The 38th KTCVS Spring Meeting 2024 SEOUL

Prediction and Management of post-LVAD RV failure

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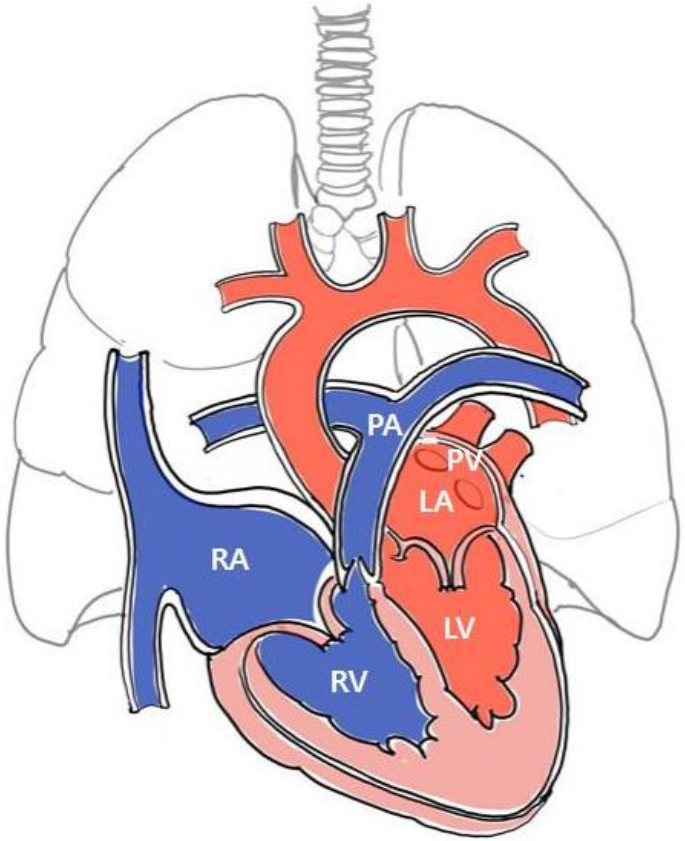
Pathophysiology of Group II PH

Isolated post-capillary PH (IpcPH)
PVR < 3WU, (DPG < 7mmHg)

Progressive pulmonary arteriolar remodeling (medial hypertrophy & intimal thickening)

Pulmonary vascular disease

Combined pre-and post-capillary PH (CpcPH)
PVR ≥ 3WU,
(DPG ≥ 7mmHg)



Backward pressure transmission to pulmonic veins and capillaries

Increased LA pressure

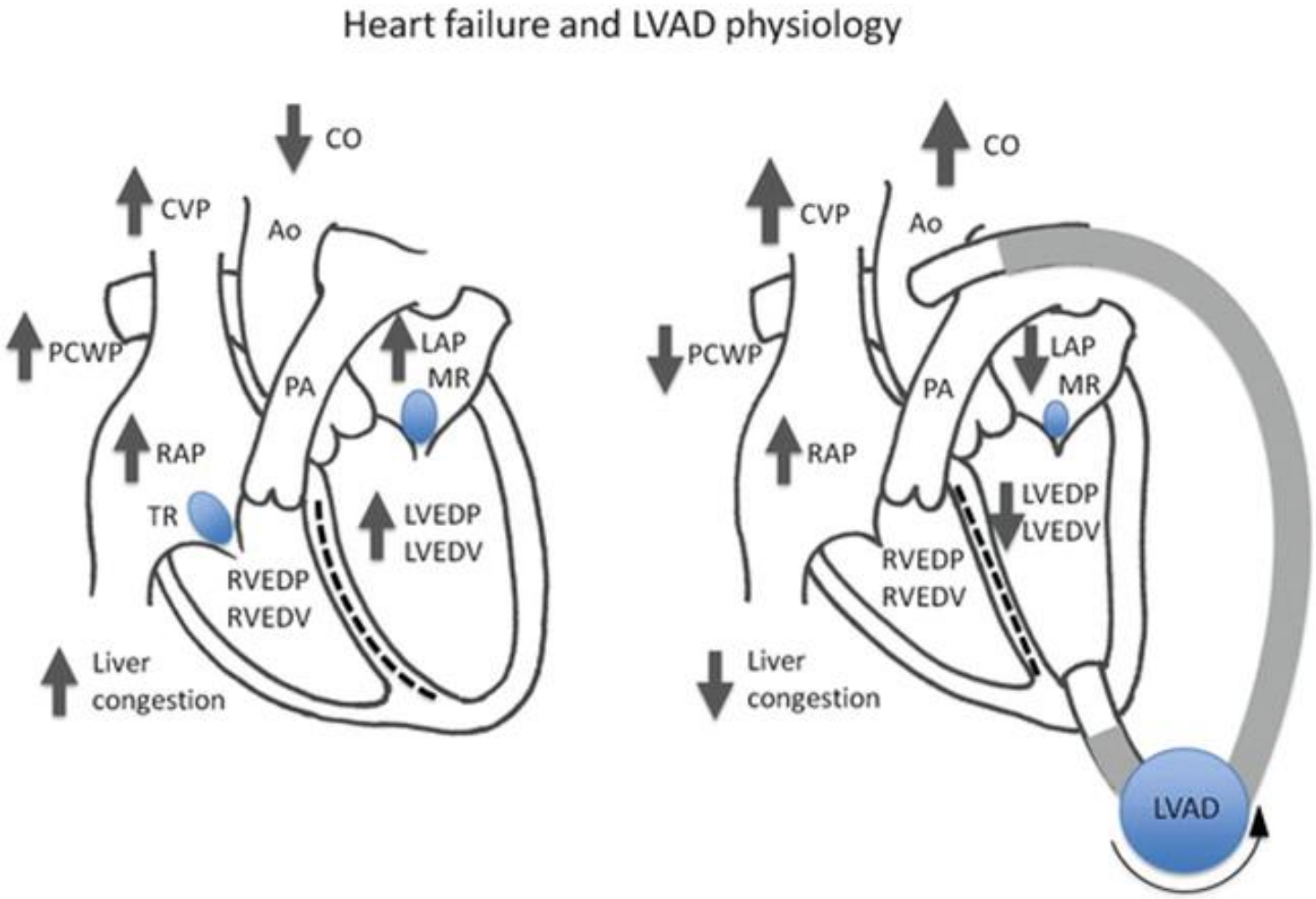
Left Heart Disease(LHD):
heart failure, ischemic heart disease, valvular heart diseases, cardiomyopathies, or arrhythmic diseases

Jang and Chung et al. *Int J Heart Fail.* 2021 Jul;3(3):147-159.

LVAD only support LV

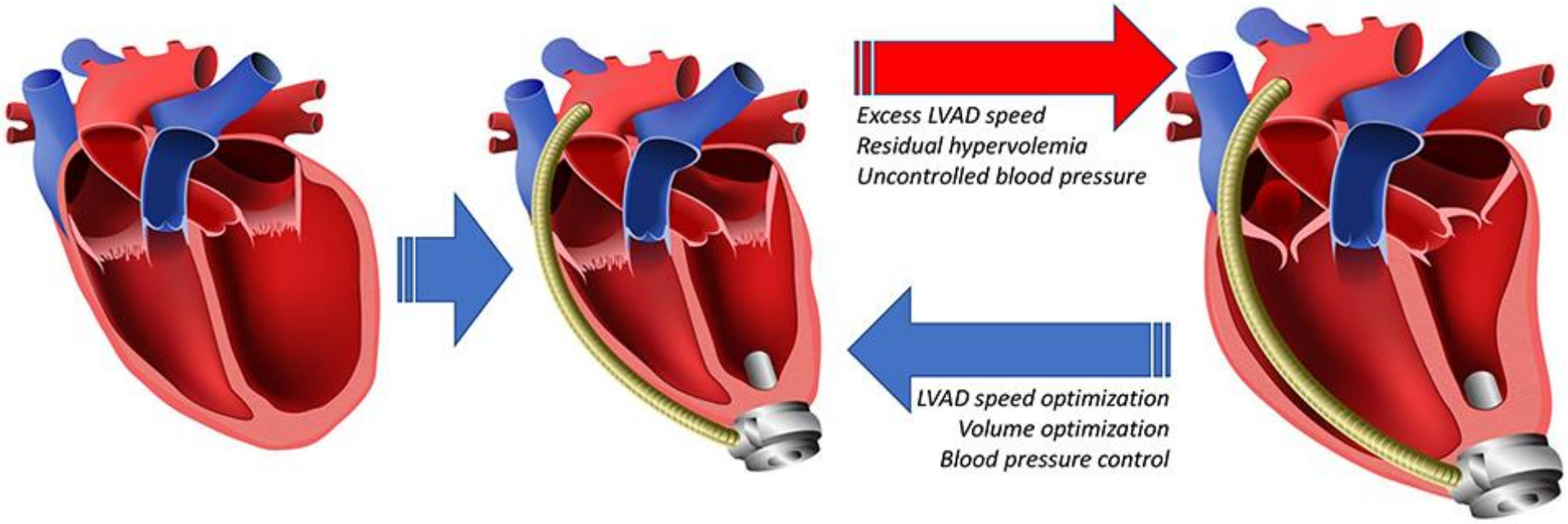
There still left….

