CARDIOLOGY 2025

Mechanical Circulatory Support
The Road to Explant

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February 21, 2025

Children's Hospital of Philadelphia®
Cardiac Center

VENTRICULAR ASSIST DEVICE

Berlin Heart EXCOR ®

- 2008 approved for an investigational device
- 2011 approved for pediatrics

HeartMate 3

- 2017 Approved
- patients >25 to 30 kg
- Timely implantation
- Preserve & recover end-organ function

Increased focus on post-implant management

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WHO

Myocarditis

Dilated Cardiomyopathy

Tachyarrhythmias

Mechanical unloading VAD → myocardial recovery

WHO

VAD Explants UNCOMMON

1% Adults (126)

Limited Pediatric info ~35 patients

Higher Likelihood for Myocardial Recovery

- < Age
- < Duration
- Non-ischemic CM
- Medications
- Surveillance
- Weaning Protocols

“Myocardial recovery exists, but one must look for it and strive to obtain it”

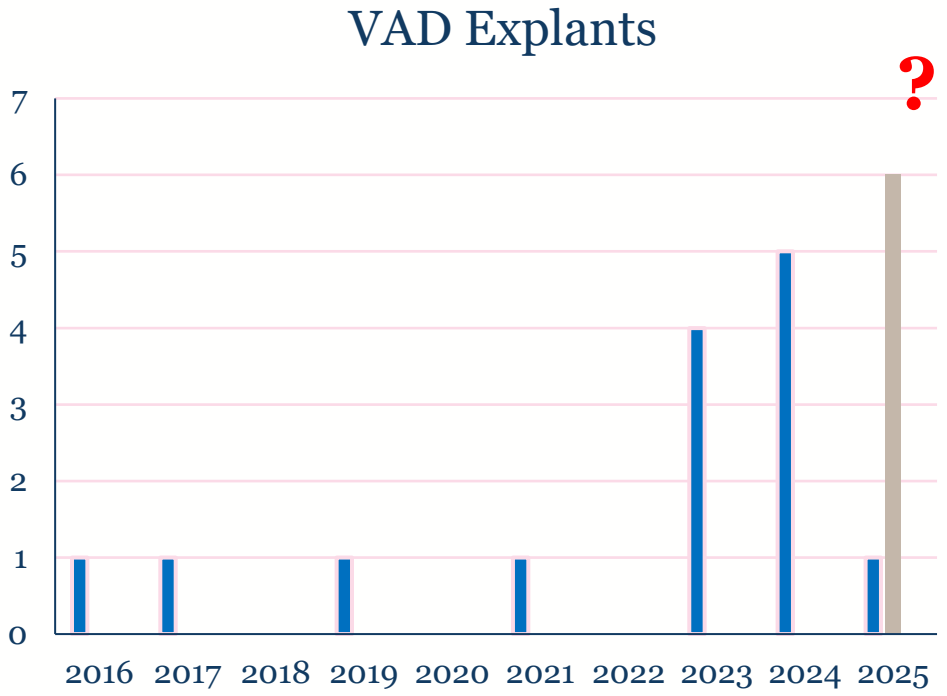
WHO

CHOP Explants

2016 - 2022 3 patients

2023- 2025 10 patients

- Age 10 months- 17ys
- DCM (5)
- Myocarditis
- ALCAPA
- Ischemic CM
- Tachycardia induced CM (2)



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WHAT CHANGED

- Myocardial Function Recovery (MFR) is possible
  pt < 2yrs with Goal Directed Medical Therapy
  Vigilance

- Bivalirudin significantly lower hospital mortality, is cost-effective therapy used in 90% pediatric VADs

- Early VAD patients had significantly higher survival rate as compared to ECMO

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WHO

1. All patients are candidates for recovery
2. Attention to reverse modeling
3. Protocolized Assessment
4. Regular Review

