

Dynamic Vascular Assessment (DVA): Premises

- Vessels autoregulate for adjacent vessel segments and systemic conditions
- DVA measures non-invasively the “state” of autoregulation
- DVA measures “endothelial function” at rest
- DVA explains how vascular disease, in both subtle and severe conditions, causes or is affected by a large number of medical conditions
- DVA may be used to formulate a physiological differential diagnosis that may, in some conditions, be diagnostic

Dynamic Vascular Assessment: what is it?

Consists of:

- 3-parameter nomogram of well-characterized physiological parameters normalized to standard deviation z-scores
- Considers acceleration, time domain (dynamic information) that measures vessel wall properties

Produces:

- Vascular physiological profiles for segments and systems of segments
- “Bar charts”

Clinical Value:

- Objective, quantitative, automated TCD data processing
- Physiological DDx that has the potential to be diagnostic

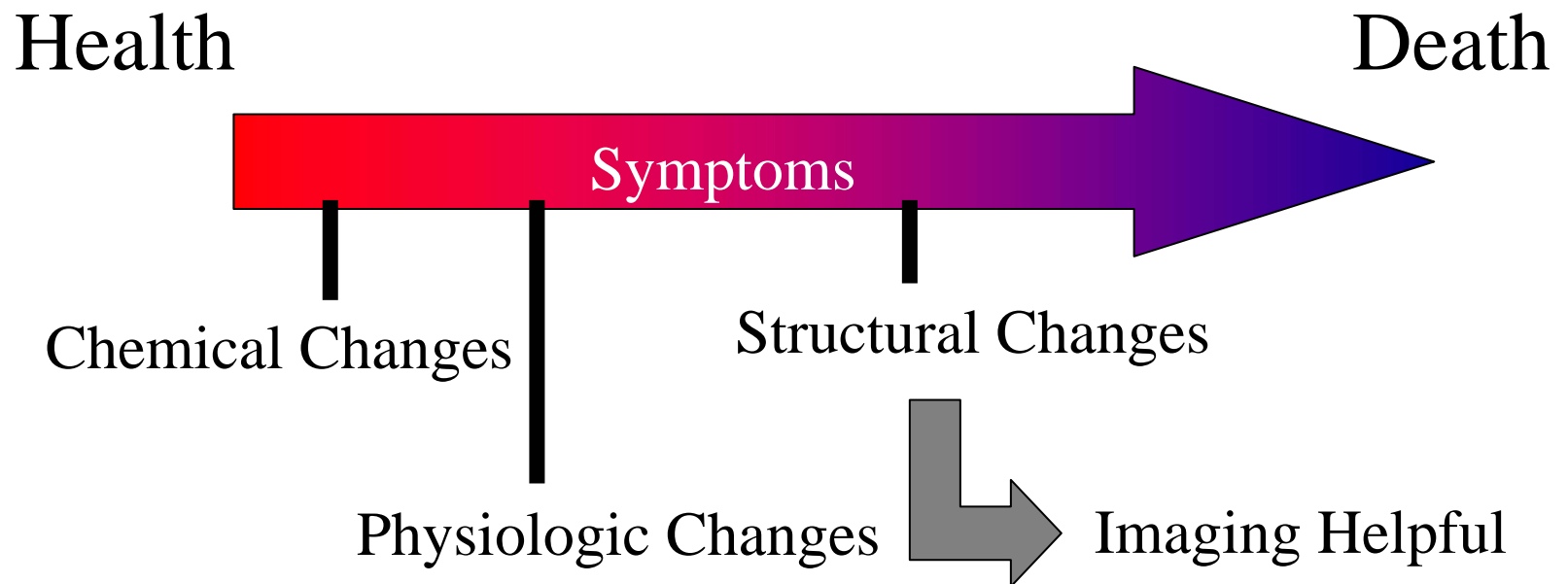
Compares to:

- Good medical lab practice of gathering reference norms
- Physiological (stress) testing

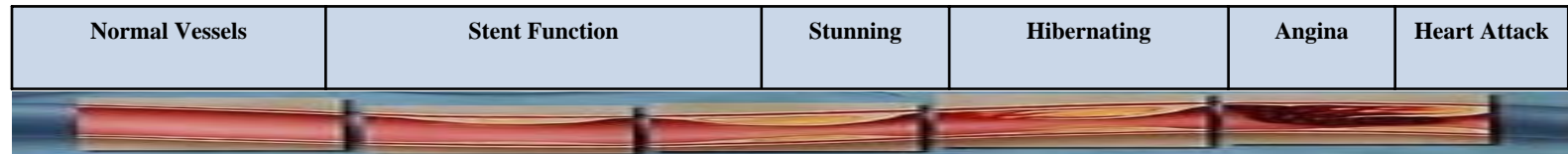
Flow Paradigms: volumetric (flow rate) vs dynamic (vessel performance)

- Steady
- Volumetric
- First order velocity
- Blood Flow
- Pulsatile
- Dynamic
- Second Order Velocity
- Vessel Function

Disease Progression








Cardiovascular Continuum



- There is a continuum of vascular disease associated w a relatively limited set of cardiac symptoms
- Measures along the continuum include:
 - Physiological screening (stress testing)
 - Functional studies (echo, nuclear scan)
 - Anatomical assessments - end-stage, occlusive heart disease

Cerebrovascular Continuum

Normal	Chronic Degenerative, Depression, Parkinsonism	Cognitive Impairment	TIA	Stroke
				

- DVA measures vascular performance and relates the measurements to a continuum of cerebrovascular disease
- Physiological states reflect directly:
 - vascular disease at the large or small vessel level, or
 - elevation of pressure in the skull
- Carotid artery disease causes many neurological symptoms however, stroke risk is the only current indication for treatment
 - Is the risk-benefit ratio optimal at 70% stenosis – with more sensitive tools, probably not.
- Systemic diseases can have neurovascular effects and primary neurovascular disease can have systemic effects

DVA Process and NHSi Platform

Doppler blood flow velocity spectra acquisition

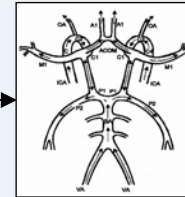
Target Vascular System



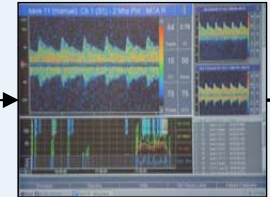
Doppler ultrasound clinical test with current instrumentation



