# Innovation in Pediatric Cardiac Interventions: Laser Technology


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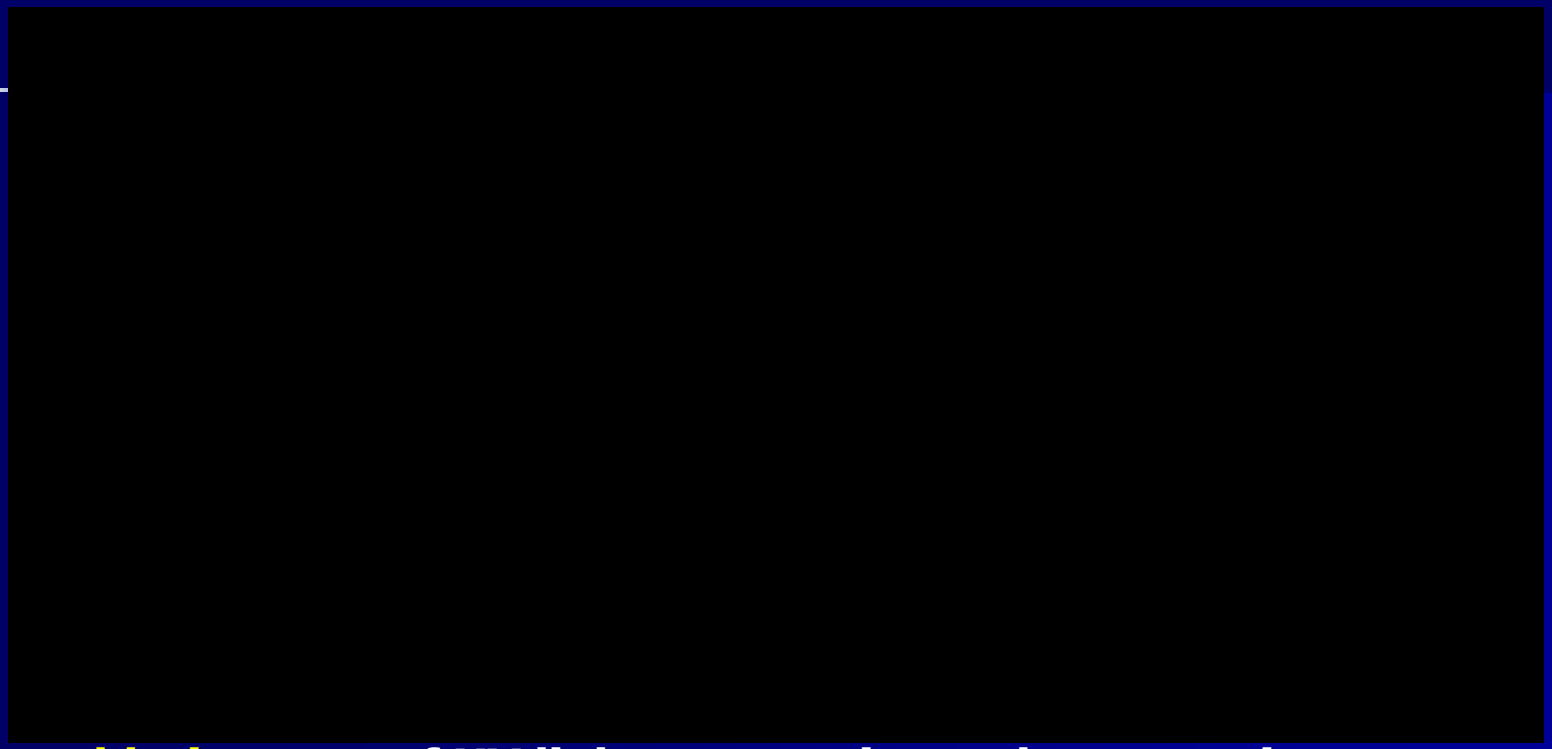
# Disclosure: None

# Principle of Laser Photoablation

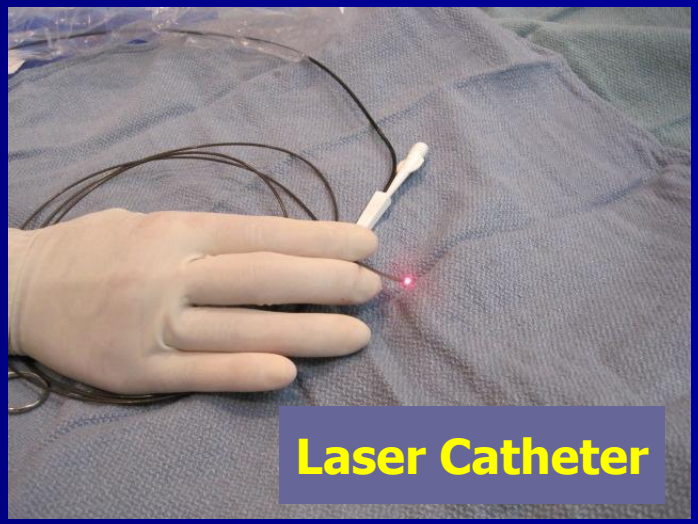


- **Photoablation:** use of UV light to vaporize and remove tissues.
- **Photochemical Rx**: molecular bonds are broken by UV light (125 billionth/sec  results in 50 micron penetration)
- **Photothermal Rx**: tissues experience molecular vibration, causing temperature rise, leading to intracellular H2O evaporation & cell lysis
- **Photomechanical/kinetic energy**

# Equipments: Spectronetics Laser & catheters

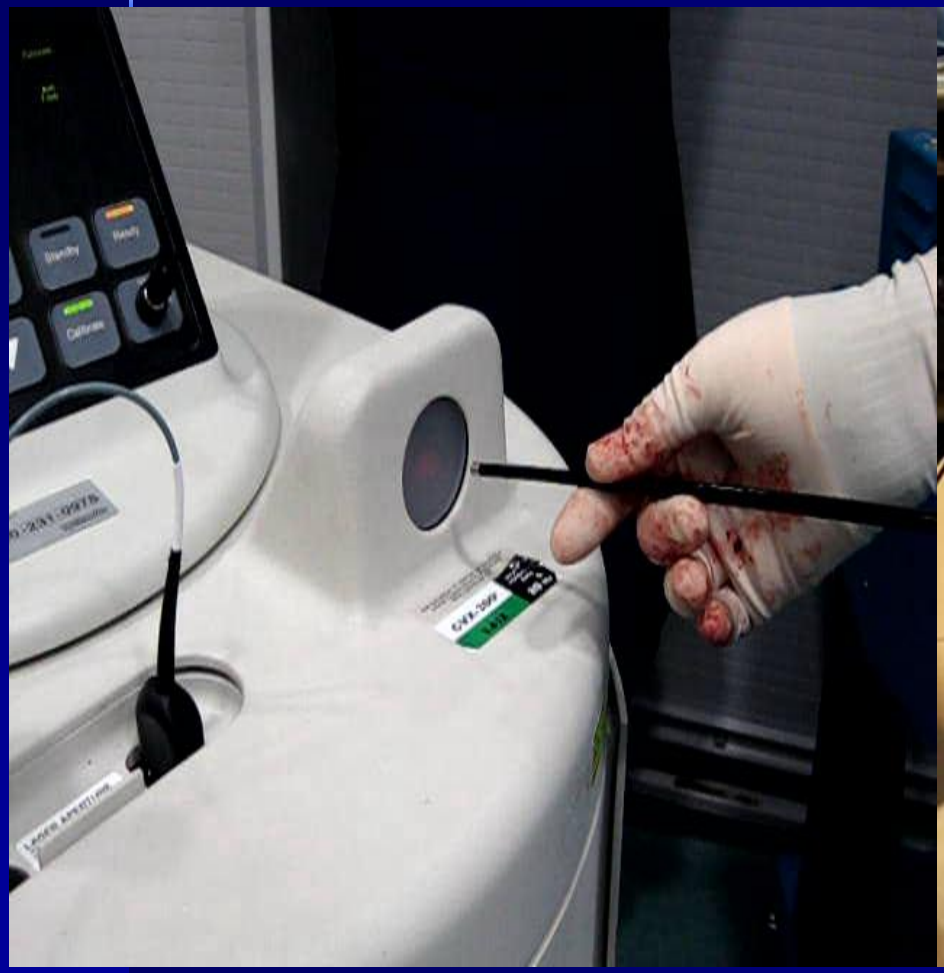
**CVX-300**
**Excimer Laser System**


**Catheter Size: 0.9-2.5 mm**



# Laser Catheter Caliberation

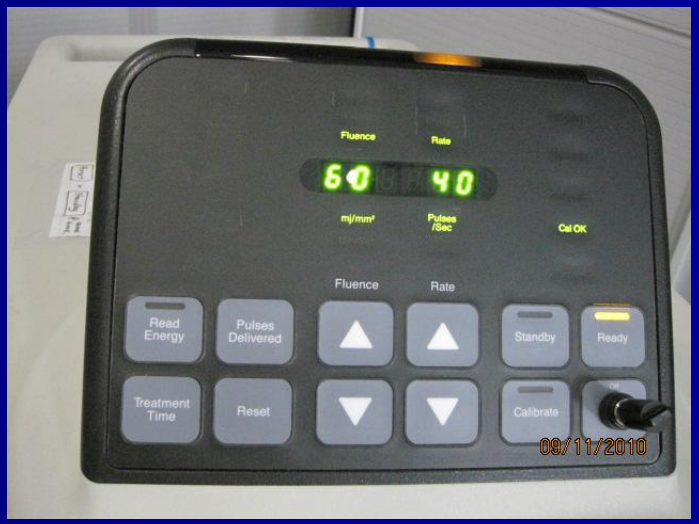
**2.5mm**



**0.9 mm**

# Laser Setting

- **Fluence(30-80):** output energy density in millijoules/mm2
- **Frequency (25-80Hz):** repetition rate in cycle/second



# Fetal Cardiac Intervention
## In Utero PFO Creation in HLHS/IAS
**EJ Suh, JC Huhta, R. Quintero**

- 2005: a 28 week gestational age fetus with HLHS and intact atrial septum
- Transatrial delivery of Laser beam x 7 against the atrial septum (fenestrated PFO)
- Result: FT 3.2 Kg infant with HLHS and restrictive PFO but patent, who underwent Stage I Norwood.

