

Joint Coronary Revascularization 2018

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**COMPUTATIONAL FLUID DYNAMIC
ANALYSIS OF RIGHT AND LEFT ATRIA
IN PATENT FORAMEN OVALE :
POTENTIAL LINKS WITH ATRIAL
FIBRILLATION**

**...TOO MUCH
IMMAGINATION?**

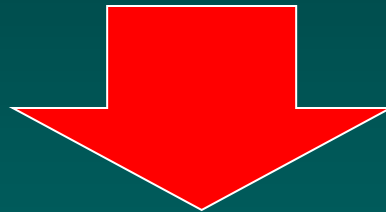




CFD STUDY

MODEL RECONSTRUCTION

The geometrical model of the right atrium (RA), left atrium (LA), left atrial appendage (LAA) and PFO based on TEE and MRi

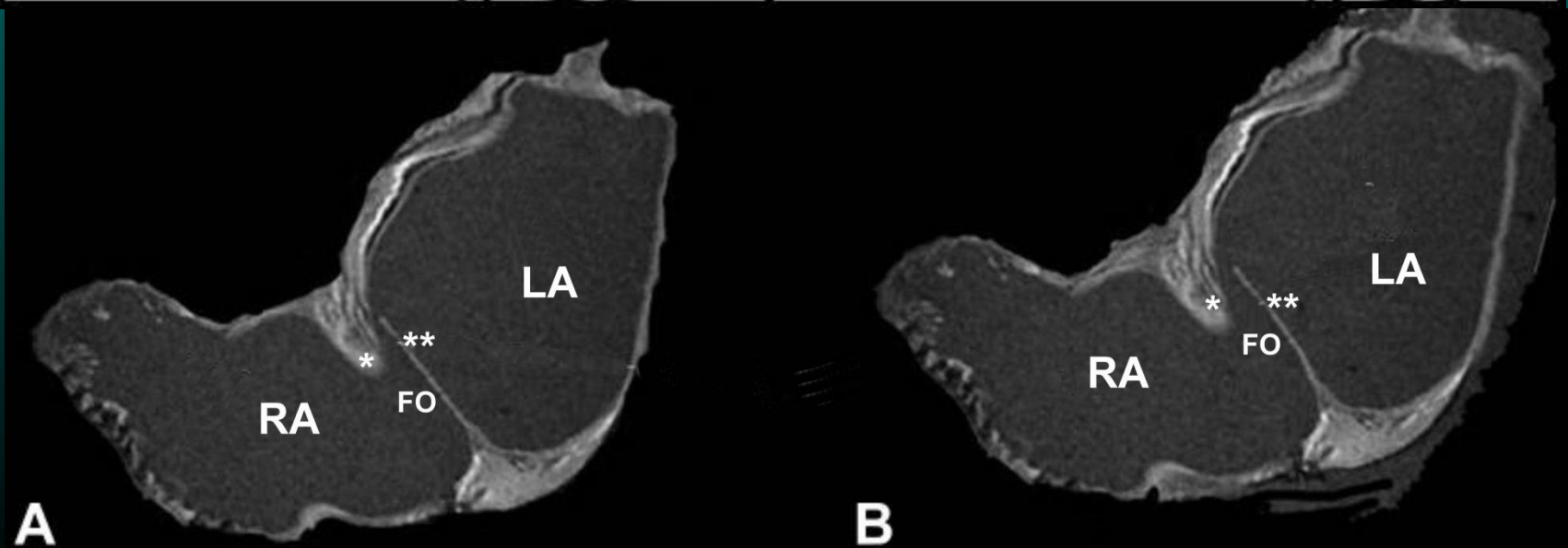
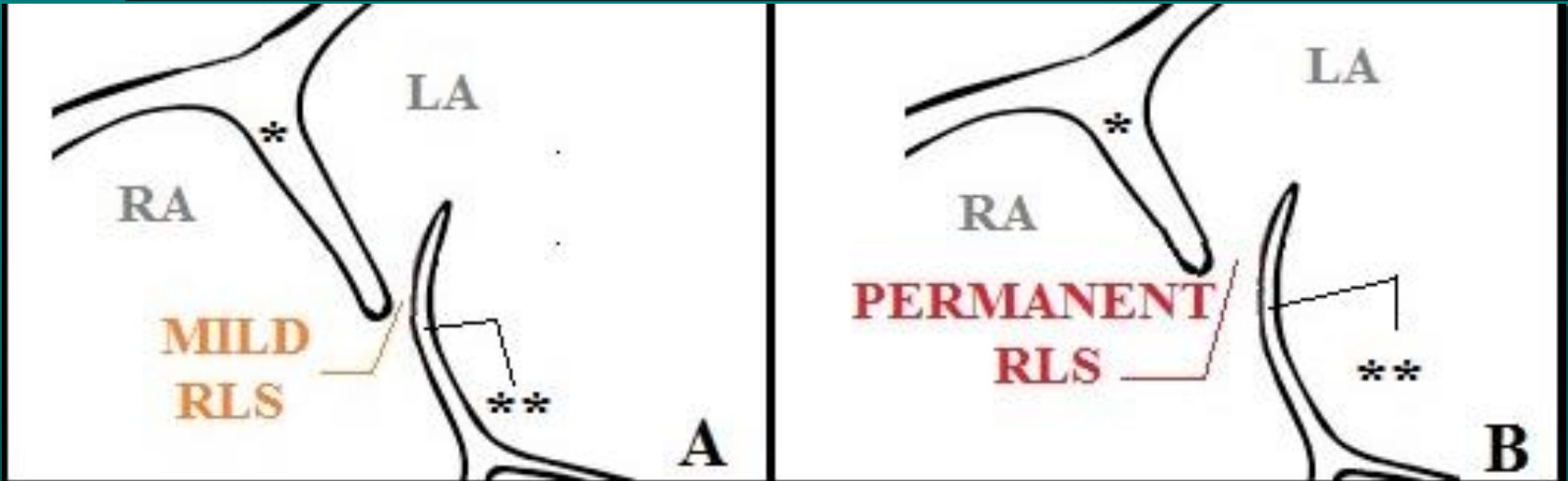