- **Innate RV dysfunction**
- **PAH**
- **TR**



RV failure after LVAD

Hemodynamic pathophysiology



Dilated LV
Low cardiac output
Right shifted septum

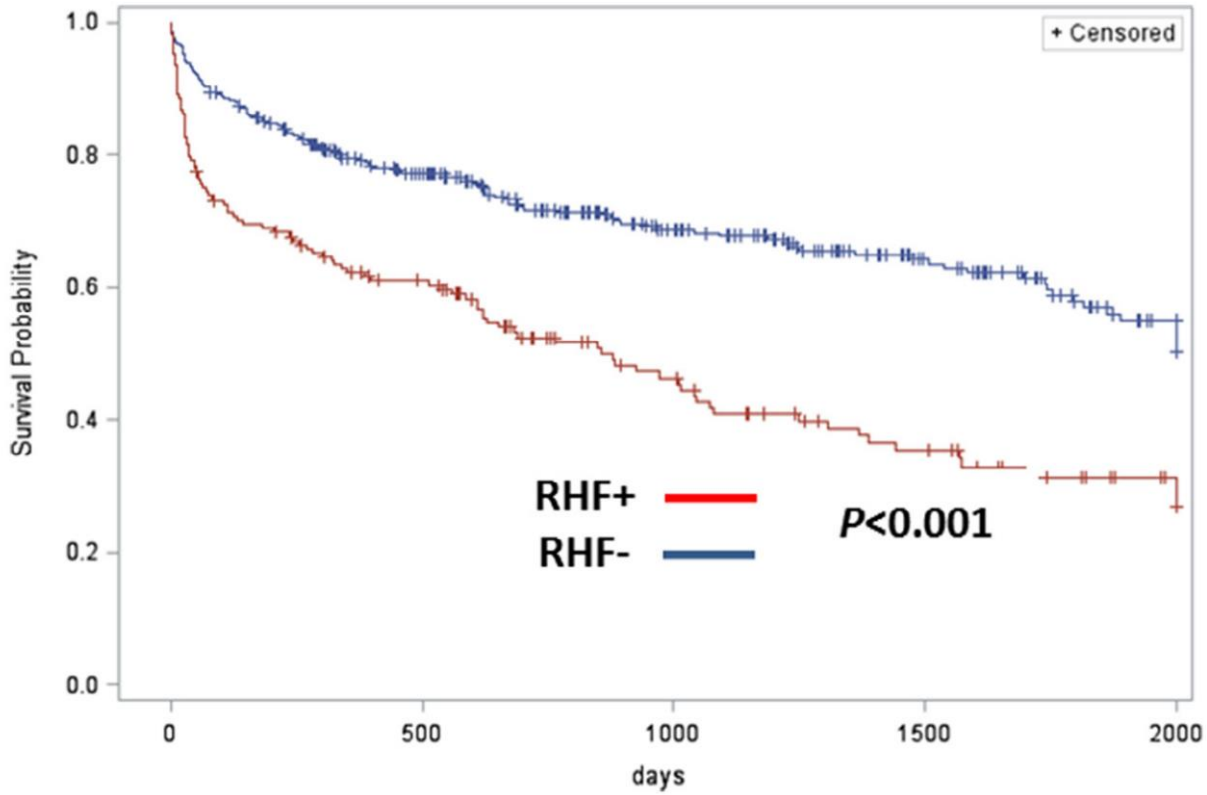
Increased cardiac output
LV decompression
Left shifted septum
Increased RV preload

RV dilation
Worsening TR
RHF

Front. Cardiovasc. Med. 9:1023549.

RHF AFTER LVAD

INCIDENCE 9-42%
ASSOCIATED WITH POOR PX



Am j cardiol 2018 feb 1:121(3):336

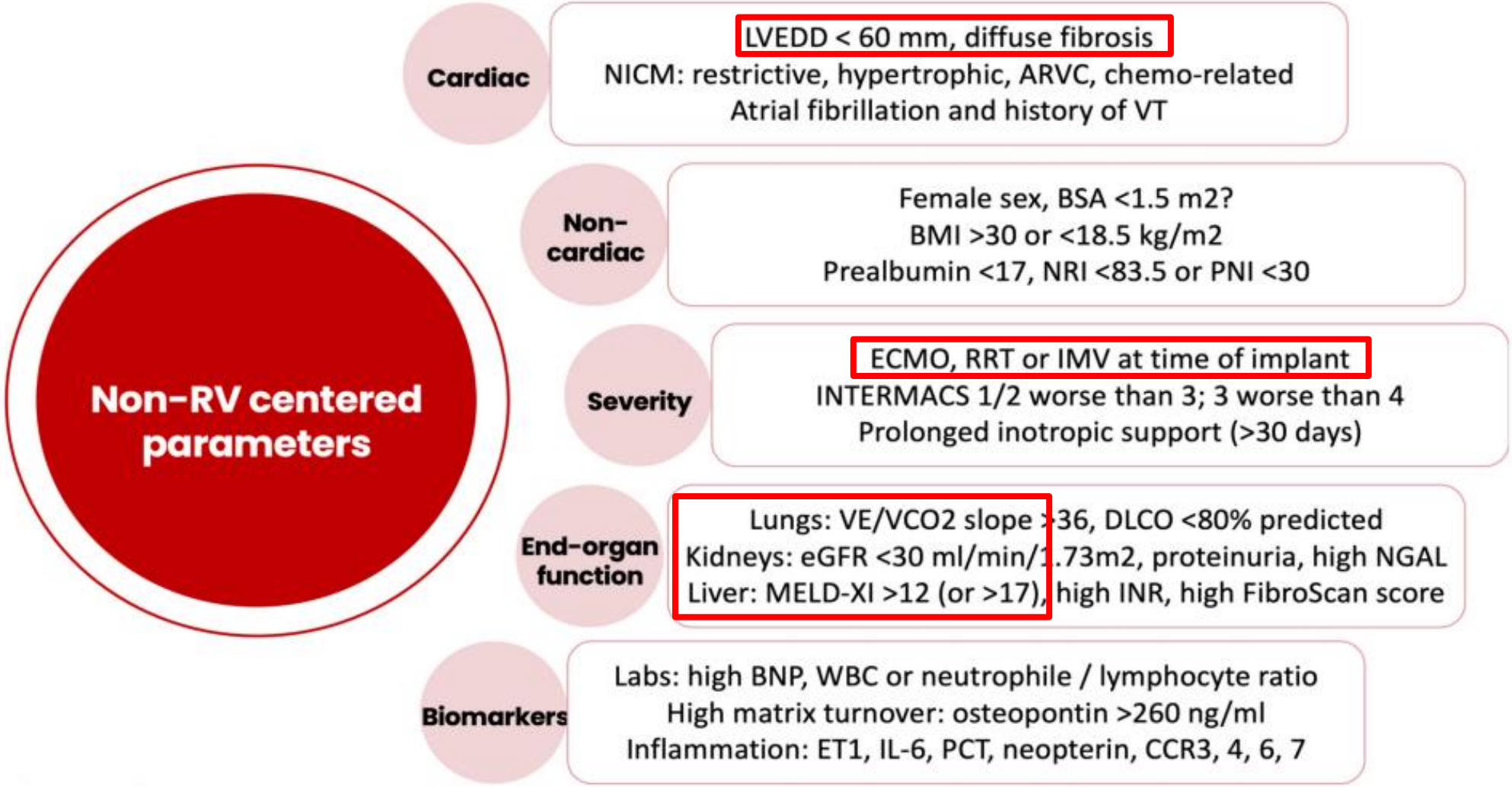
Definition of RHF after LVAD

MCS-ARC INTERMACS (2021)	Definition	**At least 2**: peripheral edema ≥2+ **OR** ascites **OR** JVP at half neck in upright position **OR** CVP >16 mmHg **OR at least 1:** bilirrubin >2 mg/dl **OR** AST/ALT x2 ULN **OR** creatinine x2 baseline **OR** Svo2 <50% **OR** CI <2.2 l/min/m2 **OR** lactate >3 mmol/l **OR** drop >30% in pump flow		
	Timing	Early acute	Early	Late
		Need for temporary or durable RVAD (or ECMO) implanted in the operating room	1) Need for RVAD within 30 days 2) Failure to wean from inotropes, vasopressors or iNO for >14 days during the initial 30 days 3) Death within 14 days while on inotropes or pressors in patients who have not received RVAD	1) Need for RVAD 30 days after LVAD implant 2) Admission at least 30 days after LVAD implant requiring IV diuretics or inotropes for >72h

Front. Cardiovasc. Med. 9:1040251.