Standard Doppler segmental study

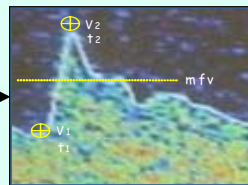


Segmental spectra saved to instrument file



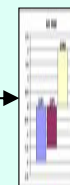
NHSi DVA PLATFORM

DVA Analytical Platform

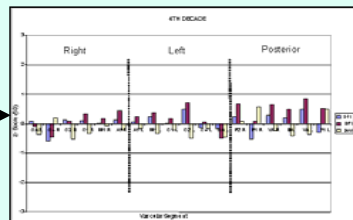


Spectral Data Analyzed and DVA Variables Extracted

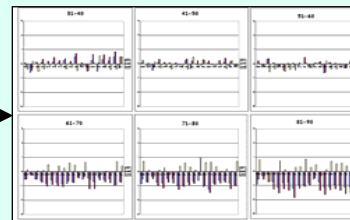
DVA Indices Calculated and Compared with Reference Databases



DVA Indices z-scores generated for each vascular segment



All z-scores for all segments compiled as "bar code" profile

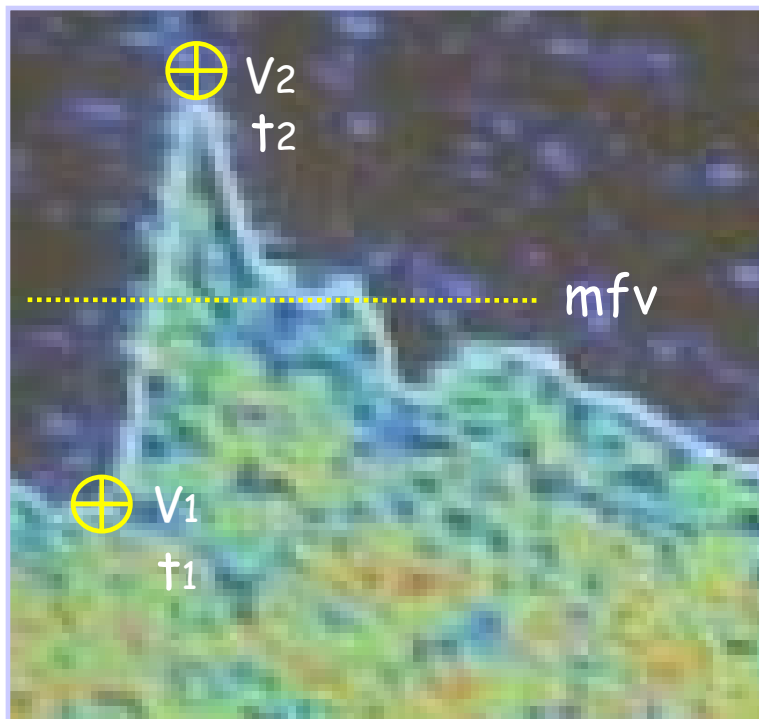


DVA profile compared against suite of reference and disease specific databases



DVA Report: Degree of fit between subject findings and known vascular conditions

DVA Makes TCD Readings Quantitative and Objective



Force of Flow:

$$F \propto SA = \Delta V / \Delta t$$

Mean Flow Velocity:

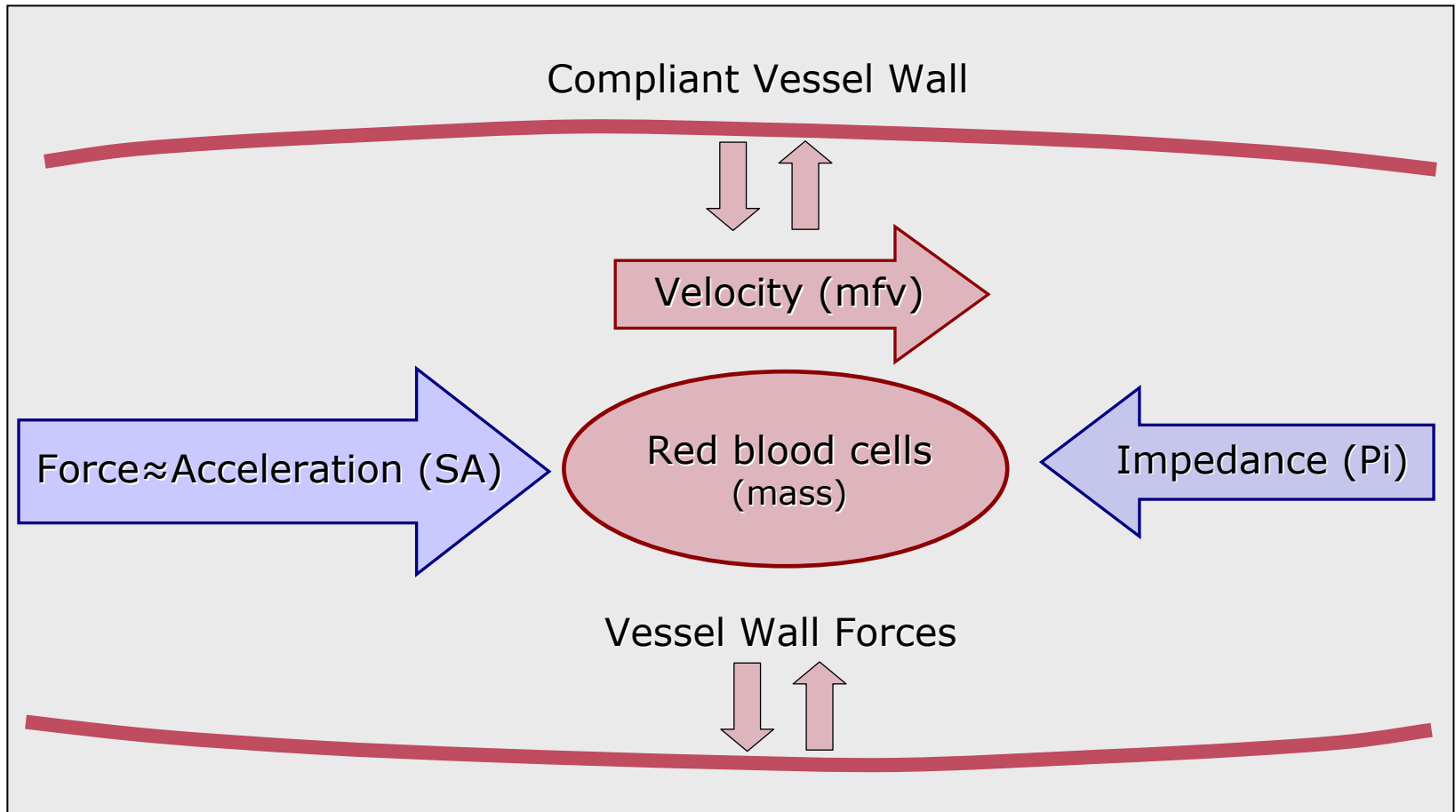
$$mfv = \Delta V / 3 + V_1$$

Impedance to Flow:

$$P_i = \Delta V / mfv$$

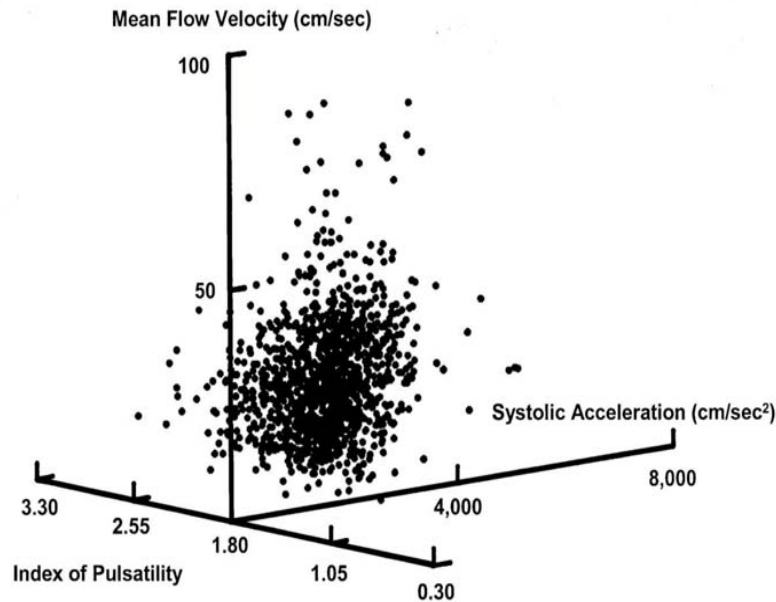
DVA takes the TCD waveform and systematically measures it to quantify the different components of vascular physiology

