Place de l'assistance cardiaque de longue durée dans l'insuffisance cardiaque

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Insuffisance cardiaque

- **Problème de santé publique : données épidémiologiques 2022**
  - 150 000 nouveaux patients/an
  - 1 376 692 patients prévalents en France en 2022
  - Dépenses de santé considérables
  - 181 178 hospitalisations /an
  - 24 645 DC/an

- **Traitements :**
  - Education thérapeutique
  - Réadaptation cardiovasculaire
  - Traitement médicamenteux (IEC, BB, ARM, Entresto®, Forxiga®),
  - Traitement électrique (DAI, CRT)
  - Traitement chirurgical (valvulopathie, revascularisation)

Insuffisance cardiaque avancée

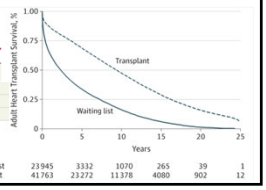
- **Définition**
  - Stade avancé de l'insuffisance cardiaque chronique
  - NYHA 3-4
  - Malgré traitement optimal (médical, électrique et chirurgical)

- **Traitement de référence** ⟶ **Transplantation cardiaque**

- **Mauvais pronostic**

Table 2. Survival Benefit of Solid-Organ Transplant After Propensity Score Matching

Transplant Type and Patient Category	No. of Patients	Unadjusted Median Survival, y	No. of Patients After Matching	Median Survival After Matching, y
Heart				
Waiting list	38 578	2.3	31 086	2.7
Transplant	54 039	9.5	53 173	9.5



Survival Benefit of Solid-Organ Transplant in the United States, JAMA Surg. 2015

Insuffisance cardiaque avancée

- **CI à la greffe (Age, comorbidités …)**

- **Pénurie de greffon**

Tableau C1. Évolution du devenir des candidats à une greffe cardiaque

	2017	2018	2019	2020	2021	2022	2023
Liste d'attente							
Candidats en liste d'attente active au 1er janvier*	235	183	258	261	300	289	201
Candidats en liste d'attente inactive au 1er janvier**	92	131	113	132	144	151	161
Nouveaux inscrits dans l'année	546	628	574	544	539	453	
Décédés dans l'année	44	68	62	69	76	61	
Sortis de la liste d'attente	48	53	65	54	58	59	
- dont sortis de la liste d'attente pour aggravation	17	22	22	21	24	21	
Greffes	467	450	425	370	409	411	
Greffes (pmh)	7,0	6,7	6,3	5,5	6,0	6,0	..

*Un candidat est en liste d'attente active au 1er janvier si il n'est pas en contre-indication temporaire au 1er janvier.
**Un candidat est en liste d'attente inactive au 1er janvier si il est en contre-indication temporaire au 1er janvier
Données extraites de CRISTAL le 07/03/2023

942 inscrits pour 414 greffes en 2024

⟶ **Assistance cardiaque de longue durée**

Objectifs

- Permettre au patient de vivre une vie pratiquement normale sous support mécanique.

- Eviter les longs séjours à l'hôpital pour limiter:
  - Les infections nosocomiales,
  - L'ennui et la dépression,
  - Les problèmes sociaux.

- Libérer les ressources de l'hôpital via la création d'une « filière soin » adaptée bien définie.

The 2023 International Society for Heart and Lung Transplantation Guidelines for Mechanical Circulatory Support: A 10- Year Update

Table 1 Triggers for Referral of Heart Failure Patient for Advanced Therapies Evaluation

I	IV Inotropes
N	NYHA IIIB/IV or persistently elevated Natriuretic peptides
E	End-organ dysfunction
E	EF ≤ 35%
D	Defibrillator shocks
H	Hospitalizations >1
E	Edema despite escalating diuretics
L	Low blood pressure, high heart rate
P	Progressive intolerance or downtitration of GDMT

The Journal of Heart and Lung Transplantation, Vol 42, No 7, July 2023

Les indications

Table 13.1 Terms describing various indications for mechanical circulatory support

Bridge to decision (BTD)/ Bridge to bridge (BTB)	Use of short-term MCS (e.g. ECLS or ECMO) in patients with cardiogenic shock until haemodynamics and end-organ perfusion are stabilized, contra-indications for long-term MCS are excluded (brain damage after resuscitation) and additional therapeutic options including long-term VAD therapy or heart transplant can be evaluated.
Bridge to candidacy (BTC)	Use of MCS (usually LVAD) to improve end-organ function in order to make an ineligible patient eligible for heart transplantation.
Bridge to transplantation (BTT)	Use of MCS (LVAD or BiVAD) to keep patient alive who is otherwise at high risk of death before transplantation until a donor organ becomes available.
Bridge to recovery (BTR)	Use of MCS (typically LVAD) to keep patient alive until cardiac function recovers sufficiently to remove MCS.
Destination therapy (DT)	Long-term use of MCS (LVAD) as an alternative to transplantation in patients with end-stage HF ineligible for transplantation or long-term waiting for heart transplantation.

