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Baby Fae Stuns the World

By Claudia Wallis

A baboon-heart transplant inspires both awe and anger

Except for the gauze-covered wound stretching almost the length of her torso, the tiny, dark-haired baby girl might have been just any infant. Lying in her crib with a pacifier close at hand, she gave a couple of gaping yawns. She delicately stretched her scrawny arms in weariness. And mostly she slept. But last week, as television viewers got their first glimpse of the newborn known only as Baby Fae, it was her visibly heaving chest that stole the show. There was no mistaking the pulsations of life and no forgetting that the power source was the freshly implanted heart of a young baboon.

One week after the historic transplant operation at Loma Linda University Medical Center in Southern California, the first infant—though not the first person—to receive a simian heart was reported to be doing remarkably well. "All vital signs are still good, and there's no sign of rejection," said Hospital Spokeswoman Patti Gentry, noting that Baby Fae was "just gulping down her formula." Outside the hospital, there was wonder and excitement over this latest medical marvel, but the enthusiasm was dampened somewhat by controversy. Antivivisectionists around the country and abroad protested what they called "ghoulish tinkering" with human and animal life. "This is medical sensationalism at the expense of Baby Fae, her family and the baboon," charged Lucy Shelton of People for the Ethical Treatment of Animals. The group was one of several that demonstrated outside the Loma Linda hospital last week.

The medical community, though normally receptive to technical innovation, was sharply divided. "There has never been a successful cross-species transplant," declared University of Minnesota Surgeon John Najarian, one of the country's leading pediatric-transplant specialists. "To try it now is merely to prolong the dying process. I think Baby Fae is going to reject her heart." Others defended the experiment. "It's very easy to sit back and be negative when a new treatment is announced," said Dr. John Collins, chief of cardiac surgery at Boston's Brigham and Women's Hospital. "If we all were afraid to attempt the untried, we would have no new treatments."

Little is known about the 5-lb. object of all this controversy or how she came to be the subject of so dramatic an experiment. Loma Linda officials have refused to reveal the child's real name, the identity of her parents or even her exact age. They did say that she was about two weeks old at the time of surgery and had been born three weeks premature. Baby Fae was referred to Loma Linda by a pediatrician in Barstow, Calif. The 546-bed facility is one of more than 60 U.S. hospitals operated by the Seventh-day Adventist Church and has a fine reputation in pediatric heart surgery. Fae was suffering from hypoplastic left-heart syndrome, a

fatal condition said to affect one in 12,000 newborns. In children with this defect, the left side of the heart, including its main pumping chamber, the left ventricle, and the aorta, is seriously underdeveloped. In Fae's case, doctors said, the left side of the organ was virtually nonexistent.

Dr. Leonard Bailey, 41, the pediatric cardiac surgeon who treated Fae, over the years had seen dozens of infants with this defect die, generally within two weeks of birth. While a transplant from a human donor could theoretically be used to help such babies, Bailey was discouraged by the drastic shortage of infant hearts. Seven years ago he began investigating the possibility of using hearts from other species, or xenografts. He performed more than 150 transplants in sheep, goats and baboons, many of them between species. Last December, after what Bailey called "months of agonizing," the Loma Linda institutional review board gave him preliminary approval to implant a baboon heart in a human infant. The final go-ahead came just two days before Baby Fae's surgery. "There is evidence that the chimpanzee, orangutan or gorilla may be a better donor," Bailey noted last week, "but they are either an endangered species or don't procreate well in captivity."

Baby Fae, who had no defects other than her hypoplastic heart, was the first infant to come to Bailey's attention who met the criteria for his experiment. As in the case of the late Barney Clark, who in 1982 became the world's first recipient of a permanent artificial heart, an elaborate consent form had been prepared. Fae's parents signed the form once, then thought over their decision for 20 hours before signing it the required second time. According to the hospital, the couple were well informed of the risks and the alternatives.

Meanwhile, Sandra Nehlsen-Cannarella, a transplantation immunologist brought in from New York City's Montefiore Medical Center, conducted five days of laboratory tests to determine which of six baboons at Loma Linda most closely matched Baby Fae's tissue type. However, before the tests were complete, the infant's heart suddenly deteriorated and her lungs filled with fluid. The dying child was swiftly transferred to a respirator and given drugs to keep her blood circulating. The measures were able to sustain her long enough for a baboon donor to be chosen and surgery to begin.

