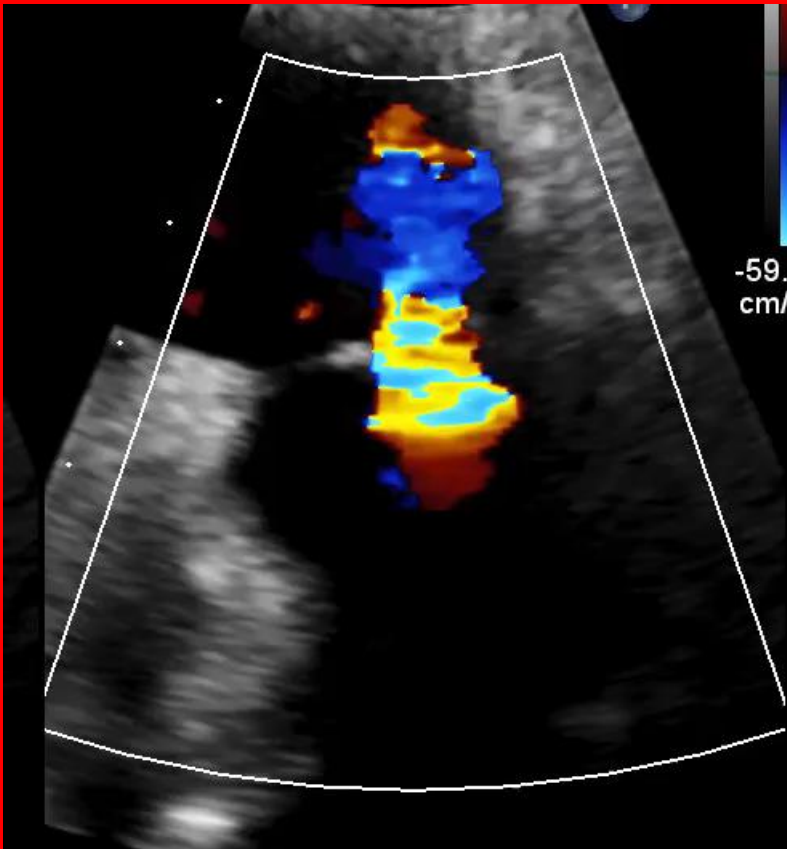




Imaging pulmonary regurgitation; diagnosis and patient selection



Agnès Pasquet, MD, PhD
Pôle de Recherche Cardiovasculaire
Institut de Recherche Expérimentale et Clinique
Université catholique de Louvain

- Nothing to disclose regarding this lecture

Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



European Heart Journal (2025) **00**, 1–102
<https://doi.org/10.1093/eurheartj/ehaf194>

ESC GUIDELINES

2025 ESC/EACTS Guidelines for the management of valvular heart disease

Developed by the task force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)



Imaging pulmonary regurgitation

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0 hits !

Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



ESC

European Society
of Cardiology

European Heart Journal (2021) **42**, 563–645
doi:10.1093/eurheartj/ehaa554

ESC GUIDELINES

2020 ESC Guidelines for the management of adult congenital heart disease

**The Task Force for the management of adult congenital heart
disease of the European Society of Cardiology (ESC)**



Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



ESC

European Society
of Cardiology

European Heart Journal (2021) **42**, 563–645
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10 hits !

Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



ESC

European Society
of Cardiology

European Heart Journal - Cardiovascular Imaging (2022) 23, e171–e232
<https://doi.org/10.1093/ehjci/jeab253>

EACVI DOCUMENT

Multi-modality imaging assessment of native valvular regurgitation: an EACVI and ESC council of valvular heart disease position paper

Patrizio Lancellotti ^{1,2,3*}, Philippe Pibarot ⁴, John Chambers⁵, Giovanni La Canna⁶, Mauro Pepi⁷, Raluca Dulgheru¹, Mark Dweck⁸, Victoria Delgado ⁹, Madalina Garbi¹⁰, Mani A. Vannan¹¹, David Montaigne ¹², Luigi Badano^{13,14}, Pal Maurovich-Horvat¹⁵, Gianluca Pontone ¹⁶, Alec Vahanian ^{17,18}, Erwan Donal ¹⁹, and Bernard Cosyns ²⁰; On behalf of the Scientific Document Committee of the European Association of Cardiovascular Imaging



Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



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Patrizio Lari
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Victoria Del
Luigi Badano
Alec Vahanian
Scientific Director
Imaging

Pulmonary regurgitation

A slight amount of PR has been reported in 40–78% of patients with normal pulmonary valves. Acquired mild to moderate PR is most often seen in patients with pulmonary hypertension with dilatation of the pulmonary artery. Severe PR is uncommon and usually observed in patients with anatomic abnormalities of the valve or after valvulotomy.⁴⁸ There are very few validated studies owing to the low prevalence rates and difficulties in imaging.

ne  ¹²,

half of the
vascular



Imaging pulmonary regurgitation

- Pulmonary regurgitation ?



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vascular



Imaging pulmonary regurgitation

- Pulmonary regurgitation ?

➤ Frequent: physiologic or trivial PR !

➤ Severe PR:

Secondary PR: pulmonary hypertension

Primary PR:

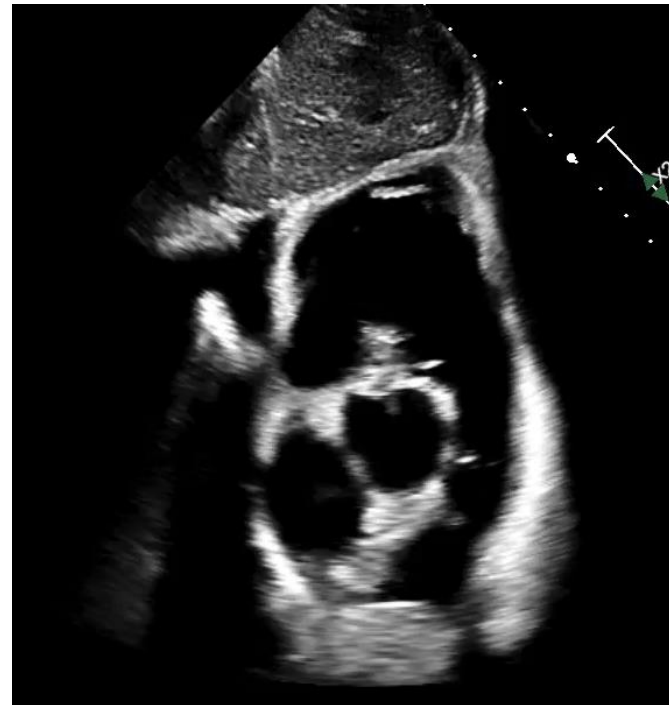
- Congenital abnormalities: tetralogy of Fallot
- Infective endocarditis
- Rheumatic heart disease
- Carcinoid syndrome
- Iatrogenic : post valvulotomy...

Imaging pulmonary regurgitation

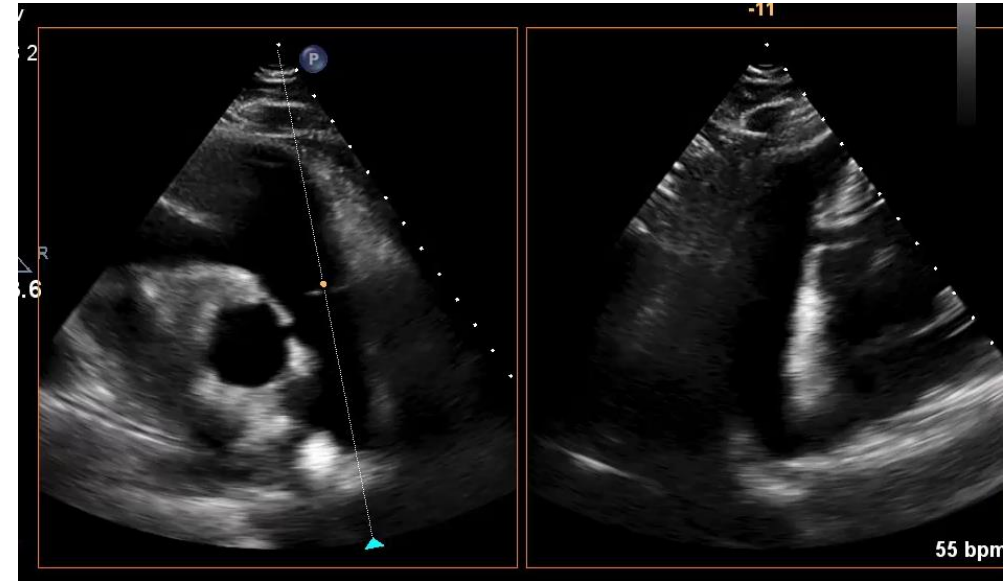
- Imaging the valve: TTE or TOE first choice !