RHF AFTER LVAD
PREDICTION

Prediction of RHF after LVAD



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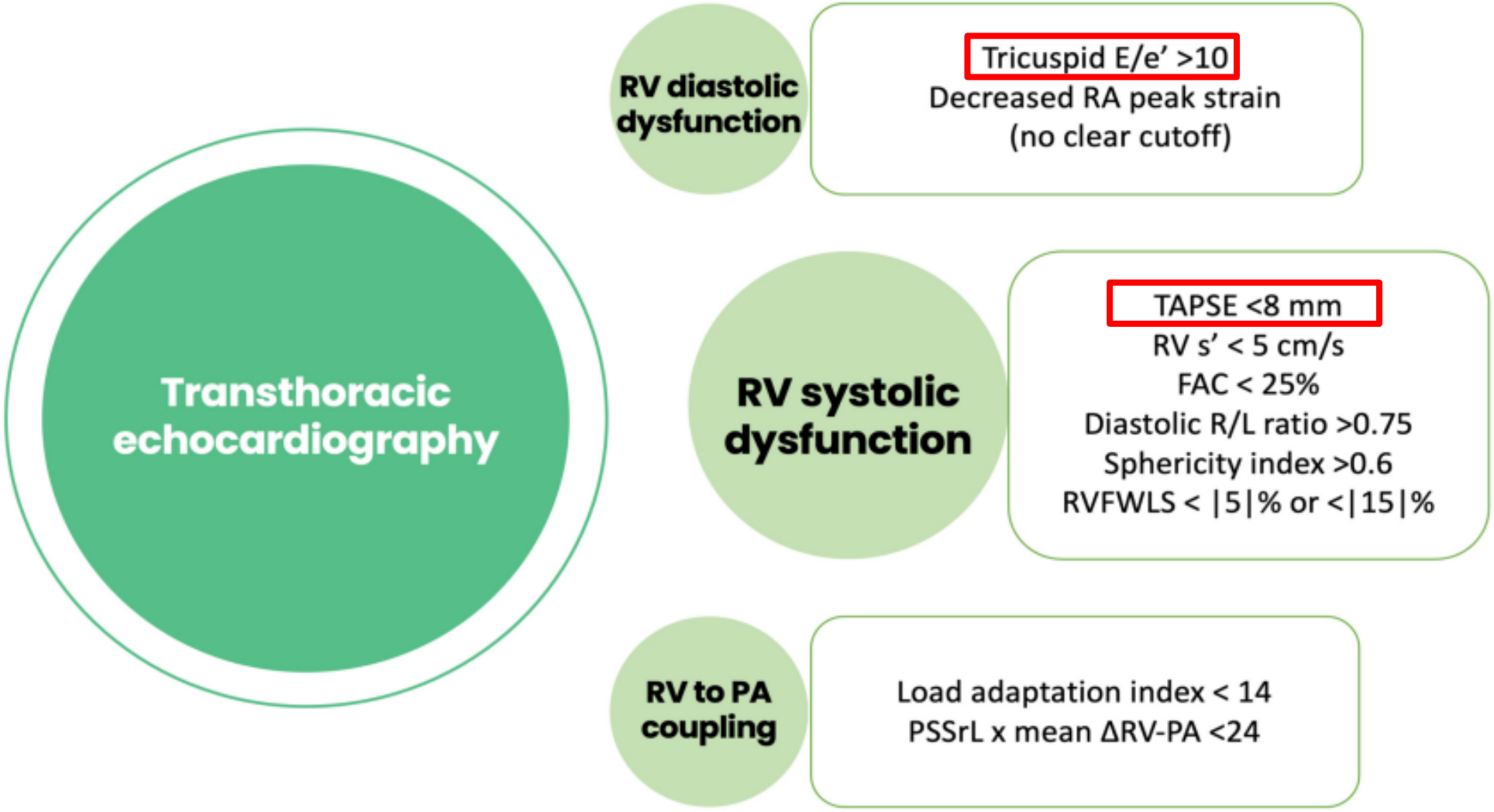
Prediction of RHF after LVAD



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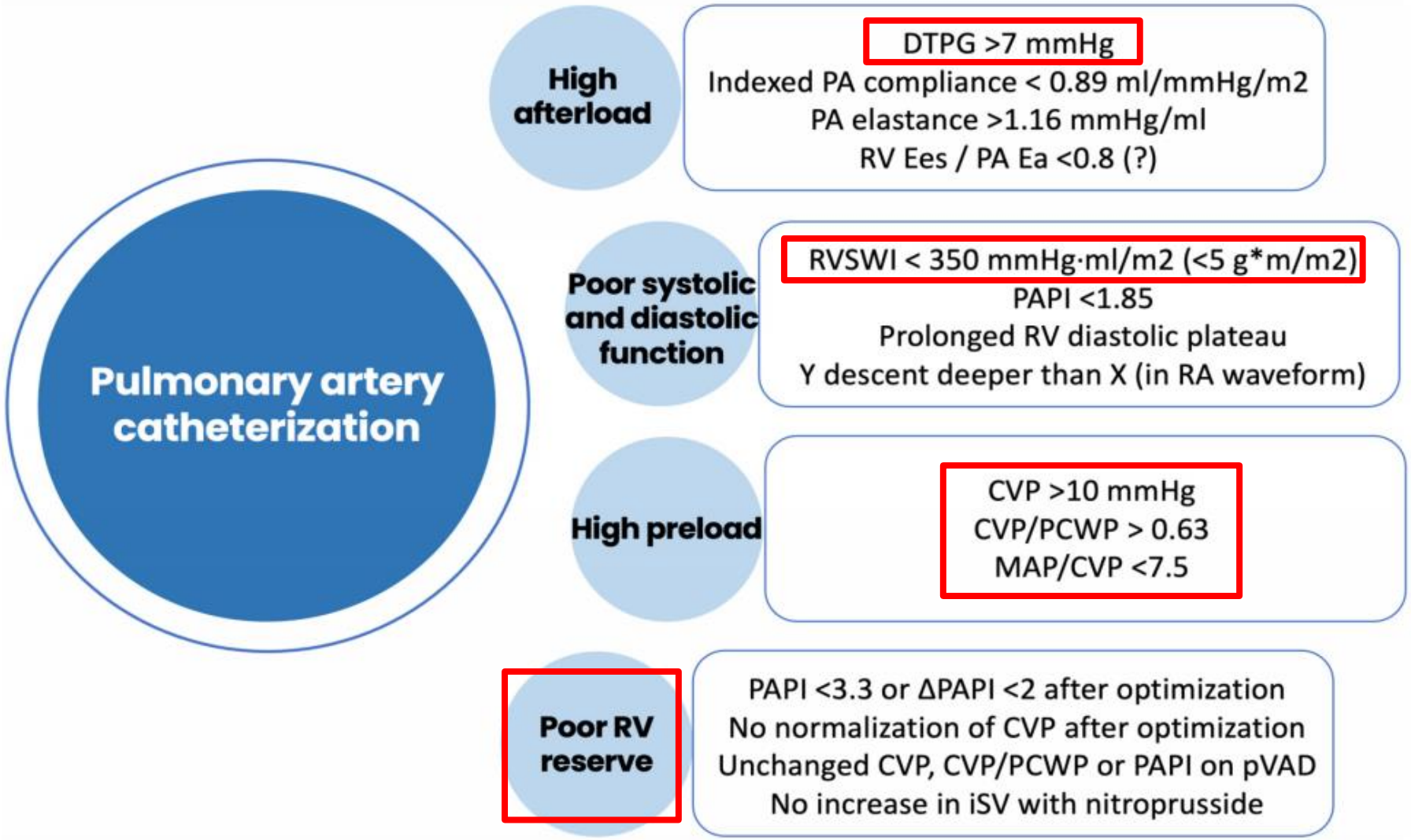
Prediction of RHF after LVAD



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Prediction of RHF after LVAD

ELSEVIER

The Journal of Heart and Lung Transplantation
http://www.jhltonline.org

BRIEF COMMUNICATION

Degree of change in right ventricular adaptation measures during axillary Impella support informs risk stratification for early, severe right heart failure following durable LVAD implantation

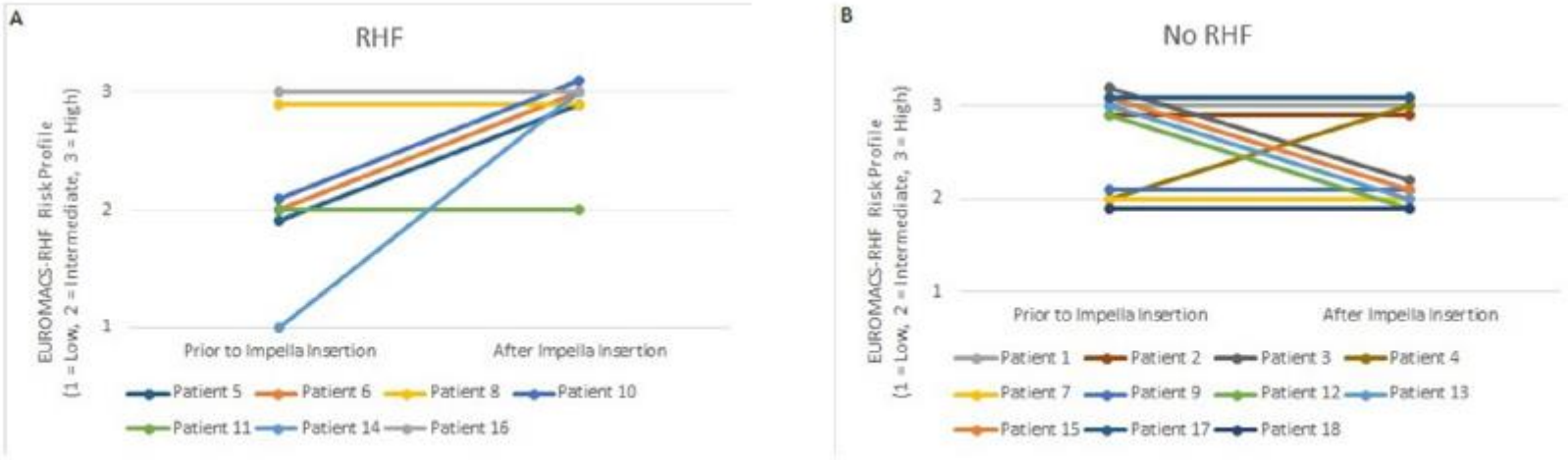

Figure 1 EUROMACS-RHF risk profile before and after axillary Impella insertion for patients in the RHF (Panel A) and no RHF (Panel B) groups.

