1. Introduction

Ventricular Stroke Work (VSW) is an important physiological parameter when assessing patient cardiovascular performance. Decreased VSW occurs during many states of cardiovascular dysfunction. However, quantifying VSW normally requires ventricular pressure and volume measurements, which are highly invasive and thus typically unavailable clinically. This research presents a model-based analysis of aortic pressure contours to estimate beat-to-beat VSW trends through the aortic pressure-velocity gradient (pc).

2. Methods

Figure 1 illustrates the method used for identifying pc from measured data for each beat.

- Measured aortic pressure waveform (Pao)
- Identify physiological parameters from aortic pressure contour (τ = RC)
- Separate Pao into excess and reservoir pressure using identified parameters [1].
- Identify Pulse Wave Velocity (PWV) using Bramwell & Hill Equation [2].
- Calculate pressure-velocity gradient, pc in aortic compartment using Joukowsky Equation [3].

Figure 2 shows a time-series of measured VSW and estimated pc during hemodynamic changes induced via alterations to mechanical ventilation pressure during an experiment (stepwise PEEP recruitment maneuver). Clearly, pc captures trends in VSW very well.

The methods presented in this study show the potential for continuous, accurate monitoring of VSW trends by estimating pressure-velocity relationship in the aortic compartment. Importantly, this method only requires an aortic pressure measurement, which is often available in intensive care patients.

3. Results and Discussion

The correlation coefficient between measured VSW calculated from a Pressure-Volume loop and model-based estimate of pc from aortic pressure showed good agreement with R = 0.71.

References

