INDICATION OF **CENTRAL ECMO** CANNULATION

부산대병원 송승환

First ECMO

- ECMO was **first used successfully in 1971** by a patient with severe lung dysfunction after a motorcycle accident.
- Developed respiratory failure **four days after** successful repair of the thoracic aorta.
-
- Veno-arterial ECMO with **peripheral cannulation** was used for 75 hours and the patient recovered

Definition

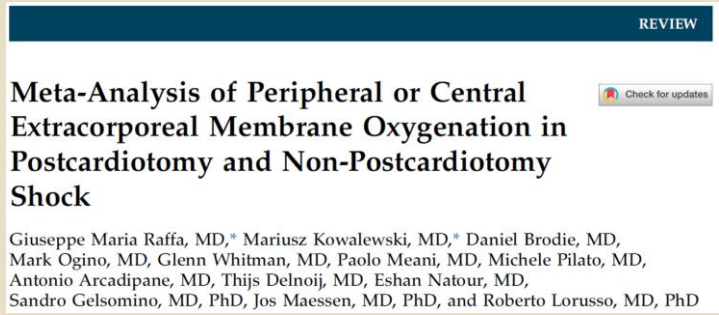
the access for **inflow cannula** dictates the actual configuration

Central

- Cannulation involving the **aorta** for the patients' arterial inflow and **right atrium** or both **venae cavae** for patients' outflow
- Aorta and femoral vein cannulation strategies

Peripheral

- Cannulation of the **femoral** and **axillary** artery for patients' arterial inflow and Femoral vein for patients' inflow.
- Right atrium and femoral artery cannulation


REVIEW

Meta-Analysis of Peripheral or Central Extracorporeal Membrane Oxygenation in Postcardiotomy and Non-Postcardiotomy Shock

Check for updates

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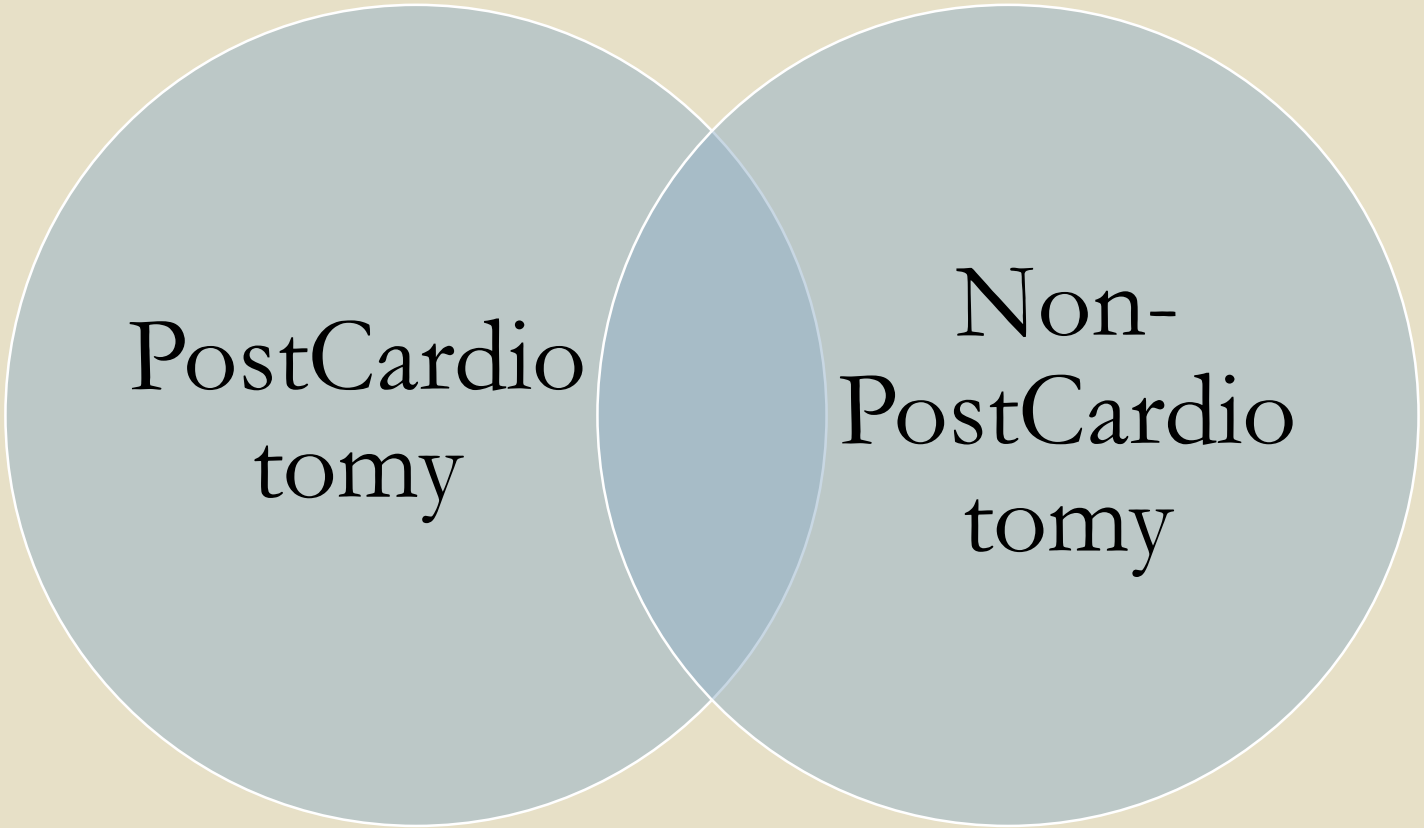
Indication of central cannulation



