How to assess the risk of embolism?

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April 2018

Cardiovascular and other conditions independently associated with atrial fibrillation (1)

Characteristic/comorbidity	Association with AF
Genetic predisposition (based on multiple common gene variants associated with AF)	HR range 0.4–3.2
Older age 50-59 years 60-69 years 70-79 years 80-89 years	HR: 1.00 (reference) 4.98 (95% CI 3.49–7.10) 7.35 (95% CI 5.28–10.2) 9.33 (95% CI 6.68–13.0)
Hypertension (treated) vs. none	HR 1.32 (95% CI 1.08–1.60)
Heart failure vs. none	HR 1.43 (95% CI 0.85–2.40)
Valvular heart disease vs. none	RR 2.42 (95% CI 1.62–3.60)
Myocardial infarction vs. none	HR 1.46 (95% CI 1.07–1.98)
Thyroid dysfunction Hypothyroidism Subclinical hyperthyroidism Overt hyperthyroidism	(reference: euthyroid) HR 1.23 (95% CI 0.77–1.97) RR 1.31 (95% CI 1.19–1.44) RR 1.42 (95% CI 1.22–1.63)
Obesity (body mass index) None (<25 kg/m²) Overweight (25–30 kg/m²) Obese (≥31 kg/m²)	HR: 1.00 (reference) 1.13 (95% CI 0.87–1.46) 1.37 (95% CI 1.05–1.78)
Diabetes mellitus vs. none	HR 1.25 (95% CI 0.98–1.60)

HR = hazard ratio; RR = risk ratio

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What do you think?

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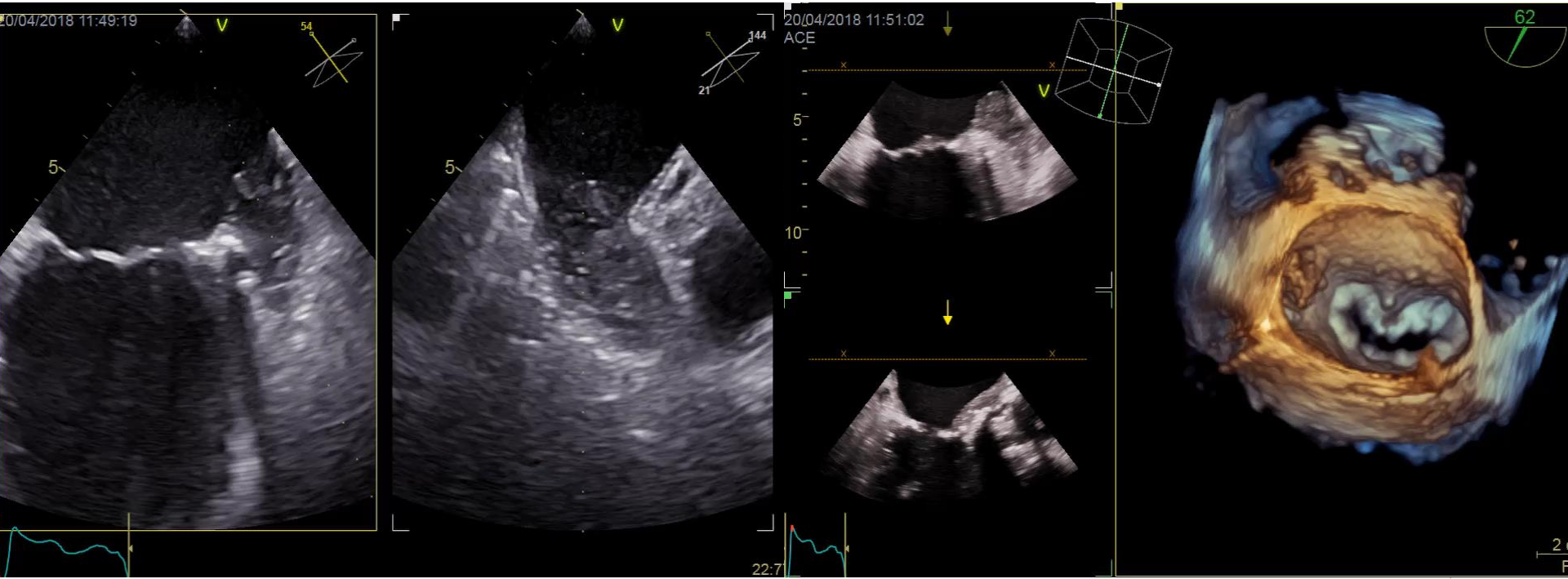

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What do you think?

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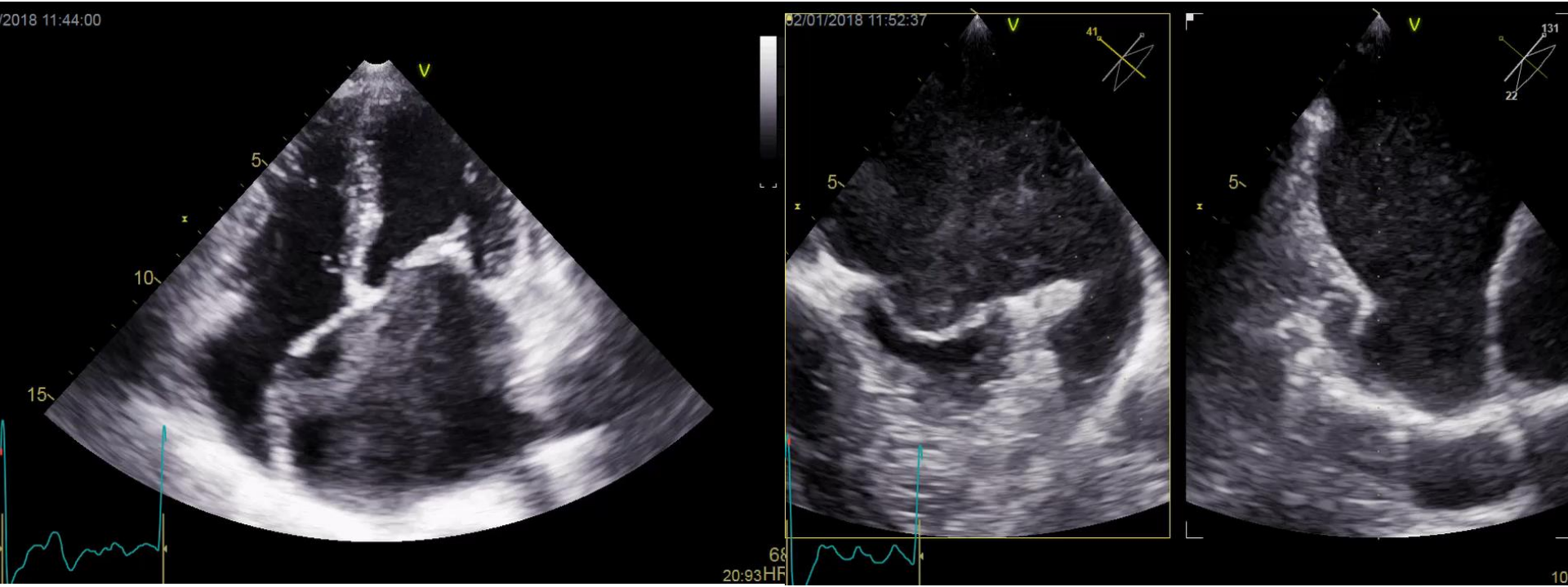

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Prediction of stroke and bleeding risk

Recommendations	Class	Level
The CHA_2DS_2-VASc score is recommended for stroke risk prediction in patients with AF.	I	A
Bleeding risk scores should be considered in AF patients on oral anticoagulation to identify modifiable risk factors for major bleeding.	IIa	B
Biomarkers such as high-sensitivity troponin and natriuretic peptide may be considered to further refine stroke and bleeding risk in AF patients.	IIb	B

CHA_2DS_2-VASc risk factor	Points
Congestive heart failure Signs/symptoms of heart failure or objective evidence of reduced left-ventricular ejection fraction	1
Hypertension Resting blood pressure >140/90 mmHg on at least two occasions or current antihypertensive treatment	1
Age 75 years or older	2
Diabetes mellitus Fasting glucose >125 mg/dL (7 mmol/L) or treatment with oral hypoglycaemic agent and/or insulin	1
Previous stroke, transient ischaemic attack, or thromboembolism	2
Vascular disease Previous myocardial infarction, peripheral artery disease, or aortic plaque	1
Age 65–74 years	1
Sex category (female)	1

EACVI/EHRA Expert Consensus Document on the role of multi-modality imaging for the evaluation of patients with atrial fibrillation

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	2D Echocardiographic description	Emptying flow velocities
Sludge	Dense smoke, viscid echodensity, not solid	<20 cm/s
Severe spontaneous echo-contrast	Intense echodensity and very slow swirling patterns in the left acid appendage,	20–40 cm/s
Mild to moderate spontaneous echo contrast	Swirling pattern in the LA appendage	40–60 cm/s

Of the echocardiographic indices, LV systolic dysfunction, dense spontaneous echo contrast (SEC), low LAA peakflow velocities, and complex aortic plaque were reported to be related to thromboembolic risk.

