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Big Things Don’t Fit in Small Spaces

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Cardiology 2018

Disclosures

No financial relationships to disclose

Big Things Don’t Fit in Small Spaces

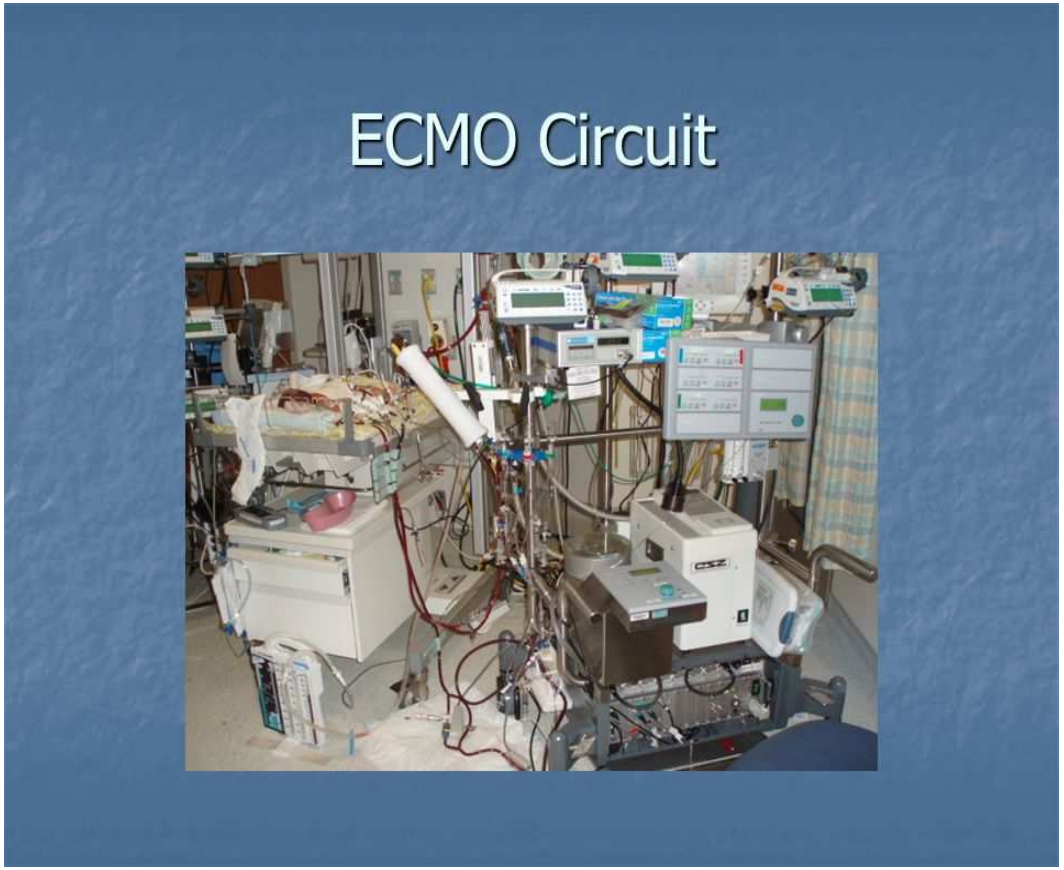
Pediatric Challenges

- Size of MCS for proper fit and function
- Limited pediatric experience with device
- Limited certified pediatric centers
- Device modification for complex congenital anatomy
- Anticoagulation protocols for children
- Cost


Hearts will never be practical until they can be made unbreakable.
But I still want one.

Types of MCS

- ECMO
- Short-term MCS
  - CentriMag
  - PediMag
  - Tandem Heart
  - Impella
- Longer-term MCS
  - BERLIN EXCOR
  - Heartware HVAD
  - HM II
- TAH