Prediction of RHF after LVAD

Validation of clinical scores for right ventricular failure prediction after implantation of continuous-flow left ventricular assist devices

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Jeremy F. Weinberger, MD,[a] Alanna A. Morris, MD,[a]
Vasiliki V. Georgiopoulou, MD, MPH,[a] David W. Markham, MD, MSc,[a]
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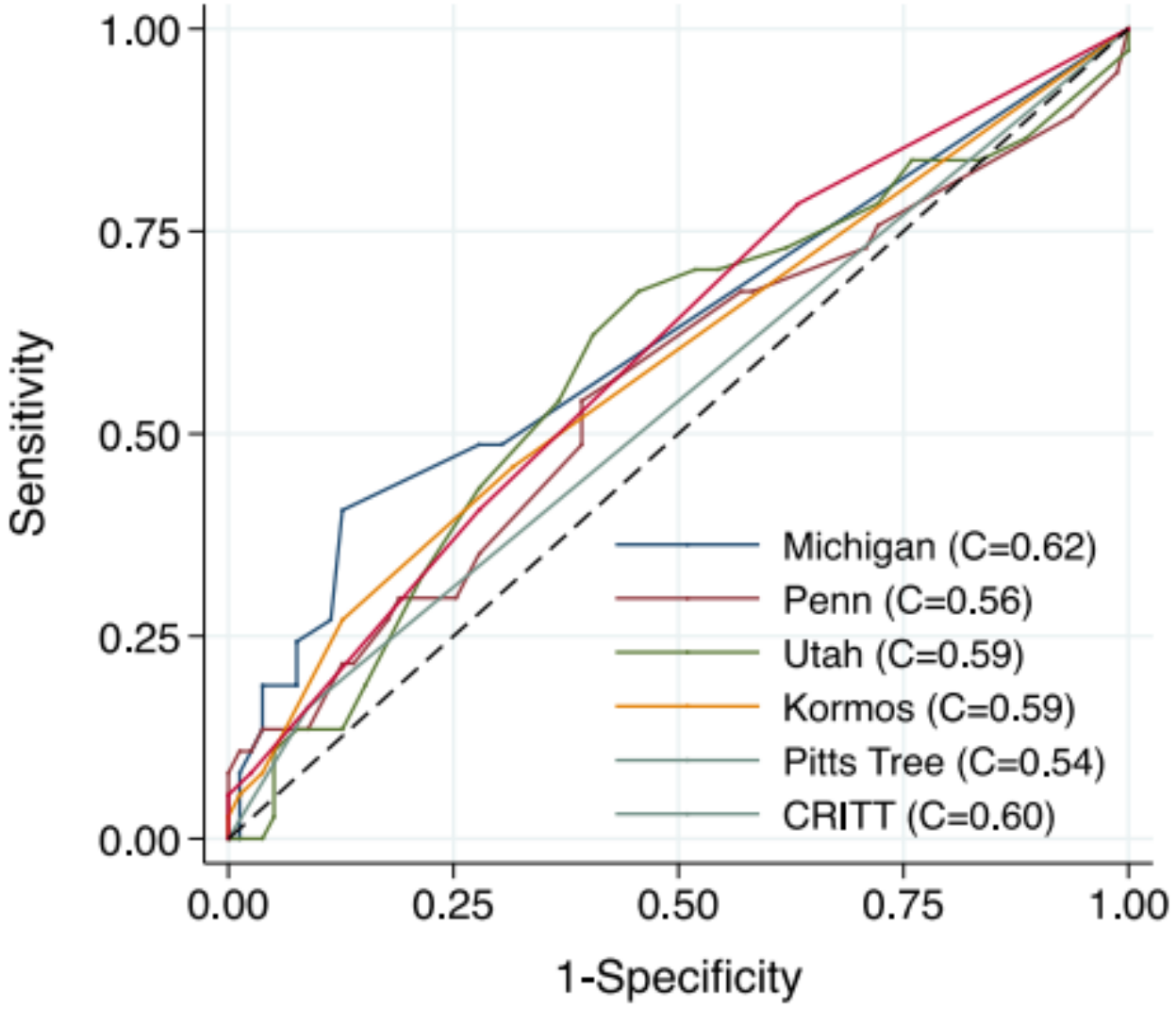
Risk prediction models

- **Michigan RV failure risk score**
  J Am Coll Cardiol 2008;51:2163-72.
- **Penn RVAD risk score**
  J Heart Lung Transplant 2008;27: 1286-92.
- **Utah RV risk score**
  Am J Cardiol 2010;105:1030-5.
- **Kormos et al.**
  J Thorac Cardiovasc Surg2010;139:1316-24.
- **Pittsburgh Decision Tree**
  J Heart Lung Transplant 2012;31:140-9.
- **CRITT score**
  Ann Thorac Surg 2013;96:857-63.



Prediction of RHF after LVAD

Table 1: HeartMate II Risk Score Calculations[12,§]

Variable	Log Multiplier
Age	0.0274
Albumin (per g/dl)	0.723
Creatinine (per mg/dl)	0.74
INR (per unit)	1.136
Center volume <15*	0.807
Calculation formula: age – albumin + creatinine + INR + center volume	

*[§]Low risk (<1.58); medium risk (1.58≥ to ≤2.48); high risk (>2.48). *Enter value of 1 if total center left ventricular assist device volume is <15 and 0 if ≥15. INR = international normalization ratio.*

EUROMACS-RHF Score

Determines risk of right ventricular HF in patients after LVAD implantation.

When to Use

RA/PCWP >0.54	No 0	Yes +2
Hemoglobin ≤10 g/dL	No 0	Yes +1
Multiple intravenous inotropes	No 0	Yes +2.5
INTERMACS class 1–3 See Evidence for details.	No 0	Yes +2
Severe RV dysfunction Semiquantitative assessment of RV systolic function on echocardiography.	No 0	Yes +2

0 points
EUROMACS-RHF Score

Low risk
Risk of RHF

Copy Results | Next Steps

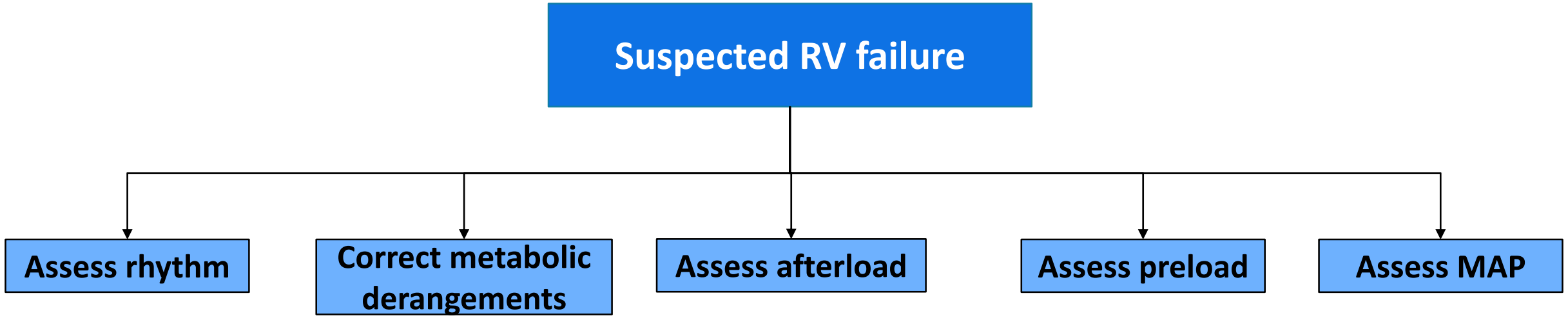
Selected Hemodynamic Parameters to Predict post-LVAD RV Failure

