Right ventricular failure during LVAD implantation : Management

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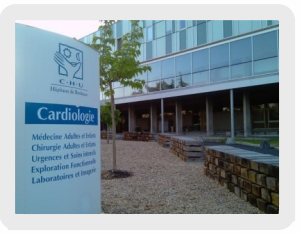

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Conflicts of interest

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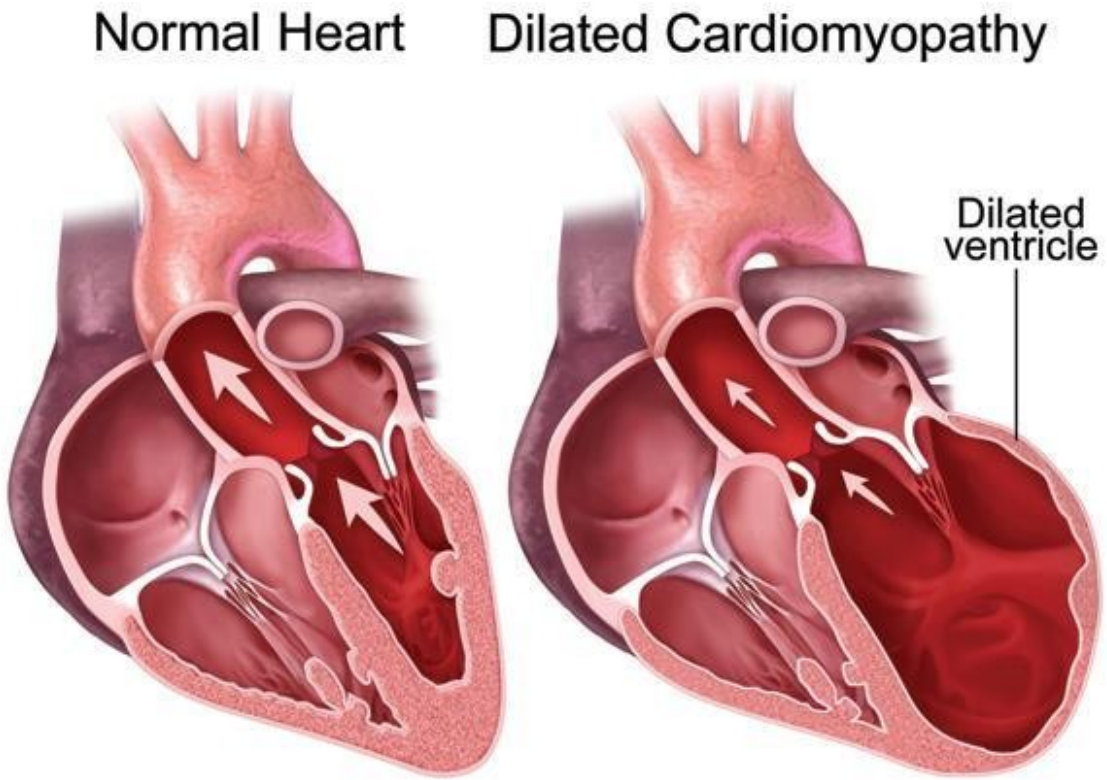
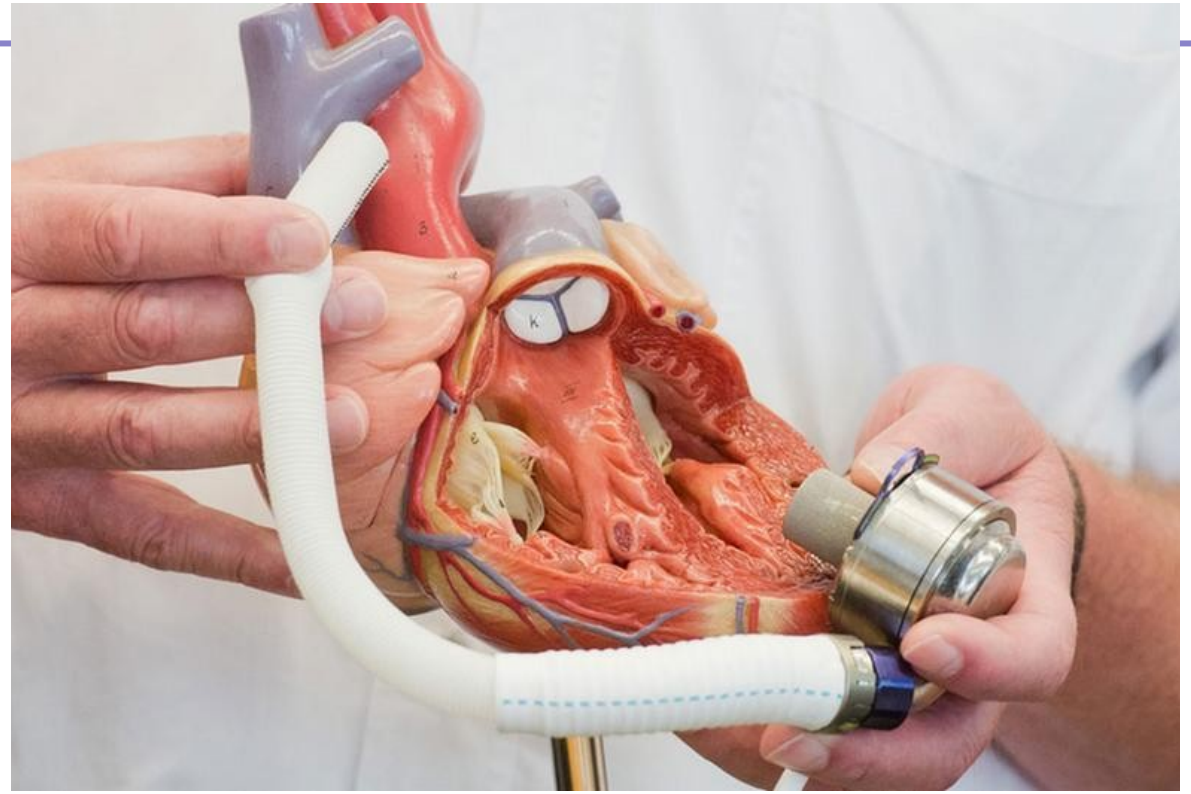