PS sax



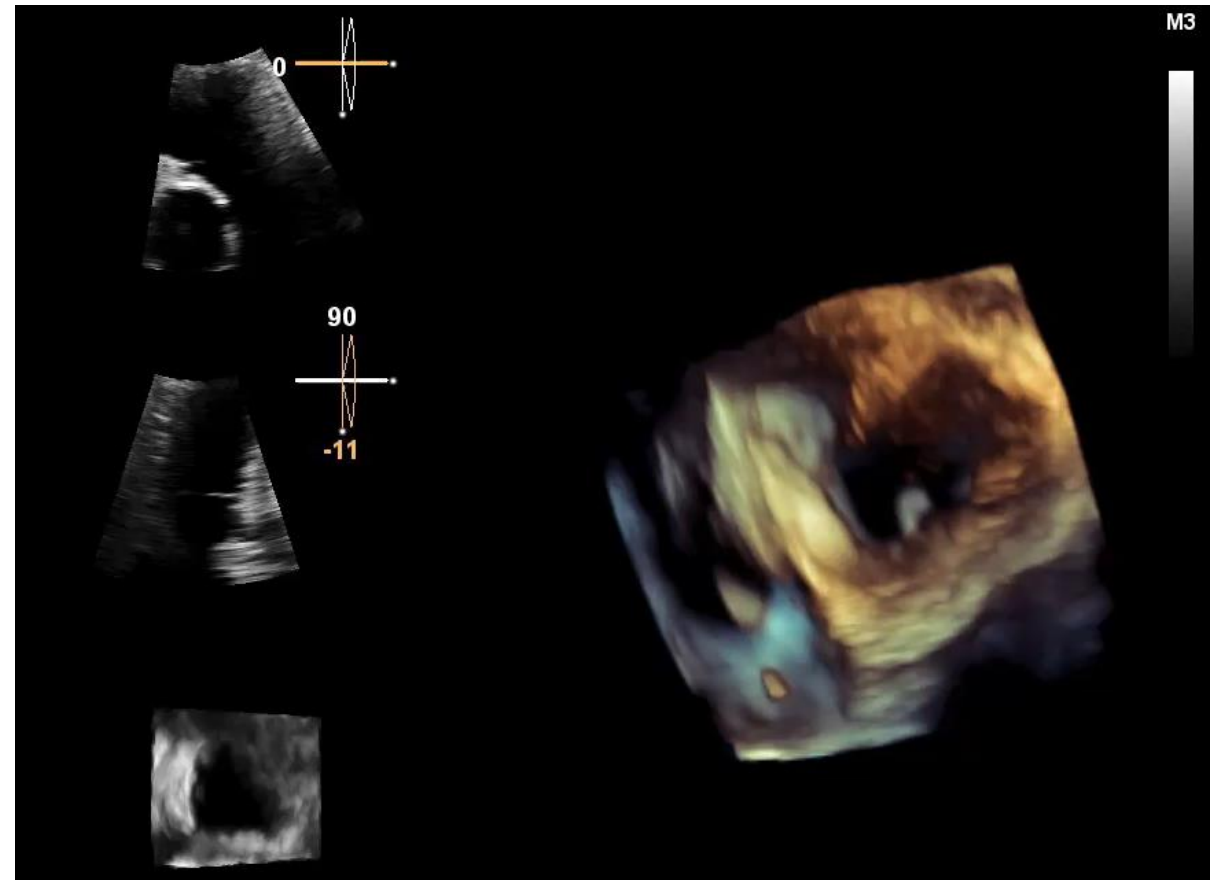
Sax Subcostal



PS Xplane

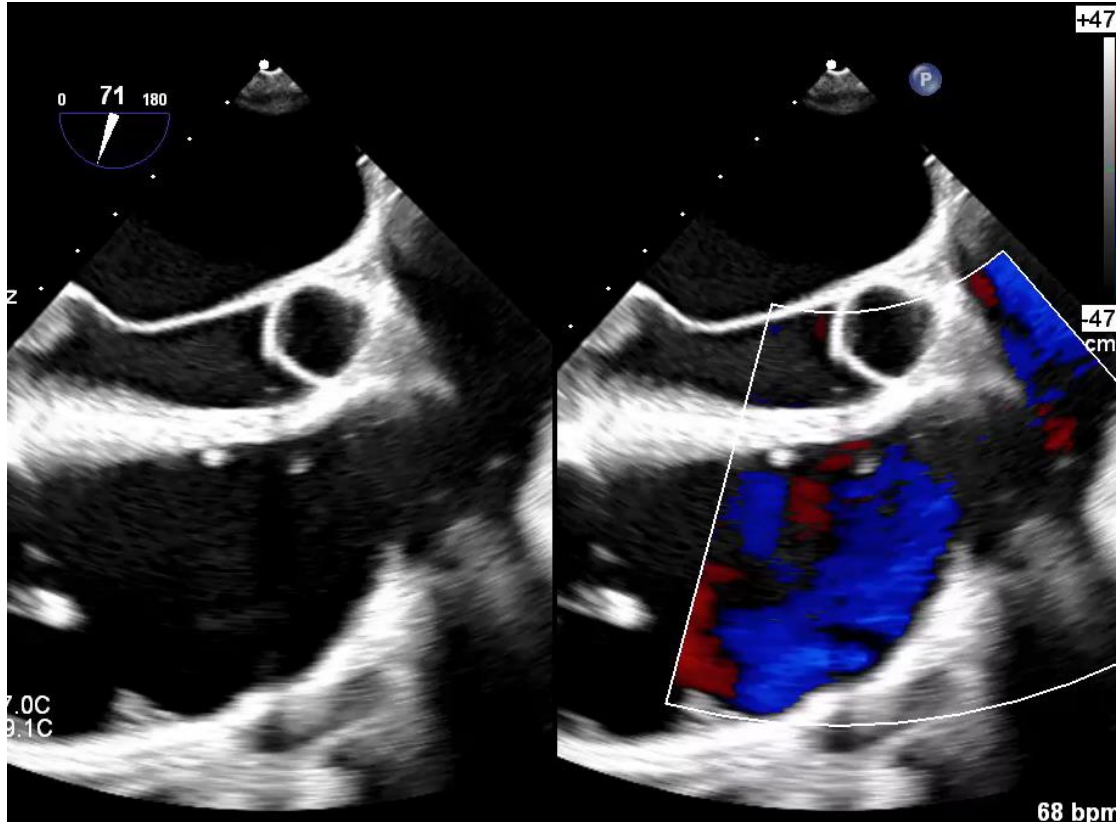
Imaging pulmonary regurgitation

- Imaging the valve: TTE 3D !

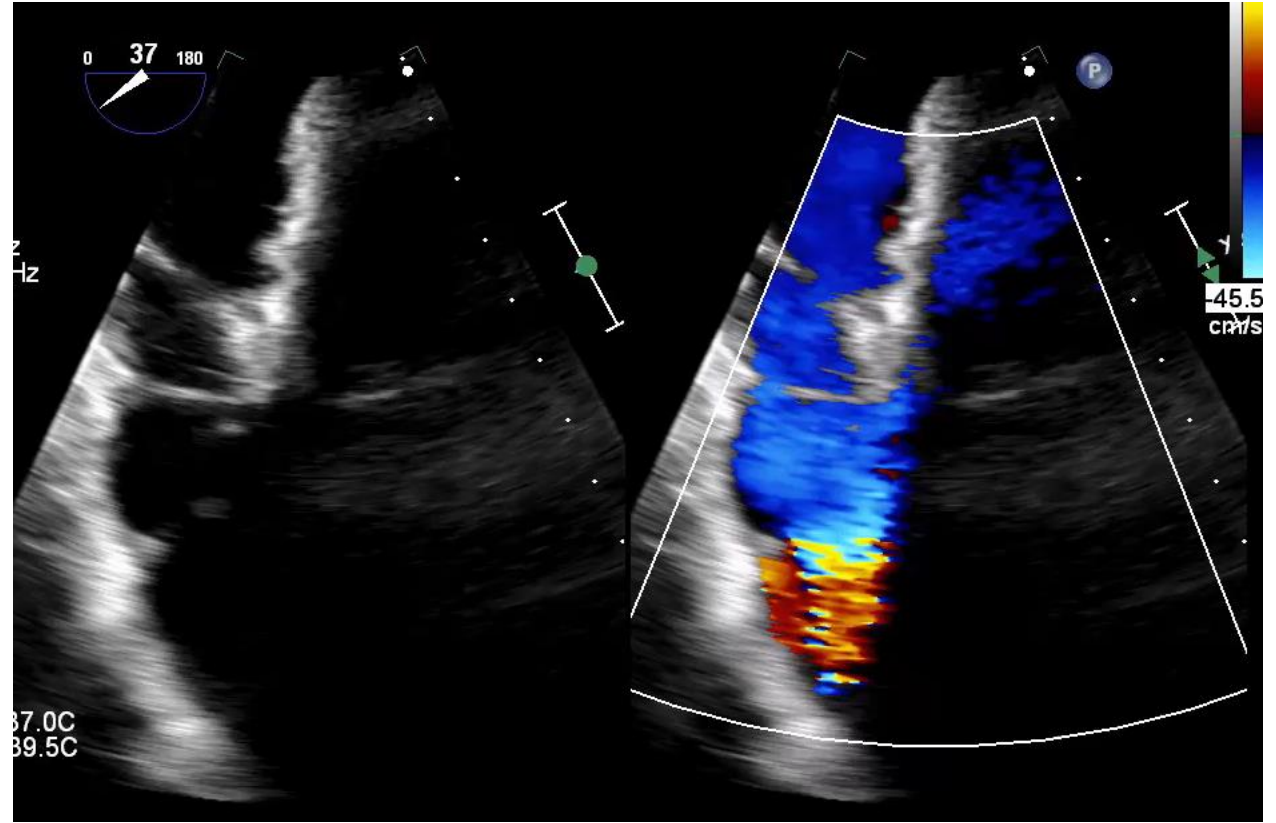


Imaging pulmonary regurgitation

- Imaging the valve: TEE



Short Axis

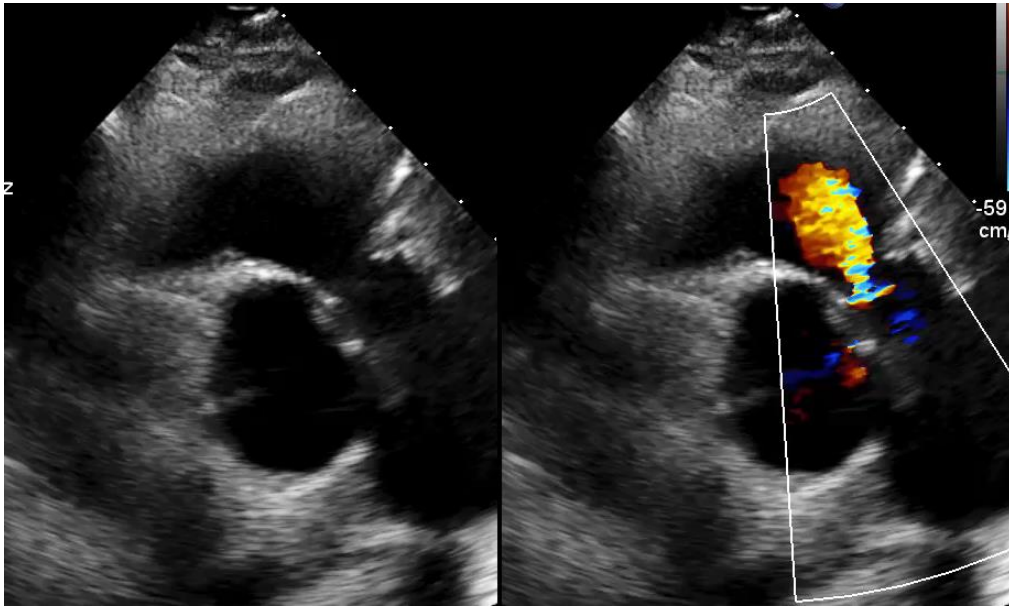


Deep Transgastric

Imaging pulmonary regurgitation

- Assessment of PR severity ?

➤ Qualitative : look at the color flow !