A) 36 normotensive otherwise healthy patients with mild (mean age 45.5 ± 6.8 years, 24 females) RLS

B) 29 patients with permanent RLS (mean age 45.1 ± 5.3 years, 21 females)



CFD STUDY



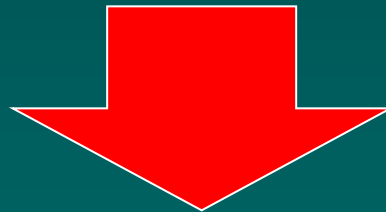


CFD STUDY

CONSIDERED PARAMETERS

VORTICITY MAGNITUDE (1/s)

the magnitude of the vorticity vector while vorticity could be defined as a measure of the rotation of a fluid element as it moves in the domain, defined as the curl of the vector:



A low value of vorticity magnitude could be interpreted as a reduction or even absence of atrial contraction and as consequence, an index of relative blood stagnation.



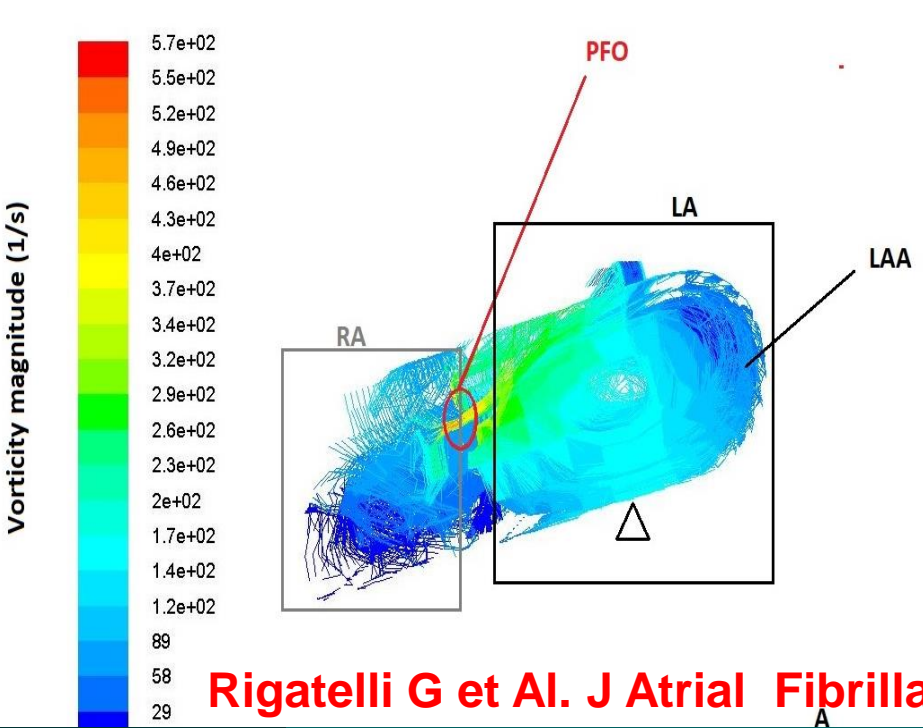
RESULTS 1

	LA			LAA		
	Mild RLS	Permanent RLS	p	Mild RLS	Permanent RLS	p
Vorticity Magnitude (1/s)	101.12±21.3	88.3±22.6	0.02	62±14.	32.4±12.3	<0.01

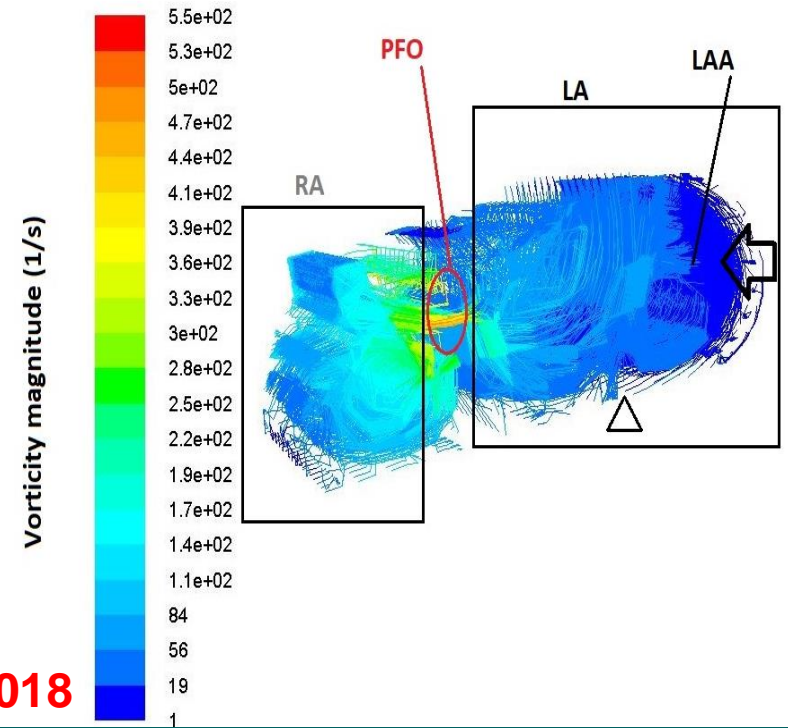


RESULTS 2

MILD RLS



PERMANENT RLS



Rigatelli G et Al. J Atrial Fibrillation 2018

MUCH BLOOD FLOW STAGNATION AND INCREASING IN STATIC ENERGY

LA CHAMBER ENLARGEMENT

LA CARDIOPATHY



ARE THERE CLINICAL PROOF?

