



**Karolinska
Institutet**

Icke-invasiv diagnostik av pulmonell hypertension med magnetresonanstomografi

João Ramos MD PhD

Karolinska CMR Group

Vik/UL FO Klinisk Fysiologi, KS Huddinge

SFKF Play
06/10/2020

Disposition

1. Hjärt-MR idag

2. PA tryck skattad med "vortex duration"

- Metoden
- Vortex vs eko vs högerhjärtkateterisering
- Tillämpning

3. Framtiden

MR idag

- Krankärlssjukdom
 - Stressperfusion
 - Late-gad och myokardskada
- Kardiomyopati
 - VK parametrar
 - Fibros och T1 kartor
 - Myokardit (...)
- Flöde
 - Medfödda hjärtfel
 - Klaffer

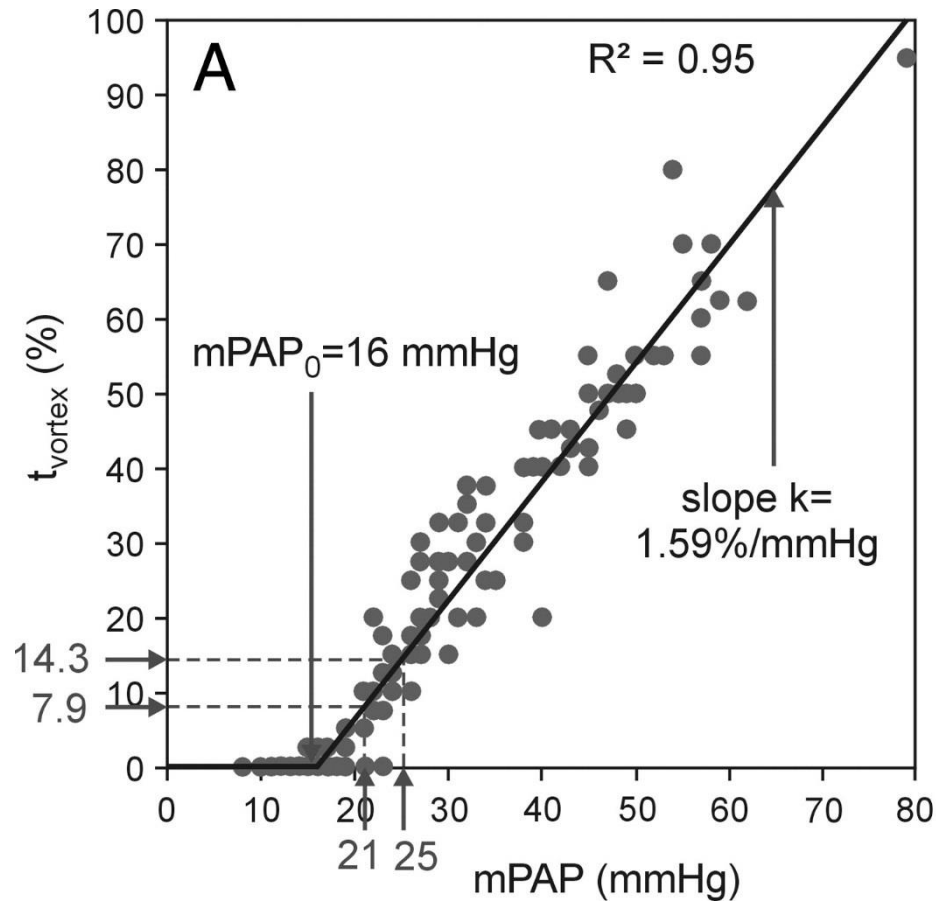
- Diffusion tensor MR
 - "Biopsi"
 - Myokards mikrostruktur
- 4D Flow
 - **PA tryck**
 - VK virvlar
- Diastologi