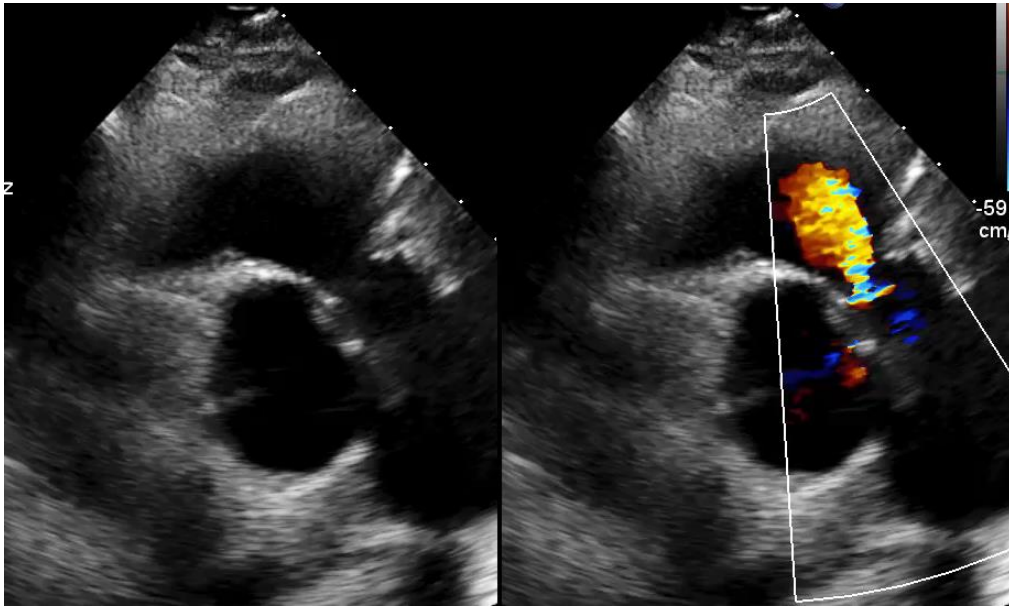


Jet extension and width >10 mm severe PR

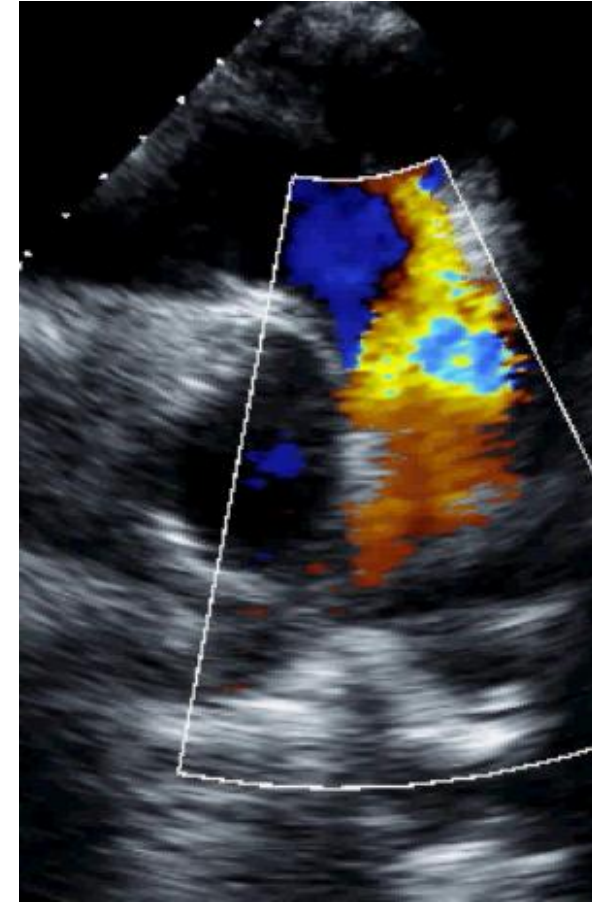
Imaging pulmonary regurgitation

- Assessment of PR severity ?

➤ Qualitative : look at the color flow !



Jet width and extension >10 mm severe PR



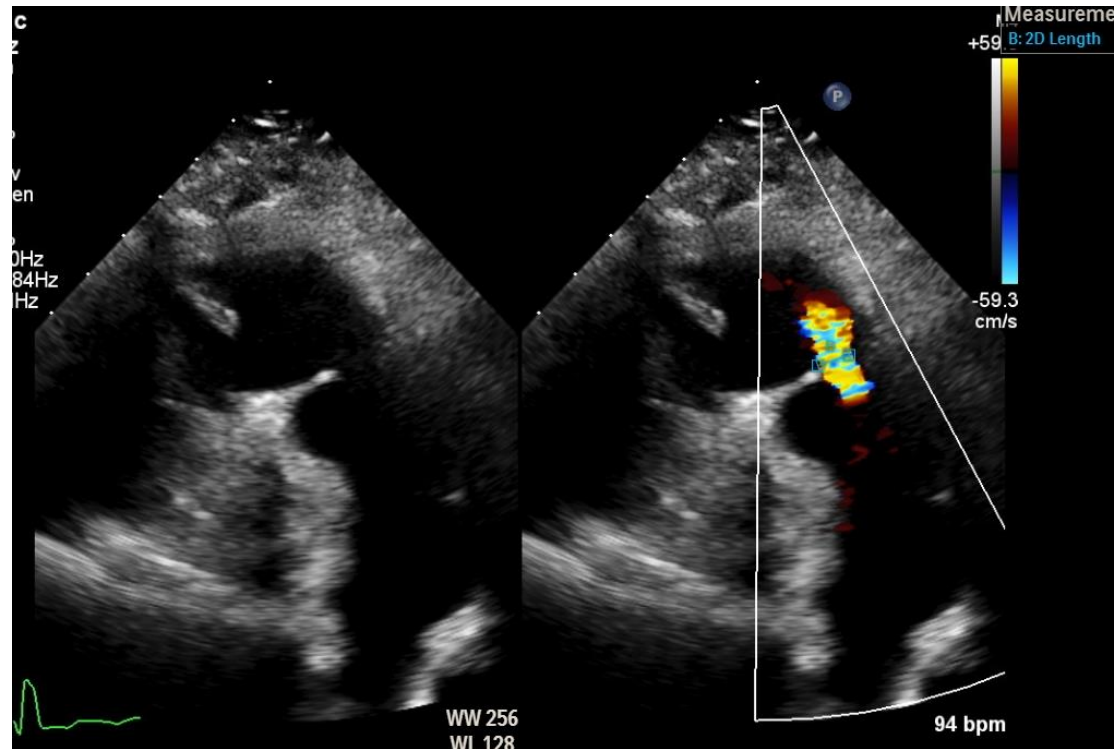
reversal colour Doppler flow in branch of pulmonary arteries is a very specific (87%) sign of severe PR

Imaging pulmonary regurgitation

- Assessment of PR severity ?

➤ Semi quantitative :

➤ Vena contracta :



Value for severe PR: ?

Ratio Jet/annulus:
>65% indice for *severe*
PR !

Imaging pulmonary regurgitation

- Assessment of PR severity ?

➤ Semi quantitative :

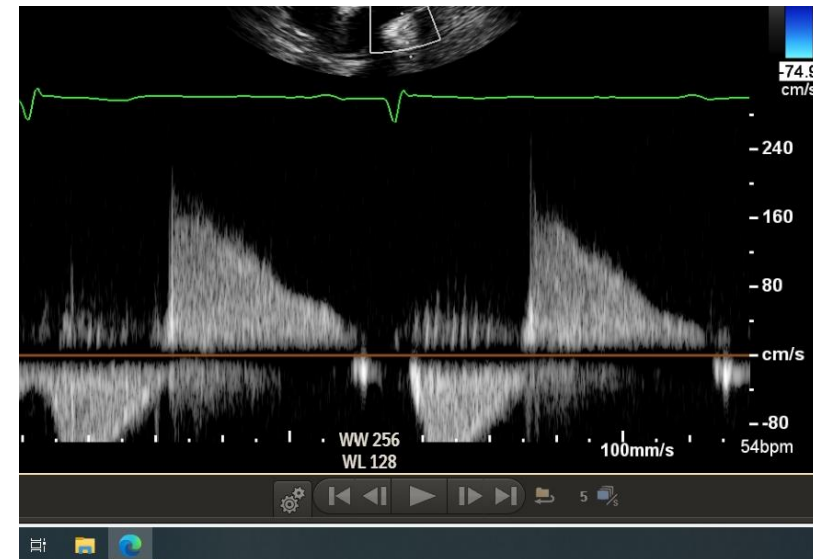
➤ Continuous wave doppler CW



Deceleration times: **< 260** msec

PHT **< 110** msec

PR index (PR duration/diastolic times) **< 0,77**

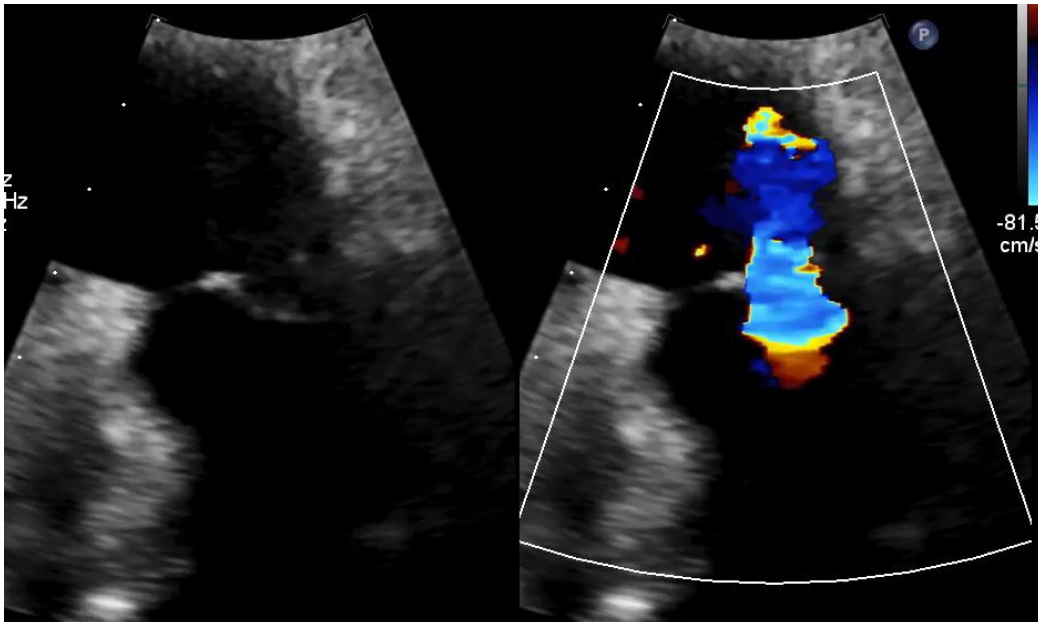


Imaging pulmonary regurgitation

- Assessment of PR severity ?

➤ Semi quantitative :

➤ PISA ?



EROA: ??

RV: ???

No validation

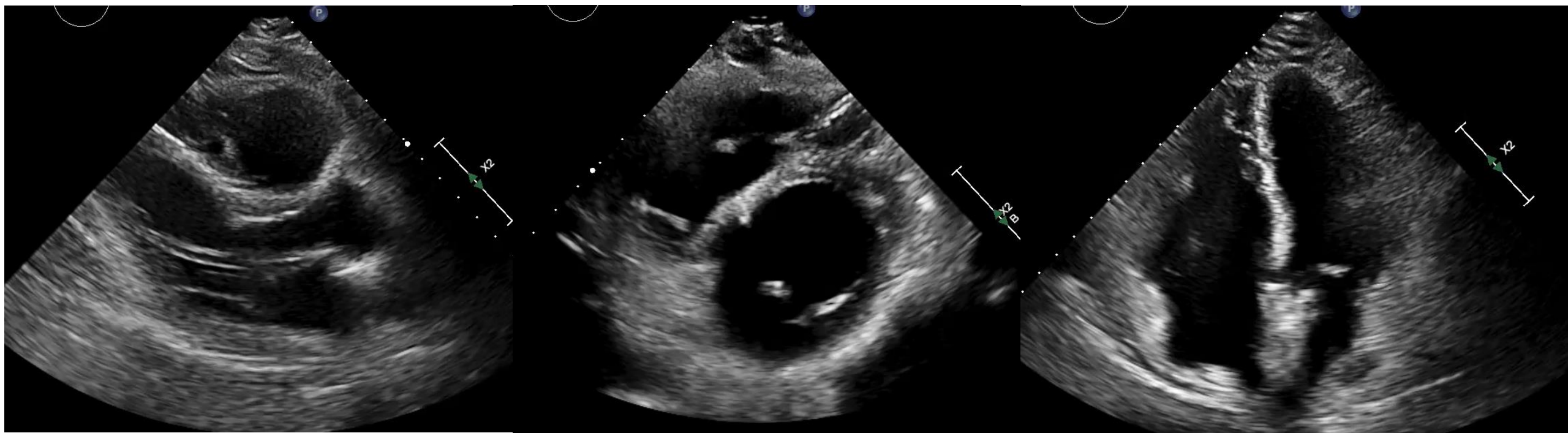
Imaging pulmonary regurgitation

- Grading the severity of PR ?

