Is it necessary to correct for heart rate when we are discussing PPG width during hypovolemia?

Introduction: Photoplethysmographic (PPG) waveform, also known as the pulse oximeter waveform, is one of the most commonly displayed clinical waveforms[1]. Peak analysis of the PPG waveform could provide important clinical variables (such as amplitude, width, area) besides heart rate and oxygen saturation. These parameters may prove to be sensitive and specific as early indicators of blood loss[2]. The pulse width is more sensitive than the other parameters on the PPG waveform in detecting changes in systemic vascular resistance[3]. PPG waveform width represents the duration of stay of the waveform under the probe and is influenced by the heart rate (HR), hence the rationale for correcting it. Lower body negative pressure (LBNP) creates a reversible hypovolemia by sequestrating blood in the lower extremities.

This study sought to determine if there is a difference in the percent change between uncorrected and HR adjusted width of the finger and ear PPG during LBNP induced hypovolemia.

Methods: With IRB approval 17 subjects underwent progressive LBNP. Each subject was monitored for EKG, finger arterial blood pressure (BP), finger PPG and ear PPG. These parameters were measured during baseline, -30 mmHg, -45 mmHg, -60 mmHg and -75 mmHg LBNP. 2 out of the 17 subjects were excluded from the study due to insufficient data. The width of finger and ear PPG waveform was calculated using Labchart 7. The HR adjusted width was calculated by dividing the width by the square root of the mean NN interval obtained from the EKG at corresponding phase of the LBNP. The percent changes from the baseline were calculated for both the uncorrected and HR adjusted width groups on ear and finger PPG. Furthermore, both groups were subdivided into low tolerance (LT) and high tolerance (HT) to LBNP. LT subgroup included subjects who developed lightheaded, nausea, dizziness at LBNP -60 mmHg, while subjects who did not develop symptoms or developed symptoms at LBNP lower than -75 mmHg were assigned to the HT subgroup as shown in table 1 and 2. Data was presented as mean Â±SD, t-test was performed to detect statistical significance. p value < 0.05 was considered significant.

Results: There was non-significant differences between the percent change of uncorrected and HR adjusted width from baseline on either subgroup of finger or ear PPG waveforms during different phases of the LBNP (figures 1-A, 1-B, 2-A, 2-B). Summary of the data is demonstrated in table 1 (LT) and 2 (HT).

Conclusion: according to these results, The PPG waveform width can be used without being corrected for HR during LBNP induced hypovolemia.
References:

