Dlouhodobé mechanické srdeční podpory v léčbě pokročilého srdečního selhání

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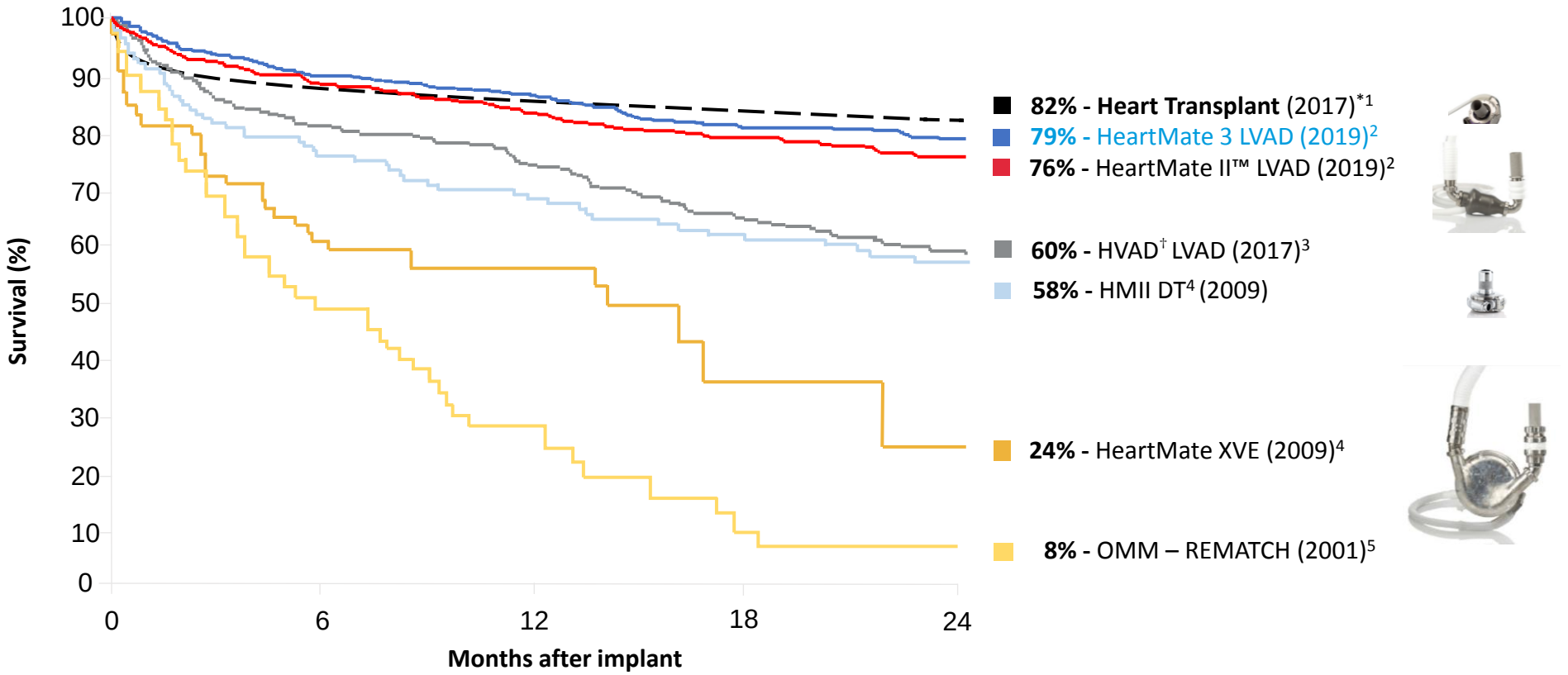
Impact of advancing technology and best practices

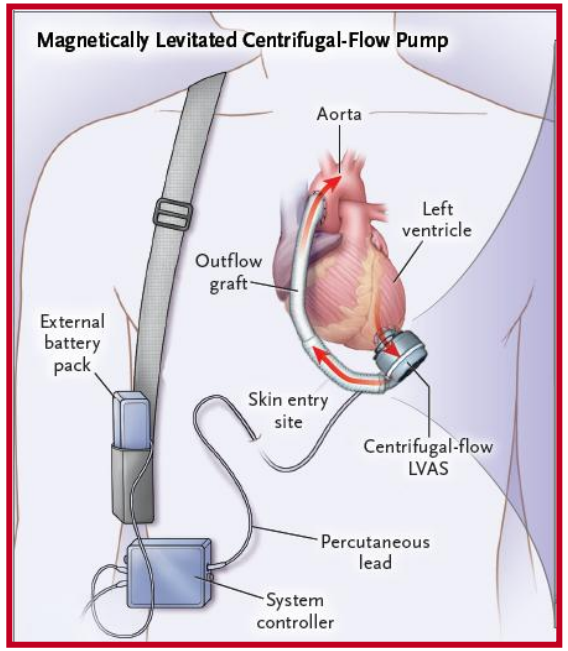


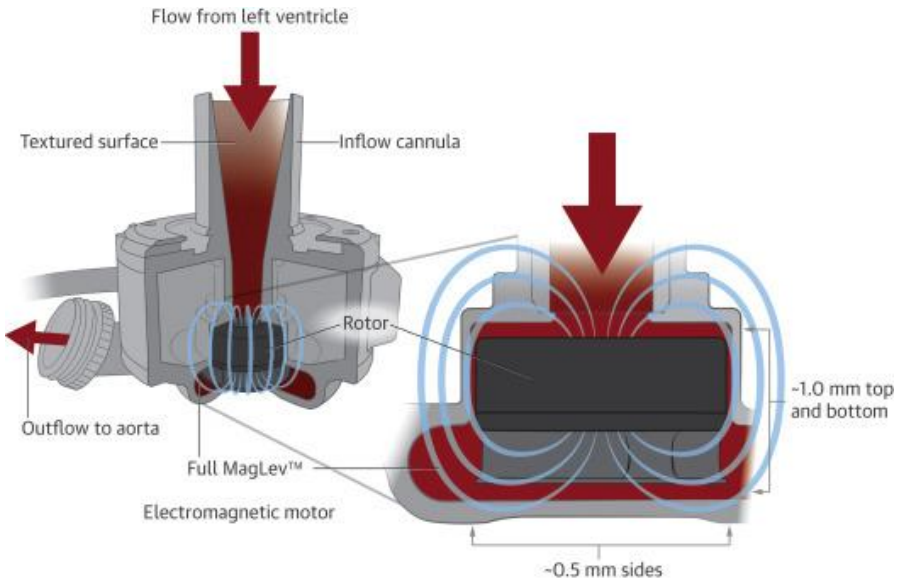
Based on published data from multicenter experience and separate studies, which may involve different patient populations and other variables. Not a head to head comparison. Data presented for informational purposes only.

*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.

A New Survival and Functional Status Benchmark with Contemporary LVAD Therapy





Key Attributes

Enhanced "Thrombo-resistance"

-Near Elimination of Pump Thrombosis
-Low Stroke Rates

Improved Survival

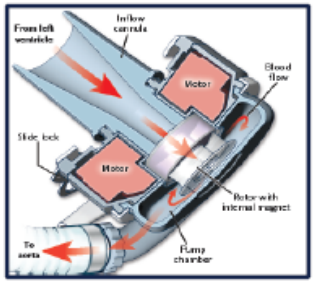
Netuka I. et al. *J Am Coll Cardiol. 2015;66:2579-2589.*

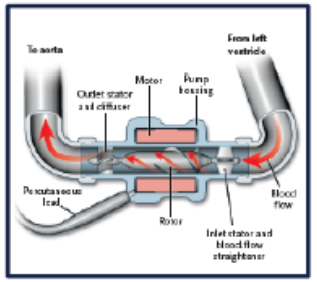
Mehra MR. et al. *N Engl J Med. 2019;380:1618-1627.*

5-year survival of 58.4% and excellent functional capacity on the centrifugal flow HeartMate 3 pump in advanced HF patients *irrespective of therapeutic intent*

Mehra MR et al. *JAMA* 2022; 328(12):1233-1242.

Full Cohort





Full Cohort
N=1028
24-month follow-up

HeartMate 3
N=516

HeartMate II
N=512

Intent-to-Treat (ITT) Population
N=1028

Withdrawn before implant
N = 1
Death: 1

Withdrawn before implant
N = 7
Death: 2
No LVAD implant: 2
Withdrawal of consent: 1
Transplant: 1
Implanted with non-study LVAD: 1

As-Treated Population
N=1020

Implanted with HeartMate 3
N=515

Implanted with HeartMate II
N=505

Withdrawn after implant
N = 6
Implanted with non-study device: 2
Withdrawal of consent: 1
Non-compliance: 1
Other reason: 2

Withdrawn after implant
N = 15
Implanted with non-study device: 5
Withdrawal of consent: 1
Implanted with HM3: 6
Other reason: 3

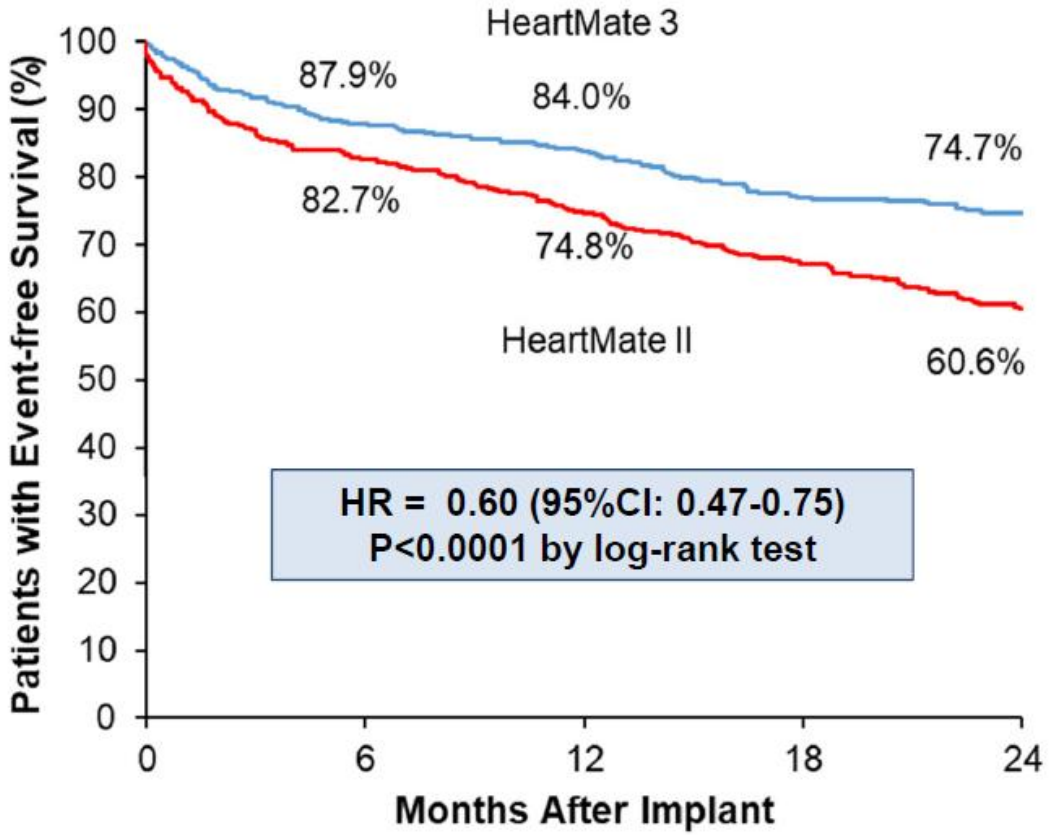
Completed study follow-up
N=509

Completed study follow-up
N=490

MOMENTUM 3

Primary End Point (ITT)

Survival at 2 years free of disabling stroke (>3 mRS) or reoperation to replace or remove a malfunctioning device



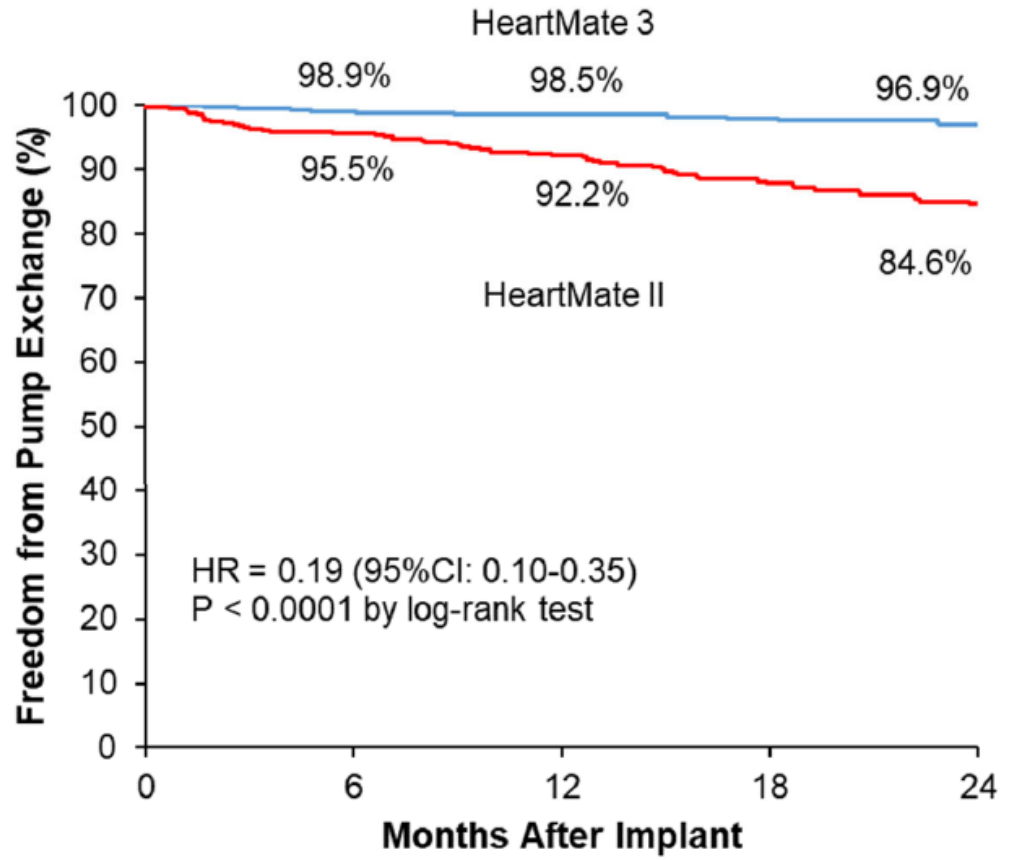
No. at Risk:					
HeartMate 3	516	438	373	313	280
HeartMate II	512	401	321	264	223

MOMENTUM 3

mRS denotes modified Rankin Score; HR, hazard ratio; CI, confidence interval

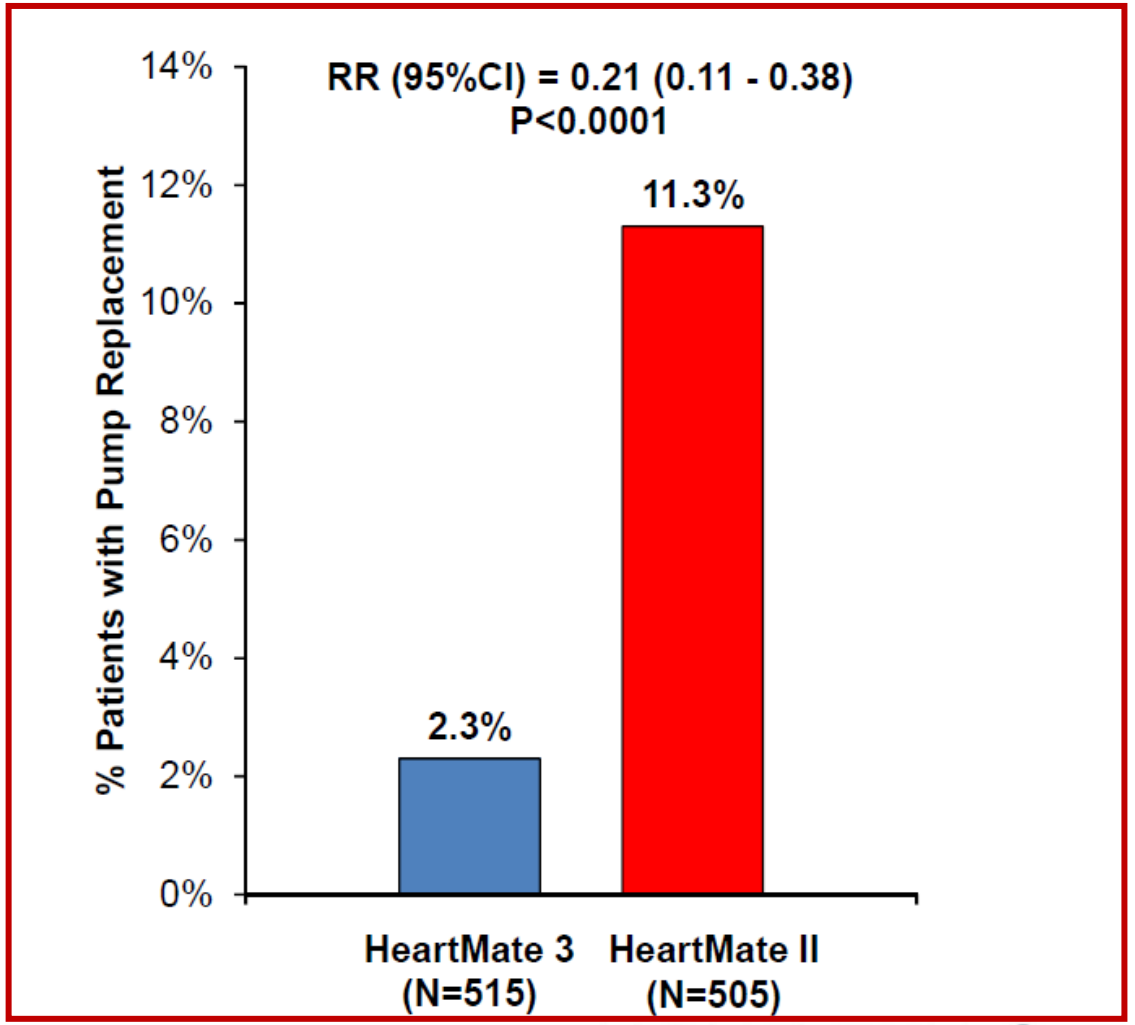
Principal Secondary End Point

Pump replacement at 2 years



No. at Risk:

HeartMate 3	515	444	379	317	283
HeartMate II	505	403	322	264	226

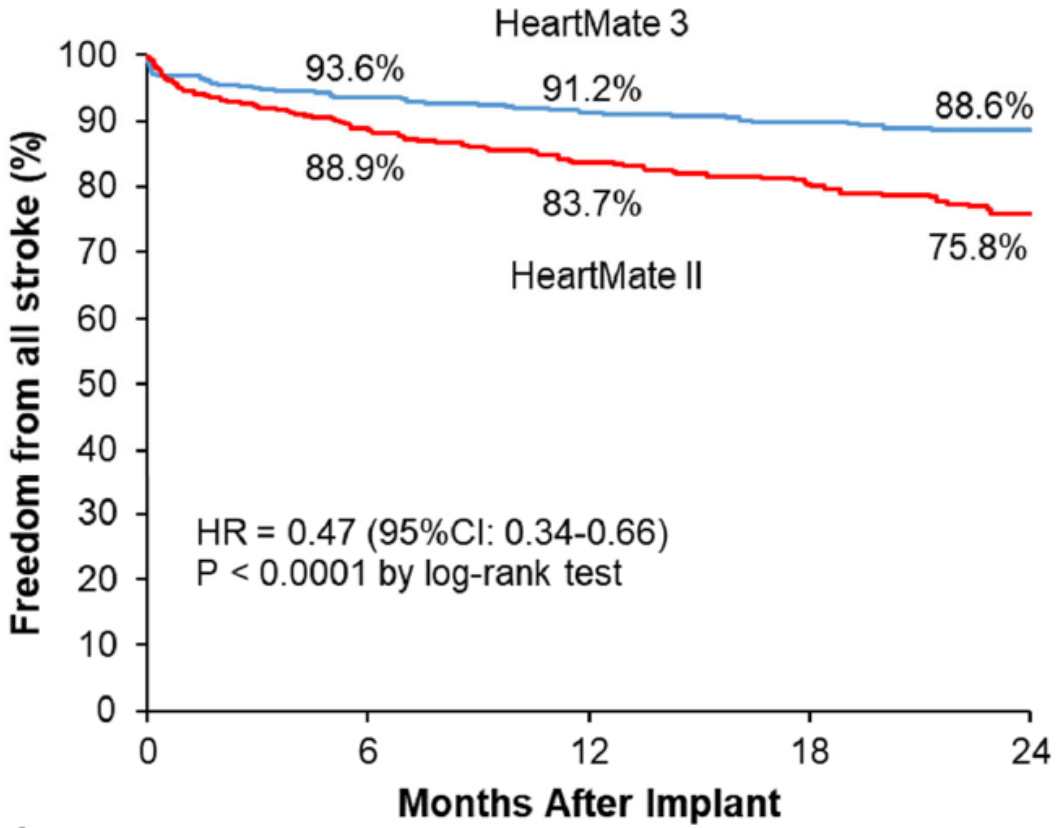


MOMENTUM 3

RR denotes relative risk; CI, confidence interval; HR, hazard ratio

Stroke

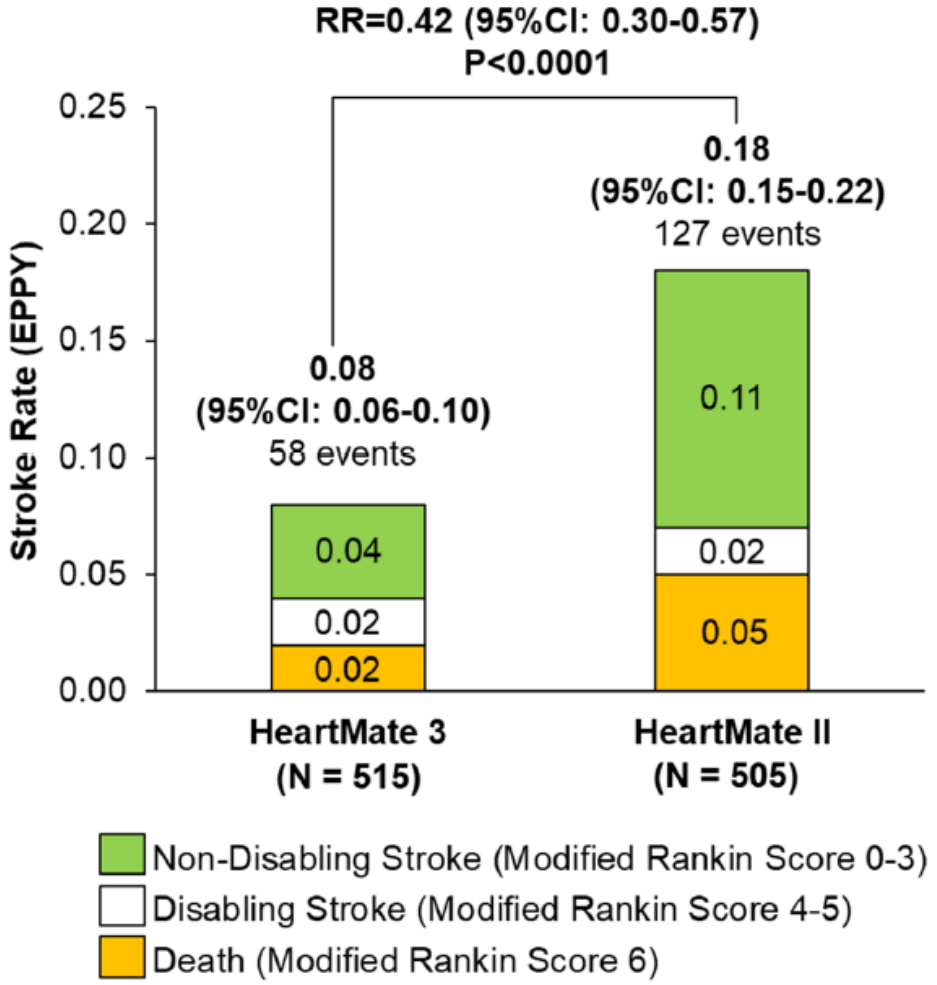
Freedom from All Stroke



No. at Risk:

