



Aortic Stiffness by MRI in MESA

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Introduction

Thoracic Aorta Imaging



Structure

- Wall thickness
- Calcifications

Function

- **Distensibility**
- **Pulse wave velocity**

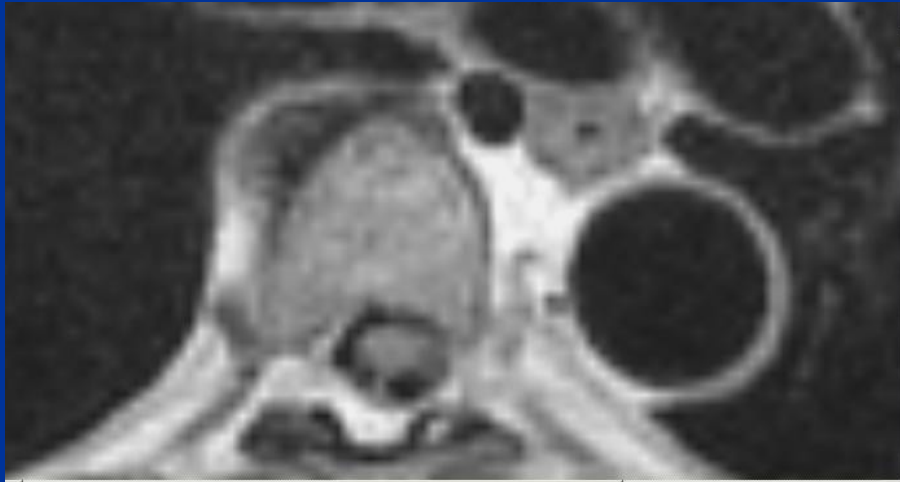
Aortic Wall Analysis in MRI

Average aortic wall thickness

→ 1053

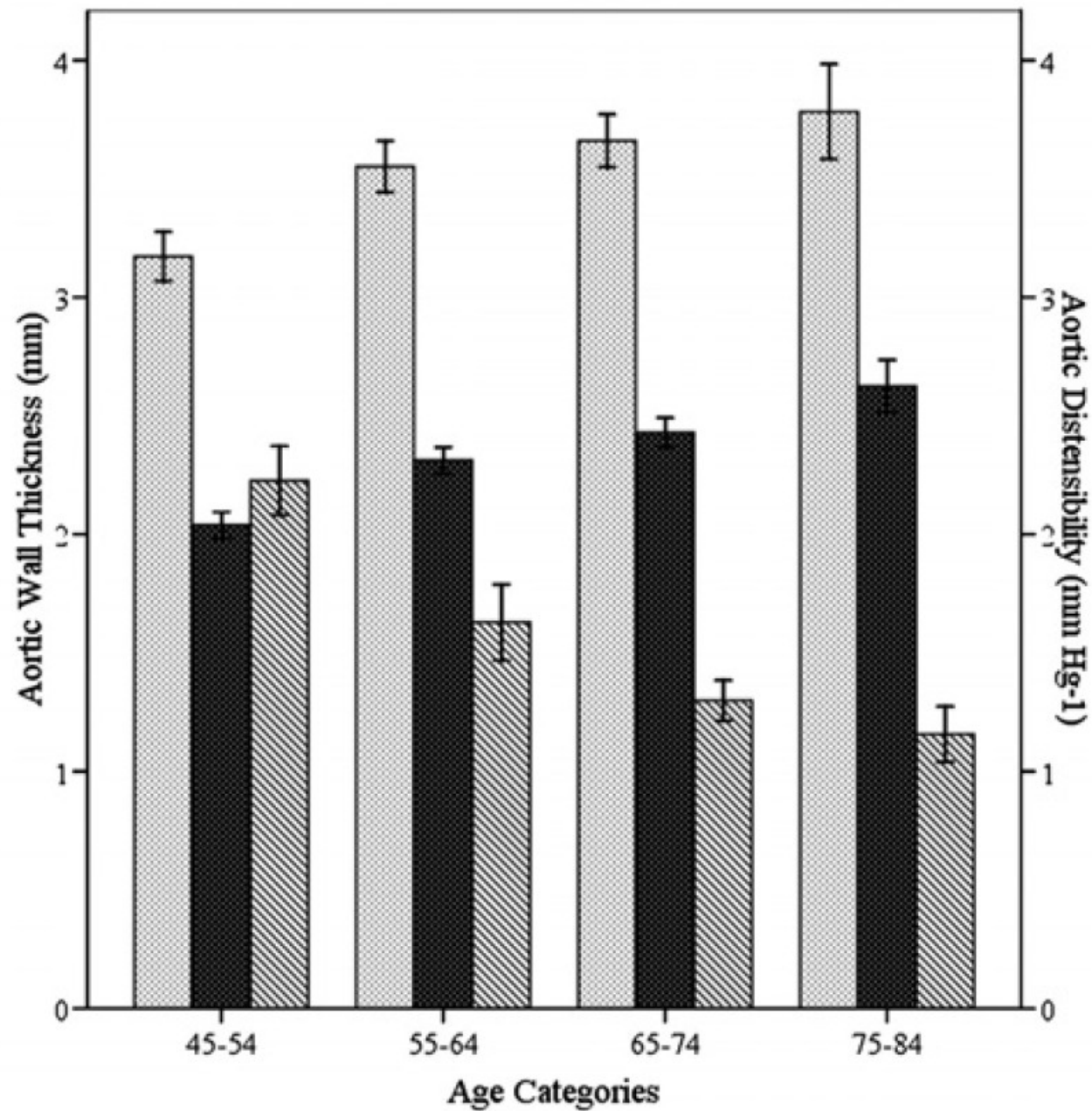
Max aortic wall thickness

→ 782



Aortic Wall Analysis

- **Determinants of AWT and MWT in multivariate analysis**
 - Age
 - Hypertension
 - Male gender (MWT)



Research on Aortic Distensibility in MESA

■ Published papers

- Relation of aortic wall thickness and Distensibility to CVRF - A. Malayeri, AJC 2008
- Aortic Distensibility and Retinal Arterial Narrowing – N. Cheung, Hypertension 2008

■ Proposals relating Aortic distensibility

- Sub-clinical atherosclerosis: CAC, Aortic Ca, cIMT
- Diabetes, impaired fasting glucose
- Global and regional LV function
- Lung density and function

Genetics and Aortic Distensibility

■ Candidate genes

- RAA pathway: ACE, AGT, AGTR1, and AGTR2 (Vargas et al.)
- Fibulin: FBLN 5, HMCN1, EFEMP1 and MMP-3 (Vargas et al.)

■ CWAS

- Collaboration Johns Hopkins - University of Virginia
- Josyf Mychaleckyj, Michele Sale, Stephen Rich

Available MRI Aortic Distensibility in MESA at baseline

MESA 1 (2,3)

6814



5004 MRI
(Δ : 326)



4678

w/PC



3718

w/AD

- Transfer of the velocity images
- Unavailable VENC value
- Unavailable PP during MRI
- Image quality issues (mvt)

— — —

→ 3574 (missing Maximum area=143)

Available MRI Aortic Distensibility in MESA at follow-up

MESA 1 (2,3)

6814



5004 MRI
(Δ : 326)



4678 w/PC
(Δ : 960)