PR severity classes	Mild	Moderate	Severe
Qualitative parameters			
Pulmonic valve morphology	Normal	Normal/Abnormal	Abnormal
Colour flow PR jet width ^a	Small, usually <10 mm in length with a narrow origin	Intermediate	Large, with a wide origin; may be brief in duration
Reversal flow in pulmonary artery branches	Absent	Absent	Present
CW signal of PR jet ^b	Faint/Slow deceleration	Dense/variable	Dense/steep deceleration, early termination of diastolic flow
Pulmonic vs. aortic flow by PW	Normal or slightly increased	Intermediate	Greatly increased
Semi-quantitative parameters			
VC width (mm)	Not defined	Not defined	Not defined
Deceleration time of the PR	Not defined	Not defined	<260 ms
Pressure half-time ^c	Not defined	Not defined	<100 ms
Jet width/annulus ratio	Not defined	Not defined	>65%
PR index ^d	Not defined	Not defined	<0.77
Quantitative parameters			
EROA (mm ²)	Not defined	Not defined	Not defined
R Vol (mL)	Not defined	Not defined	Not defined
RF (%)	<20	20–40	>40

Imaging pulmonary regurgitation

- Consequence of PR



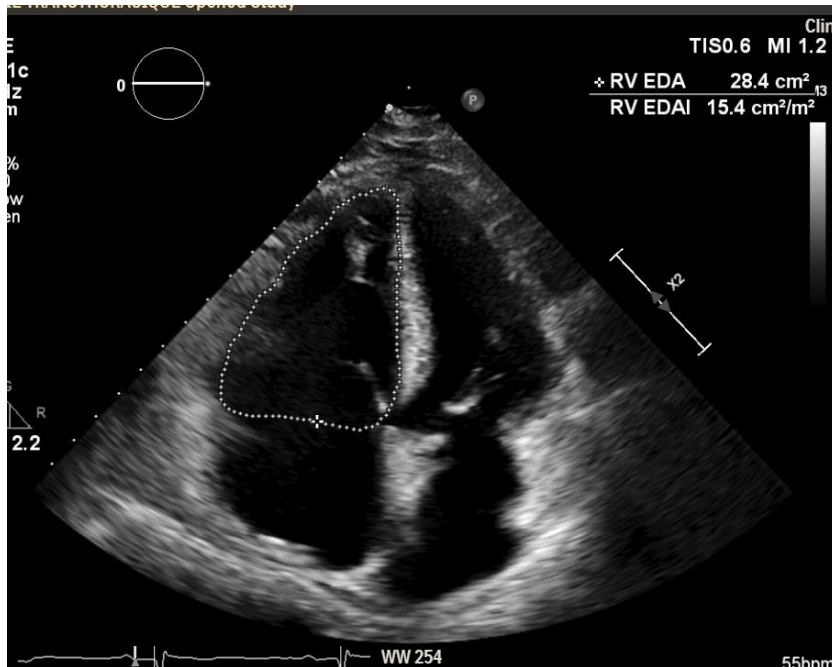
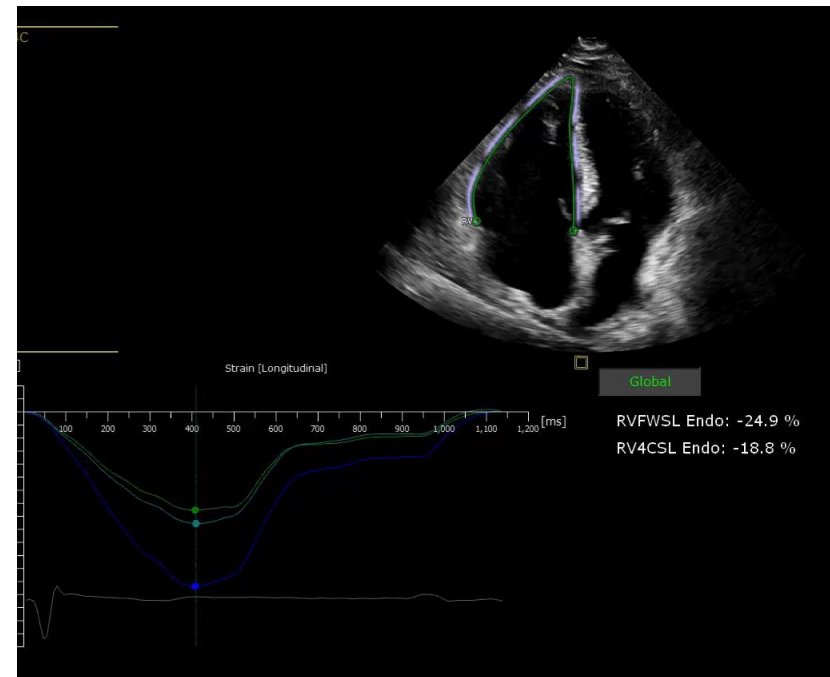
RV dilatation: argument for significant PR but other cause than PR could explain RV dilatation (pulmonary hypertension !)

Imaging pulmonary regurgitation

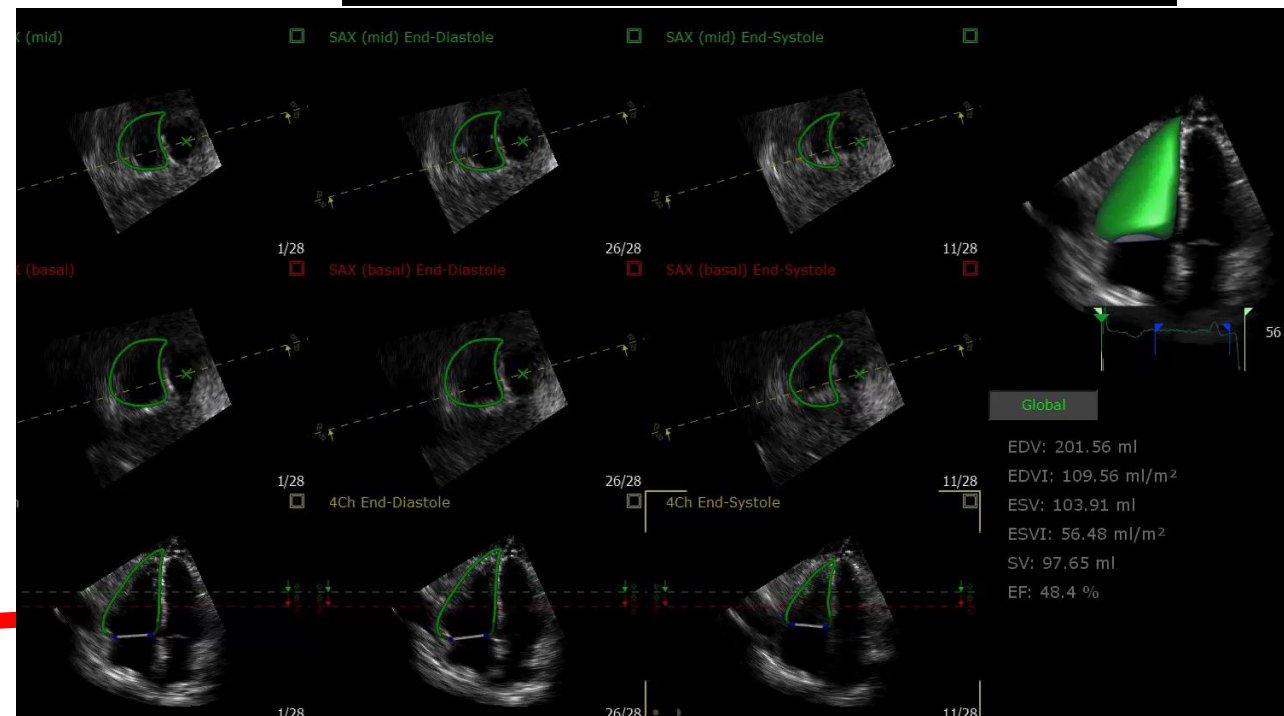
- Consequence of PR: RV function...