History of ECMO in Korea

EBS
Terumo
2003

2009
H1N1
Influenza

2015
MERS

EBS neo
2017

2019
COVID-19

Xenios
console
PMC 2021

PLS
Maquet
2010

Cardiohelp
Marquet
2020

Rotaflow 2
Getinge
2021

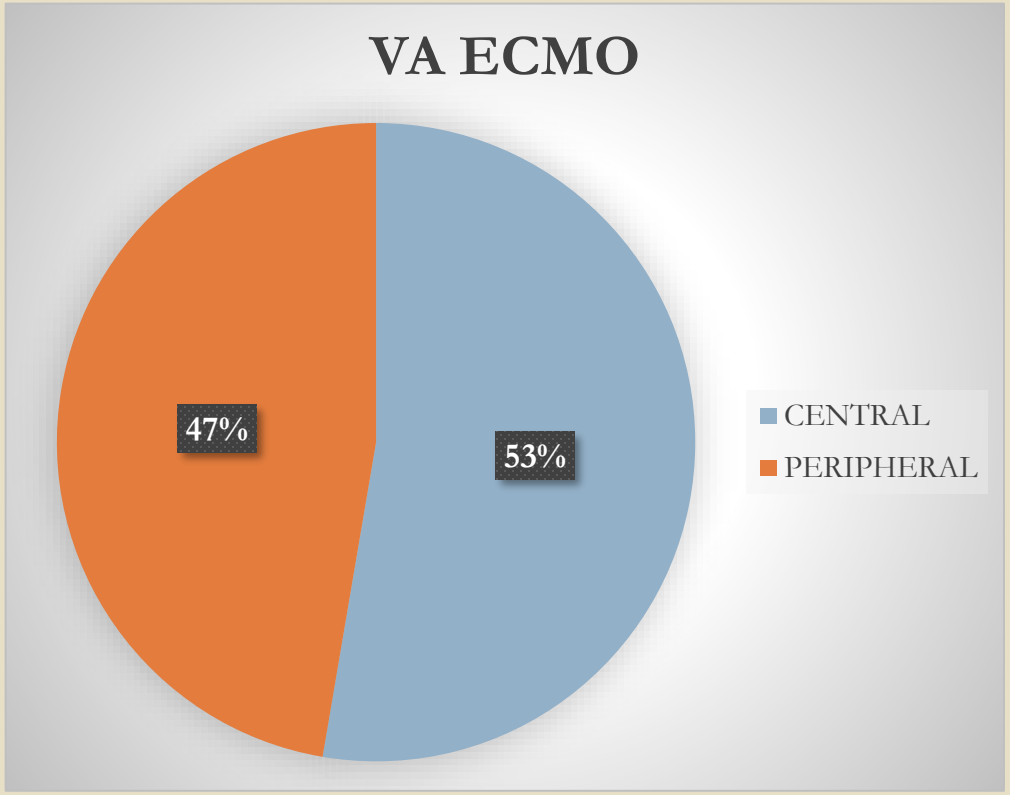
Optimal cannulation strategy

- Survival
- Myocardial recovery
- Management
- Complication rate

- Neonate and pediatrics

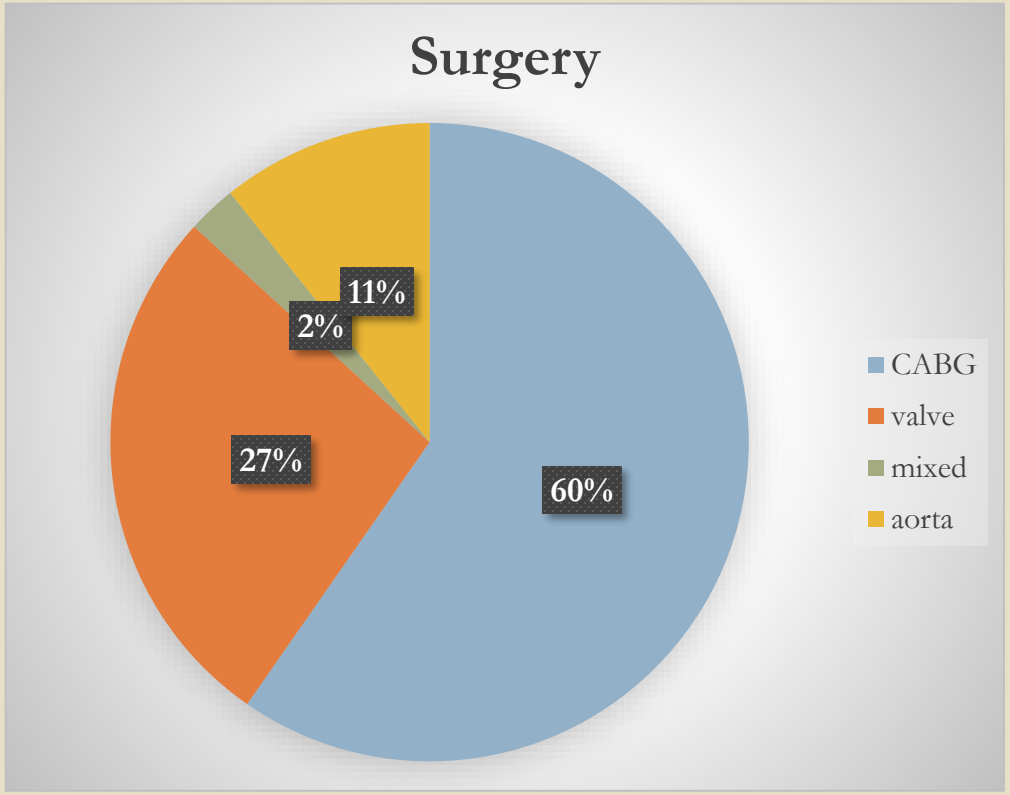
Cannulation

- 17 retrospective observational studies
- October 31, 2017
- A total of **1,691 patients**.
- Of those, 980 patients (57.95%) underwent peripheral, and 711 (42.05%) central, cannulation for VA-ECMO



PostCardiotomy VA ECMO

- Unable to wean bypass
- Most commonly (85.1% of the time), VA-ECMO was instituted for PCS;
  - coronary artery bypass grafting (33.9%)
  - Valve surgery (15.4%)
  - mixed cases (8.7%).
  - aortic surgery in 103 cases (6.1%), 36 of which (2.1%) were for acute type A aortic dissection
- Primary graft failure after HT



Advantage of central cannulation

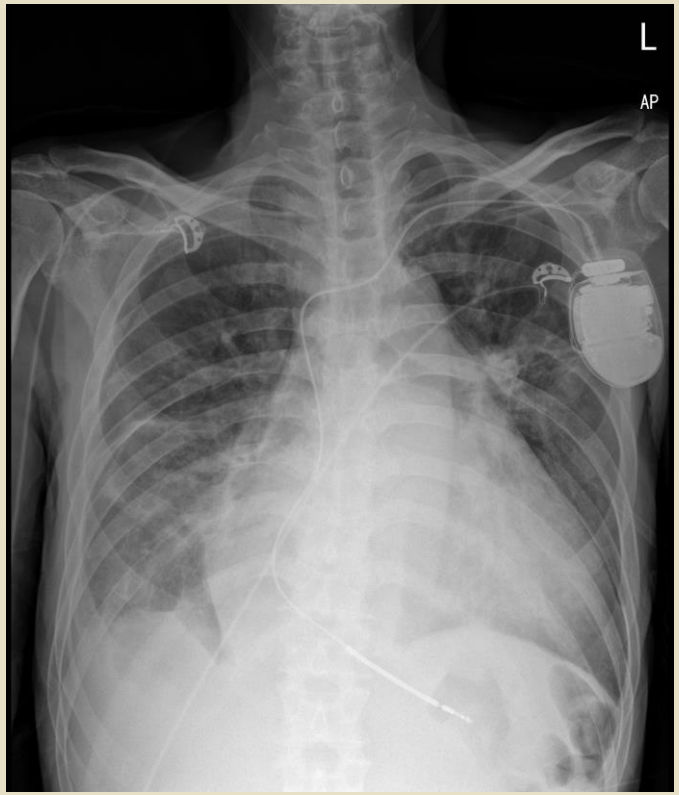
Table 2. Advantages and Disadvantages of Central Versus Peripheral Cannulation in Patients Undergoing Postcardiotomy Extracorporeal Membrane Oxygenation

	Advantages	Disadvantages
Central cannulation (aortic/atrial)	Use of originally (CPB) implanted cannulas	Opened sternum (chest closed possible)
	Antegrade flow	High bleeding risk
	Better drainage (bigger right atrium cannulas)	Cardiac compression (if exit port subxyphoid)
	Long-lasting support (subclavian artery use)	Resternotomy to remove cannulas
	Higher ECMO flow (better unloading through RA drainage)	More infection (sepsis)
	Patient mobilization (particularly with subclavian artery access)	Higher rate of cerebral emboli
	More options (and more easily) for LV venting	Higher risk of closed aortic valve
	No harlequin (or north/south) syndrome	

Case 1

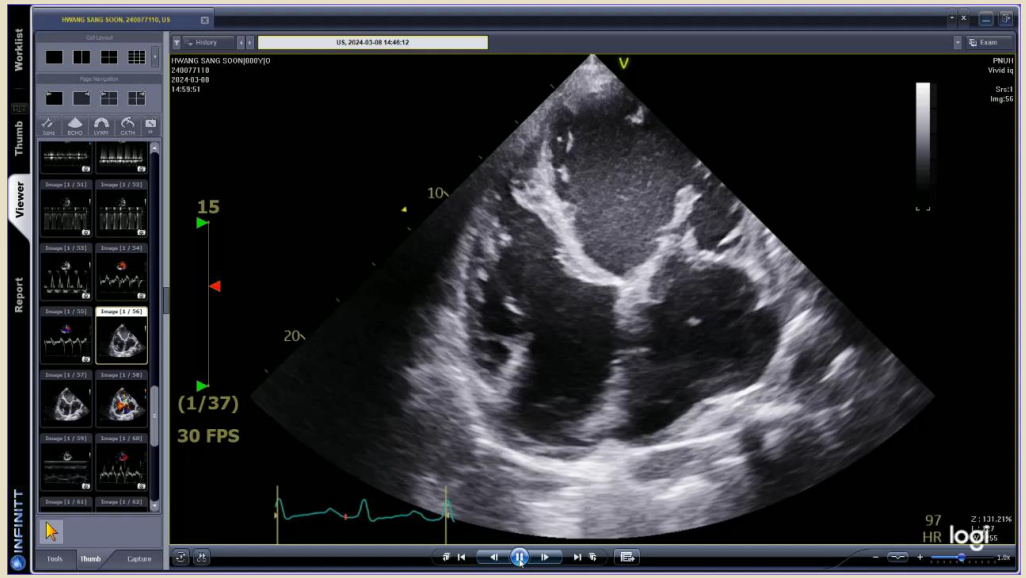
- M/67, B+, 161cm, 51kg
- 2020 VF arrest
- HFrEF, DCMP, EF 13%

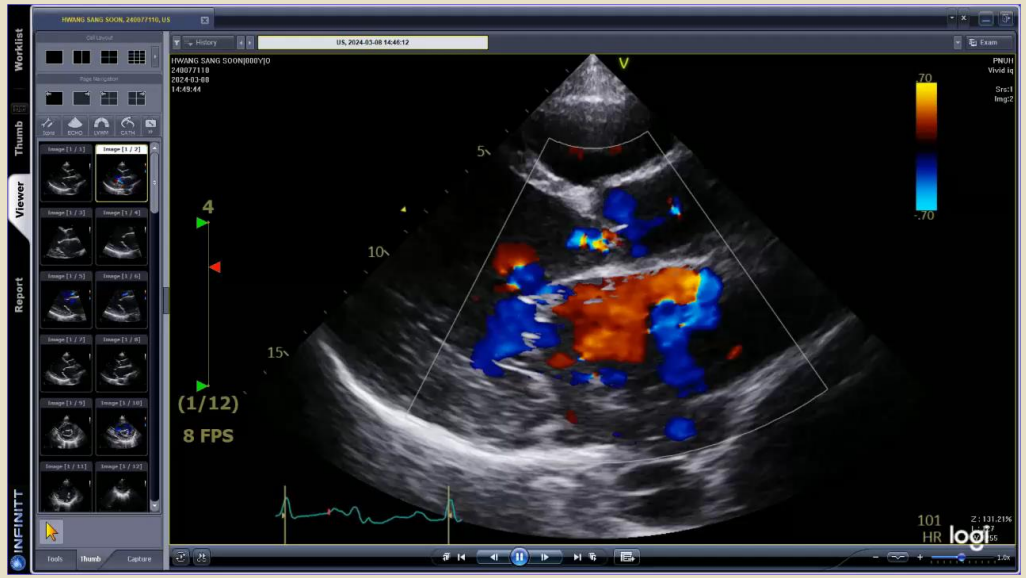
- Admitted other hospital for 3 month
- Klebsiella pneumonia, worsening CKD
- transferred for VAD or HT



