# Kde LVAD nestačí:
# Jak na biventrikulární srdeční selhání?

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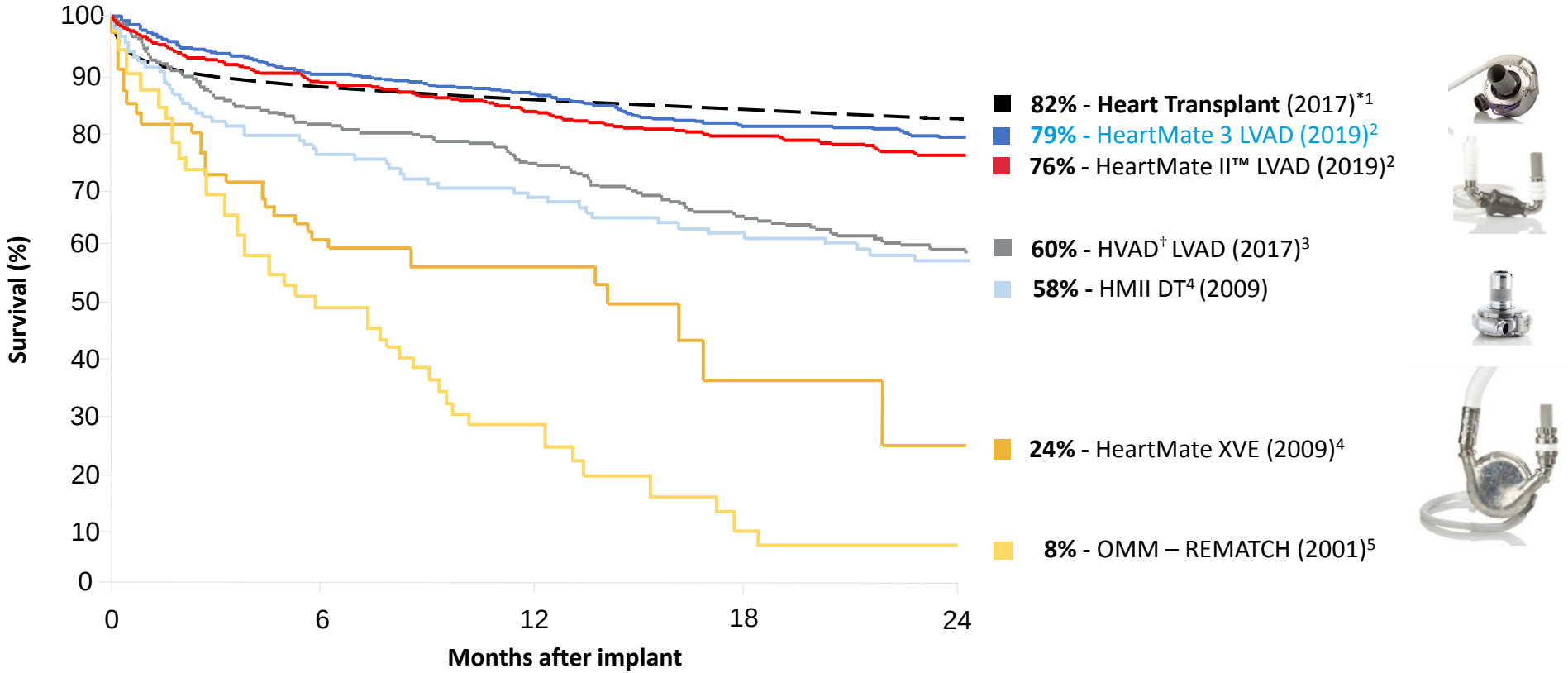
IK+E M

# Impact of advancing technology and the best practice




Based on published data from multicenter experience and separate studies, which may involve different patient populations and other variables. Not a head to head comparison. Data presented for informational purposes only.

*82% 2-year survival for adult heart transplants patients between 2009 and 2015[1]

**References: 1.** Lund LF, Khush KK, Cherikh WS, et al. The Registry of the International Society for Heart and Lung Transplantation: Thirty-fourth Adult Heart Transplantation Report—2017; Focus theme: allograft ischemic time. *J Heart Lung Transplant*. 2017;36:1037-1046**. 2.** Mehra MR, Uriel N, Naka Y, et al. A Fully Magnetically Levitated Ventricular Assist Device-Final Report. N Engl J Med. 2019. **3.** Rogers JG, Pagani FD, Tatooles AJ, et al. Intrapericardial Left Ventricular Assist Device for Advanced Heart Failure. *N Engl J Med*. 2017;376:451-60**. 4.** Slaughter MS, Rogers JG, Milano CA, et al. Advanced heart failure treated with continuous-flow left ventricular assist device. *N Engl J Med*. 2009;361:2241-2251. **5.** Rose EA, Gelijns AC, Moskowitz AJ, et al. Long-term use of a left ventricular assist device for end-stage heart failure. *N Engl J Med.* 2001 Nov 15;345(20):1435-43.

