



Forget Me Not

Assessing the Pulmonary Valve

Bonita Anderson
(No disclosures)

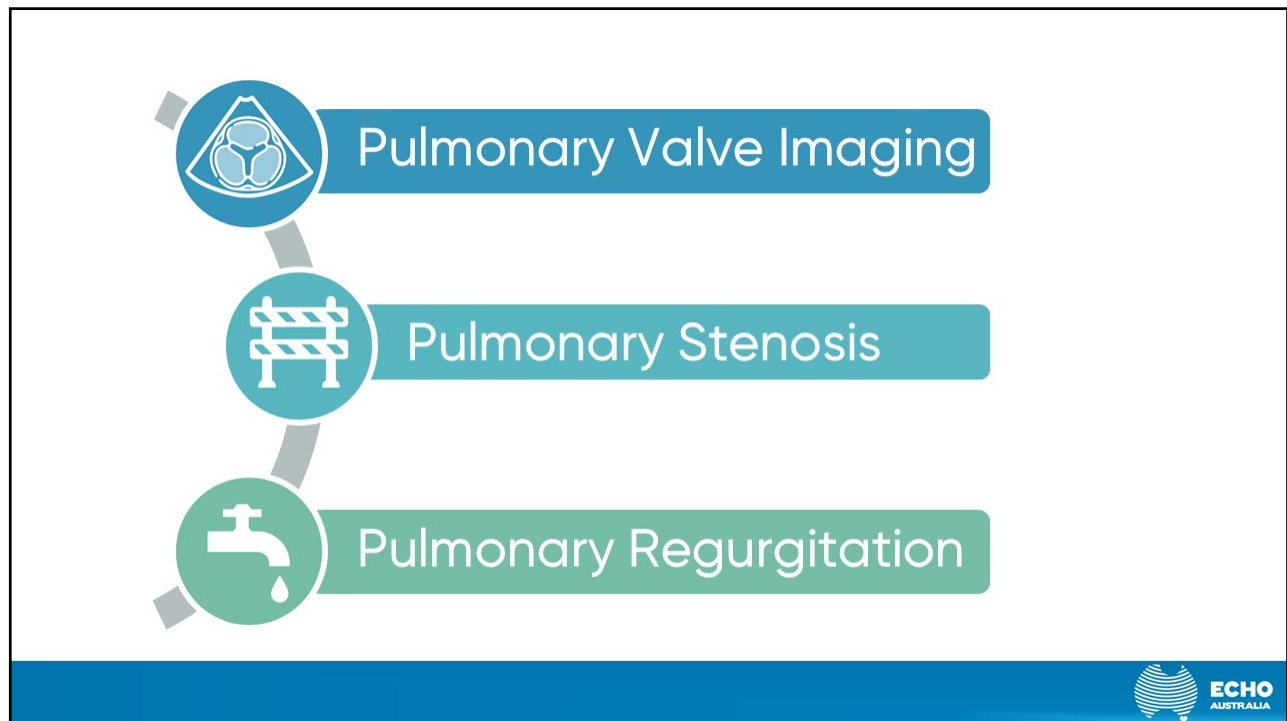


ECHO
AUSTRALIA



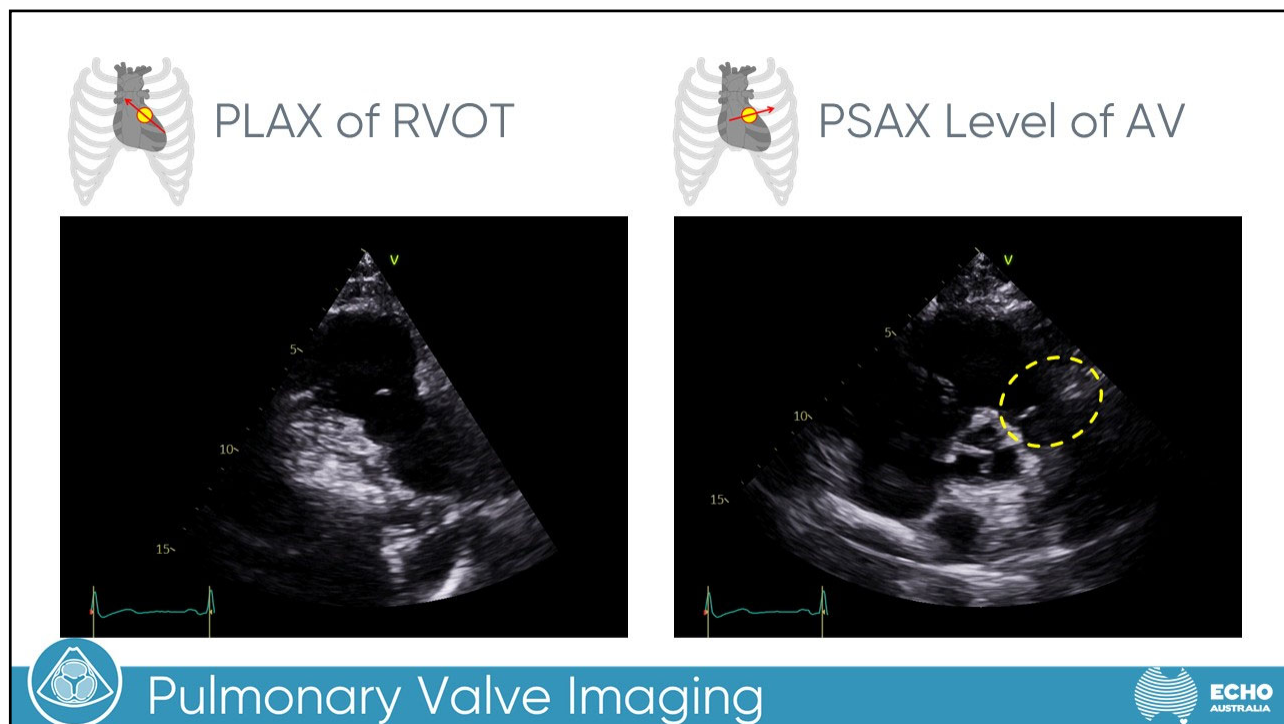
17 – 19 March 2025
Marvel Stadium, Melbourne

