

# Cardiovascular aspects and Cognition

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Alfred Wong

Geriatrician and MD student  
Fall and Balance Research Group  
POWMRI

# Cardiovascular risk factors

- Classical cardiovascular risk factors are associated with cardiovascular adverse events and cognitive decline
- Arterial stiffness is an additional cardiovascular risk factor which has been studied extensively - now included in the guidelines of European Society of Hypertension

# Predictor of adverse CV events

- Boutouyrie; Hypertension 2002; 39: 10-15
  - Aortic stiffness is an independent predictor of primary coronary events in hypertensive patients in a longitudinal study
  - N= 1045, mean follow up 5.9 year
  - As good as, if not better than Framingham risk score
- Mattace-Roso; Circulation 2006; 113: 657-663
  - Arterial stiffness and risk of coronary heart disease and stroke: the Rotterdam Study
  - Predictive value of arterial stiffness is independent of common CV drug therapy

## Factors affecting Arterial Stiffness

- Gender
- Age
- Disease processes such as hypertension, renal failure, diabetes, visceral obesity etc

## How do we measure arterial stiffness non-invasively?

- Direct versus surrogate
- Sites of direct measurement
- Type of machines

# Direct versus surrogate

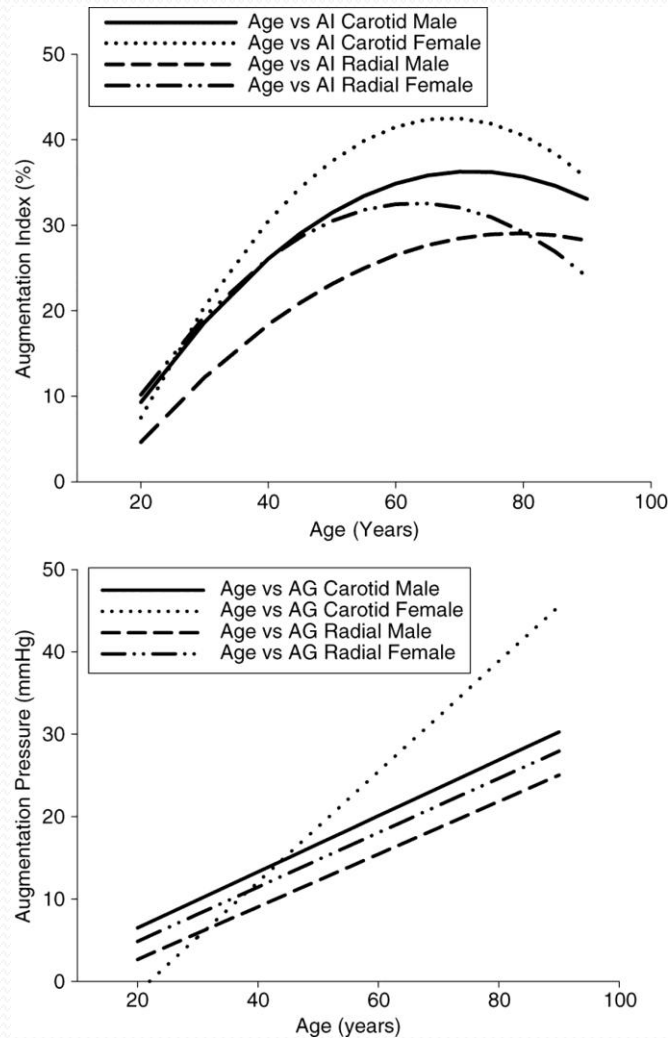
- Pulse wave velocity (PWV)
  - Pulse transit time
- Pulse wave analysis (PWA), usually radial pulse
  - Augmentation pressure (AG)
  - Augmentation index (AIx)
    - Based on reflected pressure wave i.e. combined aortic and peripheral arterial stiffness
    - Plateau after age of 50
- TensioMed Arteriograph
  - Relatively new with very few studies available, yet
  - Using brachial pulse wave and some clever maths model