Recommendations for implantation of mechanical circulatory support in patients with refractory heart failure

Recommendations	Class[a]	Level[b]	Ref[c]
An LVAD should be considered in patients who have end- stage HFrEF despite optimal medical and device therapy and who are eligible for heart transplantation in order to improve symptoms, reduce the risk of HF hospitalization and the risk of premature death (Bridge to transplant indication).	IIa	C	

Recommendations for implantation of mechanical circulatory support in patients with refractory heart failure

An LVAD should be considered in patients who have end-stage HFrEF despite optimal medical and device therapy and who are not eligible for heart transplantation to, reduce the risk of premature death.	IIa	B	605, 612, 613

2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

European Journal of Heart Failure (2016)

Les indications

Table 13.2 INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support) stages for classifying patients with advanced heart failure

	INTERMACS level	NYHA Class	Description	Device	1y survival with LVAD therapy	
AIGU	1. Cardiogenic shock "Crash and burn"	IV	Haemodynamic instability in spite of increasing doses of catecholamines and/or mechanical circulatory support with critical hypoperfusion of target organs (severe cardiogenic shock).	ECLS, ECMO, percutaneous support devices	52.6±5.6%	14%
	2. Progressive decline despite inotropic support "Sliding on inotropes"	IV	Intravenous inotropic support with acceptable blood pressure but rapid deterioration of renal function, nutritional state, or signs of congestion.	ECLS, ECMO, LVAD	63.1±3.1%	36%
	3. Stable but inotrope dependent "Dependent stability"	IV	Haemodynamic stability with low or intermediate doses of inotropics, but necessary due to hypotension, worsening of symptoms, or progressive renal failure.	LVAD	78.4±2.5%	30%
CHRO	4. Resting symptoms "Frequent flyer"	IV ambulatory	Temporary cessation of inotropic treatment is possible, but patient presents with frequent symptom recurrences and typically with fluid overload.	LVAD	78.7±3.0%	15%
	5. Exertion intolerant "Housebound"	IV ambulatory	Complete cessation of physical activity, stable at rest, but frequently with moderate fluid retention and some level of renal dysfunction.	LVAD	93.0±3.9%[a]	3%
	6. Exertion limited "Walking wounded"	III	Minor limitation on physical activity and absence of congestion while at rest. Easily fatigued by light activity.	LVAD / Discuss LVAD as option	-	
	7."Placeholder"	III	Patient in NYHA Class III with no current or recent unstable fluid balance.	Discuss LVAD as option	-	

2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

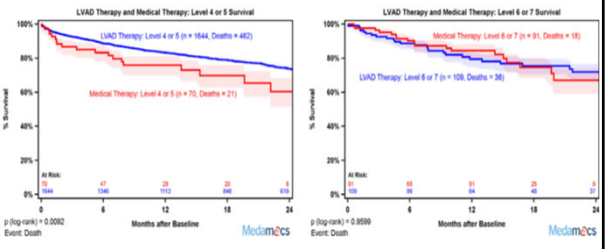
European Journal of Heart Failure (2016)

Seventh INTERMACS annual report: 15,000 patients and counting

J Heart Lung Transplant 2015;34:1495–1504

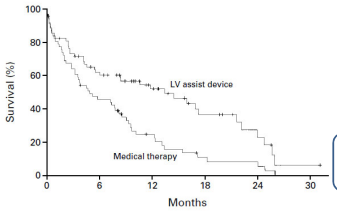
Les indications

Outcomes with ambulatory advanced heart failure from the Medical Arm of Mechanically Assisted Circulatory Support (MedaMACS) Registry



The Journal of Heart and Lung Transplantation, Vol 38, No 4, April 2019

LVAD en destination therapy



- Etude Rematch
- 129 patients
- 2 groupes: tt med ou LVAD
- Patients stade 4
- Inéligibles à la greffe
- LVAD pulsatile

Améliore la survie et la qualité de vie

LONG-TERM USE OF A LEFT VENTRICULAR ASSIST DEVICE FOR END-STAGE HEART FAILURE

N Engl J Med 2001;345(20):1435-43

LVAD en pont à la transplantation

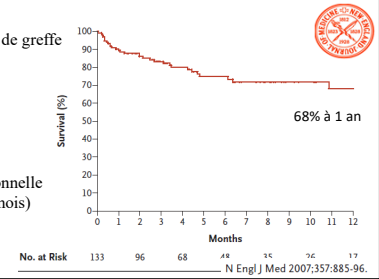
Use of a Continuous-Flow Device in Patients Awaiting Heart Transplantation

Avant la greffe

- 133 patients inscrits sur liste de greffe
- NYHA 4, FEVG 16%
- 90% sous inotropes
- 133 LVAD (HM2)

Résultats :

- Meilleur survie
- Meilleur capacité fonctionnelle (80% NYHA1 ou 2 à 6 mois)

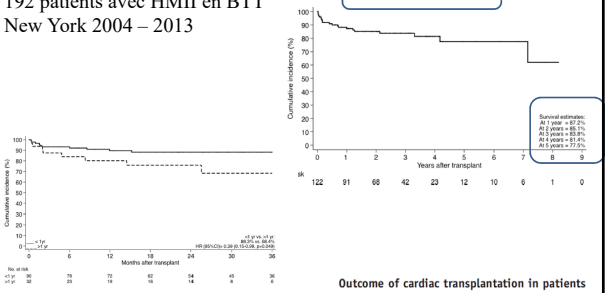


N Engl J Med 2007;357:885-96.

