Scisense PV Technical Note

Glossary of Pressure-Volume Terms

AFTERLOAD

Afterload is the mean tension produced by a chamber of the heart in order to contract. It can also be considered as the ‘load’ that the heart must eject blood against. Afterload is therefore a consequence of aortic large vessel compliance, wave reflection and small vessel resistance (LV afterload) or similar pulmonary artery parameters (RV afterload).

ARTERIAL ELASTANCE (Ea)

This is a measure of arterial load and its impact on the ventricle. Calculated as the simple ratio of ventricular end-systolic pressure to stroke volume.

CARDIAC CONTRACTILITY

The intrinsic ability of the heart to contract independent of preload and afterload. On a cellular level it can be characterized as the change of developed tension at given resting fiber length. Used interchangeably with Cardiac Inotropy.

CARDIAC INOTROPY

The ability of the heart muscle to generate force through contraction. Used interchangeably with Cardiac Contractility.

CARDIAC OUTPUT (CO)

Cardiac output is defined as the amount of blood pumped by the ventricle in unit time.

COUPLING RATIO

Indication of transfer of power from the ventricle to the peripheral vasculature.

DERIVATIVE OF PRESSURE (dP/dt)

Reported as max and min rate of pressure change in the ventricle. dP/dt are dependent on load and heart rate. LV dP/dt max occurs before aortic valve closure.

DERIVATIVE OF VOLUME (dV/dt)

Rate of volume change in the ventricle. Maximum and minimum values of dV/dt are normally reported.

EJECTION FRACTION (EF%)

Ejection fraction is the ratio of the volume of blood ejected from the ventricle per beat (stroke volume) to the volume of blood in that ventricle at the end of diastole. It is widely clinically misunderstood as an index of contractility, but it is a load dependent parameter. Healthy ventricles typically have ejection fractions greater than 55%.

E-MAX

Maximum point in the pressure-volume relationship occurring at the end of systole. E-max is directly related to the contractile state of the ventricle chamber. This number is different for each individual heart beat, representing the maximal systolic elastance (E-max) at that moment in time.

END-DIASTOLIC PRESSURE (EDP)

Pressure in the ventricle at the end of diastole.

END-DIASTOLIC PRESSURE VOLUME RELATIONSHIP (EDPVR)

The EDPVR describes the passive filling curve for the ventricle and thus the passive properties of the myocardium. The slope of the EDPVR at any point along this curve is the reciprocal of ventricular compliance (or ventricular stiffness).

END-DIASTOLIC VOLUME (EDV)

Volume in the ventricle at the end of diastole.

END SYSTOLIC ELASTANCE (Ees)

Slope of the end systolic pressure volume relationship.

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END-SYSTOLIC PRESSURE (ESP)

Pressure in the ventricle at the end of systole.

END-SYSTOLIC PRESSURE VOLUME RELATIONSHIP (ESPVR)

The ESPVR describes the maximal pressure that can be developed by the ventricle at any given cardiac chamber volume. This implies that the PV loop cannot cross over the line defining ESPVR for any given contractile state.

END-SYSTOLIC VOLUME (ESV)

Volume in the ventricle at the end of systole.

E(T)

Time Varying volume elastance provides means to discriminate end systole from the end of ejection as they might not happen at the same time. Normal LV ejects every shortly after end systole.

EXCITATION-CONTRACTION COUPLING

The cellular relationship between electrical stimulus and contraction which is primarily influenced by Na^{+}, K^{+} and Ca^{2+} ions and the neural, hormonal and exogenous agents which influence their behavior in the cell.

FRANK-STARLING CURVE

"The heart will pump what it receives"-Starling's law of the heart

SV vs EDP: Afterload dependent measure of inotropy where an increase in inotropy shifts the curve up and to the left; a decrease in inotropy shifts the curve down and to the right.

HEART RATE (HR)

Number of times the heart beats per minute.

ISOVOLUMIC RELAXATION CONSTANT (TAU)

Tau represents the exponential decay of the ventricular pressure during isovolumic relaxation. Several studies have shown that Tau is a preload independent measure of isovolumic relaxation.

LUSITROPY

The relaxation properties of the heart during the diastolic phase.

MYOCARDIAL OXYGEN CONSUMPTION (MVO_2)

Amount of oxygen consumed by the heart as a measure of energy consumption. MVO_2 is dependently correlated with cardiac total mechanical energy (TME).

POTENTIAL ENERGY (PE)

Elastic potential energy of the heart is defined by the area between the ESPVR and EDPVR curves to the left of the PV loop. PE = ESP(ESV-V0)/2 -EDP(EDV-V0)/4 where V0 is the theoretical volume when no pressure is generated.

PRELOAD

Preload is described as the stretching of a single cardiac myocyte immediately prior to contraction and is, therefore, related to the sarcomere length. Since sarcomere length cannot be determined in the intact heart, other indices of preload such as ventricular end diastolic volume or pressure are used.

