

### Viewing Time

The program will take up to one hour to complete.

### Target Audience

This program is designed for primary care physicians.

Other health care professionals working with patients and their families may also find this program of interest.

### Faculty Disclosure

It is the policy of Children's Hospitals and Clinics of Minnesota to ensure balance, independence, objectivity, and scientific rigor in all its educational programs. Our faculty have been asked to disclose to our program audience any real or apparent conflicts of interest related to the content of their presentation. They have also been requested to let you know when any product mentioned in their presentation is not labeled for the use under discussion or is still under investigation.

### Faculty Disclosure

**Daniel Gruenstein, MD**, has disclosed a relationship which may be perceived as a conflict of interest in relation to this educational activity.

During this educational activity **Dr. Gruenstein** will not be discussing the use of any commercial or investigational product not approved for any purpose by the FDA.

### Hybrid Approach to Congenital Heart Disease – The Future is Now

**Daniel Gruenstein, MD**  
Director, Pediatric Interventional Cardiology  
University of Minnesota Children's Hospital, Fairview

*Discussant:*  
**James St. Louis, MD**  
Pediatric Cardiac Surgeon  
Pediatric Specialty Clinic  
University of Minnesota

### Hybrid Approach to Congenital Heart Disease – The Future is Now

*A lecture presenting which hybrid surgical procedures are available for treatment of congenital heart defects and the potential advantages to patients of the hybrid approach to hypoplastic left heart syndrome.*

### Program Objectives

*Upon completion of this program, participants should be able to:*

- What hybrid surgical catheterization-surgical procedures are available for treatment of congenital heart defects.
- The potential advantages to patients of the hybrid approach to hypoplastic left heart syndrome.

### Disclaimer

Children’s Hospitals and Clinics of Minnesota accepts no responsibility for the materials presented through these Grand Rounds seminars. Each professional host assumes all responsibility for maintaining confidentiality or obtaining authorization, in accordance with all applicable laws.

### Accreditation

Children’s Hospitals and Clinics of Minnesota is accredited by the Minnesota Medical Association to provide continuing medical education for physicians. Children’s Hospitals and Clinics of Minnesota designates this educational activity for a maximum of 1 AMA PRA Category 1 Credits™ toward the AMA Physician’s Recognition Award. Each physician should only claim those credits that he/she actually spent in the activity.

### Receiving CME Credit

To receive CME credit you must view the entire program and complete the evaluation form at the end.

### Hybrid Approach to Treating Congenital Heart Disease

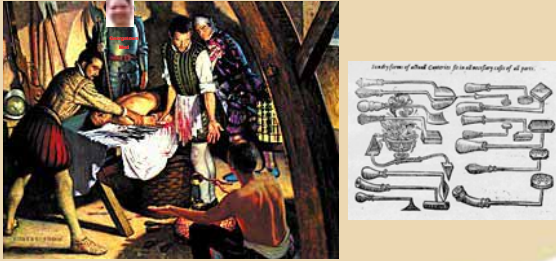
Daniel H. Gruenstein, M.D.  
Director, Pediatric Interventional Cardiology  
University of Minnesota Children’s Hospital, Fairview

### Disclosure: Daniel H. Gruenstein, M.D.

Daniel H. Gruenstein has financial interests to disclose. Potential conflicts of interest have been resolved.

Grant/Research Support/Patents:	N/A
Consultant:	AGA Medical; Plymouth, MN
Investor (> 10% of holdings)	N/A
Educational (Speakers list, etc.)	NW Imaging Forums
Other Financial or Material Support	N/A


### History of Cardiac Surgery




History of Cardiac Surgery

Diagrams of several cardiac surgical instruments, including forceps, retractors, and specialized tools, arranged in a grid.

Wilmar Publishing, www.wilmar.com




### History of Cardiac Surgery




History of Cardiac Surgery

Dr. C. Walton Lillehei's first cross-circulation, U of Minnesota, March 26, 1954

Wilmar Publishing, www.wilmar.com




### History of Cardiac Surgery



History of Cardiac Surgery

Wilmar Publishing, www.wilmar.com



### History of Cardiac Surgery



Stents!!!