LVAD en pont à la transplantation

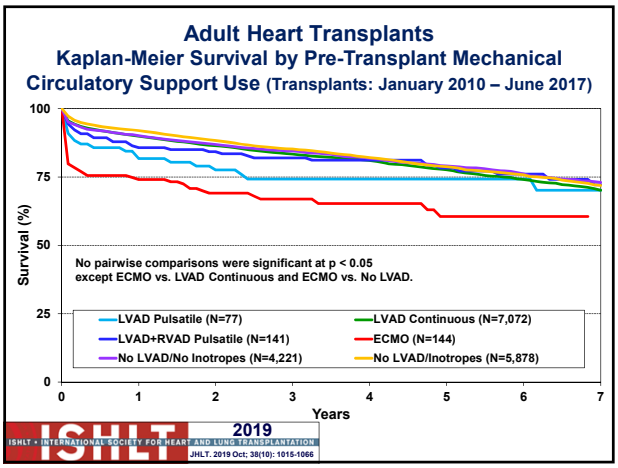
192 patients avec HMII en BTT
New York 2004 – 2013

Après la greffe



Outcome of cardiac transplantation in patients requiring prolonged continuous-flow left ventricular assist device support

The Journal of Heart and Lung Transplantation, Vol 34, No 1, January 2015



Sélection des patients

- NYAH stade III ou IV échappant aux traitements médico-chirurgicaux
- FEVG< 25 -30%
- Age < 80ans
- Fonction VD peu altérée

→ réalisation du bilan pré-implantation

LVAD ou BiVAD : Fonction VD ??

- Conséquences LVAD sur VD
  - Diminution PTDVG / post charge VD
  - Majoration pré-charge VD
  - Attraction septale vers le VG
    - Perte de la part septale dans la contraction VD
    - Dilatation de l'anneau : majoration IT

    → Altération FEVD
- Prédire la fonction VD post implantation ??

Fonction VD et LVAD

Comment la prédire la dysfonction droite après LVAD

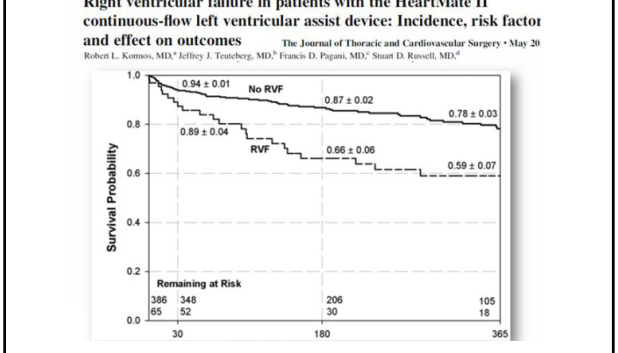
1. ETT
2. Cathétérisme cardiaque
3. Scores
   - Matthews (2008)
   - Fitzpatrick (2008)
   - Kormos (2008)
   - Atluri (2013)

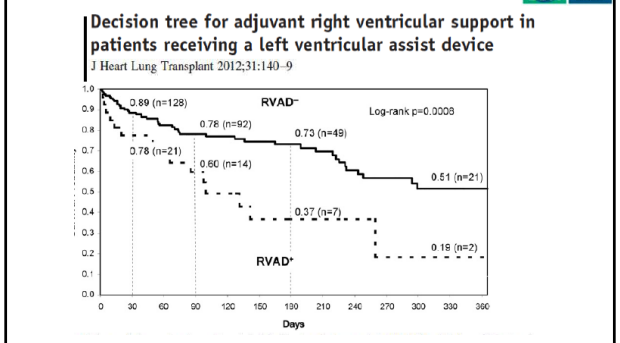
Recommendations for assessing RV function:[102,130–139]
Class I:

1. All patients should have an echocardiographic assessment of RV function prior to MCSD implantation.
   Level of evidence: C.
2. All patients should have invasive assessment of intracardiac filling pressures prior to MCSD implantation, with a particular emphasis on RV hemodynamics.
   Level of evidence: C.

The 2013 International Society for Heart and Lung Transplantation Guidelines for mechanical circulatory support: Executive summary

The Journal of Heart and Lung Transplantation, Vol 32, No 2, February 2013





Données échographiques

Table 2 Echocardiographic Parameters Correlated with Right Ventricular Failure After Left Ventricular Assist Device

- Qualitative right ventricular dysfunction
- Tricuspid annular plane systolic excursion (TAPSE)
- Fractional area change
- Right ventricular index of myocardial performance
- Right ventricular systolic and diastolic longitudinal strain
- Right ventricle short-axis-to-long-axis ratio
- Right ventricle end-diastolic dimension-to-left ventricle end-diastolic dimension ratio
- Tricuspid annular dilation without significant tricuspid regurgitation
- Left ventricular ejection fraction
- Left ventricular end diastolic dimension
- Tricuspid regurgitation duration corrected for heart rate
- Peak systolic (S') velocity of the right ventricular free wall at the tricuspid annulus assessed with tissue Doppler
- Early diastolic (E') velocity of the right ventricular free wall at the tricuspid annulus assessed with tissue Doppler
- Right ventricular E/E' ratio
- TAPSE increase in response to dobutamine infusion
- Severity of tricuspid regurgitation
- 3-Dimensional right ventricular end-systolic and end-diastolic volume index