Background

- Right ventricular failure is the main risk of LVAD implantation decision :
  - Right ventricular function evalution before surgery (LVAD)
  - Per and post-operative management
  - Management during the follow-up
- Poor prognosis : Right ventricular dysfunction

Pre-operative evaluation

Multimodal evaluation :

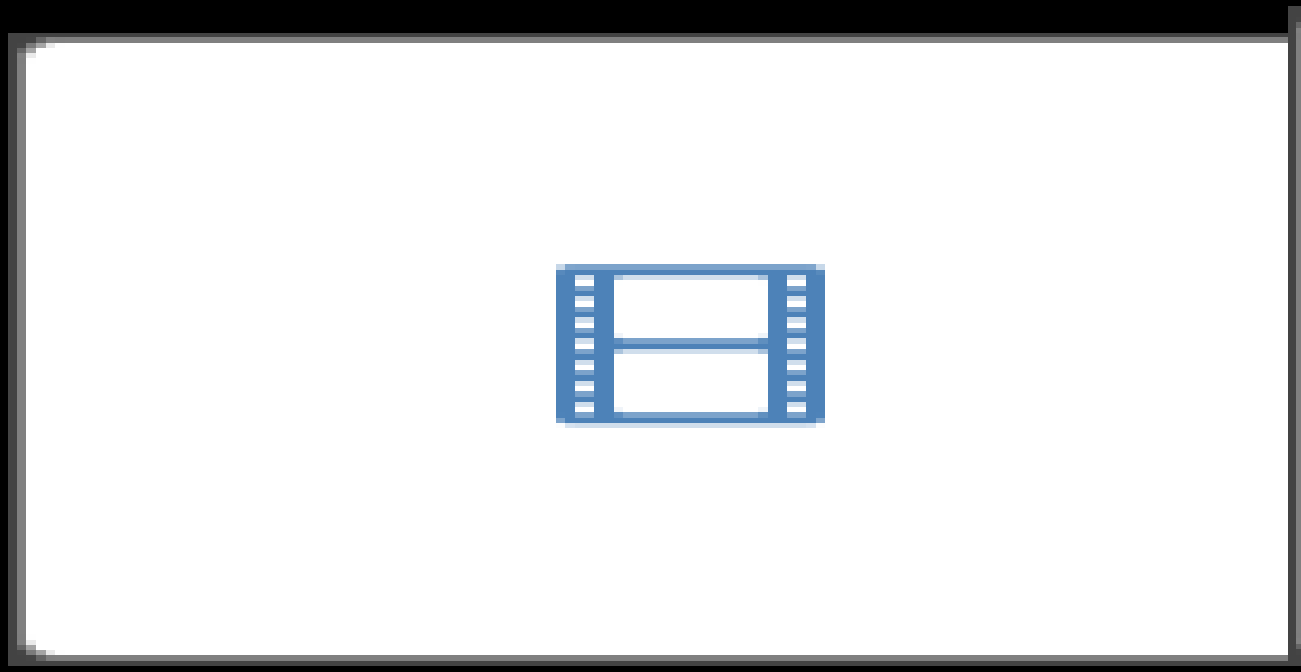
- Clinical : background of cardiogenic shock, Etiology (ischemic or not)

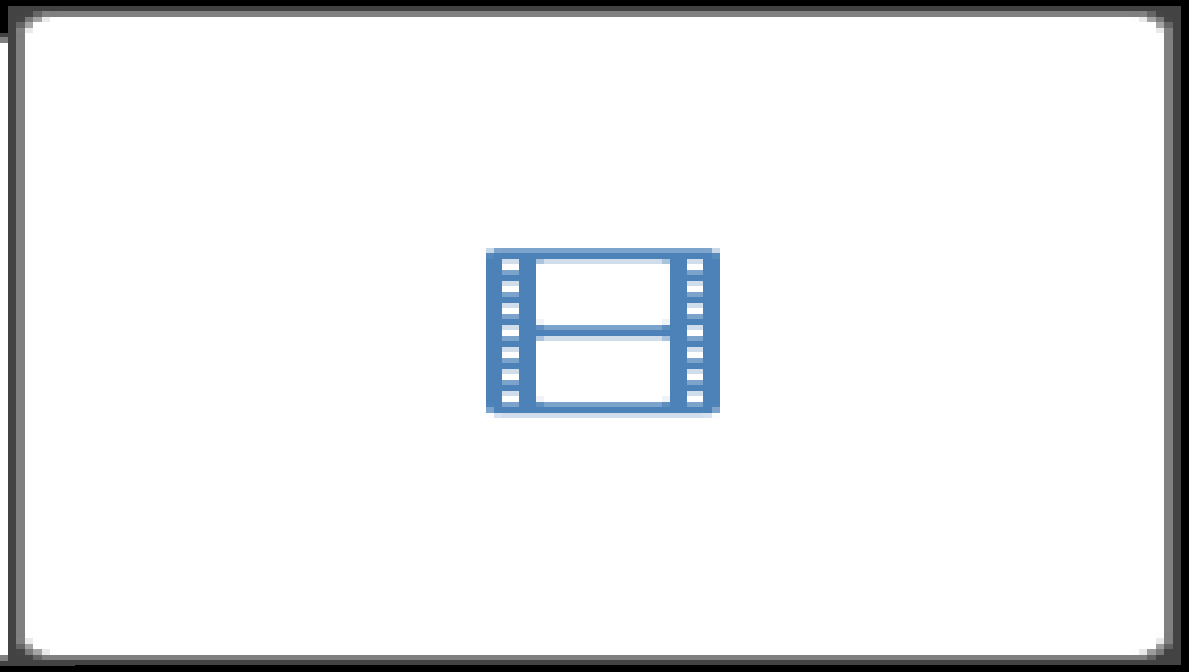
Heart failure etiology and risk of right heart failure in adult left ventricular assist device support: the European Registry for Patients with Mechanical Circulatory Support (EUROMACS). Scand. Cardiovasc. J. SCJ 54, 306–314

- Echocardiographic : Different parameters (free-wall RV ***longitudinal strain*** , but also classical evaluation (TAPSE, S'VD, ventricular volume, RV/LV ratio, …)
- Hemodynamic parameters : Right Heart catheterization: right atrial pressure (RAP), plumonary pressure, pulmonary vascular resistance, RAP/PCWP ratio, pulmonary artery pulsatility index (PAPi) and RV stroke work index (RVSWI)

Clinical, echocardiographic and hemodynamic predictors of right heart failure after LVAD placement. Int. J. Cardiovasc, Stricagnoli, M and all

Pre-operative evaluation





Per-operative

Surgical management :

Sternotomy vs left thoracotomy and upper hemisternotomy or right thoracotomy

Multicenter retrospective cohort study 5 centers

April 2011 to December 2019

427 patients 305 Sternotomy and 122 Less Invasive surgery

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Less invasive surgical implant strategy and right heart failure after LVAD implantation

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Table 1 Baseline Characteristics for Overall and Propensity Score–Matched Cohort