PRELOAD RECRUITABLE STROKE WORK (PRSW)

PRSW is determined by the linear regression of stroke work with the end diastolic volume. The slope of the PRSW relationship is a highly linear index of myocardial contractility that is insensitive to preload and afterload.

PRESSURE-VOLUME AREA (PVA)

The PVA represents the total mechanical energy (TME) generated by ventricular contraction. This is equal to the sum of the stroke work (SW), encompassed within the PV loop, and the elastic potential energy (PE).

PRESSURE-VOLUME LOOP (PV LOOP)

Graph of pressure (y-axis) and volume (x-axis) of a ventricle over a single cardiac cycle. Several loops are often shown superimposed upon one another.

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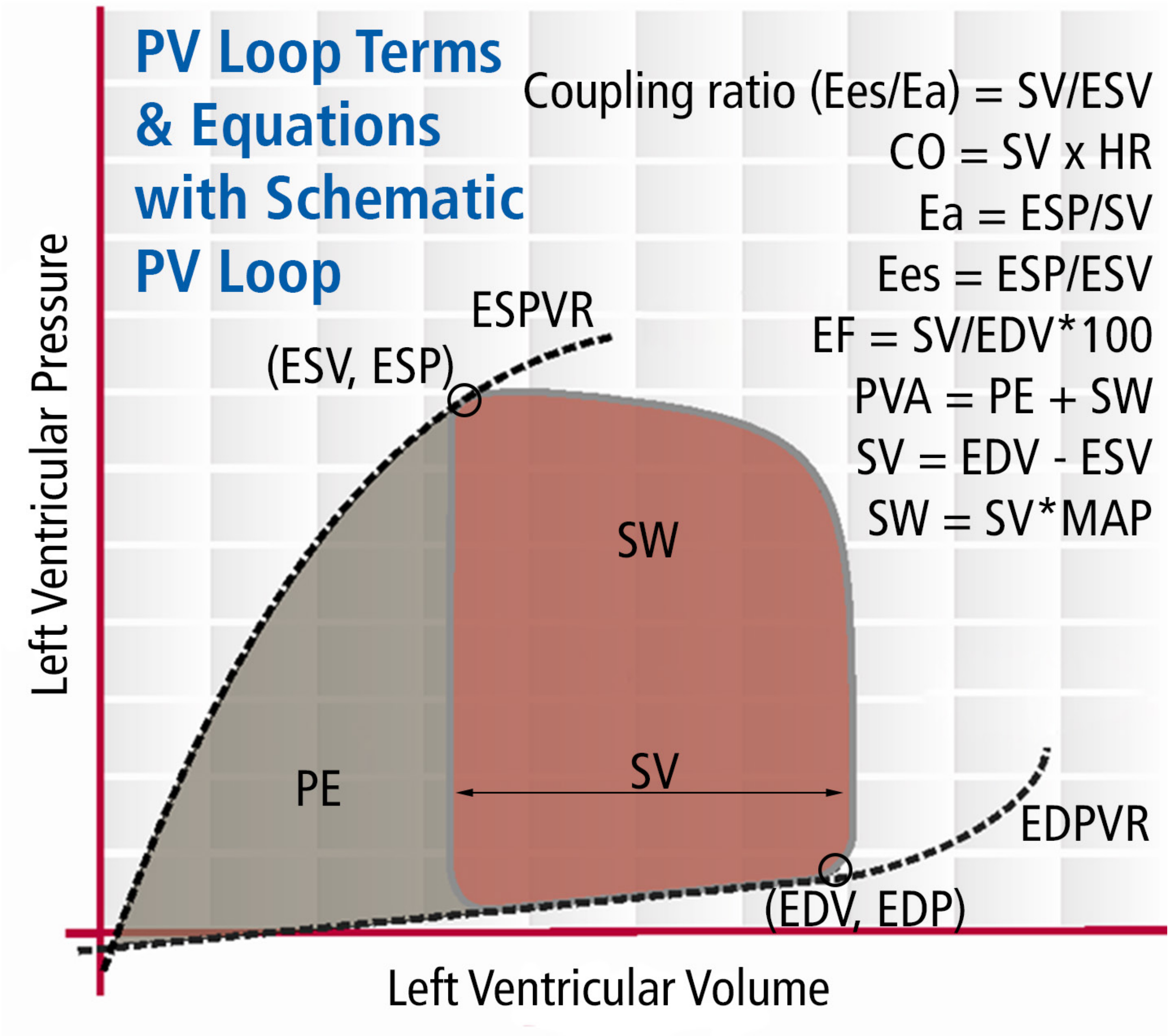
STROKE VOLUME (SV)

Stroke volume is the volume of blood ejected by a ventricle in a single contraction. It is the difference between the end diastolic volume (EDV) and the end systolic volume (ESV).

STROKE WORK (SW)

Ventricular stroke work is defined as the work performed by the left or right ventricle to eject the stroke volume into the aorta or pulmonary artery, respectively. The area enclosed by the PV loop is an estimation of the ventricular stroke work.



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