REVERSE MODELING MEDICATIONS

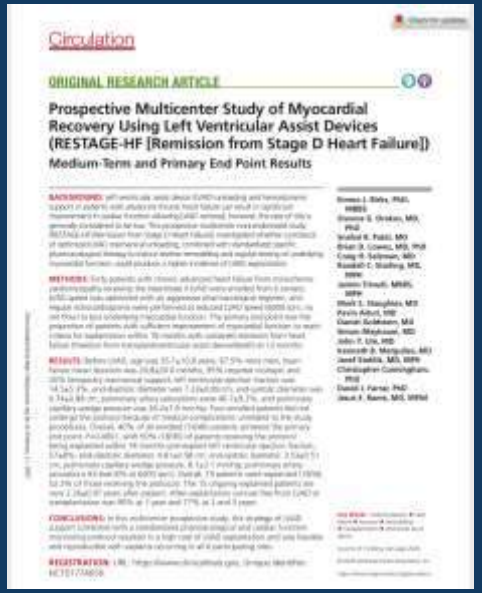
Goal of Cardiac Remodeling Medications

- Ventricular Dilation
- Fibrosis
- Contractility

Guideline-Directed Medical Therapy (GDMT)

- Beta-Blocker
- ACEi or
- ARB or
- ARNi
- Plus: Aldactone, Digoxin, SGLT-2 Inhibitor

GUIDELINE DIRECTED MEDICAL THERAPY

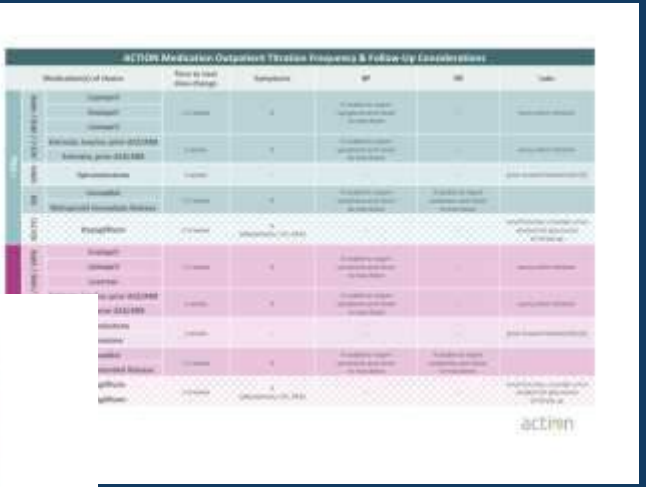


Circulation

ORIGINAL RESEARCH ARTICLE

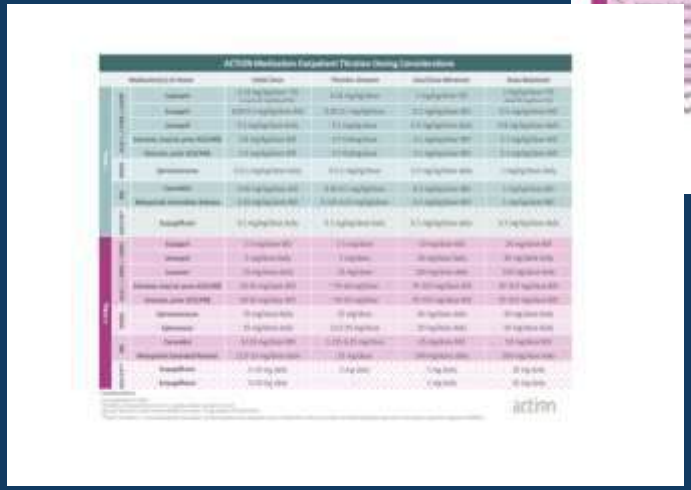
Prospective Multicenter Study of Myocardial Recovery Using Left Ventricular Assist Devices (RESTAGE-HF [Remission from Stage D Heart Failure])

Medium-Term and Primary End Point Results



ACTION Medication Outpatient Titration Frequency & Follow-Up Considerations

actinn



actinn

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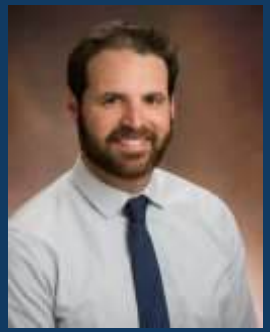
VAD PROTOCOLS

VAD Weaning Protocols
April 2023
Systematic approach
Determine readiness

1.Berlin ECHO Turndown Protocol
2.Berlin Cath Turndown Protocol
3. HeartMate3 Explant Protocol