The DVA Paradigm

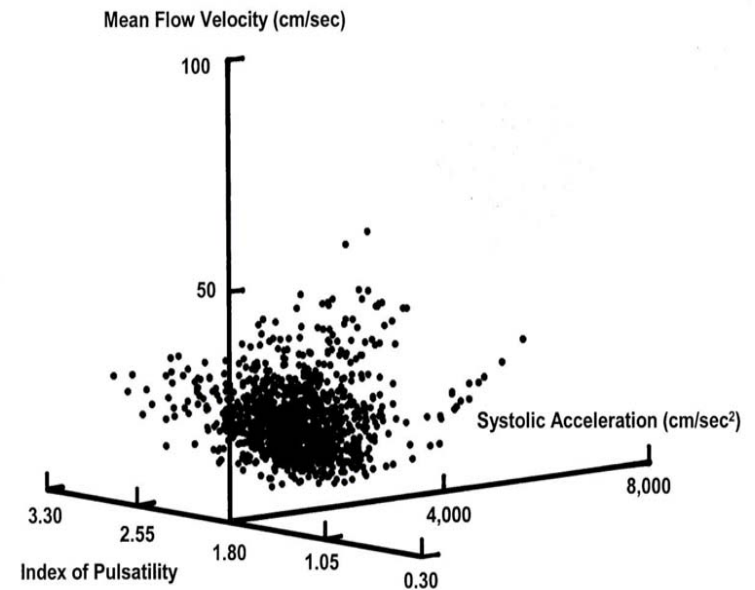


Different Vessels Have Different DVA Signatures

Basilar Artery

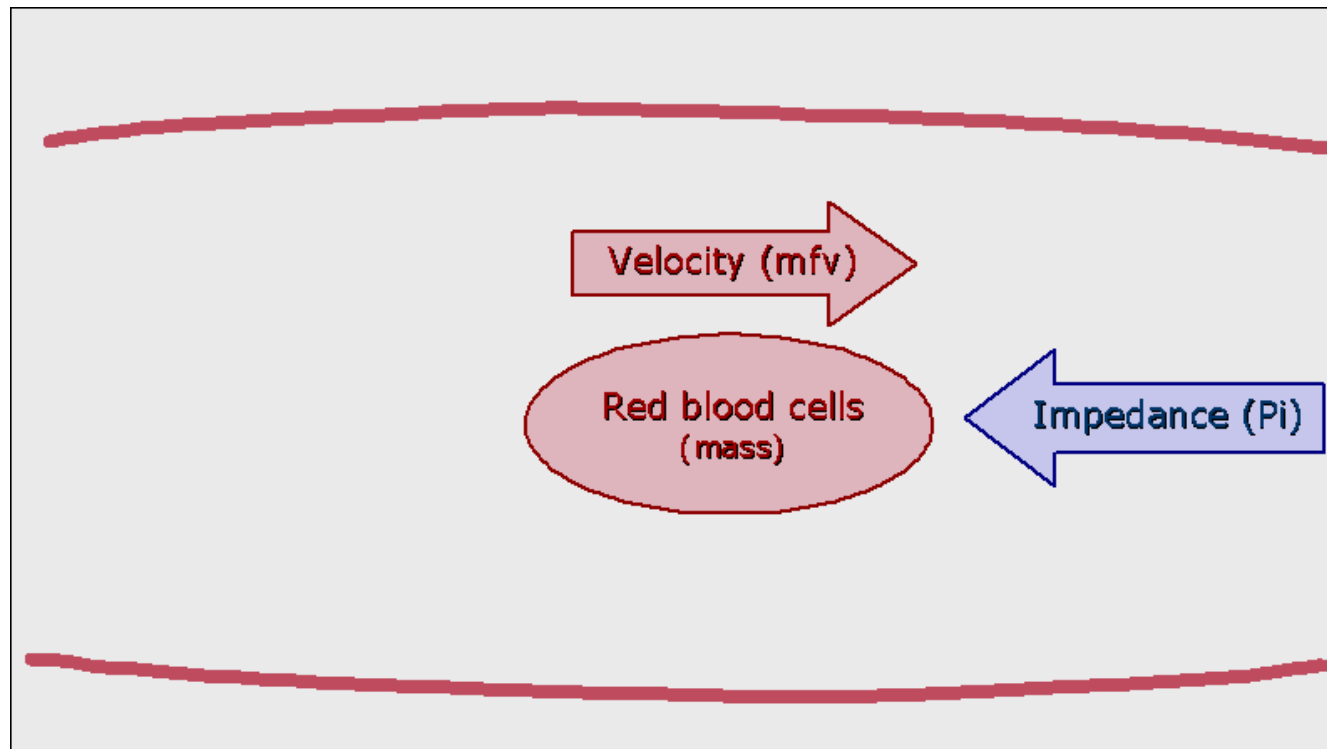


Ophthalmic Artery



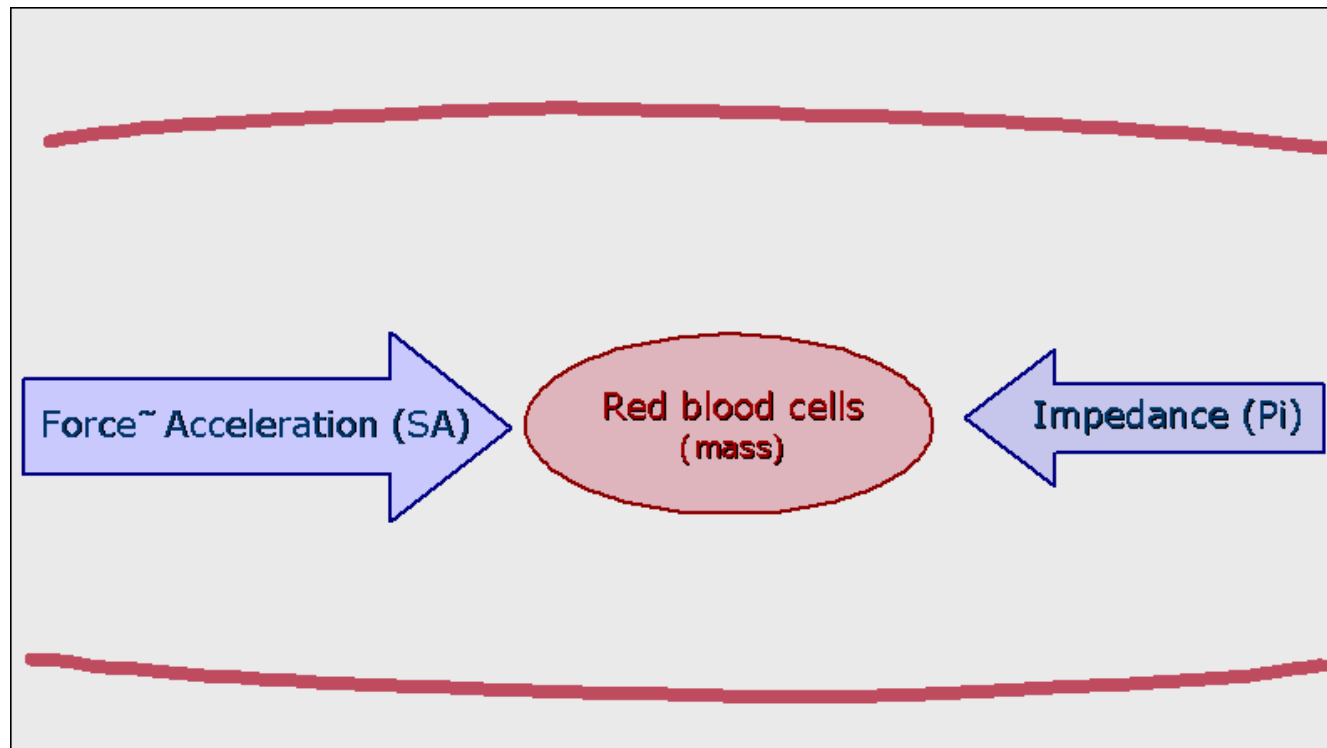
DVA: Dynamic Flow Index

- $DFI = mfv/Pi$
 - Relates Mean Flow Velocity to Impedance (Pi)
 - Capacitance effect on flow through conductance vessels



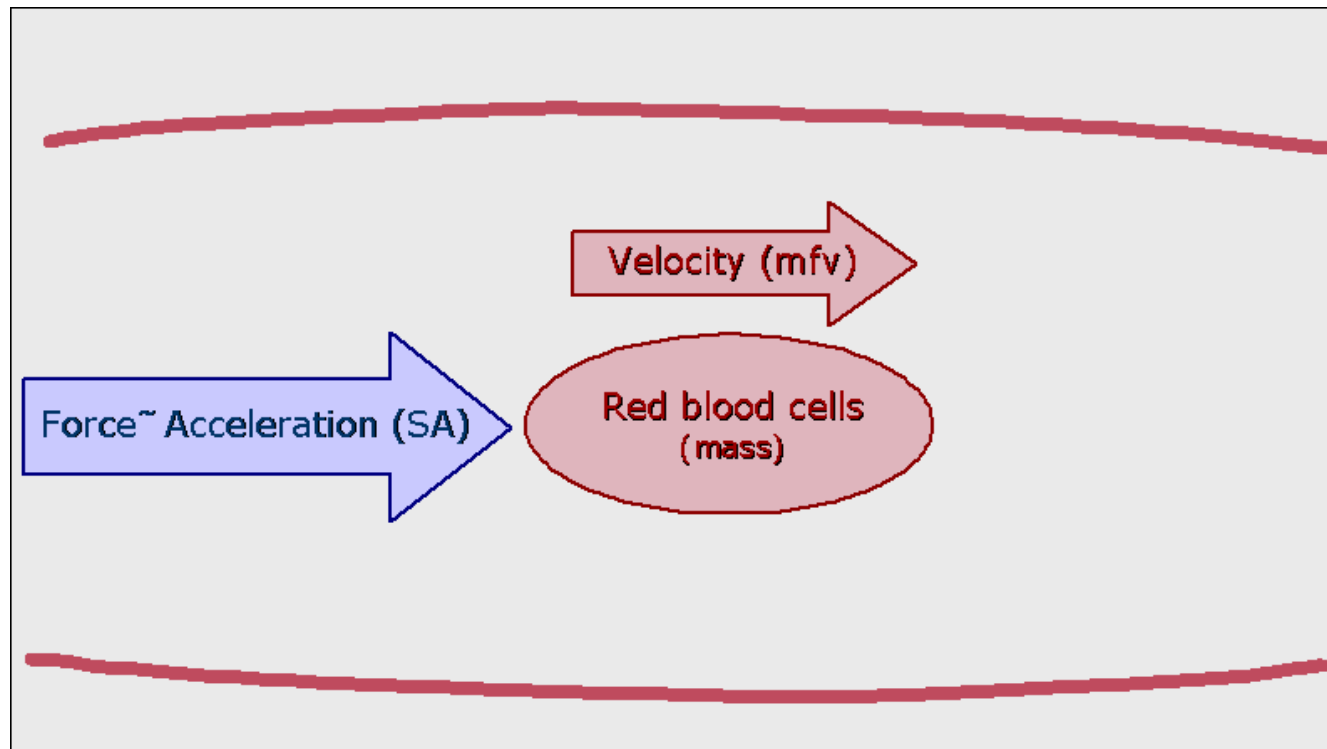
DVA: Dynamic Perfusion Index

- $DPI = SA/Pi$
 - Relates Force of Flow to Impedance
 - Effect of capacitance vessel volume on the force of flow



