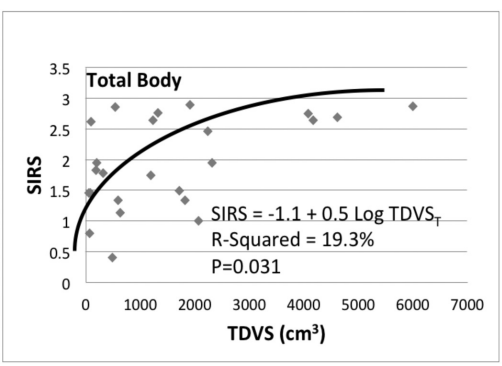
Tissue Damage Volume Predicts Systemic Inflammation in Multiply Injured Patients with Fractures

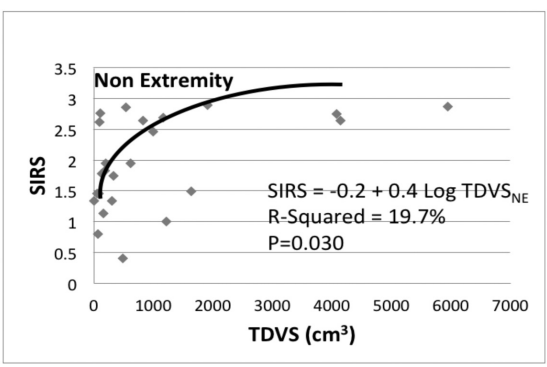
Travis L. Frantz, MS; Greg E. Gaski, MD; Scott Steenburg, MD; Timothy Pohlman, MD; ***Todd O. McKinley, MD****;*
Indiana University School of Medicine, Methodist Hospital, Indianapolis, Indiana, USA

Background/Purpose: The Systemic Inflammatory Response Syndrome (SIRS) occurs in multiply injured patients (MIPs) and can lead to organ failure and death. Evidence has accumulated showing that SIRS results from an immune response to endogenous molecules, damage-associated molecular patterns (DAMPs), which are liberated from damaged tissue secondary to trauma. However, it is not known how the magnitude of tissue damage or the types of tissues that are damaged translate into an inflammatory response. The purpose of this study was to quantify how the magnitude of tissue damage affected inflammation in MIPs. Additionally, we explored the differences in inflammation resulting from extremity versus non-extremity tissue damage.

Methods: Data from 23 MIPs (ISS ≥18) ages 18 to 65 years were collected. Daily SIRS scores (0 to 4) were calculated from vital sign data and white blood cell count, and averaged for the entire ICU length of stay. A novel radiographic index, the Tissue Damage Volume Score (TDVS), was calculated by measuring every injury sustained by each patient as detected on all CT scans and plain radiographs. A characteristic radius (r) of each injury was determined by two reviewers, and the TDVS was calculated assuming each injury was spherical ($V_i = 4/3\Pi r^3$). Individual injuries were summed into three damage volume values representing the total body ($TDVS_T$), extremities ($TDVS_E$), and non-extremities ($TDVS_{NE}$). Linear and nonlinear regression analyses were used to assess relationships between $TDVS_T$, $TDVS_E$, and $TDVS_{NE}$, and average SIRS scores.

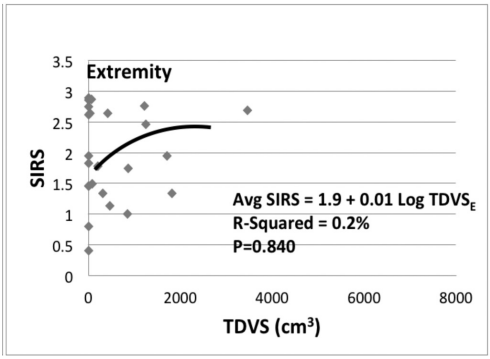
Results: $TDVS_T$ and $TDVS_{NE}$ demonstrated statistically significant relationships to average SIRS scores. $TDVS_E$ did not correlate to average SIRS scores.





Conclusion: The magnitude of inflammation correlated to $TDVS_T$ and to $TDVS_{NE}$. In contrast, inflammation showed no correlation to $TDVS_E$. $TDVS_E$ calculations did not include spine and pelvis fractures. Patients with $TDVS_T$ >2500 cm^3 or $TDVS_{NE}$ >2000 cm^3 uniformly had average SIRS scores ≥2.5, which correlated closely with organ failure and death in this set

See pages 99 - 147 for financial disclosure information.



of patients. These data show that the magnitude of inflammation is a function of the volume of injury. The bridge between tissue damage volume and inflammation needs subsequent investigation to determine pathomechanistic pathways that cause SIRS and organ failure.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.