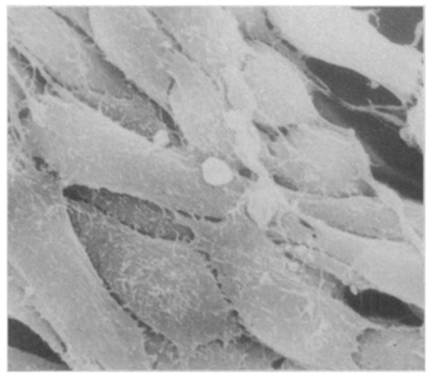
Fetal Ultrasound: How Safe?

Diagnostic ultrasound exposure before birth doesn't seem to pose any immediate major health problems. However, the possibility of it exerting subtle or long-range health problems remains to be ruled out.



Liebeskind, et al./Radiology

By JOAN AREHART-TREICHEL

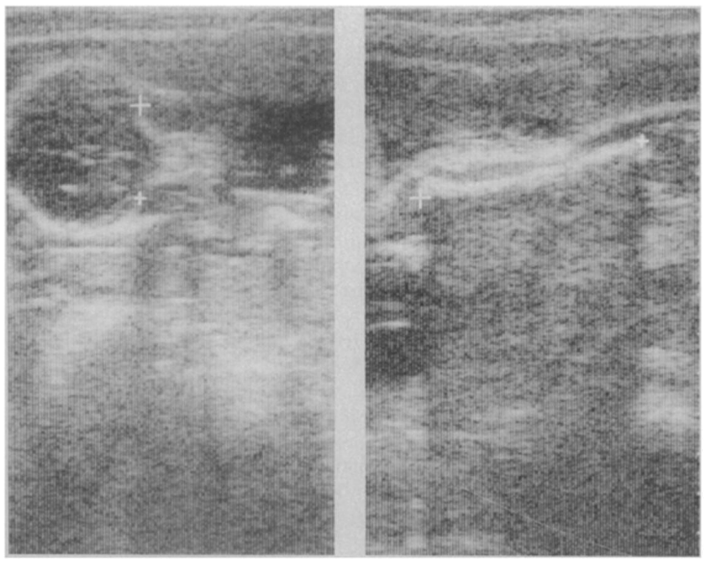
During the past decade, the use of ultrasound (sound waves) to visualize and assess the health of unborn children has grown from being a rarity to being fairly commonplace. For instance, 10 years ago only a few medical centers in the United States had ultrasound machines; today every major hospital, many minor hospitals and even some obstetric group practices have them. Ten years ago, ultrasound was able to diagnose only a handful of fetal problems, such as inadequate growth and development and Rh disease (SN: 12/25/71, p. 424); today it is able to detect such other problems as pending miscarriages, a variety of birth defects and ectopic pregnancies.

But is diagnostic ultrasound exposure before birth safe? The March of Dimes and the pediatrics department of Columbia University's College of Physicians and Surgeons recently co-sponsored a symposium in New York City to assess the issue. The data presented at the symposium — primarily those from *in vivo* studies — suggest that diagnostic ultrasound probably doesn't cause major birth defects, grossly impair neurological development or growth or cause childhood cancer. But studies conducted *in vitro* indicate that more research must be conducted before the possibility of its exerting subtle or long-range health problems or adversely affecting future generations can be ruled out.

Two studies conducted during the 1970s — one by Douglas L. Miller and colleagues at the University of Vermont and one by Morton W. Miller at the University of Rochester School of Medicine — suggest that diagnostic ultrasound before birth might cause subtle health problems. Using levels of ultrasound that were comparable in intensity (the power of sound divided by the area over which it is spread) to the intensity of diagnostic ultrasound used on human fetuses, Douglas Miller and his team found that ultrasound made human blood platelets aggregate around gas-filled pores on membranes. Morton Miller and his team found that ultrasound disrupted cells in bean roots. However, the intensity of the ultrasound that they used in their experiment was greater than that used on human fetuses.