Interventionalists and Surgeons in Direct Competition

Wilmar Publishing, www.wilmar.com



Friendly Competition can bring out the best

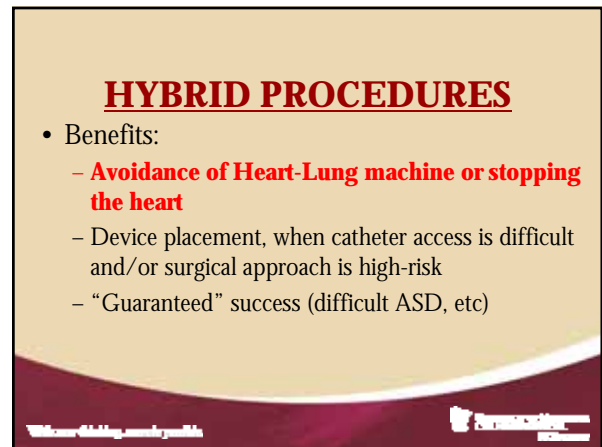
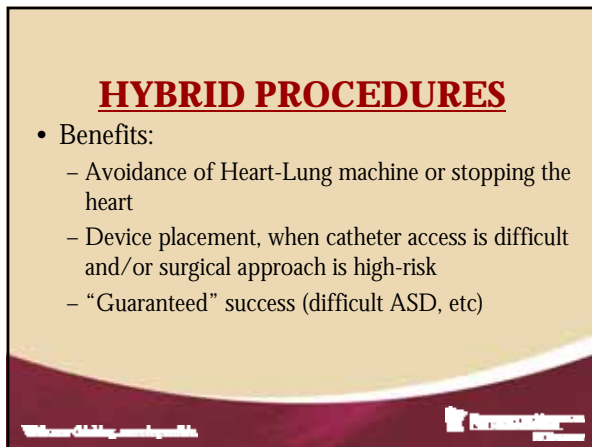
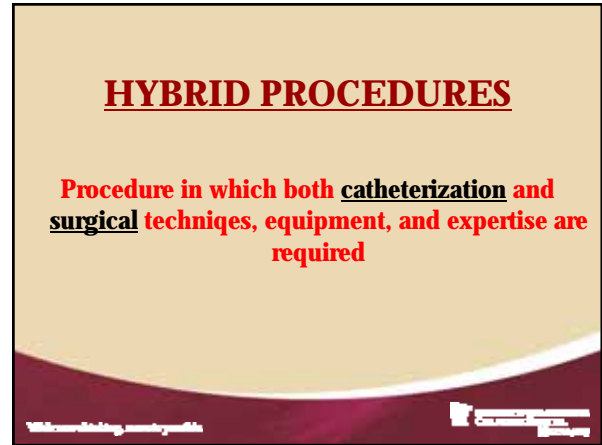
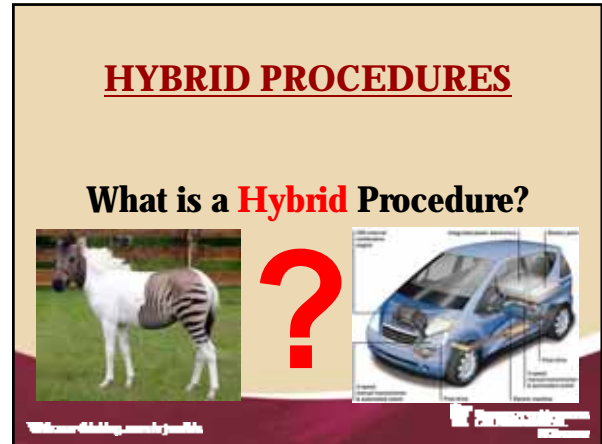
Wilmar Publishing, www.wilmar.com

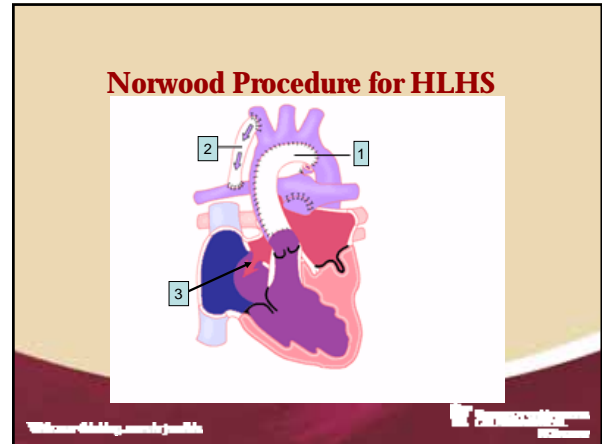
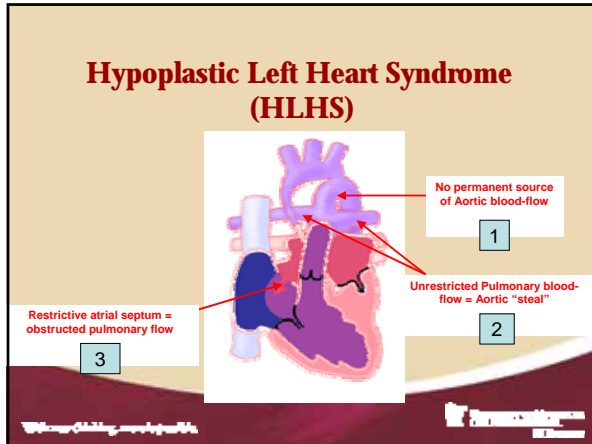


