

# Aortic valve dilation in infants & children

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AEPC Interventional course

Linz 03-2014

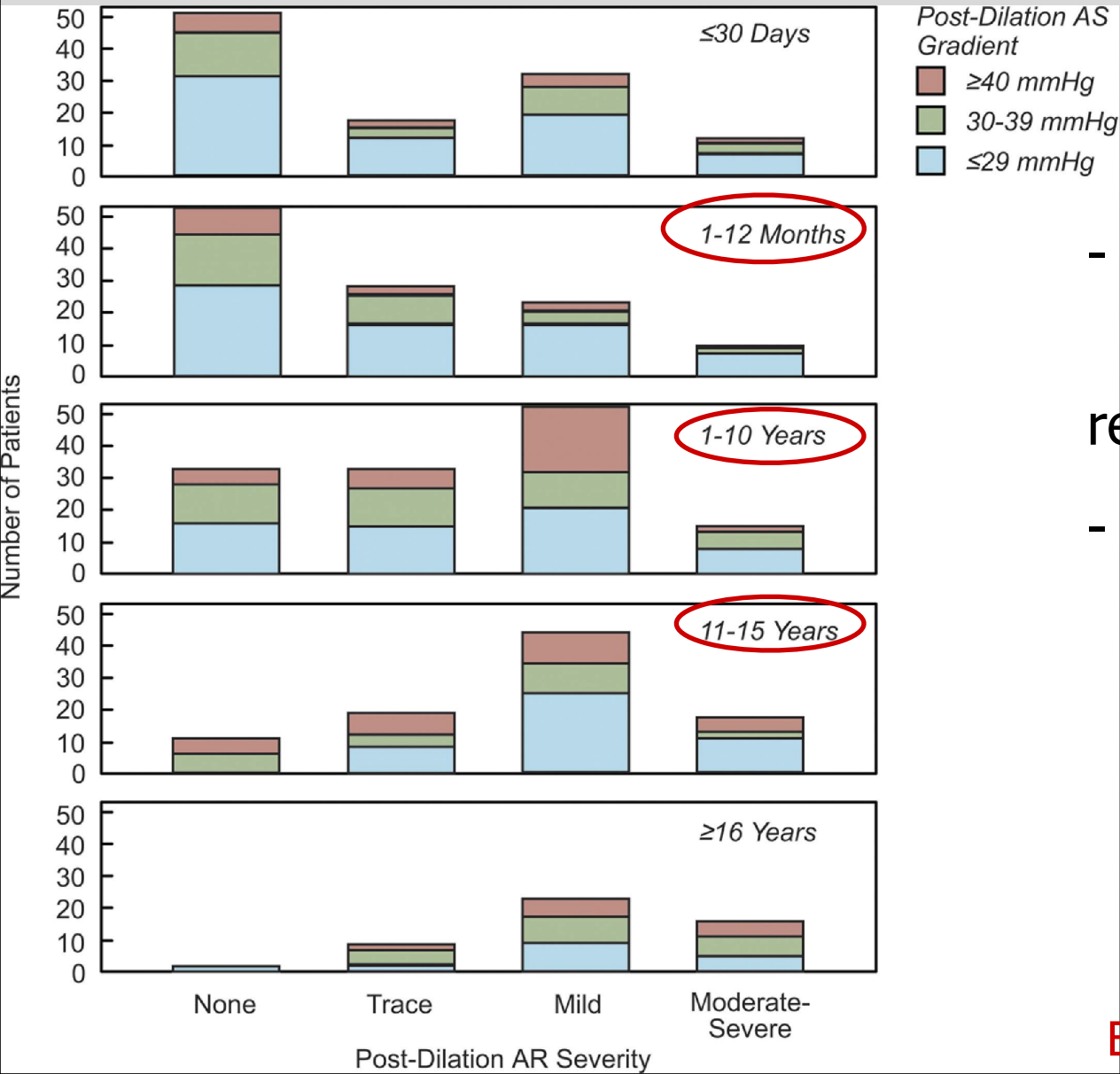
# Aortic valve dilation

No disclosures

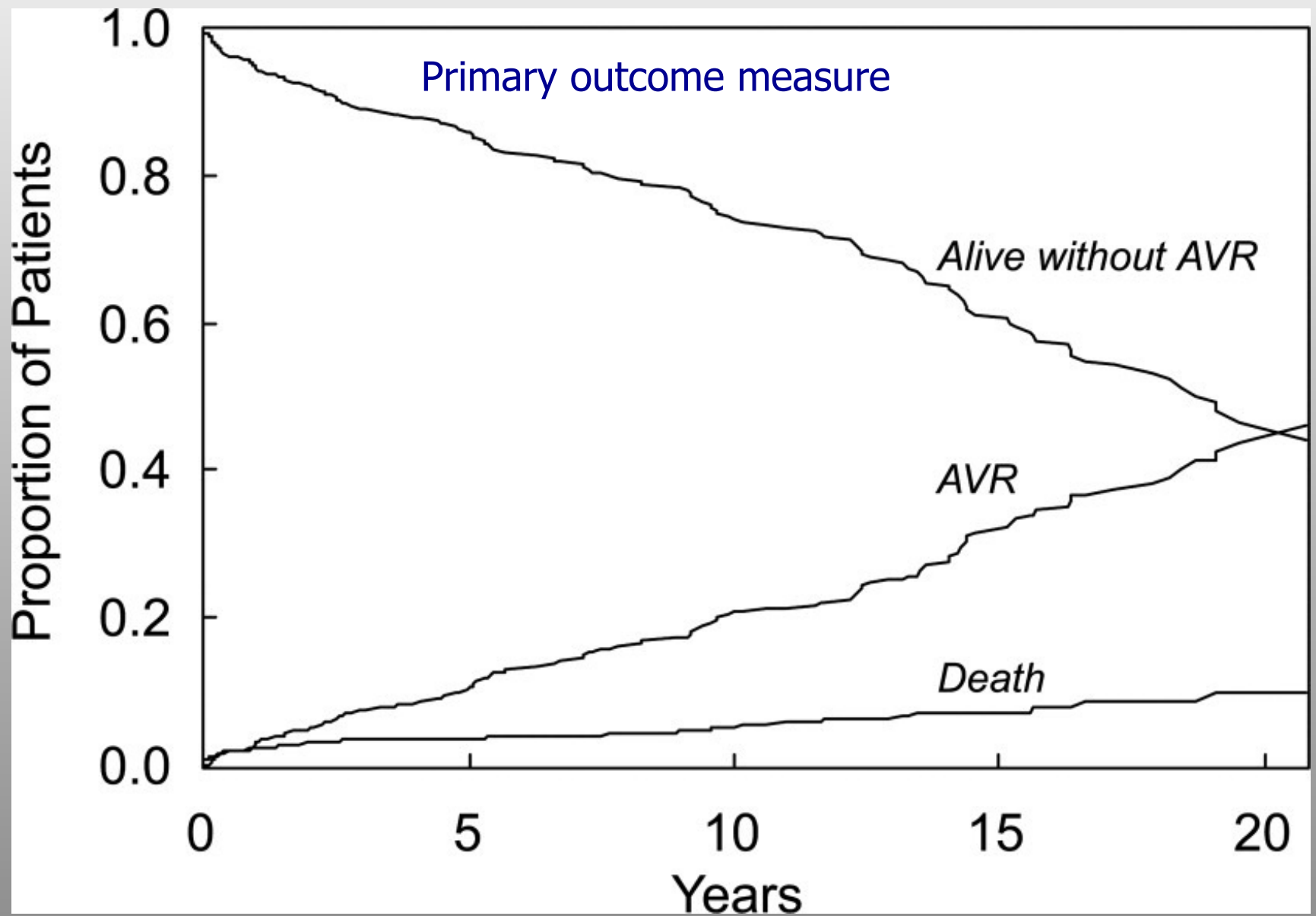
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# Palliation



- stenosis:
  - persistent
  - recurrent
- regurgitation
  - dilation induced
  - progressing



Brown et al. (Boston), JACC 2010



# What result should we aim for ?

**Table 5**

## HRs for AVR Among Patients With Different Combinations of Post-Dilation Residual AS and Acute AR

Residual Peak AS Gradient (mm Hg)	Acute Post-Dilation AR	HR (95% CI)	p Value
≤35	None-trivial	Reference	
	Mild	1.8 (0.99-3.2)	0.054
	Moderate-severe	4.2 (2.3-7.7)	<0.001
>35	None-trivial	2.0 (1.1-4.0)	0.036
	Mild	6.3 (3.5-11.1)	<0.001
	Moderate-severe	9.9 (4.8-20.4)	<0.001

AR = aortic regurgitation; AS = aortic stenosis; AVR = aortic valve replacement; CI = confidence interval; HR = hazard ratio.

