

2022

## Heart and Kidney Transplant in a Patient on Total Artificial Heart Bridge Therapy for 318 Days

Sunny S. Cai

*The Department of Medicine, University of Tennessee Health Science Center, Ascension Saint Thomas Hospital, Nashville, TN, USA, scai8@uthsc.edu*

Heather L. Andrews

*The Department of Medicine, University of Tennessee Health Science Center, Ascension Saint Thomas Hospital, Nashville, TN, USA*

Christopher A. Molini

*The Department of Medicine, University of Tennessee Health Science Center, Ascension Saint Thomas Hospital, Nashville, TN, USA*

Follow this and additional works at: <https://scholarlycommons.gbmc.org/jchimp>



Part of the [Medicine and Health Sciences Commons](#)

---

### Recommended Citation

Cai, Sunny S.; Andrews, Heather L.; and Molini, Christopher A. (2022) "Heart and Kidney Transplant in a Patient on Total Artificial Heart Bridge Therapy for 318 Days," *Journal of Community Hospital Internal Medicine Perspectives*: Vol. 12: Iss. 1, Article 19.

DOI: 10.55729/2000-9666.1018

Available at: <https://scholarlycommons.gbmc.org/jchimp/vol12/iss1/19>

This Case Report is brought to you for free and open access by the Journal at GBMC Healthcare Scholarly Commons. It has been accepted for inclusion in Journal of Community Hospital Internal Medicine Perspectives by an authorized editor of GBMC Healthcare Scholarly Commons. For more information, please contact [GBMCcommons@gbmc.org](mailto:GBMCcommons@gbmc.org).

# Heart and Kidney Transplant in a Patient on Total Artificial Heart Bridge Therapy for 318 Days

Sunny S. Cai\*, Heather L. Andrews, Christopher A. Molini

The Department of Medicine, University of Tennessee Health Science Center, Ascension Saint Thomas Hospital, Nashville, TN, USA

## Abstract

There are few cases in the current literature that describe simultaneous heart and kidney transplant (HKTx) while on total artificial heart (TAH) bridge therapy. We present a case of successful HKTx after 318 days on TAH bridge therapy and renal replacement therapy. This case demonstrates that TAH placement is a unique and up-and-coming option for bridging patients with heart and kidney failure to HKTx. TAH is a promising bridging option for patients who do not qualify for left ventricular assist device placement. The survival rates to heart transplant and long-term outcomes after heart transplant on TAH bridge therapy are encouraging as well. However, it is crucial for clinicians to be vigilant of the wide variety of complications associated with TAH when managing patients on TAH bridge therapy.

**Keywords:** Total artificial heart, Heart and kidney transplant, Bridge therapy to transplant, Left ventricular assist device, Renal replacement therapy, Complications of bridge therapy

## 1. Background

Heart and kidney transplants (HKTx) are often life-saving for patients with advanced heart and kidney failure. However, the demand for organ transplants far exceeds the supply, and many patients die while waiting for organ donors. The first total artificial heart (TAH) was in 1969,<sup>1</sup> and since then, TAH has become an increasingly popular method of bridging patients to heart transplant. Herein, we report a patient who underwent successful HKTx 318 days after TAH placement while receiving renal replacement therapy (RRT).

## 2. Case report

A 47-year-old man with a past medical history of essential hypertension and moderate-to-severe aortic insufficiency underwent elective aortic root replacement. Pre-operative transthoracic echocardiogram showed severe left ventricular (LV) dilation at 229 mL, normal LV ejection fraction of 60–65%, normal LV diastolic function, normal right ventricular (RV) systolic function, and

moderate-to-severe aortic regurgitation. CT angiography of the chest showed severe aneurysmal dilation of the aortic root and ascending thoracic aorta, with the latter measuring up to 6 cm transversely, without evidence of dissection. Pre-operative left heart catheterization (LHC) showed no hemodynamically significant aortic stenosis, no significant obstructive lesions in the left main artery, as well as angiographically normal left anterior descending (LAD), left circumflex (LCx), and right coronary artery (RCA) systems. Intra-operatively, the patient developed biventricular heart failure (BiVHF) while coming off of heart and lung bypass and required balloon pump support. After several hours in the cardiovascular intensive care unit with a relatively uneventful recovery, he went into ventricular fibrillation cardiac arrest and required extracorporeal membrane oxygenation (ECMO) support. LHC after ECMO placement showed possible ostial RCA dissection versus significant kinking of the ostial RCA, but otherwise angiographically normal LAD and LCx systems and no significant obstructive lesions in the left main artery. He returned to the operating

Received 6 August 2021; revised 30 September 2021; accepted 3 November 2021.  
Available online 31 January 2022

\* Corresponding author at: The Department of Medicine, University of Tennessee Health Science Center, Ascension Saint Thomas Hospital, 300 20<sup>th</sup> Avenue North, Suite 601, Nashville, TN, 37203, USA. Fax: +1 615 284 1694.  
E-mail address: scai8@uthsc.edu (S.S. Cai).