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Donal et al. European Heart Journal – Cardiovascular Imaging (2016) 17, 355–383

Structural Heart Disease

Complex Left Atrial Appendage Morphology and Left Atrial Appendage Thrombus Formation in Patients With Atrial Fibrillation

Masayoshi Yamamoto, MD; Yoshihiro Seo, MD; Naoto Kawamatsu, MD; Kimi Sato, MD; Akinori Sugano, MD; Tomoko Machino-Ohtsuka, MD; Ryo Kawamura, MD; Hideki Nakajima, PhD; Miyako Igarashi, MD; Yukio Sekiguchi, MD; Tomoko Ishizu, MD; Kazutaka Aonuma, MD

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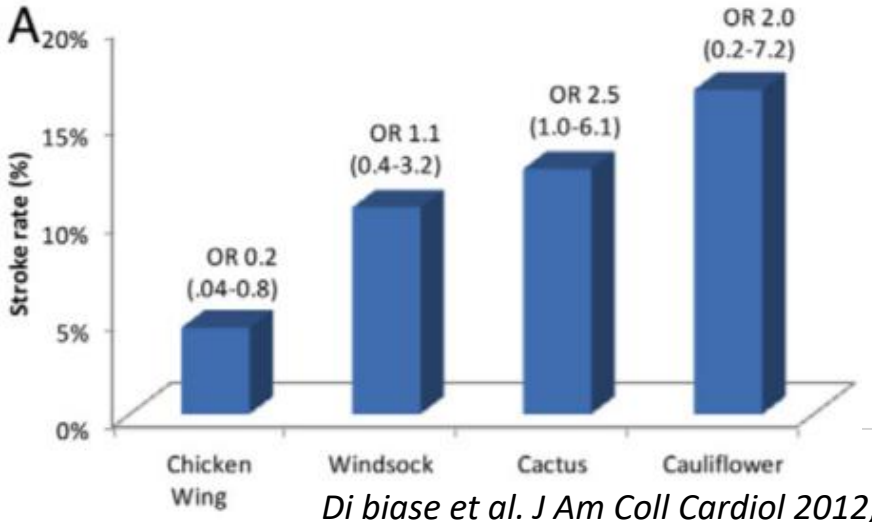
633 consecutive patients who were candidates for catheter ablation

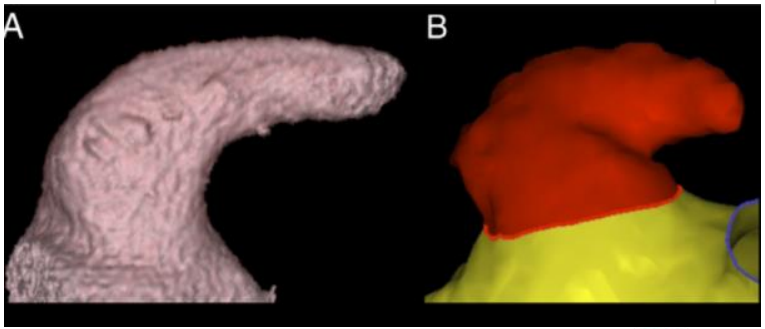
LAA thrombus was observed in 36 (6.4%) patients

Most patients with LAA thrombus (32/34, 94.4%) had ≥3 LAA lobes



Di biase et al. J Am Coll Cardiol 2012;60:531–8

Chicken Wing LAA Morphology



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Circ Cardiovasc Imaging. 2014;7:337-343.

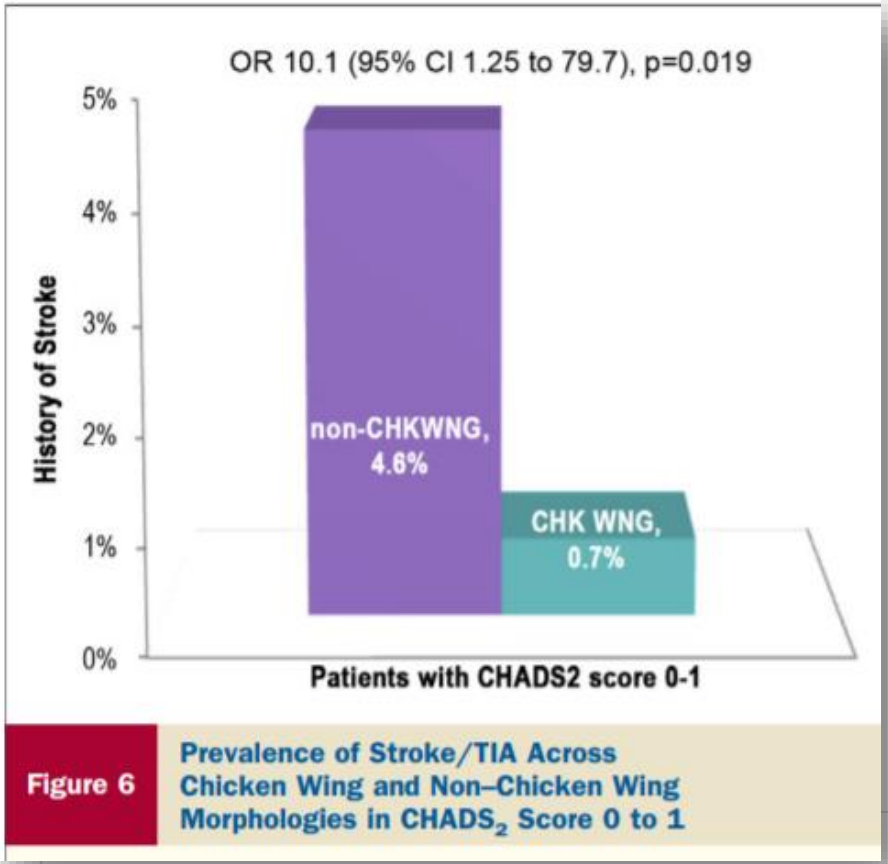
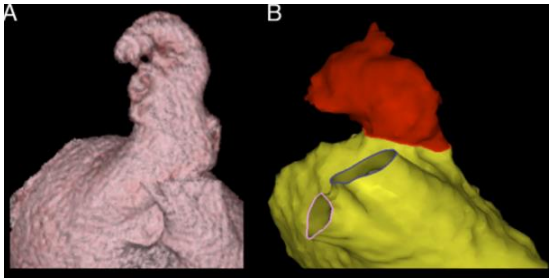
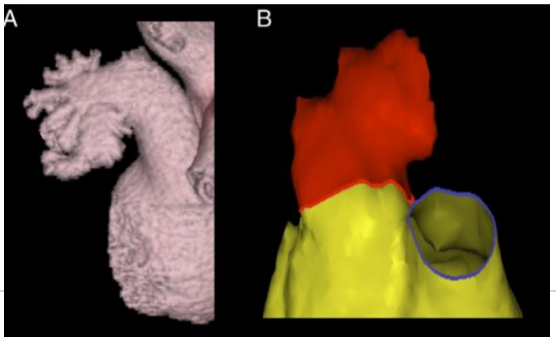


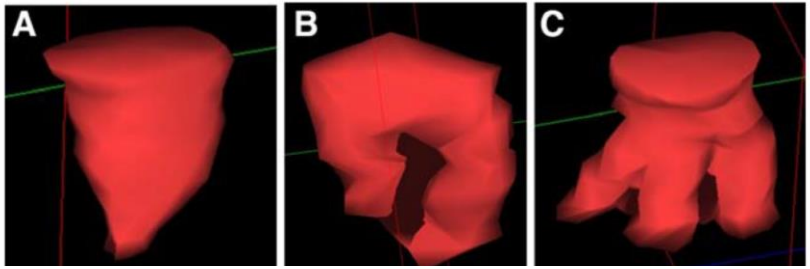
Figure 6 Prevalence of Stroke/TIA Across Chicken Wing and Non–Chicken Wing Morphologies in $CHADS_2$ Score 0 to 1

Windsock LAA Morphology



Cauliflower LAA Morphology





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Univariate and Multivariate Analyses for Presence of LAA Thrombus

	Univariate		Multivariate	
Variables	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
AF type (nonparoxysmal AF)	4.785 (2.26–10.10)	<0.001	…	0.41
$CHADS_2$ score	1.915 (1.486–2.467)	<0.001	1.752 (1.237–2.483)	0.002
Degree of spontaneous echo contrast	3.128 (2.262–4.326)	<0.001	1.783 (1.102–2.740)	0.02
Left ventricular ejection fraction, %	0.935 (0.914–0.956)	<0.001	0.962 (0.934–0.992)	0.01
LA volume, ml	1.031 (1.021–1.041)	<0.001	1.018 (1.003–1.032)	0.02
LAA emptying velocity, cm/s	0.947 (0.925–0.970)	<0.001	…	0.60
LAA volume, ml	1.038 (1.007–1.070)	0.02	…	0.86
Number of LAA lobes	3.318 (2.179–5.052)	<0.001	2.469 (1.495–4.078)	<0.001

AF indicates atrial fibrillation; $CHADS_2$, Congestive heart failure, Hypertension Age>75, Diabetes mellitus and prior Stroke or transient ischemic attack; CI, confidence interval; LA, left atrium; LAA, left atrial appendage; and OR, odds ratio.