HeartMate 3	515	429	361	304	270
HeartMate II	505	384	299	252	210

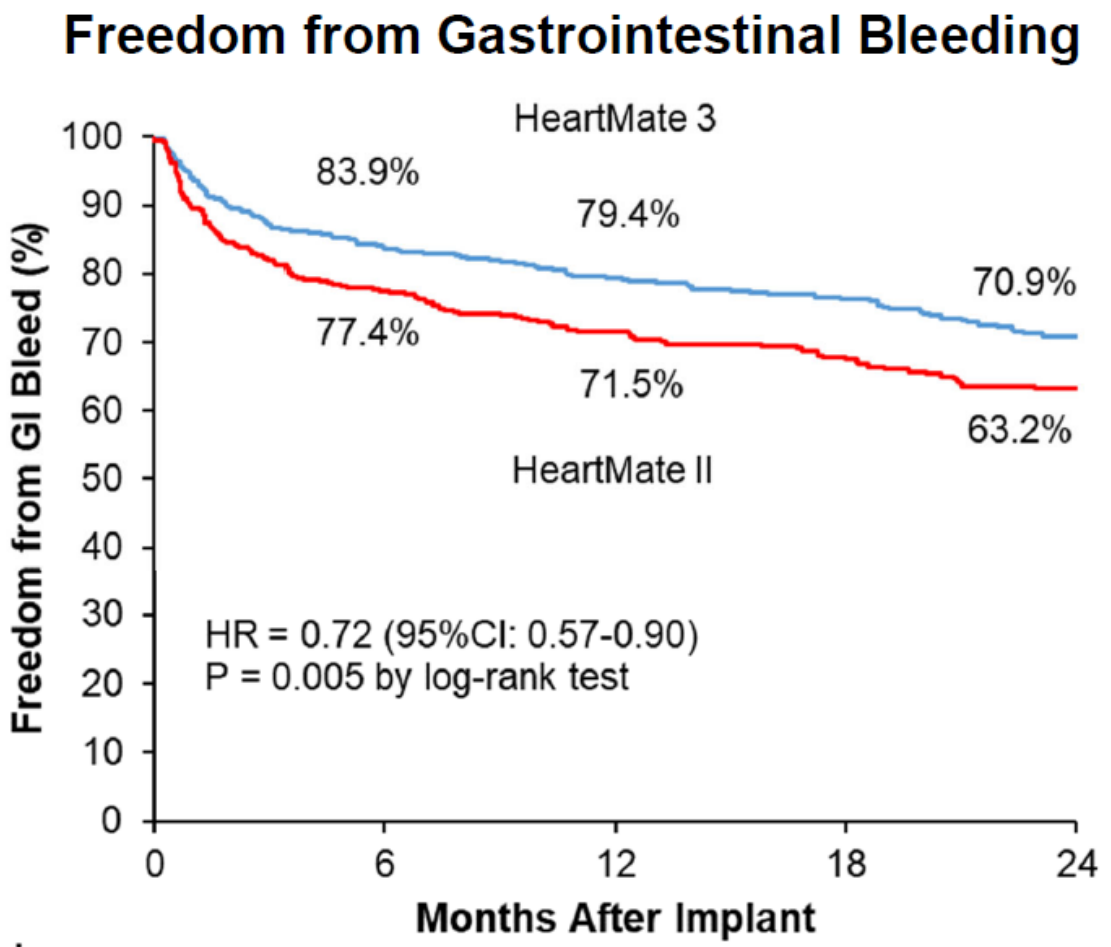
Stroke Severity



MOMENTUM 3

HR denotes hazard ratio; CI, confidence interval; RR, relative risk; EPPY, events per patient year

Gastrointestinal Bleeding



No. at Risk:					
HeartMate 3	515	381	308	251	204
HeartMate II	505	325	248	202	167

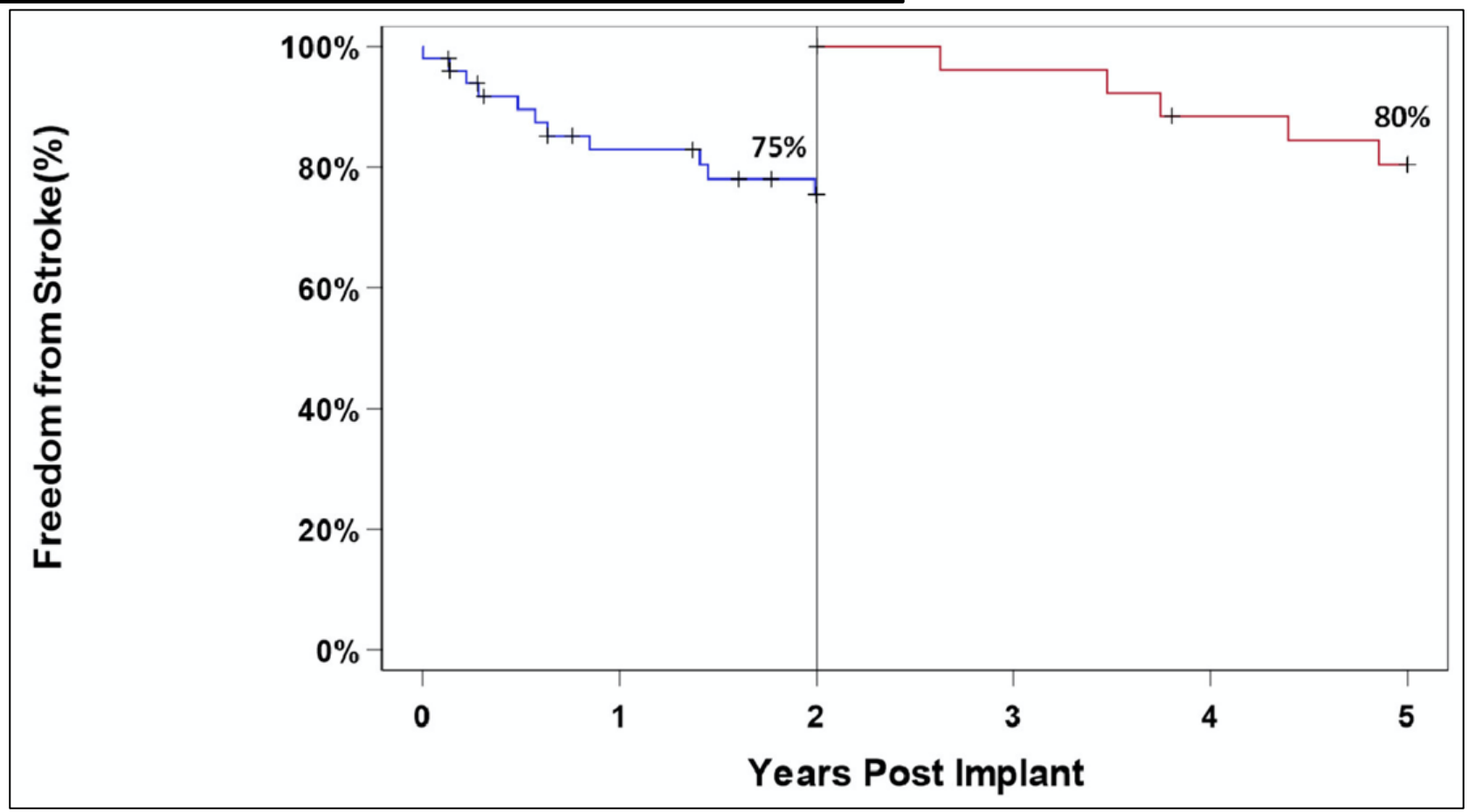
MOMENTUM 3

GI denotes gastrointestinal; HR hazard ratio; CI, confidence interval

First 5-year multicentric clinical trial experience with the HeartMate 3 left ventricular assist system

Ivan Netuka, MD, PhD,[a,1] Yuriy Pya, MD,[b] Daniel Zimpfer, MD,[c]
Evgenij Potapov, MD,[d] Jens Garbade, MD, PhD,[e] Vivek Rao, MD, PhD,[f]
Michiel Morshuis, MD,[g] Friedhelm Beyersdorf, MD,[h]
Silvana Marasco, PhD, FRACS,[i] Poornima Sood, MD, MBA,[j]
Carlo Gazzola, BSc,[j] and Jan D. Schmitto, MD, PhD[k,1]

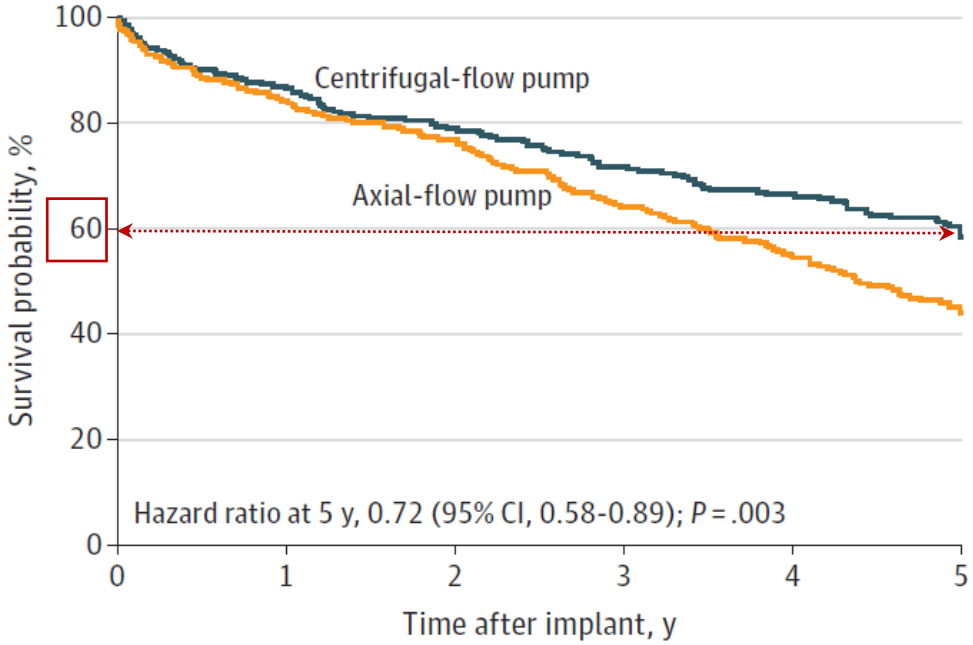
J Heart Lung Transplant 2021



JAMA | Original Investigation

Five-Year Outcomes in Patients With Fully Magnetically Levitated vs Axial-Flow Left Ventricular Assist Devices in the MOMENTUM 3 Randomized Trial

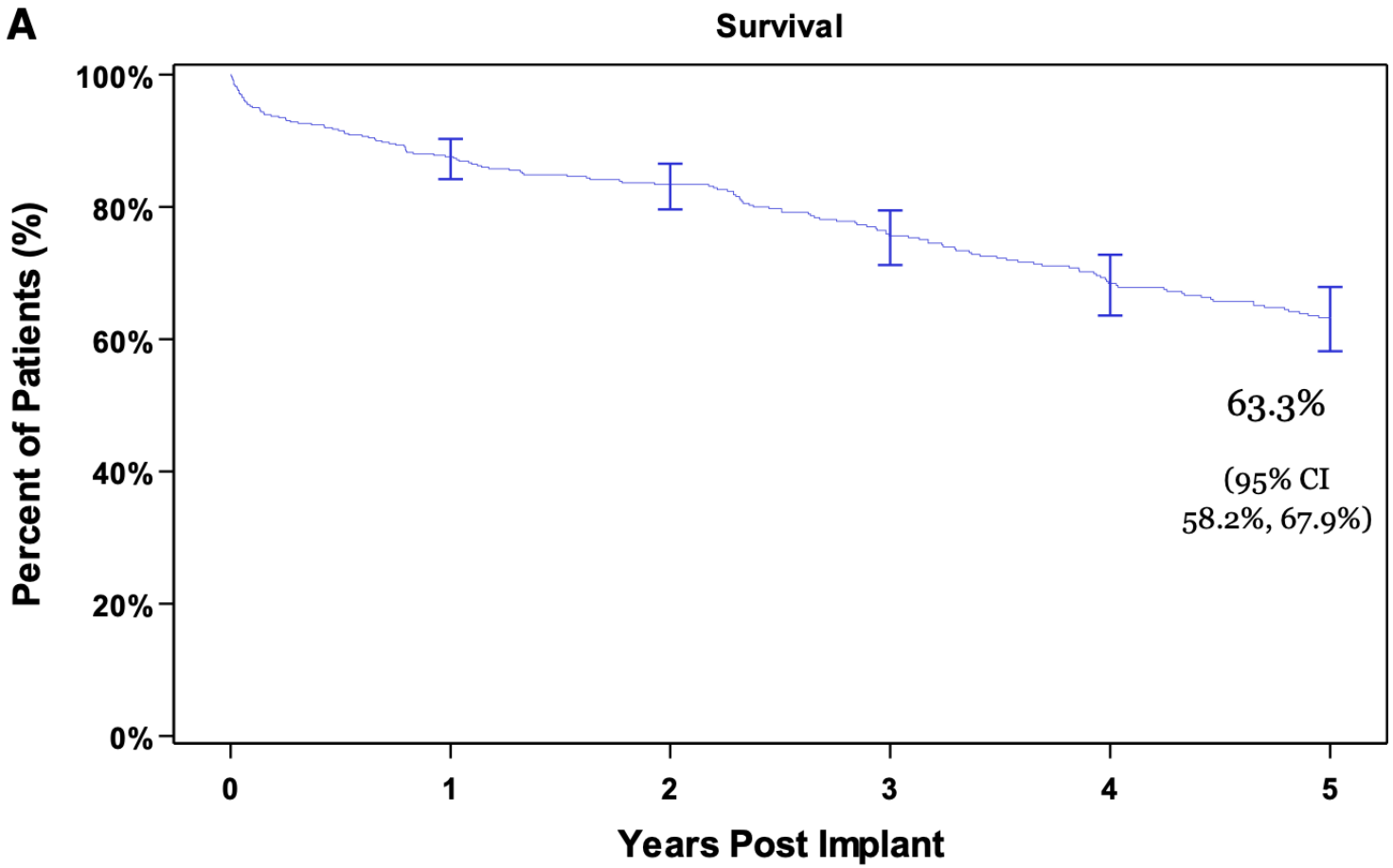
Mandeep R. Mehra, MD, MSc; Daniel J. Goldstein, MD; Joseph C. Cleveland, MD; Jennifer A. Cowger, MD, MS; Shelley Hall, MD; Christopher T. Salerno, MD; Yoshifumi Naka, MD, PhD; Douglas Horstmanshof, MD; Joyce Chuang, PhD; AiJia Wang, MPH; Nir Uriel, MD, MSc



Mehra, Goldstein, Cleveland et al, *JAMA* 2022; 328(12):1233-1242.

Fully magnetically centrifugal left ventricular assist device and long-term outcomes: the ELEVATE registry

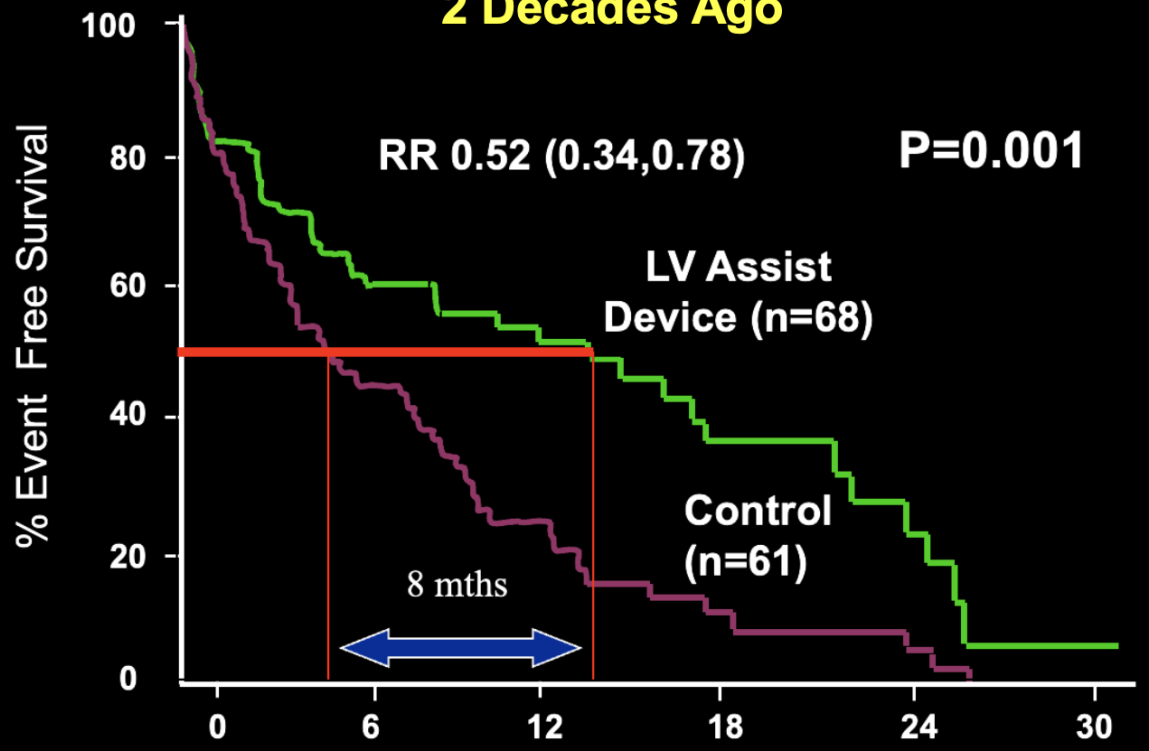
Jan D. Schmitto[1*†], Steven Shaw[2†], Jens Garbade[3], Finn Gustafsson[4], Michiel Morshuis[5], Daniel Zimpfer[6], Jacob Lavee[7], Yuriy Pya[8], Michael Berchtold-Herz[9], AiJia Wang[10], Carlo Gazzola[10], Evgenij Potapov[11†], and Diyar Saeed[12†]; on behalf of the ELEVATE Registry Investigators



The "Base Case" of Continuous Inotropic Support Median Survival<12 months

1. *Circulation: Heart Failure* 8.5 (2015): 880-886.
2. *Journal of Cardiac Failure* 27.9 (2021): 974-980.
3. *The Journal of Heart and Lung Transplantation* 39.7 (2020): 721-724.
4. *Journal of Cardiac Failure* 28.12 (2022): 1683-1691.