“reduction of AS below 35 mm Hg may be more important than previously recognized and may be indicated even at the expense of mild or greater AR”

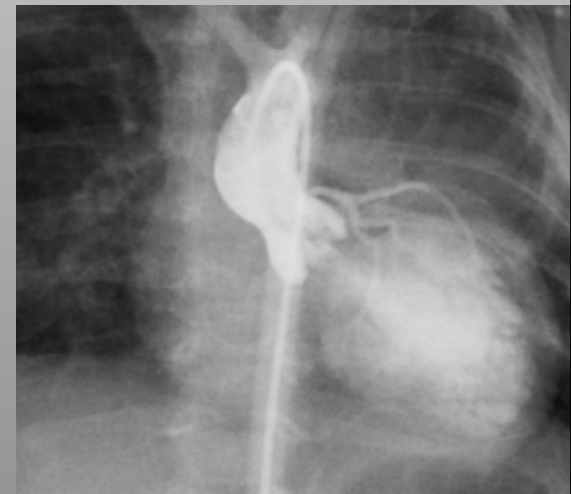
# Risk factors: lucky or good?

## Stenosis:

- Immediate: age < 3 months, severity AS predilation, **balloon/annulus < 0.9** (Vaca registry, Mc Crindle, Am J Cardiol, 1996)
- Long-term: small aortic annulus diameter (Reich, Heart, 2004)

## Aortic regurgitation:

- Immediate: AR pre, large annulus, **large balloon/annulus ratio**
- Long-term: functionnally bicuspid valve, large annulus (cusp disruption), older age at time of intervention



# Better selection based on morphology?

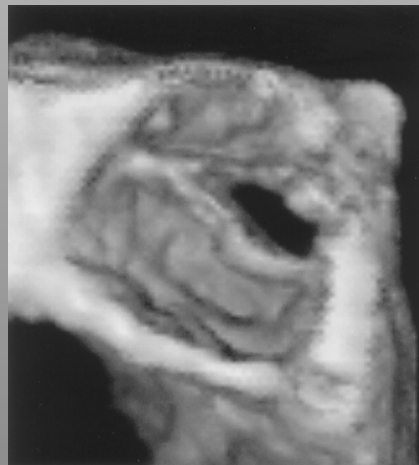
Solymar (JCTVS 1992): BD during open heart:

- Tricuspid and anatomically bic valves:  
    commisure enlarged
- $\frac{3}{4}$  fonctionnally bicuspid: cusp torn

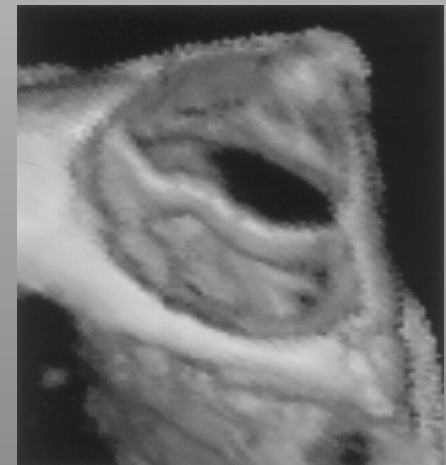
Improving imaging modalities: 3D TTE and TEE