Sometimes, competition goes too far....

Wilmar Publishing, www.wilmar.com



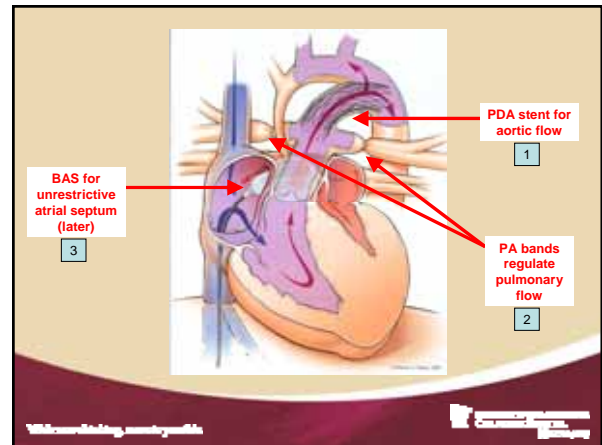




### Norwood Procedure for HLHS

**Heart-Lung Bypass Machine**  
**Circulatory arrest - Heart not beating & No blood flow to the brain**  
**Open chest for few days**  
**Intubation on a respirator for few days**  
**Continuous infusion of multiple cardiac medications**  
**“Fragile” circulatory system requiring ICU**

**Can we do this less invasively???**  
**Can we avoid these risks???**



### FIRST HYBRID HLHS STAGE I

- May 1, 2007
- How did it go???

### Norwood Procedure for HLHS

**Heart-Lung Bypass Machine**  
**Circulatory arrest - Heart not beating & No blood flow to the brain**  
**Open chest for few days**  
**Intubation on a respirator for few days**  
**Continuous infusion of multiple cardiac medications**  
**“Fragile” circulatory system requiring ICU**

<u>Norwood Procedure for HLHS</u>	<u>Hybrid Procedure for HLHS</u>
Heart-Lung Bypass Machine.....	No Heart-Lung Bypass
Circulatory arrest.....	Heart <b>never</b> stopped; <b>constant</b> blood flow to brain
Open chest for few days.....	Chest closed in Hybrid room
Intubation on a respirator for few days.....	Extubated <b>less than 24 hours</b>
Continuous infusion of multiple cardiac medications.....	Cardiac Meds <b>less than 24 hours</b>
"Fragile" circulatory system requiring ICU.....	Took a few days to start feeding well Required second stent due to ductal narrowing at PA

### Initial Results

- Patients must have appropriate anatomy
  - no severe transverse aortic hypoplasia
  - No interruption of aortic arch
- 3 patients have undergone Hybrid Stage I

### How about the rest?

- Bypass/Circulatory arrest = 0
- Open chest = 0
- Average length of inotropic support = ~ 1 day
- Time to extubation = < 24 hours

### Hybrid Stage I for HLHS

- Potential improvement in Neurodevelopmental Outcome
  - Traditional Norwood - > 5% onset of new seizures
  - HLHS has lower than normal IQ, increased ADHD, and increased psychiatric diagnoses
  - Why?

### Hybrid Stage I for HLHS

- Potential improvement in Neurodevelopmental Outcome
  - Multifactorial
  - Age at time of cardiopulmonary bypass
  - Hybrid delays CPBP until out of neonatal period

### Cardiopulmonary bypass Neonates vs. Infants

- Periventricular Leukomalacia (PVL) is one of the hallmarks of brain injury
- There is an age-dependent window of vulnerability to injury of developing white matter during myelination.