Atrial fibrillation triggering surgical or interventional therapy of valvular heart disease

Recommendations	Class	Level
Early mitral valve surgery should be considered in severe mitral regurgitation, preserved LV function, and new-onset AF, even in the absence of symptoms, particularly when valve repair is feasible.	IIa	C
Mitral valvulotomy should be considered for asymptomatic patients with severe mitral stenosis and suitable valve anatomy who have new-onset AF.	IIa	C

Atrium as Ventricle is remodeling

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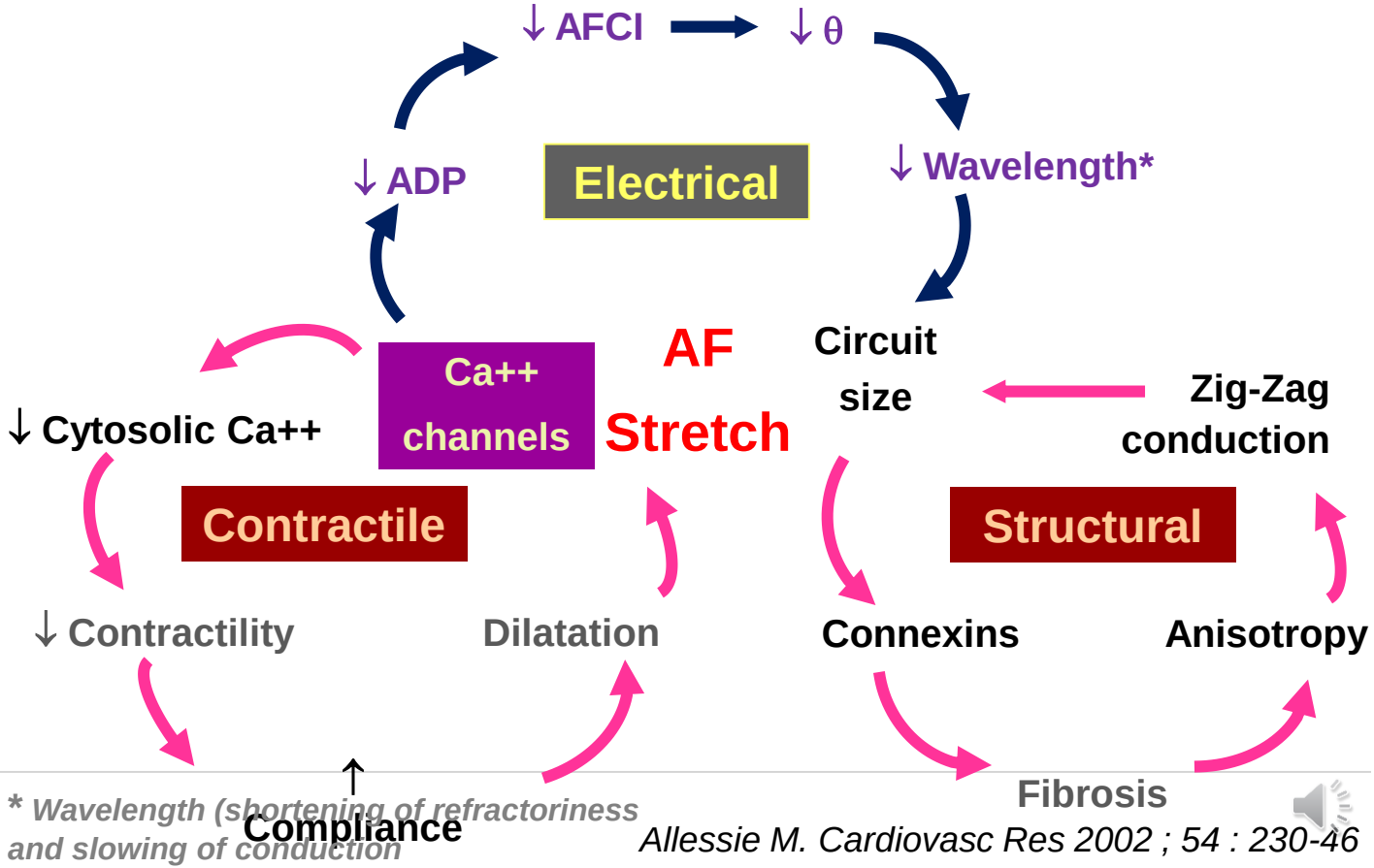

* *Wavelength (shortening of refractoriness and slowing of conduction*

Allessie M. Cardiovasc Res 2002 ; 54 : 230-46

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ATRIAL FUNCTION

QRS

T

Booster pump function related to:
- **LV Compliance**
- **LVeDP.**
- **LA contractility**

Correlated to the filling pressure & the LA compliance

Correlated to LV relaxation

diastole

systole

CONDUIT	Booster pump	RESERVOIR	CONDUIT

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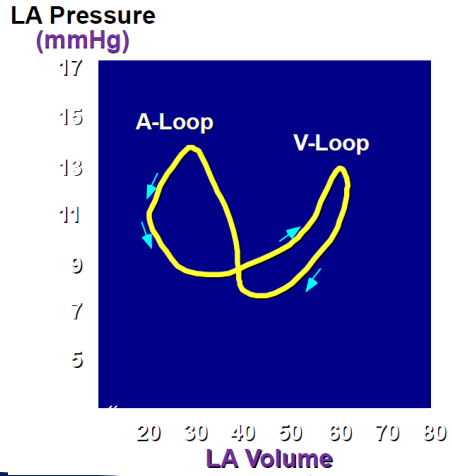

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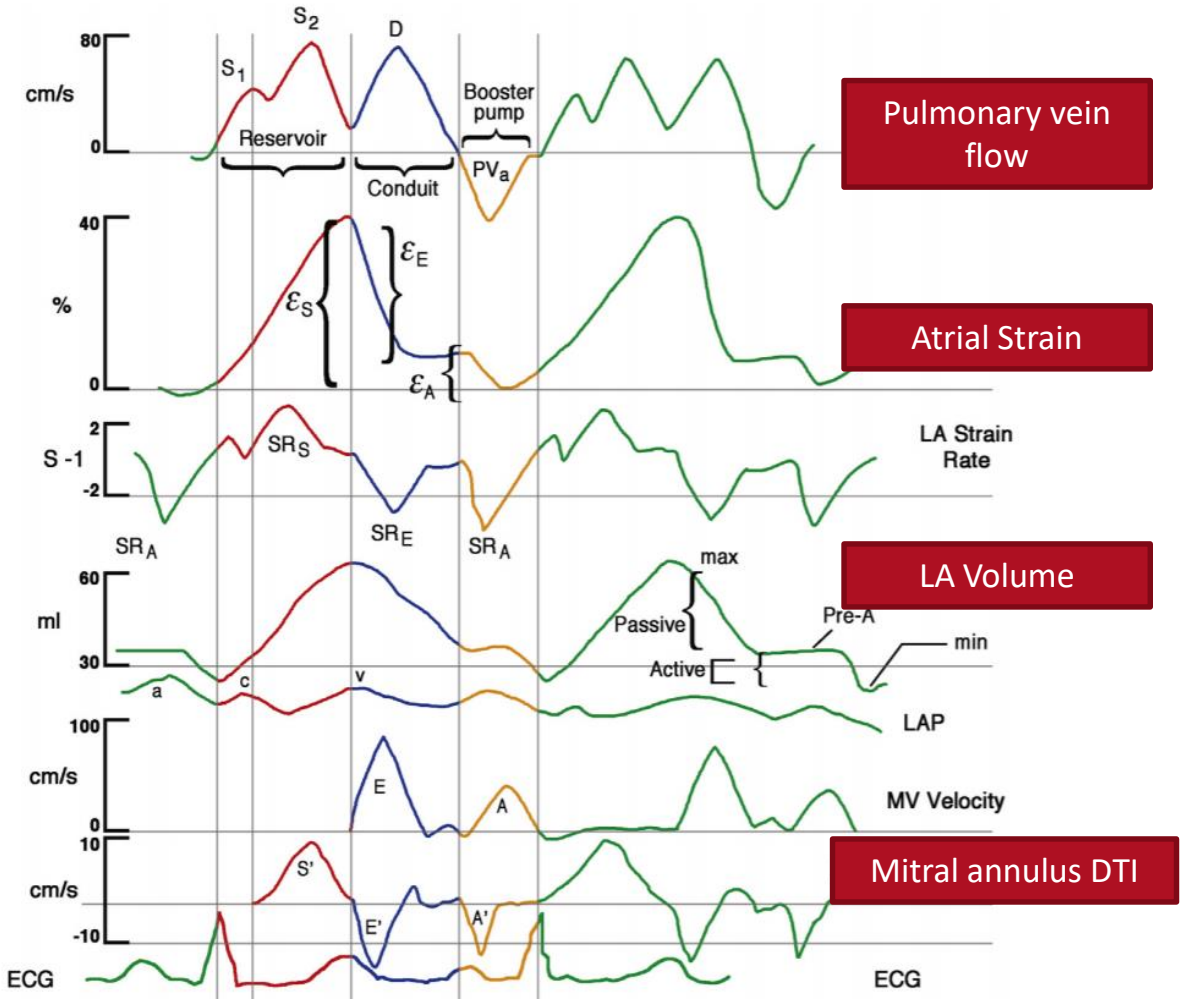
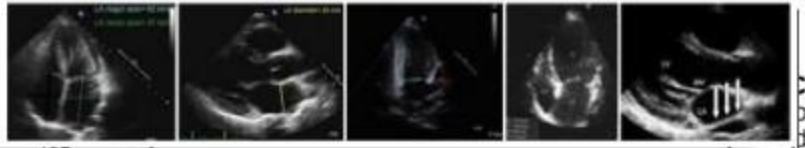
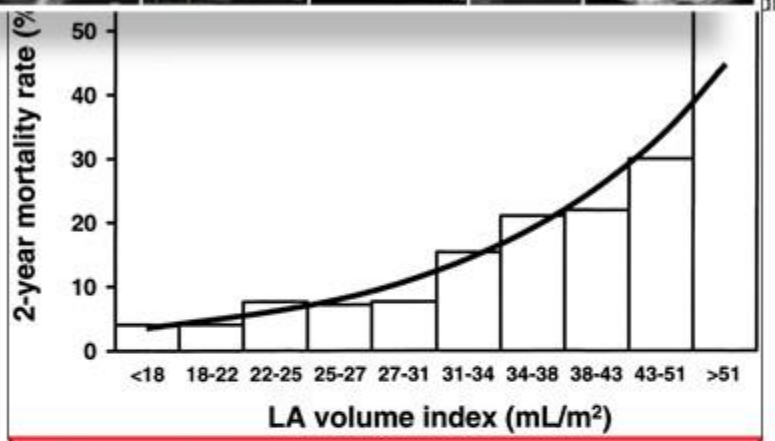


Hoit. J Am Coll Cardiol 2014;63:493–505

Relevance of LA volume



- Correlated to
- Death cardio-vascular & non-cardiovascular.
- Correlated to the risk of
  - Atrial arrhythmia and recurrence
  - Thromboembolic Complications



Cutt off values:

LA area> 18 cm²/m²

LA diameter > 16 mm/m²

the most important:

→ LA volume> 34 ml/m²

Moller et al. Circulation 2003; 107: 2207
Parkash et al. Am H J 2004; 148: 649.