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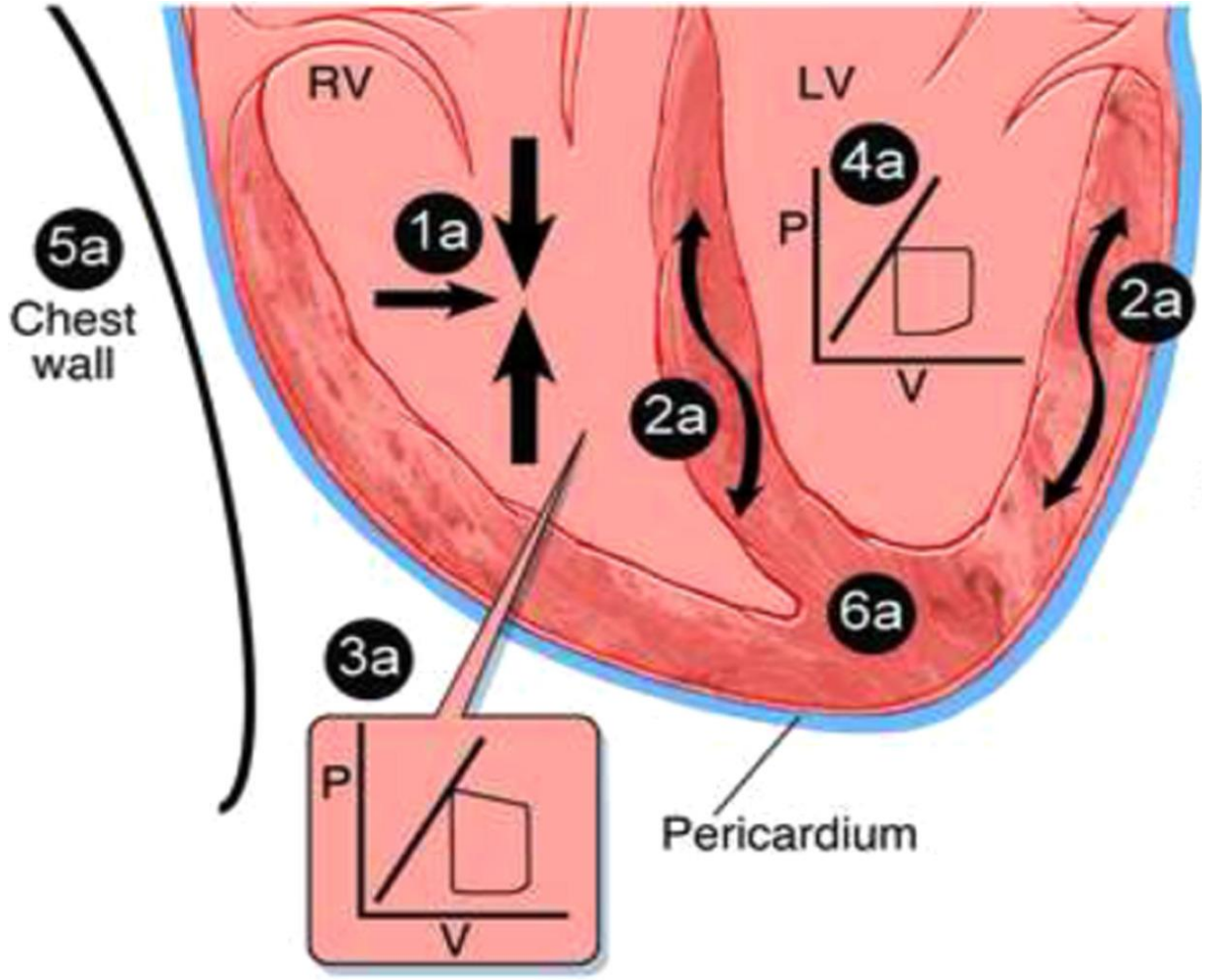
ORIGINAL ARTICLE

# Two-Year Outcomes with a Magnetically Levitated Cardiac Pump in Heart Failure

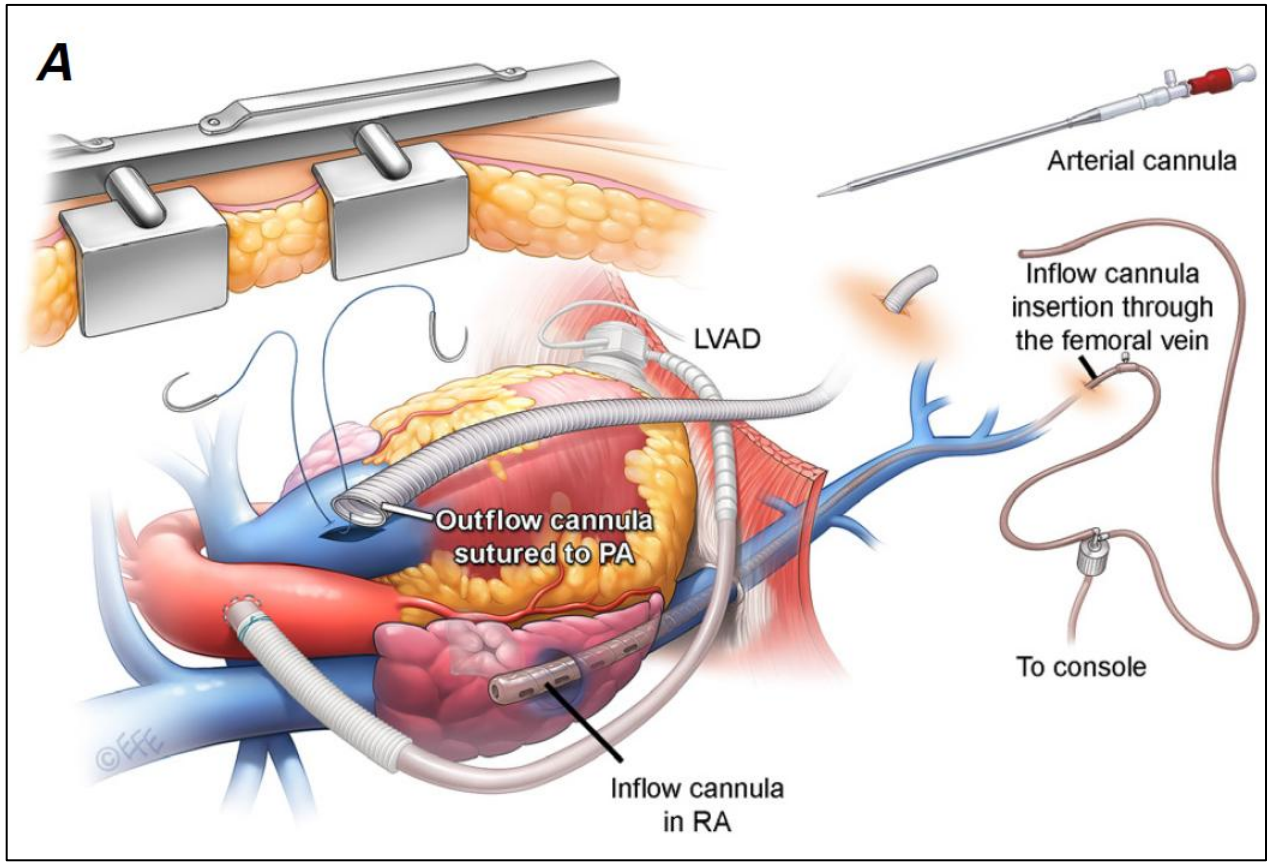
M.R. Mehra, D.J. Goldstein, N. Uriel, J.C. Cleveland, Jr., M. Yuzefpolskaya,