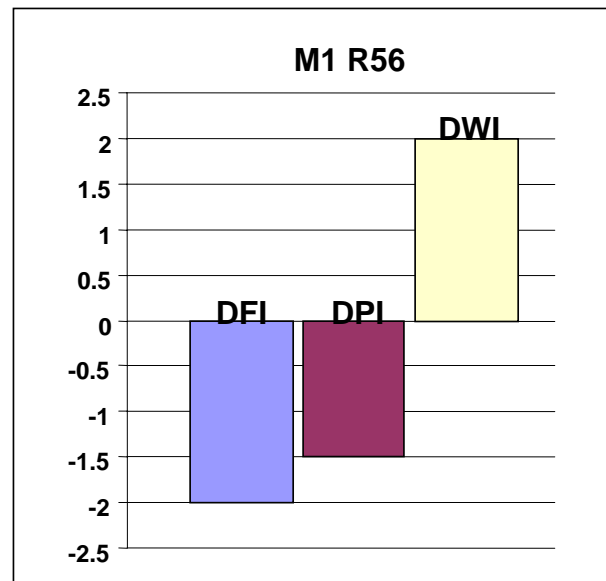
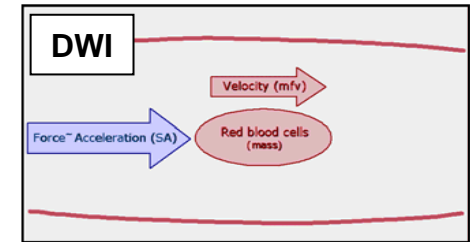
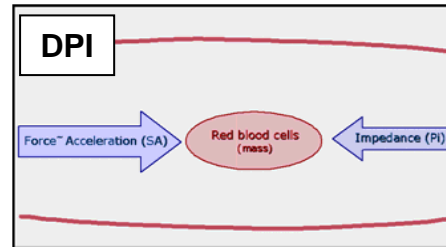
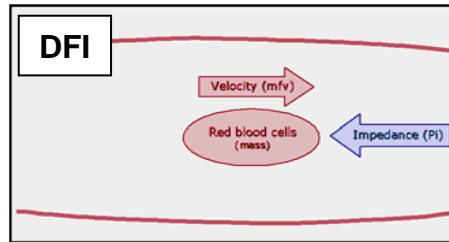
DVA: Dynamic Work Index

- $DWI = SA/mfv$
 - Relates force of flow to mean flow velocity
 - Kinetic efficiency of segment in moving blood forward

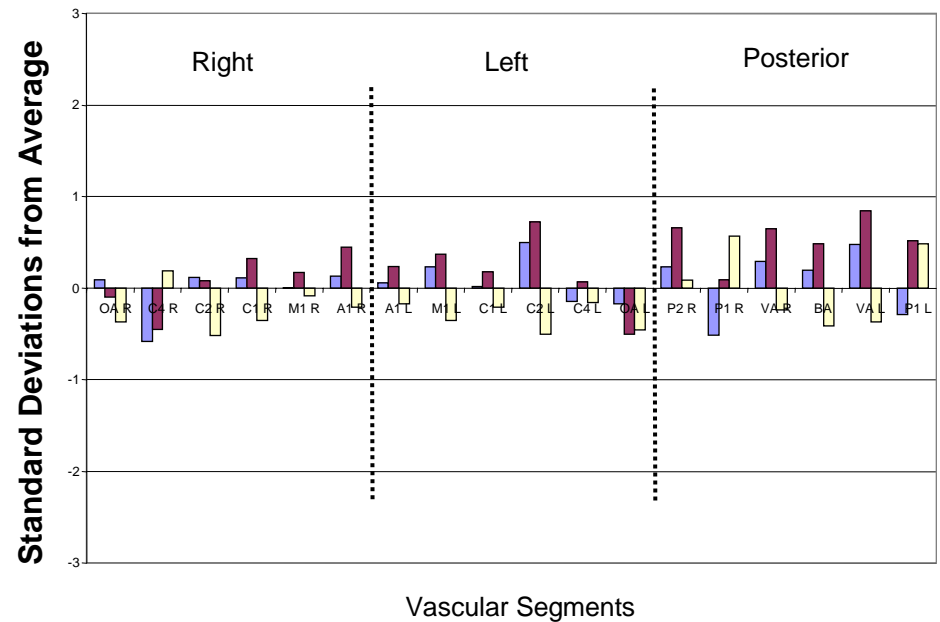
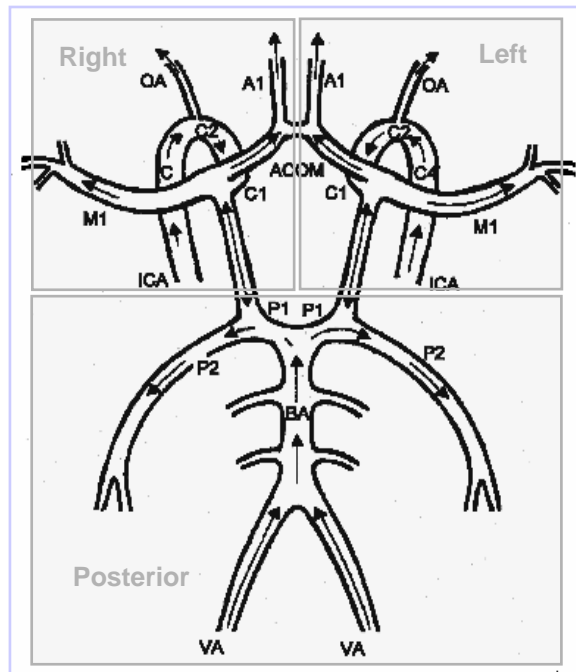