Echocardiography

- biventricular dysfunction
- all chambers dilatation
- severe functional MR
- Mild AR
- moderate to severe resting pulmonary HTN

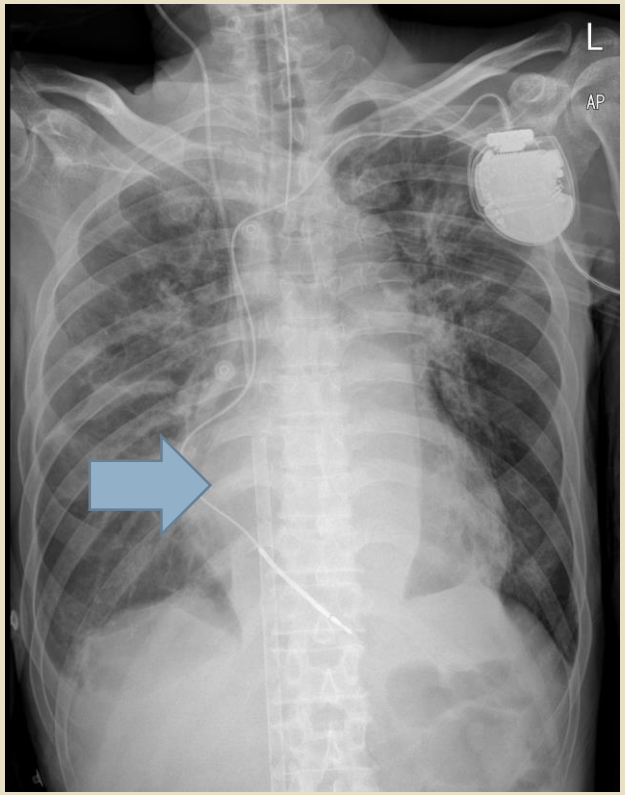




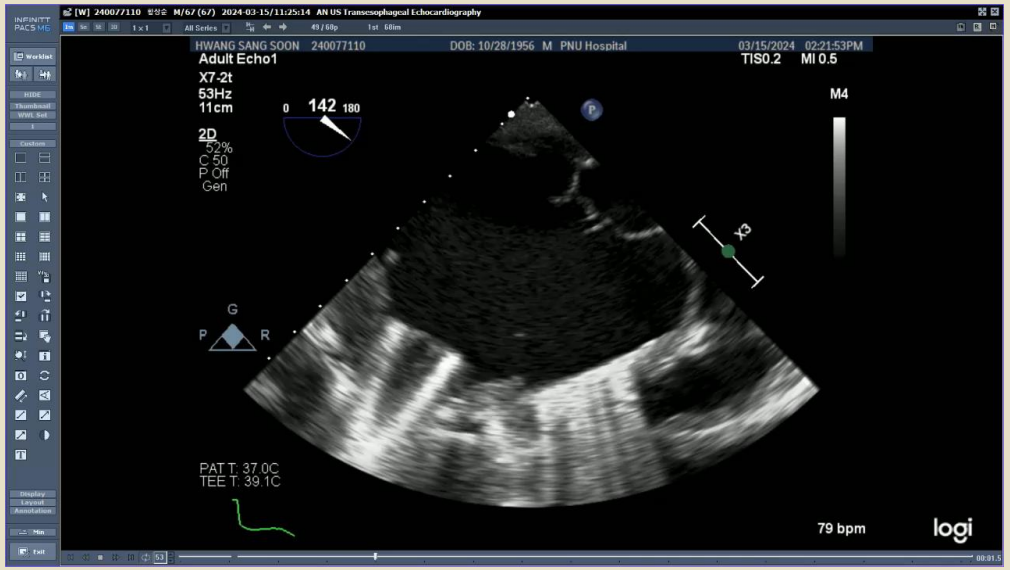
VA ECMO support, HD 2

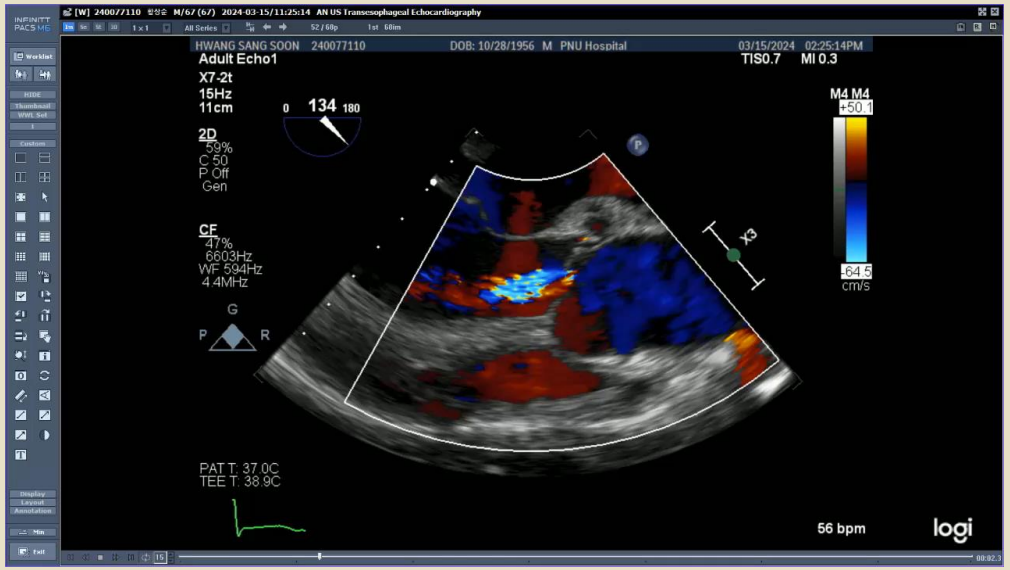
- Peripheral VA ECMO support
- Sono-guided percutaneous cannulation
- Distal perfusion +
- Venting -
- FMC genius console
- Initial flow 2.0 L/min

- LVAD approval



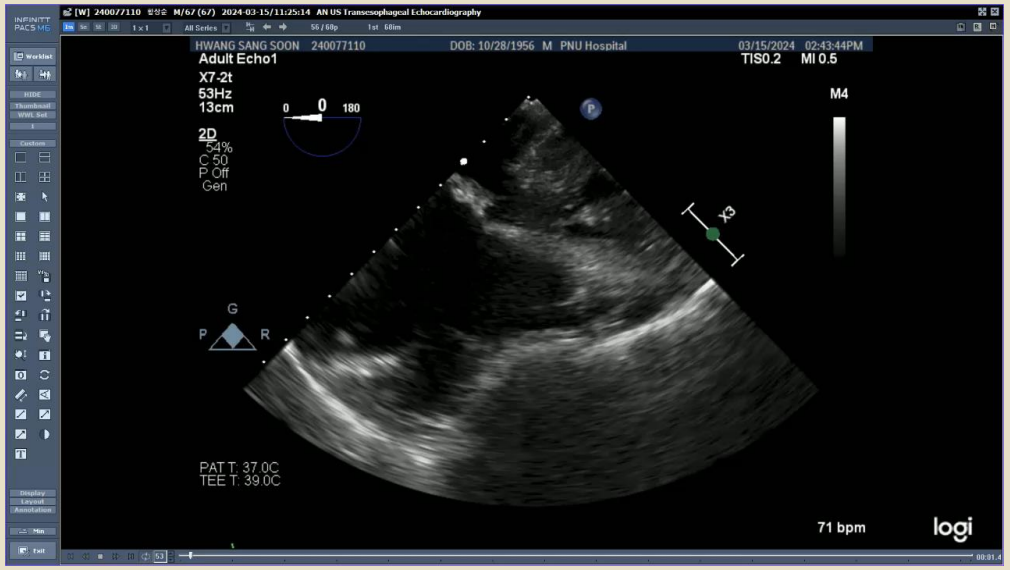
LVAD implantation with HM3
Bridge to bridge, ECMO day 7