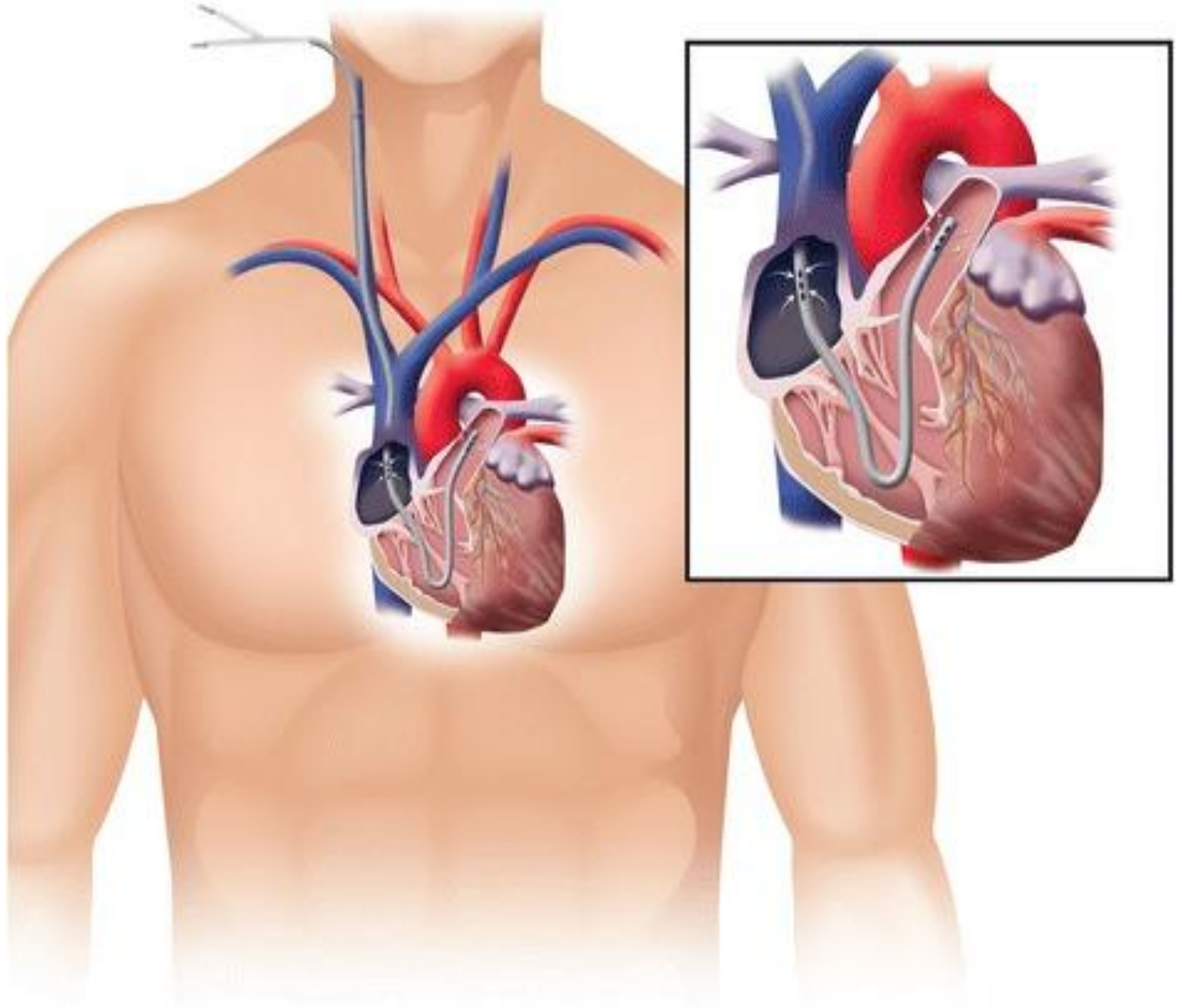
| | | | | | | |
|---|---|---|---|---|---|---|
| LVAS drive-line infection | 45 (23.8) | 68 | 34 (19.8) | 59 | 1.15 (0.73–1.79) | 0.37 |
| Local infection not associated with LVAS | 70 (37.0) | 108 | 60 (34.9) | 114 | 1.00 (0.71–1.42) | 0.74 |
| Right heart failure | | | | | | |
| Any right heart failure | 60 (31.7) | 73 | 48 (27.9) | 53 | 1.12 (0.77–1.64) | 0.49 |
| Right heart failure managed with RVAS | 6 (3.2) | 6 | 8 (4.7) | 8 | 0.67 (0.23–1.94) | 0.59 |
| Cardiac arrhythmia | | | | | | |
| Any cardiac arrhythmia | 71 (37.6) | 108 | 70 (40.7) | 105 | 0.88 (0.63–1.23) | 0.59 |
| Ventricular arrhythmia | 45 (23.8) | 67 | 39 (22.7) | 64 | 1.04 (0.67–1.59) | 0.80 |
| Supraventricular arrhythmia | 33 (17.5) | 40 | 36 (20.9) | 37 | 0.79 (0.49–1.26) | 0.42 |

# Right Ventricle and LVAD Interplay



# RVAD CentriMag & Protek Duo



# BIVAD and TAH Target Population

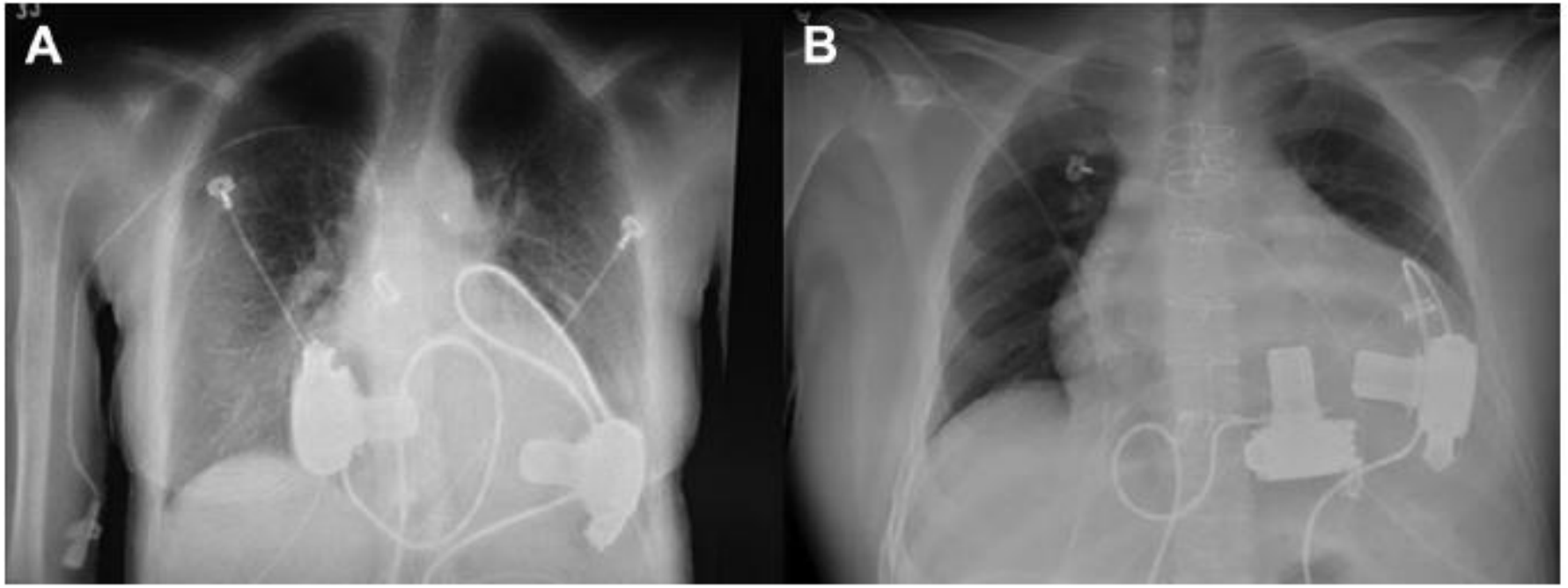
**Patients with end-stage heart failure, OMM refractory, requiring mechanical circulatory support in whom LVAD is considered inefficient or contraindicated:**