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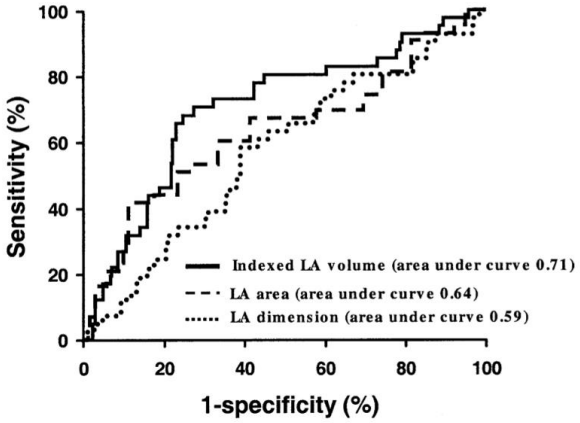
Relevance of LA volume

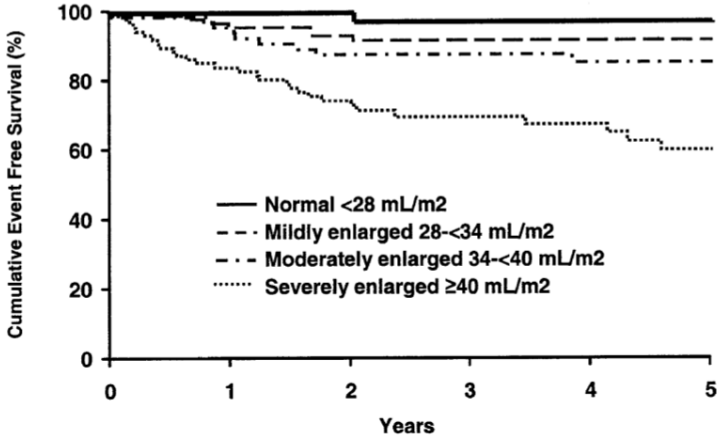
Prediction of Cardiovascular Outcomes With Left Atrial Size

Is Volume Superior to Area or Diameter?

Teresa S. M. Tsang, MD, FACC,*† Walter P. Abhayaratna, MBBS, FRACP,*† Marion E. Barnes, MS,†
Yoko Miyasaka, MD, PHD, FACC,*† Bernard J. Gersh, MB, CHB, DPHIL, FACC,*
Kent R. Bailey, PHD,‡ Stephen S. Cha, MS,‡ James B. Seward, MD, FACC*†
Rochester, Minnesota

317 subjects SR at baseline, 62 had 90 new events during a mean follow-up of 3.5 ±2.3 years





" graded association between the degree of LA enlargement and risk of CV-events was only evident for indexed LA volume."

J Am Coll Cardiol 2006; 47:1018–23

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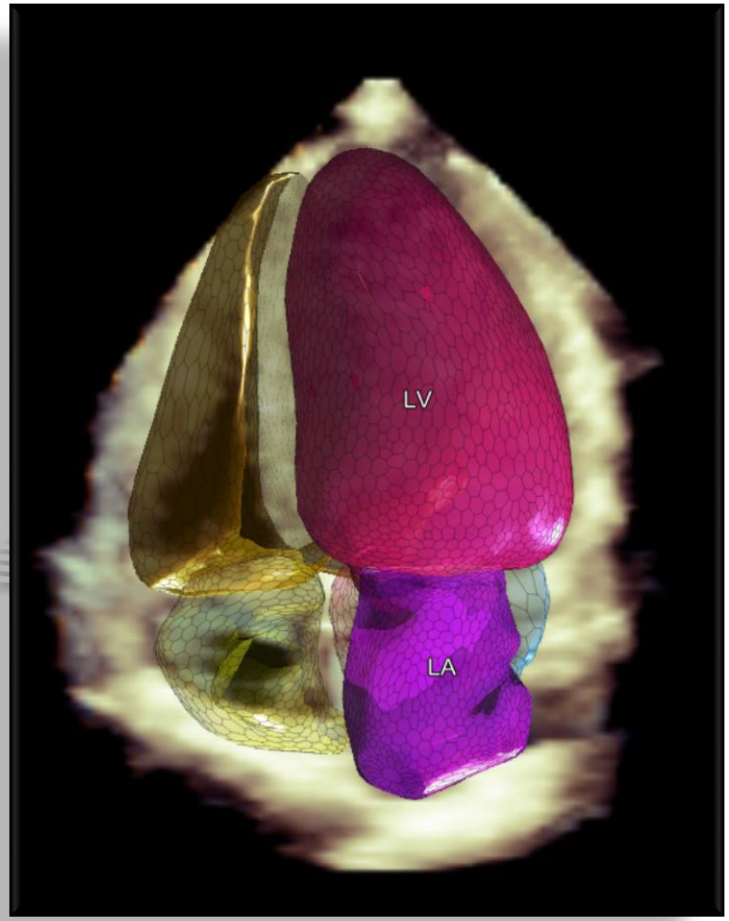

Importance of minimal volume & LA empying fraction: LA max- LA min/LA max

Structure
Versus
Function

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More sensitive and best associated with the prognosis: LA function

Reco (LANG et al. EurHJim 2016):
LA maximal volume (biplane) > 34ml/m²

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JACC: CARDIOVASCULAR IMAGING
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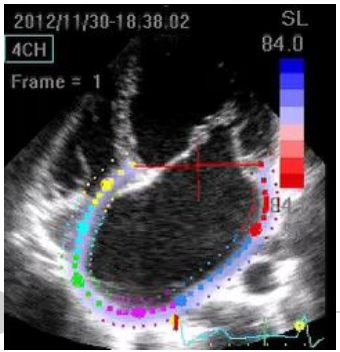
https://doi.org/10.1016/j.jcmg.2017.10.011

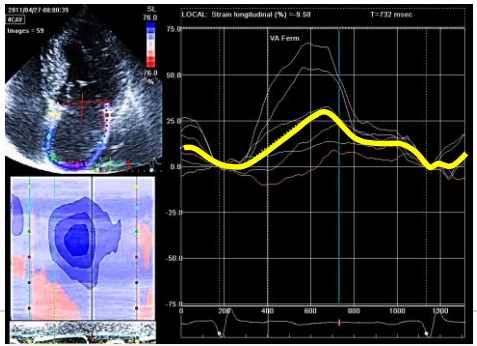
EDITORIAL COMMENT

Incremental Diagnostic Value of Left Atrial Strain Over Left Atrial Volume

An Analogy of Glucose Level and Glycosylated Hemoglobin?*

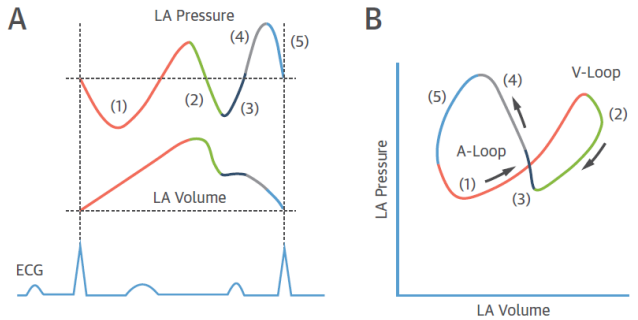
Kazuaki Negishi, MD, PHD[a,b]





QRS T P

FIGURE 1 Left Atrial Pressure-Volume Relationship



(1) Atrial filling, (2) Passive emptying, (3) Diastasis, (4) Active emptying, (5) Atrial relaxation