# Pediatric Clinical Applications

1. **Fetal Intervention:** Twin-twin Transfusion, HLHS with IAS, PA/IVS
2. **Creation of PFO/ASD**
3. **Perforation of Valve Tissues:** Pulmonary Atresia/ IVS
4. **Creation of Fenestration** in Extracardiac (Goretex) and Lateral Tunnel Fontan

# Clinical Application: Creation of PFO/ASD

## L-R Shunting

(Decompression of LA Hypertension)

- Mitral Stenosis/ HLHS+IAS
- Mitral Regurgitation & Pulmonary Edema, etc.

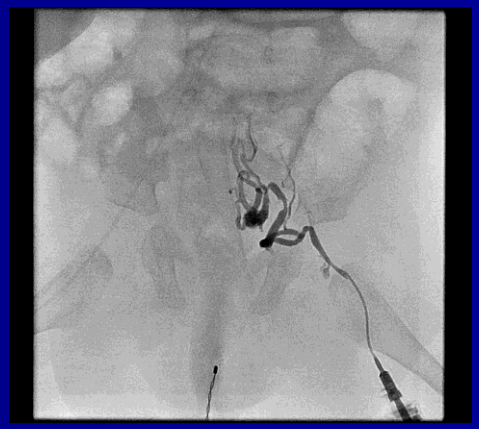
## R-L Shunting

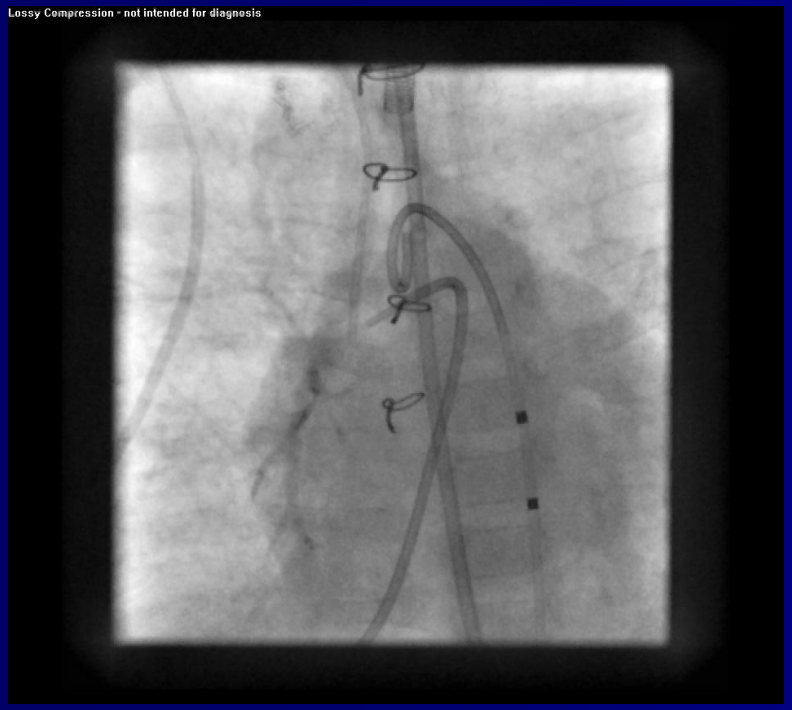
(Decompression of RA Hypertension)

- RV Hypertension (from PHTN, postop TAPVC, TOF/PA/MAPCA'S, etc.)

# PFO Creation for R-L shunting

- 1 month old 3.9 Kg male
- S/P TAPVC Repair
- Severe PHTN with frequent pulmonary hypertensive crisis
- Obstructed bilateral iliac veins and upper compartment veins
- Create atrial level R-L decompression via transhepatic approach

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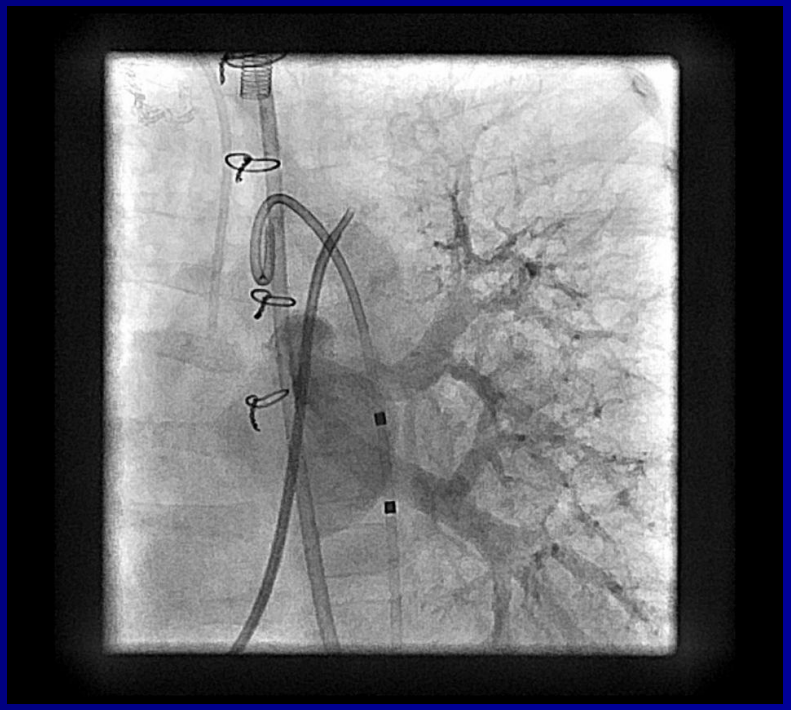