Rutin

Framtid/forskning

Vortex duration

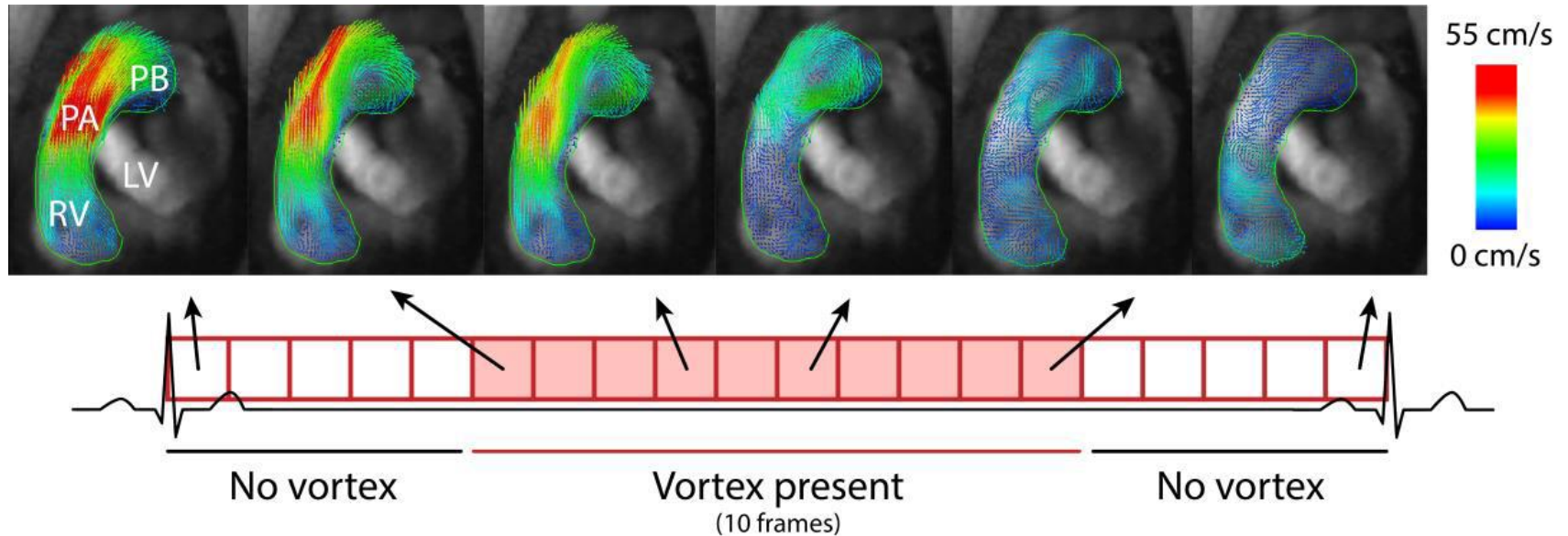


Reiter et al. (2015), Radiology

MR Sekvens

- 6-10 gapless slices (beroende på PA storlek)
- Gated 2D spoiled-gradient-echo-based cine phase contrast sequence, VENC 90 cm/s
- Akvisitionstid: 7-12 minuter
- Bildanalys: Siemens 4D Flow (prototyp)