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Speaker

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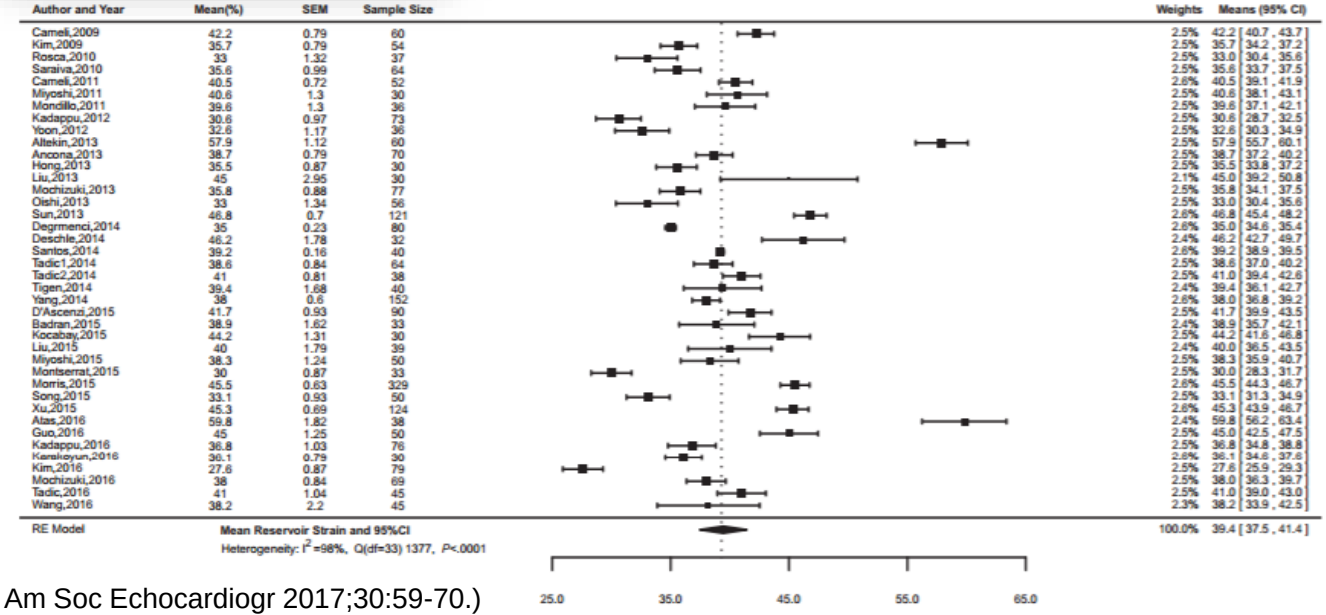
Table 2 Summary of normal ranges of LA strain components

LA strain component	Number of studies	Mean	95% CI	Cochrane Q	I^2	τ^2
Reservoir	40	39.4	38.0–40.8	1,653 ($P < .001$)	97.6	20.0
Conduit	14	23.0	20.7–25.2	420 ($P < .001$)	96.9	17.9
Contractile	18	17.4	16.0–19.0	631 ($P < .001$)	97.3	9.7

Normal Ranges of Left Atrial Strain by Speckle-Tracking Echocardiography: A Systematic Review and Meta-Analysis

Faraz Pathan, MBBS, Nicholas D'Elia, BSc, Mark T. Nolan, MBBS, Thomas H. Marwick, MBBS, PhD, MPH, and Kazuaki Negishi, MD, PhD, *Hobart and Melbourne, Australia*

Reservior Function



(J Am Soc Echocardiogr 2017;30:59-70.)

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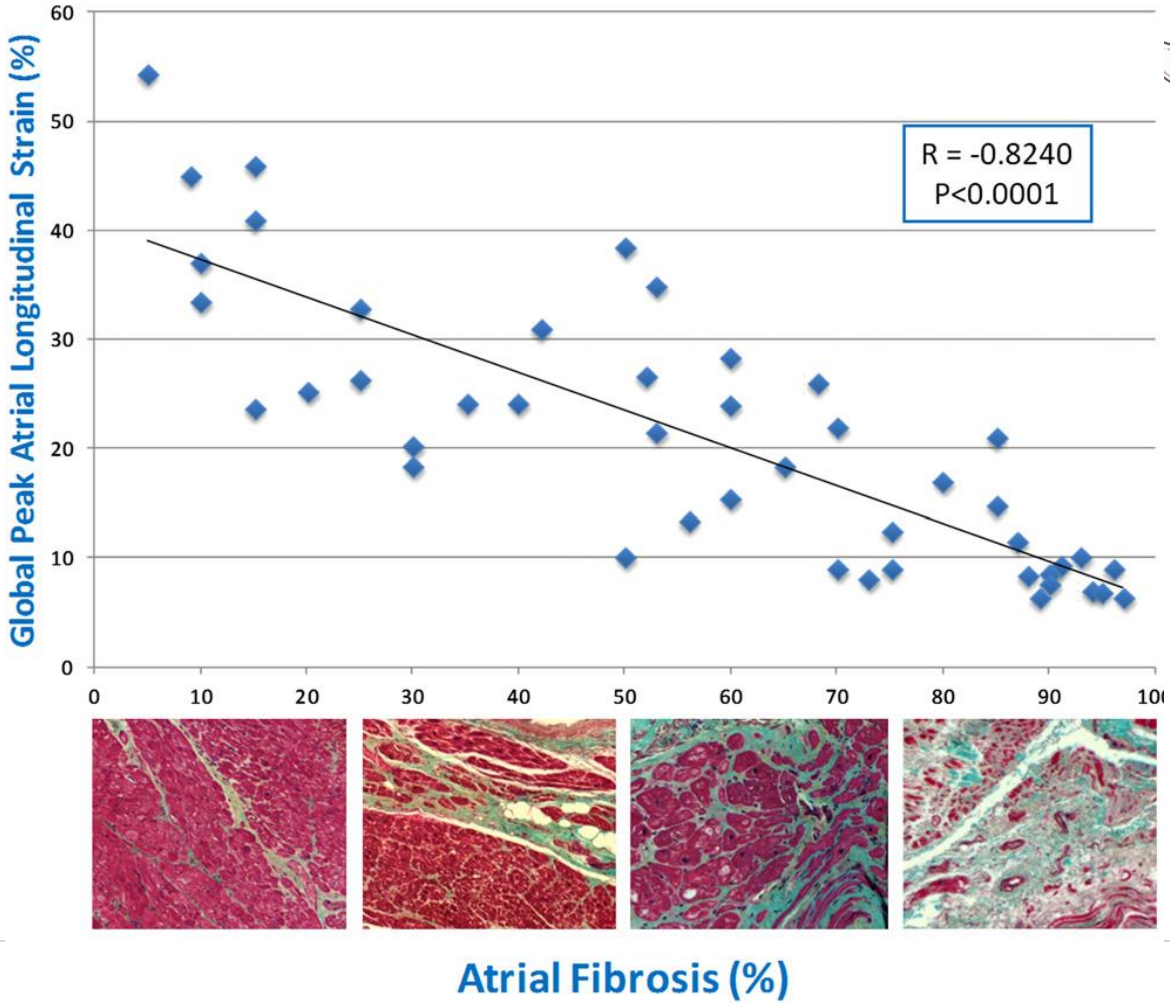
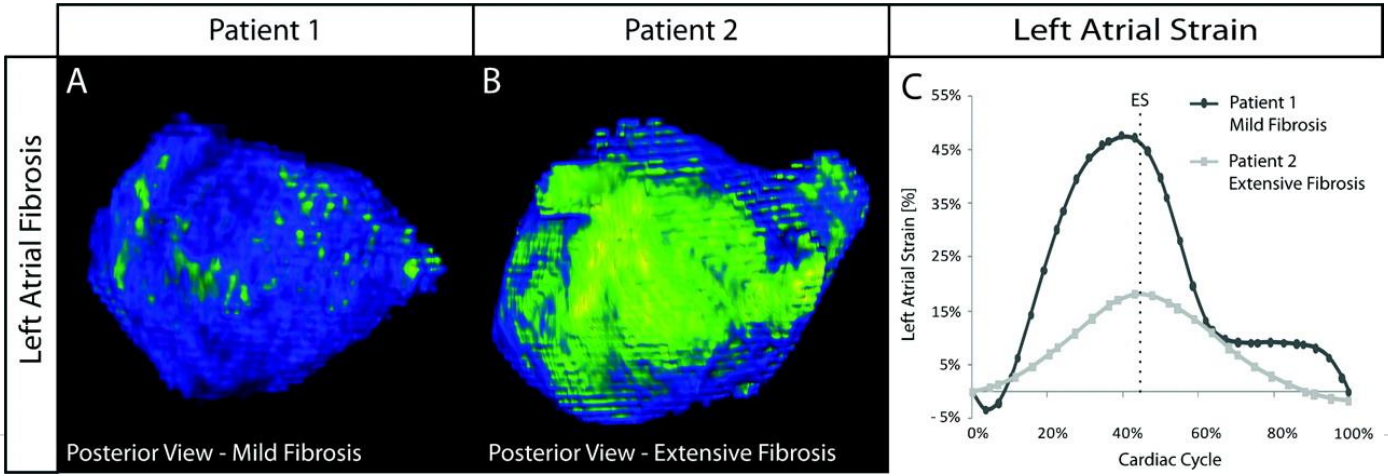


Camelli et al. Am J cardiol 2013

Left Atrial Strain and Strain Rate in Patients With Paroxysmal and Persistent Atrial Fibrillation

Relationship to Left Atrial Structural Remodeling Detected by Delayed-Enhancement MRI

Conclusions—LA wall fibrosis by delayed-enhancement MRI is inversely related to LA strain and strain rate, and these are related to the AF burden. Echocardiographic assessment of LA structural and functional remodeling is quick and feasible and may be helpful in predicting outcomes in AF. (***Circ Cardiovasc Imaging*. 2010;3:231-239.**)



Kuppahally S S et al. Circ Cardiovasc Imaging. 2010;3:231-239

ESC European Society of Cardiology

European Heart Journal - Cardiovascular Imaging (2017) **0**, 1–9
doi:10.1093/ehjci/jex225

