Passive Leg Raise (PLR) Test as a Predictor of Tolerance to Lower Body Negative Pressure (LBNP)

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**Introduction:** Fluid responsiveness (FR) is reported to be the ability to increase stroke volume (SV) in response to fluid administration. Passive leg raising (PLR) creates a transient increase in biventricular preload and has shown the capability to predict fluid responsiveness. LBNP creates a reversible hypovolemic state by sequestrating blood in the lower extremities. This study sought to examine the ability of stroke volume percent change during (PLR) to predict the extent of tolerance to hypovolemia during Lower body negative pressure (LBNP).

**Methods:** With IRB approval 12 subjects underwent PLR at 45° angle for 2 min followed by progressive LBNP protocol at -15 mmHg, -30 mmHg, -45 mmHg, -60 mmHg, -75 mmHg and -85 mmHg. Each patient was monitored for heart rate (HR), continuous noninvasive arterial blood pressure (CNAP) (CNSystems, Austria), Noninvasive CO monitor (NICOM) (Cheetah medical, MA, USA) streaming stroke volume (SV), cardiac index (CI) noninvasively at 8s intervals. These parameters were measured at baseline, during LRT and during progressive LBNP. Subjects were classified as high tolerance (HT) and low tolerance (LT) based upon the development of symptoms of hypovolemia such as lightheadedness, nausea, diaphoresis and shortness of breath at LBNP -75 mmHg or earlier. Unpaired t-test was used to assess the difference in the mean percent change in SV (ΔSV%), CI (ΔCI%) and HR (ΔHR%) with PLR between the HT and LT groups. A threshold of ≥ 12.8% in increase in SV with PLR predicted with great sensitivity the tolerance to central hypovolemia induced by the LBNP model.

**Results:** During LBNP 6 out of 12 were (LT) and 6 were (HT). There was a statistically significant difference between the HT and LT groups in terms of ΔCI% and ΔSV% during PLR, while difference in ΔHR% wasn’t significant (table-1). Using ΔSV% ROC curve (figure-1) yielded cut-off of (ΔSV% = 12.8%) with 100% sensitivity, 95% CI (54-100%) and 83% specificity, 95% CI (36-99%). AUC is 0.89, 95% CI (0.67-1.1) (p = 0.025) to predict tolerance to LBNP-induced hypovolemia.

**Discussion:** LRT is associated with 300 cc of auto transfusion. Thus, even small volume of fluid will have a great impact on CI attributed to changes in SV and not the HR. A threshold of ≥ 12.8% increase in SV with PLR predicted with great sensitivity the tolerance to central hypovolemia induced by the LBNP model.

**References:**


Figure 1:

<table>
<thead>
<tr>
<th>Table 1</th>
<th>HT</th>
<th>LT</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>ΔCl% mean ±SD</td>
<td>9.4 ±8.8</td>
<td>21.8 ±6.3</td>
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<tr>
<td>ΔSV% mean ±SD</td>
<td>8.8 ±7.6</td>
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<td>ΔHR% mean ±SD</td>
<td>0.8 ±3.5</td>
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<td>0.58</td>
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