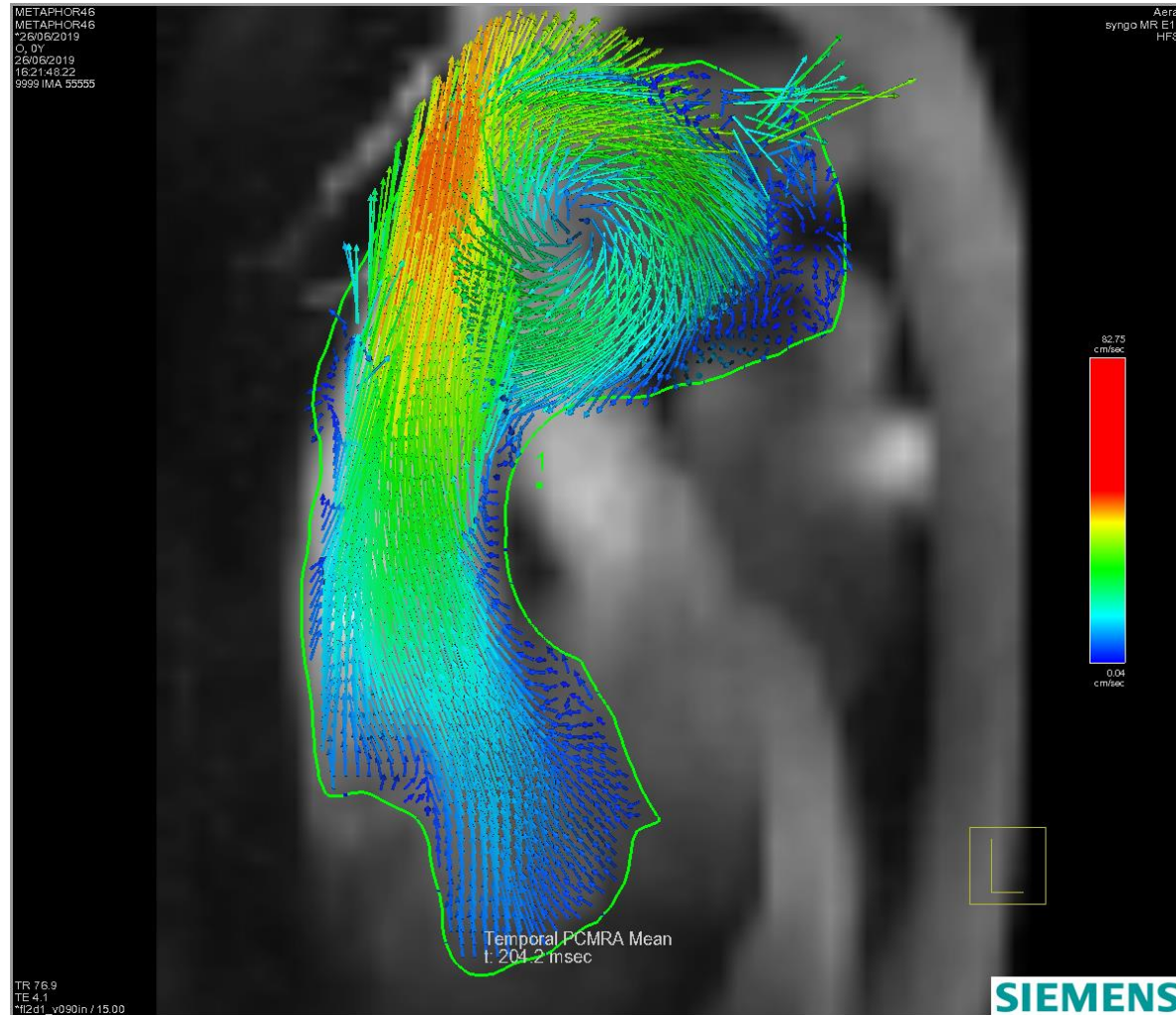
4D Flow Analys



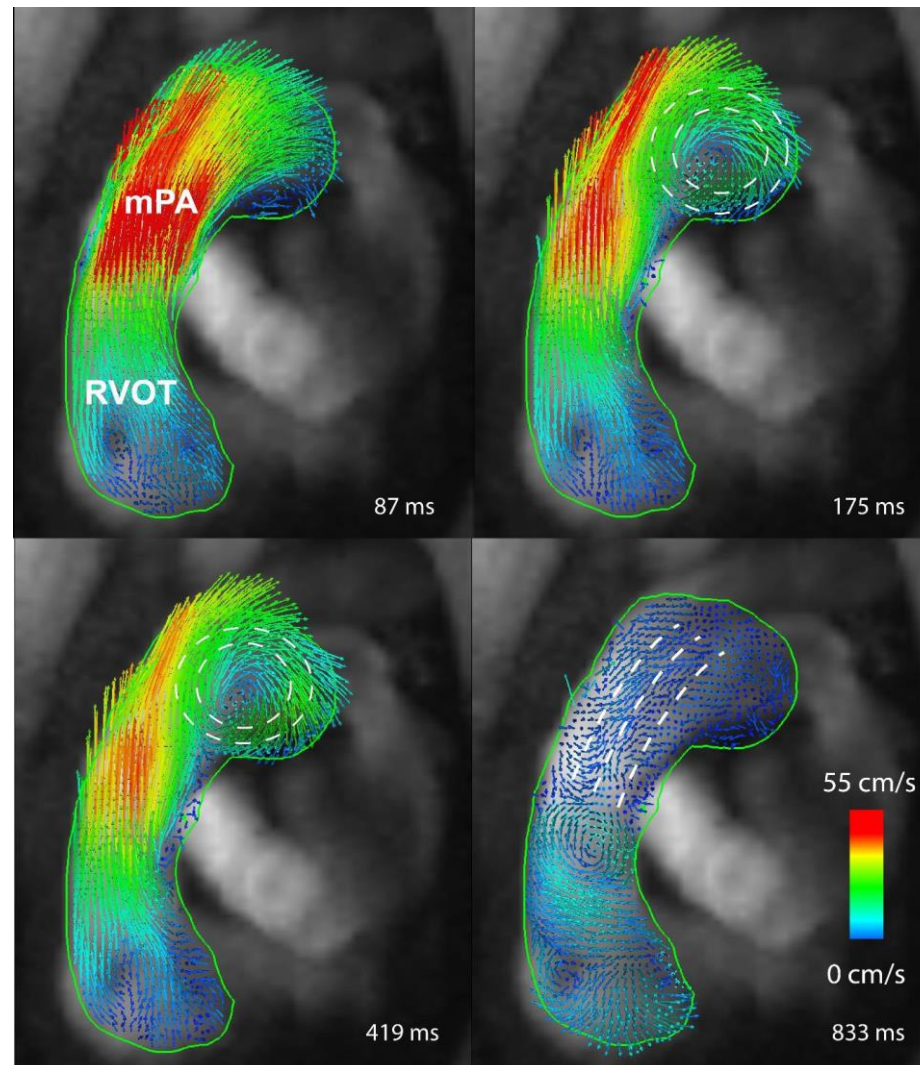
- Ett förhöjt PA tryck definieras som Vortex duration $\geq 10\%$

