Rol de la onda refleja en el descoplamiento ventrículo arterial y la falla cardíaca

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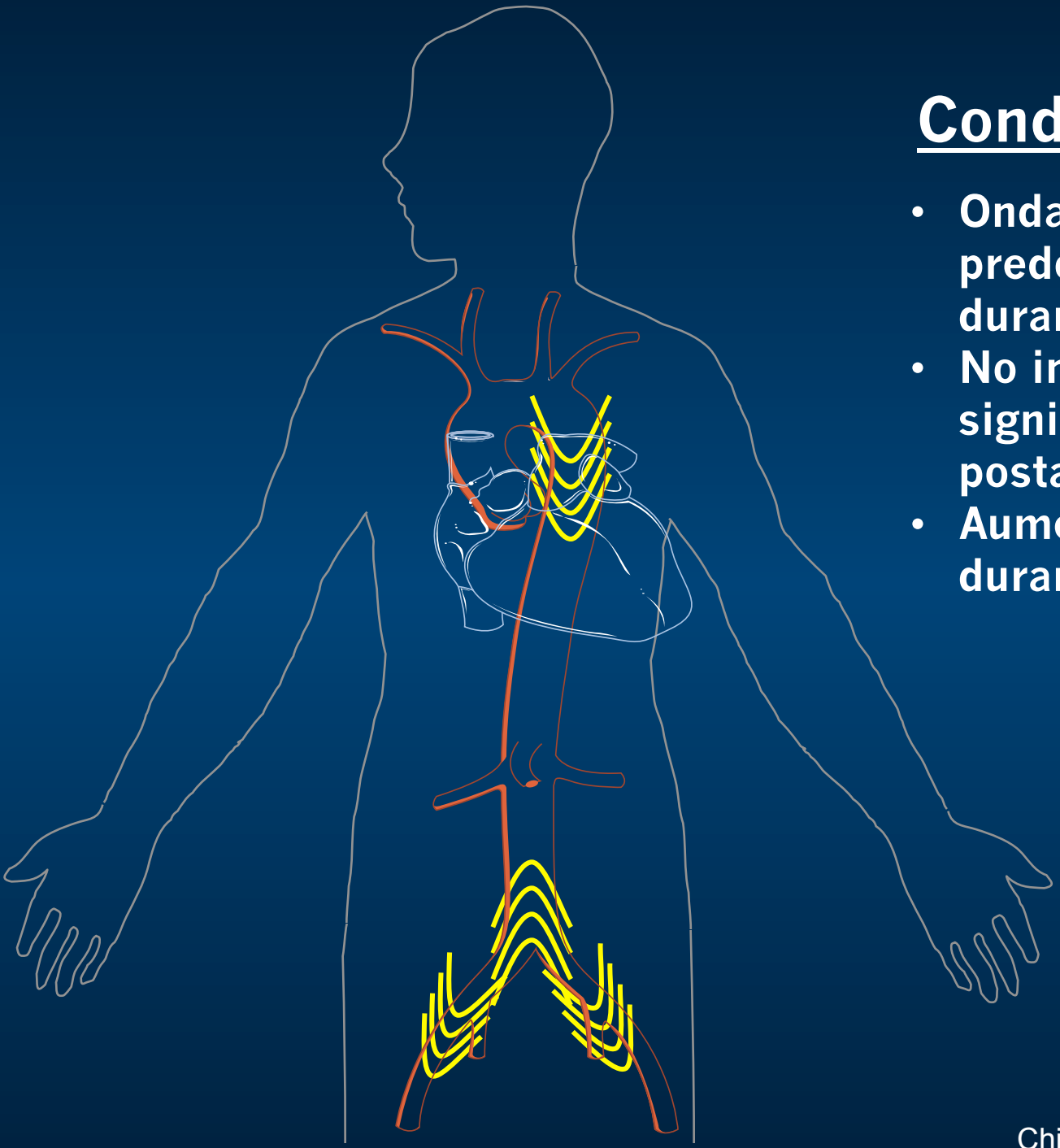
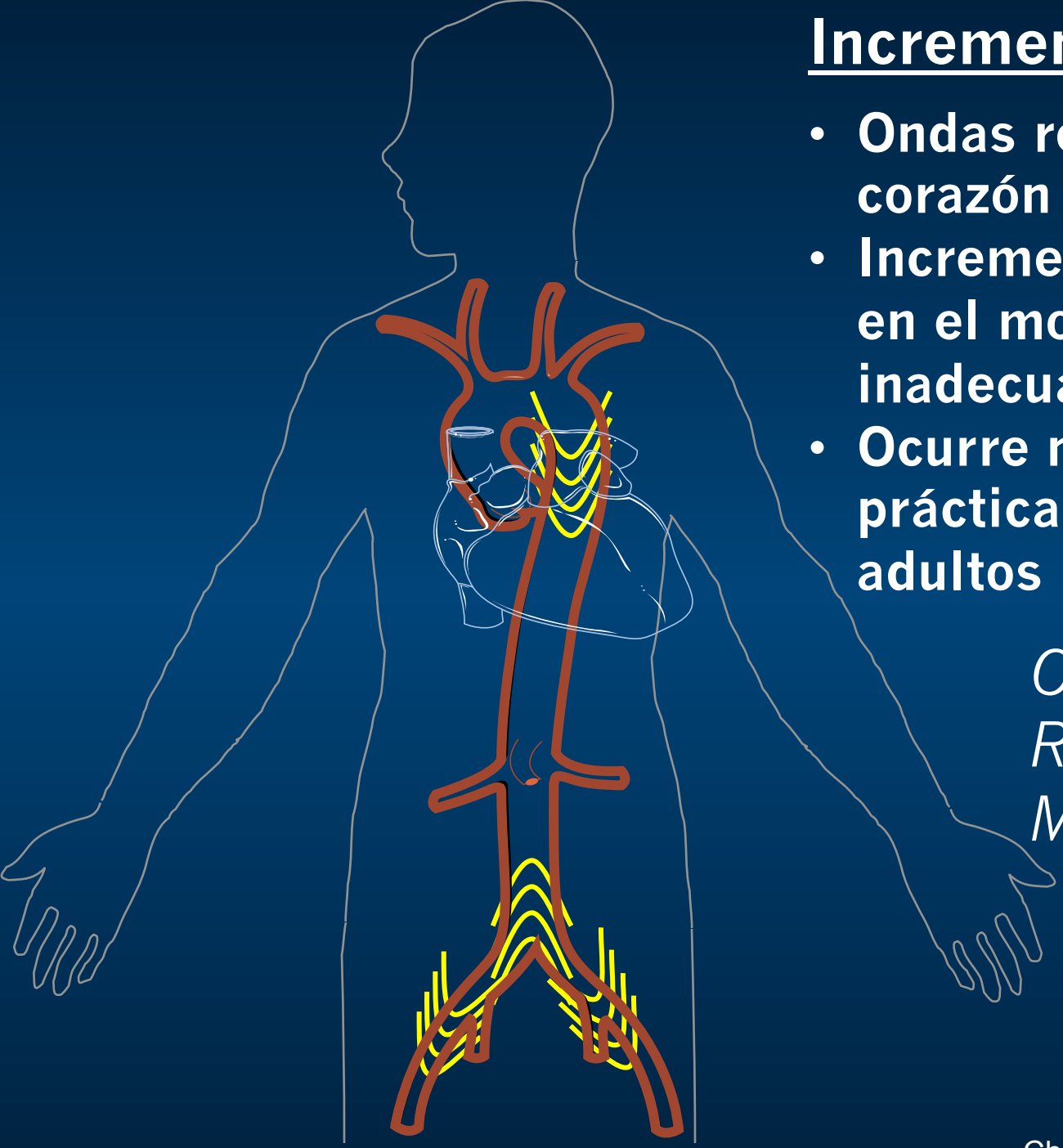


Condiciones ideales

- Ondas reflejas retornan predominantemente durante la diástole
- No incrementan significativamente la postarga
- Aumentan la presión durante la diástole

Chirinos JA. UCA, Buenos Aires, 2016.

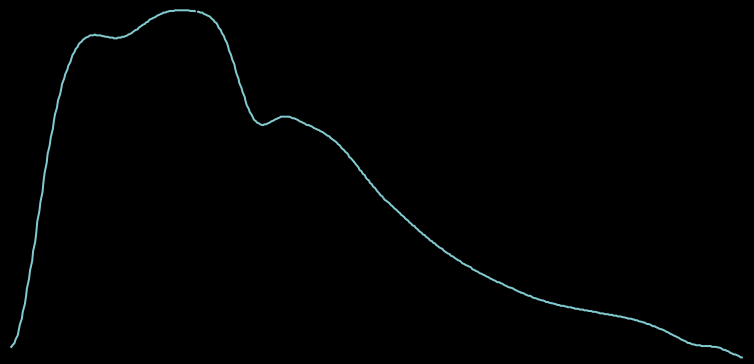


Incremento de la VOPA

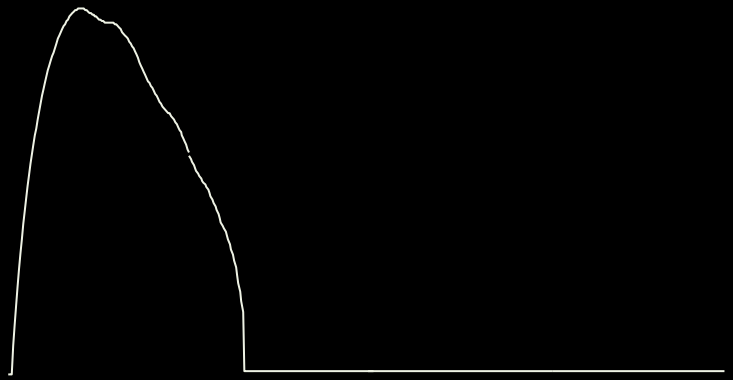
- **Ondas reflejas retornan al corazón durante la sístole**
- **Incrementan la postcarga en el momento inadecuado**
- **Ocurre naturalmente en prácticamente todos los adultos**

Ondas de Rebote tienen Magnitud variable

Presión

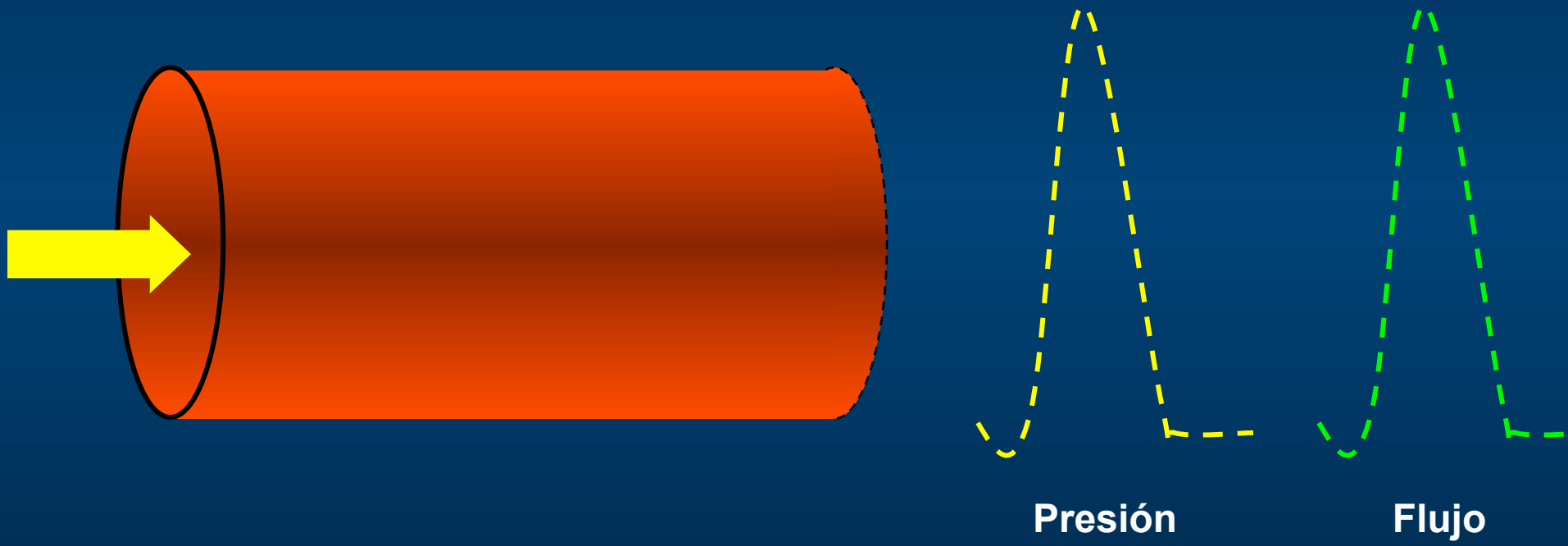


Flujo



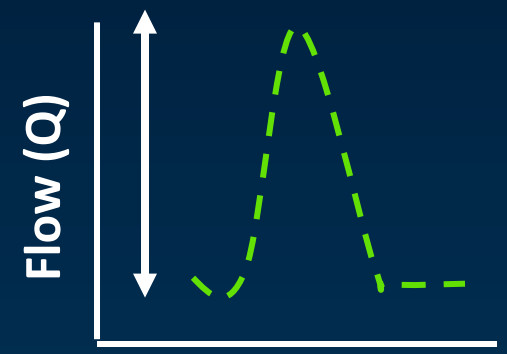
Chirinos JA. Ghent, 2012.

