A sensitive shock index for real-time patient assessment during simulated hemorrhage.

Van Sickle C, Schafer K, Mulligan J, Grudic GZ, Moulton SL, Convertino VA.

BACKGROUND: Shock index (SI = the ratio of heart rate (HR) to systolic arterial pressure (SAP)) is a metric used to diagnose patients at risk of impending hemorrhagic shock. We hypothesized that a metric called the compensatory reserve index (CRI), derived using computer modeling with continuous feature extraction from arterial waveforms, would provide an earlier indicator of cardiovascular instability than SI during progressive central hypovolemia.

METHODS: There were 15 subjects (men = 8; women = 7) who underwent progressive reduction in central blood volume induced by lower body negative pressure (LBNP) until SAP < 90 mmHg. CRI was normalized on a scale of 1 (normovolemia) to 0 (circulatory volume at which instability occurs) and displayed on a colored bar. The times at which the CRI equaled 0.6 (threshold of green to amber) or 0.3 (threshold of amber to red) were compared to a clinical threshold of SI > or = 0.9.

RESULTS: A SI > or = 0.9 required 22.4 +/- 6.2 min (95% CI = 19 to 25.8 min). CRI reached 0.6 (amber) at 12.5 +/- 4.9 min (95% CI = 9.8 to 15.3 min) when SI = 0.61 +/- 0.03, and became 0.3 (red) at 20.3 +/- 5.1 min (95% CI = 17.5 to 23.1 min) when SI = 0.81 +/- 1.4.

CONCLUSIONS: CRI provided a significantly earlier indicator of impending hemodynamic decompensation than SI > or = 0.9 during progressive LBNP. These results support the notion that the CRI represents an improved ‘shock index’ as an indicator of impending hemorrhagic shock compared to standard vital signs.