Characteristics	Overall cohort			Propensity-matched cohort[a]		
	CMS	LIS	*p*-value	CMS	LIS	*p*-value
n (%)	305 (100)	122 (100)	—	231 (100)	122 (100)	—
Sex (male), *n* (%)	267 (87.8)	106 (86.9)	0.79	202 (87.4)	106 (86.9)	0.88
Age (years), mean ± SD	58.2 ± 11.8	58.3 ± 11.2	0.97	58.7 ± 12.2	58.3 ± 11.2	0.58
BMI, mean ± SD	28.4 ± 5.6	27.4 ± 5.0	0.19	28.4 ± 5.7	27.4 ± 5.0	0.25
Ischemic cardiomyopathy, *n* (%)	128 (42.5)	63 (51.6)	0.09	107 (46.3)	63 (51.6)	0.34
Diabetes mellitus, *n* (%)	88 (37.8)	24 (34.3)	0.60	66 (35.5)	24 (34.3)	0.86
Hypertension, *n* (%)	136 (58.4)	34 (58.6)	0.97	112 (60.2)	34 (58.6)	0.83
Previous sternotomy, *n* (%)	69 (22.6)	19 (17.3)	0.24	60 (26.0)	19 (17.3)	0.08
Destination therapy, *n* (%)	123 (41.1)	56 (45.9)	0.37	100 (43.7)	56 (45.9)	0.69
Pre-operative IABP, *n* (%)	42 (13.9)	5 (4.1)	0.004	10 (4.3)	5 (4.1)	0.92
Pre-operative ECMO, *n* (%)	58 (19.1)	12 (9.8)	0.02	24 (10.4)	12 (9.8)	0.87
Off-pump implantation, *n* (%)	2 (0.7)	14 (12.7)	<0.001	0 (0.0)	14 (12.7)	<0.001
INTERMACS, *n* (%)			<0.001			0.39
Profile 1	108 (36.1)	17 (13.9)		47 (20.3)	17 (13.9)	
Profile 2	48 (16.1)	29 (23.8)		43 (18.6)	29 (23.8)	
Profile 3	87 (29.1)	49 (40.2)		87 (37.7)	49 (40.2)	
Profile ≥ 4	56 (18.7)	27 (22.1)		54 (23.4)	27 (22.1)	
TR Grade II or III, *n* (%)	105 (37.4)	49 (42.2)	0.37	87 (41.0)	49 (42.2)	0.83
Device type, *n* (%)			0.12			0.007
HM3	140 (45.9)	46 (37.7)		122 (52.8)	46 (37.7)	
HVAD	165 (54.1)	76 (62.3)		109 (47.2)	76 (62.3)	
Laboratory values						
Creatinine (μmol/liter), mean ± SD	127.0 ± 48.6	127.1 ± 50.6	0.91	126.7 ± 46.7	127.1 ± 50.6	0.97
Hemoglobin (mmol/liter), mean ± SD	7.2 ± 1.6	8.0 ± 6.2	0.10	7.4 ± 1.5	8.0 ± 6.2	0.63
Hemodynamic parameters						
HR, bpm, mean ± SD	87.5 ± 19.1	82.0 ± 18.2	0.02	85.8 ± 19.0	82.0 ± 18.2	0.13
SV, ml/beat, mean ± SD	44.8 ± 16.4	45.7 ± 18.3	0.88	44.8 ± 17.3	45.7 ± 18.3	0.81
SBP, mm Hg, mean ± SD	103.4 ± 17.0	109.7 ± 62.7	0.78	103.3 ± 17.3	109.7 ± 62.7	0.78
DBP, mm Hg, mean ± SD	65.1 ± 11.7	65.2 ± 11.2	0.95	65.4 ± 11.3	65.2 ± 11.2	0.87
MAP, mm Hg, mean ± SD	79.0 ± 12.5	79.4 ± 12.2	0.82	79.4 ± 12.6	79.4 ± 12.2	1.0
RAP, mm Hg, mean ± SD	13.3 ± 6.3	13.4 ± 7.2	0.86	12.7 ± 6.3	13.4 ± 7.2	0.35
PASP, mm Hg, mean ± SD	53.0 ± 14.5	50.8 ± 14.6	0.21	52.1 ± 14.0	50.8 ± 14.6	0.46
PADP, mm Hg, mean ± SD	26.5 ± 8.9	25.1 ± 8.3	0.17	25.8 ± 9.0	25.1 ± 8.3	0.48
MPAP, mm Hg, mean ± SD	36.3 ± 9.6	34.8 ± 9.7	0.21	35.7 ± 9.4	34.8 ± 9.7	0.47
PAWP, mm Hg, mean ± SD	26.4 ± 8.4	24.9 ± 8.3	0.20	26.1 ± 8.4	24.9 ± 8.3	0.32
PVR, Wood units, median (IQR)	2.6 (1.6–3.8)	2.5 (1.7–3.8)	0.90	2.6 (1.5–3.7)	2.5 (1.7–3.8)	0.83
RAP-to-PAWP ratio, median (IQR)	0.48 (0.35–0.63)	0.52 (0.34–0.70)	0.52	0.47 (0.33–0.61)	0.52 (0.34–0.70)	0.16
E_a, mm Hg/ml, median (IQR)	1.3 (0.9–1.7)	1.2 (0.78–1.5)	0.15	1.2 (0.86–1.7)	1.2 (0.78–1.5)	0.33
Cardiac index (TD), liter/min, median (IQR)	1.8 (1.5–2.1)	1.7 (1.4–2.1)	0.57	1.8 (1.4–2.1)	1.7 (1.4–2.1)	0.77
Cardiac output (TD), liter/min/m^2, median (IQR)	3.5 (3.0–4.4)	3.4 (2.8–4.1)	0.17	3.5 (2.9–4.2)	3.4 (2.8–4.1)	0.40
PPP, mm Hg, mean ± SD	26.6 ± 10.9	25.5 ± 10.4	0.40	26.4 ± 10.8	25.5 ± 10.4	0.50
PAPi, median (IQR)	2.0 (1.3–3.1)	2.0 (1.2–3.3)	0.68	2.2 (1.3–3.6)	2.0 (1.2–3.3)	0.38