Anatomically  
bicuspid valve



Pre dilation



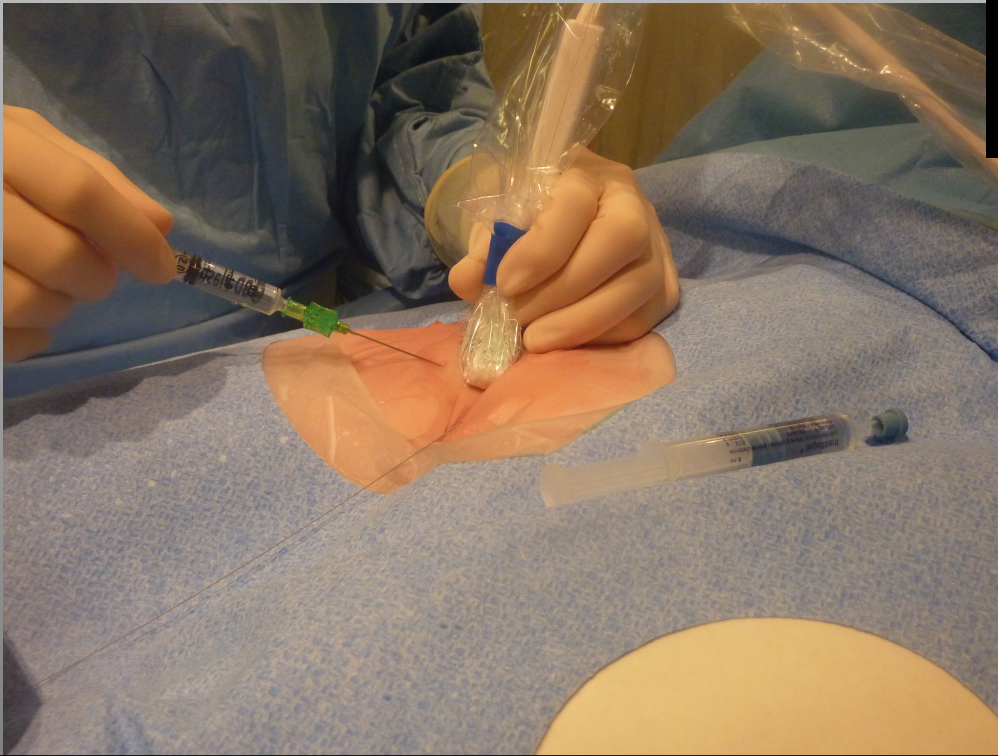
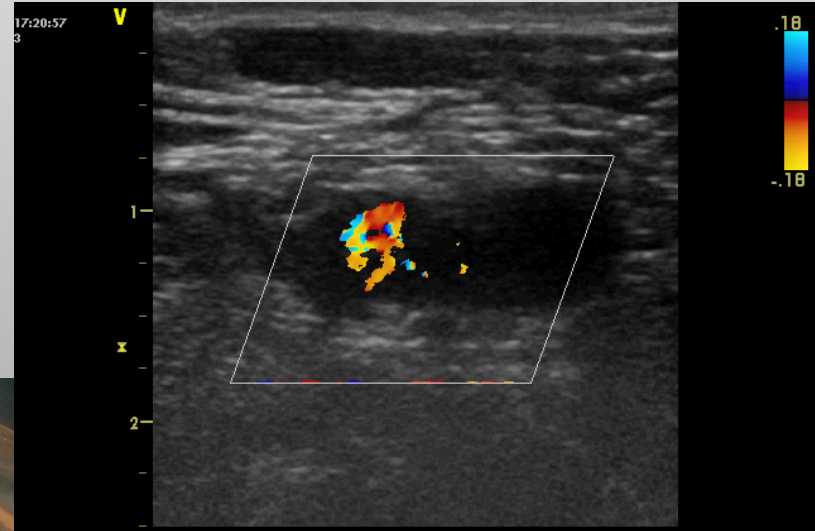
Post dilation

Acar, Circ 1999

# Procedure: neonates

- Good echo analysis (annulus, AR, ?morphology)
- General anesthesia (or deep sedation) + NIRS
- Access:
  - **Arterial:** hemodynamics, retrograde dilation
    - Femoral
    - Carotid (cutdown, infants)
    - Brachial, subclavian ....
  - +/- **Venous:**
    - anterograde dilation (PFO, ASD)
- Heparine 100 UI/kg
- Echo machine switched ON !!
- Defibrillator switched ON !!