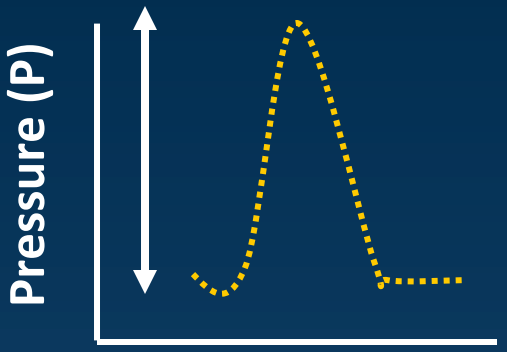
En ausencia de ondas reflejadas desde la periferie, las ondas de presión y flujo pulsátil deben ser idénticas.



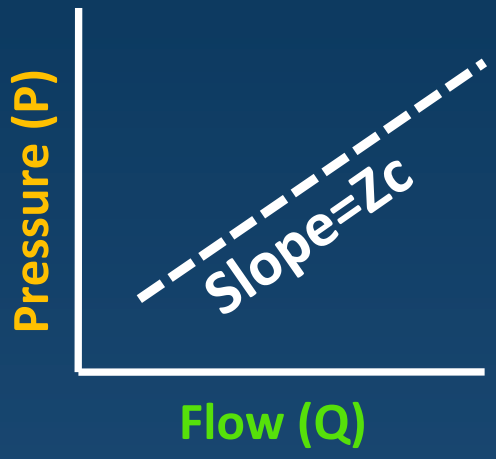
Nichols WW, O'Rourke MF. McDonald's Blood Flow in Arteries. 5th ed. 2005
Chirinos JA, Segers P. Hypertension 2010; 56(4):555-62.

$$Zc = \Delta P / \Delta Q$$





La impedancia característica (Zc) de un vaso es la relación entre la presión y el flujo pulsátil ***en ausencia de ondas reflejas***



Chirinos JA. UCA, Buenos Aires, 2016.

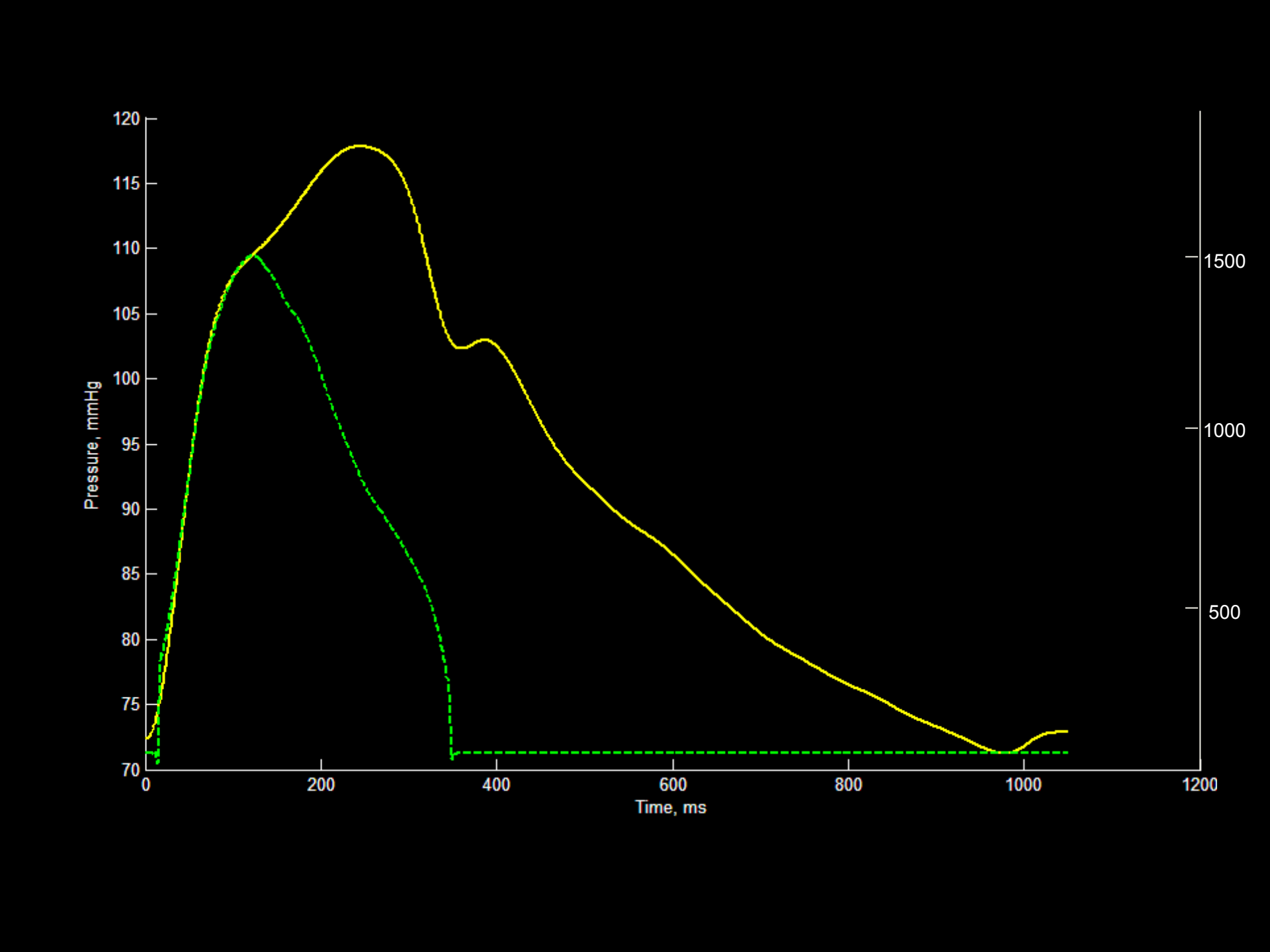
La Onda Incidente (contracción ventricular)

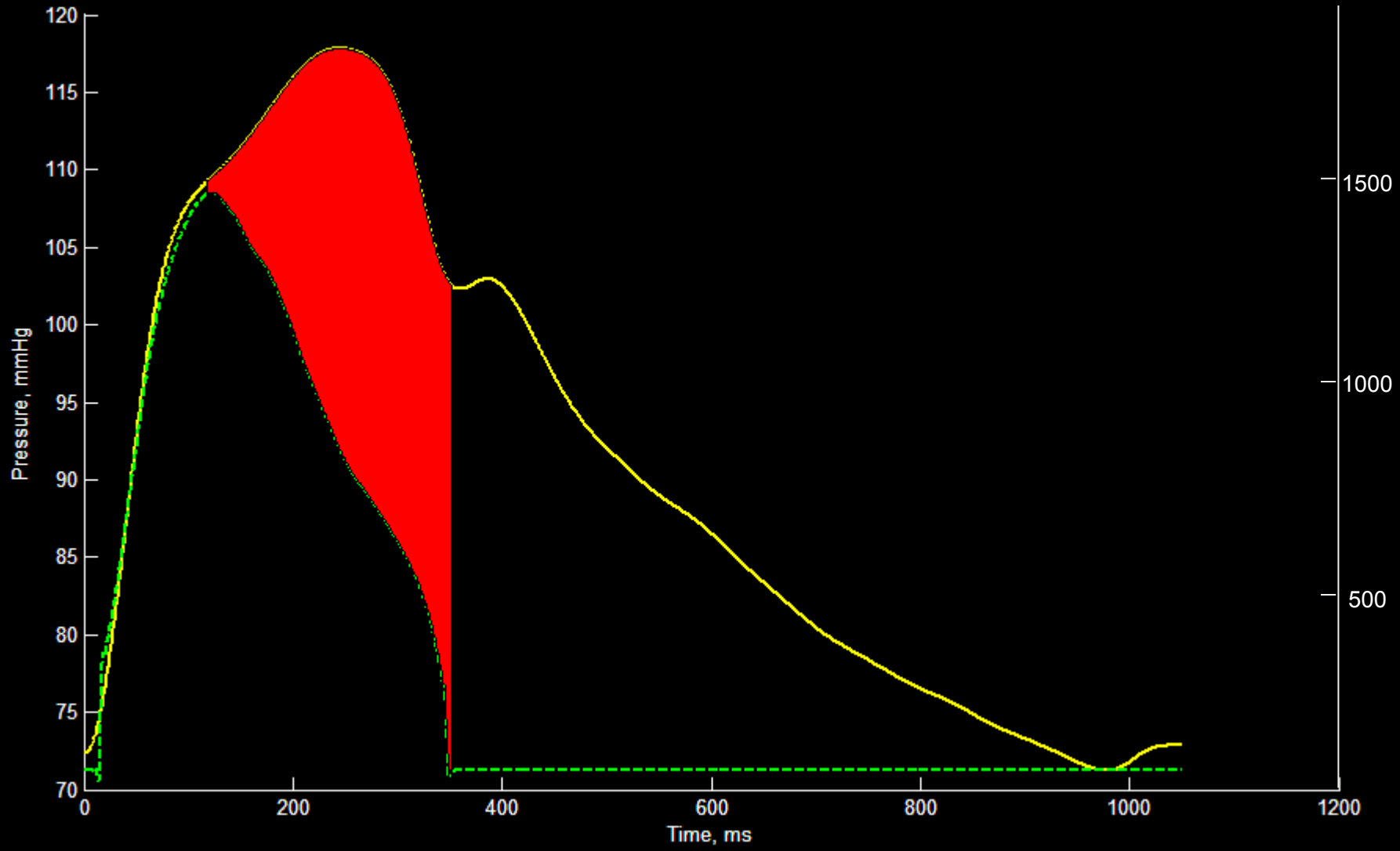
- *Aumenta la presión*
- *Aumenta el flujo*

Las ondas reflejadas desde la periferie:

- *Aumentan la presión*
- *Disminuyen el flujo*

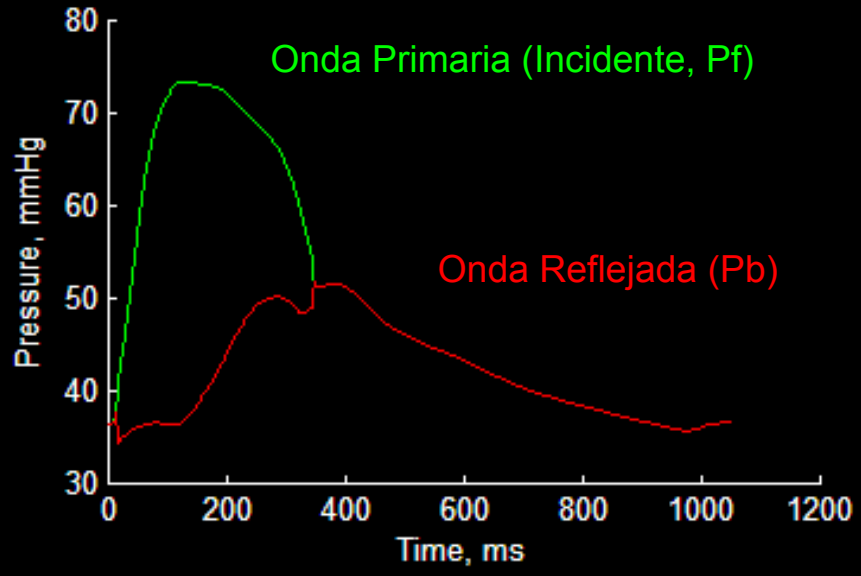
Nichols WW, O'Rourke MF. *McDonald's Blood Flow in Arteries*. 5th ed. 2005.