Kukucka[22]	2011	115	Pulsatile 56% Continuous 44%	1. RV-to-LV end-diastolic diameter (R/L) ratio obtained from transesophageal echo
Grant[23]	2012	117	Continuous 100%	1. RV free wall peak longitudinal strain
Kato[24]	2012	111	Pulsatile 29% Continuous 71%	1. LVEDD 2. LV ejection fraction 3. Left atrial diameter/LVEDD 4. Total bilirubin 5. Albumin 6. RV stroke work index
Atluri[25]	2013	367	Pulsatile 51% Continuous 49%	1. CVP >15 mm Hg 2. Severe RV dysfunction 3. Preoperative intubation 4. Severe tricuspid regurgitation 5. Heart rate >100 beats/min
Vivo[26]	2013	309	Pulsatile 15% Continuous 85%	1. RV-to-LV end-diastolic diameter (R/L) ratio obtained from transthoracic echo 1. RV end-systolic volume index 2. RV end-diastolic volume index
Kiernan[17]	2015	24	Continuous 100%	
Potapov[20]	2008	54	Pulsatile 31% Continuous 69%	1. Tricuspid incompetence 2. RV end-diastolic diameter >35 mm 3. RV ejection fraction <10% 4. Right atrial dimension >50 mm 5. Short/long-axis ratio >0.6

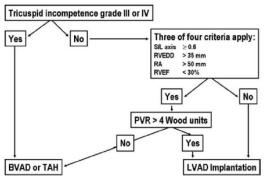
Echocardiographic parameters associated with right ventricular failure after left ventricular assist device: A review

The Journal of Heart and Lung Transplantation, Vol 35, No 3, March 2016

Données échographiques

IT

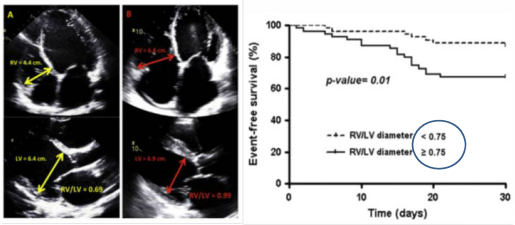
Parameter	OR	Confidence interval	p
S/L axis of RV	4.4	1.4–13.7	0.011
TI III-IV	4.7	1.26–17.65	0.012
CVP	1.24	1.04–1.47	0.019
SAPS II	1.14	1.01–1.28	0.03
Inotropic score	1	0.99–1.12	0.057
CI	0.25	0.056–1.12	0.069
SVR	1	1–1.01	0.05
CrP	1.12	1–1.26	0.048
NT-proBNP	1	1–1.002	0.1
INR	1.37	0.53–3.52	0.051



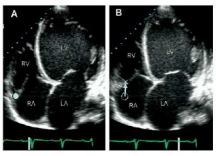
Tricuspid Incompetence and Geometry of the Right Ventricle as Predictors of Right Ventricular Function After Implantation of a Left Ventricular Assist Device
J Heart Lung Transplant 2008;27:1275–81.

VD/VG

Increased right-to-left ventricle diameter ratio is a strong predictor of right ventricular failure after left ventricular assist device
J Heart Lung Transplant 2013;32:792–799



TAPSE



Tricuspid Annular Motion as a Predictor of Severe Right Ventricular Failure After Left Ventricular Assist Device Implantation
J Heart Lung Transplant 2008;27:1102–7.

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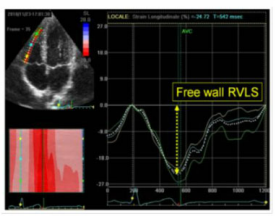
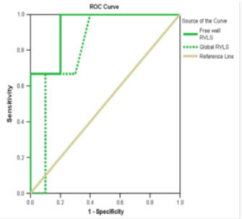
Table 3. Right Heart Echocardiographic Variables

Variable	RV failure, mean ± SD	No RV failure, mean ± SD	p value (univariate)
Tricuspid annular motion, mm (No.)	8 ± 4 (11)	15 ± 6 (22)	<0.01[a]
RV fractional area change, % (No.)	37 ± 15 (10)	45 ± 12 (19)	0.18
RA volume, ml (No.)	98 ± 36 (11)	100 ± 77 (22)	0.41
RA volume index, ml/m^2 (No.)	48 ± 19 (11)	48 ± 36 (22)	0.55
Hepatic vein variables			
Systolic forward flow, cm/s (No.)	−3 ± 35 (8)[b]	12 ± 38 (17)	0.66
Diastolic forward flow, cm/s (No.)	37 ± 17 (9)	34 ± 19 (17)	0.66
Diastolic reversal flow, cm/s (No.)	32 ± 19 (8)	33 ± 12 (13)	0.69
RIMP	0.94 ± 0.37 (11)	0.77 ± 0.36 (18)	0.38
Moderate to severe TR, *n* (No.)	3 (11)	10 (22)	0.47
RVSP, mmHg (No.)	60 ± 14 (10)	46 ± 11 (19)	0.02[a]
LVEF, % (No.)	22 ± 6 (11)	19 ± 4 (22)	0.11

Strain VD

Speckle tracking echocardiography as a new technique to evaluate right ventricular function in patients with left ventricular assist device therapy
J Heart Lung Transplant 2013; 32: 424–430





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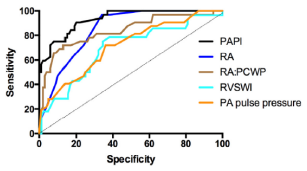
Données hémodynamiques

Facteurs pronostics de défaillance droite post op:

1. CVP > 15 mm Hg
2. CVP / PAPO > 0.63
3. RVSWI < 300/600 — *RVSWI = (PAPm-PVC) * SV/BSA*
4. PAPi < 2 — *PAPi = (PAPs-PAPd) / CVP*
5. PACi < 0.89 — *PACi = (PAPs-PAPd) * SV/BSA*



$$PAPi = \frac{(PA_{systolic} - PA_{diastolic})}{RA}$$

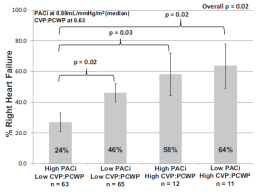
Table 3. Receiver Operating Characteristic Curve Analysis for Hemodynamic Determinants of Right Ventricular Failure

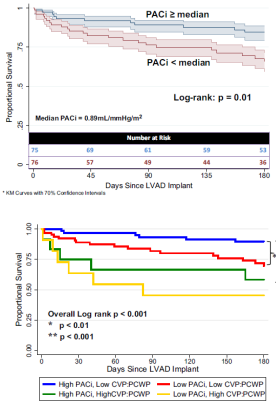
Parameter	AUC (95% CI)	SE	Sensitivity	Specificity	PPV	NPV
PAPi < 1.85	0.942 (0.876, 0.980)	0.0195	0.938	0.810	0.832	0.928
RA > 11.5 mm Hg	0.846 (0.777, 0.917)	0.0326	0.968	0.650	0.735	0.954
RA:PCWP > 0.59	0.837 (0.749, 0.925)	0.0195	0.719	0.870	0.847	0.756
PA pulse pressure < 22.5 mm Hg	0.742 (0.613, 0.817)	0.0520	0.718	0.640	0.663	0.695
RVSWI < 0.57 mm Hg L^{-1} m^{-2}	0.692 (0.576, 0.809)	0.0595	0.786	0.631	0.680	0.747
Moderate-severe TR	0.678 (0.571, 0.783)	0.0542	0.743	0.446	0.603	0.680

Pulmonary Artery Pulsatility Index Is Associated With Right Ventricular Failure After Left Ventricular Assist Device Surgery

Journal of Cardiac Failure Vol. 22 No. 2 2016

$$PACi = SV/(PAPs\text{-}PAPd)/BSA$$





Right ventricular response to pulsatile load is associated with early right heart failure and mortality after left ventricular assist device

The 2023 International Society for Heart and Lung Transplantation Guidelines for Mechanical Circulatory Support: A 10- Year Update

Recommendations to assess pre-VAD RV function

Class I: All patients should have invasive focused hemodynamic evaluation of the right heart unit before DMCS implantation. Low Pulmonary artery pulsatility index is a prognostic indicator for right ventricular failure after durable LVAD.

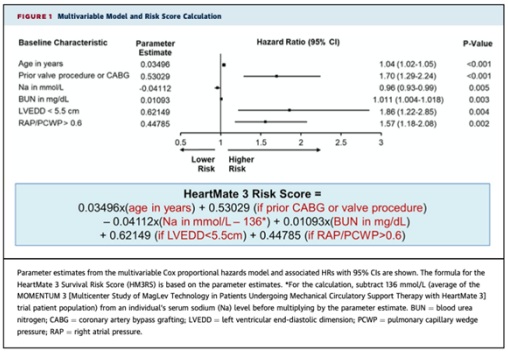
Level of Evidence: B.

Class I: All patients should have invasive hemodynamic evaluation before DMCS integrated with multimodality imaging with echocardiography and/or cardiac MRI focused quantitative parameters of right heart function and tricuspid valve integrity.

Level of Evidence: B.

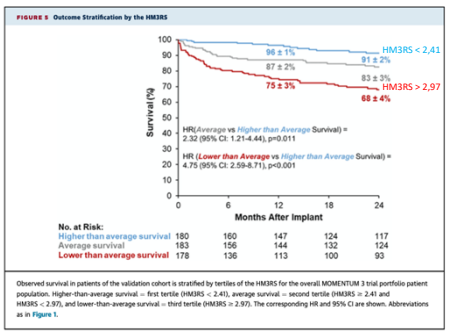
The Journal of Heart and Lung Transplantation, Vol 42, No 7, July 2023

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



JACC Heart Fail. 2022 Dec;10(12):948-959.

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



https://codetoheal.shinyapps.io/HeartMate3RS/

JACC Heart Fail. 2022 Dec;10(12):948-959.

