Left atrial strain is highly predictive of pulmonary artery pressures in patients with aortic stenosis

JC Eicher, NV Yameogo, LS Aho, JL Philip, G Laurent, P Dobšák

François Mitterrand University Hospital
Dijon, Fr

St Anne's University Hospital
Brno, Cz

Deklarace konfliktu zájmů

	Nemám konflikt zájmů	Mám konflikt zájmů	Specifikace konfliktu (vyjmenujte subjekty, firmy či instituce, se kterými Vaše spolupráce může vést ke konfliktu zájmů)
Zaměstnanecký poměr	✓		
Vlastník / akcionář	✓		
Konzultant	✓		
Přednášková činnost	✓		
Člen poradních sborů (advisory boards)	✓		
Podpora výzkumu / granty	✓		
Jiné honoráře (např. za klinické studie či registry)	✓		

Background

- Pulmonary hypertension (PH) is one of the most powerful predictors of outcome in patients with severe aortic stenosis (AS).

- Mechanisms of PH in AS
  - usually the result of passive transmission of the increased left ventricular filling pressures due to LV hypertrophy and LV diastolic dysfunction (post-capillary PH)
  - some patients present with out of proportion, severe PH, thought to be due to a pre-capillary component (reactive PH)

- The mechanisms of PH occurring in the setting of AS, however, are not fully understood
  - the role of left atrial reservoir function is probably important

Galli E. *Eur Heart J Cardiovasc Imaging*. 2016

Todaro MC. *J Cardiol*. 2016

Aim of the study

- to determine the best predictor of PH in AS
  - aortic valve stenosis severity
  - left ventricular hypertrophy
  - left ventricular systolic function
  - left ventricular diastolic function
  - left atrial reservoir function

Methods

- Patients
  - 80 consecutive AS patients referred for preoperative assessment
  - severe AS: aortic valve area < 1 cm^2 (<0.6 cm^2/m^2)

- Right heart catheterization
  - right atrial pressure
  - pulmonary artery pressure
  - pulmonary capillary wedge pressure
  - cardiac output (thermodilution)

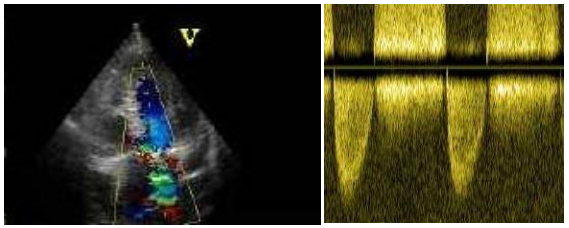
Methods

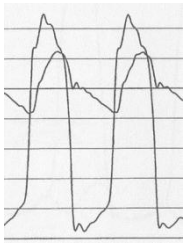
- Echocardiographic assessment (GE Vivid E9 ultrasound system)
  - Left ventricle measurements
    - Left ventricular ejection fraction (LVEF, biplane Simpson method)
    - Left ventricular mass (iLVM)
    - Left ventricular longitudinal strain
    - E/A, E/e' ratios, E deceleration time
  - Aortic valve measurements
    - Mean aortic gradient (MAG)
    - Aortic valve area (AVA)
  - Right ventricular function
    - Tricuspid annular plane systolic excursion (TAPSE)
    - Systolic velocity at the tricuspid annulus (Stric)
  - Pulmonary artery pressure measurement
    - Tricuspid regurgitant flow velocity
  - Left atrial measurements
    - Indexed left atrial volume (iLAV, biplane Simpson method)
    - Left atrial systolic longitudinal strain (4 and 2-chamber views, speckle tracking analysis)

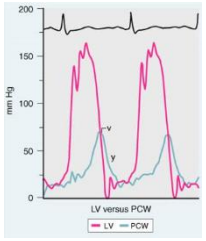
Results (1)