# Representation of a central aortic pressure waveform and calculation of the augmentation pressure and pulse pressure



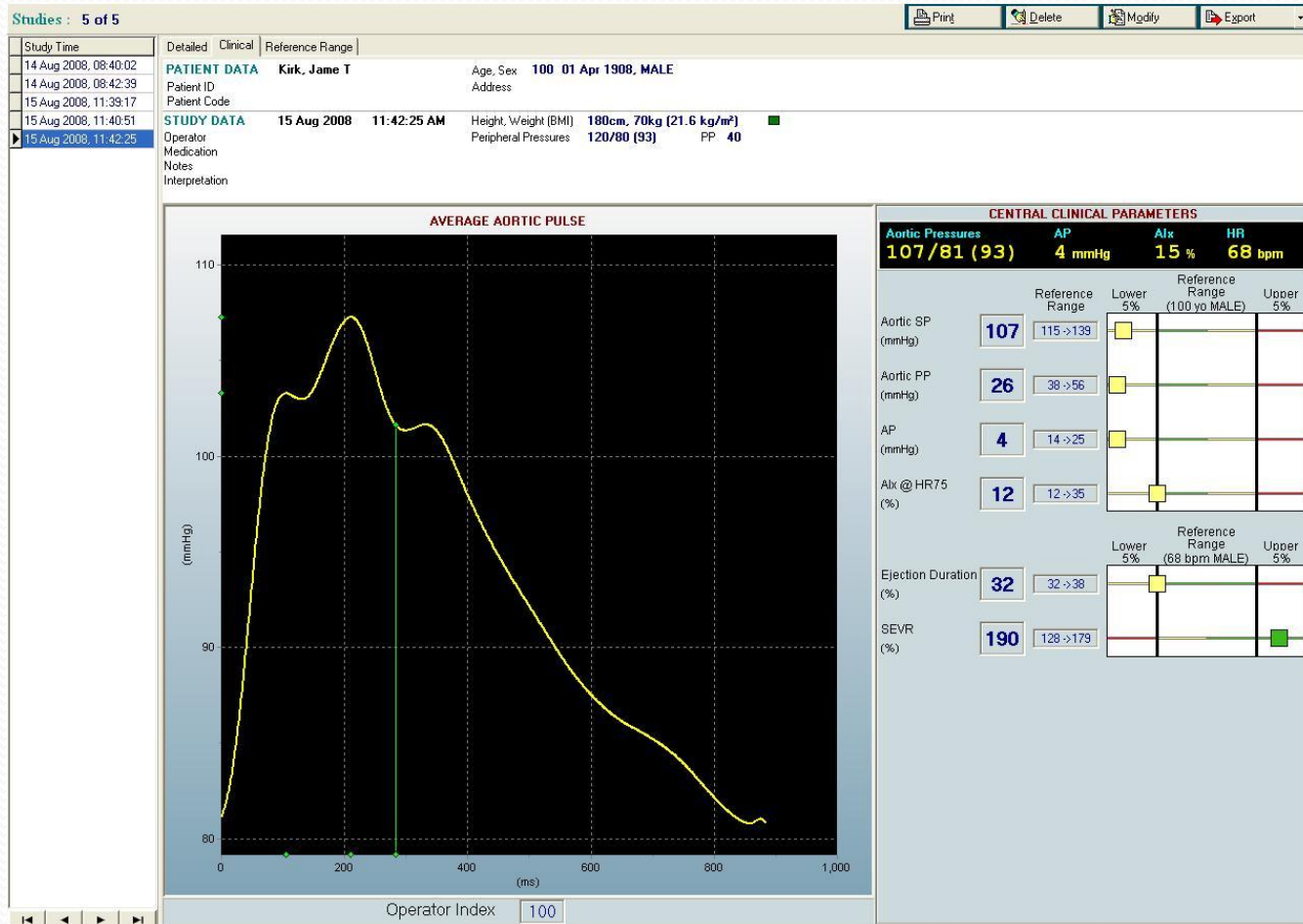
Chirinos, J. A. et al. Hypertension 2005;45:980-985