RV strain

Few studies
beside ACHD



RV FAC

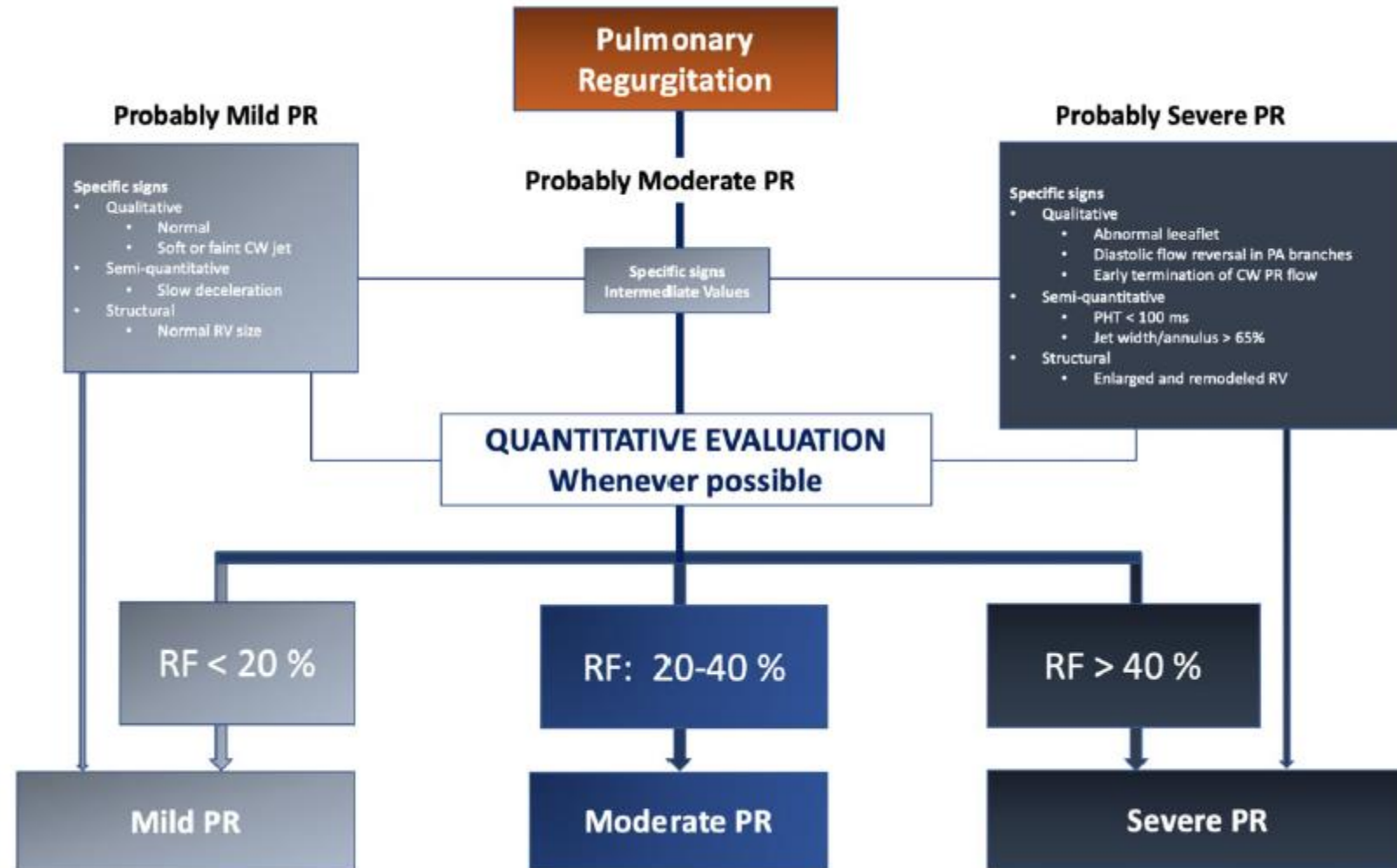


RV 3D vol

Correlated to
CMR volumes

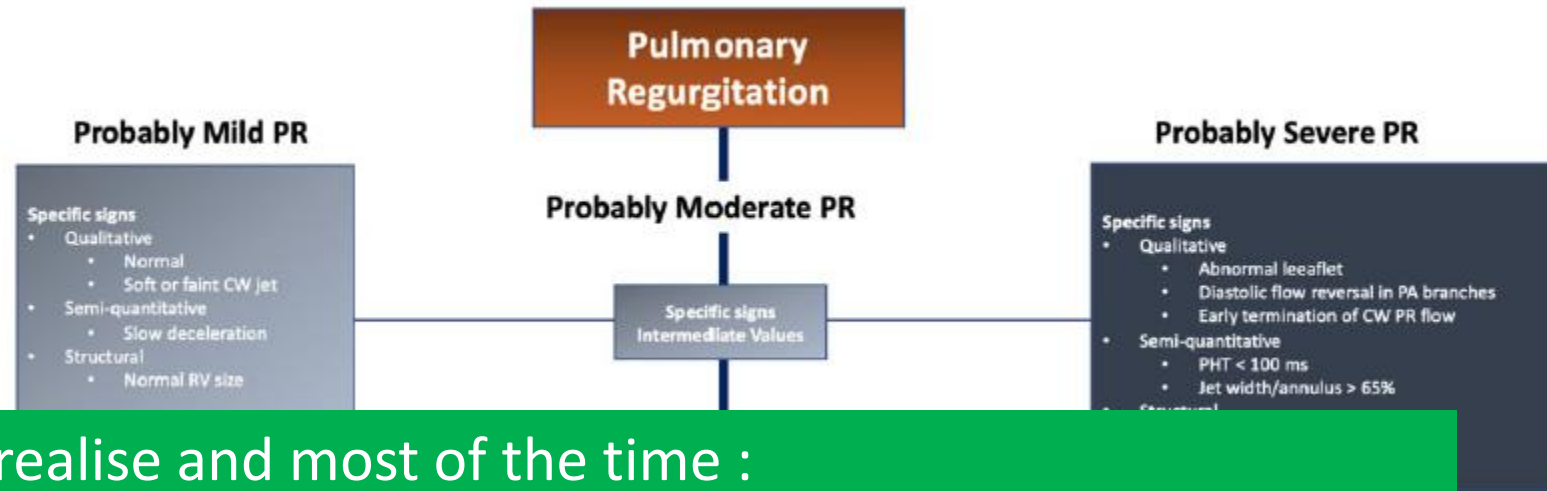
Imaging pulmonary regurgitation

- Summary :

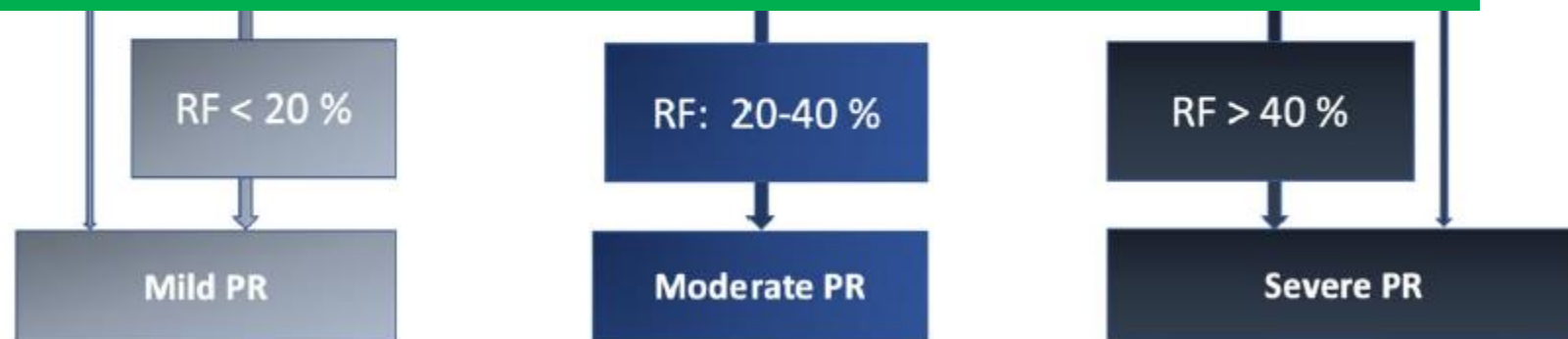


Imaging pulmonary regurgitation

- Summary :

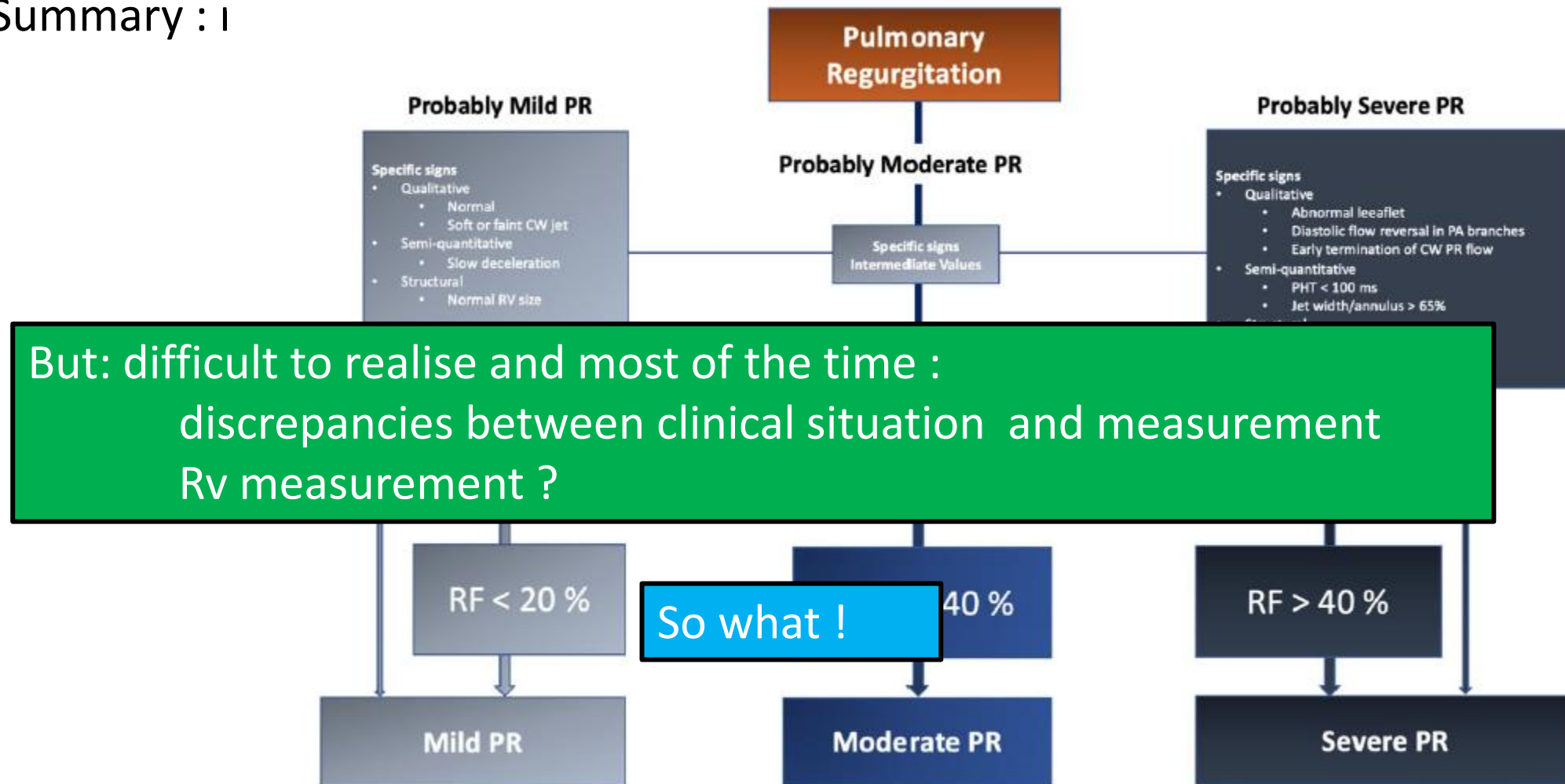


But: difficult to realise and most of the time :
discrepancies between clinical situation and measurement
Rv measurement ?



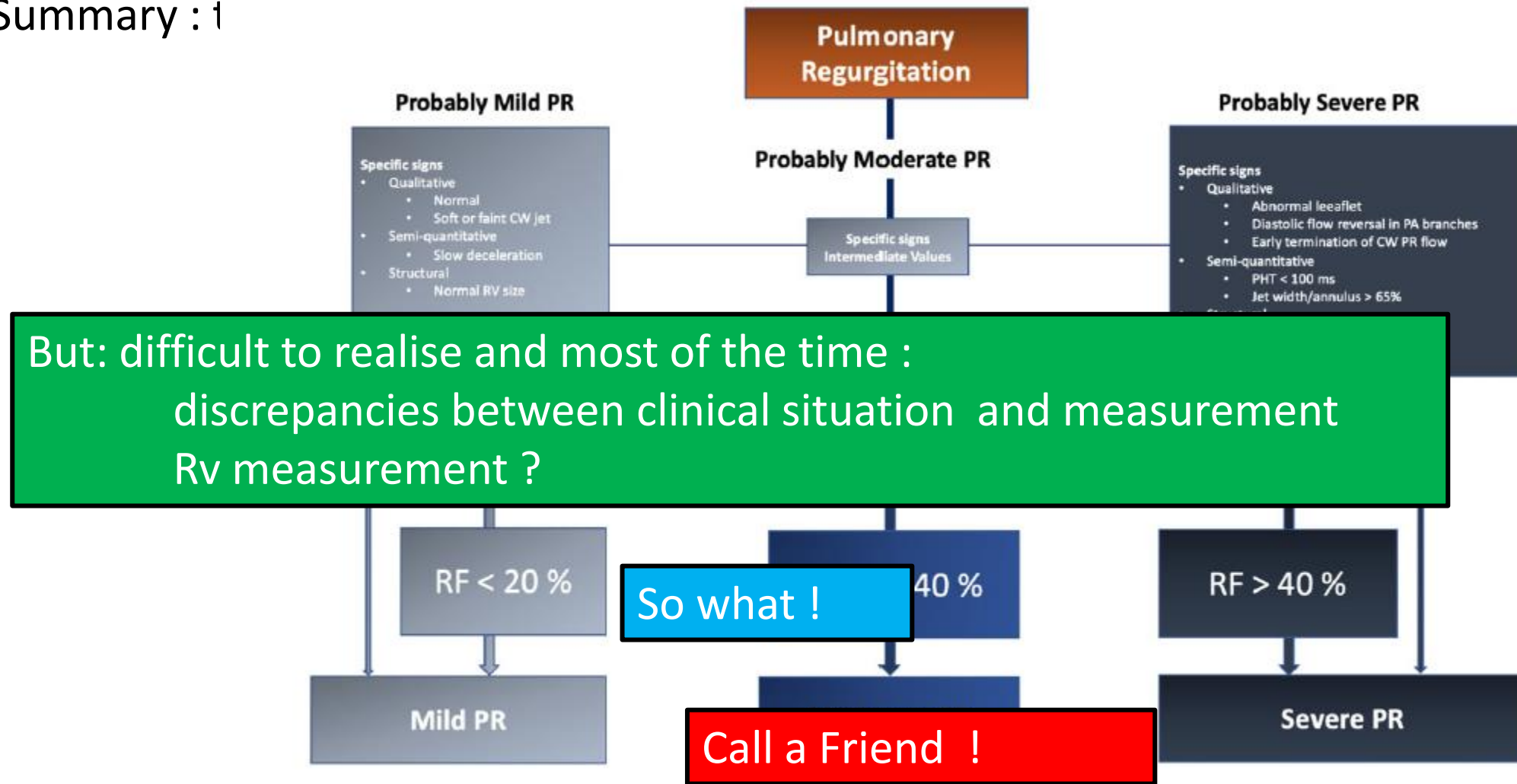
Imaging pulmonary regurgitation

- Summary :