Hemodynamic parameter	Cutoff value for risk	Reference
CVP	>20 mmHg	Altair, Ann Thor Surg 2013
CVP/PCW	>0.63	Kormos, J Thor CV Surg 2010
RVSWI	<600 mmHg-ml/m	Schenk, J Thor CV Surg 2006
PAPi	<2.0	Korabathina, CCI 2012
PVR	>3-5 Wood units	Drakos, Am J Card 2010
Tricuspid Regurgitation	Present	Altair, Ann Thor Surg 2013
Kussmaul's sign	Present	Nadir, Circ HF 2014

Adapted from Circ CV Imag 2014;7:379-389

RHF AFTER LVAD
MANAGEMENT

Proposed algorithm for management of early RHF



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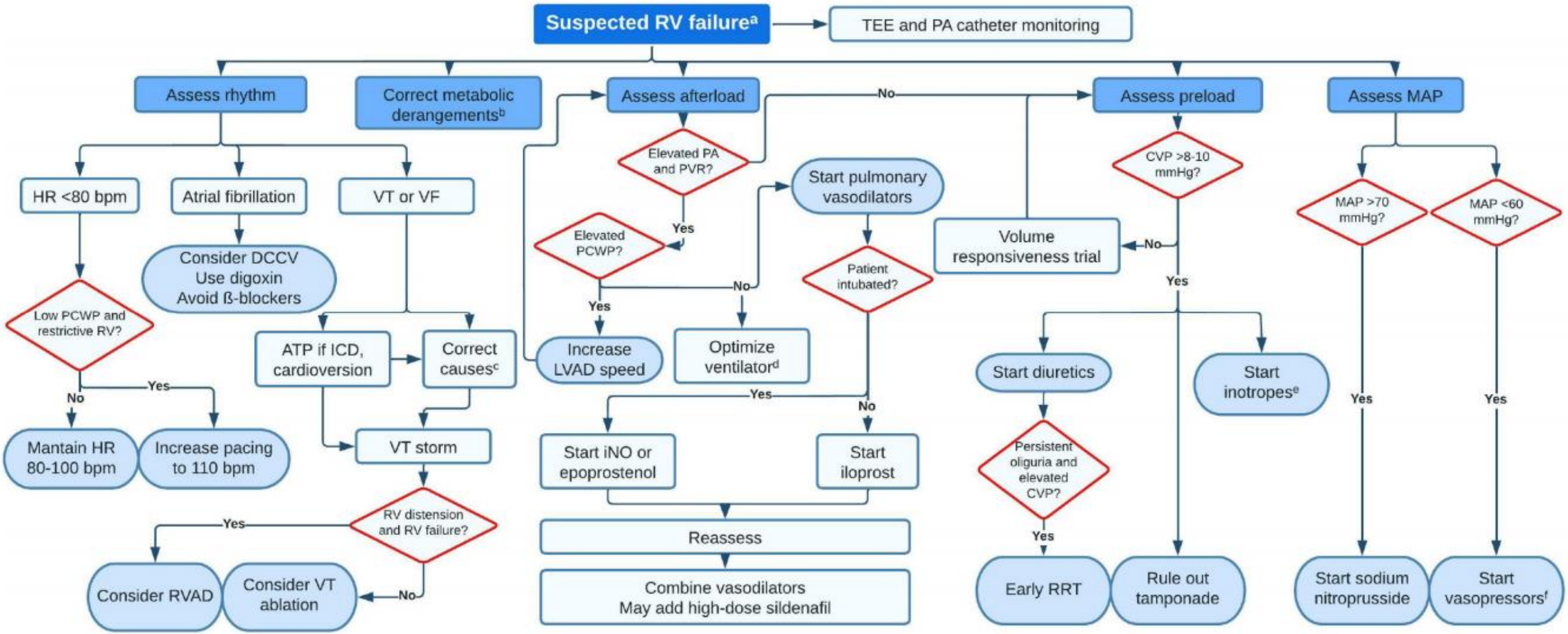
Proposed algorithm for management of early RHF



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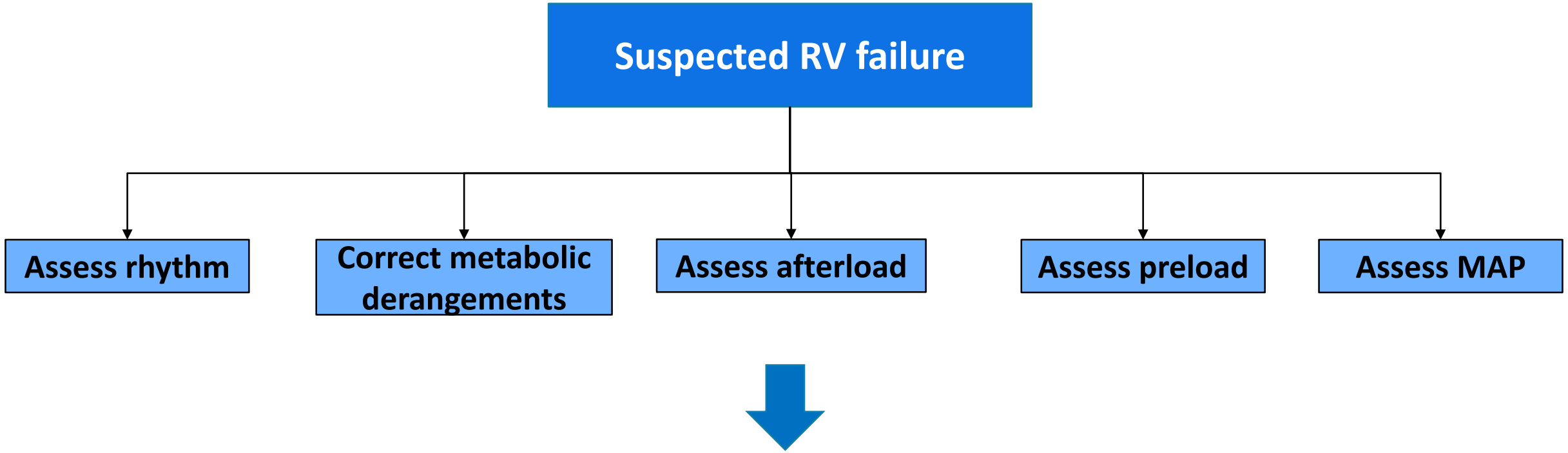
Proposed algorithm for management of early RHF



Consider **early RVAD** if worsening hypoperfusion, low MPA, low LVAD flow despite initial Tx.

Front. Cardiovasc. Med. 9:1040251.

Mechanical Circulatory Support for RHF

Intraoperative

- RVAD
  - CentriMag
  - ECMO
  - Direct cannulation
  - Using graft

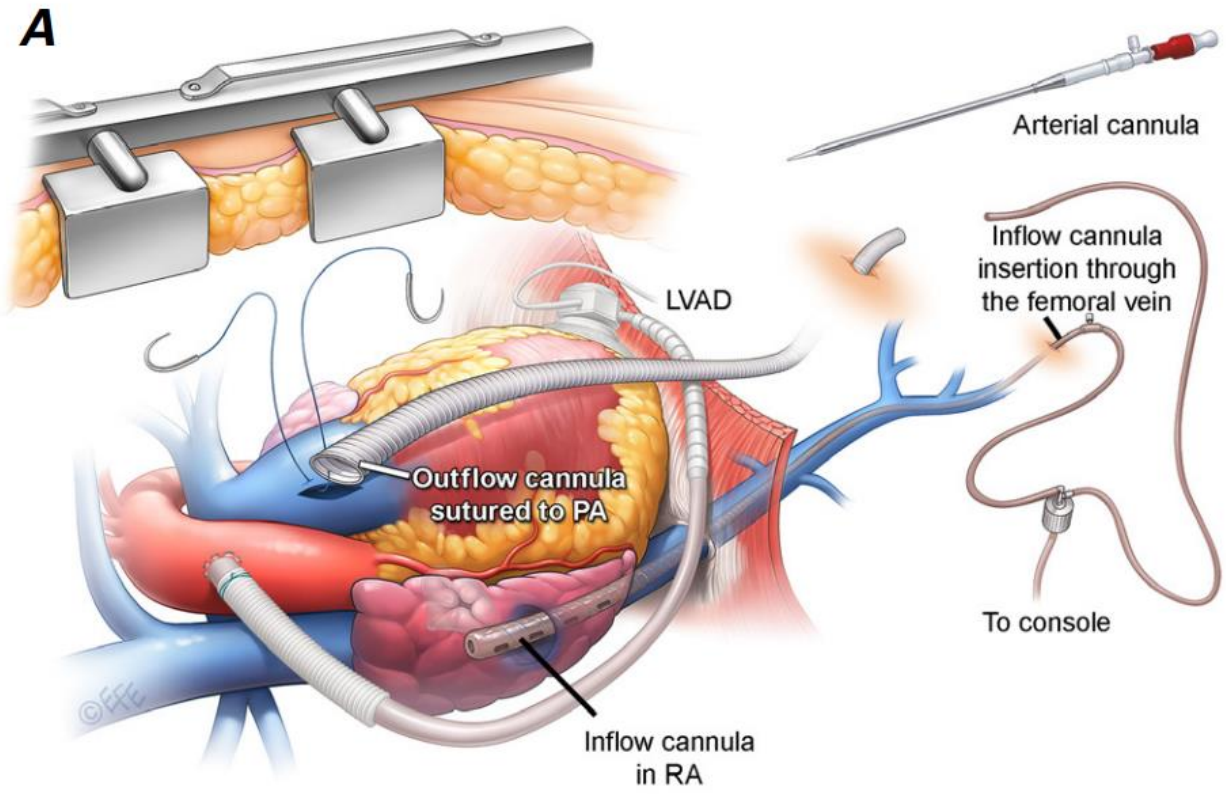
Postoperative

- Impella RP
- Protek duo
- Peripheral VA-ECMO
- Percutaneous RVAD

Mechanical Circulatory Support for RHF

Intraoperative

- **RVAD**
  - **CentriMag**
  - **ECMO**
  - **Direct cannulation**
  - **Using graft**

