Right ventricular outflow tract obstruction in the adult: native and post-op

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RVOTO – adult and post-op

- Morphology - level of obstruction
  - subinfundibular (double chambered RV)
  - infundibular
  - valvular
  - supravalvular / peripheral
  - combinations
  - conduit
- Hemodynamics
  - RVOTO (gradient)
  - PR grading
  - TR grading / TR velocity / RVP
- RV size, RVH, RVF
- RA / IVC / PA
- Associated lesions (VSD, ASD.....)

RVOTO – adult and post-op
Echocardiographic evaluation
The DIFFICULTIES

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- Limitations of RVOT gradient estimation
  - Doppler angle (underestimation)
  - Pressure recovery (overestimation)

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  → CMR

RVOTO – adult and post-op

Valvular Pulmonic Stenosis

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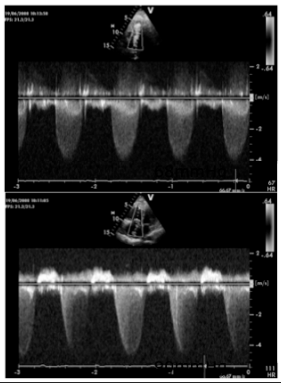

Grading	Mild	Moderate	Severe
Peak vel (m/s)	<3	3-4	>4
Peak grad (mmHg)	< 36	36-64	>60

RVOT Obstruction
INDICATIONS FOR INTERVENTION

ESC Guidelines 2010

Indications	Class[a]	Level[b]
RVOTO at any level should be repaired regardless of symptoms when Doppler peak gradient is >64 mmHg (peak velocity >4m/s), provided that RV function is normal and no valve substitute is required	I	C
In valvular PS, balloon valvotomy should be the intervention of choice	I	C
In asymptomatic patients in whom balloon valvotomy is ineffective and surgical valve replacement is the only option, surgery should be performed in the presence of a systolic RVP >80 mmHg (TR velocity >4.3 m/s)	I	C

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JACC Canadian Cardiovascular Society 2009 Guidelines

Symptoms:
PG / MG *>50/>30 mmHg*
Less than moderate PR

No Symptoms:
PG / MG *>60/>40 mmHg*
and less than moderate PR

RVOT Obstruction
INDICATIONS FOR INTERVENTION

ESC Guidelines 2010

Intervention in patients with gradient <64 mmHg should be considered in the presence of: • symptoms related to PS or, • decreased RV function or, • double-chambered RV (which is usually progressive) or, • important arrhythmias or, • right-to-left shunting via an ASD or VSD.	IIa	C
Peripheral PS, regardless of symptoms, should be considered for repair if >50% diameter narrowing and RV systolic pressure >50 mmHg and/or lung perfusion abnormalities are present	IIa	C

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JACC Canadian Cardiovascular Society 2009 Guidelines

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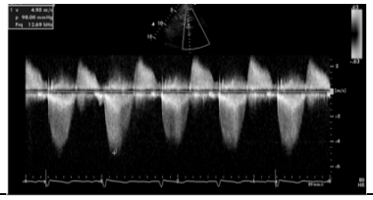
Intervention in the presence of ASD, VSD, and/or arrhythmias may be indicated
?Class / Level?

Female, 53 years



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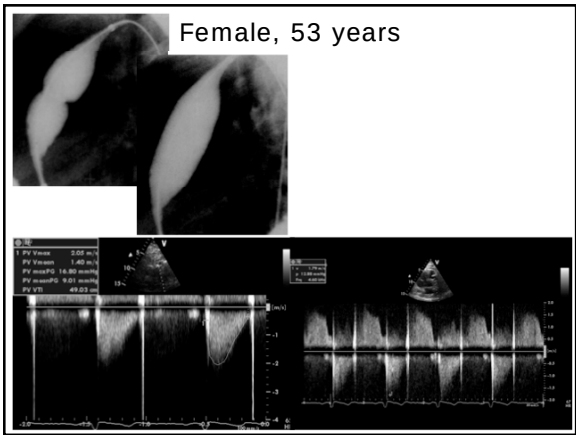
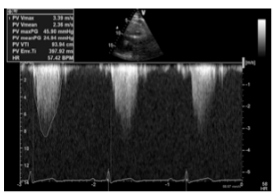