JACC: CARDIOVASCULAR INTERVENTIONS

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Left Atrial Dysfunction in Patients With Patent Foramen Ovale and Atrial Septal Aneurysm

An Alternative Concurrent Mechanism for Arterial Embolism?

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FOCUS ISSUE: STRUCTURAL HEART DISEASE

Clinical Research

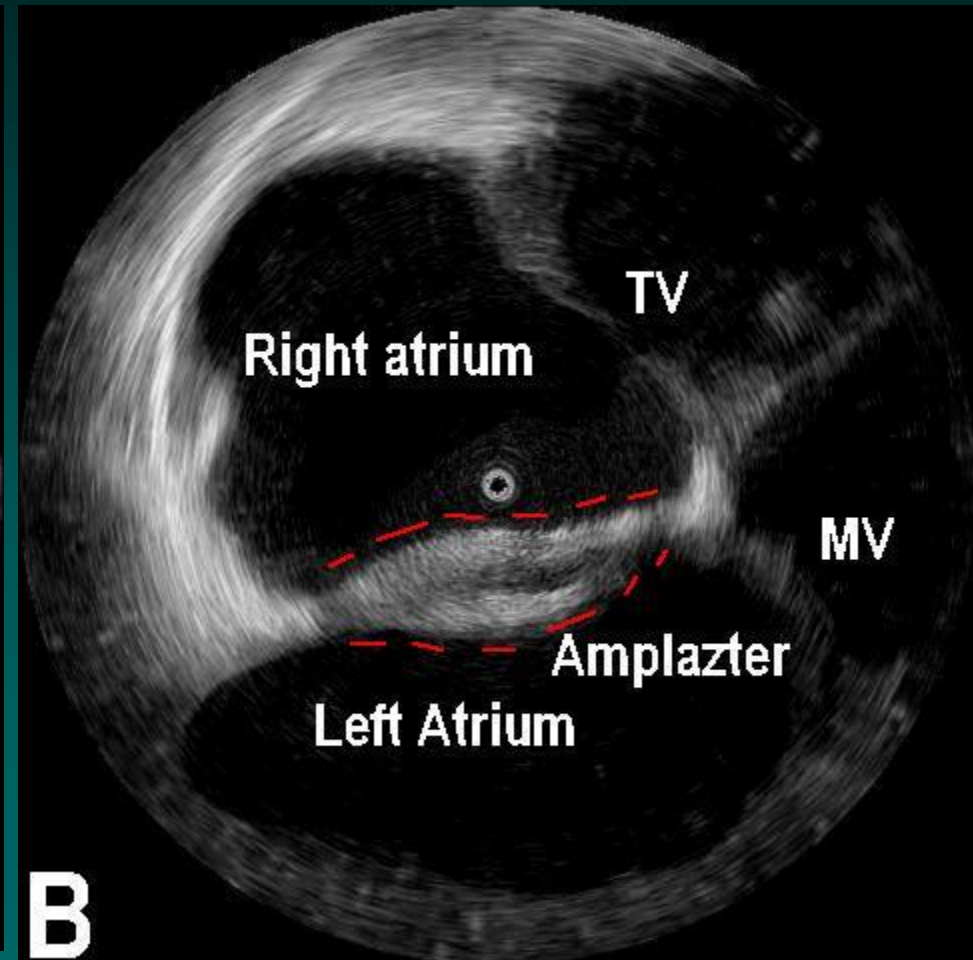
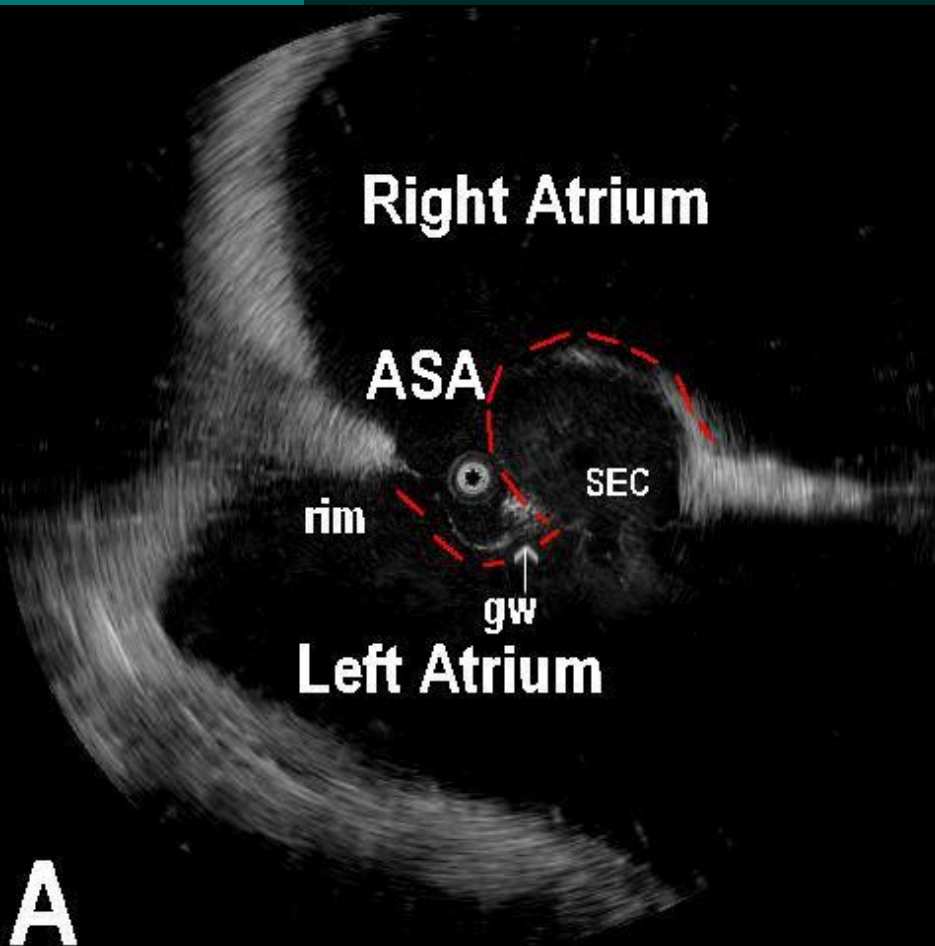
Permanent Right-to-Left Shunt Is the Key Factor in Managing Patent Foramen Ovale