- $\square\square\square\square E\square\square\square\square F =$

4D Flow Analysis



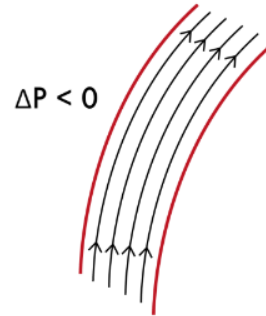
4D Flow Analysis



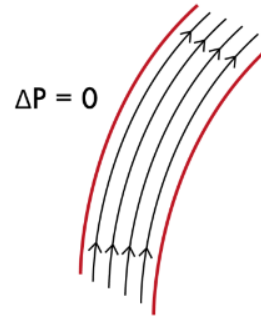
Varför?!

Normal

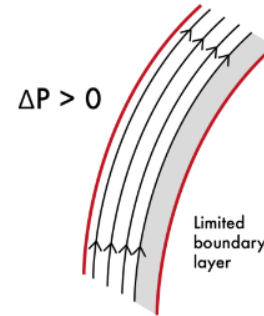
Early systole



Mid-systole

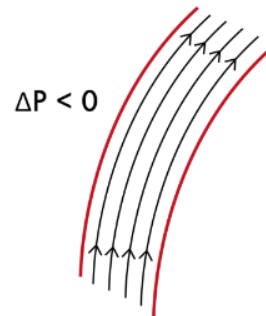


Late systole

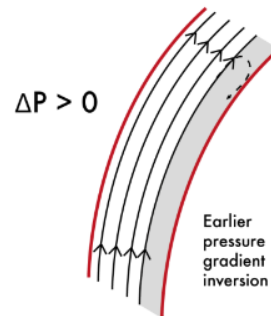


Pulmonary Hypertension

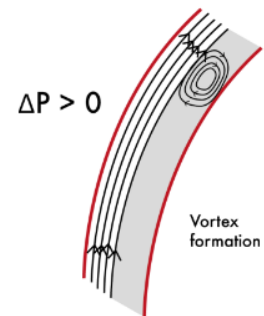
Early systole



Mid-systole



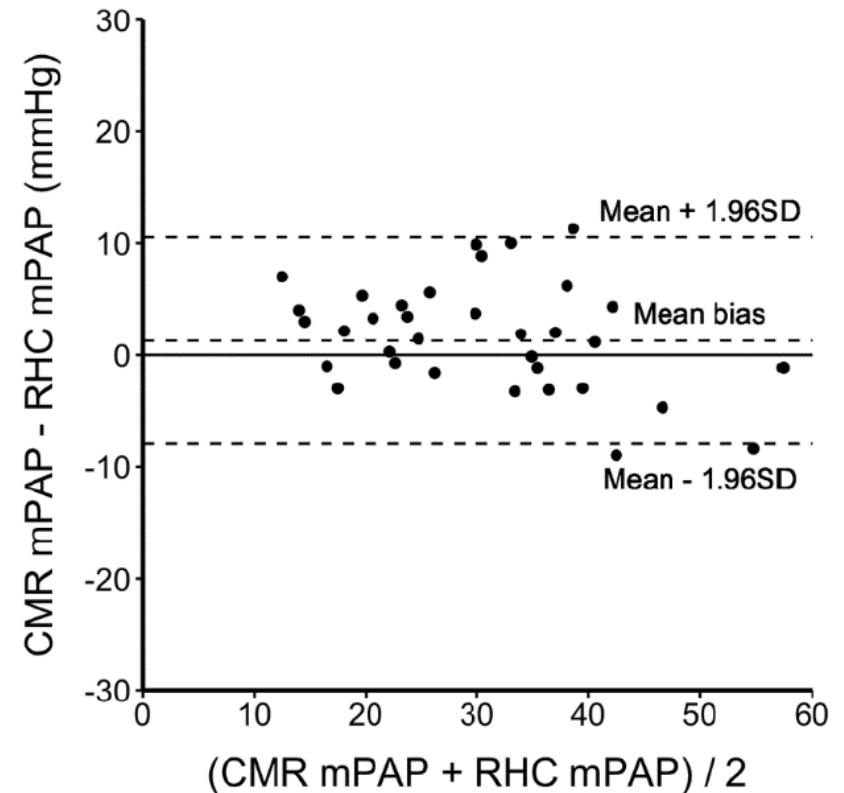
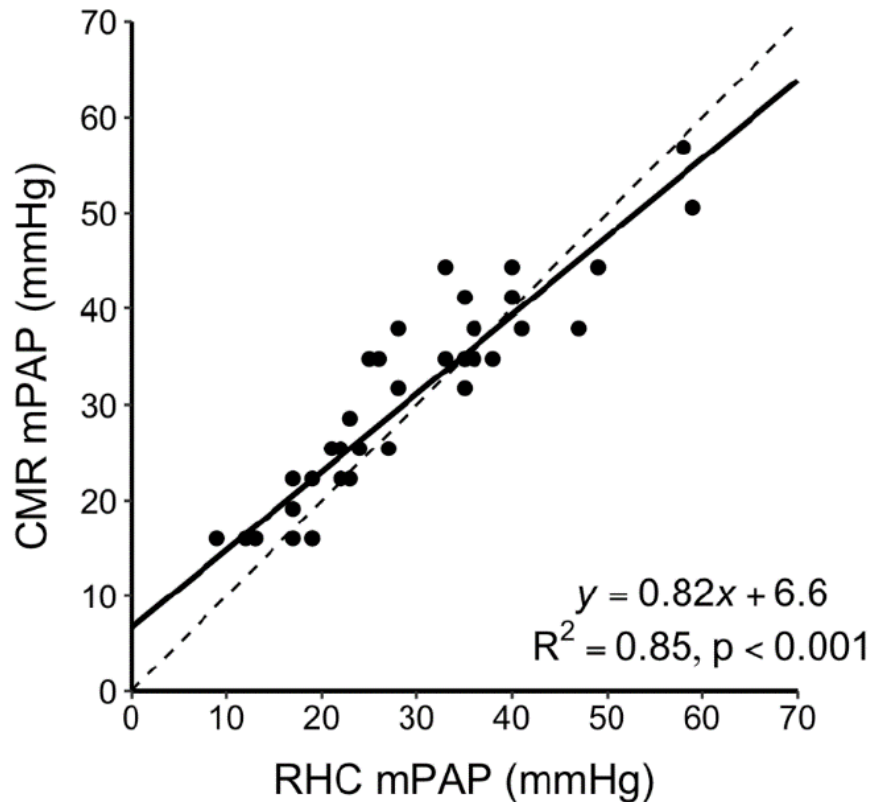
Late systole