Short-Term MCS Options

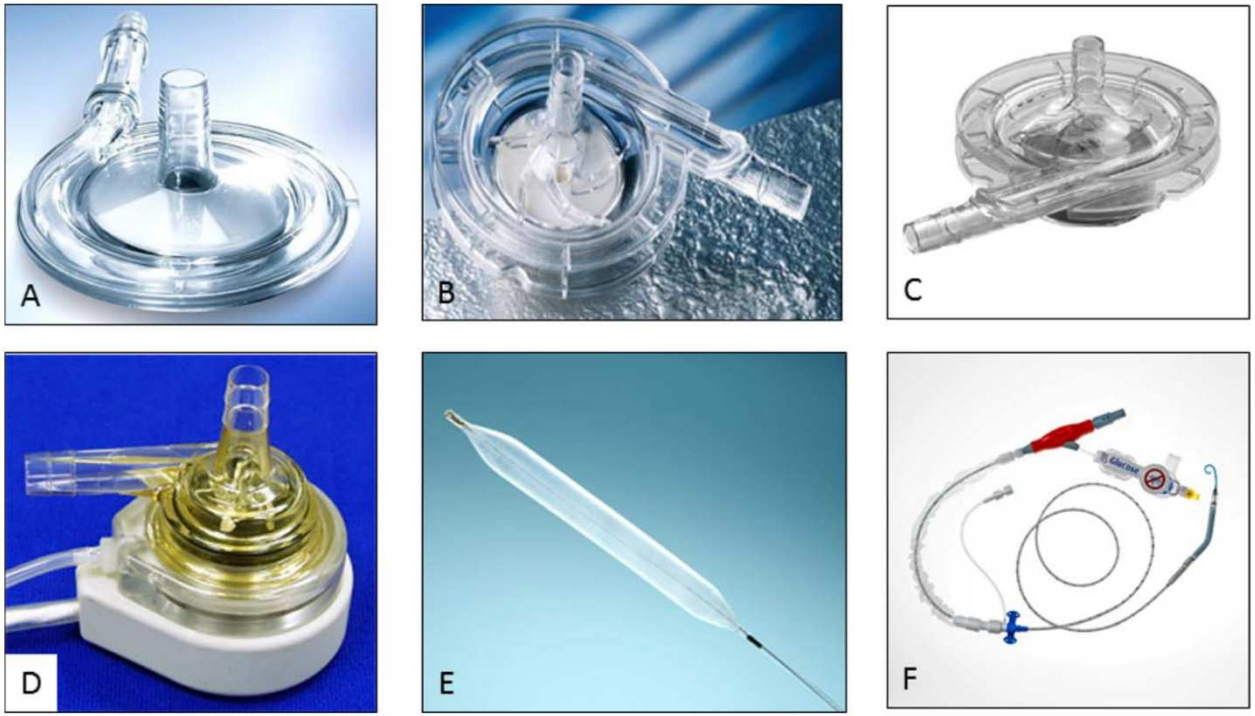


FIG. 2. Short-term mechanical assist devices. (A) Maquet RotaFlow (2); (B) Thoratec CentriMag (3); (C) Thoratec PediMag (2); (D) TandemHeart (2); (E) Pediatric intra-aortic balloon pump (98); (F) Abiomed Impella 5.0 (33).