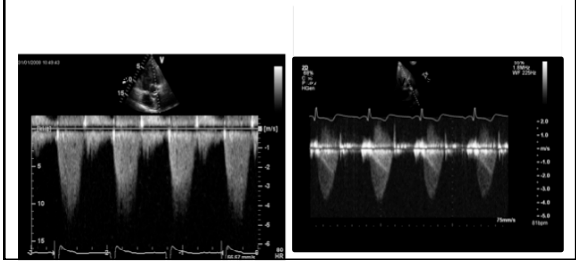
Male, 62 years Restrictive VSD



Male, 62 years Restrictive VSD

Double chambered right ventricle
Invasive RVP inflow 105/0-8mmHg, Gradient 68mmHg

RVOTO - Stenoses in series



Gradient Calculation by CW-Doppler

BERNOULLI EQUATION

$$p_1 - p_2 = \frac{1}{2}\rho\left(v_2^2 - v_1^2\right) + \rho\int_1^2 \frac{dv}{dt}\,\mathrm{ds} + R\,(\mu y)$$

Convective acceleration | Flow acceleration | Viscous friction

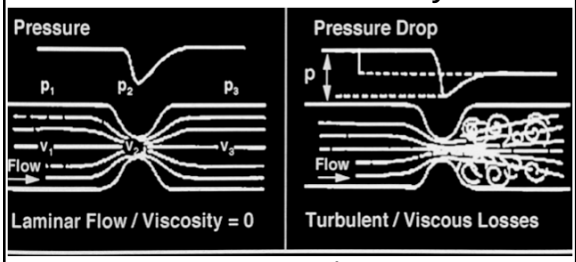
$$\Delta p = \frac{1}{2}\rho\left(v_2^2 - v_1^2\right)$$

$$\Delta p = 4\left(v_2^2 - \cancel{v_1^2}\right)$$

V_1: subv. velocity (LVOT) ≈1m/s

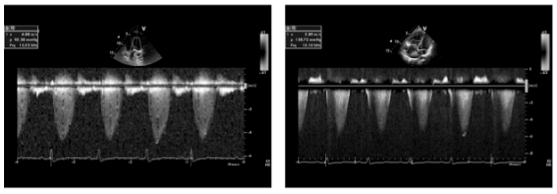
$$\boxed{\Delta p = 4v^2}$$

Pressure Recovery



Pressure recovery in RVOTO:
- Stenoses in series
- Long, tubular stenoses
- Hypoplastic PA

RVOTO – adult and post-op



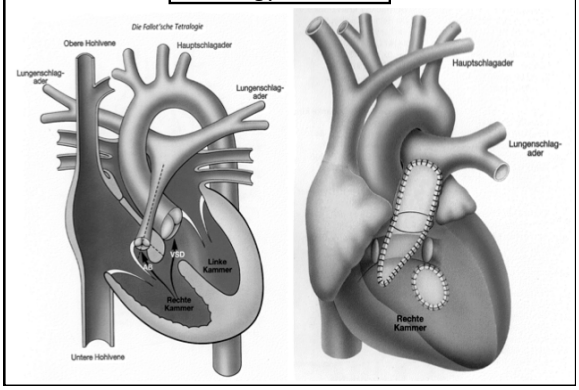
Pulmonary Artery Stenoses

RVOTO – adult and post-op

Complex CHD with RVOT repair

- Residual / recurrent stenosis
- Pulmonary regurgitation
- Conduit
  - non-valved
  - homograft
  - xenograft (Contegra®)

Tetralogy of Fallot

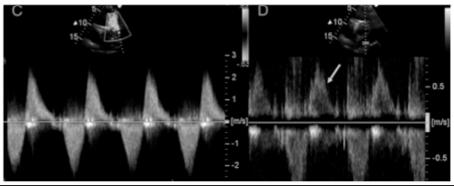


Severe PR after ToF repair

assessment of

- pulmonary regurgitation (grading)
- RVOT morphology
- RV volumes
- RV function (EF)
- TR (velocity, grading
- additional lesions (VSD, peri.PS, AR, Ao)
- LV

Grading of PR after ToF repair



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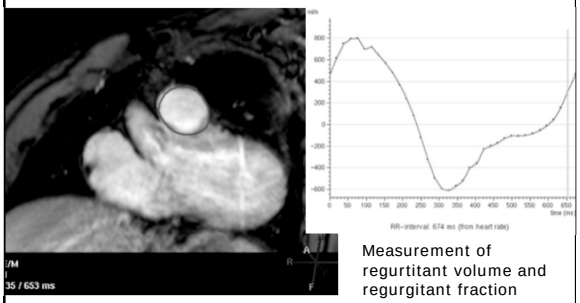
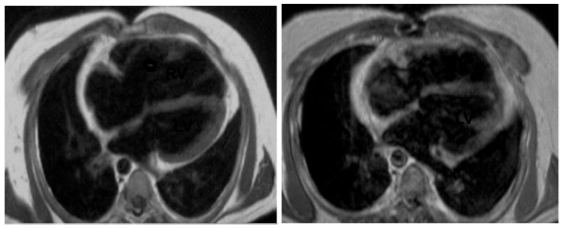