DVA – Dynamic Indices are Internally Referenced

Expressed as \pm SD (z-scores) from a reference data set

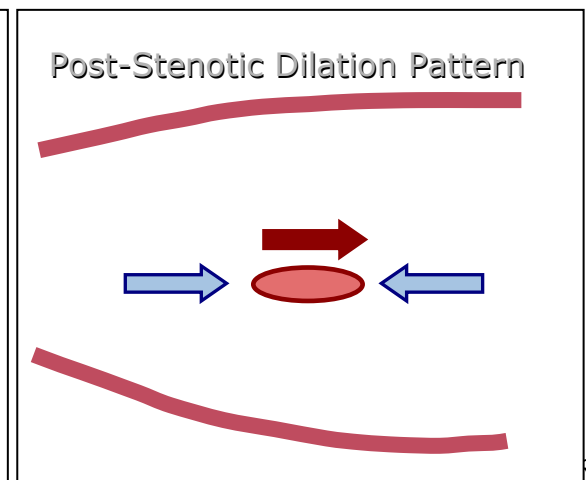
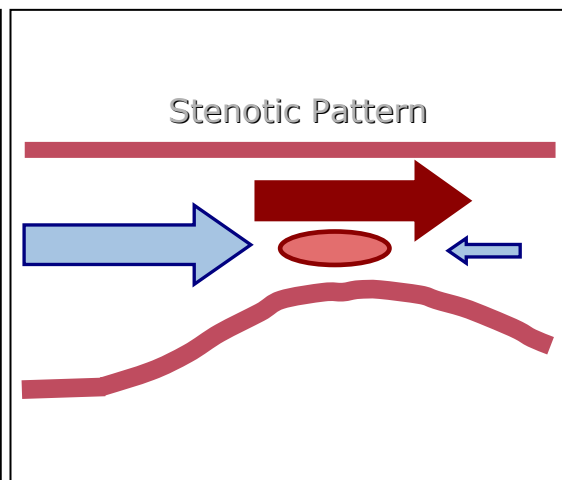
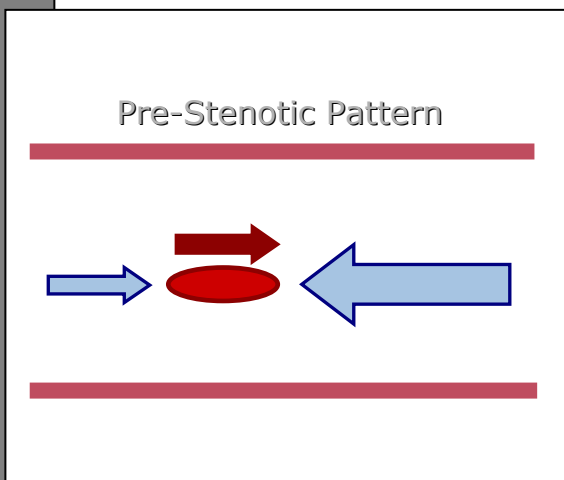
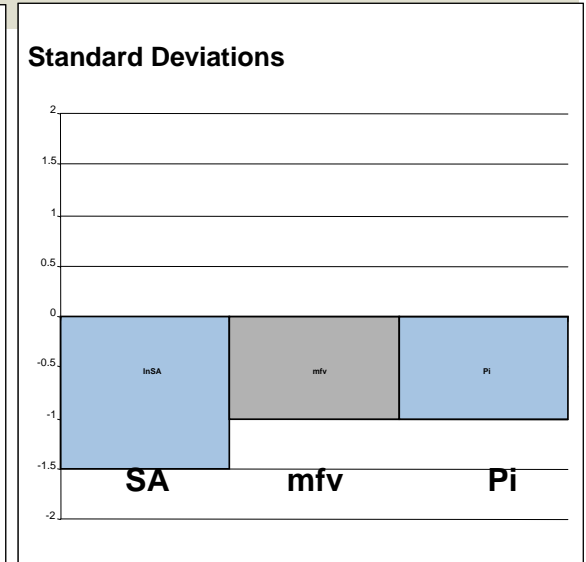
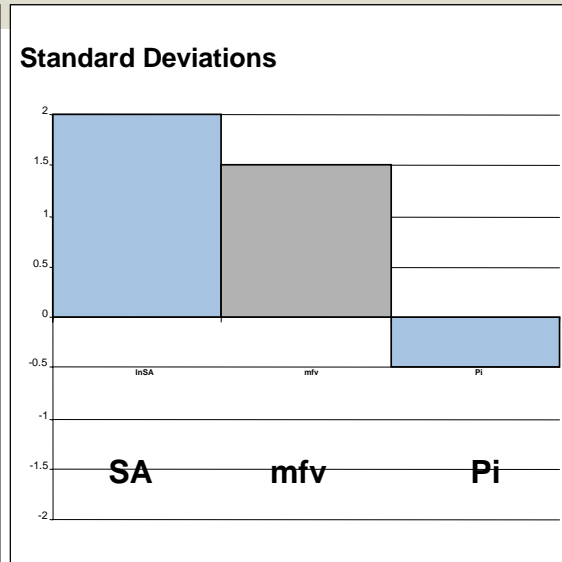
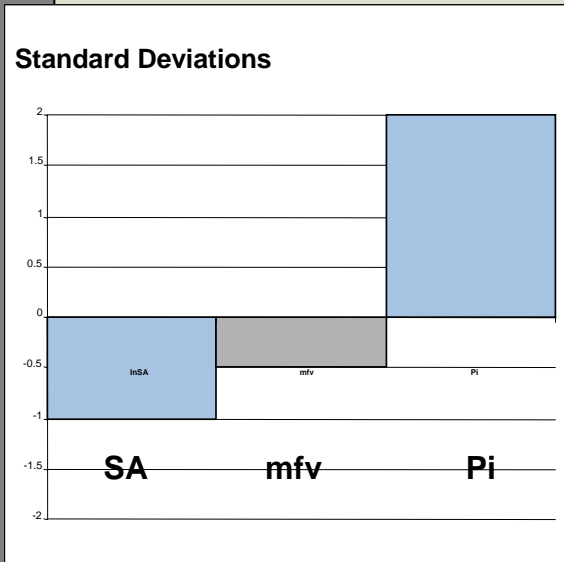