Long-Term MCS Options

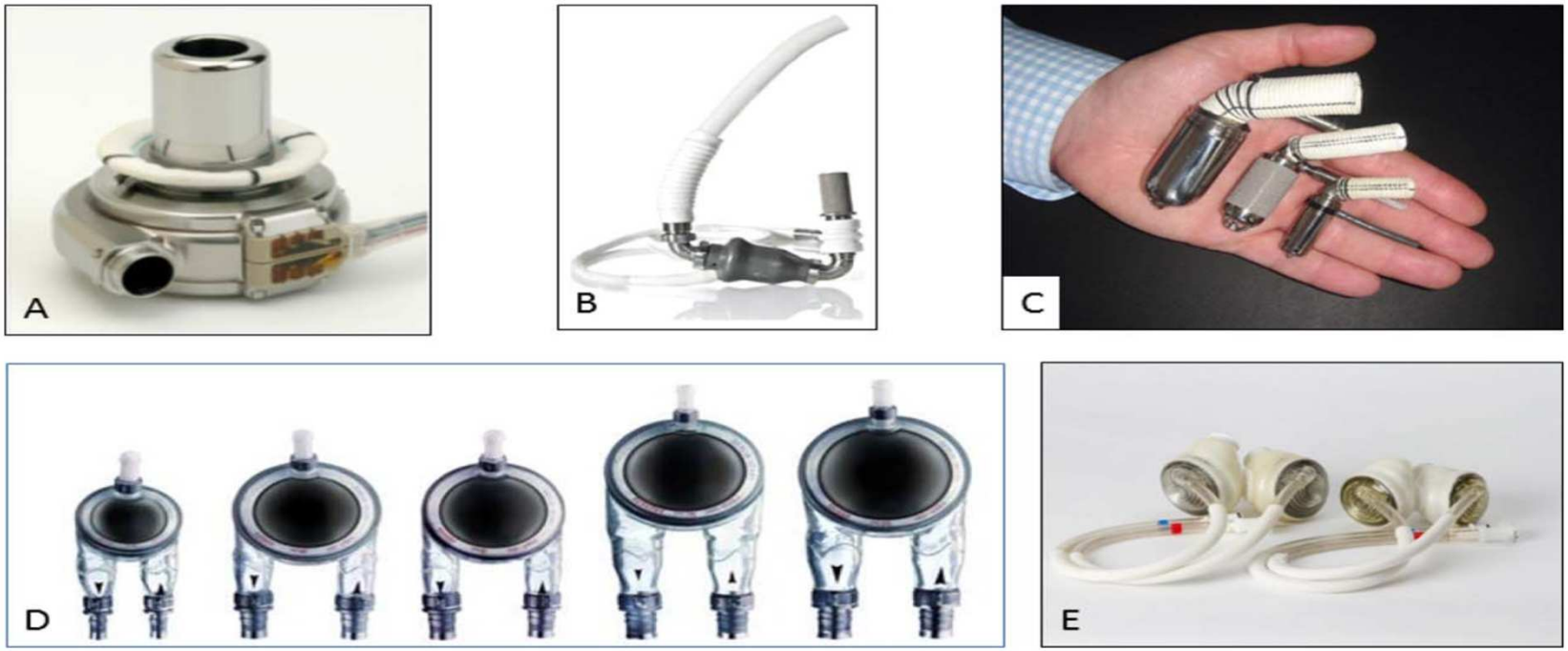


FIG. 3. Long-term mechanical assist devices. (A) HeartWare HVAD (2); (B) Thoratec HeartMate II (2); (C) Jarvik 2000: Adult VAD (left), Child VAD (middle), Infant VAD (right) (2); (D) Berlin Heart EXCOR (43); (E) Syncardia Total Artificial Heart (TAH), 70cc TAH (left), 50cc TAH (right) (60).

Total Artificial Heart: Implant at PCH

- 14 year old small male
- 50 kg and 152.4 cm = 1.5 m2 BSA
- Dilated cardiomyopathy
- Severe biventricular failure
- ECMO X 8 days with LV and
- aortic thrombi
- CT scan:
- 9 cm from T10 to sternum

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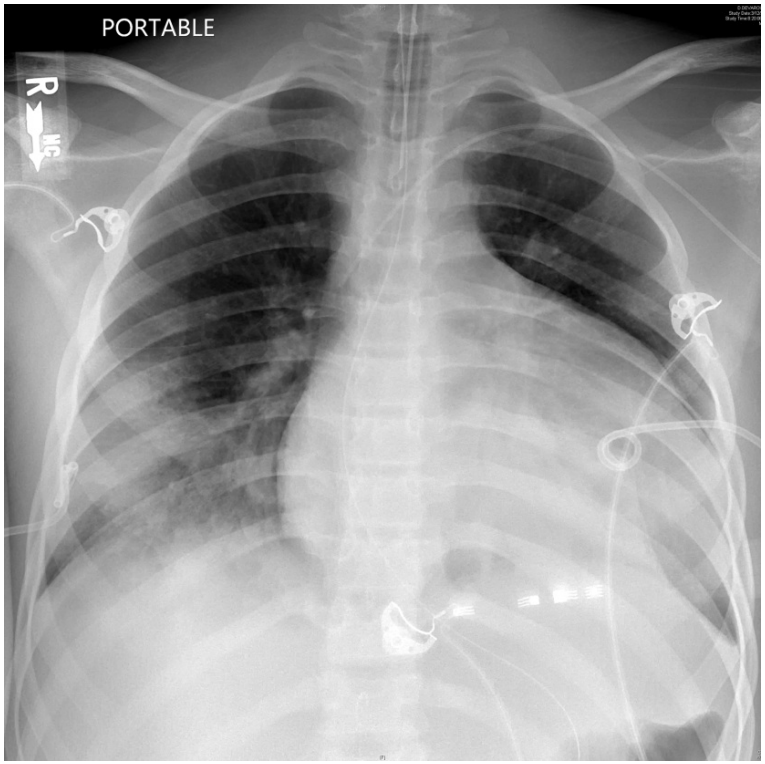

70 cc TAH: 10 cm, 1.7 m2 BSA

Pt: 9 cm, 1.5 m2 BSA (Too Small)

From: Park S et al. Total artificial heart in a small pediatric patient with biventricular heart failure