3718
w/AD

MESA Ex. 4

1300



1300 w/PC

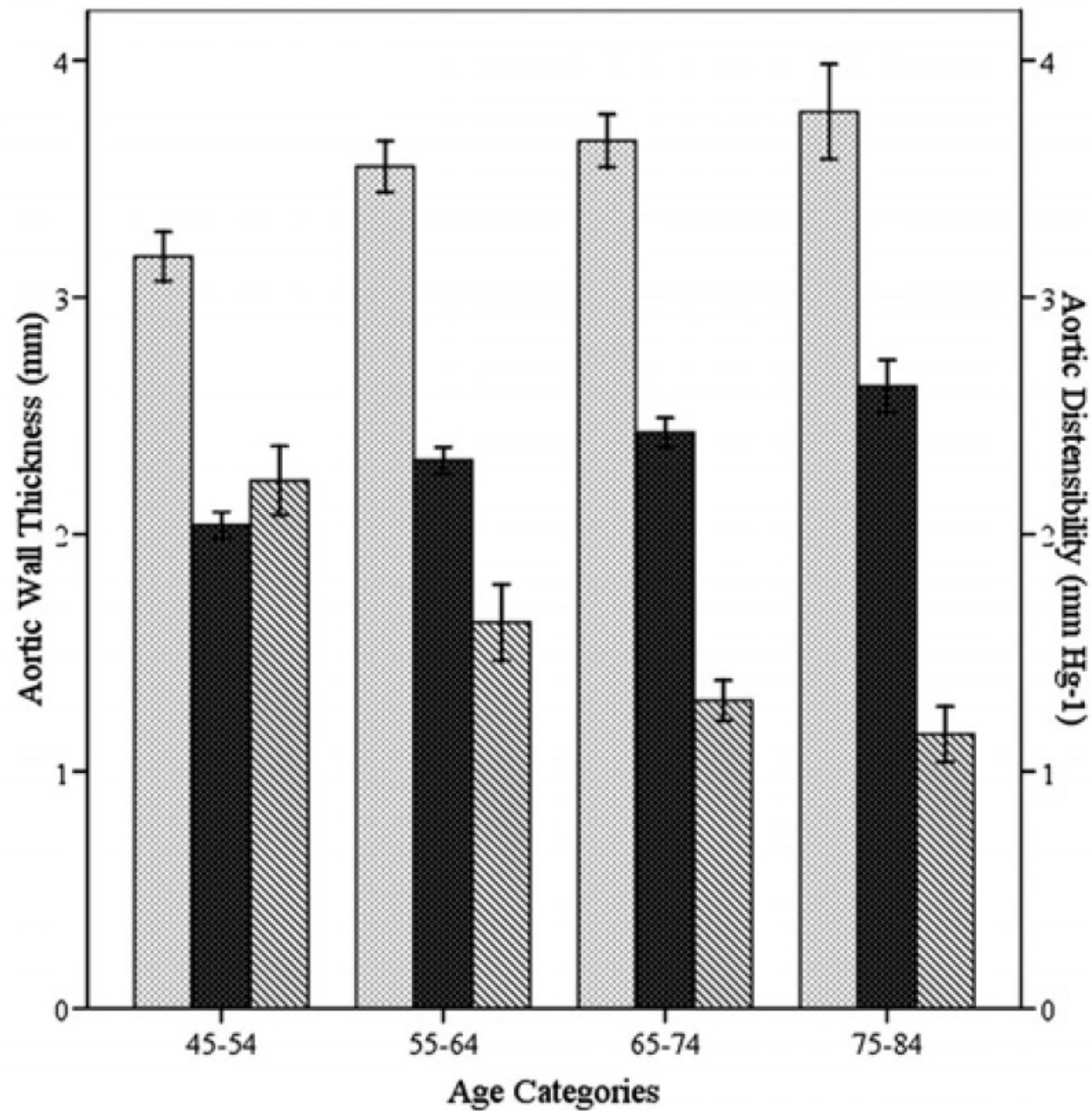


not yet analyzed

Aortic Distensibility Analysis



