Fetus tells mother: It's time for labor

A specific region in the fetal brain may serve as the biosensor that triggers the events leading to birth, according to two new studies of sheep.

This "dramatic" finding represents the first solid proof that the fetal brain initiates labor, at least in an animal model, says physiologist Gloria E. Hoffman of the University of Pittsburgh School of Medicine. "Down the line, it may offer some insight into how to develop strategies to prevent premature labor," she adds. Premature babies face a higher risk of death and serious health problems because they are born with underdeveloped organs.

Twenty years ago, New Zealand researchers showed that destroying the adrenal and pituitary glands in fetal sheep could delay labor. While this hinted that a fetal factor provided the main impetus for labor, other scientists have argued for a maternal "master switch."

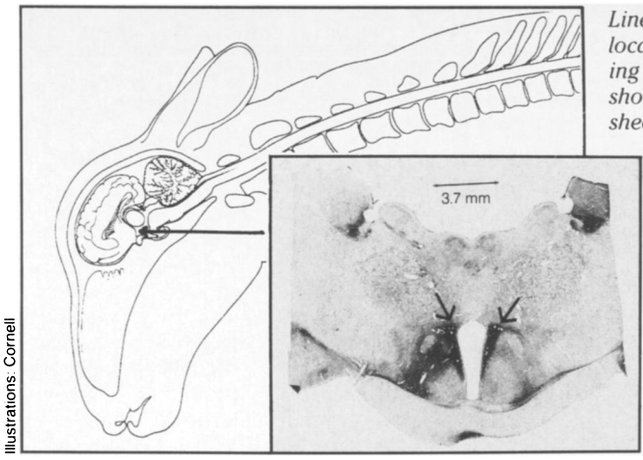
Peter W. Nathanielsz and Thomas J. McDonald of Cornell University have now extended that early work, showing that the adrenal and pituitary glands of fetal sheep respond to signals from a pea-sized region of the fetal brain, called the paraventricular nucleus.

The Cornell study, combined with similar evidence reported by Peter D. Gluckman and his colleagues at the University of Auckland, New Zealand, suggests that the paraventricular nucleus starts labor in sheep, says Nathanielsz. Both groups describe their findings in the Sept. 15 American Journal of Obstetrics and Gynecology.

Gluckman's team produced a three-dimensional map of the fetal sheep brain, which enabled the Cornell group to locate the paraventricular nucleus of nine fetuses in the third trimester of gestation. With the nine pregnant ewes under anesthesia, the researchers used an electrode-tipped needle to deliver a blast of radio waves that destroyed the paraventricular nucleus in five of the fetuses. The other four fetuses received a "sham operation" that left the brain intact.

All sheep recovered from the operation, and the pregnancies continued. Five days after surgery, the researchers began collecting daily blood samples from the carotid arteries of the fetuses.

Scientists know that two hormones — cortisol and adrenocorticotropic hormone (ACTH) — reach their peak levels in the fetal bloodstream just before birth. The four control fetuses followed this pattern, showing a steep rise in the hormones about a week before delivery. In the five experimental fetuses, however, blood levels of ACTH and cortisol remained constant throughout the experiment.



Illustrations: Cornell

Line drawing shows location of labor-triggering brain region. Photo shows section of fetal sheep brain with paraventricular nucleus (dark areas) indicated by arrows.

On average, the control ewes gave birth on schedule, at about 146 days of gestation. But the experimental group showed no signs of labor even at 157 days, when the researchers delivered these fetuses by cesarean section.

Nathanielsz suggests that the fetal brain may act as a tiny monitor, tracking its own development. When the fetus is ready for birth, the paraventricular nucleus signals the fetal pituitary gland to step up ACTH secretion. The pituitary, in turn, tells the fetal adrenal gland to secrete more cortisol. The increases in fetal hormones spark changes in maternal hormones, which lead to uterine contractions, Nathanielsz says.

Whether the sheep findings extend to humans remains unclear. The Cornell scientists now hope to determine whether the paraventricular nucleus plays a similar role in monkeys, whose reproductive systems resemble those of humans, Nathanielsz says.

Proof of the human fetus' role in labor would be tricky to obtain, he notes. However, if primate studies confirm the sheep findings, scientists could begin developing drugs to block the fetal signal in women who show signs of premature labor, he says. Obstetricians currently rely on drugs that quiet the uterine muscle — a strategy that often fails.

— K.A. Fackelmann

New Hubble trouble: Spectrograph awry

Add another malfunction to the spate of problems plaguing the Hubble Space Telescope. A faulty power supply has forced NASA to halt indefinitely all research conducted with a key spectrograph aboard the Earth-orbiting craft.

The ailing spectrograph, which uses diffraction gratings to separate ultraviolet light into its component wavelengths, has significantly higher spectral resolution than Hubble's only other spectrograph. Unless engineers can replace or compensate for its defective power supply, astronomers will have to forgo several types of Hubble observations that require resolution of minute differences between spectral lines, says Blair D. Savage of the University of Wisconsin-Madison, who helped design the spectrograph. These would include studies of the chemical composition and abundance of interstellar matter, he notes.

Scientists got their first inkling of Hubble's latest trouble on July 24, when the Goddard High-Resolution Spectrograph failed to relay some of its ultraviolet data. But the problem abated within minutes, and researchers didn't become alarmed until it recurred during observations on Aug. 5.

In the past month, researchers from NASA's Goddard Space Flight Center in Greenbelt, Md., and the Ball Corp. in Broomfield, Colo. — which built the Goddard-designed spectrograph 10 years ago — have identified what they consider the likely cause of the communications failure. The suspect: a defective solder joint on a low-voltage power supply that provides the electricity for one of the two adjacent electronic sections of the spectrograph. Each section powers roughly half of the instrument.

The balky voltage source can't supply enough power to operate the photon detector and other components on the section known as side 1, says Goddard's Jean Lane, experiment manager for the spectrograph.

Side 2, powered by a separate voltage source, still functions normally, she says. But for scientists eager to continue observations, there's a catch. In order to transmit information from the spectrograph to the ground or to an onboard computer or tape recorder, a device called a formatter must first package the raw data. And the formatter now connected to side 2 gets its voltage from the defective power supply. As a result, Lane says, side 2 transmits data only intermittently.

Hubble officials have concluded that continued use of the crippled spectrograph would waste precious observing time. Two weeks ago, they temporarily suspended all science operations with