The possibility that diagnostic ultrasound before birth might cause some long-range health problems comes from a study conducted during the past several years by Doreen Liebeskind, assistant professor of radiology at Albert Einstein College of Medicine in New York City, and reported in the April 1979 RADIOLOGY. Liebeskind and colleagues exposed fibroblasts (connective tissue cells) from mice to ultrasound of the same intensity as that used on human fetuses. In fact, they used the same ultrasound machines for their experiment as are used on human fetuses. They found that the ultrasound transformed only a few of the total number of cells. (Transformation is sometimes an early step toward a cell becoming cancerous.) They then injected ultrasound-transformed cells into mice in five separate experiments; the cell injections caused tumor formation in only one of the experiments. These results are comforting, Liebeskind pointed out at the symposium, in that they suggest that diagnostic ultrasound does not pose any immediate cancer danger to human fetuses. However, if ultrasound transformed only one cell in the body of an unborn child, she speculates, it is possible that that cell might lead to tumor formation in the years to come.

Three other studies conducted by Liebeskind and her team during the past several years and published in the Sept. 21, 1979 SCIENCE and the February 1981 RADIOLOGY and in press with the BRITISH JOURNAL OF CANCER suggest that diagnostic ultrasound exposure before birth might also adversely affect the cells of future generations. (The ultrasound used in these three studies was once again comparable in intensity to that used on human fetuses, and the ultrasound machines used were identical to those used on human



Photos: Gottesfeld

Top: Cells physically altered by diagnostic ultrasound. Although diagnostic ultrasound transformed only a few cells, Liebeskind and her colleagues found, transformation is sometimes an early step toward a cell becoming cancerous.

Diagnostic ultrasound can visualize normal and abnormal anatomical areas of the human fetus much better today than it could 10 years ago. Far left: The eye orbits of the fetal face (one orbit is indicated by two crosses). Left: The fetal thigh (indicated between two crosses). During the next decade, Gottesfeld predicts, diagnostic ultrasound will also be used to recognize fetal heart problems, to diagnose fetal tumors and to more accurately assess fetal growth and development.

fetuses.) In the first experiment, ultrasound was found to change the fine surface architecture of mouse fibroblasts after 10 generations of cell division, a change that was observed up to 100 generations.

In the second experiment, ultrasound altered the normal movements of mouse fibroblasts after 10 generations and was observed up to 100 generations. "There is a definite change in cell behavior that persists," Liebeskind reported at the symposium. "There is some hereditary pattern that we do not understand at this point."

In the third experiment, human lymphocytes (white blood cells that help make up the body's immune system) were exposed to ultrasound. The ultrasound brought about a statistically significant increase in sister-chromatid exchange (a swap of DNA between chromosome halves during cell division). This finding suggests that ultrasound broke genetic material on the chromosomes.

The symposium also presented studies whose results suggest that the use of diagnostic ultrasound on a fetus is safe. The largest study was conducted by Edward A. Lyons at the University of Manitoba in Winnipeg, Manitoba, Canada. Since 1975 Lyons and his team have been comparing the health of 10,000 children who had received diagnostic ultrasound before birth to the health of 2,000 controls and to 1,000 siblings of the exposed children who had not gotten diagnostic ultrasound in the womb themselves. There were no more birth defects among the ultrasound-exposed youngsters than among controls and siblings, Lyons reported at the symposium. In fact, there were even fewer birth defects among the ultrasound group than among children in the general Manitoba population.

Louis Hellman of the State University of New York Downstate Medical Center in Brooklyn assessed the effects of ultrasound on 1,114 infants exposed at various stages *in utero* and found that the incidence of birth defects among the infants was only 2.7 percent, compared with 4.8 percent for the general infant population in the United States. Neither the time of gestation during which the infants had been exposed to ultrasound nor the number of times they had been exposed seemed to increase the risk of birth defects.

Peter C. Scheidt, formerly of the Food and Drug Administration's Bureau of Radiological Health and now at the Uniformed Services University of Health Sciences, studied the possible risk from ultrasound during the early midtrimester of pregnancy. Scheidt's study was composed of three groups: 297 infants exposed *in utero* to both ultrasound and amniocentesis, 661 infants exposed only to amniocentesis and 949 infants who had not been exposed to either technique. There were more birth defects among the ultrasound-exposed infants than among the other two groups, but the differences were not statistically significant, implying they were due to chance.