Catherine Montgomery

Carol A. Wittlieb-Weber, MD



Jonathan B. Edelson, MD

Lynne Ha

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VAD TURNDOWN

Eligibility Criteria

- Monthly ECHOs
- Good Function = Consecutive weans, monthly checks
- LVEDD WNL Z score between -2 +2
- EF of 45% with <= mild dysfunction
- Lactate < 3
- No thromboembolism or bleeding Risk
- Anticoagulation at target

BERLIN PROTOCOLS

ECHO Protocol

Anticoagulate
Stepwise VAD wean to 35bpm
Hold 3-5 minutes
ECHO / Lab checks
- Baseline
- Each VAD wean
- At 35 BPM, sit 10 min

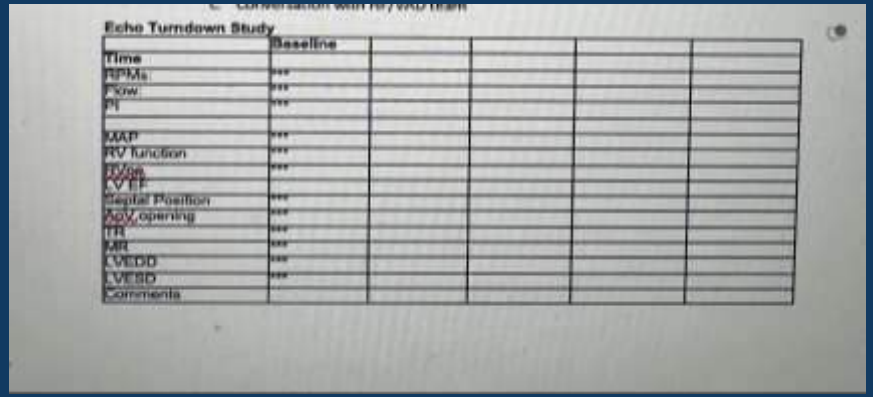
Cath Protocol

Anticoagulate
Stepwise VAD wean to 35bpm
Hold 3-5 minutes
ECHO / Lab checks PLUS
RH Cath Hemodynamics + lactate, SVO2
- Baseline
- Each VAD wean
- At 35 BPM, sit 10 min

Turn VAD OFF
Perfusion Hand pumps 6 bpm – wait 15 min
ECHO, RHC

HM3 WEANING PROTOCOL

1. **ECHO**
   6wks-2 months post VAD)
   Min 4000 rpms
2. **Exercise**
   1-2months post ECHO)
   Failure =Symptomatic
   Hypotension
   Ectopy
   Decreased function, MR
3. **Cath**
   Goal < 1LPM without flow reversal



Echo Turndown Study

	Baseline				
Time					
RPMs	***				
Flow	***				
PI	***				
MAP	***				
RV function	***				
[illegible]	***				
LVEF					
Septal Position	***				
AoV opening	***				
TR	***				
MR	***				
LVEDD	***				
LVESD	***				
Comments					

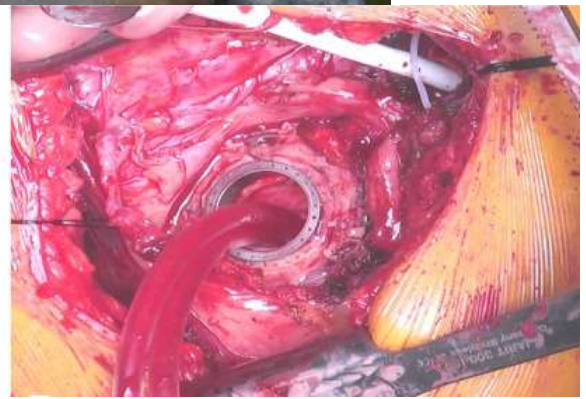
EXPLANT PREPARATION

Dedicated Team
- Surgeon /Surgical Team
- Cardiologists
- Nursing
- Perfusion
- Anesthesia
- ECHO

Pre Explant Review Meeting
- Coordination
- Explant Team Huddle
- Surgical Consent
- Risks