Vortex vs Kateterisering

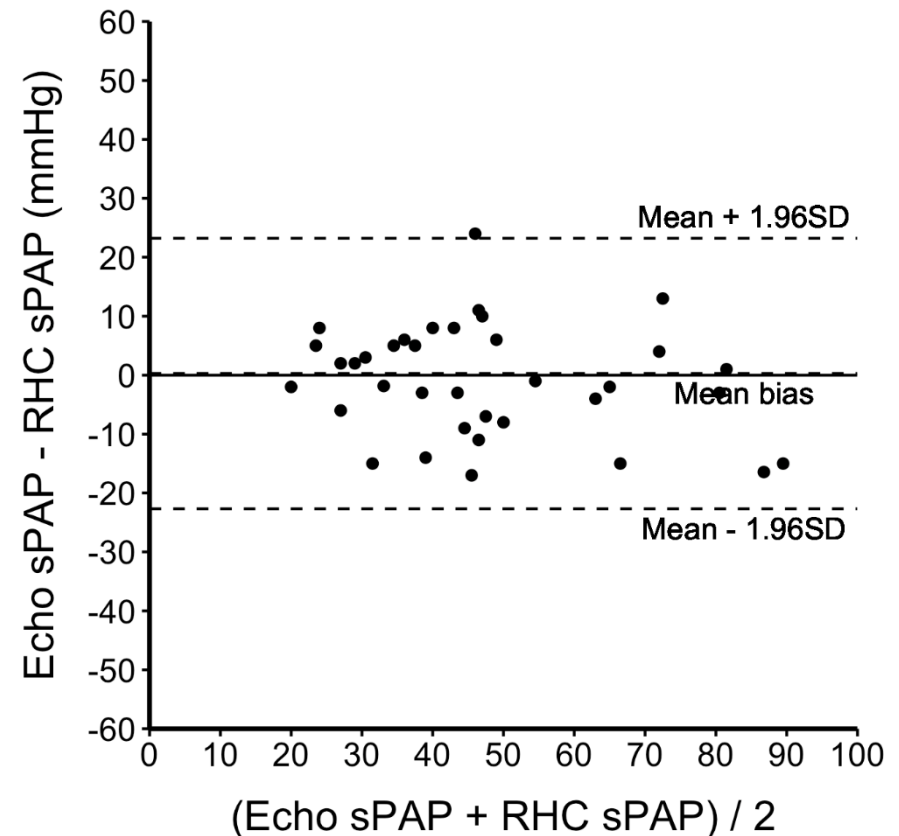
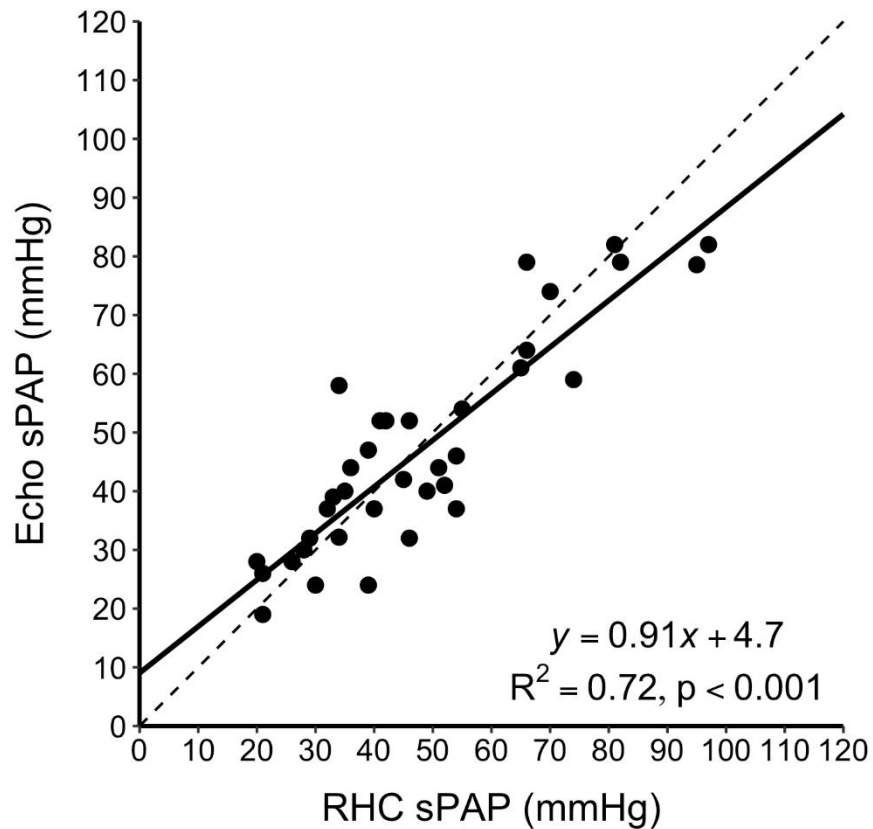
- Fyrtio (n=40) konsekutiva patienter med remiss för högerhjärtkateterisering pga känd eller misstänkt PH
- Patienterna genomgick kat + MR + eko
 - 6 [1-12] dagar mellan MR och kat
 - 0 [0-3] dagar mellan eko och kat