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Advantages of TAH

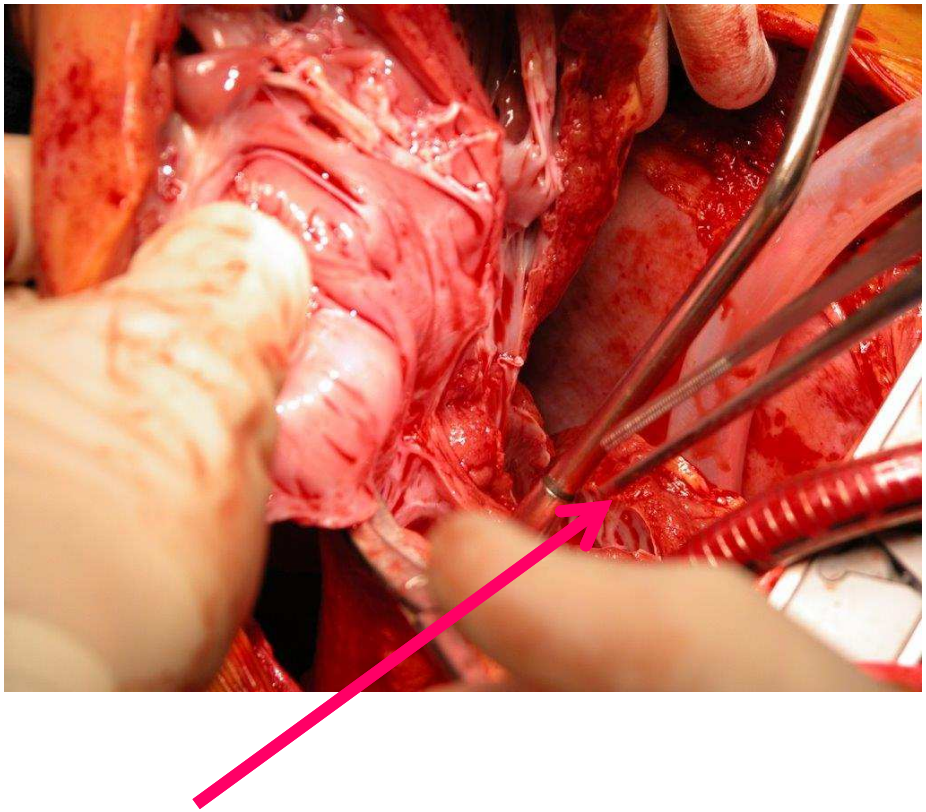
- Restores biventricular circulation
- End-organ recovery may be superior to other MCS types
- Decreased risk of thromboembolism
- Innovations:
  - 50 cc pump (women and adolescents)
  - Portable driver (13.5 lbs) can allow discharge home
  - Quiet

Innovations: Virtual Fitting

- Dr. Ryan and his team at PCH/ASU have done 102 virtual implants
- Spanning over 40 institutions and 7 countries
- Current multi-institutional trial: '3D Hearts Enabling a Randomized Trial' actively enrolling with PCH, CHOP, CNMC as lead sites
- More information and to get involved:

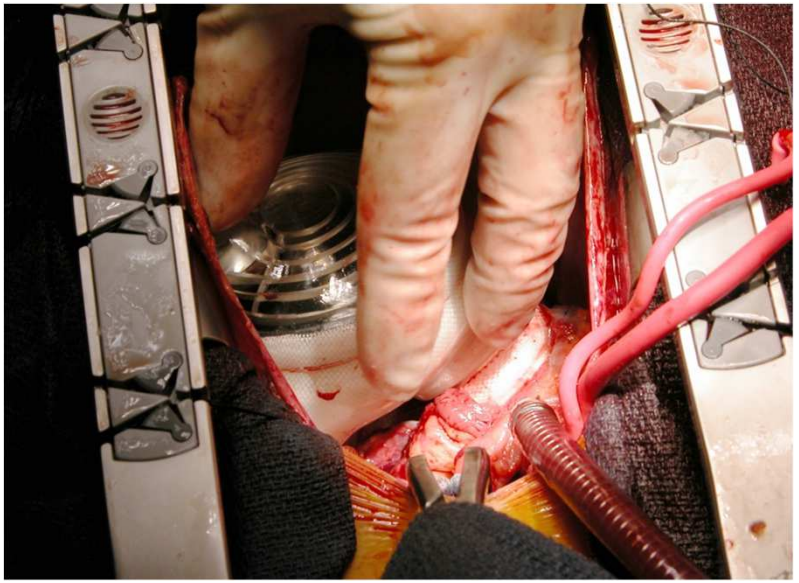
3dprintlab@phoenixchildrens.com

Total Artificial Heart: Implant at PCH



LV thrombi

Implanting – with help from 3D imaging



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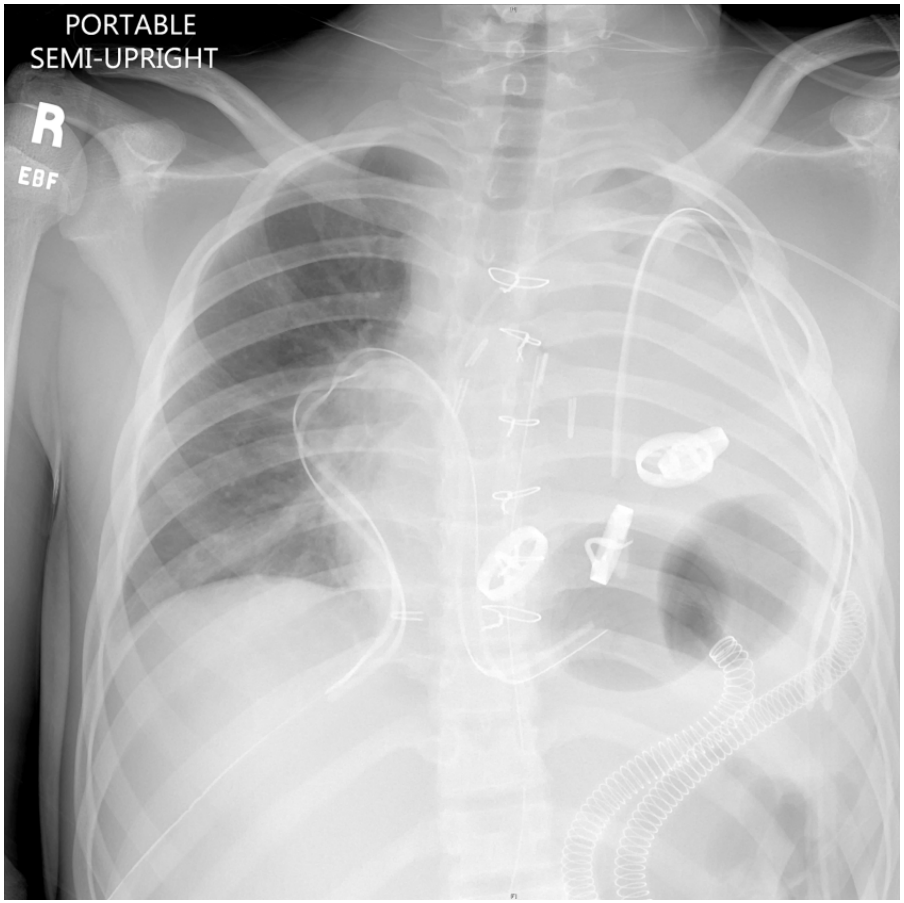
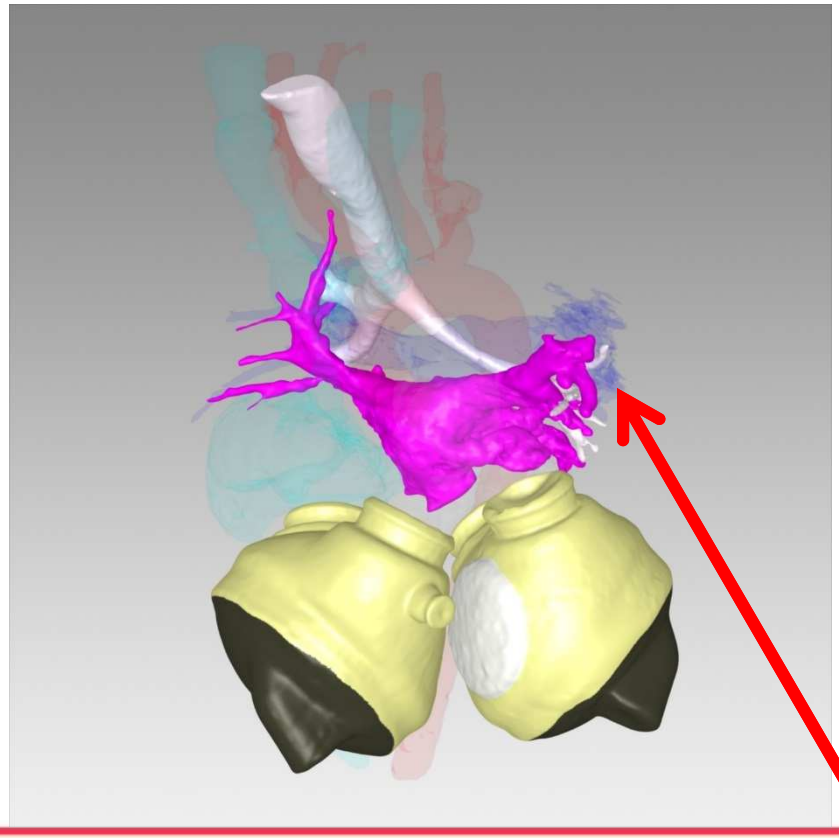
CXR Post-TAH Implantation