# Echo-guidance for puncture



# Procedure: neonates

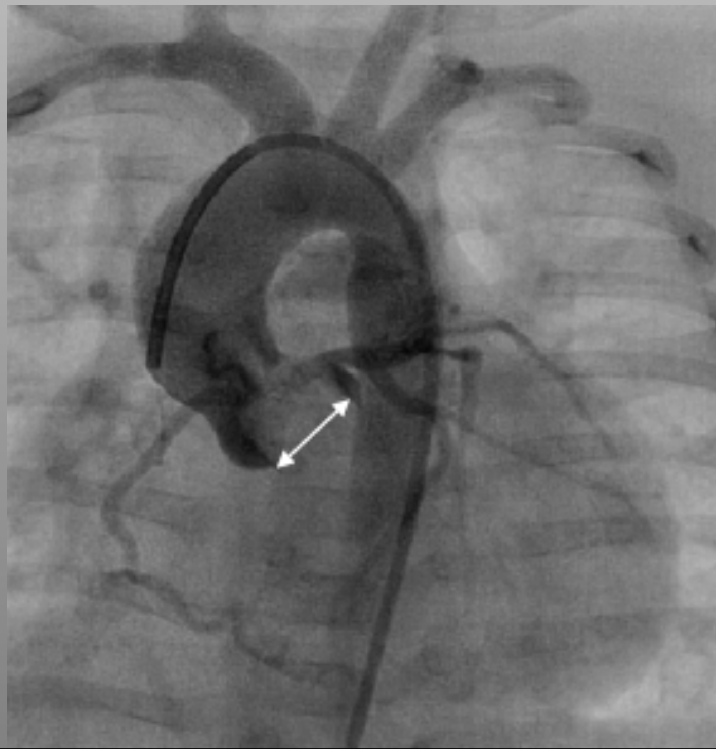
## 1. Aortogram:

Pigtail 4F

LAO 60°-cran 30°, RAO 30°-Caud 30°

→ Measurement annulus, visualize opening of valve

→AR?



+ echo data



## 2. Cross the valve: CENTRALLY!!

May be tricky and may influence results:

### Retrograde:

- femoral, brachial, subclavian, carotid artery
- catheter: (soft) right or left coronary, cobra, MP...
- wire: 0,014" (BMW, Whisper ..), terumo 0,018–25" (J)

### Anterograde: RA-LA-LV ↔ Ao

- Less valve perforation? Less FA damage?
- Needs soft catheters (cobra, terumo, balloon cath) and short soft balloons (Tyshak...)
- Easiest in neonates with depressed and dilated LV



3. Hemodynamics (– LV angiogram)
4. Choose and prepare balloon (even before you cross valve)
  - Tyshak II 2 cm (Tyshak mini)
  - balloon/annulus ratio: 0.9-1 (echo measure)
  - even smaller if very dysplastic valves ?
  - de-air balloon !!
5. Advance balloon
  - 0,014 – 0,018 – 0,21 wire (exchange not necessary)
  - at least 2 inflations
  - if unstable: partial deflation and rapid inflation
  - gradual dilation under echo control ?
  - rapidly remove balloon from coronary 'area'
6. Check hemodynamics, (repeat aortogram)