### Cardiopulmonary bypass Neonates vs. Infants

- Infant brain – “relatively resistant to injury from conditions such as hypoxia-ischemia”
- Neonate brain - “differentiating oligodendrocytes are exquisitely sensitive to a variety of insults, including hypoxia, ischemia, reactive oxygen species, and inflammatory mediators.”

“Periventricular leukomalacia is common after neonatal cardiac surgery.”  
 J Thorac Cardiovasc Surg 127:692-704; Galli KK, et al. (2004)

### Cardiopulmonary bypass Neonates vs. Infants

- MRI performed on neonates and older infants after cardiopulmonary bypass
- Neonates - PVL was seen in 54% post-op neonates
- Older Infants - PVL was only seen in 4% post-op infants.
- Thus, younger age at time of operation is a potential predictor of poor neurodevelopmental outcome

“Periventricular leukomalacia is common after neonatal cardiac surgery.”  
 J Thorac Cardiovasc Surg 127:692-704; Galli KK, et al. (2004)

IF HYBRID APPROACH IS SO  
GREAT.....

**Why isn't everyone doing it ???**

**BIG Investment**

Technology

People

SPACE

Training

Techniques

Team  
Coordination

### Trust

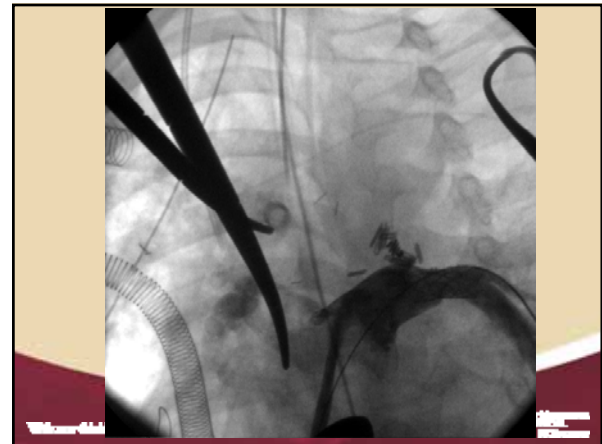
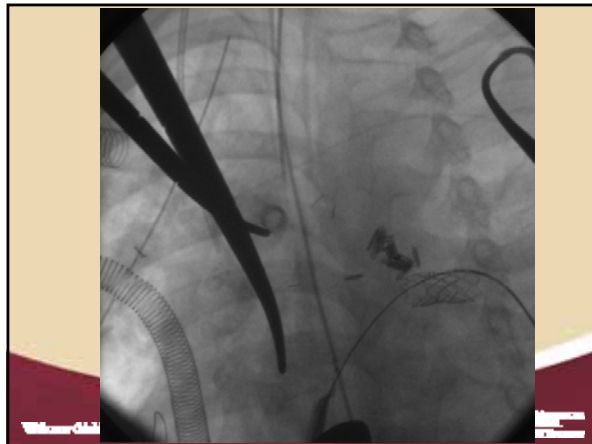
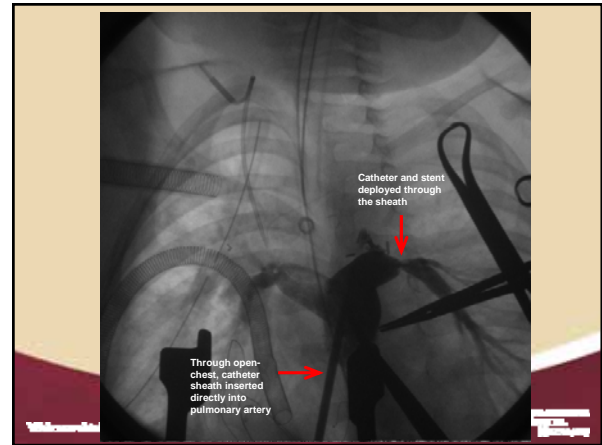
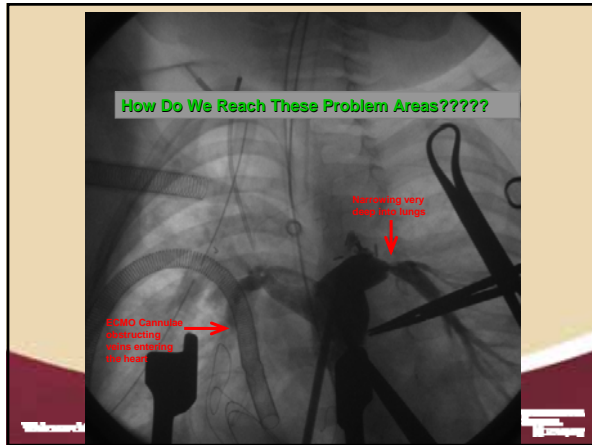
Colleagues