RV failure
Temporary oxy-RVAD

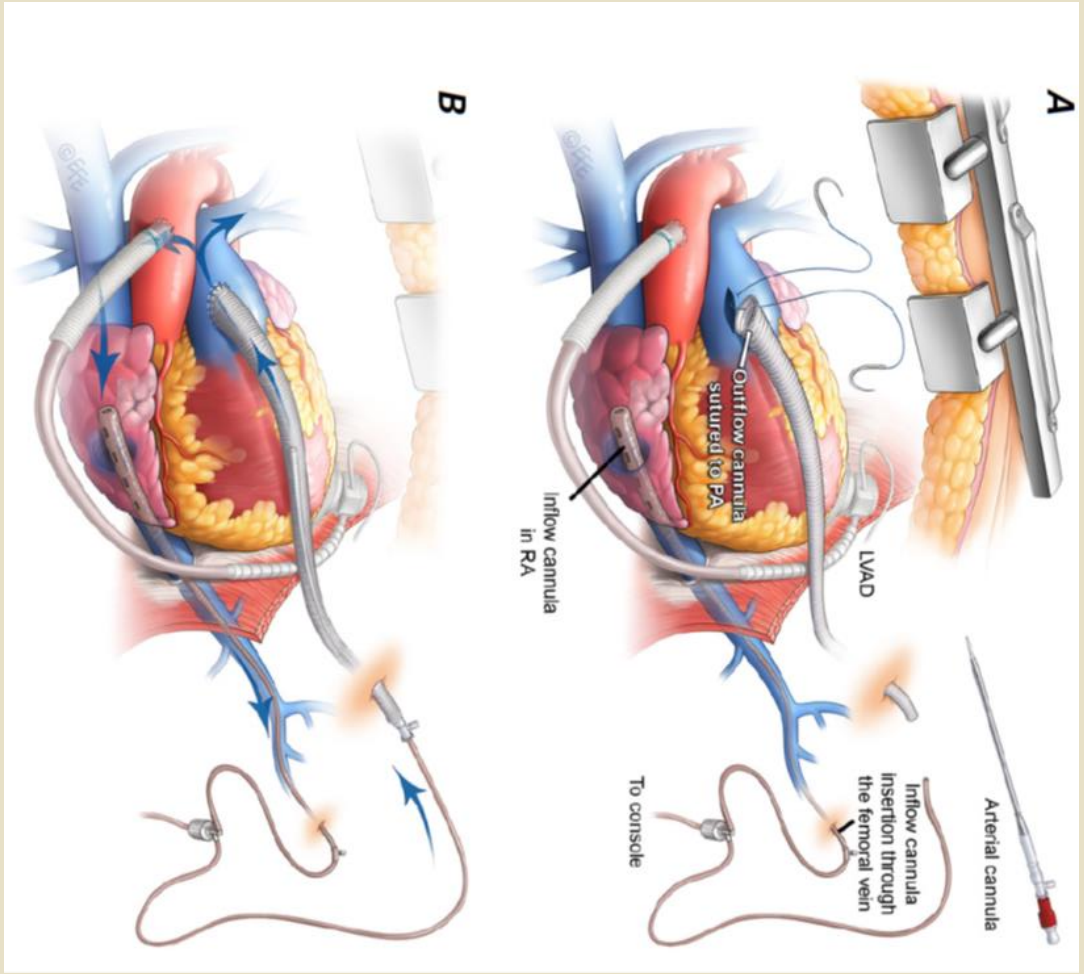
- PA – 8 mm graft, LFV venous 21 Fr
- ECMO, PLS



Surgical Techniques

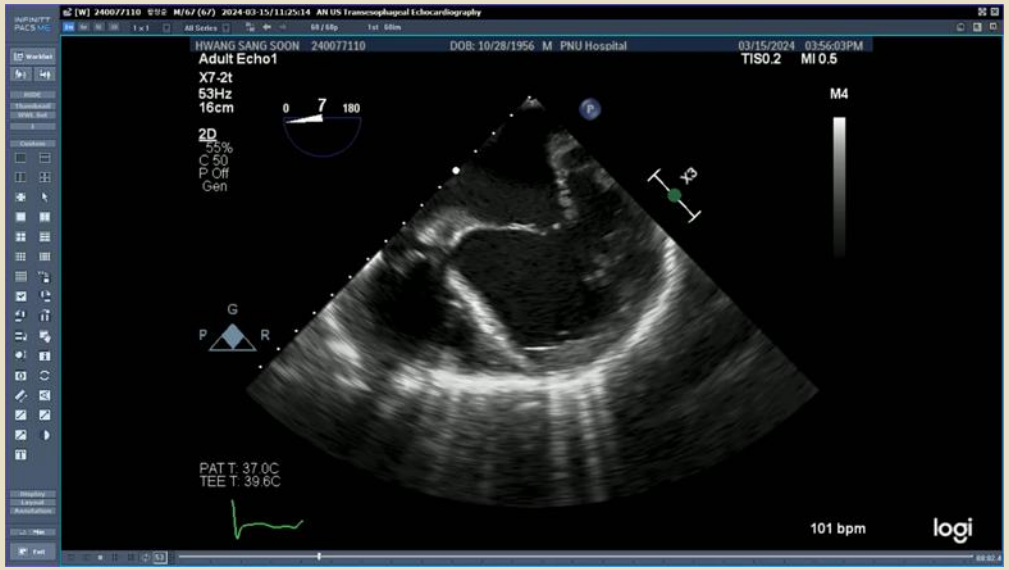
Tunneling a Pulmonary Artery Graft:

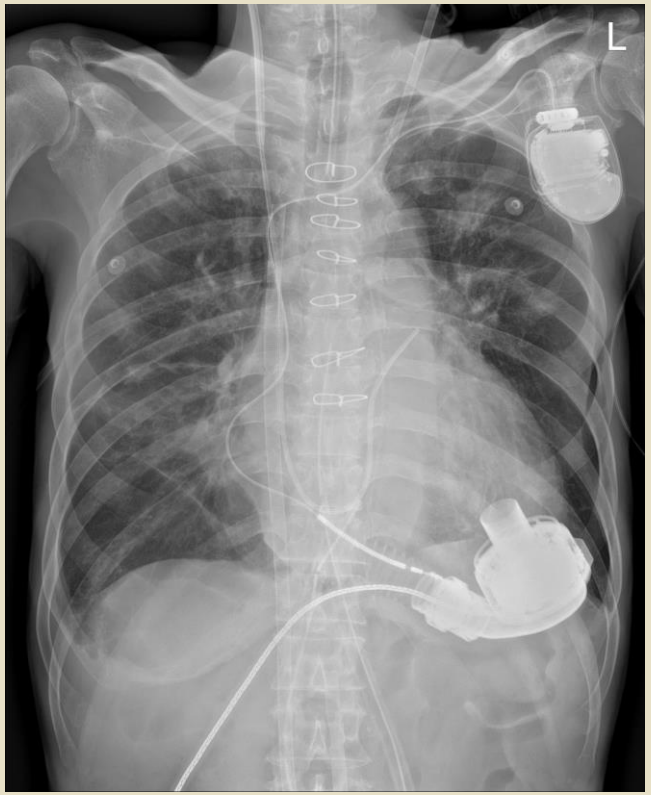
A Simplified Way to Insert and Remove a Temporary Right Ventricular Assist Device



LVAD + OxyRVAD

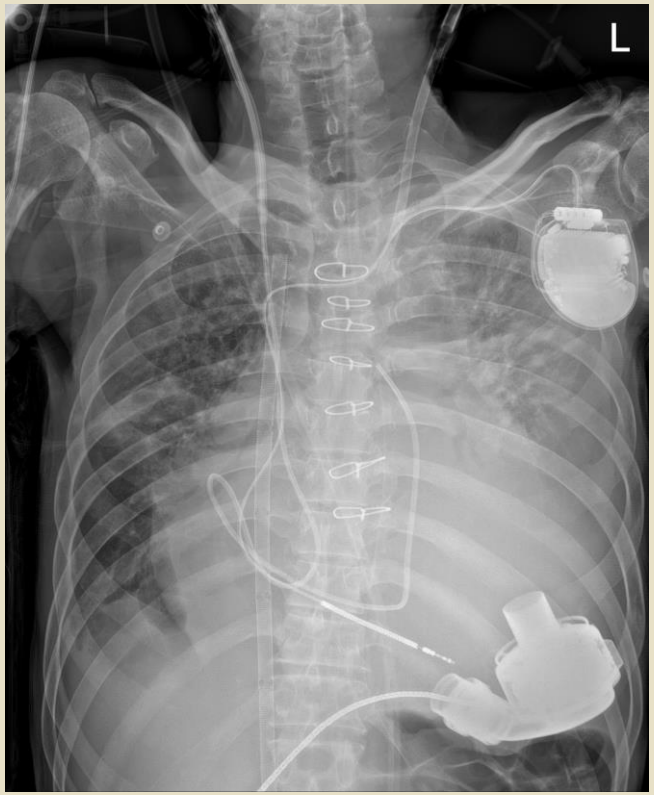
- oxyRVAD initial flow 3 L/min
- LVAD parameters
  - Pump flow 3.2 L/min
  - Pump speed 3800 rpm