# Quadratic regression augmentation index (AI)-age

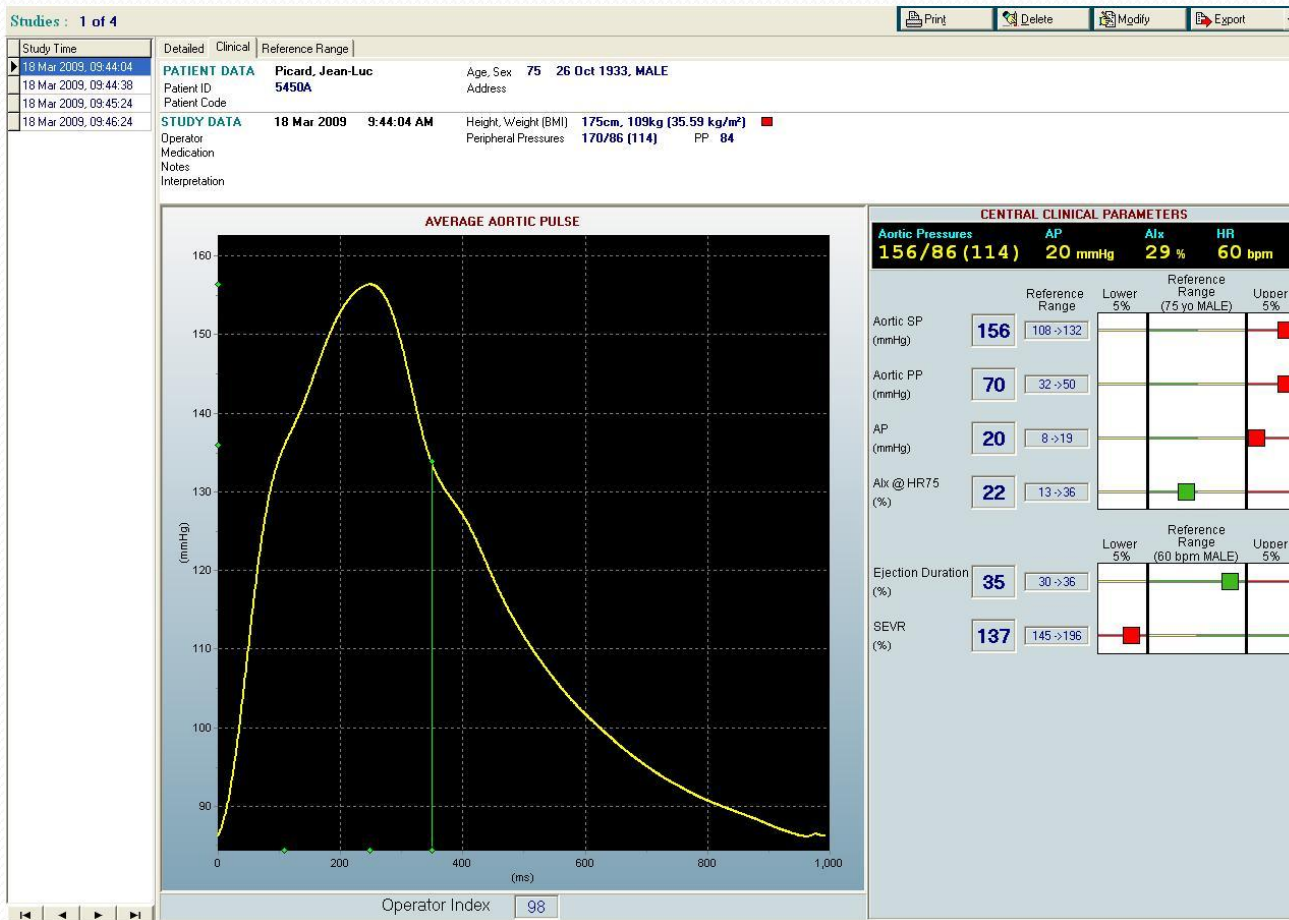


Fantin, F. et al. Age Ageing 2007 36:43-48; doi:10.1093/ageing/af115

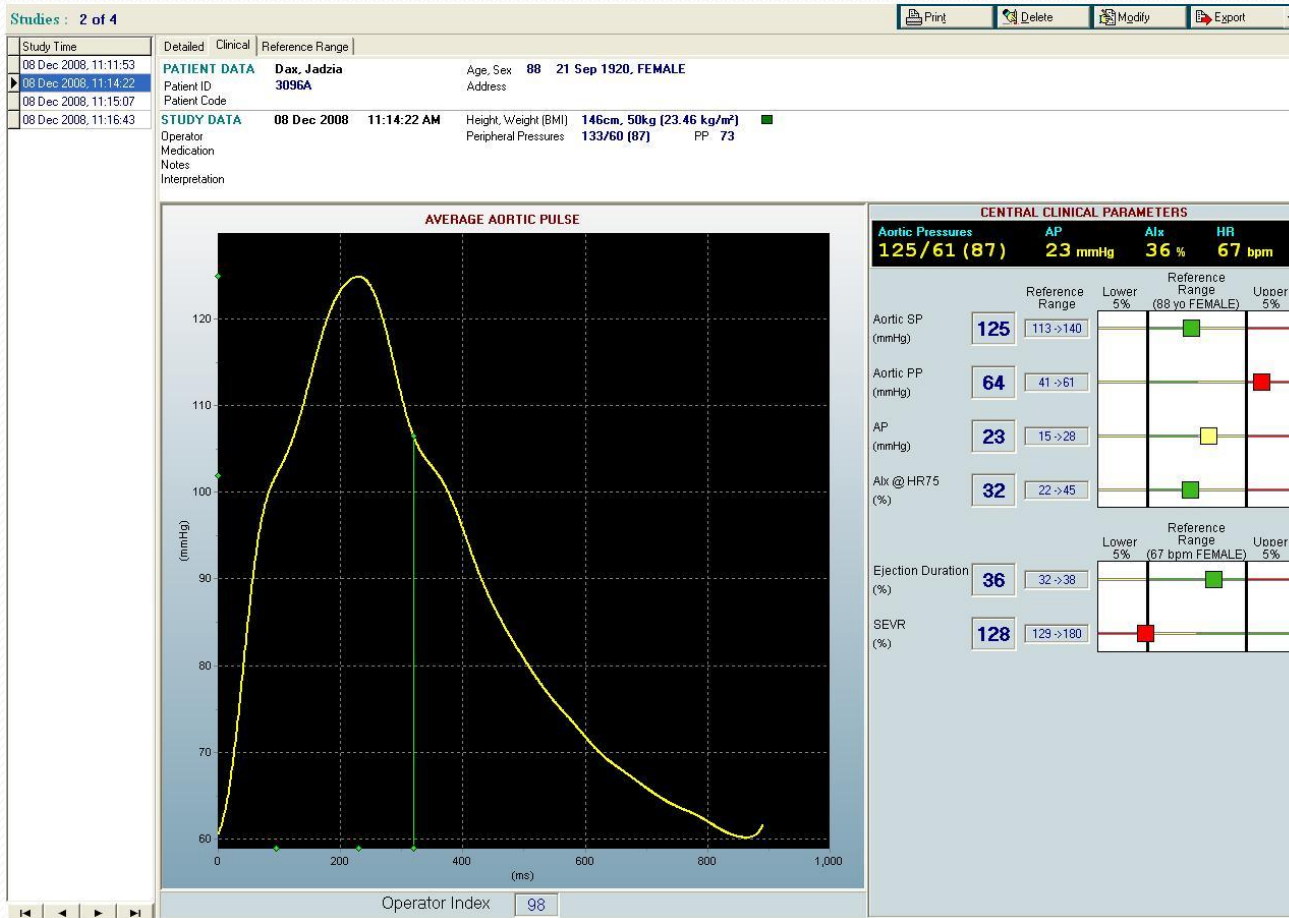
# James T Kirk



# 75 y.o. ♂



# 88 y.o. ♀



# PWV

## Site of measurement

- Carotid femoral CF PWV
  - gold standard with most of the evidence
  - Across the whole aorta
- Carotid radial
- Brachio- ankle ba PWV

## Type of machine

- Complior