Families

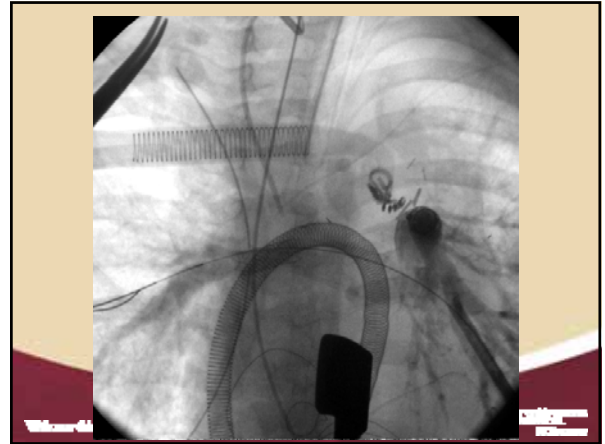
**HYBRID PROCEDURES**

- Benefits:
  - Potential avoidance of Heart-Lung machine or stopping the heart
  - Device placement, when catheter access is difficult and/or surgical approach is high-risk
  - “Guaranteed” success (difficult ASD, etc)

COMPLEX CHD  
Heart Tx !!!!  
Significant difference in PA sizes  
Right sided Heart Failure  
ECMO

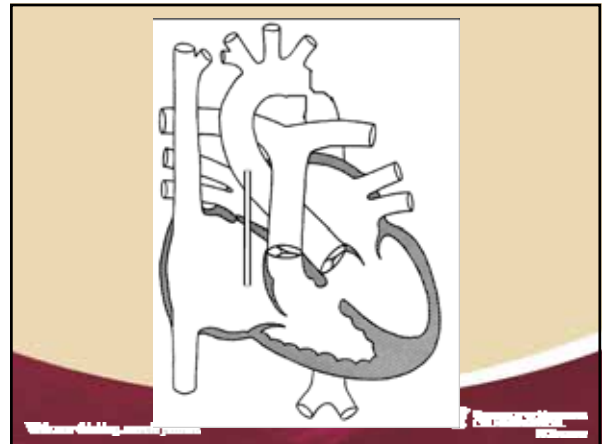
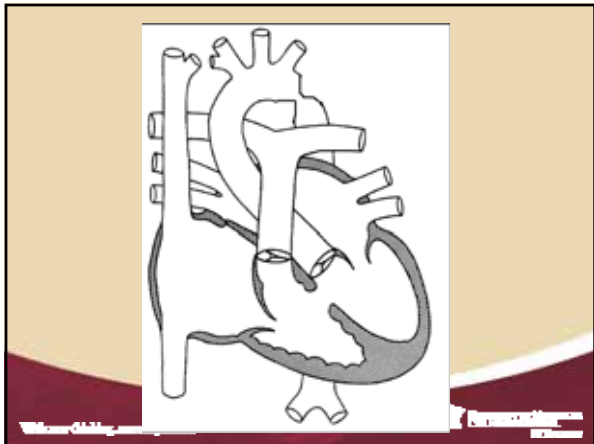
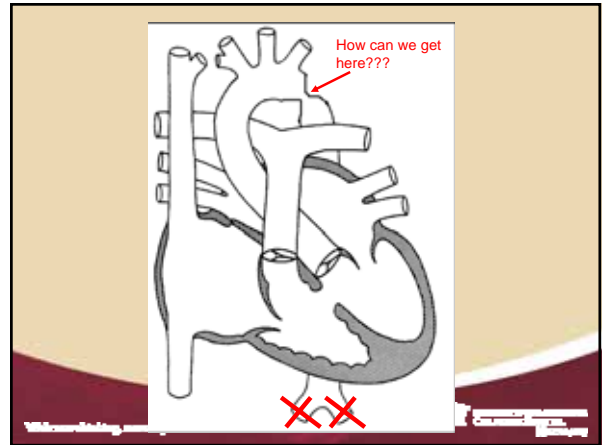


Daniel Gruenstein, MD  
Hybrid Approach to Congenital Heart  
Disease – The Future is Now