1

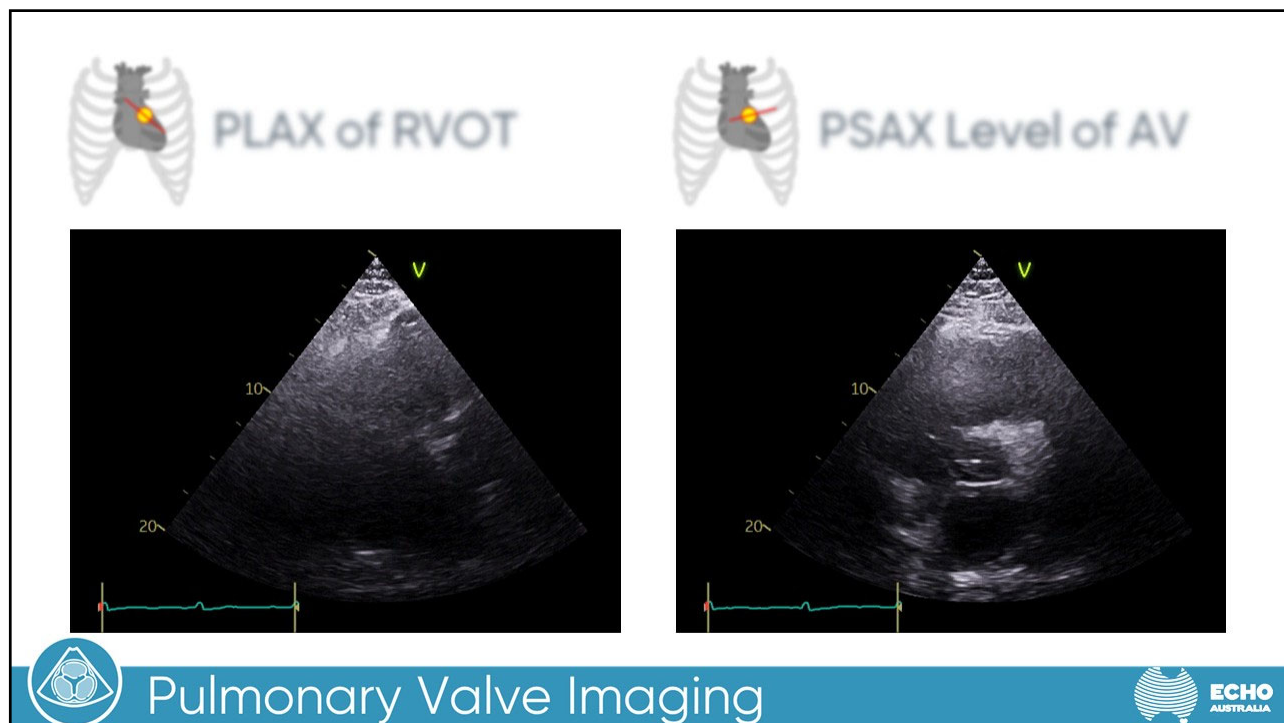


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Lost Puppy Cartoon
https://www.reddit.com/r/funny/comments/3jkpet/lost_puppy/?rdt=50348



**If you can't find it
Look Elsewhere**

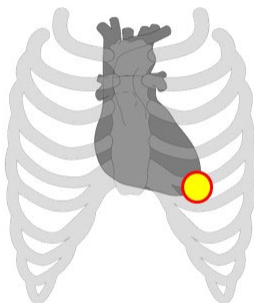


Pulmonary Valve Imaging

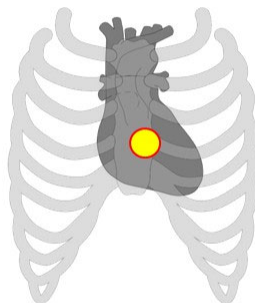


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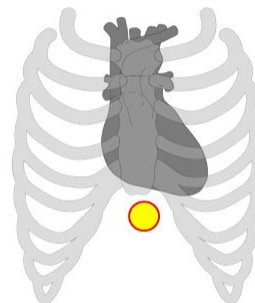
Alternative Imaging Views



Apical



Para-apical



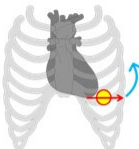
Subcostal



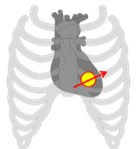
Pulmonary Valve Imaging



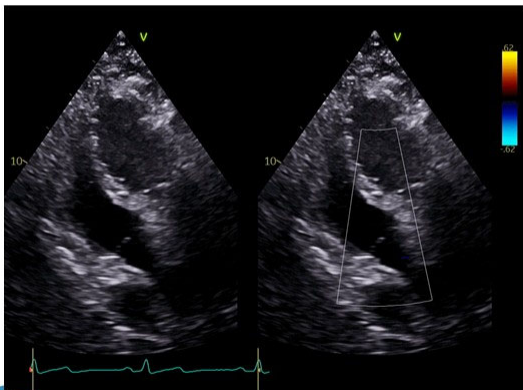
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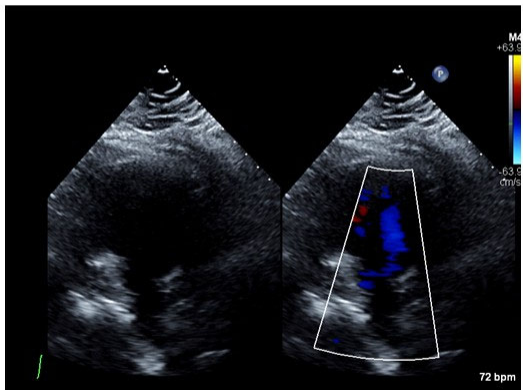


Apical 4-ch
(marked anterior tilt)