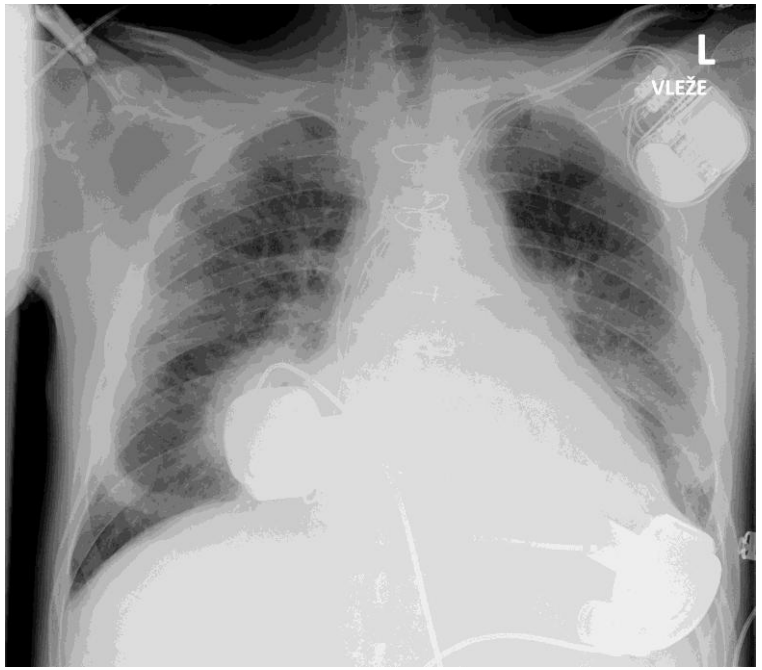
| | | | |
|---|---|---|---|
| In patients with severe chronic biventricular failure, a BiVAD or a TAH should be considered. | IIa | B | [81, 147, 162–178, 187–191, 200, 203–208, 212] |

*Potapov et al. EJCTVS, 2019*

- **RVEF ≤ 30%**
- **TAPSE ≤ 14mm**
- **RV-to-LV end-diastolic diameter ratio > 0.72**
- **CVP > 15 mmHg**
- **CVP-to-PCWP ratio > 0.63**
- **PAPi ≤ 2.0 (PAs - PAd/CVP)**
- **Tricuspid insufficiency grade 4**

# Biventricular LVAD implant (BIVAD)

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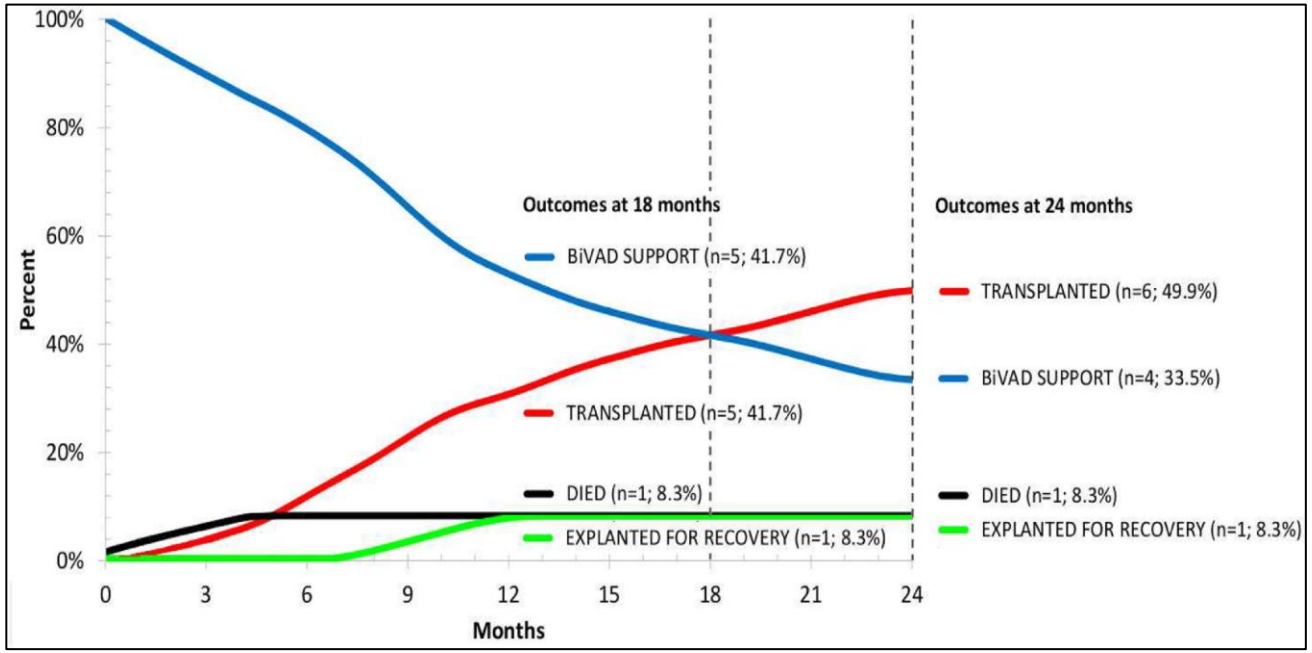
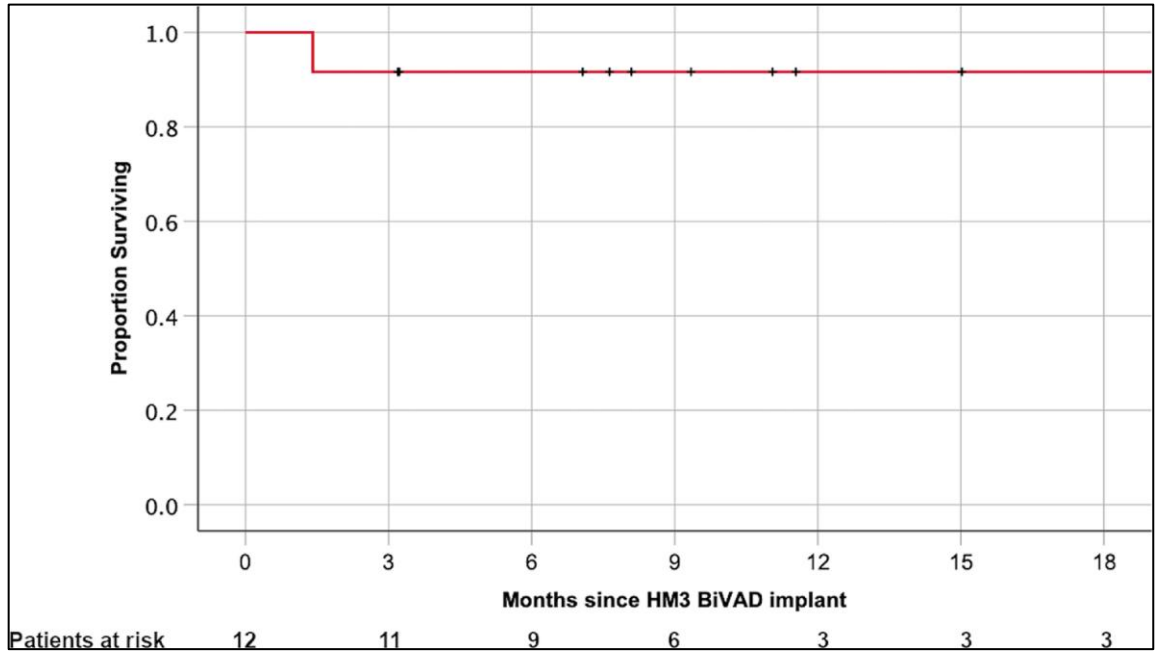
# The results of a single-center experience with HeartMate 3 in a biventricular configuration