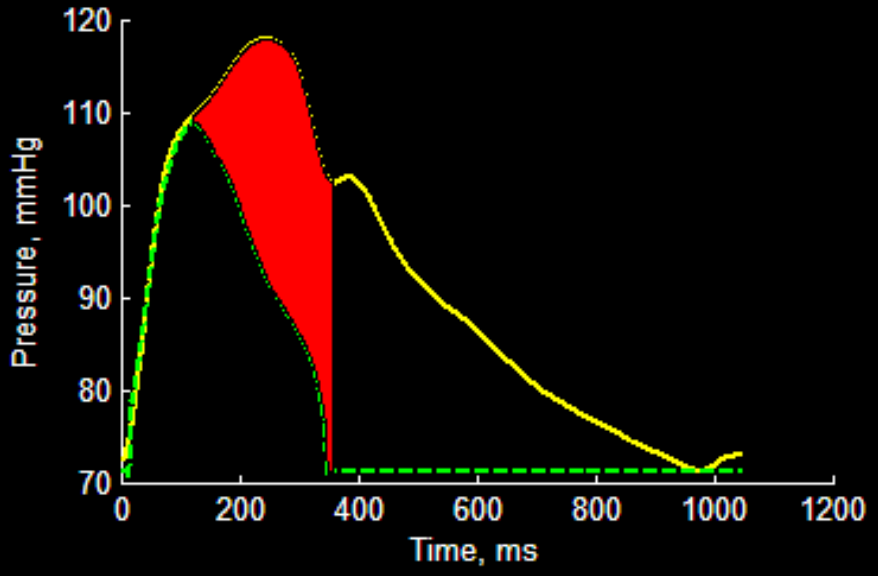

120
115
110
105
100
95
90
85
80
75
70
Pressure, mmHg
1500
1000
500
0
200
400
600
800
1000
1200
Time, ms



Westerhof BE et al. *Hypertension*. 2006;48:595-601.

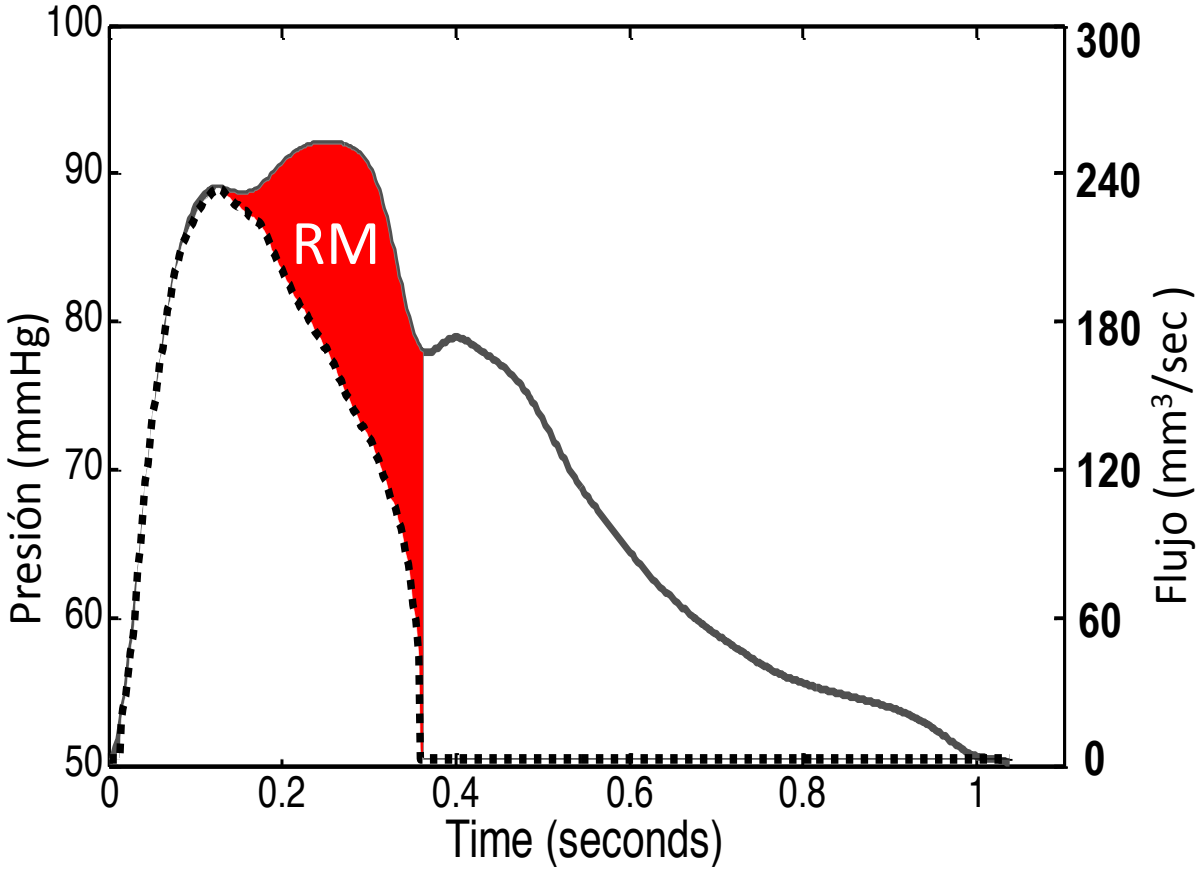
Separación de la Onda de Presion en Onda Incidente y Reflejada

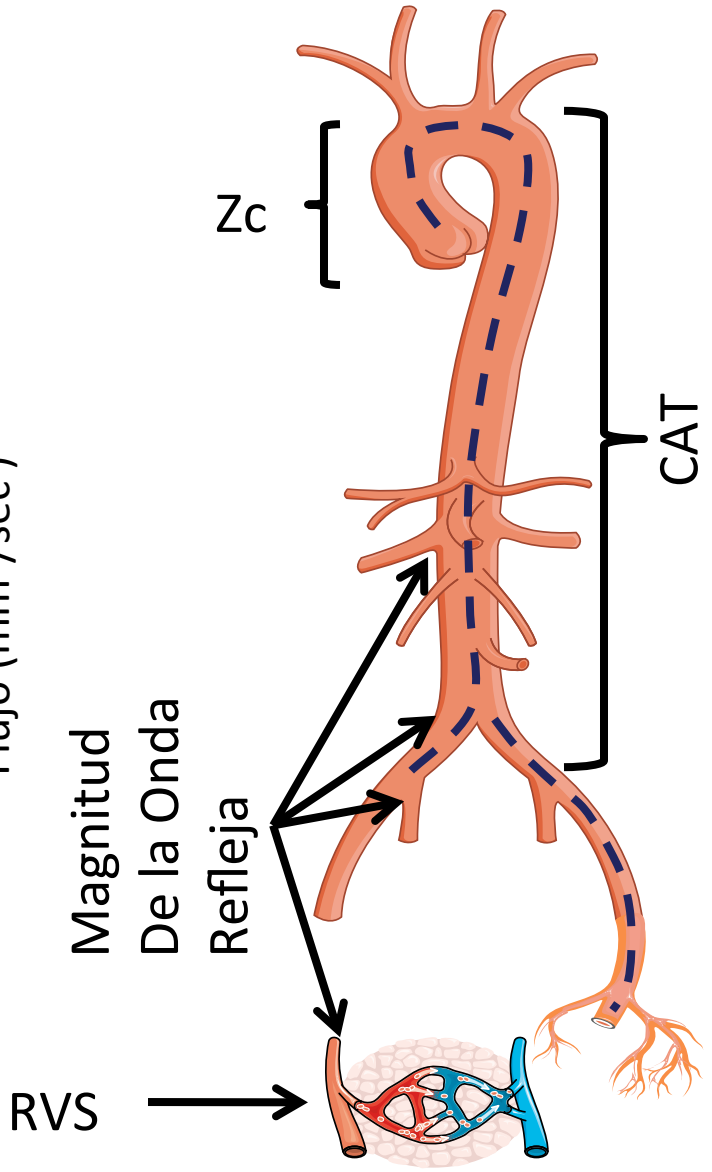




Magnitud de Rebote = Amp Pb / Amp Pf

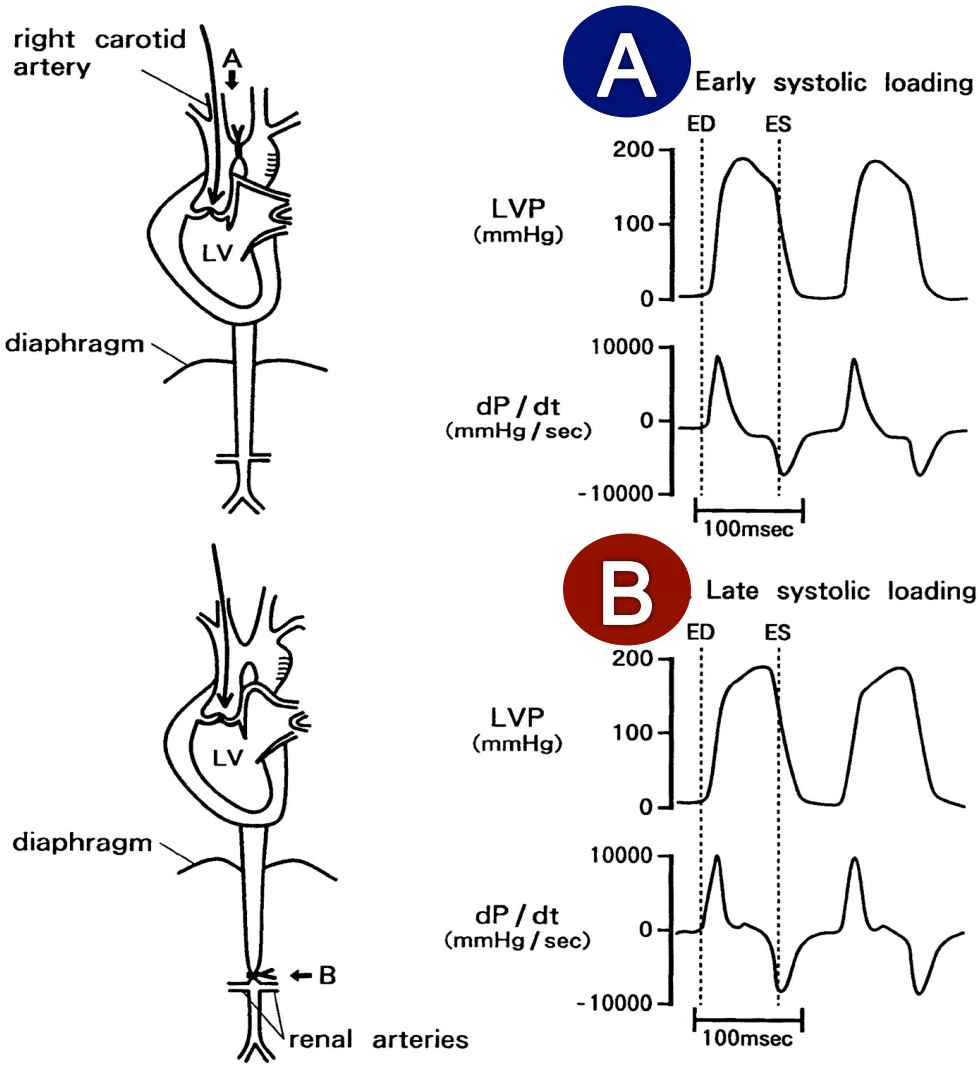
Westerhof BE et al. *Hypertension*. 2006;48:595-6`01.