Para-apical



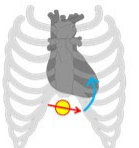




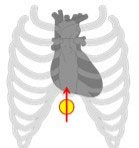
Pulmonary Valve Imaging



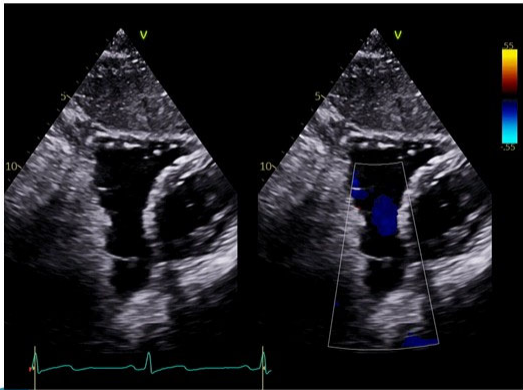
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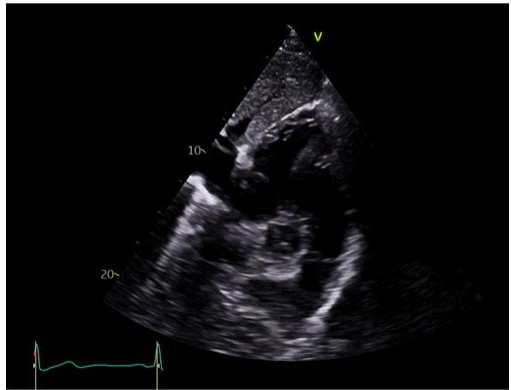


Subcostal 4-ch
(marked anterior tilt)