Right ventricular failure and surgical strategy

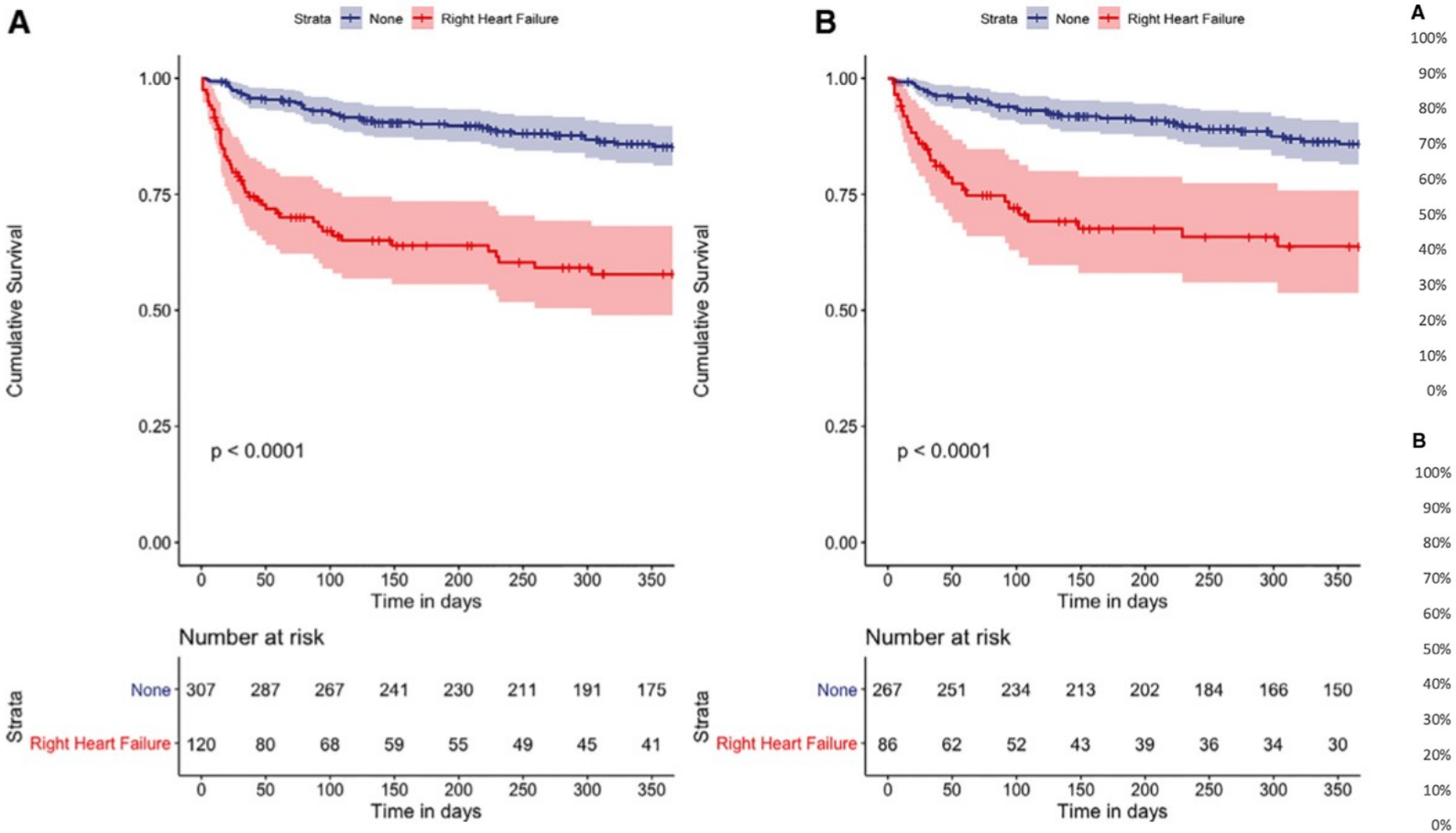
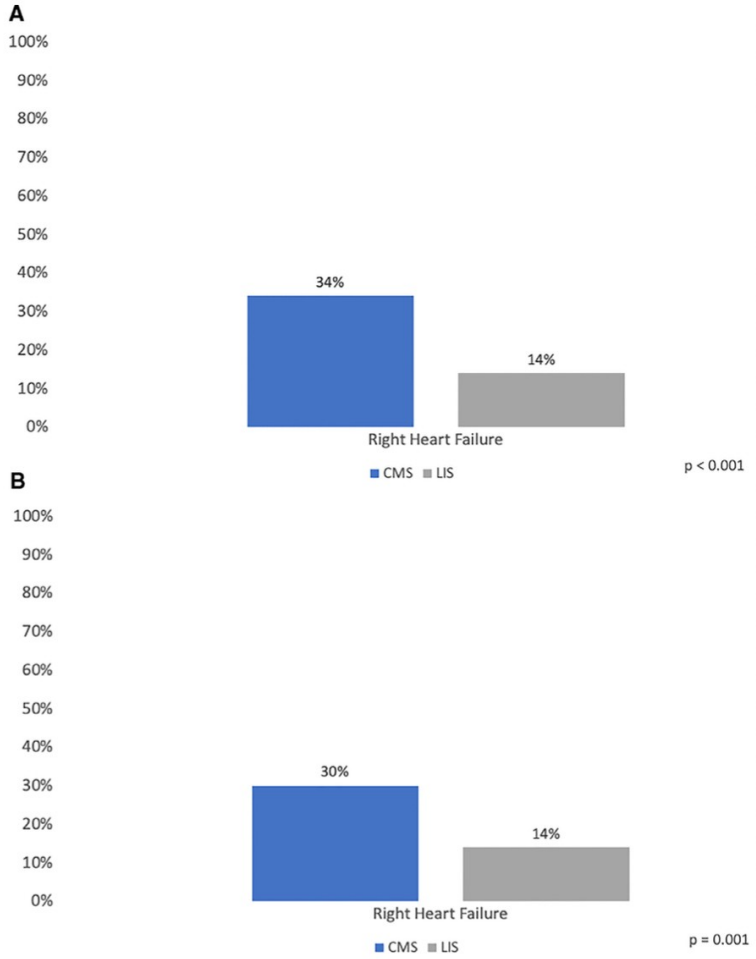
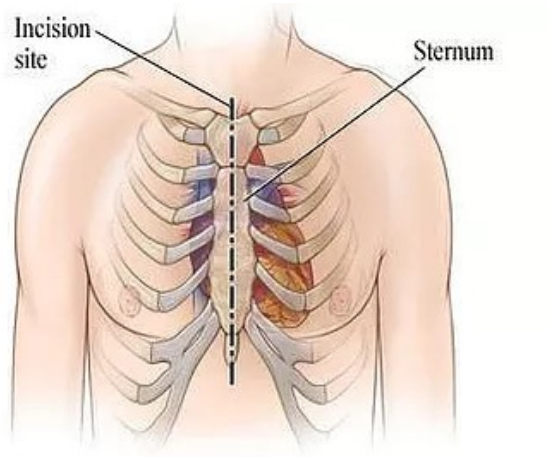
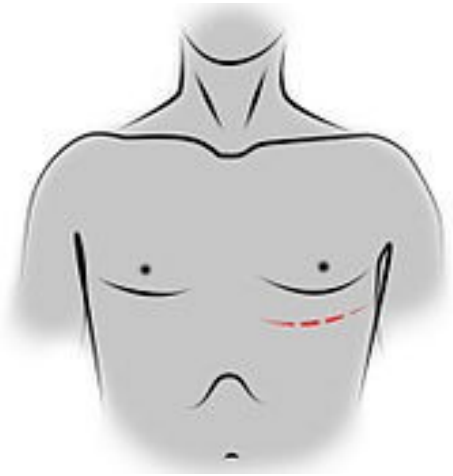


