Healthy babies by the numbers

November 10 2009

When a fetus is smaller than expected for the number of weeks of pregnancy, due to associated problems like a poorly developed heart, health concerns as severe as brain damage can result.

The condition, known as Intra-uterine growth restriction (IUGR), prompts doctors to use ultrasound to track a baby's health and determine the best time for delivery. But these measurements are often incomplete, and obstetricians have had to rely on educated guesses about the strength of a fetus's circulatory system.

Now, thanks to new research from Tel Aviv University, IUGR babies will have a better chance for a healthy life.

Prof. Ofer Barnea of TAU's Department of Biomedical Engineering, in collaboration with Prof. Jacob Bar from the Wolfson Medical Center, couples mathematical models with information about a baby's physiology inside the womb. Combining ultrasound with powerful algorithms based on real-life data, pediatricians get critical data on the development of the fetal circulatory system, so they can determine when the baby is strong enough to survive on its own.

"Babies with IUGR experience stress and growth restrictions inside the womb," says Prof. Barnea. "Doctors need to assess their growth, but currently have to rely on partial data from ultrasound systems. If they leave the baby inside too long, she may suffer from brain damage. On the other hand, we need to be sure her heart is strong enough to survive outside the womb."

Adding it all up

Prof. Barnea's team of biomedical engineers and physicians provides a way for doctors to "see" the whole picture so better medical decisions can be made.

"We can show doctors mathematically what the human eye can't see," says Prof. Barnea. "Our system integrates observable data with mathematical models of the fetus's or newborn's circulation."

Prof. Barnea is currently developing the technology in a new direction with Prof. William P. Santamore of Temple University and Nemours Children's Hospital to manage and optimize surgical repairs in newborns with cardiac malformation. It may one day be available to treat adults as well.

"This is a major advance in pediatric medicine," Prof. Santamore says. "We measure data that is available from babies and deliver it to the computer to estimate pressure, flow and other parameters that cannot be otherwise accessed in their tiny hearts."

The system was first developed to treat hypoplastic left heart syndrome, a condition in which the left side of the heart does not function. If not caught right away, the consequences can be terminal. Today, doctors medicate with prostaglandins and then operate. But since measurements of blood flow to the lung of the preemie or newborn are not possible, it's hard for them to know how to optimize flow distribution and manage the baby.

The equation for a safer delivery

Prof. Barnea's mathematical model of the baby's cardiovascular system

provides this information to doctors treating congenital heart disease, and has already changed the way the health of these babies is managed. "We are now combining these basic physiological findings with a more sophisticated mathematical model of circulation in newborns, adapting it to the individual patient using online measured data," he says.

"It's about better medicine and better healthcare. We also want fewer birth defects and better survival rates," Prof. Barnea, an inventor of other OB/GYN diagnostic devices, adds. His publications in this field include the American College of Cardiology journal and Circulation.

The scientists hope to develop their new IUGR tool as a bedside monitor based on real data. Feasibility studies are now under way, and the tool could find its way into hospitals in as few as two years.

Source: Tel Aviv University (news : web)