Imaging pulmonary regurgitation

- Summary : 1



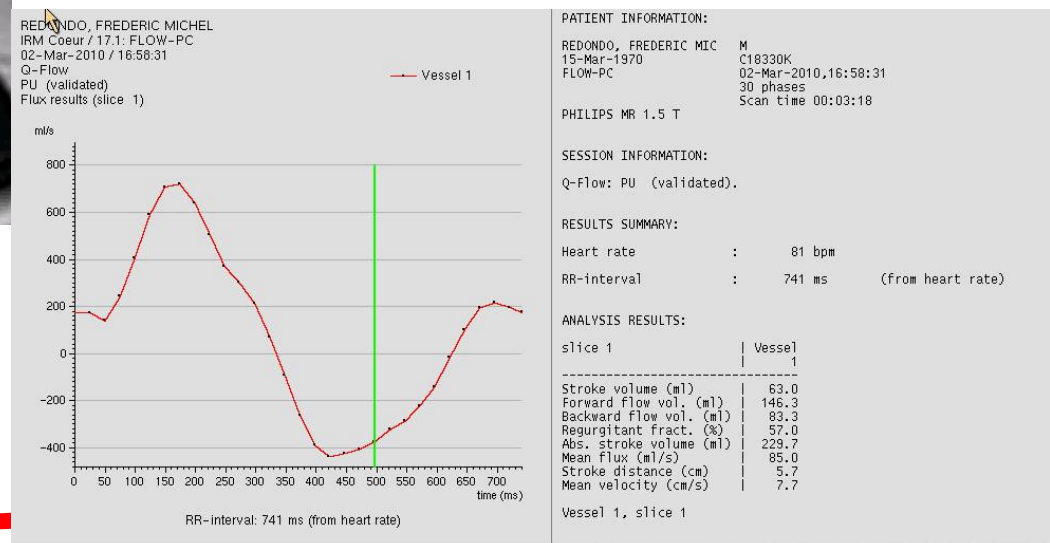
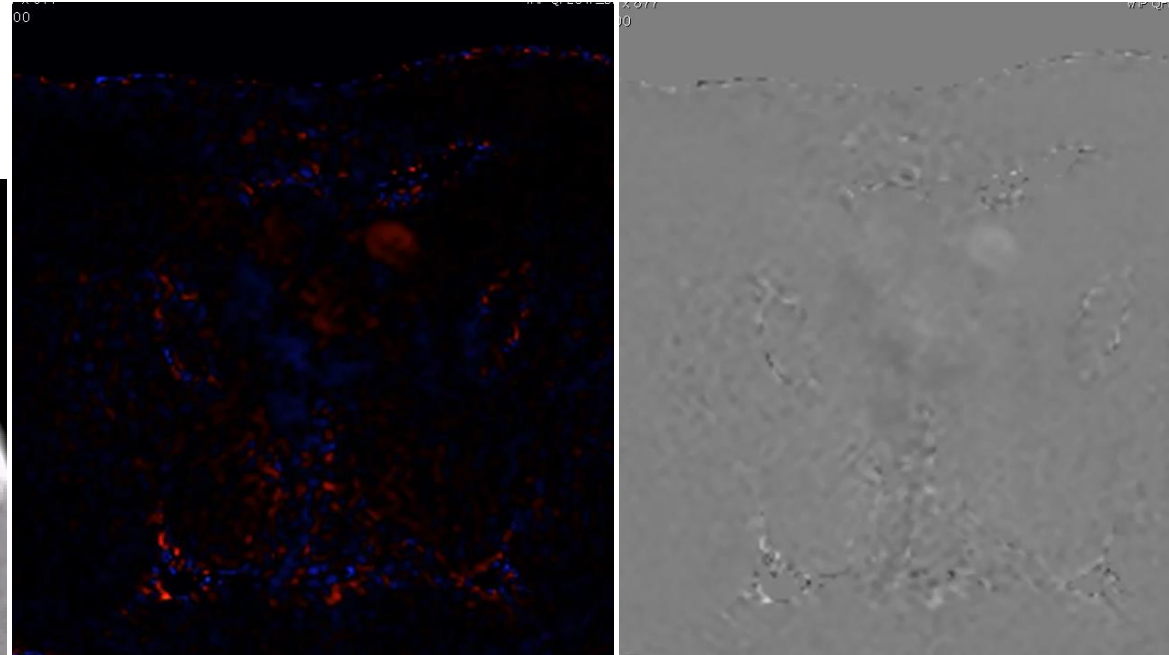
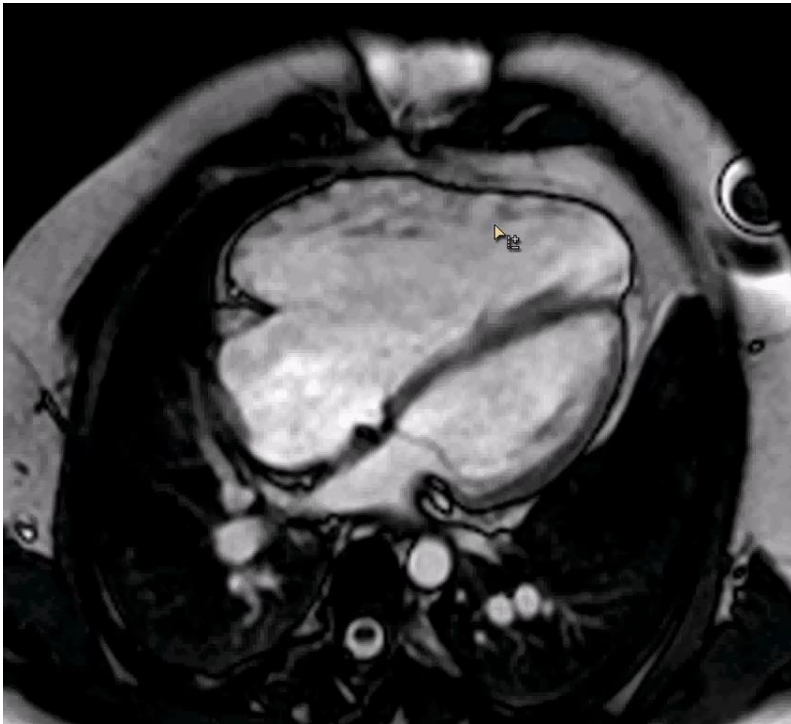
Imaging pulmonary regurgitation

- CMR



Imaging pulmonary regurgitation

- CMR

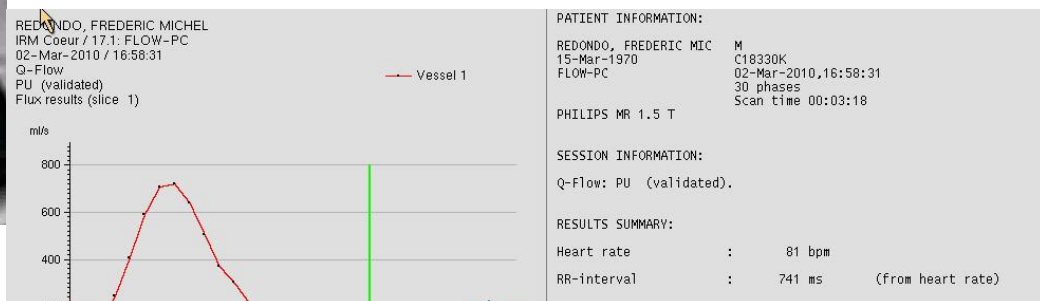
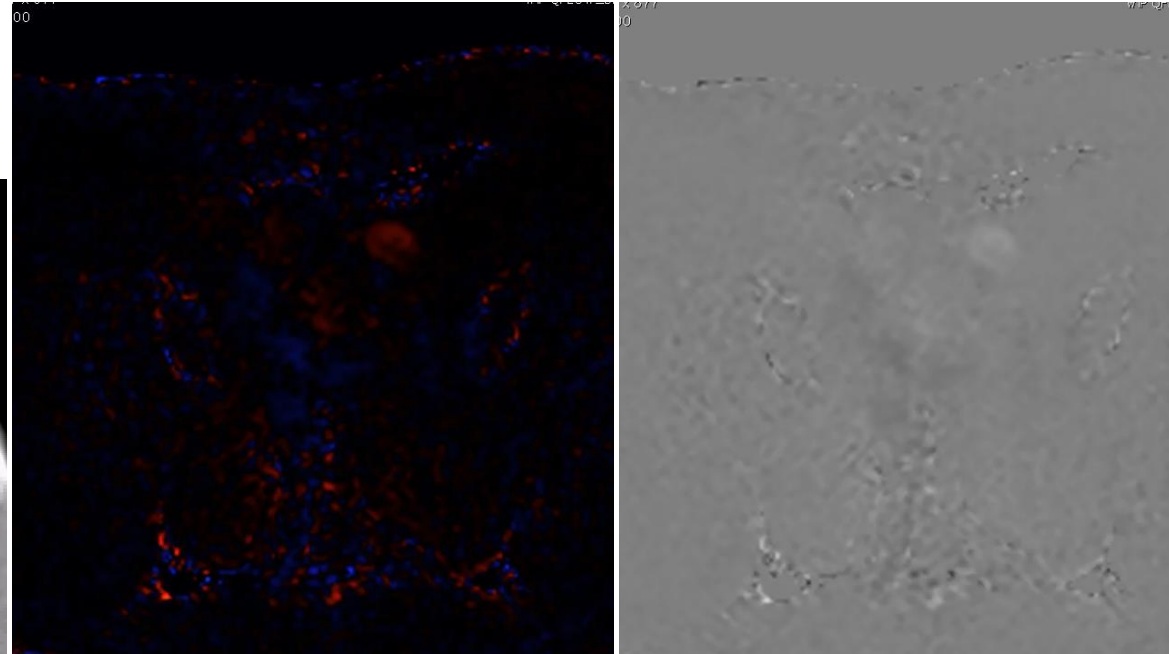
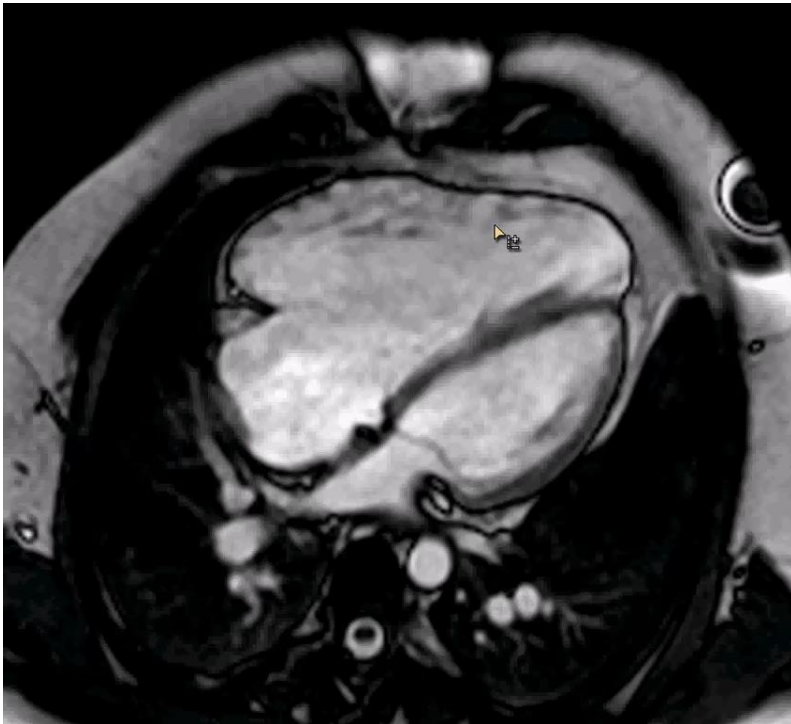


