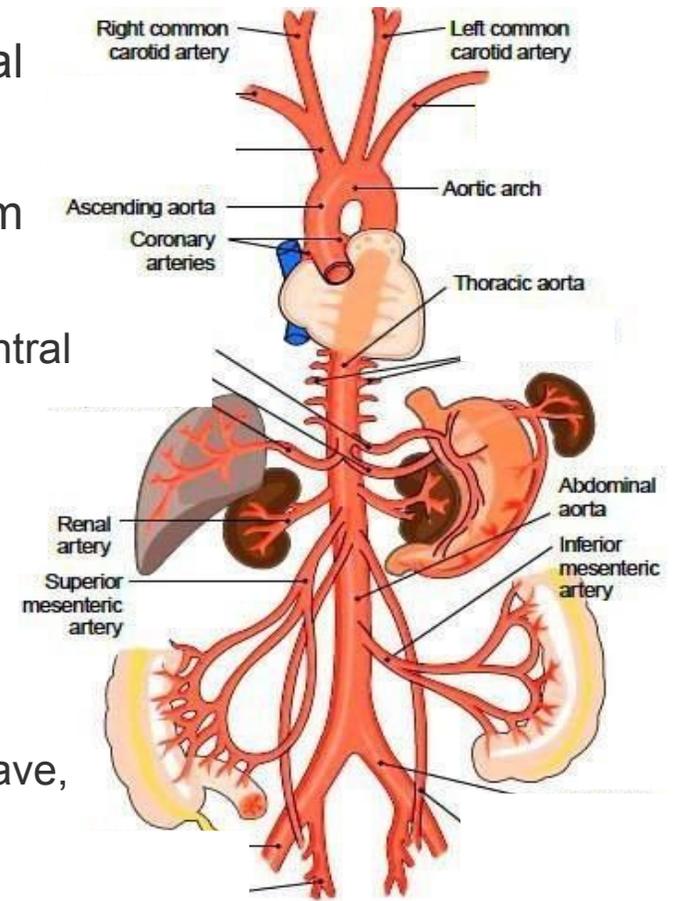




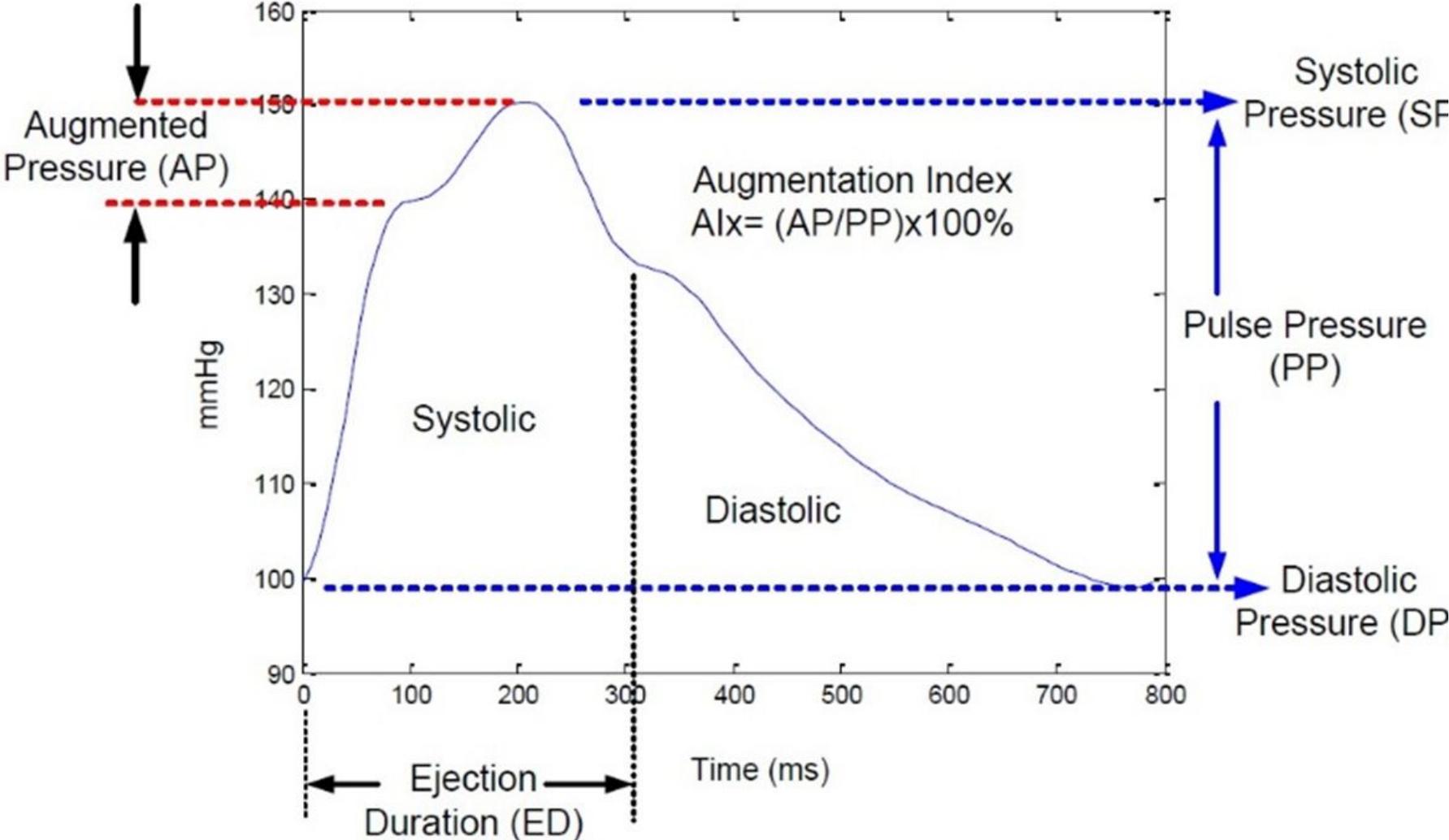
# The Role of Non-Invasive Central BP Monitoring in Improving Brain Health

# Non-Invasive Measurement of Central Aortic BP

- Central pressures directly impact organs and are generally more highly correlated with end-organ damage and clinical outcomes compared to brachial (peripheral) pressures
- Central pressures can be captured non-invasively through pressure wave form analysis (PWA)
  - Transforms the data from peripheral arterial BP waveforms into an evaluation of central aortic pressures
  - PWA corrects for pressure wave amplification in the upper limb
- Key variables produced by PWA:
  - Central aortic systolic and diastolic pressures
  - Central aortic pulse pressure (systolic minus diastolic pressure)
  - Augmentation pressure (difference between (a) reflected wave added to incident wave, and (b) incident pressure during systole)
  - Augmentation index (augmentation pressure divided by the pulse pressure)