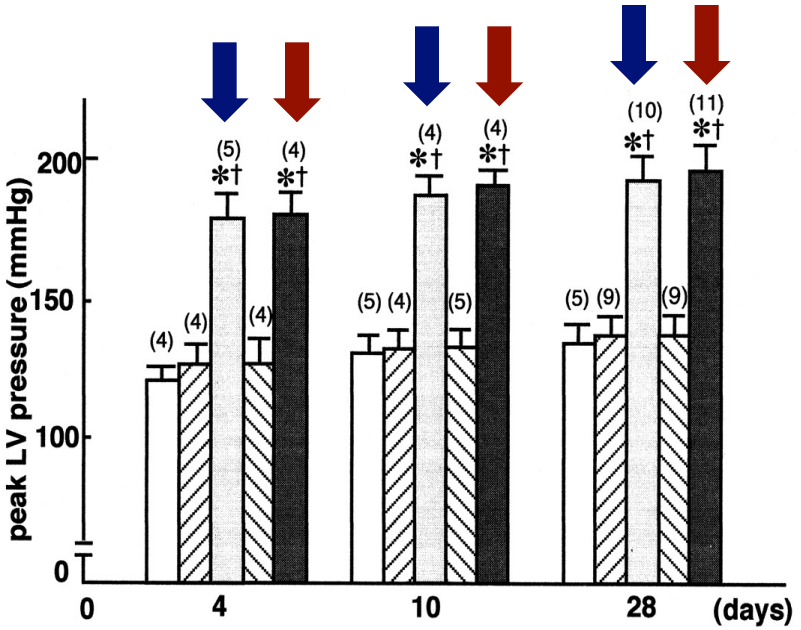


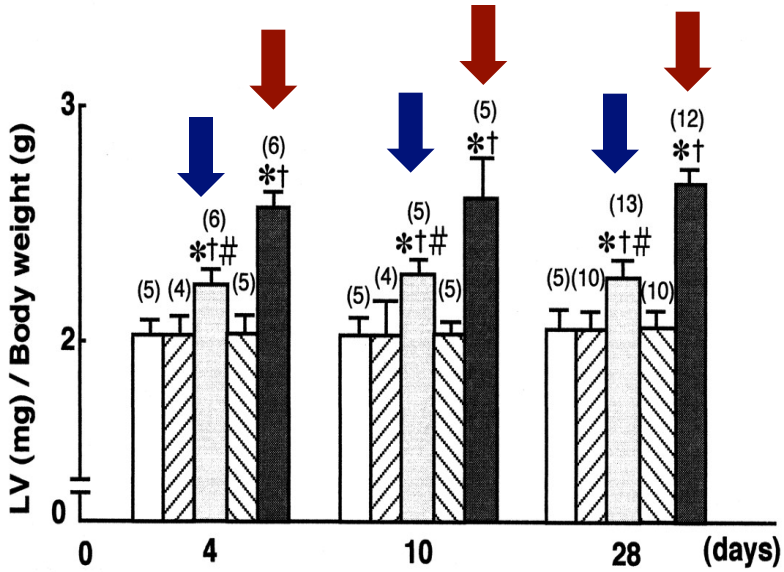


Chirinos JA, Segers P. *Hypertension* 2010; 56(4):555-62.
Chirinos JA, Segers P. *Hypertension*. 2010 56(4):563-70.

Efecto de sobrecarga de presión temprana versus tardía en ratas







Kobayashi S. *Circulation.* 1996;94:3362-3368.

Resistive and Pulsatile Arterial Load as Predictors of Left Ventricular Mass and Geometry

The Multi-Ethnic Study of Atherosclerosis

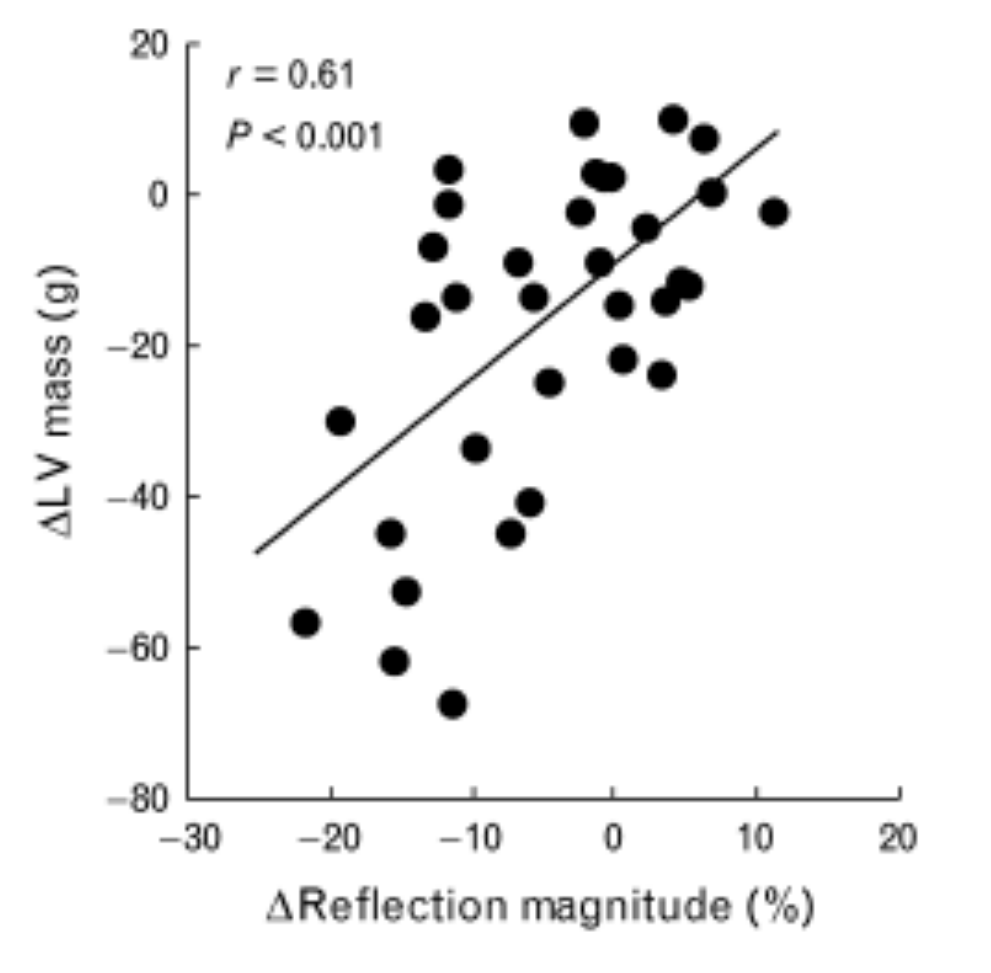
Payman Zamani, David A. Bluemke, David R. Jacobs, Jr, Daniel A. Duprez, Richard Kronmal, Scott M. Lilly, Victor A. Ferrari, Raymond R. Townsend, Joao A. Lima, Matthew Budoff, Patrick Segers, Peter Hannan, Julio A. Chirinos

	Overall (n=4031)		
Load Metric	β Coefficient	Standardized β	*P* Value
Systemic vascular resistance, Wood Units×m^2	0.19	0.08	<0.001
Indexed TAC, mL/mm Hg per square meter	26.65	0.44	<0.001
P_b, mm Hg	1.76	0.73	<0.001
P_f, mm Hg	−0.48	−0.23	0.001

Adjusted for sex, age, diabetes mellitus, diagnosis of hypertension, current smoking, ethnicity, estimated glomerular filtration rate, urine albumin:creatinine ratio, cholesterol profile, statin therapy, antihypertensive therapy, and heart rate. P_b indicates reflected wave amplitude; P_f, forward wave amplitude; and TAC, total arterial compliance.

Hypertension. 2015 Jan;65(1):85-92.

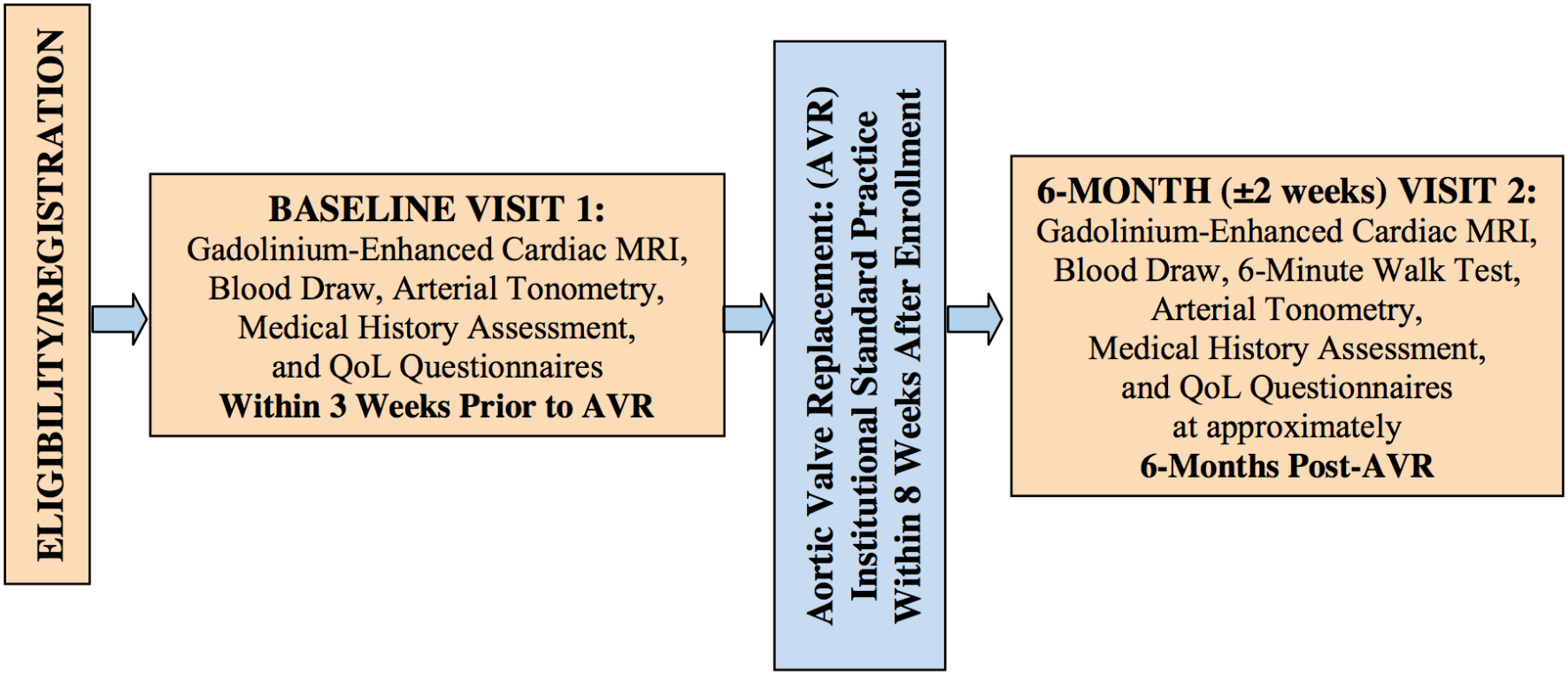
Cambios en la Masa Ventricular durante el tratamiento de la HTA en Humanos



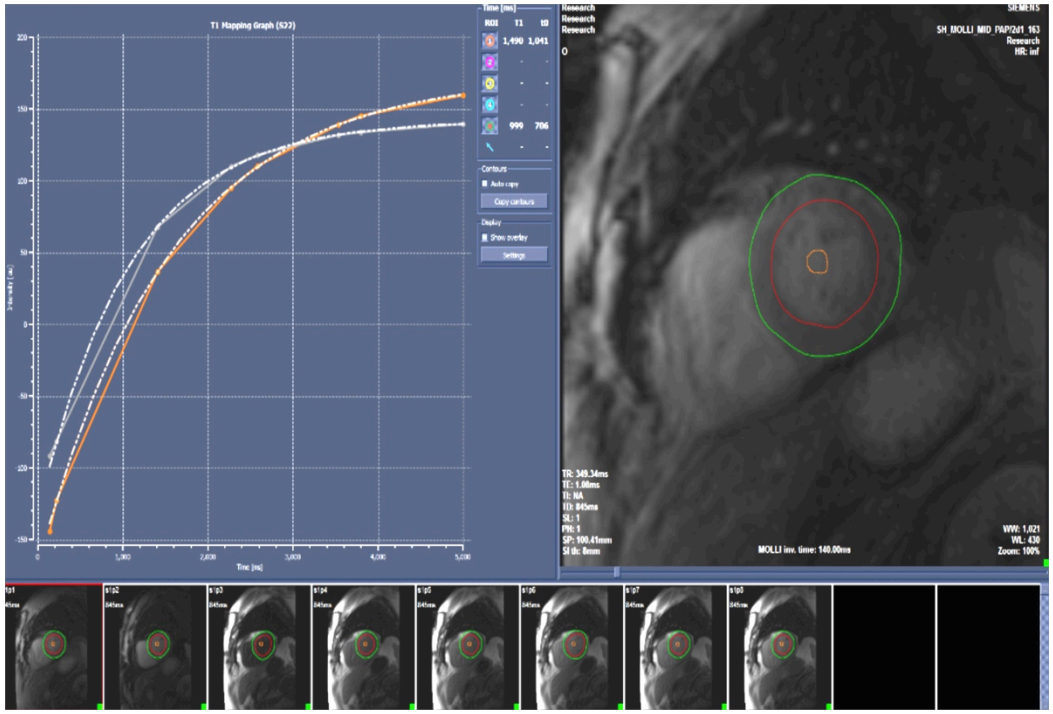
Hashimoto J, Westerhof BE, Westerhof N *et al*. *J Hypertens* 2008. 26:1017–1024

