Shock Volume Predicts Venous Thromboembolism Complications Following Orthopaedic Polytrauma

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Purpose: Venous thromboembolism (VTE) events are morbid complications that affect polytraumatized patients and are associated with the magnitude of hemorrhage. Shock Volume quantifies a patient-specific index of cumulative hypoperfusion integrating serial vital signs and is associated with acute complications, yet has not been evaluated as an index to risk-stratify VTE, including deep vein thrombosis (DVT) and pulmonary embolism (PE). Thromboelastography (TEG) provides individualized coagulation profiles and is predictive of VTE. This study aimed to evaluate the association between TEG parameters, Shock Volume, and VTE.

Methods: This is an a priori planned secondary analysis of the PRECISE prospective observational trial of polytrauma patients (18-55 years) with pelvis, acetabulum, femur, and/or tibia shaft fractures across 10 Level I North American trauma centers from 2018 to 2022. The primary outcome was clinically diagnosed and image-confirmed VTE during the index admission. Sequential measurements of shock index (heart rate/systolic blood pressure ratio) above a hypoperfusion threshold of 0.9 were temporally integrated in distinct 6- and 24-hour periods post injury to quantify corresponding Shock Volume indices. TEG analysis at admission was performed at the discretion of the clinical team. Mann-Whitney U and $\chi 2$ tests were used to compare patients with and without VTE.

Results: 322 patients were included (293 without VTE and 29 with VTE; 9.0%). There were no demographic differences between the 2 groups. Mean ISS with VTE was 24.6 (±12.4) and 27.4 (±13.4) with no VTE (P = 0.3). Shock Volume was significantly elevated in the VTE group at 6 hours (44.9 vs 31.5; P = 0.03) and 24 hours (138.0 vs 98.1; P = 0.02). Of patients with an admission TEG analysis (n = 148), there were no significant differences between patients with VTE (n = 10) compared to those without VTE (n = 138) for mean R-time (time to clot formation, 3.2 vs 3.0; P = 0.66), K-time (rate of clot formation, 1.5 vs 1.4; P = 0.49), maximum amplitude (clot strength, 61.9 vs 62.7; P = 0.79), and LY-30 (clot breakdown, 0.4 vs 0.9; P = 0.20). Admission international normalized ratio (INR) was not significantly different (1.3 vs 1.2; P = 0.06).

Conclusion: Shock Volume may serve as a noninvasive predictor associated with the development of VTE as early as 6 hours after injury.