# [Primary Transplantation for Congenital Heart Disease in the Neonatal Period: Long-term Outcomes.](https://www.ncbi.nlm.nih.gov/pubmed/31362016)

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**Take Home Points:**

* **Primary cardiac transplantation of neonates is an alternative treatment strategy to palliative reconstruction of uncorrectable congenital heart disease.**
* **This authors reviewed their single-institution experience with primary cardiac transplantation of neonates between 1985 and 2017 and found their results to be durable with acceptable long-term survival.**



***Commentary from Dr. Timothy Pirolli (Dallas), section editor of Congenital Heart Surgery Journal Watch:*** Until the early 1980s with the advent of the Norwood palliation, hypoplastic left heart syndrome was uniformly fatal. During this period, primary cardiac transplantation for neonates (and older children) was pioneered as well. As outcomes for the Norwood procedure improved in the 1990s, surgeons focused on that palliation pathway rather than primary transplant. However, there is data that shows that long-term survival for neonates undergoing primary cardiac transplant is excellent, and longer than for other age groups. This study was designed to examine the outcomes from the largest single-center series of primary neonatal heart transplants in the world at Loma Linda.

The authors reviewed their database for neonatal heart transplants between November 1985 and December 2017. They looked not only at pre- and post-operative risk factors, but also at long-term outcomes and growth/neurologic development. There was no comparison group for patients of the same age range with uncorrectable congenital heart disease who received either no surgery or palliative procedures (including the Norwood procedure). The authors described the evolution of surgical technique, immunosuppression protocols, and post-transplant surveillance.

There were 104 neonates during the study period who underwent primary cardiac transplant, of which 88 of those occurred between 1985 and 1995 (Figure 1). This was attributed to the emerging acceptance of the Norwood procedure as a primary palliative procedure for HLHS/variants after this time (as well as a sharp decline in available donors). HLHS/variants comprised 77.8% of primary diagnoses in this cohort. The diagnoses were made in utero in 35.5% of patients and 20 patients were actually listed for transplant prenatally! Median weight at transplant was 3.3 kg and median age was 17 days. An array of recipient and donor characteristics were assessed. Of note, a donor-to-recipient ratio of > 2 was found in 37.5% of transplants. Operative details revealed a 5.7% perioperative mortality of 5.7% with a median duration of follow-up of 19.9 years. Of the 104 patients, 62 are still alive at the time of the publication (Figure 2) with good 10-, 20- and 25-year survival rates.

The authors also examined the development of coronary artery vasculopathy (Figure 3) and post-transplant lymphoproliferative disease. A total of 16 patients required re-transplant (Figure 5). Of the 42 patients who died, 12 died from rejection and 6 from infection. Other notable post-operative complications are catalogued in the paper and none are unusual or occur at abnormally high frequency. The majority of surviving patients (81.2%) were of appropriate height and weight for age and almost 70% were at an appropriate education level or gainfully employed. A multivariate analysis for risk factors affecting survival showed that Glomerular Filtration Rate and the diagnosis of coronary artery vasculopathy were the main variables to have an effect on mortality.

The authors’ commentary was helpful in understanding the evolution of primary neonatal cardiac transplant at Loma Linda. Their conclusion of the therapy as durable with a minimal need for re-intervention certainly seems like a logical conclusion. So why is it not more prevalent at their institution and others? The small donor pool is part of the answer. Their discussion about the causes of and potential solutions to this issue have been discussed in prior publications, but their points resonate louder with these very good results from their transplant experience. The ideas of ABO-incompatible transplant and over-sizing donor grafts are utilized at our institution and others. The idea of utilizing donors with anencephaly was also discussed as was the associated ethical and PR-related issues surrounding it.

So these results are very good, but are they reproducible? We may never know unless there is a dramatic shift back towards utilizing cardiac transplant as a primary therapy for neonates. But who are the patients that were not offered transplant for whatever reasons? What was the waitlist mortality? Are these results as good as they are because only the “best” candidates with uncorrectable heart disease were offered transplant? It is certainly an impressive series with excellent follow-up… but the skeptic may suggest the findings, though imperfect, are almost “too good” for that first decade of neonatal transplant.

But maybe the skeptics are wrong. Maybe we over-rely on the Norwood procedure and even mechanical circulatory support to palliate patients that may be better off with a primary cardiac transplantation. One idea that was rarely utilized was listing for transplant for a fetus, which was stopped in 2016. According to a 2014 paper by Thrush and Hoffman in the Journal of Thoracic Disease, PHTS registry data indicated fetal listing in 46 of the 4,365 (1%) patients between 1993 and 2009. But what happens if expecting parents of a fetus with HLHS finds this paper from Loma Linda and compares it to published results from the Norwood palliation and request a primary transplant from their cardiologist/surgeon? These are the interesting questions that may result from this type of data.

Tables and Figures

Figure 1: Neonatal Heart Transplantation



Figure 2: Overall Survival



Figure 3: Freedom from Cardiac Allograft Vasculopathy



Figure 5: Freedom from Re-transplantation