DVA Creates a Comprehensive Cerebrovascular Footprint

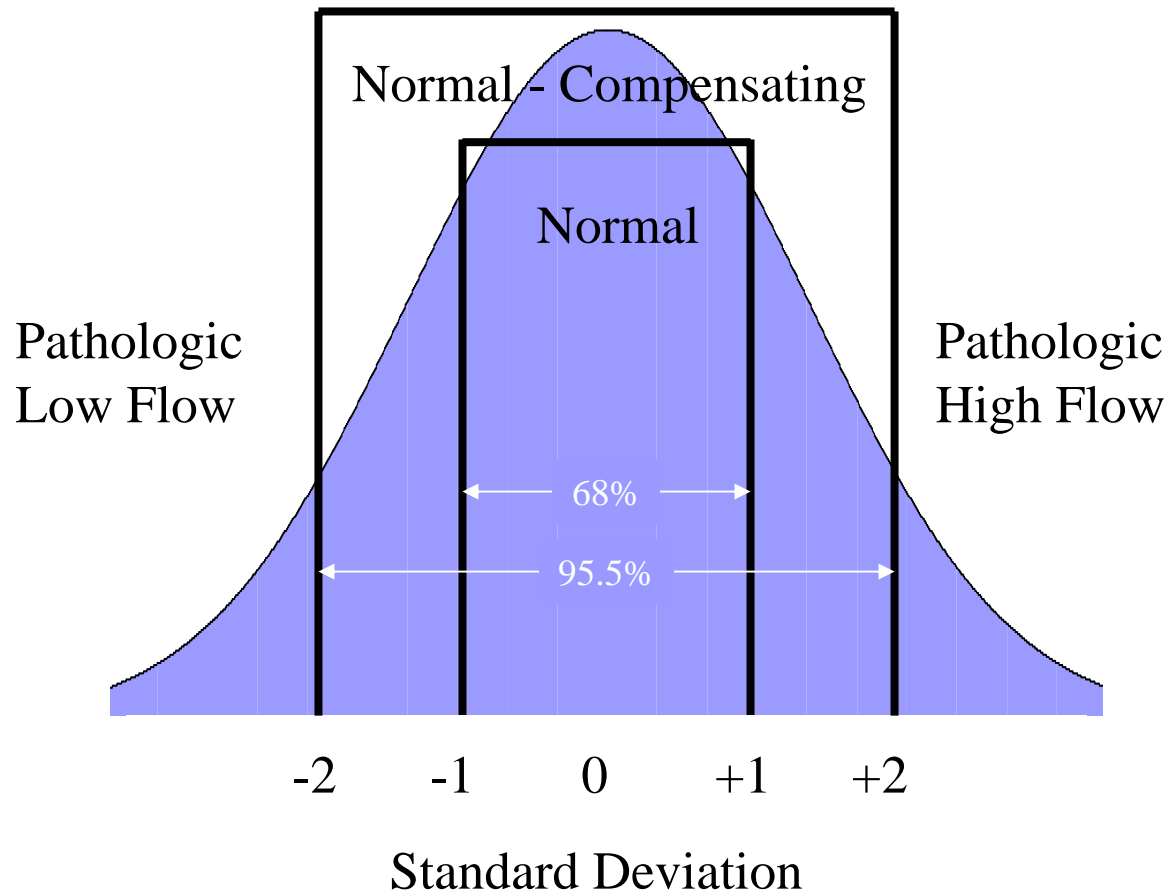


DVA measures 15+ cerebrovascular segments and compares them to a proprietary reference database creating a meaningful picture of a patient's vascular health. Assigning each measurement a normal, high or low value, there are 300k theoretically possible vascular "signatures".

DVA Measures the Physiological Impact of an Angiographically Defined Lesion



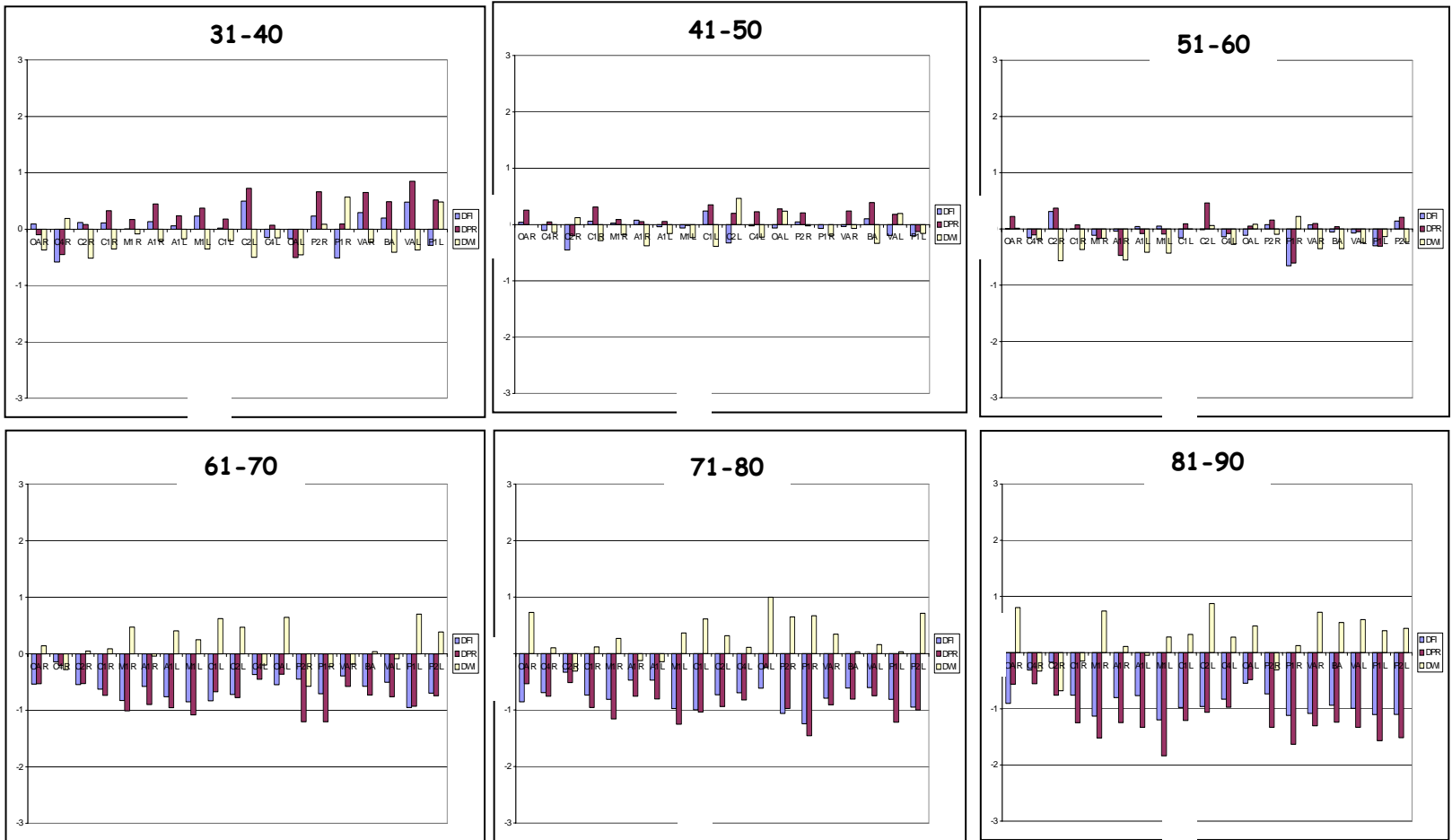
Regulatory Strategy: physiological claims of vascular states