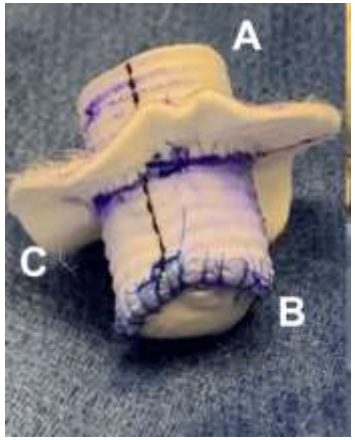
SURGERY

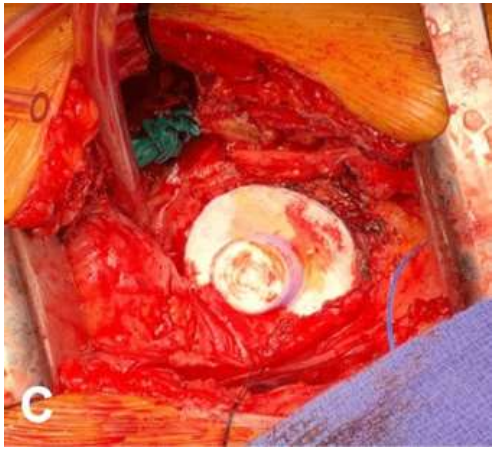
Sternotomy or Left anterior thoracotomy
ECHO
Heart Inspection
Bypass
VAD OFF
Disconnect outflow
Remove Inflow
Repair LV
Hemostasis



SURGERY LV REPAIR

LV Apex Repair
- Primary
- Patch
- Plug





HM3 PLUG

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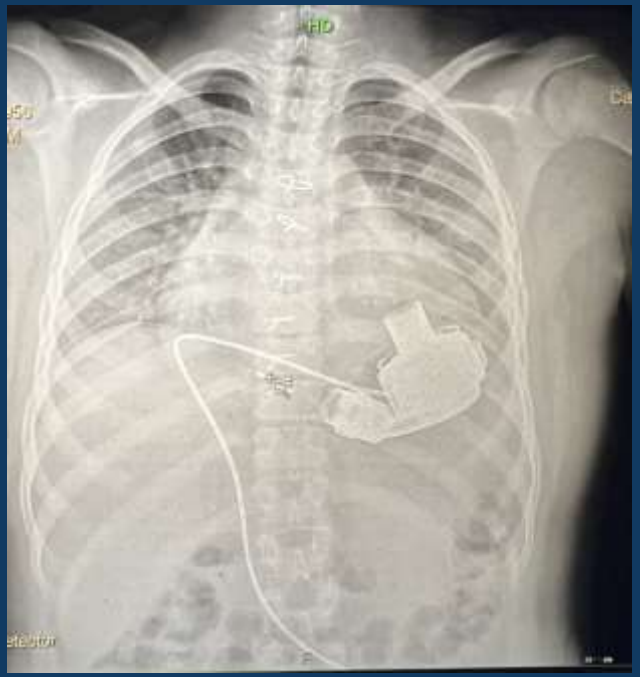
2019