David McGiffin, MD,[a] Christina Kure, PhD,[a] Janelle McLean, RN,[b] Silvana Marasco, MD, PhD,[a] Peter Bergin, MD,[b] James L. Hare, MD, PhD,[b] Angeline Leet, MD,[b] Hitesh Patel, MD, PhD,[b] Adam Zimmet, MD,[a] Julia Rix, RN,[b] Andrew Taylor, MD, PhD,[b] and David Kaye, MD, PhD[b]



# TAH Target Population

**Patients with end-stage heart failure, OMM refractory, requiring mechanical circulatory support in whom LVAD is considered inefficient or contraindicated:**

- **Ventricular thrombosis**
- **Ventricular septal defect**
- **Restrictive/constrictive etiologies**
- **Cardiac tumors**
- **Refractory arrythmias**
- **Fulminant rejection after HTx**

| | | | |
|---|---|---|---|
| A TAH may be indicated in patients with biventricular failure, restrictive cardiomyopathy, cardiac tumours or large ventricular septal defects. | IIb | C | [187, 193, 197–201] |
| In patients with anatomical or other clinical conditions that are not well served with an LVAD or BiVAD, implantation of a TAH may be considered. | IIb | C | [203–208] |

*Potapov et al. EJCTVS, 2019*

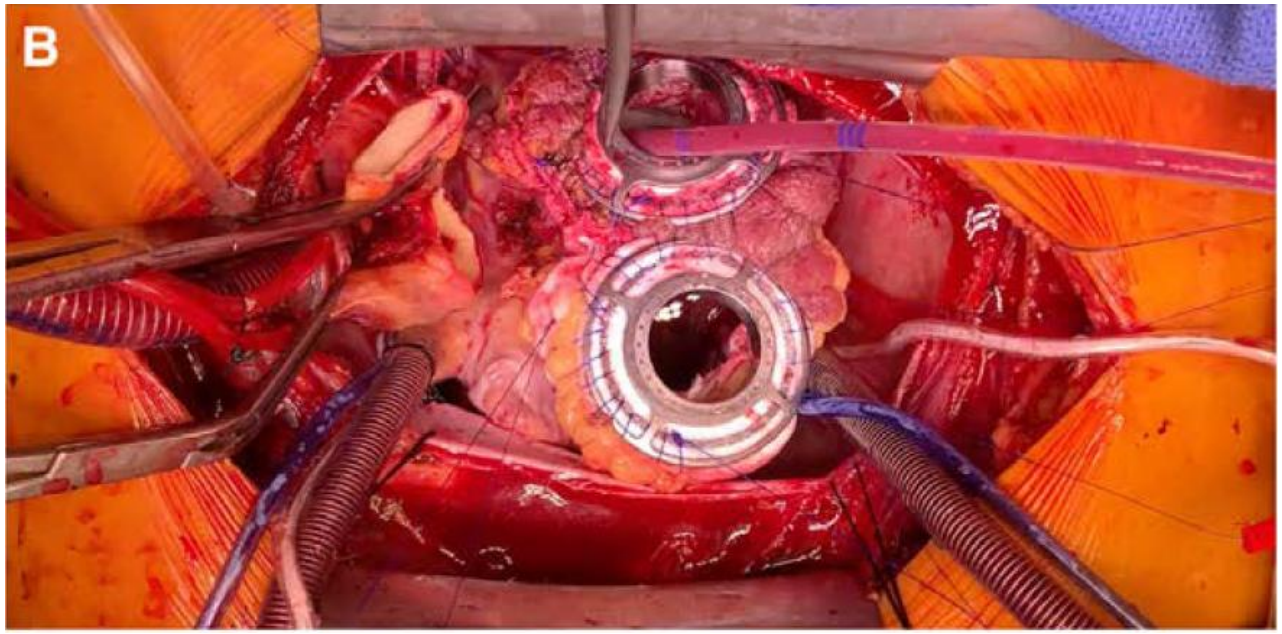
# HeartMate 6 – TAH Alternative

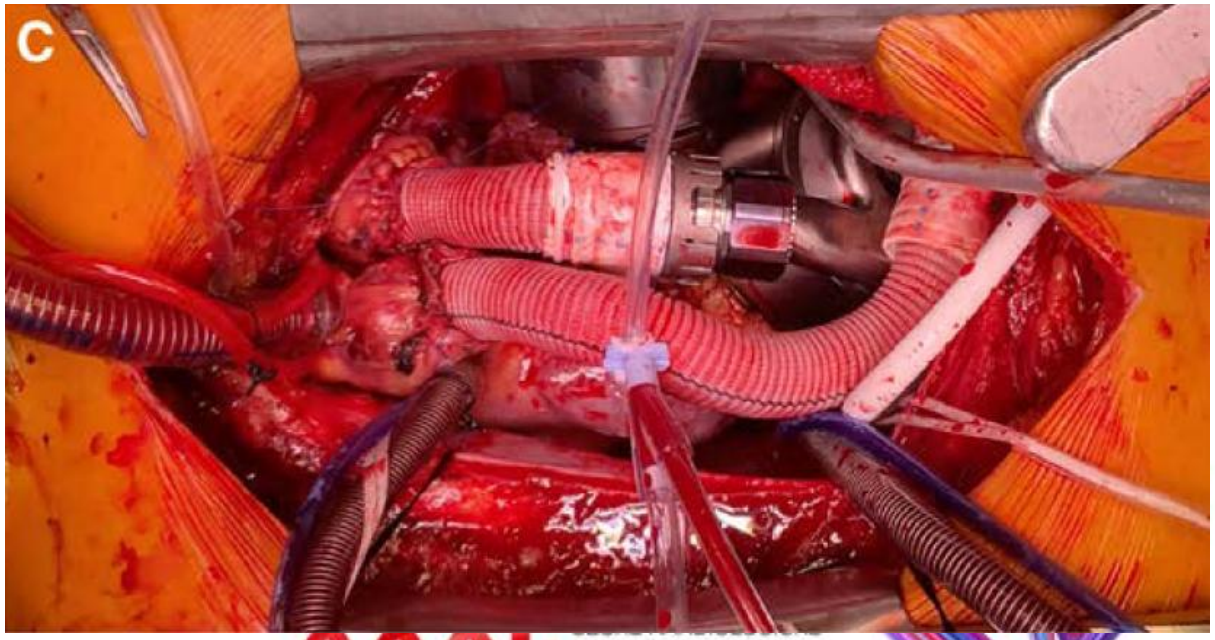
Adult

Operative Techniques in Thoracic and Cardiovascular Surgery

