News
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******Dallas surgeon to investigate surgical technique for possible consequence of brain damage.

DALLAS--Among all the known risks of performing open heart surgery on small children there is one potential consequence which is very difficult to detect--that of brain damage.

Dr. Hisashi Nikaidoh, pediatric thoracic surgeon and associate professor of surgery at The University of Texas Southwestern Medical School, is investigating hazards of a body-cooling procedure often used in complex, congenital heart surgery--a procedure sometimes criticized for causing brain damage.

He has recently received an American Heart Association grant to conduct animal studies on the technique, called "hypothermia and circulatory arrest," in hopes of determining if there is indeed damage done to brain tissue, and if so which areas are affected most frequently and most heavily.

Dr. Nikaidoh explains that in the average hospital setting one tenth of those operated on for congenital heart disease (abnormalities of the heart and vessels present from birth) do not survive. Many of the tiny patients are only hours old. Instruments must be small enough not to obstruct vision. And the lesions to be repaired are only a fraction of an inch in length.

Under investigation by Dr. Nikaidoh is a procedure involving cooling the body down to a temperature of about 60 degrees Fahrenheit and stopping blood circulation. The lowered temperature reduces the rate of metabolism in the tissue, including the brain, and is supposed to protect the body from a lack of oxygen. Supplementing a general anesthetic, hypothermia with circulatory arrest offers doctors a motionless heart along with a dry operative field in which to work. Effective for lengths of time up to one hour, the procedure is preferred by some surgeons in cases where intricate repair of malformation is required.

Dr. Nikaidoh will work with a team from the medical school (including a cardiologist, an anesthesiologist and a cardiopulmonary bypass technician) to measure blood flow distribution in various regions of the brain, kidneys, heart, gastro-intestinal tract, liver and skeletal muscles in laboratory animals. The blood flow pattern will be traced during cooling and rewarming by injecting tiny plastic beads coated with a radioactive material into the animals' blood stream. As the beads hit small blood vessels and become lodged, the doctors can measure number and placement of the beads to determine the blood flow.

"Brain damage is very difficult to detect in infants--it can be very subtle," says Nikaidoh, Japanese-born and receiving most of his medical training at the University of Tokyo and at The Mount Sinai Hospital in New York. Since these children are often below one year of age, preoperative mental aptitude testing is not conclusive; doctors have no way of telling if the children with brain damage after the operation were ever normal to begin with.

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"We have no data to prove if the technique is innocuous or has done damage," says Nikaidoh. "There is only circumstantial evidence that it is not absolutely safe."

Doctors suspect that the brain damage is probably caused by a lack of oxygen supply. During the cooling phase, the blood flow within the brain may not be uniform, and may leave some areas relatively warmer than others. Such irregularity of cerebral blood flow offers only a spotty protection to the brain during circulatory arrest. Nikaidoh's investigation is to clarify the pattern of cerebral cooling in the currently practiced method of hypothermia and circulatory arrest.

While hypothermia and circulatory arrest has indeed been used in saving the lives of small infants with congenital heart disease, it is not always the preferred method. Nikaidoh himself says he avoids the procedure whenever possible. The alternative method is the cardiopulmonary (heart-lung) bypass machine, which diverts the blood flow around the heart and lungs and oxygenates the blood artificially. More often than not, however, the cardiopulmonary bypass does not give the surgeon a dry, bloodless field. The operative field is frequently obscured by a continuous flow of blood in the area. And large tubes are required in and around the heart, limiting the space for surgical instruments.

As for the nature of congenital heart disease, the cause of 90 percent of all cases can only be guessed. Known causes of the heart disease are genetic factors, diabetes in the mother, infection during pregnancy (such as rubella), radiation exposure and drugs taken during fetal development.

About eight out of 1,000 babies within the general population are born with a heart malfunction--and of these eight, three die within the first month of life.

The use of hypothermia and circulatory arrest is not new as a means of treating children with congenital heart defects, according to Nikaidoh. It originated in the United States in the early 1950s, just to be overshadowed by the popularity of the heart-lung machine. If was left to the Japanese to develop and foster the technique. Their original method involved hypothermia by surface-cooling, covering the baby with a thin plastic sheet and then putting it into an ice water tub. Blood circulation was stopped by clamping the heart's aorta.

Core-cooling, which made the original method obsolete, is used more frequently now both in Japan and in the United States, where it has been used increasingly since 1970. This more modern method removes a technical danger inherent in the original procedure--the development of an irregular heart rhythm.

In core-cooling, a heat exchanger located on the heart-lung machine is used in cooling and rewarming the blood. Blood circulated through the heat exchanger is cooled by water-filled coils and sent back through the body. Once the body is cooled to the desired temperature the heart-lung machine is stopped and blood from the body is allowed to collect inside the machine. Tubes are removed and the surgeon is provided a dry operative field.

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Doctors actively argue about which technique is better--hypothermia and circulatory arrest (with limited use of the heart-lung machine for cooling and rewarming) or use of the heart-lung machine alone. Nikaidoh argues against "indiscriminant use" of one technique, especially in operations on very young children. "Simple lesions in a child of more than 2-3 years of age can be repaired with conventional cardiopulmonary bypass. But when challenged with a child of less than one year with a complex lesion there is a formidable problem technically. Hypothermia and circulatory arrest gives a little more space to work in. We're just not 100 percent sure it's safe, especially to the brain."

The heart-lung machine with heat exchanger is also open to criticism, says Nikaidoh, since it can cool the blood so rapidly that some of the blood vessels may go into spasm.

"We have fragmentary information on hypothermia and circulatory arrest, but the data have never been collected in a coordinated manner," says Nikaidoh. "There have been clinical studies performed, and studies have been done on organ cooling. But we continue to compare apples and oranges. We are forced to compare results of studies done on different animals, in different settings and with different anesthetics. Our study will involve all aspects done in the other studies at one time and in a setting simulating the present-day practice in our operating room.

"We will be looking to see what type of hypothermia-inducing technique would be best for the preservation of the brain--surface-cooling plus core-cooling or core-cooling alone. Or we may yet find an additional refinement in the induction of hypothermia."

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