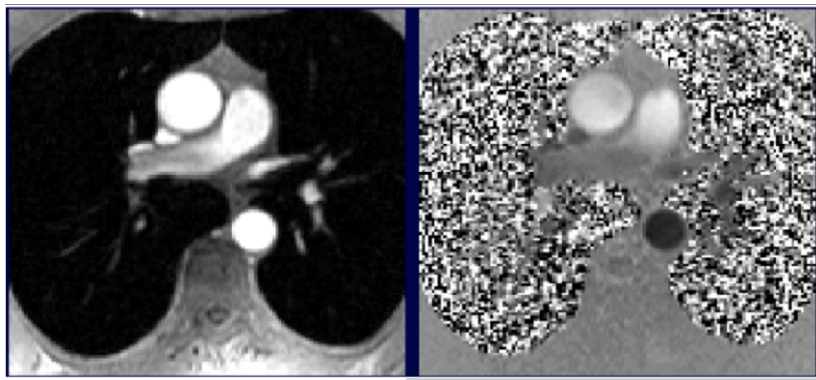
AMERICAN COLLEGE OF RADIOLOGY IMAGING NETWORK

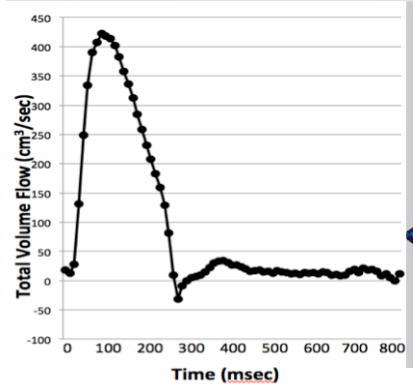
Arterial Stiffness and Wave Reflections as Determinants of Regression of Left Ventricular Hypertrophy and Fibrosis Assessed with Cardiac MRI After Aortic Valve Replacement for Severe Aortic Stenosis

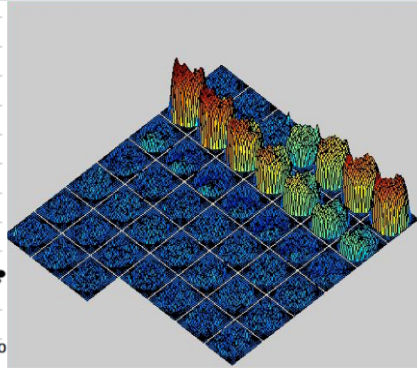


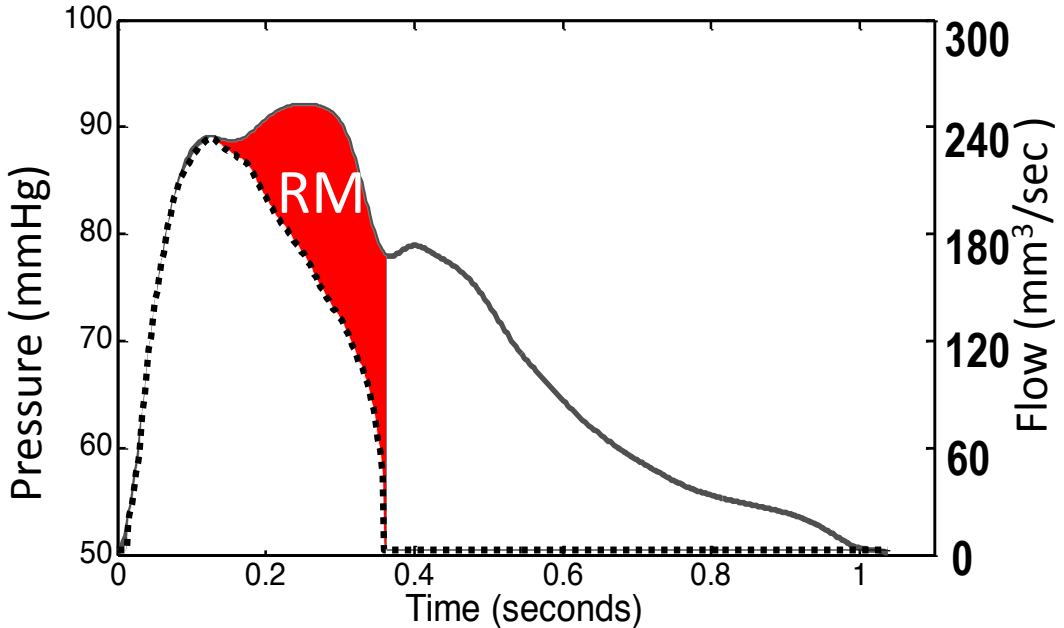
Chirinos JA, Akers S, Schnall MD *et al*.





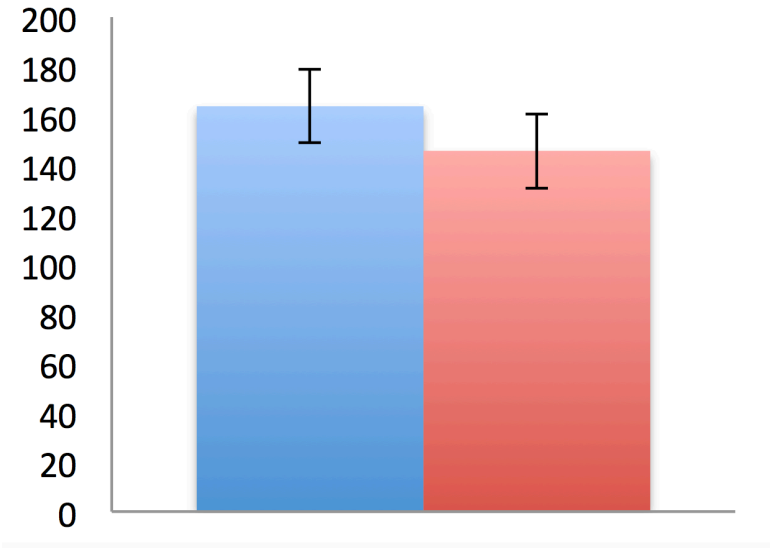




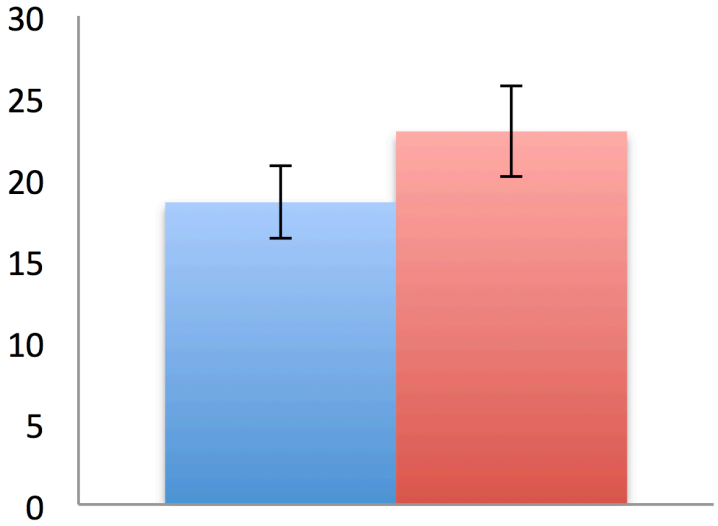


Chirinos JA, Akers S, Schnall MD *et al*.
Manuscript in preparation

Wave Reflection Magnitude as Predictor of Diffuse Myocardial Fibrosis Before and After Aortic Valve Replacement



LV Mass (g)



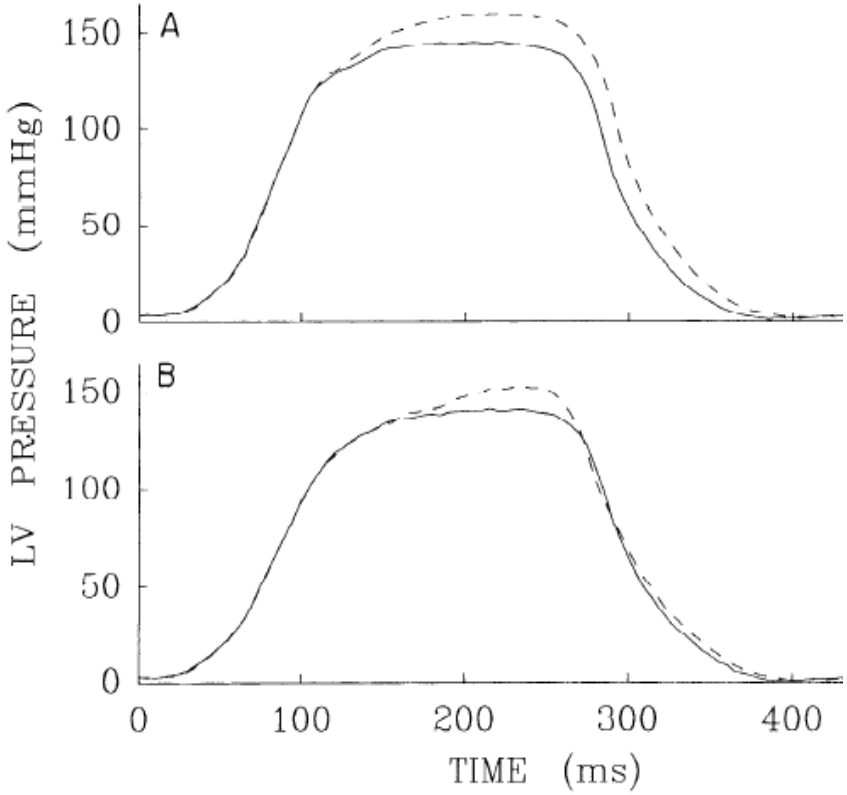
Fibrosis Fraction (%)

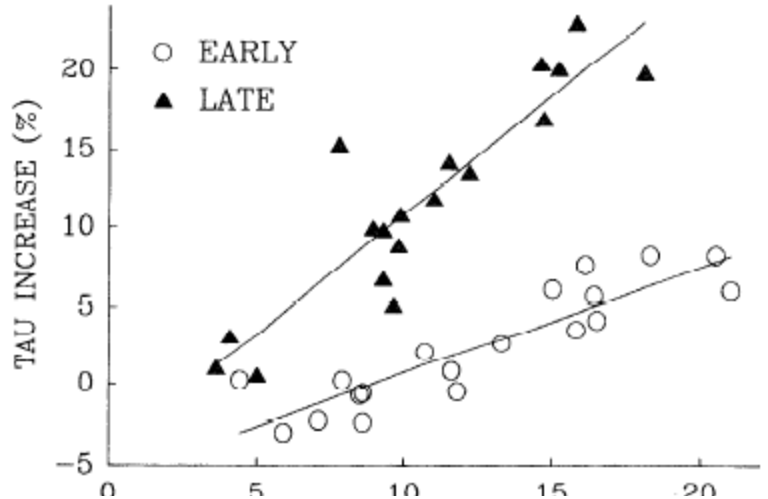
Parameter	Estimate	t	P value	95% Confidence Interval	
Intercept	13.341491	3.990	0.000	6.595503	20.087479
[Visit=1]	-2.519941	-1.911	0.070	-5.268354	0.228471
Reflcoeff_Time_Domain	13.038838	2.635	0.012	3.054095	23.023581