2 Decades Ago



Medical Therapy Survival: (23%) (8%)

Rose E et al N Engl J Med 2001; 345: 1435

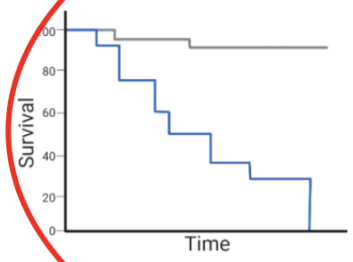
Contemporary Outcomes

Study	Study type	Time period	Patient population	Survival
[1]Hashim et al.	Retrospective cohort, single center	2007-2013	197 ambulatory patients on iv inotropes, 57% palliative (8% declined LVAD therapy), 30% bridge therapy	**Median survival: 9.0 months (IQR: 3.1–37.1)**, actuarial 1-year survival of 47.6%, and 2-year survival of 38.4% for palliative group
[2]Rao et al.	Retrospective cohort, single center	2010-2016	373 ambulatory patients on iv inotropes, 34% palliative, 66% bridge therapy	**Mean survival: 6.2 months (SD 6.6)** for palliative group, **8.6 months (SD 9.3)** for bridge group who did not receive surgical therapy
[3]Fendler et al.	Randomized stepped-wedge trial, multi-center	2015-2017	248 patients being evaluated for DT-LVAD, 15% declined, 15% deemed ineligible	**1-year survival 50% for decliners**, 60% for ineligible patients
[4]Sami et al.	Retrospective cohort, 2 centers	2015-2019	248 ambulatory patients, on palliative iv inotropes	**Median survival: 5.9 months (IQR 1.7–15.8)**, 1-year survival of 30%

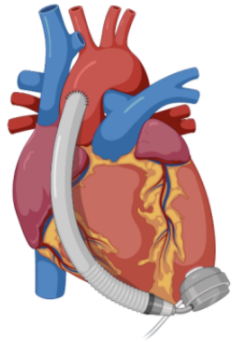
Improvement in ICD, Palliative Care, Medical Therapy

Mehra, Nayak Desai. JACC HF 2023 (online)

EXPECTED OUTCOMES IN ADVANCED HF PATIENTS



- Median survival **<1 year** in those dependent on iv inotropic therapy
- Median survival **<2 years** in ambulatory advanced HF not yet on inotropes



LVAD THERAPY

LONG TERM BENEFITS OF LVAD THERAPY

SURVIVAL

Median survival of **5 years**

FUNCTIONAL STATUS

- **NYHA class I-II** in 75-80% at 2 years
- **2.5 fold** improvement in 6MWD (to >300 meters at 2 years)

QUALITY OF LIFE

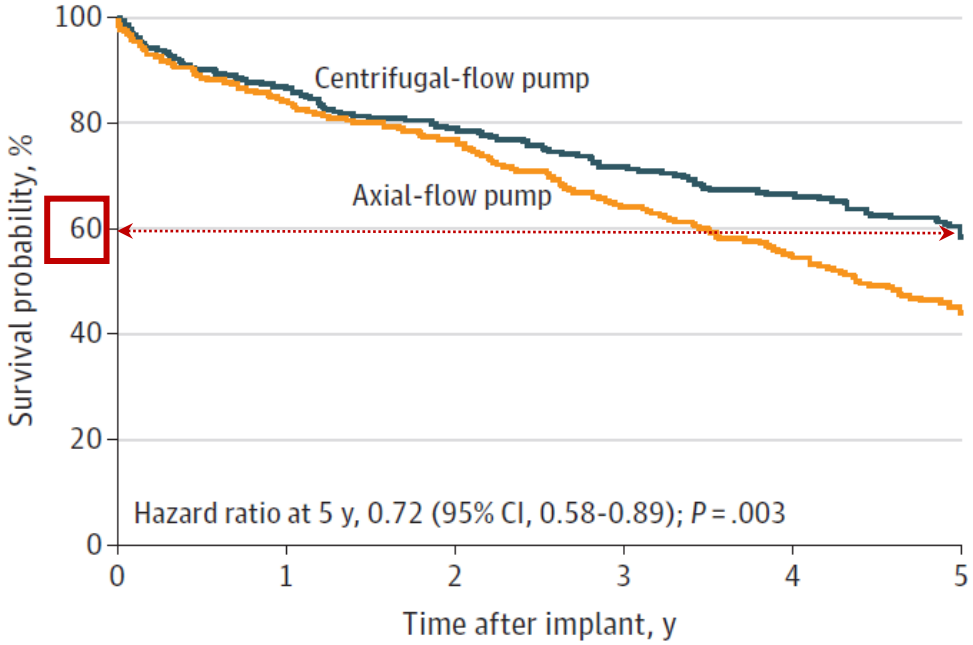
- **>75% increase** in KCCQ score (+30 points)

Mehra MR, Nayak A, Desai AS. *JACC Heart Fail*. 2023;11:1011-1017

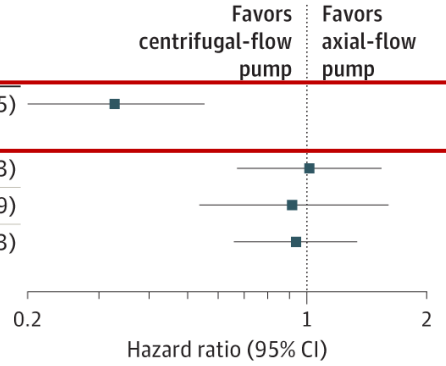
JAMA | Original Investigation

Five-Year Outcomes in Patients With Fully Magnetically Levitated vs Axial-Flow Left Ventricular Assist Devices in the MOMENTUM 3 Randomized Trial

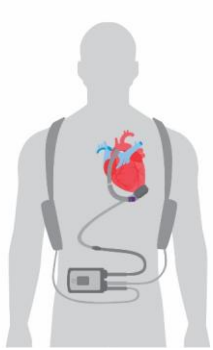
Mandeep R. Mehra, MD, MSc; Daniel J. Goldstein, MD; Joseph C. Cleveland, MD; Jennifer A. Cowger, MD, MS; Shelley Hall, MD; Christopher T. Salerno, MD; Yoshifumi Naka, MD, PhD; Douglas Horstmanshof, MD; Joyce Chuang, PhD; AiJia Wang, MPH; Nir Uriel, MD, MSc



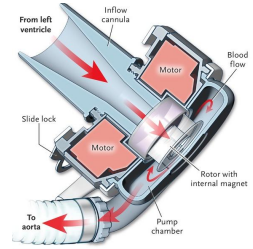
Cause of death	Difference, % (95% CI) %[a]	Hazard ratio (95% CI)	P value[b]
Hemocompatibility-related event (device thrombosis, stroke, bleeding)	-6.8 (-10.0 to -3.6)	0.33 (0.20-0.55)	<.001
Heart failure	0.6 (-2.9 to 4.1)	1.01 (0.67-1.53)	.95
Infection	-0.1 (-2.8 to 2.6)	0.92 (0.54-1.59)	.77
Other[c]	0.0 (-4.1 to 4.0)	0.94 (0.66-1.33)	.72

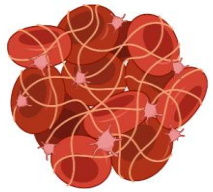


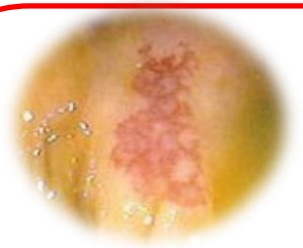
Mehra, Goldstein, Cleveland et al, *JAMA* 2022; 328(12):1233-1242.

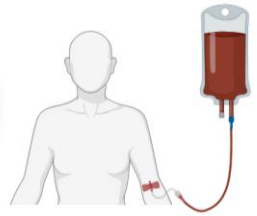


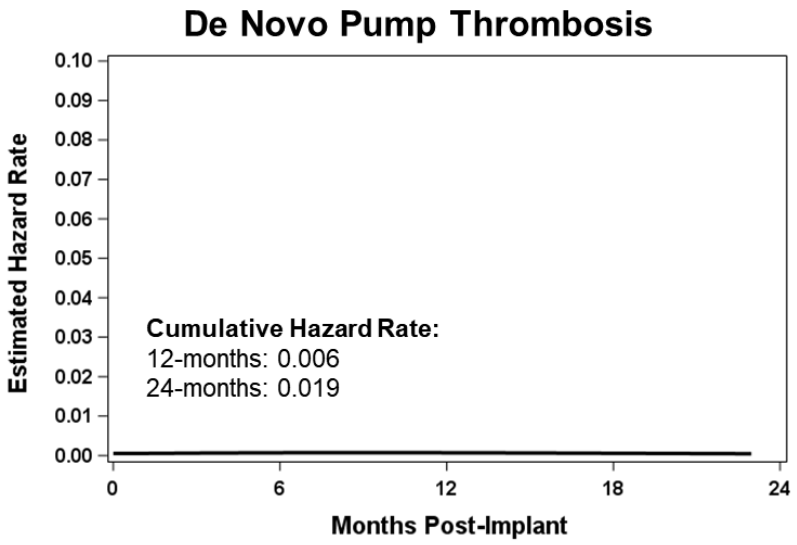
HEMOCOMPATIBILITY RELATED OUTCOMES

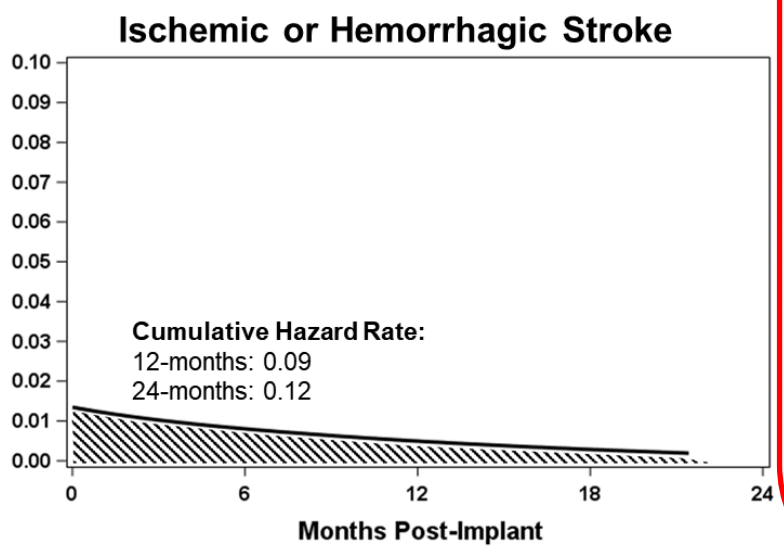


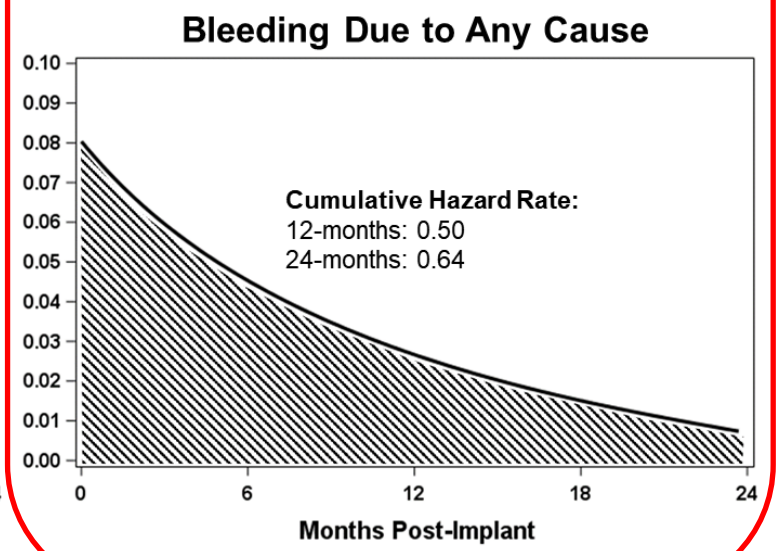












Opportunity to Reduce Residual Risk

Mehra MR, Crandall DL, Gustafsson F, et al., *Eur J Heart Fail*. 2021;23(7):1226-1237

Aspirin and Hemocompatibility Events with a Left Ventricular Assist Device in Advanced Heart Failure

The *ARIES-HM3* Clinical Trial

Mandeep R. Mehra, Ivan Netuka, Nir Uriel, Jason N. Katz, Francis D. Pagani, Ulrich P. Jorde, Finn Gustafsson, Jean M. Connors, Peter Ivak, Jennifer Cowger, John Ransom, Aditya Bansal, Koji Takeda, Richa Agarwal, Mirnela Byku, Michael M. Givertz, Abbas Bitar, Shelley Hall, Daniel Zimpfer, J David Vega, Manreet K. Kanwar, Omar Saeed, Daniel J. Goldstein, Rebecca Cogswell, Farooq H. Sheikh, Matthew Danter, Yuriy Pya, Anita Phancao, John Henderson, Daniel L. Crandall, Kartik Sundareswaran, Edward Soltesz and Jerry D. Estep

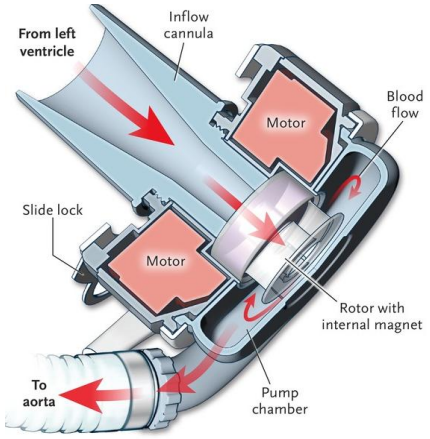
On Behalf of the ARIES Investigators

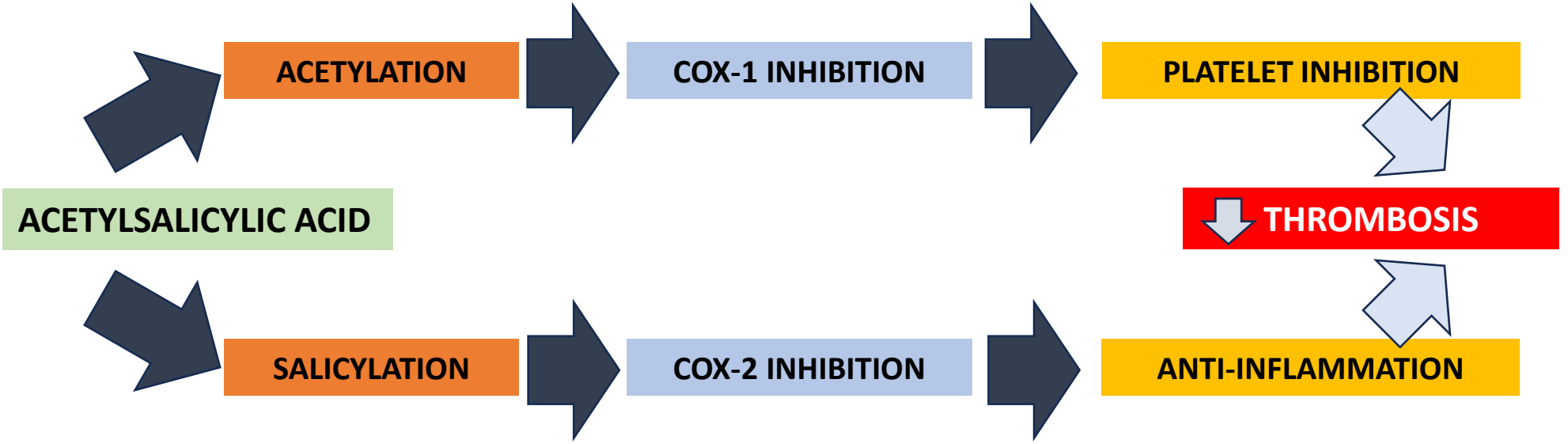
ARIES

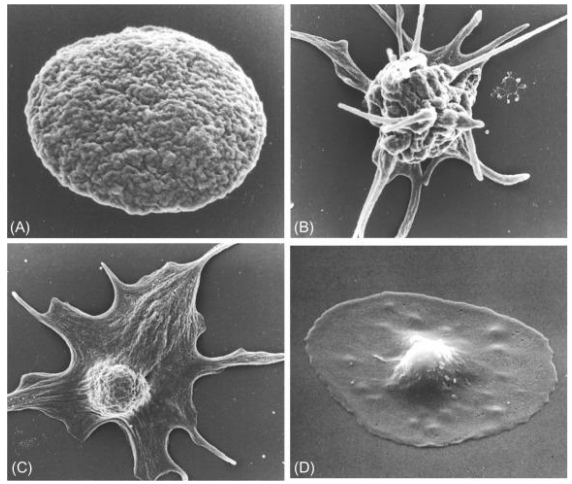
VE RI TAS

HARVARD MEDICAL SCHOOL

Can aspirin be safely excluded from the antithrombotic regimen (*which includes Vitamin-K Antagonists*) in HM3 LVAD Patients?







Mehra MR, Crandall DL, Gustafsson F, et al., Eur J Heart Fail. 2021;23(7):1226-1237
Thomas, The Structure of Resting and Activated Platelets. Platelets 4th Ed. 2019, Pages 47-77

ARIES

International, Multicenter, Prospective, Randomized, Double-blind, Placebo-controlled Study

HYPOTHESIS

Exclusion of aspirin from the antithrombotic regimen of patients supported with the HM3 LVAD will not adversely affect safety or efficacy of the HM3 and may reduce non-surgical bleeding

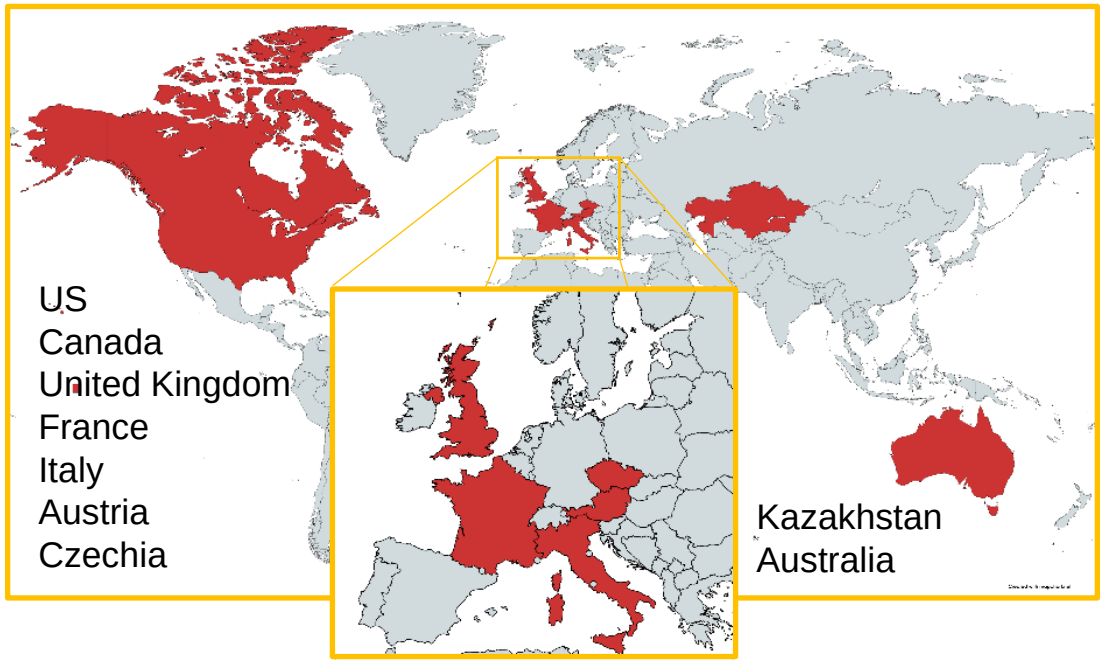
Antithrombotic Regimens

Aspirin (100mg) + Standard VKA (INR 2.0-3.0)

versus

Placebo + Standard VKA (INR 2.0-3.0)

Global Study of 51 centers in 9 countries



End Points

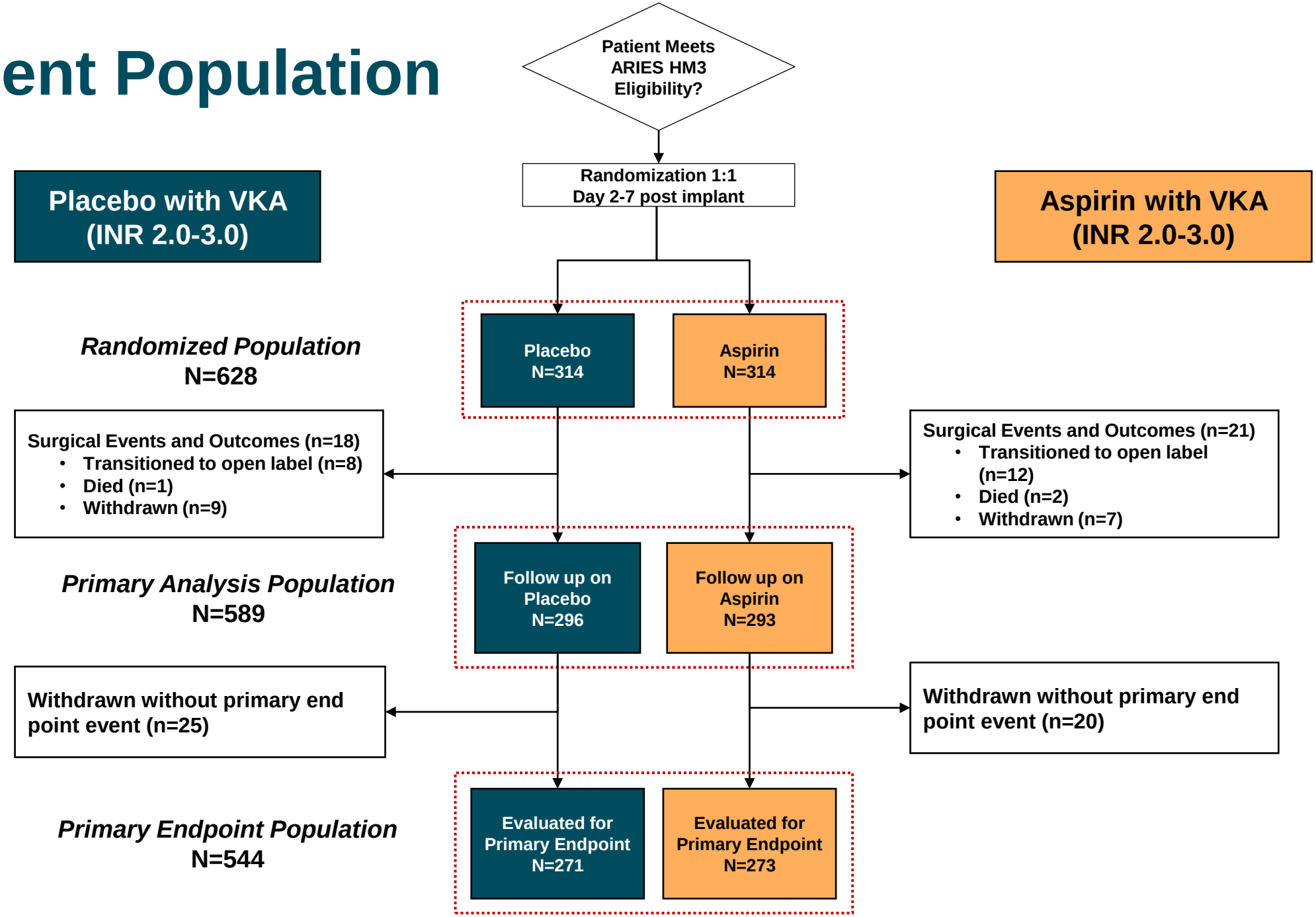
Primary: Survival free of any non-surgical[a] major hemocompatibility related adverse event[b] at 1-year post implant

