Cardiogenic Shock
Biventricular Heart Failure Advanced
Treatment Options at The Cleveland Clinic

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I have no disclosures.
OVERVIEW

• Examine respiratory and heart failure due to Influenza A.

• Explore surgical treatment options.

• Review case study summary with emphasis of perfusion techniques.
Influenza A is No Laughing Matter

A sick patient asked his doctor, "Flu?" The doctor replied, "No, I came on my bicycle actually!"

• Although rare, viruses such as Influenza A can lead to fulminant lymphocytic myocarditis: widespread hemodynamic compromise and cardiac decompensation in a previously healthy patient.

• Early death can ensue unless advanced treatment is pursued such as implantation of an extracorporeal circulatory support system to aid in cardiac recovery.
Surgical Options

• Provisional placement of a BiVAD can be used as a bridge to recovery of ventricular function.

• In most cases ventricular recovery can be expected within several weeks of onset.

• Time of implantation, device selection, and perioperative strategy must be considered before multiorgan failure occurs.
Device Selection

IABP with AV ECMO

Biventricular Assist Devices

Thoratec BiVad
Side by Side Rotoflows
Case Report

• A 20 year old male patient was transferred to CCF in respiratory failure after a 4 day regimen of Tamiflu for Influenza A.

• Upon arrival the patient was found to have:
  • Severe biventricular failure
  • Resting heart rate of 150 beats/min
  • Ejection Fraction of 5-10%
Day 1: Transferred to CCF, AV ECMO, IABP

Day 3: BiVAD placement, PFO closure

Day 5: UNOS status 1A, Heparin stopped due to Diffuse coagulopathy

Day 7: Milestone 3

Day 8: Milestone 4

Day 9-12: Milestone 5

Day 13-17: Milestone 6

Day 22: Milestone 7

Day 36: Milestone 8

Milestone 1: Patient Discharged

Milestone 2: LVAD stops flowing and is removed

Milestone 3: HIT Diagnosis, UNOS status upgraded 1A, Extubation, RVAD cannula changed

Milestone 4: Heart Transplant

Milestone 5: Heparin restarted, patient extubated, UNOS status downgraded to 1B

Milestone 6: UNOS status 1A, Heparin stopped due to Diffuse coagulopathy

Milestone 7: Transferred to CCF, AV ECMO, IABP

Milestone 8: BiVAD placement, PFO closure

Chest washout, consider UNOS, Myocardial recovery: LVEF=30%
Upon Arrival:

Emergently placed on AV ECMO:
- 24fr cannula to Right Femoral Vein
- 20fr cannula to Right Femoral Artery

IABP Placement:
- Needed to further unload the LV
- Decreased HR from 150 to 120 bpm

Day 1: Transferred to CCF, AV EVMO and IABP placed
Day 3: BiVAD Placement, PFO closure
Day 5: chest washout, consider transplant listing
Day 7: myocardial recovery, LVEF= 30%
Proper Planning Prevents Poor Perfusion

BiVAD bridge to transplant utilizing the existing AV ECMO circuit

IABP and AV ECMO support did not provide LV or RV recovery
Vasopressin required due to vasoplegia
LVEF = 5%
Normal ventilator settings proved full lung recovery

Day 1: Transferred to CCF, AV EVMO and IABP placed
Day 3: BiVAD Placement, PFO closure
Day 5: chest washout, consider transplant listing
Day 7: myocardial recovery, LVEF= 30%
Discovery of a 5mm PFO created two options for oxygenator placement

**Right side** in the event of flow reversal causing a right to left shunt
- *Do not go on CPB or close PFO*

**Left side** with hopes of weaning from the LVAD sooner
- *Full heparin, CPB, close PFO*

Existing circuit with oxygenator placed on the left side

LVAD cannulation: 32fr cannula to apex, 8mm Gelweave to aorta

RVAD cannulation: 24fr femoral vein, 8mm Gelweave to PA

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**Day 1:** Transferred to CCF, AV EVMO and IABP placed

**Day 3:** BiVAD Placement, PFO closure

**Day 5:** chest washout, consider transplant listing

**Day 7:** myocardial recovery, LVEF= 30%
To Transplant, or Not To Transplant? That is the Question.

Hope for biventricular recovery with time and side by side Rotoflows

Possible ventricular recovery with supportive care
Progress in one week or UNOS heart transplant listing

Day 1: Transferred to CCF, AV EVMO and IABP placed
Day 3: BIVAD Placement, PFO closure
Day 5: chest washout, consider transplant listing
Day 7: myocardial recovery, LVEF= 30%
Listed as UNOS status 1A and diffuse bleeding
Ventricular recovery minimal, transplant needed
Significant bleeding from PA graft cannulation site
Heparin stopped, platelets transfused

LVAD abruptly stops flowing
No clots found in LV after decannulation
LVAD is removed, improved LVEF to 25%
RV function still impaired

Day 8: UNOS list 1A, diffuse coaguopathy, heparin stopped
Day 9: LVAD abruptly stops flowing and is removed
Day 10: Heparin restarted, platelets given
Day 12: extubated, UNOS status downgraded to 1B
LV function improves, RV remains severely depressed
Continue RVAD supportive care
Attempt to wean pressers and inotropes
Consider IABP for support of LV

Hope for continued recovery
Extubation
UNOS status downgraded to 1B
HIT diagnosis made
  Precipitous drop in platelet count, PF4 positive
  Heparin stopped, Bivalirudin started
No right ventricular recovery or progress observed
  UNOS status upgraded to 1A
A suitable donor found
  7 days after being upgraded from 1B to 1A a heart transplant was performed

**“HITs” Hard**

**Day 13:** HIT diagnosis, bivalirudin started

**Day 15:** UNOS status changed to 1A

**Day 17:** extubation, RVAD outflow cannula changed

**Day 22:** Heart Transplant
The patient received a heart transplant 22 days after admission.

Strict anticoagulation policies adhered to

Therapeutic bilvalirudin blood levels achieved and maintained throughout CPB to prevent clot formation.
Time To Check Out

🌟 Milestone 8
Patient Discharged
Day 36
**Patient Care Timeline**

**Milestone 1**
Transferred to CCF, AV ECMO, IABP

**Milestone 2**
BiVAD placement, PFO closure

**Milestone 3**
UNOS status 1A, Heparin stopped due to Diffuse coaguopathy

**Milestone 4**
LVAD stops flowing and is removed

**Milestone 5**
Heparin restarted, patient extubated, UNOS status downgraded to 1B

**Milestone 6**
HIT Diagnosis, UNOS status upgraded 1A, Extubation, RVAD cannula changed

**Milestone 7**
Heart Transplant

**Milestone 8**
Patient Discharged

Day 1

Day 3

Day 5

Day 7

Day 8

Day 9-12

Day 13-17

Day 22

Day 36
Take Home Points

• Successful outcomes arise from immediate team intervention and the ability to identify the problem.
• Aggressive treatment.
• Early UNOS transplant listings offers more possibilities for specific patient management.

• This was a tremendous case from a student perspective. The team collaboration and complexity of treatment offered an opportunity to use my entire skill set thus far.
Thank You! Yes Questions???