Measurement of regurtitant volume and regurgitant fraction

Severe PR after ToF repair

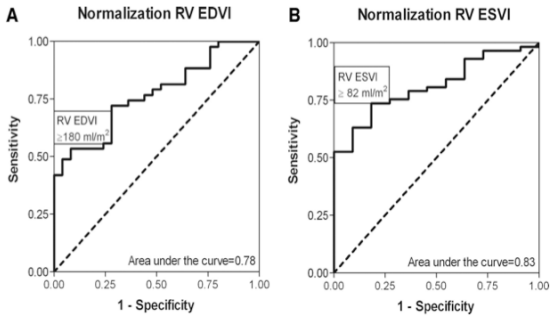
Severe PR after ToF repair: RV volume/function

Tetralogy of Fallot After Repair
Severe PR – Timing of Intervention



Prior to PVR **After PVR**

Pulmonary Regurgitation after TOF Repair
Response of the RV to valve replacement



Oosterhof Th et al Circulation. 2007;116:545-551

Indications for Intervention After Repair of Tetralogy of Fallot

	Class[a]	Level[b]
Aortic valve replacement should be performed in patients with severe AR with symptoms or signs of LV dysfunction	I	C
PVRep should be performed in symptomatic patients with severe PR and/or stenosis (RV systolic pressure > 60 mmHg, TR velocity > 3.5 m/sec)	I	C
PVRep should be considered in asymptomatic patients with severe PR and/or PS when at least one of the following criteria is present: ● decrease in objective exercise capacity (CPET) ● progressive RV dilation ● progressive RV systolic dysfunction ● progressive TR (at least moderate) ● RVOTO with RV systolic pressure > 80 mmHg (TR velocity > 4.3 m/sec) ● sustained atrial/ventricular arrhythmias	IIa	C
VSD closure should be considered in patients with residual VSD and significant LV volume overload or if the patient is undergoing pulmonary valve surgery	IIa	c

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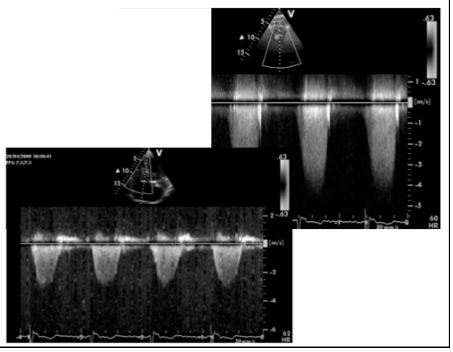
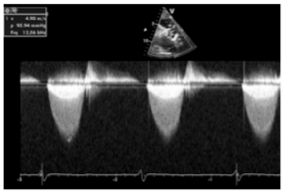
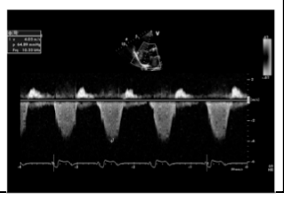
Male, 65 yrs ToF, repair 1982 re-op for VSD 1983+1987



Female, 22 yrs ToF, repair+Contegra 2002



Male, 16 yrs ToF, repair 1995, re-op 1998
homograft 21mm 2000



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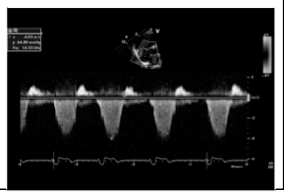

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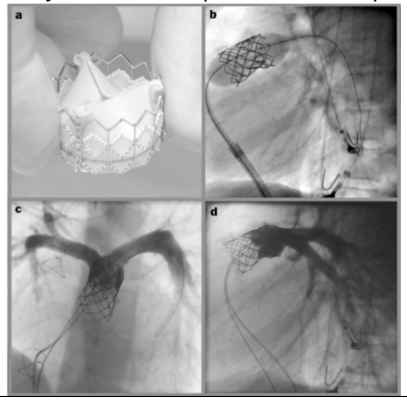

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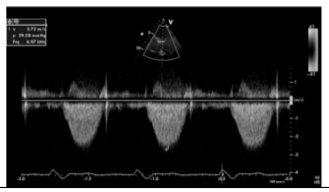

Thank you for your attention!