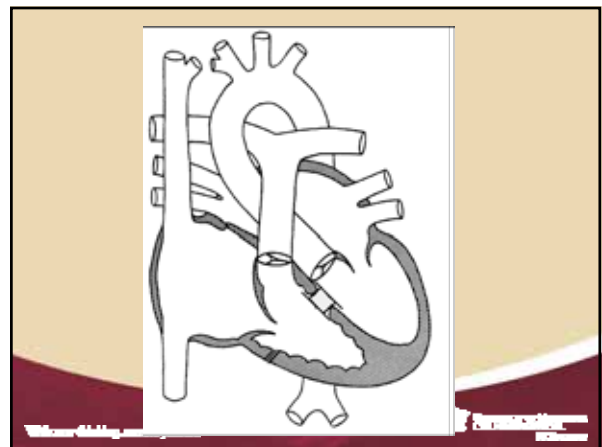
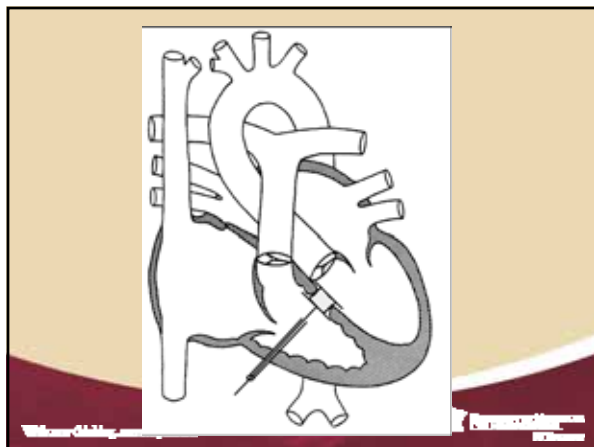
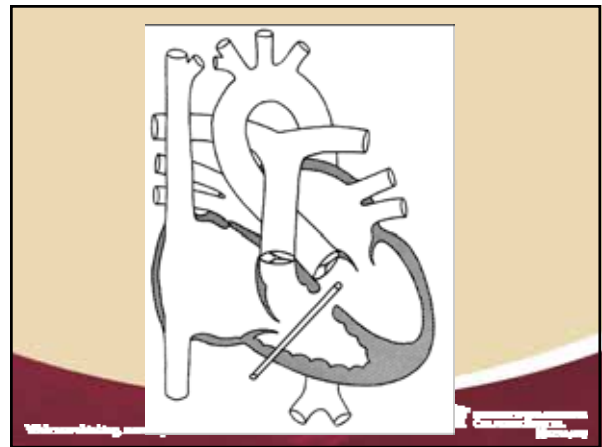
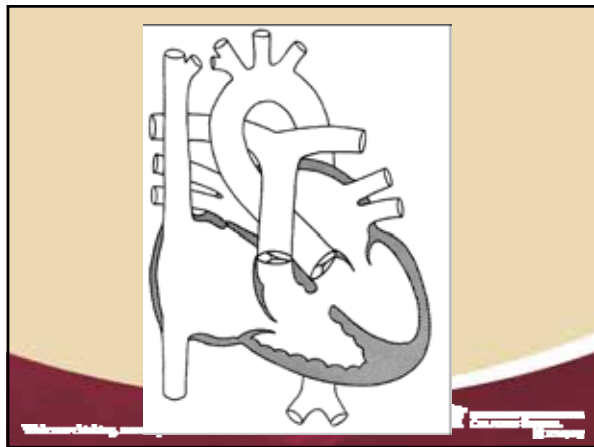
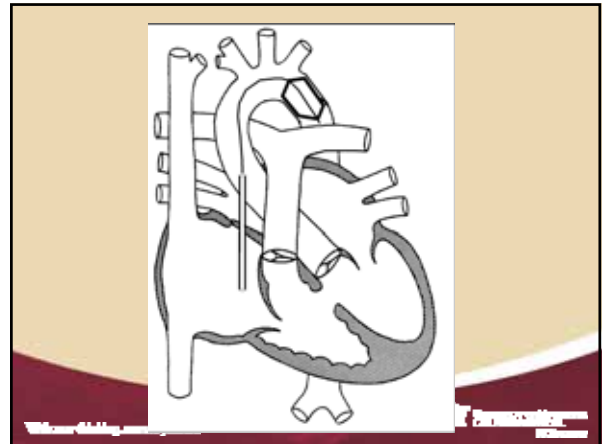
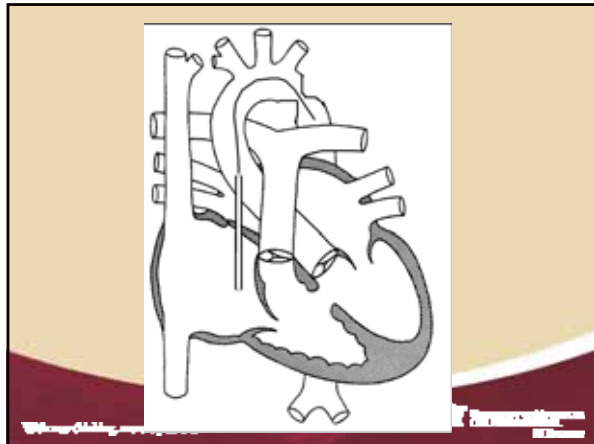