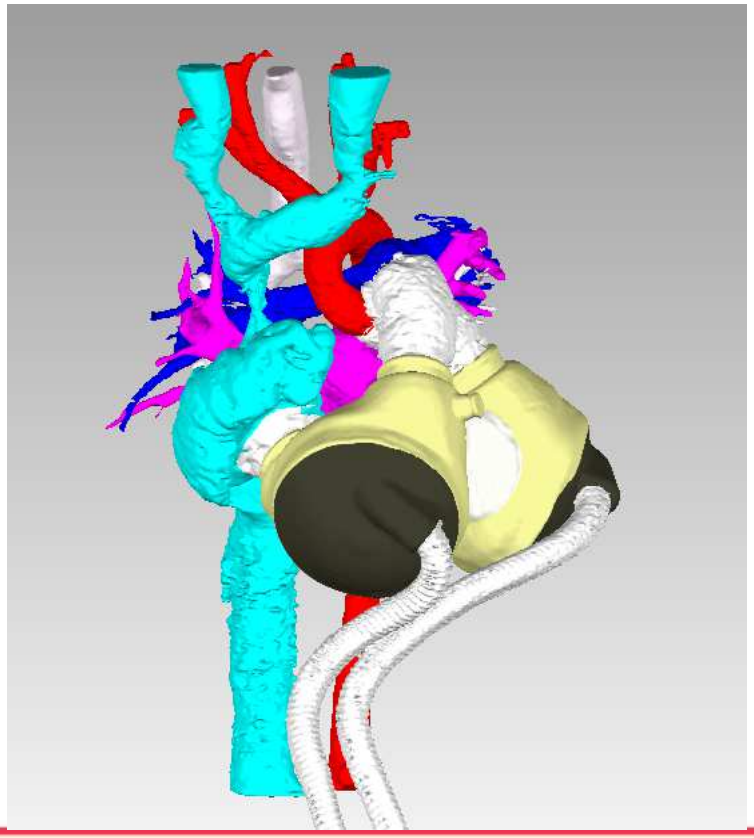


CXR showed 'white-out' of left lung

Question: What is cause?