Bilan pré-implantation

- ECG: ACFA
- ETT/ETO +/- contraste:
  - Fonction VD: taille VD et OD, S', TAPSE et IT
  - Autres: RM, IAo, CIA ou FOP thrombus intraVG
- Coronarographie
- Cathétérisme cardiaque droit:
  - Après stabilisation
  - PVC, PAPO, PAPS, RVSWI, PVC/PAPO, RVP et IC…
- EE VO2max
- RP, EFR, GDS
- Body scanner sans et avec injection
- Doppler TSA et MI

Evaluation des organes abdominaux

- Exploration de la fonction rénale
  - Urée, créatinine, clairance de la créatinine, ionogramme urinaire et protéinurie des 24h
  - Échographie rénale, de la vessie (et de la prostate chez les hommes+++)
- FOGD, coloscopie longue
- Bilan hépatique:
  - ASAT, ALAT, bilirubine T et C, PAL, GGT et LDH
  - Échographie hépathique,
  - fibroscan, consultation avec un hépatologue +/- biopsie hépatique si cirrhose

Evaluation psycho-neurologique

- Evaluation des fonctions supérieures
- Consultation neurologique si ATCD d'AVC, athérosclérose carotidienne et/ou vertébrale
- Doppler TSA sans oublier les artères vertébrales+++
- TDM cérébrale
- IRM cérébrale si ATCD d'AVC cérébral

- Evaluation psychologique (et sociale)
- Questionnaire de qualité de vie : Minnesota Living with Heart Failure questionnaire

Evaluation biologique et infectieuse

- Bilan d'hémostase complet et spécialisé
  - TP, INR, TCA, FII, FV, fibrinogène
  - Test d'agrégation plaquettaire
  - Dosage du facteur de Von Willebrand
- Bilan infectieux
  - Panoramique dentaire, scanner des sinus
  - Cartographie bactérienne et fongique
  - ECBU
  - Sérologiques virales

Les critères d'exclusion

- **Age** (> 80 ans : Attention aux comorbidités)
- **Hémodynamique** : instabilité hémodynamique majeure
- **Cancer** : néoplasie active et espérance de vie < de 2 ans
- **Sepsis** :
  - Endocardite : plus de bactériémie depuis 5 jours et ATB depuis 7 jours
  - Infection DAI et PM avec bactériémie
- **Atteinte sévère autres organes** (poumon, cerveau, rein, foie)
- **Consommation active drogues** (y compris alcool)

The 2013 International Society for Heart and Lung Transplantation Guidelines for mechanical circulatory support: Executive summary

Les critères d'exclusion

- **Atteinte psychiatrique ou psychologique** (institution ou incapacité à se prendre en charge)
- **ATCD de mauvaise compliance au traitement**
- **Isolement** : patient vivant seul sans personne ressource proche
- **Grossesse**
- **dysfonction VD**

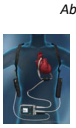
The 2013 International Society for Heart and Lung Transplantation Guidelines for mechanical circulatory support: Executive summary

Les types de LVAD

HMIII, Abbott®

HVAD, HeartWare®

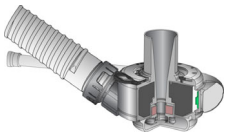
JARVIK2000, JarvikHeart®



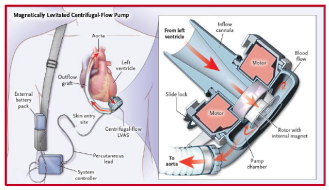
HMII, Abbott®

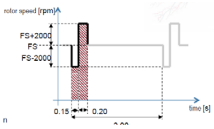
LVAD : HeartMate3®

- Pompe centrifuge à débit continu
- Dispositif intra-thoracique avec batteries et contrôleur externes
- Câble avec sortie percutanée au niveau abdominal
- Pompe implantable miniaturisée
- Début jusqu'à 10 litres/mn



LVAD : HeartMate 3®





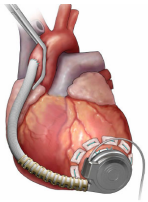
- **Wide** blood-flow passages to reduce shear stress
- **Frictionless** with absence of mechanical bearings
- **Intrinsic Pulse** designed to reduce stasis and avert thrombosis

LVAD : Heart Ware®

- Pompe centrifuge à débit continu
- Dispositif intra-thoracique avec batteries contrôleur externes
- Câble avec sortie percutanée au niveau abdominal

- Pompe implantable miniaturisée

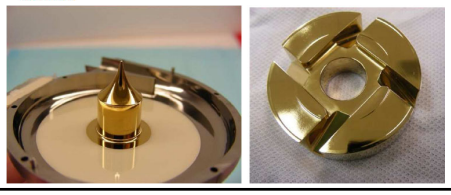
(50cc / 160g, 50mm de diamètre externe)



- Début jusqu'à 10 litres/mn
- Marquage CE 2009-2021
- Approuvé FDA en BTT nov 2012-2021
- SC sup 1,2 m²

LVAD : Heart Ware®

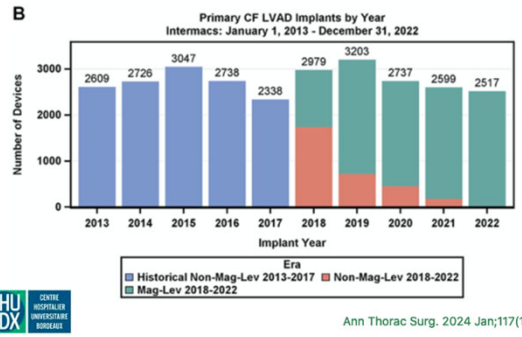
- Le rotor est l'unique élément mobile
- Suspension Hybride Magnetique/Hydrodynamique
- Rotation du rotor sans aucun contact mécanique



LVAD : Heart Ware®

The Society of Thoracic Surgeons **Intermacs 2023** Annual **Report**: Focus on Magnetically Levitated Devices.