## Implantation of two HeartMate 3s in the setting of a Total Artificial Heart

Jasmin S. Hanke, MD, Günes Dogan, MD, Axel Haverich, MD, PhD and Jan D. Schmitto, MD, PhD



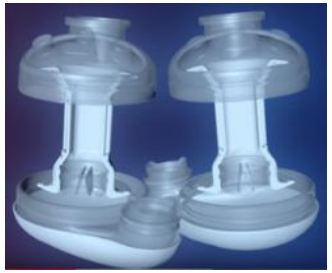

SPOLEČNOSTI

# Novel Total Artificial Hearts

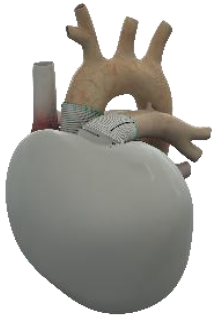
TOTAL ARTIFICIAL HEART

PULSATILE FLOW

ReinHeart



RealHeart



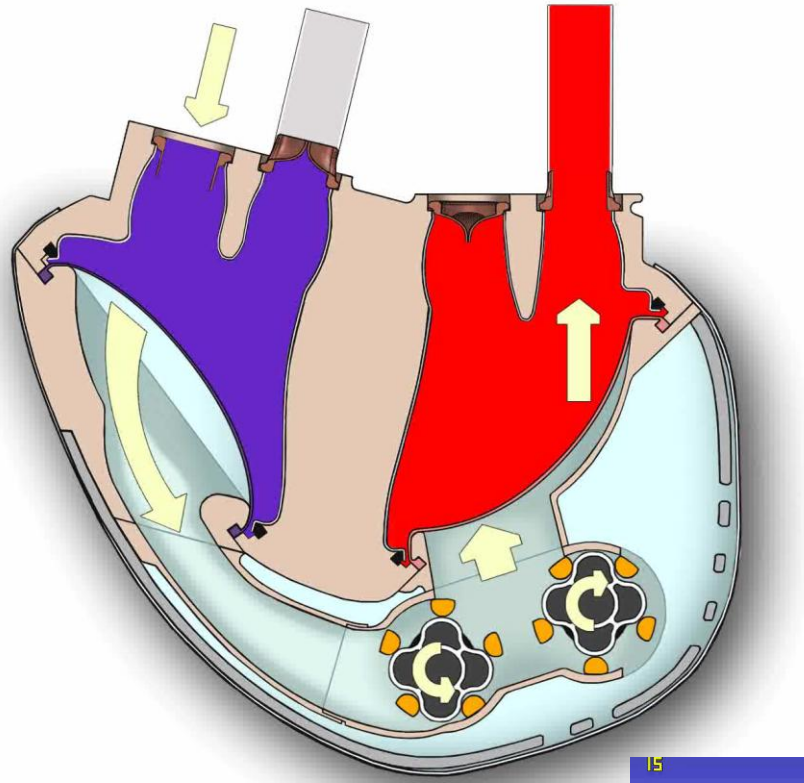
CARMAT

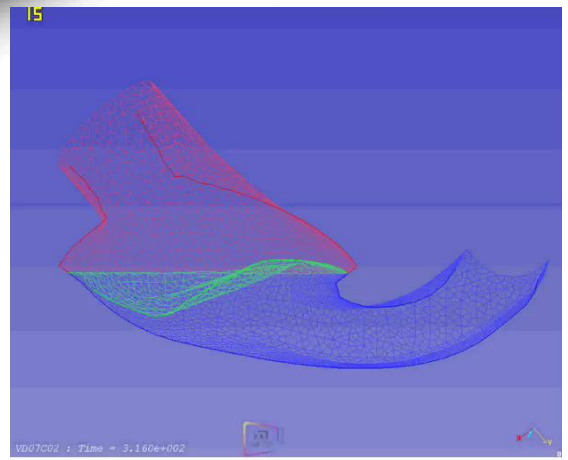
# Carmat TAH CE-Mark Target Population

Patients with end-stage heart failure, OMM refractory, requiring mechanical circulatory support in whom LVAD is considered inefficient or contraindicated:

- Biventricular failure necessitating RVAD support in addition to LVAD
- Treatment-refractory recurrent ventricular tachycardia or fibrillation
- Restrictive or constrictive physiology (hypertrophic cardiomyopathy, cardiac amyloidosis or other infiltrative heart disease)

# Principle of Carmat TAH – Sensors based autoregulation





**1 – Blood flow assessment**

Inflow pressure measured by sensors every millisecond to calculate flow required

**2 – Flow auto-regulation**

Speed and direction of rotation of volumetric pumps adapted every 2 milliseconds to deliver the necessary pulsatile flow

**3 – Flow Control**

Position of the membranes checked by 2 ultrasound sensors every 2 milliseconds to ensure full ejection at every beat, to avoid stasis in blood compartment