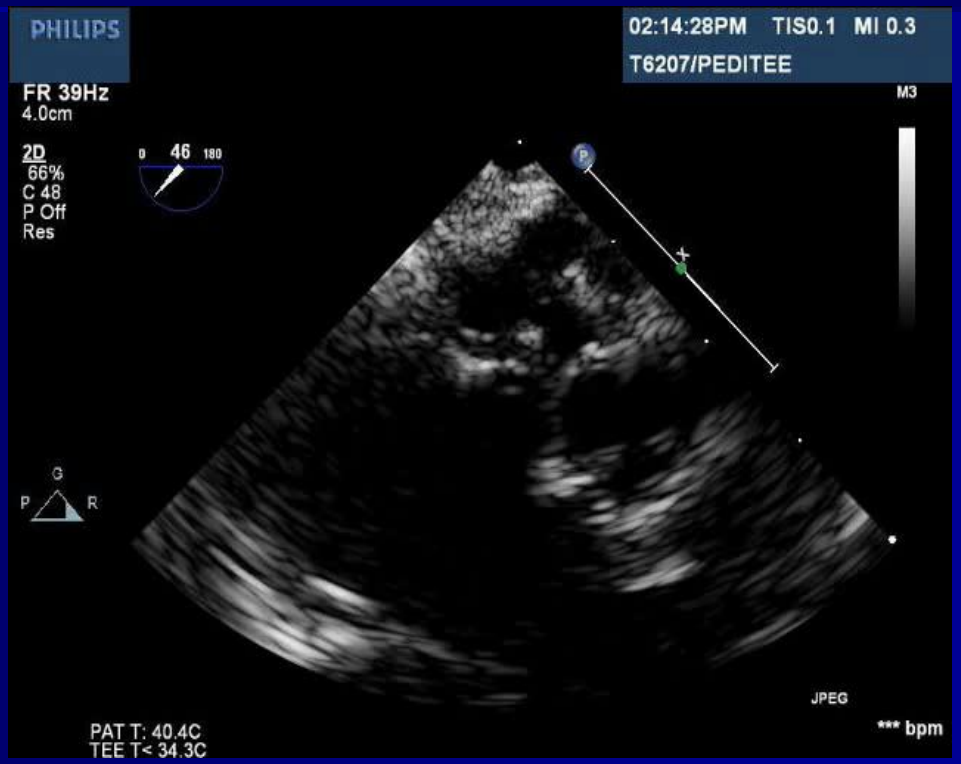
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M3
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C 48
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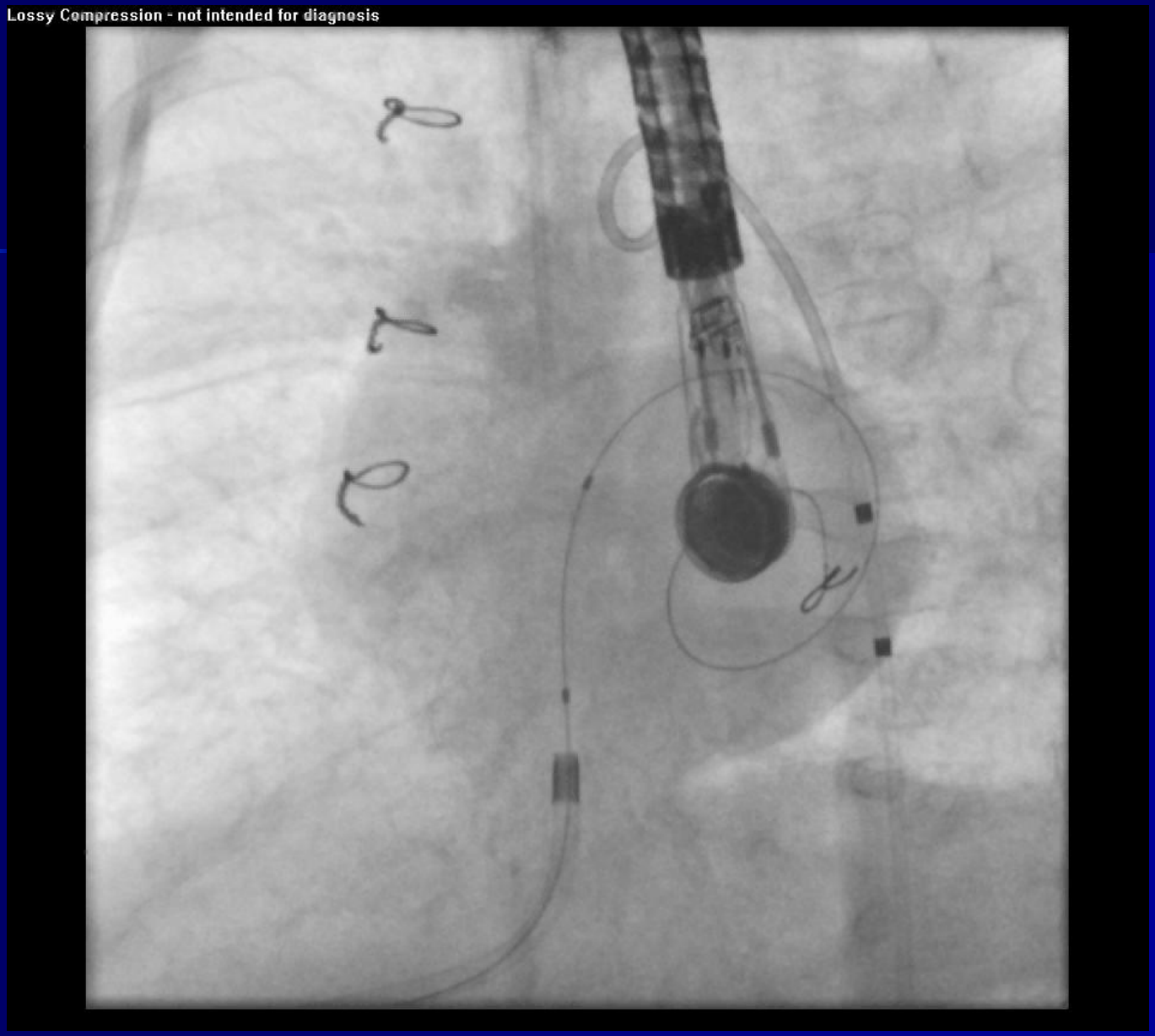
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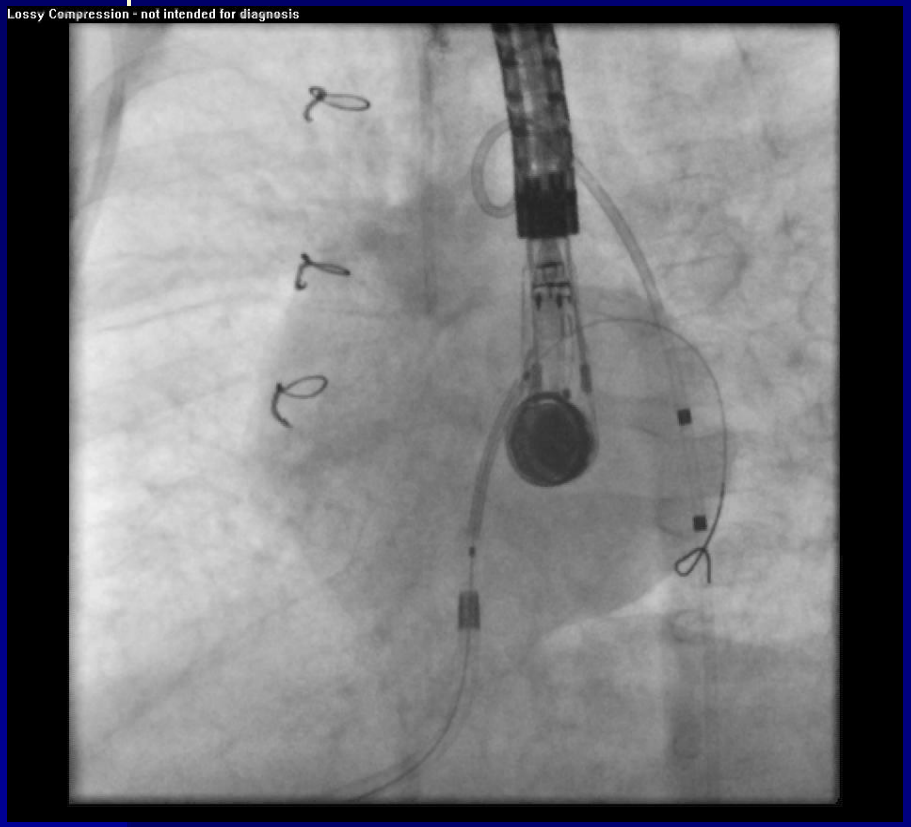
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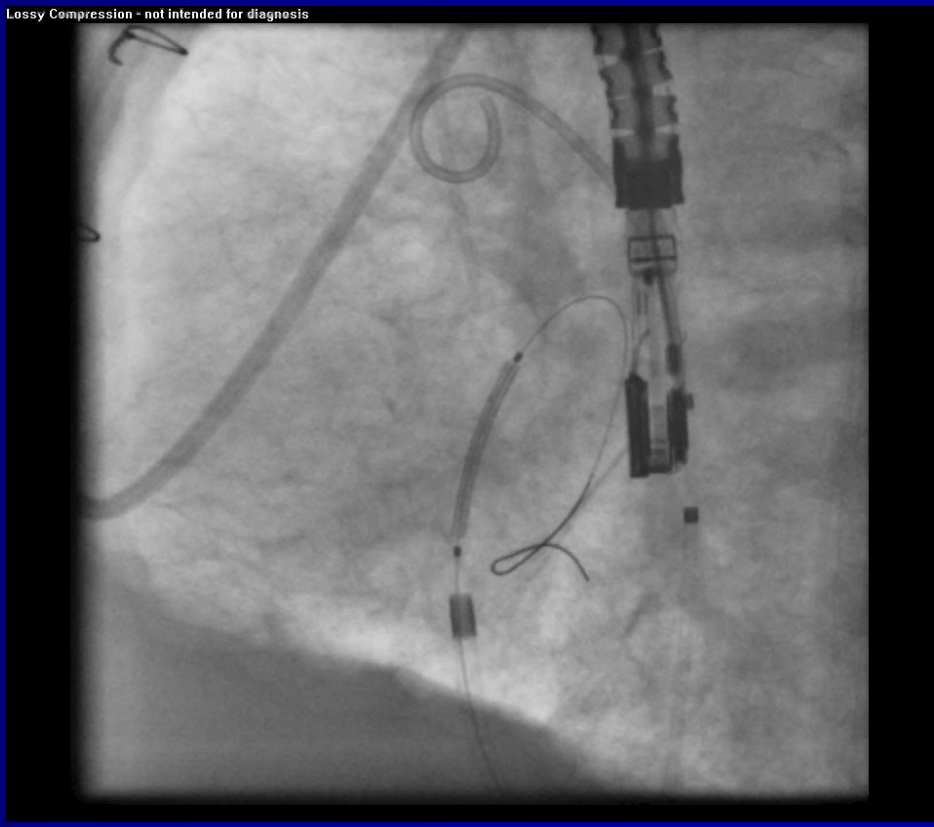
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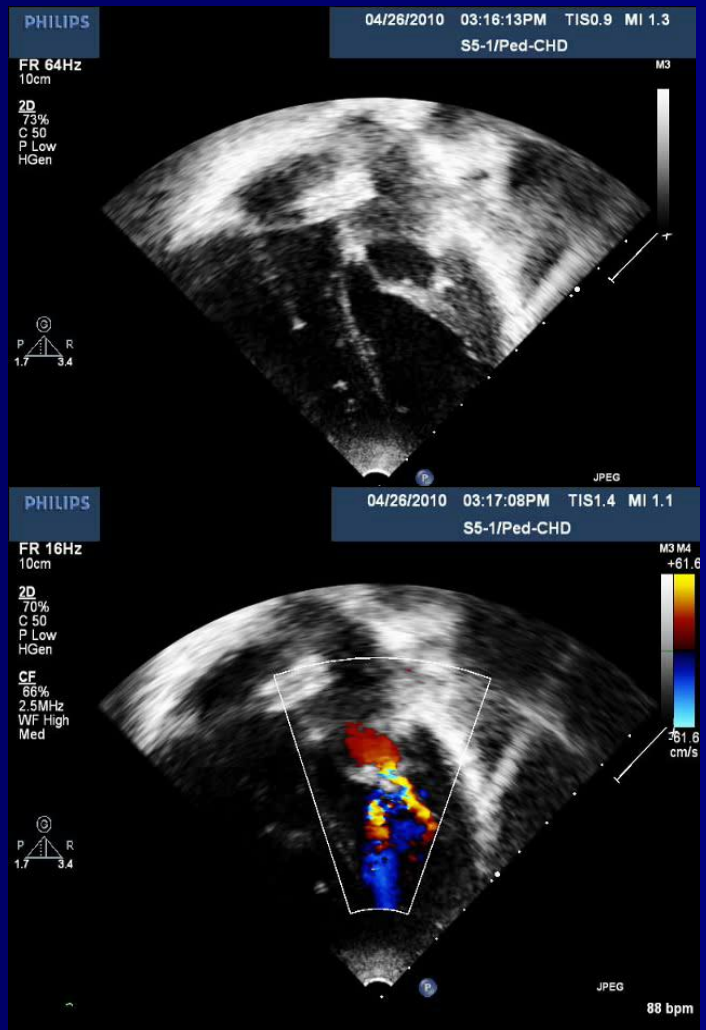
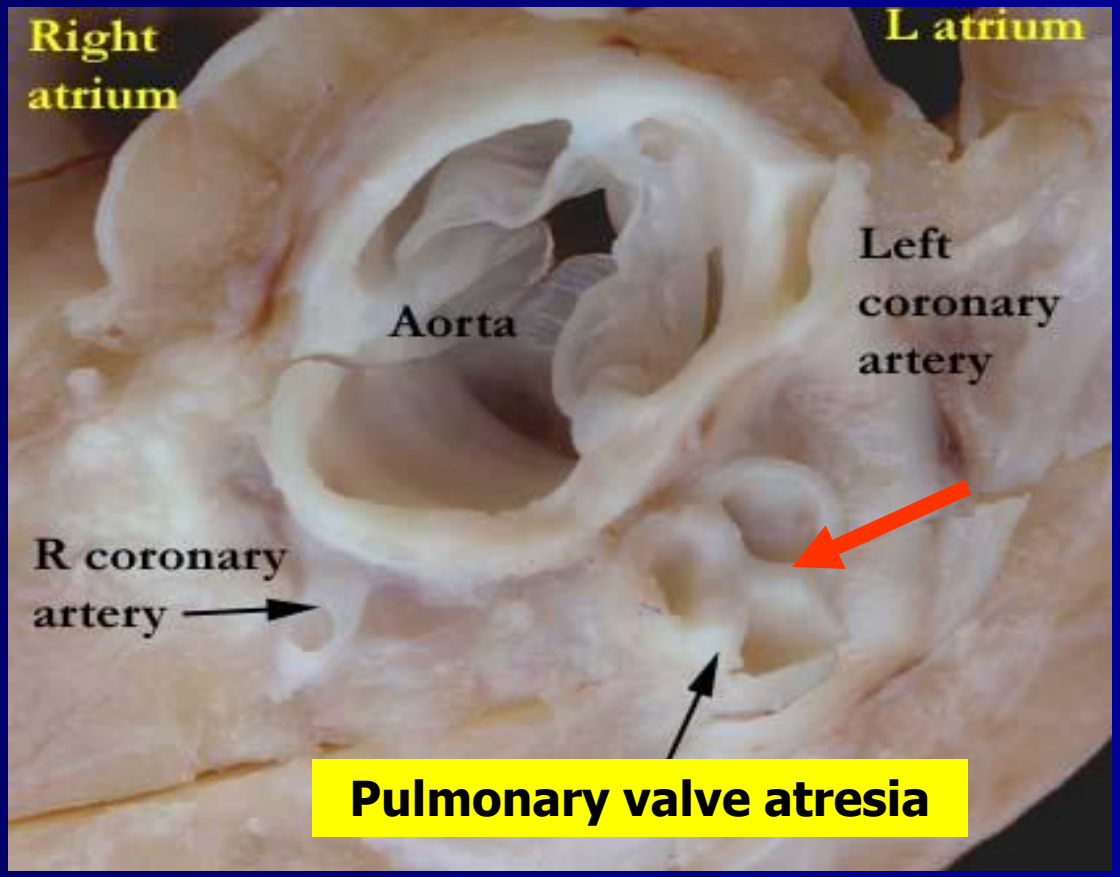
# Creation of PFO for L-R Shunting: Mitral Stenosis



