

The Alternative

Partial heart transplants in children and their success rate. Simar Bajaj reports

Owen Monroe was born blue. The arteries in his heart that transport blood to the lungs and the rest of the body were fused together, leaving only a single, faulty pipeline. Within a few hours, he was in end-stage heart failure, with 20 to 30 intravenous medications barely keeping him alive.

To treat his heart defect, known as truncus arteriosus, doctors usually need to perform a risky surgery. Almost half of infants die within a month of this operation and two-thirds are dead within a year.

So, Dr Joseph Turek, the chief of paediatric cardiac surgery at Duke University Medical Center, US, proposed a partial heart transplant, which would use valves, arteries, veins and muscle from a donor heart to repair Owen's own.

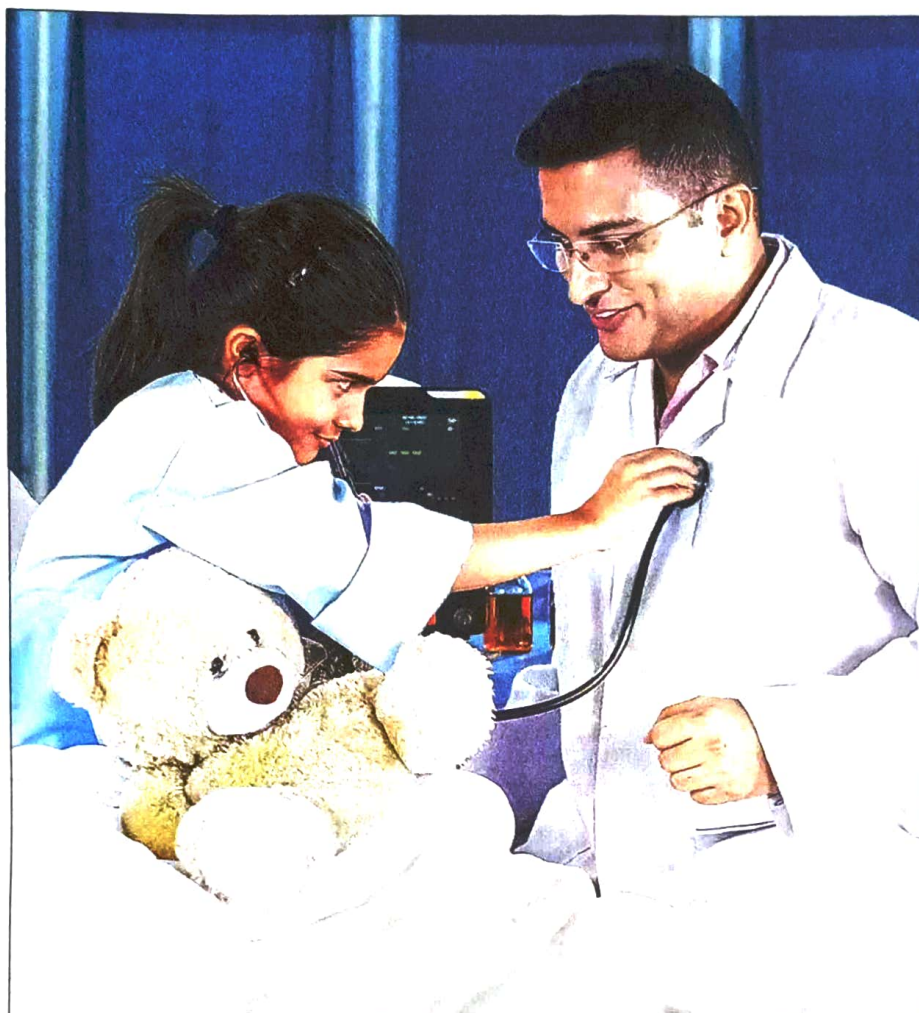
"I asked him, 'How's it gone before? How many have you done?'" recounts Tayler Monroe, Owen's mother. "He said, 'Well, I've done it on five piglets.'"

Monroe and her husband Nick agreed. On April 22, 2022, after eight hours of surgery, Dr Turek completed the first successful partial heart transplant on Owen, who was just 17 days old at the time, his heart the size of a strawberry.

Owen is one of fewer than 50 people who has undergone this operation, a new way to repair various life-threatening heart defects with living tissue. Most have taken place at Duke, and a new study, published last month in *The Journal of the American Medical Association*, offers the first systematic analysis of partial heart transplants, tracking Owen and 18 other patients who range from two days old to their early 30s.

Most of these operations were "domino" transplants, in which one patient receives a total heart transplant, and their old heart is broken down to help several others. (While that heart's muscle might be diseased, the valves can still be in good condition.)

Overall, the researchers showed that the transplanted valves were healthy and reliable over time, even growing among



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the infants. But the average follow-up period was only six months, and researchers don't yet know if the valves will function long term.

In the US, more than 2,000 children and 1,00,000 adults are on the transplant waiting list. Donor organs are scarce, and many are discarded because they're not suitable for a full transplant — an issue that's gotten worse, as *The New York Times* previously reported.

The discard rate of hearts is even higher because minor imperfections can make them unsuitable for transplant, says Dr Taufiek Konrad Rajab, a cardiothoracic surgeon at Arkansas Children's Hospital in the US. According to an analysis of

the United Network for Organ Sharing data, around 43 per cent of donor hearts from children and young adults go unused.

But if these hearts were used

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for partial transplants, Dr Rajab adds, they could potentially save many lives.

Surgeons can replace a heart valve with one from a cadaver or animal tissue, or use a mechan-

ical implant. But none of these options expands as patients grow, so children born with valve defects often need three to five open-heart surgeries before they reach adulthood, Dr Rajab says. As scar tissue accumulates, every operation is more complicated than the last, and they usually require stopping the heart, risking organ injury and even death.

Partial heart transplants offer patients a living valve — one that seems to function well and grow with infants, says Dr Kevin Daly, the medical director of the heart transplant programme at Boston Children's Hospital, US. In the new study, nine infants were tracked

for about a year on average, during which their valves doubled in size. It's unclear if growth will persist, but the evidence is reassuring, he says.

All transplants come with trade-offs. Organ recipients need lifelong drugs to suppress their immune system, and these medications can lead to serious infections and kidney damage over time. With partial heart transplants, the team at Duke was able to wean patients down to roughly a quarter of the usual amount of immunosuppressant drugs, Dr Turek says. He believes the level is too low to trigger many of the complications.

One infant, Kix Soderblom, stopped taking immunosuppressant drugs a month after his partial heart transplant, when he developed an infection from an unrelated surgery.

"It wasn't a choice at all; we just had to do it," says Zach Soderblom, Kix's father, about stopping immunosuppression. For weeks, he and his wife Lorna held their breath, praying that Kix wouldn't reject the transplant. Instead, his valve continued to grow, Dr Turek says, suggesting that long-term immunosuppression might not be needed with partial heart transplants.

It's too early to say for sure, says Dr David Kalfa, the chief of cardiovascular surgery at Nicklaus Children's Hospital in Miami, US. In an analysis on eight patients who received partial heart transplants at New York-Presbyterian Morgan Stanley Children's Hospital, US, most developed antibodies against the donated valve, which may be linked to worse function, although this data has not yet been peer-reviewed. More research is needed to determine the right dose and duration of immunosuppression, or whether heart valves are even susceptible to rejection, Dr Kalfa says.

Valve growth isn't as relevant for adults. Still, partial transplants could potentially benefit them, too. Cadaveric or animal valves degrade over time and need to be replaced roughly every 15 years, Dr Turek says, whereas partial valves can maintain and repair themselves.

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