Subcostal SAX



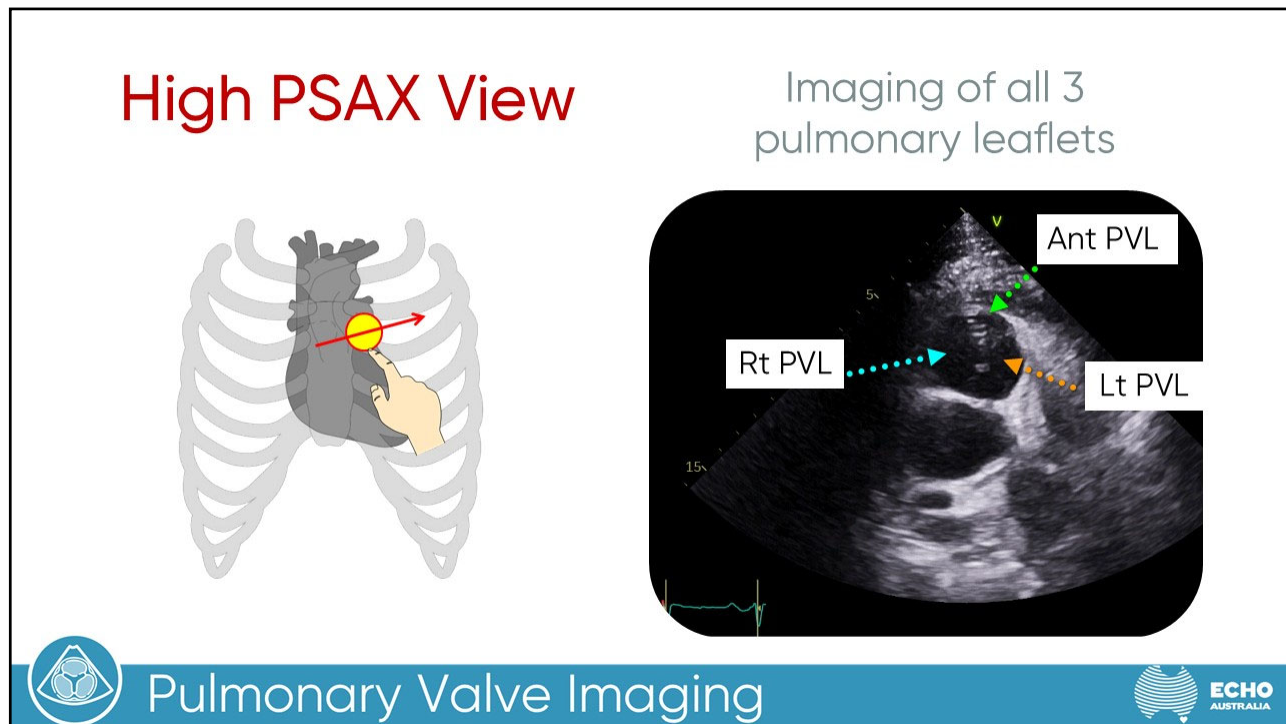




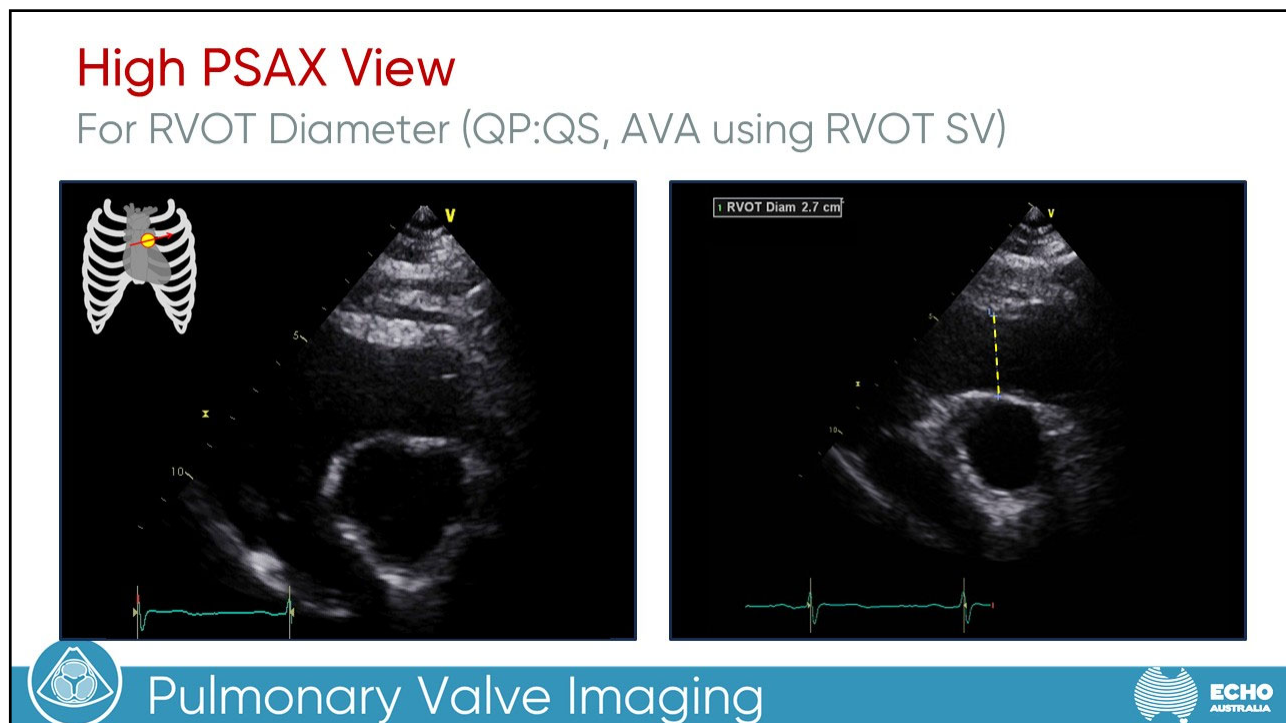
Pulmonary Valve Imaging



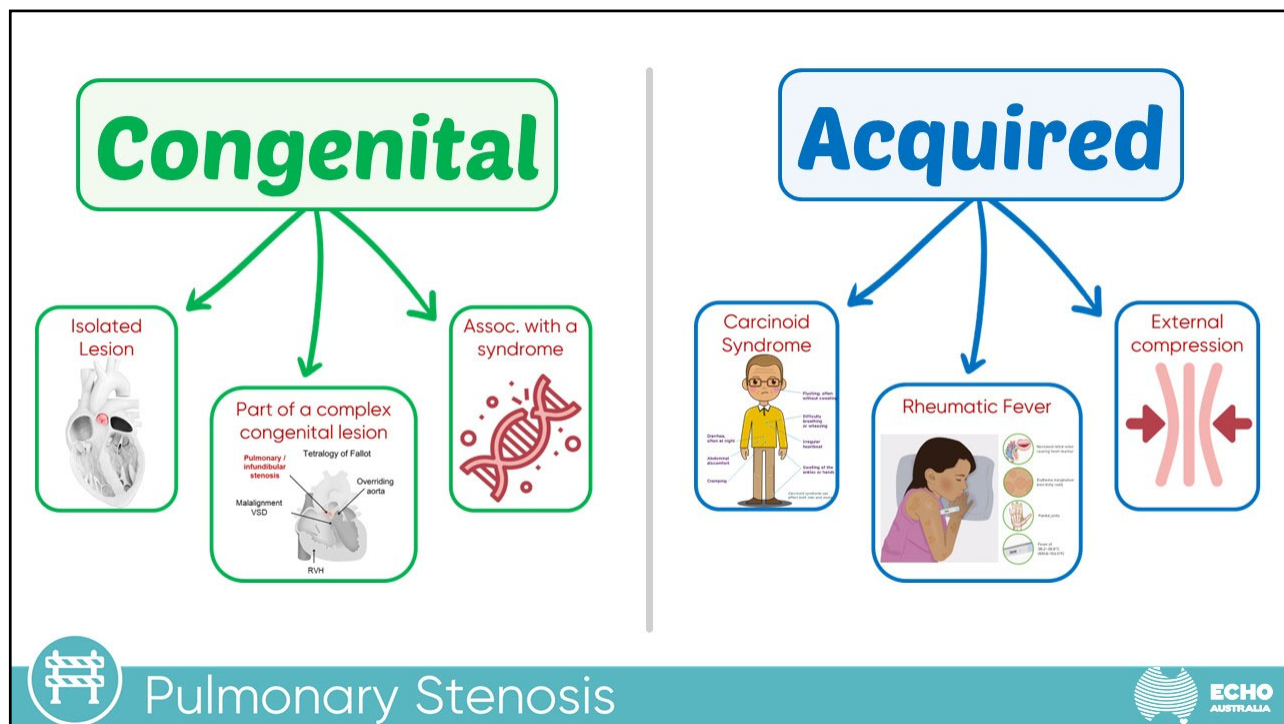
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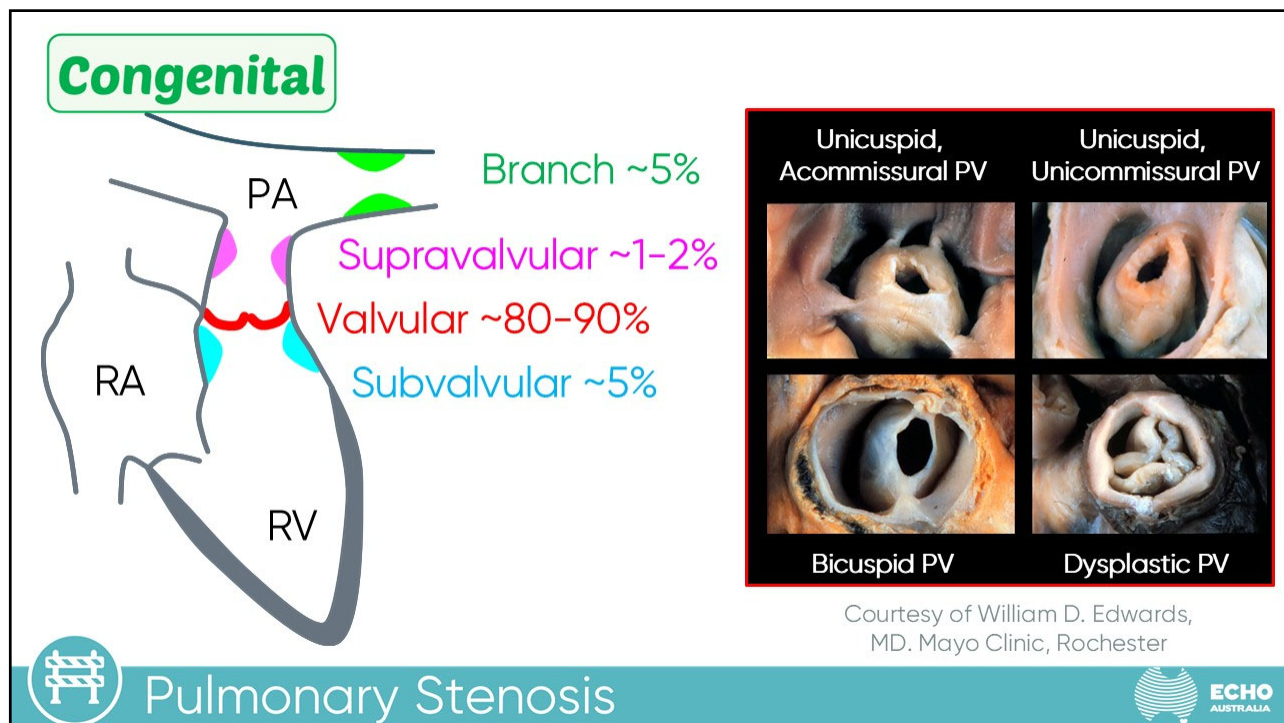
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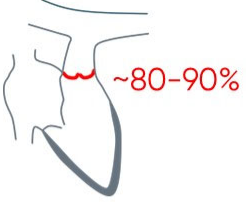
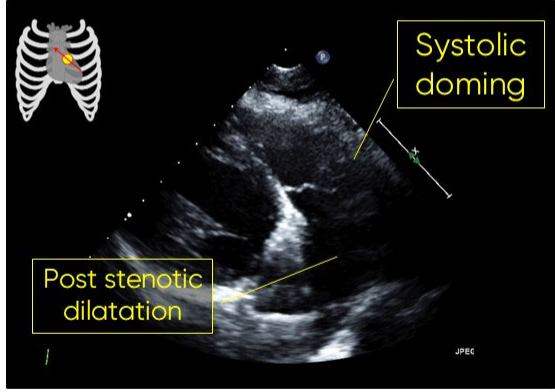
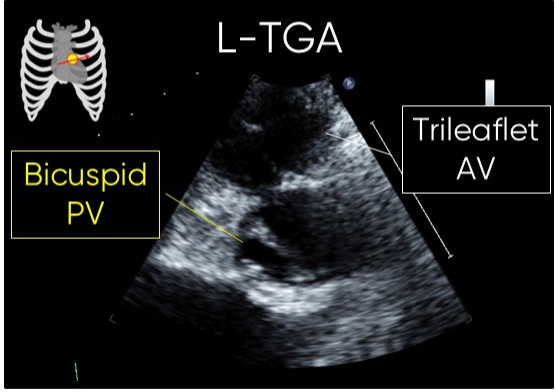