Patient course, POD 3

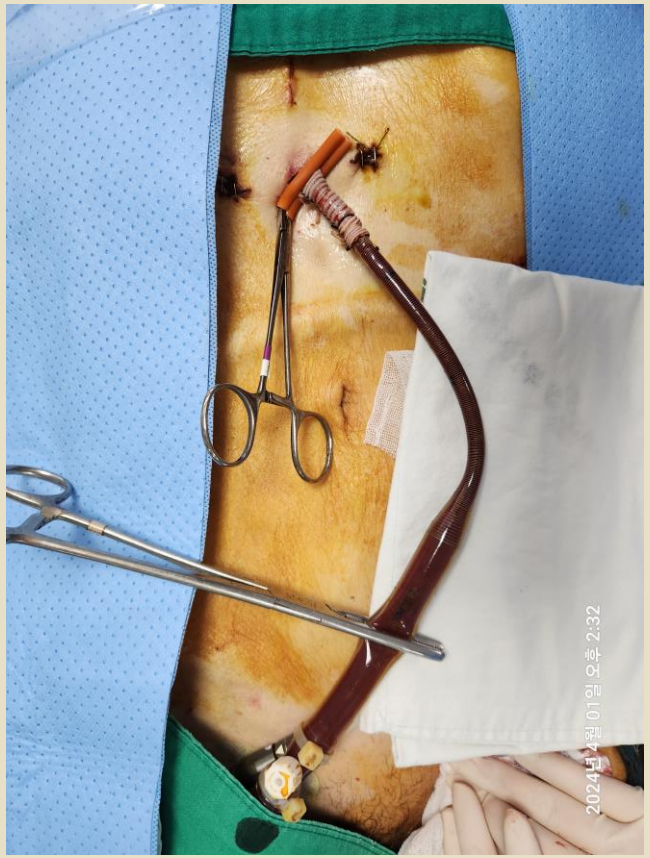
- Extubation
- LVAD parameters
  - Pump flow 3.1 L/min
  - Pulse index 6.1
  - Pump speed 4800 rpm
- OxyRVAD
  - Flow 1.7 L/min
  - Sweep gas 2 L/min, FiO2 0.7
- Dobutamin and milrinone iv

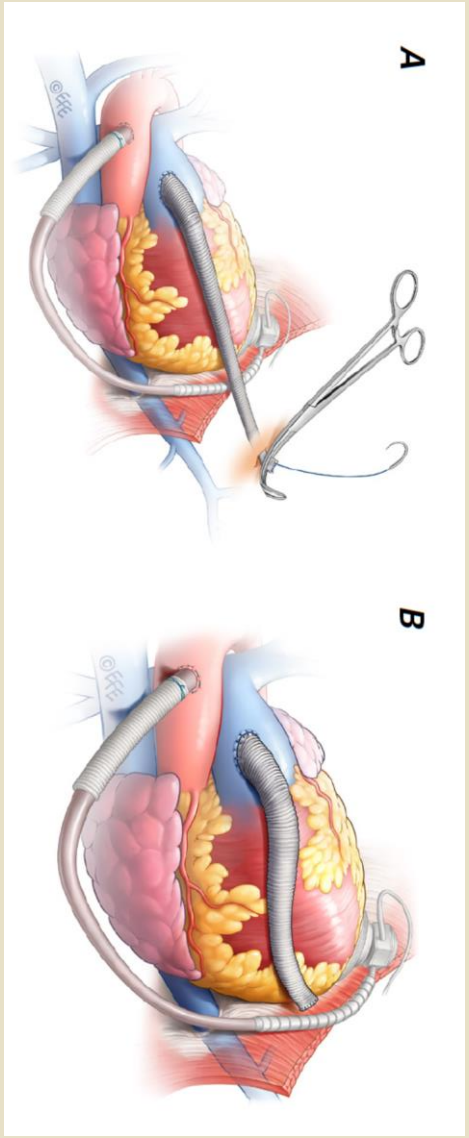


Patient course, POD 15

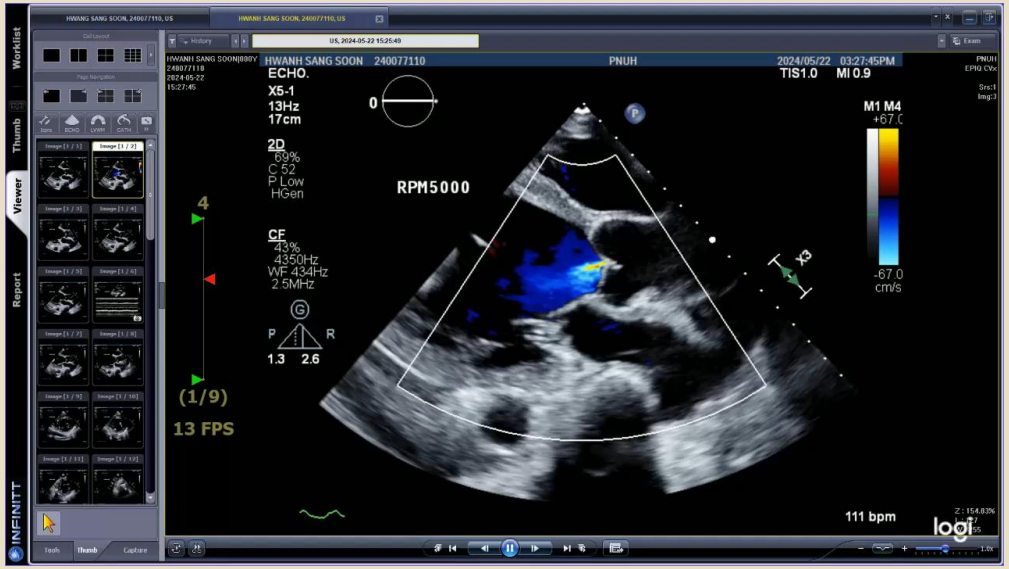
- RVAD weaning and decannulation
- No chest re-open

- POD 30 general ward transfer





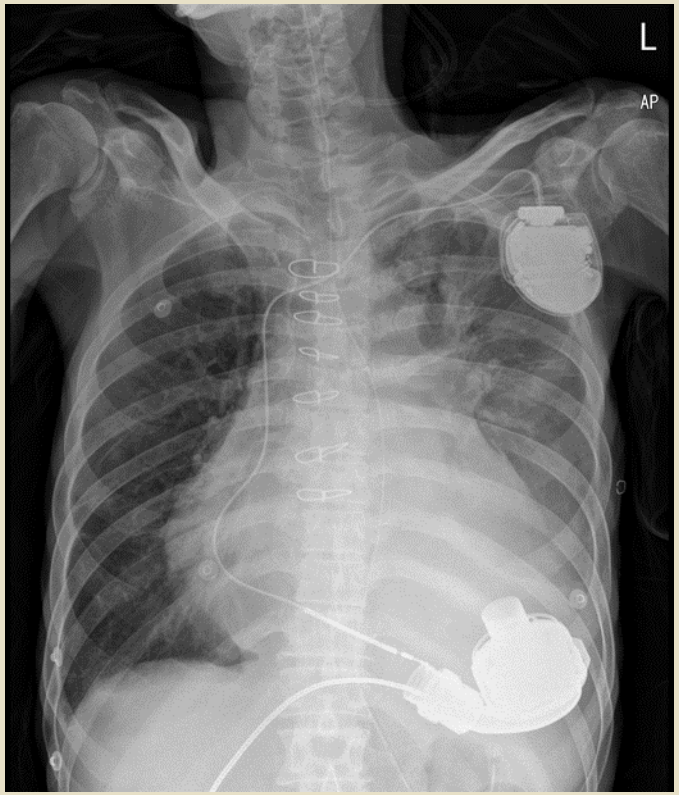
Echocardiography, POD 45

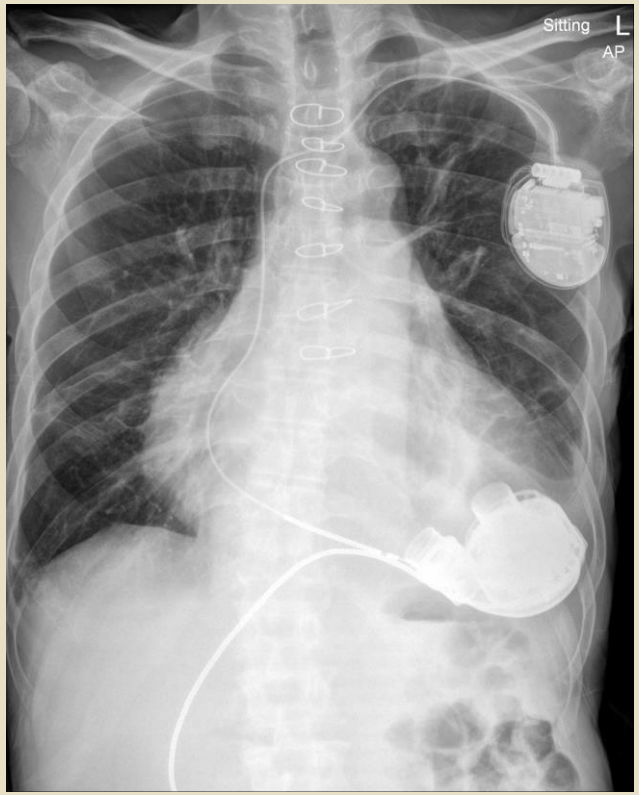


Patient course

- POD 2month – admitted, rehabilitation
- Weigh gain

- HT waiting ?