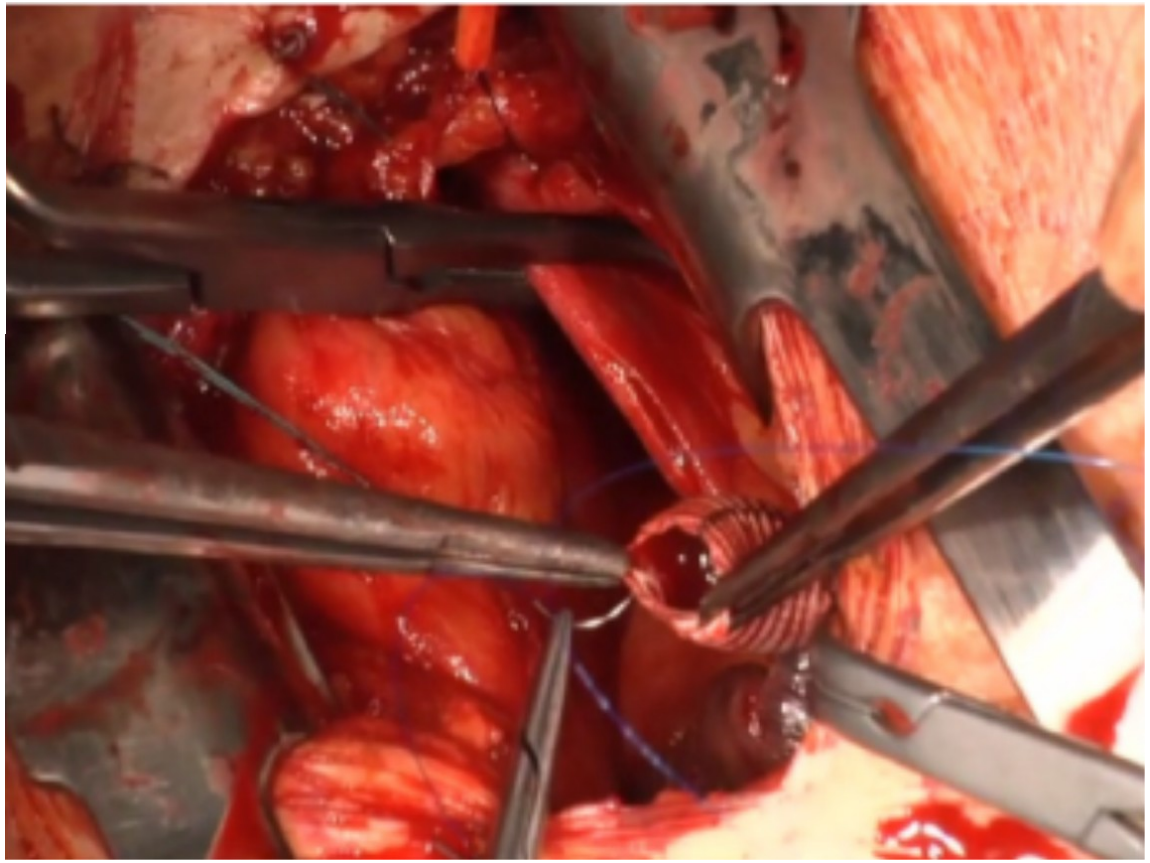
Figure 3 Kaplan–Meier curve for all-cause mortality at 1 year in the (a) overall cohort and (b) propensity-matched cohort.