- Demographic and haemodynamic data

	Overall population (n = 80)	sPAP ≤55 mmHg (n = 51)	sPAP > 55 mmHg (n = 29)	p
Age (years)	80.3 ± 8.4	78,8 ± 7,6	83,5 ± 9,4	0.11
Sex ratio (M/F)	0.48	0.5	0.45	0.86
Mean aortic gradient (mmHg)	45.5 ± 18	48 ± 18	40.1 ± 1.3	0.16
Aortic valve area (cm^2)	0.74 ± 0.18	0.72 ± 0.14	0.75 ± 0.23	0.61
Mean pulmonary artery pressure (mmHg)	29.3 ± 9.7	24.2 ± 7.2	41.4 ± 6.5	< 0.001
Mean capillary wedge pressure (mmHg)	18.4 ± 8.3	14.3 ± 5	28.3 ± 5.5	< 0.001
Diastolic pulmonary gradient (dPAP – PCWP)	-0.07 ± 4	0.48 ± 3.9	-1.5 ± 4.6	0.17



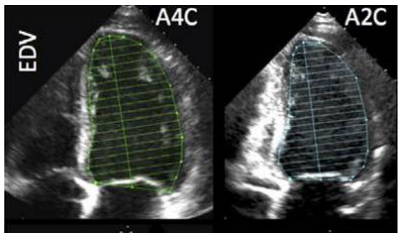


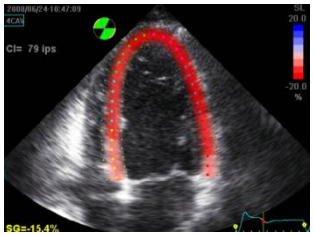


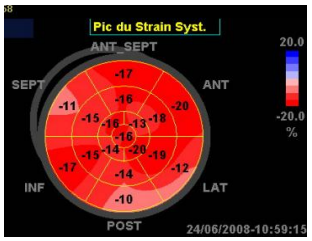
Results (2)

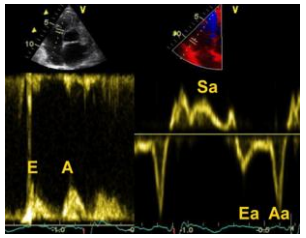
- Left ventricular measurements

	Overall population (n = 80)	sPAP ≤ 55 mmHg (n = 51)	sPAP > 55 mmHg (n = 29)	p
LV ejection fraction (%)	61.7 ± 14.3	63.9 ± 12.3	55.6 ± 17.6	0.07
LV mass, indexed (g/m²)	147.6 ± 41.2	146.9 ± 35.8	155.8 ± 49.3	0.5
LV longitudinal strain (%)	- 16.4 ± 4.3	- 16.8 ± 4.2	- 13.6 ± 3.4	0.07
LV end diastolic diameter (mm)	**51.6 ± 6.7**	**50.5 ± 5.3**	**55.4 ± 7.7**	**0.02**
E/A ratio	**0.96 ± 0.5**	**0.76 ± 0.21**	**1.52 ± 0.64**	**< 0.001**
E/e' ratio	**17.7 ± 7.02**	**15.7 ± 5.9**	**22.5 ± 7.4**	**0.001**
E deceleration time (ms)	**209.3 ± 81.2**	**230 ± 83.4**	**169.5 ± 64.8**	**0.02**