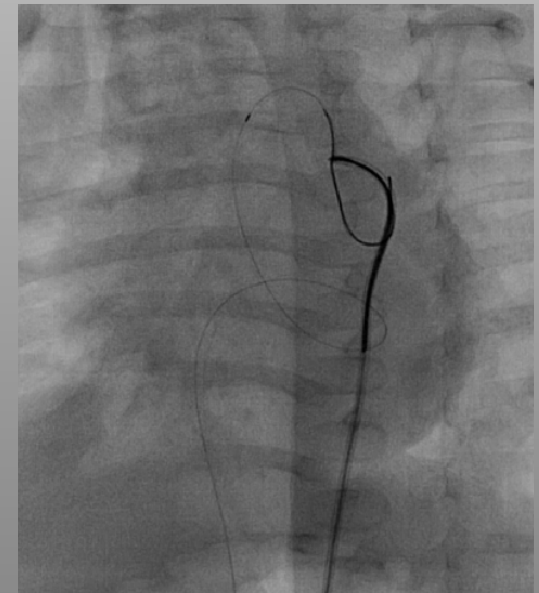
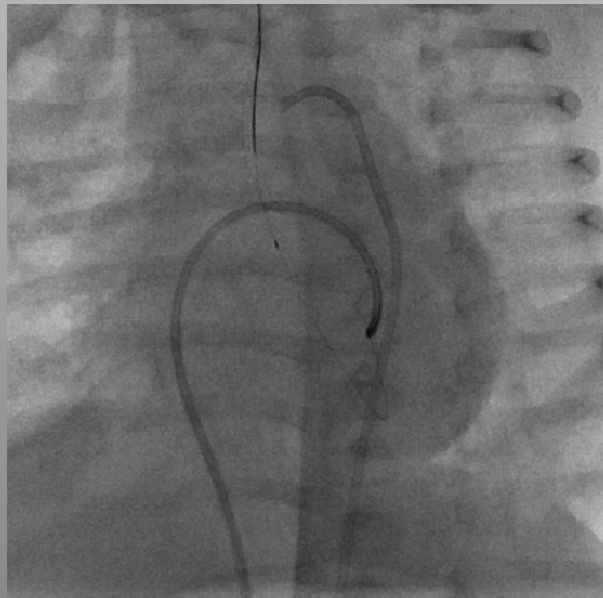
# Anterograde crossing with retrograde dilation

Advance a catheter or a wire antegrade (RA-LA-LV)

Snare it in aorta

Establish an arterio-venous loop

Advance a balloon catheter retrograde



# Procedure: older children

- Good echo analysis
- General anesthesia (or deep sedation)
- Access:
  - **Arterial:** hemodynamics, retrograde dilation
    - Femoral
  - +/- **Venous:**
    - rapid pacing
- Heparine 100 UI/kg
- Echo machine switched ON
- Defibrillator switched ON

# Procedure: older children

1. Aortogram: Pigtail: LAO 60°-cran 30°, RAO 30°-Caud 30°

- Measurement annulus
- Visualize opening of valve

2. Cross the valve: CENTRALLY

May be tricky and may influence results

- Retrograde:**
- femoral
  - catheter: right or left coronary, cobra, MP...
  - terumo 0,025", 0,035 (J)

# Procedure: older children

3. Hemodynamics – LV angiogram

4. Choose balloon

- Tyshak II 3-4 cm – Nucleus
- balloon/annulus ratio: 0.9-1 (echo measure)
- double-balloon: sum of diameters of the 2 balloons should be 1,2 X the valve diameter
- de-air balloon !!