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ARE THERE CLINICAL PROOF?

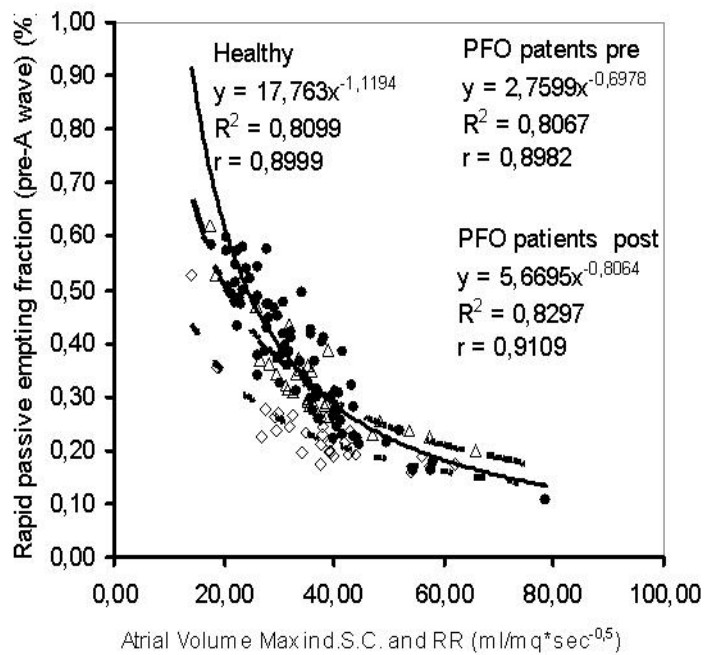


• In Situ microembolic formation hypothesis



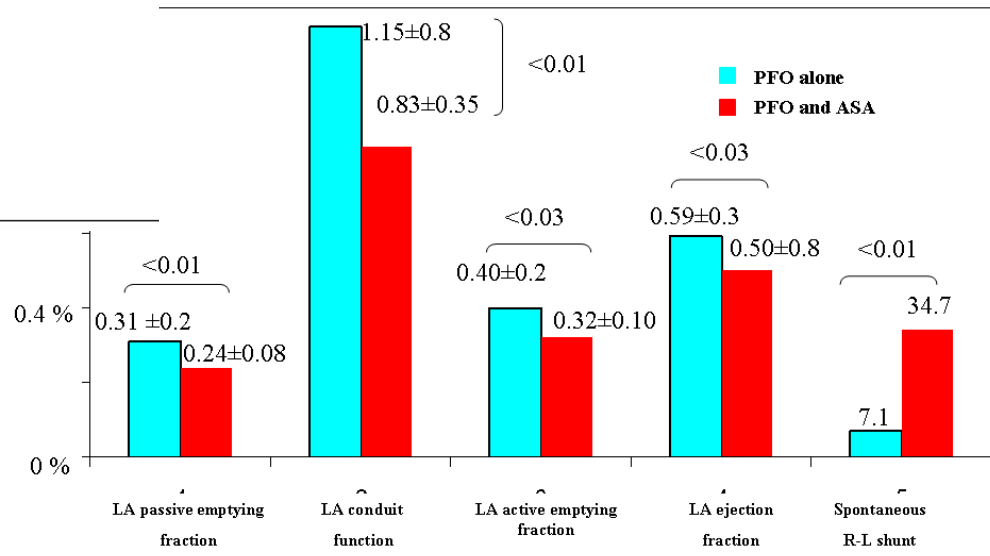
ARE THERE CLINICAL PROOF?

• Reservoir, conduit, active and passive emptying and EF of left atrium of patients with large PFO and ASA are impaired compared to healthy



