

# Extracorporeal membrane oxygenator as a bridge to definitive treatment in patients with persistent infective endocarditis

Soraya Fereydooni<sup>1</sup>, Kevin Hu<sup>1</sup>, Michal Shang<sup>1</sup>, and Prashanth Vallabhajosyula<sup>1</sup>

<sup>1</sup>Yale University School of Medicine Yale Center for Thoracic Aortic Disease

July 25, 2022

## Abstract

Considering the worsening opioid epidemic, complicated infective endocarditis (IE) secondary to intravenous drug use (IVDU) that fails medical management is increasingly common. We present a 31-year-old patient post tricuspid valve replacement who relapsed with recurrent IE and secondary complications of severe tricuspid stenosis and regurgitation, ventricular septal defect (VSD), pulmonary emboli, right-sided heart failure with severe hepatic congestion, and cardiogenic shock. Despite maximal medical management, the patient remained in septic and cardiogenic shock with a potential disposition to hospice care. Upon consulting cardiothoracic surgery, she underwent a first-stage valvectomy with Extracorporeal Membrane Oxygenation (ECMO) as a bridge to definitive treatment. After clearance of infection, she underwent a second-stage valve replacement, VSD repair, and final ECMO decannulation. Our case alludes to ECMO as a potential bridge for patients with complicated infective endocarditis who fail medical management and are high-risk candidates for immediate definitive surgical management.

## Extracorporeal membrane oxygenator as a bridge to definitive treatment in patients with persistent infective endocarditis

*Author list*

### Corresponding author

*Soraya Fereydooni, BS*

Yale School of Medicine, New Haven, CT

Department of Surgery, Division of Cardiac Surgery

Address: 333 Cedar St, New Haven, CT 06510

Tel: (818) 802-3598

Email: [soraya.fereydooni@yale.edu](mailto:soraya.fereydooni@yale.edu)

Fax #: (203)785-3346

*Kevin Hu, BS*

Yale School of Medicine, New Haven, CT

Department of Surgery, Division of Cardiac Surgery

*Michal Shang, MD, MS*

Yale School of Medicine, New Haven, CT

Department of Surgery, Division of Cardiac Surgery

*Prashanth Vallabhajosyula, MD, MS*

Yale School of Medicine, New Haven, CT

Department of Surgery, Division of Cardiac Surgery

The Aortic Institute at Yale-New Haven Hospital

*Short running title*

Bridging ECMO for infective endocarditis

*Disclosure & funding*

There was no specific source of funding for this work. There was no conflict of interest. This manuscript has not been published on any preprint servers.

*Metadata*

Abstract word count: 171

Word count: 1,199

Number of references: 8

*Keywords*

Infective endocarditis; Intravenous drug user; Extracorporeal membrane oxygenation; Severe tricuspid regurgitation

*Abstract*

Considering the worsening opioid epidemic, complicated infective endocarditis (IE) secondary to intravenous drug use (IVDU) that fails medical management is increasingly common. We present a 31-year-old patient post tricuspid valve replacement who relapsed with recurrent IE and secondary complications of severe tricuspid stenosis and regurgitation, ventricular septal defect (VSD), pulmonary emboli, right-sided heart failure with severe hepatic congestion, and cardiogenic shock. Despite maximal medical management, the patient remained in septic and cardiogenic shock with a potential disposition to hospice care. Upon consulting cardiothoracic surgery, she underwent a first-stage valvectomy with Extracorporeal Membrane Oxygenation (ECMO) as a bridge to definitive treatment. After clearance of infection, she underwent a second-stage valve replacement, VSD repair, and final ECMO decannulation. Our case alludes to ECMO as a potential bridge for patients with complicated infective endocarditis who fail medical management and are high-risk candidates for immediate definitive surgical management.