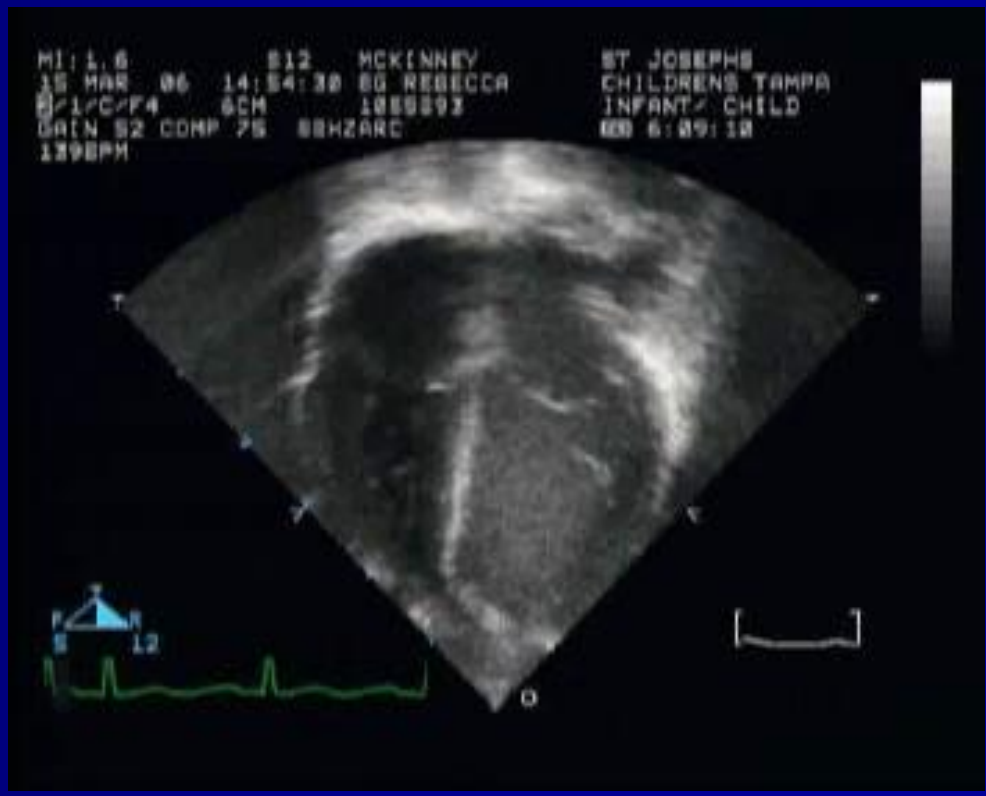

- Shone's Complex with Mitral Arcade & MS
- s/p 6 mm Genesis PM stent at 8 mo of age for LA HTN causing secondary PHTN
- Underwent MVR surgery at age 5 YO

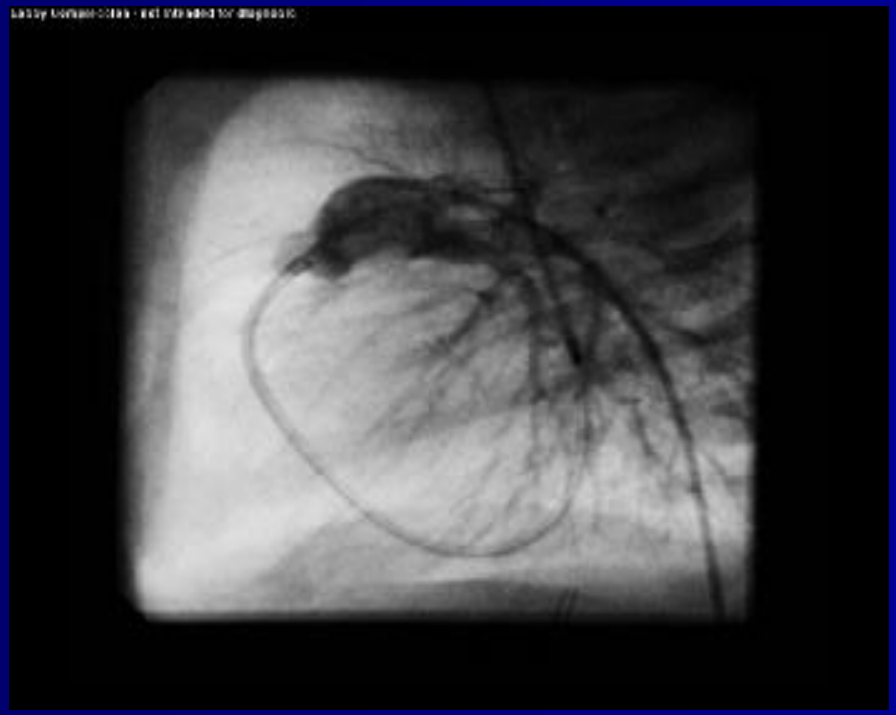
# Clinical Application: Perforation of Pulmonic Valve: Pulmonary Atresia/IVS