Jorde UP, Saeed O, Koehl D, Morris AA, Wood KL, Meyer DM, Cantor R, Jacobs JP, Kirklin JK, Pagani FD, Vega JD.



Ann Thorac Surg. 2024 Jan;117(1):33-44.

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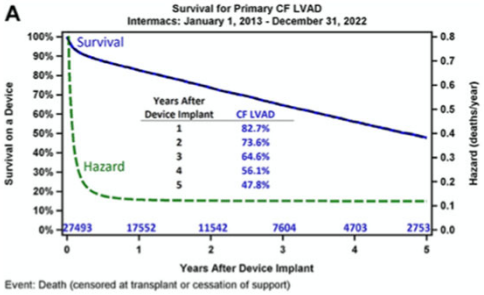

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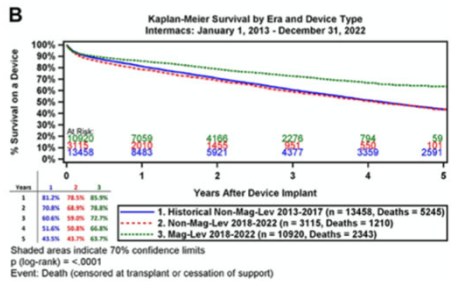

Ann Thorac Surg. 2024 Jan;117(1):33-44.

Principales complications

- Neurologiques :
  - 11% AVC invalidants (hémorragique et ischémique), 17% AVC/AIT
- Septiques :
  - 20 à 35%, infections liées ou non au LVAD
- Saignements :
  - 41% nécessitant reprise chirurgicale
  - 70% nécessitant transfusion > 2CGR
- Hémodynamiques :
  - 5-20% défaillance VD; 4% hémolyse; 24% arythmie ventriculaire

Eur J Cardiothorac Surg 2010;37(2):357-361
N Engl J Med. 2007; 357(9):885-96
N Engl J Med. 2009;361(23):2241-51

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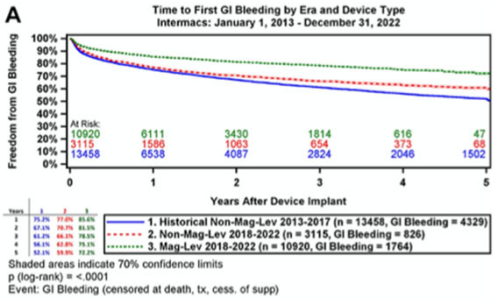

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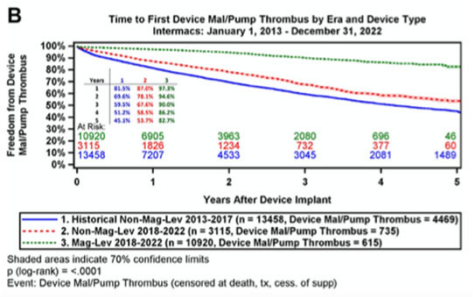

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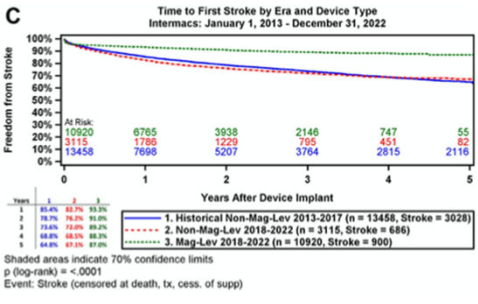

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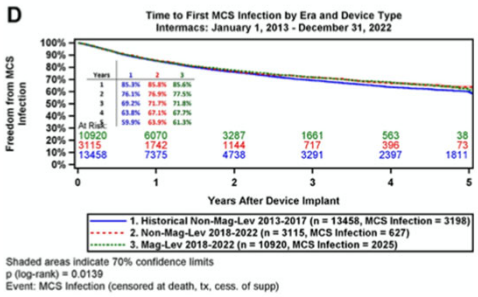


Ann Thorac Surg. 2024 Jan;117(1):33-44.

Le Suivi

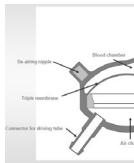
- Hôpital de jour
- Interrogatoire, examen clinique, ECG
- Bon fonctionnement du dispositif
- Pansement infirmier :IDE spécialisée pour la consultation
- Bilan bio: NFS, coag, Iono, BNP, bilan d'hémolyse
- RP
- ETT: recherche de complications, fonction VD
- +/- Contrôle rythmo, équilibre diabète, etc..

