

Impact of Preload Changes on Peripheral Venous Pressure (PVP), Stroke Volume (SV) and Thoracic Fluid Content (TFC) in Healthy Volunteers

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Background: Accurate assessment of blood volume status and the response to fluid challenge remains an important clinical goal. Leg raise test (LRT) is associated with an increase in venous return (300 cc) to the heart,^{1,2} while Valsalva maneuver is associated with increased intrathoracic pressures and a reduction in preload and stroke volume (SV). Peripheral venous catheter is the most commonly used method of vascular access and peripheral venous pressures (PVP) reflects 'downstream' pressure to the right atrium.

Methods: With IRB approval 28 healthy volunteers underwent two physiologic challenges: 1) LRT: period of baseline (2 min) followed by LRT (2 min) and 2) Valsalva maneuver: baseline period for (3 min) followed by Valsalva maneuvers for 20 seconds. Each subject was monitored with EKG, blood pressure and PVP waveform were recorded at 100 Hz with a data acquisition system (Collect S5). PVP waveforms generated from a transduced upper extremity 20-gauge intravenous catheter. SV as well as an index of thoracic fluid content (TFC) derived from the measured impedance to an electrical current applied to the chest was measured non-invasively using (Cheetah Medical, MA, USA)³. Data analyzed with commercially available software (LabChart 7 Pro, v 7.3.8). Values during LRT and Valsalva maneuver were compared to their corresponding baseline with paired t-tests, data is expressed as mean (SD). P value <0.05 is considered significant.

Results: LRT was associated with an increase in PVP, SV and TFC (28%, 13% and 1%) respectively, while Valsalva maneuvers showed an increased in PVP by 130% with reduction in SV and TFC by 15% and 6% respectively. All variables were found to be statistically significant. Raw data of PVP is shown in figure 1-(A), while figure 1-(B,C,D) and (E,F,G) showed changes in PVP, SV and TFC during LRT and Valsalva respectively. Table-1 shows the percent change for complete data set.

Discussion: Transient LRT resulted in an increase in preload which lead to an increase in SV and TFC and reflected as an increased in PVP at the periphery. On the other hand, Valsalva (increased intrathoracic pressure) was associated with reduction in preload, SV and TFC and an increased in PVP (shock wave down the arm). This is an example of the importance of understanding the context of an increase in PVP and its relation to the preload and SV.

References: 1. *Intensive Care Med* 2016; 42(12):1935-47. 2. *Intensive Care Med* 2010; 36(11):1875-81.
3. *Am J Physiol Heart Circ Physiol* 2007; 293(1):H583-589 4. *Acad Emerg Med* 2016; 23(2):186-190.

		Leg raise test (LRT)			
		Baseline	LRT	1 min after LRT	% change from baseline
PVP	Mean	11	14	10	28
	SD	3	5	3	
SV	Mean	93	103	94	13
	SD	29	35	23	
TFC	Mean	65.50	66.17	65.18	1.05
	SD	13.51	13.57	13.32	

		Valsalva			
		Baseline	Valsava	1 min after Valsalva	% change from baseline
PVP	Mean	10	25	11	133
	SD	3	12	3	
SV	Mean	91	76	94	-15
	SD	21	18	28	
TFC	Mean	65.13	60.97	64.88	-6
	SD	13.64	11.57	13.57	

Table 1: Summary of the data with percent change from baseline during each challenge

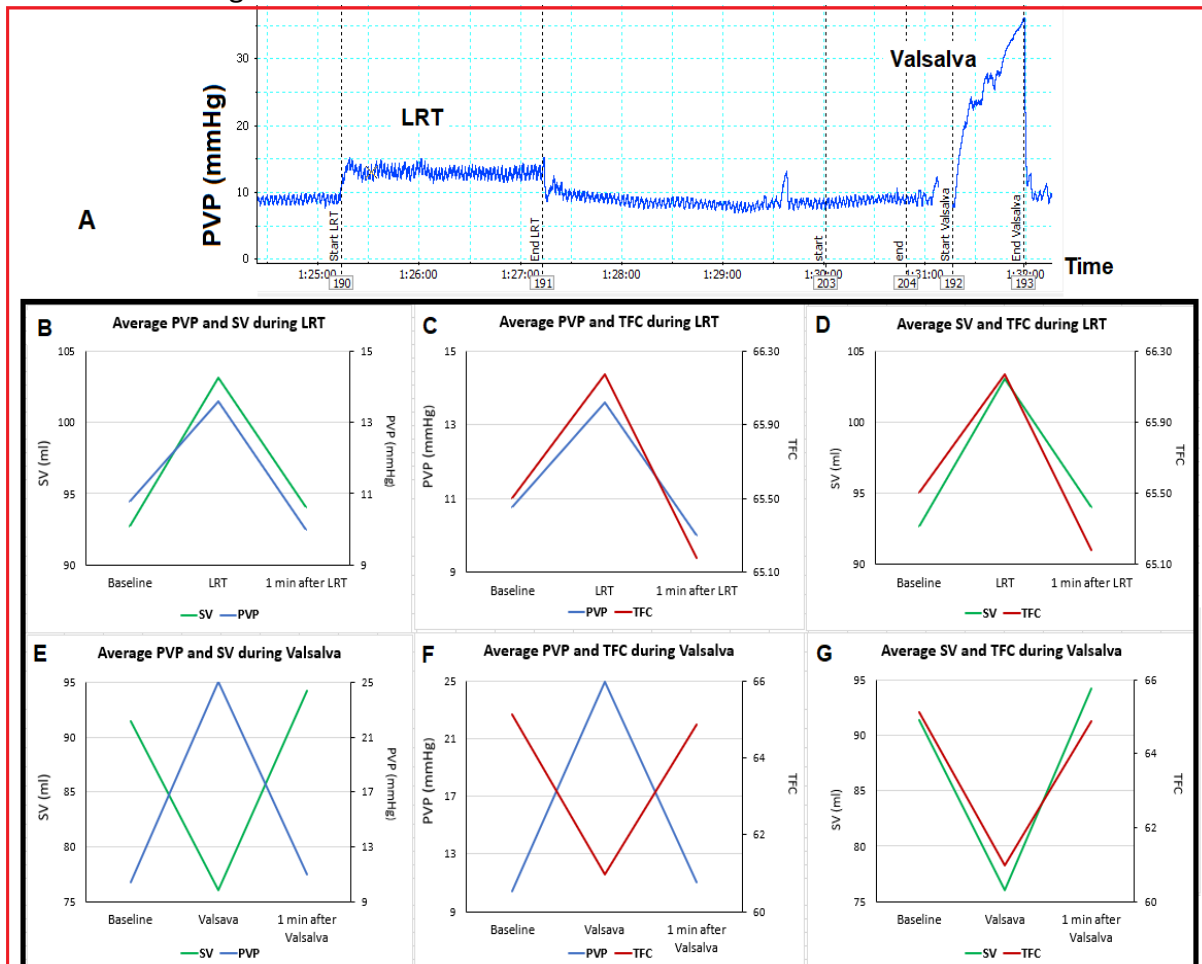


Figure 1. Changes in PVP, SV and TFC during LRT and Valsalva