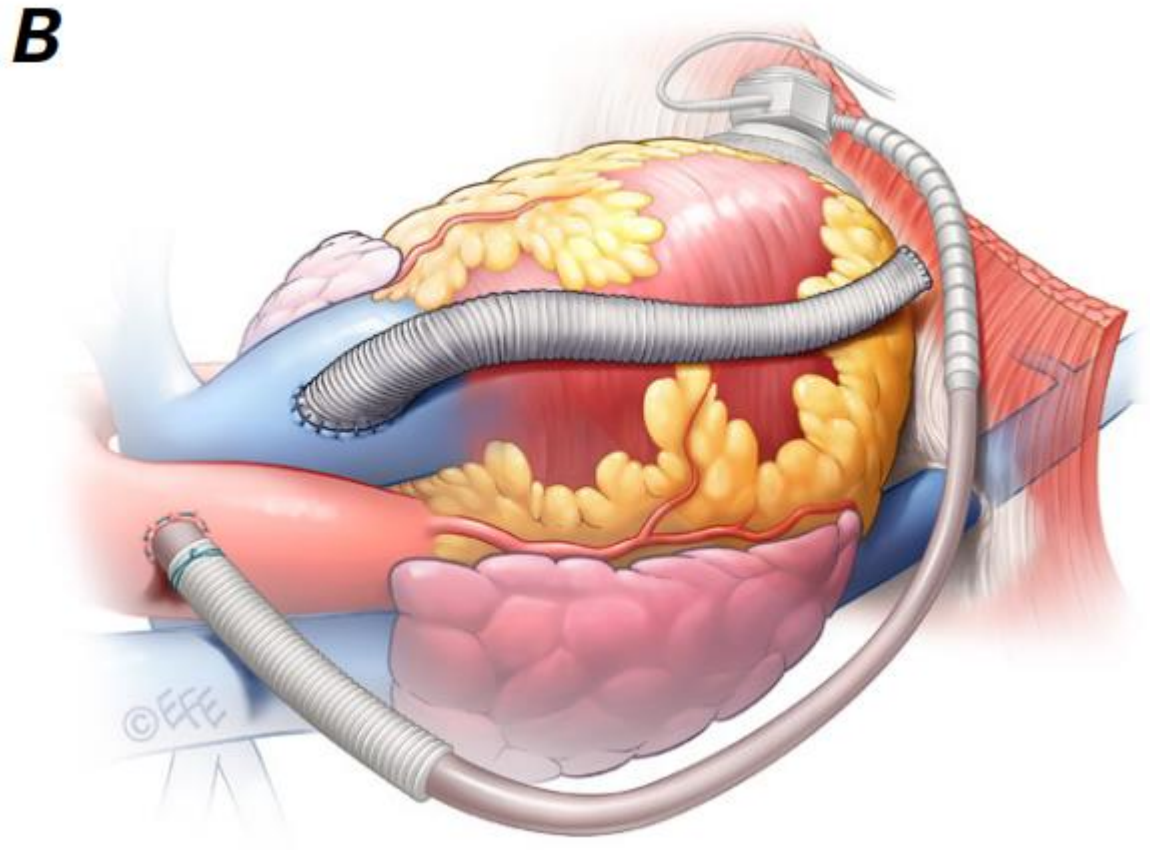


Tex Heart Inst J 2015;42(6):540-2

Mechanical Circulatory Support for RHF

Intraoperative

- **RVAD**
  - **CentriMag**
  - **ECMO**
  - **Direct cannulation**
  - **Using graft**



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Mechanical Circulatory Support for RHF