Case summary

- RV failure after LVAD implantation
- temporary Oxy RVAD (VV ECMO, central cannulation)

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Non-PostCardiotomy

- AMI
- DCM
- Myocarditis
- others

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ECMO as a Bridge to Left Ventricular Assist Device or Heart Transplantation

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ECMO

for circulatory support

- Bridging therapy
  - ECMO bridged HT – poor outcome
- Korean medical insurance applies implantable LVAD 2018.09.28
- HM3 is available since 2020

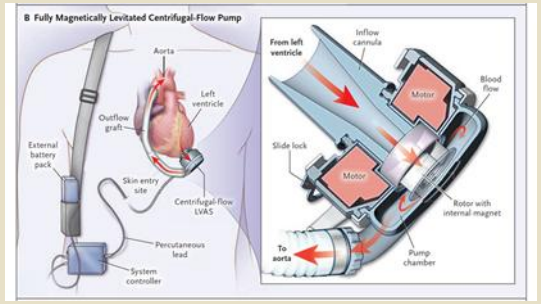
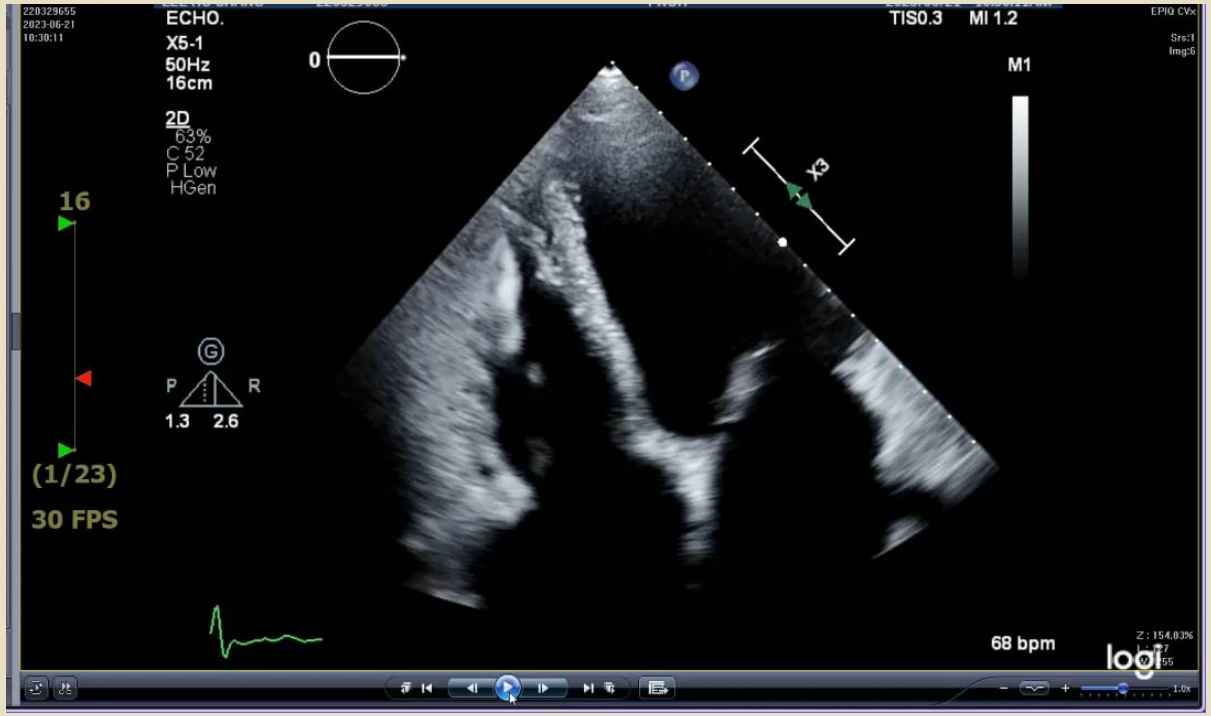


Table 13.1 Terms describing various indications for mechanical circulatory support

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.

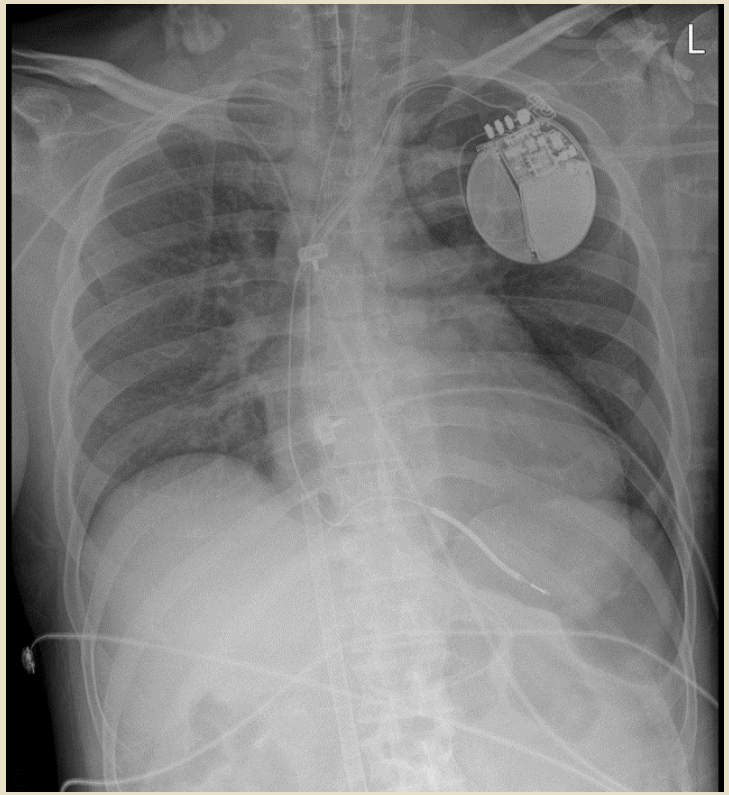
Case 2

- M/45, A+, 168cm, 68kg
- HFrEF, DCMP, EF 22% - diagnosed at 2014
- missed OMT due to his Job
- delayed to workup for VAD or HT
- admitted for evaluation 2022.06.20
- severe biventricular dysfunction



VA ECMO support

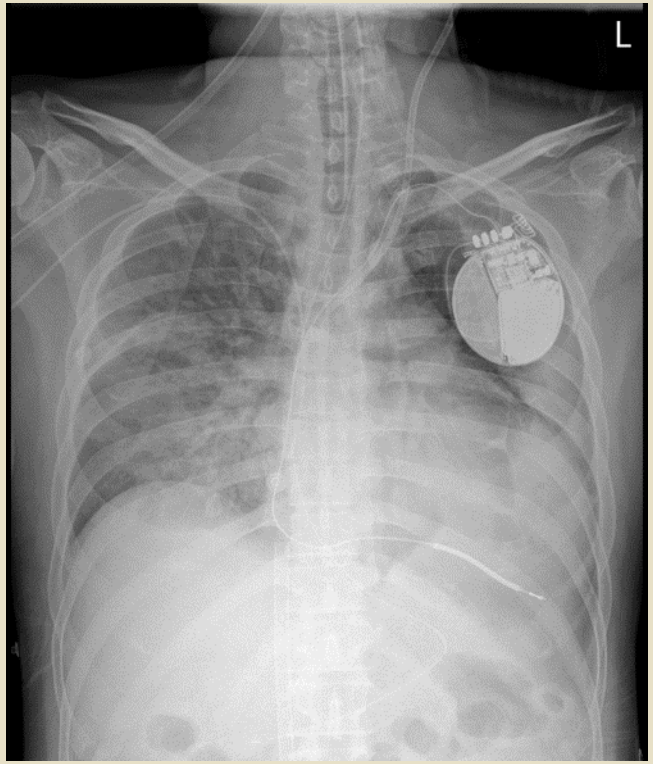
- sudden collapse in general ward
- intubated
- VA ECMO insertion in Cathlab
- RFA – 17 Fr arterial
  - Distal perfusion
- LFV – 23 Fr venous
- EBS neo
- initial flow 3.0 L/min
- HT listing