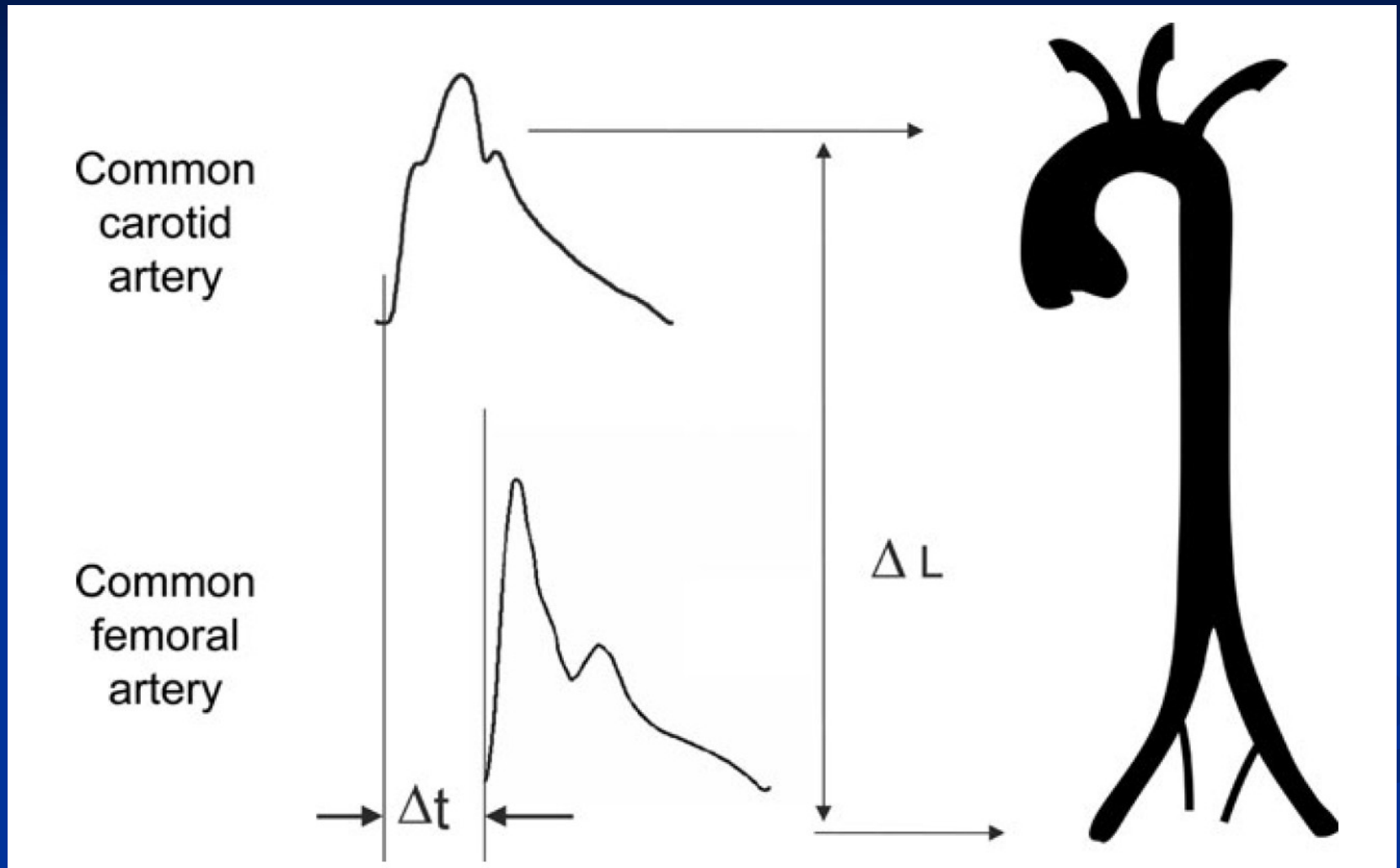
**AD = relative area change of the ascending aorta
mean brachial pulse pressure**