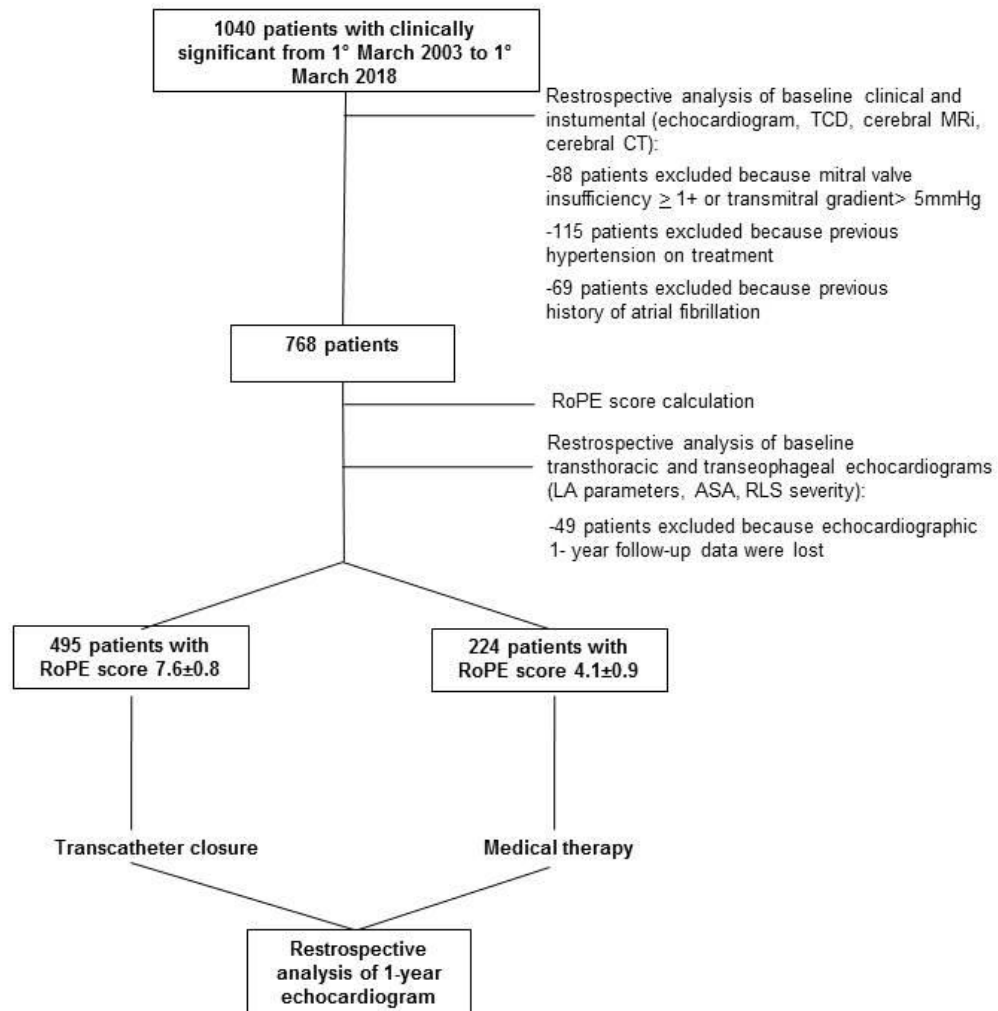
- Healthy subjects
- ◇ PFO patients pre
- △ PFO patients post
- Healthy subjects
- - PFO patients pre
- PFO patients post

Patients with large PFO and ASA had more events and much more dysfunction than PFO alone patients





....TEH DEFINITIVE PROOF..