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Congenital

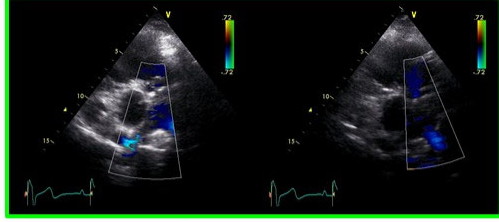
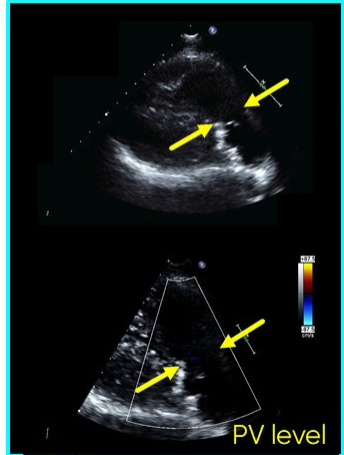
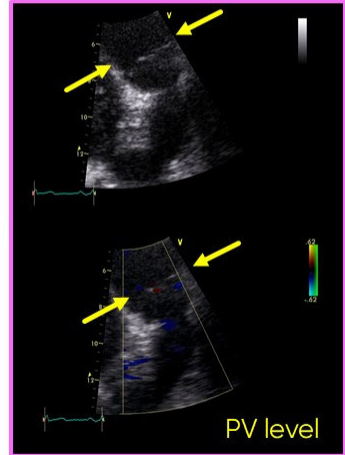




Pulmonary Stenosis

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Congenital

Pulmonary Stenosis

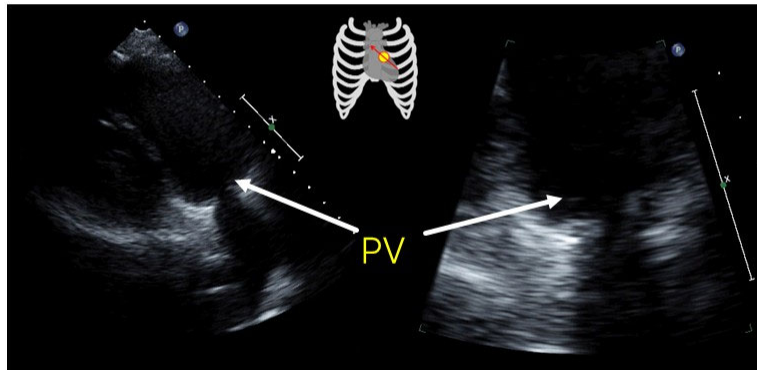
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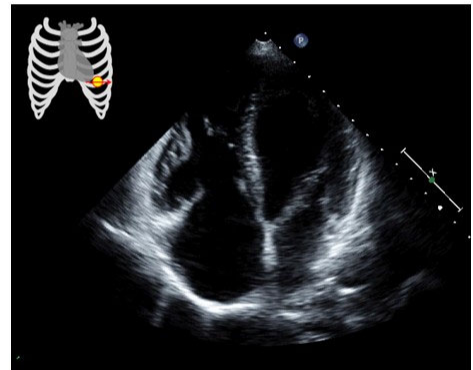
Acquired