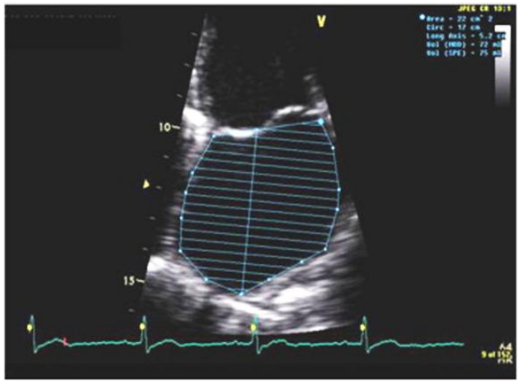


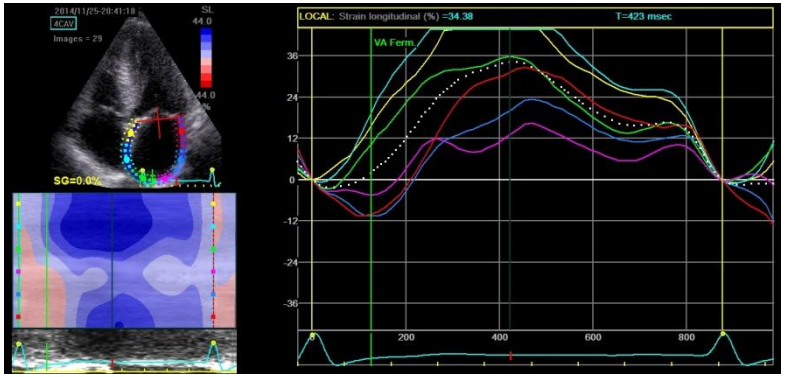


Results (3)

- Left atrial measurements

	Overall population (n = 80)	sPAP ≤ 55 mmHg (n = 51)	sPAP > 55 mmHg (n = 29)	p
LA volume (ml/m²)	49.9 ± 29	47.4 ± 31.5	59.8 ± 21.9	0.13
LA strain (4 c view)	**17.4 ± 7.6**	**20.4 ± 6.65**	**10.7 ± 5.3**	**< 0.001**
LA strain (2 c view)	**18.5 ± 8.05**	**21.1 ± 8.2**	**9.9 ± 5.5**	**< 0.001**





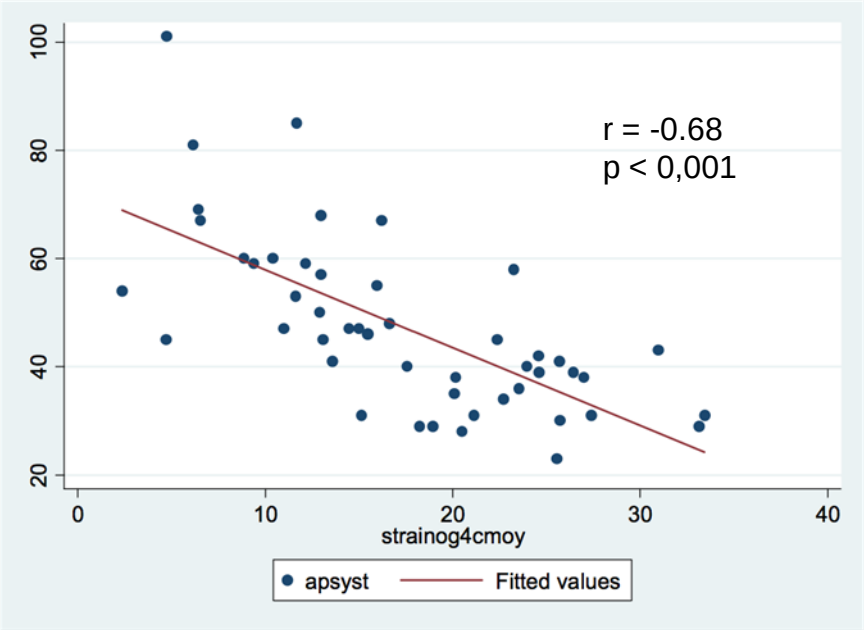
Results (4)