# Central Aortic Pressure Waveform

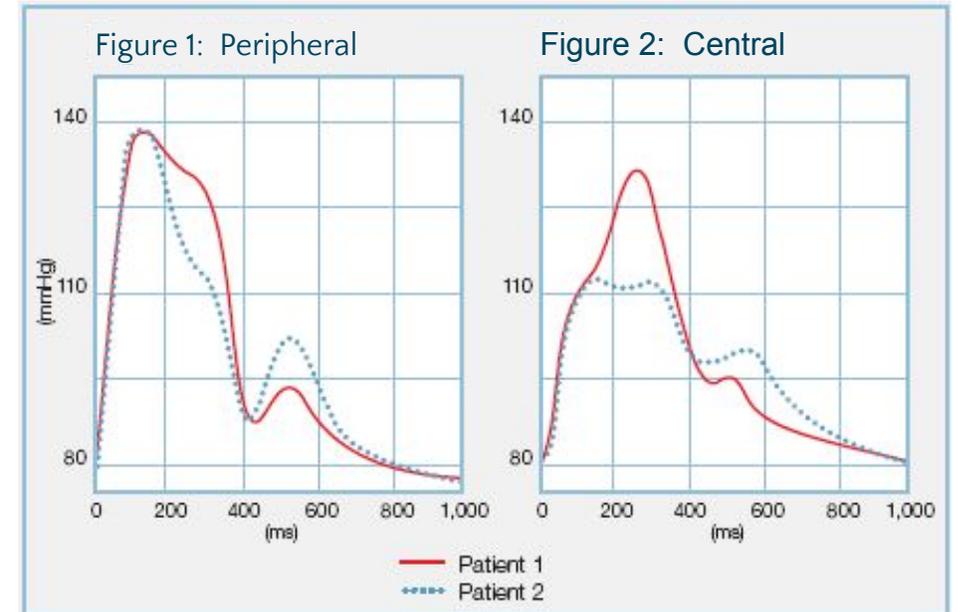


# Brachial Pressure Differs from Central Pressure

## Brachial Cuff Pressure vs. Central Aortic Pressure

Two patients with SIMILAR BRACHIAL CUFF pressures (Figure 1), but with significantly DIFFERENT CENTRAL/AORTIC arterial pressure waveforms (Figure 2).

- The difference in waveform shapes, due to differences in arterial stiffness and the effects of wave reflections, effects the aortic but not the brachial systolic and pulse pressures



Brachial and Central Aortic Pressure Measurements are Not Redundant and Provide Clinically Relevant and Complimentary Information

# Why Central Waveforms and Central BP?

1

**Additional risk determination** of hypertension and related diseases, such as stroke, CKD, pre-eclampsia, cognitive impairment. Central BP is independently predictive of CV events.

2

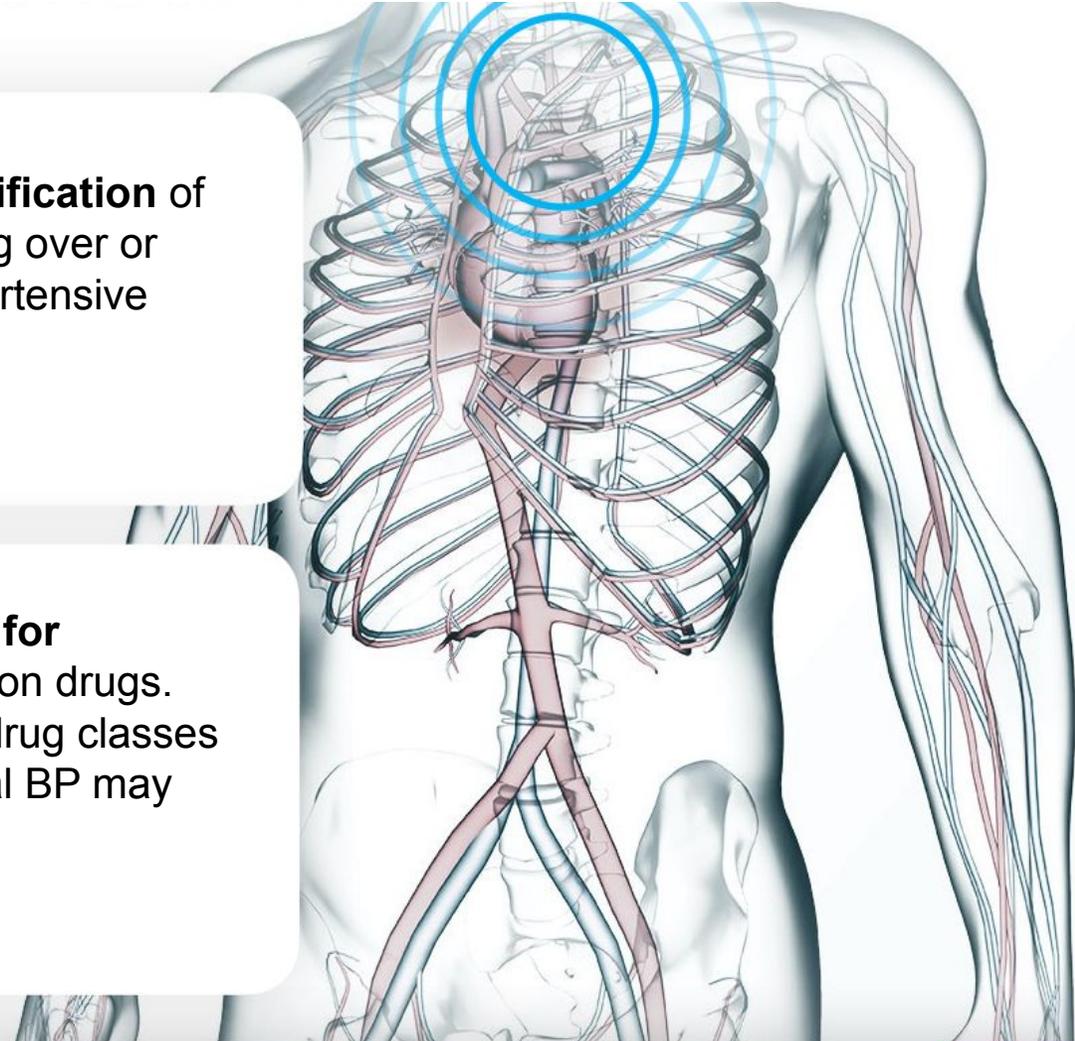
**Closer reflection of CV risk** than brachial BP – studies indicate predictive superiority of central over brachial BP. Elevated central BP predicts CV events, mortality, and organ damage (e.g., LVH, intima-medial thickness, reduced GFR).

