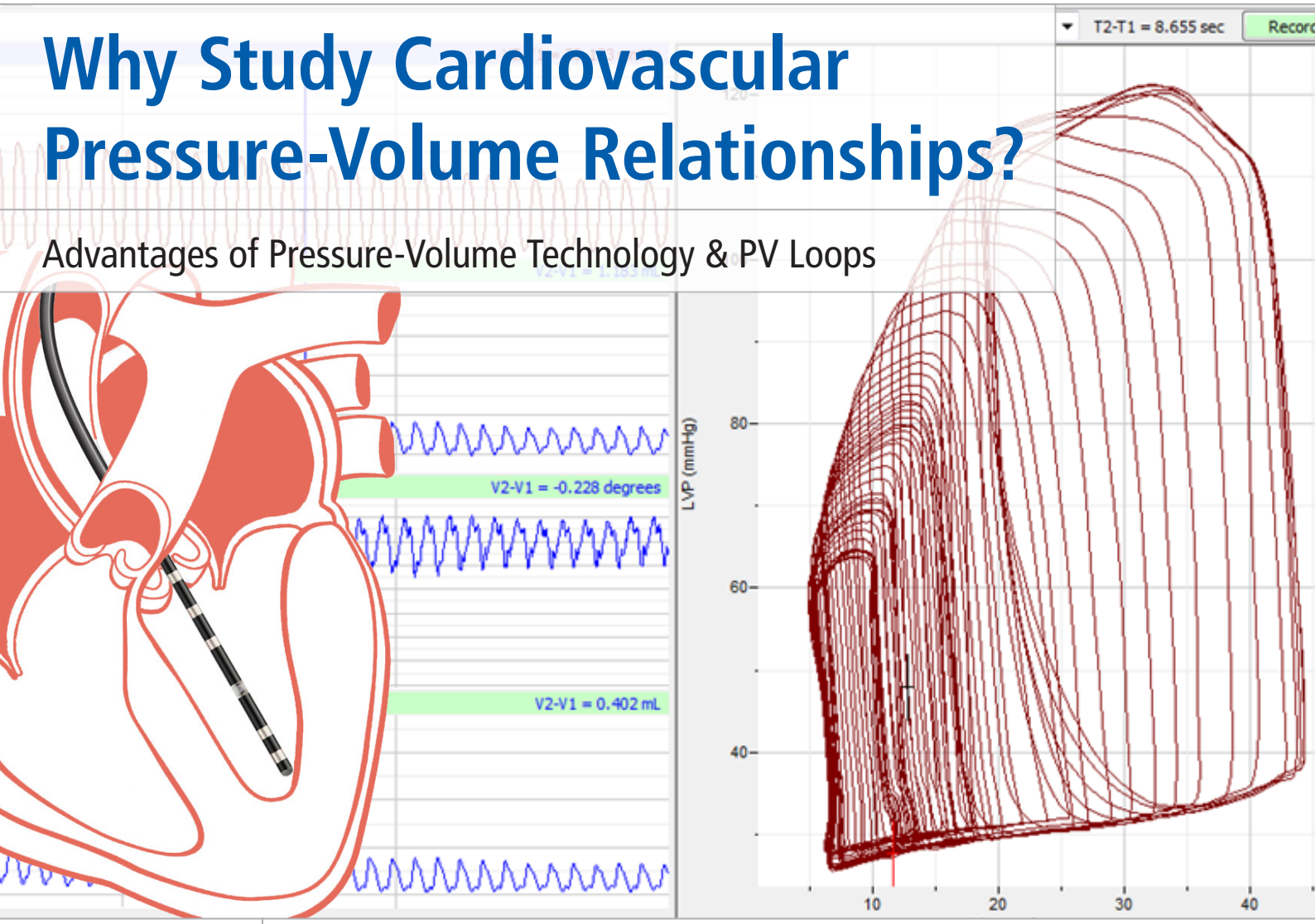
Why Study Cardiovascular Pressure-Volume Relationships?

Advantages of Pressure-Volume Technology & PV Loops



"Physiologists, and in particular physician physiologists, have often fallen into the trap of measuring certain cardiovascular parameters to explain cardiac performance because they could be measured, rather than because they should be measured."