Intraoperative

- RVAD
  - CentriMag
  - ECMO
  - Direct cannulation
  - Using graft

Postoperative

- Impella RP
- Protek duo
- Peripheral VA-ECMO
- Percutaneous RVAD

Mechanical Circulatory Support for RHF

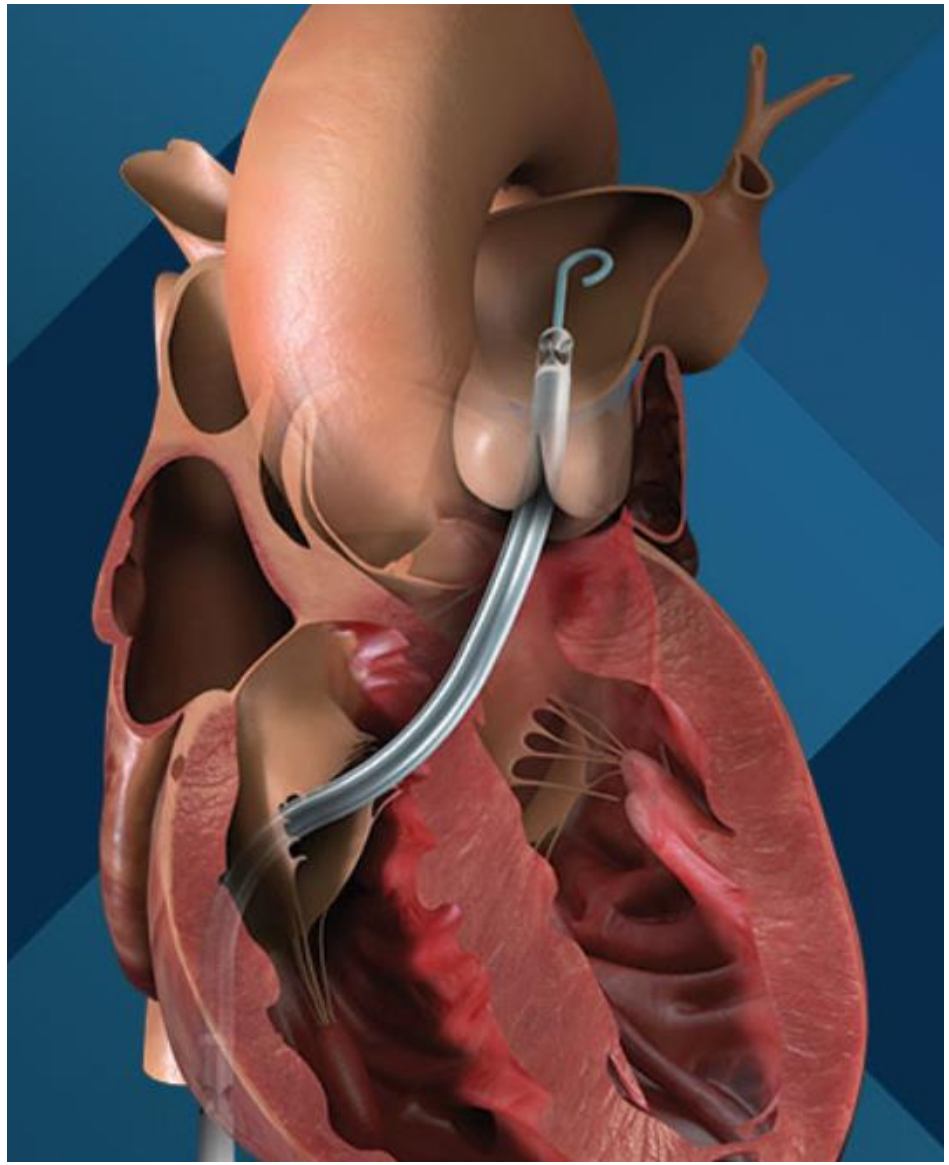
Intraoperative

- RVAD
  - CentriMag
  - ECMO
  - Direct cannulation
  - Using graft

Postoperative

- Impella RP
- Protek duo
- Peripheral VA-ECMO
- Percutaneous RVAD

Impella RP



Impella RP®

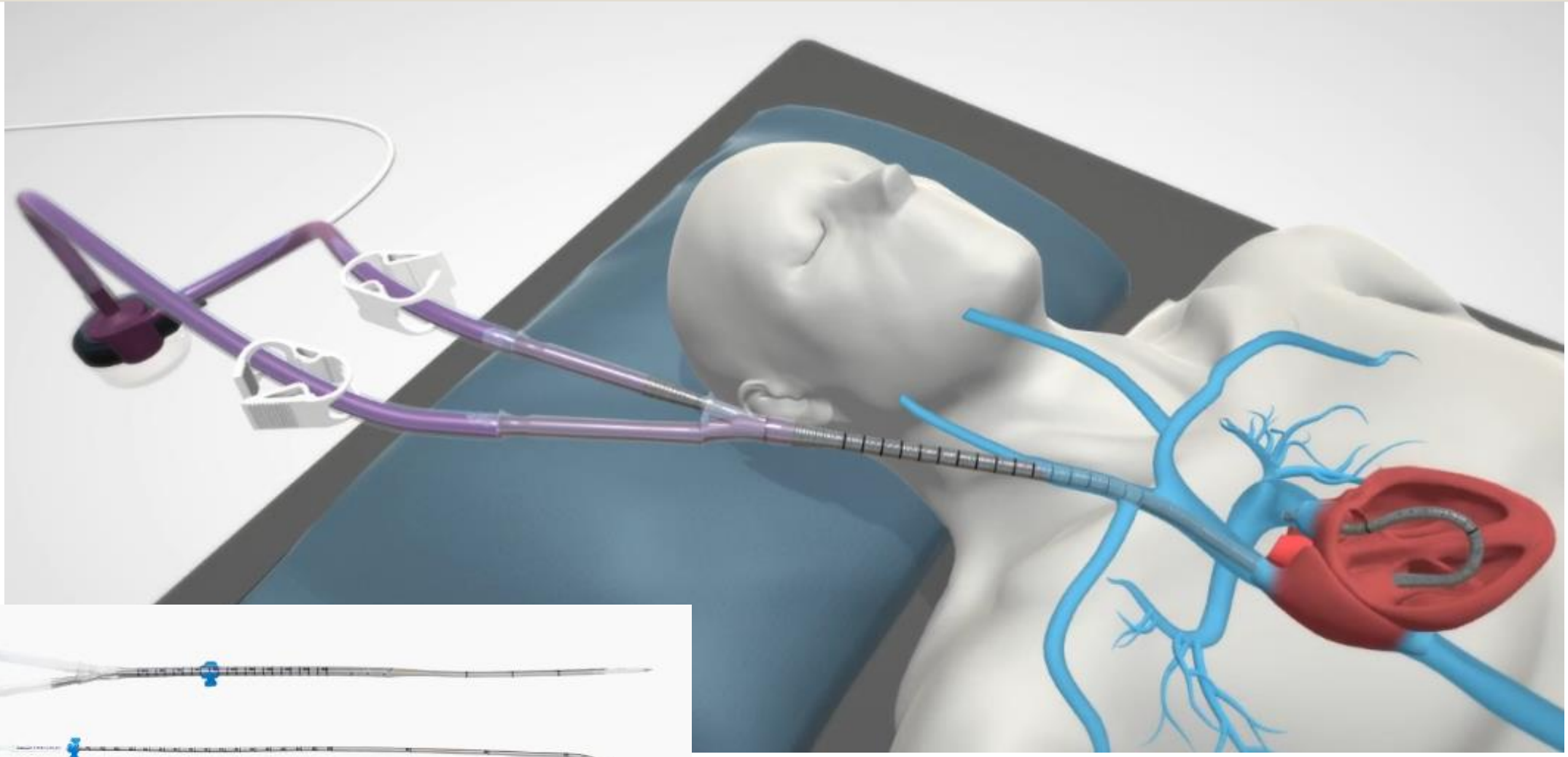
with SmartAssist®

The only percutaneous pump approved for right heart support with single vascular access, designed for intelligent patient management

- Dual-lumen 22 Fr cannula, Microaxial pump
- IVC into the PA
- No oxygenator
- Femoral vein ; precludes ambulation (device migration)