Patient course, ECMO day 4

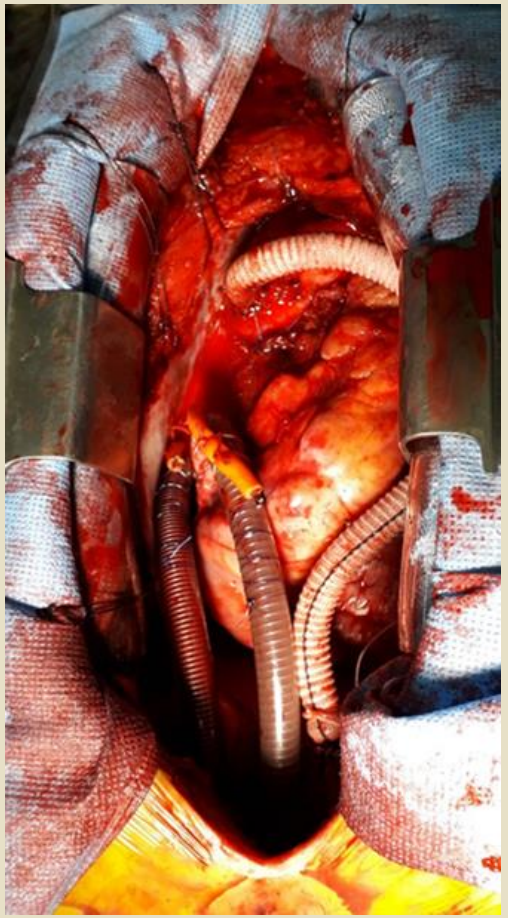
- severe pulmonary edema
- combined pneumonia
- multi-organ failure

- de-listing HT
- plan to convert central ECMO
  - For long-term support
  - Mobilization
  - LV unloading



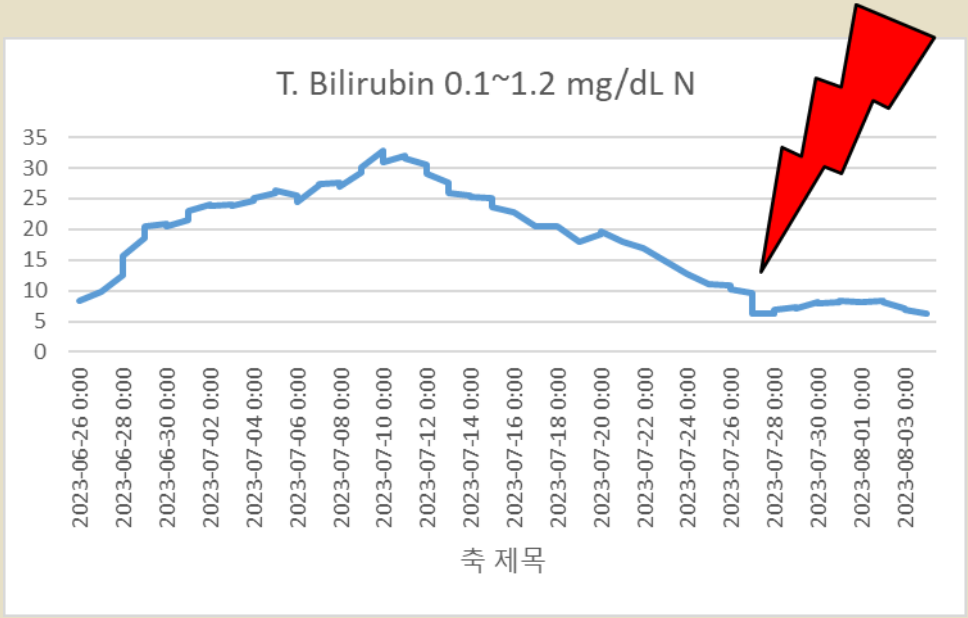
Central ECMO

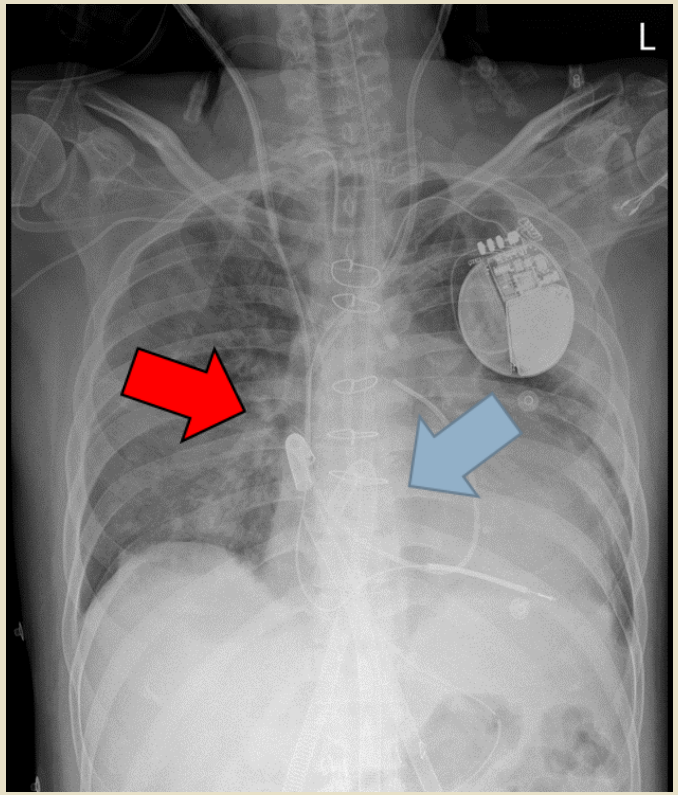
- LA - venous curved metal 24 Fr
- RA – venous curved 28 Fr
- ascending aorta – 10 mm graft
- PLS
- initial flow 4.5 L/min
- RA – 3.5 L/min, LA 1 L/min