William J. Mazzei, M.D 1998

Scientists have historically relied on systemic blood pressure, blood flow, and ventricular pressure to report changes in heart performance. These are all important parameters, but only form part of the picture of heart performance. PV Loops provide a range of hemodynamic parameters which are not readily measurable by other methods; including changes in contractility, elastance, power, energetics and efficiency. What is even more powerful about PV loops is that they provided quantitative measurements of parameters not just qualitative results. This makes PV loops the single most comprehensive measurement of hemodynamics and cardiac function available.

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Why Study PV Loops?

There are three main areas of cardiovascular assessment where PV loops provide the ideal measurement approach:

1. When it is the best method to measure the contractile parameter of interest including ESPVR and EDPVR.
2. When a comprehensive analysis of cardiac function is needed such as for phenotyping.
3. When the parameter of greatest interest is unknown during drug or genetic studies.

PRESSURE-VOLUME CATHETER TECHNOLOGY HAS...

- no radiation use
- no need for a special technician
- high temporal resolution
- good data reproducibility
- low maintenance cost
- low initial price for the system
- no need ECG gating
- very good volume data reproducibility

All About Contractility

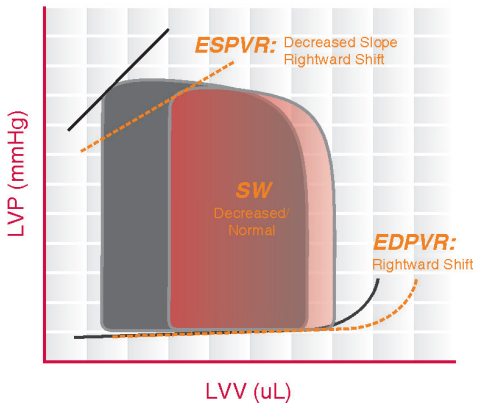
The single greatest advantage of PV loops is the ability to determine the contractility of the heart independent of preload and afterload. By an occlusion procedure (typically the inferior vena cava) a series of pressure-volume loops are created which can be analyzed for a multitude of load independent parameters which are unavailable from other hemodynamic measurement techniques such as echocardiography, MRI and cardiac CT.

EXAMPLES OF CARDIOVASCULAR PATHOLOGY THAT CAN BE EXAMINED BY PV LOOPS

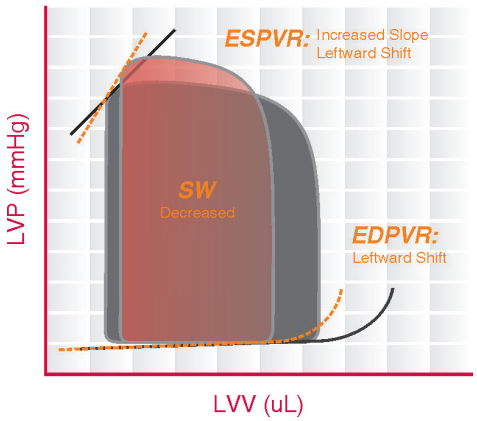
- Myocardial Infarction
- Dilated (Diabetic) Cardiomyopathy
- Left Ventricular Hypertrophy
- Right Ventricular Hypertrophy
- Restrictive Cardiomyopathy
- Aortic Valve Stenosis
- Mitral Valve Stenosis
- Aortic Regurgitation (Aortic Insufficiency)
- Mitral Regurgitation
- Right Ventricular Function and Pulmonary Hypertension

Dilated Cardiomyopathy (top) and LV Hypertrophy (bottom) both cause distinct, characteristic changes in the appearance and calculated parameters of their respective PV loops.

Dilated



Hypertrophic



PV LOOP MEASUREMENTS

VARIABLE	DESCRIPTION
ESP	End-Systolic Pressure
EDP	End-Diastolic Pressure
ESV	End-Systolic Volume
EDV	End-Diastolic Volume
HR	Heart Rate
Max dP/dt	Maximum Derivative of Pressure
Min dP/dt	Minimum Derivative of Pressure
Max dV/dt	Maximum Derivative of Volume
Min dV/dt	Minimum Derivative of Volume
CO	Cardiac Output
EF%	Ejection Fraction
SV	Stroke Volume
SW	Stroke Work
Ea	Arterial Elastance
maxPwr	Maximum Power
plPwr	Preload Adjusted Power
Eff	Efficiency
PE	Potential Energy
PVA	Pressure-Volume Area
ESPVR	End-Systolic PV Relationship
EDPVR	End-Diastolic PV Relationship
PRSW	Preload Recruitable Stroke Work
E(t)	Time-Varying Elastance
Tau	Isovolumic Relaxation Constant

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