DVA-Enabled Differential Diagnosis and Evaluation

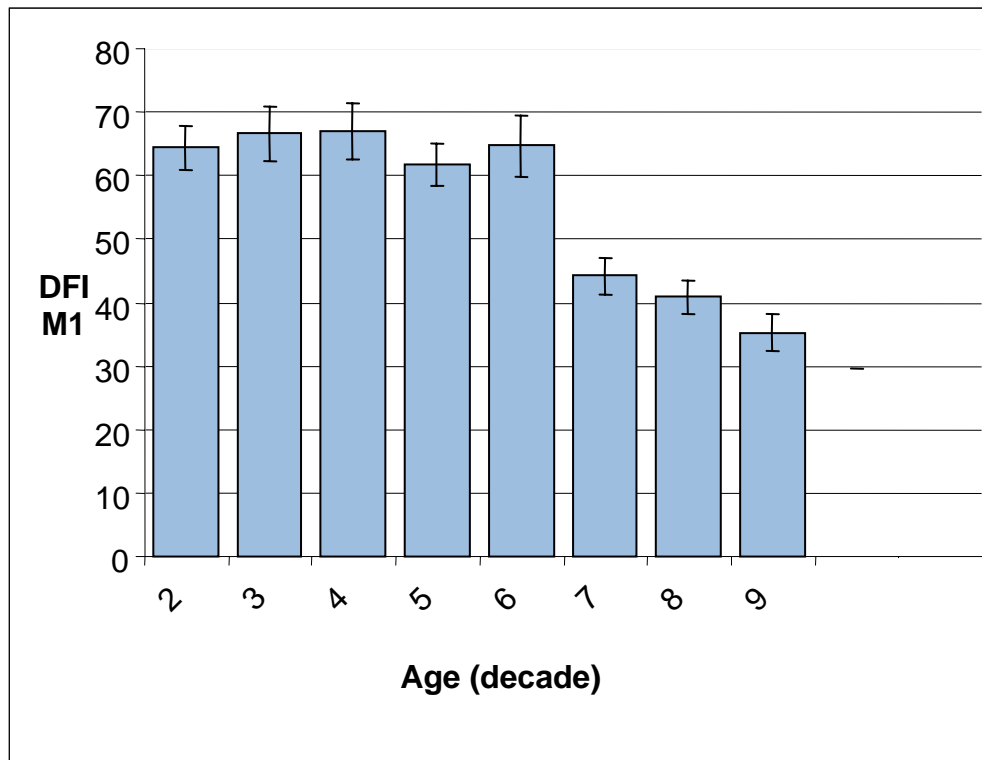
- **Segmental Vasculopathy (diminished compliance, narrowing)**
 - Atheromatous disease-
 - Spasm (hemorrhagic stroke, head trauma)
 - Vasculitis
- **Global Vasodilatation**
 - Metabolic Vasculopathy – diagnostic tests and consultations
 - Sleep Apnea
 - Hypothyroid
 - B-vitamin deficiency
 - Medication effect
 - Low Input
- **Vessel disease vs. intracranial pressure (‘perfusion-impedance mismatch’)**
 - Global
 - Alzheimer’s disease – normal pressure
 - Extensive small vessel disease
 - Hydrocephalus – shunt unresponsive
 - Regional
 - Frontal – shunt responsive
 - Adult hydrocephalus – VP Shunt

DVA: Cerebral Reference Data by Decade of Life, 147 subjects



DVA Research: Normal Aging

- Cerebral blood flow dynamics demonstrate how the vascular system ages
- DFI declines after the 6th decade of life

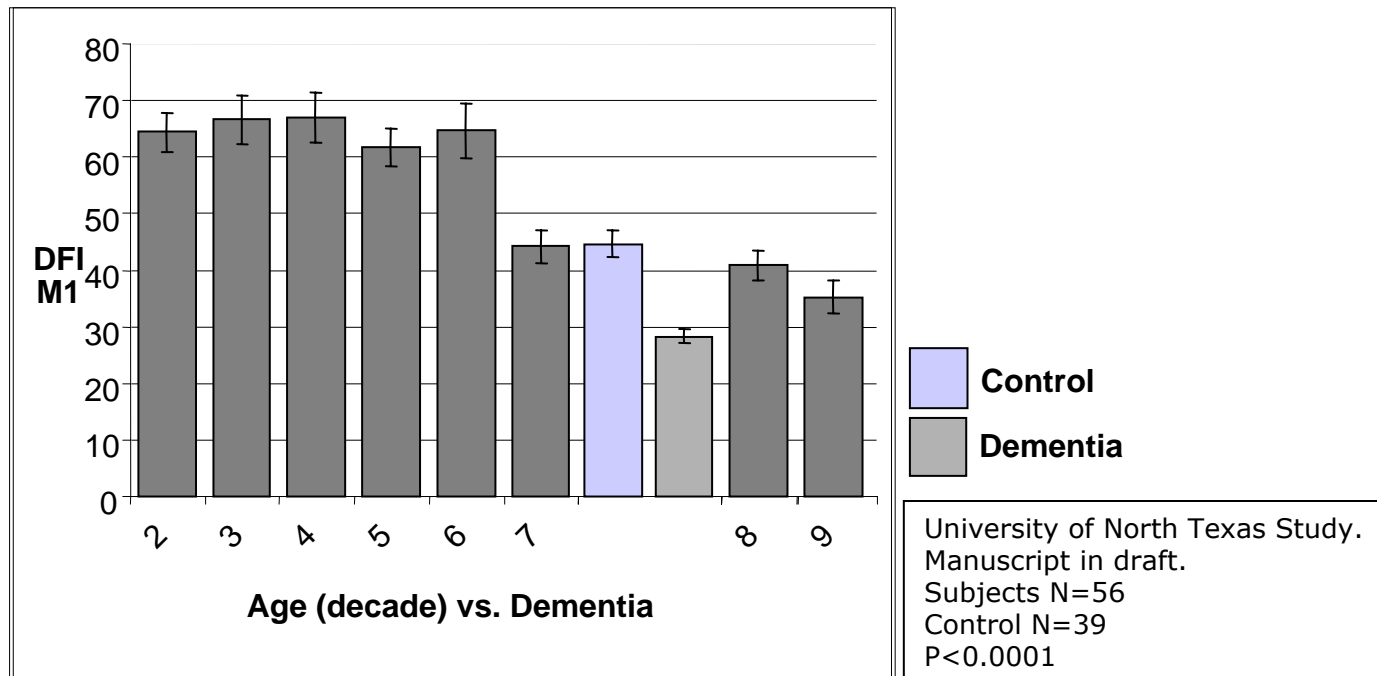


NHSi Internal Study

N=147, 1400 measurements

DVA Research: Dementia

- Alzheimer's Dementia assisted living facility (Ft. Worth, TX)
- Shows subtypes – sorts among forms of dementia
- Findings consistent with contraction of capacitance vessel volume
 - Amyloid angiopathy in majority
- DVA studies identified patterns associated with vascular dementias



DVA Summary

- DVA quantifies TCD waveform morphology
- Defines vascular physiologic states
- Defines ensemble states
- Classifies disease states by vascular physiologic characteristics or signatures

contact information:

New Health Sciences, inc, Rockville, Maryland, USA

www.newhealthsciences.com

+1- 240-453-9191

DVA@newhealthsciences.com