Following what is now standard practice in heart transplants, Bailey transferred his tiny patient to a heart-lung machine, using it to gradually lower her body temperature from 98.6° F to about 68° F. The lower temperature slowed the baby's metabolism, allowing her other organs to better tolerate a reduced blood flow. One hour and 45 minutes into the operation, Bailey descended three floors to the basement, where the hospital maintains a colony of 29 primates. There, he removed the walnut-size heart of a seven-month-old female baboon, the animal that had proved to be the best match for Baby Fae, and placed the organ in a cold saline "slush." Elapsed time: 15 minutes.

Back in the operating room, Bailey removed Fae's defective heart and replaced it with the heart from the baboon. Because baboons have only two major arteries leaving the aortic arch, as opposed to the three in humans (see diagram), two of the baby's vessels were first joined together before being connected to one of

the two arterial openings in the baboon's aorta. When the delicate plumbing job was completed, doctors slowly raised the infant's temperature and weaned her from the heart-lung machine. At 11:35 a.m. on Oct. 26, four hours and five minutes after Baby Fae had first entered surgery, her new heart began to beat spontaneously. "There was absolute awe," recalls Nehlsen-Cannarella. "I don't think there was a dry eye in the room."

Baby Fae was not the first person to receive the heart of an ape. In 1964, when heart transplants were a new idea, University of Mississippi Surgeon James Hardy replaced the heart of a 68-year-old man with that of a chimpanzee, but the patient died within a few hours. In 1977 Christiaan Barnard, the South African pioneer of heart transplants, made two attempts to use simian hearts: in a 26-year-old woman, who survived for only six hours, and in a 59-year-old man, who died four days after surgery. In each case, Barnard "piggybacked" the animal organ onto the patient's own heart to act as a supplementary pump. He decided to abandon the technique because of the poor results and the risks of becoming "emotionally attached" to donor chimpanzees, which, he says "are very much like humans." Barnard is nonetheless enthusiastic about the Baby Fae case and has no qualms about the use of baboons, which, he says, are shot on sight by South African farmers, who consider them a nuisance. Perhaps the strangest example of simian-human surgery was tried in 1975 by Cardiologist Magdi Yacoub in England. In an effort to sustain the life of a one-year-old boy during extensive surgery, Yacoub connected the child's circulatory system to the heart of a living baboon. Both the boy and the animal died during the procedure.

In general, the obstacle to using animal organs is that the human body quickly rejects foreign tissue. What gave Leonard Bailey hope of better results was the advent of the wonder-drug cyclosporine. Developed by Sandoz Ltd. in Switzerland, cyclosporine inhibits organ rejection by partly suppressing the immune system. It is considered safer than earlier drugs used for this purpose because it is less likely to destroy the body's ability to fight infection. Since its first use in the U.S. in 1979 it has revolutionized transplant surgery, raising the one-year survival rate of heart recipients from 65% in the 1970s to 80%. Bailey believed that by focusing on the treatment of newborns, whose immune systems are not yet fully developed, he could further reduce the risks of rejection. Says he: "A newborn is a gracious host."

Yet even as Baby Fae seemed to be demonstrating Bailey's point, critics charged that xenografts are still too uncertain and that other treatments should have been considered. Dr. Moneim Fadali, a cardiovascular surgeon at the University of California, Los Angeles, was one of several physicians to suggest that the decision to use an animal organ may have been "a matter of bravado" and that a human heart "would have offered the child a better chance of survival." Loma Linda Surgeon David Hinshaw explained that he and his colleagues believed that the hope of finding a compatible human heart in time to save the dying Fae was "almost nonexistent." Indeed, infant hearts are so seldom available that transplants into very young children are rarely attempted.

Ironically, the heart of a two-month-old infant was available the day of Fae's operation. Transplant coordinators from the Regional Organ Procurement Agency at UCLA called Loma Linda hospital to offer the

infant's kidneys (the heart was not discussed because Loma Linda does not have a human-heart-transplant program). When word of the potential human donor became public last week, Loma Linda officials explained that the call from the procurement agency had come after the baboon heart was implanted, that the heart of a two-month-old might have been too big for Fae, and that it would have taken too long to complete compatibility testing. Eventually hospital officials admitted that they simply had not considered the possibility of a human donor.