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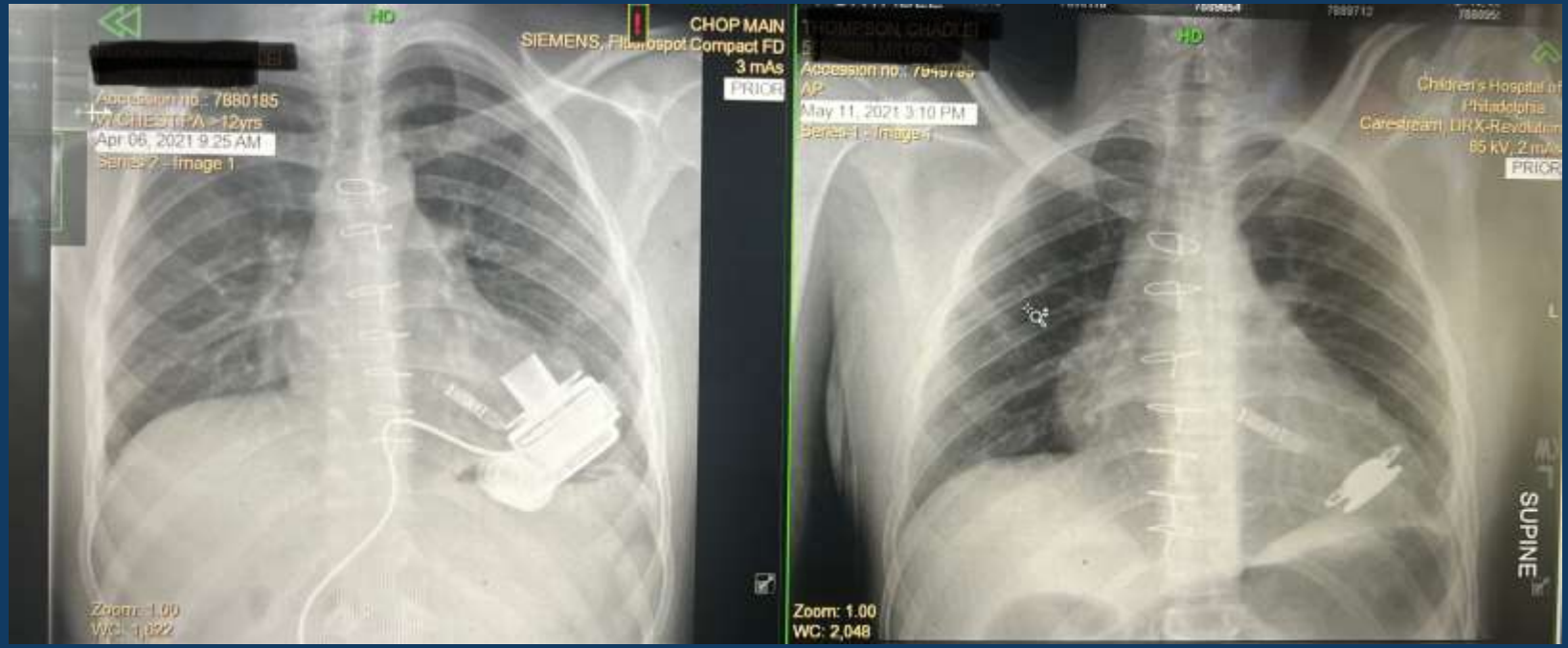
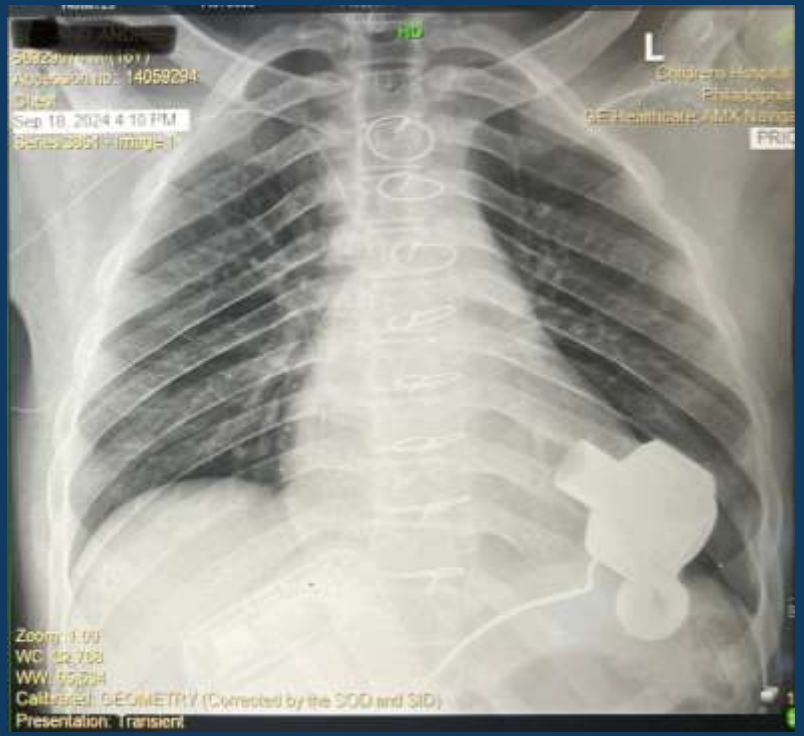
2021