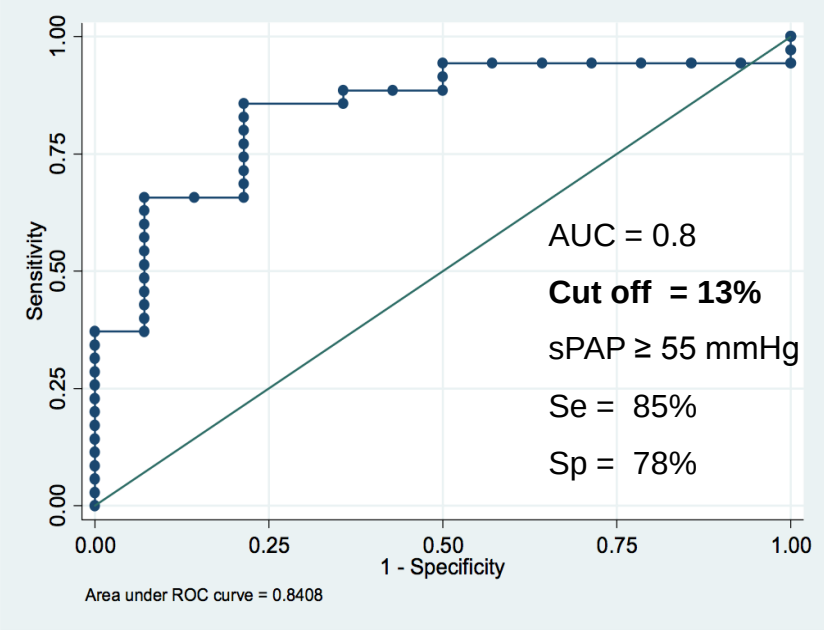
- Predictors of severe PH > 55 mmHg (univariate analysis)

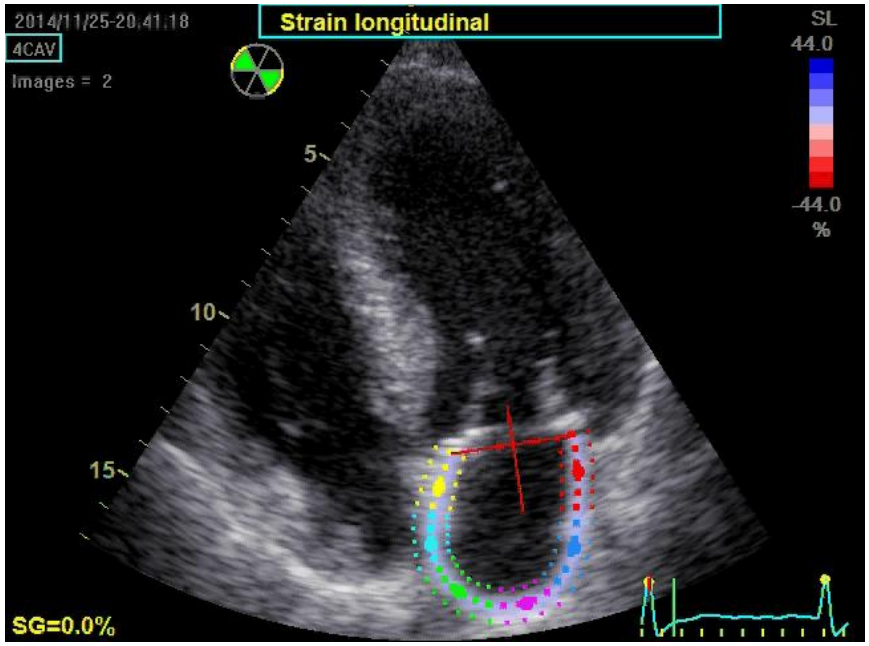
Factors	β (95% IC)	r	p
Age	0.32 (-0.19 to 0.85)	0.17	0.21
Aortic valve area	-5.1 (-33.9 to 23.6)	-0.05	0.72
Mean aortic gradient	-0.24 (-0.05 to 0.01)	-0.27	0.06
LV end diastolic diameter	**1.09 (0.4 to 1.8)**	**-0.27**	**0.002**
LV ejection fraction	-0.29 (-0.6 to 0.07)	-0.25	0.11
Indexed LV mass	0.08 (-0.003 to 0.17)	0.22	0.06
Indexed LA volume	0.14 (-0.04 to 0.3)	0.26	0.14
LV strain	**1,44 (0.16 to 2.7)**	**0.42**	**0.028**
E deceleration time	**-0.07 (-0.12 to -0.02)**	**-0.36**	**0.006**
E/A ratio	**16 (12.3 to 19.9)**	**0.50**	**< 0.001**
E/e' ratio	**0.77 (0.26 to 1.27)**	**0.33**	**0.004**
TAPSE	**-1.14 (-2.02 to -0.25)**	**-0.41**	**0.012**
S Tricuspid annulus	-0.002 (-0.04 to 0.04)	-0.002	0.90
sPAP/TR	**0.78 (0.58 to 0.99)**	**0.76**	**< 0.001**
LA strain 4 c view	**-1.43 (-1.95 to -0.91)**	**-0.68**	**< 0.001**
LA strain 2 c view	**-1.13 (-1.59 to -0.67)**	**-0.67**	**< 0.001**