Paper submitted



LA ENLARGMENT AND PFO

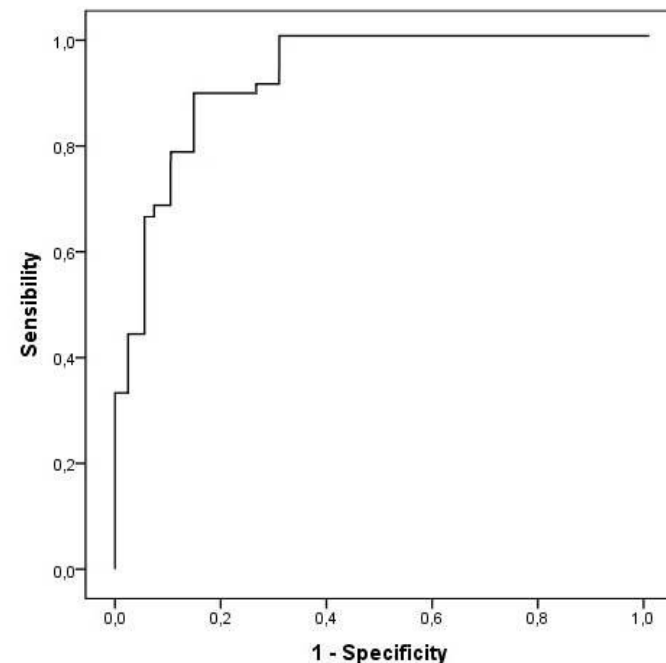
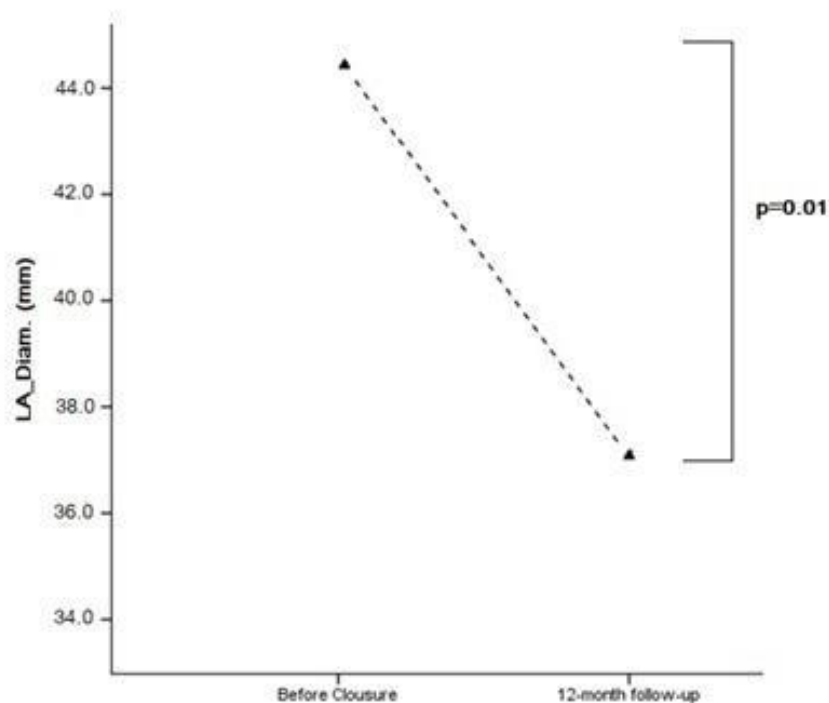
Clinical variables	LA diameter (Mean \pm SD)	p
RLS		
-Curtain	46.2 \pm 3.4	0.001
-Shower	44.3 \pm 3.6	
-Valsalva	47.5 \pm 4.9	<0.0001
-Permanent	41.8 \pm 3.3	
ASA		
-yes	47.3 \pm 2.6	<0.0001
-no	42.2 \pm 3.3	
Brain Rmi		
-Multiple lesion	49.4 \pm 2.2	<0.0001
-No lesion	41.3 \pm 2.9	

Outcome: RoPE > 7	β	Wald	sig	OR	95% CI
Valsalva RLS	1.80	12.7	<0.0001	3.0 2	2.84- 3.51
Permanent RLS	1.77	40.10	<0.0001	3.2 6	3.02- 4.34
ASA*	1.69	27.33	0.001	5.0 4	2.64- 6.28
LA diameter >43	0.71	6.69	<0.0001	2.7 8	2.46- 3.06
Outcome: Curtain vs	β	Wald	sig	OR	95% CI
Shower RLS					
RoPE >7	1.94	24.3	<0.0001	4.2 1	3.54- 4.92
ASA*	1.77	10.1	0.001	2.1 6	1.92- 3.26
LA diameter >43	1.96	25.9	<0.0001	4.5 2	4.11- 4.98

DIAMETRO DELL'ATRIO SX >43 CORRELA CON ENTITA' DELLO SHUNT, SHUNT PERMANENTE, RoPE SCORE, NUMERO LESIONI CEREBRALI



LA ENLARGEMNT BEFORE AND AFTER PFO CLOSURE



DIAMETRO DELL'ATRIO SX >43 TENDE ALLA NORMALIZZAZIONE AD UN ANNO DOPO CHIUSURA MECCANICA:MARKER DI CARDIOPATIA ATRIALE SX





CONCLUSIONS

✓ IT WOULD BE LIKELY THAT A LA CARDIOPATHY RATHER THAN PARADOXICAL EMBOLISM IS AT THE BASIS OF SYMPTOMS IN PFO PATIENTS

✓ THE MECHANISM MIGHT BE AN IN SITU THROMBOSIS

✓ TRANSCATHETER PFO CLOSURE SEEMS TO REVERSE THE CARDIOPATHY AND THIS ALSO MIGHT EXPLAIN WHY RATE OF AF AND RECURRENCE ARE SO LOW IN DEVICE CLOSURE PATIENTS