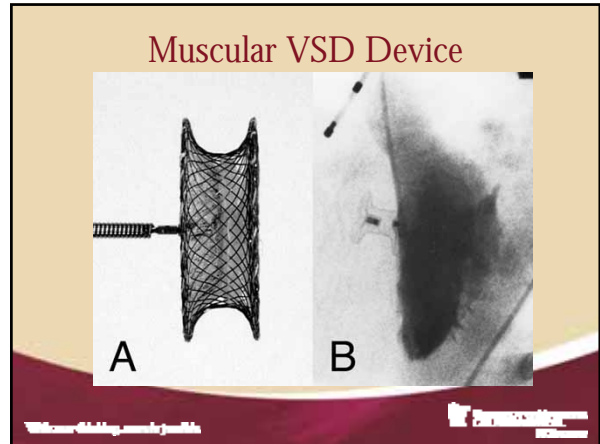
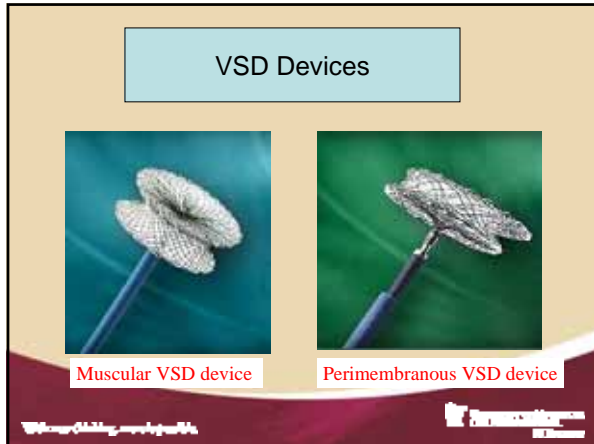
The Patient was successfully taken off  
ECMO.....

**THE NEXT DAY !!!**

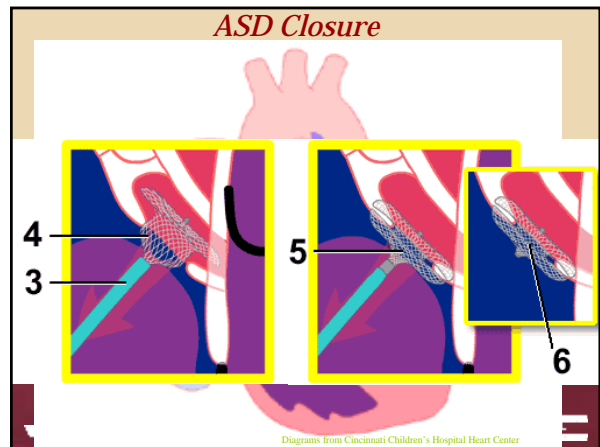
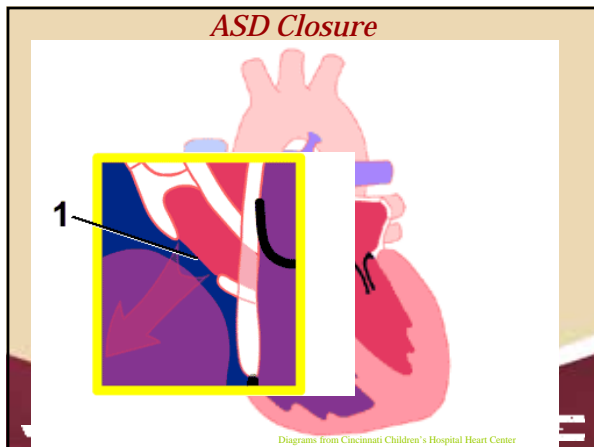
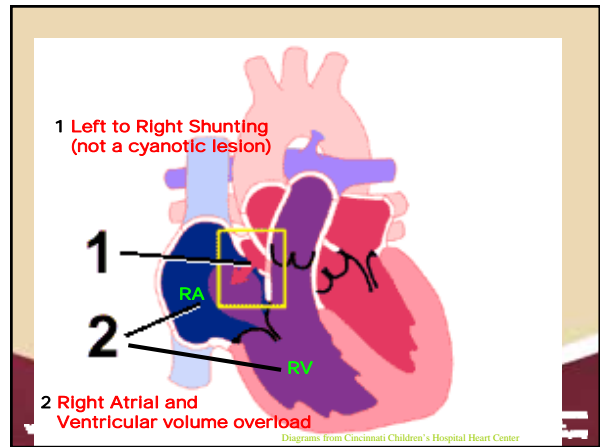