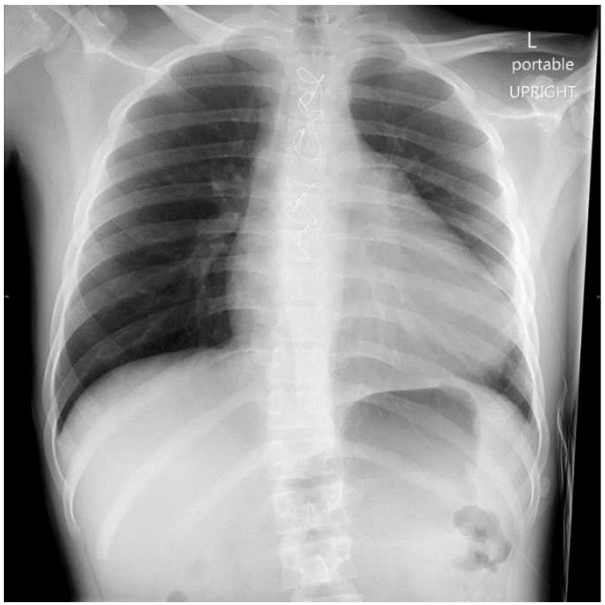
Innovations from PCH Implant



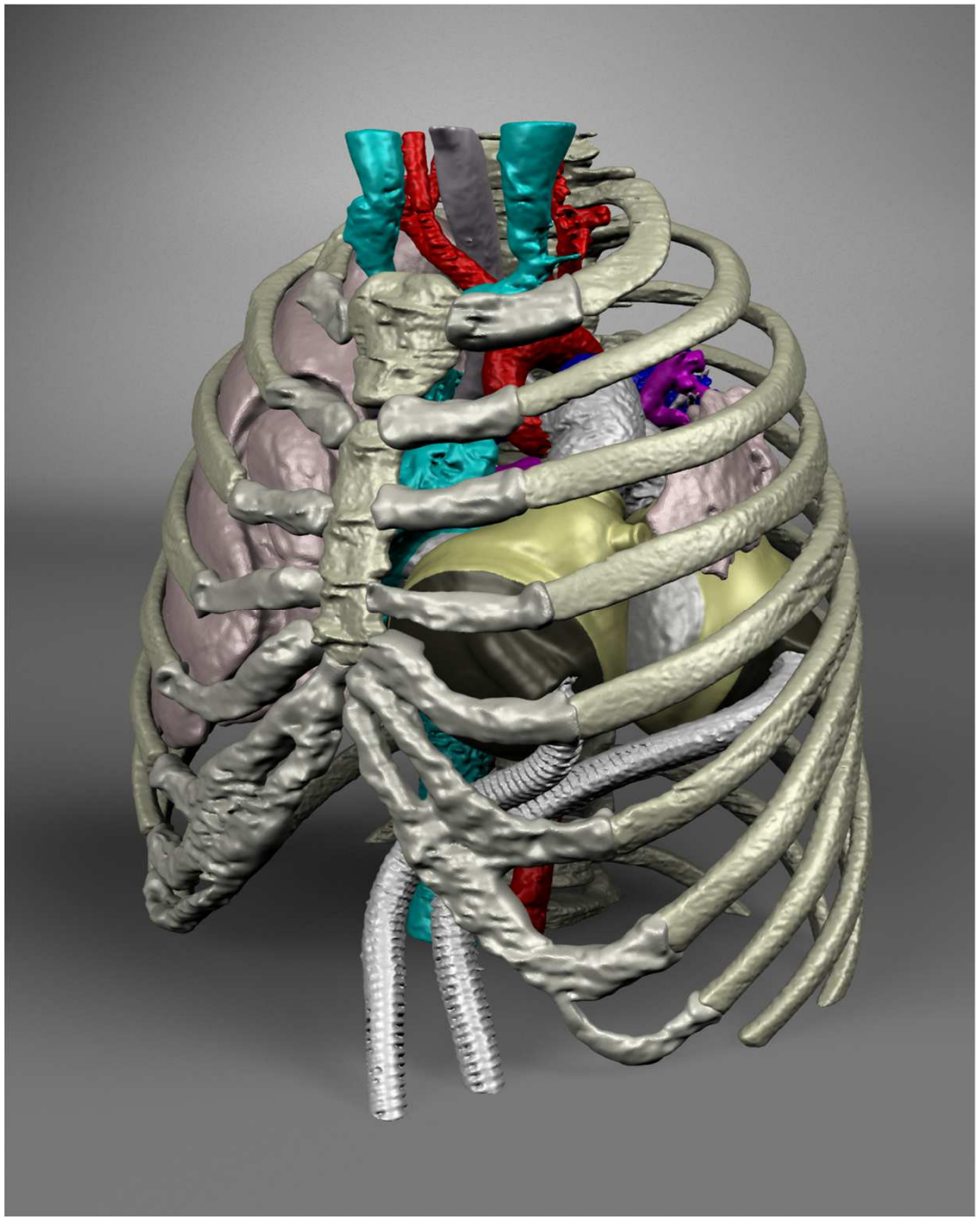


Unobstructed bronchi and pulmonary veins

Successfully Bridged to Transplant 12 Days After TAH



Post Heart Tx



Total Artificial Heart: Innovations

Using CT imaging
And 3D models
for virtual fitting

Courtesy of
J. Ryan, PhD
and the PCH/ASU
3D Print Lab

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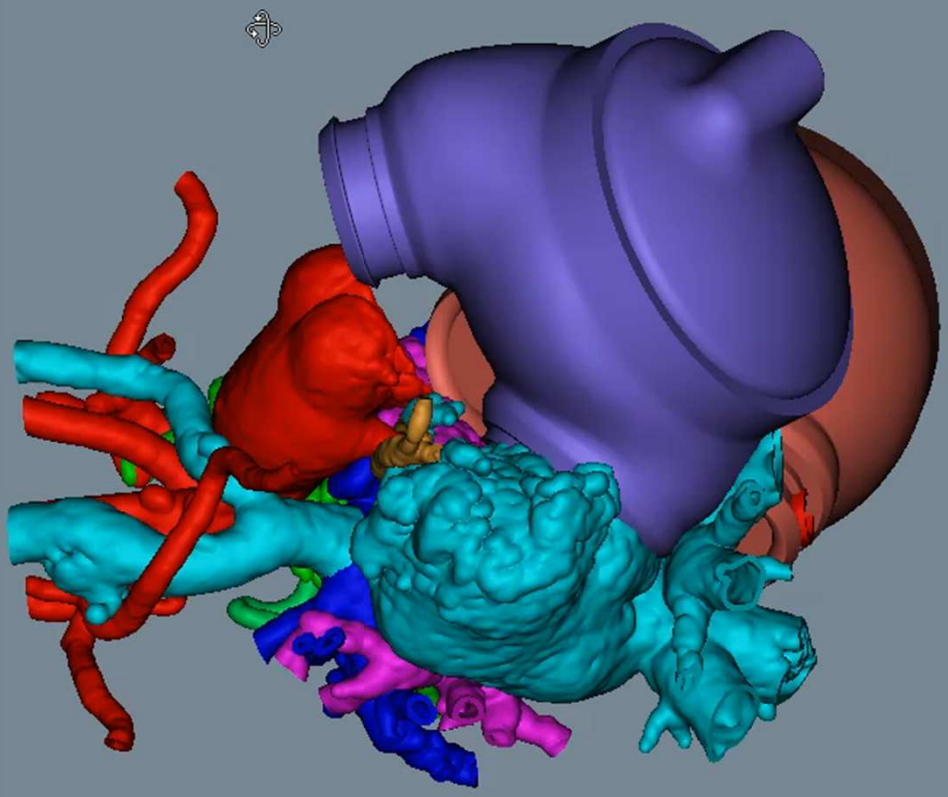


Innovation: Virtual Heart Transplantation

- Size Matching Concerns:
  - Cardiac output (allograft undersized)
  - Compression (allograft oversized)
- Size Matching Methods:
  - Donor: Recipient Body Weight Ratio (clinical standard)
  - Echocardiogram Measurement Ratios
- Limited/no donor and recipient anatomical aberrations directly considered

Innovation: Virtual Heart Transplantation

	Donor	Recipient
Gender	Female	Female
Age (yrs.)	16.4	10.3
Height (cm)	163	140
Weight (kg)	60	28
	DRBW	**2.1**