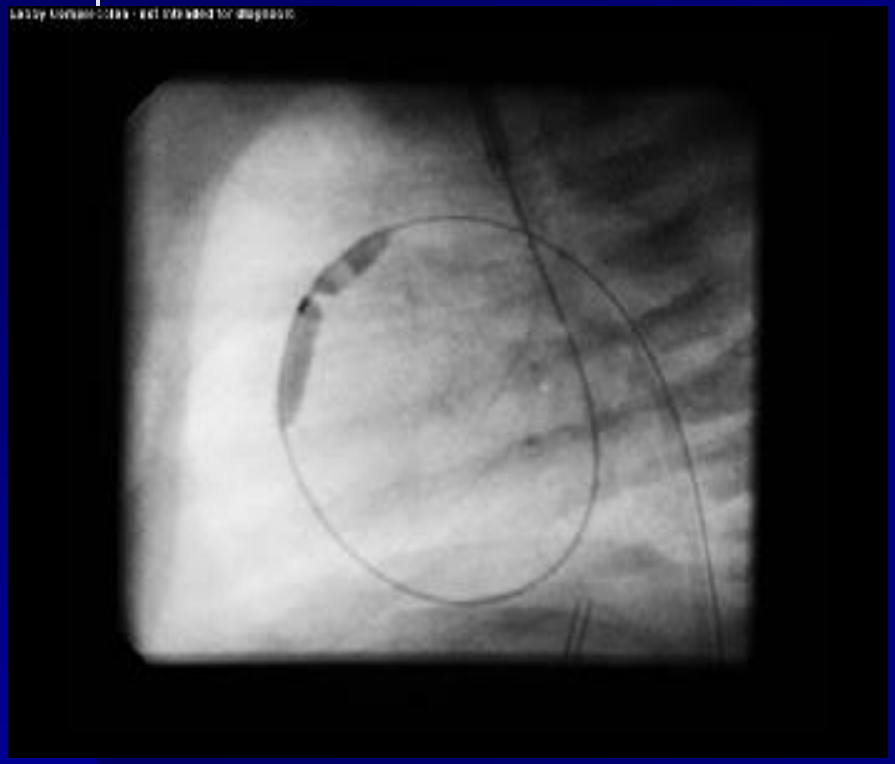


# Postnatal Echocardiogram: PA/IVS s/p fetal valvotomy

- Fetal Dx of PA/IVS
- S/P fetal pulmonic valvotomy at 29 weeks gestation
- FT female delivery BW = 2.9 Kg



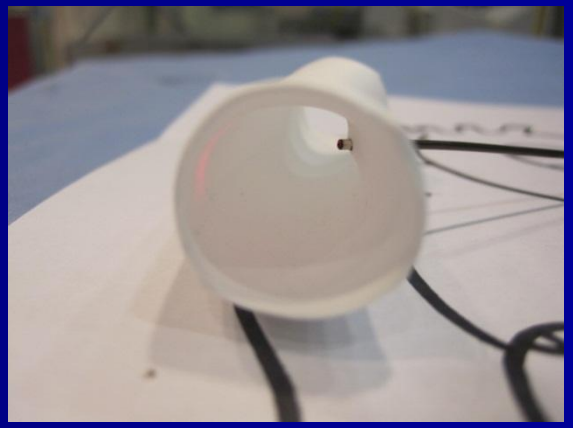


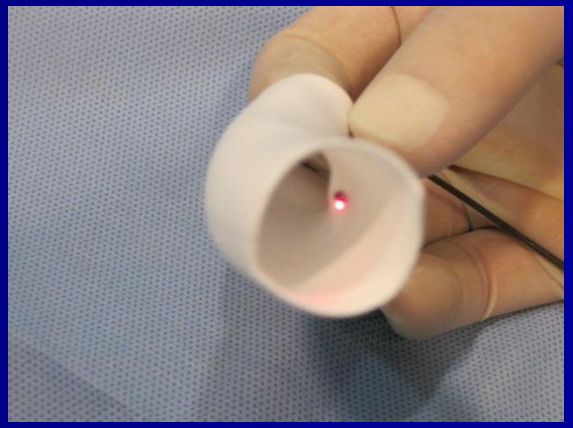


# Fontan Conduit: Creation of Fenestration

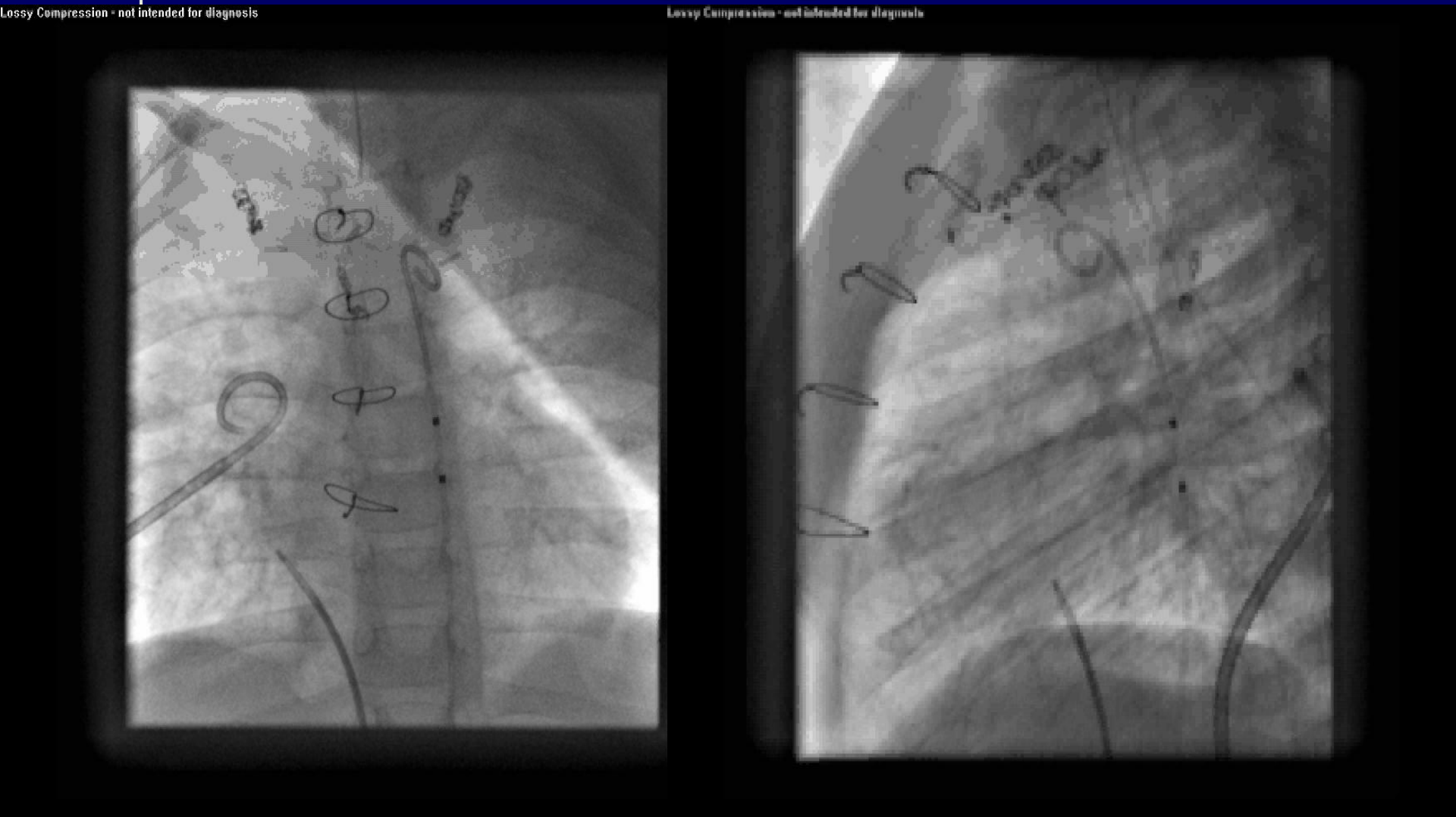
- Useful technology for perforating Goretex (PTFE) conduit in Extracardiac Fontan

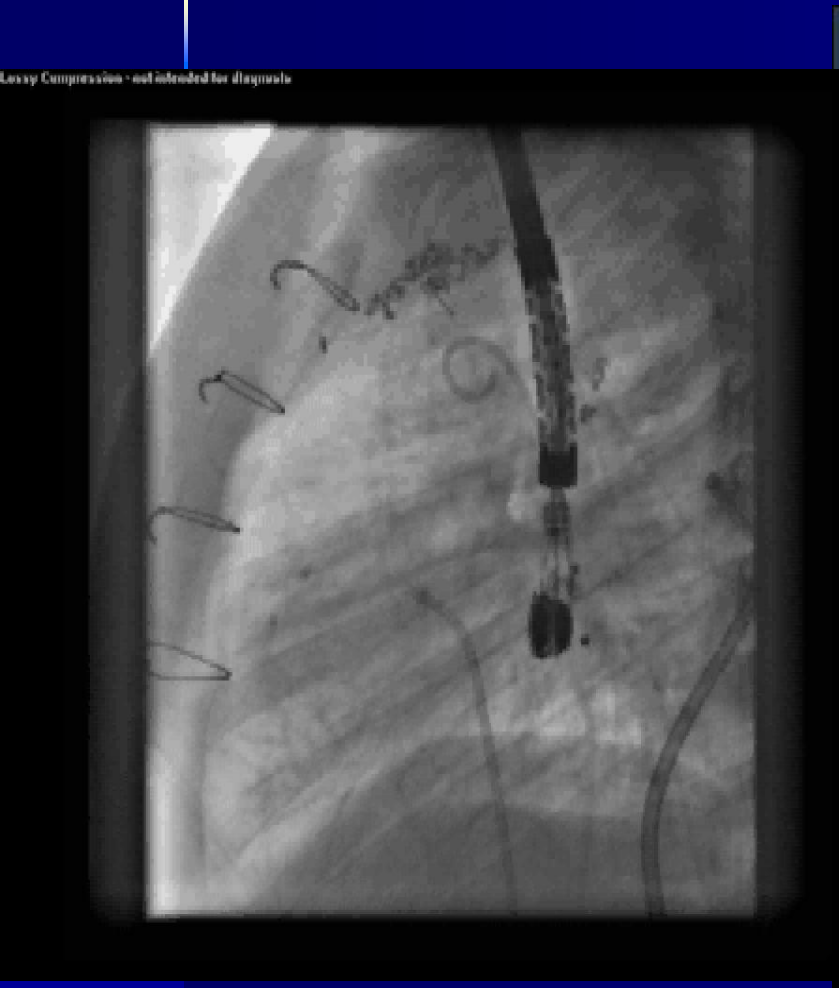
- **Melting Point of** PTFE = 400 Celsius (752 F)