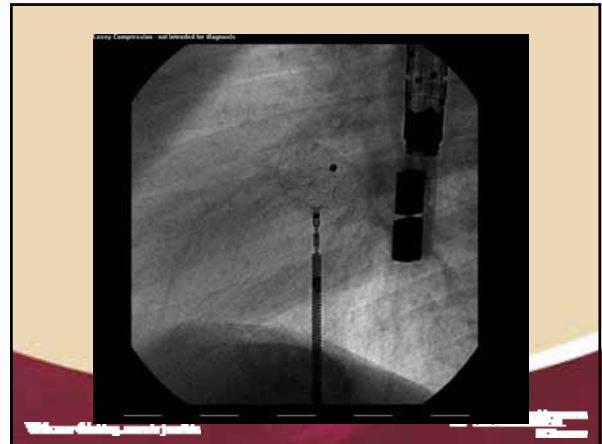
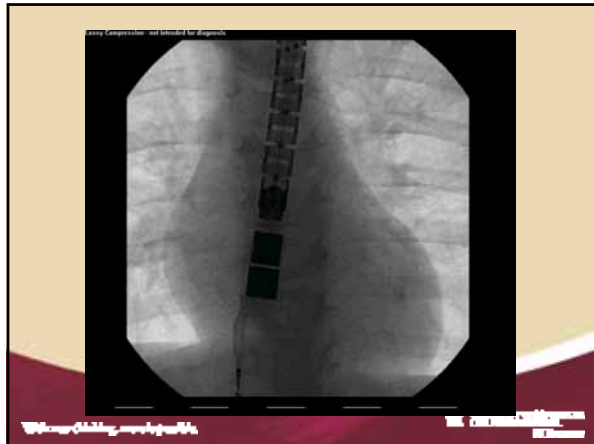
Daniel Gruenstein, MD  
Hybrid Approach to Congenital Heart  
Disease – The Future is Now





- HYBRID PROCEDURES**
- Advantages:
    - Potential avoidance of Heart-Lung machine or stopping the heart
    - Device placement, when catheter access is difficult and/or surgical approach is high-risk
    - “Guaranteed” success (difficult ASD, etc)





### What if the defect is large/unusual?

- Sometimes, device closure is not attempted
- If percutaneous closure is attempted, but unsuccessful, what then?
- Patient is awakened from anesthesia, sent home, and returns on a different day for surgical closure.

### How Does Hybrid Lab Help?

- Can attempt technically challenging/unusual defects – with surgical team present.
- If not able to repair with minimally invasive catheter techniques, will proceed with surgical repair..... in same room under same anesthesia on same day.

### **HYBRID PROCEDURES**

- Summary:
  - Involves a combination of Cardiothoracic Surgical and Interventional Cardiology skills

### **HYBRID PROCEDURES**

- Summary:
  - Avoidance of Heart-Lung machine or stopping the heart
  - Device placement, when catheter access is difficult and/or surgical approach is high-risk
  - “Guaranteed” success for challenging percutaneous cases in a single operative time and setting

## **HYBRID PROCEDURES**

- Summary:
  - Initial experience with Hybrid for HLHS suggests potentially significant improvement in survival, recovery, and neurodevelopmental outcomes, but vigorous study is needed
  - Requires a large commitment of people, training, resources, space, and TRUST

www.hoffman.com



**Comments  
and  
Questions**

*Thanks for viewing  
this presentation!*



*To receive CME credit, please click  
the CME Eval button below  
and complete the form.*