


Review of Hemodynamic Parameters: SVR, CO, CI, SV, PPV & SVV

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Donor Management

Interval between brain death and the procurement of organs is characterized by unstable hemodynamics

Unstable hemodynamics needs to be managed in order to maintain the viability and optimal condition of the organs

Timely hemodynamic management is the cornerstone of successful donor management




Before brainstem herniation and brain death

Catecholamine rush or shower

Heart muscle has been stunned and is ischemic leading to decreased left ventricular function

How do we improve ischemia and left ventricular function?
Improve Cardiac Output or Stroke Volume




Goal of Donor Management
Ensure adequate intravascular volume

Appropriate cardiac output

Consistent organ perfusion

Perfusion of all organs is important
(not just kidneys)



Blood Flow from the Body


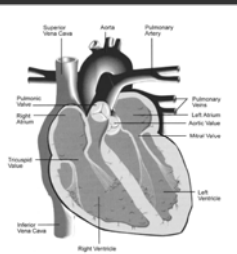
Superior & Inferior Vena Cava

Right side of the Heart
Right Atrium
Tricuspid Valve
Right Ventricle

Lungs

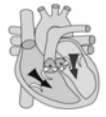
Left side of the Heart
Left Atrium
Mitral Valve
Left Ventricle

Aorta


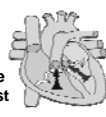


Cardiac Cycle

Diastole - Relaxation or Filling
Preload coming into the heart




Systole - Contraction or Pumping
How well can the heart pump
Ejection or Stroke Volume
What is the heart pumping against
SVR



Flow is the key: CO or CI/SV


CO = SV x HR
Cardiac Output = Stroke Volume X Heart Rate

Stroke Volume is made up of:
Preload
Afterload
Contractility




**During the last 10 years Hemodynamic Monitoring has changed from:
Invasive to Minimally Invasive**

Non-Invasive → → → Invasive
EKG → NIBP → Arterial Line → CVP → PA catheter



Ways to Clinically Determine Cardiac Output

- Pulmonary Artery Catheter
 - Thermodilution
 - Continuous Cardiac Output
- Arterial Waveform Analysis
 - Calibrated
 - Uncalibrated
- Blood sample to calculate the Fick equation
- Transepophageal Echo (TEE)
- Esophageal Doppler & Others




Importance of Stroke Volume

Cardiac Output = Stroke Volume X Heart Rate

Stroke Volume = Preload + Afterload + Contractility


Preload – volume
 Afterload – resistance (SVR)
 Contractility – muscle compliance (EF)



Importance of Preload (volume)

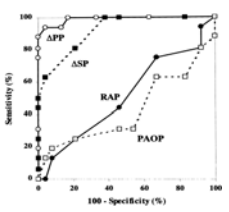
The heart performs more efficiently when appropriately filled.

The term preload refers to: the maximum stretch on the heart's muscle fibers at the end of diastolic filling. The degree of stretch is determined by the volume of blood contained in the ventricle at that time.




Importance of Preload

Commonly used preload indicators are not sensitive or specific predictors of a patient's ability to respond to fluid bolus




Michard F., Boussat S, Chemla D, et al. Relation between respiratory changes in arterial pulse pressure and fluid responsiveness in septic patients with acute circulatory failure. American Journal of Respiratory and Critical Care Medicine. Jul 2006;162(1):134-138



Importance of Preload –

Pulse Pressure Variation - PPV
Stroke Volume Variation – SVV
Systolic Pressure Variation – SPV

MOniToR study will help determine where should be for donor patients




Importance of Preload –

Frank Starling's Law


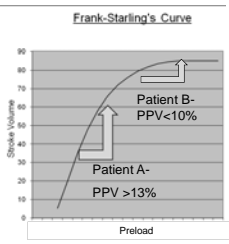
The greater the ventricle is filled during diastole, the more the muscle fibres are stretched, the greater is the force of contraction.

This is true to a defined point of stretch above which point contraction force will not increase further.




Frank Starling's Curve

Patient A is preload responsive
On steep part of curve
Increased preload results in significant increase in SV
Patient B is not preload responsive
An equal preloading does not result in a great increase in SV
This patient does not require fluid resuscitation.



High Preload responsiveness is associated with increased interleukin-6 and lower organ yield from brain-dead donors

- Nearly half of the brain-dead organ donors exhibited preload responsiveness.
- Preload responsiveness was significantly associated with increased IL-6 concentrations and lower organ yield.
- Murugan, R., Venkataraman, R., et. al. Critical Care Med. 2009; 37(8): 2387-2393.




Importance of Afterload – Resistance (SVR)

The amount of pressure the heart works against

SVR decreases as CO/CI increases

Can be controlled with medications

- Vasoconstrictors – Increases SVR & BP
- Vasodilators – Decreases SVR & BP




Importance of Afterload – Resistance (SVR)

As drips/drugs are decreased or discontinued then see changes in preload and contractility

Vasoconstrictors decreased results in:

- Decrease in SVR & BP
- Increase in PPV & SVV
- More volume needed
- Increase in CO & SV




Importance of Contractility – Muscle Compliance (EF)

The ability of the heart muscle fibers to stretch and contract

The power of contraction

Independent of Preload and Afterload



Importance of Contractility – Muscle Compliance (EF)


Medications can assist with Contractility

At a constant Preload

Positive inotropic agents > contractility > SV

Inotrope: is an agent that alters the force or energy of muscular contractions

- Adrenaline – Epinephrine (Epi or Adrenalin)
- Noradrenaline - Norepinephrine (Levophed)
- Dopamine
- Dobutamine -Dobutrex



Flow is the key: CO/CI/SV

Consistent organ perfusion

Perfusion of all organs is important

Competing fluid requirements between the lungs and the kidneys

- Higher rates of procurement of lungs as associated with less fluid replacement
- Higher rates of procurement of kidneys may be associated with more fluid replacement