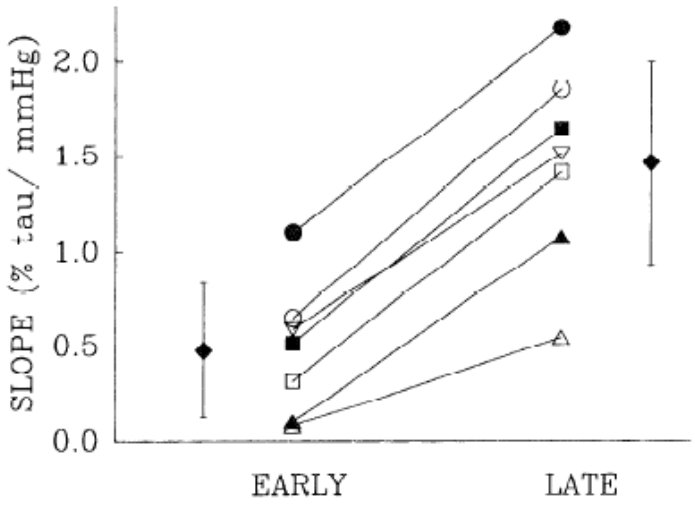
a. Dependent Variable: MOLLI_ECV

Chirinos JA, Akers S, Schnall MD *et al*. Manuscript in preparation

Efecto del perfil de presión sistólica en tau

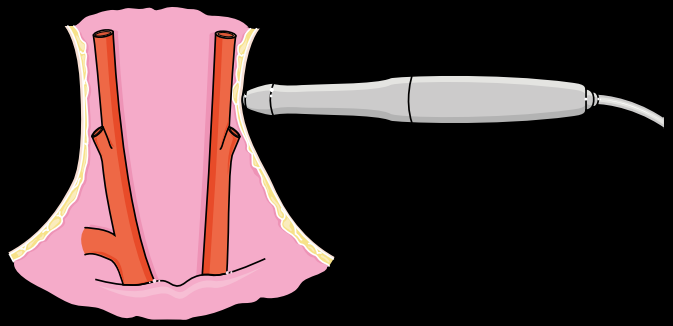


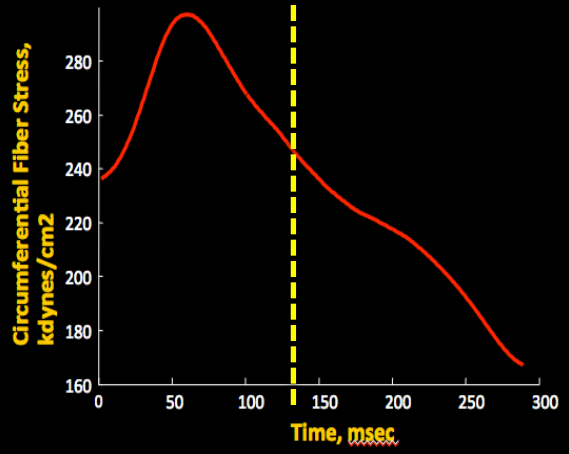


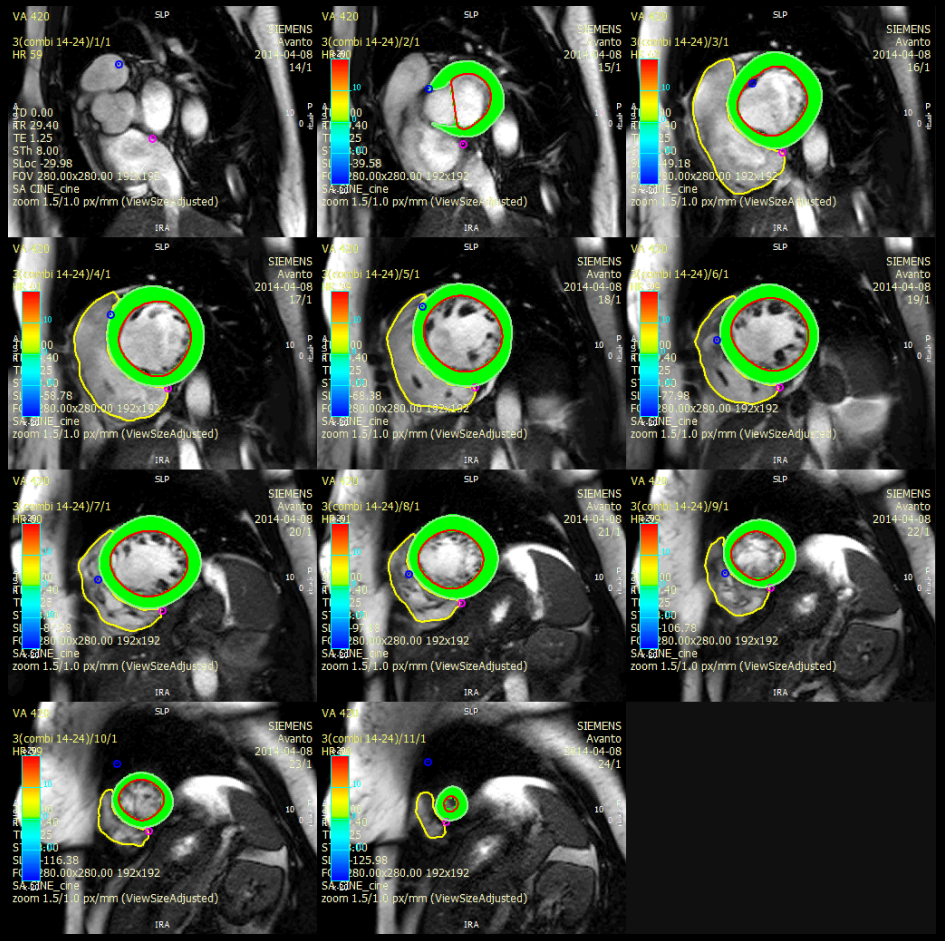


Gillebert TC, Lew WY. *AJP Heart Circ Physiol.* 261: 805-13.

Estrés parietal Sistólico a través del tiempo







Chirinos JA. *et al*. *Circulation*. 2009; 119: 2798-807
Chirinos JA, Gillebert, Segers et al. *Hypertension (*2013); 61 (2): 296-303

Early and Late Systolic Wall Stress Differentially Relate to Myocardial Contraction and Relaxation in Middle-Aged Adults

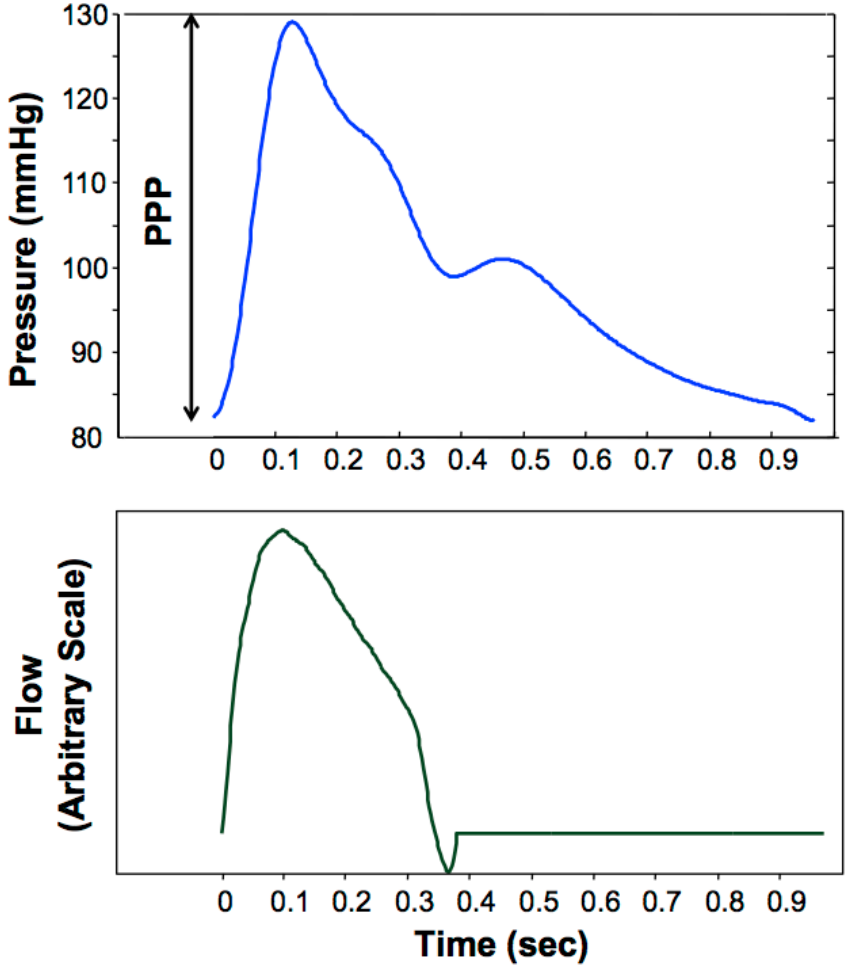
Independent Variables	Standardized Coefficient β	*P* Value
(Constant)		<0.0001
Late ejection-phase MWS, kdynes·cm^{-2}·s	–0.25	<0.0001
Early ejection-phase MWS, kdynes·cm^{-2}·s	0.18	<0.0001

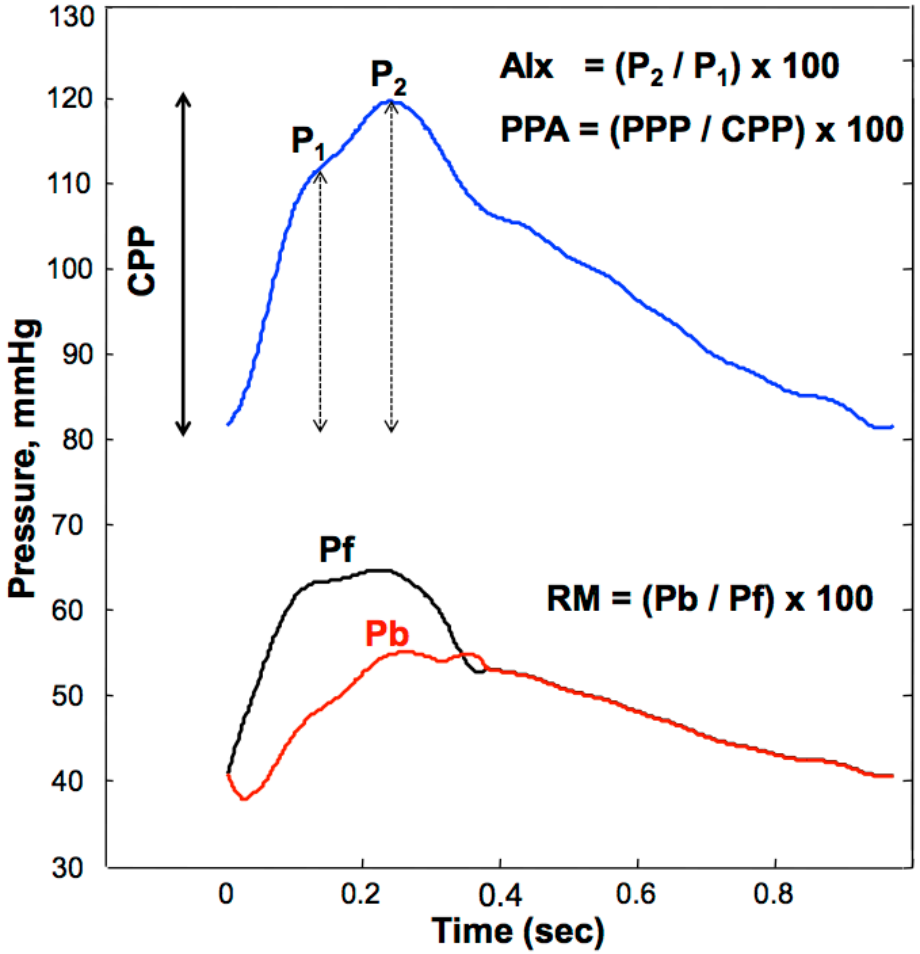
American Heart Association | American Stroke Association