# Extracardiac Fontan Angiogram

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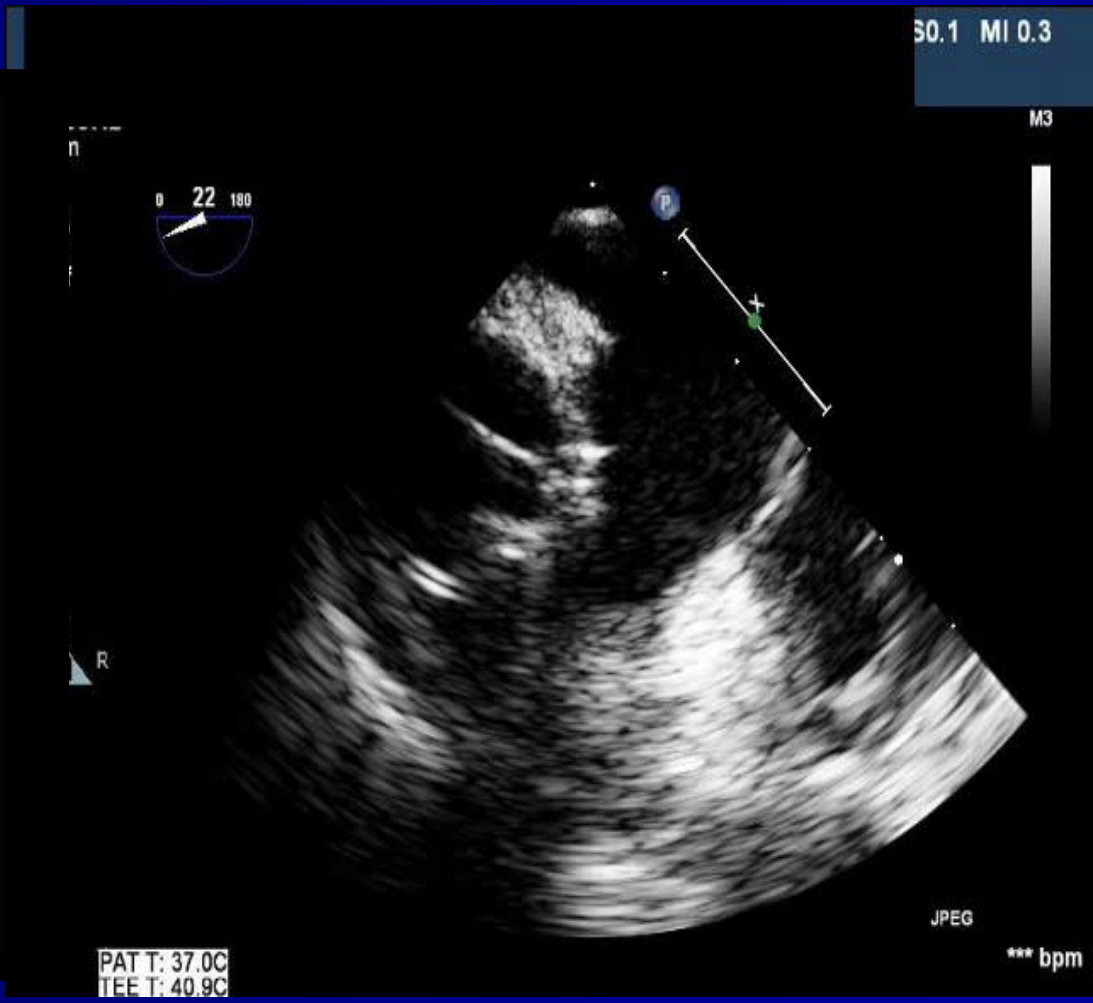
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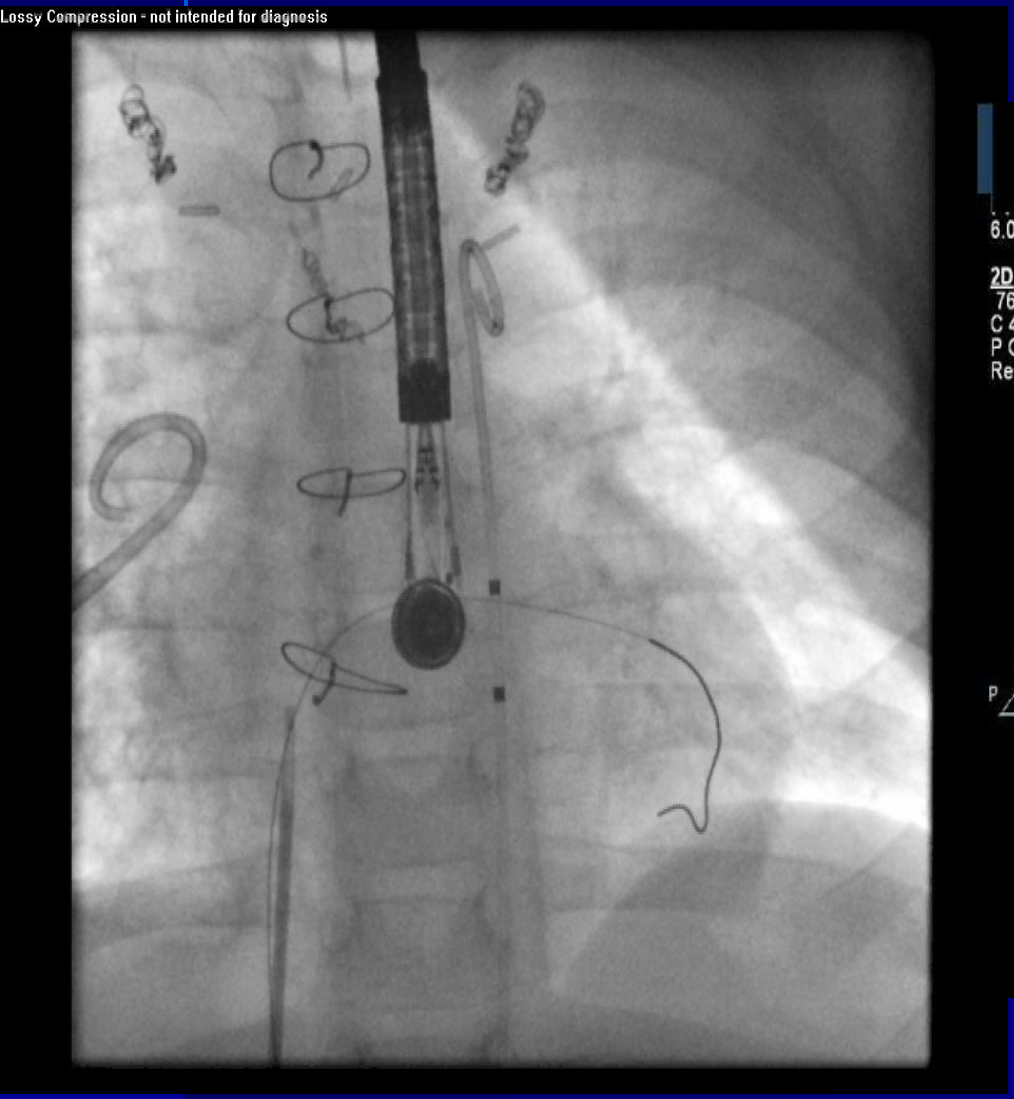
M3
0 22 180
R
JPEG
PAT T: 37.0C
TEE T: 40.9C
*** bpm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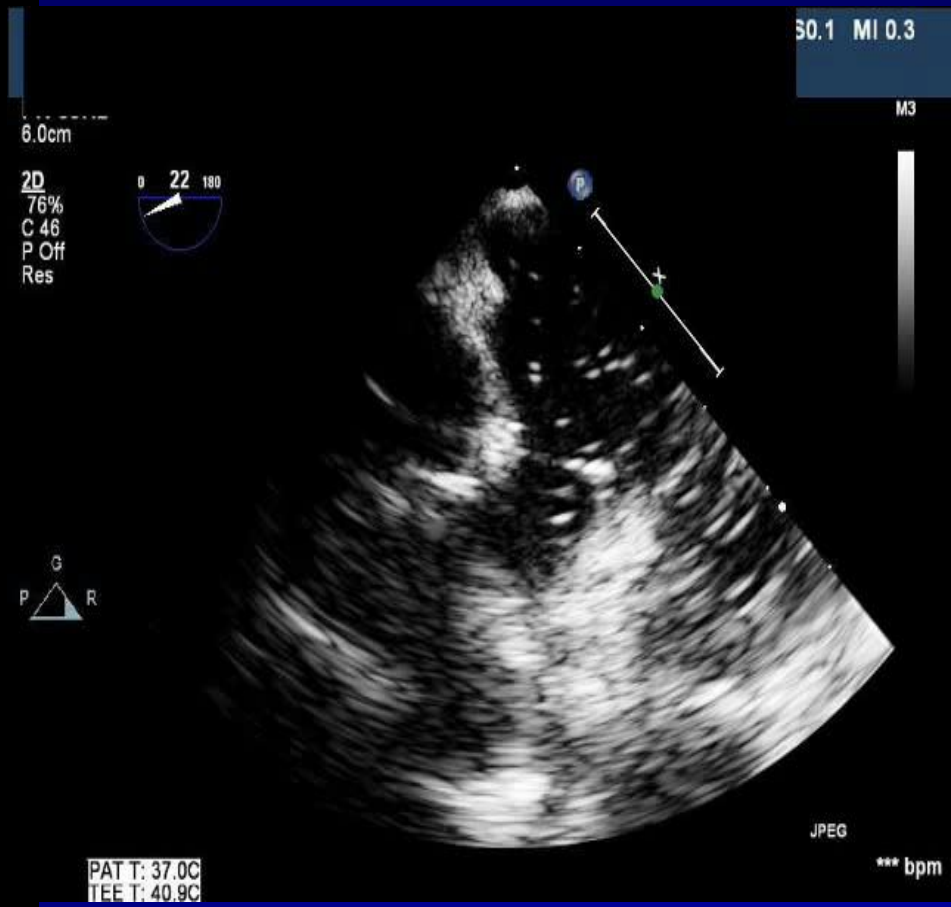
50.1 MI 0.3
M3
6.0cm
2D
76%
C 46
P Off
Res
0 22 180
G
P R