  - Simultaneous measurement of carotid and femoral pulses
- AtCor SphygmoCor
  - Sequential measurement of carotid and femoral pulses with ECG synchronisation

# AtCor SphygmoCor PVx system



# PWV of a young man



# 75 y.o. ♂

**Studies: 1 of 5** Print Delete Recalculate Create PwA Export

Study Time	PATIENT DATA	Picard, Jean-Luc
18 Mar 2009, 09:52:58	Patient ID	5450A
18 Mar 2009, 09:57:24	Patient Code	Address
18 Mar 2009, 09:58:50	Age	75 26 Oct 1933, MALE
18 Mar 2009, 10:02:46	STUDY DATA	18 Mar 2009 9:52:58 AM Hgt, Wgt (BMI) 175cm, 109kg (35.59kg/m <sup>2</sup> ) Dist: 540 mm
18 Mar 2009, 10:05:35	Medication	
	Notes	
	Operator	

Sp/Dp (Mp) **170/86 (-)** Algorithm: **Intersecting tangent**

**Site A - CAROTID**

100  
5  
1  
9

433  
2  
1  
3

**Site B - FEMORAL**

120  
8  
1  
20

434  
1  
1  
1

Site A-B	MeanT(ms)	SD(ms)	N	HR(bpm)
ECG-CAR	75.0	2.0	6	57
ECG-FEM	108.3	3.1	8	59
CAR-FEM	33.3	3.7		