Direct measurement: phase contrast technique

Indirect measurement: LV and RV stroke vol (no TR)

Imaging pulmonary regurgitation

- CMR



Direct measurement: phase contrast technique

Indirect measurement: LV and RV stroke vol (no TR)

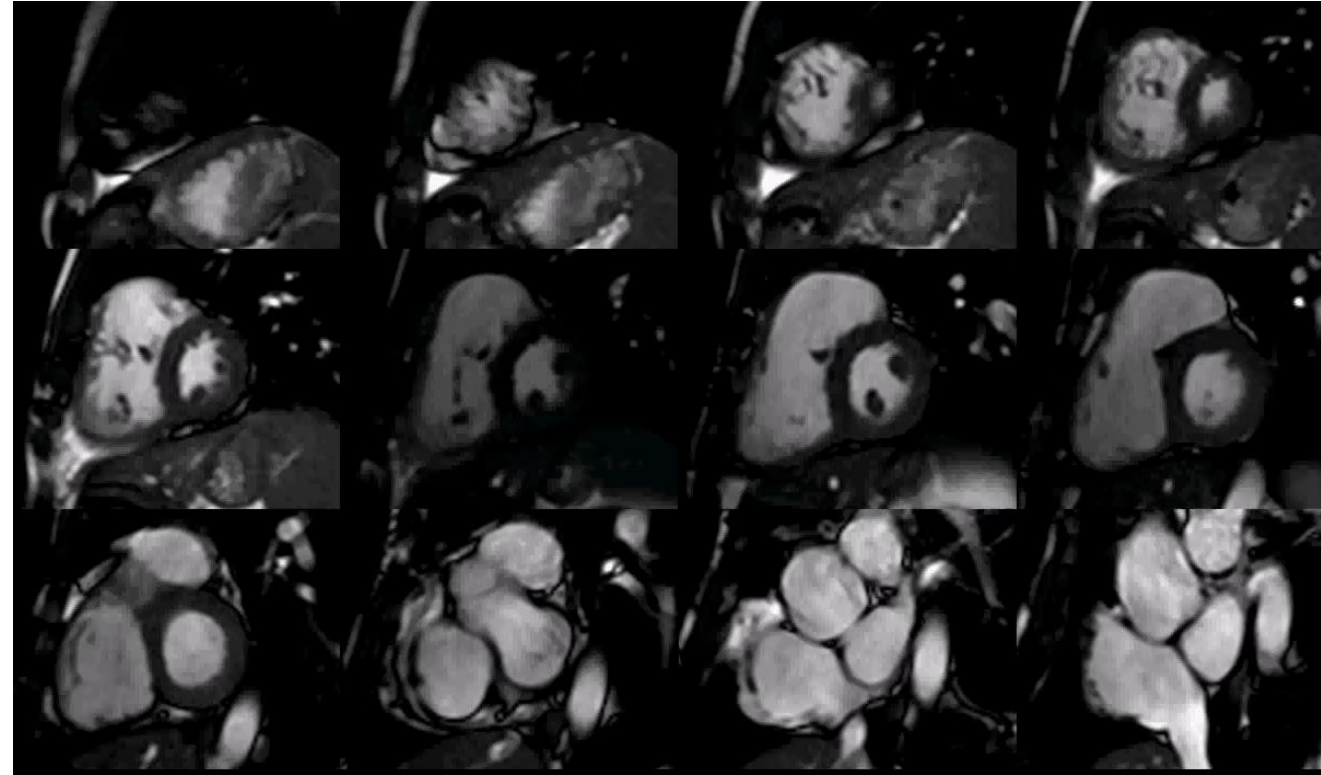
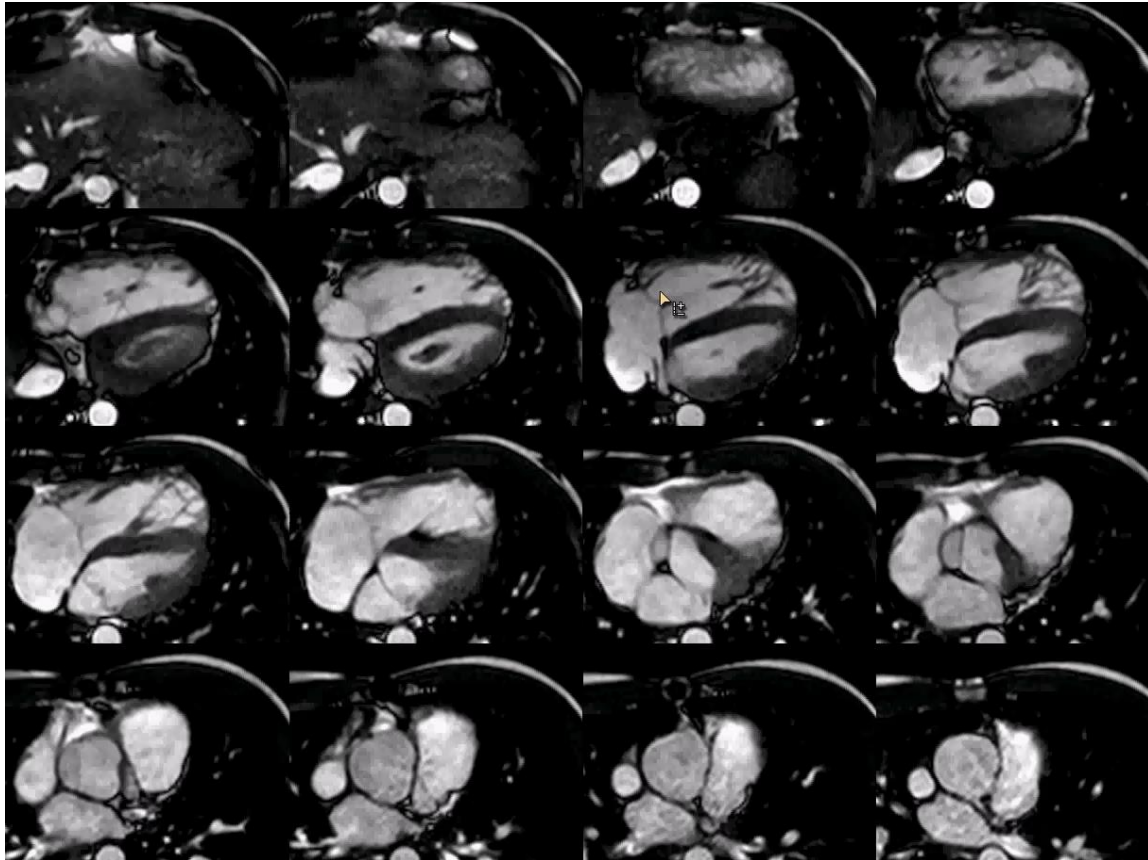
mild	Modere	severe
RF < 20 %	20 < RF < 40%	RF > 40%

Stroke distance (cm) | 5.7
Mean velocity (cm/s) | 7.7
Vessel 1, slice 1

RR-interval: 741 ms (from heart rate)