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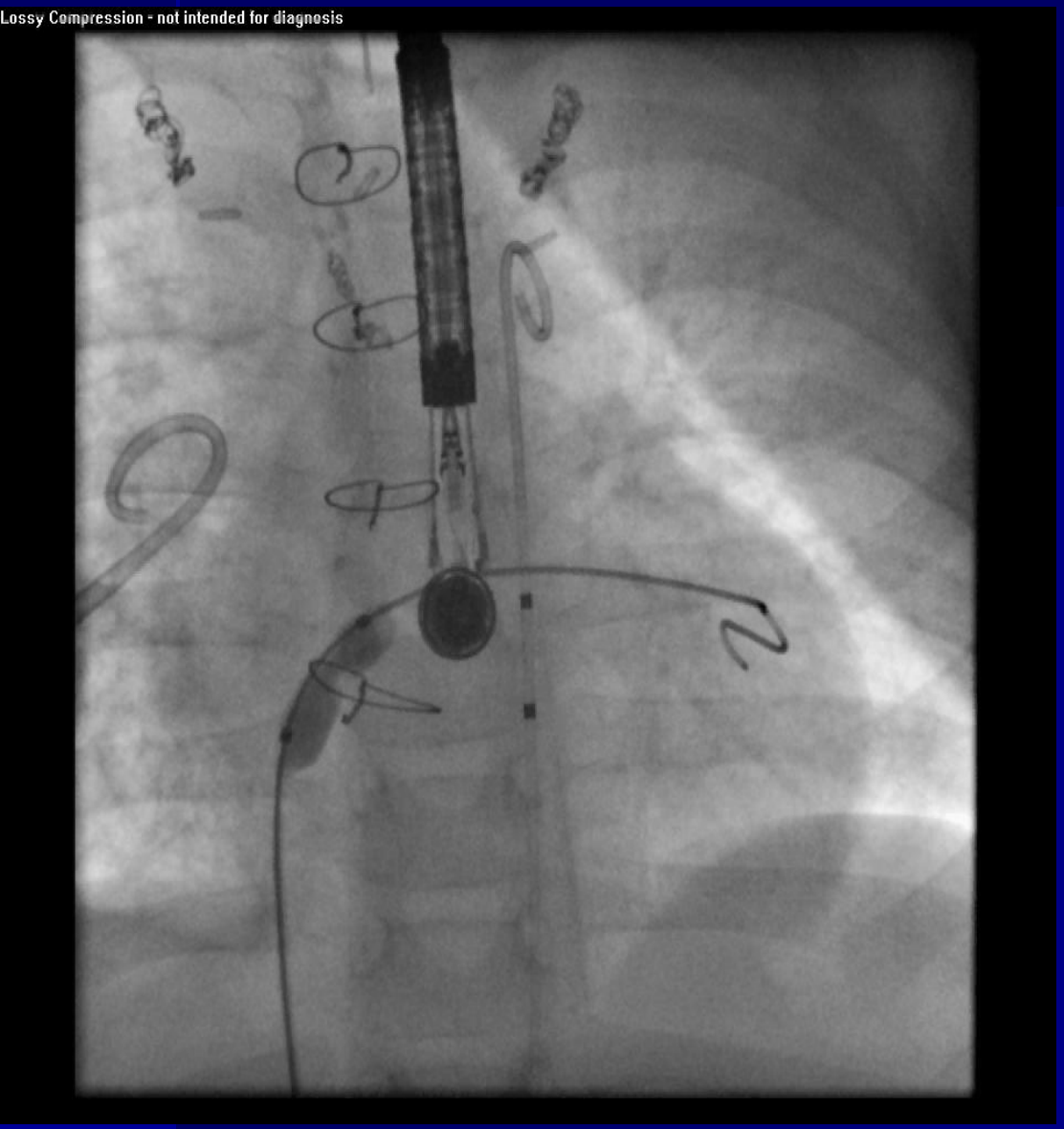
PAT T: 37.0C
TEE T: 40.9C
*** bpm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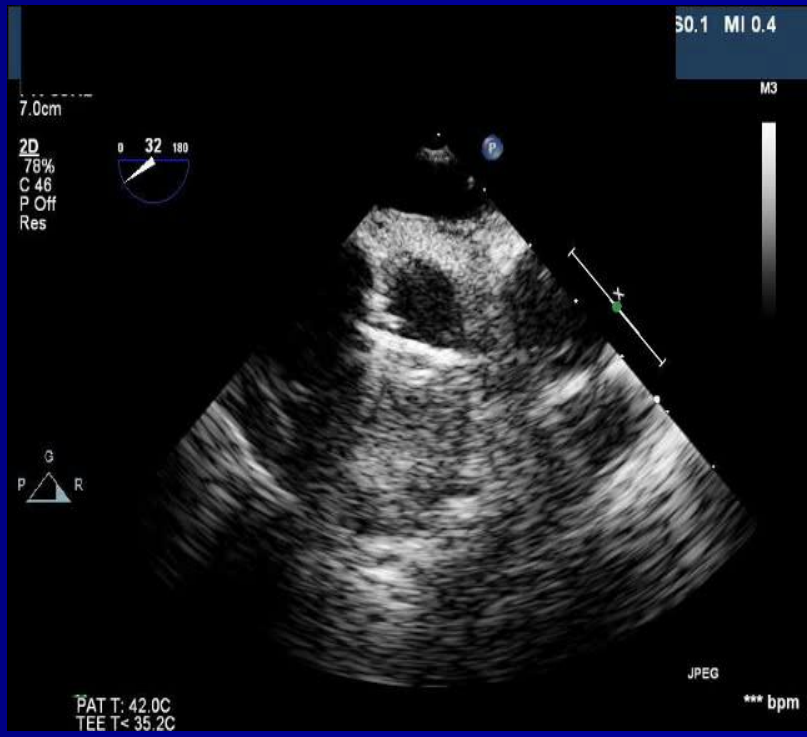
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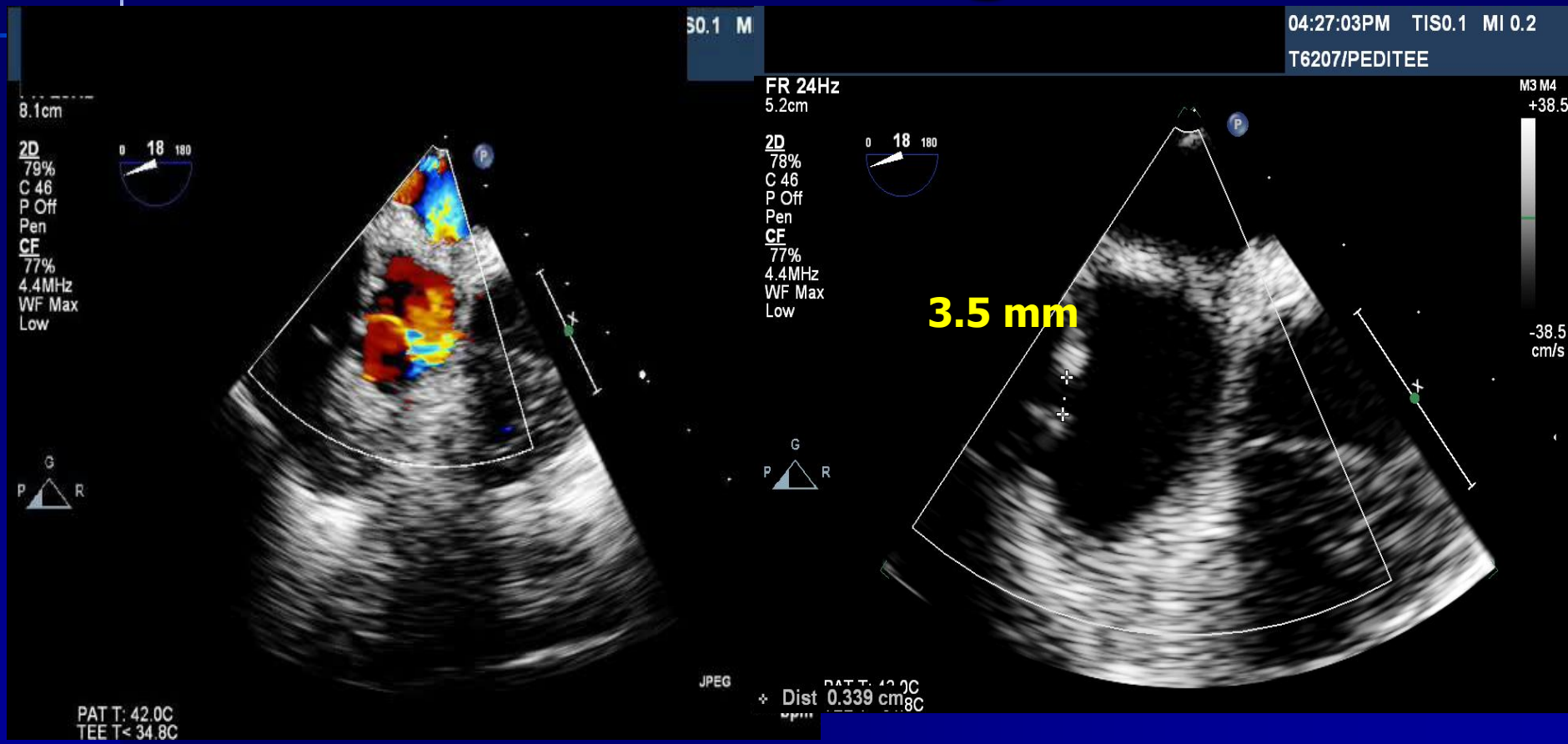
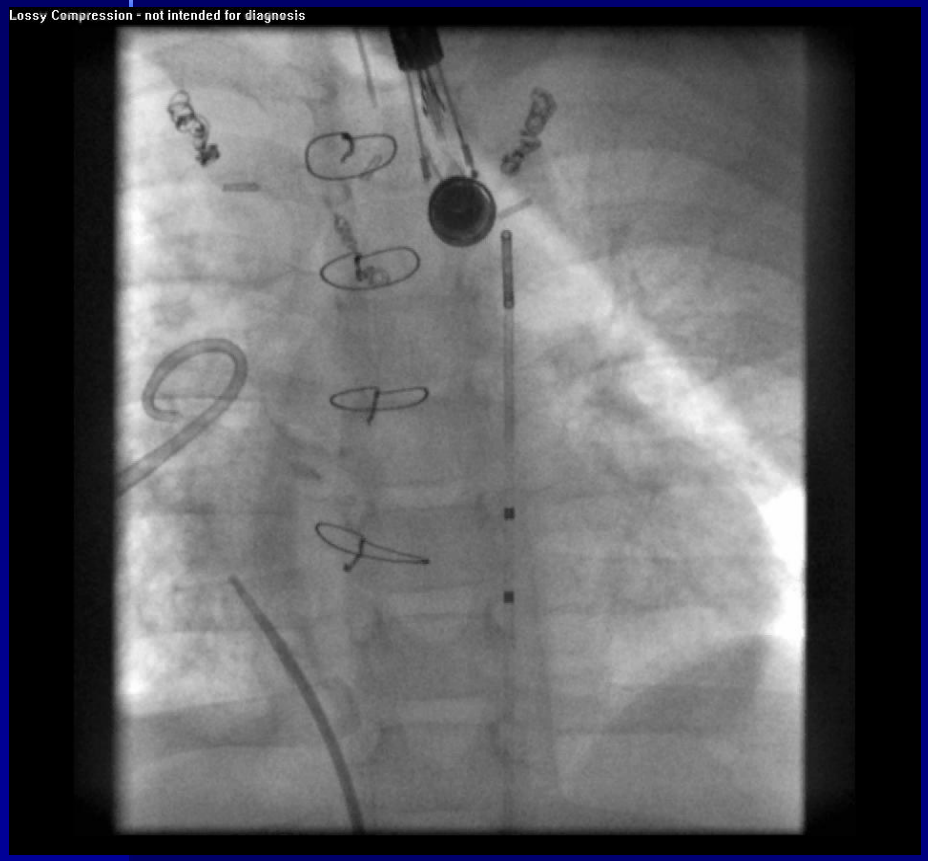
M3
7.0cm
2D
78%
C 46
P Off
Res
0 32 180
G
P R
JPEG
PAT T: 42.0C
TEE T< 35.2C
*** bpm