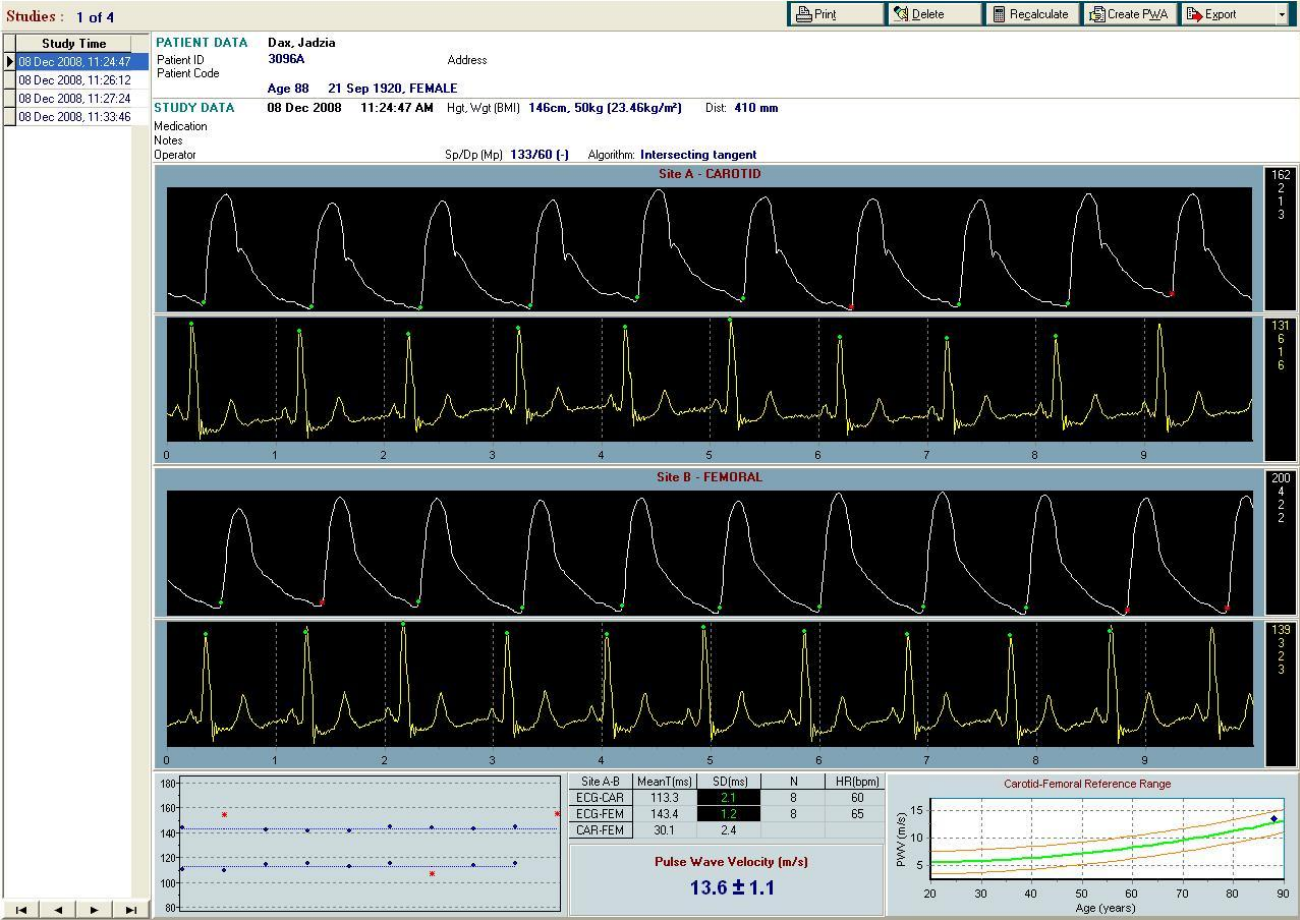
**Pulse Wave Velocity [m/s]**

**16.2 ± 1.8**

# 78 y.o. ♀



# 88 y.o. ♀



# Hanon; Stroke 2005; 36: 2193-2197

## PWV and Cognition

- Patients in memory clinic
- N= 308, mean age  $78 \pm 8$  with 64% F
- Used MMSE and Cognitive Efficiency Profile (CEP)
- Control:  $11.5 \pm 2.0$
- MCI:  $12.6 \pm 2.6$
- VaD:  $15.2 \pm 3.9$
- AD:  $13.3 \pm 2.9$
- “Our result showed a relationship between arterial stiffness and cognitive impairment, suggesting that functional changes of the arterial system could be involved in the onset of dementia”

# Poels; Stroke 2007; 38: 888-892

## PWV and Cognition

- Population study- The Rotterdam Study
- N= 2767, age  $72 \pm 6.7$  with 42.3% M
- “We did not identify arterial stiffness as an independent risk factor to cognitive decline or risk of dementia”

# Henskens; Hypertension 2008; 52: 1120-1126

## PWV and MRI

- N=167 with 85 M, mean age  $51.8 \pm 13.1$
- BP  $169 \pm 25/104 \pm 12$
- 1.5T Philips scanner
- “aortic stiffness is independently associated with manifestations of cerebral small vessel disease in hypertensive patients, linking systemic large to cerebral small artery disease”

# Kim; Clinical Neurology & Neurosurgery; 110 (2008) 599-604

- Control n=64,
  - mean age 65.3, PWV 16.77
- Silent SVD n=67,
  - mean age 67.4, PWV 18.73
- Symptomatic SVD n=65,
  - mean age 67.2, PWV 19.76
- “Increased ba PWV was significantly associated with the risk of SVD in elderly persons with hypertension. Therefore, the measurement of ba PWV could be used to predict SVD.”