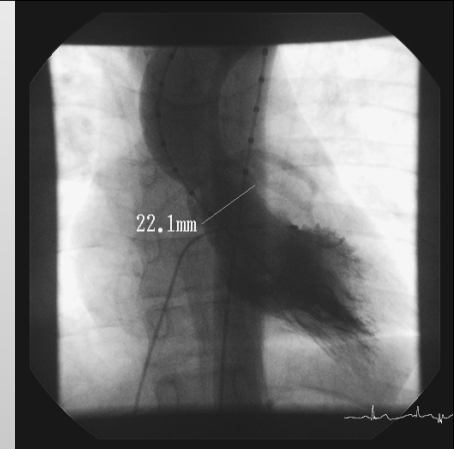
5. Advance balloon

stiffer (exchange) wire 0,018 (platinum) – 0,21 – 0,35 ′  
the older the stiffer

6. **Stabilization balloon !!**

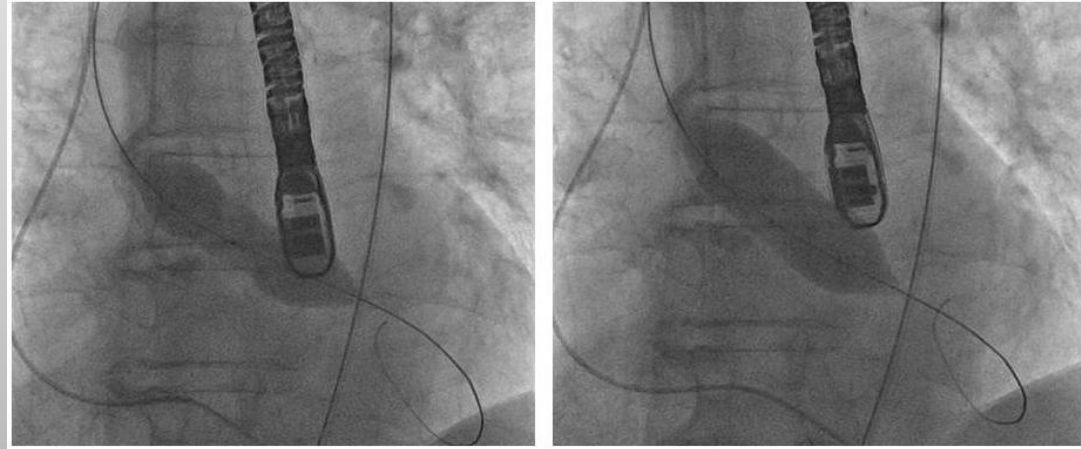
2-3 inflations

7. Check hemodynamics, repeat aortogram



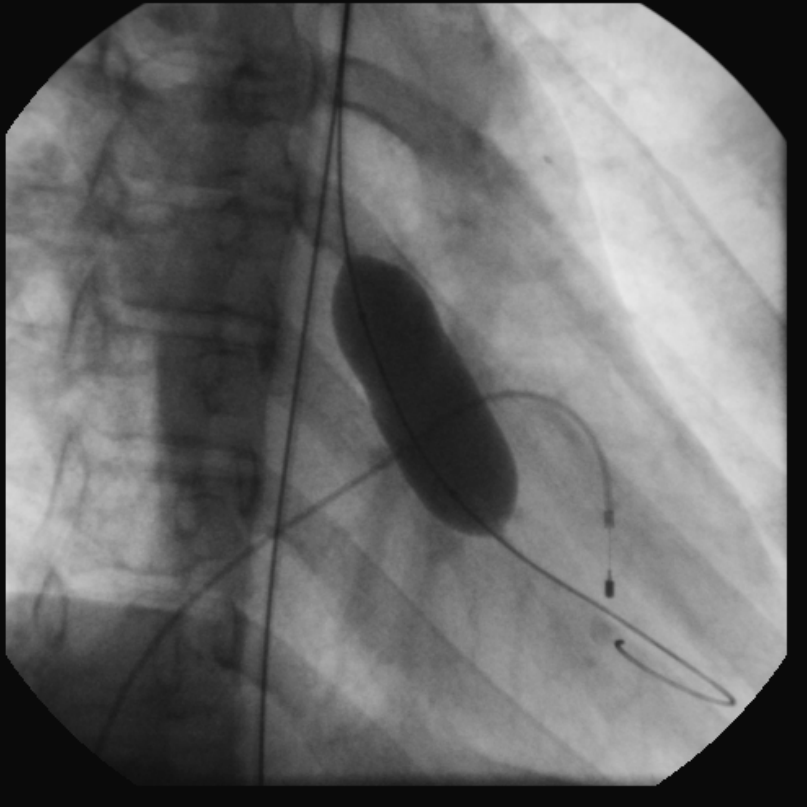
# Stabilization of balloon

- wire: stiff ←
- balloon: quick inflation
  - ◇ long balloon ←
  - ◇ 'Double' balloon
  - ◇ 'Nucleus' balloon (Numed)
- ↘ LV 'ejection' force
  - ◇ Adenosine
  - ◇ Rapid ventricular pacing
    - Right ventricular pacing ←
      - + controlled transient respiratory arrest
    - left ventricle pacing