In a study of neurological development, Scheidt found that infants who had received diagnostic ultrasound in the womb did not differ from the other two groups in neurological function, with the exception of grasp and neck reflexes. These neurological functions were normal in the exposed infants by the time they were discharged from the hospital after birth. By one year of age, the ultrasound-exposed infants still did not differ from the infants in the other two groups in neurological function.

The investigation by Scheidt and his co-workers also suggests that diagnostic ultrasound does not impair growth. The heights and weights of the infants who had received ultrasound before birth were similar to the heights and weights of the other two groups both at birth and at one year of age.

Evidence that diagnostic ultrasound before birth doesn't impair growth also comes from the research performed by Lyons and colleagues. Although the ultrasound-exposed children in his study were found to be slightly smaller and lighter at four years of age than their siblings and unrelated children not exposed to ultrasound, Lyons contends that this difference cannot be attributed to the use of ultrasound. He suggests instead that such children may have been predisposed to growth problems in the womb.

The study also found no increase in childhood cancer among the ultrasound-exposed group compared with controls and siblings.

Only more studies and results from ongoing studies, of course, will reveal whether diagnostic ultrasound exposure before birth can cause any of the biological effects demonstrated *in vitro*. The study being carried out by Lyons and his team, for instance, will be particularly valuable in answering such questions since they plan to follow their subjects, siblings and controls until they reach at least 21 years of age. They also plan to study more than 100 different health factors that might be affected by diagnostic ultrasound such as I.Q., attention span, social development and nerve and muscle function.

Meanwhile, clinicians will probably continue to use diagnostic ultrasound on human fetuses as they have been doing, if an informal survey of obstetricians, radiologists, pediatricians and ultrasound technologists attending the March of Dimes symposium is any indication. The preliminary results of an unpublished study on ultrasound by Charles Hohler, an obstetrician at the University of Miami School of Medicine, suggest that current usage is prudent. Hohler surveyed 12 percent of the members of the American College of Obstetrics and Gynecology and found that 30 percent of their patients received ultrasound — a smaller number than expected. The survey also revealed that only one-fifth of the fetuses are being exposed to ultrasound more than once. □

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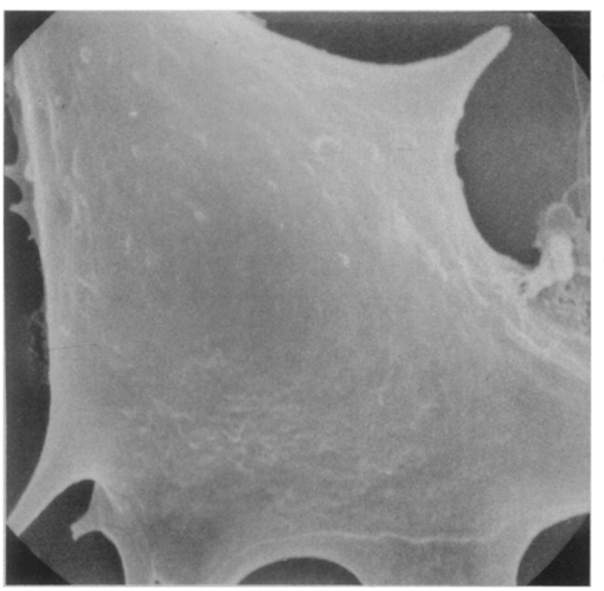

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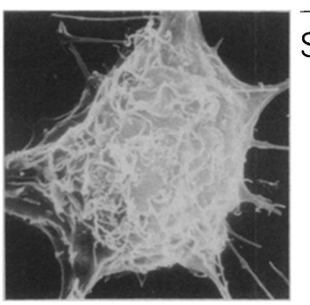

Diagnostic ultrasound changed the fine surface architecture of mouse fibroblast cells after 10 generations of cell division and up to at least 100 generations, Liebeskind and colleagues have found. For instance, it caused tiny, fingerlike projections to form on cells (above), compared with control cells (left), which were mostly smooth.