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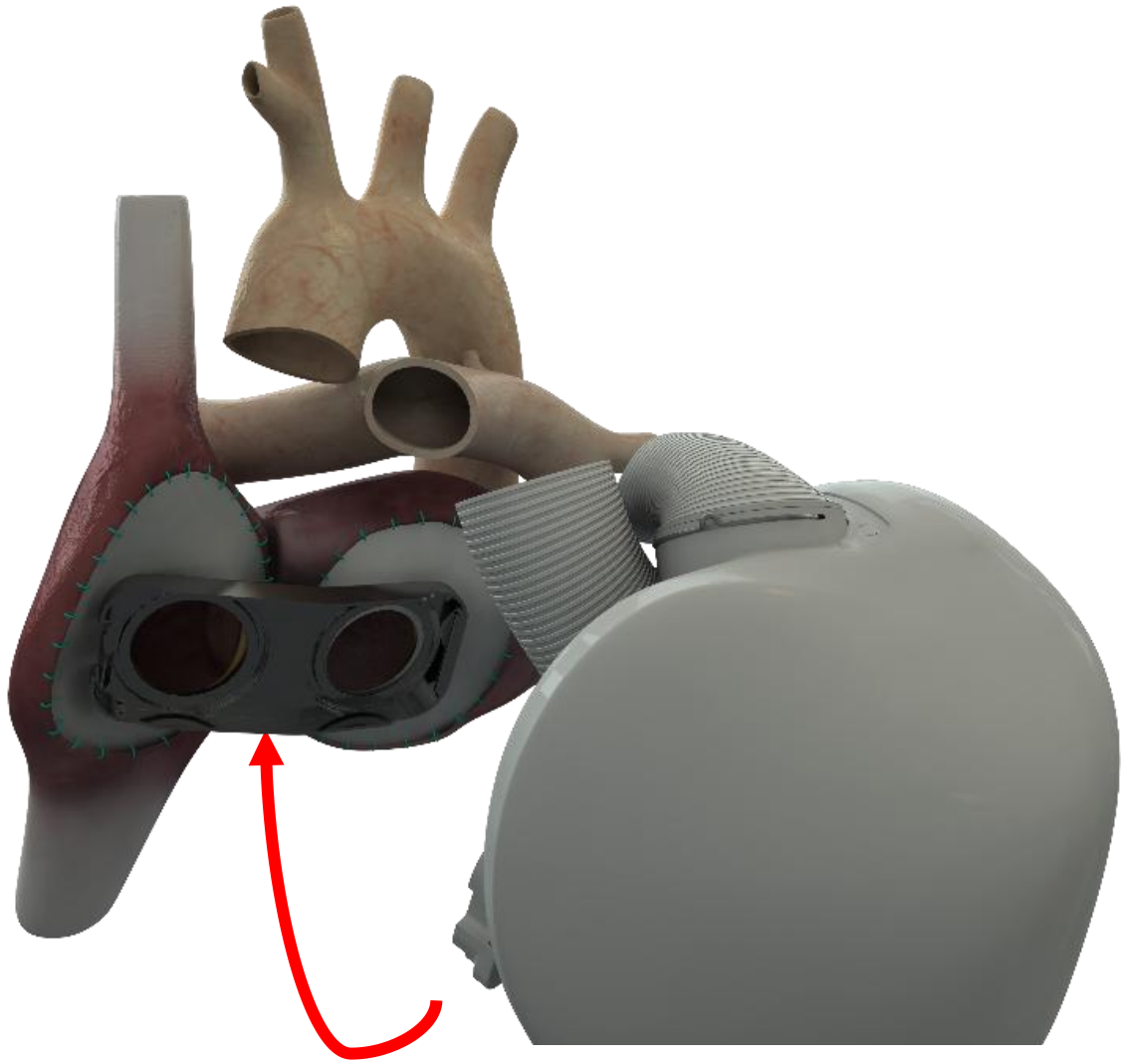
**Initial bridge to transplant experience with a bioprosthetic autoregulated artificial heart**

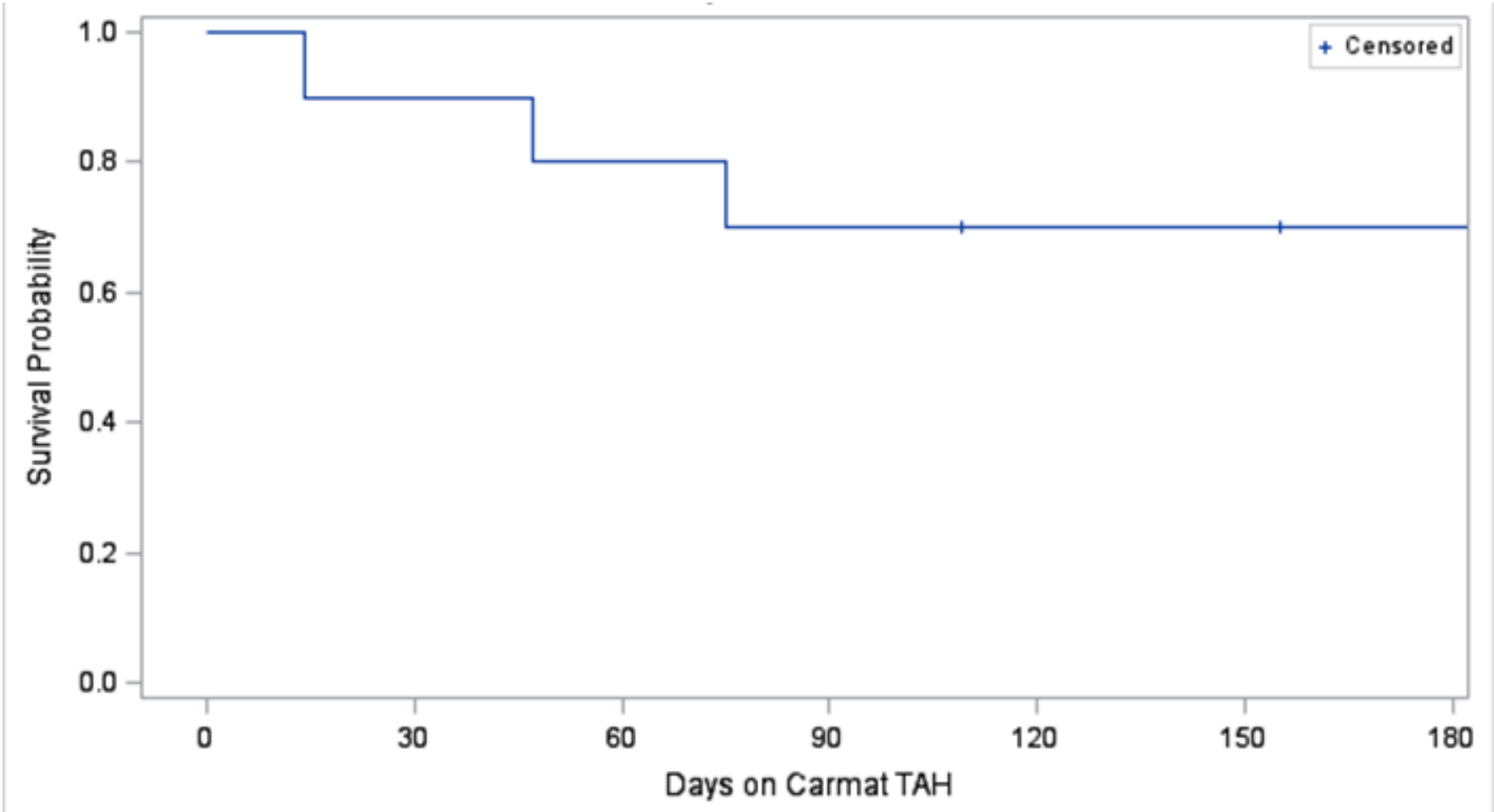
Ivan Netuka, MD, PhD,[a] Yuriy Pya, MD,[b] Makhabbat Bekbossynova, MD,[b] Peter Ivak, MD, PhD,[a] Miroslav Konarik, MD,[a] Finn Gustafsson, MD, PhD,[c] David M. Smadja, PharmD, PhD,[d] Piet Jansen, MD, PhD,[e] and Christian Latrémouille, MD, PhD[d]