Aortic Distensibility and CVRF in MESA

	AD (mm Hg ⁻¹)
Age (per 10.2 yrs)	−0.3 (<0.01)
Men vs women	−0.035 (0.6)
Systolic blood pressure (per 21.5 mm Hg)	−0.2 (<0.01)
Never smoker	Reference
Former smoker	−0.03 (0.61)
Current smoker	−0.3 (0.004)
Non-Hispanic white	Reference
African American	−0.18 (0.01)
Hispanic	−0.16 (0.15)
HDL cholesterol (per 14.9 mg/dl)	−0.07 (0.04)

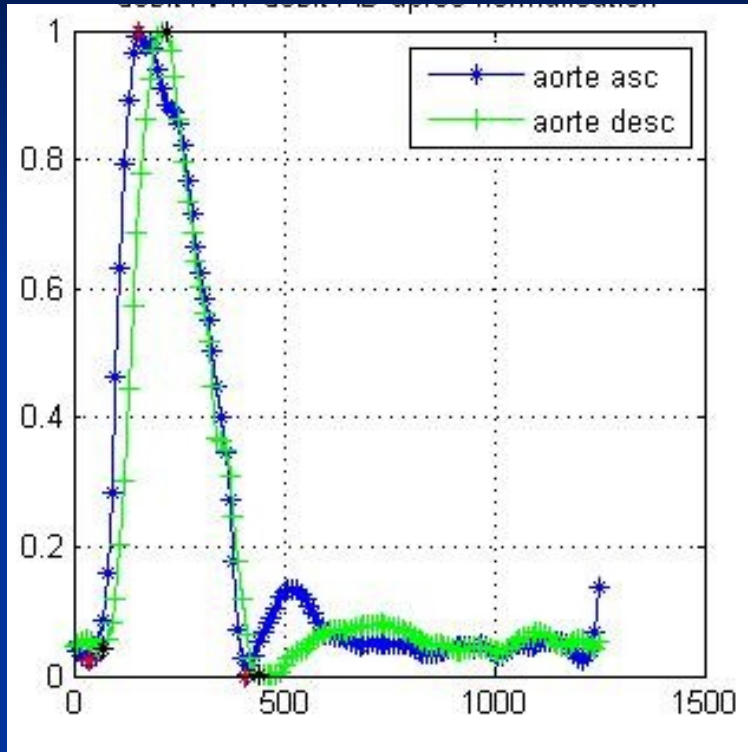
Pulse Wave Velocity



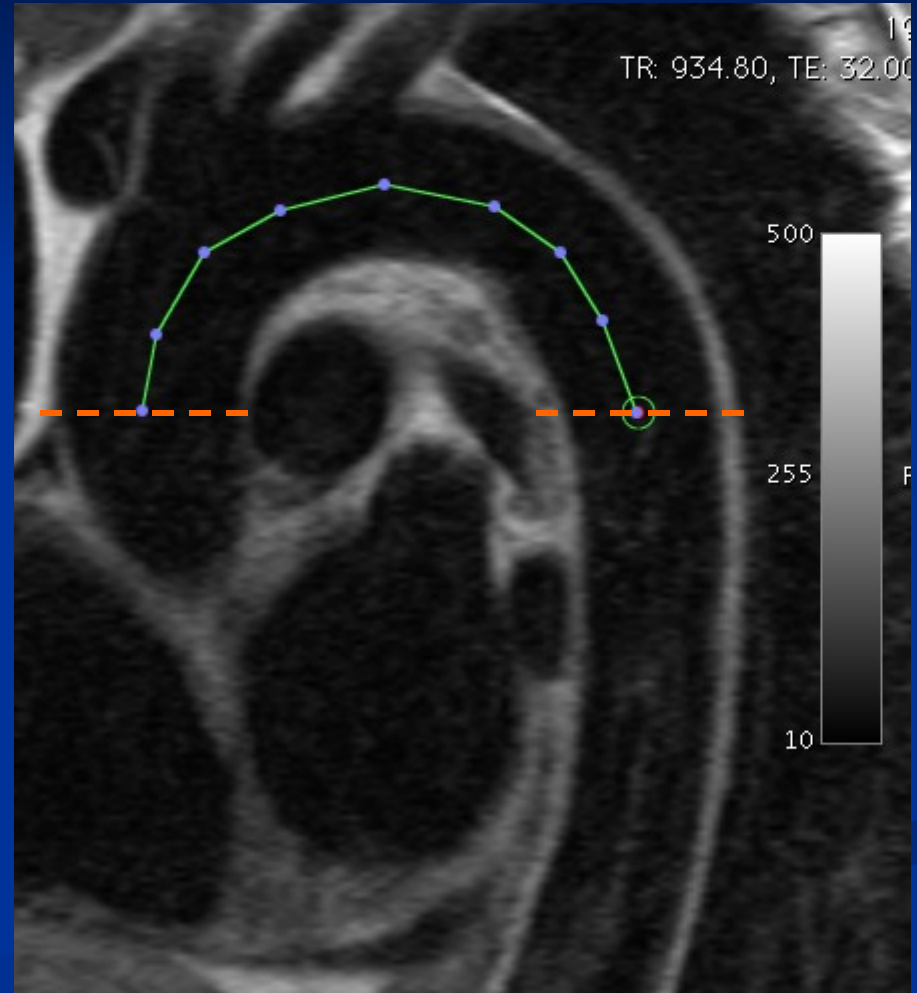
Why Pulse Wave Velocity ?

- **The most simple, non invasive, robust and reproducible method to determine arterial stiffness**
- **Direct measure of aortic stiffness and aging**
- **PWv has been used in the epidemiological studies demonstrating the predictive value of aortic stiffness for CV events over traditional CVRF**
 - Shokawa (2005): CV mortality in the general population
 - Willum-Hansen (2006): CV mortality in the general population
 - Sutton-Tyrell (2005): CV mortality, CHD, Stroke in older adults
- **Surrogate endpoint?**

