

Assessment of Volume Status in Spontaneously Breathing Patients

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Introduction: Functional hemodynamic parameters were used to detect fluid responsiveness. Positive mechanical pressure ventilation is a prerequisite for adequate dynamic preload assessment. It has been shown that no reliable hemodynamic preload assessment can be detected during spontaneously breathing due to minimal intrathoracic pressure variations (1). In this experiment we are trying to use Incentive spirometry (IS) as a tool to provide adequate changes in intrathoracic pressure and impede venous return. We are utilizing IS induced PPG waveform changes to assess the preload during mild hypovolemia. Lower Body Negative Pressure (LBNP) is a known model for experimental hypovolemia where -30 mmHg is equivalent to 500-700 cc blood loss (10% of blood volume) (2).

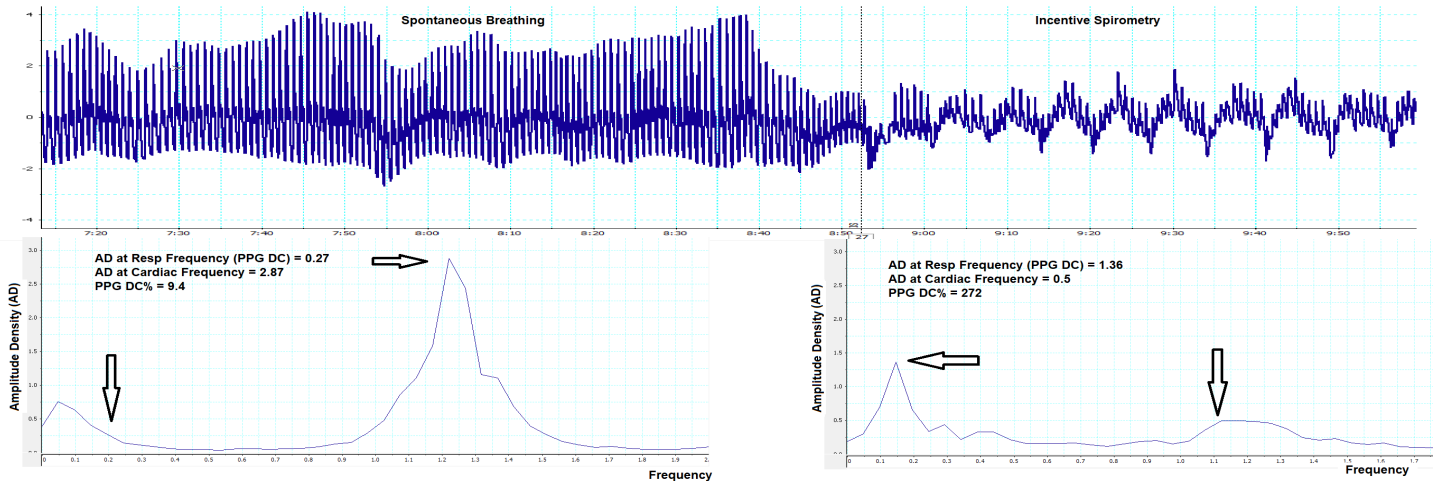
Methods: With IRB approval, 12 healthy subjects underwent an LBNP protocol as in figure 1. The pressure was progressively decreased to -30. Subjects performed IS at baseline and at -30. PPG waveforms were recorded from finger sensors. PPG waveforms were analyzed to calculate the amplitude density using LabChart 7. Respiratory and cardiac PPG amplitude densities were compared to each other at baseline and at -30. We analyzed the frequency analysis of the PPG waveform to detect the amplitude density at respiratory (PPG DC) and Cardiac frequency and calculated the PPG DC% (the ratio of amplitude density at respiratory to cardiac).

Results: At LBNP -30 and during spontaneous breathing there was an increase in PPG DC% from baseline value. With the use of the IS there was statistically significant increase in the PPG DC% values (p-value < 0.05). The IS increase the strength of the PPG CDC% by 6.6-14 times (from 8.8 to 125.7 at baseline and from 20.2 to 132.3 at -30).

Conclusion: Incentive Spirometry can be used as a tool to elicit changes in the intrathoracic changes that can help with preload assessment.

References:

1. Curr Opin Crit Care 2008;14:334-9.
2. J. Trauma 2008;64 S342-53



	PPG DC% Spontaneous Average (SD)	PPG DC% IS Average (SD)	Ratio (IS to Spontaneous)
Baseline	8.8 (± 5.7)	125.7 (± 114.9)	14.3
LBNP -30	20.2 (± 18.2)	132.3 (± 54.5)	6.5