Systemic Lipidomic Profile Changes Align With Injury Severity and Predict Outcomes in Polytraumatized Patients

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Purpose: Recent advances in analytic technology allow for characterization of lipid profile dynamics on a molecular level. Experimental models suggest individual lipid profiles based on injury severity. The aim of this study was to characterize the lipidomic response in a cohort of polytrauma patients.

Methods: Lipidomic analysis was performed on samples from a polytrauma biobank. Patients were included upon arrival at the trauma bay and venous sampling was performed at 6 time points (arrival, 8 hours, 24 hours, 48 hours, 5 days, and 10 days). Inclusion criteria were an ISS> 25, survival >24 hours, and age >18 years.
Plasma samples were analyzed using liquid chromatography mass spectrometry (LC-MS). Lipid profiles were characterized using bioinformatic approaches and dimensionality reduction. Linear mixed models were programmed to analyze lipid class dynamics over time. Demographics, injury characteristics, outcomes (eg, length of stay [LOS], mortality, complications), and laboratory markers were exported from our clinical information system. Lipid profile dynamics were collated with clinical data.

Results: 85 subjects with a total of 440 samples were analyzed to account for the optimal batch size for LC-MS. Mean ISS was 31.7 and mean NISS (New Injury Severity Score) 38.4. Overall, 633 individual lipids were identified. Principal component analysis (PCA) revealed clustering of lipids with similar molecular characteristics, thus lipids were organized into 19 functional subgroups (classes). K-means clustering based on lipid profile revealed 2 specific patient groups, which differed in injury pattern and severity. In more severely injured patients, we detected a significant decrease of the majority of lipid classes over the early time points (0- 48 hours). Restoration of lipid levels at 24 hours was indicative of clinical outcome: levels of “AcCa” and “HEX” in combination with clinical markers were highly predictive of major complications (R2 = 0.69)

Conclusion: The early lipid profile in polytraumatized patients aligns with injury pattern and severity while the dynamic over time can predict complications. AcCa (acylcarnitine) as a marker of mitochondrial damage seems to be a promising clinical marker for point of care resuscitation. Our results match nicely with previous results from animal models.