

Early Definitive Fracture Fixation Does Not Impair Neutrophil Homeostasis in Cardiopulmonary Compensated Polytrauma: A 72hr Porcine Observation Study

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Purpose: The treatment of polytrauma patients has changed markedly during the last 2 decades. It is believed that in polytrauma cases, early definitive fracture fixation is associated with more profound dysregulation of the cellular immune system (eg, neutrophils). Consequently, staged treatment protocols became the mainstay of therapy. Specific patients, however, may benefit from prompt definitive fracture care. We hypothesized that early definitive long bone fracture fixation is not associated with impaired systemic neutrophil homeostasis in experimental cardiopulmonary compensated polytrauma.

Methods: 12 adult pigs were exposed to standardized polytrauma (ISS = 27), including a unilateral femur fracture. Upon cardiopulmonary compensation, animals were randomized for treatment strategy. Early definitive fracture fixation (EDFF) included intramedullary nailing, whereas animals from the damage control orthopaedics (DCO) group were treated by external fixation. Animals were observed for 72 hours. Blood was collected at specific time points. Routine laboratory analysis were performed and neutrophil numbers and activation status (Mac-1/CD11b and L-selectin/CD62L) were determined by flowcytometry.

Results: All animals survived the 72-h observation period. No differences were encountered in hemodynamics, ventilation and metabolic status between groups. Neutrophil-to-lymphocyte ratios (NLRs) instantly increased after intervention (Pooled: baseline: 0.89 ± 0.08 vs 4.5-h: 2.99 ± 0.11 , $P < 0.001$). Thereafter NLRs gradually returned to baseline levels in both groups. Similar kinetics were seen in both study groups. Neutrophil CD11b-expression slightly increased 6.5 h after trauma and thereafter normalized in all animals. CD62L-expression dropped after trauma and started to rise significantly ($P < 0.05$) in both groups. Peak levels were measured after 72 h. No differences in neutrophil CD11b/CD62L expression level changes were seen between groups.

Conclusion: The current experimental large animal polytrauma study demonstrated that early definitive long bone fracture fixation is not associated with impaired systemic neutrophil homeostasis in compensated polytrauma. These findings imply that avoidance of instant definitive fracture fixation may be unnecessary in specific patients with compensated physiology. Prospective clinical studies should be performed to validate these findings in a clinical setting.