*Introduction*

The proportional incidence of intravenous drug use (IVDU)-associated infective endocarditis (IE) cases requiring surgery has increased significantly, mirroring the national opioid crisis.<sup>1</sup> Relapse among patients with a history of IVDU is common and is the leading cause of death.<sup>2</sup> Here we present treating a patient who relapsed post valve replacement presenting with severe TR and stenosis, right-sided heart failure, and ventral septal defect (VSD). As medical management failed, we offered the patient valvectomy and Extracorporeal Membrane Oxygenation (ECMO) as a potential bridge to definitive treatment with valve replacement.

*Methods/results*

We report the case of a 31-year-old female with a history of IVDU and chronic hepatitis C who presented to the hospital with a fever and back pain. She had previously left an outside hospital against medical advice, where she had been found to have MSSA bacteremia. Upon arrival at our ED, a CT angiogram found septic pulmonary emboli, raising suspicion of IE. Transthoracic echocardiogram (TTE) showed a tricuspid valve (TV) vegetation with severe tricuspid regurgitation. The patient underwent bioprosthetic TV replacement, followed by 6 weeks of cefazolin. She also received two epicardial pacing leads and a permanent pacemaker

during the procedure for heart block. After discharge, the patient was only seen once before being lost to follow-up.

7 months later, the patient returned to our ED with fatigue, fevers, night sweats, chronic back pain, shortness of breath, and reported heroin usage prior to presentation. TTE revealed recurrent TV vegetation with severe regurgitation and secondary ventral septal defect (Figure 1. A, B). She was admitted to the cardiology service in the ICU and despite maximal medical management, deteriorated with severe cardiogenic and septic shock due to persistent bacteremia. Ten days into ICU care she became anuric in spite of inotropic support. Cardiac surgery service was consulted as hospice care was being considered. Upon evaluation, the patient was deemed very high risk and a poor candidate for redo sternotomy and tricuspid valve replacement without infection source control. We planned a staged approach with the initial stage of valvectomy for source control and ECMO for hemodynamic stability to definitive treatment. After a redo sternotomy and tricuspid valvectomy, she was placed on venous arterial ECMO with right femoral arterial cannulation, allowing time for possible infection clearance, right heart decompression, and hepatic decongestion (Figure 1. C, D). After 7 days, repeated blood cultures showed bacteremia clearance and return to hemodynamic stability with resolving renal failure. The patient was taken back to the operating room and underwent 29 mm bioprosthetic valve replacement, ventral septal defect (VSD) repair, and new epicardial lead placement (Figure 1. E, F).

The patient had a prolonged subsequent at the hospital due to developing sacral debutis pressure ulcer, placement concerns due to extensive history of polysubstance use disorder, depression/anxiety, and post-traumatic stress disorder, and the requirement of intravenous antibiotics. At the end of her hospitalization, the patient agreed to be discharged to a long-term acute care hospital, after which she would continue with methadone and buprenorphine treatments as well as receiving significant physical therapy, speech therapy, and nutritional support. This study was approved by IRB (ID: 2000020356) on 4/4/2022 and written with the informed consent of the patient.

### *Discussion*

Management of right-sided IE affecting the TV includes medical versus surgical management, with intravenous antibiotics as the cornerstone treatment for this condition.<sup>3</sup> However, surgical intervention, such as valve replacement, valve repair, and valvectomy may be warranted in several situations including persistent infection, large valve vegetations, and right-sided heart failure secondary to severe TV regurgitation.<sup>3</sup> Despite similar survival outcomes, valve repair is preferred to valve replacement due to freedom from re-operation and lower pacemaker implantation.<sup>3</sup> Due to concerns about developing right-sided heart failure and its association with in-hospital stroke, renal failure, and mechanical ventilation, valvectomy has been recommended as a bridge to valve repair or replacement.<sup>4</sup>

Despite its risks, valvectomy may be an appropriate intervention in patients with persistent sepsis, extensive lesions, and abscess.<sup>3</sup> A staged valvectomy before valve replacement has also been recommended in patients with ongoing drug use with concerns for inconsistent follow-up and poor IVDU abstinence. This gives providers time to manage addiction and other psychosocial morbidities before valve replacement.<sup>5</sup> Valvectomy is generally contraindicated in patients with pulmonary hypertension and right-sided heart failure due to severe tricuspid regurgitation.<sup>5</sup> Despite the existence of this contraindication in our patient, we pursued valvectomy to get source control of the persistent infection. Concomitant arterial-venous ECMO helped with right-sided decompression and optimizing systemic perfusion.