Imaging pulmonary regurgitation

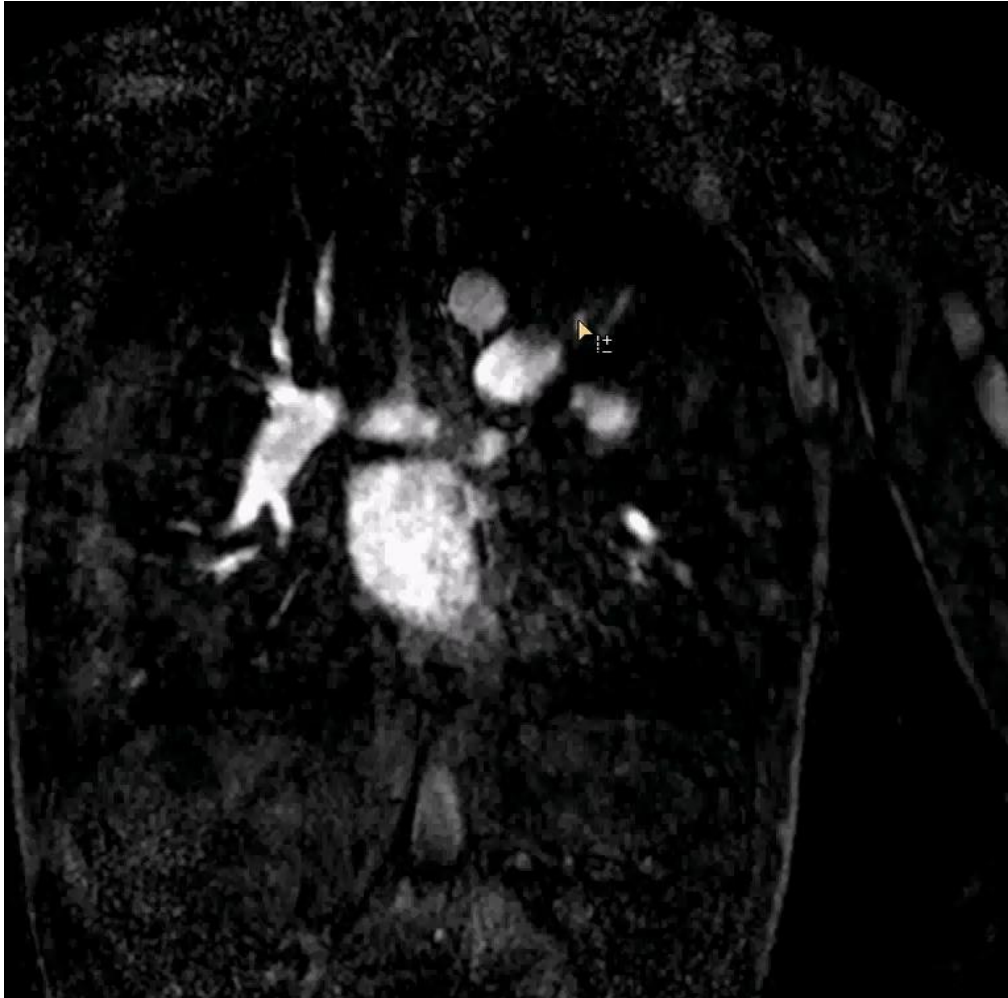
- CMR



RV volume and function

Imaging pulmonary regurgitation

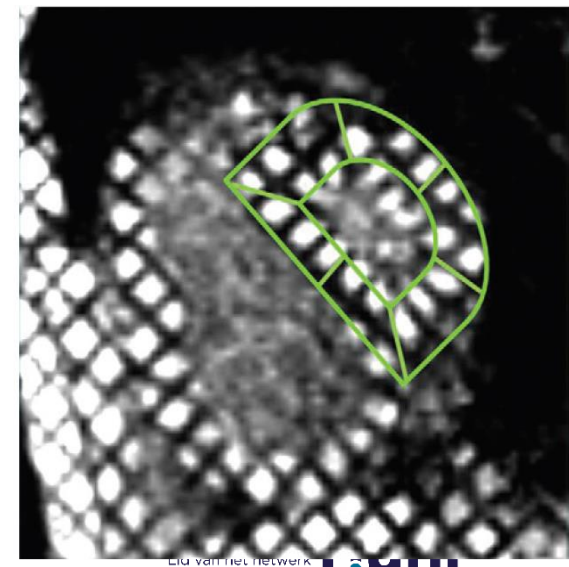
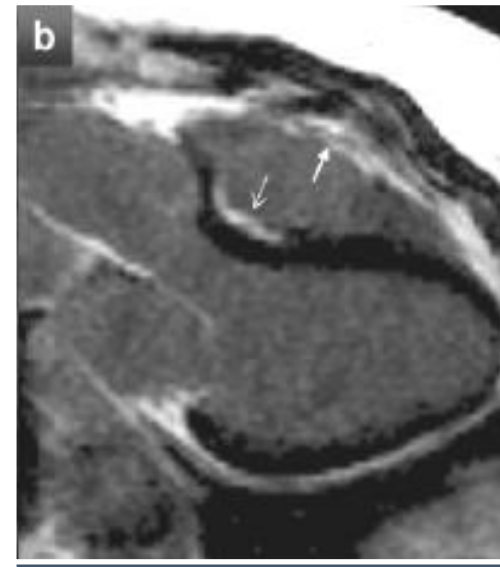
- CMR



- Cine angio pulmonary artery

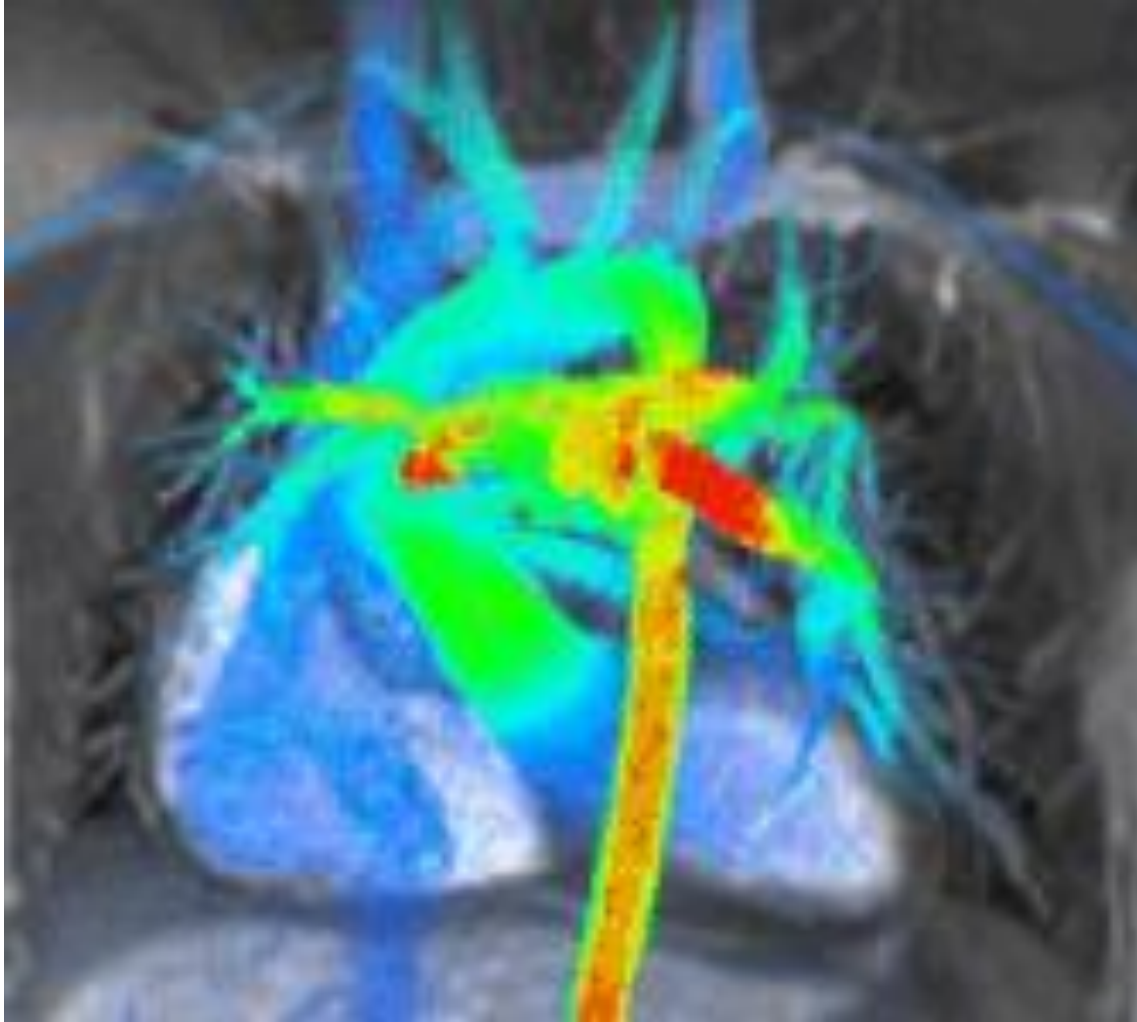
But also:

assessment of fibrosis
strain



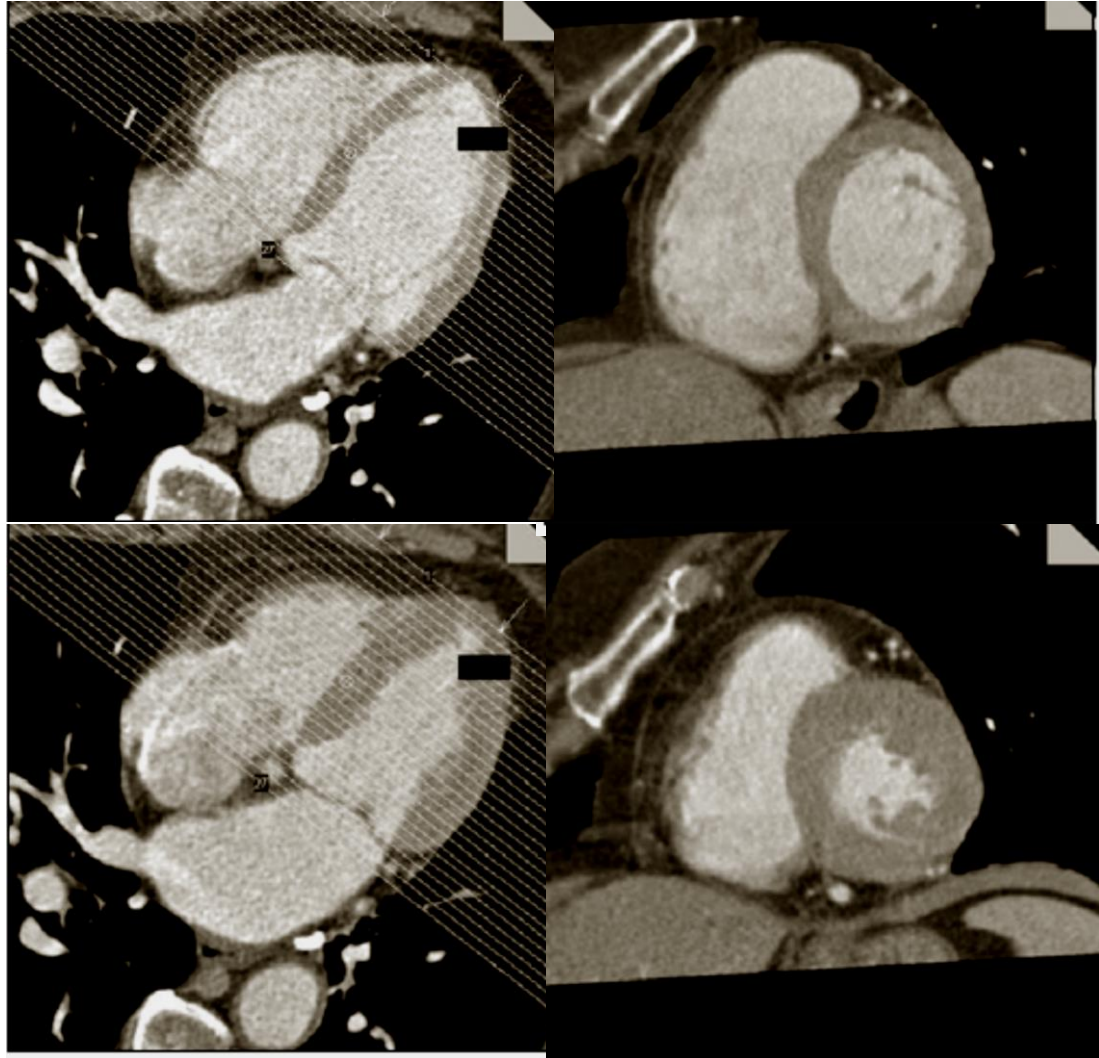
Imaging pulmonary regurgitation

- CMR: 4D flow quantification



Imaging pulmonary regurgitation

- MDCT : the outsider ...



Advantage :

- high spatial resolution and can define cardiac and vascular anatomy. RV and LV function
- Sizing pulmonary annulus
- faster image acquisition compared with CMR
- patients with non-CMR-compatible pacemakers or implants
- Better than MRI for coronary anatomy

Disadvantage

- requirement for ionizing radiation,
- reduced temporal resolution compared with CMR,
- inability to calculate flow directly.

Imaging pulmonary regurgitation

- Indication for valve replacement surgical or transcatheter?

For symptomatic, severe PR,

For asymptomatic, severe PR when any two of the following four criteria (suggested)

- Mild or moderate RV or LV systolic dysfunction.
- Severe RV dilation (RV end-diastolic volume index $\geq 160 \text{ mL/m}^2$, or RV end-systolic volume index $\geq 80 \text{ mL/m}^2$, or RVEDV greater than or equal to 2 times the LV end-diastolic volume).
- RV systolic pressure due to RV outflow tract obstruction greater than or equal to 2/3 systemic pressure.
- Progressive reduction in objective exercise tolerance.

Patients with asymptomatic severe PR and progressive TR, although evidence is more limited to support this approach (TOF)

Imaging pulmonary regurgitation

- Conclusion

- Echo remain the first line examination for detection and first assessment of PR
- But CMR emerged as « the tool » for quantification of PR and RV function and volumes specially when a decision to replace the valve must be discussed

Thank you for your attention