- Contraindications
  - mechanical valves
  - PS, PR , Clots in the RV

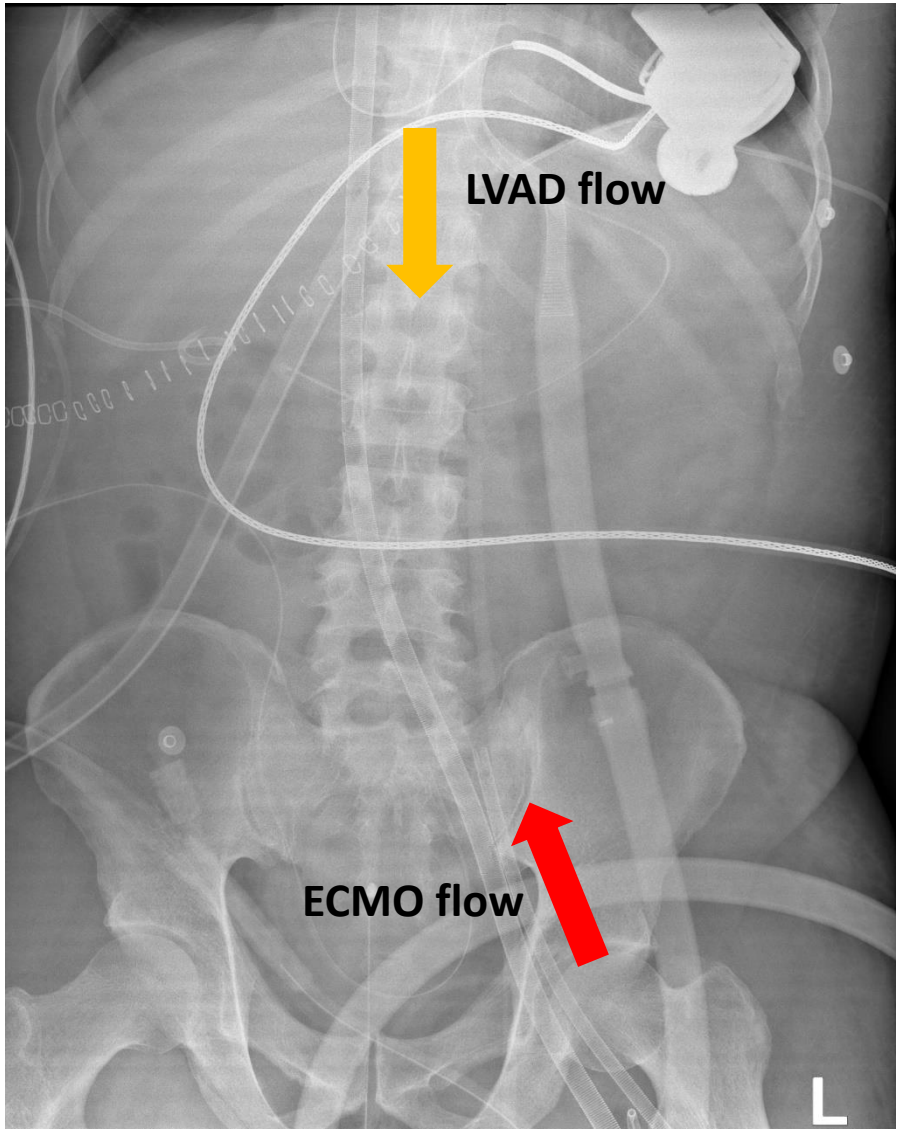
Protek duo



Pros : Ambulation and better rehabilitation

Cons : SVC syndrome, RCA compression

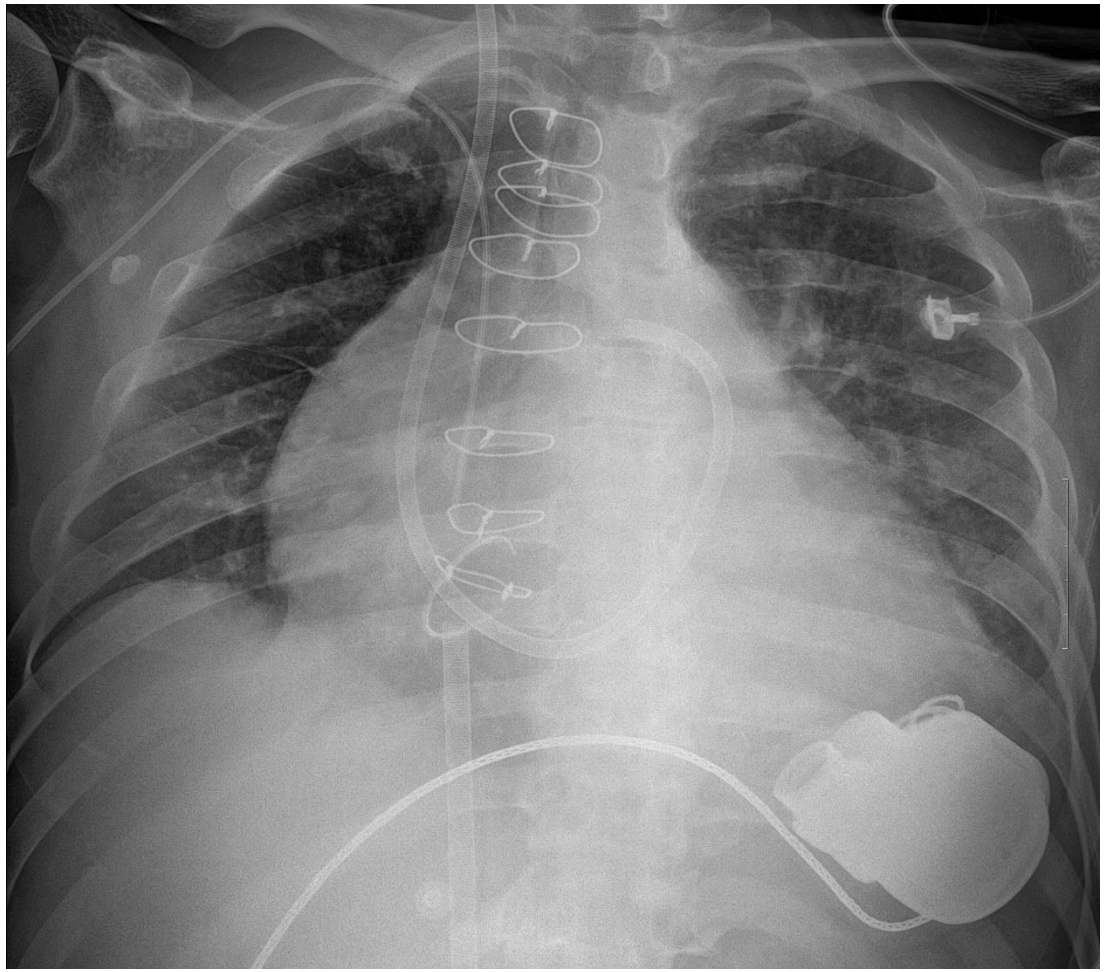
VA ECMO



- **Temporary RV support**
- **Reduces LVAD preload by unloading RV**
- **Increased LVAD afterload**

> Competition of both two mechanical support device

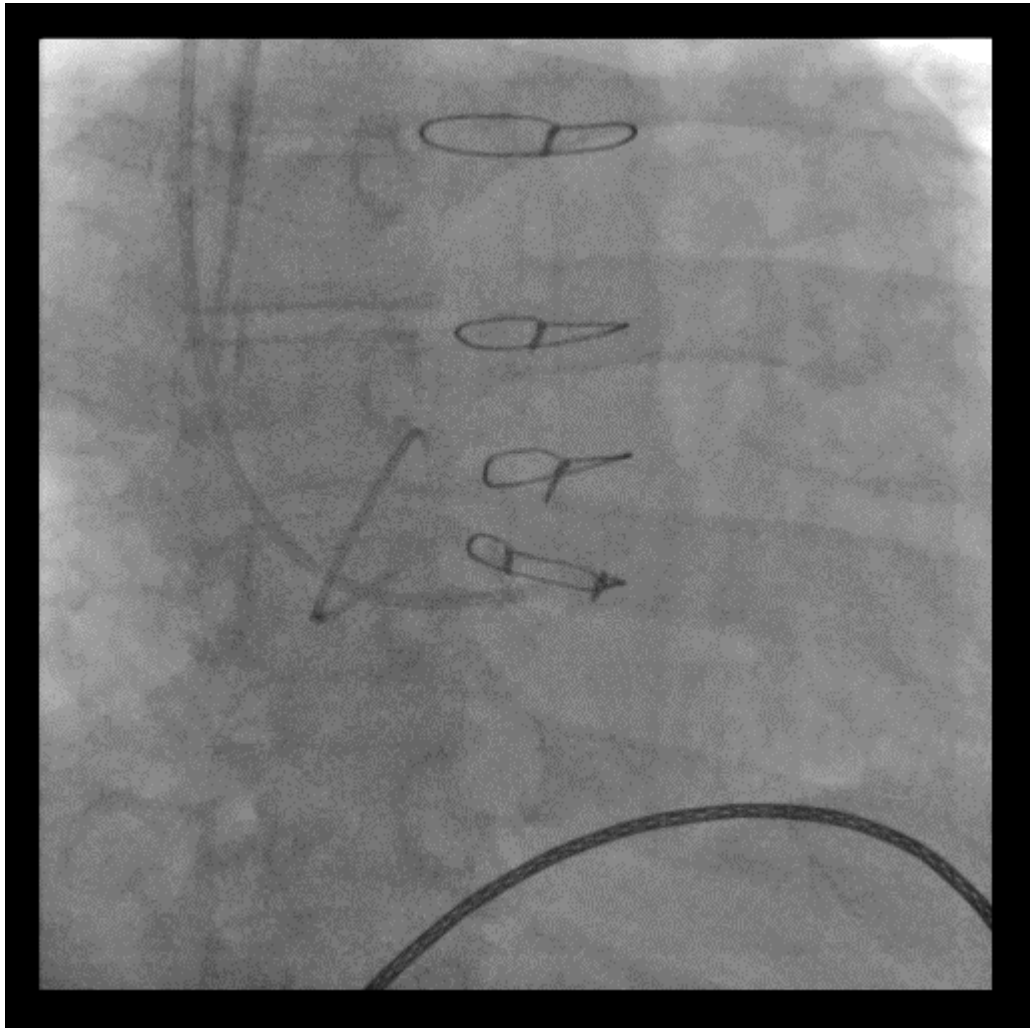
Percutaneous RVAD

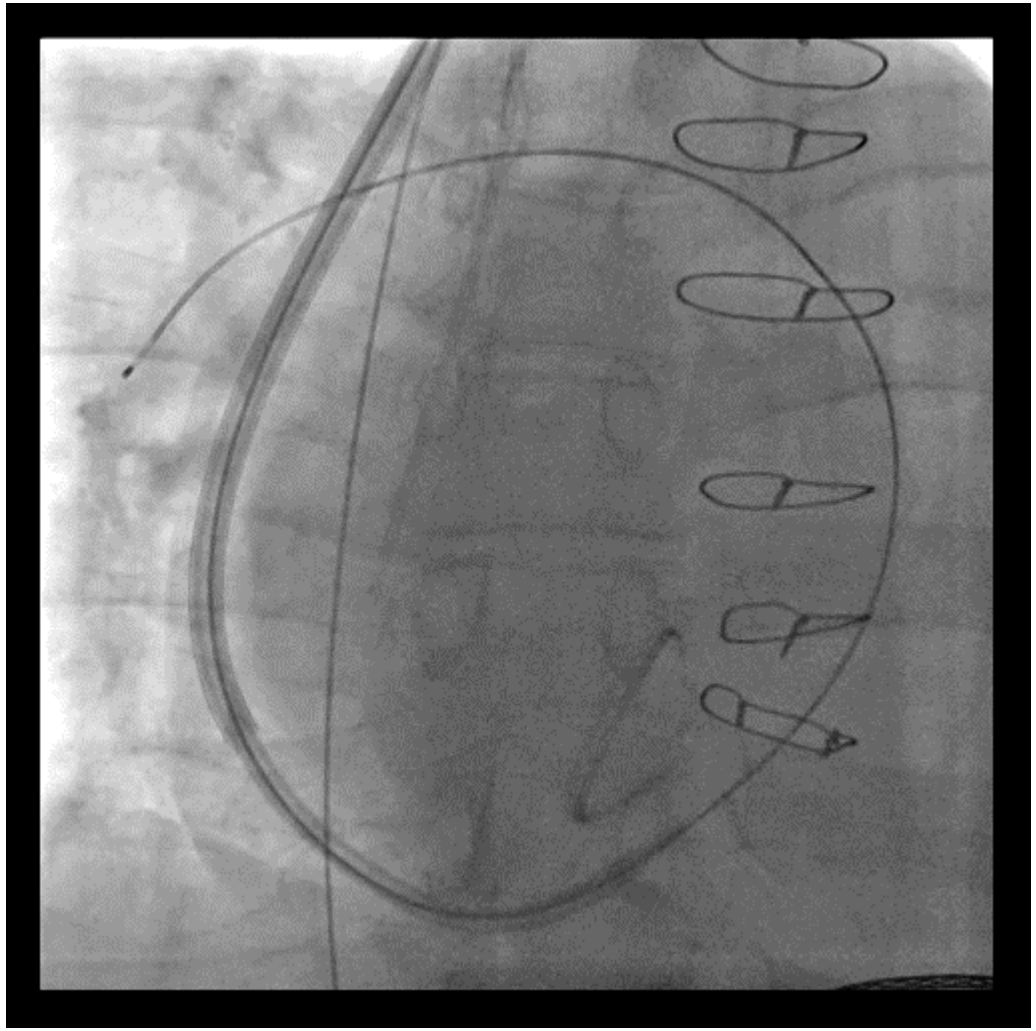


- Temporary RV support
- Unloading the RV without decreasing LVAD preload and increasing LVAD afterload
- Provide oxygenated blood

> Same physiology of Protek Duo

Percutaneous RVAD





Percutaneous RVAD

Summary

- **Definition**
  - Early acute RHF
  - Early post implant RHF
  - Late RHF
- **Prediction**
  - CVP, PAPi, CVP/PCWP, RVSWI
  - Echo parameters
- **Management**
  - Medical therapy
  - RVAD

THANK YOU FOR LISTENING!