Vortex vs Kateterisering



Mean Bland-Altman bias 1.3 ± 4.7 mmHg

Vortex vs Kateterisering



Mean Bland-Altman bias 0.2 ± 11.7 mmHg

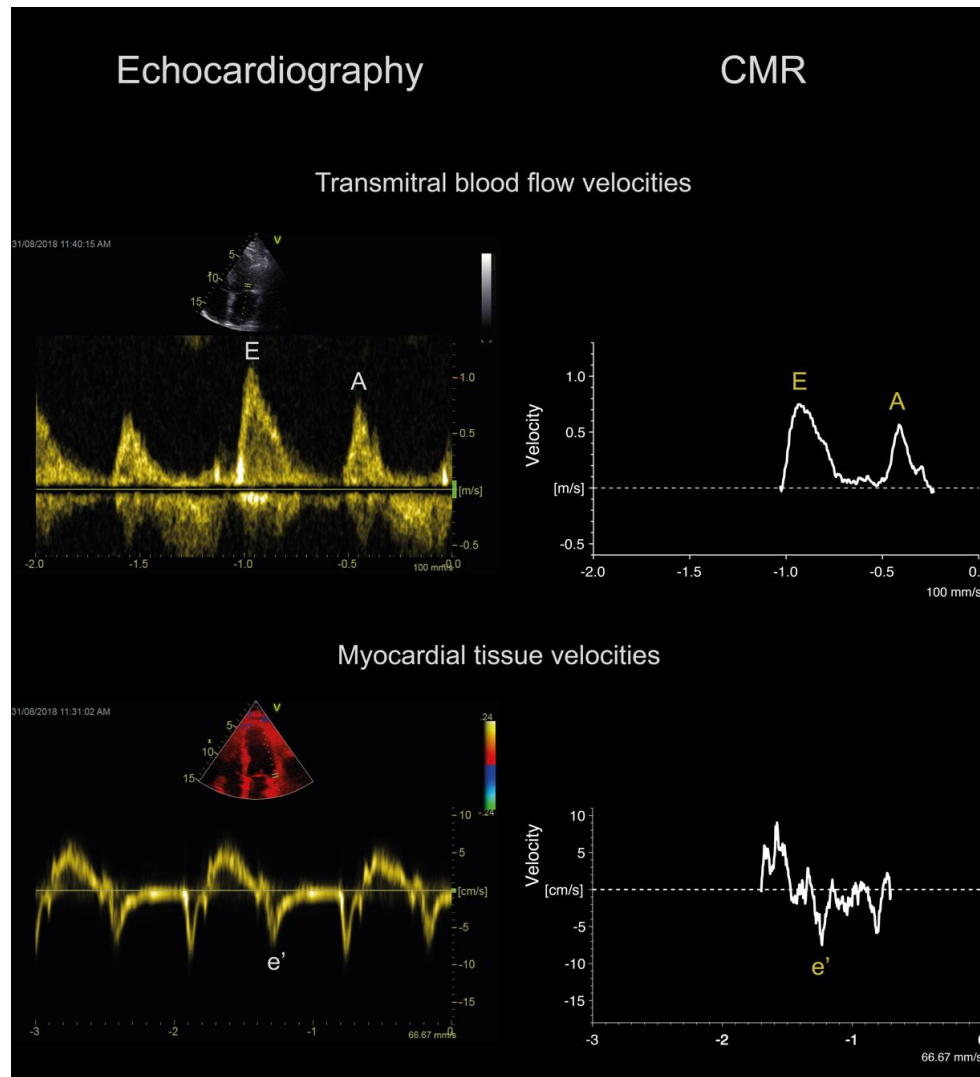
Vortex vs Kateterisering

Contingency table for RHC vs echocardiography TR				
Echo	Pulmonary hypertension		Total	
	Present RHC mPAP > 20 mmHg	Absent RHC mPAP ≤ 20 mmHg		
TR > 2.8 m/s	21 (56% true positives)	2 (5% false positives)	23	PPV = 91%
TR ≤ 2.8 m/s	6 (16% false negatives)	8 (22% true negatives)	14	NPV = 57%
Total	27	10	37	
	Sensitivity = 78%	Specificity = 80%	Accuracy = 78%	