That admission raised the larger question of whether Baby Fae's parents had been properly advised of possible alternatives to the baboon heart. "If they didn't even look for potential life-saving alternatives, what does this mean in terms of the 'informed consent' of the parents?" asked Michael Giannelli, science adviser for the Fund for Animals. According to Minnesota Surgeon Najarian, Baby Fae's doctors should have recommended a form of corrective surgery for hypoplastic heart developed by Dr. William Norwood, chief of cardiac surgery at Children's Hospital of Philadelphia. Norwood's procedure, which is practiced at only a few U.S. hospitals, involves a rerouting of blood through the heart so that the right ventricle takes over the pumping function normally performed by the left ventricle. Norwood says that of 100 infants he has treated, 40 have survived; the oldest is now four. But, he admits, the procedure "is not a trivial business and if one intends to have serious impact on this disease, numerous alternatives have to be explored."

As the week wore on and the questions continued, Bailey retreated into silence, and other doctors were delegated to meet the press. "He is totally absorbed in nursing this child," explained Surgeon Hinshaw. "He is not a publicity seeker, and he is very sensitive about this." The pressure on Bailey and his colleagues drew understanding from another surgeon who knows what it is like to have microphones continually thrust at his face. "I really have sympathy with what they're going through," said Dr. William DeVries, who had been Barney Clark's surgeon.

For his part, Bailey found it hard to understand why people would question a procedure that was saving the life of a dying infant. "If you had the opportunity to see this baby and her mother together, and see this baby in the best shape she's ever been, you would see the propriety of what we are doing," he said.

The surgeon from Takoma Park, Md., has devoted his career to trying to help victims of hypoplastic heart. A Seventh-day Adventist, he was educated at Loma Linda University Medical School, the only Adventist medical college in the world. Bailey had first considered using xenografts during his residency at Toronto's Hospital for Sick Children, where, he admits, the idea "drew snickers." When he tried to develop the procedure at Loma Linda, he found it difficult to get his research papers published and impossible to get funding. "I felt rather lonely," he reflected last week. "People didn't understand the importance of this; they weren't watching babies die." Ultimately a research fund was set up by 20 physicians at Loma Linda, who contributed part of their salary each month. In seven years they raised more than \$1 million.

While some religious groups find the idea of animal-to-human transplants repugnant, it is not inconsistent with Seventh-day Adventist teachings, says Dr. Jack Provonsha, a minister of the church as well as a doctor

at Loma Linda. The church has always placed a strong emphasis on health. This, he explains, is part of the belief that "our redemptive concern for man's need should include not only his spiritual life but his physical life as well." Because Adventists see man as "the ultimate level of our value concerns," says Provonsha, "then the sacrifice of an animal for the sake of the life of a baby is acceptable, even though we value animal life as well."

By week's end Baby Fae's remarkable progress was making many critics of the experiment think again. Loma Linda doctors expressed relief that their tiny patient had so far avoided "hyperacute rejection," a reaction to foreign tissue that often occurs immediately after a transplant. However, Hinshaw cautioned that the seventh to tenth days after a transplant are a peak period for rejection. Should the child begin to show signs of rejecting the baboon heart, said Hinshaw, a second transplant would be considered. In this event, a human heart was said to be the team's first choice and another baboon organ would be the second.

Even if Fae does not reject her new heart, she might ultimately need a replacement. Though Dr. Bailey's animal research suggests that a xenograft adjusts to the needs of its new host, no one really knows what to expect. Also unknown is the long-term effect of cyclosporine, which Fae may have to take for the rest of her life. The drug has been found to cause liver and kidney damage and to increase the risk of certain cancers.

Loma Linda hospital has given Bailey permission to try five baboon-to-human transplants, but doctors say they have no immediate plans for other patients. Last week they were referring parents to Dr. Norwood at Children's Hospital of Philadelphia. Already some optimists are envisioning a day when the transplanting of simian hearts will be as acceptable in human medicine as the use of heart valves from pigs and bovine insulin. "Maybe one of these days we can start farming baboons for this purpose," suggests Christiaan Barnard. Others believe that baboon hearts could be used as a temporary measure, to gain time for patients who are awaiting human donors.

As the possibilities unfolded, many wondered what life would be like for a human with the heart of a monkey.

Asked whether Baby Fae would have trouble adjusting and perhaps be teased for being different, Loma Linda's Hinshaw replied, "Society may have to adjust to her." The heart, he added dryly, "is only a muscular pump. It is not the seat of the soul."

—By Claudia Wallis. Reported by Steven Holmes/Los Angeles, with other bureaus

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