean they go about the task differently than their brothers.

The researchers also administered another test, the Wechsler Intelligence Scales, to the boys and young men in the study. They discovered that the DES-exposed group scored lower than their nonexposed brothers on a spatial component of the test. In that component, subjects have a certain amount of time to find missing parts of a picture, complete a jigsaw puzzle, and perform other tasks that measure spatial ability. Males tend to perform better than females on this component, and the DES-exposed males again followed the feminine pattern.

These results do not suggest that males exposed to DES in the womb are less intelligent than their nonexposed brothers, Reinisch cautions. In fact, the overall IQ test scores for both groups were about the same, she notes.

However, Reinisch and Sanders believe that exposure to DES in the womb does — in a very subtle way — change the way men approach certain tasks, especially spatial tasks. The researchers believe that by studying DES exposure, they may be better able to understand the powerful effects of natural hormones on the fetal brain before birth. Such research might help explain possible gender differences in the way the human brain functions, they say.

Chemistry

Chinese nanocheckers

A new technique for making glass wafers riddled with regularly spaced, nanometer-size holes promises to help shrink microelectronics components to microscopic proportions.

Already this process has produced glass arrays that pack 30 billion channels, each 33 nanometers in diameter, into a square centimeter of glass, says Ronald J. Tonucci, a physicist at the Naval Research Laboratory in Washington, D.C. He and his colleagues expect to halve that diameter. They have also modified the technique to make patterns as well as periodic arrays, Tonucci told SCIENCE NEWS.

The scientists begin by inserting a 1- to 2-inch-wide rod of acid-etchable glass into a close-fitting tube of glass that does not dissolve in acid. They heat the filled tube and draw it into a thin filament. They then bundle many of these filaments together and heat and draw the bundle. The scientists repeat the process several times, they report in the Oct. 30 SCIENCE. Their success depends on picking and processing the glasses very carefully, says Tonucci. Otherwise, the glasses might fuse during the 40-hour processing time.

As a final step, the scientists dissolve the acid-etchable glass, leaving behind an array of holes or tubes that can serve as molds for making nanometer-size semiconductors, says Tonucci. This technology can also yield lithographic masks that hold their shape at higher temperatures than most metal and plastic masks used today. Moreover, "it's possibly the world's smallest glass Chinese checkers board," Tonucci adds.

In their latest work, the scientists start with very fine glass filaments, bundling acid-etchable and non-acid-etchable ones in specific configurations, says Tonucci. With this technique, they hope to mass-produce intricate patterns.

Dual design for "coal-fired" fuel cells

Burning coal to fuel power plants represents a relatively inefficient way of transforming the energy tied up in carbon's chemical bonds into electricity. In addition, attempts during the last century to make carbon-based fuel cells first required converting the element to carbon monoxide, which also reduced the efficiency of energy production, says Turgut M. Gür, an electrochemist at Stanford University.

Now, Gür and Robert A. Huggins from the Center for Solar Energy and Hydrogen Research in Ulm, Germany, report in the October JOURNAL OF THE ELECTROCHEMICAL SOCIETY that a two-compartment, high-temperature fuel cell can use raw carbon.

"It's just a preliminary experiment," Gür says, "but it demonstrates that one can, without pretreatment, convert the chemical energy of coal [directly] into electrical energy. This has not been shown before."

In the fuel cell, one compartment houses a yttria-zirconia tube, which transports oxygen to the carbon. The other holds carbon pellets. The dual-chamber design lets the researchers regulate the temperature of the carbon and of the zirconia independently. Thus, they can heat the zirconia electrode to 800°C yet leave the carbon cool enough — below 700°C — that it combines with oxygen to form carbon dioxide rather than carbon monoxide. That reaction doubles the energy yield per carbon atom, say Gür and Huggins. However, the carbon and oxygen tend to react much more slowly at this lower temperature. Consequently, the prototype fuel cell does not generate sufficient current or power to be of practical use, they add.

By using a fluidized bed of fine coal bits, they expect to increase the surface area of carbon exposed to oxygen and speed up the reaction rate. In this way, their approach could eventually lead to technologically useful energy yields, says Gür. Also, this fuel cell would, in theory, turn sulfur and other impurities in coal into energy, he notes.