<https://doi.org/10.55729/2000-9666.1018>

2000-9666/© 2021 Greater Baltimore Medical Center. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

room for bypass grafting of the RCA. He initially did well post-operatively, but later lost intrinsic electrical activity and required pacing.

He subsequently developed acute renal failure requiring RRT by post-operative day (POD) 1. He underwent ECMO decannulation and SynCardia TAH placement on POD 2. He continued to require RRT post-operatively, initially with continuous renal replacement therapy (CRRT), which was transitioned to intermittent hemodialysis (iHD). For anticoagulation, he was initially on intravenous (IV) heparin, which was transitioned to warfarin post-operatively. His post-operative course was additionally complicated by prolonged respiratory failure requiring tracheostomy placement 13 days after TAH placement, liver injury, ischemic colitis, and recurrent gastrointestinal (GI) bleeds requiring sigmoid colectomy with end colostomy. Eventually, his tracheostomy was decannulated, and he was discharged home on iHD and warfarin 172 days after TAH placement.

After 318 days on TAH bridge therapy and RRT, the patient underwent orthotopic heart transplant and deceased donor kidney transplant, with removal of TAH. Post-operatively, he required CRRT, which was weaned off by POD 4, with no further RRT requirements. He required significant vasopressors and inotropes until POD 11. He was anticoagulated with IV heparin prior to surgery, which was transitioned to subcutaneous heparin post-operatively. He recovered well and was discharged to inpatient rehabilitation on POD 20.

### 3. Discussion

This case illustrates the potential of TAH for bridging patients with advanced heart and kidney failure to HKTx. The patient in our case was initially considered for left ventricular assist device (LVAD) placement for bridge therapy to HKTx, but he had several contraindications. The contraindications to LVAD placement are as follows: severe RV failure; sepsis or current active infection; untreated, severe carotid artery disease; severe obstructive or restrictive pulmonary disease; irreversible severe cerebral injury; RRT-dependent renal failure; elevated international normalized ratio from liver failure or disseminated intravascular coagulation; any severe end-organ failure; heart failure that is expected to recover without mechanical circulatory support; or non-cardiac illness likely to limit survival to less than 2 years.<sup>2</sup> Our patient had BiVHF with loss of electrical activity and total cardiac infarction as well as RRT-dependent renal failure; therefore, he was not eligible for LVAD placement.

He was considered for TAH as a bridge therapy to transplant. He met the inclusion criteria for TAH, as he had BiVHF, a body surface area between 1.7 and 2.5 m<sup>2</sup> (2.3 m<sup>2</sup> at the time of TAH placement), and hemodynamic insufficiency requiring cardiopulmonary bypass with ECMO.<sup>3</sup> He also did not have any major contraindications to TAH placement. Contraindications to TAH placement include LV failure without RV failure, life expectancy less than 2 years, history of cardiac surgery, thrombophilia, and concomitant use of another vascular assist device. Unlike in LVAD placement, neither hepatic failure nor renal failure are absolute contraindications to TAH placement, as TAH has demonstrated its ability to reverse liver and/or kidney failure by re-establishing both satisfactory organ perfusion and adequate venous return.<sup>4,5</sup>

Studies have shown that TAH bridging is a promising therapy for patients awaiting heart transplant. A five-center retrospective study published in 2004 found that patients with BiVHF had a 79% survival to transplant rate on TAH.<sup>3</sup> In another retrospective study of 66 patients who received TAH as a bridge therapy to transplant between 2006 and 2012, the overall survival to transplant for all patients was 86% (n = 55).<sup>6</sup> The patients in the study were further categorized into two groups. The first group consisted of those who received TAH due to BiVHF or RV dysfunction prohibiting LVAD implantation. The second group consisted of those who received TAH due to alternative anatomical and pathophysiologic causes that preclude LVAD implantation, which included hypertrophic cardiomyopathy, refractory arrhythmias, post-infarction shock, ventricular rupture, LVAD failure, and cardiac allograft failure. The survival to transplant on the TAH bridge therapy was 93% for the first group and 77% for the second group. The authors of the study state that the decreased survival in the second group is driven by the high-risk nature of the conditions described in that group.<sup>6</sup>

After heart transplant, the patients who had received TAH as bridge therapy also had encouraging long-term outcomes. In the aforementioned study published in 2004, one-year and five-year survival rates after heart transplant among patients who had received TAH bridge therapy to transplantation were 86% and 64%, respectively.<sup>3</sup> In another retrospective study of 73 patients who received a SynCardia TAH as a bridge therapy to transplant between 1988 and 2019, 50 (68%) received a heart transplant. The long-term survival rates after a heart transplant at 5, 10, and 12 years were 79.1 ± 5.9% (n = 32), 76.5 ± 6.3% (n = 22), and 72.4 ± 7.1% (n = 12), respectively.<sup>7</sup>