Chirinos JA *et al. Hypertension*. 2013 (2):296-303

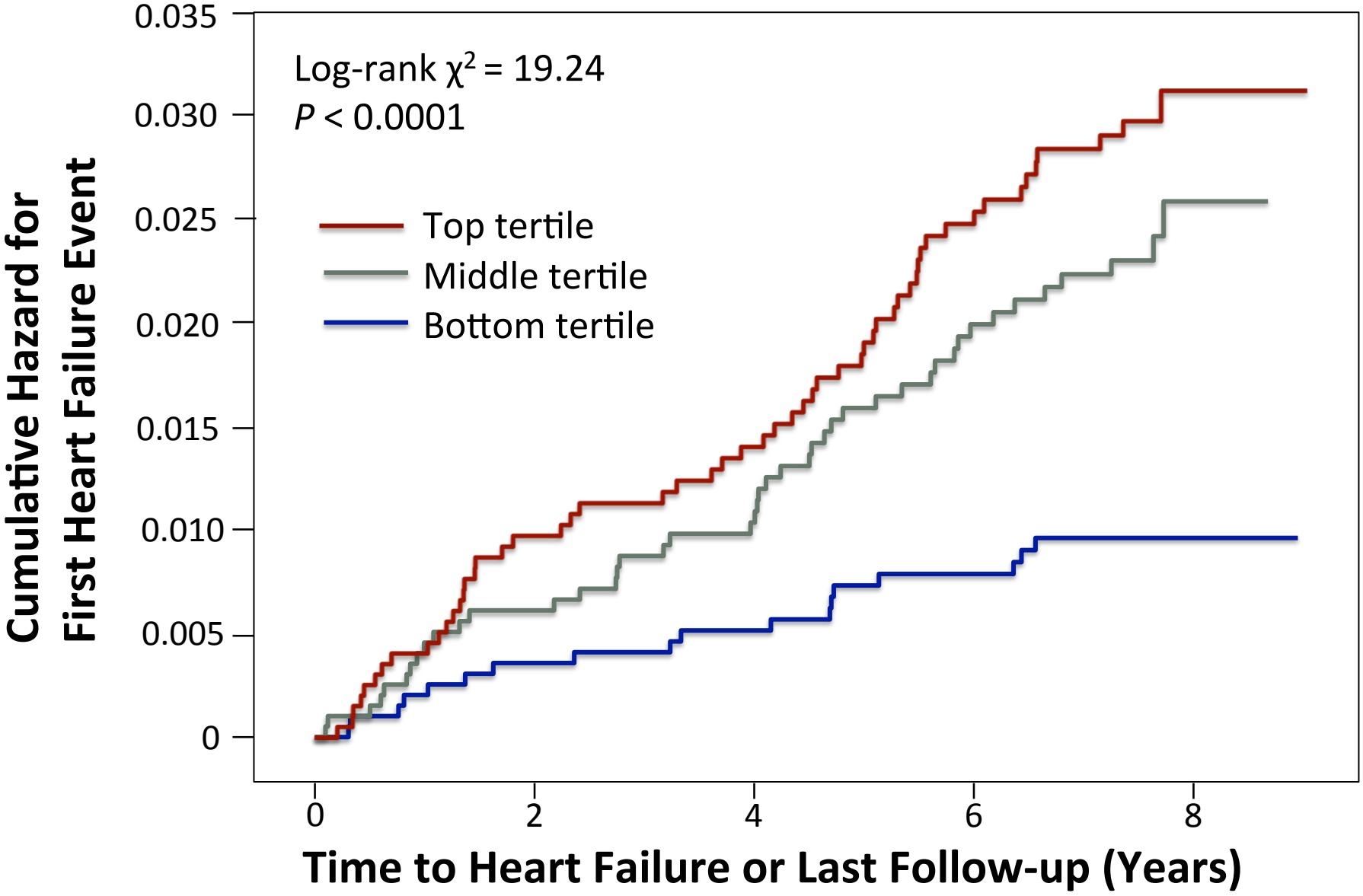
Arterial Wave Reflections and Incident Cardiovascular Events and Heart Failure

MESA (Multiethnic Study of Atherosclerosis)





Chirinos JA et al. JACC 2012;60:2170-7. .



Chirinos JA et al. JACC 2012;60:2170-7. .

Predictores de FC incidente en análisis multivariado (*n*=5932)

Table 3 Predictors of Incident Heart Failure in Multivariate Analysis (N = 5,934)*

Predictor	Full Model With Adjusted HRs (*c*-Index: 0.802; AIC: 1893; BIC: 1943)			Effects of Adding Individual Predictors to a Model Containing All Other Variables					
	Standardized HR (95% CI)	Wald Statistic	p Value	Change in BIC†	Change in AIC†	Change in *c*-Index‡	NRI‡	IDI‡	rIDI‡
Age (10 yrs)	1.62 (1.26–2.08)	14.44	<0.0001	−10.10	−12.87	0.020	0.47§	0.010§	0.22§
Male	1.74 (1.38–2.21)	21.37	<0.0001	−17.09	−19.85	0.015	0.34§	0.017§	0.44§
BMI (10 kg/m^2)	1.26 (1.03–1.55)	4.83	0.028	0.15	−2.62	0.007	0.32§	0.002	0.050
Diabetes mellitus	1.24 (1.07–1.44)	8.37	0.004	−3.09	−5.86	0.010	0.019	0.003	0.061
SBP (10 mm Hg)	1.69 (1.33–2.13)	18.97	<0.0001	−13.10	−15.86	0.013	0.31§	0.011§	0.25§
DBP (10 mm Hg)	0.67 (0.52–0.86)	9.71	0.002	−4.94	−7.70	0.006	0.15§	0.007§	0.14§
Reflection magnitude (10%)	1.61 (1.32–1.96)	22.03	<0.0001	−17.79	−20.55	0.011	0.38§	0.018§	0.48§
SBP and DBP together‖	—	—	—	−8.46	−13.98	0.013	0.28§	0.011§	0.25§

*Only significant predictors of CHF are shown. However, all models are also adjusted for ethnicity, antihypertensive medication use, total cholesterol, HDL-cholesterol, current smoking, heart rate, and estimated GFR. All HRs are standardized. †Larger decreases (changes with negative sign) indicate a larger improvement in model fit. ‡Larger increases indicate a larger improvement in performance in reclassification or discrimination. §$p < 0.05$. ‖Improvements in model performance when both SBP and DBP are added to a model containing all other variables contained in the full model.

AIC = Akaike information criterion; BIC = Bayesian information criterion; IDI = integrated discrimination improvement; rIDI = relative integrated discrimination improvement; NRI = net reclassification improvement (category free); other abbreviations as in Tables 1 and 2.

Chirinos JA et al. JACC 2012;60:2170-7. .

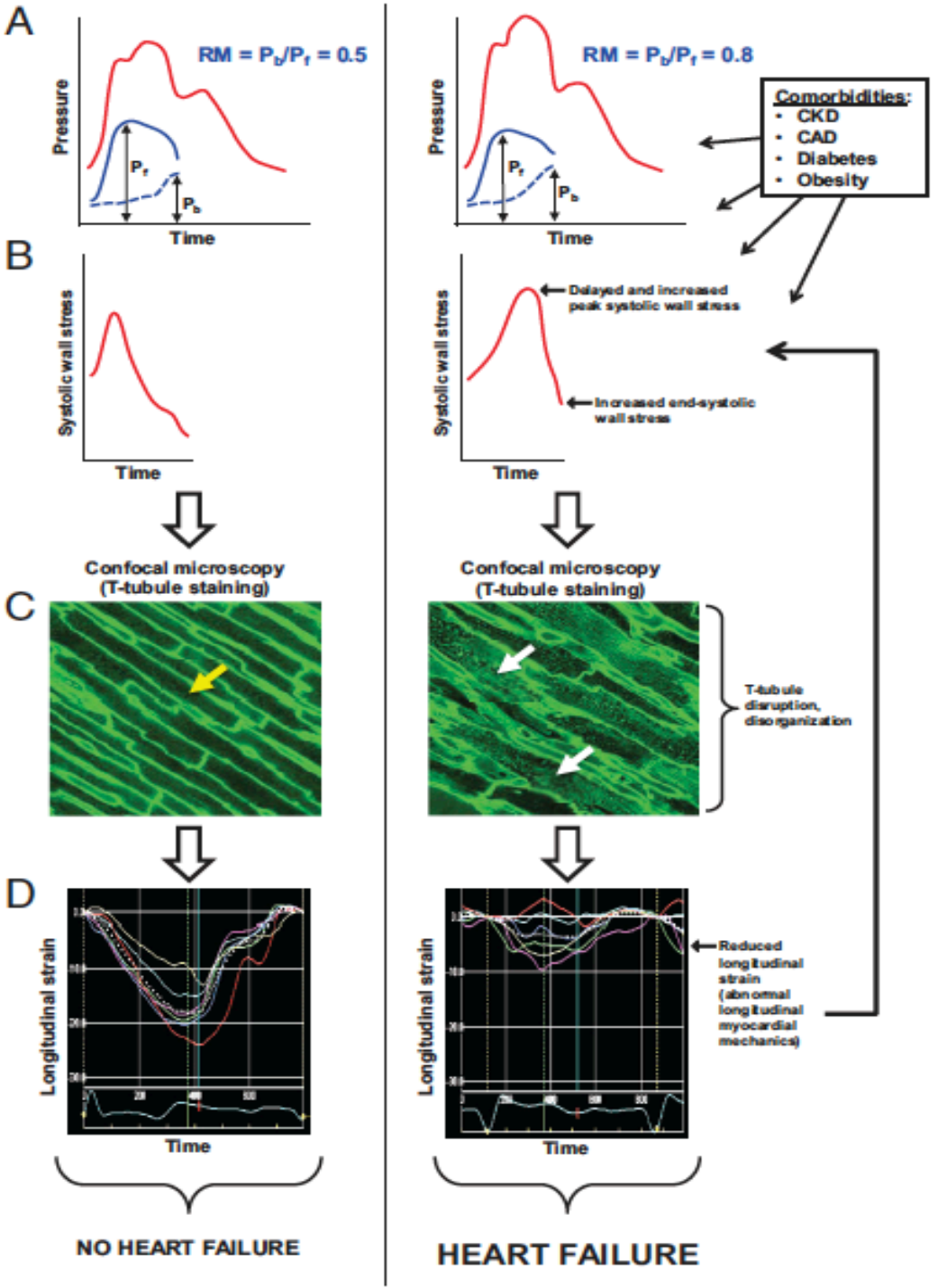
EDITORIAL COMMENT

Increased Arterial Wave Reflection Magnitude

A Novel Form of Stage B Heart Failure?*

Sanjiv J. Shah, MD, J. Andrew Wasserstrom, PhD

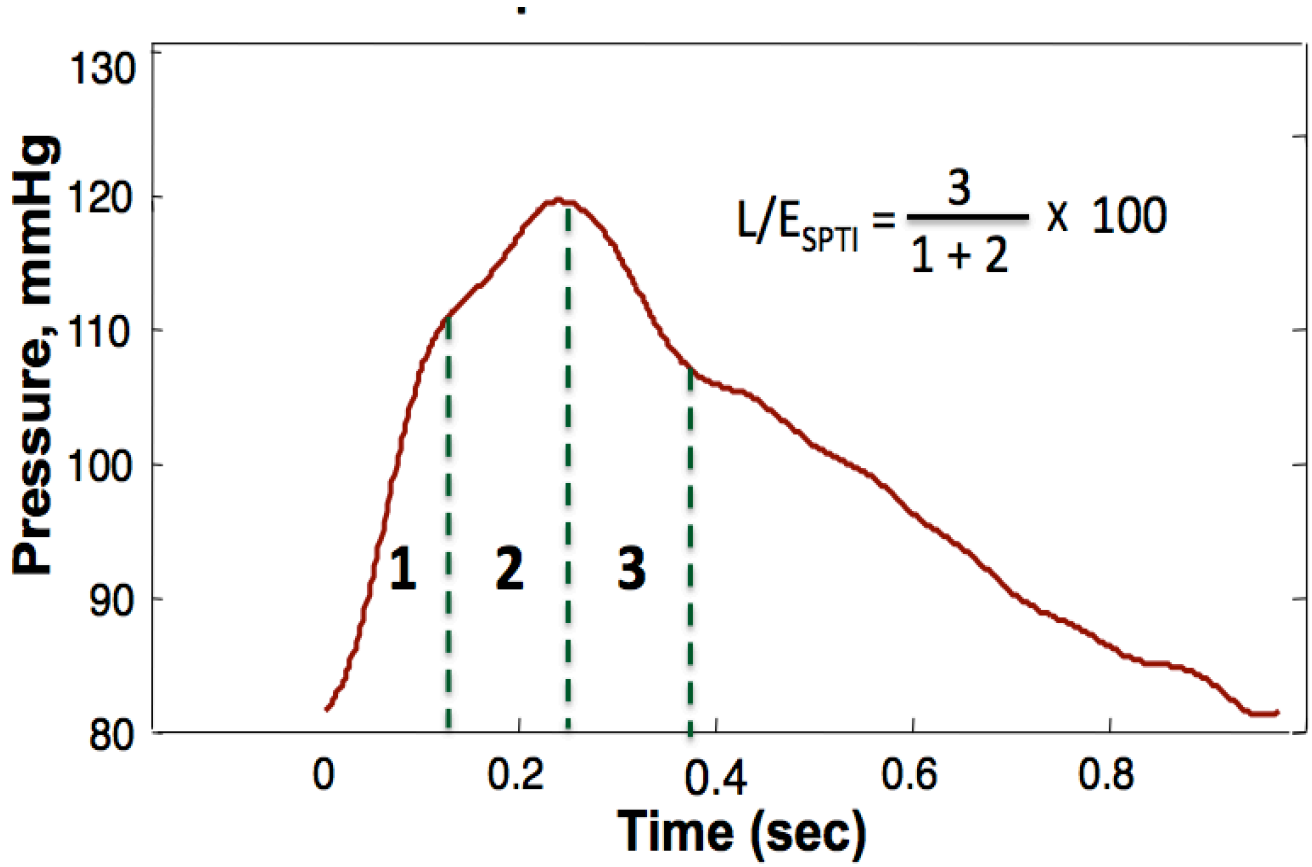
Chicago, Illinois



Shah SJ, Wasserstrom JA. JACC 2012.