Carcinoid Syndrome

Thickened, retracted PV



Thickened, fixed TV



Pulmonary Stenosis

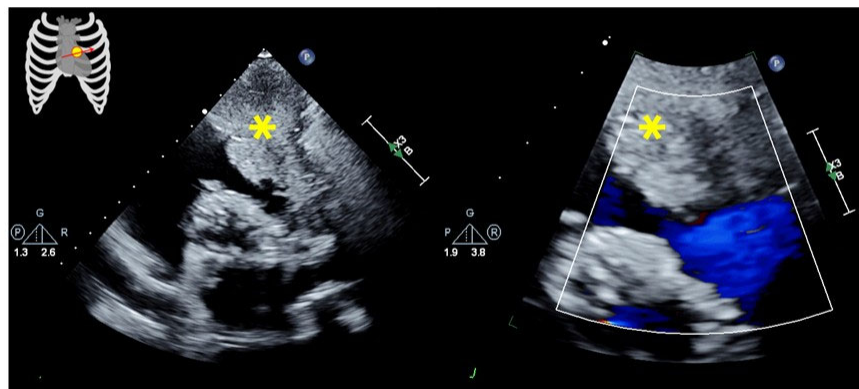


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Acquired

External RVOT Compression

Anterior mediastinal soft tissue mass*, ? Thymic carcinoma



Pulmonary Stenosis

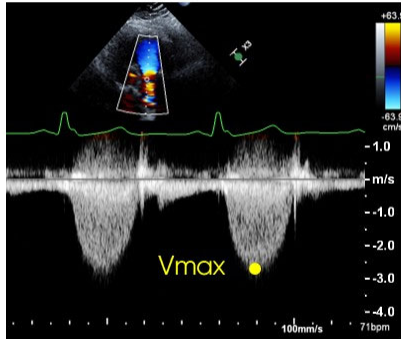


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Haemodynamic Severity

$$\Delta P_{\max} = 4 (V_{\max})^2$$



	Mild	Moderate	Severe
Vmax (m/s)	< 3	3 – 4	> 4
$\Delta P_{\max}$ (mmHg)	< 36	36 – 64	> 64

★ When normal RV function & normal transvalvular flow

Baumgartner H, et al; American Society of Echocardiography; European Association of Echocardiography. J Am Soc Echocardiogr. 2009 Jan;22(1):1-23; Baumgartner H, et al; ESC Scientific Document Group. Eur Heart J. 2021 Feb 11;42(6):563-645.



Pulmonary Stenosis



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**ΔP are
Flow Dependent**



Pulmonary Stenosis



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ΔPmax = 4 (Vmax)²

Flow Dependent



PS Severity
Overestimated

High flow across RVOT/PV:

- L-R shunt across ASD/VSD
- Coexistent severe PR



PS Severity
Underestimated

Low flow states:

- Poor RV systolic function
- Coexistent severe TR



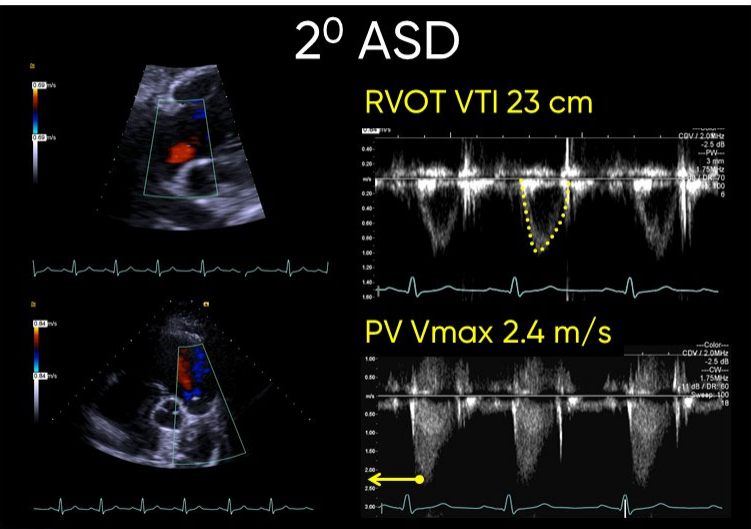
Pulmonary Stenosis



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↑ PV Velocities but Not PS

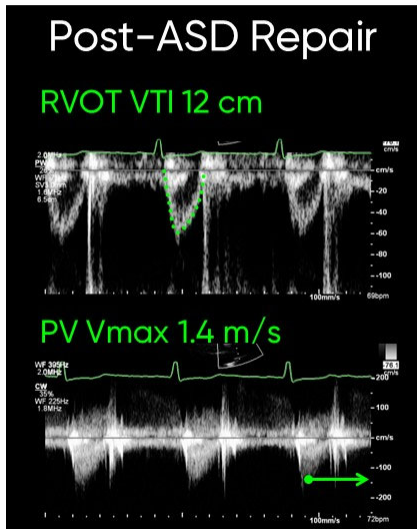
2^o ASD



RVOT VTI 23 cm

PV Vmax 2.4 m/s

Post-ASD Repair



RVOT VTI 12 cm

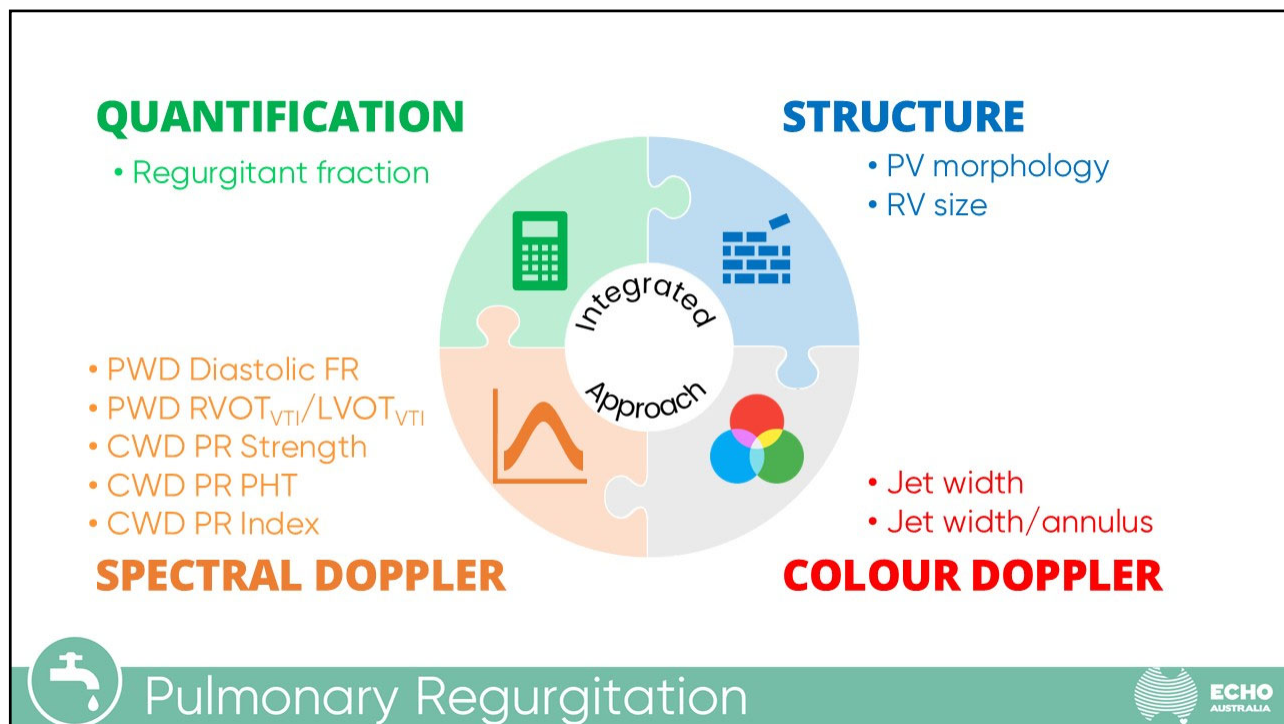
PV Vmax 1.4 m/s



Pulmonary Stenosis



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		Mild	Moderate	Severe
1	PV morphology	Normal	Normal/abnormal	Abnormal
2	RV size	Normal (Unless other reasons for RV enlargement)	Normal or dilated	Dilated (exception: acute severe PR)
3	CD Jet width (NL 50–60 cm/s (ESC); 50–70 cm/s (ASE))	Thin (usually <10mm in length) with narrow origin	Intermediate	Large with broad origin
4	CD Jet width/annulus ratio	-	-	>0.7 (ASE); >65% (ESC)
5	CWD PR Index (PR duration/total diastolic duration)	-	-	< 0.77
6	CWD PR strength	Faint/slow deceleration	Dense/variable	Dense/steep deceleration; early termination
7	CWD PR PHT	-	-	< 100 ms (Not reliable when high RVEDP)
8	PWD diastolic flow reversal	-	-	Prominent/Present
9	PWD $RVOT_{VTI}$ vs. $LVOT_{VTI}$	Slightly increased	Intermediate	Greatly increased
10	Regurgitant fraction	< 20%	20–40%	> 40%

Adapted from J Am Soc Echocardiogr. 2017 Apr;30(4):303–371 & Eur Heart J Cardiovasc Imaging. 2022 Apr 18;23(5):e171–e232

Pulmonary Regurgitation

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Mild PR	Moderate PR	Severe PR
Specific Signs: • Normal PV • Small jet, narrow width • Soft/faint CW jet • Slow deceleration • Normal RV size	Specific signs or intermediate values	Specific Signs: • Abnormal PV • Jet width/annulus $\geq 70\%$ • Dense jet, PHT < 100 ms • Early termination of PR flow • Diastolic FR in PA branches • Dilated RV with NL
No single parameter precise enough to quantify PR severity		
Quantification • RF $< 20\%$	Quantification • RF $20 - 40\%$	Quantification • RF $> 40\%$
 <i>There is little experience with quantitation of PR severity with Doppler echocardiography</i>		 <i>..... absence of extensive data on quantitation of PR</i>

Adapted from J Am Soc Echocardiogr. 2017 Apr;30(4):303-371 & Eur Heart J Cardiovasc Imaging. 2022 Apr 18;23(5):e171-e232



Pulmonary Regurgitation



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Mild PR	Moderate PR	Severe PR
Specific Signs: • Normal PV • Small jet, narrow width • Soft/faint CW jet • Slow deceleration • Normal RV size	Specific signs or intermediate values	Specific Signs: • Abnormal PV • Jet width/annulus $\geq 70\%$ • Dense jet, PHT < 100 ms • Early termination of PR flow • Diastolic FR in PA branches • Dilated RV with NL
No single parameter precise enough to quantify PR severity		
Unsatisfactory/inconclusive TTE, discordant parameters with clinical data → Indeterminate PR → Consider CMR for quantification		



Adapted from J Am Soc Echocardiogr. 2017 Apr;30(4):303-371 & Eur Heart J Cardiovasc Imaging. 2022 Apr 18;23(5):e171-e232



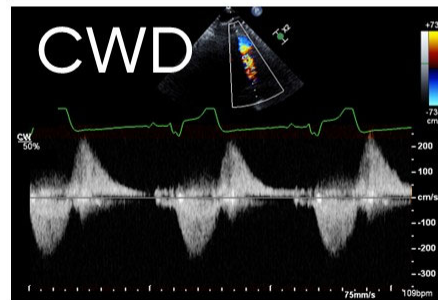
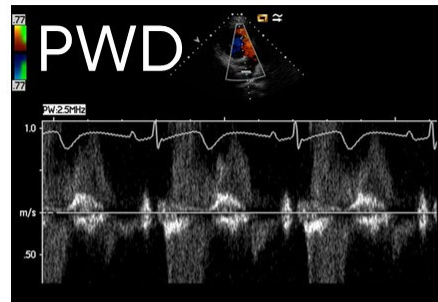
Pulmonary Regurgitation



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Spectral Doppler is Key



Pulmonary Regurgitation

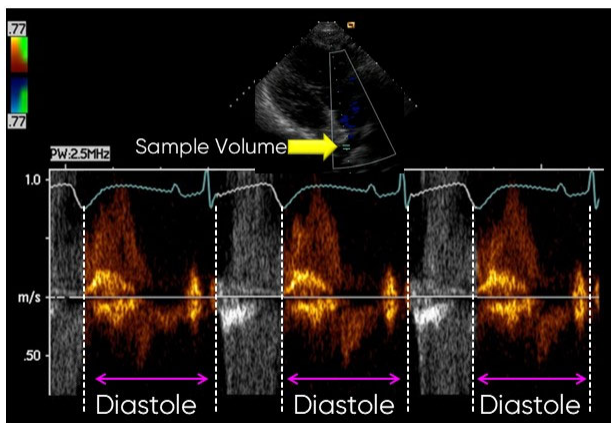


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PW Doppler

Diastolic Flow Reversal in Branch PA



DFR in branch PA ~ severe
PR (CMR-RF > 40%)

- Sens. 87-100%
- Spec. 71-87%
- PPV 67-87%
- NPV 87-100%

Renella P, et al. J Am Soc Echocardiogr 2010;23:880-6
Van Berendoncks A, et al. Congenit Heart Dis. 2019
Jul;14(4):628-637.



