

Monitoring of Pleth Variability Index in Seriously Injured Combat Casualties.

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Purpose

In severely injured combat casualties (1) to describe the correlation between functional indicators from an arterial catheter-systolic pressure variation (SPV/SPV%), pulse pressure variation (PPV), and the noninvasive pleth variability index (PVI) during resuscitation and (2) to describe the accuracy of PVI for predicting fluid responsiveness on the basis of arterial catheter functional indicator thresholds.

Background/ significance

Resuscitation of seriously injured combat casualties is complex. Vital signs may not reflect occult blood loss nor are they predictive of whether a patient will respond to a bolus with an increase in stroke volume, increasing the risk for fluid overload. Under combat conditions, invasive monitoring is limited; thus, noninvasive monitoring of fluid status and response to treatment is critical. The accuracy and reliability of PVI, a noninvasive indicator of fluid responsiveness, has not been studied in these patients.

Method

Prospective observational design. Severely injured combat casualties admitted to 2 US military trauma hospitals in Afghanistan were studied from admission through resuscitation. Continuous PVI data were obtained via pulse oximeter (Masimo Rainbow SET, Rev E/Radical-7 Pulse Co-Oximeter v 7.6.2.1). Patients were ventilated (tidal volume [Vt] 7.7 [SD, 1.5] mL/kg; 72% had a Vt < 8 mL/kg). Vital signs and arterial catheter tracings for functional indicators were obtained every 15 minutes and before/after any bolus/therapy that might affect outcomes. Arterial catheter indicator thresholds for fluid responsiveness were used to establish a PVI threshold for fluid responsiveness. Data were reported for the subset of patients with more than 60 minutes of intensive care.

Results

A total of 15 patients were studied. Demographics: Injury Severity Score 21 (SD, 10); age 29 (SD, 8) years; male 100%; body temperature <95°F (n = 1). Not significantly different from 10 patients who went to the operating room. Injury cause: improvised explosive device (67%)/gunshot (27%). Monitoring time 150 (SD, 59) min. A total of 81 PVI-arterial catheter indicator data pairs were analyzed. Each patient contributed 6 (SD, 4) pairs per indicator. There was a strong correlation between PVI and SPV ($r = 0.61$; SPV% $r = 0.72$ and PPV $r = 0.73$). Independent of Vt, a PVI > 15.5 discriminated fluid response status for SPV% (area under curve [AUC]= 0.89 [SD, 0.04]; sensitivity = 0.83/specificity = 0.92), PPV (AUC= 0.89 (SD, 0.04); sensitivity = 0.77/specificity = 0.97). PVI > 16.5 discriminated for SPV (AUC 0.73 [SD, 0.06; sensitivity = 0.66/specificity = 0.84).

Conclusions

This study was the first in which PVI was evaluated during the resuscitation of severely injured combat trauma patients. PVI correlates with other well-established functional indicators and can be used to predict fluid response status during the ICU phase of resuscitation. The noninvasive nature of the monitoring is potentially beneficial under austere conditions as it allows for immediate monitoring. The results of this study apply to all seriously injured patients. Further study of the use of PVI during transport is needed.