

THE PATIENT-SPECIFIC INJURY SCORE: PRECISION MEDICINE IN TRAUMA PATIENTS PREDICTS ORGAN DYSFUNCTION AND OUTCOMES

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Introduction: Current injury scoring systems in polytraumatized patients are limited at predicting patient outcomes. We present a novel method that quantifies mechanical tissue damage and cumulative hypoperfusion using a precision medicine approach. We hypothesized that a Patient-Specific Injury score formulated from individualized injury indices would stratify patient risk for developing organ dysfunction after injury. We compared correspondence between PSI and the Injury Severity Score with outcomes of organ dysfunction and MOF.

Methods: Fifty Multiply-injured-patients (MIPs) were studied. Tissue Damage Volume scores were measured from admission pan-axial CT scans using purpose-designed post-processing software to quantify volumetric magnitude and distribution of injuries. Ischemic injury was quantified using Shock Volumes. SV is a time-magnitude integration of shock index. Values above 0.9 were measured in the 24-hours after injury. Metabolic response was quantified by subtracting the lowest first 24 hr pH from 7.40. PSI combines these indices into the formula: $PSI = [0.2TDV + SV] * MR$. Correspondence coefficients from regression modeling between PSI and organ dysfunction, measured by the Marshall Multiple Organ Dysfunction score averaged from days 2-5 post-injury, were compared to similar regression models of ISS vs. day 2-5 MOD-scores. We compared PSI and ISS in patients that did or did not develop MOF.

Results: PSI demonstrated better correlation to organ dysfunction ($r^2=0.576$) in comparison to ISS ($r^2=0.393$) using the MOD-score on days 2-5. Mean PSI increased 3.4x (58.5 vs. 17.0; $p < 0.02$) and ISS scores increased 1.4x (39.0 vs. 28.0; $p = 0.10$) in patients that developed MOF versus those that did not.

Conclusions: This study shows that a precision medicine approach that integrates patient-specific indices of mechanical tissue damage, ischemic tissue injury, and metabolic response better corresponds to phenotypic changes including organ dysfunction and MOF compared to ISS in MIPs. The PSI-score can be calculated within 24 hours of injury, making it useful for stratifying risk and predicting the magnitude of organ dysfunction to anticipate.