3

**More accurate identification** of patients that are being over or undertreated for hypertensive related disorders.

4

**Additional precision for targeting** of prescription drugs. Differential effects of drug classes on brachial and central BP may occur.



# Central Pressure Indices & Brain Health

- **Brain health** is linked to vascular health and the preservation of large artery elasticity.<sup>1</sup>
  - Arterial elasticity (inverse of stiffness) is evaluated from central aortic pressure waveform
- Elevated central BP associated with **cognitive impairment** and risk of cerebrovascular events.<sup>2</sup>
  - Brachial and central BP independently associated with silent brain infarctions
- **Cognitive engagement** increase augmentation index (AIx) as measured by SphygmoCor.<sup>3</sup>
- AIx and pulse pressure amplification are associated with **poor executive function** and **language cognitive domain deficits**.<sup>4</sup>
- Aortic and cerebral pulsatility are strongly related, suggesting a key role for transmission of aortic pulsatility to the brain.<sup>5</sup>
- Intracranial pressure waveform is similar to the central pressure waveform (SphygmoCor).<sup>6</sup>
- **White matter abnormalities consistent with Alzheimer's Disease** had higher correlations with central aortic systolic BP compared to brachial systolic BP.<sup>7</sup>
- Central pressures were sensitive indicators of **cognitive aging**, predicting aspects of cognitive performance not predicted by brachial blood pressure.<sup>8</sup>

1. Gauthier et al, Neurobiology of Aging 2014, 1-11; 2. Matsumoto K adults. Hypertension 2020. 3 Heffernan et al, American Journal of Hypertension 2014; 4. Suleman R et al, Clinical Hypertension 2017 23:2; 5. Webb A, Journal of Cerebral Blood Flow & Metabolism 2020; 6. Kim M et al, Intracranial Pressure and Brain Monitoring XV 2016, Acta Neurochirurgica Supplement, Vol. 122; 7. Chetouani. Neuroimage: Clinical 2018;17:804-10. 8. Pase. Psychological Science 2013

# Conclusions

- Measuring central BP provides health care providers and patients additional information about the possibility of experiencing end-organ damage, cerebrovascular disease, cognitive impairment, and cardiovascular disease.
- Monitoring central BP at home will:
  - increase the effectiveness of management plans (lifestyle and medical) that are anticipated to positively impact brain health
  - provide feedback directly to patients and further empower patients
  - Improve the relationship between health care providers and patients
  - Improve the ability of health care providers to evaluate complex interactions between comorbidities and drugs that can affect vascular physiology