- 1A listed patient (Hypoplastic left heart) offered oversized allograft
- Clinical team initially leaned towards *declining* donor offer
- Virtual heart transplant assessment performed to supplement patient care

Innovation: Virtual Heart Transplantation

Results:

- Virtual Transplant suggested no oversized fit-related complication
- No fit-related complications observed

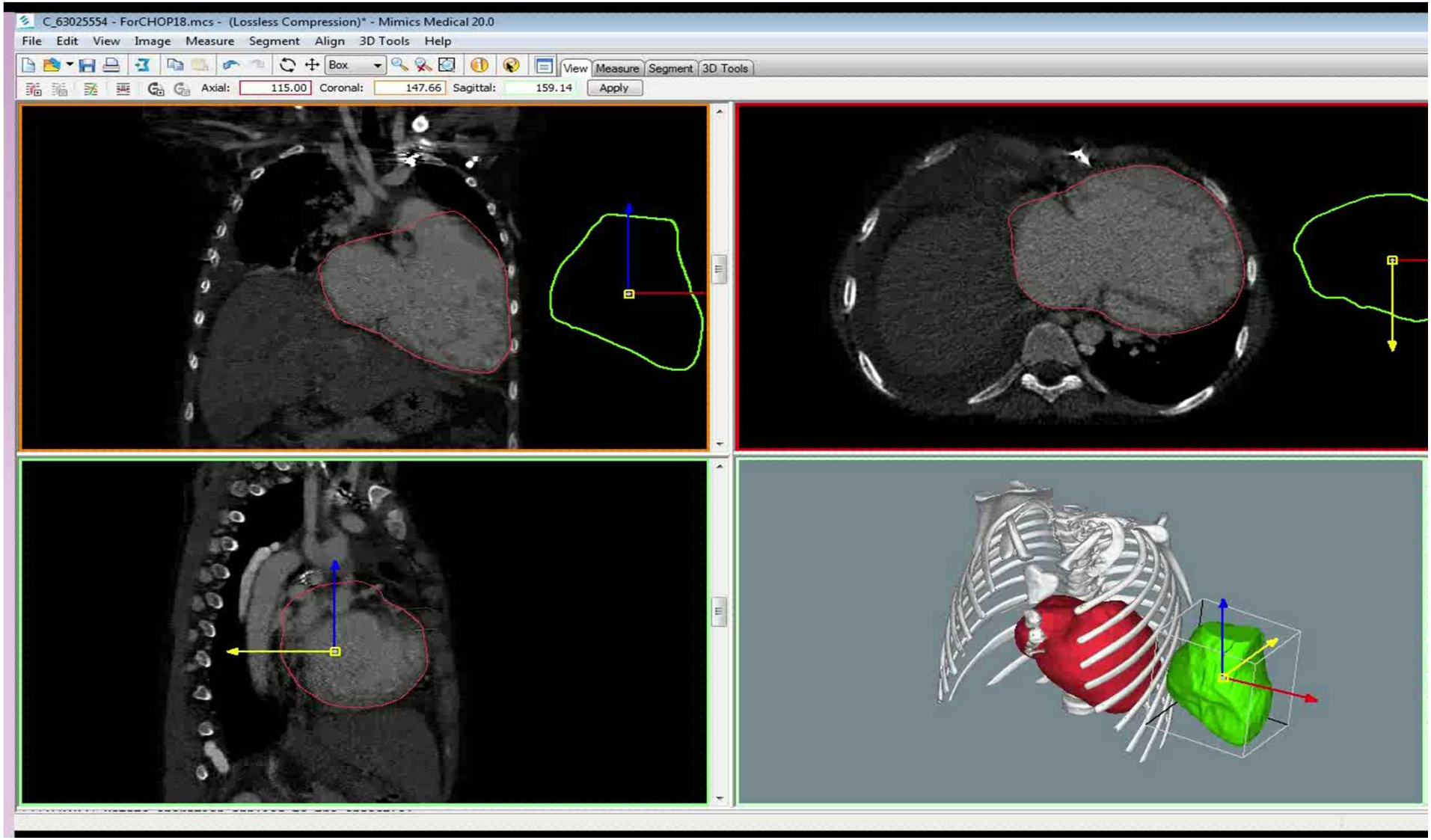
	Donor	Recipient
Weight (kg)	60	28
	DRBW	**2.1**
Total Cardiac Volume (mL)	398	682
	TCV ratio	**0.6**

- Discharged home after 15 days
- Currently thriving over one year later

Conclusion:

- The virtual heart transplant augmented the clinical team's available information and assisted in the acceptance of a donor offer
- Potential to expand patient donor pools by accounting for patient aberrations

Innovation: Virtual Heart Transplantation




AT&T LTE
9:56 PM
80%
cat stuck in a box


IF IT FITS, I SITS!
DAILYBEST


I DON'T CARE ABOUT YOUR FRUITS.
IF I FITS, I SITS.

Thank you!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