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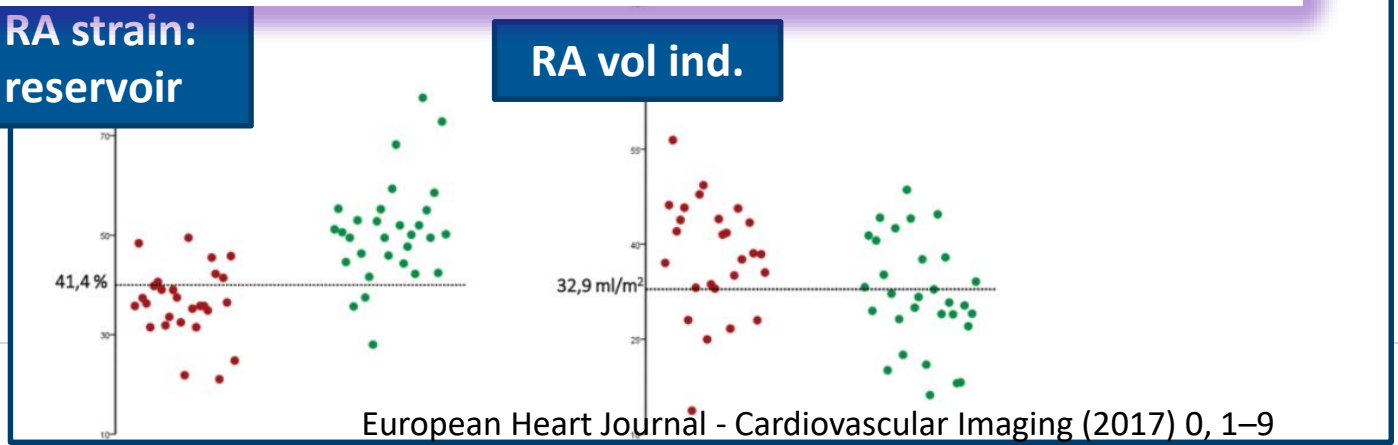
Atrial function is altered in lone paroxysmal atrial fibrillation in male endurance veteran athletes

Arnaud Hubert[1,2,3], Vincent Galand[1,2,3], Erwan Donal[1,2,3], Dominique Pavin[1,2,3], Elena Galli[1,2,3], Raphaël P. Martins[1,2,3], Christophe Leclercq[1,2,3], François Carré[2,3,4], and Frédéric Schnell[2,3,4]*

RA strain: reservoir

RA vol ind.



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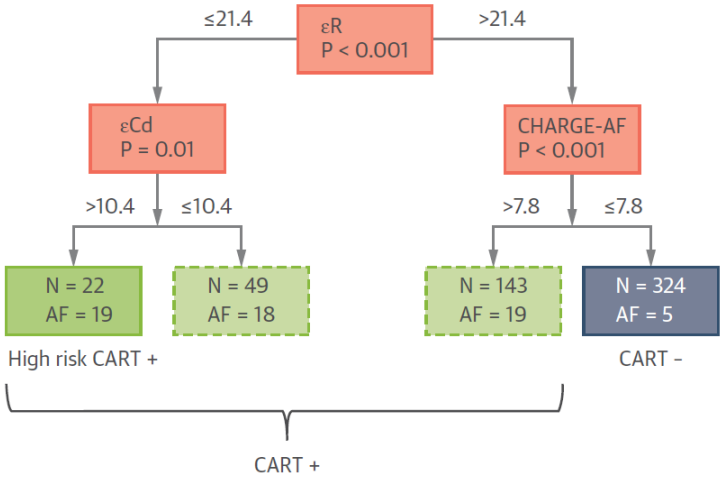
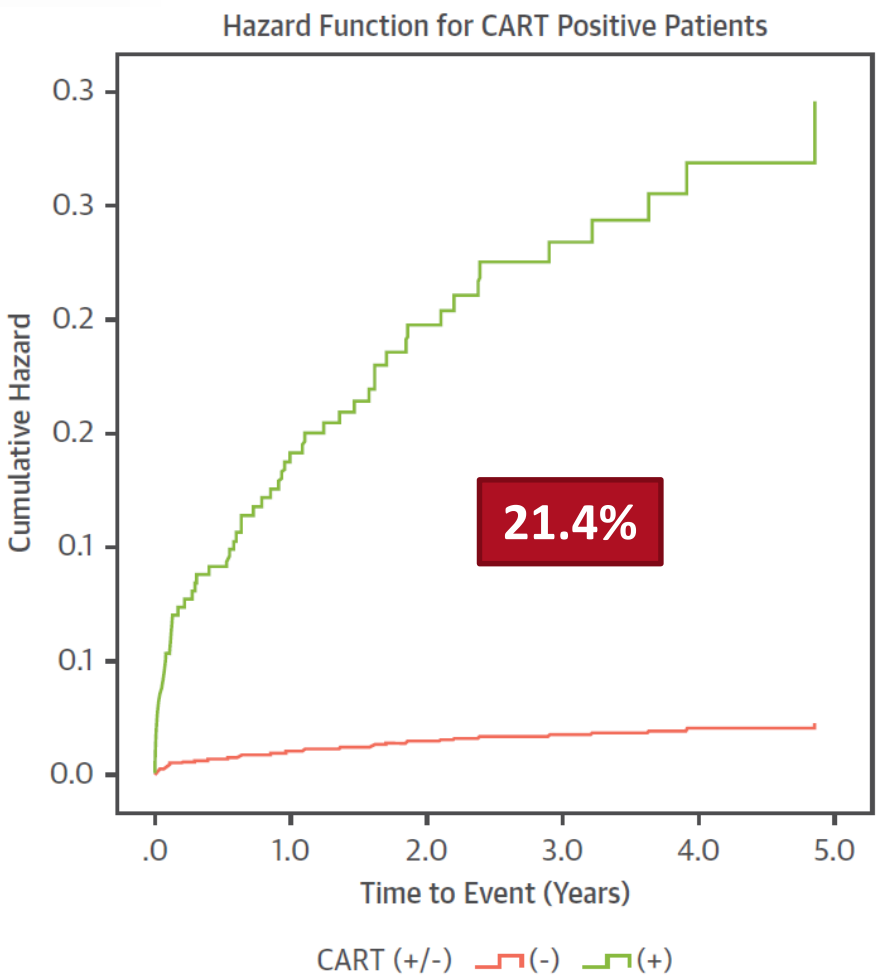
Use of Atrial Strain to Predict Atrial Fibrillation After Cerebral Ischemia

Faraz Pathan, MBBS,[a,b] Eswar Sivaraj, MSc,[b] Kazuaki Negishi, MD, PhD,[a,b] Rifly Rafiudeen, Shahab Pathan, MBBS,[c] Nicholas D'Elia, MBBS,[d,e] John Galligan, MBBS,[b] Samuel Neilson, M Ricardo Fonseca, MBBS,[a] Thomas H. Marwick, MBBS, PhD, MPH[a,d]

538 patients, 61 (11%) developed AF, and this occurred within 2 years in 85% of patients. Patients who developed AF were older, had higher clinical risk scores, had higher LA volume, and had lower atrial strain than did those who did not develop AF.