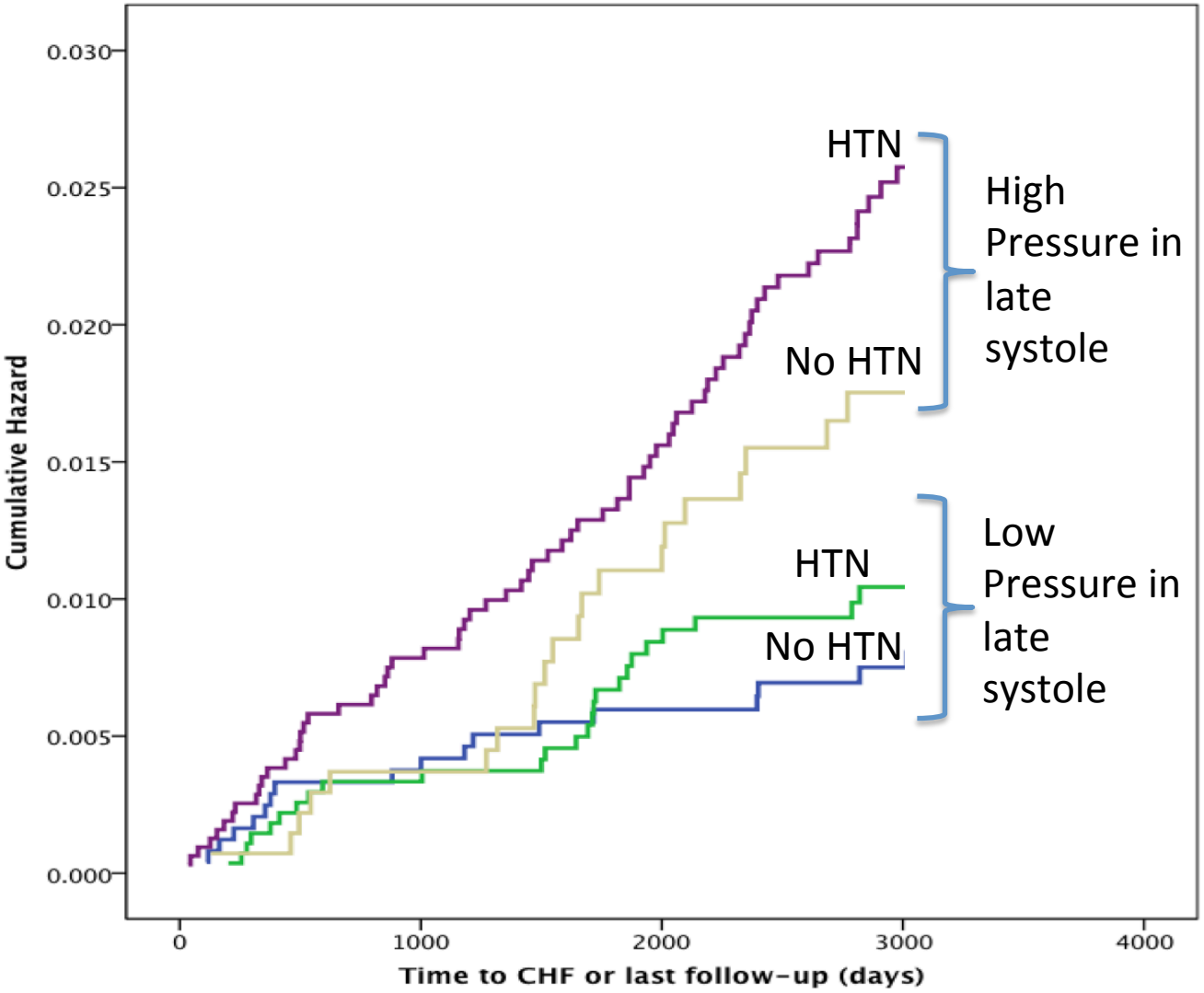
Late Systolic Central Hypertension as a Predictor of Incident Heart Failure: The Multi-Ethnic Study of Atherosclerosis

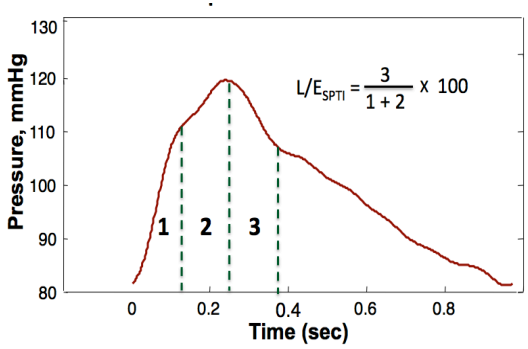
Julio A. Chirinos, MD, PhD; Patrick Segers, PhD; Daniel A. Duprez, MD, PhD; Lyndia Brumback, PhD; David A. Bluemke, MD; Payman Zamani, MD; Richard Kronmal, PhD; Dhananjay Vaidya, MBBS, PhD; Pamela Ouyang, MD; Raymond R. Townsend, MD; David R. Jacobs, Jr, PhD



Chirinos JA et al. *J Am Heart Assoc.* 2015; 3;4(3).

Late Systolic Central Hypertension as a Predictor of Incident Heart Failure: The Multi-Ethnic Study of Atherosclerosis



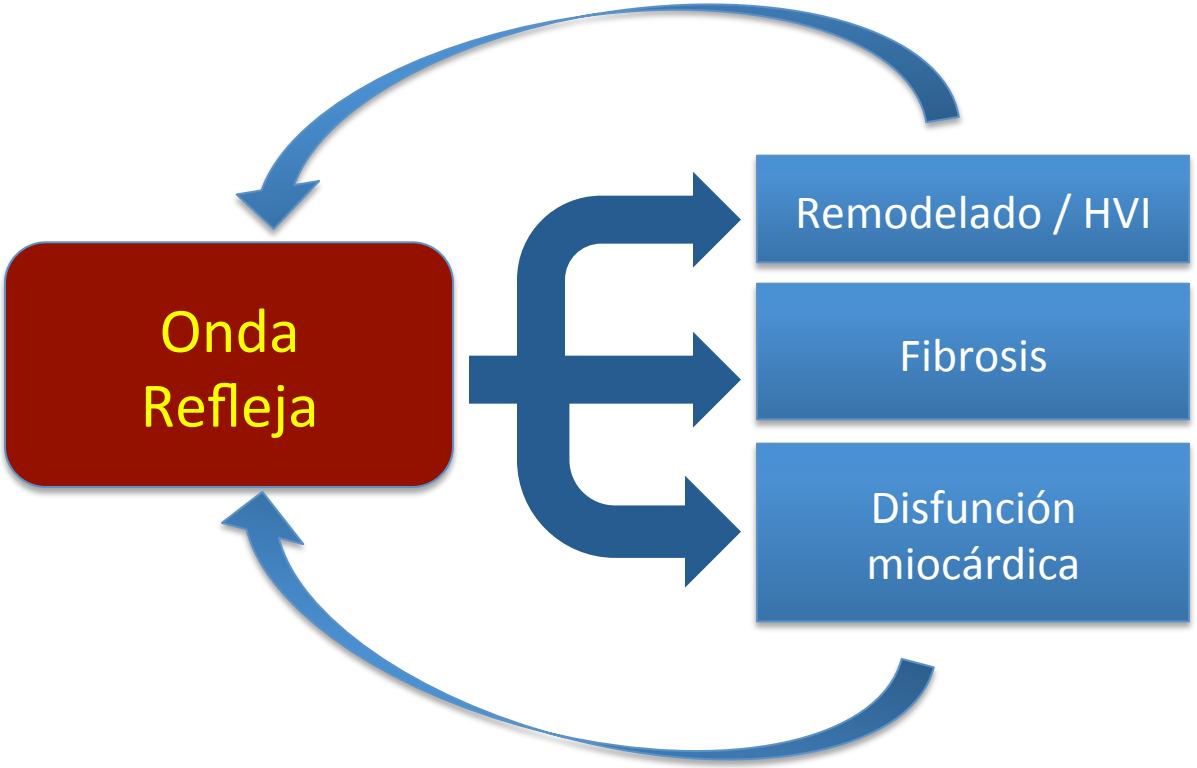


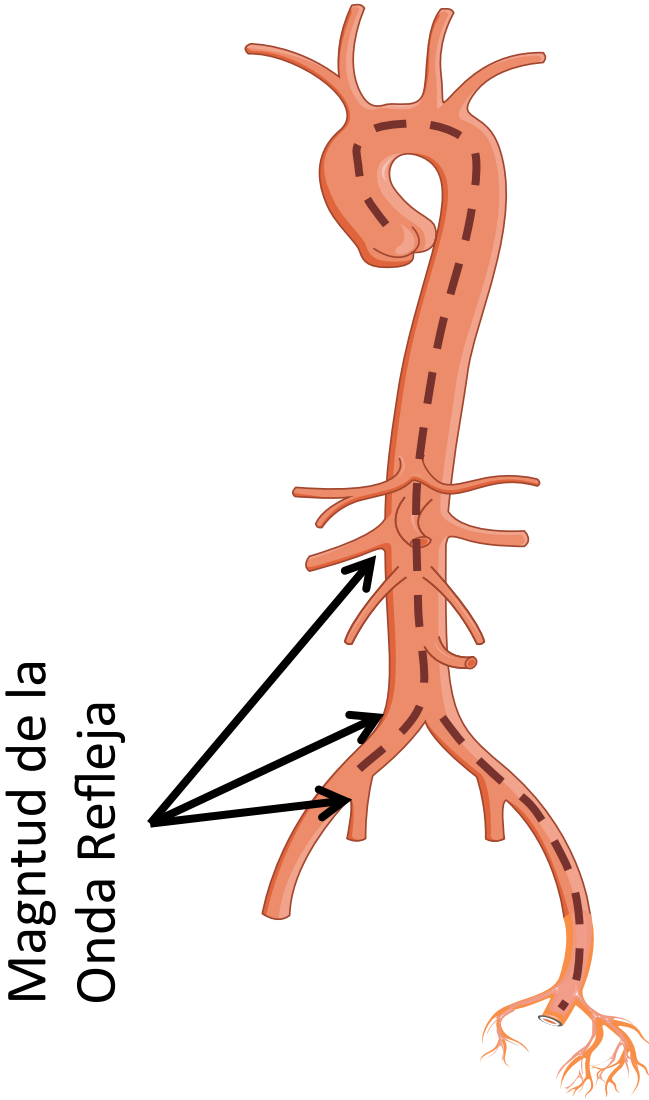
American Heart Association | American Stroke Association

Chirinos JA et al. *J Am Heart Assoc.* 2015; 3;4(3).

Magnitud de la onda refleja representa un nuevo y fuerte predictor de FC en la población general

Datos en animales indican un rol causal. Estudios en humanos apoyan este rol causal





Es un prometedor blanco terapéutico (particularmente en ICC con FE conservada)

Muchas gracias