[a] >14 days post implant. [b]Any Stroke, Pump Thrombosis, Major Bleeding, and Arterial Peripheral Thromboembolism

- The final sample size provided >90% power to assess the primary end point for non-inferiority
- Non-inferiority met if the lower boundary of the one-sided 97.5% confidence limit was greater than the non-inferiority margin (-10%)

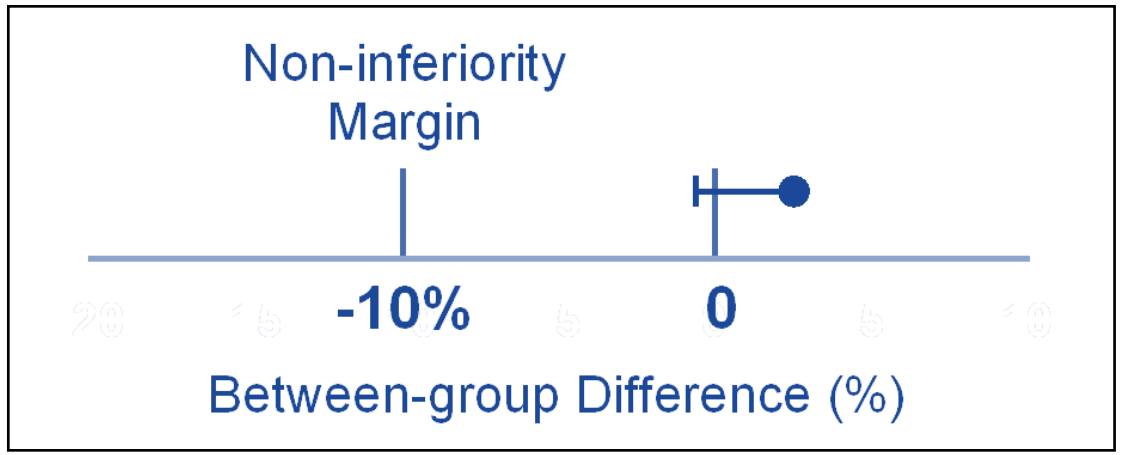
Principal Secondary: All Non-surgical Bleeding

Patient Population

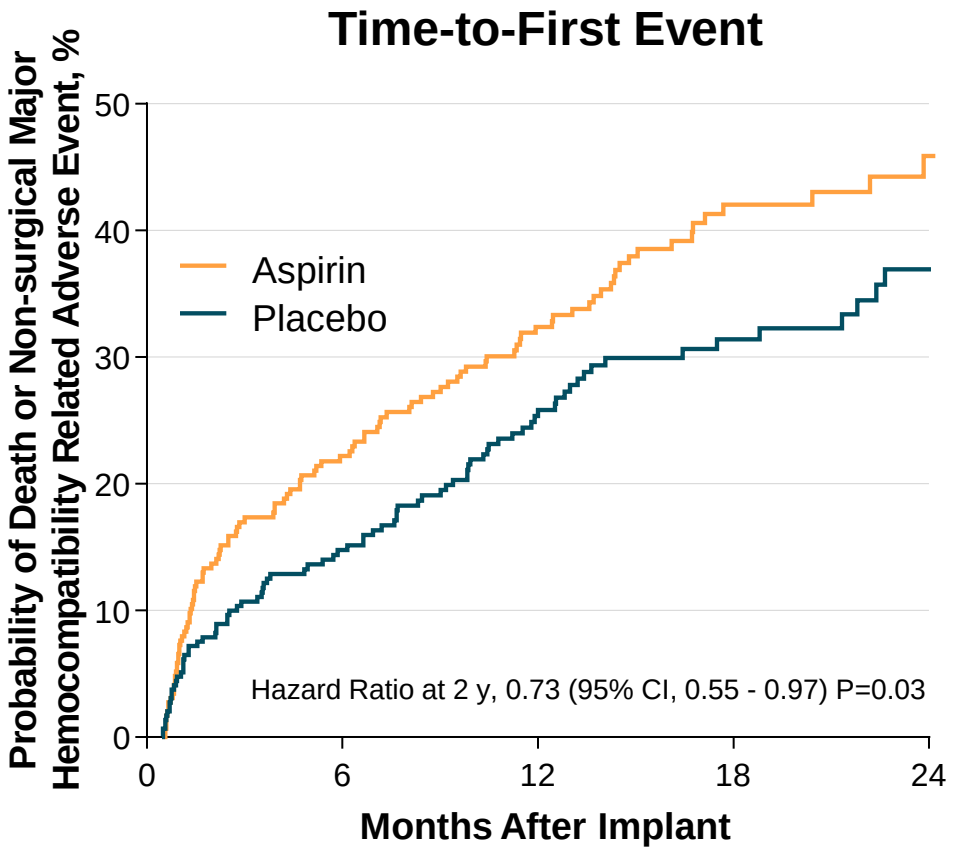


Primary End Point Analysis

	Placebo	Aspirin	Difference (Lower 97.5% CI)*	P-value*
Non-Inferiority Primary End Point Analysis	74.2 (201/271)	68.1 (186/273)	6.0% (-1.6%)	<.001



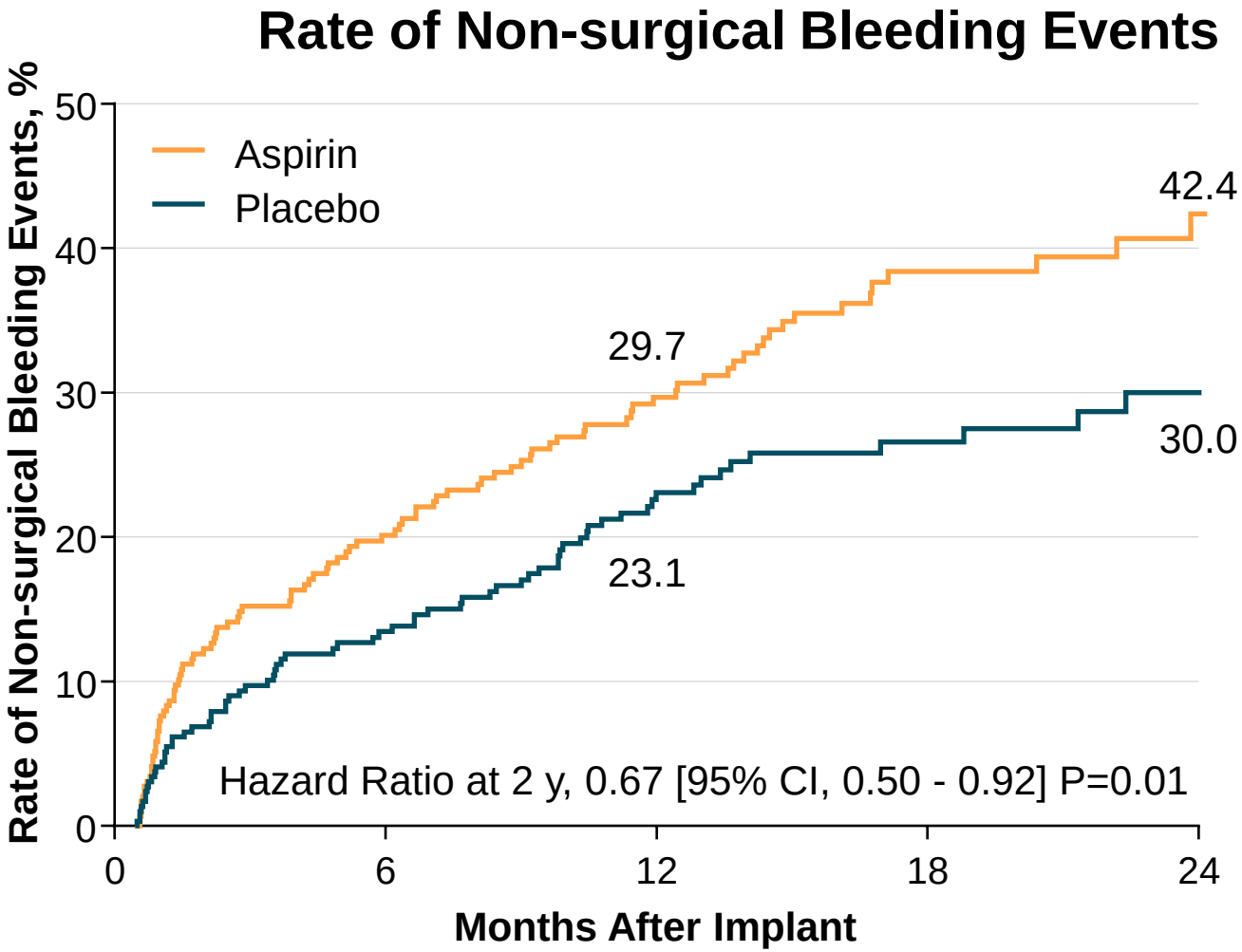
All sensitivity analyses concur with the primary analysis, including randomized population, worst case allocation of withdrawals, and impact of transition to open label



No. at Risk:

Placebo	296	221	161	84	44
Aspirin	293	205	146	72	33

Principal Secondary Endpoint

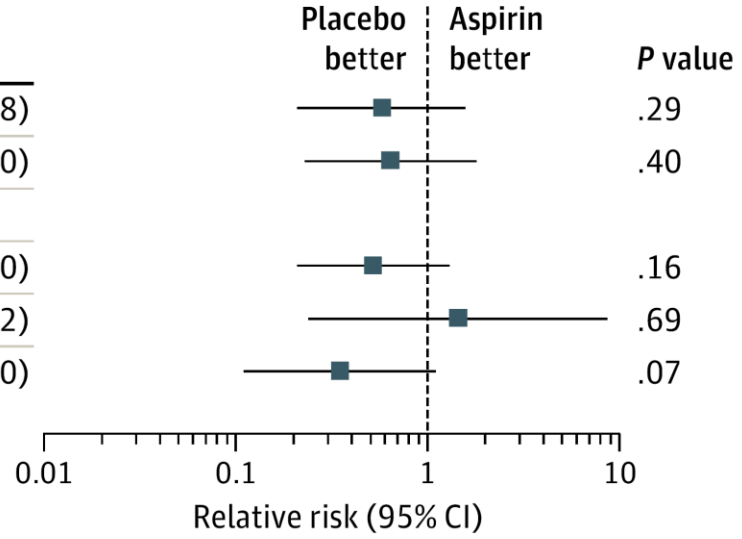


No. at Risk:					
Placebo	296	222	163	85	44
Aspirin	293	207	148	73	34

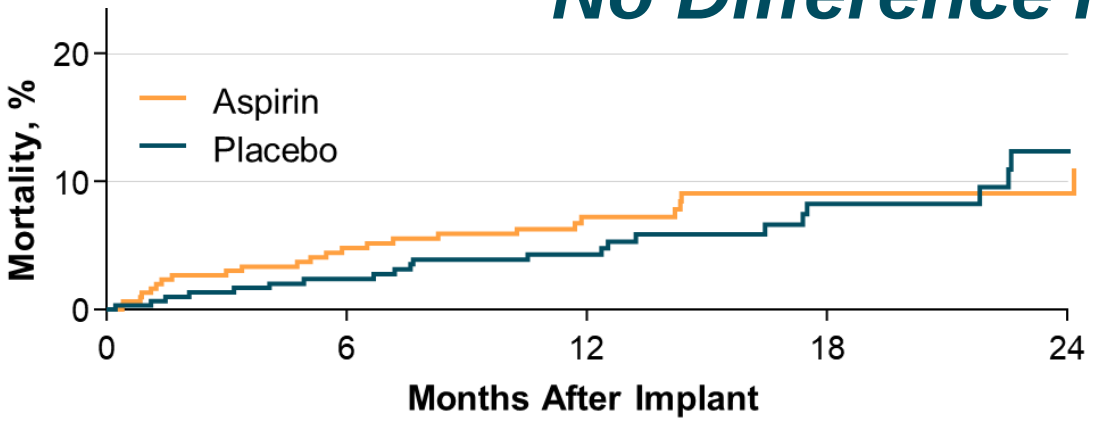
Safety Endpoints

No Increase in Thrombosis

Source	Events per 100 patient-years (No. of events): Placebo (n = 296; 366.41 patient-years)	Aspirin (n = 293; 351.64 patient-years)	Relative risk (95% CI)	*P* value
Thrombotic components of the primary end point	1.6 (6)	2.8 (10)	0.58 (0.21-1.58)	.29
Ischemic stroke[b]	1.6 (6)	2.6 (9)	0.64 (0.23-1.80)	.40
Ischemic stroke with hemorrhagic conversion[a]	0	0.3 (1)		
Any stroke	1.9 (7)	3.7 (13)	0.52 (0.21-1.30)	.16
Debilitating stroke	0.8 (3)	0.6 (2)	1.44 (0.24-8.62)	.69
Nondebilitating stroke	1.1 (4)	3.1 (11)	0.35 (0.11-1.10)	.07



No Difference in Mortality



HR [95% CI]: 0.90 [0.50 - 1.62] P=0.71

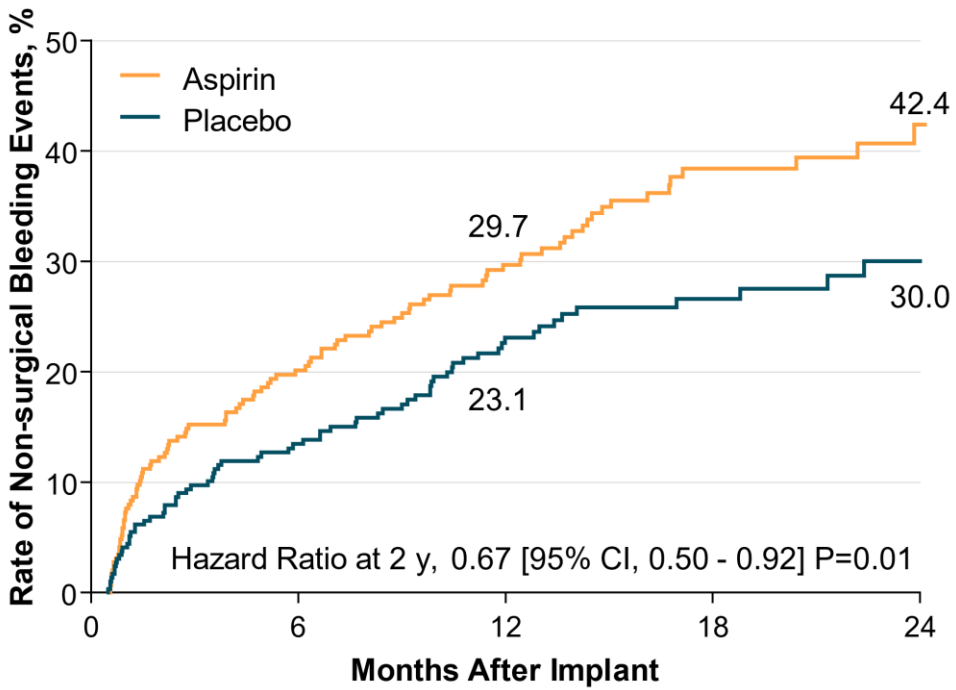
JAMA | Original Investigation

Aspirin and Hemocompatibility Events With a Left Ventricular Assist Device in Advanced Heart Failure

The ARIES-HM3 Randomized Clinical Trial

Mandeep R. Mehra, MBBS, MSc; Ivan Netuka, MD, PhD; Nir Uriel, MD, MSc; Jason N. Katz, MD, MS; Francis D. Pagani, MD, PhD; Ulrich P. Jorde, MD; Finn Gustafsson, MD, PhD, DMSci; Jean M. Connors, MD; Peter Ivak, MD, PhD; Jennifer Cowger, MD, MS; John Ransom, MD; Aditya Bansal, MD; Koji Takeda, MD, PhD; Richa Agarwal, MD; Mirnela Byku, MD, PhD; Michael M. Givertz, MD; Abbas Bitar, MD; Shelley Hall, MD; Daniel Zimpfer, MD, PhD; J. David Vega, MD; Manreet K. Kanwar, MD; Omar Saeed, MD, MSc; Daniel J. Goldstein, MD; Rebecca Cogswell, MD; Farooq H. Sheikh, MD; Matthew Danter, MD; Yuriy Pya, MD, DMSc; Anita Phancao, MD; John Henderson, MS; Daniel L. Crandall, PhD; Kartik Sundareswaran, PhD; Edward Soltesz, MD; Jerry D. Estep, MD; for the ARIES-HM3 Investigators

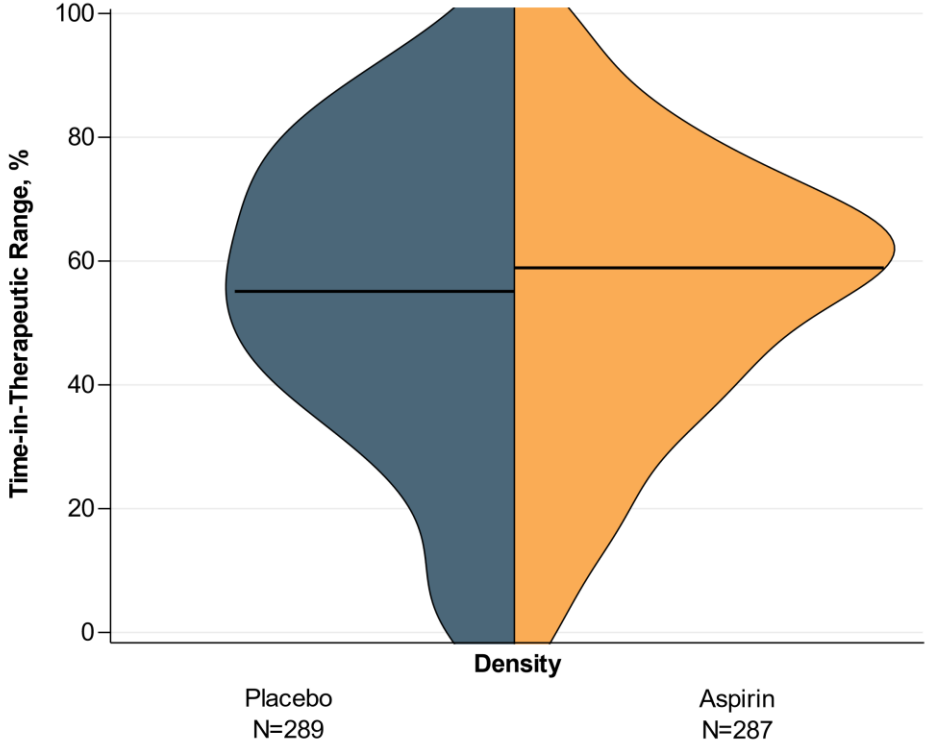
Rate of Non-surgical Bleeding Events



No. at Risk:

Placebo	296	222	163	85	44
Aspirin	293	207	148	73	34

Vitamin-K Antagonist Management



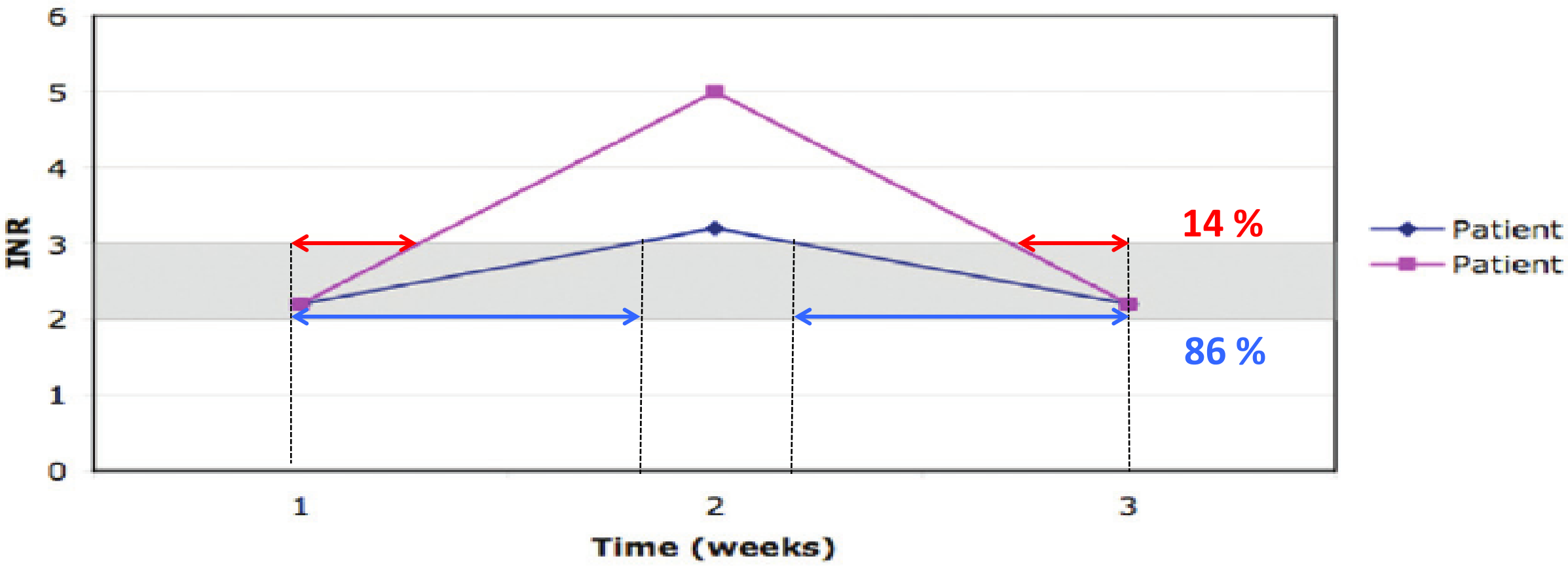
Target Therapeutic Range INR 2.0 - 3.0

Time in Therapeutic Range (TTR) 56%

JAMA. 2023;330:2171-2181.