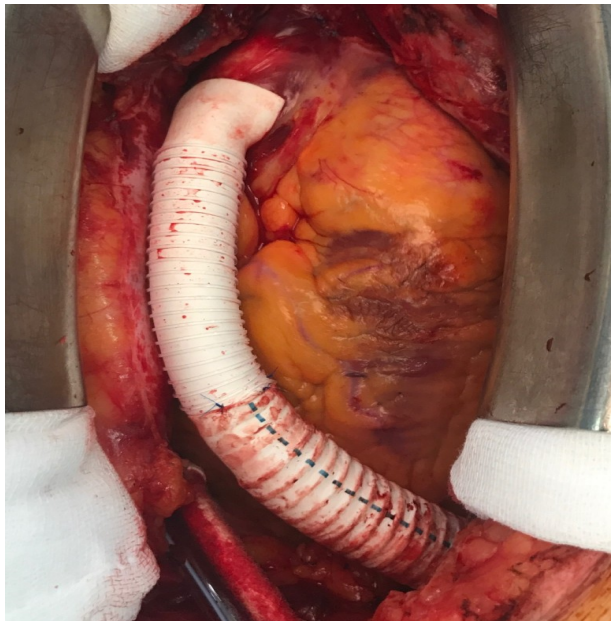


Right ventricular failure and surgical strategy









Peroperative management

Precaution during implantation :

- NO and Corotrope administration
- Hemodynamic study after gradual departure of LVAD device :
- Echographic (Ventricular size, right ventricule function, LV supply)
- Pressure ratio of RAP and PAPD.