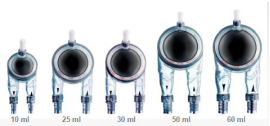
Traitement médical

- Traitement de l'insuffisance cardiaque (BB, IEC, ARM…)
- Contrôle la PA
  - PAM entre 70 et 80 mmHg
  - Facteur de risque AVC
- Anticoagulation +/- AAP
- Autre traitement si nécessaire

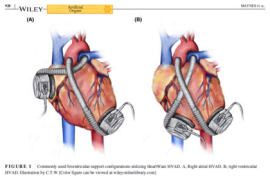
Berlin Heart®

- Assistance bi ventriculaire pneumatique pulsatile
- Para corporelle
- Enfants, adolescents et adultes de petit gabarit
- Pont à la greffe ou pont à la récupération

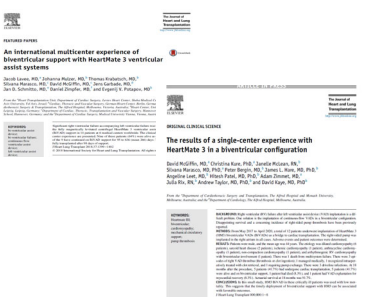


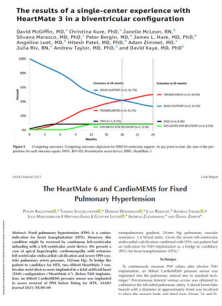


HeartMate 6

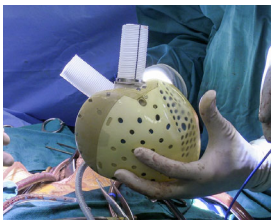


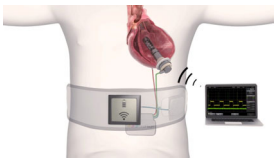
HeartMate 6

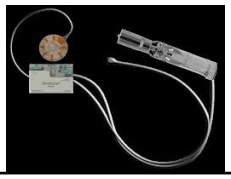




L'Avenir

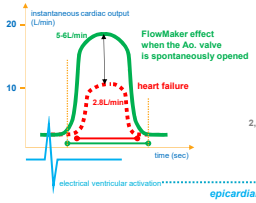


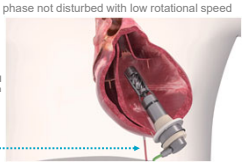




FlowMaker concept

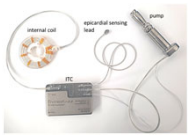
- -The pump waits for the Ao. valve opening
- -Physiological pump exit: under the Ao. valve
- -Systolic-synchronized pulsatile operating mode
- -Two rotational speed regimens (diastolic & systolic)
- -Filling phase not disturbed with low rotational speed





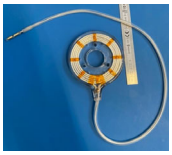
epicardial PM lead

Implantable Components



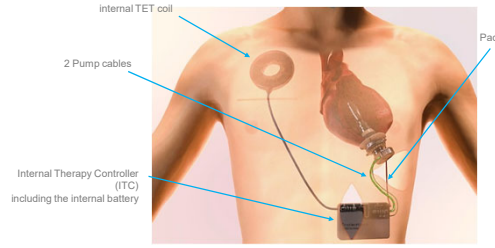
ITC: internal therapy controller
90x65x16mm

leadless ICD
95x68x16mm



diameter: 70mm
thickness: 08mm

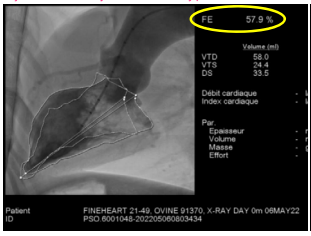
In Summary …



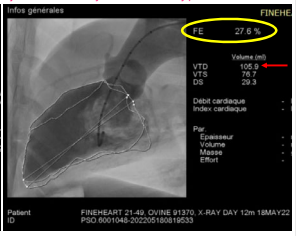
Ewe #91370 - severe chronic heart failure (6 ewes)

Induction of severe chronic heart Failure by 2 series of coronary µ-embolization

Ejection Fraction Day #0 before coronary µ-embolization



Ejection Fraction Day #12 after coronary µ-embolization



Strictly Confidential

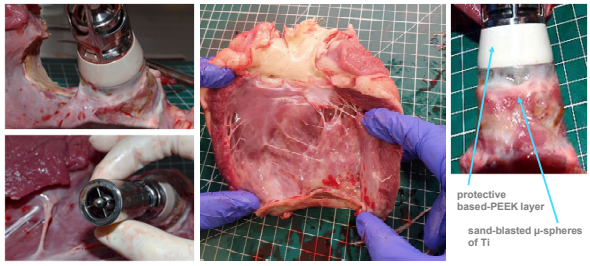
In Summary …

severe chronic heart failure in adult sheep

by using coronary µ-embolization – 2 procedures

Recovery results	LVEF baseline (%)	D+14	D+30	Pump removed	D+60 with pump reimplanted
Ewe #1	27	55	65	26	59
Ewe #2	27	48	63	25	61
Ewe #3	28	56	67	-	-
Ewe #4	33	49	61	-	-
Ewe #5	21	42	64	-	-
Ewe #6	22	58	62	-	-
mean±SD	27 ± 4	56 ± 6	63 ± 2		

Fixation Tube endothelialization & protective tube upper part



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Conclusion

- **IC terminale**
  - De + en + fréquente
  - Mauvais pronostic
  - Pénurie de greffon et nombreuses contre indication à la greffe
- **ACM de longue durée** : progrès évidents et majeurs
- **Place dans l'IC systolique terminale**
  - Aigues ou chroniques
  - Apres éventuelles assistances de courte durée
  - Indication : BTT / DT / BTR / BTD

Merci de votre attention