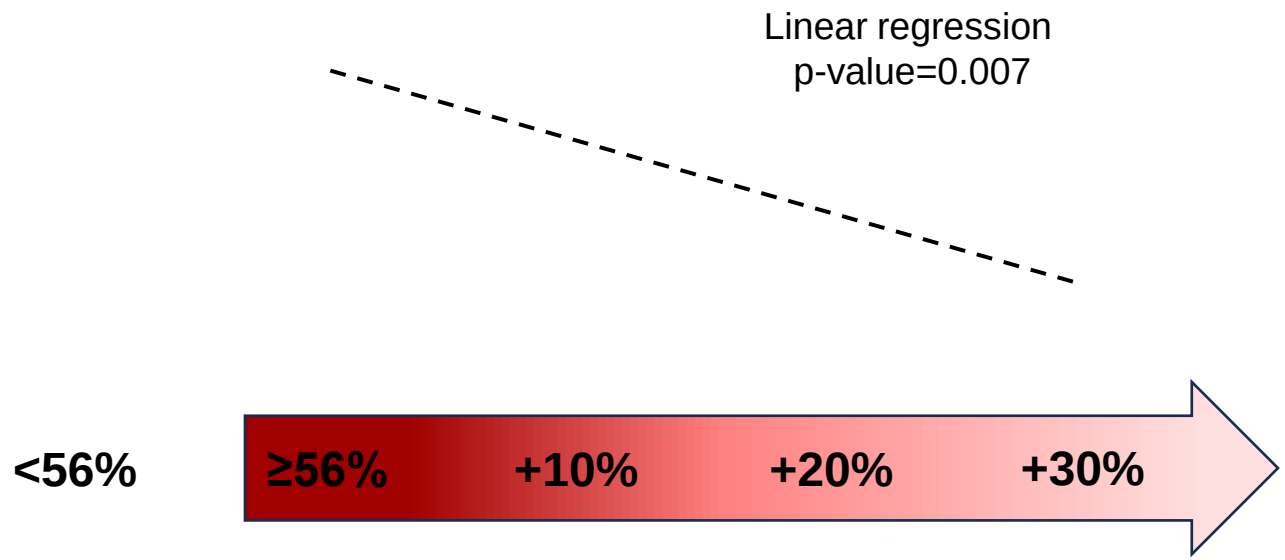
TTR – time in therapeutic range

Rosendaal method of linear interpolation



Bleeding Rate by TTR Increments

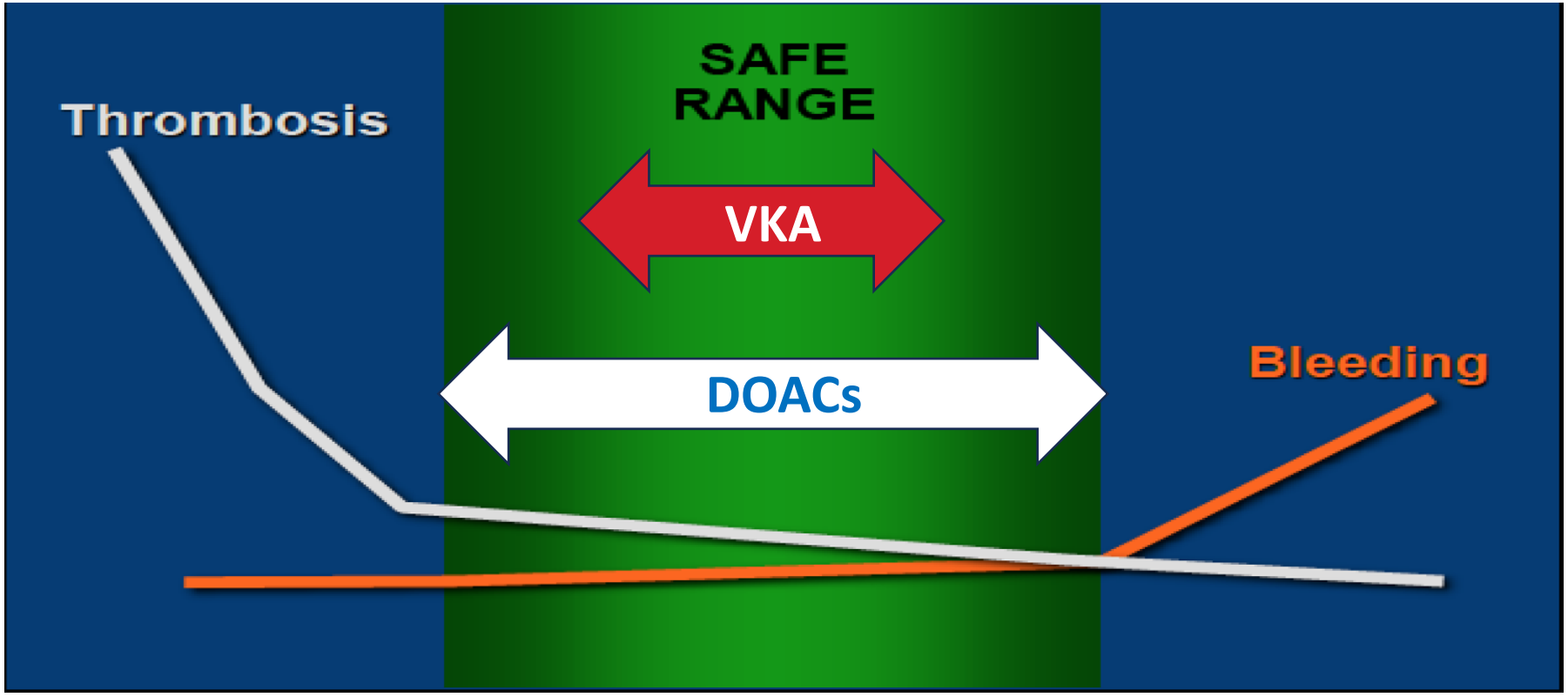
Incremental improvement of 10% above the median of 56% trends in a significant reduction in bleeding rate



Connors/Netuka/Mehra. ARIES VKA Analysis *(Preview, ISHLT Thursday April 11, 2024)*

Direct oral anticoagulants and anticoagulants and LVADs

- Vitamin-K Antagonist (VKA) remains suboptimal and resource intensive
- Direct oral anticoagulants (DOACs) alternative with a potential of better compliance and no additional monitoring for dose adjustments



A Prospective Randomized Trial of Direct Oral Anticoagulant Therapy with A Fully Magnetically Levitated LVAD

The DOT-HM3 Study

Ivan Netuka, Zuzana Tucanova, Peter Ivak, Stanislav Gregor, Dushan M. Kolesar, Tomas Marek, Vojtech Melenovsky, Jana Binova, Zora Dorazilova, Marketa Hegarova, Martina Podolec, Hynek Riha MD, Jean M. Connors and Mandeep R. Mehra

IK+E M

VE RI TAS

HARVARD MEDICAL SCHOOL

DOT HM 3 Trial Rationale

- Direct Oral Anticoagulants (DOACs) became a viable alternative to VKA in scenarios of non-valvular Atrial Fibrillation or Deep Vein Thrombosis
  - However, their risk-benefit ratio can be precarious as they are not necessarily safe in scenarios of valvular atrial fibrillation or with Mechanical Prosthetic Valves
- Substantial concern exists with use of DOACs in patients with LVADs
  - A small study using Dabigatran in patients with an older generation LVAD, the HeartWare HVAD, demonstrated increased thrombotic complications (Andreas M. et al. *Circ Heart Fail. 2017)*
- Can the observed Thromboresistance with the HeartMate 3 LVAD allow judicious use of Direct Oral Anticoagulants in selected conditions?

Direct Oral Anticoagulant Therapy With the HeartMate 3 LVAD (DOT-HM3) Trial

Study Aim

- Prospective, single-center, randomized, safety and feasibility trial of apixaban anticoagulation in patients on HeartMate 3 LVAS *(Clinical Trials.gov NCT04974684)*

Primary Endpoint

- The primary *safety endpoint* was survival-free of pump thrombosis, disabling stroke, or major bleeding at 3 months post-randomization.
- If no safety concerns, clinical outcomes were mandated at completion of 6-month follow-up.
- Heart transplantation was considered success, and other withdrawals, a failure.

Funding: Investigator-initiated study supported by an institutional grant by Abbott (USA). The sponsor was *not involved* in the design, execution, analysis or presentation and publication decisions of the study

DOT–HM 3 Study

HeartMate 3 LVAS

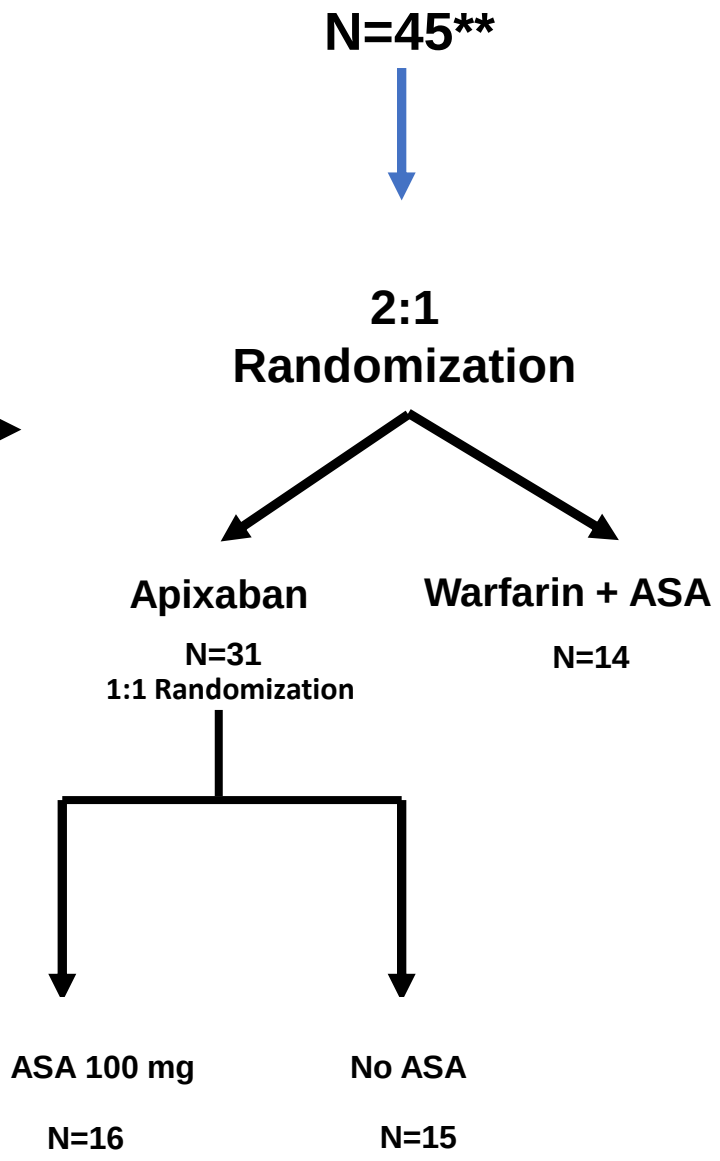
- INR 2.0-3.0 + ASA 100mg*

Entry Criteria

- Minimum 3 months post HeartMate 3 implant
- Stable, ambulatory and home discharged
- Consent provided

Key Exclusion Criteria

- Any Thromboembolism or Major Bleeding after implant
- Weight ≤ 60 kgs. or age ≥ 80 years
- Poor kidney function with serum creatinine ≥ 221umol/L or creatinine clearance < 0.042 mL/s
- Mechanical valve or ancillary MCS
- Hemodynamically significant carotid stenosis
- Need for antiplatelet therapy for reasons other than LVAD therapy
- History of hyper-/hypo- coagulable disorder
- Aspirin or Apixaban hypersensitivity



*ARIES trial results unknown at inception of trial

**No study power assigned in this exploratory study and ITT principles used in describing outcomes

Clinical Outcomes (6-months)

CLINICAL OUTCOME (6-months)	APIXABAN + 100mg ASA N=15	APIXABAN Alone N=16	Warfarin + 100 mg ASA N=14
Cumulative Follow-up (pt/days)	2338	2656	2338
Primary outcome: Patient survival-free of pump thrombosis, disabling stroke, or major bleeding (HTx considered success and other withdrawal a failure)	13/15 (86.7%)	15/16 (93.7%)	12/14 (85.7%)
Individual Components			
Thromboembolism (pump malfunction, stroke or arterial thromboembolism) at 6 months	0	0	0
Major bleeding	1 (Gastrointestinal)	0	2* (uterine)
Withdrawals (without a primary event or transplantation)	1	1	1
Heart transplants	4	2	1

* 2 uterine bleeding events occurred in 1 patient (treated as a single count in the primary endpoint)

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association®

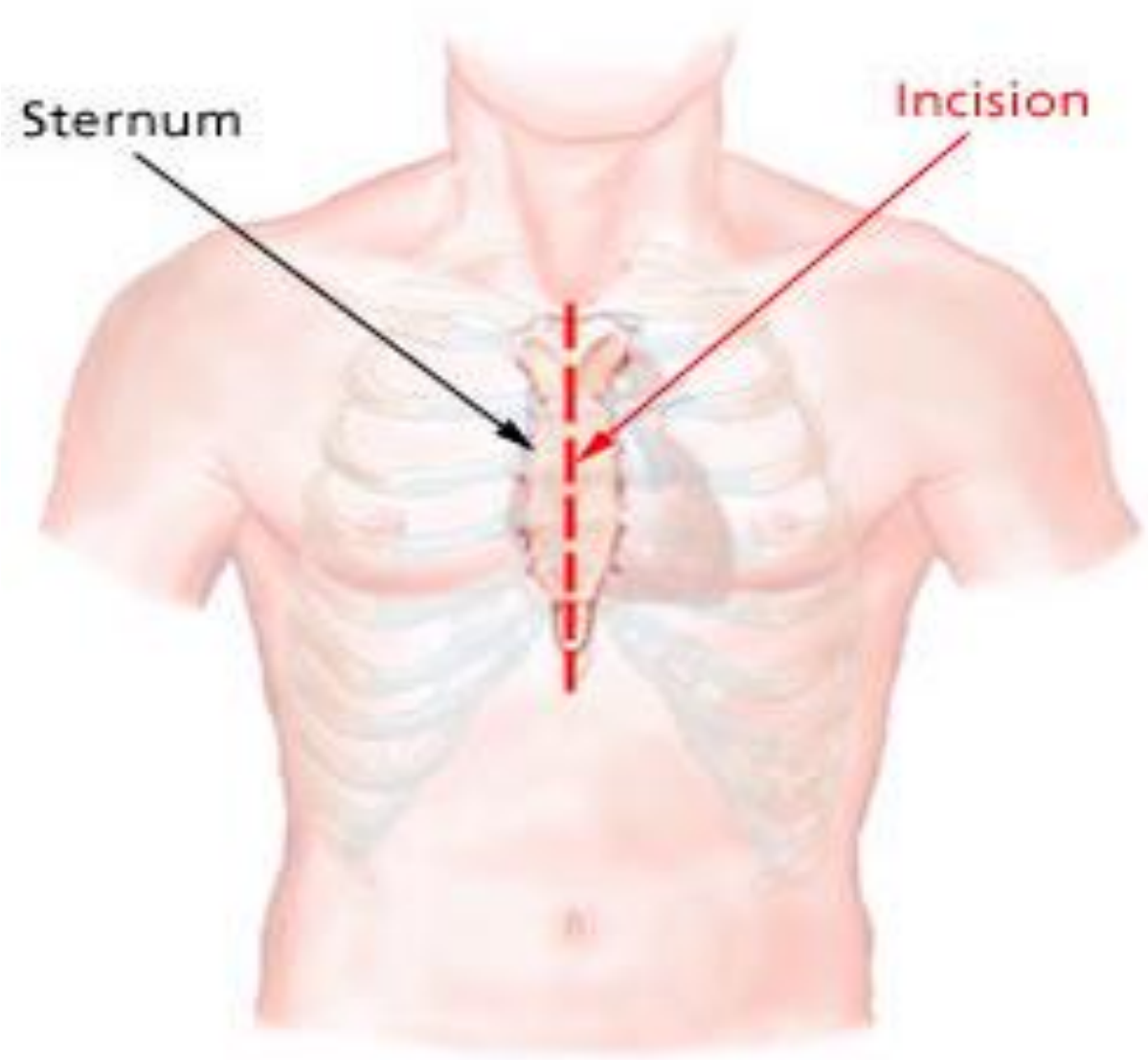
A Prospective Randomized Trial of Direct Oral Anticoagulant Therapy with A Fully Magnetically Levitated LVAD: The DOT-HM3 Study

Ivan Netuka, MD, PhD[1], Zuzana Tucanova, MD[1], Peter Ivak, MD, PhD[1], Stanislav Gregor, PharmD[1], Dushan Michael Kolesar, MD[1], Tomas Marek, MD[1], Vojtech Melenovsky, MD[1], Jana Binova, MD[1], Zora Dorazilova, MD[1], Marketa Hegarova, MD, PhD[1], Martina Podolec, MD[1], Hynek Riha MD, PhD[1], Jean M. Connors, MD[2], Mandeep R. Mehra, MD, MSc[2]

[1]Institute for Clinical and Experimental Medicine, Prague, Czech Republic, [2]Brigham and Women's Hospital and Harvard Medical School, Boston, MA

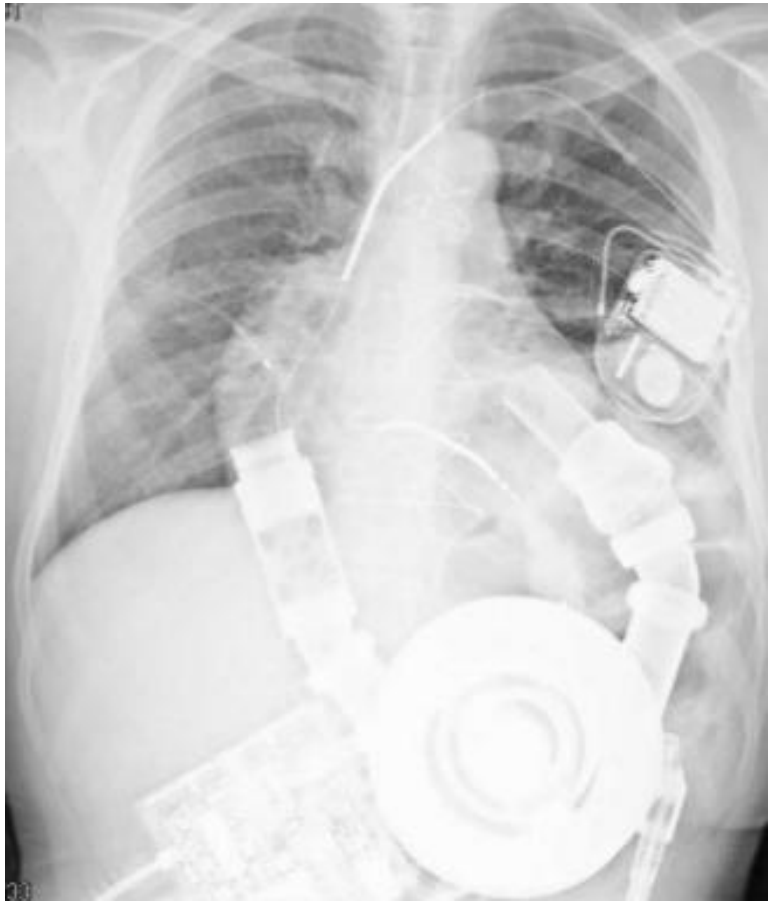
Available now on https://www.ahajournals.org/journal/circ