# Rapid ventricular pacing

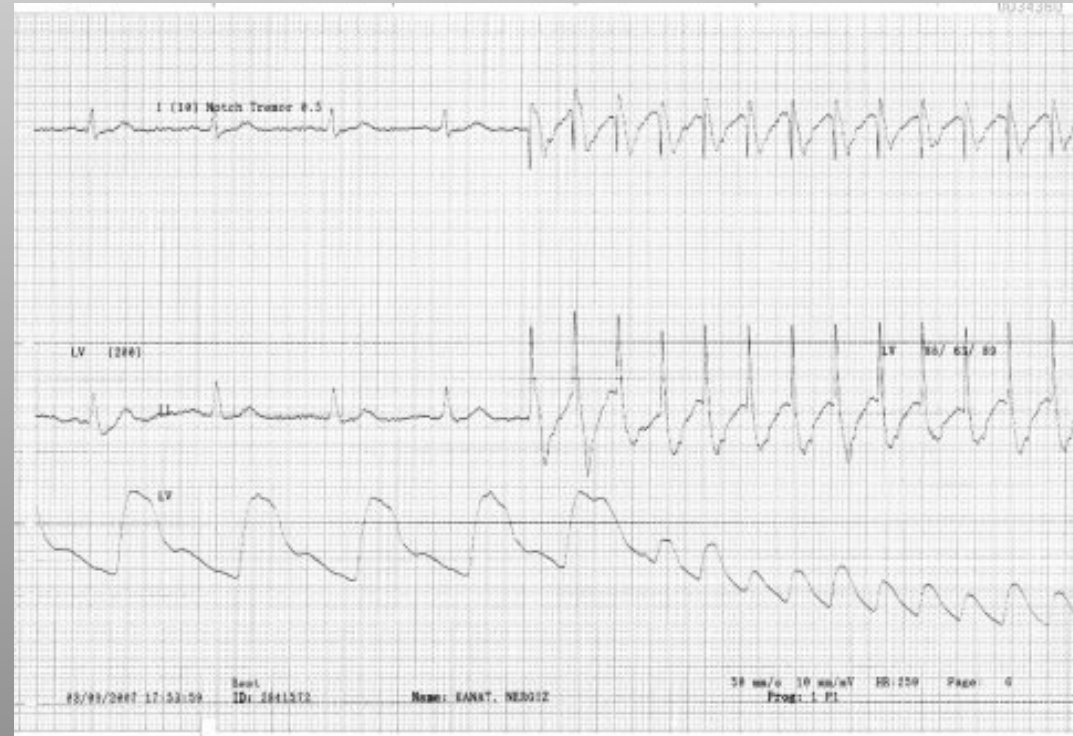
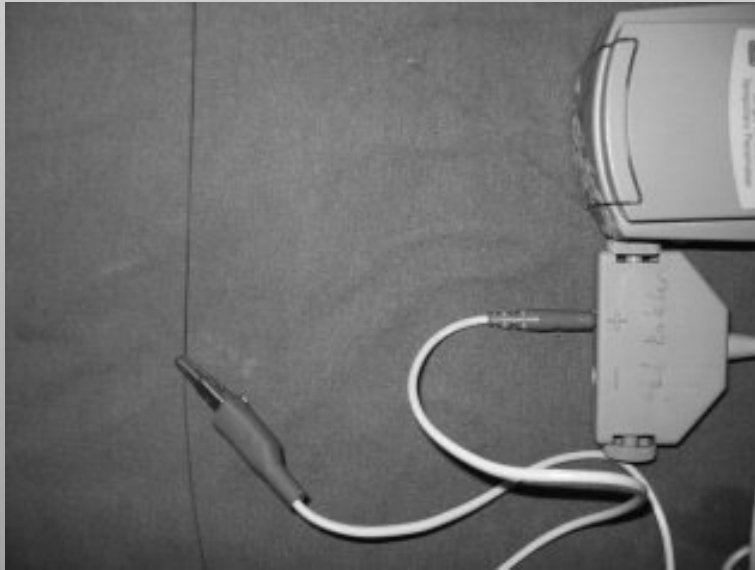
Right ventricle



Storage: 00:00

# Rapid ventricular pacing

## Left ventricle



### Guidewire

- > alligator head
- > external pace

# Algorithm ???

Neonates:

- Echo guidance if LV function poor
- If good function:
  - dP > 35 mmHg and no AR: repeat dilation
  - dP 25-35 and no AR ?
  - If dP < 35 and significant worsening AR: stop

Older children:

- Happy if invasive gradient < 35 mmHg
- If 35 - 45 mmHg and significant worsening AR: stop



# Summary

- Technical improvements help us with the procedure and probably improve the results, but result is still difficult to predict
- Better morphological selection might further improve our results
- This always has to be put in balance with surgical improvements in your own centre and elsewhere