# New Fenestration with R-L Shunting

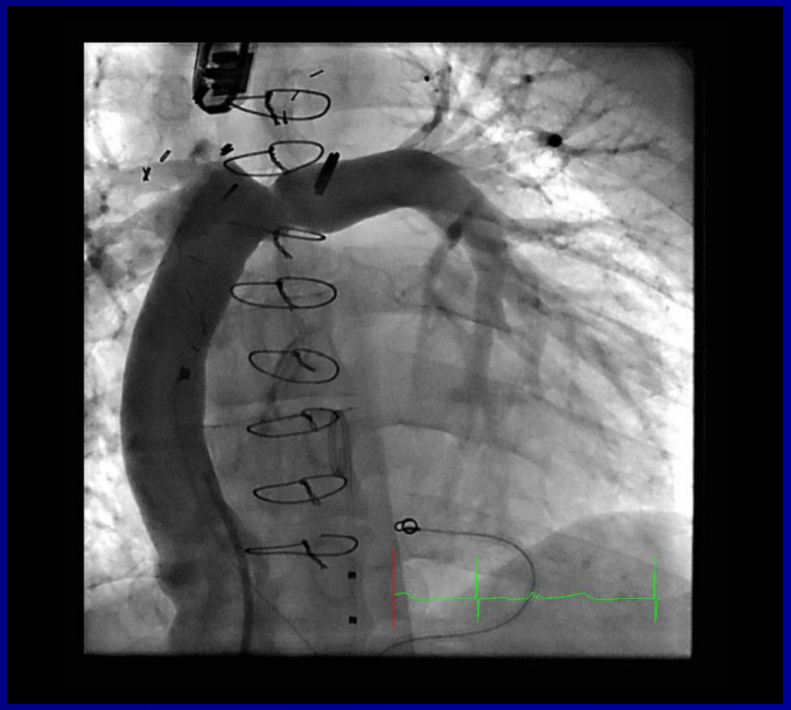


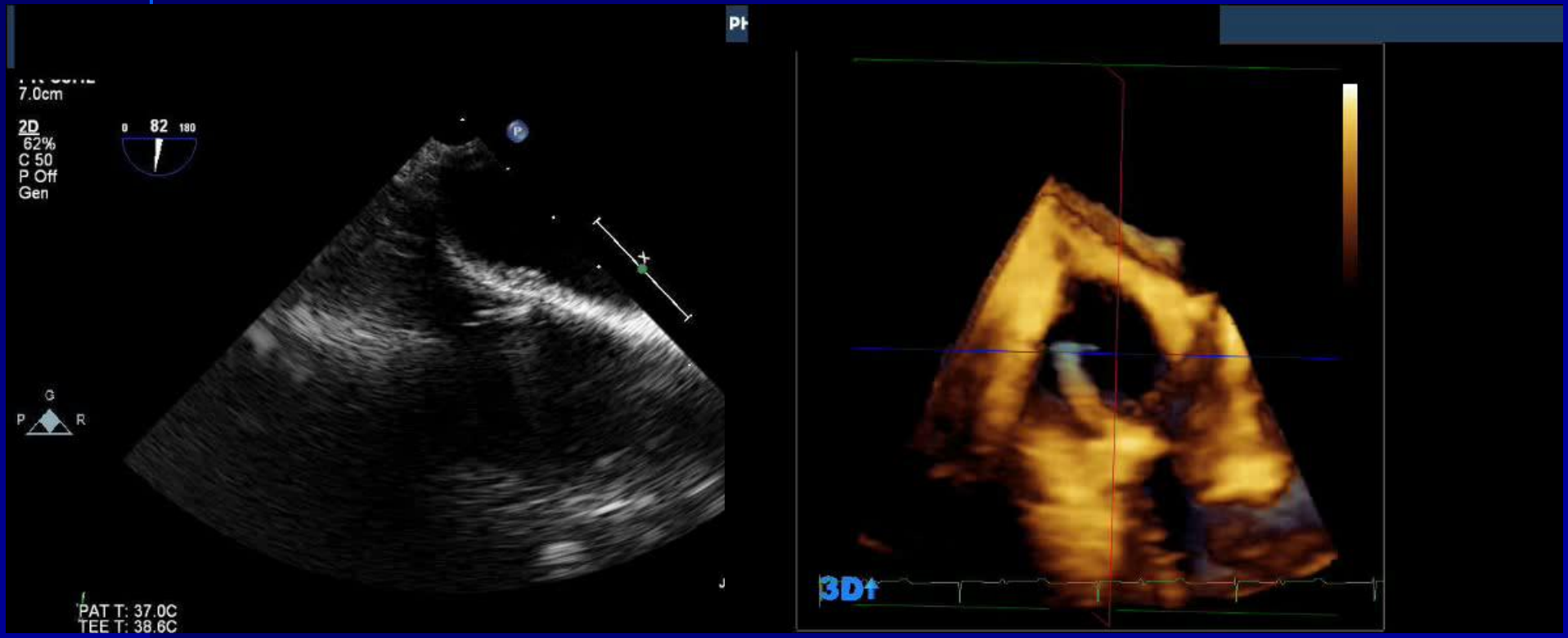

Lossy Compression - not intended for diagnosis


Lossy Compression - not intended for diagnosis

# Laser Failure

- 30 YO male with MA/TGA (S,L,L) & PS & VSD
- S/P RBTS (6 week) & shunt revision (5 YO)
- S/P Extracardiac Fontan (10 yo)
- S/P Epicardial pacemaker for SSS
- Hx of A.Flutter for EPS & RF Ablation




7.0cm
2D
62%
C 50
P Off
Gen
0
82
180
P
G
P
R
PAT T: 37.0C
TEE T: 38.6C
3D

# Conclusion: Advantage of Laser Technique

1. The smallest laser catheter could be inserted through a 4f delivery : useful in small infants

2. Perforates different tissue types, including synthetic materials i.e. PTFE (Goretex)

3. Vascular access does not limit its feasibility: the only requirement is that the laser catheter to be in physical contact with the target

# Disadvantage of Laser Technique

1. It is quite EXPENSIVE $$$:
   Laser System: $ 250,000
   Laser Catheter: $2000

2. Old calcified PTFE conduit (>15 years) does not respond to current laser system. Needs higher energy output !!!