

Tissue Damage Volume Quantified on CT Is Associated with Organ Dysfunction in Polytrauma Patients with Fractures

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Purpose: Although the ISS is the most commonly used instrument for associating regional and whole-body trauma with clinical outcomes, it does not precisely quantify tissue injury. In recent studies, we associated CT-based volumetric quantification of patient-specific mechanical tissue damage volume (TDV) in polytrauma patients with the development of multiple organ failure. We therefore hypothesized that larger TDV would be associated with the development of organ dysfunction in multiply injured orthopaedic trauma patients.

Methods: As a secondary analysis of the prospective observational PRECISE study, polytrauma patients aged 18 to 55 years admitted to a higher level of care, with operative pelvis, acetabular, femur, and /or tibia fractures (OTA / AO 61B-C,62A-C,31,32,33A-C,42A-C) were enrolled from 2018 to 2022. All injuries on admission CT scans and radiographs were measured to determine TDV. A semi-automated, 3-dimensional annotation tool was used to quantify volumes of damaged soft tissue and hematoma to a resolution of 0.1 mL. TDV scores were analyzed by region (head / neck, chest, abdomen, pelvis / retroperitoneum, extremities) and tissue type (soft tissue, hematoma, parenchyma, bone). The primary outcome was organ dysfunction as measured by the Marshall Multiple Organ Dysfunction Score averaged over post-injury days 2-5 (aMODS2-5). Three groups of total TDV were compared (<500 cc, group A; 500-1000 cc, group B; >1000 cc, group C).

Results: 135 polytraumatized patients were enrolled at 7 high-volume US trauma centers. There was a significant trend in higher mean ISS across the groups (group C 28 > group B 21 > group A 18; non-parametric test, $P = 0.02$). Age and gender were similar among groups. A non-parametric test showed significantly ($P < 0.001$) greater organ dysfunction across groups (group C mean aMODS2-5 2.8 ± 2.7 > group B 2.2 ± 2.0 > group A 1.2 ± 1.4). Patients with larger osseous tissue damage volume (>100 cc) had greater levels of organ dysfunction (mean aMODS2-5 1.9 ± 2.1) compared to those with a lower degree of osseous injury (<100 cc, 1.0 ± 1.4 ; $P = 0.01$). Interestingly, while there was no statistically significant, independent effect for overall TDV after adjustment for admission lactate and pH ($P = 0.35$), there were independent effects for head/neck TDV ($P = 0.009$), retroperitoneal TDV ($P = 0.040$), and total hematoma TDV ($P = 0.046$).

Conclusion: Precision CT-based methods of tissue injury assessment identified groups of trauma patients with fractures at higher risk of short-term organ dysfunction. In conjunction with post-injury blood loss and patient-specific response to injury, TDV may help stratify patients at risk of organ dysfunction and potentially inform treatment decisions surrounding the optimal timing of surgical interventions.

See the meeting website for complete listing of authors' disclosure information. Schedule and presenters subject to change.