Results (5)

- Predictors of severe PH > 55 mmHg (multivariate analysis)
  - *the only independent parameter associated with PH was the left atrial strain*







72 year-old male

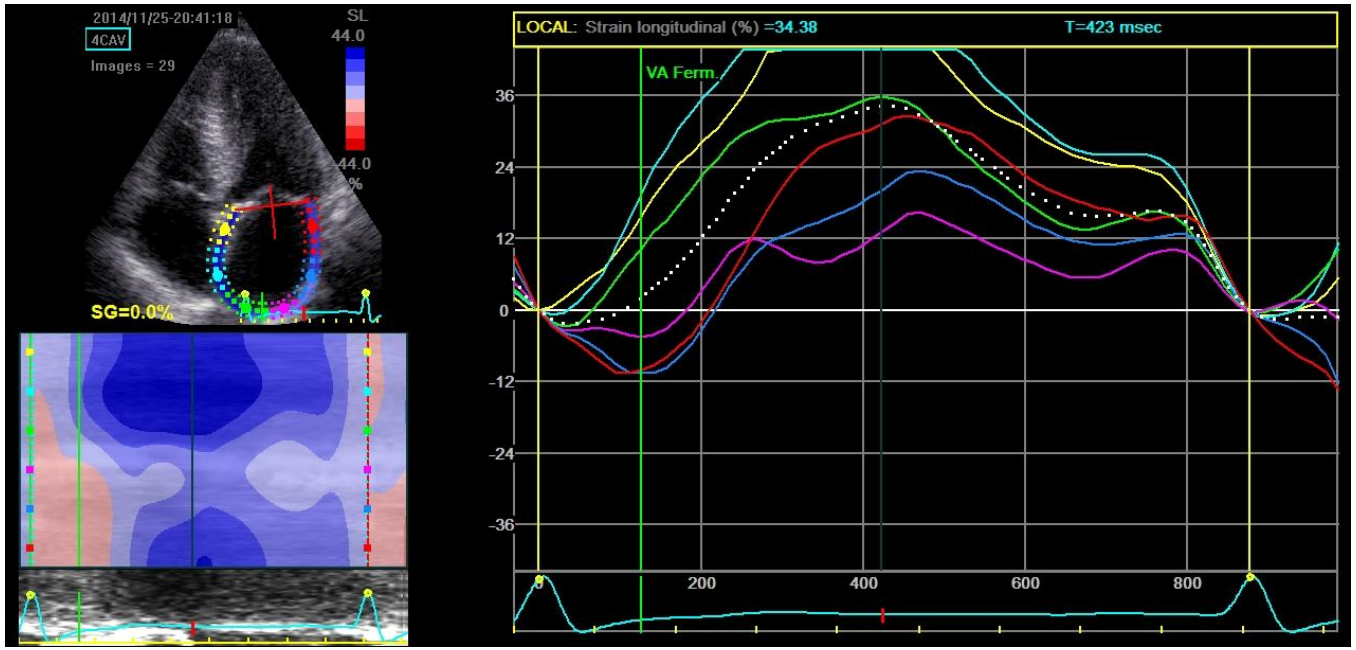
AVA 0.7 cm²

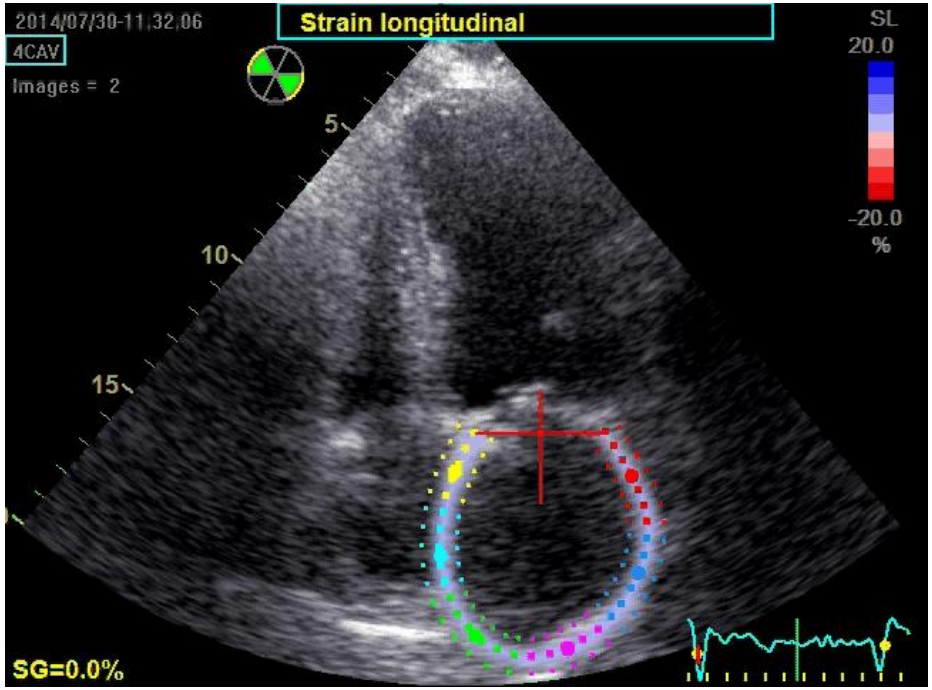
