Implementing a Novel Orthopedic Polytraumatic Injury Model in Laboratory Mice

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Background/Objective: Traumatic injury is consistently the leading cause of death up to middle age and is the largest factor in reducing the United States economic productivity. Currently, there are few murine models that emulate orthopedic polytraumatic injury. Existing models typically require sophisticated vascular access resulting in higher costs. We have identified the need for a simple and easily reproducible model. Therefore, we developed a new polytrauma mouse model which included femoral fracture, quadriceps muscle crush, and hemorrhagic shock.

Methods: Sixty 12-week-old, C57BL/6 female mice were used in this study. Briefly, a mid-shaft femur fracture was surgically induced on the right leg of each mouse and was stabilized by an intramedullary wire. Next, the ipsilateral quadriceps muscle underwent an interval of crushing injury. Then, to create hemorrhagic shock, mice had approximately 400µL removed through the retroorbital sinus. Lasty, mice were resuscitated with intraperitoneal 1.6 ml of saline 90 minutes later. Other mice served as uninjured controls. Splenocytes were harvested in the control group and at 0-, 1-, 4-, and 24-hours post-trauma (n=12/group). Flow cytometric analyses and animal survival were examined.

Results: Of the 48 C57BL/6 mice undergoing the polytrauma model, all survived to their respective time point. There was a significant increase ($p<0.05$) in neutrophils from the 4-hour cohort compared to the control. There were also significant increases in the 24-hour group in natural killer (NK) cells compared to control ($p<0.05$), 0-hour ($p<0.0001$),1-hour ($p<0.0001$), and 4-hour groups ($p<0.05$).

Conclusion: The survival of all of the mice shows the effectiveness of this model to emulate non-fatal, poly-traumatic injuries. Additionally, increased levels of neutrophils, and NK cells, along with steady levels of B cells are consistent with the known immunologic traumatic response, further validating this model's ability to create survivable polytrauma conditions.