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THE PRESENT AND FUTURE OF HEART ALLOGRAFT PRESERVATION

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MHI Grand Rounds
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DISCLOSURES

- The authors have no relevant disclosures

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BRIEF HISTORY

Comparative Study > J Thorac Cardiovasc Surg. 1998 Nov;116(5):821-30.
doi: 10.1016/S0022-5223(98)00452-8.

Continuous perfusion of donor hearts in the beating state extends preservation time and improves recovery of function

Heart, Lung and Circulation (2015) 24, 611-613
1443-9506/04/\$36.00
<http://dx.doi.org/10.1016/j.hlc.2015.01.005>

BRIEF COMMUNICATION

Successful Heart Transplant after Ten Hours Out-of-body Time using the TransMedics Organ Care System



Ex Vivo Heart Perfusion for Cardiac Transplantation Allowing for Prolonged Perfusion Time and Extension of Distance Traveled for Procurement of Donor Hearts: An Initial Experience in the United States

Transplantation DIRECT ■ 2023

Clinical Trial > JACC Heart Fail. 2024 Mar;12(3):438-447. doi: 10.1016/j.jchf.2023.11.015.
Epub 2024 Jan 24.

Increasing Utilization of Extended Criteria Donor Hearts for Transplantation: The OCS Heart EXPAND Trial

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BRIEF HISTORY ->WHAT MAY BE NEXT



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WHAT MAY BE NEXT

> [Sci Transl Med.](#) 2021 Sep 15;13(611):eabf7601. doi: 10.1126/scitranslmed.abf7601. Epub 2021 Sep 15.

Static lung storage at 10°C maintains mitochondrial health and preserves donor organ function

> [NEJM Evid.](#) 2023 Jun;2(6):EVIDoA2300008. doi: 10.1056/EVIDoA2300008. Epub 2023 Apr 20.

Extension of Cold Static Donor Lung Preservation at 10°C

> [JTCVS Open.](#) 2024 Aug 21;21:197-209. doi: 10.1016/j.jxon.2024.08.005. eCollection 2024 Oct.

Out of the ice age: Preservation of cardiac allografts with a reusable 10 °C cooler

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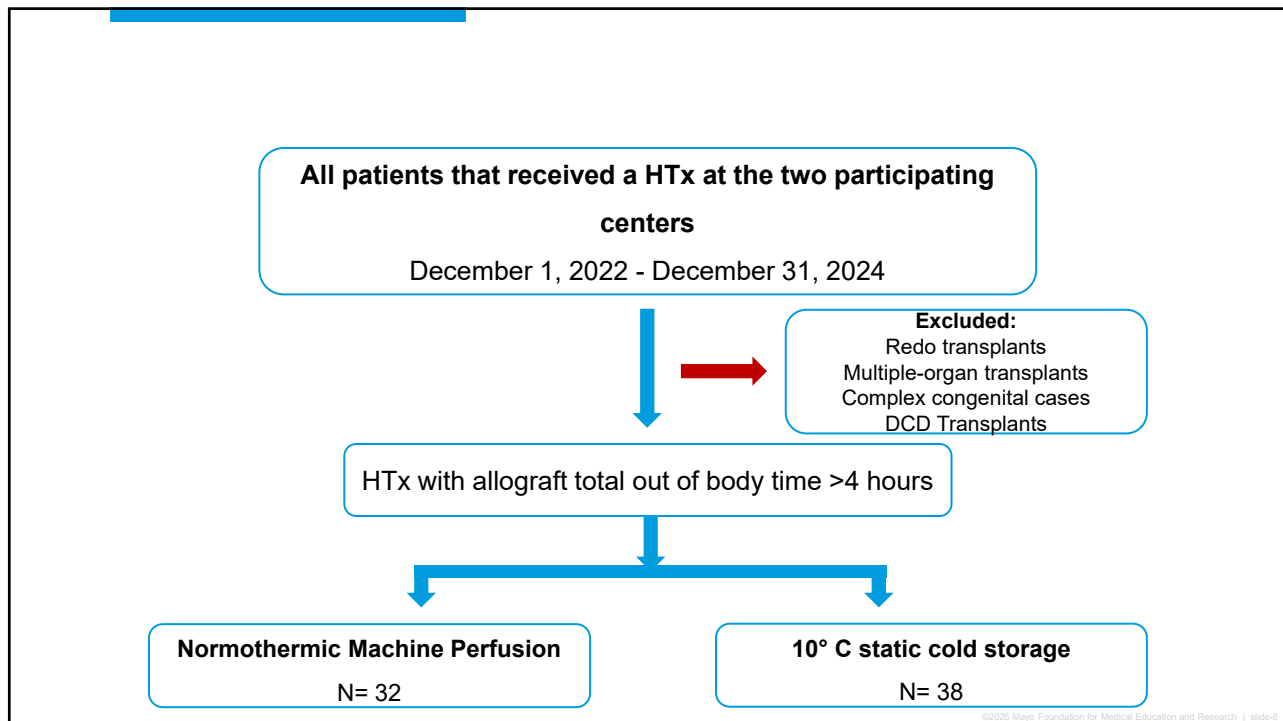
TICK TOCK GOES THE CLOCK: NORMOTHERMIC MACHINE PERFUSION VERSUS STATIC COLD STORAGE AT 10 C FOR EXTENDED PRESERVATION OF CARDIAC ALLOGRAFTS