LA strain 34.4%

PAP 26/13,19 mmHg

PCWP 13 mmHg

Normal Vwave

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Strain longitudinal
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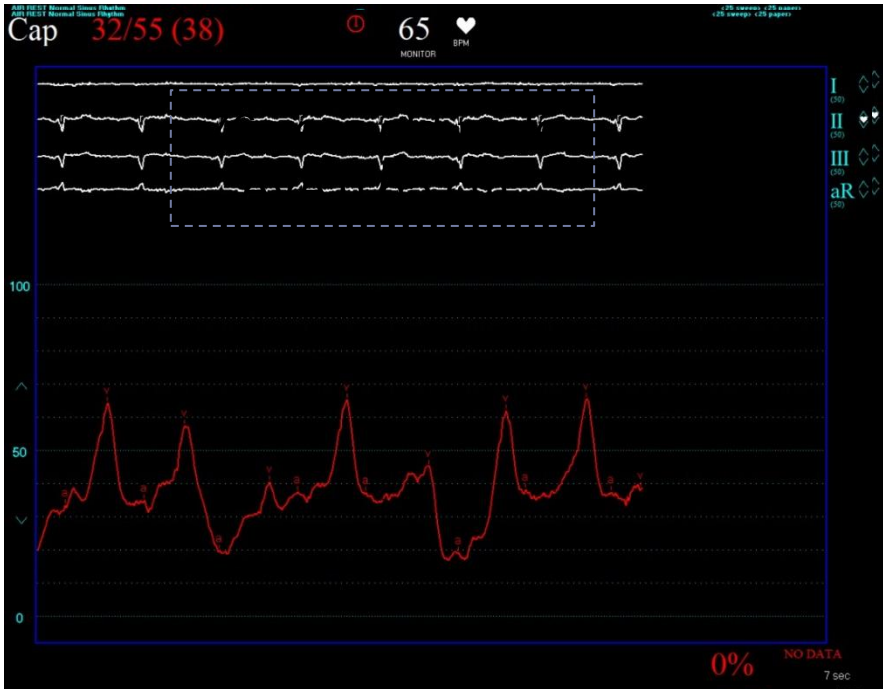
-20.0
%
5
10
15
SG=0.0%