CARDIOLOGY 2025

2024



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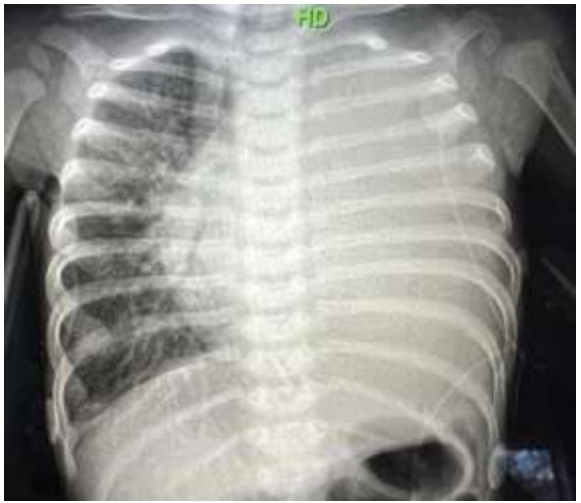
PRESENTATION & DIAGNOSIS

6 month old female New onset Heart Failure:

- tachycardia, tachypneic
- wt loss
- decreased urine
- troponin leak
- BNP >5000
- elevated Bun/Cr, AST, ALT
- Wide complex rhythm with LBBB pattern
- ECHO, CT, Consult



Day 2 Intubated
Discussed VAD
Chronic Resynchronization Therapy (CRT)

SURGERY & POST OP

Day 3	SURGERY
	VAD (10cc Berlin) Bypass 99 min
==========	==========
POD 1	iNO, epi, dopa, milrinone
	ECHO
	LV decompressed; good function
POD 2	Extubated, Bivalirudin
POD 3 – 15	Off EPI/Dop/iNO
	ON sildenafil, Aldactone, Carvedilol
	Transfer to Cardiac Step Down

VAD TURNDOWNS AND EXPLANT

2 months Post VAD

→ **ECHO turndown**

Ongoing wide QRS with LBBB
Planned CRT

→ 3.5 months post VAD
CATH Turndown

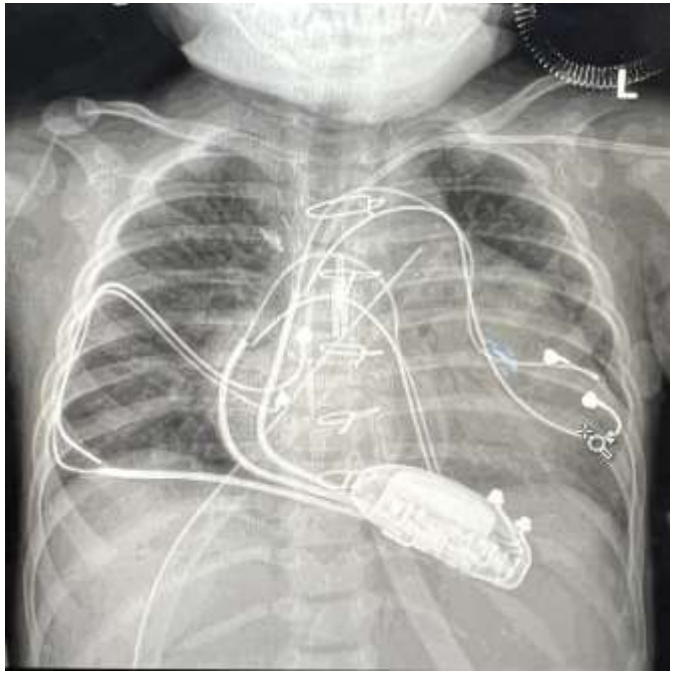
→ 5.5 moths Post VAD
EXPLANT + CRT

POST VAD EXPLANT

POD 1 Extubated

POD3 ECHO
NL LV function, mildly decreased ejection
paradoxical septal motion
Normal RV size and systolic shortening

POD 21 Discharged
ECHO: Mild dilatation of LV
NL LV systolic shortening
Continue Cardiac Remodeling Medications
Aldactone/ Enalapril/ Carvedilol
DDD 80-180



POST EXPLANT

Early VAD placement
Medication Protocols
VAD Wean Protocols
CRT at time of VAD removal

Follow-up
Regular Clinic Visits
Medications
ECHO
Surveillance

STEPS FOR SUCCESS

Commitment to Change
Dedicated Teams
Guideline Directed Medical Therapy
Standardized weaning protocols
Active surveillance
Serial cardiac imaging
Regular Explant Review
Structured rehabilitation program

ROAD TO EXPLANT

Active surveillance
Guideline Directed Medical Therapy
Standardized weaning protocols
Concerted effort

Thank you

REFERENCES

- REFERENCES

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