Inflammation Biomarker Clusters are Associated With Organ Dysfunction in Polytrauma Patients With Fractures

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Purpose: The immune response following polytrauma is complex, dynamic, and thought to play a fundamental role in organ dysfunction and resolution after injury. Organ dysfunction trajectories after major trauma are highly variable even in demographically similar patients with comparable injury profiles. The post-injury immunologic response likely influences clinical outcomes. This investigation aimed to identify groups (latent classes) of short- term organ dysfunction trajectories in polytrauma patients with major orthopaedic injuries. We hypothesized there would be differential expression of immunologic mediators among the groups.

Methods: This is an a priori planned secondary analysis of a multicenter prospective observational trial of polytrauma patients age 18 to 55 years (ISS>15) with pelvis, acetabulum, femur, and/or diaphyseal tibia fractures. Organ dysfunction trajectories were identified using latent process modelling, classifying patients into three groups based on the dynamic evolution of their total multiple organ dysfunction score (MODS) over the first five days post-injury: low, intermediate, and high organ dysfunction. A panel of 33 trauma-relevant immunologic mediators were measured at 0 hour, 1 hour, 12 hours, 24 hours, and 48 hours post-admission. The primary outcome was variation in mean log transformed immunologic mediator concentrations among groups. A mixed analysis of variance (ANOVA) model with repeated measures was used to assess differences in mediator concentrations between groups and temporal changes.

Results: A total of 322 polytrauma patients was enrolled. Nine mediators differed significantly at multiple time points between the low, intermediate, and high organ dysfunction groups, dominated by five mediators belonging to the inflammation cluster: MCP-1 (24-hour low: 2.71 ± 0.31, intermediate: 2.89 ± 0.30, high: 3.14 ± 0.35); IL-6 (low: 1.96 ± 0.41, intermediate: 2.28 ± 0.44, high: 2.60 ± 0.46); IL-8 (low: 1.26 ± 0.43, intermediate: 1.42 ± 0.47, high: 1.74 ± 0.47); IL-10 (low: 1.89 ± 0.56, intermediate: 2.16 ± 0.60, high: 2.49 ± 0.49; all $p<0.001$); and MIG ($p = 0.039$). Over time, 25 immune mediators fluctuated significantly, with IL-10, IL-1Ra, and IL-8 ($p<0.001$) exhibiting the most pronounced temporal changes.

Conclusion: Notable differences in the inflammation biomarker cluster were observed among orthopaedic polytrauma patients in three distinct groups of patients that had varied levels of organ dysfunction. Characterization of the early and dynamic immune response after trauma may aid clinicians in identifying patients at risk of a sustained organ dysfunction trajectory.