Conventional implantation technique: Full sternotomy

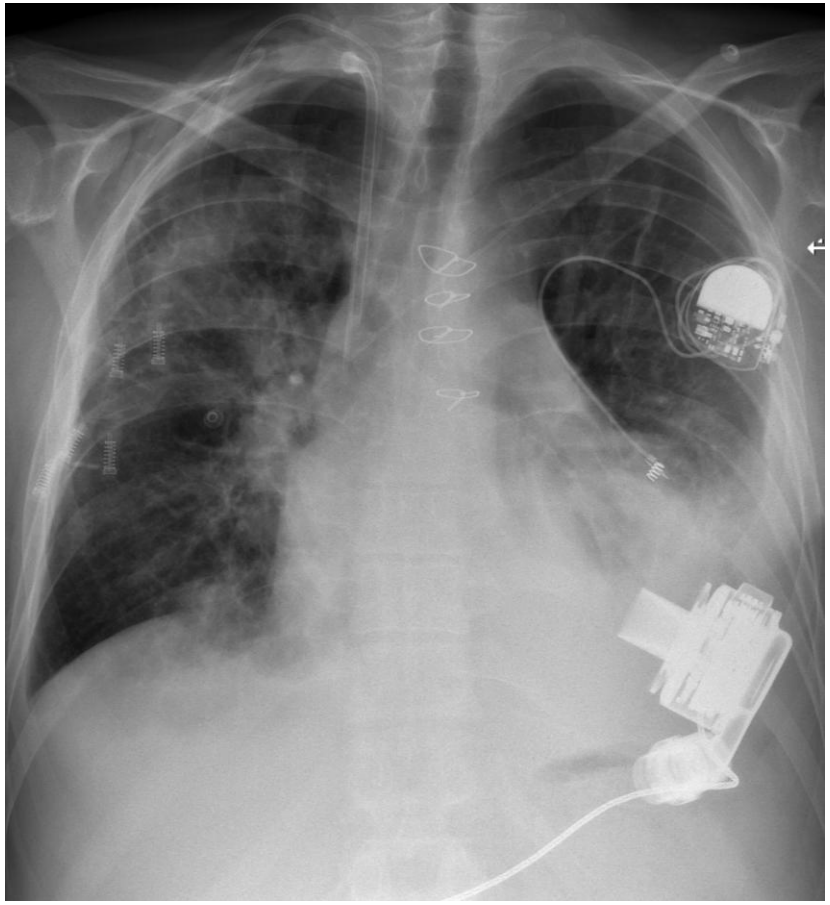


Dimensional evolution of the technology

HeartMate XVE

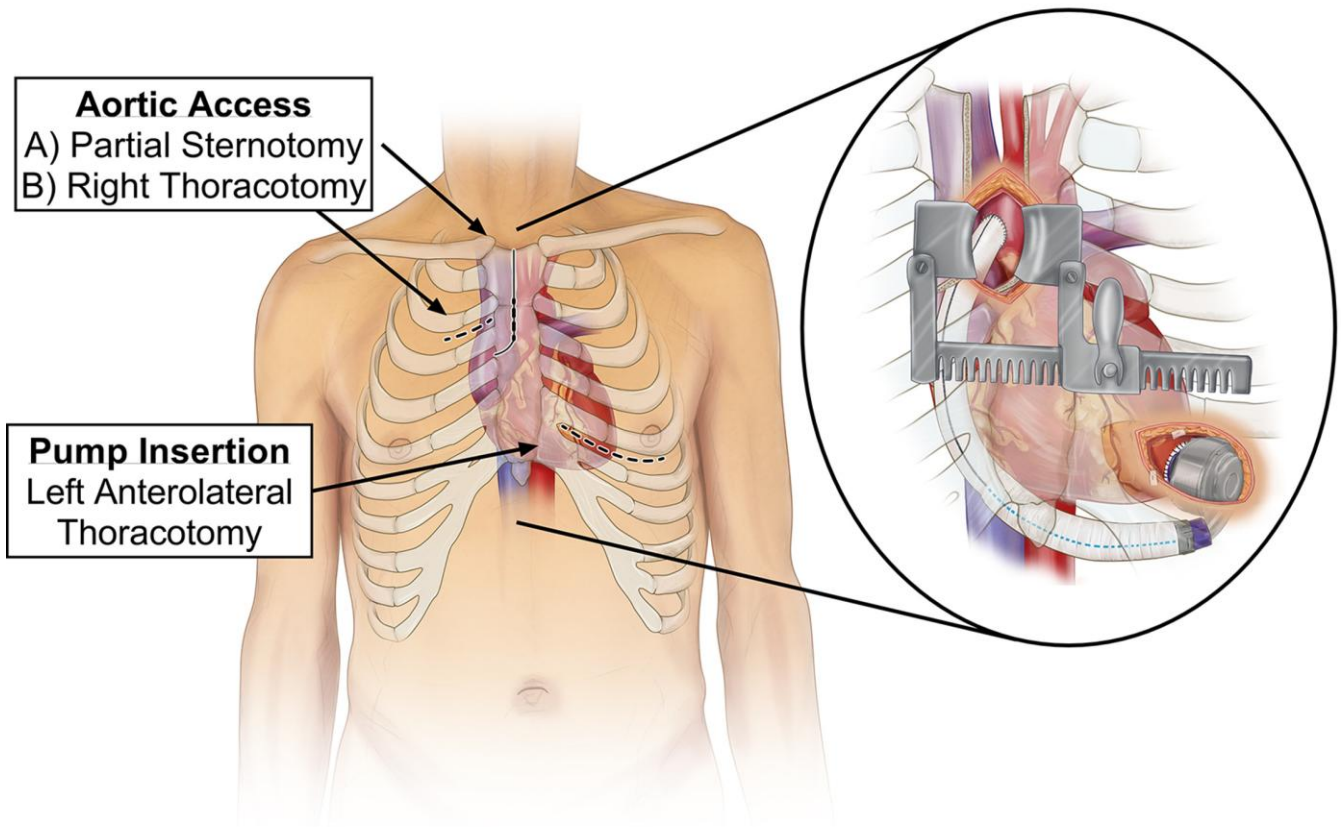


HeartMate 3



Ventricular assist device using a thoracotomy-based implant technique: Multi-Center Implantation of the HeartMate 3 in Subjects With Heart Failure Using Surgical Techniques Other Than Full Median Sternotomy (HM3 SWIFT)

Thoracotomy-based Implant Technique



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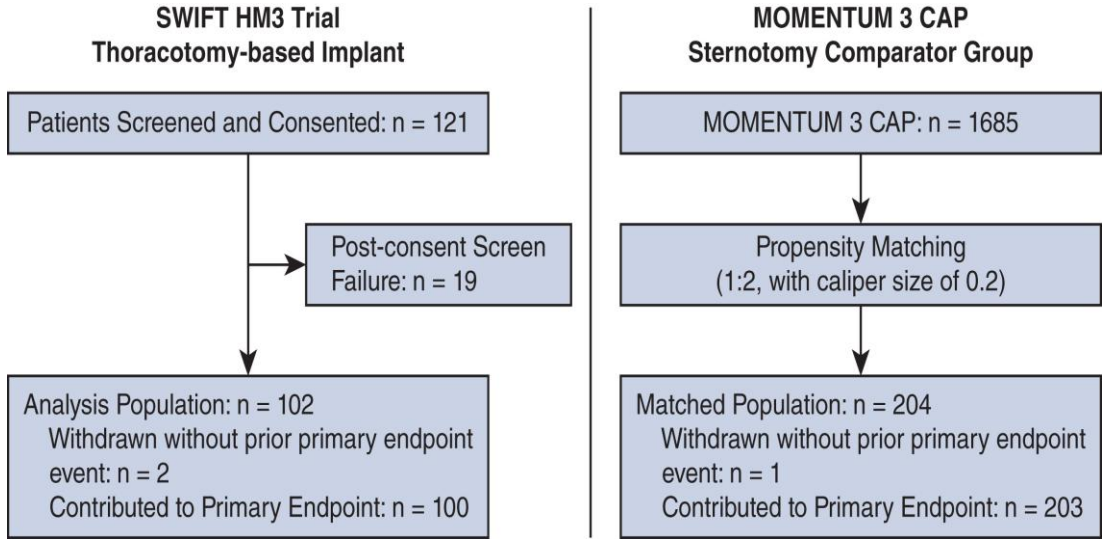
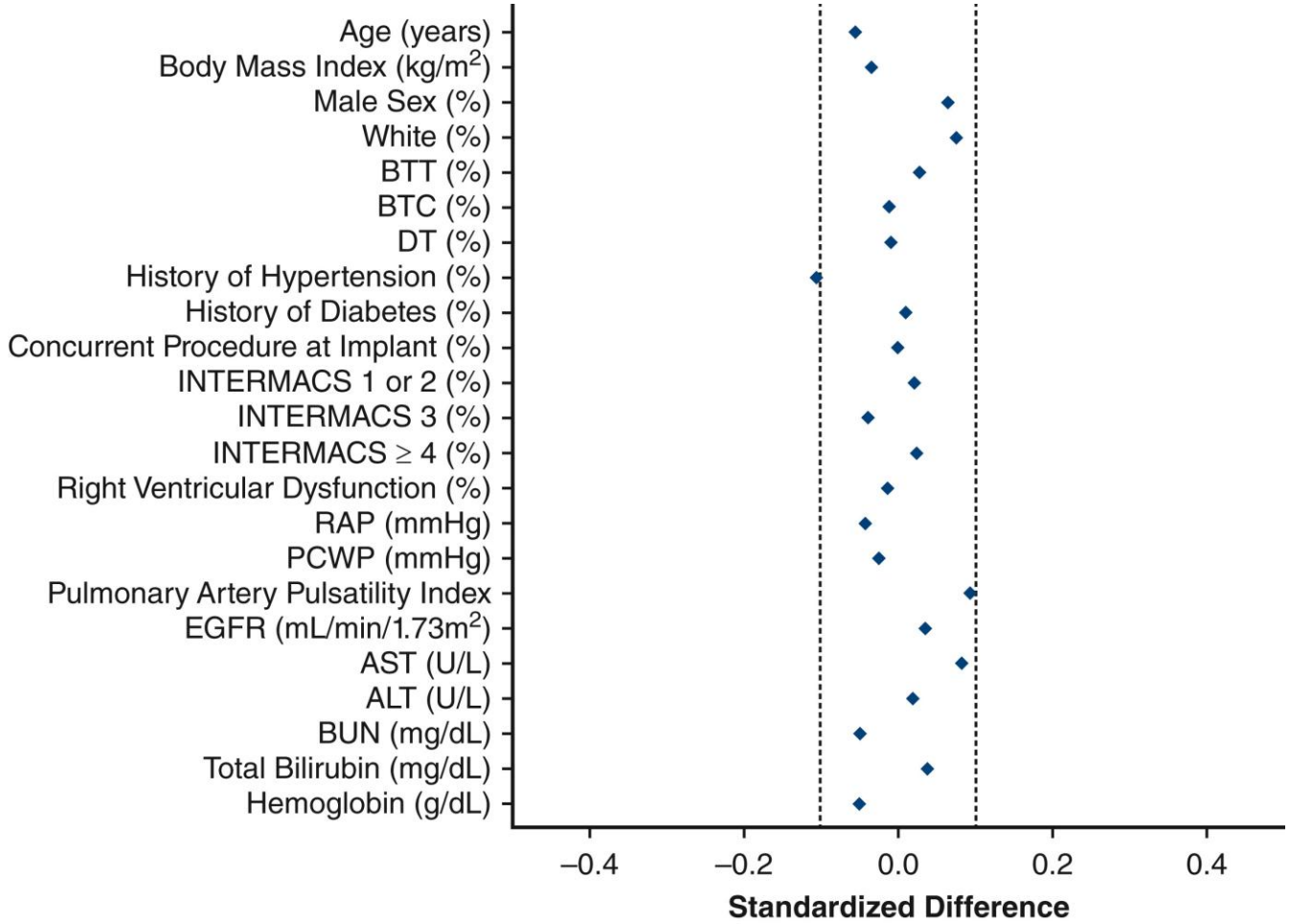
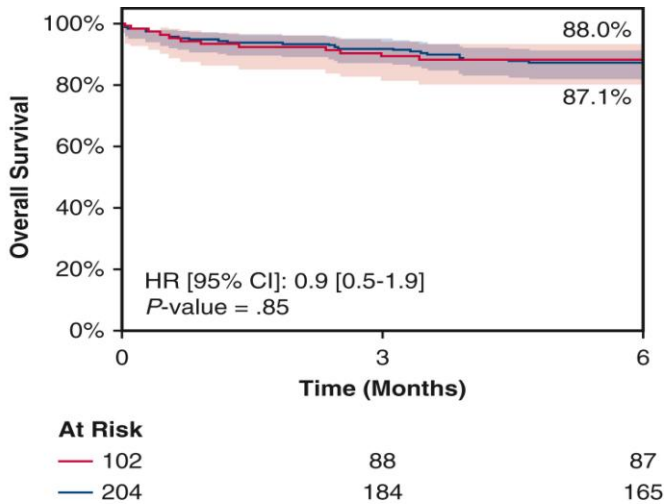
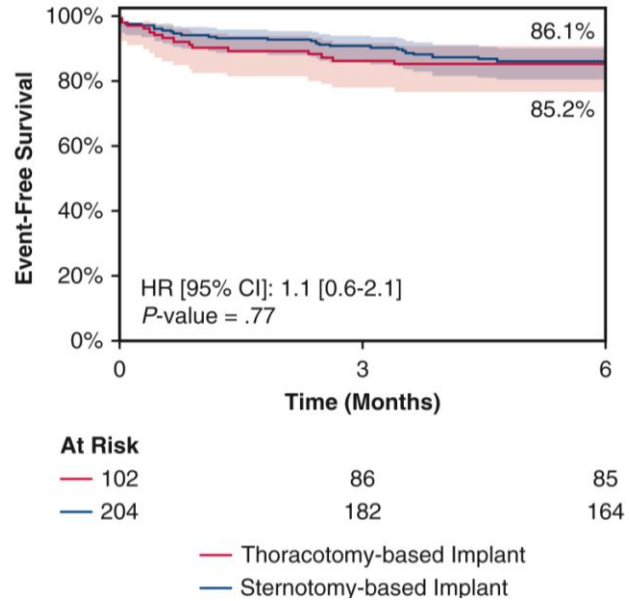




Ventricular assist device using a thoracotomy-based implant technique: Multi-Center Implantation of the HeartMate 3 in Subjects With Heart Failure Using Surgical Techniques Other Than Full Median Sternotomy (HM3 SWIFT)





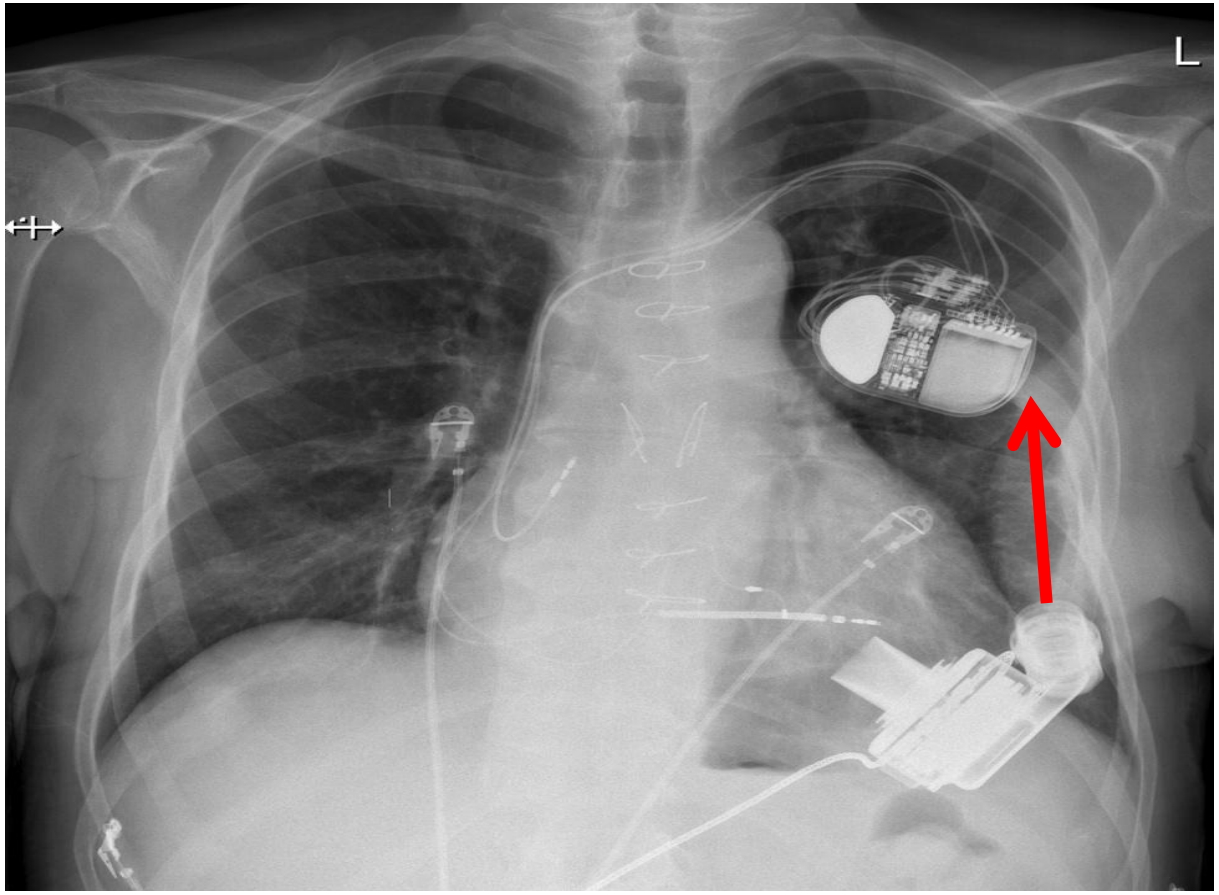
Ventricular assist device using a thoracotomy-based implant technique: Multi-Center Implantation of the HeartMate 3 in Subjects With Heart Failure Using Surgical Techniques Other Than Full Median Sternotomy (HM3 SWIFT)

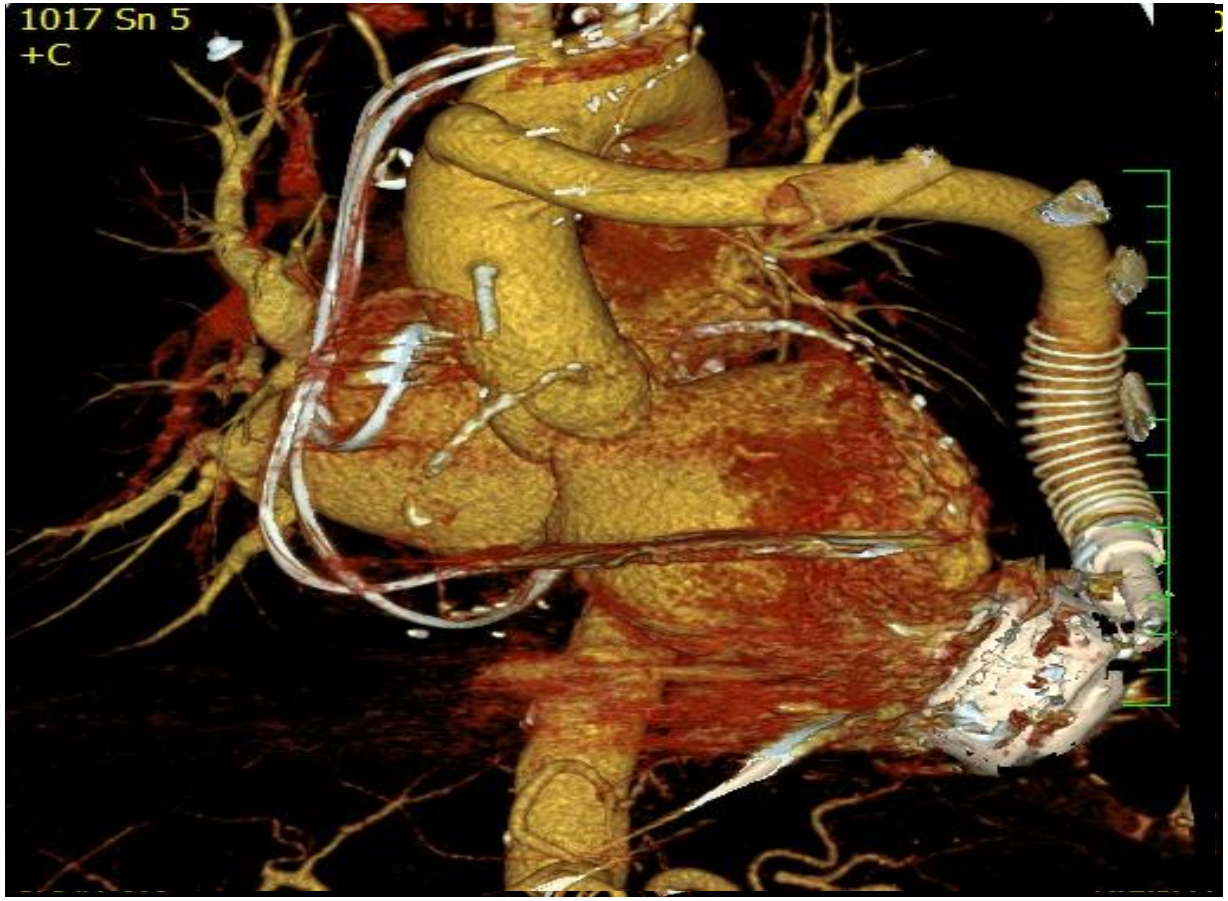
TABLE 4. Implant procedure details

Characteristic	Thoracotomy-based (n = 102)	Sternotomy-based (n = 204)	*P* value
Total implant time (min)	395.8 ± 129.5 (n = 102/102)	284.3 ± 110.9 (n = 204/204)	<.0001
Total time on CPB (min)	122.6 ± 64.8 (n = 100/102)	83.5 ± 39.8 (n = 203/204)	<.0001
Received blood products	82.4 (n = 84/102)	79.9 (n = 163/204)	.61
Whole blood	1.0 (n = 1/102)	2.0 (n = 4/204)	.67*
Packed red blood cells	44.1 (n = 45/102)	34.8 (n = 71/204)	.11
Fresh frozen plasma	32.4 (n = 33/102)	37.3 (n = 76/204)	.40
Platelets	43.1 (n = 44/102)	40.2 (n = 82/204)	.62
Cryoprecipitate	25.5 (n = 26/102)	27.0 (n = 55/204)	.78
Cell saver	56.9 (n = 58/102)	54.4 (n = 111/204)	.68
Concurrent procedures	12.7 (n = 13/102)	12.7 (n = 26/204)	.27
CABG/valve	4.9 (n = 5/102)	8.3 (n = 17/204)	.22