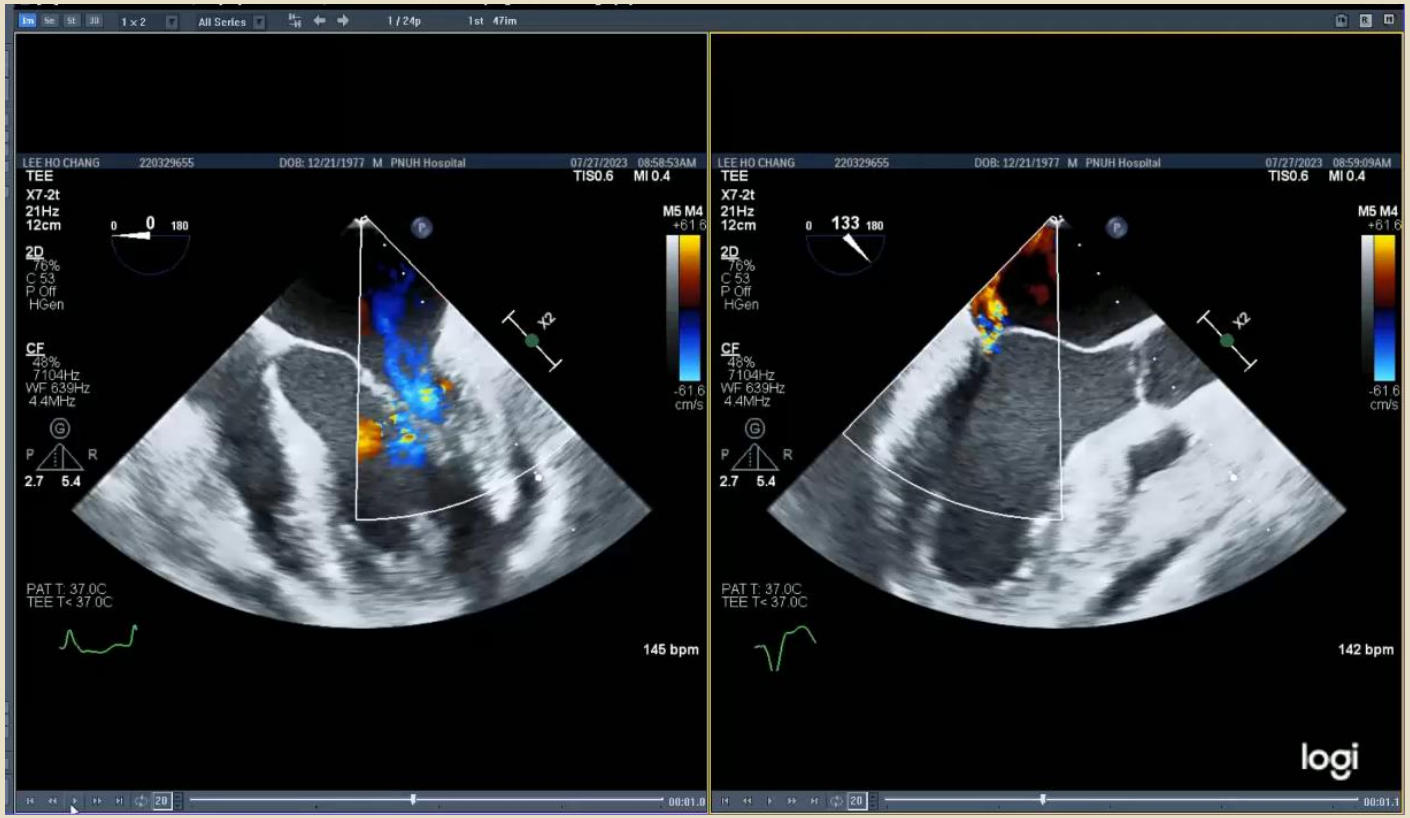
Patient course

- Tracheostomy
- nutrition, rehab
- pneumonia, on going liver failure



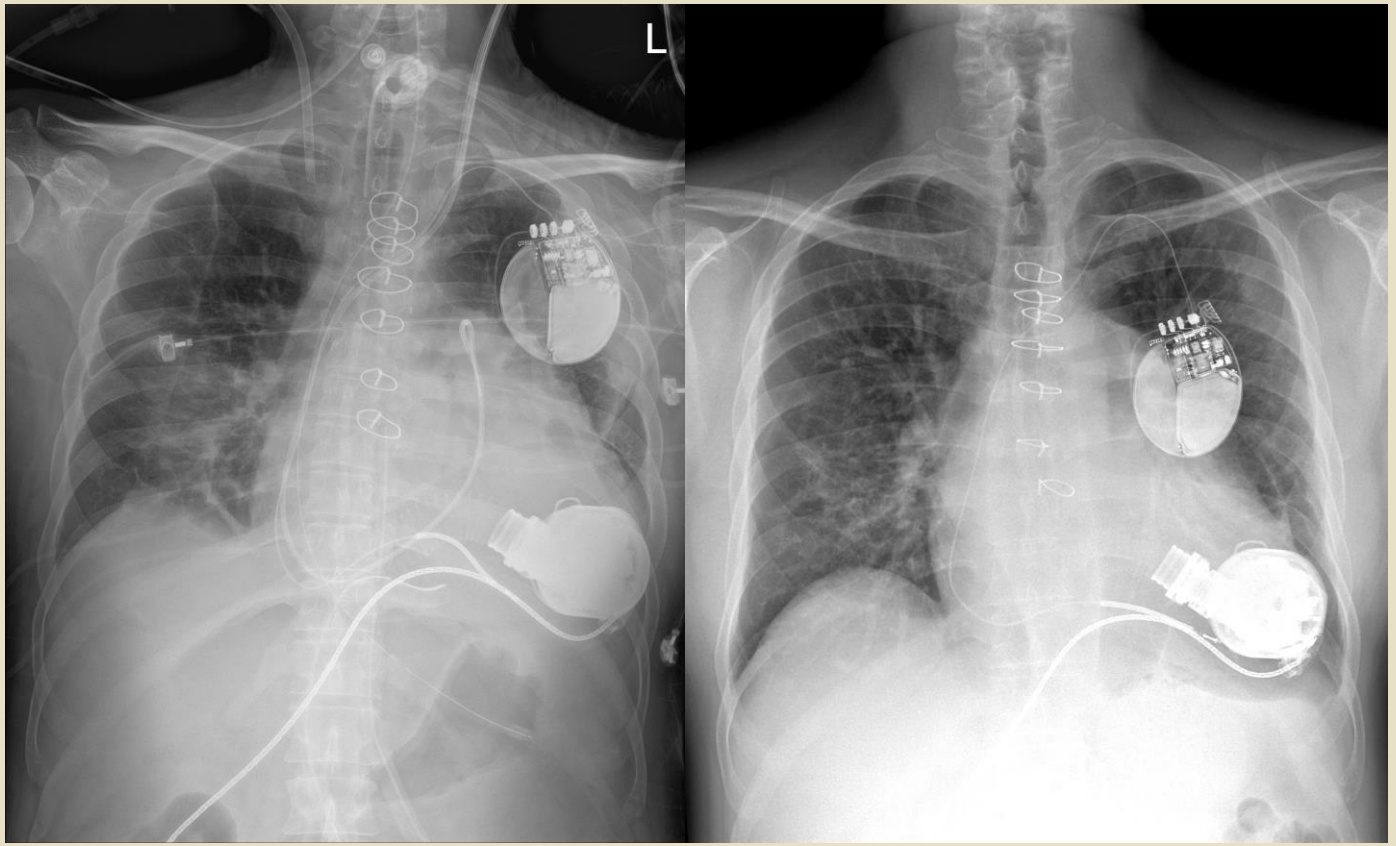


LVAD implantation with HM3
Bridge to bridge, ECMO day 34



Patient course

- POD 22 general ward transfer
  - With home ventilator
  - rehabilitation
- Discharge after 2.5 month
- Waiting HT under healthy condition
- Back to work



Case summary

- Bridge to LVAD or HT
- Effective flow, LV venting, Mobilization
- Evaluate lung and RV function strategy (remove RA drain / oxygenator)

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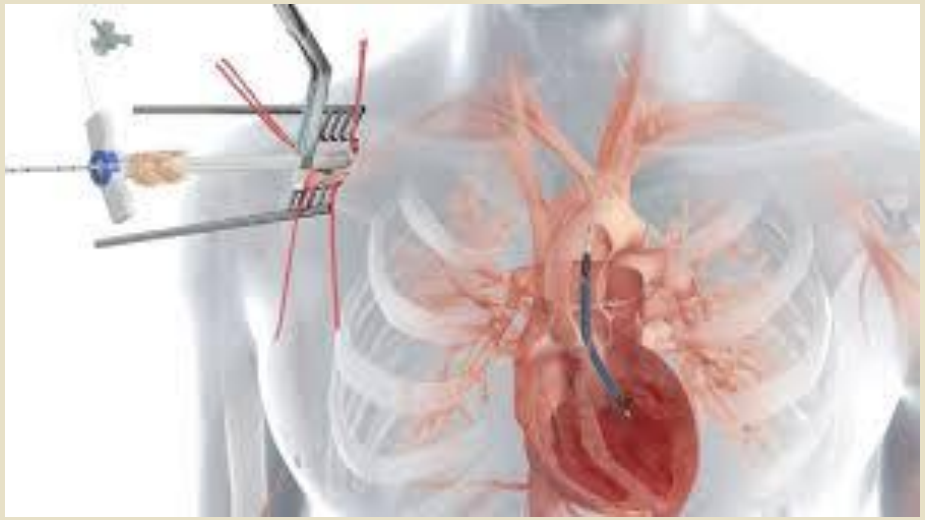
Axillary cannulation

- "Sport model"
- Impella 5.5



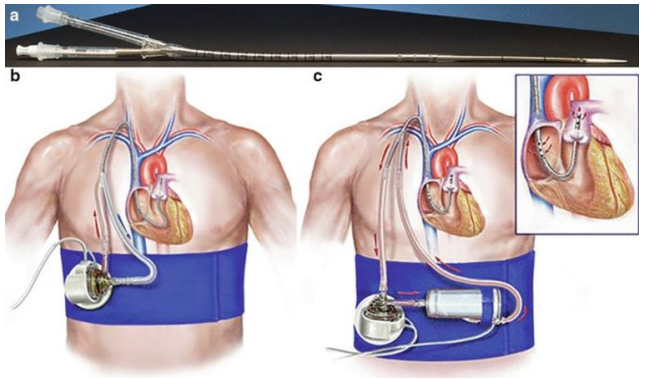
Axillary artery	Avoidance of leg ischemia	Upper limb compartment syndrome
	Avoidance of harlequin (north/south) syndrome	Upper limb HPS (with graft interposition)
	Patient mobility if prolonged support (bridge-to) required	Higher bleeding risk (site of cannulation)
	Visualization of peripheral vessel and appropriate cannulation site	Higher cerebral embolic risk
	Reduced bleeding than central access	Lower ECMO flow (limited right chamber unloading)
	Closed sternum	Retrograde flow[d]
	No cardiac compression	Higher rate of vascular complications
		Time-consuming

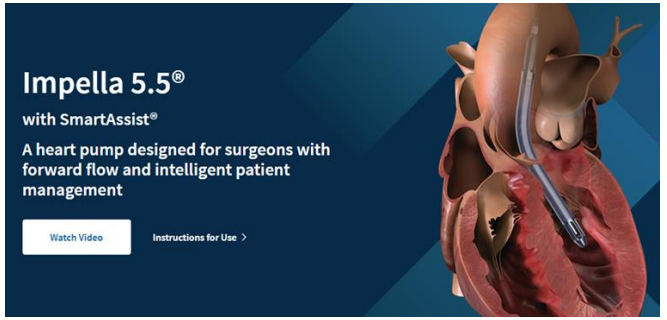
Summary

- Central VV ECMO (oxy-RVAD)
  - RV failure after LVAD
  - Bridge to lung transplantation combined with RV failure

- Central VA ECMO
  - bridge to LVAD or HT
  - for long-term, mobilization

THANK YOU FOR YOUR ATTENTION





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