Cap
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II
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100
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NO DATA
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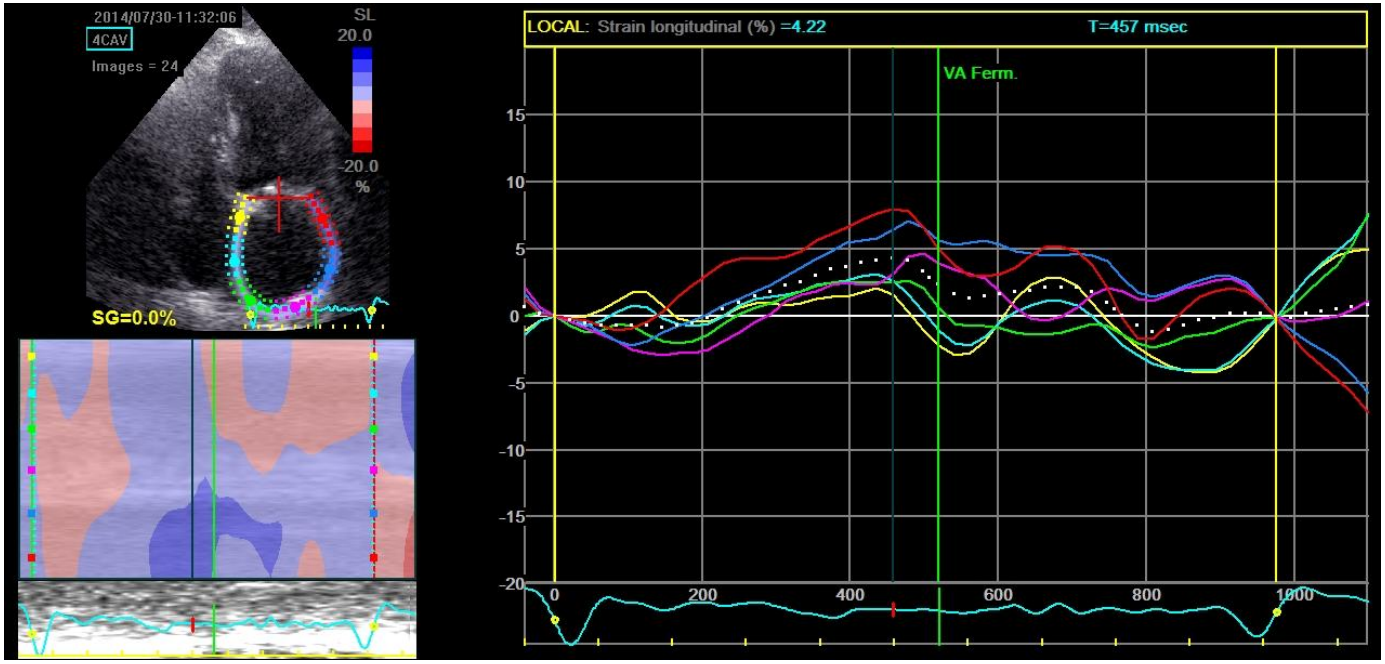
2014/07/30-11:32:06
4CAV
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SL
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-20.0
%
SG=0.0%
LOCAL: Strain longitudinal (%) =4.22
T=457 msec
VA Ferm.
15
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5
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-5
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-20
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200
400
600