Right heart failure	22 (21.6)	22	0.52	58 (28.4)	61	0.68	.26
RVAD	14 (13.7)	14	0.33	11 (5.4)	11	0.12	.02
>14 consecutive days on inotropes	10 (9.8)	10	0.23	22 (10.8)	22	0.25	.90

Alternative implant strategy: Via left hemithorax



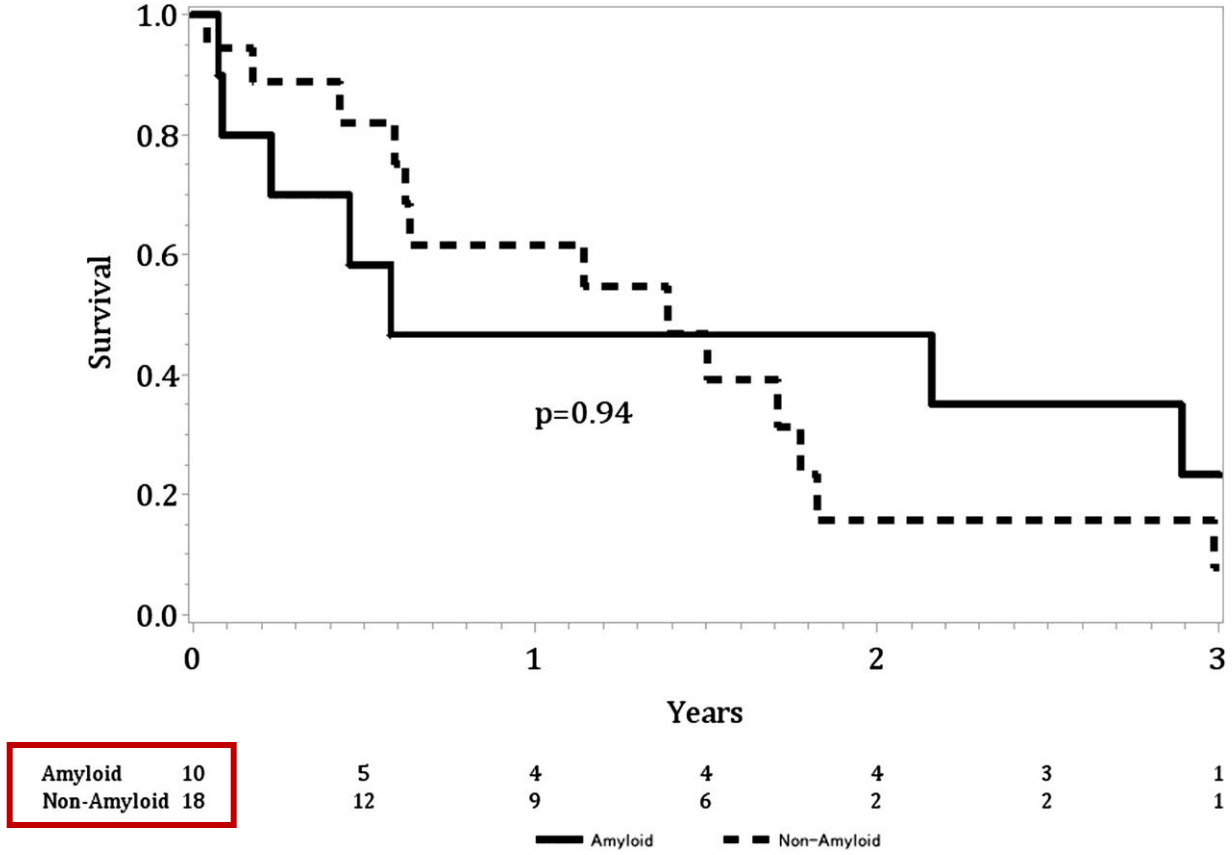


Challenges in small LV and restrictive physiologies

Role of ventricular assist therapy for patients with heart failure and restrictive physiology: Improving outcomes for a lethal disease

Avishay Grupper, MD,[a] Soon J. Park, MD,[b] Naveen L. Pereira, MD,[a] Sarah D. Schettle, RN,[b] Yariv Gerber, PhD,[c] Yan Topilsky, MD,[a] Brooks S. Edwards, MD,[a] Richard C. Daly, MD,[b] John M. Stulak, MD,[b] Lyle D. Joyce, MD, PhD,[b] and Sudhir S. Kushwaha, MD[a]

J Heart Lung Transplant 2015;34:1042–1049



Challenges in small LV and restrictive physiologies

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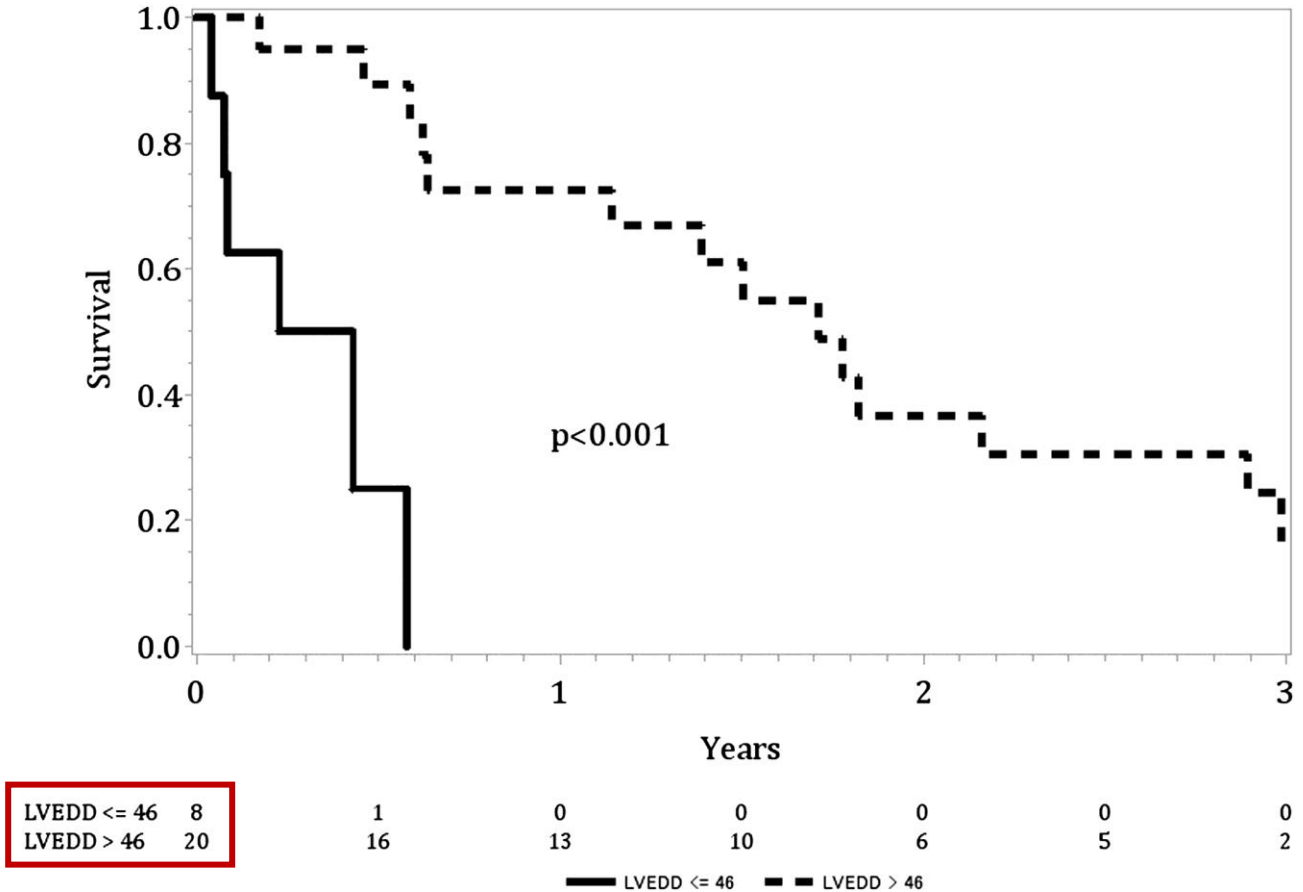


Prediction of Survival After Implantation of a Fully Magnetically Levitated Left Ventricular Assist Device

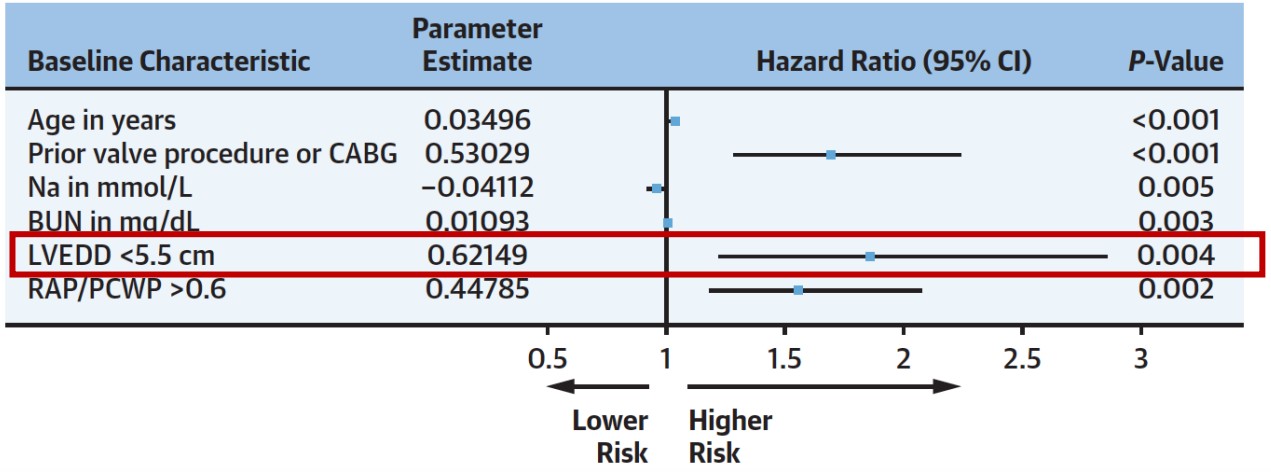
Mandeep R. Mehra, MD, MSc,[a,*] Aditi Nayak, MD,[b,*] Alanna A. Morris, MD, MSc,[b] David E. Lanfear, MD, MS,[c] Hassan Nemeh, MD,[c] Sapna Desai, MD,[d] Aditya Bansal, MD,[d] Cesar Guerrero-Miranda, MD,[e] Shelley Hall, MD,[e] Joseph C. Cleveland, Jr, MD,[f] Daniel J. Goldstein, MD,[g] Nir Uriel, MD, MSc,[h] Leway Chen, MD,[i] Stephen Bailey, MD,[j] Anelechi Anyanwu, MD,[k] Gerald Heatley, MS,[l] Joyce Chuang, PhD,[l] Jerry D. Estep, MD[m]

CENTRAL ILLUSTRATION **Prediction of Survival After Implantation of a Fully Magnetically Levitated Left Ventricular Assist Device: the HeartMate 3 Survival Risk Score**

The HM3RS provides individual survival prediction at 1 and 2 years post-implant

The HM3RS contains 6 predictors

- 2 demographic variables
- 2 chemistry labs
- 1 echocardiogram parameter
- 1 invasive hemodynamic parameter

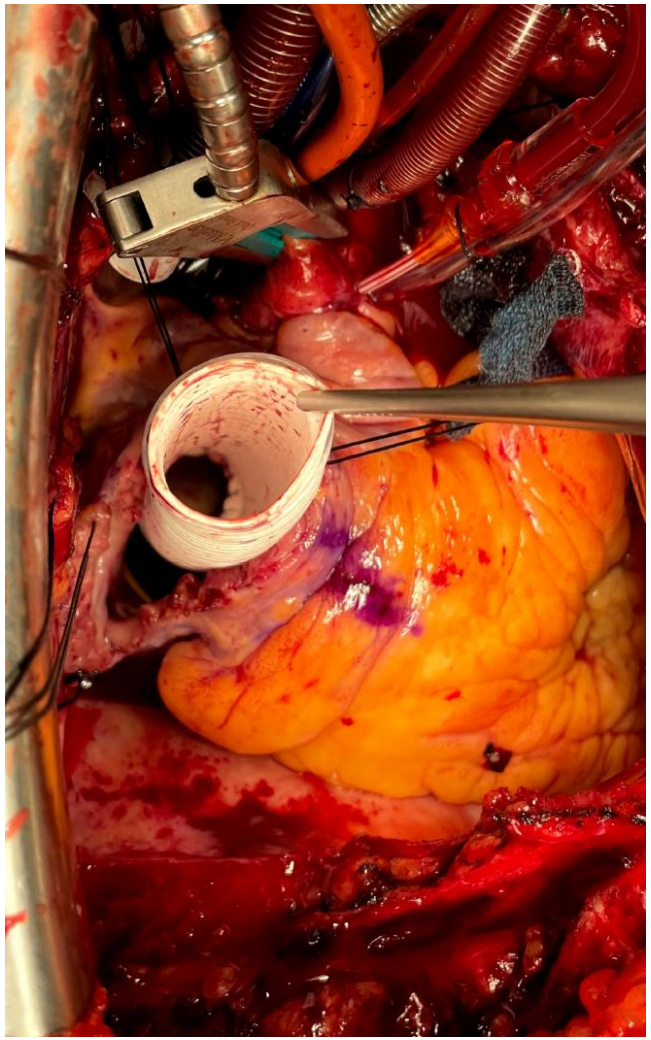


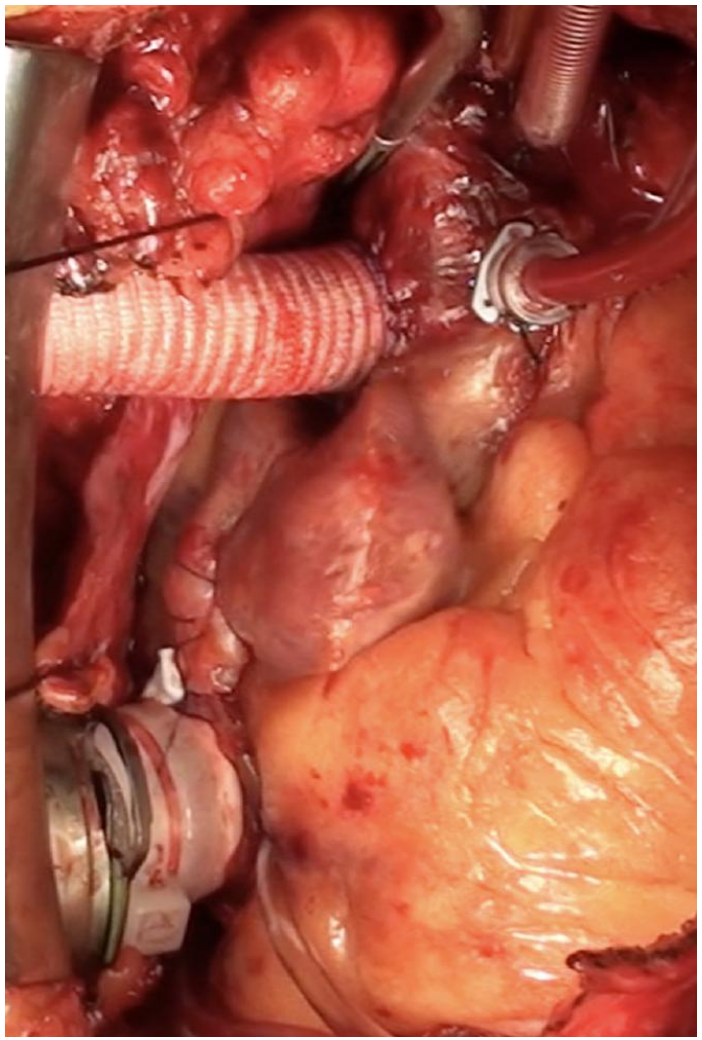
Intra-atrial conduit LVAD implant considerations

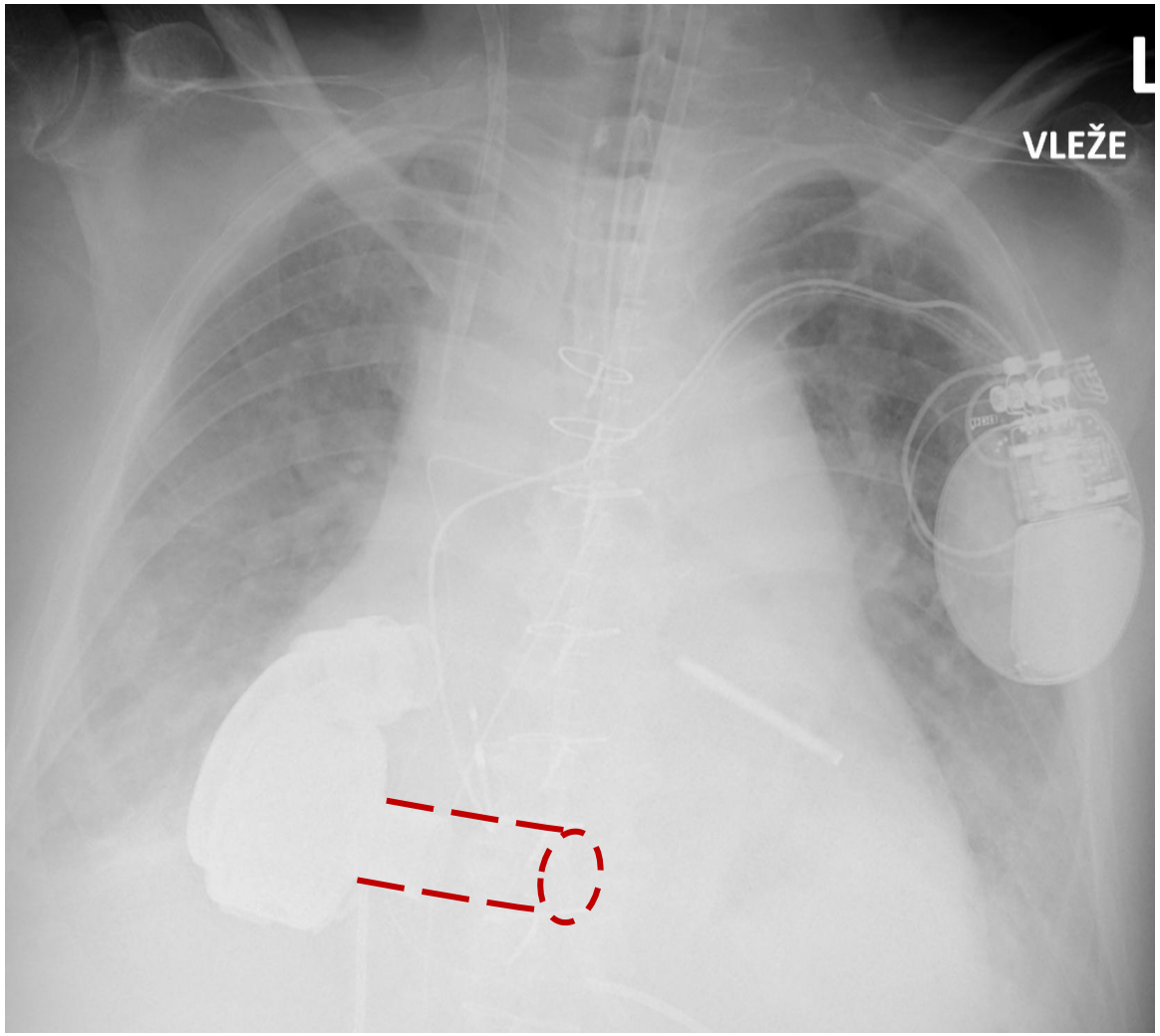
- Small LV dimension
- Technical concerns of the cannula insertion (LV aneurysm, calcified or friable apex)
- Other anatomic considerations

Consequences of suboptimal inflow cannula positioning

- Cannula encroachment to the septum or free-wall
- Risk of intraventricular/pump thrombosis
- Ventricular arrhythmias
- Insufficient LV unloading with residual HF
- Impaired RV function







LA appendage closure mandatory in de novo cases!