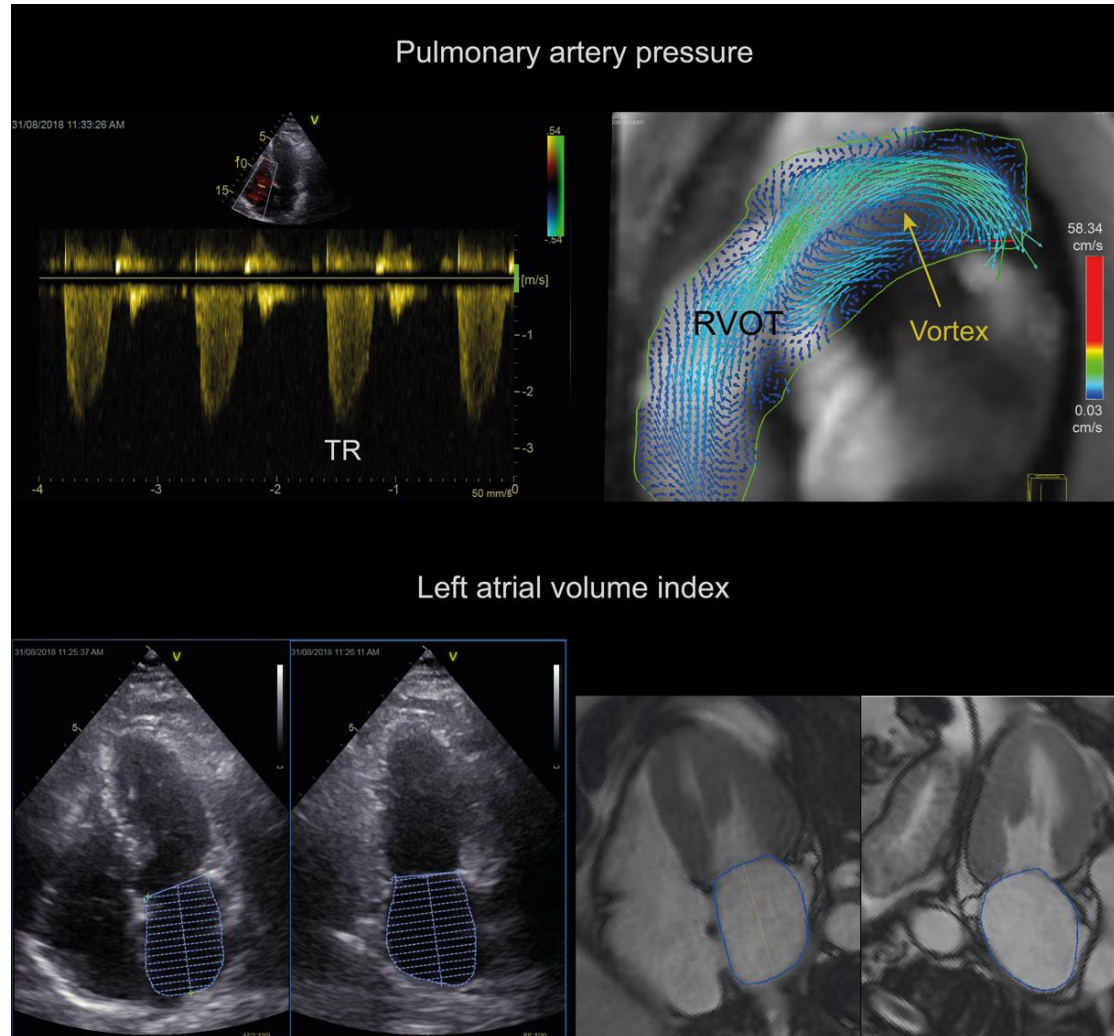
Vortex vs Kateterisering

Contingency table for RHC vs CMR Vortex Duration				
CMR	Pulmonary hypertension		Total	
	Present RHC mPAP > 20 mmHg	Absent RHC mPAP ≤ 20 mmHg		
Vortex duration ≥ 10%	27 (73% true positives)	2 (5% false positives)	29	PPV = 93%
Vortex duration < 10%	0 (0% false negatives)	8 (22% true negatives)	8	NPV = 100%
Total	27	10	37	
	Sensitivity = 100%	Specificity = 80%	Accuracy = 95%	

Diastolisk dysfunktion



Diastolisk dysfunktion



Framtiden

- Compressed sensing
 - Snabbare ackvisition: 3-6 minuter
- AI bildanalys
- Större studier
 - Fler patienter i alla PH WHO kategorier
 - Association med andra MR mätningar
 - Reproducerbarhet
 - Utvärdera behandlingssvar med MR?





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