A multi-institutional retrospective analysis on impact of RV acute mechanical support timing after LVAD implantation on 1-year mortality and predictors of RV acute mechanical support weaning. J. Heart Lung Transplant. Kumar and all

Multicenteric retrospective database of 826 patients (HeartMate II or HVAD)

January 2007 to December 2016

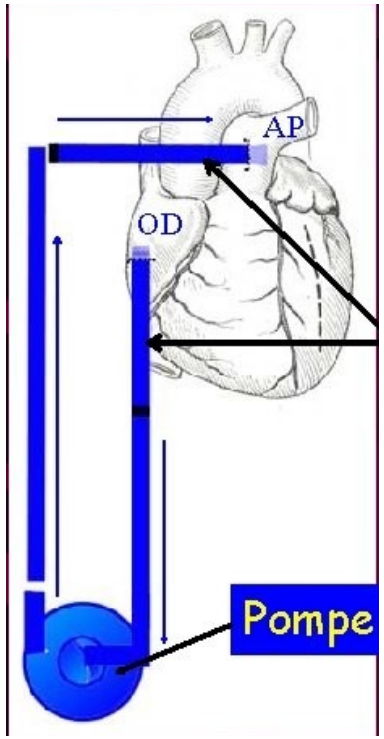
91/11% Right ventricular failure, 51/56% concomitant RVS, 40/44% postoperative; 48/53% weaned.

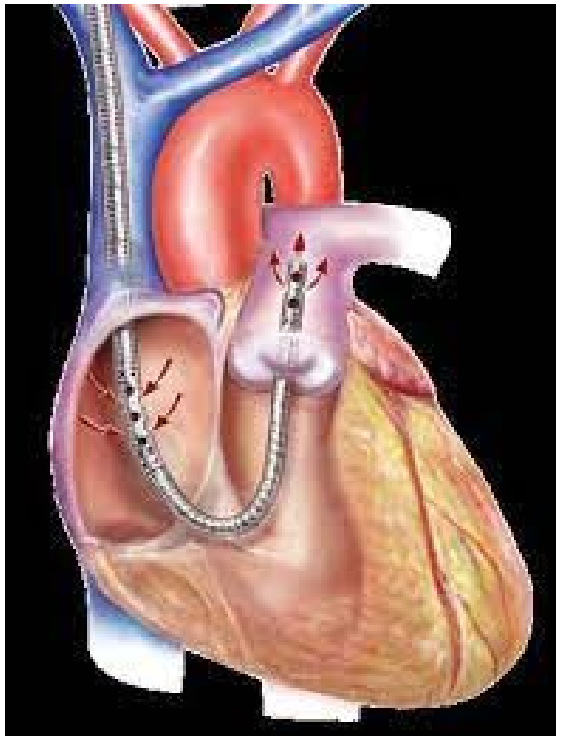
Concomitant RV AMCS : lower mortality (HR 0.45 [95% CI 0.26-0.80], $p = 0.01$) in multivariable model (age, BMI, angiotensin-converting enzyme inhibitor use, and heart transplantation as a time-varying covariate).

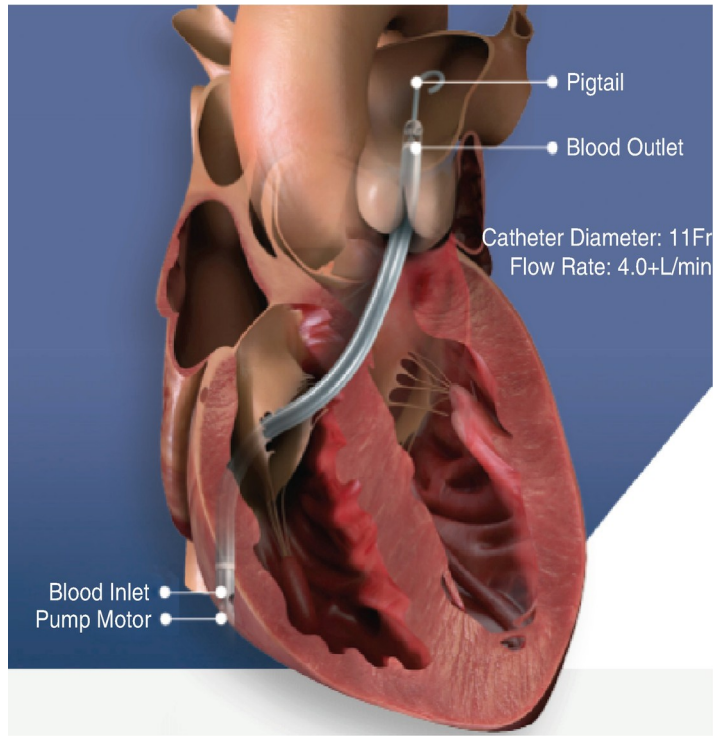
Multivariate competing risk analysis, concomitant insertion (SHR 3.35 [95% CI 1.73-6.48], $p < 0.001$) were associated with a successful wean.

Peroperative management

- RV AMCS
  - ECLS : Medical management, Hard with LVAD device
  - ECMO double canule droite-droite or central support
  - R impella : Circulatory support but peripheral access …
  - Single channel : Protek duo :allows mobilization, Jugular access







Background

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