BIVAD and TAH Considerations

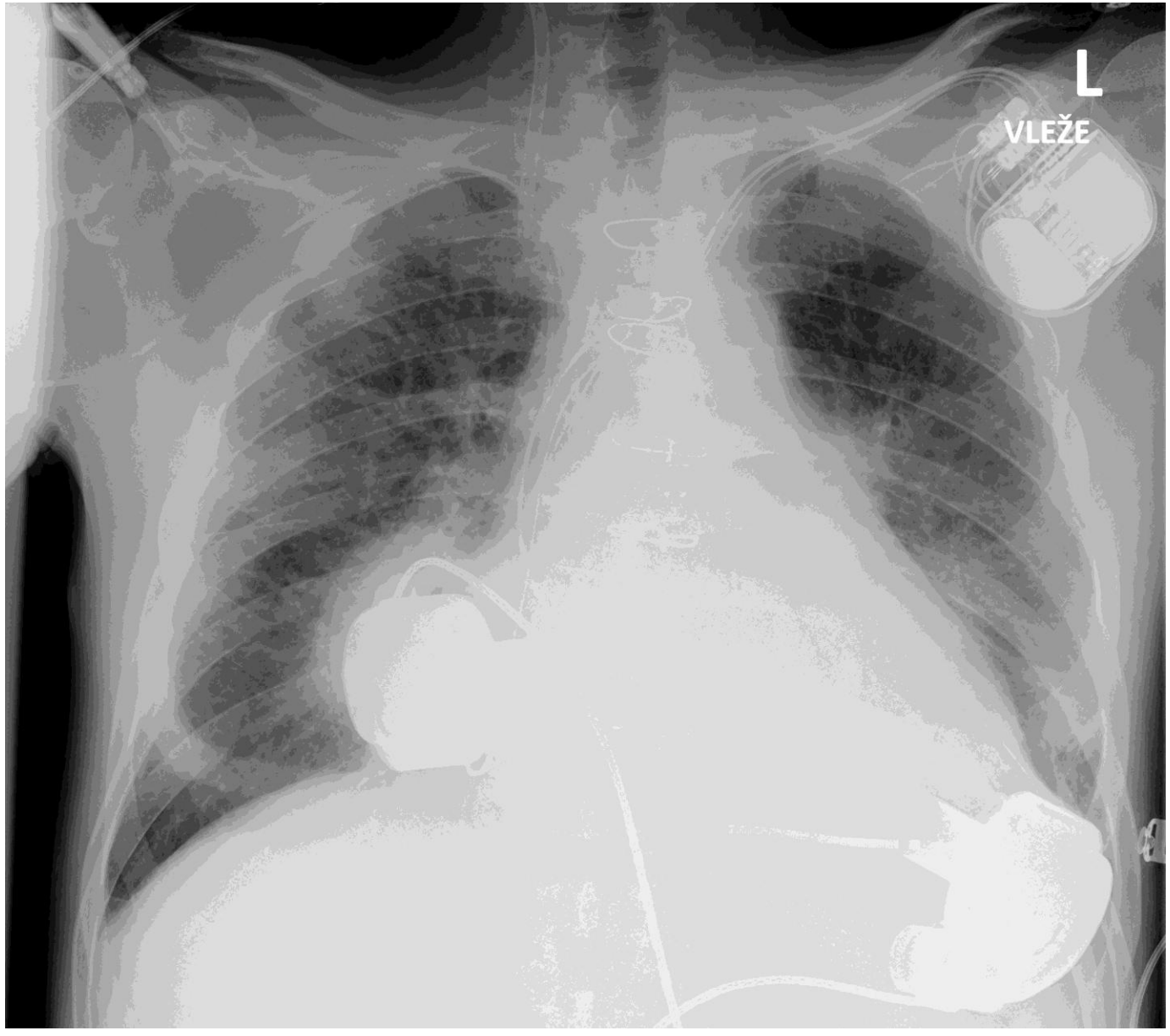
Patients with end-stage heart failure, OMM refractory, requiring mechanical circulatory support in whom LVAD is considered inefficient or contraindicated:

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]

- **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**

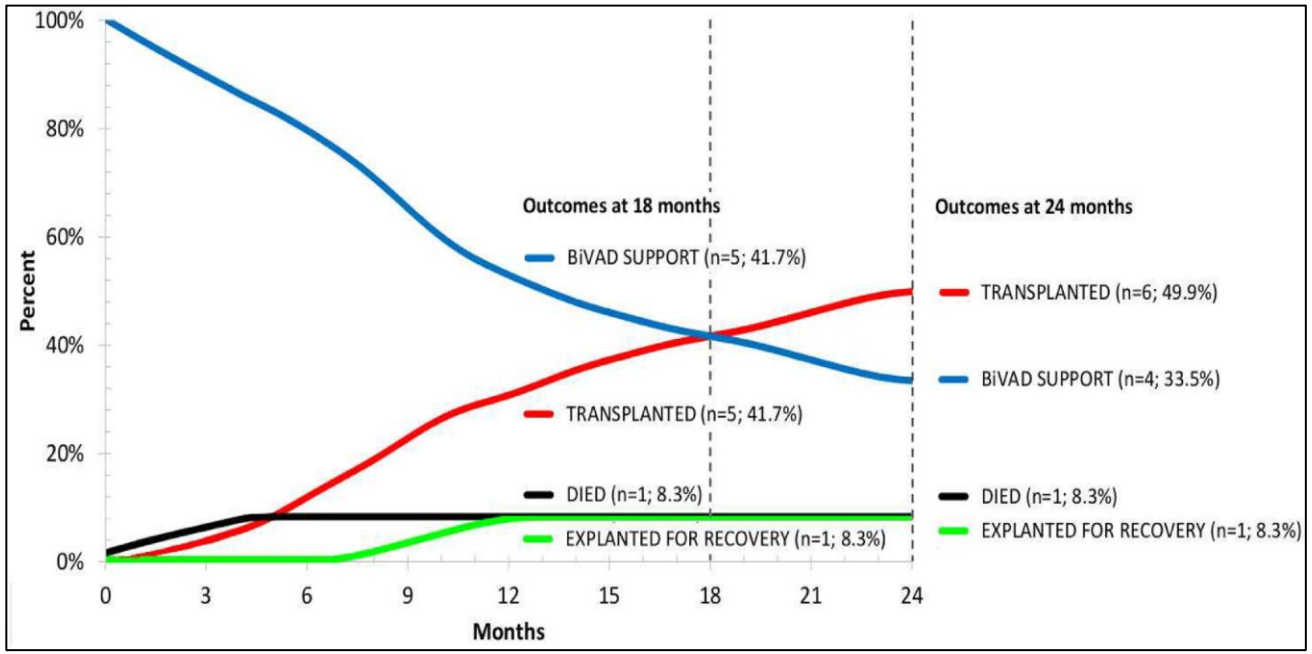
Potapov et al. EJCTVS, 2019

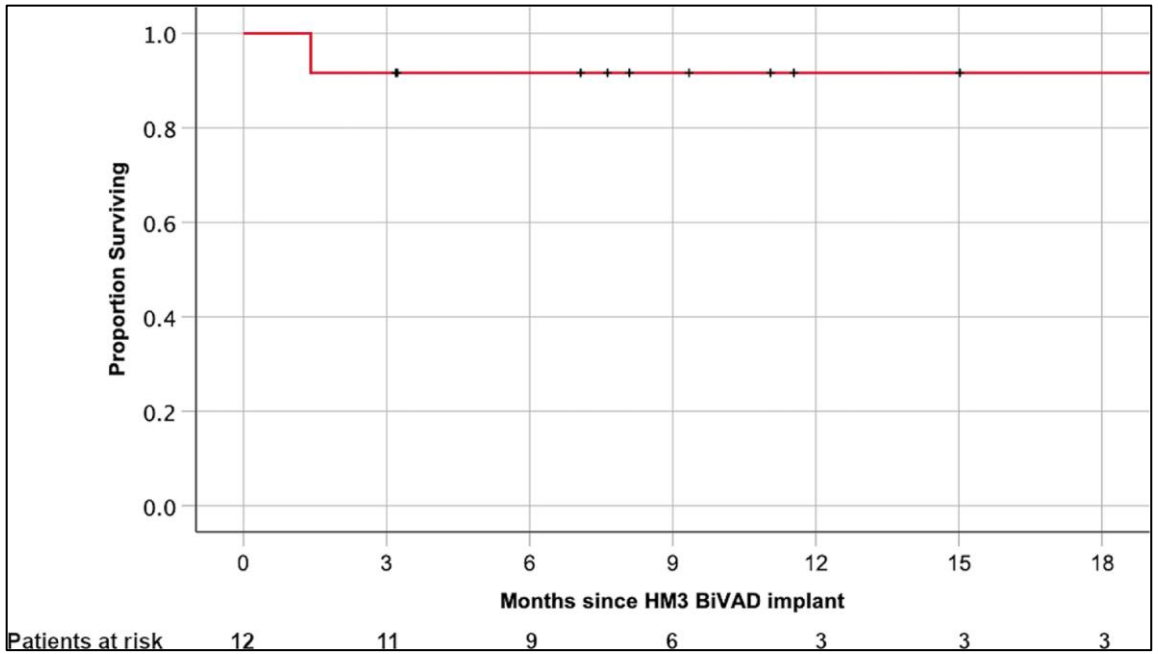
Alternative implant considerations



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

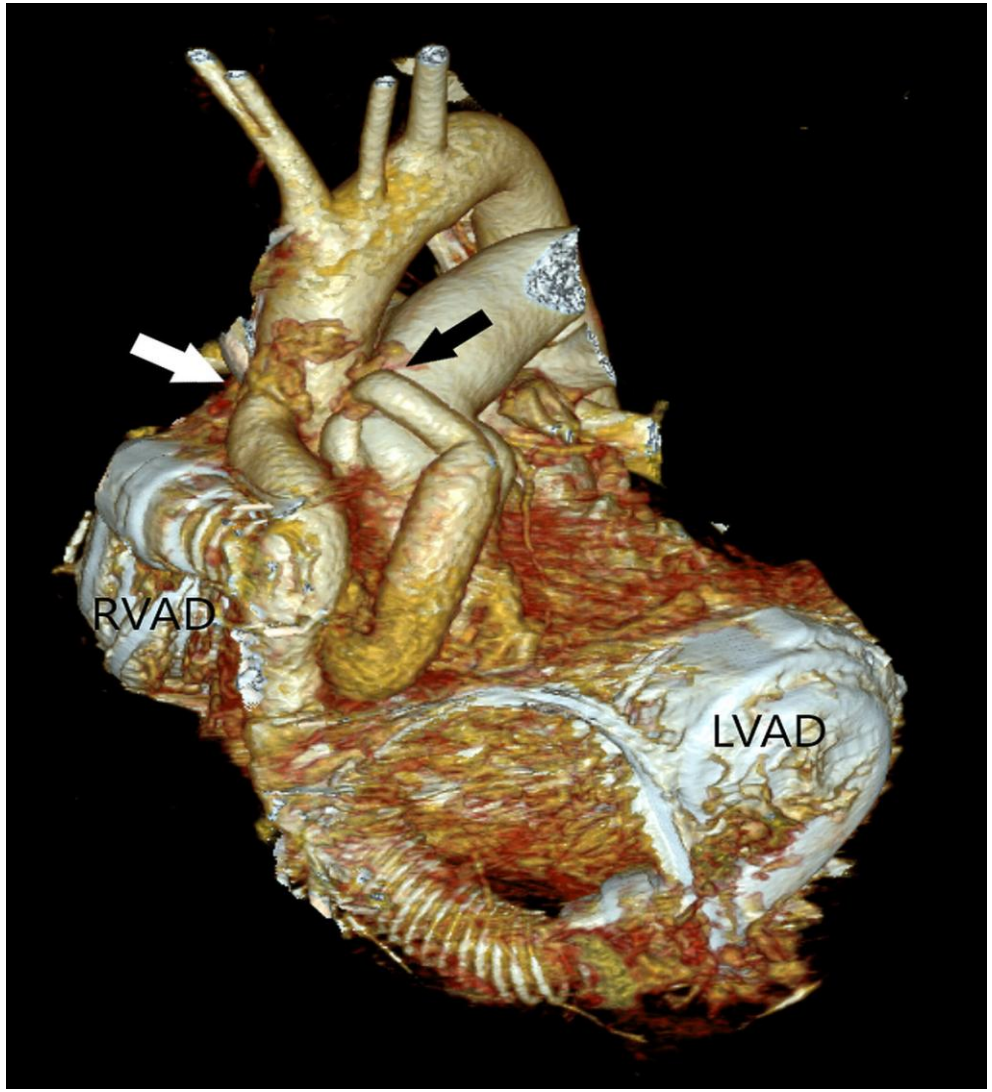
David McGiffin, MD,[a] Christina Kure, PhD,[a] Janelle McLean, RN,[b] Silvana Marasco, MD, PhD,[a] Peter Bergin, MD,[b] James L. Hare, MD, PhD,[b] Angeline Leet, MD,[b] Hitesh Patel, MD, PhD,[b] Adam Zimmet, MD,[a] Julia Rix, RN,[b] Andrew Taylor, MD, PhD,[b] and David Kaye, MD, PhD[b]





HeartMate 3 biventricular support exceeding 4.5 years

Hrvoje Gasparovic[1]*, Davor Milicic[2], Kristina Krželj[1], Maja Hrabak Paar[3], Tomislav Kopjar[1], Nina Jakus[2], Ivo Planinc[2] and Maja Cikes[2]



ESC Heart Failure 2023:10,3, 2094-2098.

BIVAD and TAH Considerations

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]

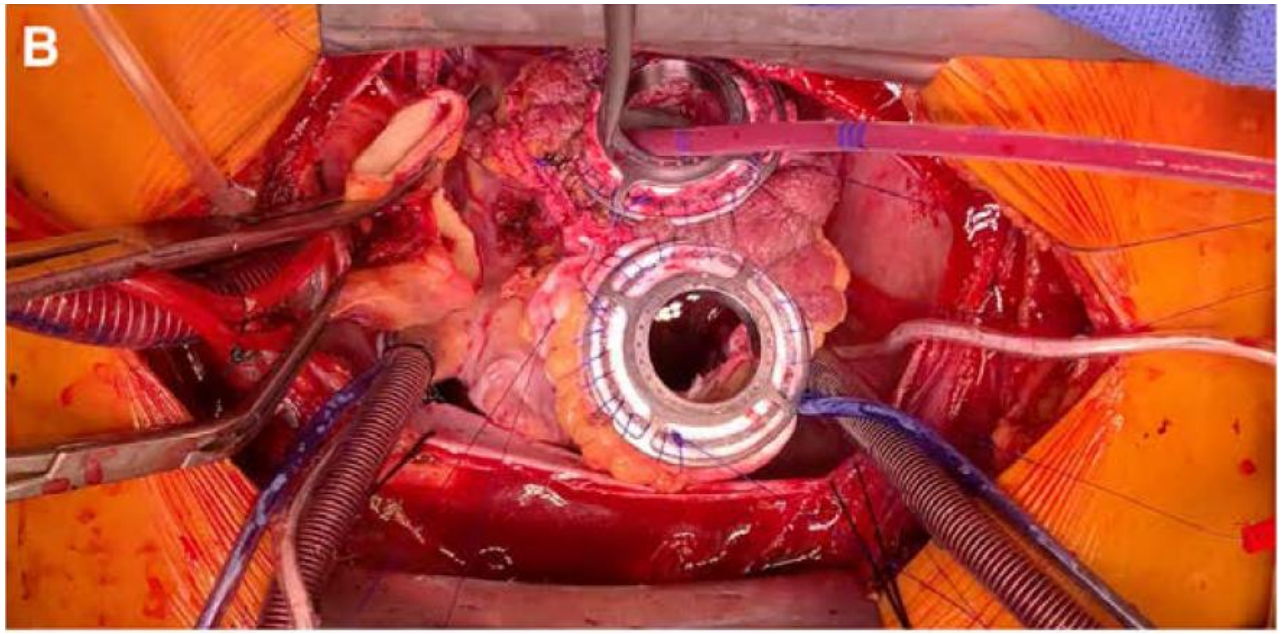
Potapov et al. EJCTVS, 2019

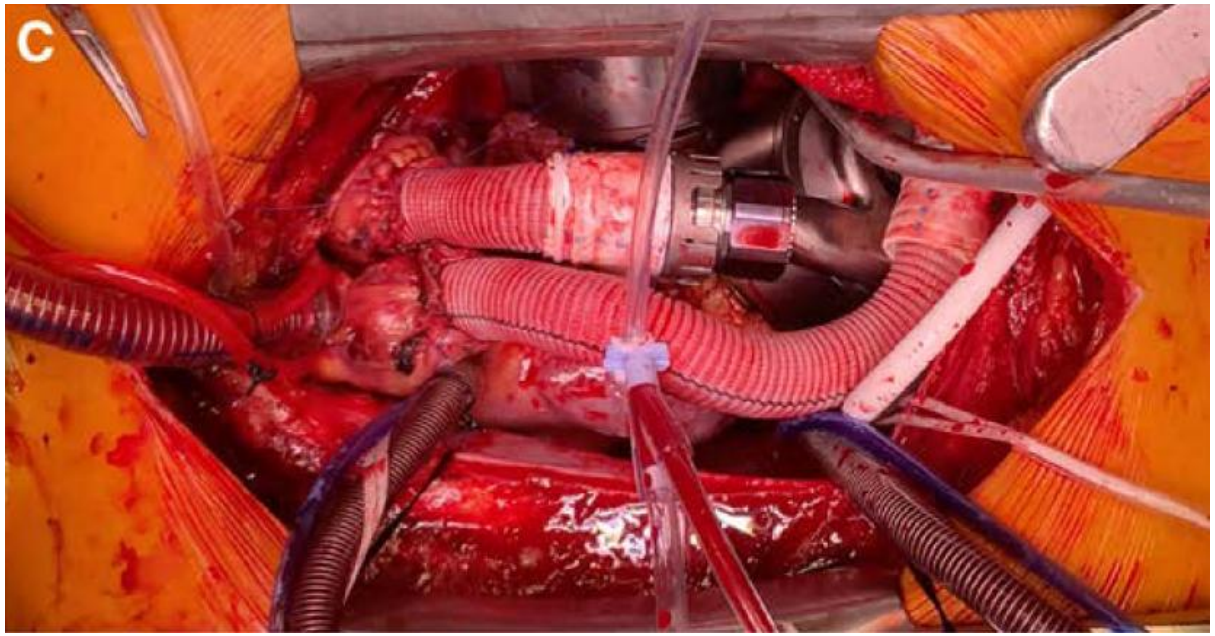
Adult

Operative Techniques in
Thoracic and
Cardiovascular Surgery

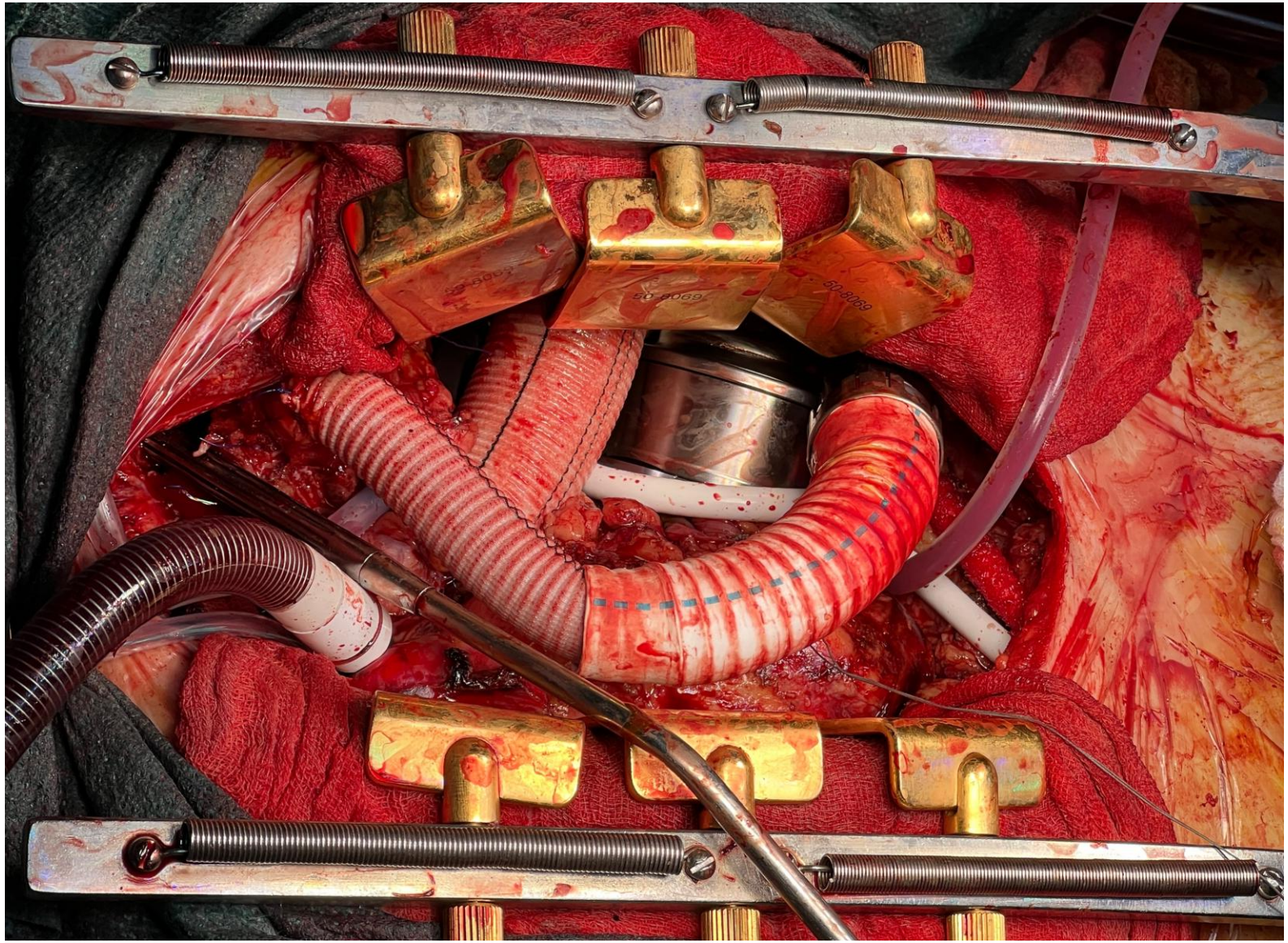
Implantation of two HeartMate 3s in the setting of a Total Artificial Heart

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





Modified TAH Implant (S/P Mustard operation) - IKEM



Conclusions

- LVADs – game-changer in HF patients prognosis with significant survival benefit
- 5-years survival above 60% with improved functional capacity QoL
- Accomplishments in addressing residual risks (bleeding AEs)
- Signal of DOACs (Apixaban) safety use
- Clinical feasibility in challenging anatomies with alternative surgical strategies
- Versatility in biventricular heart failure and TAH mandated scenarios