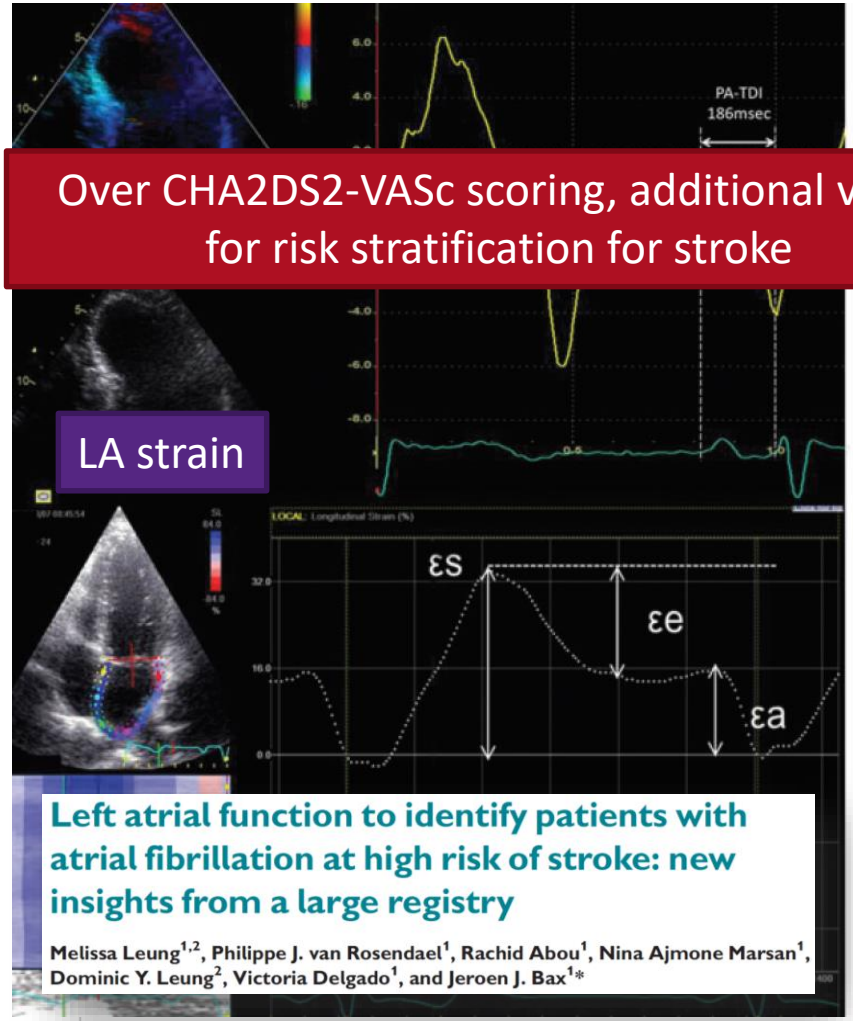
FIGURE 4 CART Analysis





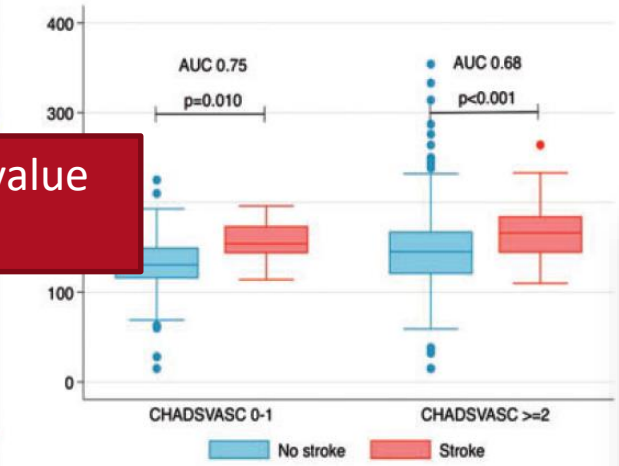
JACCim 2017

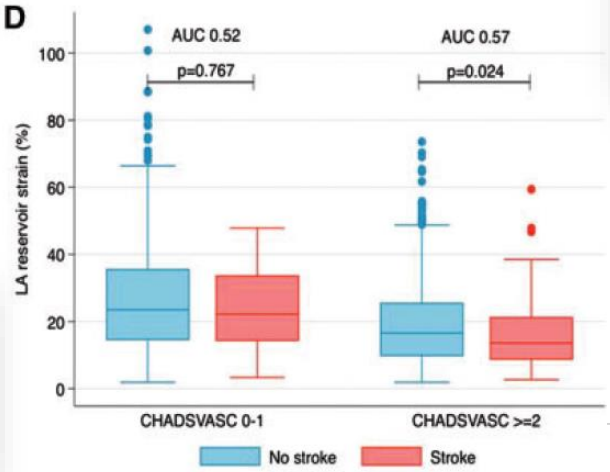
Over CHA2DS2-VASc scoring, additional value for risk stratification for stroke



Left atrial function to identify patients with atrial fibrillation at high risk of stroke: new insights from a large registry

Melissa Leung[1,2], Philippe J. van Rosendael[1], Rachid Abou[1], Nina Ajmone Marsan[1], Dominic Y. Leung[2], Victoria Delgado[1], and Jeroen J. Bax[1]*





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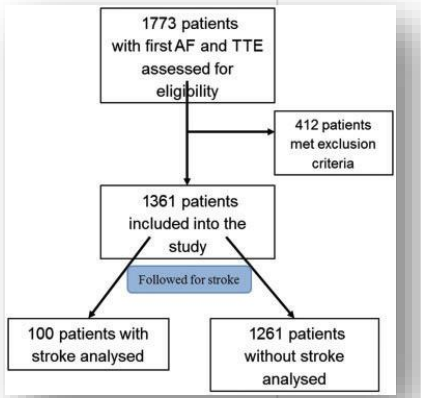

Median follow-up 7.9 years

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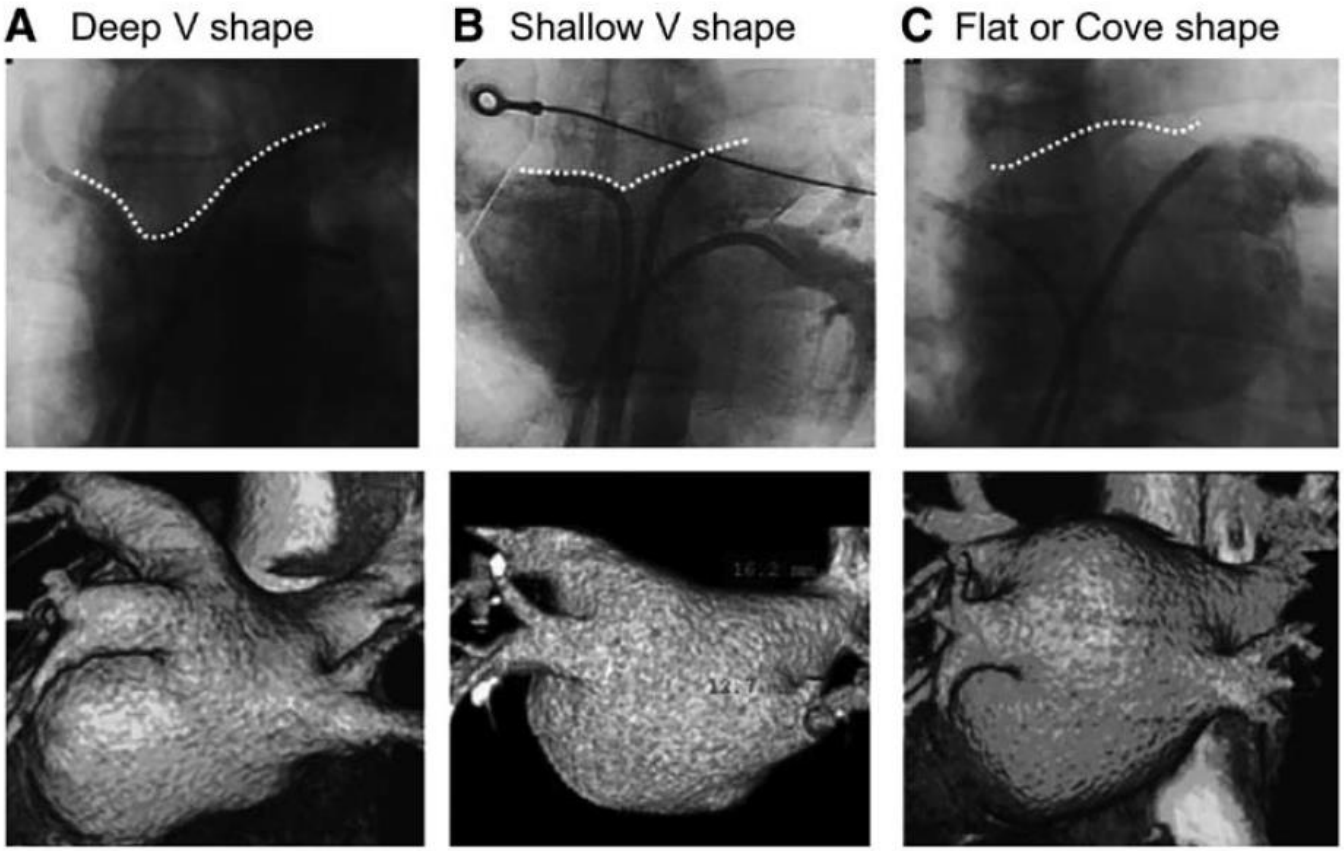
European Heart Journal (2018) 39, 1416–1



LA roof shape assessed by CT imaging (deep-V, shallow-V, or flat) can help determine the possible sites of AF triggers, as triggers from the PVs become less common as the LA roof shape flatten

Take home message: importance of the anatomy but perhaps even more of the function(s)

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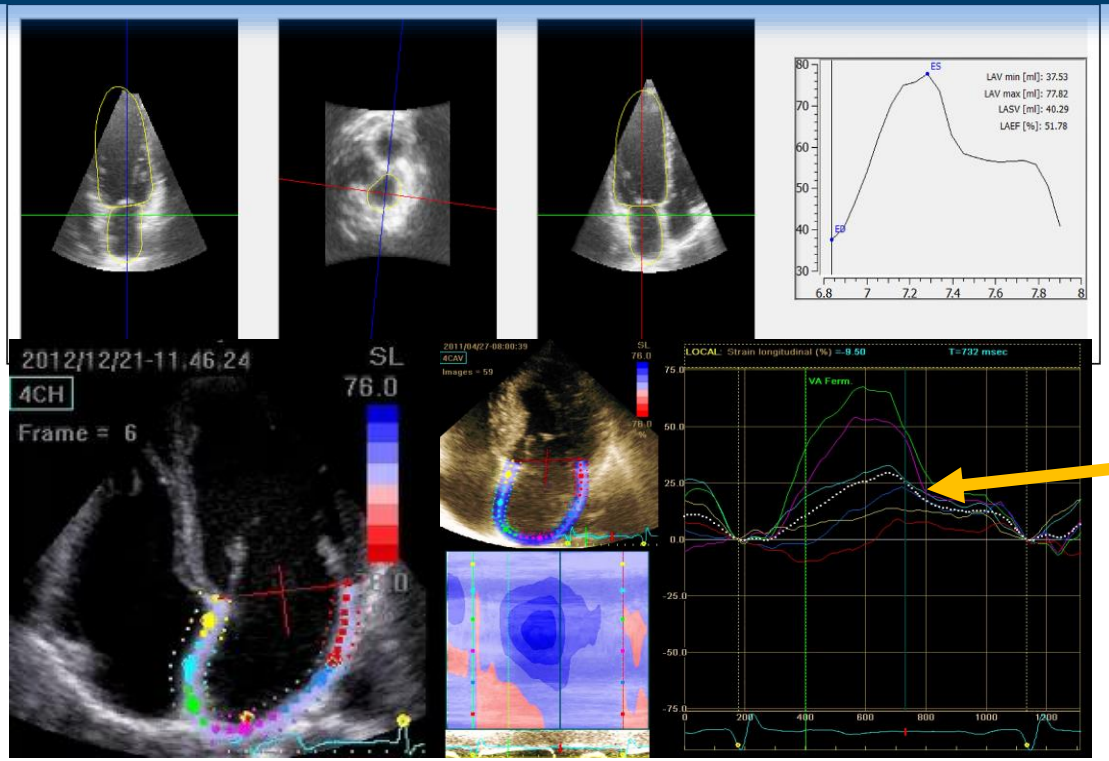