- Review all heart transplants from DBD with a total out of body time over 4 hrs.
- Exclude: CHD, redo HTX, and multi-organ transplants

- 32 transplants with OCS (All Mayo Rochester)
- 38 transplants with 10 degree storage (All Vanderbilt)

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OUTCOMES OF INTEREST

- Severe primary graft dysfunction
- 30-day, 90-day, and 6-month all-cause mortality
- Cardiac function (cardiac index, RV systolic function)
- Vasoactive inotropic scores
- Postoperative dialysis, mechanical circulatory support

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RECIPIENT BASELINE CHARACTERISTICS

Characteristic	NMP N= 32	10° C N= 38	P
Age	57.1 (49.5, 65.5)	56.9 (43.1, 63.7)	0.78
Male sex	17 (53.1%)	23 (60.5%)	0.63
Body mass index, Kg/m2	27.37 (23.46, 31.42)	28.55 (25.70, 33.46)	0.09
Hypertension	18 (58.1%)	25 (65.8%)	0.62
Diabetes	13 (40.6%)	24 (63.2%)	0.09
Dialysis	0 (0.0%)	1 (2.6%)	1.000
Smoking	14 (43.8%)	7 (18.4%)	0.008
Pretransplant LVAD	7(21.9%)	15(39.5%)	0.13

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DONOR BASELINE CHARACTERISTICS

Characteristic	NMP N= 32	10° C N= 38	P
Donor Age	39.5 (32.5, 46.7)	37.1 (32.0, 43.0)	0.213
Donor EF < 55%	2(6.3%)	10(26.3%)	0.03
Donor BMI	27.3(24.3-33.8)	24.2(21.9-28.3)	0.02
PHM ratio	1.05(0.93-1.15)	0.91(0.79-1.03)	0.002
OCS time, minutes	251.0 (219.5, 303.2)	NA	
Total ischemic time, minutes	82.5 (76.8, 88.5)	279.0 (261.2, 343.8)	< 0.001
Total out of body time, minutes	343.5 (306.8, 385.0)	279.0 (261.2, 343.8)	0.001

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OUTCOMES

- Post-transplant, thirty-day and 6-month mortality were comparable between both groups
- Compared to the 10°C cohort, patients that received allografts preserved using NMP had a non-significant trend towards **higher incidence of severe primary graft dysfunction** (9.4% vs 2.6%; p=0.32)

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POST-TRANSPLANT OUTCOMES

Characteristic	NMP N= 32	10° C N= 38	P
30-day mortality	3 (9.4%)	2 (5.3%)	0.65
90-day mortality	3(9.4%)	2(5.3%)	0.65
6-month mortality	4(12.5%)	2(5.3%)	0.40
Severe PGD	3 (9.4%)	1 (2.6%)	0.32
New postop MCS	3 (9.4%)	4 (10.5%)	1.00
Renal failure requiring dialysis	12 (37.5%)	8 (21%)	0.11
Hospital LOS (days)	19(12-28)	18(13-26)	0.71
ICU LOS (days)	6(4-13)	8(6-11)	0.44

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POSTOPERATIVE DATA

- Patients that received allografts preserved using NMP had higher cardiac indices (3.2 [2.8-3.9] vs 2.9 [2.1-3.4]; p=0.04) post-bypass when compared to 10° C static cold storage allografts
- Vasoactive inotrope scores were significantly lower in the NMP group after bypass, at 24 and 72 hours postoperatively
- A higher proportion of patients in the NMP group had moderate or greater RV dysfunction (40.6% vs 2.6%, p<0.001)