Pulmonary Regurgitation

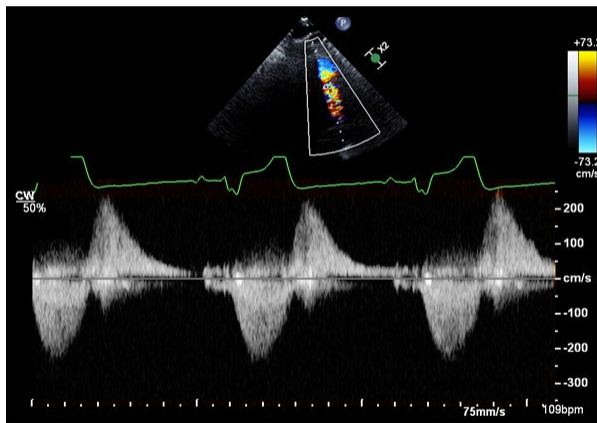


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CW Doppler

PR Signal Density, PHT & Duration



Denser signal ~ more severe

Other Signs of severe PR:

- **PHT < 100 ms:** ↑ RVDP due to ↑ PR volume



Pulmonary Regurgitation

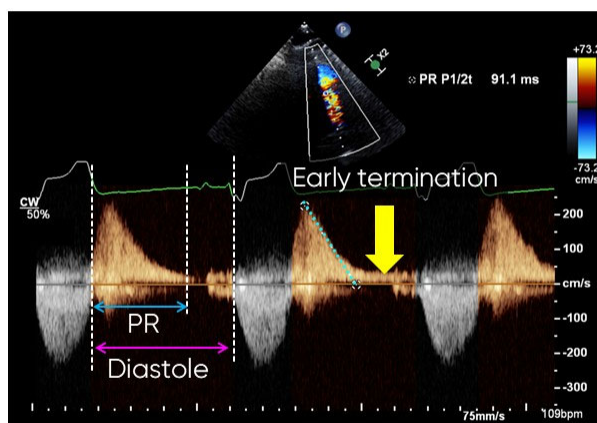


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CW Doppler

PR Signal Density, PHT & Duration



Denser signal ~ more severe

Other Signs of severe PR:

- **PHT < 100 ms:** ↑ RVDP due to ↑ PR volume
- **Early termination:** reflects diastolic pressure equalization between PA & RV
- **PR Index < 0.77:** PR duration ÷ total duration of diastole



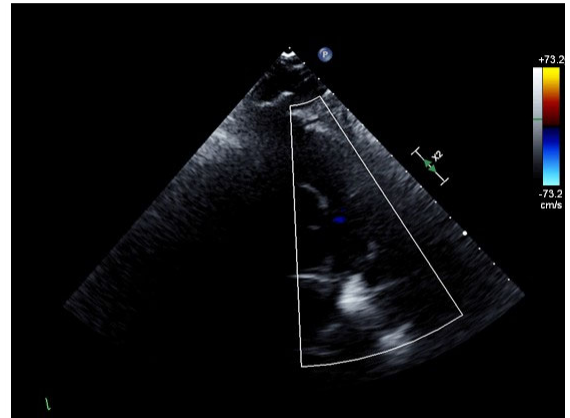
Pulmonary Regurgitation



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Beware of using CDI alone



Pulmonary Regurgitation

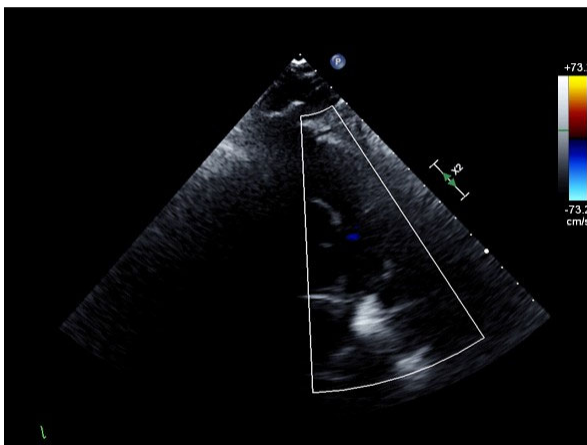


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Severe PR

Easily missed on colour Doppler alone



- PR is low velocity
- PR appears laminar
- PR duration often brief



Pulmonary Regurgitation

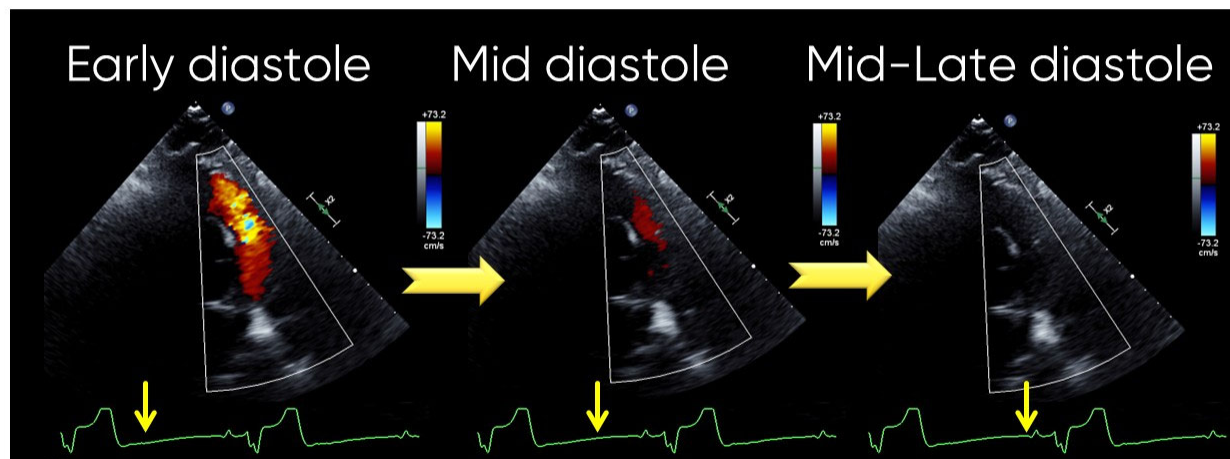


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Severe PR

Easily missed on colour Doppler alone



Pulmonary Regurgitation



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Pulmonary Valve Imaging

- Use alternative views
- Try a higher PSAX window



Pulmonary Stenosis

- Multiple causes & multiple levels
- Peak velocity & peak gradient
- Gradients are flow dependent



Pulmonary Regurgitation

- Consider multiple parameters
- Spectral Doppler key to severe PR
- Beware of "free" PR on CDI



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