Complications related to TAH bridge therapy are wide-ranging and well-documented. A 1986 case report describes cerebral embolic events in 4 out of 7 patients who received TAH, with subsequent intracranial hemorrhage from anticoagulation therapy in 2 patients.<sup>8</sup> In a study of 42 TAHs placed between 1990 and 2006, 12 patients (28.5%) died before organ transplantation, including 6 from multiorgan failure, 2 from sepsis, 2 from acute respiratory distress syndrome (ARDS), and 1 from alveolar hemorrhage. Additionally, 35 patients (85%) developed infections and 3 patients (7%) developed strokes while on TAH bridge therapy.<sup>9</sup> In another study of 101 TAHs placed between 1993 and 2009, 32 patients (31.7%) died before organ transplantation, including 13 from multiorgan failure, 6 from pulmonary failure, and 4 from neurologic injury. Other adverse events included hemorrhage (25%) and stroke (8%).<sup>10</sup> In a more recent study of 66 TAHs placed between 2006 and 2012, the most common complications were infection (24%), hemorrhage (23%), and pericardial effusion/tamponade (15%). Other complications included tracheostomy (6%), acute pulmonary embolism (4.5%), stroke (4.5%), and hemodynamic collapse (4.5%). Ten patients (15%) died before organ transplantation.<sup>11</sup>

The patient in our case experienced several of the aforementioned complications while on TAH bridge therapy. He had renal failure requiring RRT, right occipital ischemic stroke, respiratory failure requiring tracheostomy, liver injury, hematomas, recurrent GI bleeding requiring colectomy and colostomy, as well as intra-abdominal abscesses requiring drainage and prolonged courses of IV antibiotics and antifungals. It is crucial for clinicians to recognize the potential for these complications and promptly manage them, when caring for patients on TAH bridge therapy, in order to maximize their chances of survival to organ transplantation.

#### 4. Conclusion

We reported a case of successful HKTx after 318 days on TAH bridge therapy and RRT. We hope that this case demonstrates that TAH is a unique and up-and-coming option for bridge therapy to HKTx in patients with heart and kidney failure. TAH is a

promising bridge therapy to heart transplant in patients who do not qualify for LVAD placement, including those with BiVHF, RV failure, concomitant kidney or liver failure, or anatomical or pathophysiological conditions that preclude LVAD placement. However, it is crucial for clinicians to be vigilant of the wide variety of complications associated with TAH when managing patients on TAH bridge therapy.

#### Acknowledgements

The authors would like to thank Dr. Guillermo Nava for helpful discussions.

#### Conflicts of interest

The authors report no potential conflicts of interest.

#### References

1. Khan Sanna, Waqas Jehangir. Evolution of artificial hearts: an overview and history. *Cardiol Res.* 2014;5(5):121–125. <https://doi.org/10.14740/cr354w>.
2. Khazanie Prateeti, Rogers Joseph G. Patient selection for left ventricular assist devices. *Congest Heart Fail.* 2011;17(5):227–234.
3. Copeland Jack G, et al. Cardiac replacement with a total artificial heart as a bridge to transplantation. *N Engl J Med.* 2004;351(9):859–867.
4. Senage Thomas, et al. Total artificial heart: patient selection and risk factors. *Ann Cardiothorac Surg.* 2020;9(2):118–120. <https://doi.org/10.21037/acs.2020.02.10>.
5. Gomez Carrie K, Hobbs Susan K. Total artificial heart imaging and complications: a pictorial review. *VAD J.* 2016;2(1):18.
6. Thanavaro Kristin L, et al. Clinical indications for implantation of the total artificial heart. *Am Soc Artif Intern Organs J.* 2014;60(5):594–596.
7. David Charles-Henri, et al. A heart transplant after total artificial heart support: initial and long-term results. *Eur J Cardio Thorac Surg : Off J Euro Assoc Cardio-thorac Surg.* 2020; 58(6):1175–1181. <https://doi.org/10.1093/ejcts/ezaa261>.
8. Levinson Mark M, et al. Thromboembolic complications of the Jarvik-7 total artificial heart: case report. *Artif Organs.* 1986; 10(3):236–244.
9. Roussel Jean Christian, et al. CardioWest (Jarvik) total artificial heart: a single-center experience with 42 patients. *Ann Thorac Surg.* 2009;87(1):124–130.
10. Copeland Jack G, et al. Experience with more than 100 total artificial heart implants. *J Thorac Cardiovasc Surg.* 2012;143(3):727–734.
11. Parker Mark S, et al. Total artificial heart implantation: clinical indications, expected postoperative imaging findings, and recognition of complications. *Am J Roentgenol.* 2014;202(3):W191–W201.