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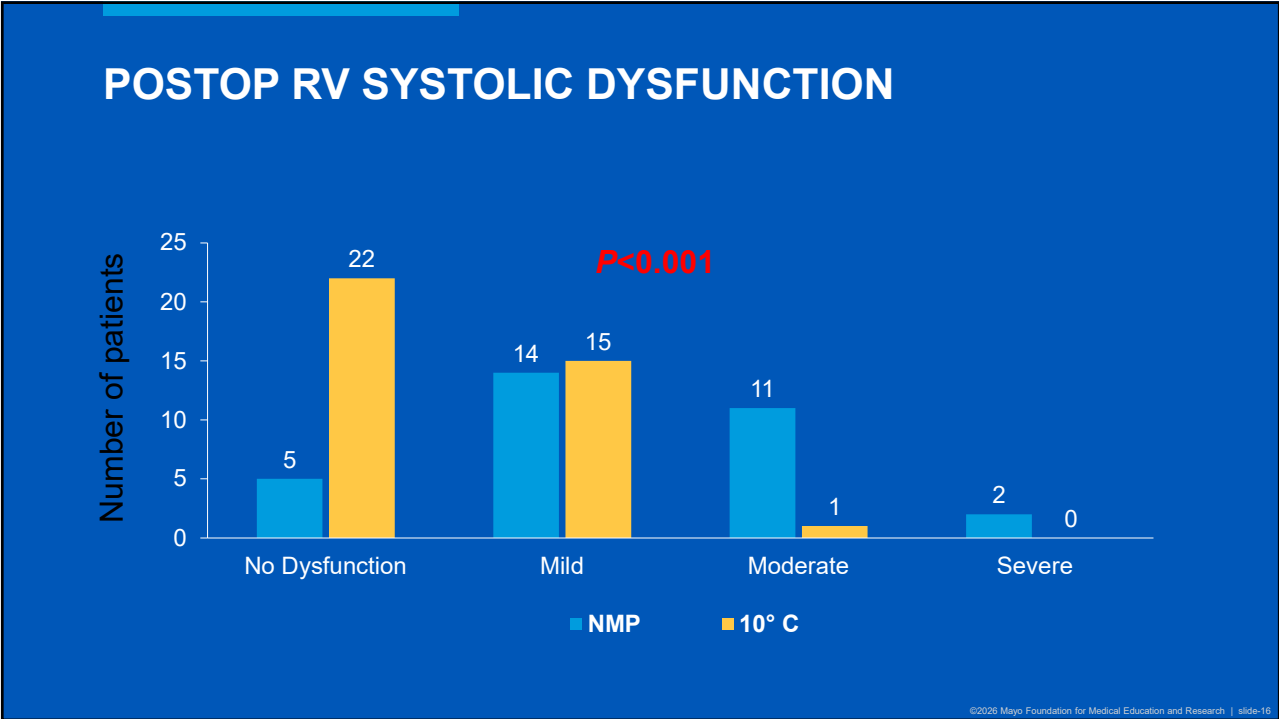
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POSTOPERATIVE OUTCOMES

Characteristic	NMP N= 32	10° C N= 38	P
LV Ejection Fraction <55%	6(18.8%)	2(5.3%)	0.13
Cardiac Index			
Post-bypass	3.2 (2.8, 3.9)	2.9 (2.1, 3.4)	0.041
At 24H	3.1(2.7-3.8)	3.0(2.3-3.4)	0.07
At 72H	3.5(3.0-3.9)	2.8(2.5-3.2)	0.002
Vasoactive inotrope scores			
Post-bypass	10.7 (8.5, 13.8)	17.0 (12.2, 20.6)	< 0.001
At 24H	6.9 (5.0, 10.8)	12.3 (8.6, 15.9)	< 0.001
At 72H	3.9 (1.0, 5.2)	8.3 (5.0, 12.9)	< 0.001
Acute cellular rejection ≥ 2 at first biopsy	1(3.1%)	5(13.2%)	0.21

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LIMITATIONS

- Retrospective series
- Selection bias
- Differences in institutional practices- patient selection, pre- and post-operative management may impact measurements and outcomes

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CONCLUSIONS

- Both Normothermic Machine Perfusion OCS device (NMP) and 10° C static cold storage appear to yield similar post-transplant survival
- Possible differences were observed in cardiac function (NMP had higher cardiac indices but greater RV dysfunction), incidence of PGD and graft rejection
- Requires further investigation with larger samples

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REAL TIME CHANGES?

- We have moved heavily to DBD extended distance heart recovery at 10 degrees
 - <6Hr Cold ischemic time
- In 2024 cost of organ recovery decreased by \$1 million in the heart transplant program.

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WHAT MAY BE NEXT



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WHERE FROM HERE?

- We did not include all available strategies or up and coming strategies



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Case Reports > [ASAIO J. 2024 Jan 1;70\(1\):e13-e15. doi: 10.1097/MAT.0000000000002029.](https://doi.org/10.1097/MAT.0000000000002029)
Epub 2023 Dec 23.

Heart-Lung Transplantation From Donation After Circulatory Death Using Mobile Normothermic Regional Perfusion

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NO, REALLY, WHERE FROM HERE?

- DBD and DCD?
- NMP, CMP, NRP
- What about pediatric donors and recipients, ReUp?!
- Lastly, cost to the system and the planet?



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QUESTIONS?



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