Lipidomic Analysis in a Porcine Polytrauma Model Shows Significant Posttraumatic Changes to the Circulating Lipid Profile

***Yohei Kumabe, MD**; Yannik Kalbas, MD; Sascha Halvachizadeh, MD; Thorsten Hornemann, PhD; Roman Pfeifer, MD; Paolo Cinelli PhD; Hans-Christoph Pape, MD*
Zurich University Hospital, Zurich, Switzerland

Purpose: Posttraumatic release of pro-inflammatory mediators and the subsequent inflammatory response are key components in the development of complications in polytraumatized patients. New methods for the investigation of specific circulating and organ-bound lipids have found rapidly increasing usage investigating metabolic and cardiovascular disease; however, they have not yet been applied in the field of trauma. Several lipid subgroups have been shown to mediate inflammatory response. In this study, we investigated the posttraumatic intravasation of 233 specific lipids in a well-established porcine polytrauma model.

Methods: 54 male pigs (Swiss landrace) weighing 50 ± 5 kg underwent general anesthesia for 6 hours. Pigs were split in polytrauma (PT), monotrauma (MT), and sham group. PT received a combined injury of blunt chest trauma with a lung contusion, a grade II (AAST) liver laceration, controlled hemorrhagic shock (mean arterial pressure [MAP] 30 ± 5 mm Hg for 60 minutes), and femoral shaft fracture. MT received an isolated femoral shaft fracture. After 60 minutes animals were resuscitated with crystalloid fluids and fractures received intramedullary nailing. Venous blood was taken regularly from baseline (B) to 6 hours (6h) post-trauma. Lipid concentrations and lipid composition were investigated using mass spectrometry. 233 specific lipids were analyzed.

Results: Lipids were organized into 17 subgroups based on molecular characteristics. Dilution was normalized for albumin. Total lipid concentration, especially CEs (cholesteric esters) showed a significant ($P<0.05$) decrease in PT (total: 30,609 ± 17,459 nM/mL at B and 14,570 ± 6660 nM/mL at 6h). AcCa (acylcarnitines), PC (phosphatidylcholine), and FA (fatty acyls) showed a significant ($P<0.05$) increased directly after polytrauma. Five subgroups (Cers [ceramides], DAGs [diacylglyceroles], LPCs [lysophosphatidylcholines], PEs [phosphatidylethanolamines], and TGs [triacylglycerols]) showed a significant increase in MT group after trauma and in in both groups after treatment ($P<0.05$). Almost all subgroups of lipids in MT and PT showed significant decrease 6 hours post-trauma.

Conclusion: Our data clearly suggest significant changes to intravasal lipid composition after trauma and treatment with intramedullary reaming and nailing. Corresponding factors might be the posttraumatic intravasation of lipids from bone marrow, a response to posttraumatic cytokine storm, or the onset of a hypermetabolic state. Individual pathways have yet to be investigated and collation with clinical data is needed.