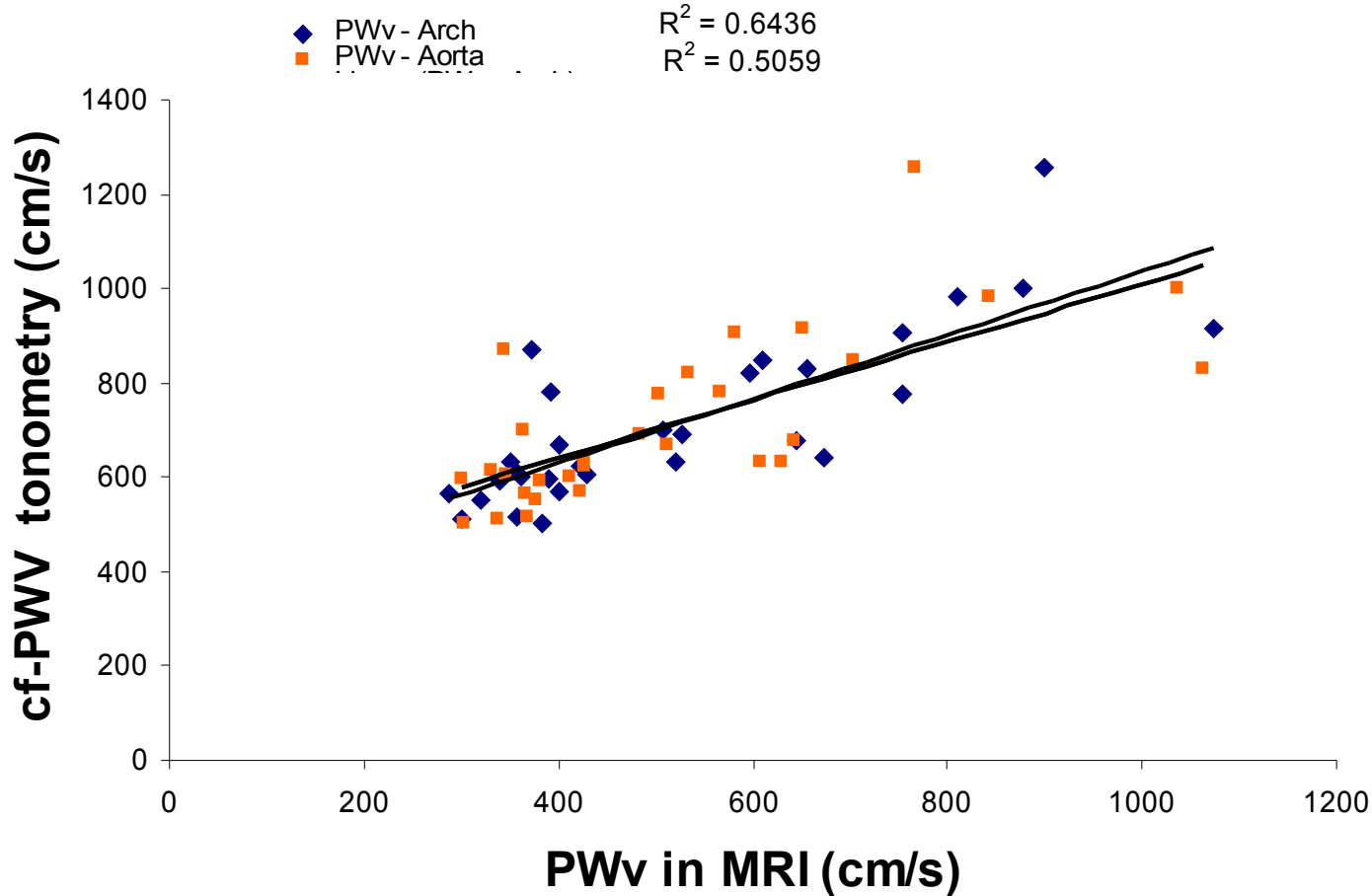
Proximal Aortic PWv in MRI



$$PWv = \frac{\Delta d}{\Delta t}$$



Carotid-Femoral vs. Central PWv



Ancillary PWv Study in MESA

- Completed: 206 PWv (goal: 500 by nov. 2008)
- Proposal: all participants having an MRI in MESA
 - Baseline
 - Follow-up: MESA Ex. 4 and MESA Ex.5
- Sample relevant to main MESA population
- Largest cross sectional study of PWv with MRI in general population
- Largest longitudinal study of arterial stiffness by MRI in general population

Objectives of main MESA

■ Primary Objectives

- Determine characteristics related to **progression of subclinical CVD** and **progression of subclinical to clinical CVD**.

■ Secondary Objectives

- Assess **ethnic, age, and gender differences in subclinical disease** prevalence and progression and clinical CVD.
- Interrelationships of **newly identified factors, established risk factors, and subclinical disease** and determine the incremental predictive value for clinical CVD of newly identified factors above that of established risk factors.

Specific Burden

- **To participants**
 - Original MRI protocol (baseline)
 - 3 breath-holds for the sagittal oblique aortic images
- **To staff**
 - Original MRI protocol (baseline): no new specific training
 - Time: + 1 minute / MRI protocol of MESA Ex. 4
 - Data size: only 3 static images added (not dynamic series)
- **No significant acquisition burden**
- **Post processing and analysis burden significant**
(20 min/case without data retrieval)

Thank you,

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- Joao Lima
- David Bluemke