While not common practice, urgent ECMO can be used as a bridge to diagnosis and corrective surgery in patients who develop complications post tricuspid valvectomy. In one case, an undiagnosed or newly developed PFO in the patient resulted in right to left shunting and subsequent refractory hypoxemia post tricuspid valvectomy.<sup>6</sup> ECMO gave providers time to diagnose the PFO on imaging and appropriately prepare patients for corrective surgery. In our case, ECMO was a planned procedure, allowing the clearance of bacteremia and preventing further complications from VSD and right-sided heart failure in preparation for definitive management.

High-risk repeat surgery for endocarditis secondary to IVDU recidivism is an ethically controversial topic.

As recidivism is the leading cause of mortality in patients who undergo surgical management, some providers consider repeat surgery psychosocially futile.<sup>2,7</sup> As follows, strategies such as the “three-strike approach” have been proposed. This is a contract in which the patient agrees to appropriate follow-up and addiction management with only two chances of surgical interventions. Others believe that because prosthetic valves, unlike donor organs, are not a scarce resource, healthcare professionals should not limit treatments on the basis of patient adherence to lifestyle recommendations.<sup>8</sup> Our institution does not restrict the number of reoperations for recurrent prosthetic valve endocarditis, as long as they are surgical candidates from an operative risk standpoint. Furthermore with a multidisciplinary IVDU Addiction Team in place, consisting of addiction medicine physicians, social workers, infectious disease physicians, psychiatrists, cardiac surgeons, nutritionists, pain service specialists, physical therapists, and cardiologists, our postoperative follow-up success continues to improve. Therefore, this has allowed us to not refrain from helping patients with IVDU recidivism. On follow-up care 2 months later, our patient was in rehab and remained asymptomatic.

### Conclusion

With the rising IE secondary to IVDU, providers must be increasingly aware of treatment strategies to manage its complications. As the medical community will care for increasingly critically ill patients, early involvement of cardiac surgery may enable timely intervention with valvectomy and bridging ECMO.

### Acknowledgment

The historical information was documented in the medical electronic system by the physician. The medical student obtained informed consent for this case study from the patient after 6 months after the surgery. The study was further approved by Yale IRB under the study name “outcomes of cardiac surgery,” protocol ID: 2000020356