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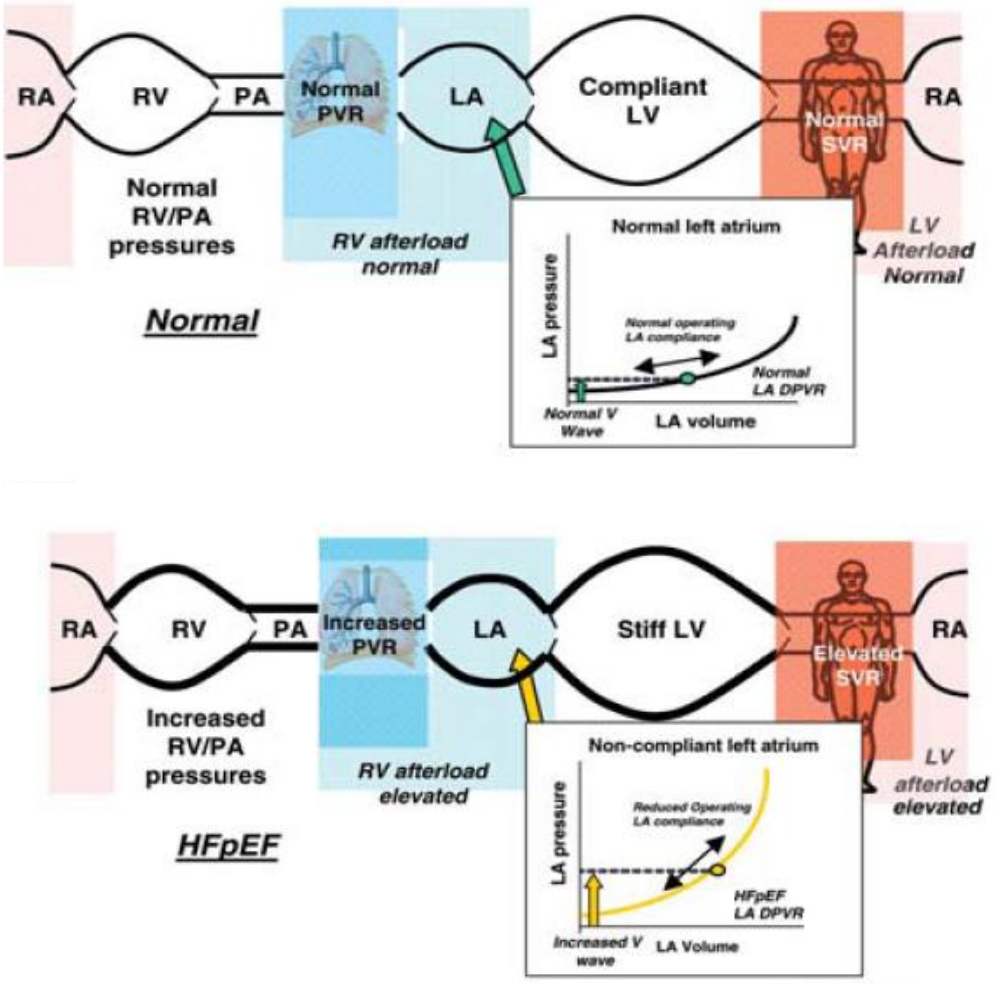
1000

Discussion



Boilson BA. Eur J Heart Fail 2010

Conclusion

- 36% of patients with AS present with severe PH > 55 mmHg
- PH is not predicted by AS severity, LV mass or ejection fraction
- Patients with PH have worse LV diastolic function and LV longitudinal strain
- In multivariate analysis LA strain measured by speckle tracking analysis is the only independent predictor of pulmonary artery pressure in patients with severe AS
- These results suggest that the increase in sPAP is tightly linked to the decrease in left atrial reservoir function.
- The prognostic value of LA strain should be further assessed