Indexed LA volume (at end-systole): 34ml/m²

Systolic peak: (reservoir)
N 40%
Clearly abnormal ≤ 20%
Prognostic value ~ 20%

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European Heart Journal - Cardiovascular Imaging (2017) 18, 730–731

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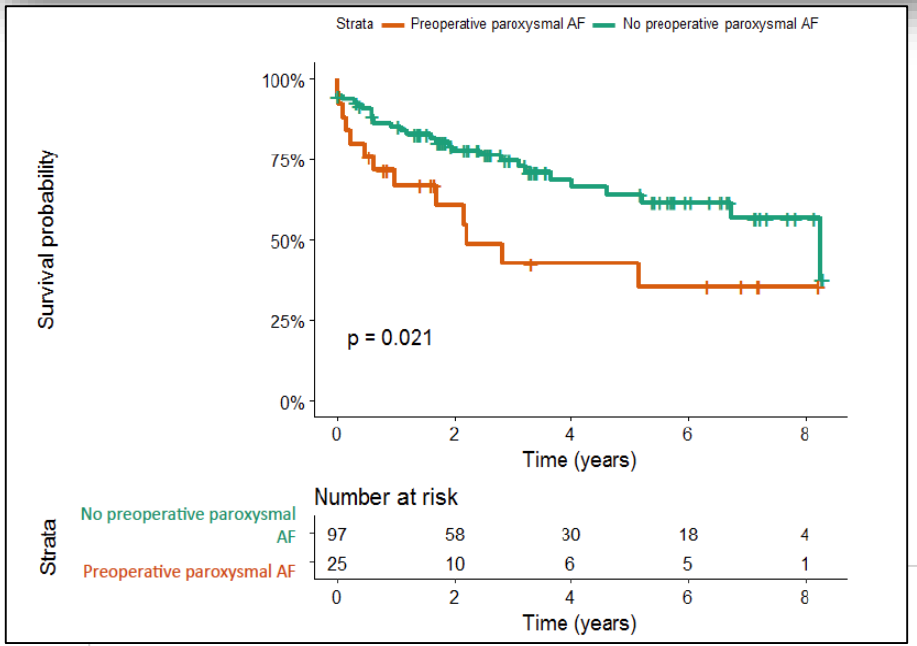
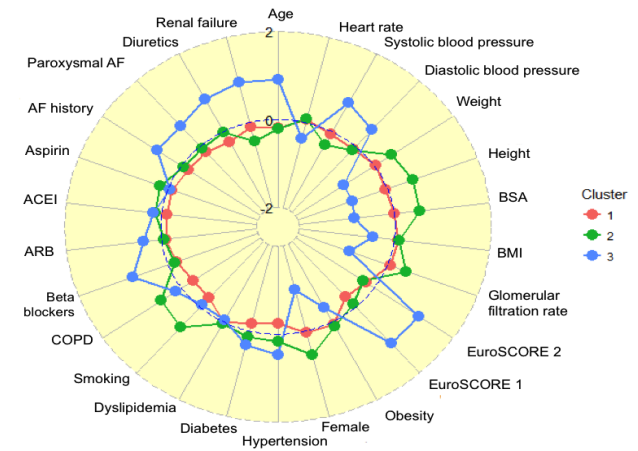
European Heart Journal - Cardiovascular Imaging (2018) **0**, 1–8
doi:10.1093/ehjci/jey049

Predictors of post-operative cardiovascular events, focused on atrial fibrillation, after valve surgery for primary mitral regurgitation

Anna Pimor, Elena Galli, Emilie Vitel, Hervé Corbineau, Christophe Leclercq, Guillaume Bouzille, and Erwan Donal*





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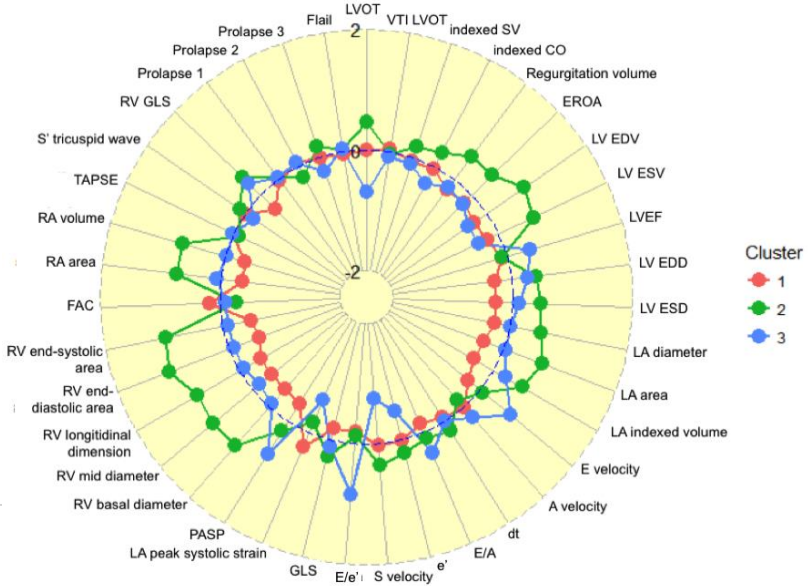

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European Association of Cardiovascular Imaging

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Milan, ITALY

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Valvular Heart Disease

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Call for abstracts & clinical cases
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Early registration
30 September

Late registration
31 October

ESC

It is not the size of a man, but the size of his heart that matters.
—Evander Holyfield

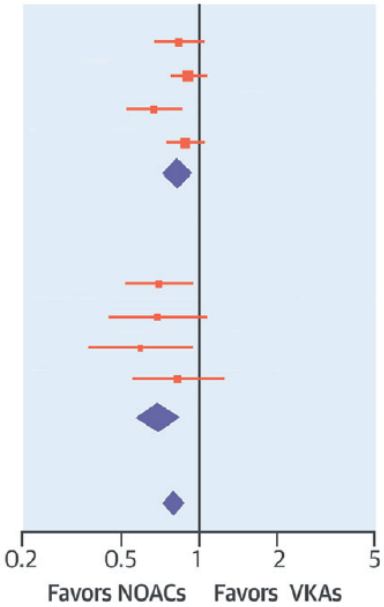
Non–Vitamin K Antagonist Oral Anticoagulants in Patients With Atrial Fibrillation and Valvular Heart Disease

Giulia Renda, MD, PhD,[a] Fabrizio Ricci, MD,[a] Robert P. Giugliano, MD, SM,[b] Raffaele De Caterina, MD, PhD[a]

EACVI
European Association of Cardiovascular Imaging

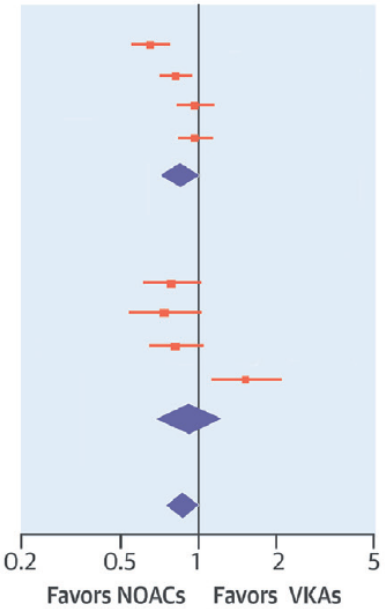
Stroke/SEE

Study or Subgroup	Risk Ratio IV, Random, 95% CI
NO VHD	
ARISTOTLE	
ENGAGE AF-TIMI 48 (Higher Dose)	
RE-LY (Higher Dose)	
ROCKET AF	
Subtotal RR (95% CI)=0.84 (0.75-0.95)	
VHD	
ARISTOTLE	
ENGAGE AF-TIMI 48 (Higher Dose)	
RE-LY (Higher Dose)	
ROCKET AF	
Subtotal RR (95% CI)=0.70 (0.58-0.86)	
Total (95% CI) RR=0.81 (0.73-0.89)	



Major Bleeding

Study or Subgroup	Risk Ratio IV, Random, 95% CI
NO VHD	
ARISTOTLE	
ENGAGE AF-TIMI 48 (Higher Dose)	
RE-LY (Higher Dose)	
ROCKET AF	
Subtotal RR (95% CI)=0.85 (0.70-1.02)	
VHD	
ARISTOTLE	
ENGAGE AF-TIMI 48 (Higher Dose)	
RE-LY (Higher Dose)	
ROCKET AF	
Subtotal RR (95% CI)=0.93 (0.68-1.27)	
Total (95% CI) RR=0.88 (0.75-1.02)	



Renda, G. et al. J Am Coll Cardiol. 2017;69(11):1363-71.