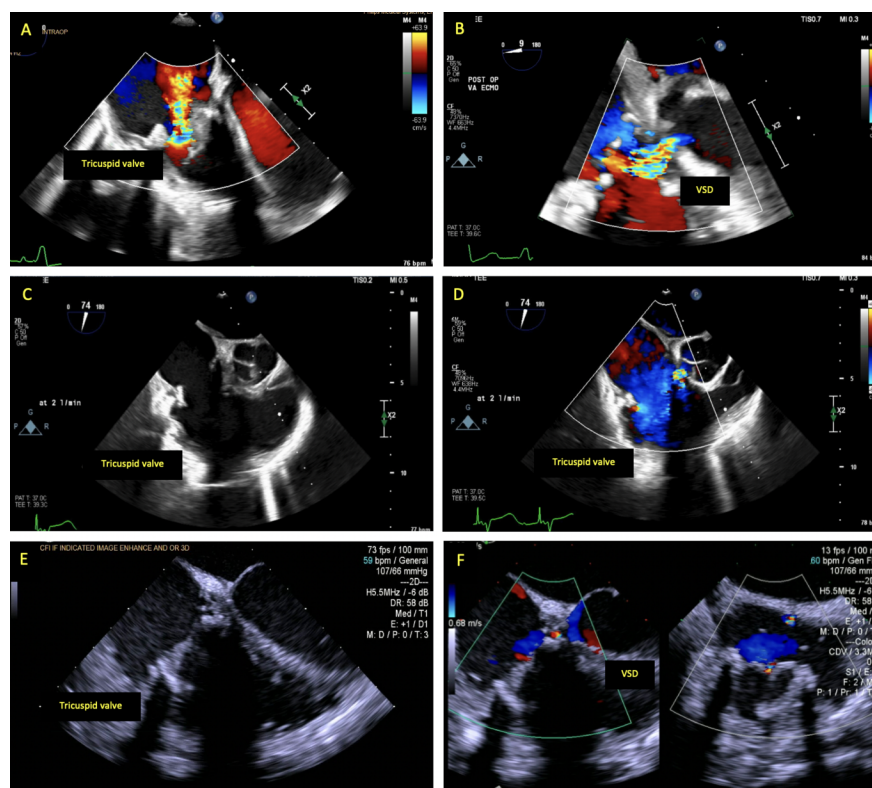
### Author contribution

Fereydooni S. and Hu K. conceptualized the case study and drafted the article. Shang M. made critical revisions to the article. Vallabhajosyula P. was the surgeon on the case and approved the final version of the article.

### Reference

1. Bearpark L, Sartipy U, Franco-Cereceda A, Glaser N. Surgery for Endocarditis in Intravenous Drug Users. *Ann Thorac Surg* . 2021;112(2):573-581. doi:10.1016/j.athoracsur.2020.09.013
2. Nguemeni Tiako MJ, Mori M, Bin Mahmood SU, et al. Recidivism Is the Leading Cause of Death Among Intravenous Drug Users Who Underwent Cardiac Surgery for Infective Endocarditis. *Semin Thorac Cardiovasc Surg* . 2019;31(1):40-45. doi:10.1053/j.semtcvs.2018.07.016
3. Shmueli H, Thomas F, Flint N, Setia G, Janjic A, Siegel RJ. Right-Sided Infective Endocarditis 2020: Challenges and Updates in Diagnosis and Treatment. *J Am Heart Assoc* . 2020;9(15):e017293. doi:10.1161/JAHA.120.017293
4. Slaughter MS, Badhwar V, Ising M, et al. Optimum surgical treatment for tricuspid valve infective endocarditis: An analysis of the Society of Thoracic Surgeons national database. *J Thorac Cardiovasc Surg* . 2021;161(4):1227-1235.e1. doi:10.1016/j.jtcvs.2019.10.124
5. Luc JGY, Choi JH, Kodak K, et al. Valvectomy versus replacement for the surgical treatment of infective tricuspid valve endocarditis: a systematic review and meta-analysis. *Ann Cardiothorac Surg* . 2019;8(6):610-620. doi:10.21037/acs.2019.11.06
6. Macedo J, Grawe ES. Hypoxemia Requiring Venovenous Extracorporeal Membrane Oxygenation after Tricuspid Valvectomy for Infective Endocarditis. *CASE* . 2019;3(4):183-186. doi:10.1016/j.case.2019.04.002
7. Hull SC, Jadbabaie F. When Is Enough Enough? The Dilemma of Valve Replacement in a Recidivist Intravenous Drug User. *Ann Thorac Surg* . 2014;97(5):1486-1487. doi:10.1016/j.athoracsur.2014.02.010

8. Elbatarny M, Bahji A, Bisleri G, Hamilton A. Management of endocarditis among persons who inject drugs: A narrative review of surgical and psychiatric approaches and controversies. *Gen Hosp Psychiatry* . 2019;57:44-49. doi:10.1016/j.genhosppsych.2019.01.008



**Figure 1:** Diagnostic Echocardiography A. Tricuspid valve with vegetation and severe tricuspid regurgitation B. Ventral septal defect secondary to infective endocarditis C. Patient status post tricuspid valvectomy with D. Free tricuspid regurgitation from valvectomy E. Patient status post tricuspid valve replacement with valve coaptation F. Repaired ventral septal defect with no evidence of leakage