J Heart Lung Transplant 2021

# Carmat Total Artificial Heart



# 6-Month Survival in CE Mark Study

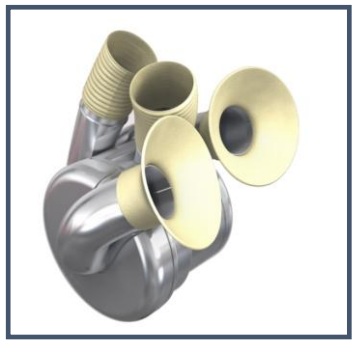



| | |
|---|---|
| Stroke | 0 |
| Thromboembolism | 0 |
| Late bleeding | 0 |

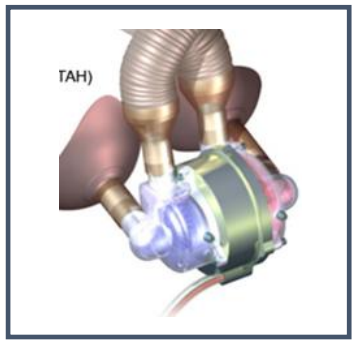
# Novel Total Artificial Hearts

TOTAL ARTIFICIAL HEART

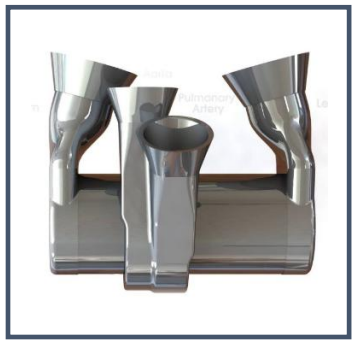
CONTINUOUS FLOW



BiVACOR

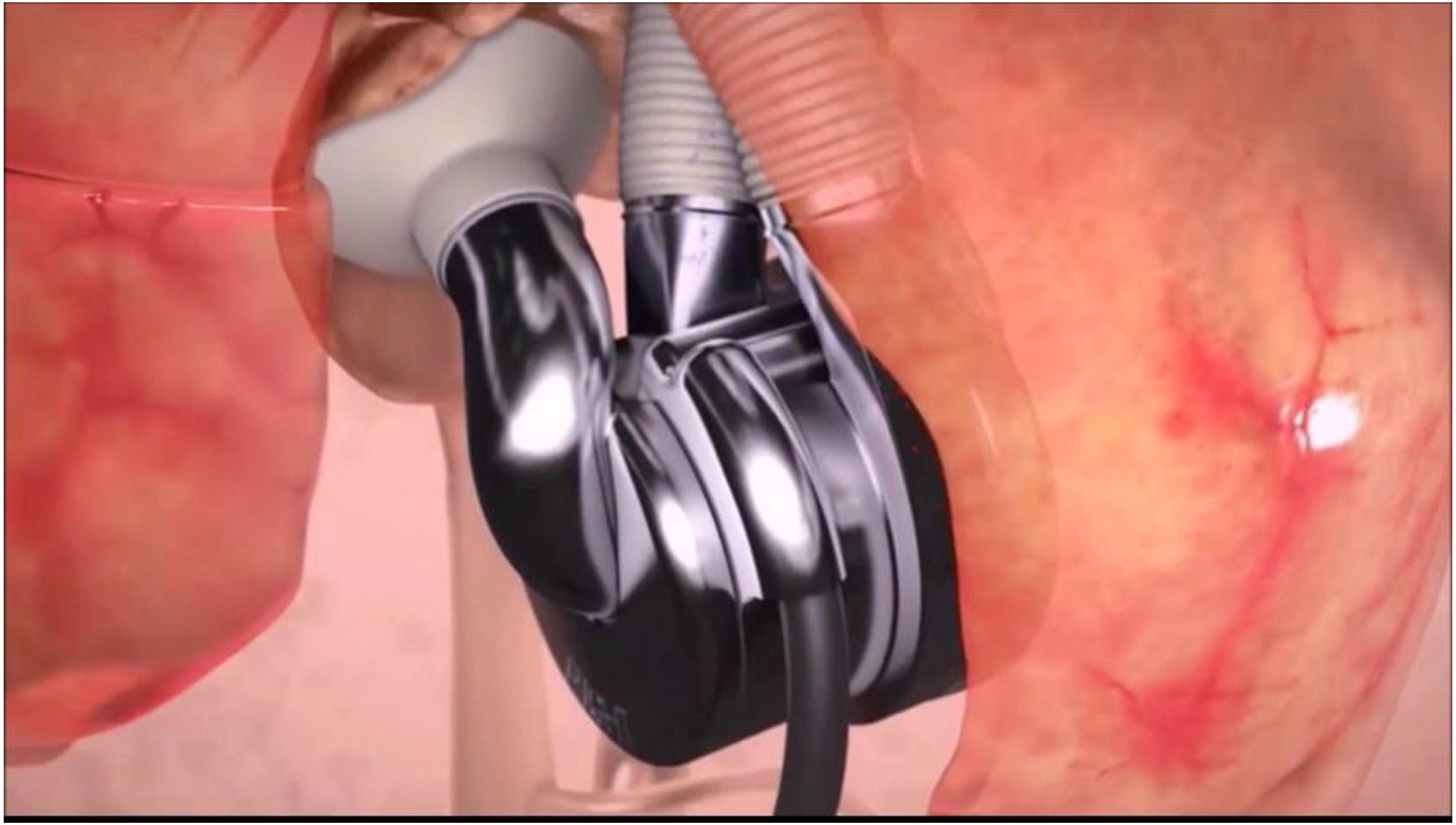


SmartHeart



OregonHeart

# Continuous-flow TAHs



**BiVACOR** device operation

# Conlusions

- Complex interaction between RV and implanted LVAD
- Lower threshold for a less invasive temporary RVAD
- Dual LVADs in a BIVAD configuration outcomes encouraging
- Dual HeartMate 3 TAH - complex challenge
- Dedicated pulsatile Carmat TAH promising, yet long-term durability to be determined
- Continuous-flow rotary TAHs clinical testing warranted



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